

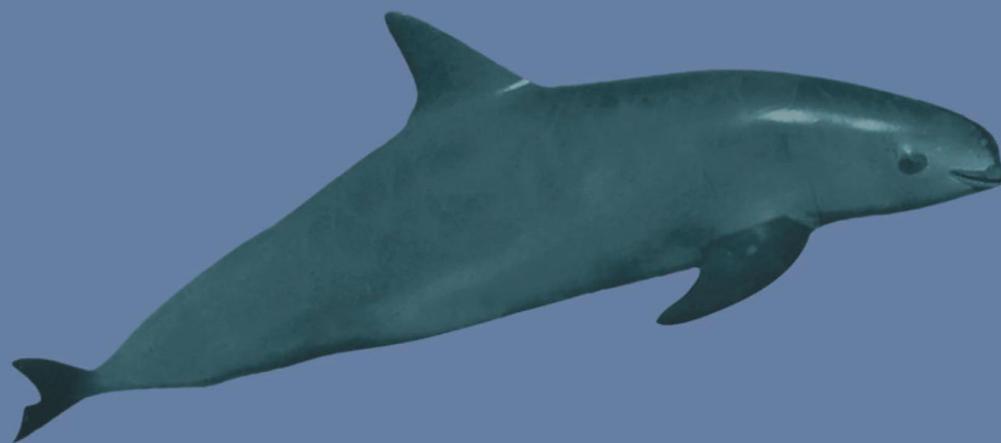
ACTION PROGRAM FOR THE CONSERVATION OF THE SPECIES:



VAQUITA (*Phocoena sinus*)

UNITED MEXICAN
STATES
FEDERAL GOVERNMENT

SEMARNAT



**Comprehensive Strategy for Sustainable
Management of Marine and Coastal
Resources in the Upper Gulf of California**

February 2008



Vivir Mejor



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FOREWORD

For more than 20 years, the Mexican Federal Government, working through various government agencies and civil society, has carried out a number of actions aimed at the protection, study, conservation and restoration of the Gulf of California porpoise known as the vaquita (*Phocoena sinus*), and its habitat. In addition, various social organizations concerned with the conservation of biodiversity in the Upper Gulf of California and particularly that of the vaquita, as well as non-governmental organizations such as the International Fund for Animal Welfare (IFAW), the World Wildlife Fund (WWF), Conservation International (CI), The Nature Conservancy (TNC) and PRONATURA, have all placed the vaquita on their agendas.

Among the conservation activities are the establishment in 1993 of the Upper Gulf of California and Colorado River Delta Biosphere Reserve (DOF June 10, 1993), the establishment of the International Committee for the Recovery of the Vaquita (Comité Internacional para la Recuperación de la Vaquita, CIRVA) in 1997, the creation of the group known as Sustainable Upper Gulf (Alto Golfo Sustentable – AGS) in mid-2005, and the establishment of the Refuge Area for the Protection of the Vaquita (DOF September 8, 2005) and the corresponding Protection Program (DOF December 29, 2005).

This document, titled Action Program for the Conservation of the Species Vaquita (*Phocoena sinus*), Comprehensive Strategy for the Sustainable Management of Marine and Coastal Resources in the Upper Gulf of California (PACE-Vaquita), follows up on previous efforts and establishes specific goals and actions with target dates and budget allocations in order to lend continuity and certainty to projects aimed at recovering this

important species while maintaining the well-being of local communities.

This Action Program is part of a much broader program called the Endangered Species Conservation Program [Programa de Conservación de Especies en Riesgo – PROCER], and is complemented by the Reserve Conservation and Management Program, the Protection Program for the Vaquita Refuge Area established in 2005, and a variety of environmental and fishing regulations either currently in place or being drafted at the regional level.

It also includes an overview of the efforts at research, protection, conservation and recovery of the vaquita carried out to date, a diagnosis of the species and its current condition, the socioeconomic context in the region, particularly with regard to fishing activities and strategies for dealing with this diverse and complex situation. Most of the information and actions included here reflect the efforts of working groups such as the International Committee for the Recovery of the Vaquita (CIRVA), the Advisory Council for the Reserve, the Consultative Technical Subcommittee for the Recovery of the Vaquita, the Coalition for the Upper Gulf of California and Sustainable Upper Gulf (AGS).

This Action Program is intended as a tool to promote the synergies necessary to achieve the conservation and recovery of the vaquita through short-, medium- and long-term actions to eliminate bycatch of vaquitas in gillnets and trammel nets, allocate resources for shifting and diversifying production, encourage research and development of new fishing methods and gear, implement an ongoing program of inspection and monitoring, and provide the necessary support for achieving the sustainable harvesting of the natural resources of the Upper Gulf of California.

INTRODUCTION

Since enactment of the General Ecological Balance and Environmental Protection Law (1988) and the General Wildlife Law in 2000, natural protected areas and other types of protected habitats have been strategic and model centers for the recovery of species that are deemed top priorities for conservation through protection and management activities due to their cultural and economic value and their relevance for communities and ecosystems, or because they are considered to be at some level of risk.

As a result, the Endangered Species Conservation Program [PROCER] was developed and since 2004 has been carried out by the National Commission for Protected Natural Areas [Comisión Nacional de Áreas Naturales Protegidas – CONANP] in coordination with the National Consultative Technical Committee for the Recovery of Priority Species as well as other strategic allies. This Program is designed to promote participation and responsibility among all sectors of society in the protection of the most threatened species in Mexico. Special attention is given to the species listed in Mexican Official Standard (NOM) 059 and the Red List of Threatened Species maintained by the International Union for Conservation of Nature (IUCN), and to some other species that are not at risk but are emblematic of our national culture.

In particular, PROCER's central strategies involve creating opportunities for social participation in projects for the recovery of priority species, optimizing national and international cooperation efforts, strengthening participative monitoring capabilities, formulation of suitable legal instruments for conservation, and updating available information. Overall, the idea is to ensure that efforts to improve the environment and our

society's quality of life complement sustainable development policies.

The protection, conservation and recovery of the vaquita (*Phocoena sinus*) is a top national and international priority. This species, also known as the marine vaquita, the cochito, and the Gulf of California porpoise, is listed in NOM-059-ECOL-2001 and in the Convention on International Trade in Endangered Species [CITES], Appendix I, as being in danger of extinction, and in the IUCN Red List as being in critical danger of extinction. Its habitat is an area of endemism for many species, especially macroinvertebrates, fishes, birds and other vertebrate species that would also benefit from the conservation and protection actions proposed in this document.

The conservation actions included here extend beyond the environmental sphere to encompass the programs and activities carried out by the National Commission on Aquaculture and Fishing (CONAPESCA) and the National Institute of

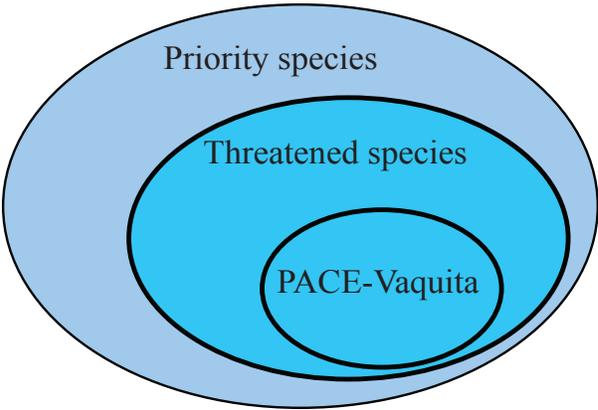


FIG. 1 INSTITUTIONAL FRAMEWORK FOR THE CONSERVATION OF THE VAQUITA

Fishing and Aquaculture (INAPESCA) under the direction of the Secretariat of Agriculture, Livestock, Rural Development, Fishing, and Food (SAGARPA). These agencies are working to organize fisheries by region and/or by species with a systems approach to achieve the comprehensive management of the coastal zone. They encourage producers and academic institutions as well as the three levels of government to participate in defining frameworks for the administration of fisheries and the evaluation of opportunities for fishing development and promotion.

I. VAQUITA AND HABITAT PROTECTION BACKGROUND

Because of its great biodiversity, high level of productivity, and critical importance for the reproduction, maturation and development of marine species, the Upper Gulf of California and the Colorado River Delta have been the focus of protection efforts by a variety of civic and scientific organizations and by the Mexican Government since the 1950s. A range of protection instruments have been used, including the declaration of the area as a “refuge for all species” in 1955 by the former Directorate of Fishing and Related Industries, the decree establishing the Upper Gulf of California and Colorado River Delta Biosphere Reserve (DOF June 10, 1993), the Mexican Official Standard establishing measures for the protection of the totoaba [*Totoaba macdonaldi*] and the vaquita (DOF June 29, 1994) and the Agreement Establishing the Refuge Area for the Protection of the Vaquita (DOF September 8, 2005) and the corresponding Protection Program (DOF December 29, 2005).

Early in the 1970s, several researchers took an interest in the vaquita and wrote reports that enhanced knowledge of the species’ population biology and state of health. They concluded that this population was isolated, diminished and threatened. At first it was suggested that the bycatch of vaquitas in fishing gear, the lack of water flowing from the Colorado River into the Upper Gulf, water pollution and endogamy (inbreeding) might be risk factors for the survival of the species.

Thus in the 1990s, the first measures were established to protect the vaquita by prohibiting the use of the chinchorro (a gillnet with a 12-inch mesh) for catching totoaba throughout the Gulf of California (DOF February 13, 1992), and in 1992

the Technical Committee for the Preservation of the Vaquita and the Totoaba [Comité Técnico para la Preservación de la Vaquita y la Totoaba – CTPVT] was created. This committee coordinated the conservation efforts of government agencies, research centers, higher education institutions and non-governmental organizations, which in 1993 culminated in the establishment of the Upper Gulf of California and Colorado River Delta Biosphere Reserve, an area covering 934,756 hectares (Fig. 2).

The provisions of the declaration creating the Reserve and its Management Program (1996) were taken into consideration in the development of the National Fishing Chart (INP 2000, 2004, 2006), the Secretariat Notices on Shrimp Closed Seasons, the issuance of commercial fishing licenses and concessions by SAGARPA, and the wording of several Mexican Official Standards for harvesting fishery resources. These standards include one protecting the totoaba and the vaquita (NOM-011-PESC-1994 Secretariat of Fishing, 1994), one regulating shrimp harvesting and its amendments (NOM-002-PESC-1993, Secretariat of Fishing, 1993, 1997, 2006), the standard mandating the use of turtle excluder devices (CONAPESCA, 2007), and those governing crabbing (CONAPESCA, 2006) and fishing for shark, rays and related species, and for gulf corvina (CONAPESCA, 2007).

In 1997 the Mexican Government established the International Committee for the Recovery of the Vaquita (CIRVA) with a mandate to develop a recovery plan for the species based on the best available scientific information, considering the socioeconomic impacts of any potential regulation involving social, economic and fishing alternatives.



FIG. 2 UPPER GULF OF CALIFORNIA AND COLORADO RIVER DELTA BIOSPHERE RESERVE

That same year, the Committee estimated the population at 567 animals and determined that incidental mortality caused by fishing, specifically by trammel and gillnets, posed the most significant and direct threat to the vaquita and therefore should be eliminated immediately. It also recommended that although it was unlikely that vaquita would be caught in shrimp trawl nets, regulation of such nets should be implemented

to protect the porpoise’s habitat. Specifically, the Committee recommended the following:

- Reduce the bycatch of vaquitas to zero.
- Extend the Reserve further south to include the entire distribution range of the vaquita.
- Eliminate gillnets and trawl nets in the Reserve.
- Experiment with alternative fishing gear.
- Encourage and create productive activities alternative to net fishing.

In 2001, with the participation of various entities in the public, private and social sectors, a strategy for the conservation of the vaquita and its habitat was formulated. Under this strategy, actions were taken to ensure compliance with environmental and

TABLE 1. PROTECTION HISTORY

Year	Action
1955	Declaration of refuge area for all species in waters from the mouth of the Colorado River south to an imaginary line extending from the southern end of the Ometepe Bay in Baja California to the mouth of the Santa Clara Estuary in the State of Sonora
1974	Declaration of zone for the protection, cultivation and/or repopulation of all species of fish in the Colorado River Delta area of the Gulf of California
1975	Indefinite ban on totoaba fishing
1992	Agreement prohibiting the use of gillnets with a mesh of more than 10 inches (totoaba nets) made of 36 to 40 caliber monofilament lines called totoaberas, throughout the entire year in the indicated area of the Gulf of California
1992	Establishment of the Technical Committee for the Preservation of the Vaquita and the Totoaba (CTPVT). It drew up a proposal to establish the biosphere reserve and compiled important data on the vaquita and the ecosystem of the Upper Gulf
1993	Establishment of the Upper Gulf of California and Colorado River Delta Biosphere Reserve
1994	Publication of Mexican Official Standard NOM-059-ECOL-1994, classifying the vaquita as a species in danger of extinction
1994	Publication of NOM-012-PESC-1993 establishing measures for the protection of the totoaba and vaquita species in federal waters of the Gulf of California
1996	First Reserve Management Program submitted
1997	Establishment of the International Committee for the Recovery of the Vaquita (CIRVA)
1997	NOM-002-PESC-1993 amended to set the maximum length allowed for the chinchorro net for shrimping in the Gulf of California
2001	Establishment of the Consultative Technical Subcommittee for the Recovery and Protection of the Vaquita (<i>Phocoena sinus</i>)
2001	Development of the strategy for conserving the vaquita and its habitat and beginning of inspection and monitoring operations coordinated by PROFEPA
2002	Publication of Emergency Standard 139 prohibiting shrimping boats and banning the use of trammel and gillnets with a mesh larger than 6 inches in the Upper Gulf Biosphere Reserve
2003	Public forums on updating the Reserve Conservation and Management Program
2005	Establishment of the Refuge Area for the protection of the vaquita
2005	Publication of the Vaquita Protection Program

wildlife standards within the Reserve, and the first steps were taken to enhance cooperation between SAGARPA and the Secretariat of the Environment and Natural Resources (SEMARNAT) in the region. With a view to validating the initiative and formalizing its execution, the Consultative Technical Subcommittee for the Recovery and Protection of the Vaquita (*Phocoena sinus*) and its Habitat was founded on October 28, 2001. Members of the Subcommittee include experts, non-governmental organizations, and government representatives. Among the objectives outlined by the Subcommittee are the following:

- Develop, propose and, in close collaboration with the CIRVA, provide consultation on a national strategy for the recovery of the vaquita and its habitat.
- Act as a consultative body to issue technical-scientific recommendations to the federal, state and municipal governments.
- Compile data on the recovery and protection of the vaquita.
- Establish a vaquita database.
- Promote enforcement of the law on the protection and conservation of the vaquita.
- Promote and contribute to public appreciation and respect for the importance and benefits of protecting the vaquita and its habitat.

In 2002, in order to increase protection of the species and its habitat, SEMARNAT published Emergency Mexican Official Standard NOM-EM-139-SEMARNAT-2002 prohibiting the use of trawl nets and of trammel and gillnets with a mesh larger than 6 inches within the buffer zone of the Biosphere Reserve. A number of conflicts arose when this NOM was issued, especially in the industrial fishing sector. The conflicts were resolved by means of an environmental impact authorization allowing 162 trawlers to operate in the Reserve for three months (Oct.-Dec.). In addition to complying with the provisions of the Protected Natural Areas

Regulations limiting the bycatch to a 1:1 ratio and preventing the capture of species at risk, the authorization required them to use devices that exclude fish and turtles. They also had to observe a fishing ban in a zone that includes part of the area where the vaquita is most heavily concentrated according to various studies, most notably those conducted by Gerrodette et al. (1995), Gallo-Reynoso (1998) and Jaramillo et al. (1999), and that matches a variety of areas and shapes that have been proposed for protection.

