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From social networks to bird enthusiasts: reporting interactions between plastic waste and birds in Peru

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Summary

Peru has the second-highest diversity of birds in the world, but little is known about the interactions between birds and plastic waste. To fill this knowledge gap, we searched the scientific literature, collected information from social networks such as Facebook and databases such as Macaulay Library and iNaturalist and solicited records through messaging with researchers and bird enthusiasts. We found 119 bird interactions with plastic debris involving 39 species from 20 families, with the red-legged cormorant *Phalacrocorax gaimardi* and the neotropical cormorant *Phalacrocorax brasilianus* being the most affected species. By type of interaction category, plastic waste in nests was the most abundant, followed by entanglement, capture and handling and ingestion. Ropes, nets and soft plastics such as bags were the most frequently reported types of waste. As our methodology has limitations, it is probable that other species that also interact with plastic waste have not been reported, so we recommend further study.

Introduction

Birds are good indicators of environmental quality (Eeva et al. 2020, Liang et al. 2020). The degree to which their environment is disturbed by plastic waste can be measured by their presence, both in nesting and foraging areas (Blettler et al. 2020, Ibañez et al. 2020). Plastics have been reported in nests, and their abundance may be influenced by their availability in the environment (Grant et al. 2018, Jagiello et al. 2018, Yorio et al. 2022). These can entangle both adults and chicks, sometimes with fatal outcomes (Votier et al. 2011, Witteveen et al. 2017). In addition, birds can ingest plastics through their confusing them with regular prey (Henry et al. 2011, Savoca et al. 2016). Although ingested plastic waste can be expelled through regurgitation and defecation (Bessa et al. 2019, Bond et al. 2021), some hard items can cause the obstruction or perforation of the gastrointestinal tract (e.g., Senko et al. 2020). Plastic waste spans a wide range of sizes and shapes, from millimetre-sized to large, and recently has come to include single-use discarded objects such as personal protective equipment (Rossi et al. 2019, Neto et al. 2021).

A total of 282 bird species around the world (2.6% of all bird species) have been reported to interact with plastic waste (i.e., entanglement, ingestion and addition of plastic waste to nests; Ryan 2018, Battisti et al. 2019, Jagiello et al. 2019, Kühn & van Franeker 2020, Billerman et al. 2022). Many other bird species probably interact with plastics, but the available records are limited. Recent studies have increased knowledge in this regard (e.g., Blettler & Mitchell 2021, Bond et al. 2021, Nam et al. 2021), but gaps remain regarding potential benefits, adaptations for the use of these materials (repel ectoparasites, avoid conflict with other birds) and physiological and toxicological impact (e.g., reduction of blood calcium and genotoxicity), with there being limited existing research, especially in developing countries

(Suárez-Rodríguez & Garcia 2014, Jagiello et al. 2019, Lavers et al. 2019, Malizia & Monmany-Garzia 2019, Blettler & Mitchell 2021).

Peru currently has 1889 recorded bird species, which places it second in the world in terms of bird species richness after Colombia (Remsen et al. 2022). It also has 117 endemic species and life zones that are important resting and feeding sites during the journeys of migratory birds, as well as for resident species (Senner & Angulo 2014, SERFOR 2018, Remsen et al. 2022). Birds in Peru face different threats such as deforestation, illegal trade bycatch and the introduction of exotic species such as rats and cats, amongst others (SERFOR 2018). Plastics are currently considered a new and increasing threat that can affect bird survivorship and reproduction (Ryan 2018, Battisti et al. 2019). However, in Peru, bird interactions with plastic waste have been scarcely reported, so attention being given to this issue is required.

Social networks and citizen science websites are ideal for data collection (Siriwat et al. 2019, Sánchez-Clavijo et al. 2021). Furthermore, they can be valuable sources of inventories and information regarding the impacts of plastic waste on wild populations (Abreo et al. 2019, Coram et al. 2021, Hiemstra et al. 2021, Ammendolia et al. 2022). Researchers can access records of impacted species across a wide range of locations through digital means that previously would have been restricted by distances and limited resources (Abreo et al. 2019, Coram et al. 2021). In this sense, our goal is to bridge the knowledge gap and to inventory Peruvian birds interacting with plastic waste through photographic records of researchers and civil society published on Facebook™, documented personal communications, citizen science databases such as iNaturalist and Macaulay Library and the authors' own records. We specifically sought to provide a baseline study for future research.

