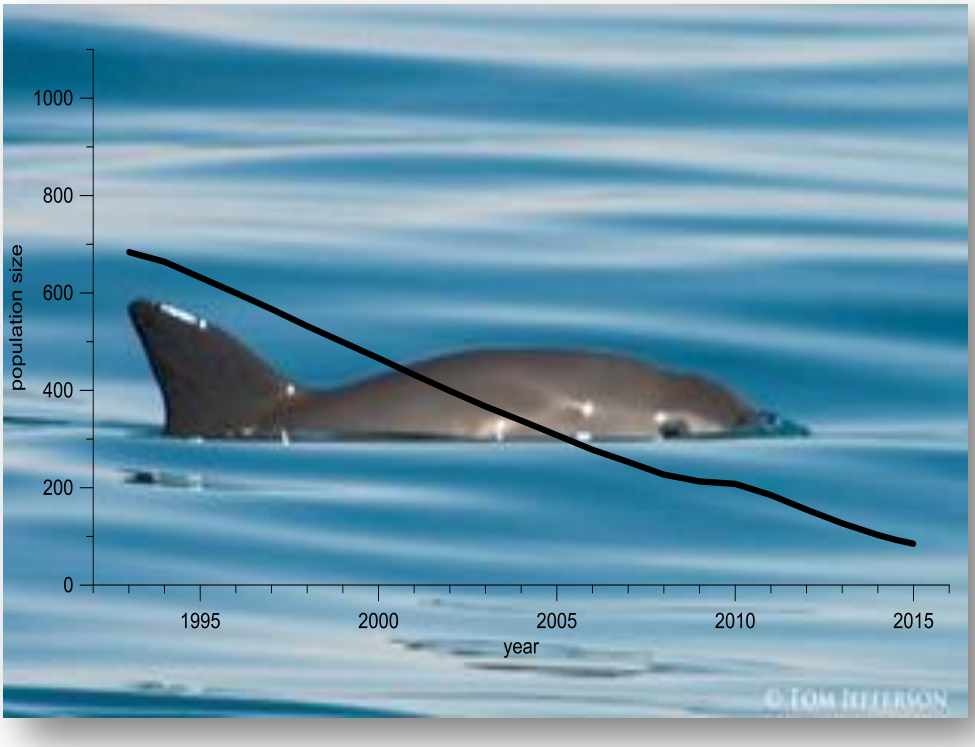


REPORT OF THE FIFTH MEETING OF THE 'COMITÉ INTERNACIONAL PARA LA RECUPERACIÓN DE LA VAQUITA' (CIRVA-5)

CIRVA members want to gratefully thank the Comisión Nacional de Áreas Naturales Protegidas / SEMARNAT, World Wildlife Fund México and US Marine Mammal Commission for providing the funds to organize the Fifth Meeting of the Comité Internacional para la Recuperación de la Vaquita, held at the Hotel Coral y Marina, Ensenada, B.C., México, July 8-10, 2014.

Contents

ANNEXES

ANNEXES 7 – 9 ARE REPORTS OF MEETINGS RELATED TO THE ACOUSTIC MONITORING PROGRAM COMPLETED BEFORE CIRVA-V AND REVIEWED AT CIRVA-V. THEY ARE PAGE NUMBERED INDEPENDENTLY OF THE CIRVA-V REPORT. THEY ARE:

Executive Summary of CIRVA-5

THE VAQUITA IS IN IMMINENT DANGER OF EXTINCTION

The fifth meeting of the Comité Internacional para la Recuperación de la Vaquita (CIRVA) was held at the Hotel Coral y Marina in Ensenada, BC from July 8 – 10, 2014.

At its last meeting in 2012, CIRVA estimated about 200 vaquitas remaining. Since then, about half of them are thought to have been killed in gillnets, leaving fewer than 100 individuals now. The vaquita is in imminent danger of extinction.

EMERGENCY REGULATIONS ARE REQUIRED

Despite all efforts made to date, the most recent acoustic data show the vaquita population to be declining at 18.5% per year (Fig. 1). The best estimate of current abundance is 97 vaquitas of which fewer than 25 are likely to be reproductively mature females. The vaquita will be extinct, possibly by 2018, if fishery by-catch is not eliminated immediately. Therefore, CIRVA **strongly recommends** that the Government of Mexico enact emergency regulations establishing a gillnet exclusion zone (Fig. 2) covering the full range of the vaquita - not simply the existing Refuge - starting in September 2014.

FULL ENFORCEMENT IS CRITICAL

Past at-sea enforcement efforts have failed and illegal fishing has increased in recent years throughout the range of the vaquita, especially the resurgent fishery for another endangered species - the totoaba. However, it is no longer sufficient to eliminate only illegal fishing as has been recommended many times in the past. With fewer than 100 vaquitas left, *all* gillnet fishing must be eliminated. To save this species from extinction, regulations must prohibit fishermen from deploying, possessing or transporting gillnets within the exclusion zone and must be accompanied by both at-sea and shore-based enforcement. CIRVA **recommends** that the Government of Mexico provide sufficient enforcement to ensure that gillnet fishing is eliminated within the exclusion zone. CIRVA further **recommends** that all available enforcement tools, both within and outside Mexico, be applied to stopping illegal fishing, especially the capture of totoabas and the trade in their products.

USE OF ALTERNATIVE GEAR

CIRVA **commends** the work undertaken to date on developing alternative fishing gear to gillnets but it is concerned at the slow progress of implementing the transition despite existing legislation. CIRVA **recommends** that the Government of Mexico expedite both the granting of permits for small-type shrimp trawls to trained fishermen and the investment in production of small-type trawl gear and the training of fishermen to fish with the new gear. It further **recommends** increased efforts to introduce alternatives to gillnet fishing in the communities that will be affected by enforcement of the exclusion zone.

CONTINUED MONITORING IS ESSENTIAL

Finally, CIRVA **commends** the excellent vaquita monitoring program and associated research. The monitoring program must be continued to determine whether new mitigation measures are working.

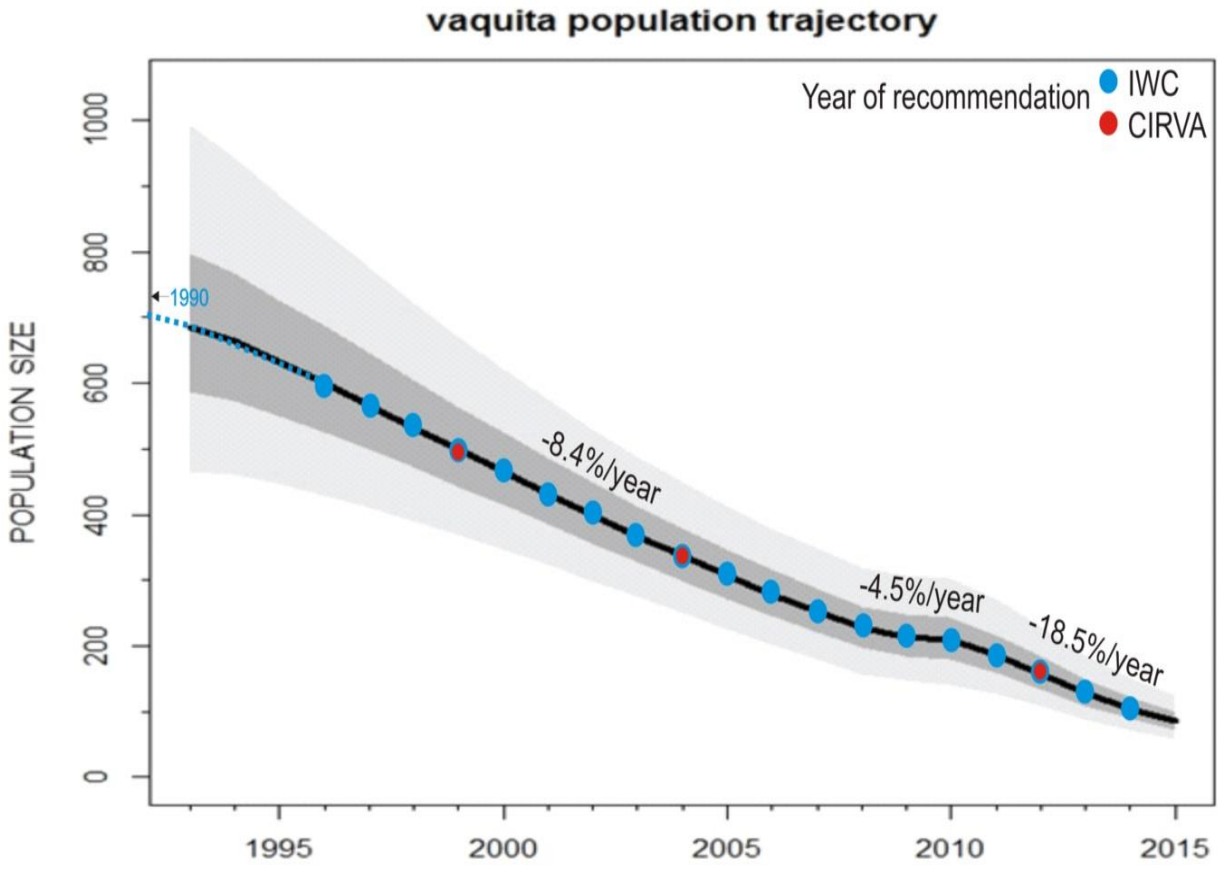


Figure 1. This figure depicts the population trajectory of the vaquita. Blue dots represent recommendations from the International Whaling Commission (IWC) and red dots represent recommendations from the International Committee for the Recovery of the Vaquita (CIRVA); both the IWC and CIRVA have recommended repeatedly that gillnets be eliminated from the range of the species (see Item 3.1). Rates of decline originate from Gerrodette and Rojas-Bracho (2011) prior to 2010 and from the Expert Panel results (Annex 8) using the passive acoustic data from 2011 onwards. The recent increase in the rate of decline can primarily be attributed to increased illegal gillnet fishing for totoaba.

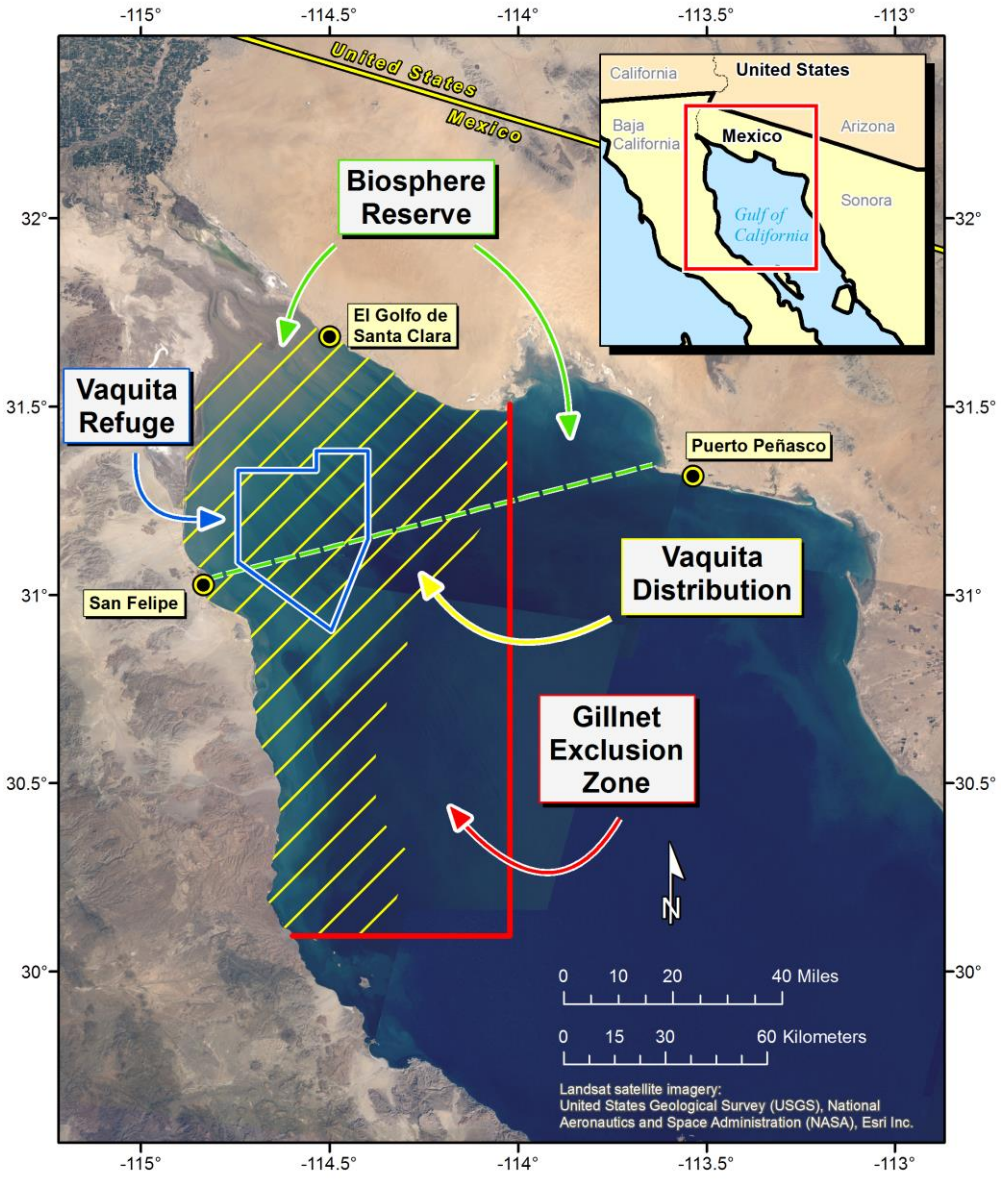


Figure 2. Gillnet exclusion zone proposed at the fifth meeting of CIRVA (north and west of red lines intersecting at 30º05'42"N, 114º01'19"W), which contains all the confirmed visual and acoustical detections of vaquitas since 1990 (yellow hatching). The exclusion zone encompasses vaquita critical habitat with muddy waters created by strong currents that comprise this critical habitat that can be seen in the satellite image. Further details on vaquita distribution are given in Annex 6. The polygon delimited by blue lines is the Vaquita Refuge established in 2005. Gillnet exclusion zone boundaries were also chosen for ease of use by fishermen and enforcement agents. A simple GPS reading or line of sight to well-known land markers can be used ('Punta Borrascosa in the north and 'Isla El Muerto in the west').

