MAREA

Assessment of the Potential Impacts of the Liquefied Natural Gas Project on Whales and Dolphins in the Gulf of California

MAREA
(Sea and Environmental Education)

CONTENTS

SUMMARY

This document assesses the potential impacts of the Liquefied Natural Gas (LNG) Project on whales and dolphins in the Gulf of California (GDC). The project aims to transport gas through the GDC via ships, which could have severe effects on the biodiversity of the area, particularly on cetaceans. The GDC is home to 39% of the world's marine mammals and is a key area for whales and dolphins. Many of these species are residents that rely exclusively on these waters for feeding, breeding, and reproduction, while other migratory species use the Gulf temporarily for essential activities.

Potential impacts include: 1) Collisions: Increased maritime traffic could significantly raise whale mortality due to collisions with vessels, a risk that is amplified when shipping routes overlap with critical whale areas; 2) Acoustic Pollution: Underwater noise can interfere with cetacean communication and behavior; 3) Climate Change: Greenhouse gas emissions from the project would accelerate global climate change, increasing the threat already posed to whales.

This project poses a serious threat to the GDC and whales, with the potential to cause irreparable damage. Now more than ever, it is crucial to act to protect this invaluable ecosystem before it is too late

THE GULF OF CALIFORNIA, "THE AQUARIUM OF THE WORLD": DESCRIPTION AND IMPORTANCE

The Gulf of California is an area of unparalleled natural beauty and extraordinary biological wealth. It is an extension of the Pacific Ocean located between the Baja California Peninsula and the states of Sonora and Sinaloa. It spans 1,126 km in length and 48 to 241 km in width, covering an area of over 267,000 km² (Secretaría de Medio Ambiente y Recursos Naturales, n.d.).

The Gulf of California is one of the most biodiverse marine locations in the world and is considered a conservation priority area (Enrique Andrade et al., 2005; Lluch-Cota et al., 2007). The renowned oceanographer Jacques Cousteau referred to this paradise as "The Aquarium of the World" due to its clear waters and high richness, abundance, and marine biodiversity (Secretaría de Medio Ambiente y Recursos Naturales, n.d.). The Gulf of California is home to 922 islands, 900 species of fish with 90 being endemic; 39% of the world's marine mammals; 4,500 species of marine invertebrates; 181 species of seabirds; and six species of sea turtles (Secretaría de Medio Ambiente y Recursos Naturales, n.d.). This combination of factors makes it a natural sanctuary of critical importance for biodiversity.

The Gulf's unique oceanographic processes support high productivity in its waters (Lavín and Marinone, 2003), resulting in a complex food web (Díaz-Uribe et al., 2012) and remarkable biodiversity (Lluch-Cota et al., 2007). Additionally, the Gulf provides essential habitats for the reproduction and nurturing of numerous species (Soria et al., 2013) and generates a fishery production that represents about half of Mexico's total catch (Brusca, 2010). These exceptional features have

led to the Gulf of California being considered a biodiversity "hotspot," housing a total of 12,105 species of flora and fauna (Morzaria-Luna et al., 2018).

The Gulf of California and the Mexican Pacific have been the focus of multiple conservation initiatives due to threats such as mining (SEMARNAT, 2018), the expansion of mega-tourism projects (such as mega-cruisers docked in the Bay of La Paz) (García and Hernández, 2021), and the extraction of salts and minerals (López and Martínez, 2023). Many of these threats have been successfully addressed through government intervention, citizen pressure, regulation implementation, and the designation of protected areas. In 2005, UNESCO recognized the importance of the Gulf of California by listing the Islands and Protected Natural Areas of the region as a World Natural Heritage Site (Secretaría de Medio Ambiente y Recursos Naturales, n.d.). This designation underscores the Gulf's significance and reinforces ongoing efforts to preserve this invaluable ecosystem in the face of increasing environmental challenges.