Materials and methods

To assess the interaction of birds with plastic waste, we searched different sources of records that included: (1) a social network platform (Facebook); (2) citizen science databases (Macaulay Library, iNaturalist); (3) personal communications with researchers and/or bird enthusiasts; and (4) published studies in peer-reviewed journals and grey literature.

Record collection began on 6 January 2020 and extended through 10 September 2021.

On Facebook, we used keywords in Spanish through the general search engine. Photographs were searched using the word strings 'nest and garbage', 'entanglements and birds', 'plastics and birds', 'plastics and nests', 'birds and solid waste', 'birds and waste ingestion' and 'necropsy and plastics in birds'. When a photograph of interest was found, the author of the image was contacted and we requested permission to include it in the study. We also reviewed and made announcements in social media groups dedicated to ornithology and wildlife in general (Supplementary Table S1). We posted announcements on social media networks, which led to other researchers, bird enthusiasts and general public helping us to contact others and ask them to submit their records.

In Macaulay Library, we used the English filters 'nest building', 'foraging or eating', 'habitat', 'nest', 'eggs' and 'dead'. For iNaturalist, the Spanish keywords 'garbage', 'plastic pollution', 'waste', 'entanglement', 'synthetic fibres', 'necropsies', 'nests', 'plastic' and 'debris' to locate these reports.

A third way to obtain records was through email messages to researchers and/or bird enthusiasts asking for unpublished records.

Finally, an exhaustive review of reports on birds and their interactions with plastic waste in Peru was carried out using Scopus, Google Scholar and other websites. The keywords used were 'plastic waste in Peruvian birds' accompanied by 'ingestion', 'entanglement', 'nest' and 'capture and handling'. Information was retrieved from scientific articles, conference proceedings and reports from governmental institutions.

For the taxonomic nomenclature and status of birds in Peru (resident or visitor), the version of the South American Classification Committee (SACC) of 6 June 2022 was used. Species were also classified according to their global conservation status (International Union for Conservation of Nature), their distribution and type of foraging habitat (BirdLife International and Handbook of the Birds of the World, 2019; Supplementary Table S2).

Plastic waste was classified into categories using an adapted methodology based on Tavares et al. (2017) with modifications: 1 = hard plastics (e.g., fragments), 2 = soft plastics (e.g., bags and tapes), 3 = monofilaments, 4 = ropes and nets, 5 = rubber/latex and 6 = textiles (e.g., fibres or clothing remnants).

Results

Four types of interactions were identified: (1) ingested plastics; (2) entanglement; (3) plastic waste as nesting material; and (4) capture and handling of plastics. We found a total of 119 interactions in 79 photographs. These involved 39 species in 20 families and 9 orders. Of all species, 95% (n = 37) were continental, both inland and coastal, and two species were oceanic (*Thalassarche melanophris* and *Hydrobates hornbyi*). The species with the most interactions was *Phalacrocorax gaimardi* at 25% (n = 30), followed by *Phalacrocorax brasilianus* at 24% (n = 29) and *Larus dominicanus*, *Larus belcheri*, *Pyrocephalus rubinus*, *Campylorhynchus fasciatus* and *Spheniscus humboldti* at 3% (n = 4) of records each (Fig. 1). Of these and other species with fewer records, *S. humboldti* is listed as Vulnerable, *Sternula lorata* as Endangered and *H. hornbyi*, *Larosterna inca*, *Pelecanus thagus*, *Phalacrocorax bougainvillii* and *P. gaimardi* as Near Threatened (Table S2). Most (87%) of the recorded species (n = 34) had a wide distribution range. Only 10% (n = 4) of the species are found in Peru and Chile (i.e., *S. humboldti*, *P. thagus* and *L. belcheri*) or Peru and Ecuador (i.e., *Campylorhynchus fasciatus*). In addition, one endemic species for Peru was reported (*Cinclodes taczanowskii*; Table S2).