Mexico's Porpoise Nears Extinction: a simple statement on the situation now

The vaquita, a small porpoise found only in the upper Gulf of California in Mexico, is one of the world's most endangered mammals. In the past three years, half of the vaquita population has been killed in fishing nets, many of them set illegally to capture an endangered fish. Fewer than 100 vaquitas remain and the species will soon be extinct unless drastic steps are taken immediately.

The species was described in 1958 and has the smallest range of any whale, dolphin or porpoise. Vaquitas live in an area used intensively by fishermen from three small towns along the shores of the northern Gulf of California.

Vaquitas die after becoming entangled in gillnets. Gillnets are designed to entangle fish and shrimps but also capture other animals, including porpoises, dolphins and turtles. The Government of Mexico has been pursuing a conservation plan for the species that includes a refuge, where all commercial fishing (including with gillnets) is banned, and a program to encourage fishermen to switch to fishing gear that does not threaten vaquitas. Over the past five years, the Government invested more than $30 million (U.S.) in these efforts that slowed, but did not stop, the decline of the species. Scientists have warned for almost twenty years that anything short of eliminating gillnets would be insufficient to prevent the extinction of the vaquita.

A new, illegal fishery has emerged in the past few years that is an even greater menace to the vaquita. Many vaquitas have died in nets set for totoaba, a giant fish that can reach 2 m in length and 100 kg in weight. This endangered fish is prized for its swim bladder, which is exported to China where it is used as an ingredient in soup and believed to have medicinal value. Thousands of swim bladders are dried and smuggled out of Mexico, often through the United States. The remainder of the fish is left to rot on the beach. Fishermen receive up to $8,500 for each kilogram of totoaba swim bladder, equivalent to half a year's income from legal fishing activities.

At a meeting in July 2014, an international recovery team advising the Government of Mexico warned that time is rapidly running out. Unless drastic action is taken immediately, the vaquita will be lost. Mexican authorities must eliminate the gillnet fisheries that threaten the vaquita throughout the entire range of the species and enforce this gillnet ban. The Government must also stop illegal fishing for totoaba. The Governments of the United States and China must help Mexico eliminate the illegal trade in totoaba products. Unless these steps are taken immediately, the vaquita will follow the Yangtze River dolphin into oblivion and become the second species of whale, dolphin or porpoise driven to extinction in human history.

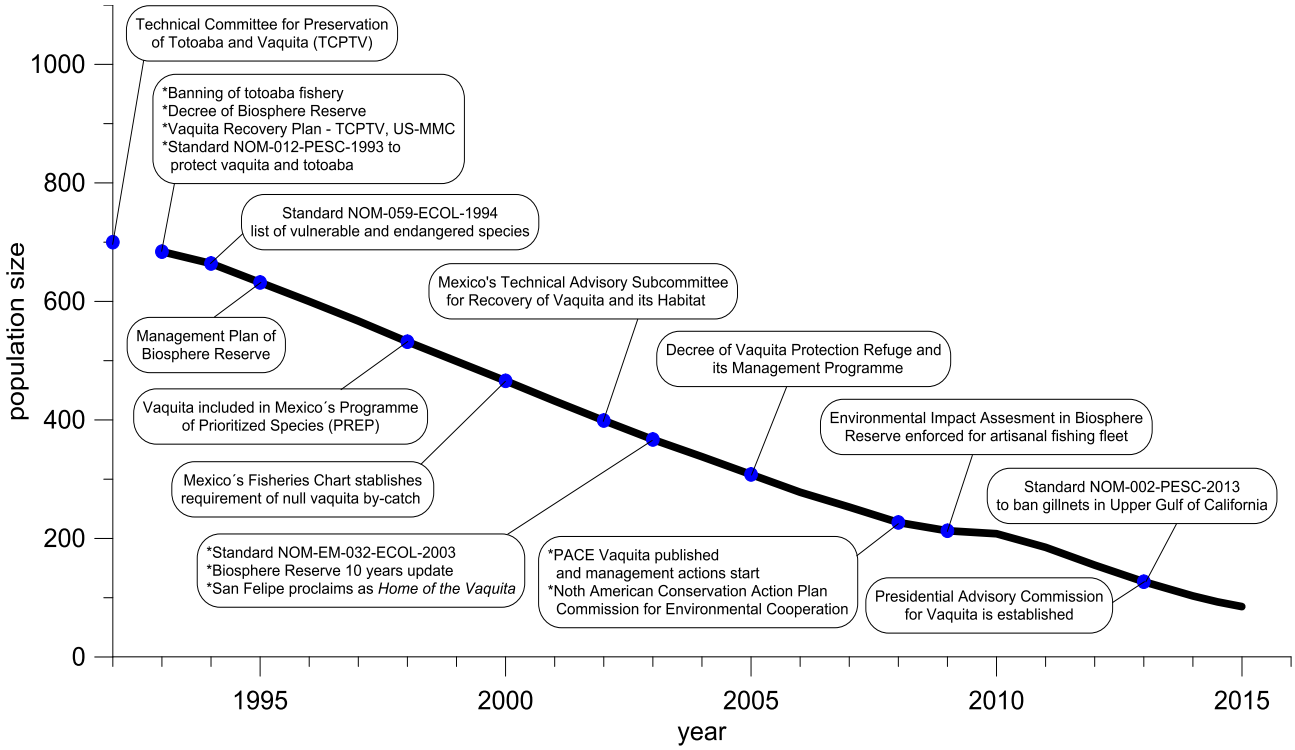


Figure showing the population decline of the vaquita alongside key management events.

1. Introduction

The fifth meeting of the Comité Internacional para la Recuperación de la Vaquita (CIRVA) was held at the Hotel Coral y Marina in Ensenada, BC from July 8 – 10, 2014. Lorenzo Rojas-Bracho welcomed participants and thanked CONANP, WWF and the U.S. Marine Mammal Commission for their support of the meeting.

The following CIRVA members attended: Lorenzo Rojas-Bracho (chair), Oscar Ramírez, Armando Jaramillo-Legorreta, Barbara Taylor, Jay Barlow, Arne Bjørge, Peter Thomas, Andrew Read, Robert Brownell, Greg Donovan and Randall Reeves.

Longtime CIRVA member Tim Gerrodette was unable to attend the meeting but contributed directly to the committee's work on abundance estimation (see Item 2.3 and Annex 3). A number of invited experts provided support by making presentations and contributing to the discussions. Rojas-Bracho chaired the meeting and Read, Thomas and Donovan served as rapporteurs with assistance from Reeves.

The full list of meeting participants is given in Annex 1. The agenda is given as Annex 2.

2. Population Trend and Status of the Vaquita

2.1 ACOUSTIC MONITORING

The information from the acoustic monitoring program and the analysis of the data obtained for the period 2011-2013 (Item 2.1.1) was reviewed extensively by first the Acoustic Monitoring Steering Committee (see Item 2.1.2) and then an Expert Panel (Item 2.1.2) before being considered by CIRVA.

2.1.1 Report of the Acoustic Monitoring Program

Jaramillo-Legorreta briefly reviewed the history of the passive acoustic monitoring program from its inception in 1997 to the present. The monitoring program currently employs autonomous echolocation click detectors (C-PODs) at 48 sites inside the Vaquita Refuge between June and September, when fishing effort in the region is relatively low, thereby minimizing the risk of losing equipment.

Jaramillo-Legorreta then presented the progress report of the acoustic monitoring program, which included results from the first three years of sampling (2011 – 2013) and an initial analysis of these data. This included an analysis of changes in the acoustic encounter rate, which was used as an index of population trend. The full progress report is attached as Annex 7.

Data are available from 127 C-POD deployments and 9,817 pod sampling days in the first three years of monitoring, which yielded 6,270 encounters. Vaquita echolocation was recorded most frequently in the southern portion of the Refuge.

This report had been submitted to the Acoustic Monitoring Steering Committee (see Item 2.1.2).

2.1.2 Report of the Acoustic Monitoring Steering Committee

Jaramillo-Legorreta then presented the report of the second meeting of the Steering Committee of the Vaquita Acoustic Monitoring Program, which convened in April 2014 to review the first three years of the Monitoring Program. The report of this meeting is appended as Annex 8. The Steering Committee concluded that the Monitoring Program had performed well and generated data of high quality and that the performance of the monitoring team had been exceptional.

The Steering Committee concluded that preliminary results of the Monitoring Program indicated that the vaquita population is declining at a rapid rate and that immediate action is necessary to save the species. Nonetheless, to confirm its findings, the Steering Committee convened an Expert Panel (see Item 2.1.3) to agree on: (1) the best measure of acoustic detections and (2) the best estimate of rate of change from 2011-2013 using the acoustic data alone.

2.1.3 Report of the Expert Panel

The Expert Panel met in June 2014 to review the findings of the Monitoring Program. The panel consisted of six modeling experts, including two from the Vaquita Acoustic Monitoring Steering Committee (Jaramillo-Legorreta and Barlow) and four globally recognized experts in spatial statistics and population trend analysis. The report of the Expert Panel is appended as Annex 9.

The Expert Panel considered the monitoring design to be sound, but noted that analyses were complicated by the loss of some C-PODs in 2011 and low numbers of recording days for numerous C-PODs in 2013. It developed several analytical approaches to account for the uneven sampling; all indicated substantial declines. The Panel agreed that year-to-year variation in the proportion of vaquitas present within the monitoring area could not be accounted for with only three of the intended six sampling periods completed, but that it is very likely that this critically endangered species has continued to decline at a high rate.

The Expert Panel generated an independent estimate of the rate of decline from 2011 to 2013 using the acoustic encounter data from the Monitoring Program. The best estimate of this rate of decline was 18.5% per year, a value much greater than any rate of decline previously reported for vaquitas. The Panel found a very high probability (88%) that the rate of acoustic encounters had declined during the monitoring period, with a strong likelihood (75%) that the rate of decline has been greater than 10% per year.

2.1.4 CIRVA conclusions

CIRVA **agreed** with the conclusions of the Expert Panel and **commended** the efforts of the acoustic monitoring team. It noted that this program had yielded one of the most complete pictures of the distribution and relative abundance of any endangered marine mammal. It **agreed** that the analyses presented by the Expert Panel (above) represented the present best estimate of the rate of decline of the vaquita between 2011 and 2013 i.e. 18.5%.

2.2 FUTURE OF THE ACOUSTIC MONITORING PROGRAM

In addition to the usual sampling grid, five more C-PODs were deployed in the southern portion of the monitoring area in 2014. This will be the fourth year of the Monitoring Program within the Vaquita Refuge. CIRVA **agreed** with the conclusions of the Expert Panel that the Monitoring Program inside the Refuge is working as intended. CIRVA **strongly recommends** that this program continue indefinitely, with strong financial support, in order to determine whether mitigation efforts are indeed working.

Jaramillo-Legorreta reported on the problems that had been experienced in trying to deploy acoustic detectors on the buoys delimiting the Vaquita Refuge. So far, four different mooring techniques have been tested; however in all cases most of the detectors were lost or stolen. CIRVA concluded that the information obtained from acoustic detectors deployed in buoys would be of marginal value. CIRVA therefore **recommends** that attempts to deploy C-PODS on the perimeter buoys be abandoned, and that instead funds be allocated to enabling project personnel to retrieve and repair or replace acoustic detectors inside the refuge as needed during the sampling season in order to maximize acoustic sample size and minimize data gaps.

