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Observations of Hypopigmented Dolphins Sighted in Mexican and Alaskan Waters (2012-2013)

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Mammalian integument coloration mainly depends on the amount and type of melanin which is regulated by the enzyme tyrosinase. The dark coloration of cetaceans is mainly a result of the presence of melanocytes (Behrmann, 1998). Melanocytes produce melanin, which is stored in the dorsal part of the skin of cetaceans, while white body parts (e.g., the ventrum) do not contain melanin due to anomalies in the tyrosinase (Behrmann, 1998). If tyrosinase is defective, pigmentation patterns can differ markedly from the typical colorations of a given species (Fertl & Rosel, 2009). Approximately 100 possible mutations in the tyrosinase gene can cause a phenotypic anomaly called hypopigmentation that can manifest in different ways (Oetting et al., 2009).

Albinism, or the complete absence of pigmentation in the body, including the iris that appears red or pink, is one of those manifestations. In contrast, leucism is a skin and hair pigmentation anomaly that does not affect eye color and is caused by defects in pigment cell differentiation (Miller, 2005). Moreover, there is a reduction in melanin production with leucism. As some parts of the body can match symptoms of albinism, many white animals with normally colored eyes are incorrectly assumed to be albinos. Another phenotypic pigmentation anomaly is piebaldism or partial leucism in which only certain parts of the body lose their color (Miller, 2005; Fertl & Rosel, 2009; Peters et al., 2016).

These kinds of hypopigmentation are not common in wildlife; however, they have been reported in different vertebrate species (Hain & Leatherwood, 1982; McCardle, 2012). Approximately 25 cetacean species, eight mysticetes, and 17 odontocetes have been observed with hypopigmentation (Fertl et al., 2004; Acevedo et al., 2009; Fertl & Rosel, 2009; de Boer, 2010; Kautek et al., 2019).

Hypopigmented cetacean individuals are rare in natural populations (Hain & Leatherwood, 1982; Fertl et al., 1999). These organisms could be detected earlier by their prey, which would complicate their feeding success as well as decrease opportunities for social behavior and potentially increase intraspecific rejection. Furthermore, these individuals are more conspicuous to predators (Hain & Leatherwood, 1982; Hubbard et al., 2010). Reduced heat absorption in cold waters would be an additional problem for hypopigmented cetaceans (Hain & Leatherwood, 1982; Fertl et al., 1999). Additionally, melanin protects the skin from excessive exposure to ultraviolet light, and a darker pigmentation is advantageous in protecting whale skin from sun damage (Martinez-Levasseur et al., 2011, 2013). Another possibility is that if hypopigmentation is associated with inbreeding, then affected individuals could be at a fitness disadvantage due to inbreeding depression (Peters et al., 2016). Altogether, it is evident that pigmentation anomalies might impact an individual's Darwinian fitness. Thus, knowledge regarding this issue is necessary to improve our understanding about ecological and physiological implications of this condition in cetaceans (Fertl et al., 2004). Cases of hypopigmentation in juvenile and adult cetaceans have been observed, which indicates survival may be more likely than previously expected (Polanowski et al., 2012; Hauser-Davis et al., 2020). However, genetic samples are often difficult to collect from these marine mammals, preventing robust examination of the genetic mechanisms that cause pigmentation changes (Peters et al., 2016). Thus, all records of cetacean sightings with this anomalous condition are valuable.

We report herein sightings of hypopigmentation for an adult spinner dolphin (*Stenella longirostris*) and an adult Risso's dolphin

Table 1. Cases of odontocetes with hypopigmentation recorded in Mexican waters

Record #	Species	Location	Description	Age class	Citation
1	*Lagenorhynchus obliquidens*	Baja California	Possible leucistic	None provided	Brown & Norris, 1956
2	*Grampus griseus*	Banderas Bay	Leucistic	Calf	Esquivel et al., 1992
3	*Tursiops truncatus*	Gulf of California	Leucistic	Subadult	Pérez-Puig et al., 2019
4	*Stenella longirostris*	Mexican Central Pacific	Piebaldism	Adult	This report
5	*Grampus griseus*	Mexican Central Pacific	Leucistic	Adult	This report

(*Grampus griseus*) in the Mexican Central Pacific (MCP), and a killer whale calf (*Orcinus orca*) in Alaska (Juneau). Our observations offer evidence that odontocetes with an anomalous coloration pattern can survive to adulthood. This implies avoidance or compensation of the previously mentioned ecological and physiological limitations posed by hypopigmentation, which coincides with information proposed for albino terrestrial vertebrates (Sazima & Pombal, 1986; Sazima & Di-Bernardo, 1991).

