

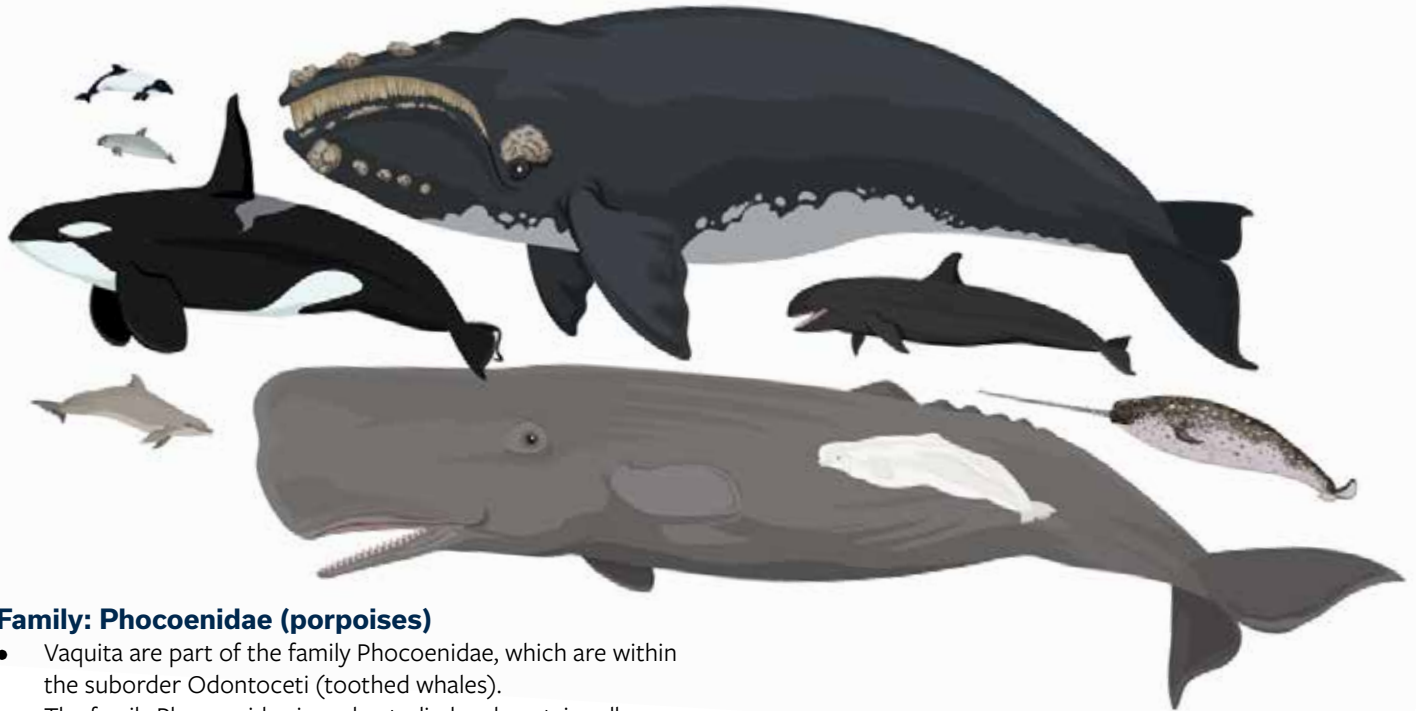
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VAQUITA PORPOISE

SCIENTIFIC CLASSIFICATION

Order: Cetacea

- The order Cetacea includes all whales, dolphins, and porpoises. All species within this order are entirely aquatic and cannot survive on land.
- There are two suborders of cetaceans: Odontoceti (toothed whales) and Mysticeti (baleen whales).



Family: Phocoenidae (porpoises)

