Marine Mammal Research Program

Autonomous University of Baja California Sur

Impact of the Saguaro LNG Energy Project on cetaceans in the Gulf of California

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January 2025

Content

Executive summary

This document aims to identify the threats that whales and other large marine mammals of the Gulf of California (GOC) would face if the "Terminal GNL de Sonora" (TGNLS) project of Mexico Pacific Limited, LLC, also called Saguaro Energía GNL, is carried out in Puerto Libertad, Sonora.

In this analysis, the distribution of cetacean species in the GOC was compared with the area of influence of the project and the ship routes proposed by the developer. In addition, a literature review was conducted on the impact of marine traffic on cetaceans (collisions and noise), in particular the review focused on the liquefied natural gas (LNG) carriers proposed to be used in the project. Finally, the documentation submitted by the proponent on the project was analyzed to determine whether the studies and programs planned for the project are adequate to ensure the protection of marine mammals in the GOC.

Our analysis results in two main conclusions. First, the transit of LNG carriers through the GOC threatens to become the leading cause of death of large whales from collisions. Second, noise in the construction phase of the gas plant, as well as noise from ship operation and docking, will cause serious acoustic and behavioral disturbances. Both the collisions and the noise from the project would impact the 30 species of cetaceans that are distributed in the area, mainly affecting the resident, migratory and most abundant species such as the fin whale, fin whale, blue whale, humpback whale, sperm whale, orca whale, Risso's dolphin, and short-finned pilot whale. Impacts to these species will occur throughout the route of the vessels and in particular in the Great Islands area. The resident fin whale population, which is considered an indicator of the health of the GOC, will be the most affected by the development of this project.

Any alteration to the distribution patterns and decrease in the abundance of the species targeted by tourism would negatively affect the economy of the coastal communities of the GOC: according to SEMARNAT data, the economic revenue generated in the last 10 years for humpback whales is $1,126,943,640.00 (MXN) and for blue whales $18,417,921.00 (MXN) (SEMARNAT-DGVS 2024).

We conclude that the project impact analysis and mitigation measures proposed in the project documentation (the 2006 Environmental Impact Assessment (EIA) and the Biodiversity Protection and Conservation Program (PPCB) published in 2023) are insufficient to ensure the protection of marine mammals in the GOC. In contrast to the size of the impacts that the project would entail, the EIA presented by TGNLS in 2006 does not propose any "set of activities aimed at reducing the consequences of an accident" (definition of mitigation according to the EIA). The only thing it mentions is to follow a precautionary principle such as slowing down the speed of vessels when transiting critical areas, however, they do not indicate what speed this would be. In addition, the EIA only recognizes the region of the Great Islands and the Area

Priority Marina Guaymas as critical areas, excluding possible impacts from ship traffic in the rest of the gulf.

The Biodiversity Protection and Conservation Program (Programa de Protección y Conservación de la Biodiversidad, PPCB) shows similar deficiencies to those of the EIA. For example, it does not adequately address the radius of acoustic dispersion of the noise that the project will emit, it only takes into account the Great Islands area, and the protection measures it proposes are based on erroneous information. Meanwhile, biological studies show that the affected regions excluded in the PPCB, the area north of Puerto Libertad, the central region of the GOC, and the Loreto - Los Cabos corridor, are also of great importance for the well-being of marine life and cetaceans, both resident and migratory, in the GOC.

Accordingly, we recommend the following:

- That the liquefaction plant not be built and thus prevent the navigation of large ships through the Great Islands region;
- If it is still decided to begin construction of the project, acoustic dispersion models should be generated with the machinery and ships that will be used during construction, transportation, and docking of the gas, in order to know exactly the damage that this will generate;
- Also, that the potential impact of collisions of vessels with cetaceans along all routes proposed by the GOC be modeled;
- That analysis of the risks and mitigation and monitoring programs in MIA and in the PPCB be redone, updating the information presented in these documents and correcting the deficiencies pointed out in this report, so that conditions made by the DGIRA in the official letter C. S. G. P. A./DGIRA.DDT.2277.06 are fulfilled;
- In redeveloping the mitigation measures for the project, include concrete and effective measures to protect marine mammals, such as establishing a maximum speed for the transit of LNG tankers through the GOC.
- It is necessary that the promoter considers that areas of high diversity, abundance and critical regions for whales (reproduction, breeding and feeding areas), are incompatible with this type of project, so in case of reconsidering the location of both the gas plant and the navigation route, the aforementioned aspects should be considered.

Introduction

This document aims to identify the threats that whales and other large marine mammals of the Gulf of California (GOC) would face in the event that Mexico Pacific Limited, LLC's "Terminal GNL de Sonora" (TGNLS, or also called Saguaro Energía) project is carried out in Puerto Libertad, Sonora.

The GOC is considered an exceptional place for the development of marine life and a worldwide refuge for biodiversity, harboring close to 6,000 species and macroscopic subspecies of marine animals (Brusca *et al*. 2005). The cetaceans in the GOC are also diverse, with 36 species recorded in the area, representing 31% of the world's species (Urbán *et al*. 2005). For all reasons, the GOC area includes 13 marine protected areas, 17 Ramsar Wetlands of International Importance, and since 2005 it has been on UNESCO's World Heritage List (UNESCO, 2005).

Whales are indicators of, and contribute to, the ecological well-being of the GOC, as play an important role in the carbon cycle and the fertilization of the oceans. By living and dying in the ocean, they act as carbon sinks. During their lifetime, they absorb large amounts of carbon into their bodies. When they die, they sink to the bottom of the sea, carrying carbon with them (Pearson et al., 2023). On the other hand, whale excrement releases nutrients such as nitrogen and iron and acts as a fertilizer in surface waters. These nutrients stimulate the growth of phytoplankton, which through photosynthesis captures a large amount of atmospheric carbon dioxide (CO_2) (Smetacek and Nicol, 2005).

In addition to their ecological importance, whales are also of socio-economic importance. Whale watching tourism is an activity with an important economic benefit and job generation. Mexico is among the top 10 destinations worldwide for whale watching, the first in Latin America and the second in the Americas (Hoyt and Iñiguez, 2008). Within the Gulf of California, the main sites are located in the states of Baja California Sur, Sinaloa, Nayarit, and Jalisco. The target species in the GOC are the humpback whale and blue whale, both migratory.[1] According to data sent to SEMARNAT by tourism service providers (SEMARNAT-DGVS 2024), the economic revenue generated in the last 10 years for humpback whales is $1,126,943,640.00 (MXN) and for blue whales $18,417,921.00 (MXN) (Table 1A, Appendix 1). Sightings also generated some 9,359 jobs during this period (SEMARNAT-DGVS 2024). Any alteration to the distribution patterns and decrease in the abundance of the species targeted by tourism would negatively affect

[1] Gray whales are not considered for this analysis because the main observation sites for this species are on the west coast of the peninsula and according to the route of the MIA 2006, LNG ships would not pass through this area.

the economy of the coastal communities that dedicate themselves exclusively to this activity every winter season.

Methodology

This report was made through the compilation of information generated by the Marine Mammal Research Program (PRIMMA) of the Autonomous University of Baja California Sur, which has been studying whales, dolphins and their threats in the GOC for more than 35 years. PRIMMA data were used to create maps of distribution of cetacean species in the GOC and overlapped with the navigation routes proposed in 2006 Environmental Impact Assessment (MIA), which was carried out for a liquefied natural gas regasification plant, not for the current TGNLS plans to build a liquefaction plant.[2] Our maps show the areas at risk of collision. In addition, a literature review was conducted on the impact of marine traffic on cetaceans (collisions and noise), in particular LNG type ships, which are the ones proposed to be used in the project.

Importance of the GOC

Biodiversity of the Gulf in general

The GOC is located between 20° and 32° North latitude, and between -105° and -115° West longitude. It is an elongated and narrow basin, *ca.* 1400 km long and 150 km wide, with high productivity (Álvarez-Borrego and Gaxiola-Castro 1988). It is bounded by the Mexican states of Sonora, Sinaloa and Nayarit to the east, the Baja California peninsula to the west and the Colorado River delta to the north (Mexico-United States). The winds induce a large-scale surface circulation, and due to the pattern of these winds only two seasons are formed: the warm season influenced by cyclonic gyres (June-November) and the temperate season where anticyclonic gyres predominate (November-May) (Lavín *et al*. 1997; Marinone 2003).

The GOC is recognized as a marine biodiversity hotspot (Roberts *et al*. 2002). Almost 6,000 macroscopic marine species have been described (4,854 invertebrates and 1,115 vertebrates, including 801 teleosts and 87 elasmobranchs), of which about 16% are endemic to the GOC (Brusca *et al*. 2005), making it one of the top 10 ecosystems in the world for endemic species (Roberts *et al*. 2002). This biological diversity includes species in danger of extinction or under special protection according to Mexican Standard NOM-059.

[2] The 2006 EIS describes an LNG regasification plant and not LNG liquefaction. Likewise, the 2006 EIS project describes a much smaller project than what is proposed today. , the impacts of the proposed liquefaction plant would be different and greater than the regasification plant.

To protect and conserve the richness of the GOC's marine ecosystems and species, 13 marine protected areas have been decreed with a surface area of 2,637,887 Ha. Likewise, 17 Ramsar areas are under different conservation decrees such as: Ecological Zones of Mexico, Management Units for the Sustainable Use of Wildlife, Priority Marine Sites for Biodiversity Conservation, Priority Epicontinental Biodiversity Sites, Priority Marine Regions of Mexico, and ANP's. The GOC Islands were declared a World Heritage Site by the United Nations Educational, Scientific and Cultural Organization (UNESCO since 2005).

The marine mammals distributed in the GOC belong to the orders Cetacea (29 species from 21 genera and seven families), Carnivora (five species from five different genera and three families) and Chiroptera (one species). In summary, the GOC is one of the richest regions of marine mammals in the world (Urbán *et al*. 2005).

Cetacean Biodiversity

The GOC is particularly important for baleen whales: of the 15 species recognized worldwide, 8 of them are recorded in the GOC (see Table 1). These include the fin whale (*Balaenoptera physalus*) (Bérubé *et al*. 2002; Urbán *et al*. 2005), which according to the International Union for Conservation of Nature (IUCN) is listed as Vulnerable, and the Bryde's whale *(B. edeni*) as Least Concern (Breese and Tershy 1987; Dizon et *al*. 1996). Both species have resident populations, i.e., populations that live year-round within the GOC and carry out their entire life cycle there, so any alteration to the environment can be fatal to these populations (IUCN 2024). There are also populations of three migratory whale species, the blue whale (*B. musculus*) in the Endangered category and the humpback whale (*Megaptera novaeangliae)* in the Least Concern category (IUCN 2024). Both migratory species remain in the GOC from November to May. The gray whale (*Eschrichtius robustus*), which is also a migratory species in the Least Concern category, can be found off the coast of the Los Cabos region in cold winters (Sea Surface Temperature less than 22 degrees) and in all winters in the lagoons of the west coast of the Baja California peninsula from January to March (IUCN 2024). In addition, two infrequent species are observed: the sei whale (*B. borealis*) in the Endangered category and the Minke whale *(B. acutorostrata*) in the Least Concern category (IUCN 2024). Another species present but rare is the northern right whale (*Eubalaena japonica)* in the Endangered category (IUCN 2024). It is precisely the protection offered by the GOC that has provided refuge for large whale species from anthropogenic and environmental pressures.

As for odontocete species, of the 79 species recognized worldwide, 22 have been recorded in the GOC, of which nine are common (see Table 1), i.e. they are distributed throughout the GOC throughout the year. These are the sperm whale (*Physeter macrocephalus*), pygmy sperm whale (*Kogia breviceps*), dwarf sperm whale (*K. sima*), Risso's dolphin (*Grampus griseus*), short-finned pilot whale (*Globicephala macrorhynchus*), bottlenose dolphin (*Tursiops truncatus*), short-beaked common dolphin *(Delphinus delphis delphis*) and Risso's dolphin *(Grampus griseus*).

(D. delphis bairdii) and killer whales *(Orcinus orca*). Other species are also present year-round, but are rare, such as the pygmy beaked whale *(Mesoplodon peruvianus*), Blainville's beaked whale (*Mesoplodon densirostris*), Cuvier's beaked whale (*Ziphius cavirostris*), Longman's beaked whale (*Indopacetus pacificus*), pygmy killer whale *(Feresa attenuata*). Species that are mainly present in summer include the false killer whale (*Pseudorca crassidens*), pantropical spotted dolphin (*Stenella attenuata*), spinner dolphin (*Stenella longitostris*), rough-toothed dolphin *(Steno bredanensis*). Finally, there is one species that is present only in winter south of the GOC, the white-sided dolphin *(Lagenorhynchus obliquidens*).

The impacts caused by this project, both in the construction and operation phase the plant and the transit of vessels through the GOC, represent a risk to the 30 species mentioned above. The fin whale, fin whale, blue whale, humpback whale, sperm whale, short-finned pilot whale and killer whale are the species that present the greatest risk of collisions with LNG carriers. Derived from this concern, we focus our analysis on these seven species. In Appendix 2 we include all the biological and distribution information for these seven species.

Table 1. Cetaceans frequently observed in the Gulf of California.

Species	**IUCN Designation**	**Resident or Migratory**
Baleen Whales		
Fin whales (*Balaenoptera physalus*)	Vulnerable	Population resident
Tropical fin whales (*Balaenoptera edeni*)	Minor concern	Population resident
Blue whale (*Balaenoptera musculus)*	At risk	Migratory
Humpback whale (*Megaptera novaeangliae*)	Minor concern	Migratory
Odontocetes		
Sperm whale (*Physeter macrocephalus*)	Vulnerable	Resident
Pygmy sperm whale (*Kogia breviceps*)	Minor concern	Resident
Dwarf sperm whale (*Kogia sima*)	Minor concern	Resident
Orcas (*Orcinus orca*)	Insufficient data	Resident
Short finned pilot whale *(Globicephala macrorhynchus)*	Minor concern	Resident
Risso's dolphin (*Grampus griseus)*	Minor concern	Resident
Commerson's dolphin (*Tursiops truncatus*)	Minor concern	Resident

Short-sided common dolphin (*Delphinus delphis delphis*)	Minor concern	Resident
Long-sided common dolphin (*Delphinus delphis bairdii*)	NA	Resident

Threats of collisions and noise to whales in the GOC

Current threats to whales in the GOC are the same as those occurring worldwide, i.e. ship strikes, entanglements (Laist *et al.* 2001), anthropogenic noise (Erbe *et al*. 2018) and issues caused by habitat deterioration and climate change, such as food depletion, marine pollution, disease, among others (Guerrero *et al*. 2006, IWC 2024).

