Marginal presence of plastic in nests of yellow–legged gulls (*Larus michahellis*) in the southeastern Bay of Biscay

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Abstract

*Marginal presence of plastic in nests of yellow–legged gulls (*Larus michahellis*) in the southeastern Bay of Biscay.* Nest entanglement and consumption of plastics can be a cause of mortality in chicks of various seabird species. As plastic debris may be chosen as a source of nesting material, evaluation of its presence and contribution to nest building in seabird colonies is important. Here, we determined the contribution of anthropogenic debris to nest construction by a yellow–legged gull *Larus michahellis* population that largely depends on refuse tips to forage. Two colonies within the southeastern Bay of Biscay, Spain, were sampled in 2019. One of the colonies was in Getaria, where no debris was found in nests, and the second was in Ulia, where 40 % of the nests had some kind of artificial material. In all cases, however, this debris comprised less than 5 % of the nests' area. Among the studied nests, we found one had a piece of fabric, five had pieces of rope, and 20 had pieces of flexible plastic packaging. These results contrast with other seabird species that face problems of conservation due to the increasing use of plastic for nesting. With the low prevalence of artificial debris (chiefly plastic) in nests found in this study, mortality due to debris entanglement or ingestion is unlikely.

Key words: Anthropogenic debris, Conservation, Nest entanglement, Pollution, Seabirds

Resumen

*Presencia marginal de plástico en nidos de gaviotas patiamarillas (*Larus michahellis*) en el sureste del golfo de Vizcaya.* El enredo en nidos y el consumo de plástico pueden ser algunas de las causas de mortalidad en los pollos de varias especies de aves marinas. Los desechos de plástico se eligen como material para la construcción de los nidos y, según se ha podido evaluar, la presencia de plástico en los nidos de las colonias de aves marinas es abundante. En este estudio, determinamos la utilización de desechos antropogénicos en la construcción de los nidos de una población de gaviotas patiamarillas, *Larus michahellis*, que depende en gran medida de los vertederos para buscar alimento. En 2019, se tomaron muestras de dos colonias del sureste del golfo de Bizcaya, en España: Getaria, donde no se encontró ningún desecho, y Ulia, donde el 40 % de los nidos tenía algún tipo de material artificial, aunque en todos los casos estos desechos representaron menos del 5 % de la superficie del nido. De estos nidos, uno tenía un trozo de tela, cinco tenían cuerdas y 20 tenían plásticos de embalaje flexible. Estos resultados contrastan con otras especies de aves marinas que se enfrentan a problemas de conservación debido al uso creciente de plástico para construir los nidos. Habida cuenta de la reducida presencia de restos artificiales (principalmente plástico) en los nidos de este estudio, es poco probable que se produzca mortalidad por el enredo en material de desecho o su ingestión.

Palabras clave: Desechos antropogénicos, Conservación, Enredo en nidos, Contaminación, Aves marinas

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Introduction

Most birds collect several types of material to build their nests, including anthropogenic debris (Votier et al., 2011;Townsend and Barker, 2014; Jagiello et al., 2018). One of the main consequences of the use of this type of material is entanglement (primarily plastics) (Ryan, 2018). In some marine species, plastic debris can make a significant contribution to nesting material (Hartwig et al., 2007; Votier et al., 2011; Provencher et al., 2014; Grant et al., 2018), even in remote offshore colonies (de Souza Petersen et al., 2016). Evaluation of the contribution of anthropogenic debris to nesting material in seabird colonies is important due to its potential associated mortality, not only for chicks (Townsend and Barker, 2014) but also for adults (Votier et al., 2011).

