

INSHORE FEEDING BEHAVIOR OF BLUE-FOOTED BOOBIES *SULA NEBOUXII* AT MANTA, ECUADOR, DURING WARMING CONDITIONS IN THE EQUATORIAL PACIFIC OCEAN

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Received 17 April 2015, accepted 27 April 2015

The Blue-footed Booby *Sula nebouxii* is widespread in the eastern tropical Pacific, breeding on coastal and oceanic islands from the Gulf of California to Lobos de Tierra and Lobos de Afuera islands, Peru (Murphy 1936, Haase 2011). Extralimital records for the species have been documented in southern Chile (Araya & Millie 1986), California (Teitz & McGaskie 2014) and British Columbia (Towers *et al.* 2015).

In Ecuador, including the continental coast and Galápagos Islands, the Blue-footed Booby is one of the most abundant seabird species, but its local abundance depends on oceanic-climate conditions that affect food resources (i.e. forage fish schools; Haase 2011), especially during El Niño Southern Oscillation events (ENSO; Murphy 1936, Anderson 1989, Haase 2011). For instance, hundreds of exhausted and dead Blue-footed Boobies can be found along the coast of Ecuador during strong ENSOs (Haase 2011).

In this note, we detail an inshore feeding frenzy of Blue-footed Boobies at Murciélago Beach, Manta, Ecuador (0.94°S, 80.7°W) in late August 2014. In 20 years of experience along the coast of Ecuador, we had never seen anything like this foraging aggregation. Photos and video clips were obtained using a digital camera (Sony, DSC-H3, 6.3–63 mm, 10× optical zoom), and some of these videos were uploaded to YouTube (Table 1, Supplementary Material available on the website). This foraging event took place during the pre-emergence of what was likely an ENSO event in the El Niño 1+2 Region, with sea surface temperature (SST) anomalies varying from 0.8 °C to 1.2 °C at the end of August and early September 2014. The ENSO event exhibited positive SST anomalies of > 0.5 °C above the average across much of the Pacific, especially in the eastern tropical Pacific Ocean (CPC 2014).

On 25 August 2014, we observed groups of 5 to 20 Blue-footed Boobies, totaling ~200 individuals, during 45 min of observation. The boobies searched for prey from north to south along Murciélago Beach before noon and within an hour were joined by others to form an even larger flock of plunge-diving individuals (≤ 300–500 birds; Table 1: Videos 1 and 2).

The boobies were feeding in a dense and coordinated group, plunge-diving from at least 10–20 m (Fig. 1 top; Table 1: Video 1), followed by surface feeding just off the beach from 3–4 m in the air and surface-gleaning in sequence (Fig. 1 bottom; Table 1: Video 3). Likely brought northward by the ENSO conditions (CPC 2014), as many as 15 Inca Terns *Larosterna inca*, an uncommon seabird species in Ecuadorian waters, were observed with the boobies. Several individuals (n=10) of presumably Elegant *Sterna elegans* and Royal terns *S. maxima* and Brown Pelicans *Pelecanus occidentalis* were also observed in the flock. On 26 August 2013, a few Peruvian Boobies *Sula variegata*, another species likely present owing to the ENSO conditions, were observed among 10–15 Blue-footed Booby flocks at Santa Marianita beach (30 min by car from Manta Harbour). Guanay Cormorants *Phalacrocorax bougainvillii*, also an ENSO-related visitor from the south, were in the area as well (Santa Elena Peninsula) during mid-2014 but were not seen in mixed-species flocks (B. Haase, pers. comm., 23 June 2014). We revisited Murciélago beach on August 28 and 29, but feeding frenzies were not observed, although small groups of Blue-footed and Peruvian boobies, plus Inca Terns, were present.

Feeding frenzies of Blue-footed Boobies in mixed-species flocks are common at the Galápagos Islands ~1000 km off the coast of Ecuador (Mills 1998). To the best of our knowledge and in the

TABLE 1
Video archives for Blue-footed Boobies' feeding frenzy and foraging activities observed at Murciélago Beach (Manta, Ecuador) in August 2014

Video number	Estimated number of individuals in the flock	Video link
Video 1	300–500	https://www.youtube.com/watch?v=BHJXLqKrGC4&feature=youtu.be
Video 2	<500	https://www.youtube.com/watch?v=gyPtvhF1Fv8&feature=youtu.be
Video 3	<300–400	https://www.youtube.com/watch?v=Jk5jqt5jKVE&feature=youtu.be

20 years of experience of one of us (JJA) along this coast, this is the first documentation of a feeding frenzy of large flocks of Blue-footed Boobies along the continental coast of Ecuador, an area where large numbers of Blue-footed Boobies are sometimes found (i.e. on 17 September 1987, approximately 990 individuals were counted in front of Salinas; Haase 2011). The inshore feeding behavior described here has been observed in the Gulf of California as well (D. Ainley, pers. comm., 21 April 2015). Blue-footed Boobies would be considered a “suppressor” during feeding-frenzy activities, disrupting flock spatial structure because of their habit of diving in large numbers into the center of a fish school (cf. Hoffman *et al.* 1981, Mills 1998). This coordinated activity may stun and confuse the fish, facilitating capture by the boobies, but this feeding method may cause prey to disperse and therefore shorten the duration of the opportunity and discourage the participation of other species (Mills 1998).

The feeding frenzy activity and the presence of extralimital species from the Peru Current indicate that prey were highly local along the South American coast, even at the scale of individual prey schools. Many Blue-footed Boobies were eventually found dead

on several beaches of the Santa Elena Peninsula. All this occurred despite the ENSO being weak. Our observation of a feeding frenzy and of several other foraging behaviors by large numbers of Blue-footed Boobies in inshore waters of Ecuador indicate the potential adaptability of this species to regional climate variability as well as the use of relatively new foraging grounds at populated beaches near urbanized coastal habitats.

ACKNOWLEDGEMENTS

We thank J. Towers for valuable insights to improve the paper, and B. Haase for providing personal communications. Special thanks to David Ainley who provided editorial work to improve the paper.

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Fig. 1. Inshore feeding frenzy of Blue-footed Boobies at Murciélago Beach, Manta, Ecuador, August 2014: top — a flock plunge diving into inshore waters; bottom — the same flock surface-feeding and chasing prey. Photos by J.J. Alava.

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