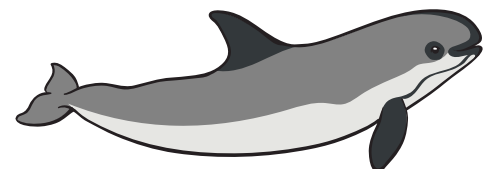
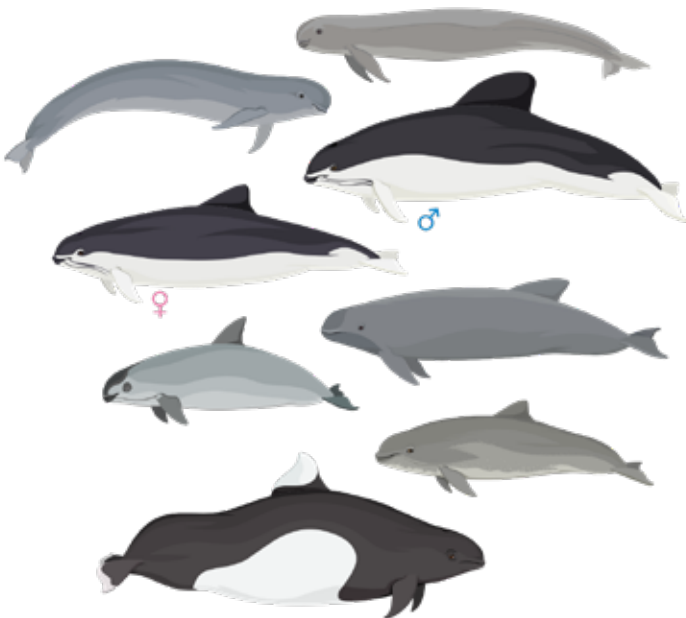
- Vaquita are part of the family Phocoenidae, which are within the suborder Odontoceti (toothed whales).
- The family Phocoenidae is understudied and contains all 7 species of porpoises, the smallest of which is the vaquita (Gaskin, 1984).
- Porpoises can be found in all oceans and one river (Norris, 1966).
- Main physical and biological differences between porpoises and dolphins include:
 - Porpoises have rounded snouts; most dolphins have pointed snouts called rostrums.
 - Porpoises have spade-shaped teeth; dolphins have conical (cone) shaped teeth.

Genus: Phocoena

- Of the seven living species of porpoises, four comprise the genus *Phocoena*, including two in the Northern Hemisphere, the vaquita (*Phocoena sinus*) and the harbor porpoise (*Phocoena phocoena*). Two are found in the Southern Hemisphere, the spectacled porpoise (*Phocoena dioptrica*), and Burmeister's porpoise (*Phocoena spinipinnis*) (Society for Marine Mammalogy, 2020).
- Species: *Phocoena sinus*
- In Latin, *sinus* means “bay” or “pocket” referring to the form of the Upper Gulf of California (UGC), the only place in the world where vaquita inhabits. The UGC is closed on the northern side, by the delta of Colorado River, which makes the basin resemble a big bay.

Common Names

- English: Vaquita, Gulf of California Harbor Porpoise
- Spanish: Vaquita (meaning “little cow”), Vaquita Marina, Marsopa Vaquita
- Sometime called the “Panda of the Sea” to highlight its similar black circles around its eyes as well as its role as a flagship species.



FOSSIL RECORD

- The vaquita was first documented in scientific literature in 1958 (Norris & McFarland, 1958). However, it remained largely unknown until the 1980s, when efforts to survey their abundance, distribution and behaviors were initiated with force (Barlow et al., 1997; Brownell, 1983, 1986; Brownell et al., 1987; Gaskin, 1984; Norris & McFarland, 1958; Silber et al., 1988).
- It is believed that the vaquita originated from an ancestral species that crossed the equator about 3 million years ago during one of many natural earth-cooling events. These small porpoises then became “trapped” in the Gulf of California as water temperatures rose, and evolved into what we know as the vaquita (Brownell et al., 1987; Mellor et al., 2009; Morin et al., 2021).
- Natural rarity is consistent with low genetic variability in the vaquita population. Specifically, low variability in the mitochondrial DNA within the species suggests a population has been 2,000-5,000 individuals for the past 250,000 years (Robinson et al. 2022).
- Genetic studies have confirmed that the closest living relative of the vaquita is the Burmeister’s porpoise (*Phocoena spinipinnis*), rather than the nearest geographic species, the Harbor porpoise (*Phocoena phocoena*), confirming the hypothesis that the ancestors of the vaquita likely came north from South America (Rosel, Haygood & Perrin, 1995; Munguia-Vega et al., 2007, Morin et al. 2021).
- Vaquitas exhibit low levels of genes associated with inbreeding resulting from purging of such genes with the small population size persisting for hundreds of thousands of years, indicating the potential for population recovery (Robinson et al. 2022, Kyriazis et al., 2023).

DISTRIBUTION



- Vaquitas are endemic only to the northwest region of the Gulf of California, also known as the Sea of Cortez, and have the most limited geographic range of any cetacean (only about 4000 km²) (Gerrodette et al., 1995).
- The current ‘core area’ of the vaquita distribution is centered close to the fishing town of San Felipe, Baja California, inside a zone named Zero Tolerance Area (ZTA, a polygon about 12x24 km), created to protect the species where most of the individuals have been detected since 2017.