Plastic waste in nests accounted for 59% (n = 70) of the interactions, entanglement accounted for 24% (n = 29), capture and handling accounted for 14% (n = 17) and ingestion accounted for 3% (n = 3). Some evidence of these interactions is provided (Fig. 2 & Supplementary Fig. S1). Nets and ropes were the most frequent waste type (60 interactions, 38%) followed by soft plastics (51 interactions, 33%; Fig. 3 & Supplementary Fig. S2). Plastic waste detected in the nests consisted of mainly bags, ropes and nets. Ropes and nets were most common in entanglement interactions (62%), soft plastics in capture and handling interactions (72%) and hard plastics, soft plastics, monofilaments and textiles in ingestion interactions, with 25% for each item (Supplementary Fig. S2).

Records of birds and interactions with plastic waste by department in Peru are shown in Supplementary Fig. S3.

Discussion

In this study, we take advantage of the information available on social networks to evaluate the interactions of birds with plastic waste in Peru. We found that 48 bird species have interacted with

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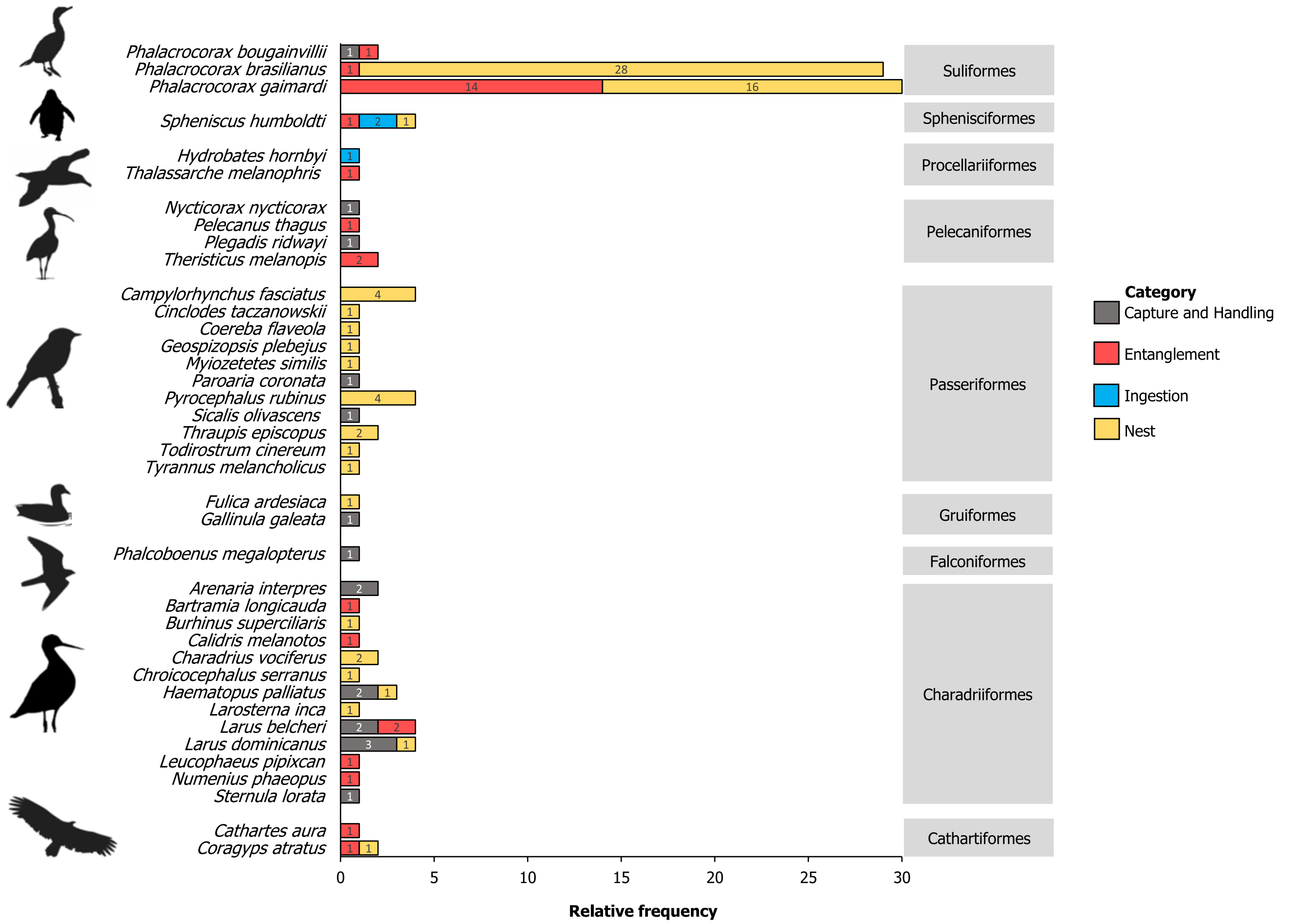

