

## **Phocoena sinus** Norris & McFarland, 1958

English: Vaquita, Gulf of California porpoise

German: Hafenschweinswal

Spanish: Vaquita

French: Marsouin du Golfe de Californie

Family Phocoenidae

### **1. Description**

The vaquita is one of the smallest odontocetes (only *P.p. minor* is smaller). Mean length for females is only 140 cm. The flippers are proportionately larger than in other phocoenids and the dorsal fin is taller and more falcate. The pigmentation is a dark grey cape, pale lateral field and white ventral field. There are large black eye rings and lip patches. The skull is smaller and the cranial rostrum is shorter and broader than in other members of the genus. The vaquita is the most endangered odontocete species in the world (Rojas-Bracho and Jaramillo-Legorreta, 2009).

### **2. Distribution**

<http://www.iucnredlist.org/apps/redlist/details/17028/0/rangemap>

*Distribution of Phocoena sinus: murky coastal waters in the northern quarter of the Gulf of California. This is the most restricted range of any marine cetacean (Rojas-Bracho et al. 2008; © IUCN).*

The vaquita is endemic to the head of the Golfo de California, from Puertecitos, Baja California Norte, north and east to Puerto Peñasco, Sonora. Reports from farther south have never been confirmed (Brownell et al., 1986). Vaquitas mainly live north of 30°45'N and west of 114°20'W. Their 'core area' consists of about 2,235 km<sup>2</sup> (the most restricted distribution of any marine mammal species) centered between Rocas Consag and San Felipe Bay, close to Baja California State coast (Jaramillo-Legorreta et al. 1999; Rojas-Bracho and Jaramillo-Legorreta, 2009).

### **3. Population size**

Jaramillo-Legorreta et al. (1999) conducted a line-transect survey in 1997 and the total population size was estimated to be 567 (95% CI = 177-1073) animals. Note the wide confidence limits: this dated estimate is, until today, the most recent population estimate (Rojas-Bracho and Jaramillo-Legorreta, 2009). The continued increase of fishing effort in the area leads to an estimate of the current population size at 40% of its 1997 level, i.e. in the range of 71 – 430 individuals (Rojas-Bracho and Jaramillo-Legorreta, 2009). A recent estimate of the number of vaquitas remaining is based on the abundance estimate for 1997, the mortality rate in fishing nets in 1993, the estimated level of fishing from 1993 to 2007, the maximum population growth rate for porpoises and a standard population model for population growth. The currently remaining population was estimated at 150 animals (Jaramillo-Legorreta et al, 2007). The IWC in its 2008 meeting confirmed that the current

vaquita population size was considered by most, including the Mexican Government, to be no more than 150 animals. This represents an extraordinarily rapid decline of approximately 75% in a decade. If this scale of fishery mortality continues, it will likely result in the effective extinction of the species in a maximum of 5 years and probably less (IWC, 2008). The species is not extinct yet and there is still hope: an expedition in 2008 reported 13 sightings (T. Jefferson, 2010, pers. comm. and Jefferson et al. 2010 in press).

#### 4. Biology and Behaviour

**Habitat:** The vaquita lives in a shallow basin, and is rarely seen in water much deeper than 30 m (Vidal, 1995). Other characteristics of its habitat are strong tidal mixing, convection processes and high primary and secondary productivity (Rojas-Bracho and Jaramillo-Legorreta, 2002). Silber (1990) reported 51 sightings in water depths of 13.5–37 m, and most of these sightings were 11–25 km from shore. Water visibility ranged from 0.9 m to 12 m.

**Behaviour:** The vaquita appears to swim and feed in a leisurely manner, but is elusive and will avoid boats of any kind. It rises to breathe with a slow, forward-rolling movement that barely disturbs the surface of the water, and then disappears quickly, often for a long time (Carwardine, 1995).

**Schooling:** Like other phocoenids, *P. sinus* occurs singly or in small groups. In 58 sightings, 91% comprised 1-3 individuals, with a mean group size of 1.9 and a range of 1–7 (Silber, 1990). Loose aggregations of vaquitas in which they were dispersed as single individuals or as small subgroups (from 2-4, greatest number 8-10) spread over several hundred square metres were also reported (Vidal et al. 1999 and refs. therein).

