Journal of Marine Animals and Their Ecology
Vol 4, No 2, 2011
Printed in Canada

First Records of Anomalously White Harbor Porpoises (Phocoena phocoena) from the Pacific Ocean

William Keener[1], Isidore Szczepaniak[1], Adam Ü[2], Marc Webber[1] and Jonathan Stern[3]
[1]Golden Gate Cetacean Research, 9 Edgemar Way, Corte Madera, CA, USA
[2]Protected Resources Division, Southwest Fisheries Science Center, 3333 North Torrey Pines Court, La Jolla, CA, USA
[3]Biology Dept., San Francisco State University, 1600 Holloway Avenue, San Francisco, CA, USA

Abstract

Anomalously white cetaceans are rarely seen, and only five records of white harbor porpoises (*Phocoena phocoena)* are found in the literature. We provide an updated list of those records, and add two photo-documented records for the first white harbor porpoises from the Pacific Ocean: an animal sighted in 2007 in the Salish Sea, WA, USA, and an animal sighted on three occasions in 2011 in San Francisco Bay, CA, USA. This report includes observations of free-ranging harbor porpoises with this aberrant coloration. [JMATE 2011;4(2):19-24]

Keywords: *Cetacean, pigmentation, albino, leucistic, Salish Sea, San Francisco Bay*

Introduction

Accounts of cetaceans with anomalously white pigmentation are infrequent, although individuals representing 24 species have been reported (3, 4, 5, 9, 17). Our literature survey produced a list of records for harbor porpoise (*Phocoena phocoena*) (Table 1), augmenting a 1999 review (5). Five detailed reports of anomalously white harbor porpoises, three from the Atlantic Ocean subspecies (*P.p. phocoena*) and two from the Black Sea subspecies (*P.p. relicta*), have been published over the past 100 years (7, 12, 14, 18, 19, 20, 22).

Because anomalously white cetaceans are rarely seen, little is known about the physiological and ecological effects of hypo-pigmentation. Potentially negative consequences include increased conspicuousness to predators and a reduced ability to thermoregulate (9). The latter is of particular importance to harbor porpoises as their small size, approximately 150-160 cm average length for adults (2), results in a high surface area to body volume ratio unfavorable for retaining metabolic heat in cold water (8). Over time, published reports may lead to insights into the implications of this aberrant pigmentation, such as the survivability and health of the afflicted animals (5).

Our contribution consists of two photo-documented records that represent the first known white harbor porpoises from the Pacific Ocean: a 2007 sighting from the Salish Sea (the waters of the San Juan Islands in Washington State, USA) and three 2011 sightings of the same animal from San Francisco Bay, California, USA. Both animals are of the eastern North Pacific subspecies *P.p. vomerina*. The previous records of anomalously white harbor porpoises were based on post-mortem examinations of by-caught or intentionally taken animals (7, 12, 14, 18, 19, 20, 22). Therefore, our behavioral observations of free-ranging individuals with pronounced hypo-pigmentation are the first reported for this species.

The 2007 Salish Sea sighting was an opportunistic observation made during a vessel-based line-transect study of marbled murrelets (*Brachyramphus marmoratus*) for the U.S. Forest Service (21). This longitudinal effort to monitor the at-sea population of murrelets in the San Juan Islands has been conducted since 1995. Records are kept of all marine mammals encountered, and the harbor porpoise and Dall's porpoise (*Phocoenoides dalli*) data has been analyzed (23). Harbor porpoises are frequently recorded for the transect that runs through the area off Orcas Island where the anomalously white porpoise was sighted.

The 2011 San Francisco Bay sightings were made during our ongoing study of harbor porpoises, which have returned to San Francisco Bay after an absence of approximately 65 years. We have begun a multi-year effort to assess the distribution and behavior of porpoises in the Bay, including photo-ID of individuals and observations conducted primarily from the Golden Gate Bridge. Normally shy, harbor porpoises are difficult to approach. However, from the bridge deck we are able to photograph them without affecting their natural behavior. Since at least 2008

Received October 28, 2011; Accepted November 18, 2011
Correspondence: William Keener
Golden Gate Cetacean Research
9 Edgemar Way, Corte Madera, CA 94925 USA
Phone: 415-297-6139
Email: bill.keener@comcast.net