The difference with other regions of the world is that under current GOC conditions, the intensity of these threats can still be considered low, i.e., the evidence for the GOC is that the collision events that occur are with small, panga-type vessels, and these are known to be non-lethal (Jimenez 2019). In contrast, the risks of lethal collisions are, for now, relatively higher in other parts of the world where there are more large vessels. For example, on the east coast of the United States and Canada, 70 whales were killed in 15 years, an average of 4.4 per year (SD ± 3.6), and of the 70 only 43 had their cause of death determined, where 33% were from collisions (Sharp *et al*. 2019). It is these relatively low pressures that make the GOC an exceptional refuge for marine life on a global scale, which is why since 2005 the islands and protected areas have been part of the UNESCO World Heritage List.

The TGNLS project would mean a drastic change in the landscape and dynamics of the GOC. The TGNLS proposes to build a Liquefied Natural Gas storage and processing plant in Puerto Libertad, Sonora and its transportation through the GOC. This involves the placement of piles for the construction of the dock, which will cause temporary, but no less important, noise levels that can cause from behavioral changes to hearing damage in cetaceans, and this is an area that is particularly important for the feeding of fin whales, fin whales and blue whales. Another significant change is the entry of LNG carriers measuring at least 300 m in length into the GOC, and their transit through almost the entire length of the GOC, all the way to Puerto Libertad. This represents a lethal threat to all whales in the area, both resident and migratory species.

While all of these threats are serious in themselves, and further in their cumulative effects, here we focus our analysis on the threats of collisions and noise, and how these would increase at the GOC as a result of the Project.

Collisions

A vessel collision is a strike by a vessel with a marine animal, especially cetaceans (NOAA 2023). Most collision reports involve large whales, but all species can be affected (Schoeman *et al*. 2020). These collisions occur in areas where species concentrate to feed or breed, or transit seasonally (Laist *et al*. 2001), such as what occurs in the GOC, in particular the Great Islands region and coasts off Port Liberty.

The increase in the intensity of this threat is a direct relationship between the number of whales and the number of vessels, i.e. the more whales in an area and the more marine traffic, the greater the probability of collision, affecting cetacean populations (IWC 2022). The types of vessels involved in collisions can be large tankers, navy ships, cargo ships, cruise ships, whale watching vessels and yachts, etc., (Laist *et al*. 2001; Jensen *et al.,* 2004; Panigada *et al*. 2006; Van Waerebeek *et al*. 2007).

The result of whale collisions with boats can be lethal or can cause serious injuries, including bone fractures, hemorrhages or propeller lacerations (Campbell-Malone *et al*. 2008). Recording the events, thus the type of injury caused by collisions is not straightforward, as they can occur in the open ocean, they cannot always be seen, not all dead whales are detected (particularly in coastal waters), and the cause of death of carcasses that are recovered cannot always be determined due to decomposition (Henry *et al*. 2012). Despite the lack of data, it is now recognized that collisions are one of the most serious threats to large whales, so being able to predict sites and species at greatest risk of collision is critical to the conservation of populations and in some cases the species.

Most ship strike assessments focus on estimating risk through the degree of spatiotemporal overlap in whale habitat and marine traffic (Redfern *et al*. 2020). However, some behavioral aspects of each species must be taken into account for modeling, as certain behaviors may determine the degree of vulnerability of each species. All whales are vulnerable to a collision as long as they are close to the surface to breathe, but some species are more vulnerable than others. For example, mysticete whales increase their buoyancy during the final ascent stage of a dive, which reduces their ability to abruptly change their surface trajectory (Williams *et al.* 2000; Nowacek *et al.* 2001), or in the case of sperm whales, after making a long dive, they spend prolonged periods (approximately 30 minutes) at the surface recovering from this dive, in which state they are unlikely to evade a vessel (Kraus *et al.* 2005). The fin whale is a lesser known species to mariners and is more difficult to track, among other reasons, because of the speed of its swim, the duration of its dive and the tendency to dive without presenting its caudal fin (Ford 2014).

Also, blue, humpback and fin whales are known to exhibit diving patterns related to the day/night cycle: all three whale species spend more time at the surface during the night than during the day (Calambokidis *et al*. 2019). The diving depth also changes according to the time of day, i.e., during the day the diving depth of these three species ranges from 30 -80 m, and during the night they change to 11.5 to
13.6 m depth (Keen *et al.* 2019; Calambokidis *et al*. 2019). These behavioral changes increase the likelihood of collision at night, as they spend more time at the surface and their shallow dives place whales in areas of ship keel impact or propeller strikes (Keen *et al*. 2019; Calambokidis *et al*. 2019).

In addition to dive patterns, vulnerability to collisions is influenced by when and how a whale reacts to an approaching vessel. In some cases whales do not exhibit evasive behavior to vessels (McKenna *et al*. 2015). Exactly why they do or do not evade vessels is not known, but the experience of whales to vessels must be taken into account in this discussion (Keen *et al*. 2019). In this sense the resident whales of the GOC have never been in front of LNG type vessels, so this is an element to consider during the first years of project operation. Some migratory species are exposed to marine noise and traffic from their home areas and migratory route, but like the residents they are not accustomed to coming to an area of high marine traffic and noise - i.e., the GOC would no longer be a suitable area for breeding and/or feeding, depending on the species.

In addition to the abovecollision vulnerability models by species should include not only density and time of day, but also feeding, transit, breeding and resting behavior, as these behaviors can reduce attention to environmental sounds (Dolman *et al*. 2006). In addition, season, and even age class, must be taken into account (Currie *et al.* 2023). In the case of hatchlings, for example, risk is because they spend more time at the surface to breathe than adults, surface often without the mother, are less visible than adults, and are relatively naive in interactions with vessels (Laist *et al*. 2001).

Context of current collisions in the GOC

For the GOC, no model has been developed to predict the rate of collisions with ships. Therefore, it is not known for sure how many cetaceans are affected annually, nor how the animals die after a collision. However, for other regions, several models have been developed that can serve as an example applicable to what could happen in the GOC, since the behavior and vulnerability of whales to ships is similar in any part of the world. Examples of these models are those developed for the region of British Columbia, Canada (Keen *et al*. 2023), where they indicate that by 2030, encounters between whales, particularly humpback and fin whales, and any type of vessel could triple, but the most extreme increase would occur with large vessels (> 180 m in length). It is noteworthy that these models predict that the greatest source of mortality risk is with LNG type vessels, i.e. the same ones that are proposed to sail in the GOC, which is alarming for all of us.

cetaceans. Resident species would face a new and lethal threat. In the case of migratory whales, the GOC would no longer be a suitable area for reproduction and would also add to the stress they already face throughout their migratory route. For the blue whale in particular, the project would affect an important feeding area.

At this time for the GOC there is no complete record of whale collisions with large vessels. Collisions can occur at night or in adverse weather conditions. Winds and currents must be favorable for a carcass to strand and come to rest on an accessible beach. Animals killed from a collision often drift and eventually sink to the bottom, and in stranded animals, the cause of death is not always easily identifiable (Ritter and Panigada, 2019). Therefore, in the event of a lethal collision event for these species it is unlikely to be detected. However, even though we currently have no records for the GOC of collisions between whales and vessels greater than 30 m in length, all whales are undoubtedly vulnerable to a collision.

The information we have for the GOC derives from a 2019 study developed by PRIMMA, where, for four cetacean species (fin whale, fin whale, killer whales and short-finned pilot whale), collision events in the GOC[3] are identified from the analysis of photographs taken of the species from 2004-2017, in which it was identified that some individuals presented injury scars. These scars were classified according to their type, depth and morphology. The result of the study indicates that, of the four species studied, collisions were more frequent in fin whales and by the type, depth and scar morphology presented by the individuals, it is suggested that they were with panga-type vessels. This result is related to the that most of the vessels currently transiting the GOC are dedicated to coastal fishing. For example, between Sonora and Sinaloa they total at least 15,000 smaller vessels (CONAPESCA 2017). Modeling studies on collisions and LNG type vessels indicate that they are lethal Keen *et al*. 2023), and it would be complicated to have the record because when several species of whales affected die, they sink.

Current marine traffic in the GOC

[3] The data from the Jiménez study, the only recent study that analyzes collisions in the GOC, are from the collection of information from two sources: 1) records in different media such as regional newspapers (Sudcaliforniano and Peninsular digital), scientific notes, technical reports from the Procuraduría de Federal de Protección al Ambiente (PROFEPA), Comisión Nacional de Áreas Naturales Protegidas (CONANP), Instituto Nacional de Ecología y Cambio Climático (INECC), the different port and RABEN; and 2) through review of the photographic collection from 2004 to 2017 that PRIMMA has (animals that survive an entanglement or collision event generally have scars from injuries on the body) (Jiménez 2019). This technique has been used previously for humpback whales (Robbins and Mattila, 2004) and fin whales (Panigada *et al*. 2006).

The traffic intensity in the GOC of different types of vessels and different sea routes can be observed in the information available from the Marine Traffic platform (https://www.marinetraffic.com) (Fig. 1). The highest traffic intensity is found in the southern part of the GOC. This traffic is associated with the routes of the Baja Ferries company, which transports people and goods; these ships measure a maximum of 198 m in length and represent the largest within the GOC. The company has two routes, La Paz
- Mazatlán, Sinaloa (6 trips per week), and La Paz -Topolobampo in Sonora (14 trips per week). Another transit route for larger vessels is the Port of Guaymas, Sonora, which serves large vessels, up to 200 m in length, that transport agricultural goods, minerals, cement, and hydrocarbons; it is also a terminal for tourist cruise ships (Dripcapital 2022; Port of Guaymas 2024). Despite the transit described above, the navigation routes of all ships occur in areas far from the points of greatest whale concentration (Fig. 1).

It is important to highlight that the area of Puerto Libertad where the TGNLS project is proposed to be built is one of the areas of the GOC that currently has the lowest marine traffic and the highest concentration of whales, as well as essential habitats for their life cycle.

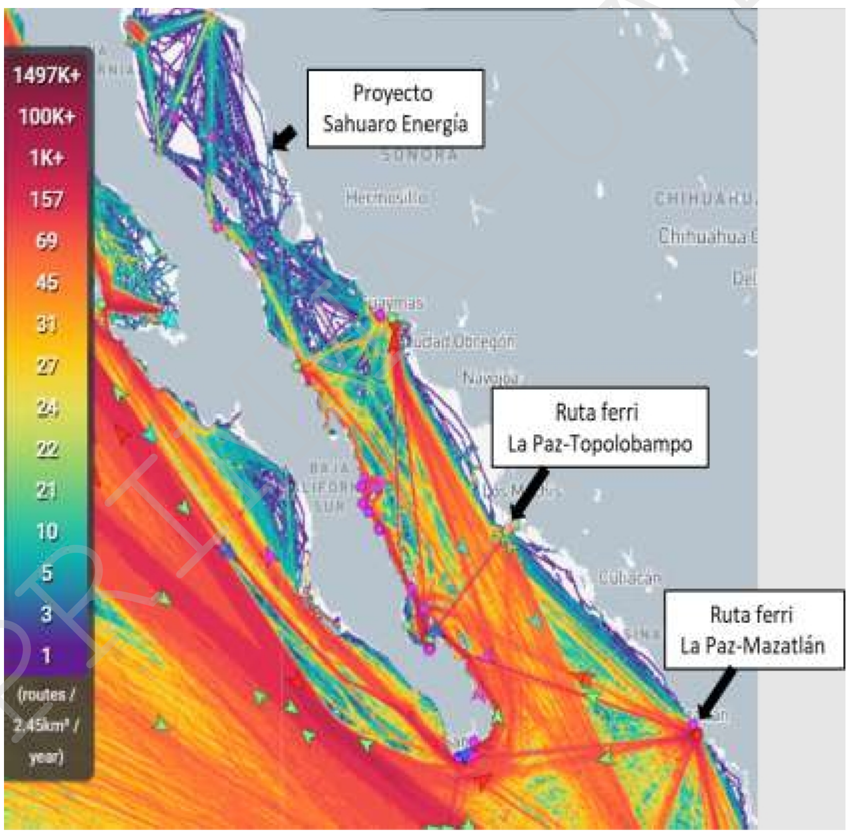


Figure 1. Density of marine traffic in 2022 in the GOC. https://www.marinetraffic.com

Large whale collision risk prediction models for LNG-type vessels.

LNG carriers, also called LNG carriers, are vessels dedicated exclusively to transporting LNG (LNG). Although several models are manufactured, in general these ships measure around 300 m in length, 50 m in beam and have a draft of approximately 12 m; they can reach an average speed of 19.5 knots.

For the GOC, no model has been developed to predict the rate of collisions with ships, and it is not proposed as a future objective in the EIA, so we believe that this model should be developed by the developer prior to the possible authorization, construction and operation of the project.

For the time being, modeling is available for other regions of the world, where they propose to develop LNG terminals and their transportation, as is happening in the GOC with the TGNLS. One of these studies is the one developed for British Columbia, Canada (Gitga'at First Nation), where they model the collision rate between fin and humpback whales and ships in general and in particular with LNG type ships. The study indicates that by 2030, with the increase in existing marine traffic and a new LNG export terminal, whale encounters could triple for most vessel types. The most extreme increase would occur with large ships (length > 180 m), as large ship-whale encounters would increase 30-fold (Keen *et al*. 2023). The authors predict that, in the area, in the next decade, mortality from ship strikes will increase 2.3 times for fin whales and 3.9 times for humpback whales, i.e. 2 and 18 deaths per year respectively. Such values represent unsustainable losses that could deplete populations of both species in the region studied. It is noteworthy that the models predict that the greatest source of mortality risk for large whales in 2030 will be from LNG-type ships. The mitigation options suggested by the authors are that the speed limit for all large ships should be 10 knots, but that the best measure to ensure mitigation would be seasonal restrictions on LNG traffic (Keen *et al*. 2023).

Cetacean distribution in the GOC and its overlap with proposed TGNLS shipping route

The EIA proposes two routes for the passage of LNG carriers through the Big Islands: one is between Tiburón Island and San Esteban Island and the other between San Esteban Island and San Lorenzo Island (Fig. 2, p. 510 of the EIA).

Although the MIA does not contain predictive modeling of collisions caused by LNG carriers, the risk can be approximated by overlapping the sighting records the three species with the highest risk of collision (fin whale, Bryde's whale, and blue whale) with the LNG carrier routes proposed in the MIA (Fig. 3).