Later, in July 2005, the group known as Sustainable Upper Gulf (AGS) was formed by representatives of the inshore and industrial fishing sector, the region's leading shrimp marketing company, and national and international civic organizations involved in conservation.

The main objectives of AGS are:

- a. elimination of the vaquita bycatch;
- b. elimination of illegal fishing; and
- c. improvement of the efficiency of shrimping operations.

On September 12, 2005, AGS met in Mexicali, Baja California to discuss the actions and commitments that months later would be incorporated into the Vaquita Protection Program in the Refuge Area (DOF December 29, 2005). AGS has three working groups, each assigned to one of the aforementioned objectives, and since 2006 it has implemented an "Inspection and Monitoring Program During the Shrimp Close Season" designed to prevent illegal fishing and vaquita bycatch. The group has also carried out other activities, such as overflights to locate and monitor fishing areas, on-board observers on small vessels (pangas), and conducting socioeconomic surveys in the communities.

At the international level, it is worth mentioning that in 2004 the International Whaling Commission Scientific Committee (IWC-SC) reiterated and endorsed CIRVA's conclusions, calling upon the Mexican Government to implement the

Committee's recommendations. This concern has also been voiced by organizations such as the American Society of Mammalogists (2005), the Society of Marine Mammalogy (2001 and 2005), the European Cetacean Society (2001), the World Wildlife Fund (WWF, 2005), the Mexican Society of Marine Mammalogy (2001), the International Fund for Animal Welfare (IFAW), and Conservation International (2005). Finally, as a result of the extinction of the baiji dolphin in China's Yangtze River, at its 2007 meeting the IWC approved by consensus a resolution recommending that Mexico should heighten its efforts to prevent the extinction of the vaquita and urging the member countries of the Commission and those of the international community to support the country's efforts by providing financial and technical resources to reduce the bycatch to zero.

Two years after the Marine Vaquita Protection Program was published, SAGARPA, acting through CONAPESCA and taking into account the complex situation of the species, has developed important instruments to regulate fishing and thus contribute to the conservation of the vaquita, its habitat and other marine resources. These measures include the development of ordering programs for the states of Sonora and Baja California, regulations for regional fisheries, implementation of programs for the administration and control of fishing activity, replacement of trawl nets with nets that have no significant impact on the sea floor, placement of observers on vessels in both fleets, research aimed at replacing fishing gear with more environmentally friendly and selective equipment, and strengthening inspection and monitoring programs.

Protected Area

One of the measures proposed for the effective protection of the vaquita population has been the delimitation of a zone in which fishing with trammel and gillnets is restricted. In this regard,

based on scientific data from the sightings made over the last three decades, the CIRVA proposed the site depicted in Figure 3. The blue circles represent the geographic location of all known vaquita sightings, which includes the data compiled as of that date (Brownell, 1972; Wells, 1979; Vidal, 1984; Silber, 1986, 1987, 1988; IBUNAM, 1992-1993; PNICMM, 1992-1993; Briebea, 1993; México Desconocido, 1993; Gerrodette, 1993; Jaramillo, 1997; and Gallo-Reynoso, 1998). The red circles represent the geographic location of the stations where acoustic signals from vaquitas were detected between 1999 and 2003.

This site, in turn, is divided into three sections: At the core zone are the largest number of historic and acoustic records of vaquitas in the Upper Gulf. This core zone, marked in blue in Figure 4, measures 2,262.69 km² and represents the minimum area where it is imperative to completely prohibit the use of trammel and gillnets in order to protect the majority of the population and allow time to implement other measures that will actually eliminate the vaquita bycatch in fishing operations.

In response to the restrictions on fishing activity included in the updated Biosphere Reserve Conservation and Management Program and the environmental impact authorization currently in effect for trawlers, the fishing industry submitted a counter-proposal for some vaquita protection areas. However considering the status of the species and present knowledge of it, these proposed areas do not truly protect the core zone where the species is most heavily concentrated; in fact, they do not even protect 20% of the total distribution range.

In this context, in 2005 SEMARNAT and SAGARPA agreed on a site smaller than the area proposed by the CIRVA, with an area of 1,263.77 km². It comprises 78.16% of vaquita records over the last three decades and represents 0.36% of the marine area of the entire Gulf of California. As a result of the negotiations and based on the provisions of the General Wildlife Act, SEMARNAT, on September

Core Zone. The rectangular area marked in green, with vertices

(31.4450°N,114.3333°W);
(31.4450°N,114.6409°W);
(30.7500°N,114.6409°W);
(30.7500°N,114.3333°W).

Northern Coastal Zone. The irregular area marked in blue, with vertices

(31.4450°N,114.8560°W);
(31.4450°N,114.6409°W);
(31.0916°N,114.6409°W);
(31.0470°N,114.8116°W);
and following the coastline to the north,
excluding estuaries.

Southern Coastal Zone. The irregular area marked in purple, with vertices

(31.0470°N,114.8116°W);
(31.0916°N,114.6409°W);
(30.7500°N,114.6409°W);
(30.7500°N,114.6962°W);
and following the coastline to the north.

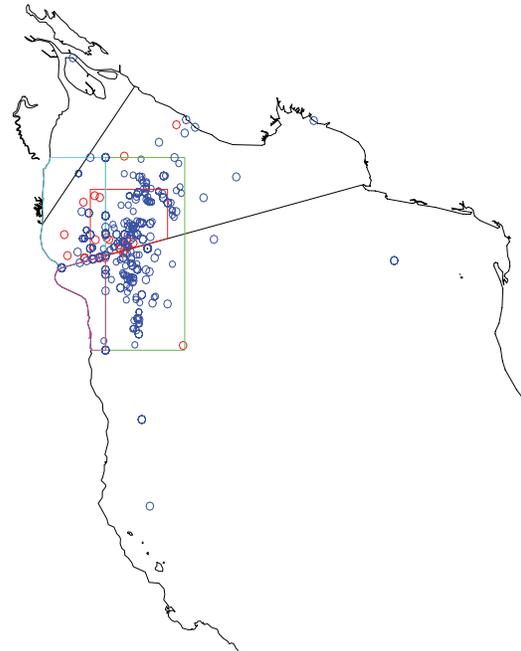


FIG. 3 CIRVA PROPOSAL WITH ZONING

8, 2005, issued the Agreement establishing the Refuge Area for the Protection of the Vaquita (*Phocoena sinus*). That area, in turn, was incorporated into the final zoning in the Reserve Conservation and Management Program (Fig. 5). The aforementioned Secretarial Agreement also provided that SEMARNAT would coordinate with other federal agencies and social and private sector entities to draw up a Refuge Area Protection Program containing the conservation and management terms governing construction projects and production activities.

Later, based on the commitments made by AGS (Mexicali, 2005) and in agreement with CONAPESCA, on December 29 of that year SEMARNAT published the Program for the Protection of the Vaquita in the Refuge Area (DOF December 29, 2005), which laid out the strategy for the conservation and recovery of the species. The most noteworthy measures contained in

the Program are the establishment of a zone in which fishing is prohibited, the regulation of the fishing fleet, the strengthening of law enforcement during the shrimp closed season, projects to place observers on board vessels, and aerial reconnaissance to monitor fishing activity in the Refuge using satellite tracking devices.

The program also calls for the design and implementation of mechanisms to mitigate the direct and indirect economic impacts that restricting fishing activity might entail. Under this provision, in December 2005 SEMARNAT allocated more than 14 million pesos through the Special Concurrent Program [Programa Especial Concurrente – PEC] to mitigate the economic impact on the inshore fishing sector in the communities of San Felipe, Baja California and Santa Clara and Puerto Peñasco, Sonora. These public funds were channeled through the governments of the respective states to support local projects.

At the same time, CONANP has provided support in the form of subsidies and direct contributions, such as the Regional Sustainable Development Program [Programa de Desarrollo Regional

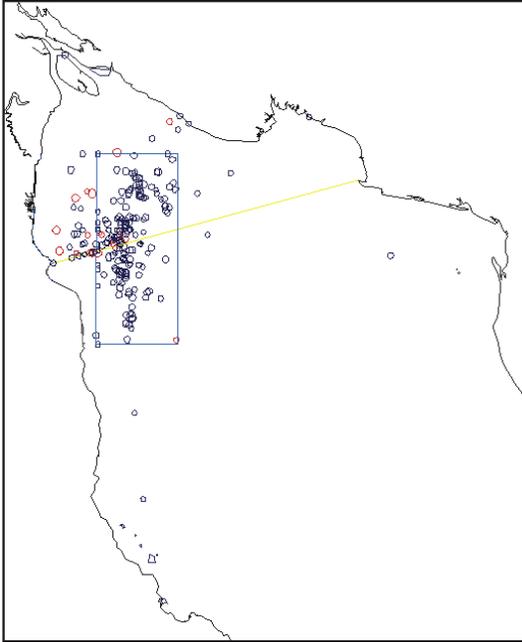


FIG. 4 CORE REFUGE ZONE FOR VAQUITA PROTECTION

Sustentable – PRODERS), the Gender Equity, Environment and Sustainability Program, the Temporary Employment Program [Programa de Empleo Temporal – PET], and other specific ones including GEF/SINAP II in the communities that use the Reserve/Refuge. This marks the beginning of support for local initiatives to develop alternatives to commercial fishing such as ecotourism, aquaculture, waste recycling, and community financial capacity-building and organization.

In addition, SAGARPA has invested resources in the implementation of fishing regulations that contribute directly to achieving the objectives of the Vaquita Protection Program, within the framework of the comprehensive program to manage marine and coastal resources, such as the regulation of fisheries in the area, technology retrofitting research projects, replacing fishing gear with more selective and environmentally friendly equipment, strengthening inspection and monitoring programs, and so forth.

Despite the efforts, measures and actions that have been carried out over the last few years to protect and recover the species, year after year the vaquita bycatch continues (Table 2). The measures taken have been restrictive in nature, confined to fishing areas and methods. They include decrees, official standards and administrative regulations that have a negative impact on economic activities and have not contributed significantly to eliminate the vaquita bycatch. These public policy instruments proposed by the federal government have been systematically rejected and ignored by the social groups involved. Although the formation of the AGS group has had a positive effect on acceptance and adherence to the policies proposed by the government, there is a need to strengthen the mechanisms to coordinate the various federal agencies and to achieve greater synergy and integration of state and municipal authorities in their dealings with all of the stakeholders.

Experience has made it clear that a fundamental condition for setting up a viable system to protect the species adequately is the active and coordinated participation of the stakeholders and civil society organizations, along with a firm commitment by the three levels of government. This is the only way to design effective measures to promote the sustainable use of resources and make the conservation of the species and its habitat a productive and profitable endeavor for the local communities.

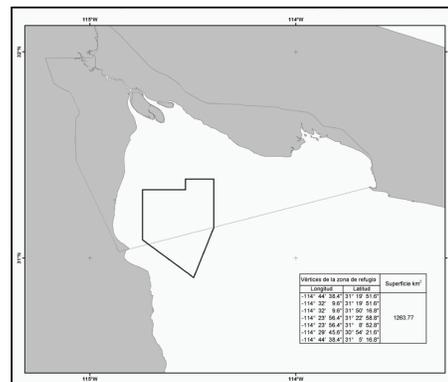


FIG. 5 REFUGE AREA FOR THE PROTECTION OF THE VAQUITA (PHOCOENA SINUS)

TABLE 2. ENTANGLED VAQUITAS IN THE LAST 4 YEARS (COMPILED BY ROJAS AND CAMPOY, 2003)

Date	No. of Vaquitas	Fishing Gear	Observations
December 9, 2003 (shrimping season)	2	<i>chinchorro</i> shrimping net	Mother and calf. Reported by fishermen in San Felipe and Francisco Valverde
December 29, 2003 (shrimping season)	1	Probably <i>chinchorro</i>	Adult in the Consag Rocks Currently in Ensenada
January 19, 2004 (shrimping season)	1	Same conditions	The Consag Rocks Buried in Santa Clara
April 28, 2004 (shrimping season)	2	Marks from gillnets, type unknown but looks like one used for bigeye croaker	Adult and one calf Reported by bigeye croaker fishermen in San Felipe
May 2004 (scale-fish season)	1	Marks from gillnets, type unknown	Young vaquita in Punta Estrella Reported by Public Works personnel
June 28, 2004 (scale-fish and shark season)	2	Marks from shark net	Mother with calf (Toboyori Ejido, south of Bahía Adair) Reported by rural authorities who could not revive them.
Early December 2004 (shrimping season)	1	10 km west of Consag	Adult; there was a lot of shrimping Reported by Valverde Jr.
February 28, 2005 (shrimping season)	1	At Punta Estrella	Adult, probably in <i>chinchorro</i> net Reported by Mr. Tamborillo of San Felipe, BC
March 2005 (shrimping season)	2		Reported by community organizer of the Reserve in San Felipe, BC Both specimens were seen floating south of the Consag Rocks
February 2007 (shrimping season)	1	Fresh	Reported in Gulf of Santa Clara Photograph taken.

II. DIAGNOSIS

TAXONOMIC CLASSIFICATION

Class:	Mammalia
Order:	Cetacea
Suborder:	Odontoceti
Family:	Phocoenidae
Genus:	Phocoena
Species:	Phocoena sinus, Norris and McFarland, 1958
Common Names:	Cochito, Gulf of California Harbor Porpoise, Gulf of California Porpoise, Gulf Porpoise

Natural History and Biology

The vaquita (Norris and McFarland, 1958) is the only member of the Phocoenidae family (true porpoises) inhabiting the waters of Mexico. The scientific name of the vaquita is *Phocoena sinus*. *Phocoena* means “porpoise” in Latin and *sinus* means “cavity,” which refers to the Gulf of California. In other words, it is “the Gulf of California porpoise.”

Porpoises are distinguished from dolphins by their spade-shaped teeth; the vaquita has 17 to 21 teeth on its upper jaw and 17 to 20 on the lower jaw. Externally, porpoises are smaller than dolphins, have a rounded, blunt head and rostrum, and a triangular dorsal fin.

The vaquita is the only marine mammal endemic to Mexico and probably to the entire Northwest Pacific; it lives exclusively at the northern end of the Upper Gulf of California. Experts in evolutionary biology believe it is a kind of “relic” species, geographically isolated in

the distribution area of the parent species, the Burmeister’s porpoise or spiny porpoise, *Phocoena spinipinnis*. Some authors suggest that the species as we know it today probably came about as a result of an evolutionary process known as “allopatric speciation,” when one or more groups of Burmeister’s porpoises or a similar species were isolated in the Gulf of California during the climatic fluctuations that produced the glacial and interglacial periods of the Pleistocene era. Due to natural selection, they underwent physiological and morphological adaptations and adapted their social and reproductive behavior to the conditions imposed by this environment, which is what has enabled them to survive to this day.

The vaquita is one of the least-known cetaceans in the world. The initial description of the species was based solely on three craniums found near San Felipe, Baja California. Some years later the entire skeleton was described when complete stranded specimens were collected, but the first formal description was not until 1958.

The vaquita is the smallest of all porpoises and indeed of all cetaceans. Females are believed to reach a maximum length of approximately 150 cm, males about 140 cm. Body weights range from 7.8 kg in newborns to a maximum weight of 55 kg recorded for adult females. Compared to other porpoises, the vaquita’s pectoral fins are longer and the dorsal fin is taller in proportion to the length of the body.