Compared to other seabirds which obtain material for their nests from the sea, many white–headed gulls (genus *Larus*) use a thin layer of grass that is obtained in the colony and its surroundings (Cramp and Simmons, 1983). It might therefore be expected that the amount of plastic or other types of anthropogenic debris would be lower if gulls use grass as their main nesting material. However, gulls may also use plastic and non–plastic debris that has been washed up on beaches or found on refuse tips, where they (Lindborg et al., 2012; Seif et al., 2018). Gulls have been shown to use large amounts of debris inn their nests (Witteveen et al., 2017). The contribution of anthropogenic debris found in kelp gull nests (*L. dominicanus*) differs greatly between colonies (ranging from 4 % to 67 %). It has been found to be higher in colonies where natural vegetation is scarce and where there is a higher dependence on urban waste as a food resource (Witteveen et al., 2017). Current knowledge on the presence of plastic in gull nests is scarce, and its possible impact on fitness or survival of chicks or adults remains largely unknown.

The yellow–legged gull (*L. michahellis*) is the most abundant gull in the southwestern Palaearctic (Olsen and Larson, 2004). It breeds in Macaronesia, northern Africa, continental Europe –from Portugal to Poland– and the east of Turkey (Olsen and Larson, 2004). In recent decades, populations of the species have increased considerably, due to some extent to the exploitation of refuse tips and other types of subsidies of human origin (Duhem et al., 2008; Ramos et al., 2009; Arizaga et al., 2018). A high contribution of plastics to nests (Witteveen et al., 2017) would allow us to infer that some yellow–legged gull populations have a strong dependence on refuse tips (Arizaga et al., 2013). However, this is a question that remains unknown. Understanding the contribution of plastics to yellow–legged gull nests will help to evaluate the impact of this type of debris on a seabird species with high dependence on refuse tips. The aim of this study was to determine the contribution of anthropogenic debris (specifically, plastics) in nest construction in a yellow–legged gull population in northern Spain, and to compare results between nearby colonies with variable dependence on refuse tips to forage.

Methods

This study was carried out in two yellow–legged gull colonies from the Gipuzkoa province, north of Spain, in the southeastern part of the Bay of Biscay: Getaria (43º 18' N 02º 12' W, 165 adult breeding pairs) and Ulia (43º 20' N 01º 58' W, 824 pairs). The colony of Ulia shows a higher dependence on refuse tips to forage than the colony in Getaria, which is more marine–dependent. Getaria, however, also shows some degree of dependence on refuse tips (Zorrozua *et al.* 2019a; for details see also fig. 1).

During the incubation period (April) of the 2019 breeding season, we examined the structure of 80 nests (Getaria, n = 15; Ulia, n = 65) to look for the presence of plastics or other types of anthropogenic debris. Although these two colonies have a high number of breeding pairs, and many nests could potentially be sampled, we should point out that many of the colonies are located on coastal cliffs and are thus inaccessible. Nests were chosen randomly across each colony in places we were able to access. To quantify debris contribution, we visually assessed the percentage and type of artificial debris in the area occupied by a nest. Types of debris were classified following Provencher et al. (2017): fabric (textiles), rope or string, and flexible packaging plastics. Though Provencher et al. (2017) also consider other categories, these are not reported here because they did not appear in our study nests. The colonies were visited for a second time in June. On this second occasion, we collected a sample of nests with debris to examine the material in more detail in the laboratory. We did not create any detrimental effect on chicks as removal was carried out once they had left the nest. Due to this methodological approach, some nests were deteriorated when we went to the colony for removal; for this reason the sample size was smaller than that on the first visit in April. We extracted and classified the items according to Provencher et al. (2017). They were then weighed (with a 0.01 g accuracy digital balance) and colour was visually determined and recorded (categories as proposed by Provencher et al. (2017); white–transparent, grey–silver, black, blue–purple, green, orange–brown, red–pink and yellow).