Fig. 1. Frequency of interactions (capture and handling: grey; entanglement: red; ingestion: light blue; nest: yellow) with plastic waste by bird species in Peru.

plastic waste, and 23 of these had not been previously described as interacting with plastic waste.

Plastic waste in nests

Our records indicate that birds mostly use soft (e.g., plastic bags) and resistant materials (e.g., tapes, nets, ropes and monofilaments) with insulating and waterproof capacities in their nests. Birds have been reported to use plastic waste to indicate signaller dominance (Sergio et al. 2011), as parasite repellents (Suaréz-Rodríguez et al. 2013) or to strengthen the structures of their nests (Antczak et al. 2010). We found that this interaction was mostly intentional (i.e., birds carried plastics to their nests by themselves), while a low proportion was accidental (Supplementary Fig. S1).

P. brasilianus and *P. gaimardi* presented the highest numbers of records of plastic waste in nests. The genus *Phalacrocorax* in Chile uses plastic waste due to its availability in the environment (García-Cegarra et al. 2020), and it has shown a preference for certain colours of plastic waste – notably white, green and black – for nest construction (García-Cegarra et al. 2020). Future studies are needed to determine whether there is a colour preference in Peruvian birds, given that the colours of plastics may indicate individual preferences for satisfying demands linked to mating and/or defence (Sergio et al. 2011, Canal et al. 2016). Such preferences may also be related to the supply and availability of these colours in the environment (Sergio et al. 2011, Canal et al. 2016, Brentano et al. 2020). A limitation in our study is that there is a low number of records per species and nests were not available for evaluation.

On the other hand, the costs of using plastic nesting materials may increase their attraction to predators because of the highly visibility of these materials (Møller 2017) and increase their risk of entanglement with these nesting materials (Witteveen et al. 2017). Plastic additives may also put bird welfare at risk (Suárez-Rodríguez et al. 2013).

The records included in this category may reflect the ease with which citizen scientists can detect plastics primarily because they are conspicuous and because they remain in the same place for a long time. Therefore, the increased frequency of sightings of this interaction should be interpreted with caution.

Entanglement

Effects of entanglement often include broken limbs, strangulation, decreased flight and, ultimately, death (Seacor et al. 2014, Townsend & Barker 2014). In our study, of the 14 species recorded having experienced entanglement, *Numenius phaeopus* and *L. belcheri* showed plastic residue on their legs causing limb amputations (Supplementary Fig. S1). In addition, 12 individuals of *P. gaimardi* were found dead in the middle of fishing gear on a beach in the coastal city of Tacna in southern Peru. Two individuals of *T. melanophris* on a beach in Tacna and *Bartramia*

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Fig. 2. Photographs illustrating the four types of interactions between birds and plastics in Peru: (a) residues in nests (credit: Jhonson K. Vizcarra); (b) entanglement (credit: Jhonson K. Vizcarra); (c) capture and handling (credit: Juan Urquiaga); and (d) ingestion (credit: Karla Alfaro).