2.3 CURRENT STATUS OF THE VAQUITA

Taylor presented the results of an analysis conducted by Tim Gerrodette that estimated the vaquita population size in mid-2014. Details of Gerrodette's analysis are presented in Annex 3. This projection employed the recent rate of decline in acoustic encounters estimated by the Expert Panel (18.5% per year). The approach assumes that acoustic encounters are directly proportional to population size within the monitored area and that abundance inside the refuge is proportional to total population size. CIRVA agreed that these were reasonable assumptions.

This approach shows that using the most recent information (see Item 2.1.3), the best estimate of current vaquita abundance is 97 animals. This means that likely fewer than 25 reproductively mature females remain.

CIRVA **endorsed** Gerrodette's approach and agreed that his analysis represented the best assessment of the present status of the vaquita.

2.4 CIRVA CONCLUSIONS AND RECOMMENDATIONS

Despite all efforts made to date, analysis of the acoustic indicates that the vaquita population is declining at 18.5% per year, the species has most likely been reduced to fewer than 100 individuals (see CIRVA-4) and the vaquita may be extinct by as early as 2018 if fishery by-catch is not eliminated immediately (Fig. 1). CIRVA views this new evidence with grave concern and strongly recommends that the Government of Mexico enact emergency regulations establishing a gillnet exclusion zone (Fig. 2) starting in September 2014.

Justification for the area of the exclusion zone is given in Annex 6. CIRVA believes that this species can recover but only if bycatch is eliminated immediately. It noted that other populations of marine mammals have recovered from similarly very low numbers, including northern elephant seals that were protected by Mexico in 1922.

Past at-sea enforcement efforts have failed, and illegal fishing has increased throughout the range of the vaquita in recent years, especially the resurgent fishery for another endangered species - the totoaba (*Totoaba macdonaldi)*. It is now not sufficient to eliminate only illegal fishing. With fewer than 100 vaquitas left, *all* gillnet fishing must be eliminated. To be effective, regulations must prohibit fishermen from deploying, possessing or transporting gillnets within the exclusion zone and must be accompanied by both at-sea and shore-based enforcement.

The fates of the totoaba and the vaquita have been closely linked. The recommended gillnet exclusion zone is focused on the vaquita's distribution. However, it is important to recognize that illegal gillnet fishing for totoaba within the exclusion zone could be carried out by fishermen from areas to the south or east of the zone boundaries (including from Puerto Peñasco). The Government of Mexico will need to enforce gillnet elimination regulations in communities outside the exclusion zone if it is found that illegal totoaba fishing is continuing within the zone, thereby undermining efforts to prevent extinction of the vaquita.

Noting that past enforcement efforts have failed, **CIRVA strongly recommends that the Government of Mexico allocates sufficient enforcement resources to ensure that gillnet fishing is eliminated within the exclusion zone.**

In summary, the general outlook on the status of the vaquita and the efficacy of conservation actions have changed dramatically from the last CIRVA meeting only 2 years ago. At that time and for the first time, CIRVA concluded that progress was being made, or soon would be made, toward implementing many of the committee's past recommendations (Annex 5). In contrast, the new information showing a catastrophic decrease to fewer than 100 individuals has changed the landscape of what is now possible in terms of adopting alternative gear - **there is no longer time to wait to phase-in new fishing technologies before immediate action is taken to save the vaquita**.

3. Existing mitigation efforts and factors affecting their success

3.1 SHORT REVIEW OF PREVIOUS RECOMMENDATIONS BY THE IWC AND CIRVA

3.1.1 The IWC (Commission and Scientific Committee)

The International Whaling Commission (IWC) Scientific Committee first made major recommendations on the critical status of the vaquita 24 years ago (IWC, 1991). With the benefit of hindsight, if those recommendations had been followed, there is little doubt that the vaquita situation would now have been largely resolved. Those recommendations can be summarised as:

(1) fully enforce the closure of the totoaba fishery and reconsider the issuance of permits for experimental totoaba fishing;

(2) take immediate action to stop the illegal shipment of totoaba across the US border;

(3) develop and implement a management plan for the long-term protection of the species [vaquita] and its habitat including:

(a) an evaluation of other fisheries that take or may take vaquitas;
(b) development and implementation of alternative fishing methods or other economic activities for fishermen;
(c) education of fishermen and the public of the precarious state of the vaquita;
(d) monitoring of status and improved knowledge of vaquita biology.

Recommendations have been issued regularly by the Scientific Committee since then, with increasing levels of urgency (see Fig. 1). The Commission itself has passed three Resolutions.

Six years ago (IWC, 2009), the Scientific Committee, whilst welcoming information that the Mexican Government was taking measures to eliminate the fishing gear that accidentally kills vaquitas, was greatly concerned that the proposed phase-out period 'within three years' might not be 'rapid enough to prevent extinction." The Committee reiterated its extreme concern about the conservation status of the most endangered cetacean species in the world. It expressed great frustration that despite more than a decade of warnings, the species had continued on a rapid path towards extinction due to a lack of effective conservation measures. It strongly recommended that, if extinction was to be avoided, all gillnets must be removed from the upper Gulf of California immediately. It stated further that in the extremely unfortunate circumstance that this did not occur immediately, it would certainly have to occur within the three-year period starting in 2008.

3.1.2 CIRVA

At its first meeting in 1997, CIRVA identified gillnet bycatch as the greatest threat to the survival of the vaquita (Annex 5 and Fig. 1). The second CIRVA meeting in 1999 recommended that gillnets and large industrial shrimp trawlers be banned in a staged sequence – leading to a total ban by 2002. At its third meeting in 2004, CIRVA concluded that the decline of the vaquita population was continuing and bycatch rates had increased since the second CIRVA meeting. It expressed '**grave concern** that the species will remain in serious danger of extinction in the near future, unless

strong conservation measures are implemented immediately by the Government of Mexico.' At its fourth meeting in 2012, CIRVA reiterated that "All gillnets and other entangling nets need to be removed from the entire range of the vaquita" and called for expedited efforts to convert shrimp fishing vessels, as well as finfish vessels, to known vaquita-safe methods as soon as possible. At the present meeting, CIRVA noted that the evidence presented showed that fishing effort does not appear to have declined since 2006. The analysis of the acoustic monitoring data indicated that the catastrophic decline of the vaquita population has continued.

3.2 PROGRESS OF THE ADVISORY COMMISSION OF THE PRESIDENCY OF MEXICO FOR THE RECOVERY OF THE VAQUITA

3.2.1 Presentation

Luis Fueyo, National Commissioner for Natural Protected Areas, reported that at the start of the Mexican Presidential administration in December 2012 the new government designed a new strategy to recover species at risk. The President supported the formation of a high-level group, the Advisory Commission of the Presidency of Mexico for the Recovery of the Vaquita (under Fueyo's chairmanship), to ensure the recovery of the species, thereby indicating that he viewed actions to ensure the recovery of the vaquita as a priority of the new Government. During this same period, in November 2012, the first indications of the serious illegal take and trade of totoaba emerged, making integration of the efforts of different federal agencies in the law enforcement process a top priority of the new Commission.

Fueyo noted that the totoaba trade is a serious problem with considerable financial backing. Not all agencies are as yet able to deal with this complex illegal fishery and trade problem (e.g. able to quickly identify legal versus illegal fish products). He reported that the federal government is providing training to different agencies on land and at sea. It is also establishing a unique interagency law enforcement group with PROFEPA, the Navy and CONAPESCA, among others.

Fueyo stressed two different components of the totoaba situation. The first is primarily domestic in that many people in local communities are engaged in the illegal fishery. He hopes that as the cost to fishermen of making the transition to vaquita-safe gear is reduced, they would have less economic incentive to participate in the totoaba fishery. The second component is international and he noted that Mexican and US customs officials are working with the US Fish and Wildlife Service to identify and close the export routes for totoaba products.

Fueyo further reported that the Presidential Commission has made a number of recommendations. In particular, the fisheries authorities have enacted regulations requiring a switch from gillnets to light trawls in the shrimp fishery. A strong effort is being made to align communication processes among all concerned agencies, with monthly meetings being used to identify and address the more difficult problems of illegal fishing.

In conclusion, Fueyo indicated that he accepts the scientific information provided by CIRVA and recognizes that the situation for the vaquita is grave. He confirmed that it is the responsibility of the Presidential Commission to consider all the CIRVA recommendations and do all in its power to prevent the vaquita's extinction and support its recovery. He expressed confidence that the Presidential Commission can help with this issue.

In response to a question, Fueyo recognized that the proposed 4-hr meeting for the Presidential Commission at the end of July was inadequate given the new scientific information. He agreed that the meeting should be expanded to up to two days to allow more time for discussion and development of advice to the President. He also said he would consider having the Presidential Commission meet more frequently to follow events more closely and ensure that all relevant parts of the government are fully engaged with the vaquita conservation effort.

3.2.2 Discussion

In discussion, Young indicated that the U.S. National Marine Fisheries Service is willing to provide assistance to the Government of Mexico in addressing the vaquita/totoaba problem. In particular, joint enforcement and assistance with enforcement training are topics that can be discussed at the upcoming enforcement summit between Mexico and the United States.

In response, Fueyo agreed that the vaquita/totoaba topic should be addressed in meetings between US and Mexican fisheries authorities and that it should be high on the agenda of meetings between President Peña Nieto and President Obama. He identified help with gear changes, and cross-border co-operation on enforcement to stop illegal trade as areas that should be considered. He also noted the continued importance of international assistance with the monitoring program.

At the close of the overall discussion, Fueyo concluded by pointing out that most people working in the Upper Gulf are fishermen, or otherwise dependent on fisheries for their livelihood, and therefore that the social dimension of the vaquita conservation effort is of utmost importance. From 2008 to 2011 a lot of the boats were retired and permits withdrawn. Government and NGOs must strive as a matter of urgency to ensure that people are able to earn their livelihoods and support their families from legal activities.

3.2.3 CIRVA conclusions

CIRVA thanked Fueyo for attending the meeting and noted that the Presidential Commission is the key to the survival of the vaquita. It **welcomed** the news that the next meeting of the Commission would be expanded to up to two days. While recognizing the many logistical, legal and socio-economic challenges, CIRVA again **stressed** that the new scientific information shows the situation to be extremely grave and that concerted action on all fronts is required immediately.

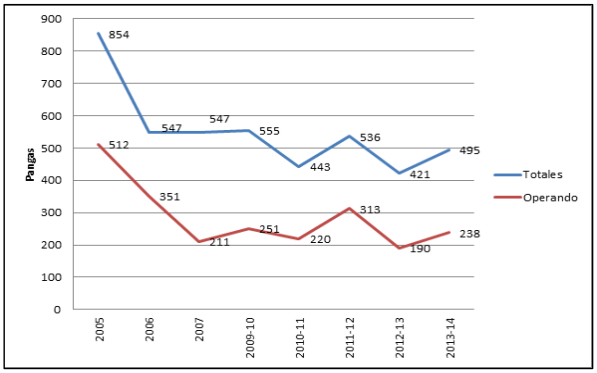
CIRVA is well aware of the socio-economic problems faced by the communities but noted that recommendations to develop alternative methods have been made repeatedly for over 20 years (and see Item 3.5). In addition, an important component of the gillnet problem relates to illegal fisheries, which should not be allowed even without the vaquita issue.

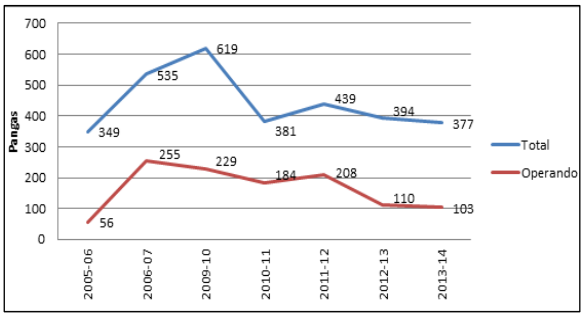
CIRVA recognized that its expertise is primarily scientific and that social and economic expertise will be needed to address many of the concerns of the communities. CIRVA is nonetheless compelled, based on what its members know about the animals and their natural environment, to emphasize that the situation is dire and action on removing gillnets and ensuring compliance is needed immediately. The last time CIRVA met (in 2012), there were probably twice as many vaquitas as there are now. The task facing the experts within the Presidential Commission is to translate CIRVA's advice into positive action before it is too late.

3.3 MONITORING FISHING EFFORT

3.3.1 Presentation

Juan Manuel García (Sustainable Fisheries Partnership) presented the results of systematic aerial surveys of the distribution and number of pangas fishing in the Upper Gulf from 2005 to 2014 (Fig. 3). These surveys are supported by the Mexican Fund for Conservation of Nature and have been conducted monthly each year during the period from October to July. The survey lines are spaced five nautical miles apart, beginning three miles south of the Vaquita Refuge and extending north to the Delta. Surveys are flown during periods of good weather at an altitude of 1500m.





