Eighth Meeting of the Comité Internacional para la Recuperación de la Vaquita (CIRVA-8)
Southwest Fisheries Science Center

November 29-30th, 2016
La Jolla, CA

ACKNOWLEDGEMENTS

Our appreciation to all the funders: The Marine Mammal Commission, the Marine Mammal Center, Center for Biological Diversity, Natural Resources Defense Council, Animal Welfare Institute, and Viva Vaquita. The views expressed in the report do not necessarily reflect those of the groups named.
Also, our thanks for hosting the meeting at the Southwest Fisheries Science Center/NOAA Fisheries to Cisco Werner, Lisa Ballance and Barb Taylor. Thanks also to Annette Henry for her support during the meeting.

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EXECUTIVE SUMMARY

The eighth meeting of the Comité Internacional para la Recuperación de la Vaquita (CIRVA) was held at the Southwest Fisheries Science Center on November 29-30, 2016.

The Dire Status of the Vaquita Has Worsened

Analysis of the 2016 Acoustic Monitoring Program data has shown that almost half of the remaining vaquita population was lost between 2015 and 2016 (a 49% annual decline). The average annual rate of decline between 2011 and 2016 is now estimated to be 39%, corresponding to a population decline of 90% over this five-year period. CIRVA estimates that, as of November 2016, only approximately 30 vaquitas likely remained. Thus, the already desperate situation has worsened, despite existing conservation measures and current enforcement efforts. Unless this decline can be stopped by eliminating mortality in illegal gillnets, the vaquita will be extinct in a few years. The critical work of the Acoustic Monitoring Program **must continue** to allow estimation of population trend and to allow evaluation of the efficacy of current and future conservation measures.

High Levels of Illegal Fishing Continue

A multi-institutional program to find and remove illegal and abandoned fishing gear in the range of the vaquita recently completed its first phase of work. In fifteen days of field work in October and November 2016, 105 pieces of illegal, abandoned, or derelict fishing gear were discovered and 85 of these were removed. Thirty-one illegal totoaba gillnets, including 23 nets that had been recently set, were recovered. This shows that illegal fishing activities, particularly the setting of large-mesh gillnets for totoaba, continue at alarming levels within the range of the vaquita. CIRVA **recommends** that this important program should continue to remove fishing gear from the range of the vaquita.

A Permanent and Complete Gillnet Ban Is Essential
CIRVA repeats its previous recommendation that the Government of Mexico implement a permanent ban on all gillnets throughout the entire range of the vaquita. Given that the current two-year ban expires in April 2017, regulations implementing this ban should be published immediately in the *Diario Oficial de la Federación*. CIRVA **reiterates its previous recommendation** that the sale or possession of gillnets on land and at sea should be illegal within the area of the current gillnet ban and adjacent lands. This permanent ban **must include** gillnets used as rodeo nets in the curvina fishery. The results of the fishing gear removal program demonstrate that illegal totoaba fishing continued to be rampant, even before the curvina season started. The curvina fishery provides cover for illegal activities and complicates enforcement. As a result, CIRVA **recommends** that the gillnet ban include the curvina fishery.

Enforcement and Prosecution Must Be Strengthened
Continued high levels of illegal gillnet fishing, the confirmed deaths of three vaquitas in gillnets earlier this year, and a 50% decline in abundance over the past year demonstrate that present enforcement efforts have been insufficient. There is a critical need for more effective enforcement of existing fisheries regulations. This includes immediate response to reports of illegal fishing activity in the Upper Gulf, arrests, and prosecutions. CIRVA commends the collaboration between the Sea Shepherd Conservation Society and the Mexican Navy and **recommends** that this important partnership be continued. In addition, CIRVA reiterates that existing **laws must be strengthened and penalties increased** so that they act as a real deterrent to illegal fishing. Unless enforcement and prosecution efforts succeed in preventing illegal fishing for totoaba, the vaquita will soon be extinct.

Development of Alternative Fishing Gear Must Be Pursued
Progress on the development of alternative fishing gear has been too slow. CIRVA **emphasises** the need for the Mexican Government to follow the recommendations and protocols of the Expert Committee for Fishing Technologies in the Upper Gulf of California. CIRVA **reiterates the need to accelerate** the development of viable alternative fishing methods and to train fishermen in their use. This will require testing and use of alternative gears and requires developing methods of monitoring, control, surveillance and traceability. In turn, this requires the lead agencies, National Institute of Fisheries and Aquaculture (INAPESCA), National Commission of Fisheries and Aquaculture (CONAPESCA), and Secretariat of Environment and Natural Resources (SEMARNAT), to work immediately, effectively and transparently with the Expert Committee.

Some Vaquitas Should Be Placed in a Temporary Sanctuary
Given the dire situation, CIRVA **recommends** that attempts be made as a matter of urgency to place some vaquitas into a temporary sanctuary. The goal of this program is to protect these animals until they can be returned into a gillnet-free environment. Capturing and housing vaquitas will be difficult, and perhaps impossible, and the species may not prove to be suitable for such conservation actions. This work should not divert effort and resources away from extension and enforcement of the gillnet ban, which remains the highest-priority conservation action for the species. Given potential risk to individual animals, these attempts must proceed in a staged manner, with review by CIRVA at appropriate intervals and the option to cease work after each review. CIRVA agreed that capture of all remaining vaquitas is not feasible and is, therefore, not a viable conservation strategy. The species must be, first and foremost, protected in its wild habitat.

Summary of Priority Recommendations
At its eight meeting, CIRVA made the following priority recommendations:

1) The sale or possession of gillnets on land and at sea must be illegal within the area of the current gillnet ban and adjacent lands. This permanent ban must include gillnets used in the rodeo-style curvina fishery;

2) The gear removal program should continue as planned and additional areas should be searched, with the involvement of additional communities. Additional methods should be used to detect illegally set and abandoned nets and to gauge the program's efficiency. In addition, the multi-party public-private partnership led by SEMARNAT and the Mexican Navy should continue;
3) The anti-poaching program should be continued and strengthened. There is a critical need for more effective enforcement of existing fisheries regulations and for existing laws to be strengthened and penalties to be increased to serve as effective deterrents to illegal fishing. The partnership between the Navy and the Sea Shepherd

Conservation Society should continue and, if possible, be strengthened with more patrols and other efforts to achieve a faster response to illegal fishing activities;

4) Some vaquitas should be captured in the spring of 2017 and placed in a short-term sanctuary for up to one year to prevent extinction of the species. SEMARNAT, with assistance of the National Marine Mammal Foundation, should proceed with the sanctuary program as outlined by the Steering Group on Ex-Situ Conservation and as agreed at this meeting;

5) The acoustic monitoring program should continue with adequate support to allow estimation of population trend and to evaluate the efficacy of current and future conservation measures. Starting in the spring of 2017, acoustic sampling should be conducted at the ten monitoring sites with highest acoustic activity to assist with the capture program described above; and

6) There is an urgent need to accelerate development of viable alternative fishing methods and train fishermen in their use and to support the development of gillnet-free fisheries in the Upper Gulf. In particular, the Mexican Government should implement the recommendations and protocols of the Expert Committee for Fishing Technologies in the Upper Gulf of California.

The eighth meeting of the Comité Internacional para la Recuperación de la Vaquita (CIRVA-8) was held at the Southwest Fisheries Science Center on November 29-30, 2016. CIRVA members in attendance included: Lorenzo Rojas-Bracho (chair), Armando Jaramillo-Legorreta, Barbara Taylor, Jay Barlow, Tim Gerrodette, Peter Thomas, Andrew Read, Robert Brownell, Greg Donovan, Frances Gulland, Nina Young, Sarah Mesnick, and Randall Reeves. The committee's work was supported by a number of invited experts who provided presentations and contributed to plenary discussions. Rojas-Bracho chaired the meeting and Read, Thomas, and Reeves acted as rapporteurs. Meeting participants are listed in Annex 1. The agenda is given as Annex 2.

1. WELCOME

Lisa Ballance, Director of the Marine Mammal and Turtle Division, welcomed CIRVA members to the Southwest Fisheries Science Center. The agenda was adopted as amended and several background documents were provided to meeting participants.

2. ACOUSTIC MONITORING PROGRAM

Armando Jaramillo-Legorreta presented an update on the Acoustic Monitoring Program, incorporating data collected during the summer of 2016, one year after implementation of the gillnet ban (full details are provided in Annex 3). The density of vaquitas is now considerably lower than when the acoustic program began, so 47 new sampling sites were added in 2016 to improve precision in future monitoring of abundance trends. In addition, three other new sites were established to document the presence of vaquitas north of the Refuge, but only one of the three CPODs was recovered, yielding 41 days of sampling data and a single day with vaquita detections. In 2016, surface buoys were used to mark each sampling site, resulting in greatly improved efficiency in checking CPODs and retrieving data.

The spatial pattern of vaquita occurrence has been fairly consistent since monitoring began in 2011, although the overall rate of detections has declined dramatically (Fig. 1). The average number of click trains per day at all sites in 2016 was only 19, down from 152 in 2011, reflecting a dramatic decline in abundance during this period.

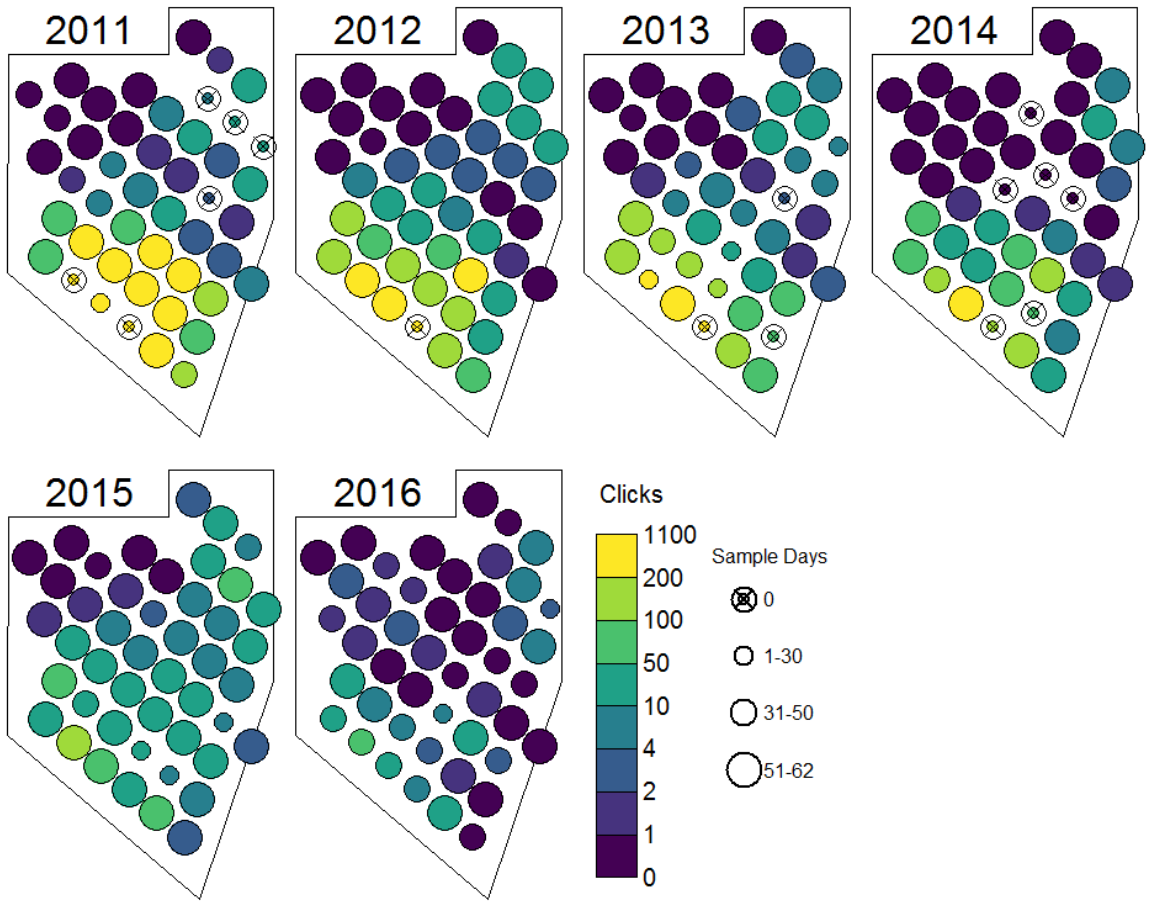

Fig. 1. Estimated mean number of vaquita clicks per day predicted by the geostatistical model for the 46 sampling sites with data for at least one year. Values in legend are posterior medians (note log scale). Some sites were missing data the year indicated. The size of each circle indicates the number of sample days in each year (see legend).

To estimate recent trends in abundance, a quantitative analysis was conducted of vaquita acoustic detections at the 46 sampling sites that were monitored consistently from 2011 to 2015 during the core period (July 19 to August 19). The estimated annual rate of decline during the past year (from 2015 to 2016) was extremely high: -49% (95% CRI = −82% to +8%). The annual average decline between 2011 and 2016 is estimated to be -39% (95% CRI: 26% to 52%), corresponding to a total population reduction of 90% over this five-year period (Figure 2). Projections forward from the abundance estimate generated from the combined 2015 visual and acoustic survey suggest that approximately 30 vaquitas remained in November 2016 (posterior mean = 33, median = 27, 95% CRI 8 to 96).

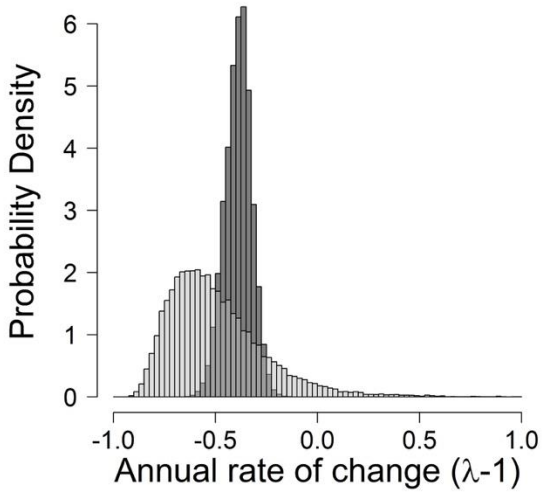

Fig. 2. Model-averaged posterior probability distribution for annual rate of change in mean clicks-per-day. The darker gray distribution describes mean annual rate of decline from 2011 to 2016. The lighter gray distribution describes the change between 2015 and 2016.

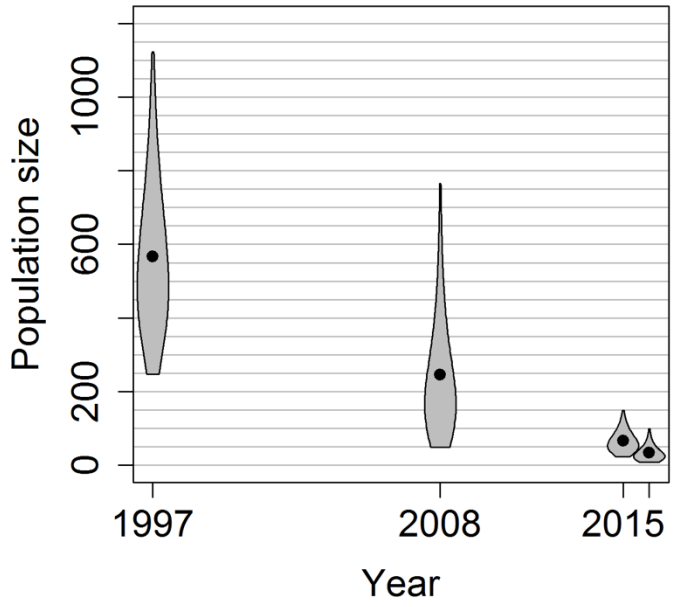

Fig. 3. Population size estimates from surveys conducted in 1997 (Jaramillo-Legorreta et al. 1999), 2008 (Gerrodette et al. 2011b), and 2015 (Taylor et al. 2016), and projected population size for 2016. Violin plots depict 95% confidence or credible limits and posterior means.

CIRVA notes the critical importance of the acoustic monitoring program in providing robust estimates of trends in vaquita abundance and **recommends** that the program continue with adequate support. CIRVA also **recommends**

that acoustic sampling be conducted during the spring of 2017 at the ten monitoring sites with highest acoustic activity to assist with the capture program (see below).

3. UPDATES ON ALTERNATIVE GEAR AND MARKET DEVELOPMENT

3.1 Alternative Gear

Chris Glass (via Skype) updated CIRVA on the work of the Expert Committee for Fishing Technologies in the Upper Gulf of California. The third meeting of the Expert Committee took place November 14-16, 2016 in Mexicali and San Felipe. The meeting included a field trip to San Felipe's fishing grounds and a conversational gathering with local fishermen. Despite the excellent work of the Expert Committee, CIRVA concluded that progress on the development of alternative fishing gear has been insufficient and much too slow. It **emphasises** the need for the Mexican Government to follow the recommendations and protocols of the Expert Committee and **reiterates** the need to accelerate development of viable alternative fishing methods and to train fishermen in their use. This requires immediate and expanded action by the lead agencies (INAPESCA, CONAPESCA, and SEMARNAT) working together effectively and transparently with the Expert Committee.

3.1.1 RS-INP-MX Small Trawl for Shrimp

The Expert Committee identified serious issues with the trials of this net. Despite evidence from previous more successful sea-trials – with a sample size in excess of five thousand hauls (see reports of CIRVA-4 and CIRVA-5, especially Annex 4) – the Expert Committee found that the net was being operated inefficiently. Shrimp catches from the small number of hauls observed during the Expert Committee's visit were small. The Expert Committee requested that data from all trials be made available so it can assess the suitability of the net. Besides the Committee's concerns, some local fishermen expressed their concerns about how the net fishes. The recent trials have reinforced what was noted in earlier trials and reported to CIRVA by fishermen experienced with the nets (see CIRVA-4 and CIRVA-5 reports), that there is a mismatch between the size of the net and the horsepower of the pangas, which reduces efficiency of the fishing effort.

In previous years, successful trials occurred during the months of August and September, when shrimp are plentiful in shallow waters. This, and better training of the fishermen, may at least partly explain the higher catches and seeming effectiveness of the net/panga combination during those earlier trials. WWF plans to re-examine previous trials conducted by INAPESCA and used to confirm the suitability of the RS-INP-MX small trawl. A re-evaluation of these data will be presented at the next meeting of the Expert Committee and will inform future modifications to fishing practices.