The vaquita’s coloration is unique. In adults, the dorsal surface is dark gray, the sides are pale gray and the ventral surface is white with some long, light gray markings. This porpoise has a large dark ring around the eyes and dark patches on the lips that form a thin line from the mouth to the

pectoral fins. In the newborn, the coloration is darker than in adults, particularly in the head and in the areas behind the eyes. There is a wide gray fringe of color that runs from the head to the dorsal flukes, passing through the dorsal and pectoral fins.

It is thought that the vaquita reaches sexual maturity at around 6 years of age. The female has only one calf in the spring, probably every two years or more. The gestation period is approximately 11 months, nursing probably lasts 8 months, and it is believed that the lifespan of the vaquita is 22 years. The oldest specimen ever found was a female estimated at 21 years of age. This means that a female could only have 5 to 7 calves during her entire reproductive life. This low birth rate needs to be considered when proposing conservation measures (Vidal, 1995).

The vaquita feeds on the fish, squid and shrimp that abound in the Upper Gulf of California. Analysis of stomach content indicates that the vaquita is opportunistic, feeding on 20 to 21 different species of shallow-water fish, squid and crustaceans with demersal and/or benthic habits associated with soft bottoms (clay-lime) and estuarine, coastal habits. This analysis also found a higher number of vaquita records in areas with clay-lime bottoms than in those with sandy bottoms, which coincide with the habitats of the species upon which they most commonly feed: corvina (*Isopisthus altipinnis*), toadfish (*Porichthys mimeticus*), squid (*Lolliguncula panamensis* and *L. diomediae*) and other benthic-demersal species.

Distribution

This porpoise has one of the most restricted distributions of any marine mammal (Brownell, 1986), limited to an area encompassing a small part of the northern and Upper Gulf of California (Vidal, 1995; Gerrodette et al., 1995; Gallo-Reynoso, 1998; Jaramillo et al., 1999). The first studies of the specific distribution of the vaquita were published by Silber (1990) and Silber and

Norris (1991). They concluded that the species is distributed year-round in the Upper Gulf, mainly on the western periphery, with high density in a location near the Consag Rocks off San Felipe Bay in Baja California. Later on, Vidal (1995), Gallo-Reynoso (1998) and Vidal and collaborators (1999) compiled and reviewed all available records of sightings, incidental captures and strandings up to 1990, and they also concluded that the species is distributed north of a line between Puerto Peñasco, Sonora and Puertecitos, Baja California. Most records are off San Felipe, Baja California, at the Consag Rocks and in the Gulf of Santa Clara, Sonora.

Sightings south of the Upper Gulf have been discounted because of a lack of detailed descriptions, data that is confusing or inconsistent with current knowledge of the vaquita and other porpoises, such group size, or a lack of physical evidence, such as entangled specimens, skeletal remains or photographic evidence (Brownell, 1986). A number of expeditions and long-term studies south of this zone have reported the presence of various cetacean species other than vaquitas in their findings (Balance, 1992; Tershy et al., 1990, 1993; Rojas-Brancho, 1985), which confirms Brownell's hypothesis (1986).

Abundance

It has been extremely difficult to determine the abundance of the vaquita population because of its small size, the porpoise's elusive behavior, and the fact that it spends much of its time beneath the surface in the shallow, murky waters of the Upper Gulf of California. Sighting the vaquita requires trained observers and calm waters. In 1997, Mexico's National Fisheries Institute and the U.S. National Marine Fisheries Service (NMFS) made a major effort to estimate the population size based on a protocol designed specifically to calculate the population density of the species. At that time the estimate of average abundance was

567 specimens, with a 95% confidence interval. At present, researchers are using acoustic detection techniques with underwater hydrophones to investigate how the vaquita uses its habitat and what its movements are, and to learn more details about its distribution and abundance.

Jaramillo-Legorreta et al. (1999) found that most sightings have occurred in the same area, located near the port of San Felipe, Baja California, specifically to the north of the Consag Rocks. The sightings have been most frequent in the spring, summer and fall, rarer in the winter. In addition, it has been determined that approximately 60% of confirmed records were within the confines of the Upper Gulf of California and Colorado River Delta Biosphere Reserve, and 40% were outside this protected area. These findings are similar to those reflected in the data compiled by Gallo-Reynoso (1998) on the distribution of vaquita sightings by different authors over a 14-year period.

Sightings near the western perimeter in Baja California throughout the four seasons of the year are as follows:

- Winter and Spring (1979-2003)

Vaquita records obtained in this area accounted for 50% of the sightings by Wells and collaborators; all but two of those by Silber and Silber and Norris; all of Brownell's; all those of the Marine Mammal Program of the National Ecology Institute [Instituto Nacional de Ecología – INE]; all but one of those reported by the Biology Institute of the Autonomous National University of Mexico [Universidad Nacional Autónoma de México – UNAM]; all but one of the sightings by the México Desconocido expedition; all of Briebe's, and all but three of Vidal's (Wells et al., 1981; Silber, 1988, 1990; Silber and Norris, 1991; Vidal, 1995; Vidal et al.,

1999; Gerrodette et al., 1995; Jaramillo-Legorreta et al., 1997, 2002).

- Summer and Fall (1992-2003)

All records of the INE's Marine Mammal Program, all but one of those reported by Gerrodette et al., and all those of the UNAM Biology Institute (Rojas-Bracho and Jaramillo-Legorreta, 2002; Jaramillo-Legorreta et al., 1999; Gerrodette et al., 1995; Jaramillo-Legorreta et al., 1997, 2001-2003).

Current Situation of the Vaquita

According to information obtained between the 1980s and 2003 (Wells et al., 1981; Brownell, 1986; Silber, 1988 and 1990; Silber et al., 1991; Gerrodette et al., 1995, Chappel et al., 1996; Jaramillo-Legorreta et al., 2001, 2002 and 2003), the largest concentration of vaquitas, according to both visual and acoustic records, is in an area measuring approximately 3,400 km², nearly 40% of which lies outside the Biosphere Reserve (see Figure 4). This is a critical consideration in establishing a zone for the effective protection of the vaquita.

Recent studies on the way this species uses its habitat (Jaramillo-Legorreta et al., 2001, 2002 and 2003) make it even more urgent that the CIRVA recommendations be implemented. These studies, whose basic methodology is passive acoustic detection, show that at present specimens are restricted to a small area in the western part of the Upper Gulf of California, off the coasts adjacent to San Felipe Bay. This contrasts with historical distribution data obtained from bycatch suggesting more restricted areas of distribution and could mean that this cetacean is at even greater risk of

extinction than previously thought (Jaramillo and Rojas, 2003).

The results of a number of systematic expeditions in 1992, 1993 and 1997 (Jaramillo-Legorreta et al., 1999) placed the greatest concentration of vaquitas in an area near the coast of Baja California, with the southernmost record being at Isla Encantada/San Luis Gonzaga Bay (~30°N). The results of these expeditions are basically identical. The results of all vaquita distribution studies agree that the area of greatest concentration of this porpoise is the western perimeter of the Upper Gulf of California (Wells et al., 1981; Silber, 1988, 1990; Silber and Norris, 1991; Vidal, 1995; Gallo-Reynoso, 1998; Vidal and collaborators, 1999; Gerrodette et al., 1995; Jaramillo-Legorreta et al., 1997, 2002). The 1997 expedition, the most comprehensive endeavor thus far, made it possible to pinpoint the core zone of distribution, meaning the location of the largest concentration of vaquitas. This expedition set out to estimate the

abundance and distribution of the species using the distance sampling method (Rojas-Bracho and Jaramillo-Legorreta, 2002; Jaramillo-Legorreta et al., 1999).

The methodology included coverage of the entire potential distribution area of the vaquita or wherever vaquitas had been detected, so three different vessels were used. A total of 3,364 km of transects were done, including the channels of the Colorado River Delta and those of the estuaries. The sightings obtained during these expeditions were mainly along the Baja California coast, between the Consag Rocks and San Felipe Bay, with a north-south range of approximately 75 km.

Figure 6 shows Zone "A," where most of the sightings occurred. Abundance in this area was estimated at 409 specimens (72% of the total). Zone "B" was defined as a "shallow zone," and abundance there was estimated at 158 specimens, or 28% of the total. Sightings are shown as circles.

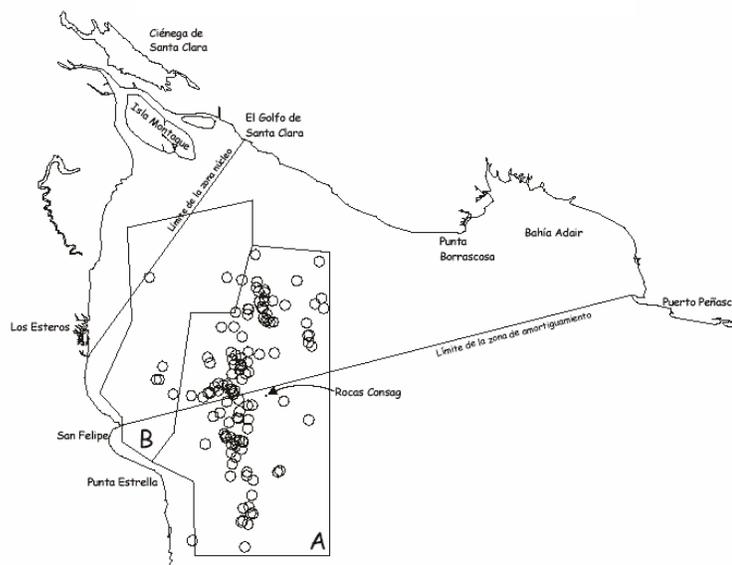


FIG. 6 DISTRIBUTION OF THE VAQUITA ACCORDING TO JARAMILLO-LEGORRETA ET AL. (1999)

TABLE 3. GEOGRAPHIC LOCATION OF THE VAQUITA DISTRIBUTION AREAS, CORE ZONE A AND SHALLOW ZONE B

Zone A						Zone B					
Longitude West			Latitude North			Longitude West			Latitude North		
°	'	"	°	'	"	°	'	"	°	'	"
114	30	30	31	27	36	114	30	30	31	27	36
114	31	1	31	26	17	114	31	1	31	26	17
114	32	60	31	18	18	114	32	60	31	18	18
114	39	0	31	18	18	114	39	0	31	18	18
114	41	24	31	1	48	114	41	24	31	1	48
114	44	18	30	57	54	114	44	18	30	57	54
114	38	42	30	55	12	114	53	18	31	0	44
114	38	27	30	45	0	114	51	29	41	7	22
114	19	60	30	45	0	114	47	7	31	17	10
114	19	60	31	26	39	114	47	44	31	30	3
						114	30	31	31	33	49

Table 3 shows the geographic location of the vertices that define these polygons.

In May 2006 and February 2007 another pair of research expeditions took place, applying passive acoustic techniques. The data obtained from them were added to the records compiled since 2001, and they reinforce the presumption of downward trends in the population.

The findings show trends over time in the rate of acoustic encounters in the area where vaquitas are most heavily concentrated, measured as the number of confirmed encounters per hour of effort. Each point represents a sampling station. Between 2001 and 2003 the encounter rate varied considerably, with some stations reporting no detections. During this period the average detection rate was 0.198 detections per hour.

Between 2004 and early 2007, the encounter rate fell significantly, reaching 0.053 detections per hour, a 73% decline. In other words, the acoustic detection time series shows the same tendencies as the demographic estimates. Given that the vaquitas themselves send the acoustic signals, the decline in detection rates could be attributed to

three causes: a) a reduction in abundance, b) a change in distribution patterns, or c) a reduction in acoustic transmission rates by the vaquitas. The research expeditions covered not only the known areas of distribution but the entire Upper Gulf. This has been done throughout the year in different seasons, and vaquitas have been detected only in the area of greatest concentration described in the above section. In other words, there has been no change in distribution.

Echolocation is the mechanism odontocetes use to explore their environment. It is what they use to find food, communicate, identify predators and navigate. In addition, in surroundings as turbid as those of the vaquita, this means of orientation and search is vital, so it is very unlikely that the animals would reduce their use of it. Therefore, the most viable explanation for the reduction in the acoustic detection rate is a decline in the number of individuals. This result could come from random variation, but a brief analysis of the data indicates that the decline could be real. Even though the sampling effort was less intense during the second period, after 2004, it amounted to 45% of the effort during the first period, which is enough for a representative sampling. The average time of effort

per station during the second period was 1.35 times longer. This is an important indicator, because in view of the nature of the vaquita's movements, it is more likely that specimens will be detected if sampling is done over a longer period of time in a single location. If the detection rate had remained even, 21 detections could have been expected, whereas only 7 were obtained in a sampling system designed to maximize the detection rate.

If the decrease in acoustic encounters is a reflection of the decline in abundance, which is very likely given the restricted distribution of the species, it is sounding an alarm about the low levels of abundance the vaquita population may be reaching, possibly indicating that recovery measures are not working.

Another disturbing sign is the lack of sightings and acoustic detections along the coast of Sonora. Available data point to a reduction in the vaquita distribution area since 1993. It should be noted that the extinction of the baiji, or Yangtze River dolphin, took place over a very short period of time after the last reported sightings. Therefore, immediate and effective measures should be taken to prevent the extinction of the vaquita, and implementing these measures requires the involvement and participation of the fishing industry, the three levels of government, and the academic, private and social sectors.

Moreover, taking into consideration the increase in fishing in the region and the data reported by D'Agrosa et al. (2000) on the vaquita bycatch in 1993-1994 in the Gulf of Santa Clara, Jaramillo et al. (2007) estimated that the vaquita population in 2007 might be around 150. These same authors indicate that the next two years are decisive for taking strong action to recover the species before the population reaches such a small size that all conservation options are futile, since a declining population increases the risks of

endogamic (inbreeding) depression and stochastic demographic processes.

Diagnosis of Fishing Activity

Geographically, the Upper Gulf of California is defined by an imaginary line between Punta Final, Baja California and El Desemboque, Sonora. Fishing, both commercial and recreational, is one of the principal economic activities in this region. The main unloading ports are San Felipe, Baja California and Puerto Peñasco and Golfo de Santa Clara, Sonora (Sierra Rodríguez et al., 2001). Fishing is obviously of strategic importance in the Upper Gulf of California as a provider of high protein food, a direct and indirect generator of employment, and a source of foreign exchange earnings from exports. The Upper Gulf of California-Colorado River Delta ecosystem has been recognized as one of the most productive regions of the Gulf of California when it comes to fishing production: blue shrimp, totoaba, gulf corvina, mullet, bigeye croaker (chano norteño or berrugata), sierra, manta ray, guitarfish, shark, crab, and clam. The primary economic activity in the Upper Gulf of California and Colorado River Delta Biosphere Reserve is fishing, both industrial and inshore. Shrimping in the Pacific Ocean yields higher values than in any other part of Mexico and is also very important from a social standpoint, accounting for approximately 79% of total shrimping in Mexico (INP/CONAPESCA, 2005).¹

In the Upper Gulf region, including the Reserve, shrimpers catch brown and blue shrimp, and the average catch of the small vessels in Golfo de Santa Clara, San Felipe and Puerto Peñasco (fleet of approximately 650 vessels) is 700 tons a year. In addition, the catch brought in by larger vessels (162 boats) varies in volume, but the yield of both types of vessels combined is an annual average of approximately 1,500 to 2,000 tons (INP, 2002). However, the Management Plan for

¹ Management Plan for Shrimping on the Mexican Pacific Coast, INP/CONAPESCA 2005.