CHARACTERIZATION OF THE MAIN WHALE SPECIES IN THE GULF OF CALIFORNIA

The Gulf of California is home to 39% of the world's marine mammals and 80% of the marine mammals present in Mexico (Niño-Torres, 2011; Secretaría de Medio Ambiente y Recursos Naturales, n.d.).

There are 36 species recorded in the Gulf of California, categorized into 11 families: Otariidae (2 species; sea lion and fur seal), Phocidae (2; harbor seal and elephant seal), Balaenopteridae (6; rorquals), Balaenidae (1; right whale), Eschrichtiidae (1; gray whale), Physeteridae (1; sperm whale), Kogiidae (2; pygmy sperm whale and dwarf sperm whale), Ziphiidae (6; beaked whales), Delphinidae (13; dolphins), Phocoenidae (1; vaquita), and Vespertilionidae (1; fishing bat; Niño-Torres, 2011). In Mexico, all cetaceans are included in NOM-059-SEMARNAT-2010, which designates species of wild flora and fauna at risk and provides special protection (Secretaría de Medio Ambiente y Recursos Naturales, 2010).

ORDER *Cetacea*

SUBORDER *Mysticeti*

FAMILY *Balaenopteridae*

Balaenoptera acutorostrata (Minke Whale)

Balaenoptera borealis (Rudolph's Rorqual, Sei Whale)

Balaenoptera edeni (Bryde's Rorqual, Bryde's Whale, Sardine Whale)

Balaenoptera physalus (Common Rorqual, Fin Whale)

Balaenoptera musculus (Blue Whale)

Megaptera novaeangliae (Humpback Whale)

FAMILY *Eschrichtiidae*

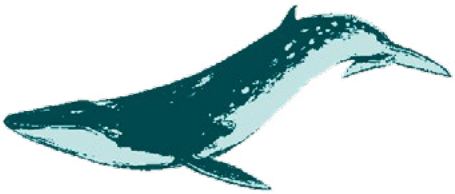
Eschrichtius robustus (Gray Whale)

FAMILY *Balaenidae*

Eubalaena japonica (North Pacific Right Whale)

BALAENOPTERA EDENI

• Bryde's Rorqual •



The Bryde's Rorqual is found in tropical, subtropical, and temperate waters worldwide (Reeves et al., 2002). Two populations are proposed in the Gulf of California: a resident population that shows the presence of calves year-round and another associated with the Tropical Eastern Pacific population (Tershy et al., 1990; Urbán and Flores-Ramírez, 1996). The most recent estimate suggests that around 400 individuals inhabit this region (Niño-Torres et al., 2011). In the Gulf, these cetaceans primarily feed on Pacific sardines, mackerels, and euphausiids (Tershy, 1992; Gendron, 1993; Urbán and Flores-Ramírez, 1996). Over the years, variations in the presence of Bryde's Whales in the Bay of La Paz have been observed, related to food availability and climatic variability (Tershy et al., 1990; 1993). These studies highlight the Gulf of California's critical importance for this population, as it is where they carry out all essential activities, including feeding and breeding, making the Gulf a key area for their survival.

BALAENOPTERA PHYSALUS

• Fin Whale •

The Fin Whale has a cosmopolitan distribution, but a unique and isolated population exists in the Gulf of California (Urbán-Ramírez, 1997). This population is resident, meaning it does not migrate to the Pacific but remains in the Gulf year-round (Jiménez López et al., 2019). With approximately 300 individuals, this population has low genetic diversity (Urbán-Ramírez, 1997). In the Gulf of California, Fin Whales primarily feed on euphausiids, with smaller amounts of copepods, fish, and cephalopods (Niño-Torres et al., 2011). Additionally, a breeding area has been identified in this region, with greater

presence of adult whales and calves during spring and summer (Jiménez López et al., 2022). During the cold season, they concentrate in the Loreto-La Paz Corridor, moving north during the warm season. This isolation and residency make them vulnerable to natural and anthropogenic threats, leading to their classification as "Endangered" and protection under CITES Appendix I (IUCN, 2024). These studies underscore the critical importance of the Gulf of California for this population, as it is where they carry out all essential activities, including feeding and breeding, making the Gulf a key area for their survival and recovery.