In the meantime, CIRVA **concurs with the recommendation** of the Expert Committee that trials be conducted with a smaller version of the net that more closely matches the towing power of the pangas. These trials should begin immediately. The NOAA Pascagoula Laboratory has offered to send at least two additional smaller nets for testing. The Expert Committee is developing a work plan that includes computer simulation and flume-tank testing to further ascertain the fishing characteristics of the RS-INP-MX design and it will make recommendations for a re-scaled net design that is more suitable for the Upper Gulf currents and the outboard pangas used in the region.

CIRVA noted that the need to consider more efficient powering of vessels to tow the RSP-INP-MX net was first raised at CIRVA -4 in 2012 and discussed again at CIRVA-5 in 2014, but unfortunately the matter was not pursued. Recalling the recommendations from its own earlier meetings, CIRVA **endorses** the recommendation of the Expert Committee that one or two diesel-powered vessels, no longer than 10 m, be employed to test the RS-INP-MX design. The importance of this action was given a lower priority by the Expert Committee during its first meeting. However, given the mismatch between towing power and the size of the nets currently being used, the Expert Committee has revised its position.

3.1.2 Suripera Net

During earlier Expert Committee meetings, participants expressed skepticism with regard to the potential effectiveness of the suripera net. However, after seeing new data, having the opportunity to see the net first-hand and better evaluate its functionality, and taking into account the opinions of local fishermen, the Expert Committee has revised its position. CIRVA concurs and **recommends** expanding the number of tests with suripera nets, with appropriate observer coverage, to collect additional information and allow comparison of catch rates in these nets with those in trawl operations.

3.1.3 Finfish Fisheries

During its most recent meeting the Expert Committee discussed appropriate fishing technologies that should be employed for finfish fishing in the Upper Gulf, including traps, pots, stow nets, trolling, fish trawls, fyke nets, and others. CIRVA **concurs** with the **recommendation** that bait testing for pot fisheries be conducted immediately and also **recommends** that trials be conducted with small-scale Danish seine nets for finfish.

3.1.4 Fishing Used to Disguise Illegal Activities

CIRVA **reiterates** its concern that legal fishing activities may be used as a cover for illegal totoaba fishing. Totoaba nets are left anchored to the bottom for long periods and the illegal catch can be retrieved quickly, so this concern is redoubled. Thus, any fishing activity within the range of the vaquita must be monitored by a robust surveillance program that ensures no illegal activity can take place. Such a monitoring program would also help to document that catches obtained by fishermen using alternative gear are obtained without harming vaquitas.

3.2 Market Development

Sarah Mesnick provided updates on a multi-institutional (NOAA Fisheries, WWF-Mexico, U.S. Marine Mammal Commission, Pronatura, and Aquarium of the Pacific) project to engage market-based approaches to vaquita conservation. This project focuses on tools to improve potential earnings and incentivise conservation along the value chain. Market data are used to analyze potential net earnings for different types of fishing gear (cost-earnings analysis). Estimation of potential net earnings will help to determine if the alternative gears described above are economically viable.

CIRVA **reiterates** its previous **recommendation** that every effort be made to support the development of gillnet-free fisheries in the Upper Gulf. Furthermore, we encourage the continued development of direct linkages between fishermen using alternative (vaquita-safe) gears and seafood buyers to incentivise the conversion of the fleet to gillnet-free operations and of alternative livelihoods for the communities of the upper Gulf of CA.

3.3 Curvina Fishery

CIRVA remains concerned that the curvina fishery is being used to disguise illegal totoaba fishing. Several publications have documented efforts to make the curvina fishery a model fishery in the Upper Gulf with respect to bycatch and catch levels. Even those familiar with those efforts now acknowledge that the situation with the vaquita is critical and that indirect effects of the curvina fishery, namely providing cover for illegal totoaba fishing, are not being controlled. CIRVA **reiterates** its **recommendation** that the gillnet ban include the nets used in the curvina fishery. The existence of this fishery as an exception to the gillnet ban reduces the efficiency of enforcement and facilitates the illegal fishery for totoaba during the curvina season when many pangas are participating in the fishery.

4. FISHING GEAR REMOVAL PROGRAM

Prior reports from the Mexican Navy (SEMAR) and the Sea Shepherd Conservation Society indicated that gillnets continued to be set illegally for totoaba and other species within the range of the vaquita. In response, the Government of Mexico established a program to remove derelict and illegally set fishing gear from the Upper Gulf of California. This program has demonstrated that widespread illegal fishing for totoaba and other species continues in the region.

The effort is headed by SEMARNAT and coordinated by INECC. Participants include the Navy, PROFEPA, CONANP, Sea Shepherd Conservation Society, WWF-Mexico, the Whale and Marine Science Museum, SEDENA, and Alternative Fishing of Baja California (a local fishermen's NGO).

In 15 days on the water between October 10 and November 15, 2016, 19 pangas were employed in this program. These pangas swept an area of 538.4 km^2 along 9,318 km of transects in one of three areas to be surveyed. Alarmingly, in this short period, and in only a portion of the Upper Gulf outside the Vaquita Refuge, 31 totoaba nets were discovered (23 of them active), together with 27 other nets, 20 longlines, and several other pieces of fishing gear (Figure 4).[1] The larger vessels assigned to remove the nets detected by the pangas removed 9.35 tons of gear, which

[1] A SEMARNAT press release from December 15, 2016 provided the following update. During 21 days (1,500 hours) of search operations covering 11,814 kilometers between October 10 and December 7, a total of 136 abandoned fishing gear were discovered, of which 103 were retrieved: 36 illegal gillnets for totoaba (28 active); 36 illegal gillnets for shrimp; 24 longlines to capture totoaba, sharks and other fish (80-500

was delivered to a recycling center. Fishing gear, once marked to assist in its detection and retrieval, must be removed from the sea immediately to prevent its recovery by illegal fishermen. More detail on this program is provided in Annex 4.

CIRVA commends the members of this multi-institutional partnership for their outstanding and ongoing efforts to address this threat to the vaquita, totoaba, and biodiversity of the region. The group's work has demonstrated that illegal fishing continues within the range of the vaquita. The levels of this illegal fishing activity, particularly with large-mesh gillnets set for totoaba, are alarmingly high and represent a critical threat to the vaquita.

CIRVA **recommends** that the gear removal program continue as planned and that additional areas be searched, with the involvement of additional communities. CIRVA also stresses the importance of repeated surveys in previously searched areas to remove nets that have been deployed illegally in the interim. CIRVA further **recommends** that additional methods be used to detect the nets and to gauge the program's efficiency (*e.g.*, re-sampling the areas covered, employing side-scan sonar).

The fishing gear removal program is an expansion of the efforts by Sea Shepherd Conservation Society's Operation Milagro that began in January 2016. Oona Layolle reported to CIRVA that a third year of Operation Milagro will continue to remove nets as part of the multi-institutional gear removal program and at other times throughout the year. CIRVA re-iterates its strong support for continued collaboration between Operation Milagro and the Mexican Navy to detect illegal fishing activities and remove illegal fishing gear.

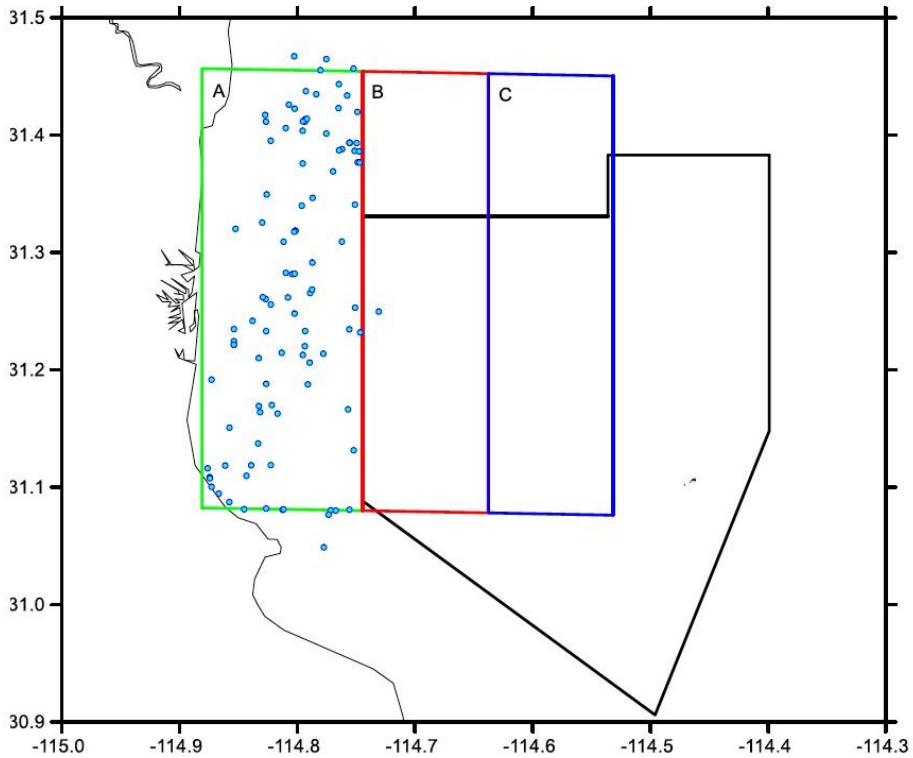

Fig. 4. Areas for fishing gear removal program. Blue circles represent locations at which fishing gear was removed from the sea in October and November 2016. Only Polygon A was surveyed. The black polygon represents the boundaries of the Vaquita Refuge.

meter in length, all in bad conditions); and 7 trawl nets and traps. Two live marine turtles, hundreds of fish (including one totoaba) and crustaceans were released; also six totoaba, three marine turtles, rays, more than a thousand different fish and a non-identified marine mammal were found dead. (https://www.gob.mx/semarnat/prensa/retiran-redes-fantasma-en-el-alto-golfo-de-california-para-proteger-a-la-vaquita-marina)

5. UPDATE ON ENFORCEMENT EFFORTS

CIRVA received brief updates on enforcement from SEMAR and the Sea Shepherd Conservation Society. The 50% decline in abundance over the past year and frequent recovery of fishing gear in the region demonstrate that illegal fishing for totoaba and other species remains widespread. In addition to the recovery of active totoaba gear and the direct observations of illegal fishing at night, the Sea Shepherd Society reported recent daylight encounters between project personnel and masked fishermen operating with apparent disregard for the gillnet ban. Despite the extensive enforcement efforts carried out since the gillnet ban was established 18 months ago, it is clear that illegal fishing is still common in the range of the vaquita. Taken together, these observations demonstrate that enforcement efforts to date have been insufficient. There is a critical need for more effective enforcement of existing fisheries regulations – for example, immediate responsiveness to reports of illegal fishing, arrests, and prosecutions. CIRVA thanks the Sea Shepherd Conservation Society and the Mexican Navy for their collaboration and reiterates its **recommendation** to continue this important work. In addition, CIRVA **reiterates** that existing laws must be strengthened and penalties increased so that they act as an effective deterrent to illegal fishing.

6. CONSIDERATION OF THE FEASIBILITY OF LOCATING, CAPTURING AND HOUSING VAQUITAS

CIRVA received two reports on progress to evaluate the feasibility of catching and placing some vaquitas in a temporary sanctuary, with the eventual goal of returning these animals to a gillnet-free environment. One of the reports focused on field protocols for locating and capturing vaquitas, and on the identification of personnel with the requisite experience and skills to carry out such a program (Annex 5).[2] The second report provided preliminary evaluations of potential short-term holding facilities for vaquitas in the Upper Gulf of California, building on options identified in Annex 5. On the basis of these reports, CIRVA discussed the need for further information on the requirements for funding, permits, logistics, etc., and how to design processes of decision-making and project management to guide possible future actions.

It was agreed that the Government of Mexico's efforts to date, forceful and costly as they have been, have not been adequate to stop the illegal fishery for totoaba. Despite these enforcement efforts, the vaquita population has continued to decline rapidly because of mortality in gillnets. CIRVA **recommends**, therefore, that steps be taken urgently to move some individuals into a temporary sanctuary, to prevent extinction of the species. Further delay will mean that the population will be too small for such efforts. One CIRVA member (Brownell) did not agree with this recommendation, believing that there are too many unknowns and maybe some 'unknowables' surrounding the plan.

At the same time, it is essential and urgent that the ban on gillnets in the Upper Gulf be made permanent, enforcement be strengthened, and more vigorous efforts be made to prosecute anyone connected with illegal fishing or the smuggling of totoaba swim bladders. The removal and disposal of derelict and active gillnets from the Upper Gulf must continue, and the development and testing of alternative fishing gear must be accelerated. A decision to move some vaquitas into a sanctuary must not be allowed to weaken the Government's resolve to provide meaningful long-term protection to the vaquita, totoaba, and other components of the region's biodiversity.

The effort to place some vaquitas in a sanctuary will be extremely difficult and expensive, and there is no guarantee of success. Many questions still need to be resolved. Importantly, it is unclear whether vaquitas can be captured safely, or how they will react to handling, transport, and confinement. The harbor porpoise, a congener of the vaquita, responds well to handling, but other porpoise species, such as the Dall's porpoise, are extremely vulnerable to capture myopathy. Steps need to be taken immediately to determine if vaquitas can be captured safely and whether they are suitable for handling and holding. Captured animals should be satellite-tagged so they can be monitored in the event that they need to be released rather than transported to a sanctuary. Such tags will also provide valuable information on movements, habitat use, and ecology. We emphasise that the sanctuary effort is designed to buy time until live, healthy vaquitas can be released back into a safe and gillnet-free natural environment.

Given current levels of illegal fishing, it is unlikely that the ongoing decline of the vaquita population will be reversed in the near future. The situation has deteriorated significantly since CIRVA-7 and, in light of the 50% decline from

[2] Names and qualifications of key personnel were discussed at the meeting but have been redacted from the public report.

2015 to 2016, CIRVA **recommends** that work move forward with utmost urgency to locate and catch vaquitas in the spring of 2017 and to provide them with short-term sanctuary of up to one year. Such efforts will provide the basis for assessing the feasibility of and prospects for a longer-term sanctuary program.

The committee expressed its appreciation for the hard work of the Steering Group on *Ex-Situ* Conservation. CIRVA **recommends** that SEMARNAT, with assistance of the National Marine Mammal Foundation, proceed with the sanctuary program as outlined by the Steering Group and as agreed at this meeting. CIRVA notes that, given the currently extreme risk of gillnet entanglement, the program should provide sanctuary to as many vaquitas as possible. CIRVA emphasises that such a program will be difficult and must be conducted in a stepwise manner, with careful evaluation at each step along the way. The program must be approved and permitted by the Government of Mexico and have the resources and infrastructure in place to provide sanctuary to the animals for the proposed period.

ANNEX 1: LIST OF PARTICIPANTS

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ANNEX 2: AGENDA CIRVA-8

AGENDA

CIRVA-8

SOUTHWEST FISHERIES SCIENCE CENTER

LA JOLLA, CA

NOVEMBER 29-30, 2016

Tuesday, November 29

8:30-9:00

1. Welcome

- Introduction of participants
- Confirm chair and rapporteurs
- Review and adopt the Agenda
- Documents available for this meeting

9:00- 10:00

2. *Acoustic monitoring program*

- Results of 2016 season
- Future plans and budget needs
- Discussion and recommendations

10:00-12:00

3. Update on alternative gear development and deployment

- Gear testing program and international experts advisory group
- Market development
- Discussion and recommendations

12:00-13:30 Lunch Break

13:30-14:00

4. Derelict (and active) gear removal program

- Report on program and gear recovered (including disposal)
- Future plans and budget needs
- Discussion and recommendations

14:00-14:30

5. Update on enforcement and regulations

- Enforcement
- Update on gillnet ban
- New regulations to support gill net ban enforcement
- Discussion and recommendations

15:00–17:00

6. Evaluation and consideration of the Feasibility of Locating, Catching and Housing Vaquitas

- Feasibility program plan (reviewed in September)
- Site survey report
- Other activities to determine feasibility of locating vaquitas
- General background on ex-situ decision-making
- Discussion of future directions
- Approval and permitting considerations to attempt capture or tagging

- Scheduling considerations
- Personnel considerations
- Next steps: conclusions, agreement on goals, and recommendations

17:00 - Adjourn for Evening

Wednesday, November 30

08:30 – 10:00
6. Evaluation and consideration of the Feasibility of Locating, Catching and Housing Vaquitas (Continued)

10:00 – 12:00
7. Discussion of previous and new recommendations

12:00- 3:30
8. Report drafting (Summary paragraph for Minister, Executive Summary and recommendations, Brief para.s for each agenda item)

3:30-5:00

9. Report discussion and finalisation

5:00 Close meeting

List of documents

1. Report of 2016 acoustic monitoring season – to be prepared
2. *Evaluation and consideration of the Feasibility of Locating, Catching and Housing Vaquitas* Vaquita ex situ feasibility program plan (reviewed in September)
3. Site survey report
4. Budget

ANNEX 3

ACOUSTIC MONITORING SHOWS VAQUITA DECLINE CONTINUES

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ABSTRACT

Previous analyses of acoustic monitoring data estimated a 34%/year decline from 2011-2015 (Jaramillo-Legorreta et al. 2016). Here we incorporate into the analysis a new year of monitoring data, collected in summer 2016. This is the second summer season of data collected since an emergency gillnet ban was implemented in May 2015, but it is the first dataset expected to reflect any positive response of the vaquita population to the ban. We use the same analytical methods and acoustic detector locations as in previous years. The estimated rate of decline from summer 2015 to summer 2016 remains extremely high [49%/year decline; 95% CRI for $(\lambda-1)*100 = -82\%$ to +8%]. The annual average decline between 2011 and 2016 is now estimated to be 39% annually (95% CRI: 26% to 52%), corresponding to a total population decline of 90% for this five-year period. While the actual rate of decline is uncertain, it is certain that the population has declined since 2011 (Probability = 1), and there is a >99% chance that the decline has averaged>20%/year. Projecting forward from the abundance estimate in 2015 results in an estimate of around 30 vaquitas remaining in fall 2016 (posterior mean = 33, median = 27, 95% CRI 8 to 96). Although surface-marked gillnets were not observed within the area of the ban during a vaquita population survey in fall 2015, the Mexican Navy in collaboration with the Sea Shepherd removed many bottom anchored gillnets since then and 3 dead vaquitas killed in gillnets were found in March 2016. The ongoing presence of illegal gillnets in spite of the emergency ban continues to exacerbate vaquita population collapse.