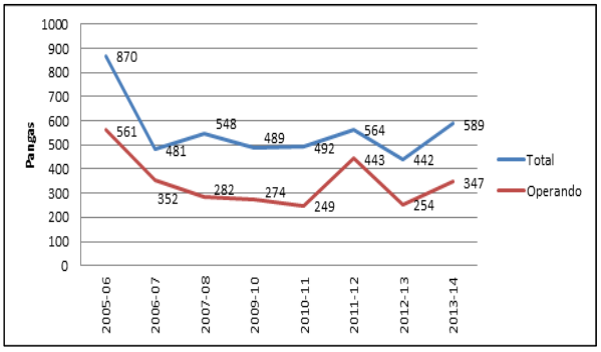


Figure 3 (top left). Total number of pangas observed from October to July (blue) and total number of pangas observed operating (fishing) during that period (red).

Fig. 3 (bottom left). Total number of pangas observed during the shrimp season from October to February (blue) and total number of pangas observed operating (fishing) during that season (red).

Fig. 3 (top right). Total number of pangas observed during the finfish season from March to July (blue) and total number of pangas observed operating (fishing) during that season.

3.3.2 CIRVA conclusions

After viewing these data, CIRVA concluded that no trend was apparent in the number of pangas fishing in the Upper Gulf since 2006 (either in the total number or the number observed fishing) nor was there any apparent effect of the buyout in 2008 on the number of pangas in the active or total fleet. Furthermore, these surveys were conducted in daytime and thus would not detect illegal night-time fishing, such as with gill nets set for totoaba.

CIRVA **welcomed** the presentation on the aerial survey data but was extremely concerned that it showed no evidence of a decrease in fishing effort. It noted that a more detailed geographical and temporal breakdown was required to better evaluate effort and develop scenarios for use with the

Gerrodette model. CIRVA **recommends** that these data are made available by the Mexican Fund for Conservation of Nature. Rojas-Bracho **agreed** to write on behalf of CIRVA with this request.

No quantitative information was provided to the meeting by INAPESCA on progress with the reduction in fishing effort as a result of the buyout work or in light of the legal requirement that all boats are to be converted from gillnetting by September 2016 (see Item 3.5.3.2).

3.4 UPDATE ON ILLEGAL TOTOABA FISHERY

3.4.1 Presentation

Martha Román provided a brief update on the history of exploitation and current situation regarding the illegal fishery for totoaba in the Upper Gulf of California. Research into the biology of totoaba conducted between 2010 and 2013 indicated that some recovery had occurred following a long period of protection.

However, due to increased demand in Chinese markets for the swim bladder (*vejiga natatoria*, or locally *buche*) of the totoaba, there has been a large increase in illegal fishing pressure on this species. Totoaba are captured in anchored, large mesh gill nets set at night and left unattended for several days. The swim bladders are used as food (in soup) in China where they are believed to have medicinal value. In one law enforcement operation, 529 swim bladders were recovered; fishermen may receive up to US$8500/kg for these bladders. Levels of illegal fishing effort have been very high over the past year and this fishing likely has had a serious impact on the totoaba population.

3.4.2 CIRVA conclusion and recommendation

CIRVA expressed its serious concern at this information, **reiterating** that the illegal gillnet fishery for totoaba poses a major threat to the survival of the vaquita, as well as to the totoaba itself. CIRVA therefore **recommends** that all available enforcement tools, both within and outside Mexico, be applied to stopping illegal fishing, especially the capture of totoabas and the trade in their products.

3.5 ALTERNATIVE METHODS OF FISHING

3.5.1 Progress on alternative methods

An extensive summary was presented of the work being undertaken to develop and introduce alternative fishing methods. This is given as Annex 4.

The development, adoption, and deployment of small trawls in the commercial fishery for shrimp has been hampered and delayed by the overwhelming intentional and unintentional blocking effect of gillnets. Gillnetting has been the easiest fishing method to use as well as the least costly in terms of nets and fuel. The elimination of gillnets in the recommended exclusion zone would release the fishermen using artisanal shrimp trawls and other alternative gear from the constraints of gillnet presence, thus creating new opportunities to realize the full economic benefits of the alternative fishing methods. Government agencies must continue and increase their investment in alternative gear solutions along with the recommended implementation of the gillnet exclusion zone.

3.5.2 CIRVA conclusions and recommendation

CIRVA looked forward to the recommendations from the technical committee on fishing gear of the Presidential Commission but reiterated that the new scientific information shows that there needs to be a complete and immediate ban on gillnets with full enforcement within the recommended gillnet exclusion zone.

The outcome of efforts to implement the mandated switch from shrimp gillnets to *small* trawls has been disappointing. Fishermen trained in the use of this gear had problems obtaining permits. CIRVA **recommends** that obtaining permits be streamlined so that any willing fisherman can obtain permits efficiently. To date, fishermen have not been provided with the gillnet-free space needed to operate the small trawls successfully. These failures on the part of the Government of Mexico send a message to other fishermen that the law pertaining to gear conversion will not be enforced, as has been the case with other laws such as that dealing with the legal length of gillnets. Immediate efforts should be made to build sufficient small trawls and train fishermen; failure to enable the conversion to small trawls will reinforce the perception that the new regulation will not be enforced. Fishermen must be convinced that the Government of Mexico is serious about enforcing the laws. This is a necessary first step in bringing about the dramatic changes in fisheries practices that must occur if the vaquita is to be saved.

Finally, CIRVA **emphasized**, in response to presentations on possible new designs of pangas or small/light shrimp trawlers, that if and when new technology is introduced, the scale at which it is introduced has to take into account the sustainability of the fisheries and the conditions and practices of local communities.

3.5.3 INAPESCA Experimental Testing Preliminary Plan

3.5.3.1 Presentation

Aguilar (INAPESCA) presented a preliminary plan for an experiment from at least September to December 2014 to assess the profitability and efficiency of fishing with the small/light trawl. He stated that the previous five years of studies had suffered because the presence of gillnetters had interfered with trawling and because it had proven impossible to obtain data throughout the full shrimp season. The proposed experiment would allow only trawl nets to be deployed and to operate in the Biosphere Reserve during the shrimp season. Aguilar said he expects 50 fishermen to operate trawls, backed up by 50 observers to collect data and 50 experts to provide training. Fishermen with gillnet permits would be given fuel compensation so they could operate outside the Biosphere Reserve. The possibility of including GIS on the vessels would be investigated.

3.5.3.2 Discussion

In discussion, it was noted that sufficient evidence exists that trawls are profitable; the proposed further studies would clarify how profitable and thus help inform compensation schemes. It was also noted that the present law anticipates that 30% of pangas (i.e. 175) will have been converted from gillnetting by September 2014 (see Table 2); thus the proposed number of 50 fishermen is far too small, even in the context of the existing law that states that total conversion from gillnets

in the shrimp fishery must be completed by September 2016. Taking the proposed experiment at face value, compensation for fuel might be provided to fishermen on up to some 500 pangas and all or most of these could operate close to the edge of any closed-area boundary (and in fact the proposed boundary crosses some known vaquita habitat).

It was noted that this plan only contemplates shrimp gillnets. CIRVA is concerned that finfish gillnets would be allowed and that funding of fuel could result in fishermen using this subsidy to fish within the vaquita area using gillnets.

Finally, CIRVA has previously noted the importance of ensuring that sufficient equipment and training in the use of alternative gear are provided as rapidly as possible. It also believes that compensation should be made available to fishermen in the event of any delay between enforcement of the recommended gillnet exclusion zone and implementation of alternative fishing methods.

Table 2

Timetable for conversion of the gillnet fleet according to Mexican law.

Zone	Total vessels/permits	September 2013-September 2014	September 2014 – September 2015	September 2015 - September 2016
G de Santa Claro	426	128	128	170.4
San Felipe	158	47	47	63.2
Total	584	175	175	234
Total	100%	30%	30%	40%

3.5.3.3 CIRVA conclusions and recommendations

CIRVA thanked Aguilar for his presentation. While welcoming some aspects of the plan that are compatible with CIRVA recommendations (e.g. increased training, the principle of excluding all gillnets in an area, use of GPS as part of enforcement), it **stresses** the following points.

(1) Gillnets are not compatible with survival of the vaquita. It **reiterates** its recommendation above for a complete removal of all gillnet operations within the exclusion zone shown in Fig. 2.

(2) Enforcement is the most urgent problem that must be addressed in the implementation of an exclusion zone. Considerable illegal fishing with gillnets takes place within the Upper Gulf in addition to the illegal totoaba fishery, including fishing without permits (or with expired permits), using illegal lengths of gillnets and fishing within protected areas including the Vaquita Refuge. Present enforcement measures are clearly inadequate and effective implementation of the CIRVA recommendation to remove all gillnets will require a considerable increase in resources and monitoring to ensure that the exclusion zone is functioning as intended.

(3) It is **essential** that sufficient training and equipment are made available as soon as possible.

3.6 PROGRESS ON ENFORCEMENT

3.6.1 Presentations

No representative of PROFEPA was present at the meeting so Martin Sau presented a short summary of enforcement efforts from a previous PROFEPA presentation in February 2014. This presentation summarized enforcement trips in 2013 (305), actions against fishermen and seizures of illegal fish or fish products, especially totoaba. Enforcement vessels also encountered and destroyed 88 ghost nets and confiscated 16 illegal nets from fishermen. Thirteen boats were seized and confiscated. PROFEPA reported on its equipment and personnel in the upper Gulf, including nine small boats and four permanent staff in both Baja California and Sonora with four seasonal employees in Baja and eight in Sonora.

The revenue that went to fishermen for the bladders confiscated in that enforcement action would be US$2.25 million, assuming the average bladder weighs ½ kg and that these were the more valuable female bladders.

During the meeting, an update was provided by Sergio Perez Valencia of CEDO on the Environmental Impact Assessment (EIA) for Small-scale Fishing in the Upper Gulf of California and Colorado River Delta Biosphere Reserve which, as explained at the last CIRVA meeting (2012), was designed to implement mitigation measures and document compliance with fishery regulations. The EIA pertains to 903 legal boats from the three main communities in the upper Gulf that target 27 species with a variety of fishing gear. It is tailored to current fishery and environmental regulations, provides mechanisms for easily distinguishing between legal and illegal fishermen, strengthens co-management by fishermen and government, facilitates adaptive management and can be co-financed by fishermen, government and NGOs. According to Perez Valencia, significant progress has been made in redirecting fishermen towards responsible fishing practices based on science, enabling fishermen to participate in decision making and in terms of training and awareness. However, fishermen who wish to comply with regulations feel they are being undercut when illegal fishermen operate without constraints or punishment. There is growing concern that the general lack of fisheries law enforcement in the region will lead to less compliance and jeopardize renewal of the EIA project, which is authorized only until December 17, 2014.

3.6.2 CIRVA conclusions and recommendation

While appreciative of this information, CIRVA agreed that a full report on enforcement is required. It **recommends** that a clear statement of the resources of PROFEPA and its resources in the Upper Gulf of California is needed, along with information on all co-operative efforts of other agencies. This should be provided to the Presidential Commission along with a comprehensive plan to enforce regulations. An informal estimate was put forward indicating that present resources would need to be increased tenfold to effectively combat the illegal totoaba fishery alone.

Anecdotal information from the fishermen present suggested that there had been increased enforcement activity on land and at sea in San Felipe, including navy personnel, PROFEPA and CONAPESCA, particularly during the shrimp season.

However, it was also noted that considerable illegal activity continues to take place in the region, involving pangas from all over the Gulf of California as well as from Pacific ports such as Ensenada, but that no serious or large-scale enforcement measures are taken. The fishermen present at the meeting insisted that enforcement should be strategic. Even a small increase in enforcement, if done intelligently, could result in a big change in how fishermen behave. A strong message must be sent that illegal activity will be punished.

3.7 EX-SITU CONSERVATION

3.7.1 Discussion

CIRVA considered briefly the possibility of an *ex-situ* conservation approach, which would involve removing individuals from the wild population, either to develop a captive breeding program or to safeguard the last few individuals of the species. Such an approach would require: (1) capture and transport of wild individuals; (2) maintenance of these individuals in a semi-captive (natural habitat) or captive facility; and (3) release of wild-caught or captive-bred individuals into the wild at some future date. It is likely that the approach would also require a successful captive breeding program if it were to provide a real conservation benefit.

There have been no past attempts to capture vaquitas or maintain them in a captive environment, but harbor porpoises have been captured successfully in the north-eastern Pacific and off West Greenland. Small numbers of harbor porpoises are maintained in captivity in several parts of the world and a few animals have been bred in captivity. Obviously any *ex-situ* approach with vaquitas would require development of new methods to capture and hold these animals. There are no facilities that could be used to house vaquitas in the Upper Gulf and the closest captive facility that could support such animals is in San Diego. Transportation across the border could be complicated for permit and other legal issues. This approach would be successful from a conservation perspective only if such individuals, or their progeny, could eventually be released into the wild. There are several challenges to such returns, releases or reintroductions. The longer animals are maintained in captivity, the more difficult it is to release them back into the wild. In addition, it is not feasible to capture or hold a sufficient number of animals to develop a captive breeding program for this species.