Results

No nests from the colony of Getaria contained any debris. In nests from the colony of Ulia, we found39 nests (60 %) did not contain any debris but 26 contained some kind of artificial material. In all cases, however, debris comprised less than 5 % of the nest area (table 1). In the 26 nests, one nest

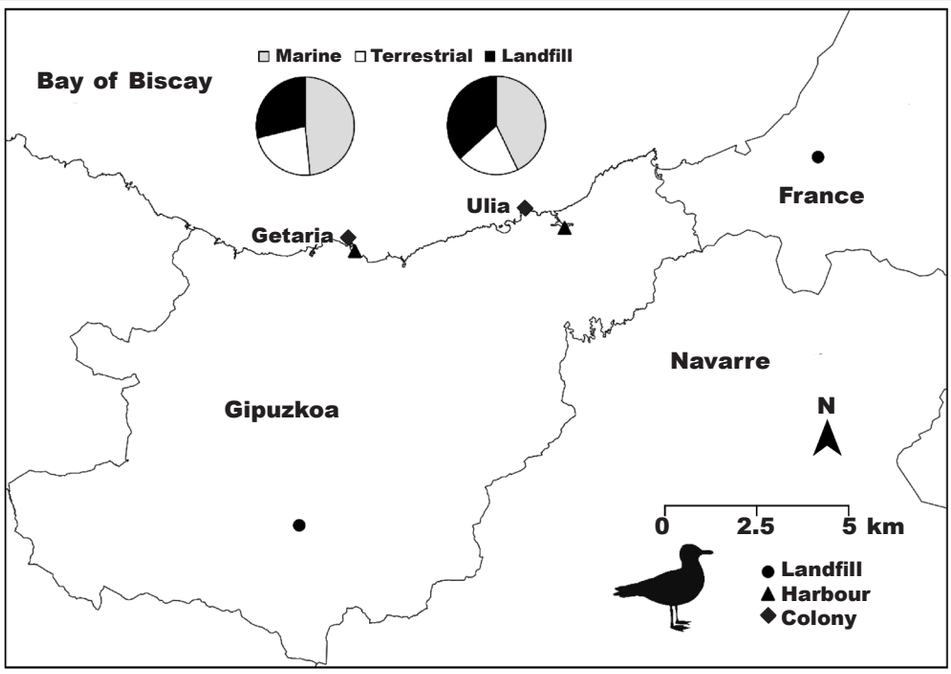

Fig. 1. Location of the two sampling colonies, refuse tips and main fishing ports from the Gipuzkoa province. Main trophic sources used at each colony during the breeding season, as obtained from stable isotopic analysis (modified from Zorrozua et al., 2019). Prey categories: marine (fish, marine invertebrates), terrestrial (mostly earthworms), landfill (mostly meat such as beef, pork or chicken; may include food remains obtained in urban areas).

Fig. 1. Ubicación de las dos colonias analizadas, los vertederos y los principales puertos pesqueros de la provincia de Guipúzcoa. Principales fuentes de alimentación utilizadas en cada colonia durante la temporada de cría, obtenidas a partir de un análisis de isótopos estables (modificado a partir de Zorrozua et al., 2019). Categorías de presas: marina (peces e invertebrados marinos), terrestre (en su mayoría, lombrices) y de vertedero (en su mayoría, carne de vacuno, porcino y aves de corral; podría incluir restos de alimentos obtenidos en zonas urbanas).

had a piece of fabric, five nests had rope, and 20 had flexible packaging plastic (bags) (table 1). The proportion of nests with or without debris differed significantly between the two colonies (χ^2 = 8.88, *df* = 1, *P* = 0.005).

The second, more detailed analysis of the items was carried out in a sample of 15 nests from Ulia that contained anthropogenic debris. We obtained a total of 19 items (11 nests were found to have a single item, while 4 nests had two items. For further details see annex 1). The mean (± SD) weight of the debris per nest was 0.4 ± 0.42 g (range: < 0.01 g to 1.44 g; *n* = 15). By material, such debris were flexible packaging plastics (*n* = 10 items; mean weight: 0.13 ± 0.17 g), rope (*n* = 8 items; mean weight: 0.43 ± 0.51 g) or textiles (*n* = 1 item; 0.85 g). By colour, 10 items were white, 3 were blue, 2 were grey, 2 red and 2 black. The majority of debris items were thus white flexible packaging plastics.

Table 1. Prevalence of artifical debris found at nests of two yellow-legged gull colonies in the Bay of Biscay. In all nests the area comprised by the debris was < 5%.

