Notornis, 2013, Vol. 60: 258-261
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SHORT NOTE

A mass mortality event of sooty shearwaters (*Puffinus griseus*) on the central coast of Peru

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Almost all of the mass mortalities of seabirds in Peru that have occurred during the 20th century have been attributed to the El Niño–Southern Oscillation, which modifies the availability of prey (Lavalle 1917; Ballen y Gastiaburú 1925; Ávila 1953; Jordán 1964; Fuentes & Antonietti, 1989; Apaza & Figari 1999). Other possible causes of seabird mortalities between 2006 and 2012 have been described in technical reports by the Instituto del Mar del Peru (IMARPE) [Peruvian Sea Institute], such as fishery interactions (IMARPE 2010; 2011), avian cholera (IMARPE 2010), poisoning with caustic substances (IMARPE 2011), tourism activity (IMARPE 2011), and reduced food availability caused by warm waters (IMARPE 2007; IMARPE 2012).

Several species of seabirds, and large numbers of individuals, are affected by these mass mortalities in Peru, including Humboldt penguin (*Spheniscus humboldti;* Jordan 1964; IMARPE 2011; Apaza y Figari 1999), sooty shearwater (*Puffinus griseus;* Jordan 1964; Fuentes & Antonietti 1989; IMARPE 2007), Peruvian diving petrel (*Pelecanoides garnotii;* Fuentes & Antonietti 1989), pink-footed petrel (*Puffinus creatopus;* IMARPE 2007), Peruvian pelican (*Pelecanus thagus;* Lavalle 1917; Tovar 1983; Apaza & Figari 1999), blue-footed booby (*Sula nebouxii;* Fuentes & Antonietti 1989; IMARPE 2011), Peruvian booby (*Sula variegata;* Lavalle 1917; Tovar 1983; Apaza & Figari 1999), Guanay cormorant *Phalacrocorax bougainvillii;* Lavalle 1917; Tovar 1983; Apaza & Figari 1999), red-legged cormorant *Phalacrocorax gaimardi;* Jordan 1964), grey gull (*Larus modestus*; Jordan 1964; Apaza & Figari 1999), Franklin gull (*Larus pipixcan*; Apaza & Figari 1999) and Inca tern (*Larosterna inca;* Fuentes & Antonietti 1989; Apaza & Figari 1999). Sooty shearwaters have been included in events that were attributed to ENSO (Jordán 1964; Fuentes & Antonietti 1989) and food shortages caused by warm water (IMARPE 2007).

The sooty shearwater is one of the most abundant seabirds of the Pacific Ocean (Spear 2008). Antipodean populations of non-breeding sooty shearwaters begin migration first, followed by breeders in mid-Apr and fledglings a month later that reach the North Pacific in Apr-early Jun. The sooty shearwaters nesting in Chile and Falkland Is are also abundant in the central coast of Chile in Jun. The total global population of this species is estimated at ~20,000,000 individuals, although there are signs of a current decline (Brooke 2004).

Received 8 Mar 2013; accepted 17 May 2013
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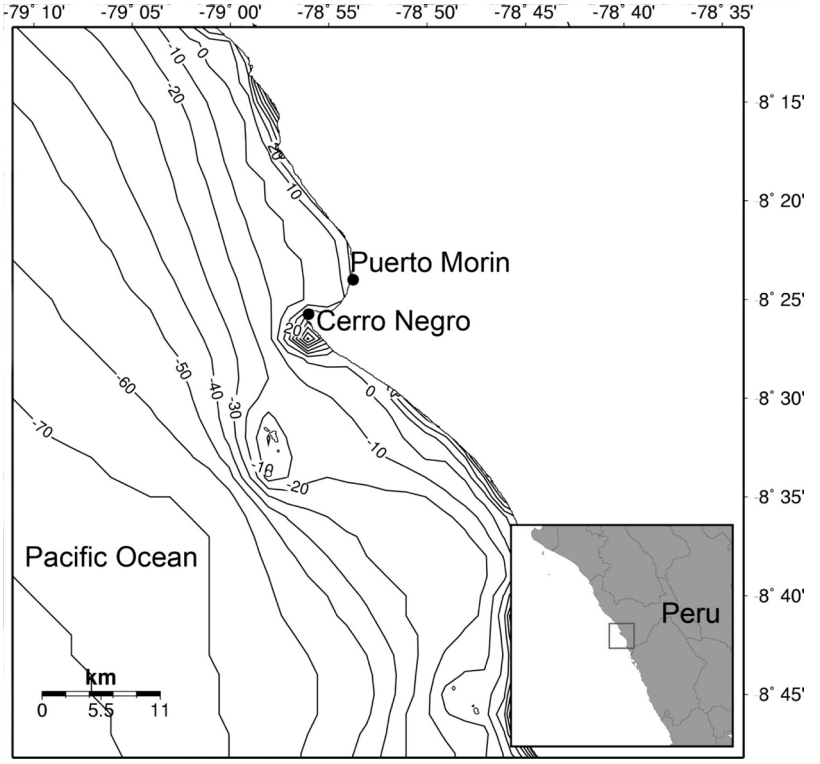