3.7.2 CIRVA conclusion

Given these challenges, therefore, CIRVA **concluded** that an *ex-situ* approach to conservation of the vaquita was not feasible. The Association of Zoos and Aquariums, which represents 221 accredited zoos and aquariums in seven countries, reached the same conclusion in a letter sent to President Enrique Peña Nieto in February 2013.

4. Summary of Recommendations

- CIRVA **strongly recommends** that the Government of Mexico enact emergency regulations establishing a gillnet exclusion zone (Fig. 2) covering the full range of the vaquita - not simply the existing Refuge - starting in September 2014.
- CIRVA **recommends** that the Government of Mexico provide sufficient enforcement to ensure that gillnet fishing is eliminated within the exclusion zone
- CIRVA **recommends** that all available enforcement tools, both within and outside Mexico, be applied to stopping illegal fishing, especially the capture of totoabas and the trade in their products.
- CIRVA **recommends** that the Government of Mexico provide a clear statement of the resources of PROFEPA in the Upper Gulf of California, along with information on any and all co-operative enforcement efforts of other agencies.
- CIRVA **recommends** that increased efforts be made to introduce alternatives to gillnet fishing in the communities that will be affected by enforcement of the exclusion zone.
- CIRVA **recommends** that issuance of permits for legal non-gillnet fishing be expedited.
- CIRVA **recommends** that aerial survey data on fishing effort and appropriate temporal and geographical scales are made available to CIRVA by the Mexican Fund for Conservation of Nature to enhance population modelling efforts (e.g. by Tim Gerrodette; see Annex 3).
- CIRVA **strongly recommends** that the acoustic monitoring program continue indefinitely, with adequate financial support, in order to determine whether mitigation efforts are working.
- CIRVA **recommends** that attempts to deploy C-PODS on the perimeter buoys be abandoned, but instead funds should be allocated to allow project personnel to retrieve and repair or replace acoustic detectors inside the refuge as needed during the sampling season in order to maximize acoustic sample size and avoid data gaps.

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Annex 2: Agenda

Julio 8
9:00-9:30
1. Welcoming to participants (CONANP, Marine Mammal Commission y WWF).
2. Introduction of participants
3. Confirm chair and rapporteur(s)
4. Review and adopt the Agenda

9:30-10:30
Vaquita population trends and status
5. Report of the acoustic monitoring program (A. Jaramillo y G. Cárdenas)

11:00-1300
6. Report of the Vaquita acoustic Monitoring Steering Committee (A. Jaramillo y G. Cárdenas)
7. Report of the Expert Panel of Modelers on vaquita population trends (J. Barlow)
8. Current status of the vaquita population (B. Taylor)

14:30-17:00
9. A brief report on totoaba fisheries (M. Román)
10. Communicating the results of the vaquita population status to stakeholders
11. The monitoring program in the next years
12. Break to draft the report of this section of the meeting

Julio 9
8:30-900
13 .Review of the report Vaquita population trends and status
Mitigation approaches and timeframe
9:00 – 10:30
14. Introduction of participants for section
15. Short Review of previous recommendations by CIRVA and the IWC
16. Progress in the Presidential Commission

11:00 – 13:00
Technological development
Expert presentations (Chris Glass, Tim Werner)
17. Small trawl technology (Daniel Aguilar, Ramses Rodríguez, Antonio García)
18. Diesel vessels for small trawl (Antonio Murillo, Lázaro Espinoza)
19. Fishing lines as an alternative (Daniel Aguilar, Ramses Rodríguez, Carlos Samudio)
20. Fish traps as an alternative (Daniel Aguilar, Antonio García)

14:30-17:00
21. Alternative fisheries (Sergio A. Pérez y Lázaro Espinoza)
22. Concluding remarks and recommendations
23. Enforcement

Julio 10
09:30 – 16:30
24. Captive and *in situ* breeding
25. Drafting of the report
26. CIRVA recommendations and Report
27. Review of CIRVA-5
28. Adoption of the Report

Annex 3: Estimation of current vaquita population size

Tim Gerrodette, Southwest Fisheries Science Center, NOAA Fisheries, La Jolla, CA

The PACE Vaquita conservation action plan was adopted in the spring of 2008. The conservation plan proposed three options for closing areas to gillnet fishing in order to protect vaquitas. Gerrodette and Rojas-Bracho (2011) estimated the probability of success of the three options, based on a population model using data on visual sightings, acoustic detections, amount of fishing effort and vaquita bycatch. The conservation plan also established an acoustic monitoring program (Rojas-Bracho et al. 2010). After a period of development and testing from 2008-2010, the program collected extensive acoustic data in 2011, 2012 and 2013. The acoustic data have been analyzed by an expert panel to estimate the rate of change in acoustic activity at the locations of the recording devices (Jaramillo Legorreta et al 2014). Here we bring together the results of these two previous analyses to estimate the current size of the vaquita population.

To estimate current (mid-2014) vaquita abundance, we begin with the estimate of abundance at the end of 2009 based on the model of Gerrodette and Rojas-Bracho (2011). We use 2009 because the model included the effects of reduced fishing in 2008 and 2009 under PACE Vaquita, but did not include data after that. As used in the model, the estimate for a calendar year meant the population size at the end of the year. Thus, the number of vaquitas on 31 Dec 2009 was estimated to be 209 with a central 95% credibility interval from 130 to 321. In this paper, we change the year convention slightly to a more intuitive interpretation by considering this the estimate of 1 Jan 2010 and plotting this estimate on the 2010 tick mark. For the remainder of this document, abundance estimates are interpreted as the population size on Jan 1 of the year given. The present task is to estimate the current (mid-2014) population size. In the terms of the model, this is year 2013.5, which can be confusing, hence the change in presentation. Numerical results are unaffected.

The acoustic monitoring program uses an array of about 45 C-PODs with the Vaquita Refuge. Each C-POD records vaquita clicks for about 3 months during the summer. Analysis of the acoustic data is complicated by the fact that, for a variety of reasons, data are not recovered from every C-POD for the full monitoring period for every year. The expert panel convened to analyze the acoustic data considered several statistical models to estimate the annual rate of change indicated by the C-POD data. For projecting the vaquita population, we use the results of the panel's analyses, which was an average of the two best models (Jaramillo Legorreta et al 2014).

To estimate current vaquita abundance from these acoustic data requires two important assumptions:

(1) Acoustic encounter rates are proportional to vaquita abundance. Porpoise acoustic monitoring programs around the world rely on this assumption. Porpoise click activity, as well as detecting clicks with a device such as a C-POD, depends on many factors. We assume that the temporal and spatial extent of the C-POD array, together with the statistical analyses, are sufficient to account for these factors. Gerrodette et al (2011) estimated a rate of decline (7.6%) between 1997 and 2008 from visual data that was the same as the rate estimated by Jaramillo-Legorreta (2008) from acoustic data for the same period, which provides some support for this assumption.

(2) Vaquita abundance at C-POD locations during the summer acoustic monitoring period is proportional to total vaquita abundance. C-PODs are located several kilometers apart, and the detection range of a C-POD is limited to a few tens of meters. Vaquitas are not detected when they move in the areas between C-PODs, and vaquitas also move outside the area covered by the array of C-PODs. However, the C-PODs are placed in a regular grid with the Vaquita Refuge, which is the central part of the vaquita range containing about 50% of the population. While Gerrodette et al (2011) found a 57% decline in total abundance and a 59% decline in abundance in the core region (similar to the Refuge Area), this cannot be considered strong support because the two estimates are strongly correlated. The variation in the proportion of vaquitas that are near C-POD locations at any moment is not known. The projection presented here assumes that the roughly 2-month core acoustic sampling period is long enough to average over this variability.

The projection of the vaquita population starts with the posterior distribution of abundance at the beginning of 2010, as described above, and proceeds to mid-2014. The period covered by the acoustic monitoring data is from mid-2011 to mid-2013 (Jaramillo Legorreta et al 2014). We assume that the same trend in the population, a change of -18.5%/year, has continued from mid-2013 to mid-2014. To project the population between the beginning of 2010 and mid-2011, we use the mean of this trend and the trend (about -4%/year) that was occurring between 2008 and 2010 in the first 2 years of the PACE Vaquita conservation plan, as estimated by the model of Gerrodette and Rojas-Bracho (2011). Thus, the rate of population change during the 1.5-year period between the start of 2010 and mid-2011 was about -11%/year.

The mean rate of annual change during 2011-2013 indicated by the acoustic data, -18.5%/year, seems reasonable given reports of increased fishing for totoaba and lax enforcement of the ban on gillnet fishing in the Vaquita Refuge. However, the posterior distribution of the rate of annual change is quite broad, with 2.5% and 97.5% quantiles of 0.54 and 1.19, respectively. These rates imply a nearly 50% annual decline for the lower limit and a 19% per year growth for the upper. These rates are not credible. They are based on the acoustic data only, and do not take account of other data, such as the amount of fishing effort and the reproductive capacity of porpoises. Prior to the CIRVA meeting, there was not time to conduct an analysis which would constrain the posterior distribution of the acoustic data by taking these other data into account. Therefore, the projection of the vaquita population from the beginning of 2010 to mid-2014 presented in this document was based on the mean values of the posterior distributions described above. The width of the posterior distribution of the mid-2014 abundance estimate depends only on the uncertainty in the 2010 estimate from Gerrodette and Rojas-Bracho (2011) projected forward. The variance of the mid-2014 population estimate is therefore underestimated. We focus instead on the mean trend of the population and the mean 2014 estimate, which are substantially unaffected.

The posterior distribution of mid-2014 vaquita abundance ranges from about 50 to 150 animals (Fig. 1). This distribution has a mean of 97 and a median of 94 (Table 1). Thus, the current best estimate of vaquita abundance is that the population consists of fewer than 100 animals. Between 1993 and 2014, the population has declined from about 700 to 100 animals (Fig. 2). The probability that the population is below 100, which CIRVA has previously identified as a critical number below which the population may not recover, will become certain in the next few years (Fig. 3).

ANNEX 3: ESTIMATE OF CURRENT VAQUITA POPULATION

The last sentence of Gerrodette *et al.* (2011) stated: "The array of acoustic recorders will provide feedback to managers about whether the conservation plan is working and the vaquita population is recovering, or whether further steps need to be taken to save this porpoise from extinction." We now have data from the first 3 years of acoustic monitoring. The results indicate clearly that the vaquita population is declining even more rapidly than previously estimated, that the current population is very small and vulnerable, and that strong and immediate management actions are necessary to prevent extinction of the species.

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Table 1

Summary statistics of the posterior distribution of the number of vaquitas alive in July 2014, rounded to the nearest whole number.

mean	mode	min	max	2.5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	97.5%
97	89	33	211	60	71	78	85	89	94	101	105	114	125	144

ANNEX 3: ESTIMATE OF CURRENT VAQUITA POPULATION

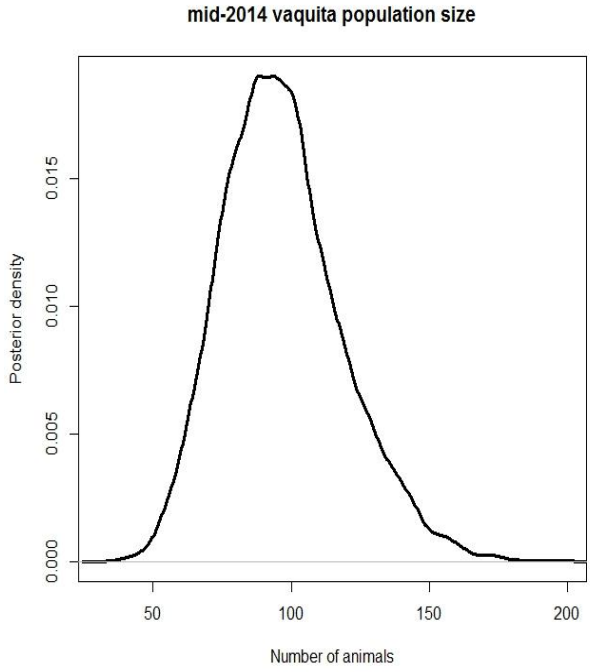

Figure 1. Posterior distribution of the number of vaquitas alive in July 2014.