INTRODUCTION

Vaquitas are porpoise endemic to the northern Gulf of California, Mexico. Historically the population has declined because of unsustainable bycatch in gillnets. An illegal gillnet fishery for an endangered fish, the totoaba (*Totoaba macdonaldi*), has recently resurged throughout the vaquita's range. Acoustic monitoring within the vaquita refuge estimated an annual rate of decline of 34% (95% CRI -48% to -21%) from 2011 to 2015 (Jaramillo-Legorreta et al. 2016). Based on preliminary results through 2014 the government of Mexico enacted an emergency 2-year ban on gillnets throughout the species' range to prevent extinction, at a cost of US$74 million to compensate fishers (Taylor *et al.* 2016).

A population survey conducted in October and November 2015 generated an estimate of about 60 vaquitas (95% CRI 22 – 145) (Taylor et al. 2016). The survey covered the entire area of the gillnet ban, where vaquitas have been detected since 1997. Acoustic monitoring was conducted in waters shallower than 20m while deeper waters were surveyed visually. This survey was conducted during the season when shrimp are harvested. Few pangas, the boat used by local fishermen, were seen. One panga was seen using a gillnet in the far southern part of the gillnet exclusion zone (Fig. 1). Some pangas were seen with air compressors indicating that they were used to harvest clams (geoducks) or other bottom-dwelling organisms. Large commercial trawlers worked the areas outside the Vaquita Refuge throughout the survey period.

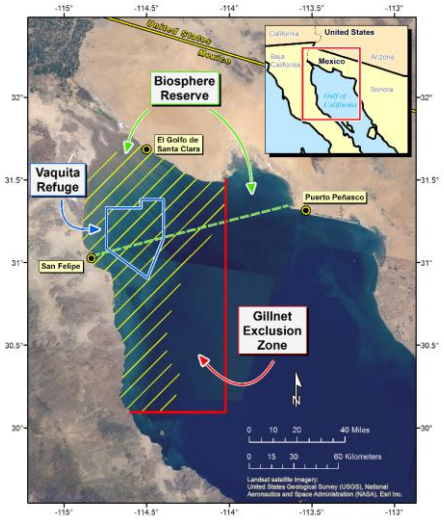

Fig. 1. Distribution of vaquitas (yellow hatched area) in the northern Gulf of California. The Vaquita Refuge is outlined in blue. The gillnet exclusion zone was given straight boundaries (red) described by single latitude and longitude to facilitate enforcement. The Biosphere Reserve was created in part because of vaquitas but has not been implemented to reduce risk to vaquitas.

Since the survey, the Mexican Navy (SEMAR) and Sea Shepherd's Operation Milagro have gathered extensive evidence of totoaba poaching. Between January and May, 2016 Sea Shepherd retrieved 42 illegal gillnets and 16 illegal longlines. Three dead vaquitas were found in March 2016 that were determined by scientists to have died in gillnets (CIRVA 7 http://www.iucn-csg.org/wp-content/uploads/2010/03/CIRVA-7-Final-Report.pdf). Gillnets and longlines were bottom-anchored with no surface marking. Very large anchors were used to hold the nets in place, and this allowed fishermen to leave the nets in place and periodically check them for totoabas at night. March was also the period of the corvina (*Cynoscion othonopterus*) fishery, which was allowed to use gillnets in a manner that actively surrounds aggregations of spawning fish. Although this method was thought not to directly catch vaquitas, the fishery allowed hundreds of pangas to be on the water, making enforcement difficult. Sea Shepherd listed recommendations to improve enforcement that are documented in CIRVA 7.

Acoustic monitoring of vaquita continued with new sampling in summer 2016, one year after the gillnet ban was implemented. Because vaquitas now number far fewer than when acoustic monitoring began, new acoustic monitoring sampling sites were added to improve precision in future trend monitoring. We present results from this higher-

density grid to qualitatively examine vaquita distribution. The quantitative analyses presented here uses the same 46 sampling sites used from 2011 to 2015 and the same analytical methods. We show that there is a very high probability that vaquita are still declining and that the mean rate of decline is similar to recent years (before the gillnet ban).

METHODS

Acoustic Data Collection and Processing

A grid of porpoise click detectors (C-PODs) was deployed in summer 2016 during the same season as previous monitoring studies. This grid was comprised of the same 46 sites that were sampled in 2011-2015. These sites were used in the analysis below. Forty-seven additional sites were added to increase the grid density in areas where vaquita were most frequently detected and will be used in future analyses, plus three more sites farther north designed to detect the presence of vaquitas on those places in the Delta of Colorado River (where vaquitas were acoustically detected often along survey 2015). In 2016, all sites were marked with surface buoys to facilitate rapid retrieval and replacement of C-PODs. To avoid complete data loss at any station due to instrument failure or loss, C-PODs were retrieved and replaced approximately every 3 weeks. As in previous analyses, porpoise clicks trains were identified with the KERNO classifier (v. 2.044) and validated by experienced analysts. Analysis is based on data from the same 62-day period (19 June to 19 August) in all years. Trend estimates are based on the changes in the average number of porpoise clicks (in recognised click trains) per site per day . Detection positive minutes [DPMs] (Carlström 2005; Scheidat *et al.* 2011; Roberts & Read 2014) are used as an index of vaquita abundance in some figures.

Trend Analyses

We use the same two statistical models used previously (Jaramillo-Legorreta et al. 2016) – a geostatistical model and a non-spatial mixture model – to make inferences about trends in click rate over time (2011-2016). These models would not be necessary if sampling effort were balanced across CPODs through time, but uneven sampling effort and missing data from some CPOD locations, mainly in the earlier years of the study, necessitate the model-based approach.

In brief, the geostatistical model compensates for locations with missing data by "borrowing strength" from those around it: the model assumes the average click rate varies smoothly over space, with a separate smooth surface fit to each year of data but with the amount of smoothness (the spatial autocorrelation) the same across years. It further accounts for variation in sampling by assuming locations with more sampling days give more precise estimates of average click rate than those with fewer sampling days.

The post-stratification mixture model probabilistically assigns individual CPOD locations to one of three strata (low, medium, or high click rate) and provides modeled estimates of the mean daily click rate for each stratum. A sampling site is permanently assigned to the same stratum for all years (which is justified based on spatial stability of the data), but the stratum rates are estimated independently for each year. The purpose of stratification is to statistically account for much of the inter-site variance in the number of clicks recorded. Annual click counts at each site are treated as negative binomial random variables with the expectation given by the product of location-specific effort and stratum-specific click rates and overdispersion. Inference is based on annual differences in the mean of the modeled click rate estimates for the 46 sites. Full model specifications are in Jaramillo-Legorreta *et al.* (2016).

Both the geostatistical and post-stratification mixture models were fitted under the framework of Bayesian analysis (with uninformative prior distributions used for all model parameters) by sampling from the posterior distributions with Markov chain Monte Carlo methods using WinBugs and OpenBugs software packages (Lunn *et al.* 2000). For both models we discard the first 10,000 samples (burn-in period) with 1,000,000 further iterations, where every 100th sample was retained for posterior distribution summaries.

Abundance estimation

The population abundance estimate for fall 2015 (Taylor *et al.* 2016) is accurately approximated by lognormal distribution with mean 66 and standard deviation of 33. To project the population forward from 2015 to 2016, we drew 20,000 random samples from this lognormal distribution and multiplied these by MCMC samples from the acoustic rate model-averaged posterior distribution (also 20,000 samples) for $\lambda_{2015\text{-}2016}$ from the two models described above. Using November 2, 2015 as the survey abundance date (since this was the midpoint date of the visual survey

cruise), the projected estimate represents the population size on November 2, 2016. The projection assumes that the mortality rate is constant throughout the course of the year.

RESULTS

Acoustic Data

Sampling effort has remained good across the truncated period for all monitoring years (Fig. 2). The increased number of monitoring sites in 2016 can be seen in the latter part of the monitoring period. The mean acoustic detection positive minutes, averaged across sampling sites shows no consistent seasonal patterns among years within the core sampling period (Fig. 3). Thus, we assume that data drawn from this period allow good inference on year-to-year changes. As in earlier years, vaquitas were detected in only some portions of the Vaquita Refuge (Figure 4A, 4B). The augmented 93 sampling sites shows that vaquita density decreases towards most edges of the Refuge.

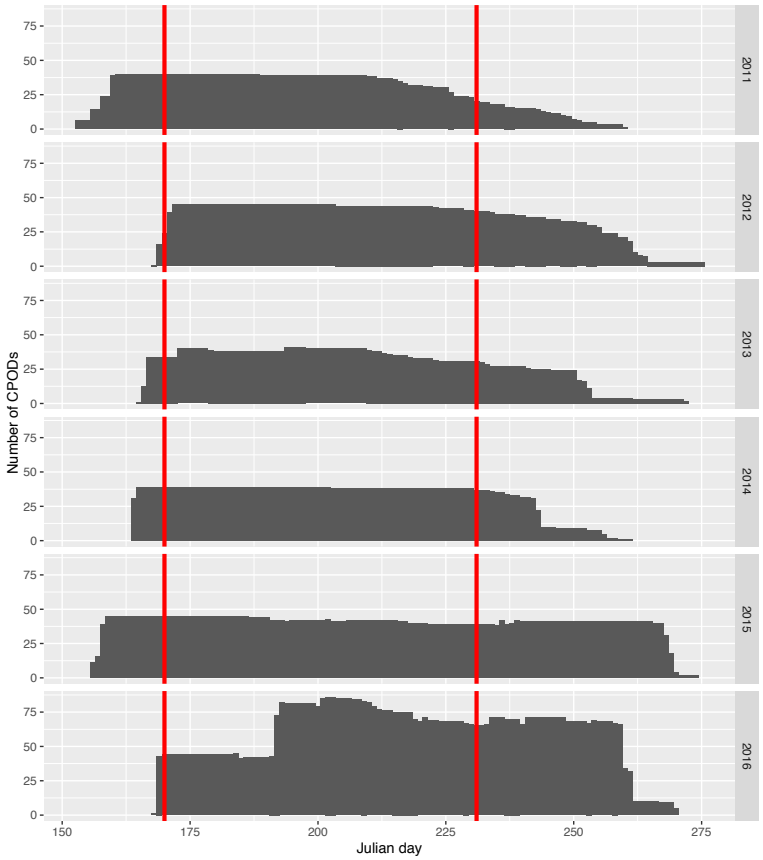

Fig. 2. Number of C-PODs active by Julian day from 2011 to 2016. Higher values in 2016 reflect the addition of 47 new sampling sites.

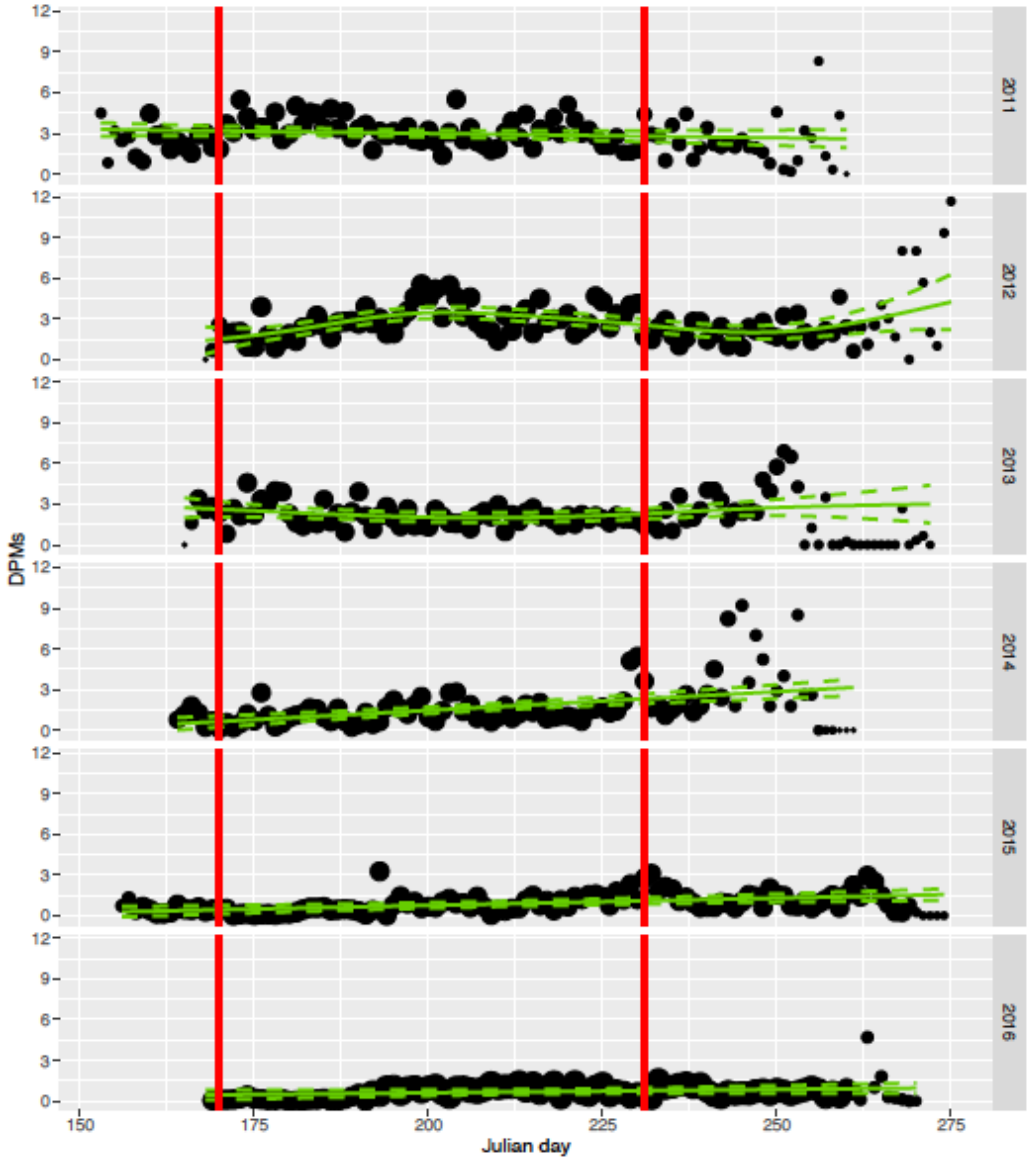

Fig. 3. Mean acoustic detection positive minutes (see Jaramillo-Legorreta et al. 2016 for details), averaged across sampling sites (Y-axis) for each day of sampling (x-axis). Each dot represents a single day of sampling, with dot size proportional to the number of sites samples on that day. The green curves represent a smooth fit (a generalised additive mixed model with separate thin plate regression spline smooths per year, normal errors, identity link, weights that are number of sampling sites and auto-regressive error structure of order 1) with approximate 95% confidence interval shown as dashed lines (no longer visible in 2016). Vertical red lines indicates the core sampling period from Julian day 170-231.

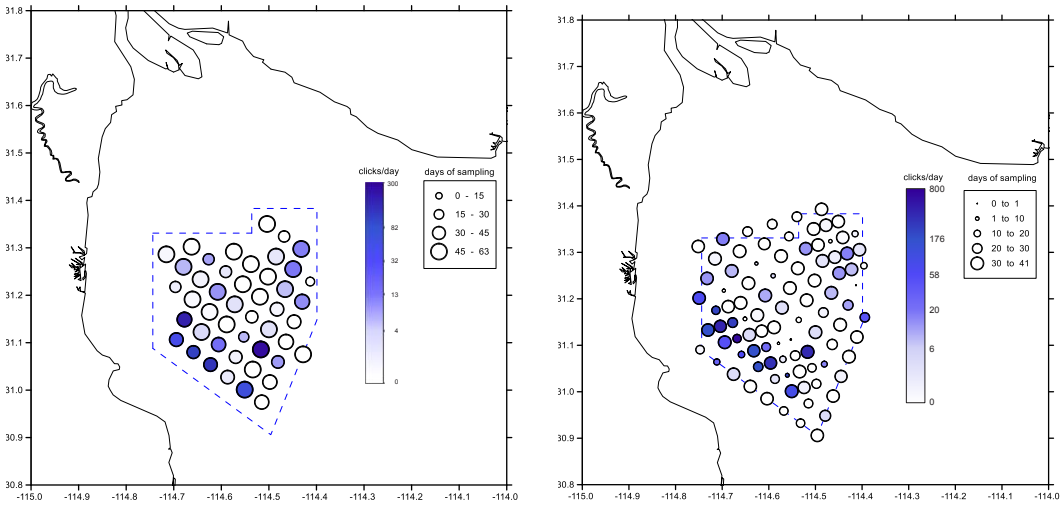

Fig. 4. Mean clicks/day (indicated by shading) and days of sampling (indicated by circle size) for the 46 sampling site grid (4A) and the augmented 93 sampling site grid (4B).

Trend analyses

The recorded number of vaquita clicks per day for the 46 standard sampling sites decreased by 44% from 2015 to 2016 ($\lambda = 0.56$). But this statistic does not account for unequal sampling effort (effort-days) across the sampling sites. The rates of decline estimated from the two statistical models incorporate those effects and estimate statistical uncertainty. Results from those models are visually depicted in Figures 5 and 6, and are also summarised along with the model-averaged estimates of λ in Table 1. The values are similar to what has been previously reported by Jaramillo-Legorreta et al. (2016). We emphasise the following model-averaged results. The estimated rate of decline [$(\lambda-1)*100$] from summer 2015 to summer 2016 was extremely high [posterior mean = 49% decline; 95% CRI = 82% decline to 8% increase] (Figure 7). The annual average decline between 2011 and 2016 has a posterior mean of 39% annually (95% CRI: 26% to 52%), corresponding to a total population decline of 90% for this six-year period. While the actual rate of decline is uncertain, it is certain that the population has declined since 2011 (Posterior probability = 1), and there is a >99% chance that the decline has averaged>20%/year.

Table 1. Estimated per-year change (λ) in acoustic activity from the statistical trend models. Quantities are posterior means with 95% posterior credible intervals in brackets.