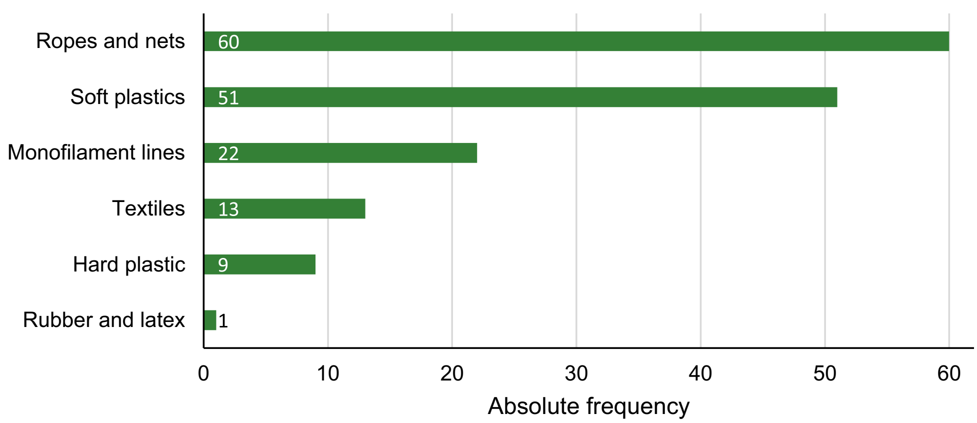

Fig. 3. Frequency of plastic waste categories identified in interactions with birds: ropes and nets; soft plastics (e.g., bags and polypropylene tapes); monofilament lines (e.g., nylon); textiles (e.g., fibres); hard plastics (e.g., fragments, toys, lighters); and latex and rubber.

longicauda near Iquitos (Peruvian Amazon) were found dead in fishing gear and were also included.

Studies focused on seabirds agree that entanglements are caused mostly by lines and nets discarded by fisheries (Ryan 2018, Battisti et al. 2019, Kühn & van Franeker 2020). For inland birds, entanglements are caused by their interaction with a variety of artefacts such as threads, ropes, twines, monofilaments, bags and nets (Houston & Scott 2006, Seacor et al. 2014, Townsend & Baker 2014, Blettler & Mitchell 2021). In our study, it was nets, ropes and bags that mainly entangled the birds (Supplementary Fig. S1). However, we are not certain as to whether these interactions were due to ghost fishing, bycatch or post-mortem entanglement.

Previous studies in different parts of the world have found that adults as well as nestlings are affected by entanglement (Houston & Scott 2006, Votier et al. 2011). In our study, we found no records of entangled chicks; however, this could be due to our methodological limitations (e.g., not having inspected the nests themselves).

There are fewer studies documenting land and freshwater bird interactions with plastic debris in South America (Blettler & Mitchell 2021) compared to seabird studies (Ryan 2018). Collaborative efforts among researchers to study terrestrial ecosystems are thus necessary.

Capture and handling

The capture and handling of plastics, especially in terrestrial species, has been rarely reported (Blettler & Mitchell 2021). As reported here, this interaction could be related to the presence of organic waste (Torres-Mura et al. 2015, Witteveen et al. 2017) or food (Savoca et al. 2016).

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We found that birds moved or pecked at plastic waste for different purposes. For example, *Nycticorax nycticorax* and *Plegadis ridgwayi* manipulated the plastics to find and extract their food under the waste (Supplementary Fig. S1). Other species, such as *L. dominicanus* and *L. belcheri*, manipulated the plastics in search of human food remains inside them. *Gallinula galeata* and *Arenaria interpres* were also observed apparently removing microorganisms attached to the plastic. Some species handled plastics very briefly, apparently out of curiosity, as in *Paroaria coronata* (plastic balloon), *Haematopus palliatus* (ropes and bags), *S. lorata* (cigarettes) and *Phalcoboenus megalopterus* (degraded plastic bags). One individual of *Sicalis olivascens* was observed apparently carrying plastic bands to its nest (Supplementary Fig. S1).