- Vaquitas are elusive and difficult to spot. This fact, paired with its murky habitat, makes estimating their abundance and distribution difficult.
- Passive acoustic techniques, applied since 1997 to study vaquita population distribution and trend, show that vaquitas remain all year round in the same area (Jaramillo-Legorreta, 2008; Jaramillo-Legorreta et al., 2019). It indicates that the Upper Gulf of California brings a reliable shelter for vaquitas.
- Vaquitas occupied their full historical range as recently as 2008. The range has changed in recent years with the loss of 99% of the species now restricted.

MIGRATION

- These animals have the most limited range of any cetacean. They are only found in one region of the world and do not migrate (Teilmann & Sveegaard, 2019).
- Vaquitas are endemic to this small region of the world, and it is unlikely they will survive anywhere else on earth; therefore, it is critical to make the waters that vaquitas call home safe for their survival.

POPULATION

- Though limited data are available on vaquitas, there is no dispute that it has been a naturally rare species. From 1986-1988 a total of 3,236 km of boat and aircraft surveys in an area of increased sighting probability resulted in 51 sightings of only 96 individual porpoises (Silber, 1990a).
- In 2007, the vaquita became the most endangered marine mammal in the world (Maderspacher, 2007; Smith et al., 2017).
- Most recent estimates (2021) suggest a minimum of around 10 remain in the world (Rojas-Bracho et al. 2022).
- The vaquita was first listed as a vulnerable species in 1978, became classified as endangered in 1990, and was registered as critically endangered in 1996 (Rojas-Bracho & Taylor, 2017).

HABITAT

- The upper Gulf of California is a fairly shallow inland sea with a high tidal range (~6m) (Alles, 2004).
- This high tidal mixing makes the waters of the upper Gulf of California among the most productive on earth, allowing for great species abundance and diversity including coral reefs, over 900 different species of fish, and endangered marine turtles. (Barlow et al., 2010; WWF, 2020).
- Currents and abundant upwelling events cause this region to be rich in nutrients and phytoplankton, providing food to fish larvae and supporting diverse fish species and other food sources for the vaquita (Alles, 2004).
- Jacques Cousteau called this region the “world’s aquarium” due to the diversity and abundance of species in the region.
- Vaquitas have narrowly defined habitats and are typically found in depths from 13.5 - 56.0m (approx. 44 -184 ft) (Reeves et al., 2002). (See Appendix B)

DIET

- Vaquitas, like other porpoises, feed on a variety of fish and squid species (Norris, 1966; Ridgway et al., 1998; Rojas-Bracho et al., 2006).
- According to Findley and Nava (1994), species with higher values on the 'Index of Relative Importance' include *Isopisthus altipinnis* (Sciaenidae) and *Porichthys mimeticus* (Batrachoididae), as well as the squid *Lolliguncula panamensis*.

ANATOMY & PHYSIOLOGY

- Vaquita are the smallest cetacean known on earth, measuring on average 1.5 m (5 ft) long and weighing approximately 50kg (110 lb.) (Reeves et al., 2002; Ridgway et al., 1998).
- Vaquita have tall dorsal fins (compared to other porpoise species) and have dark eye rings and lip patches that earn them the nickname "the panda of the sea."
- Vaquitas exhibit slight sexual dimorphism, meaning males and females differ in body size or coloration. One study, though it presents a fairly small sample size, found that females are slightly larger than males (Torre et al., 2014). These small differences do not allow sexes to be told apart in the field.
- Male vaquita have larger dorsal fins than females, both in terms of height and width at the base.
- Compared to other porpoises, vaquitas have larger flippers, dorsal fins, and flukes in proportion to their body size, which is hypothesized to help regulate body temperature (Brownell et al., 1987).
- It is also shown that, in male vaquitas, the dorsal fin and tail flukes grow proportionally during development. In females, the size of the dorsal fin and flukes remain constant as the individual grows. This is hypothesized to be due to the increased agility and speed that males utilize during the breeding season (McLellan et al., 2002; Torre et al., 2014).

SENSORY SYSTEMS

- As with other porpoises, vaquita emit only narrow band high frequency clicks, forward directed in a beam (Silber, 1990b). Clicks are produced in a series of a few to dozens, with fairly regular inter-click times.
- Acoustics have recently become the main source of monitoring and quantifying the decline of the population, which has proven to be both cost effective and accurate (Rojas-Bracho et al. 2010).