YEAR	LOCATION	SEX/LGTH	PIGMENTATION*	REFERENCES
1911	North Atlantic North Sea Scotland	♀ calf 86 cm	Eyes: dark. Body: dull yellowish, faint dark longitudinal bands on sides. Head: dark bands from eye to mouth.	MacIntosh 1912 (14) (photo cited in 9 not found) Prince 1913 (19) (no photo)
1928	Black Sea Crimea, Ukraine	Sex not stated (adult, estimated from photo)	Eyes: dark. Body: white, with dark on upper part of dorsal fin and upper tips of flukes. Head: dark lips and dark half moon behind blowhole.	Kleinenberg 1936 (12) (photo)
1929	North Atlantic Skagerrak Denmark	♂ adult 150 cm	Eyes: dark. Body: white, with dark lips, narrow stripe running along spine to dorsal fin, dark tip of dorsal fin, and small spots on flukes. Head: dark lips and large spot on forehead.	Peters 1929 (18) (photo) Flower 1929 (7) (photo)
1937	Black Sea Crimea, Ukraine	♂ adult 146 cm	Eyes: dark. Body: white with dark broad stripe along back, dark on lower half of dorsal fin along anterior edge, dark spots on dorsal surfaces of flukes. Head: white, with dark on dorsal surface, and around eyes.	Tsalkin 1938 (22) (photo)
1988	North Atlantic Ireland	♀ adult 176 cm	Eyes: dark. Body: completely white.	Quigley, Flannery 2002 (20) (no photo)

Table 1 - Published Records of Anomalously White Harbor Porpoises.
** Descriptions of pigmentation are by the authors cited, except for our term 'dark' used as a generic for 'pigmented,' 'dusky,' 'blackish-gray,' etc.*

harbor porpoises have occurred daily in the bridge area as they enter and leave the Bay with the tides.

Salish Sea: On 2 August 2007, a white harbor porpoise was sighted off Pt. Doughty, Orcas Island in the San Juan Islands of Washington State. The animal was milling in an area of tidal upwelling where the bottom contour rises abruptly from a depth of 165 m to 42 m (48º 42' 36" N, 122º 57' 36" W). Harbor porpoise sightings are common in this location (23), however the unusual color of this individual warranted a pause in the bird survey to take digital photographs. During 4 min of observations at distances of approximately 100 to 200 m, the animal continued to engage in non-directional milling (presumably foraging) in an area of about 500 m^2 between Pt. Doughty and the upwelling spot. It was swimming alone, but five other normally-pigmented harbor porpoises were recorded in that area. This individual had the same shape as other adult harbor porpoises seen off Pt. Doughty, and was also the same size, based on the length of its exposed back, approximately 1 m. It also behaved similarly, surfacing with a low smooth roll.

The left side of this anomalous animal, including its back, flank and caudal peduncle, were creamy white, with the exception of the dorsal fin, which was a dark gray typical of harbor porpoises (Figure 1). The low observation platform of the 5.2 m Boston Whaler did not afford a view of the rest of the body.

San Francisco Bay: On 30 April 2011, an adult-sized white harbor porpoise was spotted in San

Figure 1 - Anomalously white harbor porpoise, Salish Sea, 2 August 2007.

Francisco Bay, California traveling west towards the Golden Gate Bridge (37° 48' 59" N, 122° 28' 39" W). Three surfacings were observed and digital photographs of its left side were taken over the course of 2 min before the animal traveled out of sight under the bridge, continuing west (Figure 2a).

On 1 October 2011 and 24 October 2011, this individual was re-sighted beneath the Golden Gate Bridge. Photographs were taken of its left side, in addition to its right side and dorsum, that confirmed its identity based on the unique color pattern (Figure 2b, 2c, 2d and Figure 3). Its ventrum was not seen.

Both sides of the animal including flanks and caudal peduncle were bright white (Figure 2). The back was white, in contrast to the gray dorsal fin that was tipped with black. The fluke lobes were light gray, with the white of the caudal peduncle extending almost to the notch (Figure 3). The pectoral flippers appeared to be light gray, although the grayish cast may be due to the effects of underwater lighting.