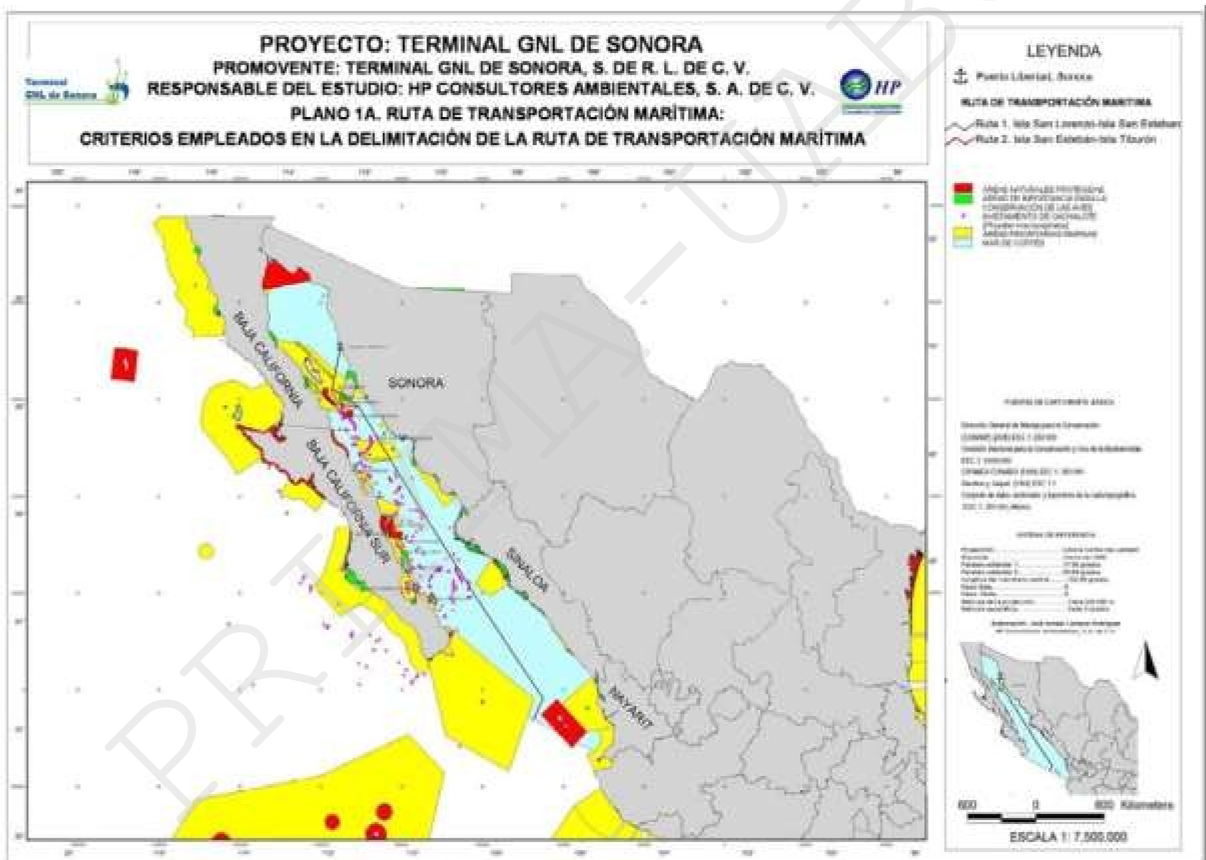
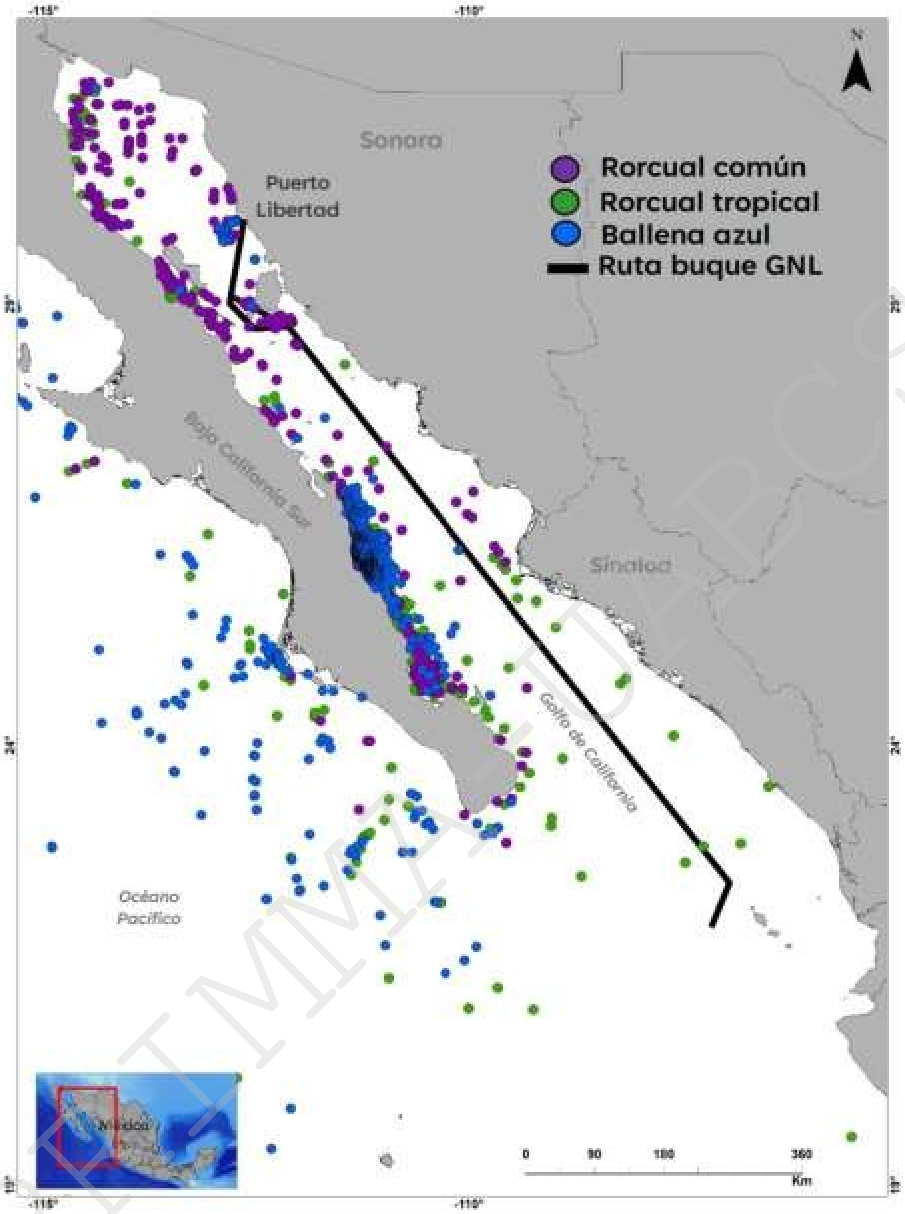


Figure 2. The two proposed routes for LNG carriers in the 2006 MIA of the TGNLS project.

The result of this overlap is that the area of the Big Islands and coasts in front of Puerto Libertad could be high-risk sites for these species if the project were to move forward. It is important to mention that in particular these three species, which are distributed throughout the GOC, have been recorded in the region off Puerto Libertad, and in the case of the blue whales and fin whales, their main activity in the area is feeding.



Sightings of three species of whales: fin whale (*Balaenoptera physalus*), Bryde's whale (*Balaenoptera edeni*) and blue whale (*Balaenoptera musculus*) and the two routes proposed for LNG carriers in the 2006 EIA of the TGNLS project.

Because fin whales are one of the species most vulnerable to ship strikes and there is a resident population in the GOC, habitat suitability maps for fin whales (Jimenez 2019) and the routes proposed in the EIS were overlaid.

The result indicates that the fin whale is found year-round in the region of Puerto Libertad and the Big Islands (Fig. 4), which confirms that it would be one of the species most affected by the TGNLS project.

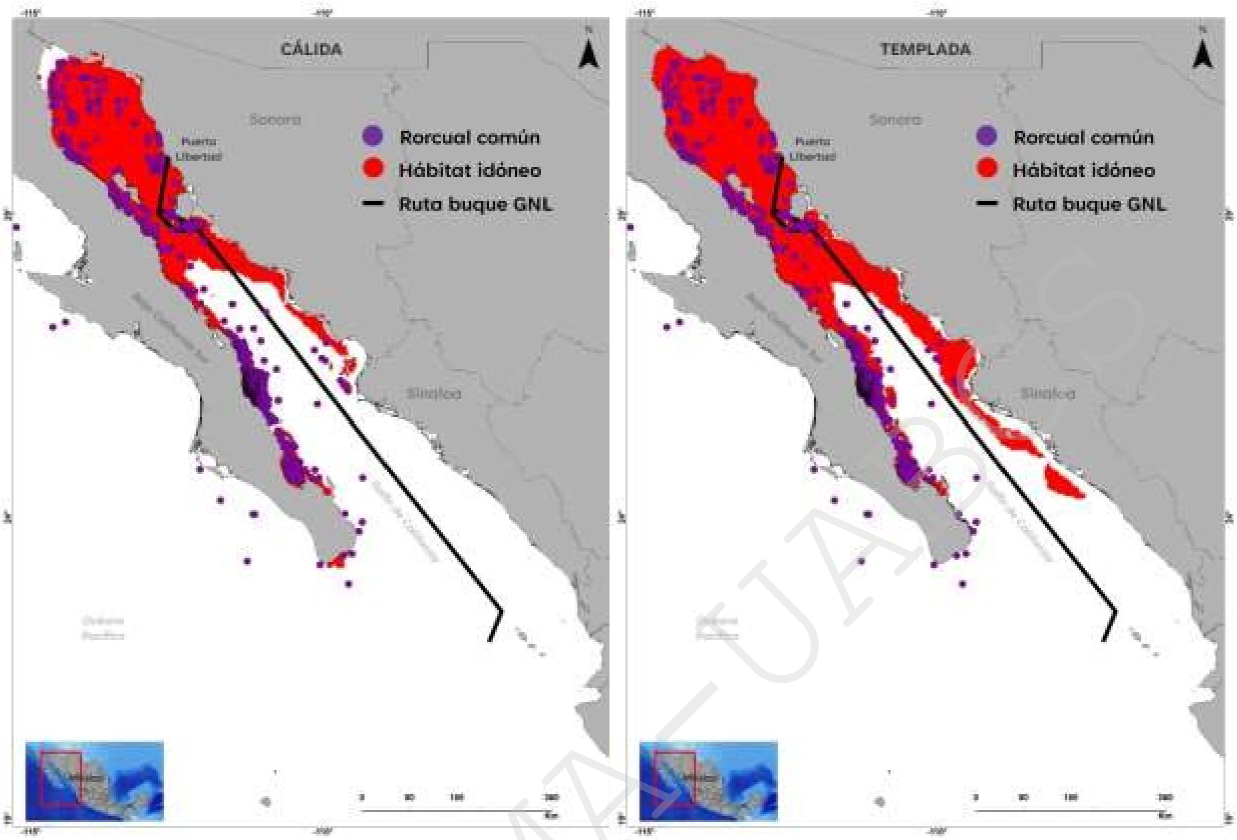


Figure 4. Suitable areas of distribution of fin whales (*Balaenoptera physalus*) in the warm season (left) and in the temperate season (right). The black lines in the center of the gulf represent the two proposed routes for LNG carriers in the 2006 EIA of the TGNLS project.

By overlapping the sighting records of the odontocete species distributed in the GOC, we observed that in the area between Tiburón Island, San Esteban Island and San Lorenzo Island there is an important aggregation of sperm whales, short-finned pilot whales, killer whales, dwarf sperm whales and dolphins Figure 5), so we consider that whichever route is chosen, including the two routes proposed by the proponent, would cause effects to the populations of these species.

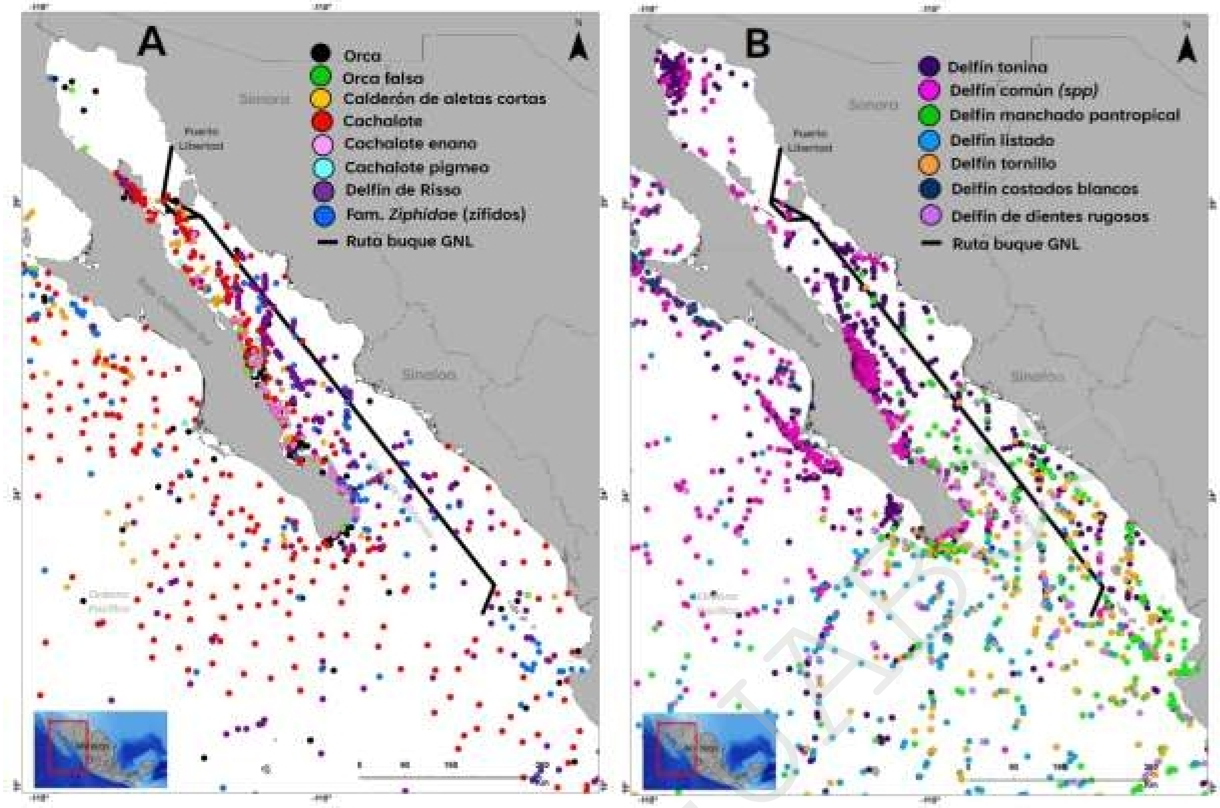


Figure 5. Odontocete sightings: **A)** killer whale *(Orcinus orca*), false killer whale (*Pseudorca crassidens*), short-finned pilot whale (*Globicephala macrorhynchus*), sperm whale (*Physeter macrocephalus*), dwarf sperm whale (*Kogia sima*), pygmy sperm whale (*Kogia breviceps*), Risso's dolphin *(Grampus griseus*), *Ziphidae* family (Zip*hidae*); **B)** Commerson's dolphin (*Tursiops truncatus*), common dolphin *(Delphinus spp.*), pantropical spotted dolphin *(Stenella attenuata*), striped dolphin *(Stenella coeruleoalba*), spinner dolphin (*Stenella longitostris*), white-sided dolphin *(Lagenorhynchus obliquidens*), rough-toothed dolphin *(Steno bredanensis*), and the two proposed LNG carrier transit routes.