Fig. 1. Location of Puerto Morin and Cerro Negro on the west coast of Peru, the area where sooty shearwaters were observed. The depth contours of the continental shelf are also given.

In this paper, we describe a mass mortality of sooty shearwaters that occurred in the central Peruvian coast in 2010. We address the possible causes and the interactions between seabirds and people on the mainland in Puerto Morin during the event.

This study was conducted as part of an ongoing Albatross, Petrel and Fisheries Project, for which we interviewed fishermen in the Peruvian coast. To obtain further information about the mass mortality of shearwaters, targeted interviews were conducted with fishermen on 13 Aug 2010 in Puerto Morin (8°24′ S 78° 56′ W; Fig. 1), the village that reported the mass mortality of shearwaters. Puerto Morin had a population of 126 people in 1993 and little fishing activity. However, by 2003 there were 50 artisanal fishermen and 25 vessels between 0.5 and 5 tons capacity. The fishing gear used in Puerto Morin are trammel nets, demersal longlines and gillnets and target 34 species of fish, molluscs and crustaceans. Minor stardrum (*Stellifer minor)*, Lorna drum (*Sciaena deliciosa)* and stripped coco croaker (*Paralonchurus peruanus)* are the most important target species.

The following information was collected from each fisherman: 1) dates, times and locations of the interactions, 2) fishing gear used, 3) number of shearwaters caught, 4) interactions with seabirds on the mainland, and 5) event effects, like costs of lost fishing gear and environmental effects. Finally, the average bycatch per boat was calculated by the total number of animals caught divided by the number of interviews.

BYCATCH

A total of 18 fishermen, each from a different vessel, were interviewed. Before the mass mortality event, 56% of fishermen were not familiar with and could not recognise sooty shearwaters because they fish near their village where the shearwaters are rare, and 28% said they had seen these birds more than 10 km from the coast. All of them observed large numbers of sooty shearwaters near Puerto Morin, both onshore and at sea. The birds were seen up to 6 km offshore from Puerto Morin, between late Apr and Jun.

Among the fishermen, 83% reported that their bird bycatch only included sooty shearwaters during this period, and named them "cágalos" due to their odour. Fifteen vessels had from 1 to 15 interactions with the seabirds (average 3.9, SD = 3.5). Cerro Negro (08°25′S 78°56′ W; Fig. 1), a fishing area 5 to 6 km southwest by sea from Puerto Morin, was indicated as an interaction area by 67% of fishermen. This group stated that when they hauled nets between 0500 h and 0800 h, they found the birds drowned and that the interaction may have occurred during the soak,

between 1800 h and 0500 h. All the fishermen who reported interactions at Cerro Negro used gillnets with 51.55 mm mesh (except one case of 51.05 mm), with a total net length of 55 to 183 m. Two fishermen also used driftnets. The mean number of birds killed as bycatch per boat during this period was 970 (0-3000 birds, SD = 1,241, n = 18).