Shrimping on the Mexican Pacific Coast recognizes that "... over the last 10 years the availability of shrimp resources in the Mexican Pacific has averaged 54,500 tons live weight. The average volume of shrimp available per shrimping season is approximately (...) 400 t (averaging 80% blue and 20% brown) for the Upper Gulf of California."

Shrimping all along the Mexican Pacific Coast has been a problem for several years, as acknowledged in the Management Plan. Overfishing affects abundance by the end of each season, which coincides with the reproductive cycle. This, coupled with the use of larger mesh nets, has a negative impact on size composition (INE/CONAPESCA, 2005). However, the most pressing problem is the constant presence of illegal and surreptitious fishing. According to the aforementioned plan, the solution to this problem might be "to reduce or eliminate future competition among different sectors for the same resource by assigning rights and responsibilities to that resource by restricting access to it." On this basis, SAGARPA has developed important instruments for managing this type of fishing, including regulations, on-board observers, buy-out programs, and control over fishing licenses, as detailed below. In addition, in an effort to protect the vaquita, in 2003 SEMARNAT suggested assigning a fishing quota to each fleet (industrial and inshore) based on the load capacity of the ecosystem in the Upper Gulf of California and particularly in the Biosphere Reserve.

As in other parts of the world, larger shrimping vessels in the Upper Gulf of California use bottom trawl nets. Not only are they not selective, but they alter soft-bottom environments, which has a direct impact on epibenthic, meiobenthic and demersal organisms living on or near the seabed. It has been estimated that, depending on the location, every square meter of the seabed in the shrimping area of the Gulf of California is swept four to seven times a year by the shrimping fleet's nets (Nava and García, 2003, cited in SEMARNAT-SAGARPA, 2004). Brown et al. (1991, cited in SEMARNAT-SAGARPA, 2004) report that the

entire area comprising the industrial fishing zone in the Upper Gulf is "dragged" an average of 6.1 times each fishing season. Furthermore, the trawl nets' lack of selectivity not only results in the bycatch of endangered species such as juvenile totoaba and sea turtles, but it also increases the proportion of fauna accompanying/target species to 10:1, thereby wasting large numbers of species that are important for other fisheries, especially inshore ones. According to the data contained in the Management Plan for shrimp, it is estimated that over the last 10 years local catches of fish by trawl nets amount to about 200,000 tons for the Gulf of California (INP/CONAPESCA, 2005). Consequently, in order to promote the sustainability of fisheries in the Biosphere Reserve, the Regulation of the General Law for Ecological Balance and Environmental Protection [Reglamento de la Ley General de Equilibrio Ecológico y la Protección al Ambiente en material de Áreas Naturales Protegidas, LGEEPA] regarding Protected Natural Areas was amended to set up a mechanism for determining limits to bycatch and gradually reduce them as fishing gear improves. SAGARPA has also developed important instruments such as NOM-062-PESC-2006, which provides technical specifications for devices to exclude sea turtles to be used by the shrimp trawling fleet in Mexican federal waters, technology research programs, fishing gear replacement, an on-board observer program, data recording in fishing logs, and others.

The artisan or small-scale fishing sector, which includes commercial divers, catches about 70 different species using small, deckless boats called "pangas" (10.5 m in length, uncovered, with a maximum capacity of 3 tons and 55-115 HP motors) and a wide variety of gear, including gillnets, chinchorro or trammel nets, trawl lines, hooks and lines, and catching fish by hand using semi-autonomous diving gear and traps (SEMARNAT-SAGARPA, 2004; CONAP, 2007). This sector is the one that has probably seen the largest increase in the number of pangas authorized for shrimping and scale-fishing, and also

the one posing the greatest problem of illegal and surreptitious fishing. In addition, the fishing gear used by the inshore fleet also has an impact on the ecosystem in the form of bycatch of at-risk species, in this case particularly the vaquita.

Thus, in response to the shrimping problem, the Program for Sustainable Fishing and Protection of Species in the Upper Gulf of California (SEMARNAT-SAGARPA, 2004) included a buy-out plan for the industrial shrimping fleet, with the purpose to reduce fishing effort. The effort has been hailed by the United Nations Food and Agriculture Organization (FAO) and the Organization for Economic Cooperation and Development (OECD). Furthermore, based on the Management Plan for this industry, administrative measures have been established, such as prohibitions in certain seasons and zones, in order to reduce mortality caused by fishing during recruitment, migration and reproduction.

As can be seen, some of the measures contained in the Management Plan for Shrimping on the Mexican Pacific Coast (Table 4) coincide with those in the Program for the Protection of the Vaquita in the Vaquita Refuge Area. Therefore,

their implementation would help solve the fishing and environmental problems of the Upper Gulf of California.

In view of the problems faced by the fishing sector in the Upper Gulf of California region, CONAPESCA's fishing management program calls for individualizing commercial fishing licenses in the local communities. This process is well underway in San Felipe; the individualization of shrimping licenses had been completed by December 2007 there. The same procedure for finfish licenses will be completed during the first quarter of 2008, followed by the individualization of all licenses (for shrimp and scale-fish) in Golfo de Santa Clara and Puerto Peñasco, Sonora. The fishing agency also plans to regionalize licenses, a process that will also be completed by February 2008. With regard to the implementation of programs for the administration and oversight of fishing activities, CONAPESCA is taking steps to require license plates for fishing vessels, credentialing for fishermen, and labeling of fishing gear. Among the actions that will contribute greatly to the conservation of the vaquita are replacing trawl nets with nets that have a much smaller impact on the seabed; conducting technology research in

TABLE 4. MANAGEMENT PLAN FOR SHRIMPING. VAQUITA PROTECTION PROGRAM. GENERAL MANAGEMENT MEASURES

Establishment of fishing rates prior to the fishing season.
Management of fishing activity by restricting fishing areas, limiting the number of trips and modifying fishing gear. Establishment of an official observer program on board fishing vessels (large and small) and thereby placing fishing activity in the times and locations that best suit the distribution of abundance that has been identified.
Due to the important role the INP currently plays in fishing research, it will have priority access to data from this program in real time.
Management Measures for the Upper Gulf of California
The research results on the status and condition of shrimping in the region demonstrate that a maximum bycatch volume must be set for the Colorado River Delta and Upper Gulf of California Biosphere Reserve. Therefore, a ratio of bycatch to shrimp catch in terms of weight must be established in the buffer zone.
Environmentally friendly fishing systems must be promoted and encouraged so that bycatch volumes can be gradually decreased and the impact on the sea floor minimized.

order to replace the gear used by inshore fishermen with more environmentally friendly and selective equipment; and strengthening inspection and monitoring programs.

Socioeconomic Diagnosis

There are three main towns in the area of interest, San Felipe, Baja California and Golfo de Santa Clara and Puerto Peñasco, Sonora. All were founded in the first third of the 20th century as fishing camps for totoaba, shark, sand perch and shrimp. At present, San Felipe has a population of approximately 16,000; Golfo de Santa Clara, 5,000; and Puerto Peñasco, 40,000. Each town has a distinct economic structure. San Felipe and Puerto Peñasco have diversified their economies, with tourism and fishing being the principal production activities. In contrast, inshore fishing accounts for 80% of the economy of Golfo de Santa Clara.

Generally speaking, fishing resources are exploited by three different groups of fishermen: industrial fishing using large vessels, inshore or artisan fishing using small vessels called “pangas” (including commercial divers), and sports/recreational fishing. Also there are three different fishing administrative offices for the Baja California coast, the Sonora coast and federal waters. Their respective administrative agencies are located in San Felipe, Baja California and in Golfo Santa Clara and Puerto Peñasco, Sonora.

The industrial sector, also called the major fleet, catches not only shrimp, but also rays, bigeye

croakers, corvinas, cabrillas, flounders, baquetas, crabs, and various species of mollusk. Most of the vessels are berthed at Puerto Peñasco, where approximately 120 shrimpers and/or finfish boats can be found, accounting for about a fifth of the shrimping fleet in Sonora. There are also 16 shrimpers in San Felipe and a variable number of shrimpers from other ports, such as Guaymas, that have operated in the Reserve at some point in the shrimping season in the past. According to the environmental impact permit (Document SGPA-DGIRA.DG.1882/04 of November 11, 2004), 162 shrimping boats are allowed to operate with trawl nets in the Reserve. Most of the business owners belong to the National Chamber of the Fishing Industry [Cámara Nacional de la Industria Pesquera – CANAINPES] and to Armadores Unidos de Puerto Peñasco, S.A. de C.V. [united boat owners of Puerto Peñasco, limited liability stock corporation].

The artisan or inshore fishing sector, called the minor fleet, consists of about 1,771 vessels authorized to fish with nets, as shown in Table 5. In addition, a number of small vessels are known to be operating without authorization in the Reserve. It can be seen that there is a marked disparity in the fishing activities carried out by the inshore fleet in the Upper Gulf of California.

At present there are more than 100 inshore fishing cooperatives licensed to operate in the Reserve, more than 60 in Golfo de Santa Clara, 17 in Puerto Peñasco, and 18 in San Felipe. The considerable growth in the number of cooperatives is one of the biggest problems in this sector because of the increased demand for fishing licenses, especially for

TABLE 5. SMALL VESSELS AUTHORIZED TO FISH WITH NETS IN THE UPPER GULF OF CALIFORNIA

Small vessels authorized	San Felipe	Golfo de Santa Clara	Puerto Peñasco	Total
Shrimp	325	249	56	630
Finfish	295	490	175	960
Shark	10	26	69	105

bay shrimp. These cooperatives have also gotten together and formed cooperative federations, one in each community in San Felipe and Puerto Peñasco and five in Golfo de Santa Clara.

The last group of fishermen is engaged in sports or recreational fishing, offering services to Mexican and foreign tourists. They are concentrated in Puerto Peñasco, with 71 medium-size and large vessels, and in San Felipe, with about 10 boats. They generally operate outside the Reserve. The most noteworthy businesses in Puerto Peñasco are Charters Pompano, Lobo del Mar Charters, Manny's Beach Club, Toshiro Arenas and Pedro Nava; those in San Felipe are Tony Reyes Sport Fishing and Embarcaciones Celia Angelina. This activity includes diving in the so-called "artificial reefs."

Minimization of Impacts and Scenario Building

Implementation of both command-control (mandatory) or voluntary environmental protection measures entails certain costs and investments for the parties involved. In this case, the proposed actions to prevent the extinction of the vaquita necessarily have an impact on the Upper Gulf communities due to the reduction in the volume of marine products that can be caught. Consequently this will bring drastic changes in the regional economy and may cause social problems. To counteract this problem, a viable plan must be put in place to minimize the economic impacts on those directly involved and reorient the regional and local economy towards alternative production activities that are compatible with the conservation of the species and the biodiversity of the Upper Gulf of California.

To find such alternatives, it is necessary to know more about the region's capital, both human and natural, fishermen's awareness and willingness to

change their lifestyles, and the growth potential of the proposed alternative activities.

A number of authors such as Latapí (2004), WWF-INE (2005), experts on the Upper Gulf and Colorado River Delta Biosphere Reserve (2002), Fuentes et al., and Latapí et al. (2004) have described the human and natural capital that exist in the region as well as its socioeconomic situation. However, we know little about the different alternatives for producing goods and services other than fishing in this area.

It is not easy to come up with alternative activities or new businesses. It is important to realize that the people who depend on fishing activities to make their living will be forced to change their entire lifestyle, one that in many cases is the legacy of several generations. In this regard, suggestions must take into account the sociocultural context as well as the need to preserve the environmental value of the region.

Alternatives for Preventing the Extinction of the Vaquita

Efforts to prevent the crisis facing us today about the disappearance of this species date back many years. Some alternatives proposed in the past were restrictive in nature and given the predominant economic, political and social context, did not succeed in preventing the vaquita bycatch. The crisis has now overtaken us and we are forced to take drastic measures.

1) The Vaquita Refuge Site

Experts suggest that this is the most important strategy to consider. It entails evaluating the possibility of preventing the use of gillnets across the entire northern end of the Upper Gulf of California in an area recommended three years ago by the International Committee for the Recovery of the Vaquita (CIRVA), or perhaps a smaller zone covering 80% of vaquita sightings (red).

It should be noted that there are other costs to consider if the use of trammel and gillnets is discontinued in this zone, including both capital and labor costs. The capital cost envisioned is the cost of no longer carrying out activities in this zone, though in that case the capital goods could continue to be used to fish in the rest of the Upper Gulf. The labor cost is different, because these are workers who will be unemployed for an undetermined period of time (one month, six months, a year) until they can find an alternative. In this case, an additional compensation might be suggested, not only for lost profits, but also for the temporary unemployment of workers.

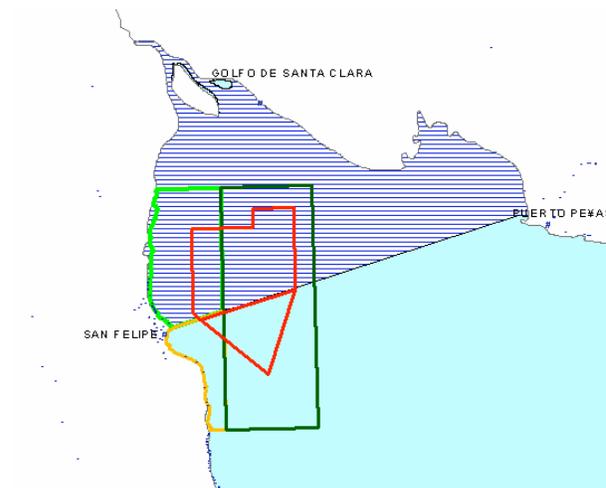


FIG. 7 AREAS FOR SCENARIO BUILDING

**TABLE 6. SCENARIO 1: INCOME AND COSTS IN THE REFUGE AREA
FIELD REVIEWED DATA (MILLIONS OF PESOS)**

Location	Species	Catch Inside Refuge Zone (tons)	On-Beach Price (pesos)	Value of Catch Inside (pesos)	Cost of Catch Inside (pesos)	Average Variable Costs of Labor* (pesos)	Profit Inside Refuge Zone (pesos)	PROFIT + LABOR
San Felipe	shrimp	150	150	\$22.50	\$13.54	\$2.71	\$8.96	
	croaker	300	5	\$1.50	\$1.41	\$0.28	\$0.09	
	corvina	175	10	\$1.75	\$1.11	\$0.22	\$0.64	
	manta ray	15	27	\$0.41	\$0.36	\$0.07	\$0.04	
	sierra	10	15	\$0.15	\$0.14	\$0.03	\$0.01	
	shark	30	18	\$0.54	\$0.37	\$0.07	\$0.17	
						\$0.00	\$0.00	\$0.00
								\$13.30
Golfo de Santa Clara	shrimp	84	150	\$12.60	\$9.76	\$1.95	\$2.84	
	croaker	0	5	\$0.00	\$0.00	\$0.00	\$0.00	
	corvina	0	10	\$0.00	\$0.00	\$0.00	\$0.00	
	manta ray	0	27	\$0.00	\$0.00	\$0.00	\$0.00	
	sierra	250	15	\$3.75	\$3.72	\$0.74	\$0.03	
	shark	50	18	\$0.90	\$0.00	\$0.00	\$0.90	
								\$6.47
Puerto Peñasco	shrimp	0	150	\$0.00	\$0.00	\$0.00	\$0.00	
	croaker	0	5	\$0.00	\$0.00	\$0.00	\$0.00	
	corvina	0	10	\$0.00	\$0.00	\$0.00	\$0.00	
	manta ray	0	27	\$0.00	\$0.00	\$0.00	\$0.00	
	sierra	0	15	\$0.00	\$0.00	\$0.00	\$0.00	
	crab	0	18	\$0.00	\$0.00	\$0.00	\$0.00	
	guitar fish	0	20	\$0.00	\$0.00	\$0.00	\$0.00	
								\$0.00
TOTAL				\$44.10	\$30.42	\$6.08	\$13.68	\$19.76