Tabla 1. Desechos artificiales encontrados en los nidos de dos colonias de gaviota patiamarilla en el golfo de Vizcaya. En todos los nidos, la superficie ocupada por desechos fue < 5%.

Type of debris	Ulia (*n* = 65)	Getaria (*n* = 15)
Plastic	20	0
Fabric	1	0
Rope	5	0
Total	26 (40%)	0

Discussion

The presence of anthropogenic material in nests of a yellow–legged gull population in the Bay of Biscay was very low: 0 % of debris in one of two sampling colonies (the smaller one of Getaria), and 40 % of debris in the larger colony of Ulia. The amount of such debris, however, was marginal (< 5 % of nest's area). We should point out here, however, that the sample size in Getaria was comparatively low, so we cannot reject the possibility that a larger sample might have revealed the presence of debris in a proportion similar to that of the Getaria nests. Nevertheless, even in this case we consider this proportion would be small, as it is unlikely that a greater sample size would give rise to a change from 0 to 40 % as we obtained for the colony at Ulia. We therefore consider our results are sufficiently robust to conclude that artificial debris in Getaria is not as relevant as that in Ulia.

Most debris items were white, but the reason for this remains unknown. Gulls may perhaps be attracted by brighter pieces or may just select them for their nests. Alternatively, white could be the most common colour in nature and the nests might simply reflect what gulls find available (washed/worn out plastic may become whiter independently of the original colour). Clearly, this is a question that deserves further research.

Anthropogenic debris was detected in a colony with a higher dependence on refuse tips to forage, supporting the hypothesis that the contribution of (mostly) plastic to nesting is higher in gull colonies where waste shows a higher importance in diet (Witteveen et al., 2017). Though both colonies have landfill sites at their disposal, we should point out that (1) Ulia is close to the main landfill within the region (the Zaluaga one, in France), while (2) Getaria is very close to a major port in the region, making it a more accessible feeding resource. With the upcoming progressive closure of open–air refuse tips within the region (Zorrozua et al., 2019) the already low occurrence of anthropogenic debris in the nests of these yellow–legged gull colonies can be expected to decrease even further.

Plastics, or other kinds of anthropogenic material, seem to pose a low mortality threat (e.g. due to entanglement) for the studied yellow–legged gull population, since they appear in small pieces, making entanglement highly unlikely. This contrasts with other seabird species which face problems of conservation due to the massive use of plastic for nesting (e.g. synthetic rope) (Hartwig et al., 2007; Votier et al., 2011; Provencher et al., 2014). Even though 40 % of the nests had some kind of artificial debris in one of the colonies, in all of these cases the total amount of debris in each nest was very low (less than 5 % of the nests' area). In view of the low incidence and small size of anthropogenic debris in gull nests in our study, mortality due to debris entanglement is unlikely in both sampling colonies. Visual observations of nests in other nearby colonies also suggest low amounts of debris. These areas were not examined as in Getaria or Ulia, however (S. Delgado, pers. obs.). In summary, our findings to date suggest that this marginal contribution of artificial debris in the nests may be a common scenario for yellow–legged gull colonies in the Bay of Biscay.

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Annex 1. Raw data showing debris details of 15 nests from the Ulia colony.

Anexo 1. Datos sin elaborar que aportan información detallada sobre los desechos encontrados en 15 nidos de la colonia de Ulia.

Nest code	No. items	Material	Colour	Weight (g)
01	1	Rope	White	0.15
02	2	Plastic + Plastic	Black + White	0.10 + 0.07
03	2	Plastic + Plastic	White + Black	0.53 + 0.06
04	1	Rope	Red	0.02
05	1	Plastic	Grey	0.06
06	1	Rope	White	0.85
07	2	Rope + Plastic	Red + Blue	0.63 + 0.03
08	1	Plastic	White	0.34
09	1	Plastic	Blue	0.04
10	2	Rope + Rope	White + White	0.17 + 0.06
11	1	Plastic	Blue	< 0.01
12	1	Fabric	White	0.85
13	1	Rope	White	0.11
14	1	Plastic	White	0.08
15	1	Rope	Grey	1.44