The high numbers of birds as bycatch damaged gear and reduced fishing success. Only 53.3% of fishermen did not have damage to their nets. On the other hand, 46.7% said they had lost nets and fishing days at a cost of $36 to $715 USD (average = $307, total = $2150). Eight fish were targeted in that period especially: stripped coco croaker (67%), Peruvian weakfish (*Cynoscion analis*; 67%), mullet (*Mugil cephalus*; 47%), Lorna drum (40%), flatfish (*Paralichthys adspersus;* 22%), Peruvian grunt (*Anisotremus scapularis*; 6%), and snakehead king croaker (*Menticirrhus ophicephalus;* 6%)

INTERACTIONS ON THE MAINLAND

During the mass mortality event, 94% of the fishermen observed live shearwaters near the houses in the village. Half of those interviewed reported more observations at night. In addition, 50% reported that birds crashed onto roofs and lamp posts, hurting themselves and were then heard calling. Birds were found dead in the mornings. Fishermen and other inhabitants disposed of the birds by burning, throwing them into the sea or burying them at the beach. Both live and dead shearwaters were eaten by dogs. Some shearwaters were caught in order to sell their meat. Others fell into corrals with domestic birds. Finally, 83% of fishermen said the most significant effect was the unpleasant odour associated with the live and dead shearwaters while 39% said it was damage to their fishing gear.

This event was singular; none of the interviewed fishermen had seen this kind of mass mortality or interaction with seabirds and their fishing gear before in the study area. Uhlmann (2003) asserted that a survey of Peruvian fishermen conducted in 1999 revealed that shearwater bycatch 'may be common' but the attempt to quantify the interactions was too vague to allow for extrapolation. Jahncke *et al*. (1999) and Mangel *et al*. (2012) reported shearwater bycatch in artisanal longline and driftnets, respectively. All cases were off-shore fishing, in contrast to the present report of interactions in a fishing area near the coast.

The sooty shearwater is the most abundant seabird species in the Peruvian current and the anchovy (*Engraulis ringens)* is its main prey. Migration patterns of sooty shearwaters from New Zealand and Chile coincided with the period of the mass mortality described. Although starvation is an explanation for mass mortality events, the anchovy landings in Peru during May and Jun 2010 exceeded 2.25 million metric tons, with a total of 3.3 tons that year, indicating that prey was available during that period (PRODUCE 2010).

The sooty shearwaters that collided with terrestrial structures at night in Puerto Morin appeared 'confused' and recalls how "crazed sooty shearwaters pelted the shores of North Monterey Bay, California" as reported by the Santa Cruz Sentinel in 1961. This report inspired Alfred Hitchcock to film "The Birds" (Bargu *et al.* 2012). Three decades later, in 1991, a mass poisoning occurred in the same area. This time, brown pelicans (Work *et al.* 1993) had ingested domoic acid, a neurotoxin produced by the diatom *Pseudonitzschia*. Later, Bargu *et al.* (2012) found plankton samples from 1961 containing the toxin-producing *Pseudonitzschia*, which supported the idea that these diatoms were responsible for the behaviour that motivated Hitchcock's thriller. Currently we are not able to explain the erratic behavior of these birds, but we recommend biotoxin analysis in seabirds when this kind of behavior is observed.

In spite of the large numbers of dead seabirds and the extended duration of the event, we were not aware of it until late Jul 2010. We strongly recommend a Peruvian network to report and study these kinds of mortalities, especially in light of the potential negative effects on both birds and human health.

ACKNOWLEDGEMENTS

ACAP (Agreement for Conservation of Albatrosses and Petrels), Rufford Small Grants and ABC (American Bird Conservancy) supported the project: Albatross, Petrel and Fisheries. Manuel Plenge and Jessica Hardesty made valuable comments on the manuscript. Also, we thank the fishermen from Puerto Morin who agreed to be interviewed. Our thanks to an anonymous reviewer for their helpful comments on an early version of this paper. The authors also wish to acknowledge use of the Maptool program for graphics in this paper. Maptool is a product of SEATURTLE.ORG.

LITERATURE CITED

Apaza, M.; Figari, A. 1999. Mortandad de aves marinas durante El Niño 1997-98 en el litoral sur de San Juan de Marcona, Ica, Perú. *Revista Peruana de Biología*, Vol. Extraordinario, pp. 110-117.

Avila, E. 1953. "El Niño" en 1953 y su relación con las aves guaneras. Problemas básicos referentes a la anchoveta. *Boletín de la Compañía Administradora del Guano 29*: 13-19.