Case 1. Spinner Dolphin

A hypopigmented spinner dolphin was sighted on 25 July 2013 during a marine mammal survey program in waters with a bottom depth of ~595 m, 24 km offshore Cuyutlán Beach, Colima (south of Manzanillo Bays) in the MCP (Table 1; Figure 1). The group was composed of ~100 to 150 dolphins, mainly adults in sailing activity. One of the individuals (an adult > 1.5 m in size) displayed an anomalous coloration; it was pale and had white patches on its flanks and dorsal region, from the head to the peduncle (Figure 2). Piebaldism is a plausible explanation for this anomalous pattern (Miller, 2005; Fertl & Rosel, 2009), and it is the most common hypopigmentation disorder for the order Cetartiodactyla (Abreu et al., 2013). However, another possibility for this skin condition is focal skin disease (Sanino et al., 2014; Onofre-Díaz et al., 2022).

There have been at least seven reports of hypopigmented spinner dolphins between 1970 and 1993 (Hain & Leatherwood, 1982; Fertl et al., 1999). One was an adult white spinner dolphin observed close to Panama (Fertl et al., 2004), similar to what has been reported for other odontocetes such as bottlenose dolphins (*Tursiops truncatus*; Pérez-Puig et al., 2019), rough-toothed dolphins (*Steno bredanensis*; Cardoso et al., 2019), and harbor porpoises (*Phocoena phocoena*; Keener et al., 2011; Robinson & Haskins, 2013; Gil et al., 2019). The present report of a spinner dolphin is the first documented case of piebaldism or focal skin disease in an odontocete in the MCP.

Case 2. Risso's Dolphin

During a survey conducted in the MCP on 7 December 2012 in waters with a bottom depth of ~470 m and approximately ~13 km from San Juan de Alima, Michoacán (Table 1; Figure 1), a mixed-species aggregation of 20 to 25 Risso's dolphins, five to eight bottlenose dolphins, and eight to ten rough-toothed dolphins was sighted, perhaps involved in feeding activity in association with seabirds.

Risso's dolphins are distributed in tropical and cold waters worldwide (Leatherwood et al., 1980), particularly in oceanic habitats where neritic and oceanic squids are abundant (Baird, 2009). The coloration pattern variation on Risso's dolphins is one of the most distinctive characteristics of the species; they are born with gray skin but become pale gray as juveniles and dark brown/black as subadults (Leatherwood et al., 1980; Baird, 2009). One individual (probable adult ~3 m in size) sighted in a mixed-species aggregation showed an anomalous white color pattern that included its dorsal fin (Figure 3), similar to what would be expected in cases of albinism (Miller, 2005). However, analysis of photographs of this individual indicated the presence of several dark spots close to the blowhole, on the ventrum close to the anus, and on the ventral flukes (Figure 3). These spots suggest the production of melanin, at least partially, implying that (1) tyrosinase is not completely defective; (2) the dolphin is affected by leucism or reduced pigmentation (Reissmann & Ludwig, 2013), similar to what was described in a humpback whale off Norway (Lydersen et al., 2013); or (3) this is partial albinism or vitiligo (Fistarol & Itin, 2010), which to our knowledge has not been reported in cetaceans. Furthermore, this oddly pigmented individual was observed swimming alone during the sighting duration (around 1 h), while other dolphins were integrated into subgroups. A consequence reported for