Another species that would be affected is the humpback whale, since the most important aggregation sites by number of whales are the coast from Los Cabos to Loreto Bay in B. C. S., Mazatlan Sinaloa, and Banderas Bay Nayarit (Fig. 7a). In its migration from the Cabos region to Mazatlan and/or Banderas Bay Nayarit it is known from satellite tag trajectories traversing the GOC (Fig. 7b) (Urbán *et al*., 2017). The introduction LNG carrier traffic would make this migration area a risk for the species.

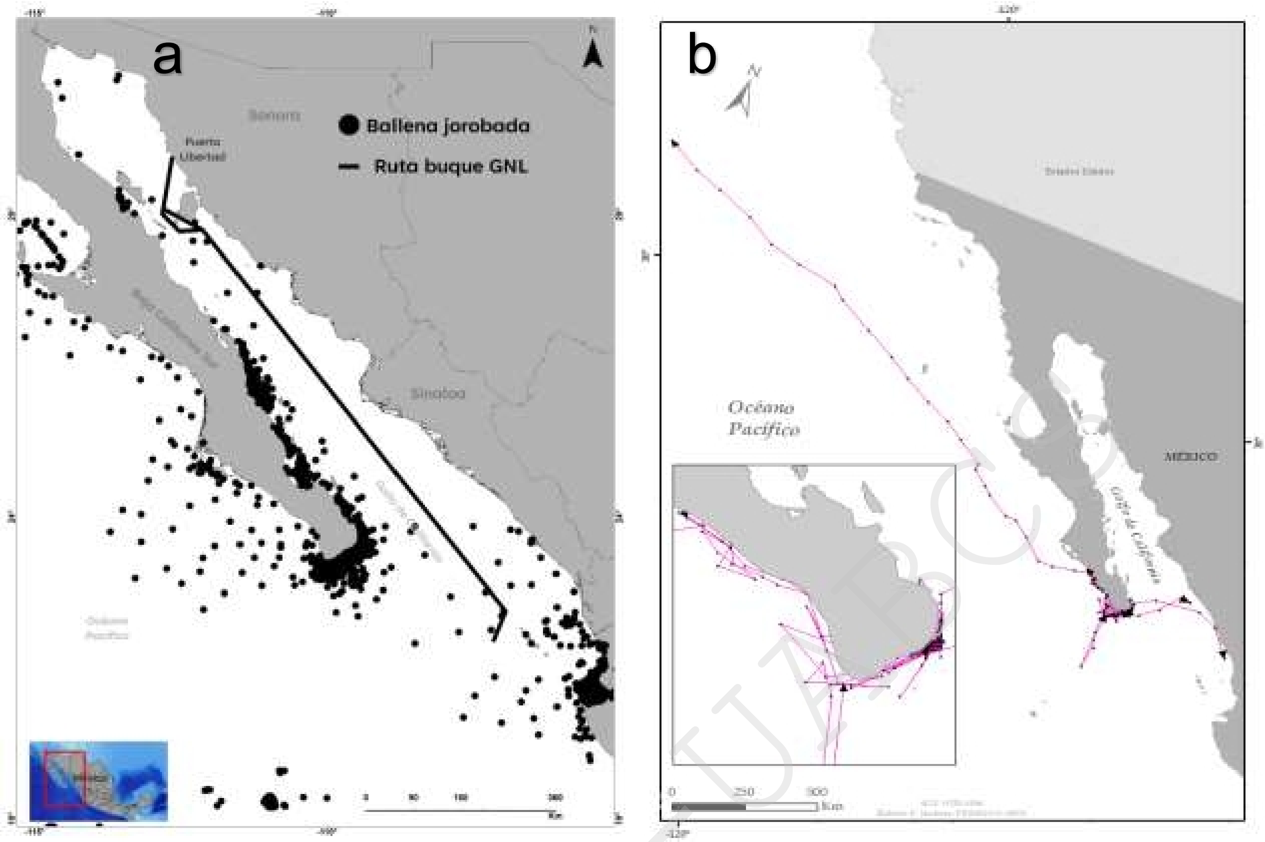


Figure 7. a) Humpback whale (*Megaptera novaeangliae*) sightings in the GOC. b) The pink line is the sum of the trajectories of satellite tags placed on 7 humpback whale mothers (Urbán *et al*., 2017).

In addition, by overlapping the two routes proposed in the MIA with sightings of the most abundant cetaceans in the area, such as fin whale (*Balaenoptera physalus),* Bryde's whale *(B. edeni), blue whale* (*B. musculus*), sperm whale (*Physeter macrocephalus)*, short-finned pilot whale *(Globicephala macrorhynchus)*, Risso's dolphin *(Grampus griseus)*, bottlenose dolphin *(Tursiops truncatus)* and common dolphin *(Delphinus spp*), (Fig. 8), **we conclude that neither is an option to mitigate harm to large whale populations, as both routes represent lethal threats of collision for large whales and acoustic disturbance for all species.**

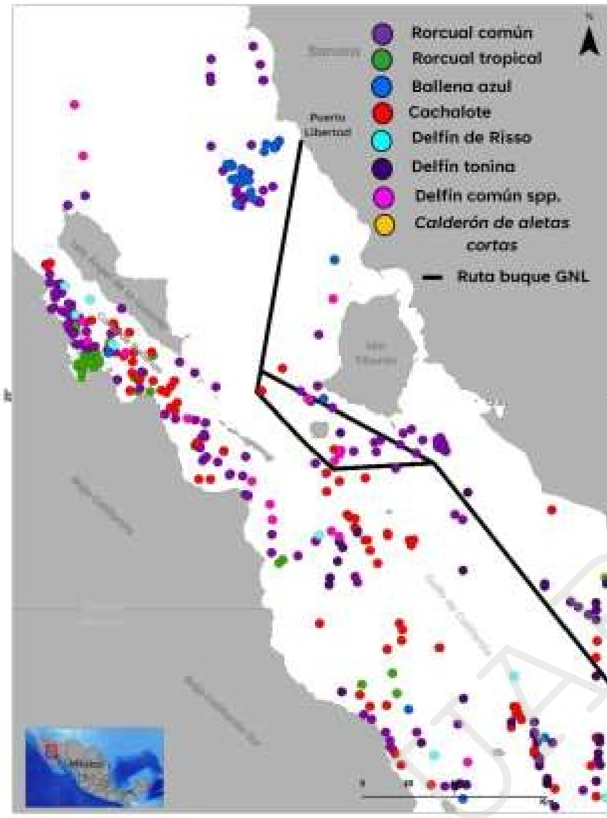


Figure 8. Sightings of the most abundant cetaceans in the Great Islands area and the two proposed inter-island LNG carrier transit routes.

In summary, the EIA concludes that effective mitigation measures to reduce vessel impacts on cetaceans is the combination of avoiding areas with high concentrations of cetaceans and reducing speed (p. 447). Additionally, on the one hand, the MIA discusses how methane tankers have "almost no maneuverability" which "makes any method of action" to avoid a collision "difficult" (p. 447). The PPCB, on the other hand, suggests the use of observers to identify whales in the area and evade them. What is not clear is how these observers, or any other method of whale sighting, would be useful for evading whales without a significant decrease in vessel speed in a pre-emptive manner, since, given the size of the vessels, evasion maneuvers require large distances and time (Schoemann *et al.* 2010). But both the MIA and the PPCB fail to mention what speed would be appropriate to avoid collisions with whales in the area.

Both the MIA and the PPCB fail to recognize that it is impossible to trace a route to Puerto Libertad without crossing a key habitat area for several species of marine mammals and the main distribution area of the fin whale, a species with a high vulnerability to collisions.

Noise

Sound is an important sensory modality for many marine animals, including marine mammals (Nowacek *et al*. 2007). Not all marine mammal species have the same hearing abilities, in terms of absolute hearing sensitivity and hearing frequency band (Richardson *et al*. 1995; Wartzok and Ketten 1999; Southall *et al*. 2008; Au and Hastings 2008) (Table 2). Cetaceans (whales and dolphins) use a wide range of acoustic frequencies. The blue whale *Balaenoptera musculus* produces low-frequency sounds down to ~15 Hz, the opposite of several porpoise , which emit echolocation signals at 120-150 kHz (e.g., harbor porpoise *Phocoena phocoena*). This wide frequency range intersects with many of the sounds that human activities introduce into the water, including ship , sonar of various types, and seismic exploration signals (Nowacek *et al*. 2007). Some human-produced sounds are well above the range used by marine mammals, such as high-frequency echo sounders. However, it is in the shared frequency range where we are concerned about the effect that anthropogenic noise may have on cetaceans. Noise pollution presents a particularly worrying problem when the noise is going to be constant, which would change the acoustic environment of the species in the area permanently.

Marine mammal hearing groups NMFS, 2016) Table 2.

Hearing Group	Generalized Auditory Range
Low Frequency Cetaceans (LF-Low Frequency) - (Baleen Whales)	7 Hz to 35 kHz
Mid-frequency cetaceans (MF-Mid-frequency) - (Odontocetes-dolphins, dolphins, beaked whales)	150 Hz to 160 kHz
High-frequency cetaceans (HF-High-frequency) - (Kogias, true porpoises, river dolphins, *Cephalorhynchus sp.*, *Lagenorhynchus cruciger* & *L. australis*)	275 Hz to 160 kHz
Phocid Pinnipeds (PW) - (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (OW) - (sea lions and artocephalines)	60 Hz to 39 kHz

* Represents the generalized hearing range for the entire group as a composite (i.e., all species).
within-group), where the auditory ranges of individual species are usually not as wide. The generalized auditory range was chosen based on the ~65 dB threshold of the normalized composite audiogram, with the exception of lower limits for LF cetaceans (Southall *et al*. 2008) and PW pinnipeds (approximation).

The scientific community has identified that animals exposed to elevated noise levels may suffer several impacts, including the following:

- Permanent Threshold Shift (PTS), or the permanent loss of hearing sensitivity caused excessive noise exposure;
- Temporary Threshold Shift (TTS) or the temporary loss of hearing sensitivity caused by excessive noise exposure;
- Behavioral alterations, such as abandonment of an important activity (feeding, nursing) or location in response to some sound, and repeated abandonment of such vital activities (Nowacek *et al*. 2007);
- Acoustic masking, which occurs when an extraneous sound covers or "masks" a desired signal, making it difficult to detect the latter, which can turn into increased energy expenditure and chronic stress, which can result in decreased biological fitness (Rolland *et al*. 2012).

Cargo vessels

Underwater anthropogenic noise from cargo ships affects marine wildlife and there are three levels of severity: injury, disturbance, and chronic and cumulative effects (Schlesinger *et al*. 2016).

The sound coming from large cargo ships is one of the most penetrating anthropogenic sounds in the ocean that falls within the low frequency range of 5 to 500 Hz and can mask the sounds produced and heard by large whales (Hildebrand 2009). The main source of this sound comes from "propeller cavitation" on these vessels, a phenomenon that occurs in the propellers when the pressure at the front of the blades is so low that steam bubbles and turbulence form.

Vessel noise is a combination of "tonal" "narrowband" sounds at specific frequencies and "broadband" sounds with energy spread continuously over a range of frequencies. The levels and frequencies of tonal and broadband sounds tend to be related to the size of the vessel, but are also greatly affected by its design and speed (Richardson *et al*. 1995).

Large vessels generate louder, lower frequency sounds due to their greater power, larger drafts, and slower turning engines and propellers. They also have large hull areas that effectively couple machinery sound to the water (Ross 1976). Broadband components are caused primarily by propeller cavitation and flow noise, secondarily with engine cylinder firing speed and shaft rotation, which can extend up to 100 kHz, with peaks of 50-150 Hz. Small vessels often have small propellers with high rotational speeds, which produce cavitation noise at higher frequencies (Ross 1976).

Ship noise is constantly present, even when there are no visible ships near the receiver (Hildebrand 2009), because in the ocean acoustic energy propagates efficiently, traveling rapidly and potentially long distances, and low frequencies can travel hundreds of kilometers with little loss of energy (Urick 1983).[(4).]

The result of these characteristics of large cargo ships, such as LNG carriers, is that they affect a wide range of species with both temporary and permanent injuries. They also cause stress and behavioral changes that are energetically costly.

Noise impacts during the construction of the LNG plant, and during the development of docking and transit activities of LNG-type vessels.

The EIA of the TGNLS project does not include acoustic dispersion models, which is a requirement since noise is known to be one of the greatest threats to marine mammals. Fortunately in the literature there are some models (Schlesinger *et al*. 2016), which allows us to have an approximation of the damage that the construction of the gas plant, as well as the docking and transit of LNG-type vessels can generate on marine mammals.

Schlesinger et al. (2016), in their study for an LNG project in British Columbia ("Aurora LNG"), applied sound propagation models to assess underwater noise exposure of marine mammals and fish during marine terminal construction activities consisting of confined bubble curtain impact pile driving and rock cavity drilling for pile installation, as well as noise exposure from marine traffic activities of LNG vessel docking and transit. They use a series of previous studies that identify thresholds for various impacts: injury (PTS or TTS), behavioral, and zone of audibility.

The following are some of the conclusions reached by Schlesinger and collaborators (2016) about the LNG terminal towards Marine Mammal Hearing Groups (NMFS, 2016), according to the distances from the sound source that represent thresholds of behavioral changes (Table 3). It is necessary to say that, the modeling of acoustic impacts must take into account the bathymetry, the geoacoustic parameters of the seabed and other factors, therefore, what is presented in the following table is only an example of the damage that these activities can generate. The EIA for the TGNLS project would have to perform a complete modeling specific to the GOC to identify and understand the damages of the project.

[4] Sound propagation can be affected by many factors, among which the most influential are:
(i) sound frequency; (ii) water depth; and (iii) density differences within the water column, which vary primarily with temperature and pressure (Urick 1983; Luchinin 2011).