Ballén, F.; Gastiaburú, J.C. 1925. La actual mortalidad de las aves guaneras. *Boletín de la Compañía Administradora del Guano 1*: 91-108.

Bargu, S.; Silver, M.W.; Ohman, M.D.; Benitez-Nelson, C.D.; Garrison D.L. 2012. Mystery behind Hitchcock's birds. *Nature Geoscience 5*: 2-3.

Brooke, M. de L. 2004. *Albatrosses and petrels across the world*. Oxford: Oxford University Press.

Fuentes, H.; Antonietti, E. 1989. Efectos del fenómeno El Niño en las aves marinas del litoral peruano. *Boletín Estudio Regional del Fenómeno El Niño Pacífico Sur Este (ERFEN) 29*: 19-26.

IMARPE. 2007. Mortandad de aves marinas frente al litoral Norte del Perú (Piura y Tumbes) En Seguimientos de las pesquerías y evaluación de los recursos pesqueros. http://www.imarpe.gob.pe/imarpe/archivos/informes/imarpe_eval_po_iii_tri07.pdf.Accessed April 2013.

IMARPE. 2010. Mortandad de aves marinas: Evaluación del POI – PTI al III Trimestre del 2010. http://www.imarpe.pe/imarpe/archivos/informes/impare_ind_poli_cumpl_iii_trim10.pdf. Accessed April 2013.

IMARPE. 2011. Mortandad de aves. En Resultados principales del POI – PTI - I Semestre 2011. http://www.imarpe.gob.pe/imarpe/archivos/informes/imarpe_eval_ejec_poi_pti_sem_i_2011.pdf. Accessed April 2013.

Jordán, R. 1964. L as emigraciones y mortandad de las aves en el invierno y otoño de 1963. *Informe Instituto de Investigación de los Recursos Marinos 27*: 1-31.

Lavalle y García, J.A, de. 1917. Informe preliminar sobre la causa de la mortalidad anormal de las aves ocurrida en el mes de Marzo del presente año. *Memoria de la Compañía Administradora del Guano 8*: 61- 88.

Mangel, J.; Alfaro-Shigueto, J.; Baquero, A.; Darquea J.; Hardesty-Norris, J.; Hodgson, D.; Godley B. 2012. Onboard observer data suggest that small scale fisheries are a major potential threat to seabirds in southeastern Pacific. In: *Interaction of Peruvian small scale fisheries with threatened marine vertebrate species.* 169 pp. https://eric.exeter.ac.uk/repository/bitstream/handle/10036/3483/MangelJ.pdf?sequence=3. Accessed April 2013.

PRODUCE (Ministry of Production). 2010. Anuario estadistico 2010. 236 pp. http://www2.produce.gob.pe/RepositorioAPS/1/jer/ANUARIO_ESTADISTICO/anuario-estadistico-2010.pdf. Accessed April 2013.

Spear, L.B.; Ainley, D.G. 2008. The seabird community of the Peru Current, 1980–1995, with comparisons to other eastern boundary currents. *Marine Ornithology 36*: 125–144.

Tovar, H. 1983. Fluctuaciones de poblaciones de aves guaneras en el litoral peruano, 1960-1981. In: Proceedings of the expert consultation to examine changes in abundance and species composition of neritic fish resources. *Food and Agriculture Organization of the United Nations (FAO) Fisheries Report*, 291:3, 957-976.

Uhlmann, S. 2003. Fisheries bycatch mortalities of sooty shearwaters (*Puffinus griseus*) and short-tailed shearwaters (*P. tenuirostris*). *DOC Science Internal Series* 92. New Zealand Department of Conservation.

Work, T.M.; Barr, B.; Beale; A.M.; Fritz L.; Quilliam, M.A.; Wright, J.L.C. 1993. Epidemiology of domoic acid poisoning in brown pelicans (*Pelecanus occidentalis*) and Brandt's cormorants (*Phalacrocorax penicillatus*). in California. *Journal of Zoo and Wildlife Medicine 24*: 54-62.

Keywords *Puffinus griseus*; mass mortality; seabird bycatch