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Short Note

Anomalously White Atlantic Spotted Dolphins (*Stenella frontalis*, Cuvier, 1892) Off the Azores

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Mammalian color is almost entirely dependent on the presence (or absence) of the pigmentation melanin in the skin, hair, and eyes (Fertl & Rosel, 2008). Certain anomalous coloration conditions that occur in mammals can be described as albinism, an inherited condition resulting in a complete lack of pigmentation in the eyes, skin, and hair; leucism, characterized by reduced pigmentation, resulting in dark-eyed anomalously white individuals; melanism, an increased amount of black pigmentation; and piebaldism, characterized by the localized absence of pigment resulting in irregular patches of light color on an animal that otherwise has normal coloring and patterning (Acevedo et al., 2009; Lodi & Borobia, 2013).

Anomalously white individuals are reported for a number of cetacean species worldwide (Fertl et al., 1999, 2004). Accounts of anomalously white cetaceans found in the North Atlantic have been described for, but are not limited to, bottlenose dolphins (*Tursiops truncatus*; Fertl et al., 2004), common dolphins (*Delphinus* sp.; Dobbs, 1984), harbor porpoises (*Phocoena phocoena*; Hain & Leatherwood, 1982; Tonay et al., 2012; Robinson & Haskins, 2013), killer whales (*Orcinus orca*; Pilleri & Pilleri, 1987), pilot whales (*Globicephala* sp.; Hain & Leatherwood, 1982), sperm whales (*Physeter macrocephalus*; Whitehead, 1995), and Atlantic spotted dolphins (*Stenella frontalis*; Fertl et al., 1999).

The Atlantic spotted dolphin is born unspotted, with a three-part color pattern of dark dorsal cape, light gray sides, and spinal blaze (see Figure 1). The belly is usually white (Jefferson et al., 1993). Spots first appear at 2 to 6 y and increase in size and density up to 16 y (Herzing, 1997). A constant diagnostic external feature of this species is a spinal blaze sweeping up into the dorsal cape, which distinguishes it from the very similar pantropical spotted dolphin (*Stenella attenuata*), also found in the Atlantic Ocean. In addition, the peduncle of the Atlantic spotted dolphin is uniformly colored and does not exhibit the division into darker upper and lighter lower halves present in the pantropical spotted dolphin (Perrin, 2008).

The Atlantic spotted dolphin is long known to occur in the Azores (Ferreira, 1935), a nine island archipelago located in the temperate North Atlantic between 36 to 39º N and 25 to 29º W. The region provides habitat for more than 25 diverse cetacean species (Prieto & Silva, 2010). The Atlantic spotted dolphin is a seasonal-resident species in the Azores, observed during late spring to late summer (Pereira, 2008). Although there are no quantitative estimates currently available, it is one of the most frequently sighted dolphin species in the Azores during the summer months (Silva et al., 2003).

Whale and dolphin watching has been conducted between April and October off the coasts of Pico and Faial Islands in the Azores on a regular basis since 1989. Cetaceans are spotted by land observers (lookouts) who scan the water with binoculars and report their findings back to the whale-watching boats. Dolphins and whales are followed during daylight hours, using rigid-hulled inflatable boats. The average time of a trip is 3 h. During four of these trips between 1997 and 2013, four different anomalously white Atlantic spotted dolphins were observed and photographed on different occasions. In this note, we discuss the occurrences of anomalously white Atlantic

Figure 1. Unusually white Atlantic spotted dolphin (*Stenella frontalis*) photographed off the south coast of Pico Island, Azores, on 18 September 1997 (Dolphin 1): (a) photographed underwater in the presence of normally pigmented individuals; and (b) surfacing next to a normally pigmented individual. (Photos by Roland Seitre)

spotted dolphins off the south coast of Pico and the north coast of Faial (Figure 2), including a detailed report of the first record of an anomalously white Atlantic spotted dolphin, listed previously in Fertl et al. (1999).

The first observation of an Atlantic spotted dolphin was photographed on 18 September 1997. The exact latitude and longitude of this sighting is unavailable; nonetheless, the approximate location is given in Figure 2 represented by a circle. This individual, described here as Dolphin 1, was seen in a pod of approximately 100 dolphins of the same species. The encounter lasted only 15 min because it occurred near sunset when the light was fading. As seen in the photograph of Dolphin 1 (Figure 1a), there is no obvious difference between the size of that individual and the other heavily spotted members in the group, leading to the hypothesis that it was a sexually mature individual. The coloration is unusually white, but it is possible to perceive a darker pattern around the beak of the animal (Figure 1a) as well as some faint spots over the body (Figure 1b).

