Marine Pollution Bulletin xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Anthropogenic debris in the nests of kelp gulls in South Africa

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ARTICLE INFO

Article history:
Received 7 September 2016
Received in revised form 18 October 2016
Accepted 19 October 2016
Available online xxxx

Keywords:
Entanglement
Nest lining
Plastics
Regurgitation
Waste management
Larus dominicanus

ABSTRACT

Anthropogenic debris results in detrimental interactions with many marine species. Several seabirds include debris items in their nests, which can lead to entanglement of chicks and adults, resulting in injury or death. Anthropogenic debris was found in 4–67% of kelp gull *Larus dominicanus* nests in seven colonies in the Western Cape, South Africa. Nests contained two types of litter: items included in the nest structure during construction (mainly ropes and straps), and regurgitated items (mainly bags and food wrappers) that probably accumulate primarily during the chick-rearing period. Debris used in nest construction was more likely to injure gulls, and was found mainly at coastal sites where there was little natural vegetation for construction. Distance to the nearest urban waste landfill significantly affected the occurrence of debris items in nests, especially dietary-derived items. The amount of debris in kelp gull nests highlights the need for improved debris management in South Africa.

1. Introduction

The effects of anthropogenic debris on marine and coastal environments have received much attention lately, especially the impacts of plastic debris (Bergmann et al., 2015). Due to the increasing abundance of anthropogenic debris in marine systems, species are increasingly likely to interact with it, often to their detriment (Derraik, 2002; Laist, 1987, 1997). A variety of marine mammals, birds, turtles and fish species are negatively affected by interactions with marine debris, with the number of species and individuals affected increasing since the early 1960s (Barnes et al., 2009; Derraik, 2002; Gregory, 2009; Kühn et al., 2015; Laist, 1997; Ryan et al., 2009). For these marine vertebrates, the major interactions are entanglement and ingestion, and the likelihood of entanglement or ingestion is exacerbated by behavioural patterns (Derraik, 2002; Laist, 1987, 1997). For seabirds, the presence of anthropogenic debris in their nests can increase the risk of entanglement, but this issue has only recently received increased attention (Bond et al., 2012; Clemens and Hartwig, 1993; Hartwig et al., 2007; Lavers et al., 2013; Lee et al., 2015; Petersen et al., 2016; Provencher et al., 2014; Verlis et al., 2014; Votier et al., 2011).

Anthropogenic debris in nests poses an entanglement threat to both parents and chicks, potentially reducing breeding success (Votier et al., 2011). Debris items have been found in a number of marine birds' nests including albatrosses (Diomedeidae, Nel and Nel, 1999), boobies and gannets (Sulidae, Bond et al., 2012; Lavers et al., 2013; Montevecchi, 1991; Norman et al., 1995; Ostrowski et al., 2005; Tavares et al., 2016; Verlis et al., 2014; Votier et al., 2011), cormorants (Phalacrocoracidae, Podolsky and Kress, 1989), kittiwakes (*Rissa*, Hartwig et al., 2007), and terns (Sterninae, Petersen et al., 2016). It also occurs in the nests of some waterbirds, such as spoonbills (*Platalea*, Lee et al., 2015). Considering how well adapted to urbanisation gulls are (Duhem et al., 2008; Lisnizer et al., 2011; Yorio and Borboroglu, 2002), it is surprising that there is little published literature on the presence of anthropogenic debris in gull nests. Apart from studies on black-legged kittiwakes (*Rissa tridactyla*) (Clemens and Hartwig, 1993; Hartwig et al., 2007), there are only some ad hoc observations for black-headed (*Chroicocephalus ridibundus*) and herring gulls (*Larus argentatus*) (Hartwig et al., 2007).

Most birds incorporate debris items in their nests because they select them for nest construction. The likelihood of so doing depends in part on the availability of natural materials close to the nest site. Brown boobies *Sula leucogaster* nesting in the open use more marine debris in their nests than those breeding in well-vegetated areas (Lavers et al., 2013), and providing additional natural nesting material decreases the amount of debris in black-faced spoonbill *Platalea minor* nests (Lee et al., 2015). Like most gulls, kelp gulls *Larus dominicanus* nest in a scrape on the ground or among low vegetation (Crawford and Hockey, 2005). In open habitats, such as coastal dunes, they gather items from surrounding areas (vegetation, kelp, shells, feathers, litter) to form the outer walls of the nest, but in vegetated areas there is less attempt to gather materials, with the scrape being formed among vegetation which creates the outer rim of the nest (Crawford and Hockey, 2005). As a result, the amount of debris used for construction is likely to vary depending on colony location and microhabitat within the colony. However, gulls also eat and then regurgitate indigestible items, including

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http://dx.doi.org/10.1016/j.marpolbul.2016.10.052
0025-326X/

plastics and other anthropogenic debris (Ryan, 1987). As a result, some nest debris could derive from regurgitations from adults or chicks. In this case, the amount of nest debris indicates the likelihood of debris ingestion, and is expected to be greater close to urban areas where many gulls scavenge on human refuse.

We compare the amounts of debris in kelp gull nests to infer the sources of different debris types, and the factors responsible for gulls including debris in their nests. We compare debris in nests at coastal sites with inland sites to test the hypothesis that debris used for nest construction should be more frequent at coastal sites, where gulls have access to stranded beach litter. We also expect that within coastal sites, debris should be more abundant in nests in open habitats where there is less natural material to use for nest construction. To identify which types of debris are derived from the diet rather than selected for nest construction, we collected debris from an inland gull colony in a remote mountain wilderness area closed to human access. This colony is so remote that any debris present derives from the gulls' diet. We hypothesise that the abundance of dietary litter in gull nests should decrease with distance from urban source areas, specifically from waste landfill sites.

