

First report of gray whale (*Eschrichtius robustus*, Lilljeborg, 1861) conjoined twin calves in the Eastern Pacific Ocean

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Abstract: In January 2014, gray whale (*Eschrichtius robustus*) conjoined twin calves were found dead in Laguna Ojo de Liebre (Scammon's Lagoon), Baja California Sur, Mexico. The thoracopagus (united ventrally at the chest) individuals were conjoined in the thorax region, sharing the navel and genital area, but with two distinct heads and flukes. Although observed in humans and domestic animals, this case is rare among cetaceans. Some conjoined twin cetacean fetuses have previously been reported; however, this is the first report of the congenital anomaly in *Eschrichtius robustus*.

Key words: Gray whale, twin calves, malformation, Baja California Sur, Mexico

Twins become conjoined during the earliest stages of development when the embryo is in the morula or blastocyst stage (Kaufman, 2004). The etiology of conjoined twins remains enigmatic; however, three hypotheses have been proposed to explain the phenomenon: 1) the fission theory states that conjoined twins are the result of incomplete separation of the embryonic discs, producing a partially separated zygote (Spitz and Kienly, 2003); 2) the fusion theory states that twins are the result of a secondary fusion of two monovular embryonic discs that originally were separated (Spitz and Kienly, 2003). The third theory argues that symmetrical conjoined twins are the result of the secondary union of two originally separate monovular embryonic discs (Spencer, 2000a, 2000b, 2003). The most widely accepted theory, which is the fission theory, argues that incomplete splitting of the embryonic axis occurs (Kaufman, 2004). It seems to be stimulated to divide into two parallel axes, gives rise to two embryos, which may or may not develop separately (Kaufman, 2004).

Conjoined twins are described in more detail by noting the anatomical zone of their union: thoracopagus (united ventrally at the chest), omphalopagus (united at the abdomen), cephalopagus (united ventrally at head and chest), ischiopagus (united at the pelvis), parapagus (united laterally), craniopagus (united at the head), pygopagus (united caudally), and rachipagus (united dorsally at the spine) (Spencer, 2000a, 2000b, 2003).

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Cases of conjoined twin cetaceans are very rare. The earliest report dates to 1917, when parapagus newborn female bottlenose dolphins (*Tursiops truncatus*) were reported in the Netherlands (Kompanje, 2005). Since then, 7 other pairs of conjoined twins have been reported in different Cetacean species: a thoracopagus fetal *Balaenoptera borealis* (Kawamura, 1969), one report of cephalopagus and one parapagus fetal *Stenella coeruleoalba* (Kawamura and Kashita, 1971; Kamiya et al., 1981), a thoracopagus fetal *Balaenoptera acutorostrata* (Patten, 1959; Zinchenko and Ivashin, 1987), one parapagus newborn *Tursiops truncatus* (Dabin et al., 2004), one thoracopagus case for the same species in Turkey (Aytemiz et al., 2014), and one case of ventropagus conjoined in *Megaptera novaeangliae* (Zemsky and Budylenko, 1970).

The present report concerns a case of conjoined twin newborn *Eschrichtius robustus* and represents the first identification of this phenomenon in gray whales.

The geographic distribution of gray whales is relatively limited in the North Pacific Ocean (Rice et al., 1984). In this area, there are two independent populations: the eastern or California-Chukotka population and the western or Okhotsk-Korean population (LeDuc et al., 2000). Most of the eastern stock spends the summer months in the northern Bering and southern Chukchi (Pike, 1962), subsequently leaving this area to migrate



Figure 1. Front view of *Eschrichtius robustus* specimens.



Figure 2. *Eschrichtius robustus* specimens showing caudal area.

south from Alaska to Baja California in October and November (Calambokidis et al., 2000).