BALAENOPTERA MUSCULUS

• Blue Whale •

The Blue Whale is the largest animal on the planet, reaching up to 30 meters in length and weighing 180 tons (SEMARNAT, 2018). The North Pacific Eastern (NPE) population migrates from the cold waters of the North Pacific to the Gulf of California during the winter months, primarily staying between December and April, although sporadic sightings have been reported throughout the year, suggesting a possible resident population (Gendron, 2002; Ugalde de la Cruz, 2008; Calambokidis et al., 2015). In the Gulf of California, Blue Whales primarily feed on krill, seeking highly productive waters to provide sufficient resources to maintain their enormous size (Branch et al., 2007; Mercado-Santana et al., 2017; Reilly & Thayer, 1990; Goldbogen et al., 2011). These waters also serve as breeding grounds, with frequent sightings of females accompanied by calves (Sears et al., 2013; Gendron, 2002). The NPE Blue Whale population is estimated at around 1,647 individuals and is considered endangered (Calambokidis & Barlow, 2013; IUCN, 2024). Part of this population migrates to the Gulf of California, where an abundance of 200 whales was estimated on average between 1994 and 2006 (Ugalde De La Cruz, 2008). Annual censuses since 1993 have recorded 621 individuals in the southwestern Gulf (Gendron Cruz, 2012).

MEGAPTERA NOVAEANGLIAE

• Humpback Whale •

The Humpback Whale is a migratory species that travels great distances between its feeding and breeding grounds. The Gulf of California is a key breeding area for this species, with documented sightings between December and April, coinciding with the calving season (Castro-Prieto et al., 2022). Humpback Whales use the warm, protected waters of the Gulf of California to give birth and care for their calves, a vital behavior for the species' survival (Hoyos-Padilla et al., 2021). Social behaviors such as male singing, which plays a role in mating, are also observed in these waters (Martínez-Aguilar et al., 2020). The Eastern Pacific Humpback Whale population is estimated to exceed 18,000 individuals, a number that has increased due to conservation measures implemented over recent decades (NOAA, 2021). In the Gulf of California, Humpback Whales are most commonly observed in Baja California Sur and Nayarit, with reports also from Sonora, Sinaloa, and the central part of the Gulf (Niño-Torres et al., 2011).

ESCHRICHTIUS ROBUSTUS

• Gray Whale •

The Gray Whale, known for its long migration, also relies on the Gulf of California to complete its life cycle. These whales migrate from the cold Arctic waters to the coastal lagoons of the Mexican Pacific, where they find their breeding and calving areas (Guerrero-Ruiz et al., 2022). Lagoons such as San Ignacio provide a safe environment for females to give birth and care for their calves before embarking on the long journey back north (Urban et al., 2021). The Eastern Pacific Gray Whale population is estimated at approximately 27,000 individuals but faces threats such as climate change and habitat degradation (IUCN, 2024). Gray Whales are sighted throughout the Gulf of California (Niño-Torres et al., 2011).

IMPORTANCE OF WHALES IN THE MARINE ECOSYSTEM

Whales play a crucial role in the marine ecosystem and in regulating the global climate. Throughout their lives, whales contribute to the absorption of large amounts of carbon dioxide (CO2). It is estimated that a whale can sequester up to 33 tons of CO2 over its lifetime, as when they die, their bodies sink to the ocean floor, trapping carbon in the depths of the ocean for centuries (Pershing et al., 2010; Roman et al., 2014). Additionally, the "nutrient pumping" process performed by whales when they feed and defecate at the surface stimulates the growth of phytoplankton, which absorbs CO2 and produces oxygen (Lavender Law et al., 2010).

Besides their impact on the carbon cycle, whales have significant aesthetic and cultural value, attracting thousands of tourists each year to observe their majestic behaviors, which generates economic income for coastal communities (O'Connor et al., 2009).