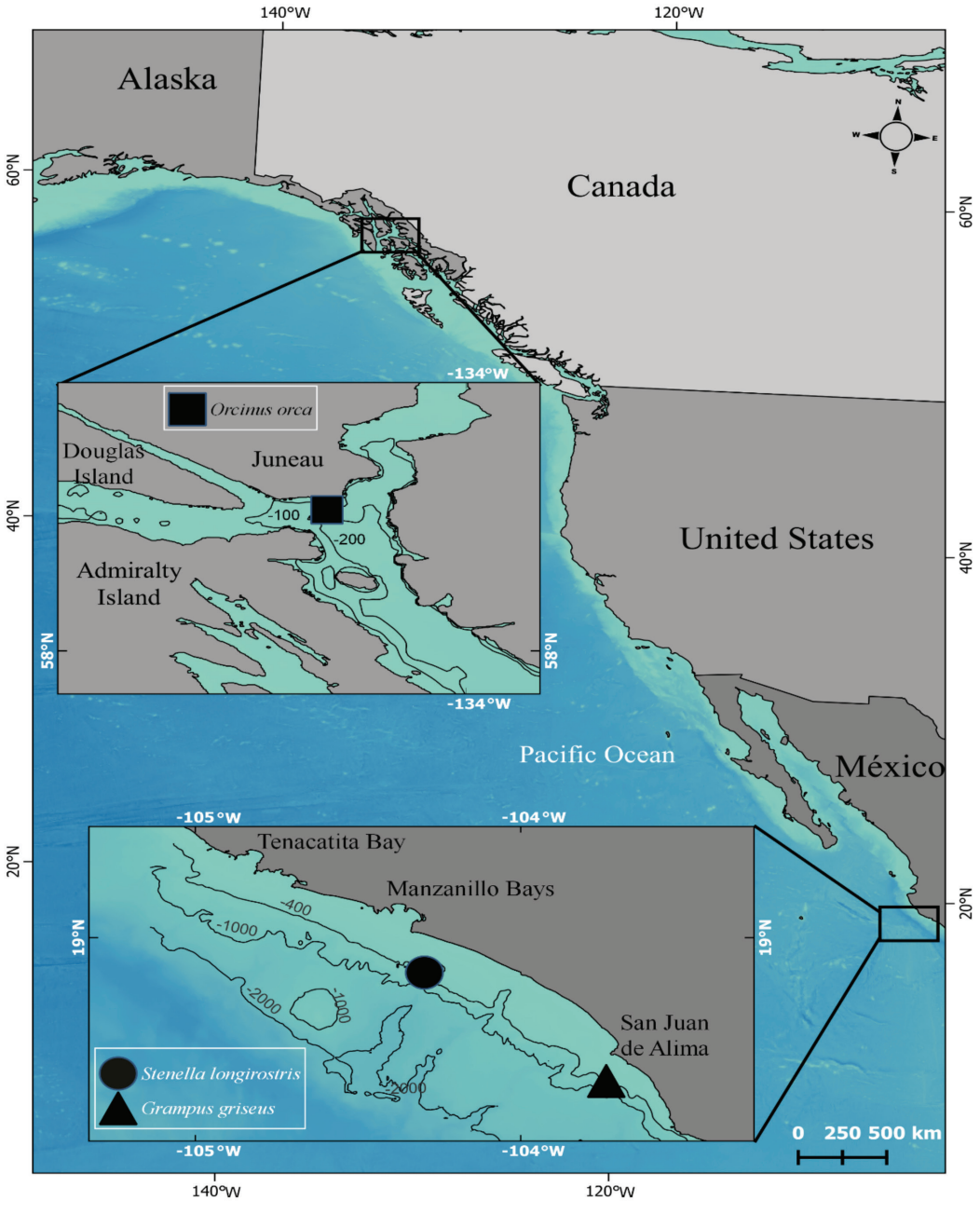

Figure 1. Location of hypopigmented odontocetes: the spinner dolphin (*Stenella longirostris*) and Risso's dolphin (*Grampus griseus*) from the Mexican Central Pacific, and the killer whale (*Orcinus orca*) from Juneau, Alaska

individuals with hypopigmentation is limited social relationships with peers (Hubbard et al., 2010). No other conspicuous behavior was observed.

Along the coast of Japan, Funasaka et al. (2017) reported three male Risso's dolphins with hypopigmentation, and all three cases corresponded to leucism. A Risso's dolphin with hypopigmentation was observed in 2015, 2017, and 2018 in Monterey Bay, California (Marine Bay Whale Watch, 2018). The identity of this individual was

Figure 2. Photographs of the spinner dolphin (*Stenella longirostris*) with a lighter coloration and white patches on both sides of the body. Animal was observed on 25 July 2013 near Cuyutlán Beach in Colima, México. (Photographs provided by Grupo Universitario de Investigación de Mamíferos Marinos [GUIMM] of the U de C)