**TABLE 7. SCENARIO 2: INCOME AND COSTS IN THE CIRVA ZONE
FIELD REVIEWED DATA (MILLIONS OF PESOS)**

Location	Species	Catch Inside CIRVA Zone (tons)	Value of Catch (millions of pesos)	Cost of Catch (millions of pesos)	Average Variable Costs of Labor (millions of pesos)*	Profit Inside CIRVA Zone (pesos)	PROFIT + LABOR
San Felipe	shrimp	274	\$41.10	\$24.33	\$4.87	\$16.77	
	croaker	355	\$1.78	\$1.63	\$0.33	\$0.14	
	corvina	600	\$6.00	\$3.04	\$0.61	\$2.96	
	manta ray	48	\$1.30	\$1.14	\$0.23	\$0.15	
	sierra	30	\$0.45	\$0.40	\$0.08	\$0.05	
	shark	70	\$1.26	\$0.70	\$0.14	\$0.56	
	crab		\$0.00	\$0.00	\$0.00	\$0.00	
	guitar fish		\$0.00	\$0.00	\$0.00	\$0.00	
					\$0.00	\$0.00	
							\$ 26.89
Golfo de Santa Clara	shrimp	82	\$12.30	\$9.52	\$1.90	\$2.78	
	croaker	70	\$0.35	\$0.34	\$0.07	\$0.01	
	corvina	250	\$2.50	\$1.34	\$0.27	\$1.16	
	manta ray	0	\$0.00	\$0.00	\$0.00	\$0.00	
	sierra	270	\$4.05	\$4.00	\$0.80	\$0.05	
	shark	75	\$1.35	\$0.75	\$0.15	\$0.60	
							\$7.79
Puerto Peñasco	shrimp	0	\$0.00	\$0.00	\$0.00	\$0.00	
	croaker	0	\$0.00	\$0.00	\$0.00	\$0.00	
	corvina	0	\$0.00	\$0.00	\$0.00	\$0.00	
	manta ray	0	\$0.00	\$0.00	\$0.00	\$0.00	
	sierra	0	\$0.00	\$0.00	\$0.00	\$0.00	
	Shark	0	\$0.00	\$0.00	\$0.00	\$0.00	
	guitar fish	0	\$0.00	\$0.00	\$0.00	\$0.00	
							\$0.00
TOTAL			\$72.43	\$47.18	\$9.44	\$25.25	\$34.68

Scenario 2: CIRVA Zone – green and yellow lines

In 2001 CIRVA proposed a rectangle extending to the coast of Baja California, where the largest number of vaquita sightings has been recorded.

Scenario 3: Distribution Area

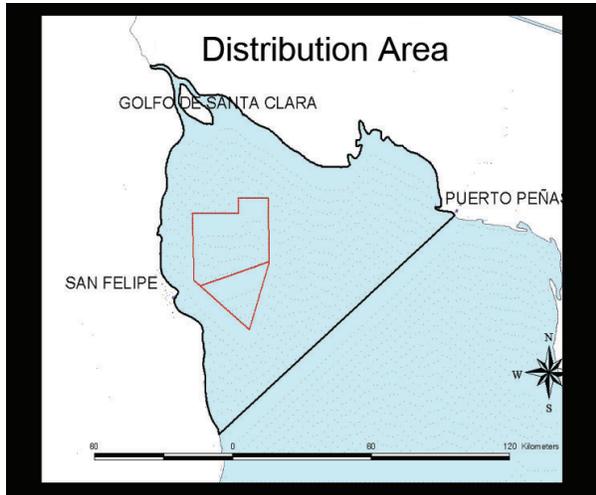


FIG. 8 VAQUITA DISTRIBUTION RANGE

This zone has been proposed by the World Wildlife Fund (WWF), and CIRVA supports it as a radical and powerful measure. This scenario does not allow the use of trammel or gillnets in virtually any of the vaquita habitat. In policy terms, it might be a temporary measure (ten years) that could be adjusted as the vaquita population recovers.

ALTERNATIVES

The proposed scenarios would have an economic impact on inshore fishermen of the three communities, so activities designed to reorient production and improve fishing technology should be promoted in order to safeguard family incomes.

The ultimate objective is to ensure the governability of the region and the economic sustainability of the communities. Accordingly, a program for diversifying income and fostering projects that benefit everyone should be contemplated. With a vision of sustainability, it is hoped that conservation projects will also contribute to the well-being of communities in the region by making efficient use of resources (natural, economic and human).

Sustainability

The proposed plan requires a long-term commitment in order to maintain a steady flow of resources and economic incentives. Moreover, costs of the proposed activities should be covered for the lifetime of the project, that is, for as long as it takes to establish socioeconomically viable alternatives to fishing.

Possible Sources of Financing

1. Identification of existing or potential resources in federal, state and municipal institutions with responsibilities, interests and involvement in the environmental, social and development issues directly related to the Upper Gulf of California, including the following:

Federal government: SEMARNAT (CONANP, PROFEPA, INE), SAGARPA, the Secretariat of Tourism (SECTUR), the Secretariat of Social Development (SEDESOL) and the National Fund for the Promotion of Tourism (FONATUR), through

**TABLE 8. SCENARIO 3: INCOME AND COSTS IN THE DISTRIBUTION AREA
FIELD REVIEWED DATA (MILLIONS OF PESOS)**

Location	Species	Catch Inside Distribution Area (tons)	Value of Catch (millions of pesos)	Cost of Catch (millions of pesos)	Average Variable Costs of Labor (millions of pesos)	Profit Inside Distribution Area (pesos)	PROFIT + LABOR
San Felipe	shrimp	342	\$51.30	\$30.88	\$6.18	\$20.42	
	croaker	355	\$1.78	\$1.67	\$0.33	\$0.10	
	corvina	600	\$6.00	\$3.80	\$0.76	\$2.20	
	manta ray	48	\$1.30	\$1.15	\$0.23	\$0.14	
	sierra	185	\$2.78	\$2.55	\$0.51	\$0.23	
	shark	143	\$2.57	\$1.77	\$0.35	\$0.80	
	crab		\$0.00	\$0.00	\$0.00	\$0.00	
	guitar fish	138	\$2.76	\$1.81	\$0.36	\$0.95	
					\$0.00	\$0.00	\$0.00
							\$ 33.57
Golfo de Santa Clara	shrimp	280	\$42.00	\$32.52	\$6.50	\$9.48	
	croaker	470	\$2.35	\$2.25	\$0.45	\$0.10	
	corvina	2705	\$27.05	\$14.46	\$2.89	\$12.59	
	manta ray	53	\$1.43	\$1.41	\$0.28	\$0.02	
	sierra	518	\$7.77	\$7.71	\$1.54	\$0.06	
	shark	150	\$2.70	\$1.86	\$0.37	\$0.84	
	guitar fish	50	\$1.00	\$0.65	\$0.13	\$0.35	
							\$35.60
Puerto Peñasco	shrimp	100	\$15.00	\$8.14	\$1.63	\$6.86	
	croaker	75	\$0.38	\$0.36	\$0.07	\$0.01	
	corvina	0	\$0.00	\$0.00	\$0.00	\$0.00	
	manta ray	71	\$1.92	\$1.58	\$0.32	\$0.34	
	sierra	22	\$0.33	\$0.29	\$0.06	\$0.04	
	crab		\$0.00	\$0.00	\$0.00	\$0.00	
	guitar fish		\$0.00	\$0.00	\$0.00	\$0.00	
							\$9.33
TOTAL			\$170.40	\$114.88	\$22.98	\$55.53	\$78.50

each agency's promotion and social development programs.

State governments: Secretariats of Ecology, Environment, Tourism and Development, among others, as well as municipal governments.

International support: from governments and non-governmental organizations that have shown an interest in the recovery of the vaquita by providing technical assistance to the Mexican Government and economic resources to the fishing communities.

2. Overtures to the stakeholders that benefit from the resources of the Upper Gulf to explore their interest in helping to promote the conservation of those resources and strengthening their image as socially and environmentally responsible companies. These stakeholders include:

- Businesses that sell marine products
- Businesses that cater to tourists
- Others

3. Overtures to national and international foundations that currently support conservation in the Gulf of California or might be interested in doing so.

4. Overtures to interested national companies.

5. National non-governmental conservation organizations. In fact these organizations, whether individually, collectively or in close collaboration with the aforementioned institutions and organizations, have offered to seek additional financial resources beyond those contributed by the institutions in the three levels of government to finance activities that will contribute to the protection and recovery of the vaquita.

TABLE 9. PROJECTS DEVELOPED IN THE UPPER GULF AND THE COLORADO RIVER DELTA TO PROVIDE ALTERNATIVES TO FISHING

Project	Location	Competitive Advantages
Formation of a cooperative for producing oysters and experimenting with other bivalves native to the region, such as the rock scallop and the lion's paw scallop.	Ejido Salinas de Gortari, 45 minutes northwest of Puerto Peñasco	*Good location (in the very productive San Judas Estuary) *Demand for this type of product in local and regional markets
Santa Clara Ecotourism Project	Ejido Luis Encinas Johnson	*Abundant wildlife (especially birds) * Scenic attractions such as the Tular and some lagoons.

Source: CONANP¹

1. CONANP, Production Projects in Protected Natural Areas. Conservation for Development, CONANP Directorate of Strategic Communication and Identity

Potential for New Businesses in the Area

Some projects to provide alternatives to fishing have been developed in the area. These endeavors include the opening of an oyster center, and of course ecotourism activities. It should be noted that Puerto Peñasco and San Felipe have naturally moved into tourist activities.

The current challenge is to develop many more alternative projects that take into account not only the requirements of the business plan but also the fishermen's view of the activities they may pursue.

In 2001 in Mexicali, Baja California, a workshop was held to devise a socioeconomic strategy for the recovery of the vaquita.² It was attended by representatives of different social, production, financial, and development organizations, and the participants concluded that creating alternatives to fishing as a means of protecting the vaquita was of the utmost importance. However, they noted that opposition to change can be expected because of the local fishing culture and the economic interests that would be affected.

To minimize opposition by the region's populace, the workshop participants concluded that five key points must be considered in new business strategies. First, the new businesses must generate at least as much if not more income than current producing activities. Second, all stakeholders should be actively involved in the design of these new businesses. Third, plans should be accomplished as soon as possible, generating tangible economic benefits that are on schedule and evident to the interested parties. Fourth, the information generated should be accessible to the entire public. And fifth, the general public (domestic and international) should be aware of

the vaquita, its habitat and the problems it faces, and the strategy for dealing with them.

Fuentes et al. conducted a survey of participation in investment projects among residents of the area affected by the Core Zone of the Biosphere Reserve. Their questionnaire identified a total of 21 proposals, which are listed in the following table.

² Results of the Meeting on Socioeconomic Aspects, February 26-28, 2001-04-20 Mexicali, Baja California, Mexico, Conservation and Sustainable Development Strategy for the Recovery of the Vaquita *Phocoena sinus*, Colorado River Delta and Upper Gulf Biosphere Reserve.

TABLE 10. IDENTIFICATION OF PROJECTS BY LOCAL RESIDENTS

Shrimp farm	Fish product processing/ marketing firm	Waste (garbage) recycling
Fresh-water fish farm	Silage processing	Ice plant
Scallop and oyster farm	Sports fishing/ecotourism	Gasoline station
Seafood freezing plant	Artificial reef	Eucalyptus and medicinal plant cultivation
Fishing resource warehouse or transfer station	Harbor for small vessels with repairs and inspection	Supplying equipment for the Golfo de Santa Clara field station
Tortilla factory	Hotels/restaurants	Textile maquiladora plant
Rabbit farming	Leather and homemade goods	Hunting projects

Source: Fuentes et al. Study conducted circa 1998.

This table shows only marketing opportunities. To assess the success or relevance of each project, variables such as costs, sociocultural impact and environmental impact must be considered. In this regard, only eight projects were analyzed, as shown in the next table.

TABLE 11. PROJECTS SELECTED FOR STUDY

Multiple species fresh-water fish farm	Fishing resource warehouse or transfer station
Scallop (Pacific calico scallop) and oyster farm	Sports fishing/ecotourism activities
Shrimp farms	Hunting activities
Shrimp freezing plant	Textile maquiladora plant

Source: Fuentes et al.

These projects were selected because they meet the sustainability requirement, but market testing was still needed to determine their viability. After financial, economic and social analyses were conducted using three investment yield measuring criteria (net present value, NPV; internal rate of return, IRR; and benefit/cost ratio, BCR), the projects' feasibility was evaluated. Fuentes et al. claim that the net benefit/investment ratio (NB/I) or the IRR can rank the projects according to how they must be executed over time in the face of temporary shortages of capital, as follows:

- 1.- Promote fishing for commercial species (i.e., mollusks, shrimp and fish) and market them at the warehouse or transfer station;
- 2.- Raise traditional commercial species (such as shrimp or scallops) on farms;
- 3.- Raise multiple species of fresh-water herbivorous fish;
- 4.- Develop hunting activities, ecotourism and sports fishing;
- 5.- Establish maquiladora and freezing plants.

It is hoped that this will bring about diversification and a change in production patterns in the study area. There are different perspectives on the most appropriate options, however. Table 12 shows those different perspectives.

More recent data (Upper Gulf and Colorado River Delta Biosphere Reserve, 2002) suggest other projects. There are no studies analyzing the projects listed in Table 13 as rigorously as the Fuentes et al. study, however.

It is very important to mention that the findings of Fuentes et al. reflect the situation that prevailed eight or nine years ago, when the study was conducted. It is highly likely that conditions have changed enough to alter these results, but it is doubtful that the results of a new study would yield drastically different conclusions from those presented here.

TABLE 12. PERSPECTIVES ON THE MOST AND LEAST FEASIBLE PROJECTS

PERSPECTIVE	MOST FEASIBLE PROJECTS (from most to least feasible)	LEAST FEASIBLE PROJECTS	UNFEASIBLE PROJECTS
Private viewpoint	Sports fishing/ ecotourism	Warehouse and freezing plant	Textile maquiladora plant
	Traditional and emerging species farming		
	Hunting activities		
Economic viewpoint	Sports fishing	Hunting activities	Warehouse or transfer station
	Fish and mollusk farms		Shrimp freezing plant
			Textile maquiladora plant
Social viewpoint	Seafood freezing plant	Traditional and emerging product farming	Hunting activities and ecotourism and sports fishing
	Warehouse		
	Mollusk farm		
	Textile maquiladora		

Source: Authors' compilation based on Fuentes et al.