**Reproduction:** Most calving apparently occurs in the spring. Gestation is probably 10–11 months. Maximum observed life span was 21 years (Hohn et al. 1996).

**Food:** All of the 21 fish species found in vaquita stomachs can be classified as demersal and/or benthic species inhabiting relatively shallow water in the upper Gulf of California, and it appears that the vaquita is a rather non-selective feeder on small fish, squid and crustaceans in this zone. (Vidal et al. 1999; Rojas-Bracho and Jaramillo-Legorreta, 2009).

#### 5. Migration

An analysis of all available sightings led Silber and Norris (1991) to suggest that vaquitas occupy the northern Gulf year-round. This has more recently been confirmed with the aid of acoustic surveys (Jaramillo-Legorreta et al. 2005).

#### 6. Threats

**Incidental catch:** The most important human-induced problem affecting this species is incidental mortality in fishing gear. Vaquitas used to be incidentally captured in gillnet fishing operations (legal, illegal and experimental) for totoaba (*Totoaba macdonaldi*), an endemic and endangered large seabass-like fish. After the ban of totoaba fishery, vaquitas continue being captured in gillnets set on sharks, rays, mackerels (*Scomberomorus sierra* and *S. concolor*), chano (*Micropogonias megalops*) (a "croaker"), and shrimp (*Penaeus* spp.). Between March 1985 and January 1994, 76 vaquitas were confirmed (to have been) killed incidentally in totoaba gill nets. All the porpoises taken in shrimp fisheries were referred to as "very small",

probably calves or juveniles. Considering the large number (ca. 500) of shrimp boats operating in the upper Gulf of California at the beginning of each typical shrimping season, this fishery poses an additional threat to vaquitas, particularly younger ones (Vidal et al. 1999, and refs. therein).

Vaquita continue to be caught in small-mesh gillnet fisheries throughout much of the range. D'Agrosa et al. (2000) monitored fishing effort and incidental vaquita mortality in the upper Gulf of California from January 1993 to January 1995 to study the magnitude and causes of the incidental take. Of those factors studied, including net mesh size, soaktime, and geographic area, none contributed significantly to the incidental mortality rate of the vaquita, implying that the principal cause of mortality is fishing with gillnets per se. The total estimated incidental mortality caused by the fleet of El Golfo de Santa Clara was 39 vaquitas per year, which is over 17% of the most recent population estimate. Progress towards reducing entanglement has been slow in spite of efforts to phase out gill nets in the vaquita's core range, and the development of schemes involving compensation for fishermen (Rojas-Bracho et al. 2006).

The boundaries of the Upper Gulf of California and Colorado River Delta Biosphere Reserve of 1993 did not correspond well with the distribution of vaquitas. The shallow water north of the town of San Felipe was found to have a higher density of animals than had been indicated by previous surveys (Jaramillo-Legorreta et al. 1999). In December 2005, the Mexican Ministry of Environment therefore declared a Vaquita Refuge that contains within its borders the positions of approximately 80% of verified vaquita sightings. In the same decree, the state governments of Sonora and Baja California were offered \$1 million to compensate affected fishermen (Rojas-Bracho et al. 2006). However although this money "ostensibly paid regional fishermen not to fish, they instead went to buy new boats and motors." Very recently, the Mexican government has gone one step further, forbidding any kind of fishing operations inside the Vaquita Refuge (Platt, 2009).

**Habitat degradation:** The international committee for the recovery of the vaquita (CIRVA) agreed that in the long term, changes in vaquita habitat due to reduction of the Colorado river flow as a result of dam construction and water withdrawal upstream is a matter of concern and needs to be investigated (Rojas-Bracho and Jaramillo-Legoretta, 2002).

**Pollution:** Concerns have been expressed about organochlorine pollutants in the food web. However relatively low concentrations of total DDT, alpha-BHC, and PCBs were found in blubber samples analysed in 1985, and values were lower than those reported for various odontocetes and marine birds from most other areas (Vidal et al. 1999, and refs. therein).

## 7. Remarks

Range states (Rojas-Bracho et al. 2008) : Mexico.

*Phocoena sinus* is listed in CITES Appendix I and II . The World Wide Fund for Nature (WWF) considers the vaquita as one of the most endangered small cetaceans world wide (WWF, 2009). A 2007 study estimated that at least 100 vaquita are necessary to preserve the species' genetic diversity. With presumably only 150 porpoises left today, every vaquita counts (Platt, 2009).

