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Commentary

Can the vaquita be saved from extinction?

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Abstract: The vaquita (*Phocoena sinus*) is considered the world's most endangered marine mammal. It is the smallest member of the porpoise family endemic to the upper part of the Gulf of California. The current population is estimated at <30 individuals. The primary reasons for the species decline includes limited habitat and incidental mortalities associated with illegal gillnet fishing activities. Since 2008, the Mexican government has taken environmental and economic actions to protect the vaquitas, focusing on reducing bycatch deaths to zero. In 2015, a federal agreement decreed by the Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación prohibited the use of any fishing gillnets for 2 years, severely affecting local human communities because coastal fisheries in the region represent 40% of the gross domestic product and 50% of the local inhabitants are devoted to this activity. Recently, an economic welfare compensation program is giving monthly to fishermen who have fishing permits if they do not continue with their fishing activities. However, none of these actions have fully considered the range of social and economic solutions for the local inhabitants of this region. The paradigms of the contemporary conservation programs must also focus on the well-being of local fishing communities to prevent the vaquita from becoming the second marine mammal species to disappear due to human activities.

Key words: artisanal fisheries, conservation, marine mammal, Mexico, natural protected areas, *Phocoena sinus*, porpoise, Upper Gulf of California, vaquita

Marine mammals are subject to high mortality from accidental capture or bycatch in fisheries (D'agrosa et al. 2000). Global bycatch of marine mammals likely numbers in the hundreds of thousands annually, mostly in gillnets, because they are relatively inexpensive to purchase and can be used in small vessels at little cost (Read et al. 2006). The extinction of the freshwater dolphin baiji (*Lipotes vexillifer*) endemic to the Yangtze River in China was due to fishery bycatches (Read 2008). Highlighting the need to reevaluate strategies intended to reduce marine megafauna bycatch, Senko et al. (2014) suggested more focus should be placed on the exploitation and commercialization of new local fish species, the transformation of the fishing gears supported by an adequate source funding (Read 2008), and long-term financial strategies to new job alternatives.

The vaquita (*Phocoena sinus;* Norris and McFarland 1958; Figure 1), is endemic to the Upper Gulf of California, and it is critically endangered because of its very small population size and the reduced range of its habitat (Jaramillo-Legorreta et al. 2017). The vaquita suffers from accidental deaths in gillnets because this species shares its habitat with several lucrative fisheries as the totoaba (*Totoaba macdonaldi*), which is highly desired because its bladder is in high demand in the Asian market (D'agrosa et al. 2000, Rojas-Bracho et al. 2006). A passive acoustic monitoring program conducted by the Comité Internacional para la Recuperación de la Vaquita (CIRVA; International Committee

Figure 1. Vaquita (*Phocoena sinus*) swimming in the Upper Gulf of California (*photo by P. Olson*).

for the Recovery of the Vaquita) in 2015 estimated that the entire world populations may consist of <30 individuals (Jaramillo-Legorreta et al. 2017).

The vaquita shares the area where fishermen from 3 Mexican communities, including San Felipe, Baja California; Golfo de Santa Clara, Sonora; and Puerto Peñasco, Sonora (Figure 2) fish for bigeye croaker (*Micropogonias megalops*), Gulf corvine (*Cynoscion othonopterus*), elasmobranchs and blue shrimp (*Litopenaeus stylitrostris*). The fishermen's gross profits are related to shrimp fishery, the most economically important fishery, followed by the Gulf corvine. These 2 resources provide employment for fishermen from September to April (Rodríguez-Quiroz et al. 2010). Income for 71% of the fishermen ranged from US$150–300 per week during the fishing season, and 87% stated that they received <US$100 per week in other activities when the shrimp and Gulf corvine season ends. These communities depend economically on these 4 fisheries, as alternative jobs are few and poorly paid (Rodríguez-Quiroz et al. 2010).

The World Wildlife Fund (WWF) in 2006 and the Centro de Investigaciones Biológicas del Noroeste in 2012 interviewed approximately 10% of the total fishermen in the 3 fishing communities. Approximately 60% of the fishermen in San Felipe, 50% in Puerto Peñasco, and 40% in Santa Clara stated that they would not stop fishing because it is the only activity in which they feel comfortable and have done for years (Rodríguez-Quiroz et al. 2010).

Redford and Taber (2000) and Knight (2006) argued that to achieve species conservation, all the related social, economic, and cultural communication issues must be addressed. In the case of conserving the vaquita, this implies the development of economically feasible alternative sources of income for the local inhabitants. This was not the case for the establishment of the biosphere reserve in the Upper Gulf of California, where fishermen's economic necessities and knowledge of the sea were not considered.

Afflerbach et al. (2013) analyzed all the buyout programs implemented in the region and reported that the programs were failing because they undervalued the role of fishing to the livelihood of the communities. The programs focused on changing the fishery activities by providing the fishermen with other economic activities such as tourism and grocery retail (Valdéz-Gardea 2010) without providing them the training needed to be successful in these new alternative jobs.