Ingestion

Two Humboldt penguins (*S. humboldti*) were necropsied, and plastic fragments and a sock were found obstructing their gastrointestinal cavities. Another species also affected by plastic ingestion was Hornby's storm petrel (*H. hornbyi*), represented by one individual who had regurgitated a piece of a plastic bag. In the present study, ingestion represented a low percentage of the interactions (3%); this could be due to our methodological limitation, even though plastic ingestion by birds has been frequently reported by scientists worldwide (Battisti et al. 2019, Rossi et al. 2019, Flemming et al. 2022).

To evaluate the ingestion of plastics, it is necessary to have access to stomach contents (Rossi et al. 2019), faecal samples (Bessa et al. 2019) and regurgitates or pellets (Uhart et al. 2020). To collect these types of samples, it is necessary to go into the field to conduct scheduled sampling and then to perform laboratory analyses. It may be that the complexity process is what has led to the scarcity of such reports.

Conclusion

We recognize the preliminary nature of our work and its limitations in terms of the search for information, as well as the bias of the records by species. However, these records demonstrate clear evidence that birds interact with plastic waste. In countries such as Peru, which has one of the highest levels of bird biodiversity worldwide, plastic waste pollution has not been adequately reported. We recommend more detailed studies are conducted on birds in Peru, and we recommend the implementation of public environmental awareness techniques to reduce waste generation.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/S037689292300005X.

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Ethical standards. None.

References

Abreo NAS, Thompson KF, Arabejo GFP, Superio MDA (2019) Social media as a novel source of data on the impact of marine litter on megafauna: The Philippines as a case study. *Marine Pollution Bulletin* 140: 51–59.

Ammendolia J, Saturno J, Bond AL, O'Hanlon NJ, Masden EA, James NA, Jacobs S (2022) Tracking the impacts of COVID-19 pandemic-related debris on wildlife using digital platforms. *Science of the Total Environment* 848: 157614.

Antczak M, Hromada M, Czechowski P, Tabor J, Zablocki P, Grzybek J et al. (2010) A new material for old solutions – the case of plastic string used in great grey shrike nests. *Acta Ethologica* 13: 87–91.

Battisti C, Staffieri E, Poeta G, Sorace A, Luiselli L, Amori G (2019) Interactions between anthropogenic litter and birds: a global review with a 'black-list' of species. *Marine Pollution Bulletin* 138: 93–114.

Bessa F, Ratcliffe N, Otero V, Sobral P, Marques JC, Waluda CM et al. (2019) Microplastics in gentoo penguins from the Antarctic region. *Scientific Report* 9: 14191

Billerman SM, Keeney BK, Rodewald PG, Schulenberg TS (2022) *Birds of the World*. Ithaca, NY, USA: Cornell Laboratory of Ornithology [www document]. URL https://birdsoftheworld.org/bow/home

Blettler MCM, Gauna L, Andréault A, Abrial E, Lorenzón RE, Espinola LA et al. (2020) The use of anthropogenic debris as nesting material by the greater thornbird, an inland–wetland-associated bird of South America. *Environmental Science and Pollution Research* 27: 41647–41655.

Blettler MCM, Mitchell C (2021) Dangerous traps: macroplastic encounters affecting freshwater and terrestrial wildlife. *Science of the Total Environment* 798: 149317.

Bond AL, Hutton I, Lavers JL (2021) Plastics in regurgitated flesh-footed shearwater (*Ardenna carneipes*) boluses as a monitoring tool. *Marine Pollution Bulletin* 168: 112428.

Brentano R, Brum AC, Montone RC, Petry MV (2020) Incidence of anthropogenic material in *Sula leucogaster* nest in a distant archipelago of Brazil. *Marine Pollution Bulletin* 151: 110815.

Canal D, Mulero-Pázmány M, Negro JJ, Sergio F (2016) Decoration increases the conspicuousness of raptor nests. *PLoS ONE* 11: e0157440.

Coram A, Abreo NAS, Ellis RP, Thompson KF (2021) Contribution of social media to cetacean research in Southeast Asia: illuminating populations vulnerable to litter. *Biodiversity and Conservation* 30: 2341–2359.