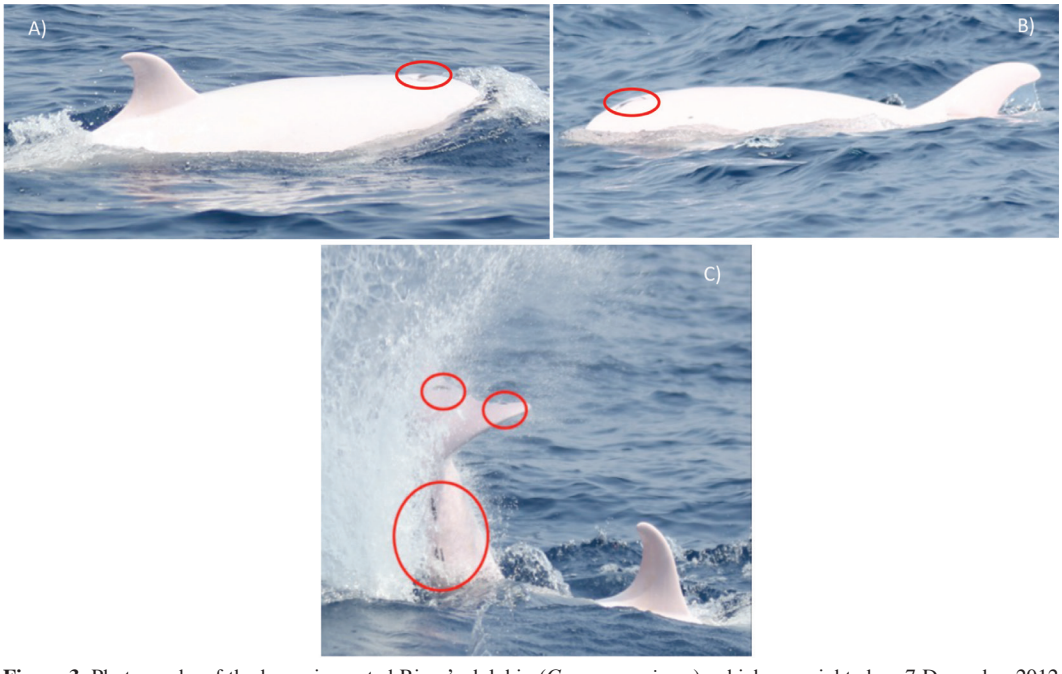

Figure 3. Photographs of the hypopigmented Risso's dolphin (*Grampus griseus*), which was sighted on 7 December 2012 near San Juan de Alima, Michoacán, México. Red circles show parts of the body with colorful spots close to the blowhole (A & B), on the ventral part close to the anus, and on the ventral flukes (C). (Photographs provided by GUIMM of the U de C)

different from the individual observed in the MCP based on dorsal fin comparison. There are only three records of leucistic dolphins off the coast of Mexico: (1) a white Pacific white-sided dolphin seen off Baja California (Brown & Norris, 1956); (2) in an unpublished summary, Esquivel et al. (1992) reported the sighting of three Risso's dolphin calves in Banderas Bay that appeared to be affected by leucism (albinism condition was not confirmed as the sighting was from a considerable distance; Luis Medrano, pers. comm., 5 May 2016); and (3) Perez-Puig et al. (2019) reported sighting a leucistic bottlenose dolphin in the Gulf of California (Table 1).

Case 3. Killer Whale

The crew of a private boat (M/V *Cielo Mare*) sighted a pod of six killer whales (two adult males, one mature female, two females [or juveniles], and one calf; presumably based on their total size and dorsal fins) in early August 2012 in a site with a bottom depth of ~200 m and ~2 km from the coast of Juneau, Alaska (Table 1; Figure 1). The calf

Figure 4. Hypopigmented killer whale (*Orcinus orca*) calf sighted during August 2012 in Juneau, Alaska (Photo courtesy of M/V *Cielo Mare* crew)

presented anomalous coloration and remained close to the adult female, presumably its mother, who displayed normal coloration and was identified as "M5" in the NOAA's killer whale catalogue from the North Pacific (Marilyn Dahlheim, pers. comm., 12 July 2015; Figure 4). The calf's skin was lighter than the other members of the group but not completely white. Similarly, an Atlantic spotted dolphin (*Stenella frontalis*) with lighter coloration but not completely white was reported in Madeira Island, Portugal (Alves et al., 2017).

White killer whales have been sighted in different parts of the world with ~24 scientific cases reported (see Supplementary Table S1; the supplementary table for this paper is available in the "Supplemental Material" section of the *Aquatic Mammals* website: https://www.aquaticmammals-journal.org/index.php?option=com_content&view=article&id=10&Itemid=147), and others recently commented upon in social networks (a calf in Washington in October 2019: Andrew, 2019; and a calf in California in August 2021: Osborne, 2019). Considering those from scientific research, one case corresponds to a calf with abnormal pigmentation, similar to the calf of this report, that died due to the Chédiak-Higashi Syndrome (record #7 in Supplementary Table S1), an inherited fatal disorder characterized by diluted pigmentation and reduced life span (Taylor & Farrell, 1973). These reports show that hypopigmented killer whales can reach adulthood (~30% of cases; Supplementary Table S1). To further understand the intrinsic and extrinsic mechanisms that can lead to cetacean pigmentation disorders, studies based on genetic and histological analysis of skin biopsies are encouraged for future research.

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