SWIMMING, DIVING & THERMOREGULATION

- Only one study has been able to provide behavior and ventilation patterns in the vaquita. Dive characteristics were like those observed in the harbor porpoise, though harbor porpoises generally exhibit slightly longer dive intervals (time underwater), surface intervals (time at the surface), time between breaths, and more breaths per surfacing (Silber et al., 1988).
- Vaquitas, relative to other porpoises, have larger flippers, dorsal fins and flukes compared to their body size, which

is hypothesized to help regulate body temperature and to prevent the vaquita from overheating since they live in warmer waters between 14 and 36°C (57 and 97°F) (Brownell et al. 1987).

BEHAVIOR

- Vaquita are most often found in pairs that often consist of a mom/calf pair (Rojas-Bracho & Taylor, 2017).
- They spend most of their time underwater, only surfacing for approximately 3 seconds every 1-2 minutes. They tend to avoid ships and boats, and vaquita rarely splash or jump when surfacing (Silber et al., 1988).
- Vaquitas have never been successfully managed in human care or tagged with radio or satellite tags, so information about their behavior comes only from vessel-based surveys using giant binoculars called "Big Eyes" and from passive acoustic monitoring with devices "managed by scientific personnel, or completely autonomously, like the C-POD used for monitoring the species since 2011 (Jaramillo-Legorreta, 2008; Jaramillo-Legorreta et al., 2017).

REPRODUCTION AND MATERNAL CARE

- Vaquita reach sexual maturity between 3 and 6 years of age.
- Gestation period for the vaquita is estimated to be 11 months, with births typically occurring in early March (Torre et al., 2014).
- A newborn vaquita weighs about 7.5 kg (16.5 lbs.) (Vidal, 1995).
- It has been suggested that below 6.8kg, a newborn calf would be unable to maintain its body temperature due to greater surface area relative to its volume (Torre et al., 2014).
- Until recently, it was thought that vaquitas could only give birth every two years (Hohn et al., 1996). Recent evidence suggests that, like most other porpoise species, vaquitas may be able to breed every year (Taylor et al., 2019).
- Previously, the maximum population growth rate was estimated to be 4% annually, although the more frequent calving would result in a slightly higher rate (Rojas-Bracho et al., 2006; Taylor et al., 2019).

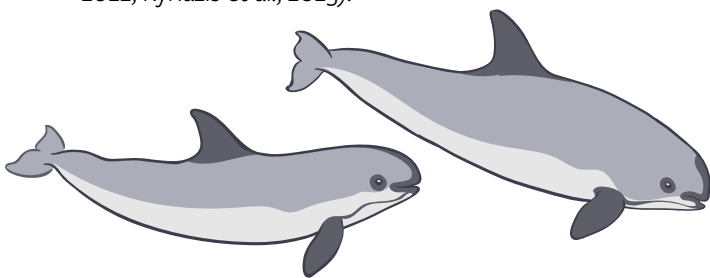


LONGEVITY & MORTALITY

- Longevity is estimated to be approximately 20 years, like that of the harbor porpoise (Hohn et al., 1996).
- Vaquitas have been declining since their discovery, and a recent 7-year acoustic monitoring study (2011 - 2018) showed an accelerated collapse in the vaquita population, disappearing at an average rate of 45% per year as opposed to the 7.6% per year from 1997-2008 (EIA, 2016; Jaramillo-Legorreta et al., 2019) However, estimates of numbers of vaquitas seen in 2019, 2021 and 2023 suggest that the decline is no longer as great (Rojas-Bracho et al. 2022).