	Geostatistical model	Post-stratification mixture model	Model average
2011-12	0.674 (0.207-1.578)	0.980 (0.460 – 1.927)	0.827 (0.250, 1.791)
2012-13	1.244 (0.381-3.23)	0.708 (0.309 – 1.409)	0.978 (0.329 – 2.647)
2013-14	0.505 (0.136-1.311)	0.546 (0.236 – 1.091)	0.525 (0.162 – 1.182)
2014-15	0.680 (0.241-1.485)	0.702 (0.304 – 1.364)	0.691 (0.267 – 1.423)
2015-16	0.401 (0.163-0.827)	0.611 (0.270 – 1.206)	0.506 (0.184 – 1.083)
Geometric mean per-year change	0.575 (0.460-0.691)	0.648 (0.562 – 0.749)	0.612 (0.480 – 0.735)

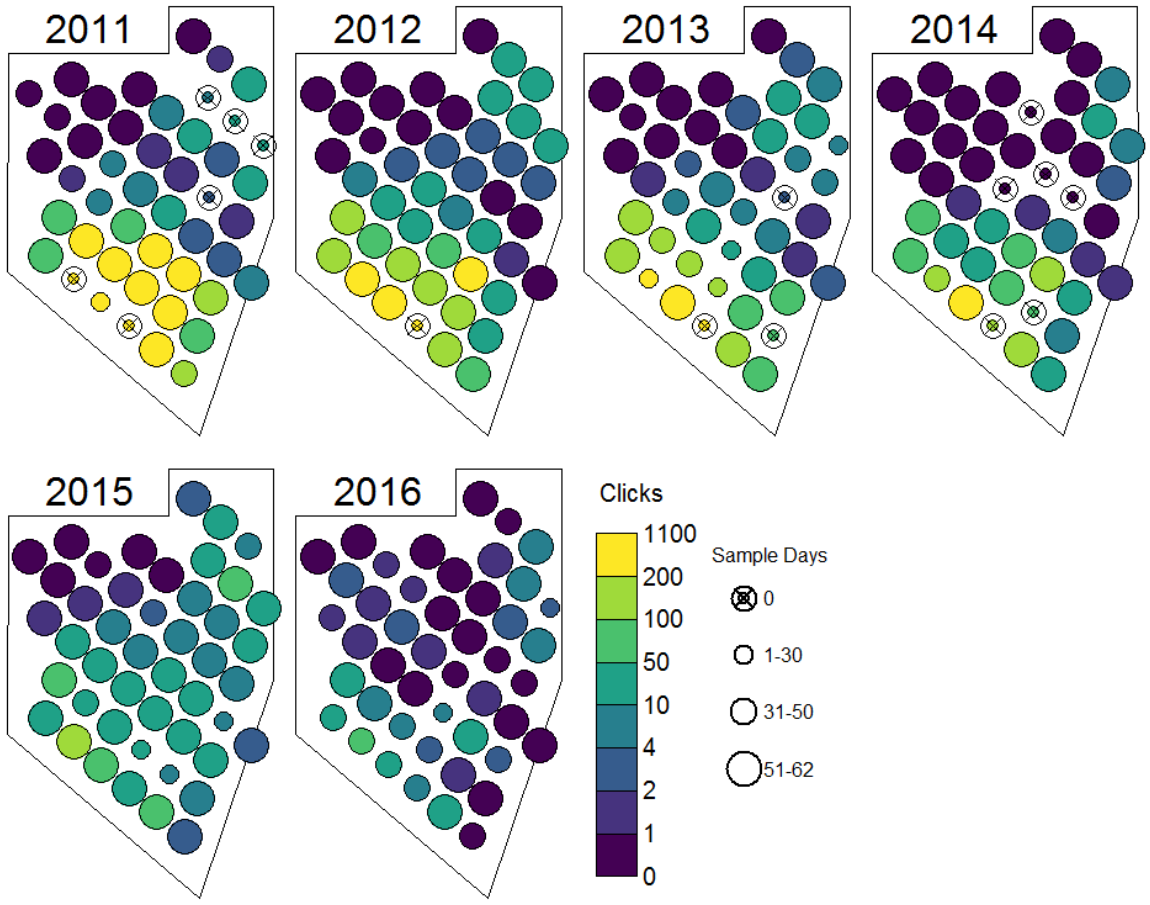

Fig. 5. Estimated mean number of clicks per day predicted by the geostatistical model for the 46 numbered sampling sites with data for at least one year. Values in legend are posterior medians (note log scale). Some sites, ⊗,were missing in the indicated year. Size of circles indicate the number of sampling days on each year (see legend).

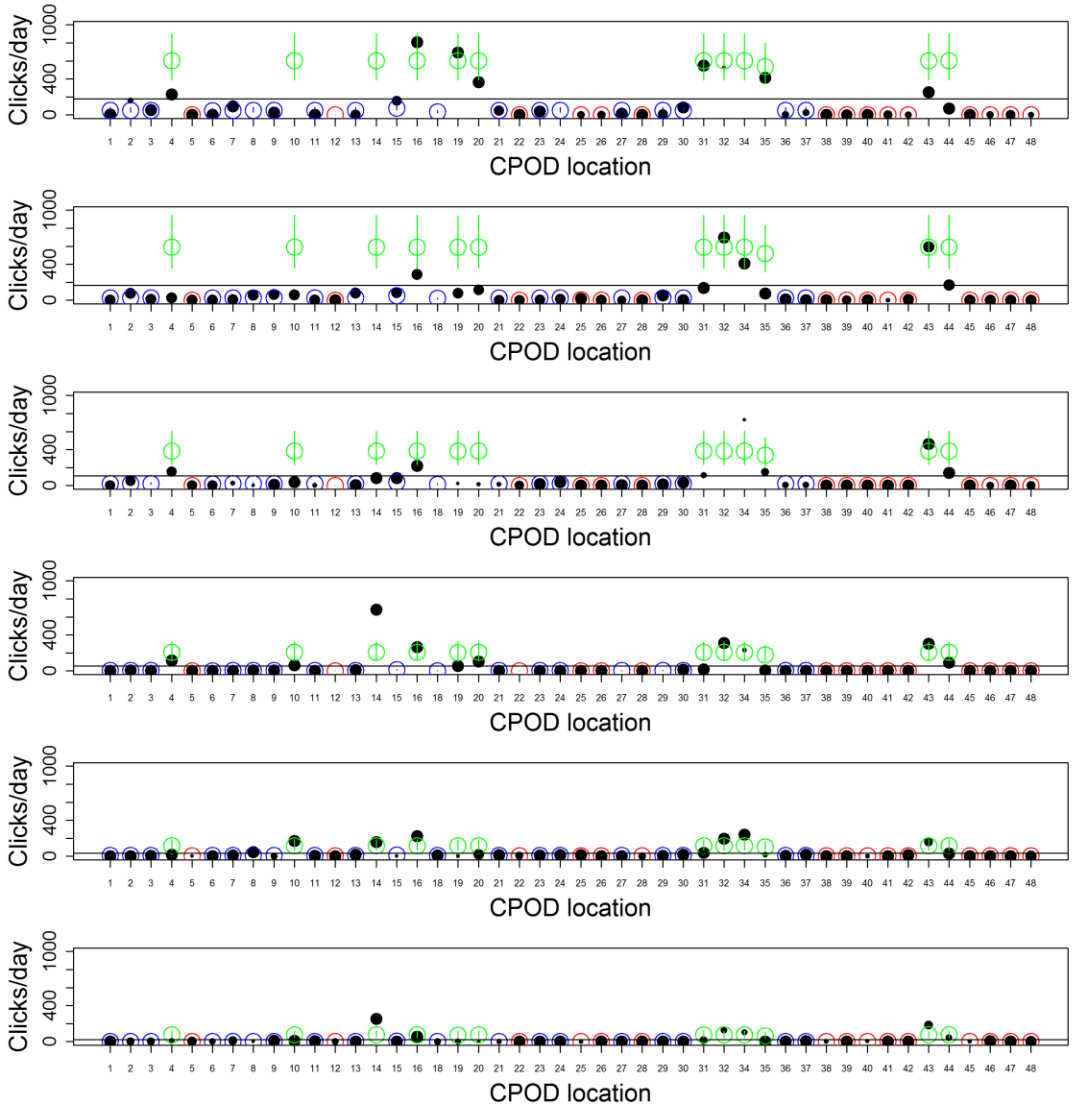

Fig. 6. Observed and expected values for 'mean clicks per day" at each sampling site that functioned in at least one year, 2011 (top) to 2016 (bottom), based on the post-stratification mixture model. Solid black points are the observed values (W_{ti}), with point size indicating the relative level of effort (large circles = more days of sampling) and the colour corresponding to the click rate strata: green—high, blue—medium, red—low. Y-axis is truncated at 1000 but some data points exceed 1000 in first two survey years (see earlier reports). Open circles are the model-expected values (with 90% credible intervals), $\theta_{v[i],t}$, for the three strata (with most likely group indicated by different colours). Horizontal black line is the estimated overall mean for the year, B_t.

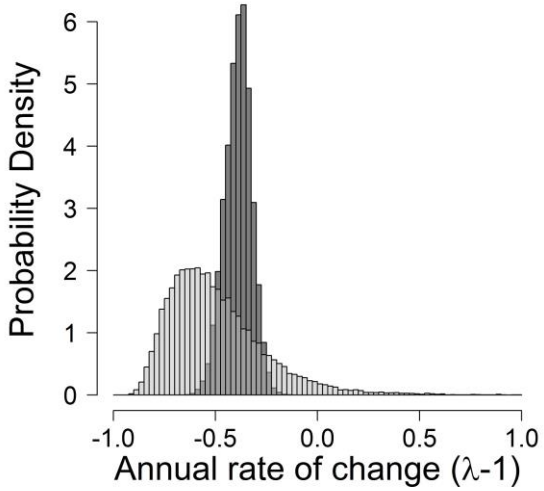

Fig. 7. Model-averaged posterior probability distribution for annual rate of change in mean clicks-per-day. The darker gray distribution describes mean annual rate of decline from 2011 to 2016. The lighter distribution describes the change between 2015 and 2016.

2016 abundance estimate

The projected population size estimate for November 2, 2016, assuming a constant rate of decline throughout the year, is estimated to be approximately 30 animals (posterior mean = 33; posterior median = 27; 95% CRI = 8 to 96) (Fig. 8).

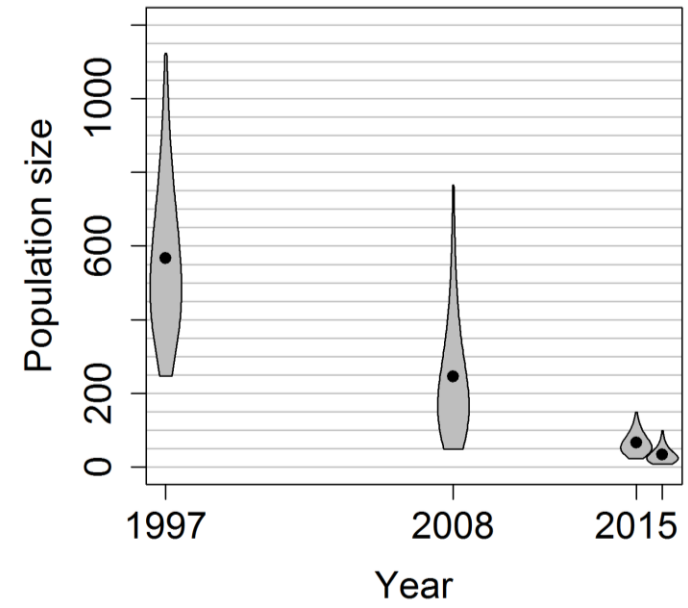

Fig. 8. Population size estimates from surveys conducted in 1997 (Jaramillo-Legorreta et al. 1999), 2008 (Gerrodette et al. 2011b), and 2015 (Taylor et al. 2016), and projected population size for 2016. Violin plots depict 95% confidence or credible limits and posterior means.

DISCUSSION

We see clear evidence that vaquita continue to decline precipitously despite the emergency 2-year gillnet ban and increased enforcement. Gillnet use continues (CIRVA 7) and the 3 dead vaquitas found in 2016 all had evidence of entanglement in gillnets (CIRVA 7). As expected, the estimate for annual rate of change for a single year (2015-2016) is too imprecise to say whether it differs either from the previous year (2014-2015) or from the series of years (2011-2015). Such inference will take several years and should improve with the augmented monitoring design. There is no doubt, however, that the decline continues and is rapid – we see no evidence that the population growth rate has improved.

These acoustic data are critical to monitor the status of this highly imperiled species. Continued monitoring depends on continued protection of the Vaquita Refuge from gillnets and trawling during the monitoring period. Although trawls could maneuver around the CPODs, which are now marked with surface buoys, many CPODs were lost during the vaquita survey which took place during the shrimp season (October and November) when trawlers were active.

The acoustic monitoring program is able to download data by replacing cards in the CPODs because of the ease of retrieving equipment with the surface buoys. This has increased the coverage towards the end of the season and leads to fewer 'holes' in the data at years' end. As a result, it is a good time to consider new analytical techniques that can obtain the most precise estimates possible. The addition of 47 sampling sites in higher-density areas will increase the power to detect future changes in vaquita density, which is increasingly more difficult as the population declines. The 2016 results from the augmented sample shows that vaquita density declines towards the southwestern edge of the study area.

The unfortunate loss of another third of the remaining vaquitas despite increase enforcement will likely alter management strategies. It is clear that despite increased efforts, totoaba fishing remains the most serious threat to vaquitas. While the agreement between Presidents Peña Nieto and Obama to make the gillnet ban permanent throughout vaquita's range is very important, the illegal fishing alone may be driving vaquitas extinct. The prediction that with continued deaths in gillnets vaquitas will be extinct in the next few years (Taylor et al. 2016) still holds.

ACKNOWLEDGEMENTS

Different institutions and agencies provided funding during the development and implementation of the acoustic monitoring program. We are especially grateful to the Mexican Government for funding through the Mexican Secretaría del Medio Ambiente y Recursos Naturales (SEMANAT), the acoustic monitoring program, for their support and funding, specially to Rafael Pacchiano and Adriana Michel, the U.S. Marine Mammal Commission for their support since the very early stages of the acoustic monitoring, in particular T. Ragen, R. Lent, and P. Thomas. O. Vidal and E. Sanjurjo from World Wildlife Fund (WWF) Mexico supported our program through different grants. We thank Le Equipe Cousteau, The Ocean Foundation, Fonds de Dotation pour la Biodiversité, MAAF Assurances (Save Your Logo), WWF-US, and Opel Project Earth. The Southwest Fisheries Science Center, NOAA Fisheries, supported several coauthors' time and the ship time for the 2008 survey to test acoustic equipment. We also thank L. Ballance for marshalling NOAA support and A. Henry for logistical support throughout. We express our sincere thanks to the Fideicomiso Fondo para la Biodiversidad, the Instituto Nacional de Ecología y Cambio Climático (INECC), Comisión Nacional de Áreas Naturales Protegidas (CONANP), and the Directorate of the Reserva de la Biósfera del Alto Golfo de California y Delta del Río Colorado, M. Sau. Many thanks to our field staff J. Osuna, P. Valverde, R. Arozamena, and all the fishers who deployed and recovered the equipment.

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ANNEX 4

GHOST FISHING GEAR REMOVAL PROGRAM IN THE UPPER GULF OF CALIFORNIA

Report of the period Oct 10 2016 – Nov 15 2016

For: The 8th meeting of the International Committee for the Recovery of the Vaquita (CIRVA).

From: The Ghost Nets Cleaning Program in the Upper Gulf of California Initiative.

Information from: Profepa; Inecc; Conanp; Shepherd Conservation Society; WWF-Mexico; Museo de la Ballena, and Pesca ABC, A.C.

November, 25, 2016

INTRODUCTION

Abandoned, lost or otherwise discarded fishing gear (ALDFG), is a problem of increasing concern as a consequence of its numerous negative environmental and economic impacts, including the continued catch of target and non-target species (such as turtles, seabirds and marine mammals), the potential impact to threatened and endangered species, physical alterations on benthic environment, navigational hazards, introduction of synthetic material into the marine food web, a variety of costs related to clean-up operations and impacts on business activities etc. Various United Nations General Assembly resolutions now provide a mandate for, and indeed require, action to reduce ALDFG and marine debris in general (Macfadyen *et al*. 2009).

In the Upper Gulf of California, the ALDFG represent a risk factor for marine fauna, but in particular for two key species of the region: vaquita and totoaba. Both are classified as critically endangered species by the International Union for Conservation of Nature (IUCN) and are listed as Endangered (Pr) in the NOM-059 of Semarnat.

During the Seventh Meeting of the International Committee for the Recovery of the Vaquita (CIRVA), the Mexican Navy (SEMAR) and the Sea Shepherd Conservation Society reported on their joint monitoring efforts. In cooperation with the Navy and PROFEPA, Sea Shepherd gathered extensive evidence of totoaba poaching and, between January and May, retrieved 42 illegal gillnets and 16 illegal longlines. The team encountered nets that had been set for very long periods, as well as freshly set nets in recently patrolled areas. Even as the illegal totoaba fishery winds down in early summer 2016, abandoned nets pose an active risk to vaquitas throughout their range. Therefore, CIRVA recommended that efforts to remove gillnets from throughout the vaquita's range be intensified, as a matter of utmost urgency.

GOAL OF THE PROJECT

Reduce the threat that ghost fishing gear represent to the navigation and health of the Upper Gulf of California ecosystem, as well as to the totoaba, vaquita and other endangered species, through a highly focused effort in the removal of as much ghost or derelict fishing gear, as possible, in the Upper Gulf of California.