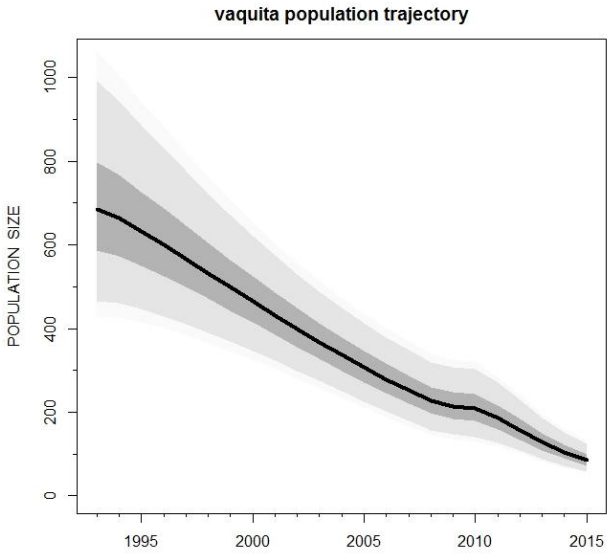

Figure 2. The estimated trajectory of the vaquita population from 1993 through 2014. The black line is the median, and the three shades of gray are 50%, 90%, and 95% of posterior probability density.

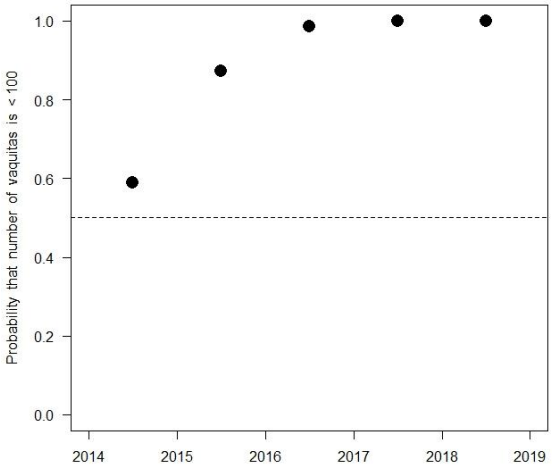

Figure 3. Probability that vaquita population size will be <100 animals at the midpoints of the next 4 years. The first point represents the current (mid-2014) population size.

Annex 4: Alternative technologies and fisheries

INTRODUCTION

As explained in detail in the main CIRVA report, all gillnets need to be removed immediately from the entire range of the vaquita if species extinction is to be prevented. Combinations of partial area and seasonal closures with different levels of enforcement are not only inadequate for protecting vaquitas, but such measures also cause fishermen to lose revenue. The development and implementation of new technologies could bring benefits to both vaquitas and fishermen.

Over the last decade, several efforts have been made to find the best technological solutions. In 2004 WWF, INAPESCA and experts from Memorial University of Newfoundland started testing traps for catching shrimp. In 2006 INAPESCA started testing small nets powered by wind developed in Sinaloa, called suripera nets. In 2008, after four years of research, INAPESCA concluded that conditions in the upper Gulf are not suitable for shrimp traps and suriperas and the agency started testing a small trawl for shrimp. In 2009, while small trawl experiments continued, WWF and INAPESCA started testing traps and longlines in combination with Fishing Aggregation Devices (FAD). From 2009 to 2013 INAPESCA conducted several tests with the prototype net including tests in nighttime and daytime, during the shrimp season and before the shrimp season, both with the original design and with modifications. In 2012, WWF and INAPESCA tested six different options for finfish fisheries. Finally in 2013 the small trawl was prescribed as part of the Mexican Standard for shrimp fishing.

SMALL TRAWL FOR SHRIMP

The small trawl for shrimp was developed by the National Institute of Fisheries (INAPESCA). This small trawl has several devices that improve its environmental performance: (1) turtle excluder device, (2) one fish excluder device, (3) double rope to avoid damaging the seabed, (4) progressive reduction in the mesh size along the net, (5) hydrodynamic trawl doors to reduce resistance and increase efficiency and (6) super-light materials.

Performance of the small trawl varies depending in the skills of the fishermen, season and fishing grounds. Its performance in optimal conditions has never been proven because this small trawl cannot be operated in the presence of gillnets. Tests in daylight during the shrimp season resulted in low performance because of the presence of gillnets (INAPESCA, 2011); tests during nighttime, absent gillnet interference, resulted in good catches of brown shrimp, which are only available at night but command lower prices than the highly desirable blue shrimp (INAPESCA, 2011); and tests before opening of the shrimp season resulted in catches of small-sized shrimp because those are what is available at that time of the year. This last test showed a good performance: 9.7 kg of shrimp per cast vs. 8.6 kg of by-catch (INAPESCA, 2012).

In 2013, the Mexican government mandated the use of the small trawl for the Upper Gulf of California shrimp fishery, with a phased approach over three years: removal of 30% of gillnet-equipped pangas in the first year, 30% in the second year and 40% in the third year. Even though this mandate represents an important step for the technological transition, significant challenges remain, among them: (1) **the small trawl cannot operate in the presence of gillnets,** (2)

fishermen are reluctant to change, (3) fuel consumption and engine depreciation are higher with the small trawl than with gillnets, (4) it has not been demonstrated that the small trawl works in the eastern part of the Upper Gulf (Golfo de Santa Clara area), (5) administrative procedures in fisheries take time to develop and change, but in the present circumstances there is no time left for things to change in the normal fashion, (6) under optimal conditions (daylight, during the season and without gillnets present) the small trawl could be as profitable as the gillnet fishery, and (7) bycatch of juvenile finfish could be a concern.

A group of 17 fishermen from San Felipe has been working with the small trawl and participating in tests of other alternative technologies. This group of fishermen has important skills in the use of the small trawl and obtained good shrimp catches with it; these fishermen represent a very important asset given their ability to demonstrate the profitability of fishing with the small trawl, to train other fishermen, and generally to make the case in favor of the technological transition. They agree with technology experts that the gasoline-powered outboard engines currently used by fishermen are not the best way for using the trawl net, and that diesel-powered engines could improve the performance of the small trawl.

Finally, with gillnets in the water there is no way that the trawl fishery could be developed, regardless of the engine type or the skills of the fisherman. **With gillnets in the water, the small trawl will not work**.

DIESEL-POWERED SMALL VESSEL FOR TRAWLING

Fishermen, technology experts and naval engineers all agree that the small skiffs with gasoline outboard engines are not the best technology for using a trawl net. Three different models for a diesel-powered small trawl vessel were presented during CIRVA meeting.

The first proposal was a 30-foot vessel with a stationary diesel engine and capacity for three people. This vessel would have a cost of about 130,000 USD for the first prototype and around 15% less thereafter. Ideally this kind of vessel should land at a dock, but it could also land on the beach. It would give fishermen more autonomy and range, greater towing depth and power, and enable longer cast and journey times. With this kind of vessel, the fishing power would increase. Therefore it would be very important to consider sustainability of the shrimp fishery itself if this technology were to be selected.

The second and third proposals were presented by fishermen from the Upper Gulf, taking into account the socio-economic circumstances there. The proposed vessels are smaller in length and weight and are designed to land on the beach and be transported to the home of the fishermen every day. The cost of each of these proposals is around 50,000 USD, i.e. considerably lower than the first one. The two proposals include a 200HP diesel engine. However, current regulations limit the engine power to 115 HP. This is a challenge that would need to be addressed if either of these models were to be selected.

The information presented at this meeting was not sufficient for making any recommendation about the best vessel design. Some similarities, however, such as the vessel size (27-30 feet) and the engine type (stationary diesel), show that different people are thinking along similar lines in the search for a best design.

ANNEX 4: ALTERNATIVE TECHNOLOGIES AND FISHERIES

LINES AND TRAPS

The small trawl for shrimp is a good solution for the shrimp fishery, but most fishermen in the Upper Gulf make a living from two main seasons: the shrimp season (September to March) and the finfish season (March to July). For the finfish season, traps and longlines have been tested (Table A.1). Rectangular traps proved to be very efficient but their dimensions were too large for the skiffs used in the small-scale fisheries in the Upper Gulf; thus some additional research has been done (but more is probably needed to develop a collapsible rectangular trap.

Table A.1

Results of tests of lines and traps in 2012

	Total Catches (kg)	Catches per unit	Catches per hour	By-catch Ratio
Collapsible traps	2.30	0.58	0.13	1 : 0.00
Rectangular traps	243.28	4.96	2.76	1 : 0.09
Longline	19.00	0.05	3.17	1 : 1.36
Conical traps	6.00	0.21	0.24	1 : 0.50
Octopus traps	3.30	0.22	0.41	1 : 0.06
Crab traps	7.90	0.18	0.21	1 : 2.13

Source: *INAPESCA, WWF, 2012.*

Longlines have also been tested commercially. The longline fishery in the Upper Gulf has existed for a long time, but it has always constituted a very small proportion of the overall fisheries. PRONATURA has been working with a group of 15 longline fishermen to understand the costs and benefits of longline fishing. In 2013, PRONATURA analyzed 136 journeys of these fishermen. The total operation costs of these journeys amounted to 20,000 USD, of which 11,600 USD consisted of payments to fishermen for labor; the benefits amounted to about 28,000 USD over a period of three months. Therefore, the benefit-cost ratio was 1.4 over that period.

Despite the good benefit-cost ratio, there are some challenges for extending the use of longlines in the region, among them: (1) longline fisheries capture different species than gillnets and are used to supplement income and not as a main earning activity, (2) the good season for the species captured with longlines overlaps with the seasonal shark fishing closure, (3) the revenue obtained from three days of fishing with longlines can be obtained from just one day of gillnet fishing , (4) longlines capture specimens of premium quality ('de primera') but domestic markets that would pay reasonable prices for such products do not exist in San Felipe, and (5) neither longlines nor traps capture the same array of species as gillnets or the same quantities of products as gillnets. In the case of traps, there are other important challenges including: (6) fishermen don't like the high selectivity of traps so there is likely to be some opposition to any switch to trap fishing and (7) the presence of gillnets interferes with the operation of traps and therefore as long as gillnets are in the water, it is unrealistic to think a trap fishery can be developed.

During the CIRVA meeting ideas were presented for dealing with some of those challenges. For example, PRONATURA suggested working with international markets and exploring added-value

options in order to find (or create?) good prices for the longline and trap fisheries. Fishermen present at the meeting suggested that tests of traps for finfish should be continued.

An important concern was raised about the use of longlines in or near the range of totoaba. However, it was reported that not a single totoaba was observed during the longline experiment conducted by PRONATURA. Also, according to the fishermen present at the meeting, the size of the hook and the bait used for sand sea bass and groupers are very different than what is needed to catch totoaba.

ALTERNATIVE FISHERIES

According to the National Fishing Chart (Carta Nacional Pesquera, 2010), some species of shellfish in the Upper Gulf are 'under-exploited' (i.e. exploited at rates below what would provide the Maximum Sustainable Yield, MSY) and can support an increase in fishing effort, mainly in the waters near San Felipe and El Golfo de Santa Clara.

Some fishermen have moved into fisheries for these shellfish species in recent years. Such fisheries do not involve the use of gillnets and they therefore represent opportunities for 'swap outs'. In 2009 the first permits for these species were issued as part of a swap-out program led by the Mexican Government under which some fishermen surrendered their gillnet permits in order to start exploring the alternative shellfish fisheries. Among the species considered to have development potential and that could be used to swap-out gillnets are geoduck, clams, rock scallop, murex and oysters. A reduction in the gillnet fishery could spur increased effort in these fisheries.

Fisheries for some of the shellfish are particularly suited to the Upper Gulf and have no by-catch and low ecological impact, and the target species grow quickly and can be harvested year-round. The demand for some of the species in international markets has been increasing and some of them could be produced with aquaculture techniques. Processing to give added value should be relatively easy. It is nonetheless difficult to find fishermen who are willing to exchange their gillnet permits for shellfish permits. Among the reasons for this are: (1) obtaining the legal permits could take a long time, (2) the requirements for technical studies could lead to considerable expense and (3) the international market for some of them, e.g. geoduck, is decreasing. Without knowing the levels of effort required to exploit new species and without having reliable information on allowable catches, fishermen are reluctant to switch to these alternative fisheries or to explore marketing opportunities.

Regardless of the challenges mentioned above, some of these fisheries are, or could be, very profitable. One of the first participants in the geoduck fishery summarized his experience for meeting participants. The business has been highly profitable for him and he is now re-investing in a laboratory for producing geoduck 'seed'.

ANNEX 4: ALTERNATIVE TECHNOLOGIES AND FISHERIES

CONCLUSIONS

The session on alternative technologies and fisheries provided considerable information related to fishing gear and techniques. Among the highlights are the following:

- After years of research, technologies and methods are available that make it possible to maintain fisheries in the Upper Gulf without dependence on gillnets.
- The majority of the fishermen are reluctant to change.
- There is a group of committed, skilled fishermen who are using the small trawl commercially and demonstrating that it is possible to making a living using this gear.
- Small trawls and fish traps are not compatible with gillnets in the same area at the same time; so the absence of gillnets will favor and promote the adoption of these new technologies.
- The use of diesel-powered engines will increase the efficiency of the small trawl.
- Based on the studies and data presented, longlines are being used profitably in the Upper Gulf, but less revenue is obtained from longlining than from gillnetting.
- There are alternative fisheries in the Upper Gulf that could be even more profitable than fishing with gillnets (for example shellfish fisheries), but fishermen often opt for the easiest, most familiar and thus 'safest' option, which is to continue fishing with gillnets.
- In all cases, opening new fisheries, catching different species with longlines and using trawls for shrimp, authorities should pay special attention to the available biomass and ensure that changes in fishing effort do not lead to overfishing.
- A well-enforced ban on gillnets could accelerate the technology change.