TABLE 13. ALTERNATIVES TO SHRIMPING IN THE AREA

Name of project	Who is proposing it?	Where would it be implemented?	What does it consist of?	Possible Problems with Project	Possible Benefits of Project
Totoaba fishing	Tourism sector of San Felipe	San Felipe	Proposal to lift totoaba (<i>Totoaba macdonaldi</i>) ban. On the other hand, the Autonomous University of Baja California (Universidad Autónoma de Baja California, UABC) is producing totoaba young to repopulate the Upper Gulf.	<ul style="list-style-type: none"> - According to Chavez et al. (1972) and Román (1994) (cited by Fuentes et al.), between the 1970s and the 1990s the totoaba experienced problems similar to those of the vaquita. - The species is threatened with extinction. - It is included in NOM 059. - If totoaba fishing is opened up, there is a risk that independent fishermen will fish without control. 	<ul style="list-style-type: none"> - If the totoaba ban is lifted, a fishing alternative that does not employ gillnets could be provided. - The San Felipe projects should be given top priority, because this area has remained isolated in terms of conservation efforts. - Sports fishing tourism might be attracted.
Tourism Project	Tourism sector of San Felipe	San Felipe	Approval of tourism development in San Felipe, a marina (now part of the Escalera Náutica project) and the creation of artificial reefs	Although this is an alternative to fishing, developing tourism could be detrimental to the ecosystem	The Secretariat of Tourism is willing to share responsibilities and objectives

Source: INE; authors' compilation based on data from the Colorado River Delta and Upper Gulf Biosphere Reserve (2002).

III. CONSERVATION SUBPROGRAMS

To implement this Action Program, a number of activities and actions have been divided into six subprograms, as follows: Protection (related to law enforcement, inspection and monitoring); Management; Restoration; Knowledge; Culture; and Administration, all linked to the general and specific objectives set forth below, which have been developed based on the proposals made by inshore and deep-sea fishermen and by non-governmental organizations in the Sustainable Upper Gulf group.

OBJECTIVES

GENERAL

CONSERVE AND RECOVER THE VAQUITA BY PROMOTING THE SUSTAINABLE MANAGEMENT OF MARINE AND COASTAL RESOURCES IN THE UPPER GULF OF CALIFORNIA

SPECIFIC

- Promote, define and establish management and conservation measures to guide the appropriate development of activities aimed at achieving the sustainable use of the Upper Gulf of California's natural resources in a manner consistent with the conservation and recovery of the vaquita, in coordination with inshore and deep-sea fishermen, the academic sector, civil society and state and municipal governments.
- Minimize the negative impacts that management measures might have on the population's well-being through various mechanisms, including but not limited to

programs for reorienting and diversifying production, improving technology, encouraging better fishing practices and developing value-added markets.

- Strengthen the development of scientific, biological and socioeconomic research to yield better knowledge of the ecosystem and its resources, to help solve the problems affecting the vaquita and its habitat, and to encourage the dissemination of findings and the exchange of information.
- Promote production alternatives and technological development for the economic and social well-being of local communities in the region and the sustainable use of natural resources.
- Achieving these objectives requires close collaboration among the stakeholders, namely: inshore and deep-sea fishermen, civil society organizations, academia and authorities of the three levels of government. Extensive consultation with the stakeholders with a view to arriving at agreements and consensus-building will make this collaboration a reality.

SEMARNAT and SAGARPA will link their institutional projects in the region and reach coordination agreements with the state governments of Sonora and Baja California and the municipal governments of Mexicali, San Luis Río Colorado and Puerto Peñasco. The federal government will maintain close ties with AGS as the coordinating body for the fishing communities, non-governmental organizations and companies of the shrimp industry.

III.1 Protection

The Protection Subprogram focuses on setting up and implementing an ongoing inspection and monitoring program, operated in close coordination with PROFEPA, CONAPESCA and the Secretariat of the Navy (SEMAR). The participation of the three levels of government and organized civil society will also be sought, along with that of the monitoring group created as part of the activities carried out and promoted by the AGS group.

In addition, the fishing communities will be engaged to reach a consensus on drafting the regulations necessary to implement Subparagraph 4.2 of the Protection Program, which was published in the Official Gazette of the Federation (DOF) on December 29, 2005.

It should be mentioned that since 2007 SAGARPA, through CONAPESCA, has been putting together State Inspection and Monitoring Committees pursuant to the provisions of the General Act on Sustainable Aquaculture and Fishing.

Objectives

- Put in place the necessary regulatory framework to protect the vaquita.
- Ensure compliance with environmental standards that protect the vaquita, its habitat and the threatened marine resources that inhabit the Upper Gulf of California and Colorado River Delta Biosphere Reserve.
- Ensure compliance with applicable fishing standards in order to protect the vaquita, its habitat and the threatened marine resources that inhabit the Colorado River Delta and Upper Gulf of California Biosphere Reserve.
- Eliminate illegal fishing.

Strategies:

- Draft the regulations called for in Subparagraph 4.2 of the Protection Program, within the applicable legal framework.
- Develop measures to promote compliance with current policies, regulations, standards and guidelines.
- Disseminate timely information on current legal provisions governing the environment and fishing.
- Ensure compliance with current standards by exercising authority and carrying out preventive and deterrent verification efforts.
- Foster inter-institutional coordination at the federal level and cooperation among educational and research institutions and civil society.
- Establish efficient systems for communicating with the relevant social actors.
- Eliminate surreptitious or illegal fishing activities.

Adherence to applicable laws and regulations governing the use of the protected natural area and the Refuge Area is a sine qua non for conservation and management. It can be achieved with a strategy combining year-round inspection and monitoring and an intensive outreach and education program, in addition to encouraging user participation in caring for the resources they rely on to earn their livelihood. To implement this component, ongoing communication and coordination will be established with the participative environmental oversight efforts that the Sustainable Upper Gulf group is supporting. Additionally, efforts will be made to exploit synergies with the instruments set up under the Culture and the Administration Subprograms.

Expected Results and Goals

- Design and implement an ongoing inspection and monitoring program aimed at protecting the vaquita's habitat.

- Prevent environmental and fishing violations.

TIMELINE

Activities* and Actions	Time Period					
	2007	2008	2009	2010	2011	2012
Regulations for the implementation of the Protection Program (SEMARNAT/CONAPESCA)						
Draft required regulations, in coordination with the appropriate authorities and the corresponding Regulatory Impact Assessment (Manifestación de Impacto Regulatorio MIR, in Spanish)						
Hold public forums on the proposed regulations						
Publish regulations						
Ongoing inspection and monitoring program						
Design and implement the ongoing joint PROFEPA-CONAPESCA/SEMAR program for vaquita protection						
Eliminate illegal fishing (CONAPESCA/PROFEPA/SEMAR)						
Coordinate special seasonal operations (shrimping ban; gulf corvina, shrimp, croaker and sierra seasons)						
Consolidate inspection and monitoring program (monitoring patrols, verifications, special operations, response to complaints and reports of violations, and meetings to educate various groups on awareness and prevention efforts)						
Follow up on coordination agreement between CONANP and PROFEPA						
Community participation in monitoring						
Establish close and ongoing cooperation with the AGS Task Force on Eradicating Illegal Fishing						
Hold informational meetings with users focusing on prevention of violations						
Operate a direct communication network linking the principal sites in the reserve						
Hold meetings of fishing commissions, federations and oversight councils of the cooperatives to gain their support in inspection and monitoring efforts						

*Activities shown in dark shading.

III.2 Management

Management occurs in different frames of time and space. It encompasses the three levels of biodiversity and will require coordination with other entities. Current scientific data must be employed to carry out adaptive management in which activities related to protection, conservation and the sustainable use of resources can be established or strengthened.

In fisheries, the activity must be compatible with the vaquita protection and recovery objectives as well as those set forth in the Reserve Conservation and Management Program for management and protection, the general principles contained in the General Act on Sustainable Fishing and Aquaculture, and the sustainability criteria outlined in the Code of Conduct for Responsible Fishing. Moreover, the Gulf of California Marine Ecology Regulations (DOF December 15, 2006) recommend that “a preventive approach should be emphasized in order to prevent further pressure on resources, particularly fishing resources, or at least maintain current levels.” In this context, the Management Subprogram has incorporated not only the required species conservation actions but also the component of supporting the adoption of sustainable fishing practices by implementing various measures and programs already initiated by CONAPESCA. It also includes the activities and commitments undertaken by the inshore and deep-sea fishermen in connection with the Sustainable Upper Gulf group, which are basically aimed at eliminating trammel and gillnets by reorienting production and improving technology.

An additional component of this Subprogram is a plan for reorienting production and reforming technology that is far from temporary in focus. In fact, it is intended to jump-start the regional economy through incentives for discovering and applying “environmentally friendly” fishing methods and other economic activities that will improve the quality of life in the three communities

and also promote the sustainable exploitation of the region’s biodiversity.

OBJECTIVE

- Eliminate the vaquita bycatch by eliminating and/or replacing trammel [chinchorro] and gillnets in the Vaquita Refuge Area in an initial phase and, in a second phase, throughout the vaquita distribution area.
- Establish and strengthen sustainable and responsible management of the marine and coastal resources of the Upper Gulf of California, minimizing practices that pose a risk to protected species.
- Bring fishing activities into line with the environmental provisions of the Reserve Conservation and Management Program.

STRATEGIES

- Individualize and regionalize fishing licenses and concessions.
- Promote the use of alternative fishing gear that prevents bycatch.
- Design and implement a plan to diversify production and technology.
- Identify and apply economic incentives for the conservation and sustainable use of marine and coastal resources (labeling and/or certification of sustainable fish products).
- Identify and address other activities that pose a threat to the ecosystem of the Upper Gulf of California.

Recognizing that the application of measures to eliminate and/or replace trammel and gillnets in the vaquita distribution area will have impacts on the regional economy, the federal government has considered implementing a mitigation program

TIMELINE

Activities* and Actions	Time Period					
	2007	2008	2009	2010	2011	2012
Phase I. Eliminate trammel and gillnets in the refuge area (SEMARNAT-SAGARPA)	Dark	Dark	Dark	Light	Light	Light
Phase II. Eliminate trammel and gillnets in the entire vaquita distribution area (SEMARNAT-SAGARPA)	Light	Light	Light	Dark	Dark	Dark
Experiment with alternative nets [suriperas] (SEMARNAT-SAGARPA)	Dark	Dark	Dark	Light	Light	Light
Individualize and regionalize fishing licenses (CONAPESCA)	Dark	Light	Light	Light	Light	Light
Design and implement a SEMARNAT/CONAPESCA data system so that the registry of fishermen can be updated and monitored constantly	Dark	Light	Light	Light	Light	Light
In coordination with CONANP/INE/CONAPESCA/INP, evaluate the status of the totoaba population with a view to possibly lifting the ban and allowing sustainable recreational/sports fishing	Light	Dark	Light	Light	Light	Light
Devise and promote the application of methods and systems for quickly identifying authorized small vessels and fishermen (CONAPESCA)	Dark	Dark	Light	Light	Light	Light
Economic Instruments						
Identify market instruments for sustainable fish products (labeling, certification, etc.) (SEMARNAT-SAGARPA)	Dark	Light	Light	Light	Light	Light
Design and implement a program of economic incentives and financial support for fishermen to reorient production and technology (SEMARNAT-SAGARPA)	Dark	Dark	Dark	Dark	Dark	Dark
In coordination with SAGARPA, SE, state governments and producers, promote research on unexploited fishing reserves	Dark	Dark	Dark	Light	Light	Light

*Activities shown in dark shading.

for inshore fishermen whose activities will be affected by these measures. It would draw on existing subsidies and support systems, such as the Conservation for Development Program (Programa de Conservación para el Desarrollo – PROCODES, formerly the Sustainable Regional Development Program – PRODERS), the Temporary Employment Program [Programa de Empleo Temporal – PET], Alianza Contigo [“alliance with you”], Oportunidades Productivas [production opportunities], and others.

The alternative of providing direct compensation without strings attached to other sorts of support or activity is the most desirable from the standpoint of economic efficiency, since it allows the beneficiaries to adapt to the new restrictions in the way they see fit. However, at times this alternative is seen by the parties involved as a means of support that does not address the problems arising out of the new restrictions, and they prefer measures that instead help them transition to other pursuits without having to cover any additional costs on their own.

For this reason, the reorientation of the inshore fishing industry that uses these nets towards other activities will be carried out in a way that not only prevents fishermen from accidentally catching and killing the vaquita but also provides them with needed income. The effort will also focus on identifying and applying new technologies and fishing gear and harvesting previously unexploited fishing resources, as well as establishing specific management plans for each fishery. In the long term, the outcome will be compatibility between conservation and profitability in commercial fishing.

The possibility of establishing a special program with its own resources and planning and budget items is currently being explored with the appropriate authorities. This program would also have operational guidelines that would allow flexibility in the type of projects to be financed with a view to eliminating vaquita bycatch.

Objective:

Promote the diversification of production and technology and the sustainable use of the region’s marine and coastal resources.

Strategies

- Educate stakeholders affected by vaquita conservation measures in the Upper Gulf about mechanisms for reorienting production.
- Implement a system of incremental benefits for voluntarily waiving the right to fish with trammel and gillnets in the vaquita distribution area.
- Implement plans for production reorientation and economic development in San Felipe, Baja California, Golfo de Santa Clara and Puerto Peñasco, Sonora, in conjunction with federal, state and municipal government agencies.
- Increase and strengthen direct support for projects involving production, training and research through existing subsidy programs in the different agencies operating in the region.
- Establish monitoring mechanisms to follow up on commitments made by compensation recipients and the results of the regional development and production reorientation strategy.

The production reorientation strategy is critical to the success of efforts to discontinue the use of nets and find new technologies to eliminate vaquita bycatch in the Upper Gulf, with the consent and support of local fishermen and communities

Activities

- Include a census of the population in the Upper Gulf area that is to receive compensation under the CONAPESCA

program to individualize and regionalize fishing licenses.

- Establish eligibility criteria and guidelines for evaluating proposals.
- Hold auctions to determine which fishermen in the Upper Gulf communities will be able to participate in the voluntary waiver of fishing rights and how much compensation will be offered.
- Sign agreements with those who have volunteered to waive their fishing rights.
- Work with CONAPESCA to implement the mechanisms for the permanent or temporary withdrawal of the fishing licenses that were voluntarily given up by fishermen who enrolled in the production and technology reorientation programs, or who expressed an interest in waiving their fishing rights for a year or more.

Once licenses to fish with trammel and gillnets have been retired, steps must be taken to ensure they are not conceded to other fishermen. The plan calls for these licenses to be turned over to the authorities or to the AGS group to ensure the success of the program.

In addition, it is to be expected that some portion of the local population will choose to continue their fishing tradition, and for this purpose fishing activities compatible with the strategy will be identified. In addition, new fishing gear and methods that are environmentally friendly and in compliance with the standards will be promoted.

Accordingly, INAPESCA began experimenting with suripera nets in 2007 in order to implement environmentally and economically efficient systems for commercial shrimping in the Upper Gulf of California. The results obtained from this initial testing are provided in Appendix 1.

Production Alternatives

This activity is designed to ensure the availability of economically viable, socially and culturally

acceptable, legally permissible, and environmentally sustainable alternatives (VALS, from the acronym in Spanish).

Such economically viable alternatives include:

- Using fishing gear that does not harm the vaquita (traps, fishing lines, trawl lines, suripera nets, diving) for catching, processing and marketing marine species;
- Recreational/sports fishing;
- Tourism, ecotourism and adventure tourism;
- All kinds of services and businesses;
- Small and medium-size industry; and
- Aquaculture (on land and offshore).

It is hoped that fishermen will adopt better practices and/or take up activities other than inshore fishing during the first three years that the Subprogram is operating. For this purpose, measures will be adopted to support, promote and finance these new production practices in fishing as well as in other sectors, and to ensure the financial viability of the initiatives designed and adopted by the stakeholders themselves. Progress will be measured by comparing the number of fishermen using safe fishing gear from one year to the next in certain areas.