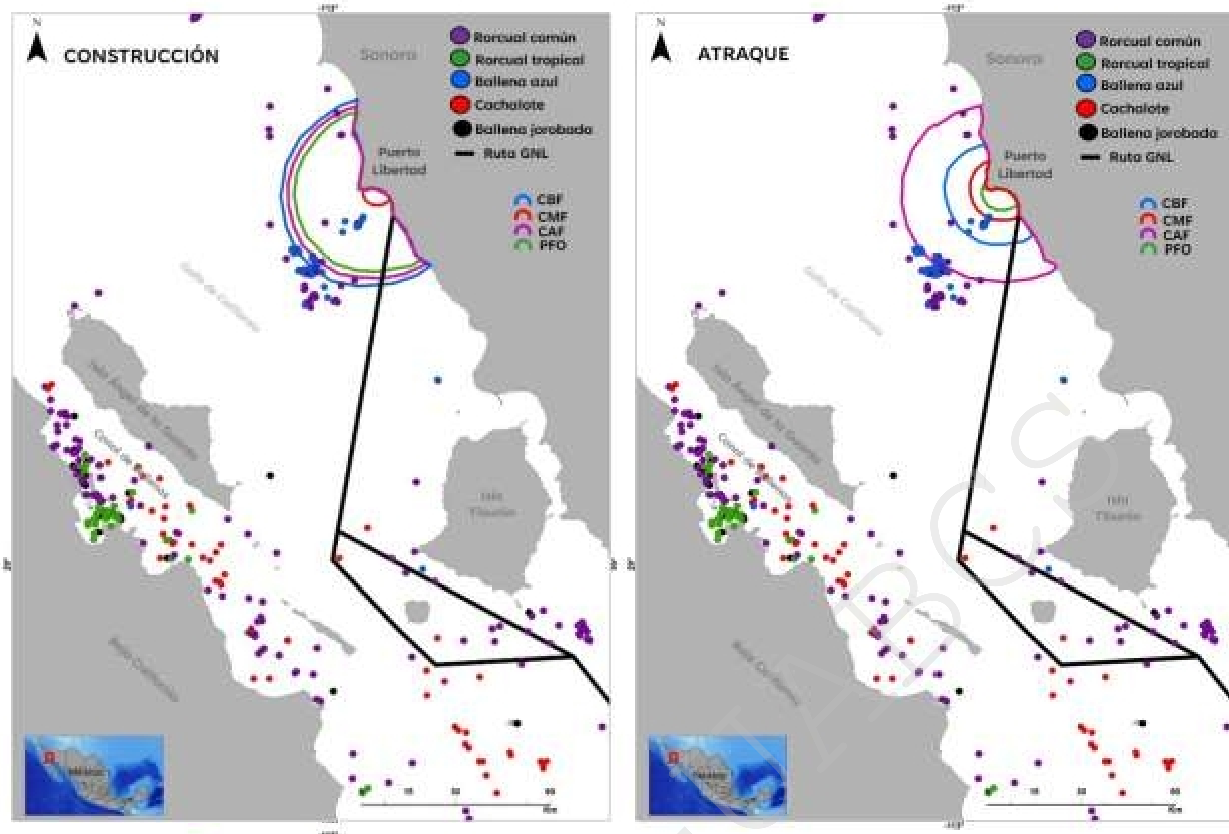
Maximum distances of acoustic impacts that cause changes in behavior for certain species, modeled for the Aurora LNG project (km)*.

Species	Construction Phase		Operations Phase	
	Drilling of rock cavities at the LNG dock	**Driving of impact piles at LNG jetty (with curtain walls) confined bubbles)**	**LNG carrier berthing with tugboats**	**Start-up of methane tankers with tugboats**
Low Frequency Cetaceans (LFC)	4.7	26.3	15.9	35.7
Cetaceans of Medium Frequency (CMF)	0.7	3.8	8.6	10.7
High Frequency Cetaceans (CAF)	2.2	26.2	28.2	51.5
Pinnipeds, Phocidae and Otarids (PFO)	1.8	26.3	5.3	14.3

*Adapted from Schlesinger *et al.* 2016, using McCauley *et al*. (2000), Bailey *et al*. (2010), MacGillivray (2012) and Tougaard *et al*. (2015). Distances represent the area where sound exceeds the impact threshold. These thresholds are different for each hearing group and in each study, so it is necessary to review Schlesinger *et al.*2016 or the foundational studies to interpret with complete information these impact thresholds.

The information from Schlesinger *et al.* indicates that both the construction phase and the operation (berthing and transit of ships) will generate important sources of noise disturbance for all marine mammal species, and, to a lesser extent, hearing damage, which is more harmful in the case of pile driving, within the construction phase. Behavioral changes (Table 3) may include basic survival behaviors such as feeding and reproduction. These behavioral changes can occur at distances away from the source of the sound of transiting LNG carriers with tugs - up to 35.7 km for the Low Frequency Cetacean (LFC) hearing group, or up to 28.3 km for High Frequency Cetaceans (HFC), at LNG carrier berths with tugs. This means that it would be difficult for these animals to escape these sounds given their range. It is important to consider the constancy and duration of these sounds from operations, as well, to understand how this project alone could affect marine mammals in the GOC for decades. The addition of other projects could multiply this damage.

Based on the findings of Schlesinger et al. (2016), we developed three maps showing the areas of acoustic disturbance from the different project activities in the port and overlapped it with the sightings of the whale species that can be most commonly recorded in the GOC (Fig. 9). **However, it should be noted that a specific analysis needs to be conducted in the area, to be submitted by the proponent.**



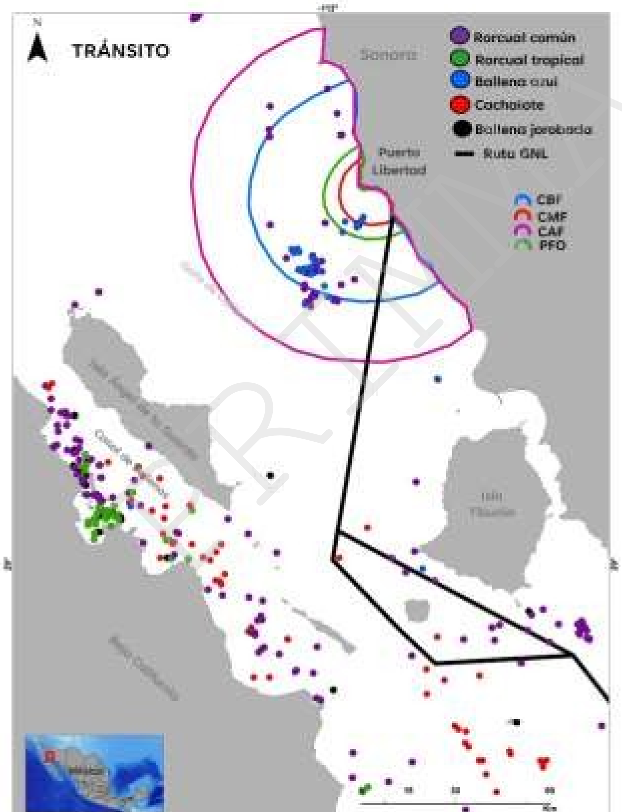


Figure 9. Acoustic threshold radii that would generate disturbance and behavioral changes in the 4 different Marine Mammal Hearing Groups (CBF-Low Frequency *Cetaceans*, CMF-Medium Frequency *Cetaceans*, CAF-High Frequency *Cetaceans*, *PFO*-Phocid Pinnipeds and Otarids) (NMFS, 2016; Schlesinger et al. 2016), from the activities of the Puerto Libertad LNG plant, according Table 3. The points are sightings of different species of marine mammals. It is important to highlight that the sightings in the area are not the product of systematic surveys but of the historical record of the PRIMMA database.

Noise impacts on cetaceans in the GOC

In particular, in the GOC, studies have examined the impact of boat noise on whales and dolphins. A decrease in the number of humpback whale singers has been observed in areas with higher levels of vessel noise, indicating a direct effect of anthropogenic noise on the emission of sounds emitted by whales: the higher the intensity of noise caused by vessels, the lower the detection of singers (Seger 2016). [5] In the case of dolphins, it has been shown that the presence of vessels (fishing panga (5-10 m); tourist panga (5-10 m); passenger panga (5-10 m); ferry (190 m); yacht (10-60 m); sailboat (10-14 m); cargo boat (200 m); jet ski (3 m)) can alter their behavior, including changes in habitat use, group composition, and foraging, resting, and socialization activity (Antichi *et al*. 2022b). In addition, dolphins have been documented to modify their vocal repertoire in response to vessel noise (Antichi *et al*. 2022a and Antichi *et al*. 2022b).

It has also been shown that, in members of the family Ziphiidae, boat noise can contribute to an increase in the level of ambient noise at high frequencies, causing disturbances in the foraging behavior of Cuvier's beaked whales (Aguilar Soto *et al*., 2006) and Blainville's beaked whales Pirotta *et al*., 2012). Likewise, a study showed that beaked whales can detect and change their acoustic behavior in the presence of sounds produced by commercial echo sounders used by vessels and that this change can cause disturbances in their feeding behavior or in their temporary presence when moving away from vessels (Cholewiak *et al*., 2017).

Based on the above information we conclude that the TGNLS project will generate acoustic disturbance and likely acoustic damage throughout its construction and operation phases. This disturbance and the resulting behavioral changes in many marine mammals could extend throughout most of the GOC due to the long distances affected by the noise from the gas tankers. It is imperative that the proponent generate the appropriate acoustic dispersion model for the area where it intends to operate, i.e. in Puerto Libertad and on any proposed shipping lanes to be transited. Based on this new analysis, mitigation measures should also be reevaluated to better minimize these impacts on marine mammals.

[5] This study did not definitively identify whether singers stop their singing activity or else move away from noisy areas to continue this behavior (Seger 2016).

Analysis of mitigation measures: the MIA, DGIRA Resolution in 2006, and the Biodiversity Protection and Conservation Program (PPCB 2023).

In this section we analyze the impact assessment and mitigation measures proposed in the documentation prepared by the project proponent. We focus on two main documents: the Environmental Impact Assessment (MIA) submitted in 2006 and Biodiversity Protection and Conservation Program (PPCB) of 2023, as these are the documents most relevant to the issue of identifying and mitigating project risks to large marine mammals discussed earlier in this report.[6]

Environmental Impact

Review of the 2006 EIS reveals several problems with the analysis of impacts and proposed mitigation measures. These errors and omissions make the EIS inadequate to ensure the protection of large marine mammals in the GOC.

First, it is important to note that the EIA describes a very different project than the current one. The version of the project in the MIA is for a regasification plant, not a liquefaction plant, as is the current plan. In addition, the size of the project has increased significantly. The original version of the project contemplated a maximum capacity of 365,000 million cubic feet of gas per year, but the current version is 912,220 million cubic feet of gas per year. Since the current version is a liquefaction plant and has a higher capacity, the impacts will be different from those of the regasification plant in the EIA. For example, there will be different and larger amounts of effluents - such as cooling water from the liquefaction plant, brine from the desalination plant[7], and possibly toxic pollutants such as amines or mercury which

[6] The 2006 MIA, the 2023 PPCB, and a 2009 "Plan de Protección Ambiental Integral" (PPAI) are the only documents to which we had access. As the PPAI was never approved, to our knowledge, we have focused on the 2023 PPCB and the 2006 MIA. We are not aware of any other relevant documents, such as a new Marine Mammal and Chelonian Monitoring Program, which is a requirement within the conditions of the 2006 project approval (Condition 1).

[7] The 2006 MIA states on page 81 that the regasification terminal "considers the installation of a seawater desalination plant," and ASEA's 2018 authorization includes a desalination plant in the

result from gas purification (Mokhatab *et al*. 2014, Woodside Energy Ltd. 2014). Vessels arriving at the port without cargo will release much more ballast water into the GOC, posing a greater risk of invasive species and disease, or toxic biocides will be used to disinfect the ballast water, which also harm the ecosystem (Calcasieu Pass 2023, Bailey 2015, Werschkun *et al*. 2014*)*. Vessels passing through the GOC will be heavier when they leave the liquefaction plant fully loaded. Those arriving at the regasification plant under the 2006 MIA, in contrast, would pass through the GOC at the end of their voyage, after combusting a good portion of their cargo. A vessel that is heavier takes longer to slow down or change its route, which may pose a greater risk of collision with marine mammals. In addition, the propeller and bow of a heavier vessel would be deeper, which would not only pose greater risks of collisions, but also greater in-water acoustic radiation (Jones 2021). Overall, increasing the amount of gas passing through the terminal would mean an increase in gas carrier traffic of approximately 2.5 times, which would multiply the impacts and risks of this traffic at the same time.

In addition, the EIA lacks information on the ecology of the species that are distributed in the GOC and on the possible effects of noise from the construction of the plant, the dock and boat traffic. In this regard, it is imperative that the proponent update all information regarding the species present in the construction zone and navigation route. The MIA also presents erroneous information: it includes species atypical to the area and rather typical of the Ensenada coasts on the Pacific coast, such as the gray whale, the white-sided dolphin, the common seal, the elephant seal, and the Guadalupe fur seal. Its update, 18 years after its first version, would allow the proponent to conduct a proper analysis and propose effective mitigation measures. These measures would go beyond the measures included in the current document, which only proposes monitoring to know the species present and their spatio-temporal distribution. Once the specific effects and appropriate mitigation measures have been identified, monitoring should be aimed at verifying that the mitigation measures are effective.

In order for the analysis of noise impacts to be sufficient to ensure the protection of the different species in the gulf, noise dispersion modeling of the construction site and transit routes in the GOC is necessary. However, the MIA does not include this kind of study in the document or the annexes. This model should include fin whales, blue whales, fin whales, sperm whales, short-finned pilot whales, Risso's dolphins and killer whales as some of the main species that may be affected, and should also include the timing and behaviors of these species off Puerto Libertad. It is expected that the proponent currently has the technical specifications on the equipment to be used during pile inflation, dock construction and terminal construction to include in the model. The developer should also report what type of vessels will be used to transport the gas and also model the dispersion of the gas.

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plans for the liquefaction terminal as well (p. 5). It is likely that the liquefaction terminal would emit much more brine than the amounts planned for the regasification terminal, because of the increased volumes of gas passing through the plant and the large amounts of water needed for cooling and processing the gas at the liquefaction terminal.

noise it will generate and its possible impact on the 30 species of cetaceans distributed along the proposed routes.

Regarding collisions, the EIA should also incorporate a model of the probability of risk of collisions with LNG type vessels along the entire transit route, something that does not appear in the EIA either. Although there is little record of collisions in the GOC, the proponent should take other sites around the world as examples and include available information regarding the distribution and density of fin whales, blue whales, and sperm whales as the main species affected and model the probability of collision risk with LNG tankers. In addition to taking into account the season of the year, the species, the behavior of the whales, the time of day, the age of the organisms.

The mitigation measures proposed in the EIS are also inadequate. It is important to note that, by not correcting the errors in the risk analysis noted above, in particular the lack of the two studies on noise and collision risk, it would not be possible to propose real and effective mitigation strategies. In addition, we have found significant deficiencies that need to be rectified.

Regarding the mitigation measure proposed in Table 2 of the MIA (Pages 616 and 617) "Decrease the speed of vessels when transiting through critical areas" it is required to indicate what speed will be, because in the literature there are sufficient elements to specify what is the recommended speed, it is also requested to update the critical regions because not only the Great Islands Region and the Marine Priority Area of Guaymas is considered in this way (Page 665). In addition, in your collision mitigation strategy you need to take into account the species, the season of the year, the behavior of the whales, the time of day, the age of the organisms, and propose real and effective mitigation strategies. Again, we believe that monitoring is essential to verify that your mitigation measures are effective.

As part of the mitigation strategies, the developer is developing a management and protection program for the vulnerable species listed in NOM-059 SEMARNAT-2001 and the appendices of CITES 2005, within the maritime route (Pages 627-628). However, this information is outdated. It is important that the proponent update new information available on cetaceans in the GOC, as well as the CITES status for cetaceans, and rethink this program, as it is obsolete, since most of what is proposed in this program is currently in place.