THREATS & CONSERVATION

- The vaquita population has declined at an increasing rate since its first documentation. In 1997, the estimated population size was approximately 567. Between 1997 and 2008, it was estimated that the vaquita population was declining at approximately 7-8% per year, primarily due to being caught in gillnets set for shrimp and other fish (Jaramillo-Legorreta, 2008). From 2011 to 2016, the rate of decline jumped to 39% per year due to entanglement in illegal gillnets set for catching totoaba (Thomas et al., 2017). In 2018, it was estimated that less than 20 vaquitas remain on earth (Jaramillo-Legorreta et al., 2019). As of 2023, survey data shows up to 10-13 Vaquita exist, including a minimum of one newly born calf (Jaramillo-Legorreta et al., 2023).
- Fisheries are the only verified threat to the vaquita. Fishing continues to be a threat because it is the sole source of income for many people in the region. A lack of a multi-year working plan by the corresponding authorities to develop and implement alternative fishing gear options has made it impossible to ban gillnets in the region (UNESCO World Heritage Center - IUCN, 2018)
- Not only is fishing the sole source of income for many people in the region, demands from traditional eastern medicine in recent years for the swim bladders of the endangered totoaba (*Totoaba macdonaldi*) have brought the vaquita to the verge of extinction (Rojas-Bracho et al, 2019).
- The totoaba (*Totoaba macdonaldi*) is a fish species also endemic to the Sea of Cortez listed by the International Union for Conservation of Nature (IUCN) as Vulnerable. Their swim bladders are believed to have medicinal properties, but there is no evidence to support this claim (Juarez et al., 2016).
- Fishers have reported in recent years receiving up to US\$5,000 on the illegal market for a large totoaba swim bladder (Valenzuela-Quinonez et al. 2015).
- Despite the small population size, there is no evidence of inbreeding depression, providing hope that if we can reduce fishing mortality, this species can recover (Robinson et al., 2022; Kyriazis et al., 2023).



CONSERVATION EFFORTS TIMELINE

- 1958** — Vaquita discovered
- 1975** — Ban on Totoaba fishing due to overexploitation
- 1978** — IUCN lists vaquita as “vulnerable”
- 1979** — First proposal of a cetacean sanctuary in the Gulf of California to protect the vaquita
- 1990** — IUCN changes vaquita status from “vulnerable” to “endangered”
- 1992** — Technical committee for the Preservation of Totoaba and Vaquita created by Mexico’s Ministry of Fisheries
- 1993** — Totoaba gill nets banned, decree creating Biosphere Reserve of the Upper Gulf of California and Colorado River Delta is published, and vaquita recovery plan is developed by Mexico with support of the Marine Mammal Commission.
- 1994** — Mexico’s first official list of vulnerable and endangered species is published
- 1996** — Listed by the IUCN as Critically Endangered (CR)
- 1997** — Mexican government, through its National Institute of Fisheries (within the Ministry of Environment, Natural Resources and Fisheries), created the International Committee for the Recovery of the Vaquita (CIRVA) to advise the Mexican government on conservation actions for the vaquita (CIRVA-9, 2017; Rojas-Bracho & Reeves, 2013).
- 1998** — Vaquita is included in SEMARNAP’s, Mexico’s Ministry of Environment, Natural Resources and Fisheries’ Programme of Prioritized Species (PREP).
- 2000** — National Fisheries Chart is published and establishes that vaquita by-catch should be zero.
- 2002** — WWF - Gulf of California establishes the Joint Initiative with other non-governmental organizations and CIRVA to promote implementation of CIRVA’s recommendations and develop an economic and legal framework.
- 2002** — SEMARNAT constitutes the National Technical Advisory Subcommittee for the Conservation and Recovery of the Vaquita and its Habitat to pursue recommendations of CIRVA and the Joint Initiative.
- 2003** — Mexican Standard NOM EM 032 ECOL 2003 is published to protect the biodiversity of the Biosphere Reserve of the Upper Gulf of California (SEMARNAT). San Felipe, Baja California, proclaims itself ‘Home of the Vaquita Marina’ and agreement is signed with the town Council to support vaquita conservation.

2005 — Ministry of Environment and Natural Resources (SEMARNAT) and the Ministry of Agriculture and Fisheries agreed to establish a refuge area for the protection of the vaquita in an area that encompassed almost 80% of all confirmed vaquita records from the previous 3 decades (Gazette of the Federation, 2005). Gillnets in this region were to be eliminated entirely, but the refuge area remained essentially unmanaged until 2008 (Rojas-Bracho & Reeves, 2013).

2008 — In response to the continued and severe decline of the vaquita, the Mexican government announced what is probably the first-ever comprehensive conservation program intended to eliminate, rather than simply reduce, bycatch of a marine mammal species throughout its range. This “Species Conservation Action Plan for the Vaquita: An Integrated Strategy of Management and Sustainable Use of Marine and Coastal Resources in the Upper Gulf of California” (PACE-vaquita) was also designed to promote sustainable use of the region’s fishing resources (Rojas-Bracho & Reeves, 2013; Rojas-Bracho et al., 2006).

- The ultimate goal was to eliminate bycatch of vaquitas by removing trammel nets and gillnets from the refuge, either by eliminating such gear or replacing it with gear that would not bring risk of entanglement (Rojas-Bracho & Reeves, 2013).
- This included a fishing ban inside of the vaquita refuge, provided compensation to fishers, and a reduction of fishing with gillnets based on a buy-out program (Rojas-Bracho & Reeves, 2013).