Annex 5: Review of progress with past recommendations

Table 1

Review of progress towards implementation of measures previously recommended by CIRVA and/or PACE-Vaquita. The subjective judgment categories under "Progress" are: H = high, M = Medium, L = Low, N = None (with the Success rating given in **2014 in bold**, 2012 in italics and 2004 CIRVA report in parentheses). Colors indicate: black--recommendation from CIRVA II and still relevant, red--recommendation of CIRVA II but current recommendation differs, blue-- recommendation of CIRVA IV. *Not discussed during CIRVA V

Recommendation	Current situation	Progress (H,M,L,N)
1. The by-catch of vaquitas must be reduced to zero as soon as possible.	Evidence suggests that fishing effort has not been significantly reduced and bycatch has not been reduced to zero. The decline of 18.5%/year indicated by the acoustic monitoring means that the by-catch rate estimate is the highest ever estimated.	**N** *L* (N)
2. The southern boundary of the Biosphere Reserve should be expanded to include all known habitat of vaquita.	The Vaquita Refuge, initiated in 2005, covers part of the range to the south, but not all. Fishing effort along the southern border of the Refuge where high densities of vaquitas are known to occur outside the Refuge is very high.	**N** *M* (N)
3. Gillnets and [industrial] trawlers should be banned from the Biosphere Reserve, in the following sequence:		
Stage One (to be completed by 1 January 2000) • Eliminate large-mesh gillnets (6-inch stretched mesh, or greater); • Cap the number of pangas at present levels; • Restrict fishing activities to residents of San Felipe, El Golfo de Santa Clara, and Puerto Peñasco.	• Large-mesh gillnets banned in the Biosphere Reserve in 2002 and have not been used since 2007. Resurgence of the toatoaba fishery in 2011 means large-mesh gillnets are currently back in use • In 2012 the number of pangas has been reduced and capped (but probably at a level that still is similar to or exceeds the number of pangas in 2000). Evidence from aerial surveys indicates relatively level numbers of pangas but new and 'cloned' pangas are reported in recent years. Progress has been made in restricting fishing activities to local permitted pangas and trawlers. This restriction has been enhanced through requirements to conform to Environmental Impact Statements to fish in the reserve. Pangas from outside the three communities of the Upper Gulf have been reported fishing in the area.	**N** *M* (M)
Stage Two (to be completed by 1 January 2001) • Eliminate medium-mesh gillnets (i.e. all except chinchorro de linea).	Reduced within Vaquita Refuge though violations are frequent. Reductions have also occurred through the program to switchout from gillnets to vaquita-friendly gear (e.g. longlines and pots). However, success rating is Low because effort with medium-mesh gillnets remains high in areas outside the Refuge where approximately half of vaquitas can be found.	**L** *L*[1] (L)

[1] CIRVA members feel that the past success rating should have been N, and that progress has been made on this recommendation.

ANNEX 5: PROGRESS WITH PAST RECOMMENDATIONS

Recommendation	Current situation	Progress (H,M,L,N)
Stage Three (to be completed by 1 January 2002) • Eliminate all gillnets and [industrial] trawlers.	Reduced gillnetting within Vaquita Refuge though violations are frequent. Industrial trawling within the Refuge is nearly eliminated. However industrial trawling has not been eliminated. Rating is also Low because effort with chinchorro de linea gillnets remains high in areas outside the Refuge where approximately half of the vaquitas can be found.	**L** *L*[2](L)
PACE eliminate gillnets throughout the range of vaquitas by 2012	Reduced within Vaquita Refuge though violations are frequent. Rating is Low because effort remains high in areas outside the Refuge where approximately half of the vaquitas can be found.	**N** *L*
4. Effective enforcement of fishing regulations should begin immediately. The development of effective enforcement techniques should be given high priority because all of the committee's recommendations depend upon effective enforcement.	Previous progress was made in terms of permits and reduction of un-permitted fishing. Trawlers are required to carry location devices (VMS). The Vaquita Refuge has been marked with buoys. Fishing (gillnetting and trawling) within the Vaquita Refuge has likely been reduced since 2008. However, violations of limits on the length and number of nets/boat are widespread, have occurred for many years, and are a serious concern. Illegal fishing within the Vaquita Refuge is not uncommon. The resurgence of the totoaba fishery makes clear the lack of effective enforcement.	**N** *M*[3] (M)
5. Acoustic surveys should start immediately to (a) begin monitoring an index of abundance and (b) gather data on seasonal movements of vaquitas.	Acoustic surveys were done by Jaramillo-Legorreta from 1997-2007 and data indicated a decline in abundance and no evidence for seasonal movements. Results from 2011-2013 provide strong evidence of a serious decline (18.5%/year)	**H** *H* (H)
6. Research should start immediately to develop alternative gear types and techniques to replace gillnets.	Shrimp pots and suriperas were tested and failed. Several small shrimp trawls (RS-INP-MX) were tested and are viable fishing alternatives. Fin-fish traps are in an early testing phase. Other alternatives (long-lines, shellfish capture by diving) have been developed.	**M** *M*
*7. A program should be developed to promote community involvement and public awareness of the importance of the Biosphere Reserve and the vaquita, stressing their relevance as part of México's and the world's heritage. Public support is crucial.	The Assessment and Monitoring Board (Organo de Evaluación y Seguimiento, 2008) was formed and includes: fishermen from San Felipe, Golfo de Santa Clara and Puerto Peñasco, academics from Baja California and Sonora states, state and federal governmental institutions from fisheries and environmental sectors and NGOs. The EIA for small-scale fishing in the Upper Gulf provides a structure for continued progress on this.	* *H* (H)
*8. Consideration should be given to compensating fishermen for lost income resulting from the gillnet ban.		

[2] Same comment as footnote 1.
[3] CIRVA members feel that the past success rating should have been L, and that progress has been made on this recommendation.

ANNEX 5: PROGRESS WITH PAST RECOMMENDATIONS

Recommendation	Current situation	Progress (H,M,L,N)
*Buy-out	247 artisanal boats with 370 fishing permits out of the water (numbers from http://www.conanp.gob.mx/vaquita_marina/)	*M*
*Biodiversity conservation actions	An average of 230 boats received compensation not to fish within the Vaquita Refuge Area (1,263 km^2) (http://www.conanp.gob.mx/vaquita_marina/). A Medium success rating was given in 2012 because fishing within the Refuge is frequent and the overlap between violators and those receiving compensation is unknown.	*M*
*Switch-out	230 pangas (including 247 permits) (http://www.conanp.gob.mx/vaquita_marina/) have participated in the switch-out to alternative 'vaquita-safe' fishing gear (in most cases presumably small trawls). A Low success rating was given in 2012 because of uncertainty about whether all 230 pangas were actually using the alternative gear provided. It is unclear whether they could use small trawls effectively on the fishing grounds given the high density of gillnets, which are obstacles to trawling. There is also uncertainty of whether CONAPESCA has provided the permits to use the alternative gear.	*L*
9. Research should be conducted to better define critical habitat of vaquitas, using data collected during the 1997 abundance survey.	Additional data gathered from both Vaquita Expedition 2008 and acoustic monitoring have been used effectively to delimit the total current distribution of vaquitas. Acoustic monitoring within the Refuge reveals some shifts in distribution between mid-June and mid-September but no progress has been made to monitor outside the Refuge	**M** *H* (M)
10. The international community and NGOs should be invited to join the Government of México and provide technical and financial assistance to implement the conservation measures described in this recovery plan and to support further conservation activities.	International organizations (Commission for Environmental Cooperation), NGOs (WWF and Cousteau Society) the governments of the US (NOAA Fisheries and the Marine Mammal Commission) have worked as active partners with the Government of Mexico towards the conservation of the vaquita and the ecosystem of the Upper Gulf. WWF Mexico and PRONATURA have provided excellent support to fishermen trained to use the small-trawls. CEDO has worked with fishermen in recording fishing effort for environmental impact assessments.	**H** *M* (M)

Annex 6: Rationale for the proposed gillnet exclusion zone

The primary objective of the gillnet exclusion zone is to encompass the complete current range of vaquitas. The secondary objective is to delimit the zone in such a way that it is easy for both fishers and enforcers to know when activities are within or outside the zone both visually and with a GPS.

The range of vaquitas is known from several sources: 1) skeletal remains, 2) reports of vaquita deaths in fisheries, 3) dedicated surveys (both visual and acoustic).

Brownell (1986) summarized confirmed stranded remains of vaquita which were mainly bones and found no confirmed remains to the south of Puertecitos along the western side or south of Puerto Penasco on the eastern side. Reports from fisheries show extensive captures in shallow-water areas (Fig. 9.1 from Gallo-Reynoso, 1998).

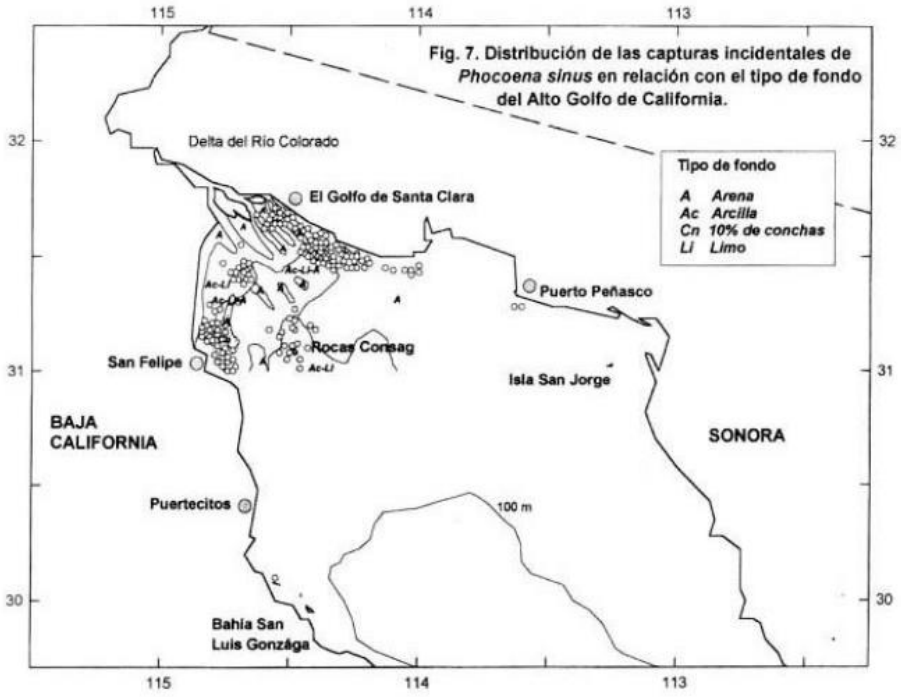

Figure 1. Distribution of incidentally captured vaquitas in relation to the type of bottom in the northern Gulf of California. Key for bottom types with English in parentheses: A = arena (sand), Ac = Arcilla (clay), Cn = 10% de conchas (10% shells), Li = Limo (silt).

Observations and interviews from El Golfo de Santa Clara that were used to estimate vaquita mortality rates also suggest these shallow water areas as important vaquita habitat (D'Agosa et al. 2000). Their description of vaquita distribution suggests vaquita presence in all the fishing grounds shown in the figure below.