Finally, the EIA does not evaluate the measure that would be most effective in minimizing the risk to large mammals: the relocation of the project site to avoid the vulnerable region of the Great Islands. In the EIA (p. 225), it is mentioned about collisions of LNG carrier vessels with marine mammals that "*While traversing the Gulf, there is a risk of collision between vessels and whales, particularly when the vessels are traveling at their economic speed of 19 knots. Large vessels have almost no maneuverability when moving fast and need a distance of several kilometers to turn; this makes it difficult to take any action to avoid a collision even if the whale is sighted. The*

The best way to reduce the probability of collisions is to locate vessel routes in areas that have the lowest density of cetaceans and to reduce vessel speed...". As shown above, it is not possible to plot a route to Puerto Libertad that does not cross the main distribution area of the fin whale, a vulnerable resident species of the GOC, as well as other species of marine mammals. , it would be important to consider relocating the plant site to avoid these sensitive areas and minimize the risk to marine biodiversity.

It is necessary for the developer to consider that areas of high diversity, abundance and critical regions for whales (reproduction, breeding and feeding areas) are not compatible with this type of project, so in case of reconsidering the location both the gas plant and the navigation route, the aforementioned aspects should be considered.

Observations on the Biodiversity Protection and Conservation Program (PPCB) (2023).

The developer prepared a Biodiversity Protection and Conservation Program (PPCB) in 2023, which we have reviewed and present our observations below. This program responded to a series of conditions set forth by the Dirección General de Impacto y Riesgo Ambiental (DGIRA) through official letter number S.G.P.A./DGIRA.DDT.2277 dated November 6, 2006. The DGIRA resolved to **conditionally** authorize the project, granting it a 25-year term to carry out the site preparation, construction, operation and maintenance activities of the project (at that time a regasification project, not liquefaction).

As conditions it is mentioned that the promoter must:

> 2. Carry out a program for the protection and conservation of the area's biodiversity with particular emphasis on:
>
> a) The potential impact on resident **marine mammal populations** on the islands closest to the shipping route, as well as those passing through it.
> b) The measures to be adopted to reduce or eliminate the negative effects identified.

The PPCB includes information on the distribution and migratory aspects of cetacean species in the GOC. However, it has important shortcomings, which are noted below.

PPCB does not address the shortcomings of the MIA

The information presented in the PPCB is not sufficient to correct for the errors and omissions in the analysis and mitigation measures proposed in the MIA noted above. In particular, they do not include a noise dispersion or collision modeling study that could estimate the probability of risk of these two impacts to whale species present in the GOC. Nor do they consider mitigation measures such as a speed limit for methane tankers or relocation of the project to a less sensitive area for marine mammal habitat.

Proposed zone of influence inadequate

The Zone of Program Influence (ZIP) does not adequately address the total area affected by the project that we identified in this report. First, the ZIP does not address the acoustic dispersion radius of the noise that will be emitted during the construction of the gas plant and its operation. Noise or sound in general is emitted into the environment in all directions, i.e. it is omnidirectional, while the ZIP only contemplates protection measures for the region southwest of the gas plant location. This is a significant error since marine mammals are distributed throughout the area in front of Puerto Libertad as shown in Figures 2-8 of this document.

In addition, the program does not take into account the entire transit route proposed by the project, but only takes into account the Great Islands area. , the same program in Figure 1 (p. 11 of the PPCB) acknowledges that there were sightings of cetaceans along the entire LNG carrier transit route. This omission is critical, as it underestimates the true extent of the project's impact on cetacean habitat, thereby jeopardizing the accuracy and effectiveness of the proposed conservation program.

Omissions of critical species

In the critical habitat identification section, it is of concern that the program does not include the sperm whale (*Physeter macrocephalus*), a common species in the GOC and one that meets the relevance criteria for inclusion in this section. This omission calls into question the completeness and accuracy of the critical habitat analysis in the PPCB. In addition, errors are made in qualifying critical habitats for rare species such as the northern minke whale (*B. borealis*) and the gray whale, whose primary range does not correspond to the Program's Zone of Influence.

Another relevant observation is that, starting on page 26 of the document, mention is made of chelonians; in fact, Table 3 is titled "Prioritization of Marine Mammals and Chelonians". However, no chelonian species are included in the contents of this table.

This inconsistency raises doubts as to whether the program was indeed designed to address chelonian conservation, or whether the specialists simply omitted them or included them in the title by mistake. This lack of consistency and the absence of information relevant to chelonians in a table dedicated to their prioritization again calls into question the integrity and scope of the program.

Errors in noise analysis in the PPCB

Since one of the biggest threats of the TGNLS project is the noise generated during the construction of the plant, the docking and transit of ships, we consider that one of the most relevant sections in the PPCB is 4.2 "Anthropogenic Noise in the Natural Environment".

Despite being one of the most relevant sections of the document, this section contains significant errors. Perhaps the most troubling of these is the use of erroneous data on the size and speed of the ships that would transport the LNG. The specialists give as an example the noise generated by ships... "with a length of 156 m and a speed of 27.8 km/h...". The use of a ship of these characteristics, which is half the size of a LNG carrier, traveling at 25% less knots than the cruising speeds of LNG carriers, evidences the lack of knowledge on the part of the specialists who developed the PPCB.

The section then concludes without making a direct analysis of the project's acoustic impacts on cetaceans - i.e., without meeting the primary objective of analyzing potential impacts to marine mammals as required by the DGIRA condition cited above.

Errors such as those mentioned above abound in noise analysis. For example, the section begins with a theoretical description of noise and its possible effects on marine mammals, as well as a description of the hearing characteristics of cetaceans. In the latter, the following contradictory information stands out: "Medium to high frequency whales include toothed whales, beaked whales, dolphins and porpoises. Cetacean ears....." "...Mid-frequency specialists, including toothed whales, beaked whales, bottlenose whales, and dolphins..." (p. 47). This information is incoherent and lacks scientific rigor, it seems to be the copy of a poor translation of a disclosure page with erroneous information.

Insufficient collision mitigation measures

The one-page section devoted to collisions in the PPCB (4.4) is remarkably sparse. It is evident that a thorough search of the existing literature on the subject was not performed. In addition, the document does not include studies or models that analyze specifically the type of vessels to be used in the TNGLS project. Because of these shortcomings, we believe that this section should not be considered in decision-making related to the PPCB as its lack of depth and absence of relevant information limits its usefulness and reliability in the context of biodiversity risk assessment and management. Likewise, it does not consider the severity of non-fatal collisions on the ability of affected species to continue their natural behavior in the long term.

The marine mammal protection measures proposed in the PPCB are based on erroneous and deficient information, and are not real, concrete proposals for the protection of mammals. Instead of specific measures, the program only states that "Terminal GNL de Sonora will recommend to LNG vessels during the operations stage that, to the extent possible, they reduce their speed in the vicinity of whales" (p. 53- 54) This recommendation is not considered a priority, as its implementation depends on the ability and willingness of ship captains and not a strict obligation. This lack concrete commitment to the protection of marine mammals and chelonians and the ambiguity in the recommendations for speed reduction reflect an insufficiency in the proposed measures, significantly limiting their effectiveness and usefulness in the conservation of these species.

Errors in the text and references

Errors such as those mentioned above can be found throughout the document. We consider that these errors are based on the inadequate use of databases. In addition, we observed that multiple scientific references do not exist, are inaccessible to the public or are irrelevant to the subject of the PPCB. After a brief review of the references, we found that at least 21 references do not appear in Google Scholar or in the archives of the cited journal, present obvious errors or are incomplete and therefore impossible to verify. In Table 4 we reproduce these references pointing out the errors we identified (Appendix 3). It is important to note that the PPCB relies heavily on several of these erroneous references. This lack of rigor in documentation and transparency significantly reduces the credibility of the data presented.

Based on the above, we consider that the PPCB, including the protection measures for marine mammals and chelonians, as well as the proposed monitoring plan, is insufficient both to protect marine biodiversity in the GOC and to comply with the conditions established by the DGIRA. Therefore, we recommend that the proponent correct, update and adapt the content of the PPCB to ensure that the protection measures are based on accurate and adequate information, and that the monitoring plan is effective and relevant to the species.

Conclusions and recommendations

The impacts of the TGNLS project to cetaceans and other large marine mammals in the GOC would be significant. The following is a summary of the key risks identified in our report:

- The transit of LNG carriers through the GOC threatens to become the leading cause of death of large whales by collision.
- The GOC would no longer be a suitable breeding and feeding area for migratory species that depend on the GOC.
- The noise generated during the construction of the gas plant in Puerto Libertad and during the docking of the ships will generate acoustic disturbance and possibly acoustic injuries to cetaceans distributed in the area.
- The transit of LNG carriers through the GOC will cause acoustic and behavioral disturbance to the 30 species of cetaceans distributed in the area.
- The TGNLS project would cause declines in resident populations of large whales in the GOC.
- The resident fin whale population, considered an indicator of the health of the GOC, will be the most affected by the development of this project.
- The two transit routes proposed TGNLS in the 2006 MIA through the Tiburon Island region, San Esteban Island and San Lorenzo Island are not adequate options to mitigate or avoid collisions and acoustic disturbance to GOC cetaceans.
- The direct and indirect impacts of the project to the GOC ecosystem and whales in particular would harm the local economy of the coastal states, between 2013 and 2023, for example, blue and humpback whale watching alone generated revenues of MXN 1,145,361,561, according to SEMARNAT data (SEMARNAT-DGVS 2024).

Our analysis of 2006 MIA and 2023 PPCB shows the following deficiencies:

- These documents are based on information that in some points is outdated, erroneous, and inconsistent.
- They do not contain adequate risk analysis to estimate the probability of risk from noise and collisions for large marine mammals in the GOC.
- The mitigation measures identified are inadequate to ensure effective protection of large marine mammals in the GOC area.
- The documents do not comply with the conditions established by the DGIRA in its official communication C.S.G.P.A./DGIRA.DDT.2277.06, in particular condition 2 regarding the program for the protection and conservation of the area's biodiversity.

The following recommendations emerge from our analysis:

- That the liquefaction plant not be built in Port Liberty, preventing the navigation of LNG tankers through the region of the Big Islands;
- In the event that the EIA is resubmitted, before construction of the project begins, acoustic dispersion models must be generated with the machinery and ships that will be used during construction, transportation, and docking of the vessels, in order to know exactly how much damage this will generate;
- Also, that the potential impact of vessel collisions with cetaceans along the entire proposed route through the Gulf of California be modeled;
- That the risk analysis and mitigation programs in the MIA and the PPCB be redone, updating the information presented in these documents and correcting the deficiencies pointed out in this report, so that the conditions made by the DGIRA in the official letter C. S. G. P. A./DGIRA.DDT.2277.06 are complied with;
- By redeveloping the project's mitigation measures to include concrete and effective measures to protect large marine mammals, such as establishing a maximum speed for the transit of LNG tankers through the gulf.
- In addition, it is necessary for the developer to consider that areas of high diversity, abundance and critical regions for whales (reproduction, breeding and feeding areas) are not compatible with this type of project, so in case of reconsidering the location of both the gas plant and the navigation route, the aforementioned aspects should be considered.

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Appendix 1: Economic value of whale watching in the GOC

Table 1A has the data that tourism service providers send to SEMARNAT on the economic benefits of whale watching (SEMARNAT-DGVS 2024). They show that the economic benefit generated in the last 10 years for humpback whales is $1,126,943,640.00 (MXN) and for blue whales $18,417,921.00 (MXN).

Table 1A. Permits, trips, income and employment generated by whale watching.

Species	Observation season	Permits granted	Number of trips	Revenues generated pesos	Jobs generated
Humpback whale	2013-2014	438	15,713	101,880,636	876
	2014-2015	454	20744	74,573,031	908
	2015-2016	479	13,158	70,689,551	958
	2016-2017	483	ND	147,848,410	966
	2017-2018	315	17301	117,346,872	936
	2018-2019	402	13755	130,422,939	804
	2019-2020	348	10213	113,246,366	696
	2020-2021	298	9409	101,454,435	596
	2021-2022	271	8455	132,219,596	542
	2022-2023	318	13619	137,261,804	636
TOTAL		3806	122367	1,126,943,640	7918
Blue whale	2012-2013	48	320	568,700	96
	2013-2014	64	376	787,600	128
	2014-2015	78	186	259,650	156
	2015-2016	88	401	807,700	176
	2016-2017	76	N.D.	6,641,555	152
	2017-2018	70	873	3,360,529	147
	2018-2019	70	328	1,229,913	140
	2019-2020	70	330	1,136,816	140
	2020-2021	62	292	1,164,891	124
	2021-2022	53	76	686,167	106
	2022-2023	38	266	1,774,400	76
TOTAL		717	3448	18,417,921	1441

Source: Secretaría de Medio Ambiente y Recursos Naturales, Dirección General de Vida Silvestre (SEMARNAT-DGVS). June, 2024. http://dgeiawf.semarnat.gob.mx:8080/ibi_apps/WFServlet?IBIF_ex=D3_BIODIV03_15&IBIC_user=dgeia_mce&IBIC_pass=dgeia_mce&NOMBREENTIDAD=*

Appendix 2: Diversity, distribution of large whales and odontocetes in the GOC and habitat use.

Fin whale

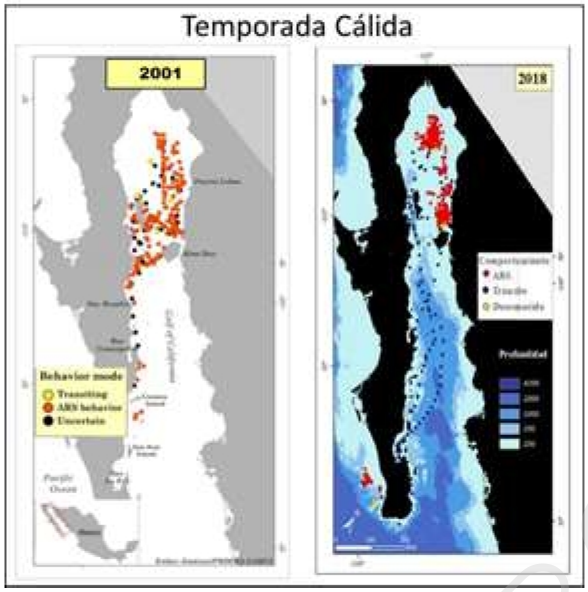
Different studies indicate that the GOC fin whale population constitutes a unique, distinct conservation with a low effective population size, which is vulnerable to anthropogenic impacts, new diseases and habitat modifications (Bérubé *et al*., 2002; Urbán *et al*., 2005; Rivera-León *et al*., 2019). The most recent abundance estimates suggest a population stability between 254 and 345 animals (95% CIs: 139-450) (Pardo *et al*., 2016).