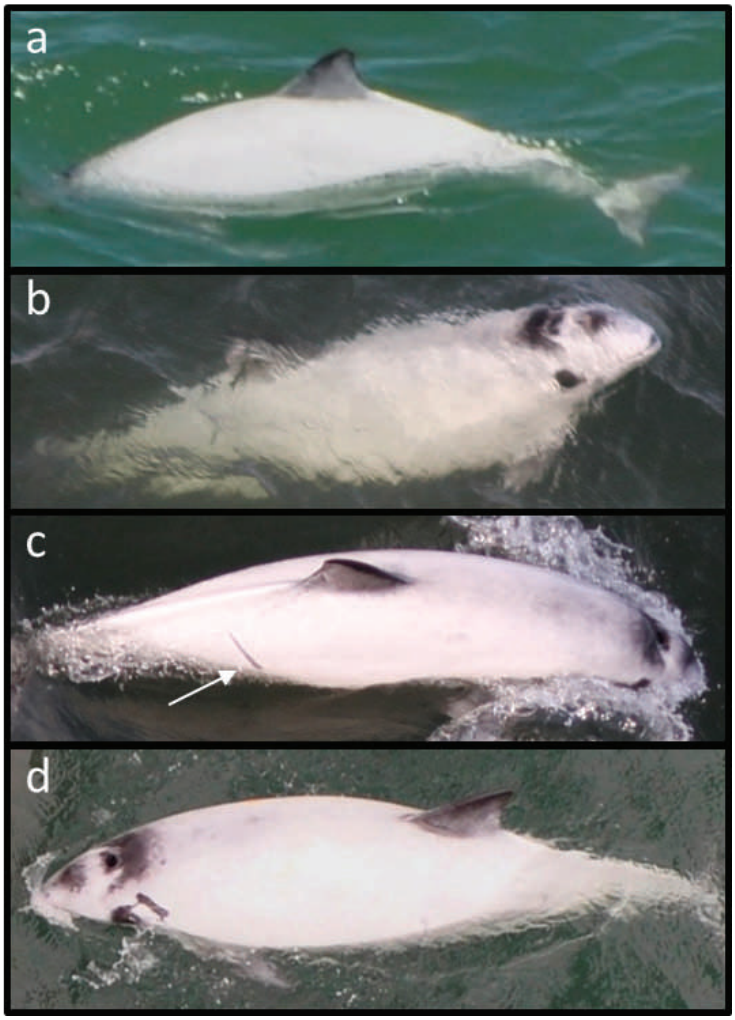

Figure 2 - Anomalously white harbor porpoise, San Francisco Bay: (a) 30 April 2011; (b & c) 1 October 2011; (d) 24 October 2011. Note - arrow in 2c points to dark linear scar on right flank.

The head was mostly white, including the rostrum and lips, with a blackish crescent posterior to the blowhole and a smaller dark smudge anterior to the blowhole over the melon (Figure 2b & 2d). The area posterior to the mouth on the right side, where a flipper stripe is normally found (13), appeared white (Figure 2b). The eyes were dark, surrounded by small dark patches, and there was a dark supraorbital "eyebrow" over the left eye (Figure 2d).

The animal's right flank displayed a linear mark, presumably a scar. The scar was dark against the contrasting white skin, the opposite of the usual color pattern of pale scars visible on normally-pigmented porpoises (Figure 2c).

When sighted on 30 April, the anomalous porpoise was swimming alone, although there were five normally-pigmented harbor porpoises within approximately 100 m. During the sightings of 1 October and 24 October, the white animal swam with a group of up to 12 normally pigmented porpoises (Figure 3) spread over an area of approximately 50 m^2, traveling in the vicinity of the bridge. On 1 October, it engaged in social interactions for approximately 20 min that included approaching another porpoise and making brief side-to-side contact before veering away, chasing another porpoise at high speed, and in one instance, executing a tight, rapid 360° turn underwater in close proximity to another porpoise.

Figure 3 - Anomalously white harbor porpoise with normally-pigmented porpoise, San Francisco Bay, 1 October 2011.

Discussion

The harbor porpoise's pigmentation pattern is normally countershaded, with a dark dorsum and a pale ventrum, and individual and inter-population differences are noted (13). Anomalously white coloration may be produced by a number of biochemical factors, so it is difficult to ascertain the cause without genetic information (9). Criteria such as eye and skin color should not be relied upon entirely to determine albinism (6). However, the five anomalously white harbor porpoises described in Table 1 and both the Salish Sea and the San Francisco Bay animals appear to be leucistic rather than albino. A total absence of melanin in true albinos results in completely white skin and pink or reddish, rather than dark, eyes (5, 6, 9). All seven anomalously white porpoises had dark eyes (14, 19, 12, 18, 7, 22, 20) and, with the exception of the 1988 porpoise from Ireland (20), had additional pigmented areas, suggesting leucism. The porpoises had almost or completely hypo-pigmented skin, with the exception of the 1937 Black Sea porpoise that showed extensive dark coloration on its upper back (22), possibly a form of piebaldism in which body pigmentation is missing in only some areas (6).