To ensure success, priority will be given to projects that yield results quickly and prove to be efficient in terms of costs and benefits in the early stages of implementing the strategy. It is also acknowledged that to achieve success, the stakeholders must be aware of the benefits of conservation and convinced of the need to change their method of earning a living. Moreover, they also need sensitization and training to give them complete information about the environmental and development-oriented improvements the strategy is designed to bring about.

Program specialists will work directly with the stakeholders to help them analyze the financial and technical viability of the alternatives they choose. In keeping with this approach, local residents

and their social and labor organizations will be encouraged to participate directly in identifying and designing these alternatives. They will be supported through intensive training, and the community will be apprised of the different sources of financing and support, both private and governmental, aimed at enhancing the viability of the businesses and sources of income that are created.

Achieving the program’s objectives requires a financial strategy capable of ensuring funding flows in the short, medium and long terms. Thus, an administrative mechanism will be devised to

attract, manage and apply public and private funding with transparency and efficiency so that the use of trammel and gillnets can be eliminated in the vaquita distribution area.

Similarly, tax incentives will be identified and promoted with a view to creating quality employment opportunities that can be maintained over the medium and long terms. Accordingly, the development plans, programs and projects run by municipal, state and federal government agencies should not interfere with this program’s development plans; rather, they must all support

TIMELINE

Activities* and Actions	Time Period					
	2007	2008	2009	2010	2011	2012
Phase I. Eliminate trammel and gillnets in the refuge area (SEMARNAT-SAGARPA)	Dark	Dark	Dark	Light	Light	Light
Phase II. Eliminate trammel and gillnets in the entire vaquita distribution area. (SEMARNAT-SAGARPA)	Light	Light	Light	Dark	Dark	Dark
Experiment with alternative nets (suriperas) (SEMARNAT-SAGARPA)	Dark	Dark	Dark	Light	Light	Light
Individualize and regionalize fishing licenses (CONAPESCA)	Dark	Light	Light	Light	Light	Light
Design and implement a SEMARNAT/CONAPESCA data system so that the registry of fishermen can be updated and monitored constantly	Dark	Light	Light	Light	Light	Light
In coordination with CONANP/INE/CONAPESCA/INP, evaluate the status of the totoaba population with a view to possibly lifting the ban and allowing sustainable recreational/sports fishing	Light	Dark	Light	Light	Light	Light
Devise and promote the application of methods and systems for quickly identifying authorized small vessels and fishermen (CONAPESCA)	Dark	Dark	Light	Light	Light	Light
Economic Instruments						
Identify market instruments for sustainable fish products (labeling, certification, etc.) (SEMARNAT-SAGARPA)	Dark	Dark	Light	Light	Light	Light
Design and implement a program of economic incentives and financial support for fishermen to reorient production and technology (SEMARNAT-SAGARPA)	Dark	Dark	Dark	Dark	Dark	Dark
In coordination with SAGARPA, SE, state governments and producers, promote research on unexploited fishing reserves	Dark	Dark	Dark	Light	Light	Light

*Activities shown in dark shading.

each other and work towards the same objective, the optimum use of the population's resources and efforts.

the quality of life enjoyed by local residents by 2012.

III.3 Recovery

Considering the scientific research that has been done and the research described in the Knowledge Subprogram, this subprogram focuses on the protection and recovery of the species and the conditions of its natural habitat.

Goal

To preserve the vaquita and 100% of its habitat in the Upper Gulf of California, maintaining the sustainability in the use of natural resources and

Specific Objectives

- Expand the Refuge Area to encompass the entire vaquita distribution area in the Upper Gulf of California.
- Design and implement the necessary regulations, protection and management to ensure the maintenance of the habitat and the recovery of the vaquita population throughout its distribution area.

TIMELINE

Activities* and Actions	Time Period					
	2007	2008	2009	2010	2011	2012
Adopt a policy of total protection for the species in the vaquita distribution area						
Draw up a technical-legal proposal to extend the Refuge Area (2005) to the natural distribution area of the vaquita, based on scientific data that is compiled (CONANP)						
Work with the public, social and academic sectors to agree on the proposal to expand the Refuge Area (SEMARNAT/SAGARPA)						
Publicize the expansion of the Refuge Area (SEMARNAT/SAGARPA)						
Design and implement the necessary regulations						
Identify the protection and management regulations needed to ensure that the vaquita population recovers and that its habitat is maintained and improved (SEMARNAT)						
Draft the above-mentioned regulations in coordination with the relevant agencies and stakeholders (SEMARNAT/SAGARPA)						
Conduct public forums on the regulations that are drafted (SEMARNAT/SAGARPA)						
Arrange for the publication of the measures to be required (SEMARNAT/SAGARPA)						

*Activities shown in dark shading.

III.4 Knowledge

As mentioned in the Management Subprogram, one of the main activities is to promote the sustainable use of the Upper Gulf of California's marine and coastal resources. This entails not only identifying alternative fishing gear but also evaluating other fishing resources. CONANP, the INE and INAPESCA will carry out these evaluations in order to diversify fishing production in a way that has a positive effect on the conservation of resources, which, according to the National Fishing Map, are now over-exploited.

Furthermore, the specific monitoring and research on the species called for in the Program will continue. Scientific evidence gathered to date indicates that the vaquita population is in serious decline. In fact, the latest scientific evidence suggests it may have reached a point of no return, leading the species to the brink of extinction. The most recent study reveals that there may be fewer than 200 porpoises in the population (Jaramillo et al., 2007). This population decline is consistent with the data obtained by other methods (acoustic).

The research proposed here is divided into two aspects. The first focuses on determining with greater precision and accuracy the current status of the vaquita population. The second addresses the need to devise an acoustic monitoring system to identify population trends. Both aspects will require the design of a model that makes it possible to estimate population densities based on acoustic information. The specifications for this model have already been completed, and data collection is needed in order to adjust the model.

The data that will be generated will provide a clear, quantitative picture of the current situation, which in turn will help shape recovery strategies. The resultant monitoring scheme will guide the actions taken in the recovery plan in order to maximize available resources and enhance the probability that the species can be recovered.

Objectives

- Design a population density prediction model based on acoustic detection frequency data.
- Make trial population density estimates based on the "distance sampling" method. These estimates will be used to adjust the prediction model.
- Adjust the prediction model using Bayesian methods, fed by population density and acoustic detection field data.
- Determine the current status of the vaquita population.
- Improve the precision of acoustic density readings by increasing sampling in terms of both time and space.
- Identify current distribution areas and potential "local" movements.
- Where possible, determine the condition of individual vaquitas through direct observation of them, facilitated by acoustic detection during daylight hours.
- Identify the presence, proportion and, where possible, condition of calves to determine the population's reproductive health.
- Move forward in the design of the population monitoring plan.
- Implement the use of autonomous acoustic detectors, which can gather data continuously over long periods of time.
- Identify the best sites for placement of autonomous equipment, based on the distribution of vaquitas and fishing activity.

Proposed Methods

Acoustic Detection

As in the research conducted to date, the study area will be divided into six strata (Fig. 8). In addition, the “hot spot” with the highest acoustic concentration will be designated as an additional stratum. The small size of the hot spot will provide a control or reference point for the rest of the study area, in light of available evidence suggesting that it is the place where the most acoustic activity occurs among the vaquitas.

Sampling will take place at stations where the vessel will be anchored with engines off. The generator will be used only when necessary to charge batteries or to use high-power equipment. The hydrophone and its cable are suspended in the water by buoys. The outer buoy marks the point where the transducer (the sensitive part of the hydrophone) is placed, at a depth of approximately 5 meters. The acoustic detection equipment to be used is a stereophonic version with two transducers, making it possible to measure the angle in a dimension from which the received signals originate. One transducer will be above the other in the water, thus indicating the approximate depth at which the detected vaquita was swimming.

The sampling will last for one day (24 hours) at each station so that circadian time series can be obtained for the variables of interest. This procedure will be suspended only when weather conditions place personnel or the vessel at risk.

In Strata 1 and 2 there will be just one sampling point, given their small size. The sampling point will be fixed, since bathymetry restricts the location of the vessel. The sampling point will be at the center of the stratum with the highest acoustic concentration. Two samplings will be taken at this point on each expedition. There will be two stations each in Strata 4 through 6. One

will be fixed, located at the geometric center of the stratum; the other position will be selected at random. At least one station will be placed in either of the two northern strata (1 and 2). Expeditions will be made continually, except when prevented by adverse weather, vessel and equipment maintenance or calibration of scientific instruments.

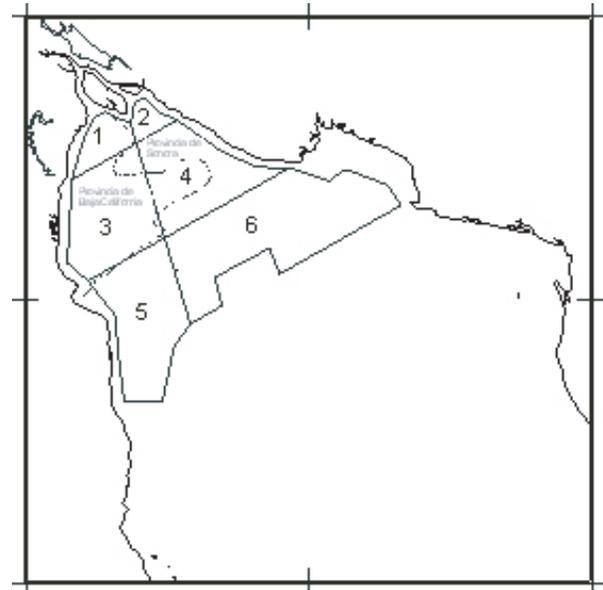


FIG. 9 STRATIFICATION OF THE VAQUITA ACOUSTIC MONITORING AREAS IN THE UPPER GULF OF CALIFORNIA

Acoustic detection will include signals from other cetaceans that frequent the area, such as bottlenose or common dolphins. These aggregate data on vaquita detection will help us understand whether this factor has a significant influence on the distribution of these populations.

This figure shows the strata that have been designated for comparing the rates of acoustic encounters among regions in the study area. The northern strata (1 and 2) consist of a typical delta region with a very strong tidal influence. The middle region (Strata 3 and 4) is dominated by tidal currents and well-mixed shallow waters. The southern strata (5 and 6) are in a region characterized by deeper water and a more stratified water column (Lavín et al., 1997). The north-south line divides the area into two regions (uneven

numbers to the west and even numbers to the east), which closely correspond to the sedimentary provinces (irregular broken line) that have been identified in the Upper Gulf of California (Carriquiry and Sánchez, 1999). The stratum with the highest acoustical concentration is delineated by a small zone located at the juxtaposition of Strata 3 and 5, near San Felipe Bay.

The personnel assigned to carry out field work will be divided into two teams. Each team will have a captain (in charge of navigation and on-board safety), a chief scientist who will be an INE employee, and two or three assistant scientists. Each team will work a two-week shift so that sampling can be done without interruption, except when weather conditions require the vessel to remain in port.

Visual Detection

The Koipai Yú-Xá will be equipped with high-power binoculars (20x120) so that routine scans for vaquitas can be carried out during daylight hours, when swell conditions allow for a reasonable probability of detection. Typically, conditions at less than 3 on the Beaufort scale will be sufficient for making observations.

Every hour on the half hour during the day, an intensive search will be conducted using the high-power binoculars as well as conventional binoculars and the naked eye. When a group of vaquitas is detected by any means, the operator of the high-power binoculars will measure the distance. These data will be used to estimate density using the point transect distance sampling method (Buckland et al., 1993). In addition, the age classes represented in the group (calf, juvenile, adult and mother when a calf is spotted at her side) will also be noted. Observations of physical condition will be made by describing swimming and diving behaviors (speed and direction of swimming, duration of dives) and body condition (e.g. bones showing through skin). To the extent possible, photographic

and videographic evidence of sighted vaquitas will be gathered so that more precise and careful observations can be made.

Other Variables

A CTD sensor (which measures pressure, salinity and temperature) will be used to obtain continuous time series of in situ variations in temperature, salinity and PAR (photosynthetically active radiation, using a spherical sensor) at different depths. Wind and tidal current direction and velocity series will also be recorded.

Radar and visual observations will be conducted at regular two-hour intervals to locate other vessels in the vicinity of the sampling station. Weather conditions will also be recorded, including cloud cover, temperature, atmospheric pressure, and swell conditions.

Data Analysis

The acoustic detector's digital files will be analyzed following the same protocol as in previous studies. The angle from which confirmed detections originated will also be calculated. In this manner, the data will provide evidence of the vaquita's acoustic and diving behavior, leading to a preliminary understanding of the mechanisms by which vaquitas are snared in nets.

At each station the acoustic density index will be calculated as in previous studies, as a function of the number of vaquita group detections per hour of effort. This variable will be analyzed in time and space in each stratum, and will be modeled in relation to the physical, biological and fishing parameters collected, in an effort to account for variations.

Sighting data will be incorporated into the correlation so that it can be determined whether the vaquita's group structures and reproductive

seasons are factors in their distribution and density in time and space. Similarly, information on physical condition can lead to more precise determinations of the factors influencing distribution.

Autonomous Detector Design

Efforts will be made to establish the technical specifications for the design and manufacture of autonomous acoustic detector prototypes. These technical requirements will be drawn up on the basis of what has been learned to date about the use of the detector described in this document.

The autonomous equipment prototype will be designed and manufactured by specialized personnel with broad experience in this type of work. Experts in Europe, North America and Japan will be consulted for this purpose. Initial testing will take place at the same time as conventional acoustic sampling to demonstrate the prototype's detection capability. When testing is complete, a capsule and hydrophone will be designed to be anchored on the sea floor in such a way that it cannot be removed by trawl nets or those used by small-scale fishermen. The prototypes will be tested primarily in the area with the highest acoustic concentration to maximize the probability of detection. Once detectors have been formally pressed into service, depending on the number manufactured, strategic points will be selected for deployment based on the acoustic density findings of the present research. The main objective is to have longer-term time series at a single point so that the variability of the acoustic index and population movements can be understood even better.

Reprediction Model of Population Density

Based on Acoustic Data Conversion Process

This process consists of the following steps:

- Calculation of the acoustic influence area, yielding a surface value that is actually covered during acoustic surveys. This value is analogous to the bandwidth obtained in transect surveys.
- Calculation of proportion of acoustic activity, making it possible to determine the proportion of groups that remain undetected within the area of acoustic influence. This value is analogous to the detection function in the distance sampling technique (Buckland et al., 1993).
- Calculation of sampling time, making it possible to determine the time to be allotted for each individual determination so that it will act like a simple survey.
- Calculation of average density, based on the number of sections obtained in a sampling cycle at each station. The number of sections will depend on the sampling time indicated in the preceding calculation.

Area of Acoustic Influence

The area of acoustic influence will be calculated on the basis of the maximum distance at which a pulse transmitted by vaquitas can be detected, at a minimum of 90 dB rms. This has been a sufficient level for vaquita identification (Jaramillo-Legorreta et al., 2001). The reception level depends on the power and frequency of the pulse and the properties of the medium through which it is transmitted (Urlick, 1983), specifically salinity, temperature and hydrostatic pressure (depth). This maximum distance will be the radius of the circle of acoustic influence.