SIERRA MADRE GAS PIPELINE AND SAGUARO LIQUEFACTION TERMINAL PROJECT IN PUERTO LIBERTAD, SONORA

This project will increase maritime traffic, with the annual departure of 64 ships carrying liquefied natural gas from Puerto Libertad, Sonora, to Asia. This could intensify negative impacts on marine biodiversity due to increased underwater noise, collisions with animals, and marine pollution. There are also concerns about seabed dredging, which has been shown to have negative impacts on marine mammals due to the generated noise. Mexico Pacific Limited estimates that the terminal and pipeline will begin operations in 2027.

IMPACTS CAUSED BY SUCH PROJECTS AND CASE STUDIES:

• Collisions •

Increased maritime traffic, especially in areas where whales are present, such as the Gulf of California, significantly raises the risk of ship-whale collisions. Ship strikes are one of the leading causes of death for these species. This risk intensifies with the size and speed of ships, as well as with the density of maritime traffic (Keen et al., 2023). Many whales in the Gulf of California are residents and those that are not use this area seasonally for vital life cycle activities. This overlaps with shipping routes, increasing the likelihood of collisions (Lazcano-Pacheco et al., 2022).

The threat of ship collisions is particularly acute when traffic rates increase within established whale habitats, especially in areas considered critically important because they attract a disproportionate proportion of a whale population over an extended period in a relatively small area compared to the rest of their range (Crum et al., 2019).

A study conducted in Sri Lankan waters found that blue whales in a breeding area south of the country appear to be especially prone to ship collisions, as indicated by both direct observations of collisions and strandings exhibiting blunt trauma (Ilangakoon, 2012; de Vos et al., 2016).

On the west coast of North America, nine blue whale deaths and some severe injuries were attributed to ship strikes between 2007 and 2013 (Carretta et al., 2017). Of 21 blue whale carcasses found off California between 1988 and 2007, eight were determined to be due to ship collisions (Berman-Kowalewski et al.,

2010). This suggests that ship collisions represent a substantial addition to natural mortality (Rockwood et al., 2017).

According to Lazcano-Pacheco et al. (2022), between 2013 and 2022, six deaths due to ship collisions were recorded in Central Pacific Mexico, near the international port of Manzanillo. These include two humpback whales, two pantropical spotted dolphins (Stenella attenuata), one blue whale, and one Bryde's whale. One of these events is believed to have been caused by a collision with a gas carrier named 'Sevilla.'

Whale mortality caused by ship collisions is seriously underestimated. This underestimation is due to several factors: first, estimates depend on ship reports, many of which do not detect collisions, and when they do, they do not always report them (Williams et al., 2011). Second, records of stranded animals do not accurately reflect the actual number of deaths, as when whales die, they often sink due to their negative buoyancy (Williams et al., 2000). Even those that do not sink can be carried away from the coast by currents or eaten by scavengers, making it difficult to determine the cause of death (Redfern et al., 2013). Rockwood et al. (2017) found that ship collisions on the west coast of the United States cause whale mortality rates for blue, humpback, and fin whales significantly higher than previously estimated, exceeding NOAA's recommended limit by 2 to 7.8 times.

Studies indicate that increased maritime traffic significantly raises whale mortality due to ship collisions, especially with large vessels. Additionally, mortality caused by these collisions is underestimated, suggesting that the real risk may be considerably higher than recognized. This danger is exacerbated when shipping routes overlap with critical whale areas, such as in the Gulf of California, where multiple species are at risk due to constant interactions with maritime traffic.

• Acoustic Pollution •

Underwater noise pollution is a threat to many marine species, especially cetaceans, as they rely heavily on sound not only for hearing (and echolocation in the case of odontocetes) but also for socializing (Tyack and Miller, 2002). Sound travels very efficiently underwater, so the impact area can be very large. The ability to hear is crucial for cetaceans' survival, as it allows them to locate mates and prey, communicate, and navigate across vast ocean expanses (Weilgart, 2007).

Ship noise has been shown to disrupt communication-feeding behavior, and displace whales from important habitats, which can affect their health and repro-

duction and cause population declines (Watkins, 1986; Schlundt et al., 2000; Weilgart, 2007).