Distribution

According to ecological niche models, it was observed that the greatest probability of presence for the species throughout the year (temperate and warm season) was mainly the region of the Great Islands, as well as the entire coast of the Peninsula and the coast of the continent up to the southern coast of Sinaloa. In contrast during the warm season the Upper Gulf area as well as the coast of Sinaloa are not suitable for fin whales. **Habitat use**

Habitat use is of say breeding, feeding, transit and resting areas are, for the temperate season the areas identified for breeding are center of the Upper Gulf, the southern Great Islands region and the Loreto-La Paz corridor. The feeding, transit and resting areas are similar to those for breeding, with the difference of being larger areas (Jimenez 2019). For the warm season, the breeding areas are located in the Bay of La Paz, San José Island and around Isla del Carmen, the area adjacent to Isla Ángel de la Guarda and Bahía de los Ángeles. Two feeding areas were identified: 1) The region of the Big Islands with the exception of the area between Isla Ángel de la Guarda and Isla Tiburón) and 2) The region of the Big Islands (with the exception of the area between Isla Ángel de la Guarda and Isla Tiburón).
2) the Bay of La Paz. Transit and staging areas in addition to these areas include the entire coast of the Peninsula south of the Big Islands and the central area between the Big Islands (Jimenez 2019).

Results from satellite tags placed in 2001 and 2018 indicate that during the warm season the most used feeding areas are Salsipuedes Channel, Ballenas Channel, and the central area of the northern gulf, that is north of Isla Tiburón to south of Isla San Jorge in Sonora (Fig. 1) (Jiménez 2019; Jiménez-López et al. 2019).



Spatial distribution of fin whale behavioral mode, according to trajectory of satellite tags 2001 and 2018 during the warm season. ARS: feeding behavior; Transiting: navigation behavior with determined course; and Uncertain: behavior not inferred. Taken and modified from Jiménez-López et al., 2019 (left) and Jiménez 2019 (right).

During the temperate season, the most important feeding area is Salsipuedes Channel and the area between San Lorenzo Island and Tiburón Island and the coast from Loreto Bay to the center of La Paz Bay (Fig. 2).

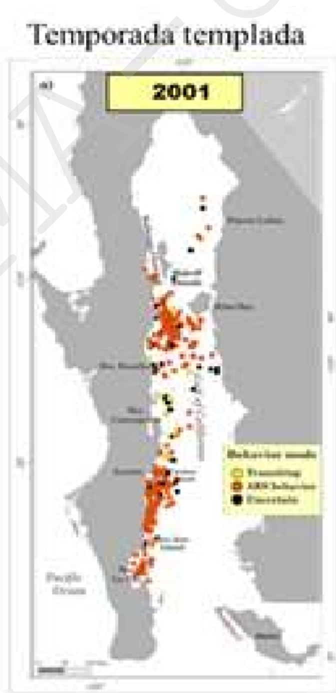


Figure 2. Spatial distribution of fin whale behavioral mode, according to trajectory of 2001 satellite tags during the temperate season. ARS: feeding behavior; Transiting: course-determined navigation behavior; and Urcertain: non-inferred behavior. Taken and modified from Jiménez- López et al., 2019.

Satellite-tagged trajectories

The results of the trajectories of eight satellite tags placed in 2001 on individual fin whales allow us to recognize three important areas for Gulf of California population: 1) Northern area of the gulf, from North of Tiburón Island, Northeast of Ángel de la Guarda Island, and all the central Northern area to South San Jorge Island in Sonora. 2) Ballenas Channel, Salsipuedes Channel, central area of the gulf south of Tiburón Island. 3) Coastal corridor from Loreto Bay to La Paz Bay (Fig. 3) (Jiménez et al., 2019).

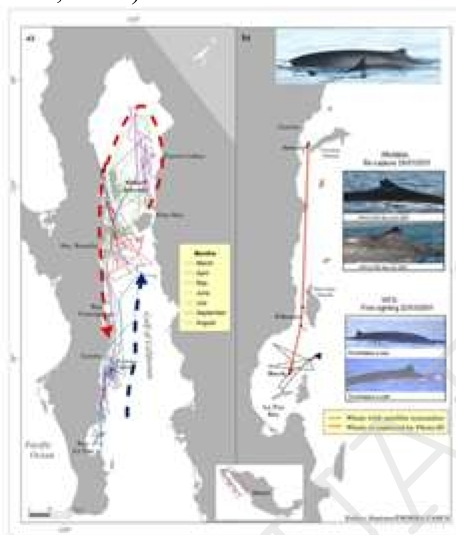


Figure 3. Trajectory of eight satellite-tagged individuals, the red and blue dotted line indicates the proposed migratory pattern (left). Photographs of tagged and photo-identified animals (2001) and recaptured in 2011 (Right). Taken from Jiménez-López et al., 2019.

Bryde's whale

Characteristics and population size in the Gulf of California

Photo-identification (Breese and Tershy, 1987), genetic (Dizon *et al*., 1996) and stable isotope studies (López-Montalvo, 2012) indicate that there is a resident population at the GOC and another that is separate from the Pacific adjacent to the Baja California peninsula. The only estimate of the population size is from the end of the last century, which indicated the abundance is estimated at 400 individuals (Gerrodette and Palacios, 1994; Urbán and Flores, 1996), which are considered to be a particular stock with respect to other populations in the world.

Distribution

For this species, the ideal areas with the highest probability of presence during the temperate season is north of the Great Islands region, including Bahía de los Ángeles. In the warm season, the northern and central gulf (with the exception of the northern coasts of Isla Tiburón, Bahía Kino and Guaymas) are ideal areas for its distribution. For this species, an extension in its area to the south of the region of Los Cabos is observed (Fig. 4) (Jiménez 2019).

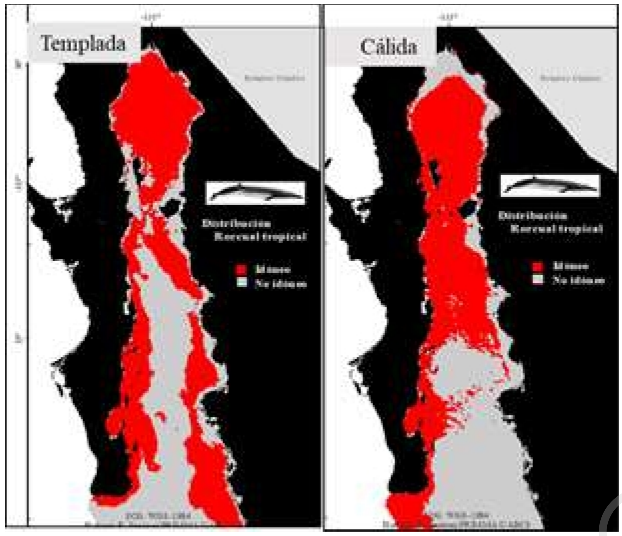


Figure 4. Habitat suitability for temperate and warm season fin whales in the Gulf of California (Jimenez 2019).

Habitat use

For the temperate season for "breeding" use, it has been recorded mainly on the eastern coast of the gulf, mainly from Santa Rosalia to the Cabo Pulmo area to the south, and on the coast of Sinaloa. The feeding areas are from the gulf, the area in the center of the Big Islands and to the north, without its coast, and the coastal area that begins south of the Big Islands to Cabo Pulmo along the peninsular coast and to the north coast of Sinaloa. The transit and resting areas are similar to the feeding areas. For this species during this season the central part of the gulf is not identified as a use zone (Jiménez 2019).

In the warm season the ideal breeding area is restricted to two areas: 1) in the center in the upper gulf and around Isla Angel de la Guarda and Bahía de los Ángeles; 2) in the Bahía de la Paz. Feeding and resting areas were very similar and are located north of the gulf (not including the north coast) with a diagonal cut from Tiburón Island to Santa Rosalía and south in the Bay of La Paz. Transit areas were identified along the coast of the Peninsula mainly from Isla del Carmen to Los Cabos (Jiménez 2019).

Blue whale

Characteristics and population size in the Gulf of California

The GOC is an important area for breeding and reproduction, but also feeding of blue whales (Gendron, 2002). The most recent estimate indicated a value of 238 whales (CI= 142-474, 95%) with capture-recapture in 2006 (Ugalde de la Cruz, 2008).

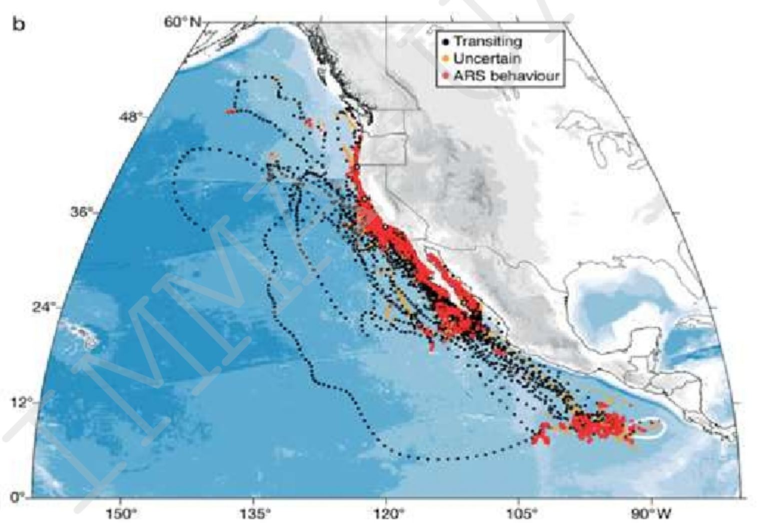
Distribution

The Loreto Bay Region is recognized as one of the most important in terms of number of aggregate individuals (SEMARNAT 2018). However, recent observations indicate that the coasts off Puerto Libertad are also important for the species (Fig. 5) particularly for feeding.

Figure 5. Distribution of blue whales off the coast of Puerto Libertad PRIMMA unpublished data).

Habitat use

Satellite tag trajectories indicate that blue whales use the entire GOC for feeding and transit (Bailey et al., 2009) (Fig. 6).



Spatial distribution of blue whale behavioral mode, according to trajectory of 92 tags on blue whales deployed between 1994 and 2007. ARS: feeding behavior (red dots); Transiting: course-determined navigation behavior (black dots) and Urcertain: non-inferred behavior (yellow dots). Taken from Bailey et al., 2009.

Sperm whale

Sperm whales occur in considerable numbers throughout the year in the Gulf of California (GC), which is why it is recognized as one of the most important feeding and breeding sites for the species in the Pacific Ocean (Valdés 2011). They are distributed from the Big Islands to the southern GOC (Fig. 7). In particular, three sperm whale aggregation zones are recognized, these areas are San Pedro Mártir, Guaymas, El Farallón and Santa Rosalía (Guerrero de la Rosa, 2008).

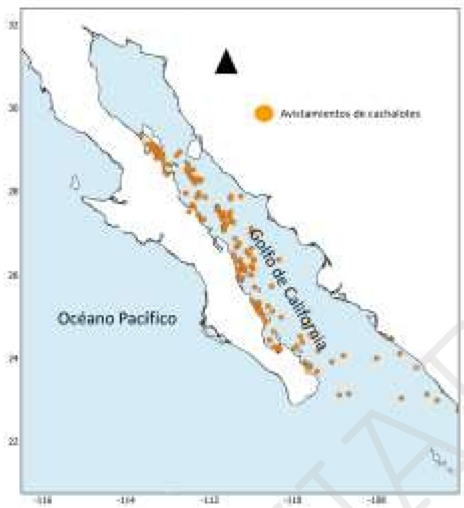
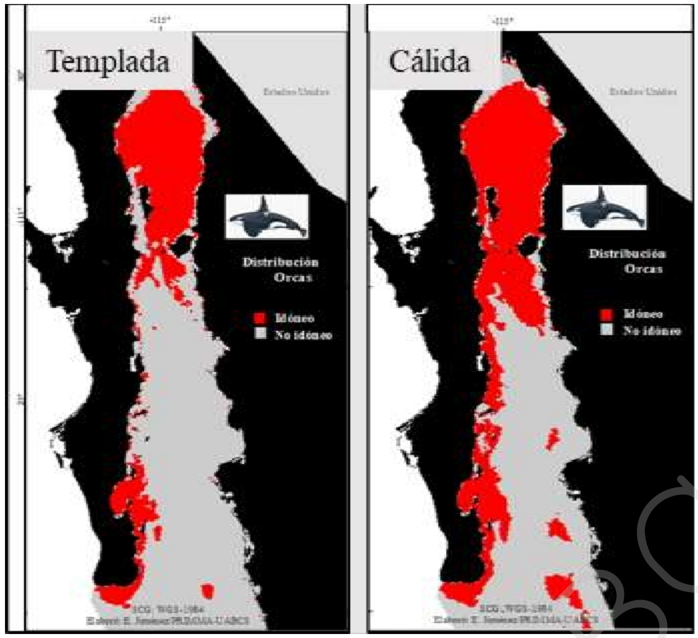


Figure 7. Sperm whale sightings from 1998-2023. (PRIMMA unpublished data)

Orcas

Distribution

This species presents differences in the use of geographic space according to the season of the year. During the temperate season its most likely distribution is the Upper Gulf region as far south as the Big Islands, with a low probability in the Whale Channel. Then there is a gap throughout the central gulf area and again a suitable area is on the coast of the peninsula from south of Isla San Jose to the Los Cabos region. During the warm season the distribution is more extensive, including all areas of the temperate season and the central gulf region is added, and there is a continuum along the coast of the peninsula from the Whale Channel to the southern tip of the peninsula (Fig. 8) (Jimenez 2019).



Areas with the highest probability of killer whale distribution in the Gulf of California. For the temperate season (left) and for the warm season (right). Taken and modified from Jiménez 2019.

Habitat use

For the temperate season, the rearing and feeding areas according to the model are the coastal area of the peninsula from the region of Los Cabos to Bahía Concepción and the southern coast of Sonora and the area off Sinaloa (Fig. 9). In the warm season for both "breeding" and "feeding" use, the area of occupation is more extensive, starting from San Felipe on the coast of the peninsula, extending across the entire width of the upper gulf region, between the Big Islands, the central gulf area is also used and opens up to both gulf coasts (Fig. 9) (Jiménez 2019) (Fig. 9).

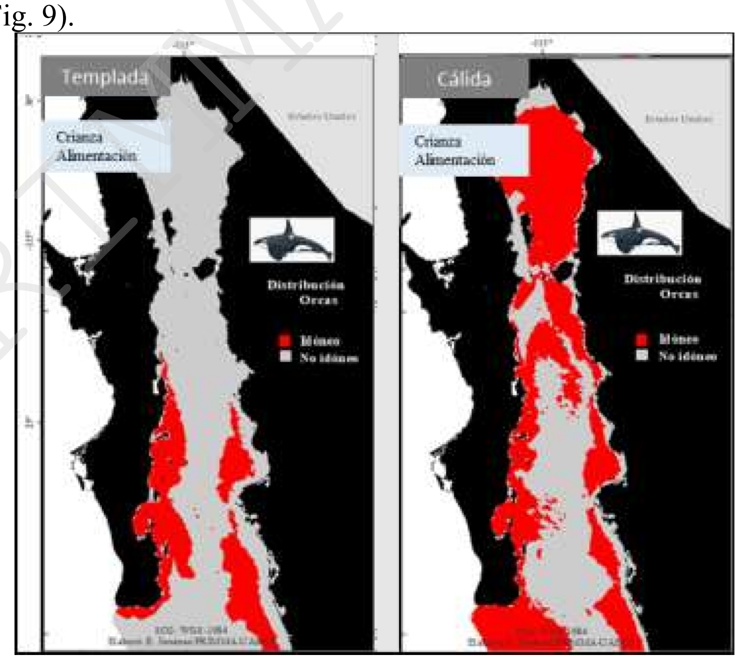


Figure 9. Habitat use during the warm season (right) and for the temperate season (left) for killer whales in the Gulf of California. a) Breeding and Feeding; b) Breeding and Feeding. Taken and modified from Jiménez 2019.

