

Short Note

First Photographic Match of an Anomalously White Gray Whale (*Eschrichtius robustus*) in the Northeastern Chukchi Sea, Alaska, and Baja California, Mexico

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Gray whales (*Eschrichtius robustus*) in the eastern North Pacific undertake long seasonal migrations from winter mating and calving grounds in Mexican waters to summer feeding areas within a high-latitude range that extends from southern British Columbia to the Arctic (Rice et al., 1984). Although this migration is well-documented, few individuals have been matched to locations at the extremes of their range. Herein, we report one such match—an anomalously white gray whale that was sighted and photographed in the northeastern Chukchi Sea, Alaska, and off Baja California, Mexico. To the best of our knowledge, the observations presented below denote the first accounts of (1) an anomalously white gray whale in the northeastern Chukchi Sea and (2) a noteworthy intra-annual match of an individual gray whale on both wintering and summering grounds.

The Aerial Surveys of Arctic Marine Mammals (ASAMM) project conducts systematic line-transect aerial surveys to document the relative abundance and distribution of marine mammals in the northeastern Chukchi Sea and western Beaufort Sea north and west of Alaska (Clarke et al., 2017). Since 2009, ASAMM surveys of the northeastern Chukchi Sea have been conducted annually from July through October (Clarke et al., 2017). Prior to 2009, surveys were conducted sporadically in summer and fall during 1979 to 1991 and in 2008 (Clarke et al., 2017). The Chukchi Sea is considered the northern extent of the gray whale's migratory range, and these surveys coincide spatially and temporally with gray whales on their summer feeding grounds. In autumn, gray whales migrate south to their breeding and wintering grounds near and around Baja California, Mexico.

On 7 July 2013, ASAMM observers sighted an anomalously white adult gray whale in the Chukchi Sea at 69° 45' N, 163° 10' W, west of Point Lay, Alaska (Figure 1). The sighting was in water 12 m deep and 3.5 km from shore. The white gray whale was sighted in a group totaling six gray whales, comprised of two other adults and three calves with normal pigmentation. The group appeared to be feeding as indicated by mud plumes in the water and exiting the mouths of the adult whales. Aerial photographs ($N = 13$) were obtained from an altitude of 294 m, and the white gray whale was photographed in close proximity to a smaller whale, presumed to be its calf (Figure 2A).

ASAMM observers made a second sighting of an anomalously white adult gray whale on 21 July 2013 at 71° 01' N, 158° 13' W, approximately 240 km north of the first observation (Figure 1). The sighting was in water 23 m deep and 21.5 km from shore. On this occasion, the white gray whale was sighted with one other gray whale, a calf. Aerial photographs ($N = 4$) were obtained from an altitude of 346 m, although the calf was not visible in the resulting images.

In addition to the two sightings by ASAMM observers, there were three other sightings of this whale that have been photographically matched to this animal. The first occurred on 11 February 2012 when photographer Alastair Marsh sighted and photographed an anomalously white adult gray whale in San Ignacio Lagoon, Baja California, Mexico (Figure 1). The shared images included close-range, high-resolution imagery of the whale's ventral flukes (Figure 3A).