The Mexican Government has implemented several environmental and economic actions to protect the vaquita. These include: 1) creating the Upper Gulf of California and Colorado River Delta Biosphere Reserve (UGCCRDBR) in 1993 (Diario Oficial de la Federación [DOF] 1993; Figure 1); 2) creating the Vaquita Protected Area (refuge) in 2005, which limits fishing activities (DOF 2005); and 3) through the Secretaría de Medio Ambiente, Recursos Naturales (SEMARNAT), launching the Programa de Acción para la Protección de la Especie: Vaquita program (Program Action for the Conservation of the Species: Vaquita; [PACE]) in 2008 (Avila-Forcada et al. 2012), which was an economic and voluntary program that considered compensation for reducing the fishing effort through the elimination of shrimp driftnet and finfish gillnets (PACE 2008; Morzaria-Luna et al. 2012).

More recently, in 2015 the Mexican Government, through the Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA) promulgated the "agreement that commercial fishing is temporarily suspended using gillnets, formwork, and/or lines operated with small boats in the Northern Gulf of California." The agreement addressed 4 specific issues: 1) the expansion of the vaquita polygon (the area where the vaquita has been seen the most; see DOF 2005); 2) a 2-year closed season for all fisheries in the site, and providing a monetary compensation to the affected fishermen with fishing permits; 3) an increased enforcement to prevent illegal

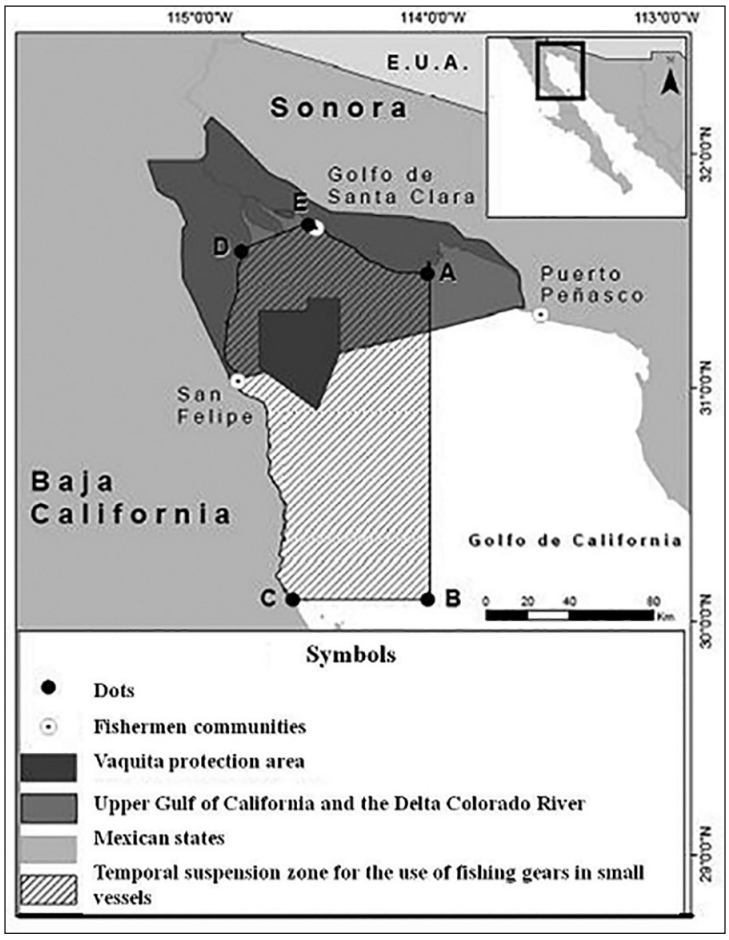

Figure 2. Location of the Biosphere Reserve of the Upper Gulf of California and Colorado River Delta and the new Vaquita (*Phocoena sinus*) Protection Area. Source: Diario Oficial de la Federación, April 10, 2015.

fisheries; and 4) the introduction of new and ecological gears (DOF 2015; Figure 1).

However, none of these cumulative measures have reversed the vaquita's population decline. Furthermore, these actions have resulted in reductions in fishermen employment and income (Morzaria-Luna et al. 2012) mainly because fishermen without permits and industrial fishery employees were not considered for the economical compensation. These restrictions did not consider catch revenue from other gears or alternative economic activities (Instituto Nacional de Ecología [INE]-WWF) 2006, Aragon-Noriega et al. 2010). The first management actions have not produced the desired conservation results because nobody (governmental and scientific authorities) anticipated that the new job alternatives and fishing gears could fail so unexpectedly.

The SEMARNAT agree-ment of April 2015 also did not fully consider a social and economic analysis of their conservation research strategies. Government buyout programs have to be adequately enforced so fishermen can find new alternative jobs related to their activity, emphasizing that fishermen are among the social groups in the primary sector with the highest socioeconomic problems and most of them are below the poverty line (Fernández-Carvajal 2013). Additionally, we observed that the lack of an inclusive vision of the human element in the design and act of these reserves by the government institutions has reached levels that encourage poaching of protected species, such as the totoaba, due to the lack of alternative livelihoods for fishermen, who are forced to perform other economic activities to complete their family income for their survival (Rodríguez-Quiroz et al. 2015).