It is considered "Critically Endangered" by the IUCN (Rojas-Bracho et al. 2008) based on the fact that the population may be declining by as much as 15% per year or more than 80% in

three generations. The cause of the mortality has not ceased and may even have increased. Current size of the mature population is estimated at less than 250 mature individuals in a single population. Because the vaquita only occurs in Mexican waters, the framework of CMS does not apply.

As pointed out by Rosel and Reeves (2000), genetic and demographic consequences associated with very small population size can result in extinction even when effective measures are in place to protect the animals and their habitat. This is explained by low genetic variation, genetic drift and inbreeding and lower fitness. Low levels of variation in the Major Histocompatibility Complex warn about a high susceptibility to novel pathogens and diseases in vaquita (Munguia-Vega et al. 2007).

According to Rojas and Taylor (1999), mortality resulting from fisheries bycatch poses the highest risk and primary conservation efforts should be directed towards immediate elimination of incidental fishery mortality. One of the possibilities could be acoustic deterrents and their compulsory use in gillnet fisheries, provided that protected areas located nearby remain net-free (Culik et al. 2001). However, CIRVA and the IWC did not recommend the use of pingers, as these would require a baseline scientific study and financial support to fishermen. Furthermore, pingers could dislocate the vaquita from its small core area without being expected to reduce by-catch to zero. Therefore, a total ban on fisheries, as pronounced by the Mexican government, was preferred (L Rojas-Bracho, pers. comm.. January 2010).

The International Committee for the Recovery of the Vaquita (CIRVA) strongly recommends:

- a reduction of vaquita by-catch to zero, by removing gill-net fisheries in three stages, starting with large mesh sizes,
- enforcement of fishing regulations,
- development and testing of alternative fishing gear,
- expansion of the southern limit of the Upper Gulf of California and Colorado River Delta Biosphere Reserve to include the entire range of the vaquita,
- banning of trawlers from the entire biosphere reserve,
- investigation of the abundance and seasonal movement of vaquitas via acoustic surveys,
- the design and development of public education and awareness programmes,
- investigation and development of strategies to offset economic hardships imposed by such regulations (Rojas-Bracho and Jaramillo-Legoretta, 2002).

D'Agrosa et al. (2000) further recommend:

- a maximum annual allowable mortality limit of vaquitas, and
- mandatory observer coverage of all boats fishing within the Upper Gulf of California and Colorado River Delta Biosphere Reserve.

Recently, the President of Mexico announced a Conservation Programme for Endangered Species, and the vaquita is listed among the top five species. Should this initiative fail the vaquita is most likely doomed to extinction in the near future (Rojas-Bracho and Jaramillo-Legoretta, 2009).

*Acknowledgement: We are grateful to Lorenzo Rojas Bracho for kindly reviewing this account.*