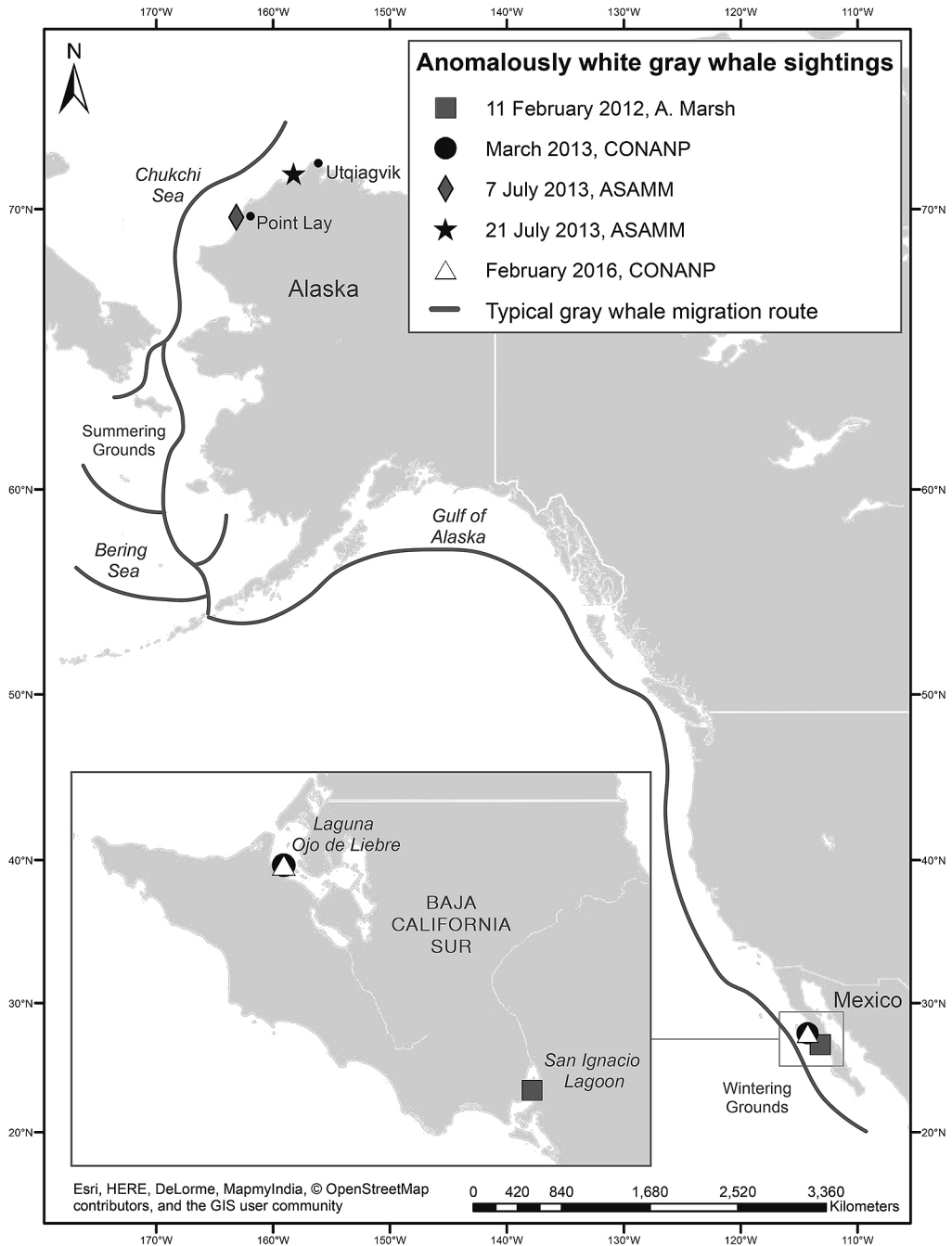


Figure 1. Anomalously white gray whale (*Eschrichtius robustus*) sightings plotted on a map of Baja California Sur (inset) and on a map of the North American west coast from Mexico to the Chukchi Sea, by date and sighting source, along with a line indicating the typical gray whale migration route.

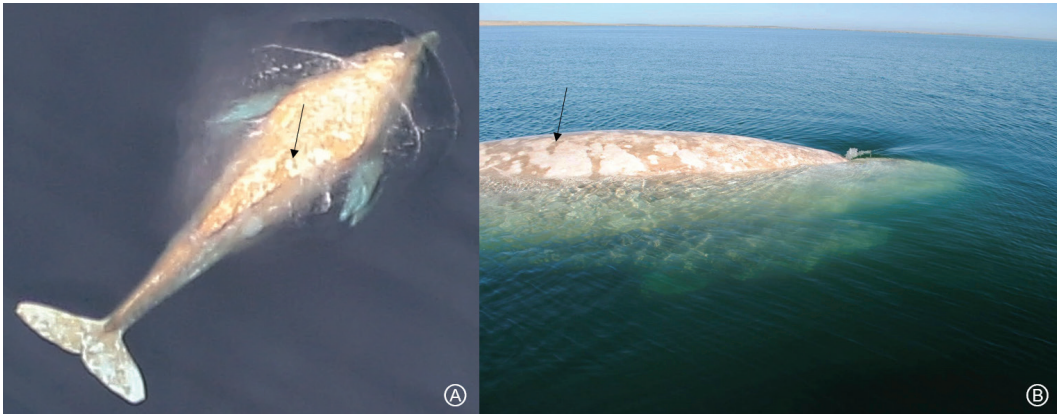


Figure 2. The pigmentation patterns on the dorsal right side photographed in (A) the northeastern Chukchi Sea, Alaska, on 21 July 2013, and (B) Laguna Ojo de Liebre, Baja California, Mexico, in February 2016, confirm that the two sightings are of the same anomalously white individual. (Photo credits: [A] Karen Vale, NOAA/NMFS/AFSC/MML, NMFS Permit No. 14245, funded by BOEM, IA Contract No. M11PG00033; and [B] © Francisco Jiménez Franco, National Commission of Natural Protected Areas)