Dark pigment was restricted to the body extremities of four of the seven animals reported, a pattern previously noted in cetaceans (9). Four of the animals in Table 1 show dark marks, such as caps, on the head (14, 19, 12, 18, 7, 22) with the 1928 Black Sea specimen described as having pigmentation "in the shape of a halfmoon on the head, directly behind the blowhole" (12). While the head of the Salish Sea animal was not visible, the white animal seen in San Francisco Bay adheres to this pattern, with a dark smudge on its melon and a dark crescent posterior to the blowhole. The 1928 Black Sea animal (12), the 1929 Denmark animal (18,7) and the 1937 Black Sea animal (22) showed some pigmentation on their dorsal fins, as did both animals we sighted.

Anomalous coloration also results from hybridization, and harbor porpoises have been known to mate with Dall's porpoises in the wild (1). In the Salish Sea, unusually pigmented harbor porpoise x Dall's porpoise hybrids are relatively common, with evidence of recurrent hybridization between the local populations of the two species (24). Putative hybrids observed at sea have a body shape intermediate between Dall's and harbor porpoises, are generally pale to medium gray, have a mouth-to-flipper stripe, surface and bowride in a manner similar to Dall's porpoises, are always found in deep water (>50 m) where Dall's porpoises are found, and regularly associate with normally-pigmented Dall's porpoises, but are never sighted with harbor porpoises (1, 24).

We believe the 2007 Salish Sea white porpoise was not a hybrid because it had the size and shape of a harbor porpoise, including a low triangular dorsal fin, and behaved similarly to the other harbor porpoises in the vicinity. Field data from 14 years of marbled

murrelet surveys (1995-2008) confirm that no Dall's porpoises have been recorded in the waters off Pt. Doughty (23).

Along the California coast, where the ranges of the harbor porpoise and the Dall's porpoise also overlap, few suspected hybrids have been reported (1). Adult grayish-brown Dall's porpoises with color patterns resembling harbor porpoises, including mouth-to-flipper stripes, were observed in Monterey Bay in the early 1970s (16, 15). In morphology and behavior, they were similar to the normally-pigmented Dall's porpoises with which they associated (16).

The 2011 San Francisco Bay white porpoise appeared to be a typical harbor porpoise in size and shape. It exhibited behavior, including surfacing and diving, similar to the harbor porpoises with which it associated in a nearshore habitat where Dall's porpoises are not known to occur (15). The similarity of leucistic pigmentation patterns between harbor porpoises from the Atlantic Ocean and Black Sea, where porpoises have no opportunity to hybridize with another phocoenid species, and the Pacific Ocean supports our contention that the anomalously white individuals we sighted were harbor porpoises, not hybrids.

Four of the animals in Table 1 survived to adulthood, but the 1911 porpoise from Scotland is described as "half grown," with a length of 86 cm (14, 19). This "dull yellowish" individual may have been a young calf, or possibly a neonate, as the birth length of this species ranges from 70-90 cm (10). With the addition of the two animals reported here, six of the seven hypo-pigmented harbor porpoises reached adult size, evidence that this condition does not necessarily pose a survival handicap in this species.

Our sightings of two adults, both behaving similarly to other adult harbor porpoises (foraging in the case of the Salish Sea individual, and socializing in the case of the San Francisco individual) indicate that at least some harbor porpoises behave normally despite their aberrant coloration. Indeed, the San Francisco Bay porpoise engaged in vigorous social interactions with conspecifics, including an instance in which it initiated brief body contact, suggestive of mating behavior we have observed in male harbor porpoises (11).

The porpoise sighted in San Francisco Bay is also interesting because of its repeated use of the same habitat over a period of nearly 6 months. Such a striking animal, far more easily visible and identifiable than a normally-pigmented porpoise, might serve as a natural marker to gain information over time on the movements of porpoises in the Bay and coastal waters off San Francisco (9).

Acknowledgements
We thank Thomas Jefferson, Dagmar Fertl, Arda Tonay, Özgür Keşapli Didrickson and Reyhan Sonmez for providing references and discussion, and Martin Raphael and Jean Olson of the U.S. Forest Service Pacific Northwest Research Station Olympia, WA, USA for their support where Adam U was working during the time this research was carried out. We extend our appreciation to the journal reviewers whose comments led to improvements in the manuscript.