## **8. Sources**

- Brownell RL Jr. (1986) Distribution of the vaquita, *Phocoena sinus*, in Mexican waters. *Mar Mamm Sci* 2 : 299–305.
- Carwardine M (1995) Whales, Dolphins and Porpoises. Dorling Kindersley, London, UK, 257 pp.
- Culik BM, Koschinski S, Tregenza N, Ellis G (2000) Reactions of harbour porpoises (*Phocoena phocoena*) and herring (*Clupea harengus*) to acoustic alarms. *Mar Ecol Prog Ser* 211: 255-260.
- D'Agrosa C, Lennert-Cody EC, Vidal O (2000) Vaquita Bycatch in Mexico's Artisanal Gillnet Fisheries: Driving a Small Population to Extinction. *Cons Biol* 14: 1110-1119.
- Hohn AA, Read AJ, Fernandez S, Vidal O, Findley LT (1996) Life history of the vaquita (*Phocoena sinus*) *J Zool Lond* 239: 235-251
- IWC (2008) International Whaling Commission: Scientific Committee Report. Santiago, Chile, 1 – 13 June 2008. 80 pp.
- Jaramillo Legorreta AM, Rojas Bracho L, Gerrodette T (1999) A new abundance estimate for vaquitas: First step for recovery. *Mar Mamm Sci* 15: 957-973.
- Jaramillo Legorreta AM, Rojas Bracho L, Urban J (2005) A review of acoustic surveys and conservation actions for the vaquita. IWC Scientific Committee meeting document SC/57/SM 10
- Jaramillo-Legorreta A, Rojas-Bracho L, Brownell Jr RL, Read AJ, Reeves RR, Ralls K, Taylor BL (2007) Saving the Vaquita: Immediate Action, Not More Data. *Conservation Biology* 21:1653-5
- Jefferson TA, Olson PA, Kieckhefer TR, Rojas-Bracho L (2010) Photo-identification of the vaquita (*Phocoena sinus*): the worlds most endangered cetacean. *LAJAM* 6 (62): in press
- Jefferson TA, Leatherwood S, Webber MA (1993) FAO Species identification guide. Marine mammals of the world. UNEP/FAO, Rome, 320 pp.
- Munguia-Vega A, Esquer-Garrigos Y, Rojas-Bracho L, Vazquez-Juarez R, Castro-Prieto A, Flores-Ramirez S (2007) Genetic drift vs. natural selection in a long-term small isolated population: major histocompatibility complex class II variation in the Gulf of California endemic porpoise (*Phocoena sinus*). *Mol Ecol* 16: 4051-4065.
- Platt J (2009) last chance to save the vaquita porpoise from extinction? add the full journal data. [ScientificAmerican.com](http://ScientificAmerican.com).
- Rice DW (1998) Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy, Special Publication Number 4 (Wartzok D, ed.), Lawrence, KS. USA.
- Rojas-Bracho L, Jaramillo Legorreta AM (2002) Vaquita – *Phocoena sinus*. In: Encyclopedia of marine mammals (Perrin WF, Würsig B, Thewissen JGM, eds.) Academic Press, San Diego, pp. 1277-1280.
- Rojas-Bracho L, Jaramillo Legorreta AM (2009) Vaquita – *Phocoena sinus*. In: Encyclopedia of marine mammals, 2<sup>nd</sup> Ed. (Perrin WF, Würsig B, Thewissen JGM, eds.) Academic Press, Amsterdam, pp. 1196-1200.
- Rojas-Bracho L, Reeves RR, Jaramillo-Legorreta A (2006) Conservation of the vaquita *Phocoena sinus*. *Mamm Rev* 36:179-216.
- Rojas-Bracho L, Reeves RR, Jaramillo-Legorreta A, Taylor BL (2008) *Phocoena sinus*. In: IUCN 2009. IUCN Red List of Threatened Species. Version 2009.2. <[www.iucnredlist.org](http://www.iucnredlist.org)>.
- Rojas-Bracho L, Taylor BL (1999) Risk factors affecting the vaquita (*Phocoena sinus*). *Mar Mamm Sci* 15:974-989.
- Rosel PE, Reeves RR (2000) Genetic and demographic considerations for the conservation of Asian river cetaceans. *Biology and conservation of freshwater cetaceans in Asia*. Vol. 23, pp. 144-152. [Occas. Pap. IUCN Species Survival Comm.].
- Silber GK (1990) Occurrence and distribution of the vaquita *Phocoena sinus* in the northern Gulf of California (Mexico). *Fish Bull* 88: 339-346.
- Silber GK, Norris KS (1991) Geographic and seasonal distribution of the vaquita, *Phocoena sinus*. *An Inst Biol, Univ Nac Auton Mex, Ser Zool* 62: 263-268.
- Vidal O (1995) Population biology and incidental mortality of the Vaquita, *Phocoena sinus*. Report of the International Whaling Commission 16: 247–272.
- Vidal O, Brownell RL, Findley LT (1999) Vaquita – *Phocoena sinus* Norris and McFarland, 1958. In: Handbook of Marine Mammals (Ridgway SH, Harrison SR, eds.) Vol. 6: The second book of dolphins and porpoises, pp. 357-378.

- WWF (2009) Small cetaceans, the forgotten whales. (Elliott W, Sohl H, Bugener V). Whaling Report. Indd 34

© Boris Culik (2010) Odontocetes. The toothed whales: "*Phocoena sinus*". UNEP/CMS Secretariat, Bonn, Germany. [http://www.cms.int/reports/small\\_cetaceans/index.htm](http://www.cms.int/reports/small_cetaceans/index.htm)

© Illustrations by Maurizio Würtz, Artescienza. © Maps by IUCN.