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Marine litter incorporation into nest construction and entanglement of Brown Noddies (*Anous stolidus*) in the Grenadines, West Indies

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Photo: John James

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Abstract Seabirds are known to ingest, become entangled in, and incorporate items of marine litter into nests, resulting in risks of injury and mortality events. Published literature for seabird interactions with marine litter is increasingly available worldwide but is generally lacking for the Caribbean region. Here, I report on observations of marine litter used as nesting material by Brown Noddies (*Anous stolidus*) and on incidental entanglement in the Grenadines, West Indies.

Keywords *Anous stolidus*, Brown Noddy, Caribbean, entanglement, Grenadines, marine litter, nest, plastic

Resumen Incorporación de desechos marinos en la construcción de nidos y enredos con estos de *Anous stolidus* en las Granadinas, Caribe Insular • Se sabe que las aves marinas ingieren, se enredan e incorporan elementos de la basura marina a los nidos, lo que supone un riesgo de lesiones y mortalidad. La literatura publicada sobre las interacciones de las aves marinas con los desechos marinos está cada vez más disponible en todo el mundo, pero en general falta para la región del Caribe. En la presente contribución informo sobre de las observaciones de la basura marina utilizada por *Anous stolidus* como material de nidificación, y de sus enredos accidentales con esta en las Granadinas, Caribe Insular.

Palabras clave *Anous stolidus*, basura marina, Caribe, enredo, Granadinas, nido, plástico

Résumé Déchets marins utilisés par les Noddis bruns (*Anous stolidus*) pour la construction des nids et entraînant des enchevêtrements dans les Grenadines, aux Antilles • Il est connu que les oiseaux marins ingèrent des déchets rejetés en mer, s'y empêtrent et les incorporent à leurs nids, ce qui peut entraîner des blessures et de la mortalité. La littérature publiée sur les interactions entre oiseaux marins et déchets rejetés en mer est de plus en plus disponible partout dans le monde, mais fait généralement défaut pour la région Caraïbe. Ici, je rapporte des observations de litière utilisée par les noddis bruns (*Anous stolidus*) pour la construction de nids et entraînant des enchevêtrements accidentels dans les Grenadines, aux Antilles.

Mots clés : *Anous stolidus*, Caraïbe, déchets marins, enchevêtrement, Grenadines, nid, noddi brun, plastique

Marine litter is a global threat to seabirds (Wilcox *et al.* 2015, Battisti 2019), which increasingly ingest (Gall and Thompson 2015, Ryan 2019), become entangled in (Votier *et al.* 2011, Ryan 2018), and incorporate marine litter into nests (Grant *et al.* 2018, Ryan 2020, Tavares *et al.* 2020). Seabird interactions with marine litter can result in negative outcomes, such as poor body condition, contaminant exposure, starvation, injury, and mortality (Lavers *et al.* 2014, 2019, Roman *et al.* 2019). Seabirds, and particularly nestlings, can become entangled in marine litter while at the nest site or the colony (Votier *et al.* 2011, Jagiello *et al.* 2019).

The Caribbean region is substantially contaminated with plastic pollution (Ivar do Sul and Costa 2007, Diez *et al.* 2019), evidenced in beach litter surveys on Caribbean islands, with the highest densities at sites receiving minimal to no human dis-

turbance (Schmuck *et al.* 2017). Plastics accounted for approximately 90% of beach litter, with items associated with fishing activity amongst the most frequently encountered (Schmuck *et al.* 2017). Fishing line and rope were abundant during beach clean-ups in 2020 and 2021 on several uninhabited islands in the Grenadines archipelago—an island chain with over 80 uninhabited islands, islets, and cays spanning between Grenada and Saint Vincent (Charles *et al.* 2021, J. Coffey unpubl. data). Marine litter has been documented on Caribbean islands where seabirds nest and in seabird colonies (Schmuck *et al.* 2017), including the Grenadines (Coffey and Collier 2020), though publications on seabird interactions with marine litter in the Caribbean are lacking (Ivar do Sul and Costa 2007).

Brown Noddies (*Anous stolidus*) are a pantropical seabird species, breeding at tropical and subtropical colonies ranging from several pairs to hundreds of thousands (Chardine *et al.* 2020). Bradley and Norton (2009) estimated the Caribbean population to be between 42,192 and 44,083 breeding pairs. Lowrie *et al.* (2012) estimated the Grenadines population at 625 breeding

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pairs, occupying more than 40 locations and totaling more than 20% of the Lesser Antilles population, though recent surveys have been substantially higher (Coffey and Collier 2020). Brown Noddies are present in the Grenadines between mid-April and September, with peak nesting occurring between May and July and fledging and dispersal occurring from mid-July through September (Coffey and Collier 2020). Brown Noddy nest sites can be on bare ground, cliff ledges, amongst cacti and shrubs, and in trees, and are often reoccupied in subsequent years. Nests are constructed by both sexes and typically consist of sticks and seaweed, often incorporating pieces of coral or stone, with materials collected close to the nest site (Chardine *et al.* 2020, Ryan 2020). Brown Noddy foraging occurs mainly at the sea surface in both nearshore and offshore waters, ranging from close proximity to > 50 km from breeding colonies (Chardine *et al.* 2020).