2011 — An improved passive acoustic monitoring program was established to quantify anticipated positive results of these conservation measures. In 2014, the acoustic program revealed a catastrophic vaquita population decline. In response to these findings, the government of Mexico implemented an emergency 2-year ban of gillnet fishing throughout the vaquitas’ range in 2015, with enforcement of this ban coordinated by the Mexican Navy. However, due to the demand of the totoaba swim bladders on the illegal market, gillnets are still being used throughout the Sea of Cortez and vaquita numbers continue to plummet.

- In a single totoaba fishing season, between December 2016 and May 2017, 150 illegal totoaba nets were retrieved from the vaquitas’ range (Cirva-9, 2017).

2017 — Vaquita CPR (Conservation, Protection, Recovery), a consortium composed of marine mammal scientists, veterinarians, and biologists from around the world was established to attempt to save the vaquita from extinction. The team set out on a bold rescue mission aimed at temporarily protecting vaquitas under human care until their natural habitat was safe for them to return. The rescue effort involved 90 experts from 9 countries and cost \$5 million USD.

- Two animals were captured using light gill nets. A juvenile was released 4 hours later, because it appeared stressed. An adult female died of capture myopathy. The program was suspended because of the risk of additional mortalities to the population (Rojas-Bracho et al. 2019).

- The lack of success in capturing vaquitas for temporary protection emphasizes the need to improve the understanding of the effects of chase, capture, handling, and enclosure on cetaceans, as well as consider intervention before populations reach critically low levels (Rojas-Bracho et al. 2019).
- The consortium supports and emphasizes the need to employ the ‘Whole Ecosystem Approach’ before populations reach critically low levels. Conservation approaches focused on single species must be integrated into broader efforts to conserve ecosystems and involve the human communities that depend on them (Rojas-Bracho et al. 2019).

2021 — A survey took place between October 17 and November 3, 2021, to estimate the number of unique vaquitas (including the numbers of unique calves) seen in the Zero Tolerance Area (Rojas-Bracho et al. 2022).

2022 — In August 2022, the Mexican Navy deployed 193 concrete blocks with 3m high metal hooks designed to entangle gillnets. Blocks were set within the vaquitas’ last stronghold: a 12 x 24 km area called the Zero Tolerance Area (ZTA). The Navy and Sea Shepherd Conservation Society (SSCS) have collaborated to monitor fishing activity. The apparent 90%+ decrease in gillnetting within the last stronghold of vaquitas is probably the most significant step taken to date toward saving the species. The concrete blocks together with enforcement within the ZTA seem to constitute an effective way to prevent gillnetting.

2023 — In May 2023, scientists conducted a survey and estimated that there were 10-13 individual vaquitas, including at least one calf. All the observed vaquitas looked healthy and were feeding. This is about the same number of vaquitas they saw in 2019 and 2021. The visual research, including both ships and contracted professional observers, was funded by Sea Shepherd Conservation Society.

AMMPA FACILITIES CONTRIBUTIONS TO CONSERVATION

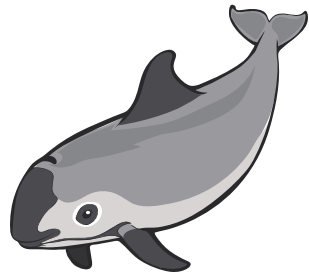
- The National Marine Mammal Foundation (NMMF) was a key partner in the aforementioned 2017 Vaquita CPR rescue effort.
- Released on July 12, 2019, the National Geographic Documentary and winner of the Sundance Audience Award, *Sea of Shadows* (rated PG-13) features VaquitaCPR’s conservation efforts. From executive producer Leonardo DiCaprio and director Richard Ladkani, also known for *The Ivory Game*, *Sea of Shadows* follows undercover investigators, scientists, journalists, and the Mexican Navy on their desperate last-minute effort to rescue the Earth’s smallest whale from extinction. The documentary crew spent a month filming with the VaquitaCPR team in San Felipe, Mexico to capture every moment of the ground-breaking conservation effort.

CONCLUSION

Information about the vaquita is limited, as researchers have had very few opportunities or specimens to study. Unfortunately, this species is on the brink of extinction. The Sea of Cortez has an incredibly diverse marine ecosystem and is the home and breeding grounds to many important and endangered species. It is not solely vaquitas that are incidentally caught in illegal gillnets, but also other marine mammals, fish, sharks, and sea turtles. Vaquitas have taken on the role as a flagship species for one of the most diverse ecosystems in the world, one that is on the verge of collapse due to the illegal trade of the totoaba throughout the world. You can help the vaquita by supporting sustainable fisheries.