References

1. Baird RW, Willis PM, Guenther TJ, Wilson PJ, White BN. An inter-generic hybrid in the family Phocoenidae. *Canadian Journal of Zoology* 76:198–204. 1998.
2. Bjorge A, Tolley KA. Harbor Porpoise. In: *Encyclopedia of Marine Mammals*, Second Edition, edited by Perrin WF, Würsig B, Thewissen JGM: Academic Press, 2009. p. 530-533.
3. De Boer, MN. First record of a white rough-toothed dolphin (*Steno bredanensis*) off West Africa including notes on rough-toothed dolphin surface behaviour. *Marine Biodiversity Records* 3:e66. 2010.
4. Fertl D, Barros NB, Rowlet RA, Estes S, Richlen M. An update on anomalously white cetaceans, including the first account for the pantropical spotted dolphin (*Stenella attenuata graffmani*). *Latin American Journal of Aquatic Mammals* 3:163-166. 2004.
5. Fertl D, Pusser LT, Long JL. First record of an albino bottlenose dolphin (*Tursiops truncatus*) in the Gulf of Mexico, with a review of anomalously white cetaceans. *Marine Mammal Science* 15:227-234. 1999.
6. Fertl D, Rosel P. Albinism. In: *Encyclopedia of Marine Mammals*, Second Edition, edited by Perrin WF, Würsig B, Thewissen JGM: Academic Press, 2009, p. 24-26.
7. Flower SS. Note on eight continental zoological

gardens visited in 1929. *Proceedings of the Zoological Society of London* 99:659-669. 1929.
8. Gaskin DE, Arnold PW, Blair, BA. Phocoena phocoena. *Mammalian Species* 42:1-8. 1974.
9. Hain JHW, Leatherwood S. Two sightings of white pilot whales, *Globicephala melaena*, and summarized records of anomalously white cetaceans. *Journal of Mammalogy* 63:338-343. 1982.
10. Jefferson TA, Webber MA, Pitman, RL. *Marine Mammals of the World - A Comprehensive Guide to their Identification.* San Diego: Academic Press, 2008, p. 278-281.
11. Keener W, Szczepaniak I, Stern J, Webber M. When pig-fish fly: the sex life of harbor porpoises in San Francisco Bay. *Abstracts, 19th Biennial Conference on the Biology of Marine Mammal.* Tampa, Florida, 27 November-2 December 2011.
12. Kleinenberg SY. K avprosu ob al'binizme u del'finov. *Izv. Akad. Nauk. SSSR* 1936:1305-1310. 1936.
13. Koopman HN, Gaskin DE. Individual and geographical variation in pigmentation patterns of the harbour porpoise, *Phocoena phocoena* (L.). *Canadian Journal of Zoology* 72:135-143. 1994.
14. MacIntosh WD. On a white porpoise. *Notes from the Gatty Marine Laboratory, St. Andrews, no 33. Annual Magazine for Natural History* 10:117-119. 1912. (Not seen, cited in 9)
15. Morejohn GV. The natural history of Dall's porpoise in the North Pacific Ocean. In: *Behavior of Marine Animals, Volume 3: Cetaceans*, edited by Winn HE, Olla BL: Plenum Press, 1979. p. 45-83.
16. Morejohn GV, Loeb V and Baltz DM. Coloration and sexual dimorphism in the Dall porpoise. *Journal of Mammalogy* 74:977-982. 1973.
17. Nascimento LF, Spinelli LHP, Santos Jr E, Queiroz REM, Pansard KCA, Medeiros PIAP, Gondim MA, Jesus AH, Silva FJL, Yamamoto EM. Atypical coloration in a specimen of estuarine dolphin, Sotalia guianensis, on the littoral of the state of Rio Grande do Norte, north-east Brazil. *Marine Biodiversity Records* 1:e89. 2007.
18. Peters N. Ueber einen weissen Tummler. *Der Fischerbote* 22:354-355. 1929.
19. Prince E. Some rare cases of albinism in animals. *The Ottawa Naturalist* 27:122-127. 1913.
20. Quigley DTG, Flannery K. Leucoptic harbour porpoise *Phocoena phocoena* (L.). *Irish Naturalists' Journal* 27:170. 2002.
21. Raphael MG, Baldwin J, Falxa GA, Huff MH, Lance M, Miller SL, Pearson SF, Ralph CJ, Strong C, Thompson C. Regional population monitoring of the marbled murrelet: field and analytical methods. *U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, General Technical Report PNW-GTR-716*. 70pp. 2007.
22. Tsalkin VI. Morphological characteristics, systematic position, and zoogeographical significance of the harbor porpoise of the Sea of Azov and Black Sea. *Zoologicheskii Zhurnal* 17:706, 712-713. 1938.
23. Ü A. Summertime Density, Abundance, and Distribution of Harbor Porpoise and Dall's Porpoise in the Inside Waters of Washington. Master's thesis. University of Aberdeen. 79 pp. 2009.
24. Willis PM, Crespi BJ, Dill LM, Baird RW, Hanson B. Natural hybridization between Dall's porpoises (*Phocoenoides dalli*) and harbour porpoises (*Phocoena phocoena*). *Canadian Journal of Zoology* 82:828-834. 2004.