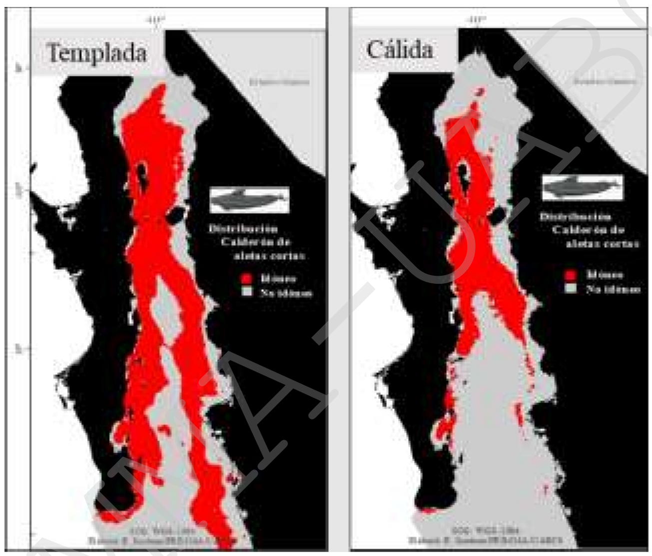
Short finned pilot whale

Characteristics and population size in the Gulf of California

The most recent estimates for the Great Islands region indicate that there is an overpopulation with a population size of 2,270 individuals (95% CI= 1,779.31- 2,898.08) (Alfonso Calles, 2020).

Distribution

In the temperate season it is distributed along both coasts of the gulf, region of the Great Islands. And in the warm season mainly the Whale Channel, Puertecitos as its northern distribution limit. To the south the coasts of Bahía Concepción and Guaymas and part of the Loreto-La Paz corridor, and the coast in front of Los Cabos (Fig. 10) (Jiménez 2019).



Areas with the highest probability of distribution of short-finned pilot whales in the Gulf of California. For the temperate season (left) and for the warm season (right). Taken and modified from Jiménez 2019.

Habitat use

For the temperate season the preferred breeding areas according to the habitat model are the coast of the Peninsula, Whale Channel, central gulf area, center of the upper gulf mainly. For the warm season these areas are reduced to the center of the gulf, center of the upper gulf and the center of the Great Islands region (Fig. 11) (Jimenez 2019).

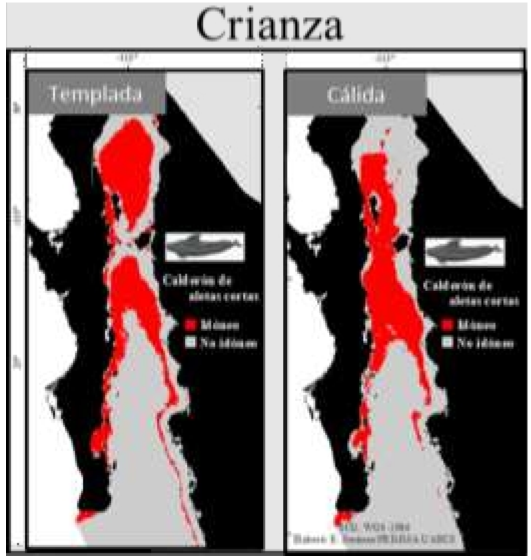


Figure 11. Suitable areas for short-finned pilot whale breeding during the temperate (left) and warm (right) seasons.

For the warm season, the feeding areas identified are the center of the Great Islands region, particularly on west coast, the entrance to Bahía de la Paz and around its islands, and the Los Cabos region. The transit area is very similar, however, it is worth noting that for this activity the area used in the center of the gulf is larger (Fig. 12) (Jiménez 2019).

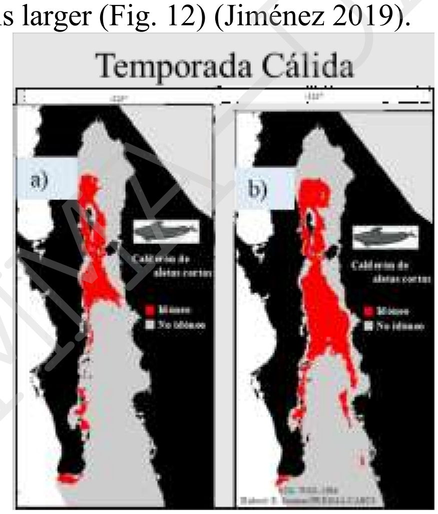


Figure 12. Habitat use during the warm season for short-finned pilot whales in the Gulf of California. a) Food; b) Transit. Taken and modified from Jiménez 2019.

Humpback whale

The humpback whale is a migratory species that moves between its feeding grounds at high latitudes and breeding grounds at low latitudes. In the Mexican Pacific, which is one of its main breeding grounds, humpback whales congregate in: The southern tip of the Baja California Peninsula, the Mexican Continental Coast, the Revillagigedo Archipelago, and the Southeast (Urbán and Aguayo, 1987; Urbán et al., 2000; González-Peral, 2011; Martínez-Loustalot, 2022). Winter aggregation of whales

Humpback whales off the southern coasts of the Baja California peninsula constitute both a destination and transit area during their migratory cycle (Urbán et al., 2000). There are whales in transit from the continental coasts and from the Revillagigedo Archipelago (González-Peral, 2011). It is known that, within the Gulf of California, humpback whales can be found at least as far as Loreto, however, they come to occur in the northernmost part of the Gulf of California (Figure 13), being an atypical distribution, since few whales are observed there, but during the four seasons of the year. For this reason, it is considered that rather than a region where humpback whales concentrate during the winter for reproductive purposes, it corresponds to an area rich in food that allows some individuals, generally young, not to make their normal migration, being able to remain all year in the interior of the Gulf of California (Rice, 1977; Urbán and Aguayo, 1987; González-Peral, 2011).

Distribution

According to the sightings recorded by PRIMMA, it can be identified that the coastal corridor from Bahía de la Paz to Bahía de Loreto is an area where they are most frequently distributed.

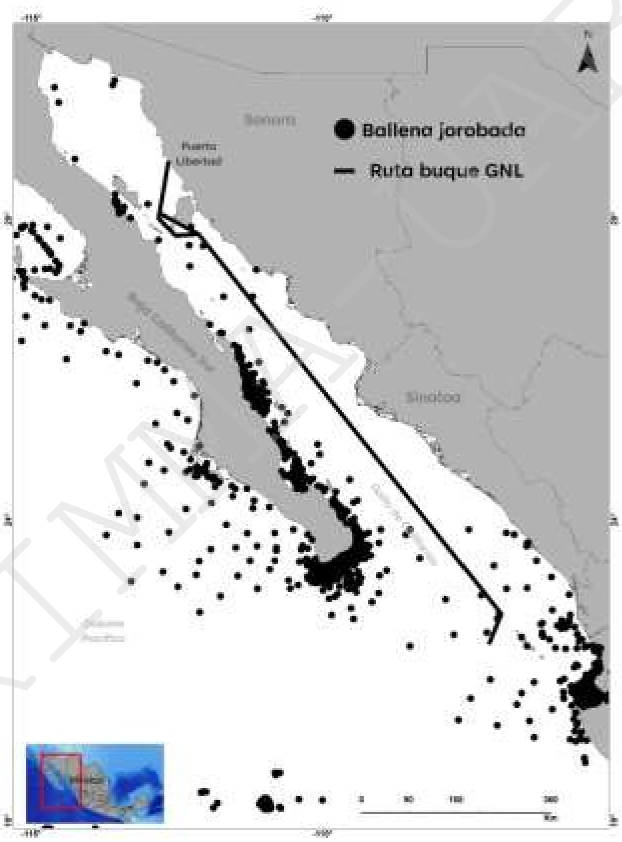


Figure 13. Humpback whale sightings at the GOC.

Satellite-tagged trajectories

The results of the trajectories of 13 satellite tags placed in 2017 (Urbán et al., 2017) to humpback whales, 7 mothers with calf, one escort and 6 to adults without sex identification in Los Cabos, Baja California Sur, allows us to recognize the trajectory of mothers with calf, which were distributed mainly near the coast around San José del Cabo. During the second week of February, two of them moved to the mainland and one began its migratory return to the feeding areas, and two more to the Pacific side (Figure 14). Of the adults, only two individuals remained more than 3 days in the same areas. The adult identified as an escort moved to the mainland (Figure X).

With this we can observe that, for humpback whales, the mouth of the GOC is a very important site for their migratory transit.

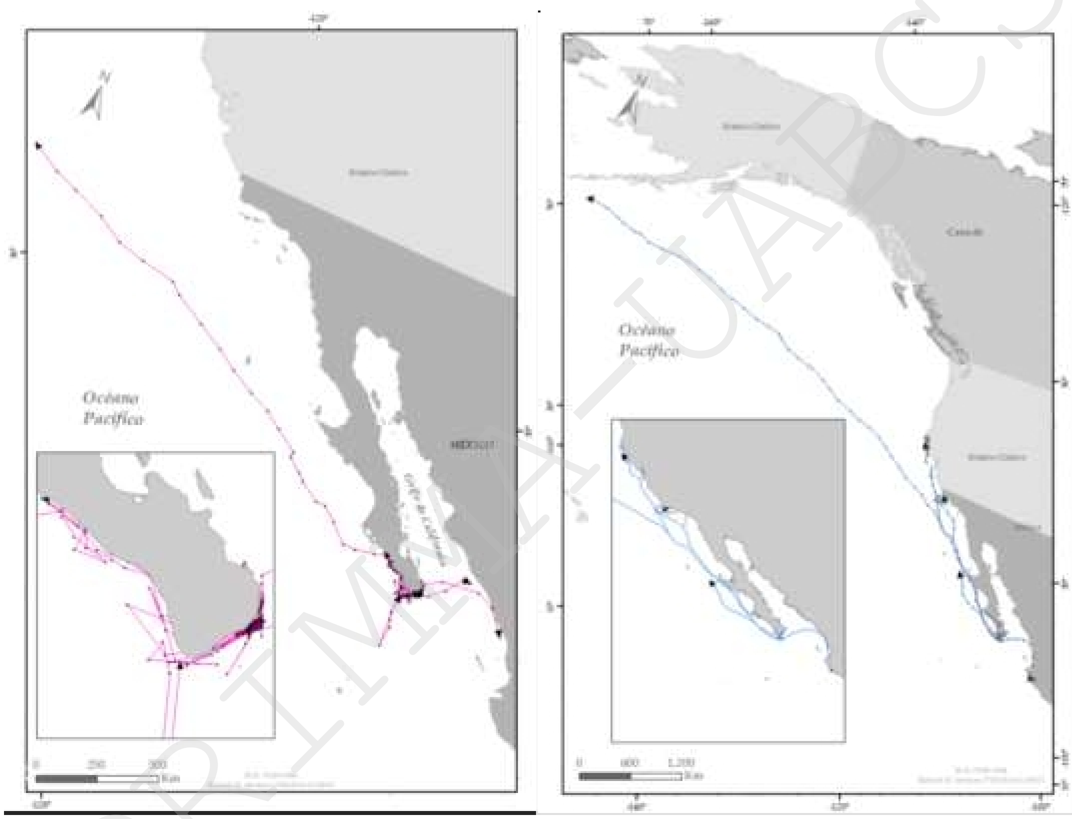


Figure 14. Movements of satellite-tagged humpback whales. Left - Mothers with calf; right - Adults.

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Appendix 3:

Table 4. Erroneous or incomplete references in the PPCB.

Reference	**Error remarks or incomplete information:**
Rosales Nanduca, H., Urbán R., J., & Hernádez B., P. (2011). Historical distribution of documented marine mammal sightings in the Pacific of Mexico.	The reference does not exist in Google Scholar and the citation does not include the journal of publication.
Urbán R., C. Hernández, O. Sánchez and P. Zavala-G. 1997. Marine mammal surveys in the Gulf of California. Eastern Pacific dolphin research, Rep 7: 13-15.	The reference does not exist in Google Scholar and the journal could not be found in the citation either.
Arroyo, J. L. (2017). Cetacean sightings in western waters of the Gulf of California. Bachelor's thesis, Universidad Autónoma de Baja California.	The reference does not exist in Google Scholar and could not be found in other publicly available databases.
Meador, J. P., Yeh, A., & Young, G. (2016). A review on the environmental impacts of shipping on aquatic and nearshore ecosystems. Journal of environmental management, 183, 260-276**.**	The reference incorrectly cites the year and authors of the article. It is also unclear what supports this reference in the paper, as it is not included in the body of the text. According to our research, the correct citation is: Annika K. Jägerbrand, Andreas Brutemark, Jennie Barthel Svedén, Ing-Marie Gren (2019). A review on the environmental impacts of shipping on aquatic and nearshore ecosystems, Science of The Total Environment, Volume 695, 133637. https://doi.org/10.1016/j.scitotenv.2019.133637.
Kim, J.w., Song, H.C., Kim, J.T. & Kim, C. (2017). Effects of ship speed reduction on underwater radiated noise in East Asia Seas.	The reference does not exist in Google Scholar and the citation does not include the journal of publication.
Vidal, O. (1991). Analysis of the spatial and temporal distributions of cetaceans in the northwestern Gulf of California. Bachelor's thesis. Universidad Autónoma de Baja California Sur.	The reference does not exist in Google Scholar and could not be found in other publicly available databases.
Yoskowitz, D. W.; Macdonald, M.; Ramanujan, A. et al., "Environmental impacts of shipping: Review and synthesis of recent scientific studies," PLoS ONE, vol. 14, no. 11, pp. 1-23, Nov. 2019.	The reference does not exist neither in Google Scholar nor in the journal included in the citation.

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Rivera-Galicia, L. G. (2008). Diversity, distribution and seasonality of cetaceans in Banderas Bay, Jalisco-Nayarit, Mexico. Master's thesis, Centro de Investigaciones Biológicas del Noroeste.	The reference does not exist neither in Google Scholar nor in the journal included in the citation.
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Laist, D. W., Knowlton, A. R., & Pendleton, D. E. (2001). Collisions between ships and whales. Marine Mammal Science, 17(1), 35-75.	The reference incorrectly cites the authors of the article. It is also unclear what supports this reference in the paper, as it is not included in the body of the text. According to our research, the correct citation is: Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S. and Podesta, M. (2001), COLLISIONS BETWEEN SHIPS AND WHALES. Marine Mammal Science, 17: 35-75. https://doi.org/10.1111/j.1748-7692.2001.tb00980.x.
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