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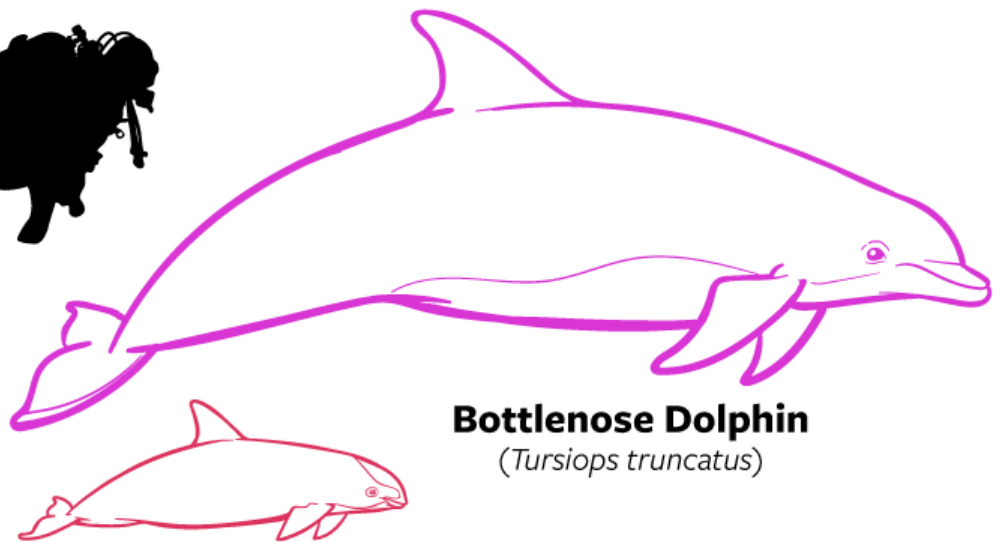
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APPENDIX

Appendix A1

Dolphins v. Porpoises - scale

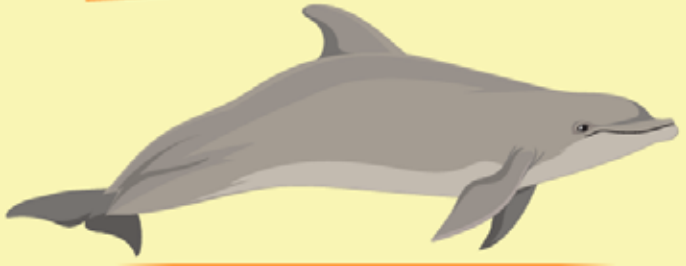

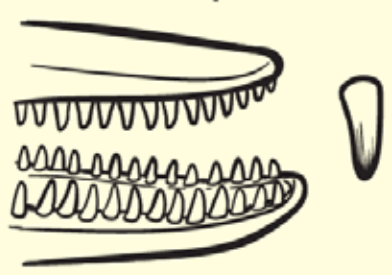



Bottlenose Dolphin
(*Tursiops truncatus*)

Vaquita Porpoise
(*Phocoena sinus*)

Appendix A2

Dolphins v. Porpoises - compare and contrast

DOLPHIN	VS.	PORPOISE
 <p>Common Bottlenose Dolphin <i>Tursiops truncatus</i></p>		 <p>Vaquita Porpoise <i>Phocoena sinus</i></p>
<p>larger geographic range - all oceans (tropical, cold, coastal & deep water) and some rivers</p>		<p>smaller geographic range - coastal, cold waters of the northern Atlantic and Pacific oceans</p>
<p>large number of species</p>		<p>smaller number of species</p>
<p>families include Delphinidae, Iniidae, Platanistidae, Pontoporiidae and the extinct Lipotidae</p>		<p>all species belong to the family Phocoenidae</p>
<p>bodies are generally longer, sleeker and more streamlined</p>		<p>bodies appear more stout, dense and portly</p>
<p>most species have a bulbous melon-shaped head with a larger rostrum</p>		<p>more round, blunt head shape that lacks a pronounced rostrum</p>
<p>most species have a more curved dorsal fin</p>		<p>most species have a more triangular dorsal fin</p>
<p>typically form larger groups or pods</p>		<p>typically form smaller groups or pods</p>
<p>more vocal</p>		<p>less vocal</p>
<p>mouth with elongated rostrum (beak) and cone-shaped teeth</p> 		<p>smaller mouth with spade-shaped teeth</p> 