2. Methods

2.1. Study sites

Nests in seven kelp gull breeding colonies in the Western Cape, South Africa, were examined for anthropogenic debris (Fig. 1). Four colonies were in coastal dune systems where they had ready access to stranded marine debris: Strandfontein (34°05.5′S 18°31.9′E), De Mond (34°42.1′S 20°08.9′E), Robberg Island (34°06.5′S, 23°23.2′E), and Keurbooms Estuary (34°02.4′S, 23°23.1′E); and three colonies were further inland: two were on salt pans without marine litter: Dwarskersbos (32°43.7′S 18°12.2′E) and Yzerfontein (33°19.9′S 18°09.8′E); and one was in a remote area of mountain fynbos, 350 m above sea level adjacent to Steenbras Dam (34°11.4′S 18°52.6′E). Colonies differed in distance to nearest urban waste landfill: the Strandfontein colony is only 2.7 km from an urban waste landfill, Robberg Island 4.2 km, Keurbooms Estuary 6.0 km, De Mond 21.1 km, Dwarskersbos 25.4 km, Yzerfontein 30.9 km, and Steenbras Dam the most remote at 36.2 km from a landfill site.

2.2. Data collection

Each breeding colony was visited towards the end of the breeding season (6–26 December 2013), by which time it was expected that pairs at most colonies would be provisioning large chicks. This was the case at all but one of the colonies. Only one pair had chicks at De Mond while all other pairs were incubating eggs (probably replacement clutches following early breeding failures due to natural predation pressure). Disturbance within each colony was kept to a minimum by sampling late in the breeding season, and by working quickly and quietly. At each colony, all anthropogenic debris was collected from a sample of 40–211 nests. Transects were walked through the colonies and all nests examined for debris. Any debris items found were collected and bagged separately for each nest. At the time of debris collection most nests contained large chicks, which moved away from the nest area. Debris items were removed carefully to maintain nest integrity. The colony at Steenbras Dam was in a remote reserve area closed to human visitors; no litter was found in areas surrounding the breeding colony, so all litter within the colony (lying between/surrounding nests) was collected as it was almost certainly carried to the site by gulls.

At coastal dune sites each nest was classified as open or vegetated based on the surrounding vegetation available for nest building. At De Mond, two breeding groups were sampled: the main group, 2.5 km east of the river mouth was on open dunes behind the beach with only marine debris (seaweed and litter) available for nest construction in the immediate vicinity, whereas a smaller group at the river mouth had access to vegetation deposited by the river (mainly Cape eelgrass *Zostera capensis*) for nest material. At the Keurbooms Estuary, two breeding groups separated by the river mouth were sampled: the main group on Keurbooms Peninsula has most nests in dense groundcover, whereas the smaller group on Lookout Beach has nests in pockets of vegetation; both had access to similar nest material. All nests at Steenbras Dam were among vegetation, but nests at the two

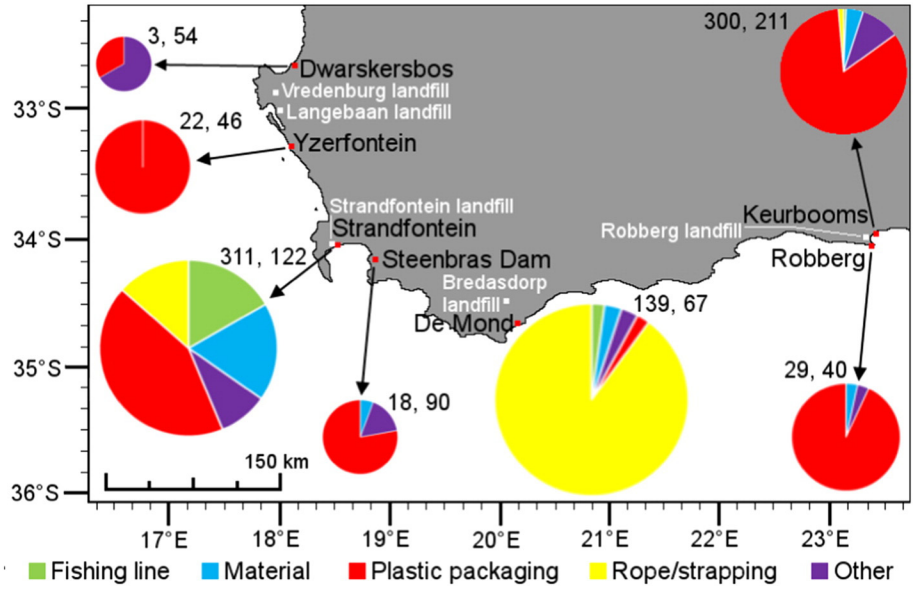

Fig. 1. Site-specific variation in the occurrence of anthropogenic debris items in kelp gull nests in the Western Cape, South Africa. De Mond was surveyed during incubation whereas other locations were provisioning large chicks. Numbers adjacent to pie charts give total items collected and total nests surveyed at each location, respectively. Pie charts are scaled to the proportion of nests containing anthropogenic debris.

Please cite this article as: Witteveen, M., et al., Anthropogenic debris in the nests of kelp gulls in South Africa, Marine Pollution Bulletin (2016), http://dx.doi.org/10.1016/j.marpolbul.2016.10.052