Exposure to sound can cause temporary or permanent hearing loss. Schlundt et al. (2000) studied cetaceans in captivity and found that the louder and more prolonged the sound, the greater the likelihood of hearing loss. Moreover, temporary or permanent hearing loss can disorient the animal, increasing the risk of ship collisions.

Documented changes in vocal behavior may lead to reduced foraging efficiency or mating opportunities (Weilgart, 2007). Noise can also indirectly affect cetaceans through their prey. Fish show permanent and temporary hearing loss, reduced capture rates, stress, and behavioral reactions to noise.

Low-frequency sounds from certain whales, such as blue and fin whales, can be heard hundreds or thousands of kilometers away and are believed to attract widely dispersed mates (Croll et al., 2002). It has been documented that fin whale vocalization rates decrease or even cease in response to ship noise (Watkins, 1986). If these reproductive calls, which are often weak, are masked by noise, mates might lose the ability to find each other, potentially leading to decreased reproductive rates and, consequently, population declines.

Seabed dredging is a noisy activity. Cetaceans have been shown to be displaced from important habitats when exposed to noise. In Mexico, gray whales abandoned the breeding lagoon Ojo de Liebre from the late 1950s until at least 1970, during an increase in dredging and maritime traffic (1957-1967), but returned once the activities stopped (Bryant et al., 1984). In British Columbia, Canada, orcas dramatically changed their location to avoid noisy acoustic deterrent devices (Morton and Symonds, 2002; Olesiuk et al., 2002). The orcas stayed away for about six years and returned when the devices were suspended (Morton and Symonds, 2002).

During the pandemic in Glacier Bay, Alaska, many ships, boats, and cruises ceased activity, leading to a significant decrease in sound in Glacier Bay. In 2020, opportunistic sightings of marine mammals documented the highest number of common seals since 1997. This is thought to be due to the decrease in noise (Hatch & Gabriele, 2021).

The activities related to construction and seabed dredging in Sonora and operation in the Gulf of California may generate underwater noise that affects cetacean communication and behavior. These noises could interfere with their behavior and pose a threat to them.

• Climate Change •

The construction of fossil gas terminals and the transport of liquefied natural gas by ships across the Gulf of California will contribute to climate change due to methane emissions, a greenhouse gas with a significantly higher global warming potential than carbon dioxide (Howarth, 2014). During the production and transport of gas, methane leaks increase its climatic impact (Álvarez et al., 2018). Additionally, combustion in ship engines releases carbon dioxide and other pollutants that contribute to global warming (Jiang et al., 2014). These effects not only exacerbate climate change but also have the potential to alter marine ecosystems and threaten species inhabiting the Gulf of California, such as whales (McDonald et al., 2006).

CONCLUSIONS

The construction of fossil gas terminals, coupled with seabed dredging and increased maritime traffic, not only represents a significant threat to the biodiversity of the Gulf of California but could also mark the beginning of irreparable damage to this fragile ecosystem. The Gulf of California, known as the "Aquarium of the World," is a crucial refuge for many cetacean species that depend on these waters for their survival. The anticipated changes, such as the increase in ship traffic, will inevitably lead to more collisions with whales and dolphins, potentially resulting in even higher mortality rates for these animals.

The underwater noise from ships and dredging activities threatens to disorient cetaceans, interfering with their communication, feeding, and reproductive patterns, potentially forcing them to abandon vital areas for their existence. Moreover, this project will not only have local effects but will also contribute to climate change, with long-term impacts on the biodiversity of the Gulf of California, including its iconic whales.

This is a critical moment for protecting the Gulf of California and its cetaceans. If we allow these projects to proceed unchecked, we may be sealing the fate of one of the planet's most important marine ecosystems. The actions we take today will determine whether whales and other inhabitants of the Gulf will continue to call these waters their home or whether the impact will be so profound that the damage will be irreversible. Now more than ever, it is essential to act to protect this invaluable ecosystem before it is too late.

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