Fishing using handline, spear, trap, net, and commercial longline is a major economic and social activity in the Grenadines, consisting of primarily artisanal and small-scale fisheries targeting demersal and inshore/offshore pelagic species, conch, and lobster (Staskiewicz and Mahon 2007). Fisherfolk in the Grenadines indicate they frequently rely on observations of Brown Noddies to find schools of bait and commercial fish, suggesting an overlap between Brown Noddy movements and fishing activity (Coffey and Ollivierre 2019).

Here, I describe single observations of Brown Noddy incorporation of green polypropylene rope into nest construction and monofilament entanglement at a breeding colony in the Grenadines, West Indies. While reports of seabirds incorporating marine litter into nests are increasingly available globally, this is the first published report describing such behavior in the Grenadines and for Brown Noddies in the Caribbean.

Observation

Sisters Rocks (12°28'37.17"N, 61°30'33.56"W) consists of two sparsely vegetated and relatively inaccessible islets approxi-

mately 40 m and 50 m in diameter (0.25 ha total), reaching 20 m in elevation and separated by a narrow 30 m channel, at the edge of the Sandy Island/Oyster Bed Marine Protected Area (SIOBMPA) off Carriacou, Grenada (The Nature Conservancy and Grenada Fisheries Division 2007). Both islets are characterized by steep rocky slopes and surging tides and thus lack any shoreline for marine litter accumulation. Their protected status and inaccessibility prevent build-up of litter directly on the islets. Although Lowrie *et al.* (2012) reported only eight pairs of Brown Noddies in June 2009, a survey on 15 July 2019 counted 94 individuals associated with the two small islets (J. Coffey *et al.* unpubl. data).

During a visit to Sisters Rocks on 20 July 2019, I photographed an active Brown Noddy nest with an adult and large chick. The nest contained a piece of green polypropylene rope ~1 m long (Fig. 1). The nest was located in the narrow channel separating the islets on a thin ledge ~4–5 m above the water and was constructed from vegetation. A section of the rope was interwoven with the sticks in the nest, implying it was intentionally incorporated during construction. Two active neighboring nests located ~3–4 m above the water suggest that the rope did not arrive naturally via tidal surge. The weathered and frayed condition of the rope indicates that it had been exposed to the marine environment for some time. No entanglement of adult or chick was evident. Images were taken with a Nikon D5100 SLR, cropped, and minimally processed for light and contrast.

On 2 November 2019, a resident of nearby Carriacou reported a Brown Noddy hanging alive from a monofilament fishing line at Sisters Rocks. I visited the site on the following day and photographed a deceased Brown Noddy of unknown age class hanging from a line that appeared to be snagged on cliff edges (Fig. 2). The monofilament was wrapped around the neck of the Brown Noddy and extended downwards taut along the abdomen towards the legs, though it was unclear if the legs were also entangled. Sisters Rocks is at the westernmost extreme of the SIOBMPA boundary, and it is possible that this line was as-



Fig. 1. Brown Noddy nest with polypropylene rope at Sisters Rocks, Grenadines, West Indies, on 20 July 2019 (photograph by J. Coffey).



Fig. 2. Brown Noddy entangled in monofilament at Sisters Rocks, Grenadines, West Indies on 2 November 2019 (photograph by J. Coffey).

sociated with recent inshore fishing activity near the islets, as it did not appear to be significantly weathered or tangled. Images were cropped and minimally processed for clarity and contrast.

Discussion

Investigations of the presence of marine litter in seabird nests are increasing worldwide and are now described for a number of species (Grant *et al.* 2018, Battisti *et al.* 2019, Jagiello *et al.* 2019, O'Hanlon *et al.* 2021). Fishing debris is becoming a common nesting material, with many studies reporting synthetic rope and fishing net sections in greater proportion than their availability compared to other nesting material (Bond *et al.* 2012, Ryan 2020), with entanglement resulting in seabird mortality at nest sites (Votier *et al.* 2011). The most common role of marine litter in avian nests appears to be structural (Jagiello *et al.* 2019), which is consistent with my observation at Sisters Rocks. Synthetic rope could have similar properties to natural nesting material (e.g., seaweed and sticks) or may be a viable substitute (Votier *et al.* 2011, Lavers *et al.* 2013, Ryan 2020). Ryan (2020) reported marine litter in Brown Noddy nests at Ducie Atoll (South Pacific) and Inaccessible Island (South Atlantic), where items consisted primarily of blue/green synthetic rope.

The Brown Noddy entanglement and subsequent mortality in the monofilament line at Sisters Rocks provides evidence that marine litter threatens roosting seabirds in Grenadines' colonies beyond the nesting season. Ryan (2018) determined that at least 36% of seabird species have been entangled in marine litter, with entanglements often associated with monofilament (Laist 1997, Donnelly-Greenan *et al.* 2019). The durability and persistence of such items at colonies could threaten to entangle additional seabird species.

The concentration of globally and regionally important seabird colonies in the Grenadines, including 12 breeding species (Lowrie *et al.* 2012, Coffey and Ollivierre 2019, Coffey and Collier 2020), combined with the known prevalence of marine litter at remote islands (Schmuck *et al.* 2017, J. Coffey pers. obs.), warrant further investigations to document the availability and occurrence of marine litter use, entanglement, and ingestion by seabirds in this understudied region.

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Title Page Illustration

Sisters Rocks, Grenadines, West Indies, on 25 July 2017. Photograph by John James.

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