MULTI-INSTITUCIONAL PARTICIPATION

This effort is leaded by The Secretariat of Environment and Natural Resources (SEMARNAT) and integrated by the National Institute of Ecology and Climate Change (INECC); the Navy (SEMAR); the Federal Attorney for **Environmental** Protection (PROFEPA); the National Commission of Natural Protected Areas (CONANP); the Sea

Shepherd Conservation Society (SSCS); the World Wildlife Fund (WWF-Mexico).; the Whale and Marine Science Museum; the Secretariat of National Defense (SEDENA); and Alternative Fishing of Baja California(PESCA ABC, a local fishermen NGO);

Operational Plan

The removal program is divided into five components-teams, per the actions required to achieve the goal of cleaning the Upper Gulf of California of ALDFG:

1) Location team *(INECC, CONANP Y PESCA ABC).* The activities of this component are addressed to the location of ghost fishing gear, marking them with buoys in the sea surface for posterior easy detection for extraction and the construction of a georeferenced map with the position of the gears found;

2) Extraction team *(SSCS, MUSEO DE LA BALLENA, SEMAR).* The activities of this component are addressed to the removal of localised ghost gear with vessels properly equipped for this activity;

3) Team of transport, storage, and destination *(PROFEPA, SEMAR, CONANP, SEDENA)*. The retrieved gear is transported from their location to a temporary storage cellar. The transport logistic plan includes maritime transport strategies to the port of destination, as well as ground transportation from the arrival dock to the storage site. The retrieved nets are stored there until the actions are executed for their destination. The destination of the retrieved nets is destruction and recycling;

4) Security team (*All*). The goal of this component is to reduce risks and keep participants safe; and

5) Communication team (*WWF and SEMARNAT*). The goal of this component is to inform audiences of the effort to eliminate the fishing gear and the benefits it brings to the marine ecosystem and local communities of the Upper Gulf.

AREAS OF INTEREST

The first part of the Project is taking place as shown in fig 1. The second part will take place to the north and east side of the Upper Gulf. The Navy and PROFEPA have suggested some areas still TBD.

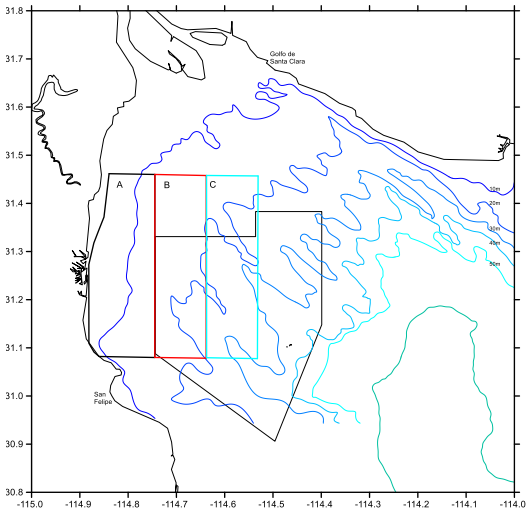

Fig. 1 Map with the priority zones of location an extraction of ghost nets (A, B y C). The zone A (black polygon) is located in the west outside of the Reserve of the Vaquita. Zone B is located mainly in the west portion of the Reserve of the Vaquita. The zone C is the east of the zone B. The depth of the location zones range of less than 10 m to 30 m water depth (see bathymetric contours).

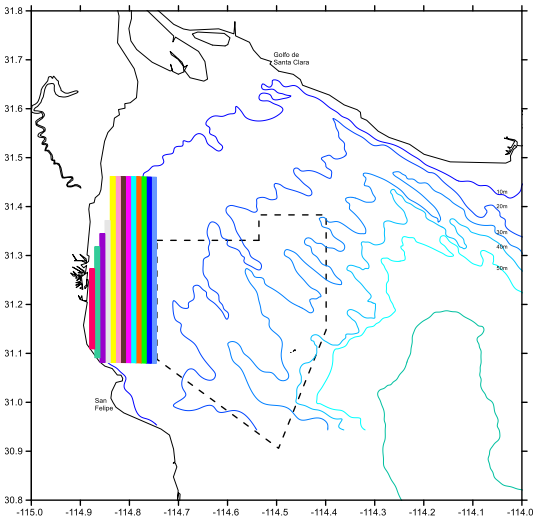

Fig. 2 Map of the distribution of the trawl transects in the zone A of location and extraction. Each colour shows the distribution of the 20 transects per each day of operation.

RESULTS

Location Team

Inside polygon 'A' were prospected during October 10th – November 15th 2016. Weather and sea conditions allowed only 15 days of effective work during that period. The systematic dragging/grappling prospected along 251 transects (96 percent of the 260 transects originally planned), which accounted for 9,318 km, navigated during 1,280 hours). Only 11 percent of those transects showed slight deviations from the originally assigned routes.

19 pangas operated by 45 artisanal fishers, focused on the detection of ghost nets. One additional boat coordinated at-sea operations of the entire fleet of artisanal boats.

105 ALDFG were detected through that effort, geo-positioned and marked with buoys. Vessels in charge of removing ALDFG attended to those positions.

Challenge

Fishers must navigate along transects, as much as accurate possible in speed and direction, to ensure the detection of ALDFGs as planned.

Extraction Team

85 ALDFG out of the 105 detected were effectively extracted from the sea bottom (80 percent). Missing ALDFGs could be to a mixture of factors including buoy loss, maneuver abortion due to difficulty or inaccuracies in geographic positioning, illegal fishers, aware of the program, recovering their gear before the vessels could arrive to the sites.

More than 1/3 of the found nets are totoaba nets and most of these ones were active.

Table 1 Detailed ALDFG retrieved

Type of ALDFG	**Amount**	**Active**
Totoabera nets	31	23
Other nets	27	6
Longlines	20	
Pieces of trawl nets	2	
Pieces of other fishing gear	2	
Other fishing gear	3	
Total retrieved	**85**	29

In addition to the ALDFG, there were findings of dead species: 5 totoabas, 1 bone of an unidentified marine mammal, 2 turtle bones structures, 1 skate, finfish and crabs.

4 skates, 1 green sea turtle, finfish and crabs were released alive.

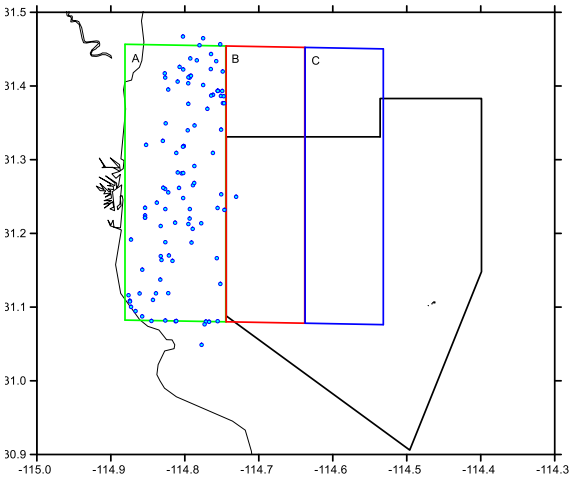

Fig. 3 Location of prospection polygons for ghost nets (1,376.1 Km^2 in total; Polygon "A": 538.4 Km^2; Polygon "B":419.9 Km^2; Polygon "C": 417.8 Km^2). Blue dots represent locations at which ghost fishing gear were effectively removed from the sea. Polygon with black contour represents the Vaquita Refuge.

Fig. 4 Bone structure of unidentified marine mammal.

Fig. 5 Green sea turtle is released alive by the Farley Mowat crew

Challenge

Detected ALDFG must be immediately removed from the sea (or the same day the latest), to prevent the recovery by illegal fishers who can also identify buoys marking the sites.

Team of transportation, collection, and destination

PROFEPA, guarded by SEMAR and SEDENA, has deposited ALDFG at a temporary storage center in eight opportunities, before their final transportation to the recycling company.

Table 2 ALDFG received at the temporary storage center

Gillnets	Longlines	Other	Total
52	12	19	83

Fig. 6 Totoaba swim bladder being destroyed by the PROFEPA

Fig. 7. Transferring the ALDFG from PROFEPA´s boat into the tuck to take them to the temporary storage center.

Fig. 8. ALDFG stored at the temporary center before taking them to the recycling Company.

Fig. 9 Separating materials at recycling company

Fig. 10 Recycling Company weight receipt

The net weight of the material received at the recycling company was 9.35 tons. The nets will be pressed and then transformed into pellet to fabric other materials,

Challenge

There was a collective concern about the risk of losing (stolen) ALDFG from the temporary storage center (a site 20 Km. north San Felipe in the private neighborhood of El Dorado). There has been no evidence of this, even though, we are looking for methods to reduce this potential risk. On November 23, the recycling company transported the derelict fishing gear recovered from the temporary storage center, to their plant San Luis Rio Colorado, Sonora.

COMMUNICATION TEAM

Internal communication: Between August and November, 6 meeting have been doneThe first two meetings were useful to conceptualise the project. The following two allowed the consolidation of the collaborating institutional team and two final meetings defined logistic and operative details.

In addition, INECC developed a standardised database where the coordinators store all the data collected. Also, a Master Plan that includes a protocol for each component was developed.

External communication: SEMARNAT generated a press release and is organising a press conference to announce the preliminary findings of the Project. This conference might take place in Cancún, during the CBD's CoP

Security

In order to reduce risks, a rulebook and a path to follow in case of an emergency were designed.

Challenge

Due to the presence of illegal fishermen during a working day, it is important to ensure and strength the Navy presence and to improve the communication systems (private frequency).

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ANNEX 5
Field Program to Evaluate and Test the Feasibility of Locating, Catching and Housing Vaquitas in the Upper Gulf of California

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Submitted on behalf of the Consortium for Vaquita Conservation, Protection, and Recovery (Vaquita CPR) on September 2, 2016

Provided in response to the *Comité Internacional Para La Recuperación De La Vaquita* (CIRVA) 2016 request for a feasibility plan for consideration

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EXECUTIVE SUMMARY

PROBLEM The vaquita is the most endangered marine mammal in the world. Bycatch in gillnets has driven a precipitous decline of the species since in was first described in the 1950s. In 1997, the entire population, limited to the Gulf of California, comprised fewer than 600 individuals. A 2015 survey indicates approximately one-tenth of this number (~60) now exists. The complete elimination of gillnet fishing in the range of the vaquita has been identified as the key element necessary for the survival of the species. As a result, essential regulatory efforts have been undertaken by the Mexican government, including the gillnet ban over the range of the vaquita, and a long-term vaquita refuge area in which all commercial fishing is banned. The continued decline of the vaquita population in the face of these efforts, however, is due in great part to the persistence of illegal gillnets aimed at catching totoaba, the swim bladders of which fetch large sums of money in Chinese markets. Thus, despite tens of millions of dollars invested by the Mexican government in preventing vaquita bycatch, the population continues to decline. ***At the current rate of loss, the vaquita will likely decline to extinction by 2022 unless the current gillnet ban is maintained and effectively enforced.***

NEED As described in the 7th Annual Report of Comité Internacional Para La Recuperación De La Vaquita (CIRVA-7), consideration of the best options for the prevention of vaquita extinction now must include exploration of *ex situ* conservation management for this species. Transfer of vaquitas from the wild to a temporary sanctuary could remove some members of the population from the threat of gillnets and provide an environment in which breeding could increase the population size prior to release back to the wild once all gill nets have been removed. While an *ex situ* management and release plan is ambitious, it has proven to be a critical tool in the recovery of numerous species, including some large mammals. As detailed in the CIRVA-7 report, the committee recommended development of a field protocol and program to evaluate and test the feasibility of locating and catching vaquitas, to include a proposed field team with the required skills and expertise. Further, CIRVA called for a plan to evaluate and test the feasibility of establishing housing facilities for vaquitas in the Upper Gulf of California. At the CIRVA-7 meeting and in subsequent actions and consultations, the Government of Mexico, through SEMARNAT, has indicated its support for the development of this plan and consideration of all options for locating, catching and housing vaquitas. ***The plan detailed in this proposal is in direct response to CIRVA's request for development of an ex situ conservation strategy to help prevent the vaquita's extinction.***

PLAN The field program outlined here has two primary goals. Determining the feasibility of locating, catching, and potentially satellite-tagging vaquitas is presented as Phase One. Phase Two is to determine the feasibility of temporarily housing vaquitas in the Gulf of California. Each of these goals has unique challenges and inherent risks, many of which represent procedures that to date have only been attempted on a limited number of individuals of other porpoise species. To address these challenges and mitigate risk, a Consortium for Vaquita Conservation, Protection, and Recovery (Vaquita CPR) has been assembled, comprising an international, interdisciplinary team with experts on all aspects of implementation of this stepwise plan. The Consortium's Management Team is intended to serve as CIRVA's Steering Group for *Ex Situ* Conservation. The *ex situ* conservation strategy is based on the best available science with regard to the vaquita and other porpoise species and takes into consideration the IUCN Species Survival Commission's Guidelines on the Use of *Ex situ* Management for Species Conservation. ***Given the current rate of decline, the ex situ conservation program described here represents a potentially critical element in the fight to prevent the vaquita's extinction, buying time while the necessary complete removal of gillnets from the vaquita's range is accomplished.*** Exploratory work on both Phase One and Phase Two has begun and this work will continue until the feasibility of both capture and housing has been evaluated, as requested by CIRVA. The Consortium's Management Team will report back to CIRVA in November/December for advice on whether and how to proceed with further plan implementation.

BACKGROUND & INTRODUCTION

The vaquita (*Phocoena sinus)* is listed as Critically Endangered in the IUCN Red List of Threatened Species and is the most endangered marine mammal in the world. In 2014, the Comité Internacional Para La Recuperación De La Vaquita (CIRVA) reported that the vaquita population was declining at 18.5% per year (CIRVA-5). The most recent

CIRVA report (CIRVA-7), released in June 2016, suggests that only approximately 60 vaquitas remain. At the current rate of decline, vaquitas will likely become extinct by 2022 unless very strong measures are taken to stop mortality in gillnets.

Gillnet fisheries are the most imminent threat to vaquitas in the northern Gulf of California, the only waters where vaquitas are found (Rojas-Bracho and Taylor 1999). Complete elimination of gillnet fishery by-catch within the vaquita's range has been identified as the key element necessary for the survival of the species (Jaramillo-Legorreta *et al.* 2007). Tragically, a large portion of the gillnet fishing in the northern Gulf has been, and continues to be, aimed at the totoaba (*Totoaba macdonaldi*), an endangered fish that is illegally harvested for its swim bladder. The Mexican government announced closure of the commercial fishery for totoaba in 1975 and announced steps to strengthen enforcement of that closure in 1993. Over the next two decades, as the scientific evidence mounted showing that vaquitas are threatened by all types of legal and illegal gillnets used in the northern Gulf to catch various species of shrimp, finfish, and elasmobranchs, the Mexican government enacted a series of measures and standards intended to reduce the number of gillnets in the vaquita range and therefore reduce the bycatch (Rojas-Bracho *et al.* 2006; Rojas-Bracho and Reeves 2013).

Despite these efforts, the vaquita population continued to decline at a rate of about 8% per year into the mid-2000s (Gerrodette and Rojas-Bracho 2011). Since the resurgence of the illegal gillnet fishery for totoaba beginning early in the second decade of the 21st century, driven by the lucrative illegal market for totoaba swim bladders in China, the vaquita population has been in steep decline. In 2015, a Presidentially decreed two-year ban was issued on the use of gillnets throughout the range of the vaquita (apart from their use in the seasonal corvina fishery which is assumed not to threaten vaquitas). However laudable the efforts made by Mexico to stop the vaquita bycatch have been, they have not been sufficient to stop illegal gillnet use in vaquita habitat. The vaquita population is now critically small. Each entanglement death acquires ever-greater significance, and the population, because of its small size, becomes more vulnerable to stochastic events, such as those involving disease or toxicosis.

In July 2016, Mexican President Enrique Peña-Nieto and US President Barack Obama agreed to collaborate and bolster efforts by both countries to protect the vaquita (White House 2016). Mexico agreed to implement a permanent gillnet ban throughout the range of the vaquita. The two countries agreed to work together to strengthen enforcement of the totoaba fishing closure and stop the illegal trade in totoaba swim bladders. Additionally, Mexico and the United States decided to intensify efforts and collaborate with international experts to develop vaquita-safe fishing gear and methods that make possible gillnet-free fisheries and eliminate the vaquita entanglement risk. Both countries also agreed to institute a long-term program for the removal and permanent disposal of derelict and illegal fishing equipment from the vaquita habitat. It remains to be seen whether and to what extent these agreements will be implemented in the upper Gulf of California.

Despite these critically important Mexico-US agreements and planned actions, exploration of emergency conservation measures is still considered essential. In similar situations with endangered animals (e.g., American bison, golden lion tamarins, Mexican red wolves, California condor), *ex situ* conservation efforts, in which individuals are removed from natural habitats and moved to habitats managed by humans, have provided a means of preventing extinction (Kleiman 1989, IUCN/SSC 2014). Although this approach is currently being attempted with the freshwater Yangtze River population of narrow-ridged finless porpoises (*Neophocaena asiaeorientalis)* in China, it has not been used for marine mammals on any large scale. The dire circumstances of the vaquita now warrant its consideration.

It is somewhat encouraging that a solid foundation of successful catching and husbandry experience has been built with other porpoise species (family Phocoenidae). Techniques have been developed to catch, rehabilitate and release harbor porpoises (*Phocoena phocoena*) caught in fishing nets or stranded (Kastelein et al. 1997, Read & Westgate 1997, Sveegaard et al. 2011). In the Netherlands, harbor porpoises accidentally caught in pound or gill nets or stranded alive are rehabilitated at the Harderwijk Dolfinarium, with eventual release of between 60 and 80% of animals admitted (van Elk pers. comm.). Along the west coast of North America, two adult stranded harbor porpoises released with satellite-linked tags following rehabilitation survived to at least 6 months post-release (Zagzebski *et al*. 2006; Vancouver Aquarium). Harbor porpoises are now caught in Europe for scientific research purposes (NAMMCO SC/20/HP/08), with ~150 individuals known to have carried their tags for up to 18 months post-tagging (Heide-Jørgensen pers. comms.). In Denmark, studies on stress in harbor porpoises accidentally entrapped in pound nets and then removed, sampled, tagged and monitored post-release, showed that indicators of stress (respiratory and heart

rates, blood cortisol levels) varied markedly amongst 42 individuals, but no deaths of the animals handled have been reported (Eskesen *et al*. 2009). In Japan, several aquaria (e.g., Toba aquarium) currently hold finless porpoises that were caught in fishing nets, removed by fishermen and subsequently taken into captivity. A stranded finless porpoise was rehabilitated and successfully released from Beijing Aquarium in China (Yu *et al*. 2009). Finless porpoises have been translocated (thus caught and transported) in China to protected areas and are thriving and successfully reproducing in semi-natural enclosures (Wang *et al.* 2005; Wang & Wang 2011; Cetacean Specialist Group website).