The Laguna Ojo de Liebre, on the west coast of the Baja California peninsula (Mexico), drains into Sebastian Vizcaino Bay and is an important calving area (Eberhardt et al., 1964; Rice et al., 1984; Urban et al., 2003). This lagoon is one of the most important regions for the reproduction of gray whales; it forms part of the “El Vizcaíno Biosphere” Reserve and it is recognized as UNESCO World Heritage site (Arriaga et al., 2000).

The gray whale, *Eschrichtius robustus*, is predominantly a benthic bottom feeder (O’Shea et al., 1999) and its diet largely consists of small invertebrates, such as amphipods and tube worms (Bogoslovskaya et al., 1981). Gray whales reach sexual maturity at 5 to 11 years of age (Rice and Wolman, 1971). Gestation time is about 12–13 months (Rice, 1983), calf size at birth is around 460 ± 0.5 cm (Sumich, 1986), and the lactation period is estimated to be approximately 7 months (Zenkovich, 1937; Tomilin, 1957).

The conjoined twin gray whale calves (Figures 1 and 2) were found in the Ojo de Liebre Lagoon, on the western coast (28° parallel-coordinates) of Baja California Sur, Mexico, on 7 January 2014. The dead specimens were found floating inside the lagoon by fishermen, in the area known as “Carros Viejos” ($27^\circ 51' 03''$ N, $114^\circ 17' 40''$ W). Fisherman incidentally took them with a net attached to their boat and transferred them to the beach, where morphometric measurements were taken (Table).

Table. Measurements of the conjoined twin gray whale (*Eschrichtius robustus*) calves (DX = right individual; SX = left individual).

Body side	Measurements	Centimeters
DX	Fluke (union)-anus	145
DX	Fluke (union)-navel	210
DX	Fluke width	150
DX	Rostrum-navel	239
DX	Rostrum-anus	245
DX	Rostrum-fluke (fork)	444
DX	Rostrum-fluke tip	485
DX	Rostrum-fin (base)	130
DX	Rostrum-fin (tip)	230
DX	Rostrum-blowhole	092
DX	Rostrum-eye	090
DX	Fin	094
DX	Fin diameter	038
DX	Rostrum diameter	184
DX	Fluke diameter	077
SX	Fluke (union)-anus	145
SX	Fluke (union)-navel	207
SX	Fluke width	117
SX	Rostrum-navel	230
SX	Rostrum-anus	290
SX	Rostrum-genitals	275
SX	Rostrum-fluke (fork)	430
SX	Rostrum-fluke tip	484
SX	Rostrum-fin (base)	120
SX	Rostrum-fin (tip)	218
SX	Rostrum-blowhole	085
SX	Fin	097
SX	Fin diameter	039
SX	Rostrum diameter	160
SX	Fluke diameter	063
	Diameter of shared fluke	170

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The conjoined twin calves were females. The following morphological features permitted us to make an immediate identification of the specimens as *Eschrichtius robustus*: body and tail shape, tail and body color, rostrum shape, lack of body spots, lack of dorsal fin, and presence of knobs along the dorsal ridge (Rice et al., 1984). The kind of conjunction for the twins makes them a thoracopagus case.

Reports of severe anatomical anomalies in cetaceans are rare; thus, ascertaining the cause in any particular case will remain difficult until it is possible to conduct more research. Other authors have proposed hypotheses to explain teratological anomalies in cetaceans (Boyd et al., 1999): congenital abnormalities (Dabin et al., 2004), incorrect embryonic development (e.g., failure of embryo to separate following fusion), the possible presence of polyembryony and the associated abnormal formation (Newman, 1923), and injury during embryogenesis and fetal formation (e.g., infection or chemical or physical factors) (Briard and Le Merrer, 1989; Shepard et al., 2000).

In conclusion we consider this case to be the result of embryonic malformation. Considering the low frequencies of conjoined twin cetaceans, more research is needed to confirm the possible causes of these deformities.

The twin calves were buried in the beach at Laguna Ojo de Liebre, Baja California, Mexico, for the skeleton to be recovered in the future.

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