Eeva T, Raivikko N, Espín S, Sánchez-Virosta P, Ruuskanen S, Sorvari J et al. (2020) Bird feces as indicators of metal pollution: pitfalls and solutions. *Toxics* 8: 124.

Flemming SA, Lanctot RB, Price C, Mallory ML, Kühn S, Drever M et al. (2022) Shorebirds ingest plastics too: what we know, what we don't know, and what we should do next. *Environmental Reviews* 30: 537–551.

Garcia-Cegarra AM, Ramirez R, Orrego R (2020) Red-legged cormorant uses plastic as nest material in an artificial breeding colony of Atacama Desert coast. *Marine Pollution Bulletin* 160: 111632.

Grant ML, Lavers JL, Stuckenbrock S, Sharp PB, Bond AL (2018) The use of anthropogenic marine debris as a nesting material by brown boobies (*Sula leucogaster*). *Marine Pollution Bulletin* 137: 96–103.

Henry P-Y, Wey G, Balança G (2011) Rubber band ingestion by a rubbish dump dweller, the white stork (*Ciconia ciconia*). *Waterbirds* 34: 504–508.

Hiemstra A-F, Rambonnet L, Gravendeel B, Schilthuizen M (2021) The effects of COVID-19 litter on animal life. *Animal Biology* 71: 1–17.

Houston S, Scott F (2006) Entanglement threatens ospreys at Saskatchewan nest. *Journal of Raptor Research* 40: 226–228.

Ibañez AE, Morales LM, Torres DS, Borghello P, Haidr NS, Montalti D (2020) Plastic ingestion risk is related to the anthropogenic activity and breeding stage in an Antarctic top predator seabird species. *Marine Pollution Bulletin* 157: 111351.

Jagiello ZA, Dylewski Ł, Tobolka M, Aguirre JI (2019) Life in a polluted world: a global review of anthropogenic materials in bird nests. *Environmental Pollution* 251: 717–722.

Jagiello ZA, Dylewski Ł, Winiarska D, Zolnierowicz KM, Tobolka M (2018) Factors determining the occurrence of anthropogenic materials in nests of the white stork *Ciconia ciconia*. *Environmental Science and Pollution Research* 25: 14726–14733.

Kühn S, van Franeker JA (2020) Quantitative overview of marine debris ingested by marine megafauna. *Marine Pollution Bulletin* 151: 110858.

Lavers JL, Hutton I, Bond AL (2019) Clinical pathology of plastic ingestion in marine birds and relationships with blood chemistry. *Environmental Science & Technology* 53: 9224–9231.

Liang Y, Rudik I, Zou EY, Johnston A, Rodewald AD, Klin CL (2020) Conservation cobenefits from air pollution regulation: evidence from birds. *Proceedings of National Academy Sciences of the United States of America* 117: 30900–30906.

Malizia A, Monmany-Garzia AC (2019) Terrestrial ecologists should stop ignoring plastic pollution in the Anthropocene time. *Science of the Total Environment* 668: 1025–1029.

Møller AP (2017) Fashion and out of fashion: appearance and disappearance of a novel nest building innovation. *Avian Research* 8: 14.

Nam K-B, Kim M, Hong M-J, Kwon YS (2021) Plastic debris ingestion by seabirds on the Korean Peninsula. *Marine Pollution Bulletin* 166: 112240.

Neto GH, Gomes Bantel C, Browning J, Della Fina N, Albuquerque Ballabio T, Teles de Santana F et al. (2021) Mortality of a juvenile Magellanic penguin (*Spheniscus magellanicus*, Spheniscidae) associated with the ingestion of a PFF-2 protective mask during the Covid-19 pandemic. *Marine Pollution Bulletin* 166: 112232.

Remsen JJV, Areta JI, Bonaccorso E, Claramunt S, Jaramillo A, Lane DF et al. (2022) A classification of the bird species of South America [www document]. URL ~https://www.museum.lsu.edu/~Remsen/SACCBaseline.htm

Rossi LC, Scherer AL, Petry MV (2019) First record of debris ingestion by the shorebird American oystercatcher (*Haematopus palliatus*) on the southern coast of Brazil. *Marine Pollution Bulletin* 138: 235–240.