ANNEX 6: GILLNET EXCLUSION ZONE RATIONALE

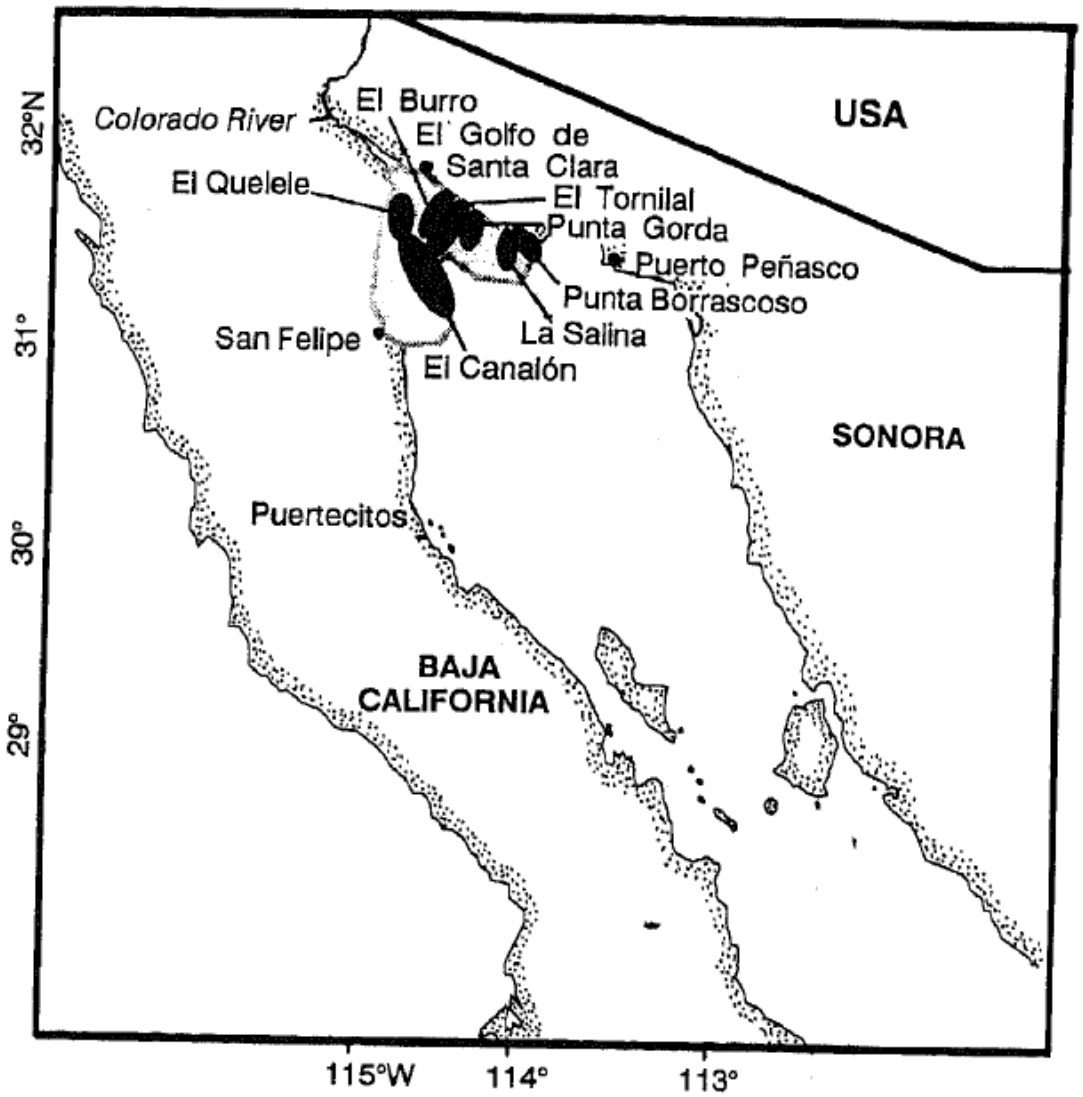

Fig. 1. Study area. Preferred fishing grounds in black, 23 January 1993–29 March 1994.

Figure 2. Fig. 1 taken from D'Agrosa *et al.*, 1995 which shows the preferred fishing grounds for El Golfo de Santa Clara. Vaquita were killed in all these fisheries. Note that data come primarily from January to March.

Visual and acoustic surveys give a different impression of vaquita distribution for two possible reasons: 1) data come primarily from September through November (visual) or mid-June through mid-September (acoustic), and 2) the vast majority of effort is for the deeper water areas where the large ship could navigate or where passive acoustic devices could be protected from gillnet and trawl removal within the Vaquita Refuge. The vaquita detections shown in Figure 9.3 result from effort focused on the deeper waters navigable by ship with very little effort in the shallow

water areas covered by the fisheries information above. All detections in the figure have high reliability for being vaquita (Barlow et al. 1997, Jaramillo et al. 1999, Gerrodette et al. 2011). The southernmost point was a sighting made by Barlow and Forney on an aerial survey (Barlow et al. 1993). Both are experienced porpoise observers. One sighting from south of Puerto Penasco was excluded from consideration because it was made from a helicopter and displayed jumping behavior not observed in vaquita. Another sighting off Isla Montegue was excluded because it was from an aerial survey with a group size of well over ten individuals, which was also deemed unlikely to be vaquita.

An additional line of evidence for the Gillnet Exclusion Zone including the western and northern shallow water zones down to about Puertecitos comes from the apparent preferred habitat of vaquita over muddy seafloors resulting from deposition from the Colorado River (Gallo-Reynoso, 1998). The sedimentation pattern in this area is shown in Figure 9.4 (from Carriquiry et al. 2001). Deposition of the fine mud that suspends in the waters above as tidal currents flow down the western portion of the Gulf.

Boundary lines were chosen to both encompass know current vaquita distribution and to be as simple as possible to implement for fishermen and enforcers. Thus, a single reading on a GPS device will determine whether you are north of 30º05'42" (which could be seen visually as the north tip of "Isla el Muerto") or west of 114º01'19" (which could be seen visually as Punta Borrascosa). If either of those conditions are true, then no gillnets are allowed (whether on land or at sea).

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ANNEX 6: GILLNET EXCLUSION ZONE RATIONALE

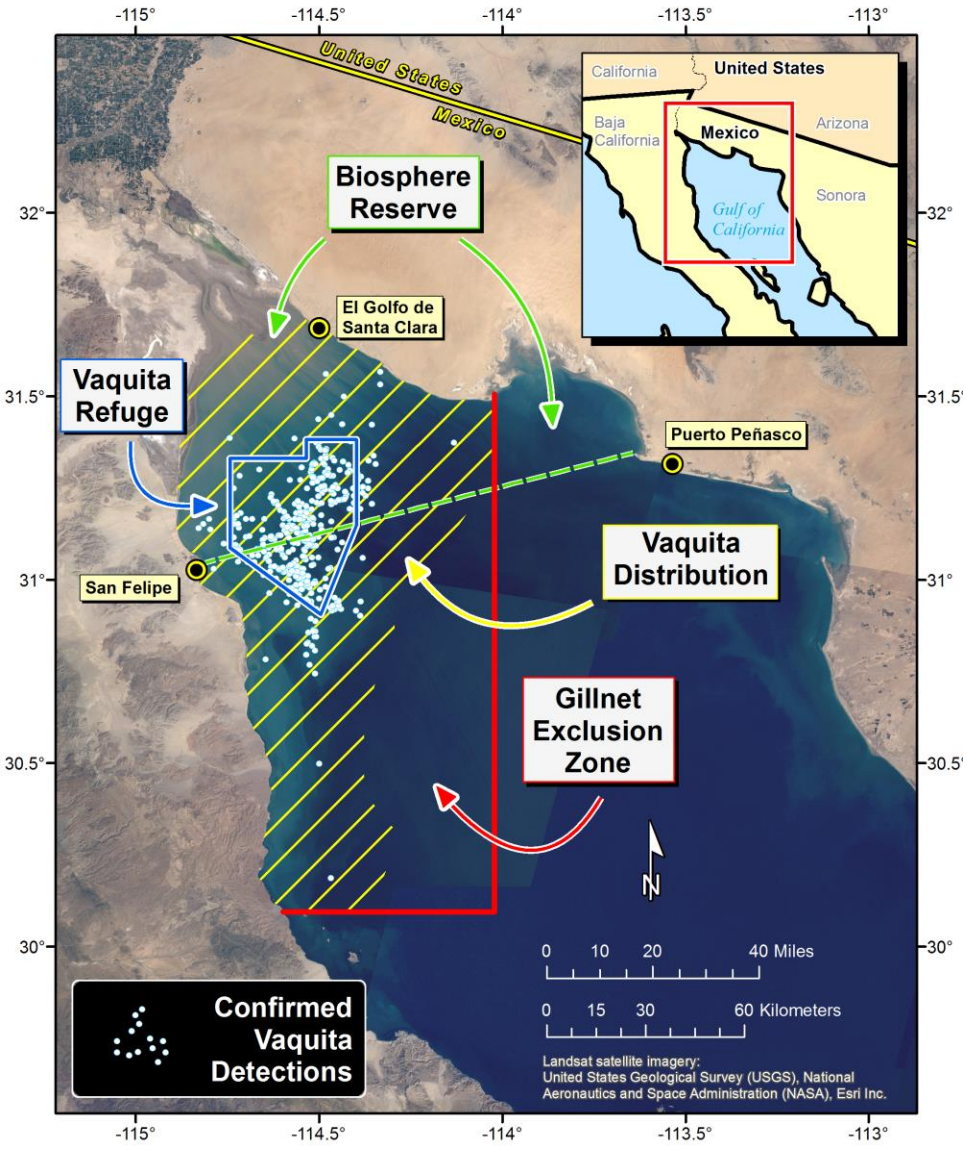

Figure 3. Gillnet exclusion zone proposed at fifth meeting of CIRVA. Red lines delimit the proposed gillnet exclusion zone. The southeast vertex of this zone, where both straight lines intersect, is at 30º05'42"N, 114º01'19"W. From this point a line extends to the north towards 'Punta Borrascosa' (Borrascosa Point). The other line extends to the west until it meets the coast of Baja California, passing along the northern tip of 'Isla el Muerto' (El Muerto Island, the northernmost island in Las Encantadas Archipelago). Gillnet exclusion zone boundaries were chosen for ease of use by fishermen and enforcement agents. A simple GPS reading or line of sight to well-known land markers can be used. The proposed gillnet exclusion zone is intended to include the full known range of vaquitas since the 1990's using data from fisheries and some survey locations for distribution in the shallow water areas and from the visual and acoustic detections (visualized with white dots) in the deeper waters. The area also encompasses the habitat with muddy waters (seen in the satellite image) created by strong currents that comprise critical habitat for vaquitas.

ANNEX 6: GILLNET EXCLUSION ZONE RATIONALE

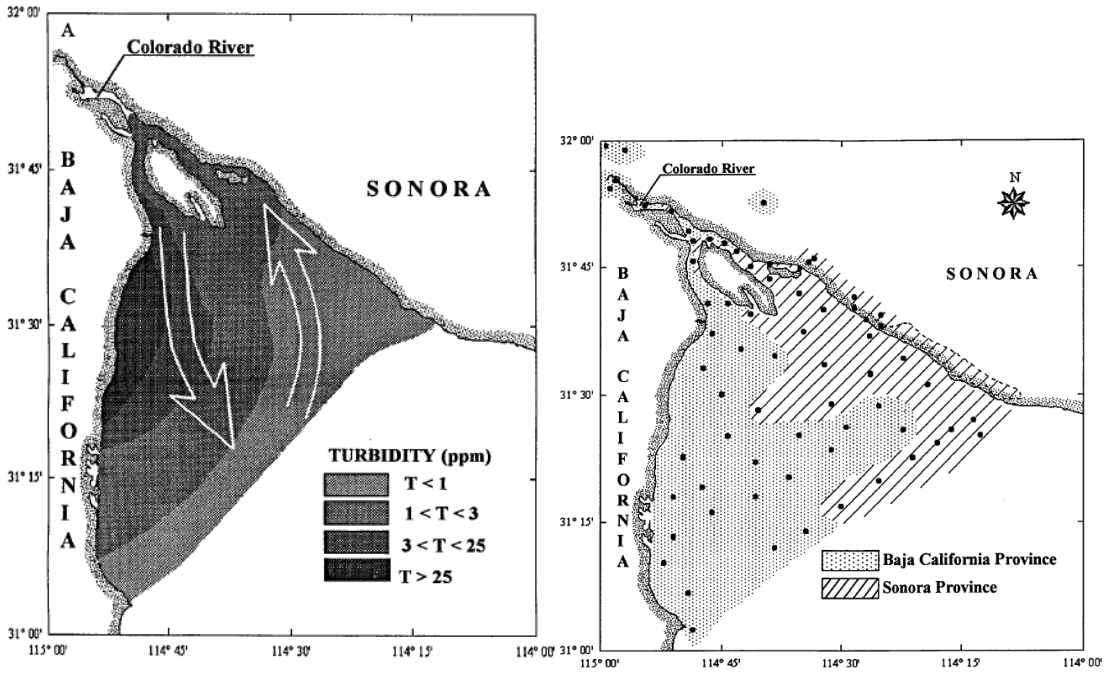

Figure 4. Spatial variability pattern of turbidity and sedimentary provices obtained by Q-mode cluster analysis from Carriquiry *et al*. 1999.

ANNEX 7-9: ACOUSTIC MONITORING PROGRAM

The following Annexes 7 – 9 are reports of meetings related to the acoustic monitoring program completed before CIRVA-V and reviewed at CIRVA-V. They are page numbered independently of the CIRVA-V report.

Annex 7: VAQUITA POPULATION TREND MONITORING SCHEME BASED ON PASSIVE ACOUSTICS DATA - PROGRESS REPORT FOR STEERING COMMITTEE – 19pp.

Annex 8: SECOND MEETING OF THE STEERING COMMITTEE OF THE VAQUITA ACOUSTIC MONITORING PROGRAM – 50pp.

Annex 9: EXPERT PANEL ON SPATIAL MODELS: REPORT ON VAQUITA RATE OF CHANGE BETWEEN 2011 AND 2013 USING PASSIVE ACOUSTIC DATA – 50pp.