Eliminating all mortality associated with bycatch is an imperative to avert vaquita extinction. We support the recommendations of scientific organizations such as CIRVA, which suggests that the Mexican Government must enact emergency regulations establishing a gillnet exclusion zone encompassing the full range of the vaquita that is wider than the existing refuge (Gerrodette and Rojas-Bracho 2011, CIRVA-VII 2017). We acknowledge these measures will exacerbate economic impacts that potentially lead to costly and socially divisive conflicts, particularly in regions that rely heavily on fishing or areas where alternative employment opportunities are poor (Mardle and Pascoe 2002).

Conservation and economic alternatives

Mexican authorities and scientific experts agree that the most immediate actions needed to prevent the extinction of the vaquita are effective enforcement of the fishing ban, continuous

removal of nets that evade the authorities, and the development and implementation of alternative light fishing gear (CIRVA-IV 2012, CIRVA-VII 2017), but these actions will not be fully implemented without changing the fishing culture of the inhabitants (PACE 2008, Rodríguez-Quiroz et al. 2010). To promote fishing culture change for a sustainable fishery in the region and the successful recovery of the vaquita, we make the following recommendations.

1. Adult totoaba could be available for sport fishing with the implementation of management units for wildlife conservation (UMAs) and supported by the Priority Species Recovery Program (PREP) as an alternative to prevent the illegal fishery of this species. The implementation of these programs will allow for the conservation of this species and its exploitation, and it will improve organized fishermen's welfare because fishermen involved in this activity will have benefits in the auction of the permits to fish the totoaba, as is done with the Mexican bighorn (*Ovis canadensis*) and the ejidatarios (Cariño et al. 2004). This will grant a better advantage for the exploitation of resources through controlled management with conservation of the natural resources in the UGCCRDBR (SEMARNAT 2008, Retes López et al. 2010). Recently, Chinese, Mexican, and U.S. authorities had a first meeting in Ensenada, México (SEMARNAT 2017) to implement measures to stop totoaba bladder commercialization (whose exploitation is banned [DOF 1975]), which is not supported by correct ecological fishing and trade guidelines in or outside of Mexico. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and other ecological trade programs like the Marine Stewardship Council could be an option to support the meat and bladder commercialization (Bellchambers et al. 2015).

The vaquita and totoaba share a wide range of common habitat. Thus, emphasizing the UMA program with the totoaba could result in a significant number of traditional fishermen who will change to totoaba sport fishing, reducing vaquita bycatches, and these fishermen will help to enforce regulations on the illegal fishermen, thereby further reducing vaquita bycatches.

2. New ecological or environmentally friendly fishing gears like "suriperas" (modified cast net) to fish marine species in the biosphere reserve, as suggested by the PACE program, must be given a high product value (Vaquita Safe label), so the use of such gears should equal the amount captured and product value of the marine products they fished with their current fishing gears (Balmori Ramírez et al. 2006, PACE 2008, Instituto Nacional de la Pesca [INAPESCA] 2011). Fishermen should not just receive financial support to change fishing gears (PACE 2008) because, as mentioned in CIRVA-IV (2012), "The conversion of the entire fishing fleet to vaquita-safe methods needs to be accomplished as soon as possible." But this has not been accomplished yet, and the "suripera" is more effective for brown shrimp than for blue shrimp (INAPESCA 2011), although the latter has a higher price in the international market (Godoy 2008).

3. Government and traders must invest to transform fishing products into high-value products so they can be widely commercialized by establishing long-term contracts with regional and international markets. Such action would reduce fishing effort because there will be well-paid employees in the fish market trade, and that will ensure sustainable fishing activity, particularly for the community of El Golfo de Santa Clara.

4. Even when PACE establishes that fishermen need new job alternatives, fishermen must be well trained in their new qualifications, because many fishermen do not have technical business skills or experience in tourism administration or any other alternative job outside of fishing. Also needed is financial insurance or funds supported by the national and international commerce chambers to prevent a massive return of fishermen to their previous activity, as it is for cattle and farming activity. Today, many of the new alternative jobs like tourism and aquaculture resulted in failures because fishermen were not trained and well-advised, as happened in San Felipe and Golfo de Santa Clara.

Conclusion

In summary, 2018 will be a crucial year for authorities to find a solution to the demise of the remaining vaquitas. The new agreement published in 2015 does not consider real complementary economic alternatives to support traditional fishermen when there is a

considerable local market for fish and shrimp. We are certain that the application of our 4 recommendations will help to save the vaquita from extinction. Fishermen must be involved in the conservation decision-making beyond being asked to change their fishing gears or increasing the fishing ban in the Upper Gulf of California area, and they must be well-trained and advised in their new alternative jobs.

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