In September 2015, The Marine Mammal Center organised a porpoise husbandry and veterinary care meeting in Harderwijk, the Netherlands [the *ad hoc* Committee for Vaquita Conservation, Protection, and Reproduction (Vaquita CPR)]. This meeting of an interdisciplinary, international group of marine mammal experts was aimed at assessing the feasibility of using existing techniques used with other small cetaceans to catch, house, breed, and release vaquitas in the Gulf of California. The resulting technical report provided a number of recommendations for locating, catching, and housing vaquitas, in a precautionary approach to the *ex situ* management and release process.

In June 2016, CIRVA called for the development of a field protocol and program to evaluate and test the feasibility of locating and catching vaquitas, to include a proposed field team with the required skills and expertise (CIRVA-7). Additionally, CIRVA recommended development of a plan to evaluate and test the feasibility of establishing housing facilities for vaquitas in the Upper Gulf of California. The conservation strategy described here is based on CIRVA's recommendations, as well as the previous recommendations of the *ad hoc* Committee for Vaquita CPR.

PROJECT MANAGEMENT & DECISION MAKING

The *ex situ* conservation field program is divided into two phases. Phase One aims to determine the feasibility of locating, catching, and potentially satellite-tagging vaquitas. Phase Two is dependent on the success of Phase One and aims to determine the feasibility of temporarily housing vaquitas in the Gulf of California. Each phase has of a number of objectives, each contingent upon the success of the previous one. Key decision points have been built into each step in the program's strategy, to ensure that the plan is frequently evaluated, realigned as needed, paused when appropriate, and aborted if deemed necessary. The ultimate goal of this field program is to determine the feasibility of an *ex situ* conservation management program, aimed at the release and protection of reproductively able vaquitas following the complete removal of gillnets from their natural range. The *ex situ* management program would also provide a unique opportunity for outreach and education to further inform the public about the importance and urgency of, and practical approaches to, vaquita conservation.

While it is imperative to proceed with the greatest haste on all vaquita conservation efforts, the division of this program into two phases is strongly recommended. It is essential to gather information and experience on the viability of catching and handling vaquitas before assembling the resources, teams and facilities required for holding vaquitas in a provisional sanctuary facility. Phase Two, which brings animals into holding, cannot be initiated until locations or facilities suitable for habituating animals to an *ex situ* environment, and housing and caring for the animals are identified and in operation. The human resources must be in place to provide around-the-clock husbandry and veterinary care for the animals into the foreseeable future. A careful assessment of the resources required and options for long-term funding of this program must be carried out on the basis of the results of Phase One.

To address challenges and mitigate risk, the Consortium for Vaquita Conservation, Protection, and Recovery (Vaquita CPR) has been assembled, comprising an international, interdisciplinary team with experts on all aspects of the proposed work to implement this stepwise approach. We propose that the Consortium's Management Team serves as CIRVA's Steering Group for *Ex Situ* Conservation. Management Team Leads will oversee implementation of the plan (pending approval, adequate funding, and necessary permitting) and will report progress to CIRVA and SEMARNAT on a monthly basis. To ensure that the Management Team has timely access to subject matter experts during the development and implementation of the plan, an Expert Advisory Group (EAG) has been established and consulted. Members of the EAG are available, either as a group or as individuals, on an as needed basis.

An Independent Review Panel (IRP) has been established to provide independent review of the proposed plan prior to implementation and to make recommendations for revisions to the Management Team. Once the plan is in action, the IRP will be consulted to evaluate any animal injuries, illnesses, or deaths that occur as a result of project activities. The IRP will be responsible for review of the conditions surrounding the animal's condition, including any available clinical data (e.g. blood work, photos, histopathology, and necropsy data), as well as the overall project progress to

date. The IRP will then make a recommendation to the Management Team Leads as to whether or not the project should proceed without modification, proceed with minor or major modifications, or be terminated. Additionally, the IRP will provide a critical review of Phase One results and any proposed revisions to Phase Two. The IRP will also offer an opinion as to whether Phase Two should be implemented.

Exploratory work has begun on both Phase One and Phase Two, and this work will continue until November/December, at which time the Management Team will report back to CIRVA for advice on whether and how to proceed with plan implementation. A budget plan is currently being devised for Phase One. Phase Two financial planning will be conducted after completion of the site survey (Phase One), since much of the Phase Two budget will be determined by the housing location, facility design, local infrastructure support, and engineering plan.

The protocols and procedures described in this program plan are based on current knowledge, relevant experiences, and recent expert discussions related to the tasks at hand. Important to note is that an adaptive management approach will be utilised; therefore, we expect these protocols to undergo further revision and refinement as new data and expert guidance are acquired. Prior to execution of each objective, the Management Team Leads will assemble, either remotely or in person, key personnel to finalise the methodologies based on the most current information on hand. Additional subject matter experts, to include members of the EAG, IRP, and CIRVA, will be consulted as needed.

PROPOSED PLAN: PHASE ONE

The proposed plan is divided into two phases. Phase One includes locating and catching vaquitas, with the option of satellite tagging to assess response to animal handling, as well as performing a site survey to consider temporary housing options in Mexico. Phase Two includes housing, transport, animal care, and post-release monitoring. At the completion of Phase One, the Management Team will submit a report to the IRP that details Phase One outcomes and planned revisions for Phase Two. Once IRP feedback has been received and incorporated into the plan, Phase Two will be resubmitted to CIRVA for review, followed by the Mexican government for approval.

Phase One objectives are detailed below, and include the primary objective, key decision points, and key personnel.

1.0 Locate (Aug 2016 – May 2017)

Primary Objective: Develop and test methods for locating vaquitas using multiple complementary approaches, including trained dolphins from the U.S. Navy Marine Mammal Program.

Key Decision Points:

1) **Resources:** Are adequate resources available for the location of vaquitas, to include funding, vessels, aircraft, personnel, and permissions?
2) **Conditions:** Will weather and sea conditions permit safe and effective efforts to locate vaquitas by air and/or sea, over sufficiently long blocks of time?
3) **Locatability**: Are any of the options for finding vaquitas capable of reliably locating and maintaining contact with the animals for a suitable period of time?

Note: The non-Navy portions of this objective, as described below, will only be implemented if the key decision points are adequately addressed, per the project team leads and appropriate key personnel. If at any time, resources, conditions, and/or locatability are deemed insufficient, the expert advisory group will be consulted to determine if the plan should be realigned, temporarily halted, or aborted.

Vaquitas are generally considered difficult to detect. Knowledge about where vaquitas spend their time has improved as a result of consistent use of underwater ridges confirmed from sightings from all surveys and from thousands of days of acoustic data. As a result, the recent 2015 vessel-based survey and subsequent boat forays into the vaquita's range found vaquita in the same locations on several occasions. Experience with the vaquita abundance survey showed that, despite previous difficulties finding vaquitas, there are core areas of the range where they can be sighted fairly reliably on different days from large and medium boats. However, this ability is extremely dependent on weather and sea-state. Additionally, the ability to track animals remains highly variable. Most porpoise are sighted briefly and never re-sighted despite multiple experts searching with high-power binoculars (25x). Vaquitas are known to avoid vessel noise and react to vessels changing speed. Thus, in addition to difficulties tracking animals they are likely to behave evasively to active approaches.

Several options are currently being proposed to locate vaquitas. These options are not mutually exclusive, and include: (1) detection using vessel-based observers, (2) aerial detection using small aircraft, and (3) use of trained U.S. Navy dolphins. Adding Navy dolphin and aerial detection capabilities to vessel-based surveys will likely improve the chances of locating vaquitas, as well as enhance the ability to track them for the purpose of catching. Other detection technologies (e.g. acoustic, drone) will be explored and evaluated for their potential to provide real-time location data, as appropriate. Regardless of the methods used, the core areas of the range would be targeted for vaquita detection followed by catching. The three current detection options are described below, based on expertise and input from key personnel.

1.1 Locating vaquitas with vessel-based surveys (Sept 2016 – May 2017)

1.1.1 Determine usefulness (Sept 2016 – Apr 2017)
Vessel-based surveys will be further evaluated by chartering a spotter vessel with an observation tower and then using this vessel prior to May 2017, specifically within the areas of highest vaquita densities per the 2015 fall survey. Vessel operations will be performed on days when weather and sea state are optimal for detection of vaquitas from vessels (Beaufort 0-2 conditions).

1.1.2. Use vessel-based surveys to locate vaquitas (Spring 2017)
If vessel-based surveys are deemed valuable, the spotter vessel will be used to assist in vaquita detection for the purpose of catching.

1.2 Locating vaquitas with small aircraft (Oct 2016; Spring 2017)
1.2.1. Determine effectiveness (Oct 2016)
The effectiveness of aircraft to locate vaquitas will be evaluated by flying twin-engine, fixed-wing aircraft over the vaquita refuge at least three times during the month of Oct 2016. Experienced porpoise observers (1-2) will be on board and the areas of highest vaquita densities reported in the fall 2015 survey will be surveyed on three separate days. Flights will be performed on days when weather and sea state are optimal for detection of vaquitas (Beaufort 0-2 conditions).

1.2.2. Use small aircraft to locate vaquitas (Spring 2017)
If vaquitas are detected on any of the test flights, aircraft support will be deployed to supplement Navy dolphin detection and vessel detection of vaquitas for the purpose of catching.

1.3 Locating vaquitas with trained U.S. Navy dolphins (Aug 2016 – Mar 2017; Spring 2017)
Based on the proven capabilities of Navy dolphins to find swimmers and objects in various open ocean environments, **the Mexican Navy has requested assistance from the US Navy to use trained Navy dolphins to help locate vaquitas.** The US Secretary of the Navy has approved this request.

1.3.1 Determine effectiveness (Aug – Oct 2016)
Navy dolphins will be trained to detect a simulated echo from a harbor porpoise using the Navy's phantom echo generator system in San Diego. The dolphins will then deploy to San Francisco Bay to evaluate the potential to detect and/or track live porpoises, routinely observed near the Golden Gate Bridge.

1.3.2 Use Navy dolphins to locate vaquitas (Spring 2017)
If the dolphins can successfully locate porpoises in San Francisco Bay, a deployment to Mexico will be planned for the spring of 2017, in coordination with other aspects of this plan.

1 Catch (Spring 2017)

Primary Objective: Safely catch up to three vaquitas using technology and procedures developed for harbor porpoises

Key Decision Points:
1) **Resources**: Are adequate resources available for the catching of vaquitas, to include funding, vessels, aircraft, personnel, and permissions?
2) **Behavior in water**: Are vaquitas approachable enough to allow the team to maintain contact, approach the animals, and corral them into nets?
3) **Behavioral response to net**: Are team members able to reach netted animals immediately and maintain them safely at the surface? Do animals react to capture in a self-endangering manner?
4) **Behavioral response to handling**: Are animals stable during handling? Or do animals exhibit a life-threatening stress response?

Note: This objective, as described below, will only be implemented if the key decision points are adequately addressed, per the project team leads and appropriate key personnel. If at any time, resources are deemed insufficient or animal behavior deemed unacceptable, the expert advisory group will be consulted to determine if the plan should be realigned, temporarily halted, or aborted.

Safe catching of vaquitas will rely on the use of technology and procedures developed for other porpoises. While final protocols are being developed, a general description of the capture protocol is described below. Protocol refinement will continue through comprehensive discussion with key personnel and additional subject matter experts. Key decision points are listed above, and if at any time, resources are deemed insufficient or animal behavior is incompatible with safe capture, the plan will be modified, temporarily halted, or aborted. Further, if the protocol described proves unsuccessful for catching vaquitas, then other methods will be explored and evaluated.

Vaquitas will be caught by an experienced team of veterinarians, biologists, handlers, and boat operators. The catch fleet will consist of 5-6 boats of at least 150 HP: 1 net boat, 1-2 animal handling boats, 1 herding boat, 1 auxiliary supply boat, and 1 transport boat. The catch process will be initiated if the team leader determines 1 or 2 animals can safely be caught with a light salmon gill net (un-stretched mesh size of ~15 cm, ~ 100 meters long, 4 meters deep) and personnel will be able to safely and effectively retrieve the animals from the net. At this point, the net will be deployed ahead of the animal(s) and three support vessels will patrol the net and continuously examine the float line for signs of vaquita entanglement. If necessary, a herding vessel may be used to encourage the vaquita(s) toward the net.

Once a vaquita is entangled in the net, it will be disentangled from the net while being assessed by a veterinarian experienced with porpoise capture. If appropriate, the animal will be gently placed into a stretcher alongside the boat. If the veterinarian deems the animal stable enough for further restraint, it will lifted into the boat and placed onto a padded surface. Further disposition of animals caught will be determined in a precautionary step-wise manner reflecting the symptoms the animal is displaying. Signs to be monitored include respiratory rate and character, heart rate and rhythm, mentation, movements, and muscle tone. Subsequent actions will depend upon the assessment of the animal's overall stress level, size, sex and pregnancy status (if detectable via ultrasound?). The options to be considered include:

- immediate release;
- short-term handling on the boat with biomedical sampling before release;
- short-term handling with biomedical sampling and placement of a minimally invasive satellite-linked tag on the dorsal fin (see satellite-linked tagging option below) before release

Emergency procedures will be established in the event that an animal is injured during capture. Emergency medical equipment and an attending veterinarian will be on hand in the field at all times. To accommodate administration of life-saving, critical care, an above-ground pool with an adequate filtration unit will be staged in San Felipe (refer to Objective 5.2.2 for details of the pool design and set-up). Criteria for transfer of an animal into emergency care will be developed in collaboration with Mexican authorities.

2 Satellite-linked tagging option (Spring 2017)

Primary Objective: Perform satellite-linked telemetry on up to three vaquitas (caught and released) to determine survival post-handling, as well as to document ranging and habitat-use patterns.

Key Decision Points:

1) **Resources:** Are adequate resources available for tagging vaquitas, to include acquisition of tags, animal tracking, and data analysis, personnel, and permissions?
2) **Animal signalment (age, sex, sexual maturity)**: Is the animal suitable for tagging, e.g. outwardly healthy; subadult male, adult male, non-lactating and non-pregnant female?
3) **Behavioral response to handling**: Are animals stable during handling? Or do animals exhibit a life-threatening stress response?

Note: This objective, as described below, will only be implemented if the key decision points are adequately addressed, per the project team leads and appropriate key personnel. If at any time, resources are deemed insufficient, animal signalment inappropriate, or animal behavior unacceptable, the expert advisory group will be consulted to determine if the plan should be realigned, temporarily halted, or aborted.

The option to satellite tag vaquitas has been included in the program plan for the following reasons. First, satellite tracking information will help determine animal movements and survival post capture and handling. Second, tracking data will document animal movements relative to the known vaquita range, in both the short-term (weeks) and long-term (months). Third, satellite tracking could help assist in relocating vaquitas for catching if needed. Fourth, tracking data could improve public awareness of the plight of the vaquita and enhance efforts to enforce the gillnet ban.

Satellite tagging of vaquitas will rely on the use of technology and procedures developed for other porpoises and small cetaceans. A basic tagging protocol is described below. Additional protocol refinement will be conducted through comprehensive discussion with the key personnel and additional subject matter experts, as needed. Key decision points are listed above, and if at any time, resources are deemed insufficient or animal behavior is incompatible with safe tagging, the plan will be either realigned, temporarily halted, or aborted.

In the event that placement of a minimally invasive satellite-linked tag is deemed appropriate, a SPOT-299 Finmount tag (Wildlife Computers, Redmond, WA USA) will be attached to the trailing edge of the dorsal fin of up to three vaquitas by means of a single Delrin pin. This tag/attachment technique has been well tested with a variety of small cetacean species, including harbor porpoises. Tags can be attached in less than 5 minutes, and based on expected battery life, it should be possible to track the animals for up to several months.

3 Site survey (Sept - Oct 2016)

Primary Objective: Perform a comprehensive site survey to determine the feasibility of building and supporting a shore-based vaquita sanctuary for the purpose of housing.

Key Decision Points:

1) **Resources:** Are adequate resources available for site survey activities, to include funding, personnel, and permissions?
2) **Government support**: Does appropriate Mexican government support exist to facilitate a meaningful exploration of potential sites?

Note: This objective, as described below, will only be implemented if key decision points are adequately addressed, per the project team leads and appropriate key personnel.

In June 2016, a preliminary site survey was performed by the National Marine Mammal Foundation for the purpose of identifying site options for shore-based sanctuary housing. A more thorough site survey involving key personnel

will be conducted to determine if these preliminary sites are suitable for development of a vaquita sanctuary, as well as explore any additional options that develop prior to Sept 2016. Three site options were identified for consideration during the site survey:

- Muelle de San Felipe (~4.5 to 30 nautical miles from the nearest border point of the vaquita refuge)
- Icehouse Lagoon (~4.5 to 30 nautical miles from the vaquita refuge)
- Gonzaga Bay (~65 to 95 nautical miles from the vaquita refuge)

Since the preliminary site survey was performed, a fourth site was identified that warrants evaluation, El Golfo de Santa Clara. The team will also determine if any additional sites deserve consideration. The site survey team will establish an engineering working group, which will help assist in the assessment of environmental, logistical, and facilities challenges of each site. Site survey planning will begin in September 2016, with the aim of conducting an onsite survey during the first week in October 2016.

Comprehensive site survey data to be gathered include *but are not limited to*: accessibility (by land, air, sea), environmental quality (land, air, sea), environmental conditions (land, air, sea, sea floor), historical weather events, local threats to animals (toxins, infectious disease, poisonous fishes/invertebrates, predators, natural and anthropogenic noise, human-related activities,), options for mitigation measures, assessment of available resources (water, power, buildings, security, food, fish, cold storage, heavy equipment, local authorities, lodging, transportation), proximity to the vaquita refuge, and evacuation options (land, air, sea).

Fig. 1 Each of the three potential sites initially identified for shore-based sanctuary housing are described below, including data gathered on the preliminary site survey.