Figure 3. The pigmentation patterns, scars, and missing fluke tips on both the left and right lobes of the ventral flukes photographed in (A) San Ignacio Lagoon, Baja California, Mexico, on 11 February 2012 and (C) Laguna Ojo de Liebre, Baja California, Mexico, in February 2016, confirm that the two sightings are of the same anomalously white individual. The angle and scale of the missing fluke tips in images A and C are similar to the flukes photographed in (B) the northeastern Chukchi Sea, Alaska, on 7 July 2013. (Photo credits: [A] © Alastair Marsh, www.alastairmarshphotography.co.uk; [B] Karen Vale, NOAA/NMFS/AFSC/MML, NMFS Permit No. 14245, funded by BOEM, IA Contract No. M11PG00033; and [C] © Everardo Mariano Meléndez/National Commission of Natural Protected Areas.

In March 2013, researchers with the National Commission of Natural Protected Areas (Comisión Nacional de Áreas Naturales Protegidas [CONANP]) sighted an anomalously white gray whale during a vessel-based visual census of gray whales on their wintering and calving grounds in Laguna Ojo de Liebre, within the El Vizcaino Biosphere Reserve, Baja California, Mexico (Figure 1). The whale was recorded as a solitary, anomalously white adult gray whale (M. E. Melendez, CONANP, pers. comm., 12 August 2016). Vessel-based identification photographs were obtained during the observation. This sighting preceded the intra-annual observations from July 2013 in the northeastern Chukchi Sea presented above.

In February 2016, nearly 3 y after the ASAMM sightings in the northeastern Chukchi Sea, CONANP researchers sighted an anomalously

white adult gray whale during a gray whale census of the shallow waters of Laguna Ojo de Liebre off Baja California, Mexico (M. E. Melendez, CONANP, pers. comm., 12 August 2016) (Figure 1). On this occasion, the white gray whale was sighted with a normally pigmented calf. Vessel-based photographs were obtained during the observation (Figures 2B & 3C).

Cross-matching of the pigmentation patterns and scars between the photographs indicated that the observations in 2012, 2013, and 2016 were of the same individual whale. The anomalously white gray whale had identifiable injuries to its flukes; specifically, the fluke tips on both the left and right sides were missing. These injuries were evident in the close-range images taken off Baja California, Mexico, by Alistair Marsh in 2012, by CONANP in 2016, and in the ASAMM aerial

images from the northeastern Chukchi Sea on 21 July 2013 (Figures 3A, 3B & 3C). Scarring was also visible on the ventral flukes in the close-range images from 2012 and 2016 (Figures 3A & 3C). Unique pigmentation patterns on the whale's right dorsal side were used to match the whale in images from observations made on 21 July 2013 and in 2016 (Figures 2A & 2B). In addition, images of the whale's left dorsal side taken by CONANP in March 2013 and in February 2016 confirmed that the anomalously white gray whale seen by ASAMM in the Chukchi Sea in 2013 was the same whale sighted by CONANP earlier that year in Laguna Ojo de Liebre off Baja California, Mexico.

Although the aerial images taken on 7 July 2013 were of lower quality, a systematic comparative analysis of key features across images from each sighting indicated that there is a high probability that the anomalously white gray whale sighted in the Chukchi Sea on 7 July 2013 was the same individual that was sighted on 21 July 2013. Furthermore, the sightings in July 2013 were the first of an anomalously white gray whale in 18 y of ASAMM surveys in the northeastern Chukchi Sea; they occurred during the same month; and they were located within 250 km of each other (Figure 1). In addition, the white whales observed on 7 and 21 July 2013 had a similar body condition and were both accompanied by a normally pigmented calf. The preponderance of evidence described above supports the likelihood that the intra-annual sightings were of the same individual.

It is unclear if the white gray whale photographed in 2012, 2013, and 2016 is a true albino. Often, hypopigmented (anomalously white) individuals are presumed to be true albinos; however, pigmentation patterns should not be the only criterion used to determine whether an individual is an albino (Fertl & Rosel, 2002; Fertl et al., 2004). Multiple types of genetic defects can result in hypopigmentation (anomalously white coloration), and further observations and genetic investigations would be needed to identify the genetic defect responsible for this particular gray whale's anomalously white pigmentation.