Ryan PG (2018) Entanglement of birds in plastic and other synthetic materials. *Marine Pollution Bulletin* 135: 159–164.

Sánchez-Clavijo LM, Martínez-Callejas SJ, Acevedo-Charry O, Diaz-Pulido A, Gómez-Valencia B, Ocampo-Peñuela N et al. (2021) Differential reporting of biodiversity in two citizen science platforms during COVID-19 lockdown in Colombia. *Biological Conservation* 256: 109077.

Savoca MS, Wohlfeil ME, Ebeler SE, Nevitt GA (2016) Marine plastic debris emits a keystone infochemical for olfactory foraging seabirds. *Science Advances* 2: e1600395.

Seacor R, Ostovar K, Restani M (2014) Distribution and abundance of baling twine in the landscape near osprey (*Pandion haliaetus*) nest: implications for nestling entanglement. *Canadian Field-Naturalist* 128: 173–178.

Senko JF, Nelms SE, Reavis JL, Witherington B, Godley BJ, Wallace BP (2020) Understanding individual and population-level effects of plastic pollution on marine megafauna. *Endangered Species Research* 43: 234–252.

Senner N, Angulo PF (2014) *Atlas de las aves playeras del Perú*. Lima, Peru: Ministerio del Ambiente.

SERFOR (2018) *Libro rojo de la fauna silvestre amenazada del Perú*. Lima, Peru: Servicio Nacional Forestal y de Fauna Silvestre.

Sergio F, Blas J, Blanco G, Tanferna A, López L, Lemus A et al. (2011) Raptor nest decorations are a reliable threat against conspecifics. *Science* 331: 327–331.

Siriwat P, Nekaris KAI, Nijman V (2019) The role the anthropogenic Allee effect in the exotic pet trade on Facebook in Thailand. *Journal for Nature Conservation* 57: 125726.

Suárez-Rodríguez M, López-Rull I, Garcia CM (2013) Incorporation of cigarette butts into nest reduces nest ectoparasite load in urban birds: new ingredients for an old recipe? *Biology Letters* 9: 2012093.

Suárez-Rodríguez M, Garcia CM (2014) There is no such a thing as a free cigarette; lining nests with discarded butts brings short-term benefits, but causes toxic damage. *Journal of Evolutionary Biology* 27: 2719–2726.

Tavares DC, de Moura JF, Merico A, Siciliano S (2017) Incidence of marine debris in seabirds feeding at different water depths. *Marine Pollution Bulletin* 119: 68–73.

Torres-Mura JC, Lemus ML, Hertel F (2015) Plastic material in the diet of the turkey vulture (*Cathartes aura*) in the Atacama Desert, Chile. *Wilson Journal of Ornithology* 127: 134–138.

Townsend AK, Barker CM (2014) Plastic and the nest entanglement of urban and agricultural crows. *PLoS ONE* 9: e88006.

Uhart M, Gallo L, Pereira Serafini P (2020) Sampling guidelines to assess plastic ingestion in ACAP species. Agreement on the Conservation of Albatrosses and Petrels [www document]. URL https://www.acap.aq/resources/acap-conservation-guidelines/3728-plastics-sampling-guidelines/file

Votier SC, Archibald K, Morgan G, Morgan L (2011) The use of plastic debris as nesting material by a colonial seabird and associated entanglement mortality. *Marine Pollution Bulletin* 62: 168–172.

Witteveen M, Brown M, Ryan PG (2017) Anthropogenic debris in the nests of kelp gulls in South Africa. *Marine Pollution Bulletin* 114: 699–704.

Yorio P, Suárez N, Ibarra C, Gonzales P, Canti S, Kasinsky T, Marinao C (2022) Anthropogenic debris in kelp gull and other seabird nests in northern Patagonia, Argentina. *Marine Pollution Bulletin* 175: 113404.