4.0 Option 1: Muelle de San Felipe (30° 20' 41.88" N 114° 38' 19.69"W)

The Muelle de San Felipe is a man-made harbor located just outside of San Felipe. A large breakwater closes in the harbor, measuring ~1900ft by 2050ft. The site is inside the bay and surrounded by landmasses that limit the fetch, thus serving as natural protection from storms. Additionally, the massive breakwater protects the harbor from wave activity even at high tide. The harbor is currently home to a Mexican Navy Outpost, the Port Captain, a number of fishing vessels, a private marina, a fuel station and two boat ramps. The harbor also has an existing 185' floating pier that is supported by pilings designed to handle the tidal fluctuation. A causeway currently exists from atop the breakwater roadway down to the pier. If the site is selected, this pier could be the foundation for a man-made vaquita lagoon. The lagoon could stretch the length of the pier toward the shore, allowing for a shallow beach to corral animals at low tide that are in need of hands-on assessment. The natural seabed would allow animals to hunt and root for food.

Fig 2 & 3

The current depth in this area is 4ft deep at extreme low tide, ranging up to 31ft at the highest tide, with an average depth of 12ft. As a result of the extreme tidal range, the preliminary recommendation is that lagoon walls be constructed out of a rigid material to minimise the risk of entanglement. One option is to construct the walls out of rigid fencing divided into panels and affixed to support pilings that extend from the lagoon floor to just above the extreme high tide line (see illustration below). Floating docks would rise and fall with the tide within the fenced area. With the addition of multiple gates, animal care experts would have access to the lagoon and be able to move animals between different areas. On the perimeter of the lagoon, multiple smaller sea pens could be constructed to aid in the transition from the refuge to the lagoon.

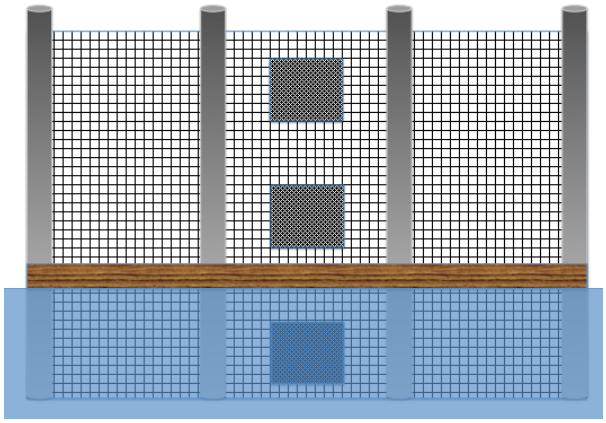


Fig. 4

Through examination of historical imagery, it appears that the existing pier and support pilings are less than five years old. If the site were chosen, additional pilings would likely need to be added to the perimeter of the facility

to support a lagoon. By reaching out to recent construction contractor(s) for survey information, the turnaround time for planning could be minimised. If needed, a number of near-by vacant buildings and land lots could be considered for development to support a vaquita sanctuary. Additionally, a great deal of infrastructure currently exists in the area, including access to utilities, housing for support staff and security. Collaboration with the Mexican Navy could provide an emergency evacuation option in the event of severe weather, as the Navy Outpost has a newly constructed building designed to shelter trailered boats. Overall, there is great potential for both in-water and shore-based facilities to provide a safe haven for vaquitas.

4.2 Option 2: Gonzaga Bay (29° 48' 56.69" N 114° 23' 47.02" W)

Gonzaga Bay is a secluded site about two-hours south of San Felipe by road. This naturally contoured bay is tucked inside a landmass with two inlets allowing for natural filtration. The large inlet to the north does not have direct access to the eastern bay, keeping that area secluded from the fetch. The inlet to the southeast corner only flows at high tide. The small, local town has limited infrastructure, but does include a Policia Federal checkpoint, small airfield, two restaurants, small hotel, some residential housing, and a campground. Within a couple miles are a fuel station and a boat ramp (located at Campo Papa Fernandez).

Due to the remote location of Gonzaga Bay, this site would require the most development. If desired, land development, construction, and engineering consultation could be used to identify requirements to build and sustain a vaquita sanctuary facility, as well as identify housing recommendations, logistical solutions, and a severe weather evacuation and sheltering plan.


Fig. 5 & 6

4.3 Option 3: 'Icehouse Lagoon' (31° 01' 34.01" N 114° 49' 52.21" W)

A natural cove ~200ft wide and protected by landmass and rock structures is located on the northern end of San Felipe, which will be referred to for the purpose of this program plan as 'Icehouse Lagoon'. This cove provides protection from storms and monsoons, as well as a relatively quiet sandy-bottom environment. On the south end of the lagoon is a small inlet. Construction of a solid wall and fencing berm could help facilitate a natural flush of the lagoon by leveraging the extreme tidal range. The natural contour of the lagoon could provide the perimeter for the vaquita housing area, thus limiting the need for a fenced perimeter. The large lagoon could be sectioned off to have separate housing areas to allow for various social groupings. Underwater gates could be installed to facilitate movement of animals around the lagoon. The natural sand beach would allow for access to animals in need of medical intervention.

As with Muelle de San Felipe, several buildings and land plots surround the lagoon, which could be developed to provide direct support to the animals. However, there are currently no structures in the direct vicinity that could provide emergency protection for animals and personnel during a severe storm. If desired, a new building would need to be constructed to provide a safe haven during severe weather.

Unfortunately, preliminary water quality testing on samples from 'Icehouse Lagoon' showed a high bacterial burden, specifically of fecal coliforms. This may be due to the location of the lagoon, which is in the heart of downtown San Felipe, and near-by residential homes. Follow-up water quality testing would be essential prior to further consideration of this site. If water quality proves problematic, engineering solutions could be considered, to include wall construction with water circulation.

Fig. 7, 8, 9 & 10

4.4 Option 4: El Golfo de Santa Clara (31° 42' 00" N 114° 30' 00" W)

El Golfo de Santa Clara was identified as a potential site after the preliminary site survey was performed. A comprehensive survey will be performed in Oct 2016.

PROPOSED PLAN: PHASE TWO

As previously stated, there are two phases to the plan. Phase Two includes housing, transport, animal care, and post-release monitoring. Prior to implementation of Phase Two, the Management Team will submit a report to the IRP that details Phase One outcomes and planned revisions for Phase Two. Once IRP feedback has been received and incorporated into the plan, the Management Team will resubmit Phase Two to CIRVA for review, followed by submission to the Mexican government for approval.

As such, it is important to note that Phase Two plans as detailed below will be subject to review, revision and improvement as Phase One is implemented and relevant data gathered.

1 HOUSING (AUG 2017 – MAY 2018)

Primary Objective: Design, build, and maintain housing to accommodate animals brought into the *ex situ* program (~5 vaquitas); and determine accessibility, functionality, and resistance of facilities to weather and tides in the area, prior to housing animals.
Secondary Objective: Temporarily house vaquitas to assess response to enclosures, first within the refuge in a shallow sea-pen for rapid assessment, followed by housing in a shore-based, sea-pen sanctuary for more thorough evaluation.

Key Decision Points:

1) **Resources**: Are adequate resources available for short-term housing of vaquitas, to include space; funding; personnel; fish storage; veterinary and husbandry facilities; and permissions?
2) **Conditions**: Does short-term housing hold up to environmental conditions, including severe weather and extreme tides? Are the water quality conditions consistent with best practices for housing cetaceans?
3) **Behavioral response to human care**: Are animals stable during human handling? Are animals tolerant of human presence?
4) **Behavioral response to housing:** Are animals stable when placed in short-term housing? Are animals tolerant of physical surroundings?

This objective, as described below, will only be implemented if the key decision points are adequately addressed, per the project team leads and appropriate key personnel. If at any time, resources are deemed insufficient or animal behavior deemed unacceptable, the expert advisory group will be consulted to determine if the plan should be realigned, temporarily halted, or aborted.

Housing is intended to accommodate the period required to achieve objectives of the *ex situ* conservation program, which includes providing a safe haven for vaquitas until the vaquita refuge is cleared of gillnets. We aim to design and build the safest type of housing for vaquitas based on expertise in porpoise care and small cetacean sea-pen enclosures. To achieve this goal, we are proposing a staged approach to housing. In stage 1, vaquita(s) will live in a transitional housing enclosure within the vaquita refuge to evaluate feasibility of holding (up to 72 hours) of vaquitas in human care. Housing within the refuge will reduce transport times from the catch site to the housing site, as well as allow the animal care team to release vaquitas immediately back into the refuge in the event that an animal is showing evidence of excessive stress due to housing. Animals will be assessed for suitability for progression to stage 2, which will involve relocation to a shore-based, sea-pen sanctuary better equipped to observe animal behavior, provide medical assessment and care, and ensure proper food storage and handling. As the shore-based facilities will be much better equipped to assess and support animals, the intent will be to transfer animals as soon as possible out of the transitional housing. Details for each stage are described below.

5 IN-REFUGE, SEA-PEN TRANSITIONAL HOUSING (AUG – DEC 2017; MAY 2018)

5.1 Design and build transitional housing (Aug – Oct 2017)

Based on consultation with sea-pen facilities experts, a preliminary design concept for in-refuge, sea-pen transitional housing has been developed. This design will be further refined as ocean engineering expertise and international seapen knowledge is leveraged. The preliminary design consists of 2-4 sea-pen netted enclosures, each fixed to the inside perimeter of a floating deck and attached to a barge within the vaquita refuge. Sea-pen depth will be approximately 4ft to allow the animal care team, when necessary, to safely enter the water to evaluate animals and/or provide timely assistance. The net will be made of 4mm nylon line with no more than a 1" stretch. Knotless netting is preferred as well as coating with flex-bar to increase rigidity and minimise biological/algal growth. A rigid speed-rail pipe frame will be installed along the floor of the sea pen to assist the net in holding its form. No more than 2 vaquitas will be housed in each enclosure. If considered necessary, engineering modifications could be made to allow for the floor to be raised for transport of the facility to a new location. The transitional housing plan will have limitations related to weather and sea state. If inclement weather threatens the area, animals will either be tagged and released into the vaquita refuge, or if appropriate, transported to the shore-based, sea-pen sanctuary. Engineers and animal care experts with expertise in sea-pen housing for small cetaceans will be included in further design development, evaluation, modification, engineering, and construction of transitional housing.

5.2 Tow to vaquita refuge for monitoring and evaluation (Oct – Dec 2017)

Once transitional housing is constructed, it will be towed to the vaquita refuge and secured. The facility will be continuously monitored and evaluated by experts for durability, ease of use, and personnel safety. Specific engineering, environmental monitoring, and animal safety criteria will be developed for tracking and analysis. If needed, modifications will be made to improve the housing facilities.

5.3 Determine suitability for vaquitas (Oct – Dec 2017)

Based on the engineering, animal safety, and environmental data collected during the previous task, suitability of the housing option for vaquitas will be determined by key personnel in collaboration with the Management Team and EAG. If deemed suitable, the transitional housing site will be used to hold vaquitas for brief periods of time, specifically to determine their short-term response to holding and enable rapid release back into the vaquita refuge if needed.

5.4 Option to hold Navy dolphins in transitional housing (May 2018)

If Navy dolphins are deployed to the region, the transitional housing site could be made available for temporary dolphin holding prior to vaquita holding. Navy dolphins are housed year-round in sea pen enclosures; therefore, housing of these net-savvy animals in the newly built vaquita housing site would help demonstrate the safety of the facility without posing risk to the animals. Dolphins would be monitored continuously while in the sea-pen housing site, ensuring their safety. Any needed facilities modifications, as determined during the dolphin holding period, would be made prior to housing vaquitas. At no time would dolphins and vaquitas be housed simultaneously in the transitional housing area.

5.5 Shore-based, sea-pen sanctuary housing (Oct 2017 – May 2018)

A shore-based, sea-pen sanctuary will be designed and built following a thorough site survey, consultation and cooperation with local Mexican authorities, input from porpoise veterinary and husbandry experts, and guidance from marine mammal facilities engineers. The intent of this sanctuary facility will be to facilitate comprehensive assessment of the vaquitas' response to holding, human observation, and when needed, handling and medical care. Criteria for site selection include: a safe and quiet environment; acceptable water quality; protection from severe weather easy access for veterinary observation and care; near-by facilities for fish storage and preparation; and potential for observation by the public for the purpose of conservation education and outreach, as deemed appropriate by the Mexican government.

5.5.1 Design and build sanctuary and animal care support facilities (Oct 2017 – Mar 2018)

Based on the results of the survey, a sanctuary facility would be designed and built at the selected site, using the expertise of experienced sea-pen operators, porpoise care personnel, and marine mammal facilities engineers. Appropriate permissions will be sought for any planned development, construction, and/or modifications.

5.5.2 Install above-ground pools (Jan – Apr 2018)

At any of the sanctuary site options, a lay-down area appropriate for above-ground pools and adequate water filtration would be developed. It is recommended that a permanent hurricane/monsoon-proof building equipped with environmental controls be constructed to house the pools. The above-ground pools could be used as a short-term housing location for animals in need of medical care or as a safe haven during storm events. The pools are easily assembled within a day and can then be disassembled for storage until needed again. Pools come in a variety of sizes and replacement parts are readily available. The ideal site could support 2-3 above-ground pools. Additionally, pools would be padded to mitigate the animals' exposure to unnecessary noise. Pools would be large enough to house multiple animals (pool pictured below is 17'x29'x5'). Open-circuit filtration could be run from the ocean to minimise changes in the water chemistry and temperature experienced by the animals. However, filtration units could also be staged and available to ensure a clean water environment in the event of a poor water quality event. An emergency generator would power the life support system in the event of local power system failure.

Fig. 11

5.3.3 Determine suitability and safety for vaquitas (Mar - Apr 2018)
Once the facility is built, expert sea pen operators and divers will inspect the facility and ensure suitability and safety for housing porpoises, to include any areas that allow for behavioral observation and/or hands-on assessment. The facility will then be closely monitored for durability during changing weather conditions and fluctuating tides, ease of use, personnel safety, and animal safety. As similarly determined with the transitional housing option, suitability of the shore-based vaquita sanctuary will be assessed by key personnel in collaboration with the Management Team and EAG. If deemed suitable, the shore-based facility will be equipped and manned to accept vaquitas in May 2017.

5.3.4 Option to house Navy dolphins in sanctuary facility (May 2018)
If Navy dolphins are deployed to the region, the sanctuary will be made available for short-term dolphin housing prior to vaquita housing. Navy dolphins are housed year-round in sea pen enclosures; therefore, housing of these net-savvy animals in the newly built vaquita sanctuary would help demonstrate the safety of the facility without posing risk to the animals. Dolphins would be monitored continuously while in the sanctuary, ensuring their safety and preventing their escape or release (whether accidental or intentional). Any needed facilities modifications, as determined during the dolphin housing period, would be made prior to housing vaquitas. At no time would dolphins and vaquitas be housed in the facility simultaneously.

6 LOCATE, CATCH, AND TRANSPORT TO HOUSING (MAY – JUL 2018)

Primary Objective: Find, catch, and safely transport vaquitas to housing using procedures developed for harbor porpoises.

Key Decision Points:

1) **Resources**: Are adequate resources available for the catching of vaquitas, to include funding, vessels, aircraft, personnel, and permissions?
2) **Behavioral response to handling**: Are animals stable during handling?
3) **Behavioral response to transport:** Are animals stable when on boat? Are animals stable during transport?
4) **Animal signalment (age, sex, sexual maturity) and health status**: Is the animal suitable for short-term housing, regarding signalment? Does the animal outwardly appear healthy?

This objective, as described below, will only be implemented if the key decision points are adequately addressed, per the project team leads and appropriate key personnel. If at any time, resources are deemed insufficient or animal behavior deemed unacceptable, the expert advisory group will be consulted to determine if the plan should be realigned, temporarily halted, or aborted.

The procedures for finding and catching vaquitas will depend on lessons learned during the location and catch experience during phase one. Assuming adequate procedures are developed for this purpose and all necessary approvals are obtained, vaquitas will be found and caught using the most appropriate means. If an animal is deemed stable, healthy, and suitable for placement in holding, it will be transported to the housing site. In the case that there are two vaquita, the animals will be transported side-by-side on the padded surface of the transport vessel. If a truck or large boat is required for transport to the holding site (for example, if the holding site is far enough away from the catch site to warrant such transport vehicles), vaquitas could be transported in containers while floating on open cell foam immersed in shallow water; or in a soft stretcher with openings for flippers, and the stretcher either rested on foam or suspended in a frame or box lined with wet foam. Animals will be kept wet and cool at all times, noise will be minimised, and vital signs will be continuously monitored by veterinary staff.

7.0 ANIMAL CARE (AUG 2016 – JUL 2018)

Primary Objective: Ensure survival of vaquitas during temporary housing.
Secondary Objective: Develop an animal care and preventive medicine program by establishing normal values for biomedical parameters (hematology, serum chemistry, hormone levels)
Tertiary Objective: Salvage gametes and stem cells from any animal should a death occur.

Key Decision Points:

1) **Resources**: Are adequate resources available to provide high-quality animal care to vaquitas, to include funding, qualified veterinary and husbandry personnel, quality fish, routine and emergency medical equipment, medical consumables, laboratory support, and permissions?
2) **Behavioral response to care:** Are animals stable when provided preventive and routine medical care? Do animals tolerate health monitoring?
3) **Behavioral response to feeding:** Do animals accept initial handling and attempts to be fed? Do animals adapt to eating frozen-thawed fish? Do animals properly digest offered fish? Do animals maintain healthy weight on managed fish diet?

This objective, as described below, will only be implemented if the key decision points are adequately addressed, per the project team leads and appropriate key personnel. If at any time, resources are deemed insufficient or animal behavior deemed unacceptable, the expert advisory group will be consulted to determine if the plan should be realigned, temporarily halted, or aborted.

Personnel experienced in caring for porpoises will be involved in all aspects of animal care for the vaquitas, to include veterinary, behavioral, and animal care experts. A comprehensive animal care plan is being modeled after the animal care program for harbor porpoises developed at the Dolfinarium in Harderwijk, as well as the NMMF's medical care program for dolphins, which is based on the preventive, routine, and emergent animal care program developed and implemented at the Navy Marine Mammal Program.

7.1 Post-catch health exams (May – Jul 2018)
Entrance exams will be performed as soon as possible after catch to collect baseline health data, essential for evaluating the animal's acclimation to housing and tracking health status. Animals will be placed on a foam mat and kept cool, wet and comfortable for vital sign monitoring, physical examination, and behavior assessment. Data will include heart rate and rhythm, respiratory rate and character, vocalisation, and mentation. For animals deemed stable, weight and morphometric data will be collected and blood sampled for hematology, serum chemistry, and hormone testing (e.g. cortisol, aldosterone, progesterone, testosterone). Additional diagnostics may be performed if needed to provide essential baseline data for the veterinary team.