The second sighting occurred on 17 September 2009 when a white-pinkish Atlantic spotted dolphin was observed south of Pico Island (Figure 2) (38º 21.500 N, 28º 01.500 W). This dolphin, described here as Dolphin 2, was travelling in a pod of about 100 Atlantic spotted dolphins of which approximately 20 were juveniles and 10 were calves. The group was observed for a total of 20 to 30 min. The dolphin was a juvenile with an estimated length of 1.5 m, colored pinkish white with a light grey patch along the flanks (Figure 3a & b). The beak and forehead to the blowhole were white to pink, as well as the dorsal fin, dorsal cape, the caudal peduncle, and fluke. A dark line was visible from the trailing edge of the dorsal fin and along the caudal peduncle toward the tail fluke. The eyes were open, but the coloration could not be verified. Detailed examination of the photograph verified the pink eyelids (Figure 3b). Dolphin 2 maintained close proximity to a normally pigmented adult and did not approach the boat, in contrast to the majority of the group, which were socializing and interacting with the boat.

The third occurrence took place on 13 July 2011, south of Pico Island (Figure 2) (38º 21.500 N, 28º 15.500 W). The animal, described here as Dolphin 3, was observed within a group of 60 to 80 dolphins with about 10 juveniles and 10 calves, which were interacting with the boat by bow

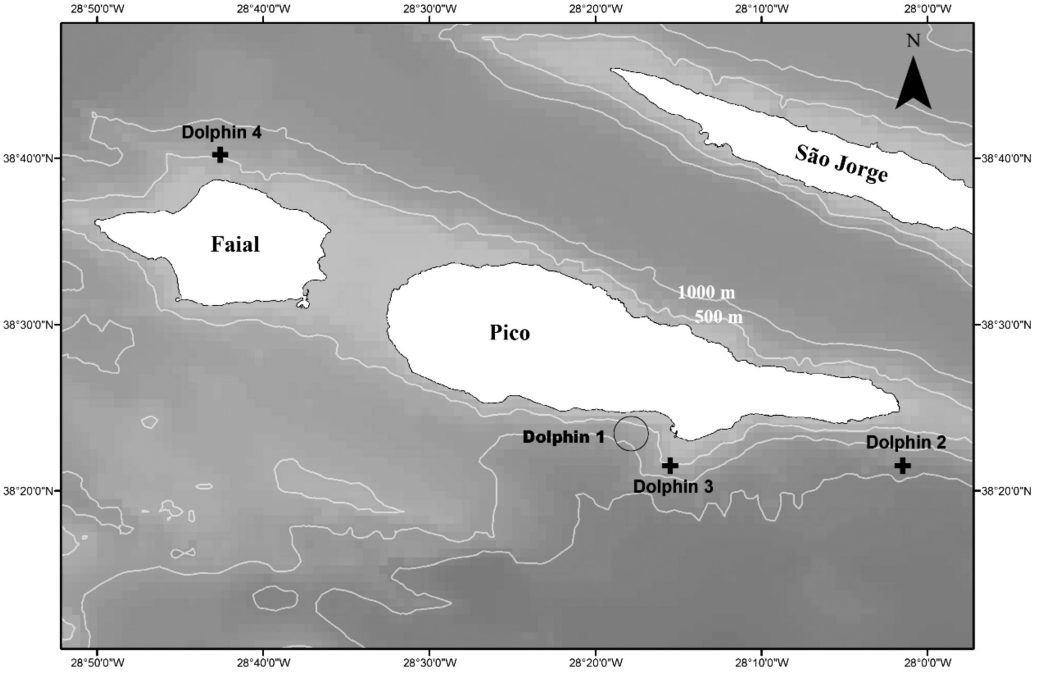

Figure 2. Sightings of anomalously white Atlantic spotted dolphins in the Azores. A circle denotes the approximate location of Dolphin 1 (18 September 1997); the sighting for Dolphin 2 was on 17 September 2009, Dolphin 3 was on 13 July 2011, and Dolphin 4 was on 13 August 2013.

riding and socializing. This group of dolphins was observed for a total of 25 to 30 min. Dolphin 3 was also possibly a juvenile, with an estimated length of 1.5 m. The coloration was completely white to light grey, with no evident tones of pink (Figure 4a & b). The coloration pattern was similar to Atlantic spotted dolphins, with lighter lateral and ventral regions appearing completely white, while the darker dorsal regions had a light grey tone, including the dorsal fin, a region normally