Our goal was to highlight sightings of anomalously white gray whales to generate distribution and habitat information, monitor the health and reproductive success of these atypical animals, and provide a database to which future sightings could be added. Building upon the work of Hain & Leatherwood (1982) and Fertl et al. (1999, 2004), who assembled known records of anomalously white cetaceans, we have expanded the list specific to gray whales. Findings from our literature and photographic research, which include published and unpublished accounts of anomalously white gray whales, are summarized in Table 1. The only publication providing specific details about white gray whales is Goebel & Dahlheim (1979), who published an account of an anomalously white gray whale sighted in the Bering Sea from the *Western Viking* on 12 July 1978. They described the whale's pigmentation as "unmistakably white," which made the whale's body detectible through the water's surface. In the same publication, Goebel & Dahlheim also report sightings of a white gray whale south of Gambell, Alaska, in June 1977 and near St Lawrence Island, Alaska, in July 1978.

Without photographs from earlier sightings of anomalously white gray whales, it is impossible to know if they involve the same individual gray whale that we describe herein or the number of unique whales they represent (Table 1). However, based upon age class, sightings of anomalously white gray whales over the last 30 y indicate that at least three separate such whales have been sighted. Observations of an anomalously white gray whale calf in 2003 and the reproductively mature anomalously white female with a calf of the year sighted in 2013 and 2016 are representative of the known life history of female gray whales for which sexual maturity occurs around age 8, with a 2-y calving interval (Reeves & Mitchell, 1988). Thus, it is plausible that this female whale was sighted as a calf in 2003 and successfully produced at least two offspring since her maturity.

Table 1. Records of anomalously white gray whales (*Eschrichtius robustus*)

Date	Location	Age class	Reference
June 1977	Bering Sea, Alaska	Adult	Goebel & Dahlheim, 1979, as cited in Hain & Leatherwood, 1982, & Fertl et al., 1999
12 July 1978	Bering Sea, Alaska	Adult	Goebel & Dahlheim, 1979, as cited in Hain & Leatherwood, 1982, & Fertl et al., 1999
6 May 1994	North of Florence, Oregon	Unknown	Fertl et al., 1999
February 1996	Laguna Ojo de Liebre, Baja California, Mexico	Unknown	Fertl et al., 1999
February 2003	Guerrero Negro Lagoon and Laguna Ojo de Liebre, Baja California, Mexico	Calf with normally pigmented cow ¹	Journey North, 2003, as cited in Fertl et al., 2004
Winter 2008/2009	Laguna Ojo de Liebre, Baja California, Mexico	Juvenile ¹	E. M. Melendez, CONANP, pers. comm., 12 August 2016 ³
11 February 2012	San Ignacio Lagoon, Baja California, Mexico	Adult ^{1,2}	A. Marsh, Alastair Marsh Photography, pers. comm., 23 April 2016 ⁵
March 2013	Laguna Ojo de Liebre, Baja California, Mexico	Adult ^{1,2}	E. M. Melendez, CONANP, pers. comm., 12 August 2016 ³
27 March 2013	Laguna Ojo de Liebre, Baja California, Mexico	Adult with normally pigmented calf of the year ^{1,2}	C. Swann, pers. comm., 27 August 2016 ⁶
7 July 2013	Chukchi Sea, Alaska	Adult with normally pigmented calf of the year ^{1,2}	This report ⁴
21 July 2013	Chukchi Sea, Alaska	Adult with normally pigmented calf of the year ^{1,2}	This report ⁴
January 2016	Vizcaino Bay in Laguna Ojo de Liebre, Baja California, Mexico	Adult with normally pigmented calf of the year ^{1,2}	E. M. Melendez, CONANP, pers. comm., 12 August 2016 ³
30 January 2016	Laguna Ojo de Liebre, Baja California, Mexico	Adult with normally pigmented calf of the year ^{1,2}	I. Lopez, Drobots, pers. comm., 25 April 2016 ⁷
February 2016	Laguna Ojo de Liebre, Baja California, Mexico	Adult with normally pigmented calf of the year ^{1,2}	E. M. Melendez, CONANP, pers. comm., 12 August 2016 ³
February 2017	Laguna Ojo de Liebre, Baja California, Mexico	Calf of the year with normally pigmented cow ²	E. M. Melendez, CONANP, pers. comm., 3 March 2017 ³

¹Presumed to be the same individual whale²Corroborated with photographs³National Commission of Natural Protected Areas (Comisión Nacional de Áreas Naturales Protegidas [CONANP])⁴Aerial Surveys of Arctic Marine Mammals (ASAMM)⁵Alastair Marsh Photography (2016)⁶Christopher Swann (2016); available at www.gettyimages.com/detail/photo/albino-grey-whale-and-calf-high-res-stock-photography/558056295⁷Ivan Lopez (2016), Drobots Aerial Imagery Service, <https://www.facebook.com/Droneondemand>

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