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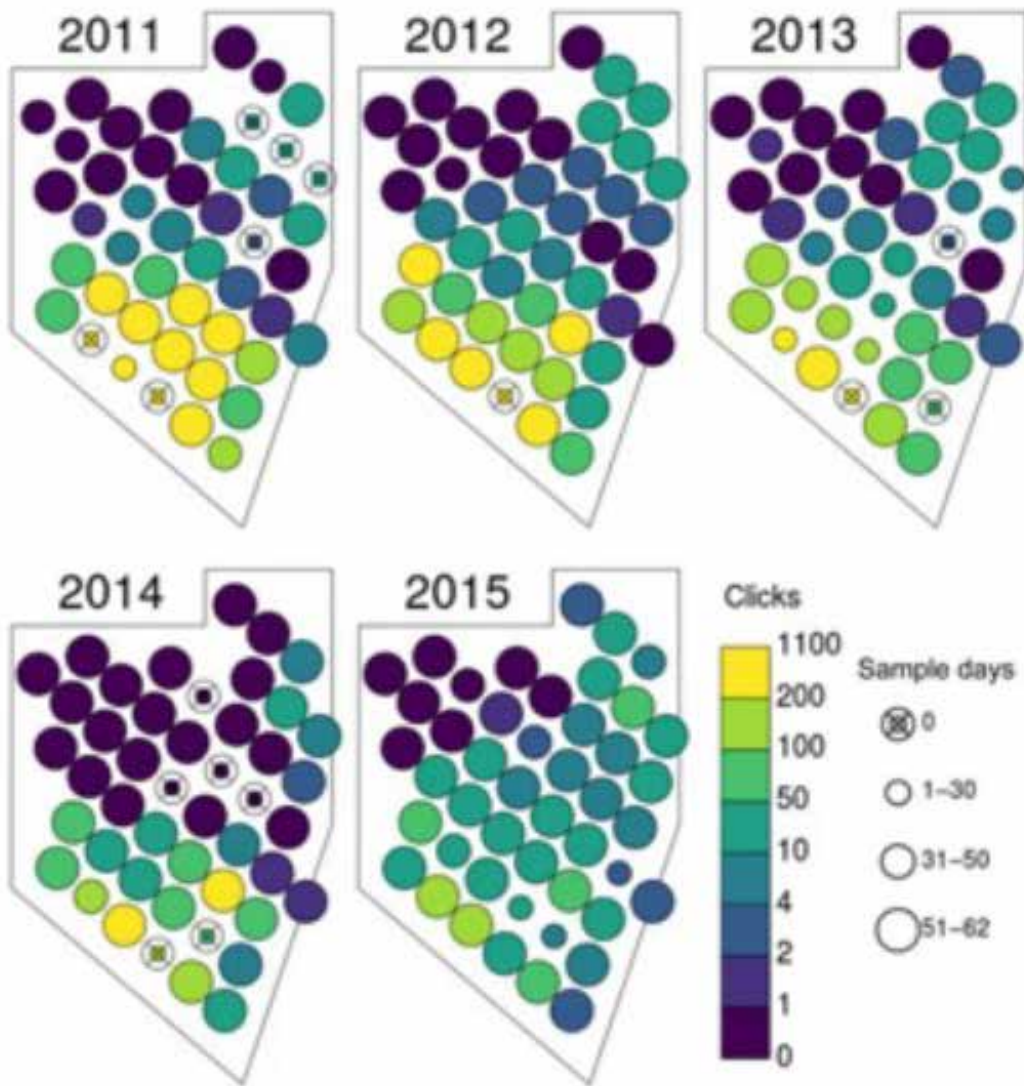


Figure 3. Estimated mean number of clicks per day predicted by the spatial model of vaquita acoustic activity for the 46 sampling sites with data for at least 1 year. Values in the key are posterior medians (log scale). Some sites (circle with an x) were missing in the indicated year. Sample days is the number of days with data in each site and year.

Jaramillo-Legorreta et al., 2017

Appendix C

Totoaba (being held) and vaquita atop a gillnet (photo by Omar Vidal) (retrieved from Jaramillo-Legorreta et al., 2017).



Appendix D

Gillnet exclusion zone in the upper Gulf of California, which includes all the distribution area of vaquitas (hatched area) (retrieved from Jaramillo-Legorreta et al., 2017).