In June 2001, the position of a vaquita in relation to the hydrophone was calculated as it emitted

an acoustic pulse. By the naked eye, the vaquita was estimated to be about 20 meters from the marker buoy. It is estimated that the pulse was transmitted at about 166 dB rms. This is the only time it has been possible to estimate the power of acoustic pulses transmitted by vaquitas. The pulse frequencies of this species are between 128 and 139 KHz (Silber, 1991). The physical variables involved will be measured with a CTD in situ.

High-power binoculars will also be used to measure the distance between the vessel and a transmitting vaquita. This will make it possible to compare the theoretical estimate with an empirical measurement. Because the waters in the Upper Gulf of California are so shallow, the radius of the area of acoustic influence will be estimated using the transmission loss equation, assuming cylindrical dispersion (Urick, 1983).

Judging by the oceanographic conditions known to prevail in the Upper Gulf of California and the single measurement that has been made of the power of a vaquita signal (described above), it is estimated that this distance will be approximately 500 meters (that is, a circular area of acoustic influence measuring approximately 0.79 km²).

Acoustic Activity

Visual sightings will be attempted constantly by means of high-power and conventional binoculars as well as the naked eye during daylight hours, and sampling will be done at each station. In this way, in addition to obtaining data on group structure and behavior (diving and swimming), it is hoped that the intensity with which vaquitas use acoustic pulses can be estimated. In other words, it should be possible to estimate the proportion of groups not producing detectable pulses within the effective radius of acoustic detection, either because they did not send any pulses at all or because the pulses were weak, remote, or aimed away from the position of the hydrophone. This proportion will be applied to the calculation of

relative abundance as a correction factor so that the total number of groups passing through the area of acoustic influence during the sampling cycle can be estimated.

Sampling Time

The sampling time in each individual survey (the time necessary to determine the presence of vaquitas in the area of acoustic influence) will be estimated based on the vaquitas' speed. This time will be the time it takes a group to move a distance equal to the estimated diameter of the area of acoustic influence. However, an allowance must be made if the group is not traveling in a straight line and therefore takes longer to pass through the area of influence.

Swimming speed data were obtained during an expedition conducted to estimate the abundance of this species (Jaramillo-Legorreta et al., 1999). There are also data on acoustic detections that can be used to estimate the time spent in the area of influence (Jaramillo-Legorreta et al., 2002). The sampling time will likely range from 15 to 30 minutes.

Average Density

The density for each individual survey will be calculated as:

$$density_i = \frac{\# \text{ of acoustic detections}}{\text{area of acoustic influence}} \quad (1)$$

$$density_a = \frac{\sum_{i=1}^n density_i}{n} \quad (2)$$

$$density_{ca} = \frac{density_a}{\text{acoustic activity}} \quad (3)$$

$density_i$ = number of detections / area of acoustic influence

The average density at a station will be calculated as:

$density_a$ = summation of $density_i$ / number of individual surveys

This density value will then be corrected for the acoustic activity factor, as follows:

corrected average density = $density_{ca}$ = $density_a$ / acoustic activity

This results in an estimate of the group density. From the abundance estimate we know that the average size of the groups is two individuals, with a coefficient of variation of 6.27% (Jaramillo-Legorreta et al., 1999). Thus, the individual density estimate will be twice the corrected average density. Observations of vaquita groups made during this research will make it possible to corroborate the average group size.

Adjustment of Model Parameters

At each sampling station, weather permitting, a systematic effort will be made to obtain pilot density estimates for the sampling site. These estimates will be made using a point approximation of line transects or distance sampling (Buckland et al., 1993). This yields reference estimates so that the parameters of the model described can be adjusted with Bayesian techniques, thus providing not point values for the parameters but a probability distribution, which is more realistic.

As shown in the description of the model's parameters, for some of them there is previous information and distributions can be constructed beforehand to feed the Bayesian estimation process.

Goals

- By the end of the study, there will be strong scientific data providing information about the current population status of the vaquita based on the analysis of acoustic and visual data.
- There will also be an appropriate monitoring system that will make it possible to track the population in a way that responds to demographic changes resulting from recovery efforts. This monitoring must be carried out in the medium and long terms, given the characteristically low population growth rates of cetaceans.

Activity Timeline

- Sampling expeditions will take place during the 2007-2008 period. Two working groups will rotate on two-week shifts so that sampling can proceed practically without interruption.
- Acoustic density calculations will be made on a monthly basis. This includes filtering and exhaustive analysis of files.
- Pilot density estimates will be submitted at three-month intervals, given that the volume of data is expected to be considerably less than the volume of acoustic data.
- Correlation analyses with physical and biological variables will be conducted towards the end of 2008 and early 2009, and they in turn will be corroborated once a statistically robust database has been compiled.
- The first prototype of the autonomous detector is expected to enter the testing phase by late 2008, and an appropriate housing design should be available by early 2009.
- It is expected that sufficient information will be available by 2009 to determine the best locations and seasons for placing the autonomous equipment, and then the pilot monitoring program can begin.

III.5 Culture

To guarantee and maintain the social and economic viability of the Program, a key component of this Subprogram is stakeholder training in the following areas:

- a. strategic planning and planning of production projects;
- b. administration and oversight of initiatives; and
- c. technical aspects of the activities they themselves identify and design.

Another important factor in vaquita conservation is the appropriate outreach, sensitization and involvement of residents, users, visitors and the general public in the execution of the Program and its scope and benefits. For this reason, the Culture Subprogram recognizes the need to create a culture of conservation through education (formal and informal), training and involvement, and through access to the available information on the situation of the vaquita, the problems the species faces and progress made in developing specific actions and strategies for its protection and recovery.

General Objective:

Involve residents and users in vaquita protection and recovery efforts through education, training and access to information, and publicize and act on vaquita conservation initiatives, alternative projects and community support programs suggested by those residents and users.

Strategies:

- Promote proactive learning between residents and institutions in the Upper Gulf of California that are associated with the

Refuge Area in particular and the Reserve in general.

- Design, with the participation of the communities, an environmental education program that will enhance their knowledge and interest in the vaquita protection and recovery actions.
- Incorporate the “learn by doing” approach in all educational strategies.
- Design and implement training courses to support the Management and Restoration Subprograms.
- Promote a Vaquita Pride Campaign that will encourage local residents to identify with the vaquita.

Community and User Education, Training and Instruction

The culture of conservation and environmental respect is essential for bringing about a change in the perceptions of communities and users. This can only be accomplished through formal and informal environmental education. Therefore, this component must be developed as soon as the Action Program is launched. It is through this component that communities and users will receive the information and education required to maximize the potential of conservation efforts.

Specific Objective

- Develop a process for teaching and learning about the environment and how its elements interact among themselves and with human activities, so that residents, academic institutions, government agencies and volunteer organizations can learn from each other about their needs and the solutions that can provide a better future for all.

Outreach, Identity and Dissemination

How well the Refuge Area functions depends on the effective dissemination of information about its ecological importance and about the proper development of production activities that are sustainable and compatible with conservation and, hence, the need to maintain a clear presence both in the region and in the national and international spheres. One way of accomplishing this is to develop outreach and publicity activities using all possible channels of communication.

Specific Objectives

- Develop activities to send a clear and consistent message that vaquita protection and related activities are important.
- Raise public awareness on the objectives of conserving the vaquita and its habitat, as well as other natural resources in the Refuge Area.
- Disseminate information about the natural, cultural and socioeconomic value of the Refuge Area.
- Implement a Vaquita Pride Campaign in local communities.

Goals and Expected Results

- Explanatory brochures published;
- Three outreach centers operating;
- Participation in radio and television programs;
- Local resident participation in outreach activities; and
- Vaquita Pride Campaign and community identification with the vaquita.

TIMELINE

Activities* and Actions	Time Period					
	2007	2008	2009	2010	2011	2012
Promotion of environmental education						
Develop a formal training program on aspects of conservation and management, environmental education and ecotourism						
Develop specific basic education programs on ecosystems of the Upper Gulf, to include presentations, courses and field trips						
Raise awareness among fishermen regarding the importance of establishing no-fishing zones to ensure the future of both local fisheries and the vaquita						
Development of an ecotourism guide training program to provide instruction on the habitats found in estuaries, rocky areas, Adair Bay tide pools, islands, Santa Clara wetlands, Great Altar Desert, Colorado River and Delta						
Promotion of environmental education in the school systems						
Develop instructional materials on the vaquita and the Refuge Area and include them in an environmental education curriculum for the school system						
Design a program of courses and presentations for primary, middle and high schools						
Work with educational institutions to train teachers and select those who will be responsible for this educational activity in each community						
Training						
Design and implementation of training activities:						
a. strategic planning of production projects b. administration and control of initiatives c. technical aspects of the activities identified and designed by the fishermen themselves						

*Activities shown in dark shading.

TIMELINE

Activities* and Actions	Time Period					
	2007	2008	2009	2010	2011	2012
Media campaigns and outreach to communities and fishermen						
Develop programs, radio and television spots to raise community awareness on the importance of the Refuge Area and how its resources can be used sustainably						
Publicize the laws, regulations and standards governing the Refuge Area						
Hold workshops for users, with an emphasis on the population of fishermen						
Vaquita Pride Campaign in local communities						
Use the mass media to communicate more and better information about the importance of conserving no-fishing zones to protect the future of the vaquita, local fisheries, and other species						
Materials to support dissemination, identity and outreach efforts						
Prepare brochures, maps, monographs and guides with basic information about natural resources						
Design and contract out the production of various promotional materials						
Promote the inclusion of articles and informative material on the progress of the Action Program in local media and publications (CEDO, "Mar Bermejo" pamphlet)						
Support scientific outreach programs involving the institutions that are conducting research for vaquita protection and in general for the conservation of natural resources in the Refuge Area						
Establish a system to publicize the most representative or ecologically important biological communities						
Disseminate the results of the research on which the current conservation and management program and its objectives and methodology are based						
Publicity and outreach at community centers						
Proposal for the establishment of a center or station in the communities of San Felipe and Golfo de Santa Clara						

*Activities shown in dark shading.

III.6 Administration

According to Article 68 of the General Wildlife Act, the agreement establishing the Refuge Area, and the provisions of SEMARNAT by-laws, the coordination of the conservation and management measures set forth in this Action Program are the responsibility of the Colorado River Delta and Upper Gulf of California Biosphere Reserve Directorate.

However, the most critical and basic element for ensuring the effectiveness of these measures is ongoing collaboration and communication, not only with the fishing communities but also among the agencies of the three levels of government, non-governmental organizations, academia, and in general any entities or experts that have been working in the region for the past few years. This goal will be attained by setting up a tracking and evaluation body in which stakeholder representatives are brought together with other relevant entities such as the AGS group, the Reserve Advisory Council, state fishing and aquaculture committees, and state inspection and monitoring committees.

General Objective:

- Track and evaluate the performance of the Subprograms and coordinate their efforts with those of the social sectors through a practical, functional, effective and efficient system.

Strategy:

- Establish a technical structure that will contribute to the execution of the Vaquita Conservation Action Program and evaluate its results.

Institutional Arrangements

The Secretariat of the Environment and Natural Resources (SEMARNAT), in coordination with the Secretariat of Agriculture, Livestock, Rural Development, Fishing and Food (SAGARPA), will conduct the fishing census and inventory mentioned in this instrument. SAGARPA, through the National Commission on Aquaculture and Fishing (CONAPESCA), operates the corresponding Fishing Management Program. SEMARNAT, through the National Ecology Institute (INE) and the Reserve Directorate, will coordinate, promote and carry out the relevant research to preserve and nurture this endangered species.

International Cooperation

The conservation of marine mammals is a subject that for some time has drawn the attention not only of specialists in the field but also of civil society organizations and the public in general.

In the case of the vaquita, as mentioned in the Protection History section, there has been evident concern for its survival and a variety of initiatives have been taken, ranging from its classification as a critically endangered species to the threat of a boycott of Mexican shrimp, issued in 2005 by the Natural Resources Defense Council (NRDC). Nevertheless, as a result of the declaration that the baiji has become extinct in China, through various forums international society has expressed a willingness to offer Mexico the support it needs to implement this Action Program.

Among these actions is the development and implementation of a North American Action Plan for the Conservation and Recovery of the Vaquita, under the auspices of the Commission for Environmental Cooperation (CEC). It should be noted that the species is listed among the 33 North American Species of Common Interest, and its area of distribution in the Upper Gulf of California is Conservation Priority Area 25. Moreover, the

three countries of North America have attributed particular importance to the recovery of marine mammals.

In this context, the CEC Council of Ministers instructed its Executive Secretariat to promote the development of an Action Plan (North American Conservation Action Plan, NACAP) that would reinforce the strategy established by the Mexican Government to protect and recover the species and include actions aimed at ensuring the well-being of the fishing communities in the region. The three countries' representatives engaged in an effort that culminated in the drafting of the aforementioned action plan (Appendix 2), which should be approved by the Council of Ministers in early 2008.

The Vaquita NACAP contains actions for capacity-building, for exchanging information, for decision-making, and for exploring other economic and commercial activities that would reduce pressure on the species, while at the same time developing local socioeconomic alternatives.

During the meeting held in 2007, the International Whaling Commission, for the first time in its history, unanimously approved a resolution on small cetaceans urging Mexico to step up efforts to prevent extinction of the vaquita. The resolution also calls on the member states and the world community to support Mexico by providing financial and technical assistance and to share experiences with respect to the socioeconomic aspects of reducing the vaquita bycatch to zero.

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ACRONYMS

CONANP. Comisión Nacional de Áreas Naturales Protegidas [National Commission on Protected Natural Areas].

CONAPESCA. Comisión Nacional de Acuicultura y Pesca [National Aquaculture and Fishing Commission].

INE. Instituto Nacional de Ecología [National Ecology Institute].

INAPESCA. Instituto Nacional de la Pesca [National Fishing Institute].

LGEEPA. Ley General del Equilibrio Ecológico y la Protección al Ambiente [General Act for Ecological Balance and Environmental Protection].

LGVS. Ley General de Vida Silvestre [General Wildlife Act].

LOAPF. Ley Orgánica de la Administración Pública Federal [Internal Regulations of the Federal Government].

LP. Ley de Pesca [Fishing Act].

PROFEPA. Procuraduría Federal de Protección al Ambiente [Federal Environmental Protection Agency].

R-LP. Reglamento de la Ley de Pesca [Regulations of the Fishing Act].

R-ZOFEMAT. Reglamento para el uso y aprovechamiento del mar territorial, vías navegables, playas, zona federal marítimo terrestre y terrenos ganados al mar [regulations on the use and exploitation of the territorial sea, navigable waters, beaches, federal maritime or terrestrial jurisdiction and land reclaimed from the sea].

SAGARPA. Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación [Secretariat of Agriculture, Livestock, Rural Development, Fishing and Food].

SAGARHPA. Secretaría de Agricultura, Ganadería, Recursos Hidráulicos, Pesca y Acuicultura del Gobierno del Estado de Sonora [Secretariat of Agriculture, Livestock, Water Resources, Fishing and Aquaculture of the State Government of Sonora].

SE. Secretaría de Economía [Secretariat of the Economy].

SECTUR. Secretaría de Turismo [Secretariat of Tourism].

SEFOA. Secretaría de Fomento Agropecuario de Baja California [Secretariat of Agricultural Development of Baja California].

SEMAR. Secretaría de Marina [Secretariat of the Navy].

SEMARNAT. Secretaría de Medio Ambiente y Recursos Naturales [Secretariat of the Environment and Natural Resources].

SHCP. Secretaría de Hacienda y Crédito Público [Secretariat of Finance and Public Credit].



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