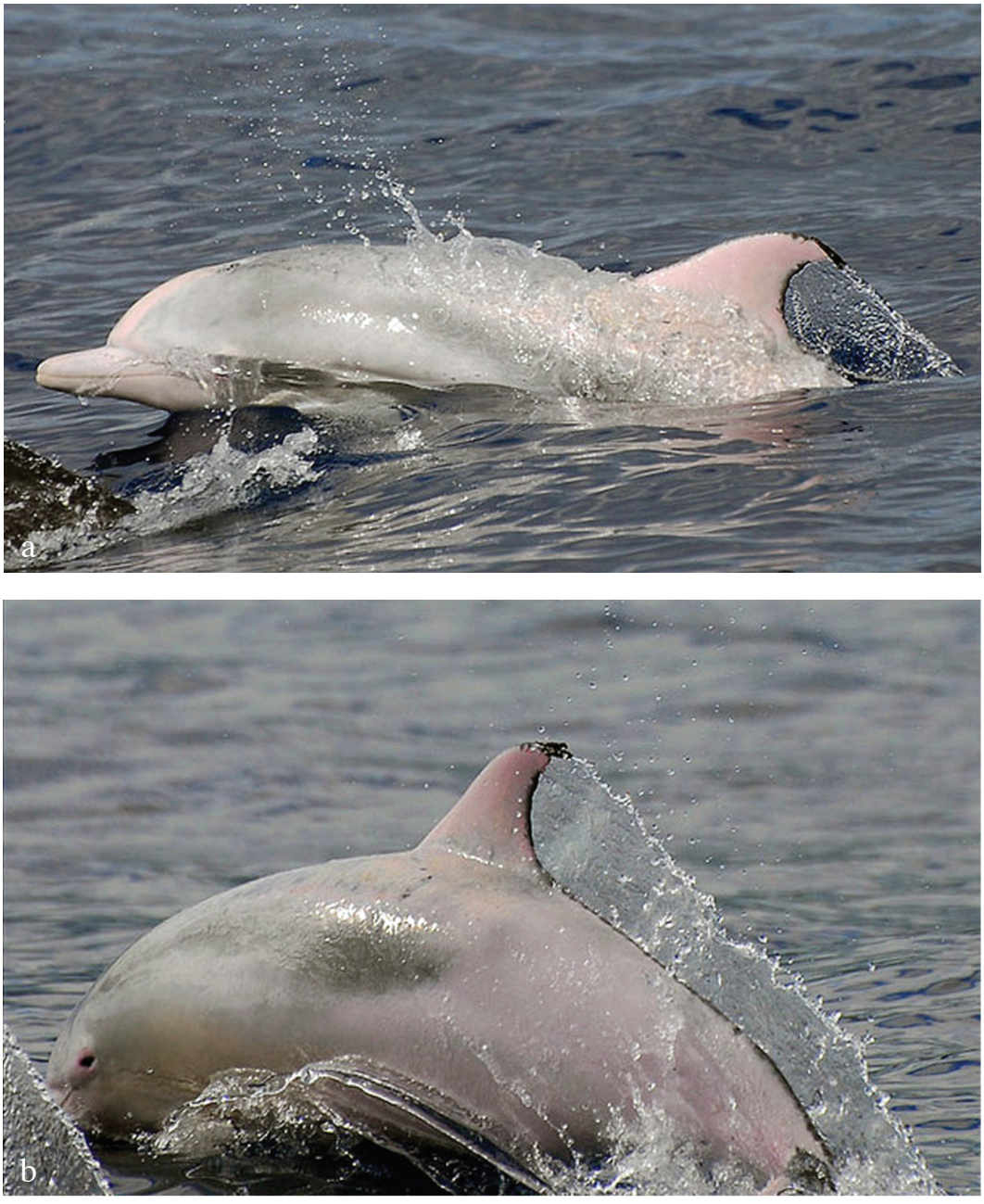

Figure 3. Anomalously white Atlantic spotted dolphin photographed off the south coast of Pico Island, Azores, on 17 September 2009 (Dolphin 2): (a) photographed on its first surfacing; and (b) surfacing with eye open. (Photos by Pedro Madruga)

darker than the rest of the body in this species. The spinal blaze is evident on the flank below the dorsal fin (Figure 4a & b) contrasted by a light grey tone. It was not possible to define the color of the eyes as the animal appeared to be surfacing with the eyes closed. Nevertheless, the eyelids appeared to have a greyish pattern circling the eye.

The fourth and last sighting occurred on 13 August 2013, north of Faial Island (Figure 2) (38º 40.200 N, 28º 42.600 W). This individual, described here as Dolphin 4, was travelling in a group of approximately 40 Atlantic spotted dolphins. All individuals in the group appeared to be medium-sized; therefore, it was considered to be a group of juveniles. The dolphins were observed for approximately 20 min; during this time, they were interacting with the boat and bow riding. The coloration of Dolphin 4 was white to light grey with a darker patch around the tip of the beak as well as on the trailing edge of the dorsal fin (Figure 5a). The spinal blaze was also evident on the flank as well as a darker shade behind and below the dorsal fin (Figure 5b). The color of the eyes appeared dark when the animal first surfaced (Figure 5a).