7.2 Monitoring during and after transport (May – Jul 2018)
Following initial health examination (entrance exams), animals will be transported by mat or transport carrier to the transitional sea pen housing site and released into it. During transport, vital signs and behavior will be monitored closely. If concerns arise, at any point from catch onward, either emergency procedures will be implemented or the transport will be aborted and the animal release. If deemed safe and appropriate, the animal will also be tagged. Once the animal is released into the sea pen, experienced staff will conduct continuous monitoring as well as video monitoring. Periodic monitoring will include respiratory rate and character, behavior, swimming patterns, body composition and feeding behavior. Findings will be analyzed daily so changes and trends can be identified as quickly as possible. Personnel will be authorised to tag and release animals if any of them are exhibiting signs of excessive stress.

Fig. 12

7.3 Routine health monitoring during housing (May – Jul 2018)
Periodic health assessments will be performed on a schedule as deemed appropriate by the veterinary team. Sampling may include body weight, morphometrics, blood, gastric fluid, feces, respiratory exudate, and urine. Sample evaluation may include hematology, serum chemistry, cytology, sedimentation rate, blood gas analysis, and reproductive and stress hormone evaluation. Through the process of performing these health exams, medical data will be generated and routinely analyzed to establish normal reference ranges with which to detect changes in health status and early stages of illness.

7.4 Monitoring for evidence of stress (May – Jul 2018)
In order to detect early signs of stress, the following parameters will be regularly monitored, recorded, and analyzed on an individual animal level:

- Changes in behavior

- Changes in appetite/lack of appetite
- Changes in swimming patterns
- Changes in respiratory rate and character
- Changes in stress hormones (cortisol and aldosterone)
- Evidence of illness

If observed, modifications to the animal's environment, social grouping or feeding protocols will be appropriately implemented, and medical intervention will be considered if deemed necessary by the veterinary team. Additionally, any animal may be released back to the vaquita refuge if this is determined to be the best course of action for the individual's long-term survival.

7.5 Medical intervention (May – Jul 2018)
Any changes noted in either behavioral or physical exam results will be acted upon as deemed appropriate by veterinary staff on an individual animal basis. Appropriate diagnostic and therapeutic equipment will be made available to provide medical care as needed, based on current standards of care for small cetaceans. Any animals that are determined to be ill, either at the time of catch or during holding, will be carefully managed with involvement of the expert veterinary team and frequent consultation with the Consortium's team leads.

7.6 Emergency response (May – Jul 2018)
Emergency medical plans will be prepared and ready to execute if needed. All attending staff will be well trained in possible emergency situations and appropriate response. All emergency drugs, equipment, and supplies will be readily available and in close proximity to vaquitas.

7.7 Feeding (May – Jul 2018)
Although animals will be housed in a sea-pen environment and live fish will likely swim in and out of the enclosure, this will not provide adequate nutrition to maintain the animal's body condition. Therefore, animals will be fed high quality frozen fish. Fish will be stored in freezers on land, as well as prepared for consumption in a designated fish preparation area. When vaquitas are housed at the in-refuge transitional housing site, fish will be temporarily stored and prepared for consumption on the barge or on work boats. Fish will be carefully handled following strict sanitary protocols, and thawed fish will be offered to individuals by introducing fish in front of the animal's path in the water column. Continuous observations will be made to determine if fish are definitively being eaten.

Extensive experience rehabilitating harbor porpoises at the Dolfinarium in Hardewijk has demonstrated the need to hand feed porpoises thawed fish 6 times/day for 2-4 weeks, encouraging acceptance of dead fish and ensuring adequate nutritional intake. If vaquitas also require hand feeding, experienced handlers will enter the enclosures, gently restrain animals, and place fish in their mouths. Harbor porpoises do very well with this process, showing few signs of stress. When feasible, supplemental live fish will be introduced into the sea pen while animals are being transitioned to frozen fish, although this is not expected to provide consistent, substantial nutrition. To ensure maintenance of a healthy body weight, animals will be monitored by recording and analyzing routine observations of animal behavior, body condition, and body weight.

7.8 Fish procurement, storage, and preparation (Jan – Jul 2018)
The vaquita diet is composed mainly of small pelagic fishes and includes croakers, grunts, crustaceans, squids, and octopuses (Lozano 2006, Morales-Zarate et al. 2004, Morzaria-Luna et al. 2012, Peres-Cortes Moreno et al. 1996, Vidal et al. 1999).

Functional group	Proportion
Squid	>0.0001
Crabs and lobsters	>0.0001
Carnivorous macrobenthos	>0.0001
Groupers and snappers	0.001
Hake	0.002
Totoaba	0.015
Small demersal fish	0.017
Herbivorous fish	0.020
Flatfish	0.023
Lanternfish and deep	0.035
Scorpionfish	0.048
Mojarra	0.073
Drums and croakers	0.094
Grunts	0.112
Small pelagics	0.559

(Vaquita Diet Composition. Morzaria-Luna *et al*. 2012)

The vaquita's natural diet will be matched as closely as possible through fisheries acquisition. Animals will be fed thawed, frozen fish held to the highest environmental and sanitary principles as outlined by the standard operating procedures of the NMMF, which are based on the US Navy Marine Mammal Program's operating procedures, as detailed below.

7.8.1 Fish storage

- All block frozen fish will be stored at temperatures of 0° F or below until thawed for feeding.
- Individual lots of fish in storage will be rotated in position to ensure minimal storage time.
- All boxes in storage freezers will be stacked at least 6 inches away from floor and wall surfaces and at least 8 inches away from the ceiling.
- Boxes will be stacked in such a manner as to minimise damage.

7.8.2 Fish handling

- All personnel will thoroughly wash hands with soap and water prior to handling fish.
- All surfaces that come in contact with thawing fish (sinks, weighing buckets, ration buckets, utensils, etc.) will be cleaned and sanitised prior to each use with approved agents and methods.
- At no time will fish intended for feeding be allowed to reach a temperature >40°F.
- When appropriate, block frozen fish will remain covered by the plastic box liners during overnight thaw in the preparation sinks with sink covers closed.
- Fish breakout and preparation times will vary depending on the outside temperature.
- Prior to final thaw, sinks will be rinsed of all residual liquid. Final thaw will then be performed with running cold water just prior to bucketing. Under no circumstances are fish to be thawed in warm water.
- IQF (individually quick frozen) fish will remain in the freezer and be thawed under running cold water just prior to bucketing.
- Individual animal rations (itemised by variety of fish species) will be carefully weighed and bucketed. Adequate ice will be layered into each bucket to ensure all fish remains below 40°F until fed.

- Only wholesome high quality fish will be fed, as determined by standard testing (proximate analysis, rancidity tests, microorganism evaluation). Contaminated fish (fish dropped on any nonsanitised surface such as boat, transport mat, floor, pens, etc.) and fish of poor quality (torn, freezer burned, mutilated, beheaded, soft bellied, or bad smelling) will not be fed.

7.8.3 Sanitation

- Fish preparation areas including floors, ditch drains, sinks, stoppers, weigh buckets, weighing scales, ice scoops, walls, outside areas of the ice machines, doors, and tables will be cleaned thoroughly every day following the completion of fish preparation and bucketing of rations.
- Cleaning will be done with antibacterial soap for all other surfaces and areas. Areas will be well rinsed with warm water after cleaning.
- Once cleaned, the above listed surface areas will be sanitised using a dilute hypochlorite (200 ppm sodium hypochlorite = ó ounce household bleach per gallon of water) solution on all surfaces. Following bleach application, surfaces will be allowed to air dry.
- Garbage disposal areas will be cleaned and sanitised following the completion of bucket washing at the end of each day.
- Appliances such as chest freezers and ice machines will be kept clean. The interior of the ice machines will be cleaned and sanitised per the manufacturer's recommended frequency.
- Cleaning items such as brushes and scrub pads will be rinsed with hot water and sanitised after each use.
- Personnel will wear sanitisable rubber gloves to help prevent disease transmission.

7.9 Gamete rescue (length of project)

In the event that a fresh-dead carcass is recovered (unrelated to this plan) or an animal dies (directly related to plan), immediate efforts will be undertaken to attempt to cryopreserve the animal's genetic material. For males, this will involve the immediate intact removal of the testes, epididymis and vas deferens at the junction of the trigone of the bladder. Care will be taken to not damage or cut any part of these structures during dissection from the body. The vas will be double ligated prior to excision to prevent loss of gametes through leakage. Once removed, each individual (right and left side) reproductive organ will be placed into zip lock bag (without air or liquid in the bag) and labeled with animal ID, side of collection (R or L), time of death and collection, air temperature at the collection sight, body temperature at the location of the testes prior to removal. Each bag will then be wrapped with 4 inches of paper towels and placed into a cooler without direct contact toward ice packs. Four to 6 ice packs will be placed at the bottom of the cooler and a minimum of 6 inches (13.2 cm) of insulation (paper towels &/or bubble wrap) will separate the testes from the ice packs. Temperature within the cooler at the level of the testes will be monitored during transport and not be allowed to drop below 10°C. The testes (hand carried for best results) will be transported to a designated laboratory for processing within 12 to 24 hours of collection. For females, immediately following removal from the animal, ovaries are wrapped in sterile gauze moistened with sterile PBS (at 19-21°C) or saline and placed in a 50ml tube/container/ziplock bag with additional moist gauze to secure the tissue in place. (label each as described for male specimens). Specimens will be placed in cooler with 2, -20°C Ice packs and 6 inches of separation between ovaries and ice packs. Temperatures will remain between 19 and 21°C during shipment to designated laboratory.

8.0 POST-RELEASE MONITORING (JUN – JUL 2018)

Primary Objective: Monitor vaquitas following release in order to ensure their survival and repopulation.

Key Decision Points:

- Intensive efforts will be made to monitor vaquitas for the first six weeks post-release, both remotely via satellite-linked telemetry and via direct observations.
- If the vaquitas appear to re-adapt to life in the wild without problems, subsequent monitoring will be continued remotely via satellite-linked telemetry.
- If telemetry data or direct observations suggest a vaquita is not thriving post-release, intervention will be considered.

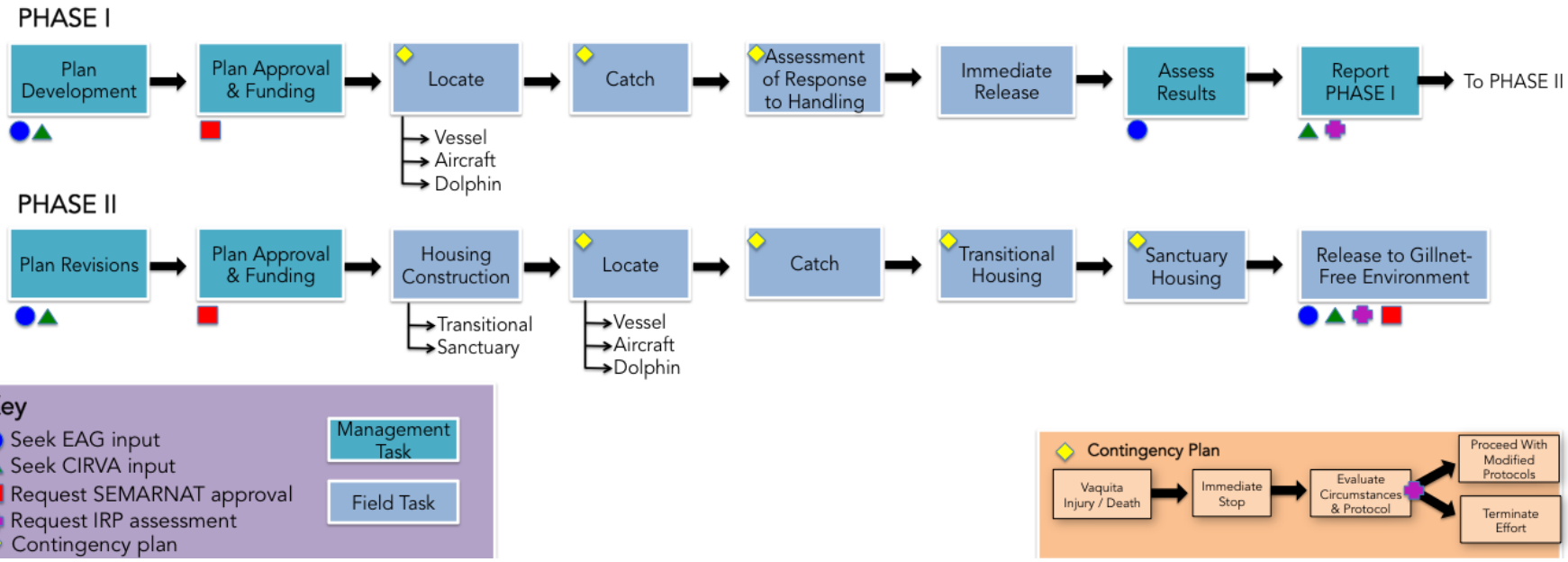
This objective, as described below, will only be implemented if key decision points are adequately addressed, per the project team leads and appropriate key personnel.

Each of the porpoises captured and held at the facility will be marked and tagged using well-tested techniques to facilitate post-release monitoring. DNA samples will be collected from the animals to provide a second means of confirming identification should the animals be recovered. Small, well-tested satellite-linked time-depth recording (TDR) tags (SPLASH, Wildlife Computers, Inc., WA, USA) will be attached to each vaquita to provide behavioral information, including ranging patterns, dive durations, dive depths, time at depth, and time at the surface. These tags are attached to the trailing edge of the dorsal fin by means of a single plastic pin. Slight variation in the position of each tag will allow identification of individual vaquitas even after the tags have been shed. Battery life is expected to be 2-4 months; when attachment screws secured into the plastic pin corrode, typically after the end of the battery life, the tag falls free from the fin.

Post-release monitoring will consist of daily remote tracking of the satellite-linked tags via Service ARGOS, and attempts to relocate tagged individuals in the field to assess condition. Duty cycles will be selected to optimise access to satellites each day. In the field, tagged individuals will be located via direct reception of signals from the tag, and/or the use of satellite phones to obtain updated location data directly from the ARGOS website or via a shore-based team. Direct observations will allow for assessment of condition of the animal (and the tag), its behavior, and fine-scale information on position with respect to other vaquitas, and potential threats. Overhead imaging of the porpoise from a UAS (drone) could provide additional information on condition.

Research on post-release monitoring of stranded/rescued cetaceans has shown that six weeks is a reasonable threshold for defining successful re-adaptation to life in the wild (Wells et al. 2013). We will apply this criterion to guide efforts to monitor the released vaquitas. Efforts to find and observe the tagged individuals will occur as often as is feasible within the first six weeks, depending on weather and logistical constraints. Individuals exhibiting unexpected behavioral patterns (as determined from tags or direct observations) or poor condition (from direct observation) will receive increased monitoring attention, and may be considered for re-capture, pending input from the IRP. Beyond six weeks, monitoring will be accomplished primarily via remote tracking.

PROGRAM FLOW CHART



TIMELINE

PHASE ONE	2016					2017						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1.0 LOCATE	X	X	X	X	X	X	X	X	X	X		
Determine effectiveness of locating vaquitas with aircraft			X									
Utilise small aircraft to locate vaquitas										X		
Determine usefulness of locating vaquitas with vessel-based surveys			X	X	X	X	X	X	X			
Utilise vessel-based surveys to locate vaquitas										X		
Determine usefulness of locating vaquitas with Navy dolphins	X	X	X	X								
Utilise Navy dolphins to locate vaquitas										X		
2.0 CATCH										X	X	X
3.0 SATELLITE TAG OPTION										X	X	X
4.0 SITE SURVEY		X	X									

PHASE ONE REVIEW & PHASE TWO REVISION PROCESS	2017		
	May	Jun	Jul
Consortium management team will review the results of phase one; determine if the plan should advance to phase two; and make appropriate adjustments and realignments to phase two.	X	X	
Consortium management team will present the results of phase one and the revised phase two plan to the independent review panel for input.			X
Revised phase two plan will be resubmitted to CIRVA for review and SEMARNAT for approval.			X

PHASE TWO	2017					2018						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
5.0 HOUSING	X	X	X	X	X	X	X	X	X	X		
Design and build transitional housing	X	X	X									
Tow to vaquita refuge for monitoring and evaluation			X	X	X							
Determine suitability and safety for vaquitas			X	X	X							
Option to hold Navy dolphins in transitional housing										X		
Design and build sanctuary and support facilities			X	X	X	X	X	X				
Place above-ground pools						X	X	X	X			
Determine suitability and safety for vaquitas										X		
Option to house Navy dolphins in sanctuary facility										X		
6.0 LOCATE, CATCH, & TRANSPORT										X	X	X
7.0 ANIMAL CARE	X	X	X	X	X	X	X	X	X	X	X	X
Post-catch health exams										X	X	X
Monitoring during & after transport										X	X	X
Routine health monitoring during housing										X	X	X
Monitoring for evidence of stress										X	X	X
Medical intervention										X	X	X
Emergency response										X	X	X
Feeding										X	X	X
Fish procurement, storage, and preparation						X	X	X	X	X	X	X
Gamete rescue (begins in Aug 2016)	X	X	X	X	X	X	X	X	X	X	X	X
8.0 POST-RELEASE MONITORING											X	X

CONSORTIUM MANAGEMENT TEAM

Role: The Consortium Management Team, serving as CIRVA's Steering Group for *Ex Situ* Conservation, developed the proposed plan with input from subject matter experts. Team Leads will oversee implementation of the plan, pending approval, adequate funding, and necessary permitting. Key Members will provide essential knowledge, skills, and resources for the proper execution of the plan.

EXPERT ADVISORY GROUP

Role: The Expert Advisory Group (EAG) assisted with development of the proposed plan. During implementation of the plan, the EAG will be called upon for input and guidance as a group or individually at critical times or when specific expertise is required.

INDEPENDENT REVIEW PANEL

Role: The Independent Review Panel (IRP) will be consulted to review any animal injuries, illnesses, or mortalities that are a direct result of the activities of this plan and make recommendations as to whether the plan should be modified, halted, or aborted. At the completion of Phase One, the Management Team will report to the IRP on Phase One results and planned revisions to Phase Two. The IRP will provide a critical review of the report and provide guidance on next steps, to include an opinion on whether Phase Two should be implemented.

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