Figure 4. Anomalously white Atlantic spotted dolphin photographed off the south coast of Pico Island, Azores, on 13 July 2011 (Dolphin 3): (a) surfacing with eye closed; and (b) surfacing next to normally colored Atlantic spotted dolphins. (Photos by Rui Santos)

Figure 5. Anomalously white Atlantic spotted dolphin photographed off the north coast of Faial Island, Azores, on 13 August 2013 (Dolphin 4): (a) surfacing with the head out of the water; and (b) showing the dorsal fin and back up to the peduncle area. (Photos by Ana Sofia Mendonça)

Anomalously white Atlantic spotted dolphins are rarely reported. Besides these observations, only one case of piebaldism was reported by Lodi & Borobia (2013) off southeastern Brazil. Anomalous coloration may be produced by a number of biochemical factors, so it is difficult to ascertain the cause without genetic information (Hain & Leatherwood, 1982). However, we believe that the pigmentation condition affecting the four dolphins we describe herein is best described as leucism, which is characterized by dark-eyed anomalously white individuals (Fertl & Rosel, 2008). Such cases have been reported for pinnipeds (Acevedo et al., 2009) and cetaceans (Perrin et al., 1995; Robinson & Haskins, 2013).

The white-pinkish skin of Dolphin 2 could be an indicator of albinism, considering the description of anomalous coloration given by Fertl & Rosel (2008). However, this individual also presents a dark grey tone on the trailing edge of the dorsal fin and along the peduncle, as well as a greyish tone on the flank (Figure 3b). Pigmentation patterns exhibited by individuals should not be the only criterion used to define albinism given that this condition in mammals is caused by the mutation of one or more genes (Fertl & Rosel, 2008). The other individuals, Dolphins 1, 3, and 4, exhibited a white greyish coloration with some darker shades in the beak (Figures 2a & 5a) and flanks (Figures 4b & 5b). In addition, the eyes of these three animals appeared dark which led to the hypothesis that these are also best described as leucistic individuals.

Little is known about the costs associated with having anomalously pigmented skin, but hypopigmented animals are more conspicuous to predators (because they lack counter-shading), more prone to sunburn or skin cancer (due to the lack of melanin), and could suffer from visual impairment (extreme farsightedness, nearsightedness, and astigmatism), which usually leads to lower survival rates (Hain & Leatherwood, 1982; Fertl & Rosel, 2008). Dolphins 2, 3, and 4 were considered juveniles due to their comparatively smaller size, and most records of anomalously pigmented cetaceans involve calves or juveniles (e.g., Fertl et al., 2004; Fertl & Rosel, 2008; De Boer, 2010; Tonay et al., 2012) as was the case reported by Lodi & Borobia (2013). Nonetheless, despite the costs, some individuals can reach adult age and breeding status (Fertl & Rosel, 2008; Keener et al., 2011; Robinson & Haskins, 2013), which seemed to be the case of Dolphin 1 given that it was approximately the same size as other heavily spotted adult individuals in the group.

In some areas of the Atlantic Ocean, Atlantic spotted dolphins are considered to be resident (Elliser & Herzing, 2014). In other regions of the Atlantic, these dolphins undertake wide-ranging movements from one area to another (Griffin & Griffin, 2004; Scott & Chivers, 2009). In the study area, although the location from where the dolphins come from is unknown, they are sighted frequently in the Azores during the summer and early autumn months (Silva et al., 2003; Pereira, 2008). Therefore, the re-sightings of these anomalously white individuals elsewhere would allow us to better understand the movements and distribution of this species. It is unclear why the Atlantic spotted dolphins suffer from leucism, but it appears there is some regular incidence in the species given that we report here four occurrences in a 16-y period, and the last three in a 5-y period, in the same region. None of them appeared to be the same individual re-sighted. Perhaps the aberrant skin condition in this population could be more frequent than suspected, though there is a constant effort of photo-identification on whale-watching trips and so far only these four individuals have been sighted. Therefore, the prospective recapture of rare, anomalously pigmented individuals, such as the animals described herein, could potentially increase our current understanding of the rates of these occurrences. If additional sightings are accompanied by sampling of genetic material, the causes of leucism in these animals could be determined, and further insights into the ecological and physiological implications of these conditions in cetaceans could be gained.

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