New Technology and Market Incentives in the Conservation of the Vaquita *(Phocoena sinus)*

Ashley Nee

The Gulf of California harbor porpoise or "vaquita" is the most endangered cetacean in the world. Threatened with extinction by the use of gillnets, the development of a new lightweight trawl could prove to be the most promising tool for the vaquita's conservation. The complexity of socio-economic factors in the Upper Gulf of California and Colorado River Biosphere Reserve has tied fishing communities and vaquita conservation together in an antagonistic relationship. The application of market incentives provides a unique opportunity for collaboration and mutual gain. This paper explores the use of ecolabels as tools for conservation and envisions the development of a Vaquita-Safe ecolabel. Caveats, next steps, and project development are discussed.

Center for Marine Biodiversity & Conservation
Scripps Institution of Oceanography

Table of Contents

Introduction

The Gulf of California harbor porpoise (*Phocoena sinus*) or vaquita is the most endangered small cetacean in the world (Jaramillo-Legorreta *et al*. 2007; Rojas-Bracho *et al*. 2012). Endemic to the Upper Gulf of California and Colorado River Delta region (herein referred to as UGCRD), the vaquita is caught as bycatch in artisanal gillnet fisheries targeting demersal fish and shrimp (Fig. 1) (Díaz-Uribe *et al*. 2011). Conservation efforts to save the species began over thirty years ago however, the vaquita population has continued to decline (PACE 2008). This is at least in some part due to the presence on three fishing communities reliant on fisheries resources. Scientists unanimously agree that the only way to save the vaquita is through a total ban on gillnets, however such a ban would be devastating to the Upper Gulf economy and has consequently been met with heavy resistance (CIRVA 2012; Jaramillo-Legoretta *et al*. 2007). Estimates of the opportunity cost of forfeiting fishing activities within the Vaquita Refuge are $1.7 million U.S. dollars (Rodríguez-Quiroz *et al*. 2012). Expansion of this to the entire range of the vaquita would increase the estimated opportunity cost considerably. Thus, upon the recommendation of the Action Plan for the Conservation of the Species (PACE Vaquita) in 2008 the National Fisheries Institute (INAPESCA) began development of alternative gear that could substitute gillnets in the region. This search resulted in the RS-INP-MEX lightweight trawl. Recently a modification has been proposed to the Mexican national shrimp fishery law calling for a ban on gillnets in the Upper Gulf Colorado River Delta Biosphere Reserve, and replacing them with RS-INP-MEX. The gear will be gradually phased out over three years. Supported by Mexican conservation agencies and nonprofits, this change in fishing gear is widely unpopular among fishermen in the Upper Gulf. The latest confrontation in a history of antagonisms between the two sectors, the Mexican government is still debating the modification and a decision is expected in the coming weeks. In the event that the shrimp fishery law does change it will represent a win for vaquita conservation, however this is perceived by fishers to cause future economic losses.

Figure 1: Vaquita caught as bycatch in finfish gillnet (© National Geographic Stock/Flip Nicklin/Minden Pictures / WWF)

Poor enforcement and compliance of previous conservation measures has highlighted the need for a new approach in the Upper Gulf communities, one that considers the socio-economics of the region and can reach a win-win for the vaquita and fishers. An ecolabel presents an opportunity to reassess conservation and frame it as a positive that can benefit fishing communities. This paper seeks to examine the context in which the conflict between vaquita conservation and the fishing communities of

the Upper Gulf developed, provide information on the concepts of ecolabeling, and outline how a Vaquita-Safe ecolabel can redirect the dialogue towards cooperation and shared goals. While all three communities have felt the impact of conservation measures, this paper will focus on the community of San Felipe.

Background

The Colorado River Delta Biosphere Reserve

Recognizing the rich biodiversity endemic to the Colorado River Delta, the Mexican government established the Biosphere Reserve of the Upper Gulf of California and Colorado River Delta in 1993, covering an area of 934,756-25-00 ha, (CONANP 2007). The Biosphere Reserve has two sections, the nuclear zone at the mouth of the river, and the buffer zone. Fishing is only permitted in the buffer zone of the Reserve allowing spawning fish and shrimp to breed in the nuclear zone (Erisman *et al*. 2012; Rojo-Ramírez & Aragon-Noriega 2006). Managed jointly by the National Commission for Natural Protected Areas (CONANP), the Secretary of the Environment and Natural Resources (SEMARNAT), and enforced by the Federal Prosecutor for the Protection of the Environment (PROFEPA), the Biosphere Reserve is actively fished requiring collaboration with the fisheries sector. In conjunction with the Secretariat for Agriculture, Livestock, Rural Development, Fisheries and Nutrition (SAGARPA), Commission of Aquaculture and Fisheries (CONAPESCA), and the National Institute of Fisheries (INAPESCA), CONANP created a management plan for the natural resources in the area. In 2000 the Biosphere Reserve was incorporated into the National System of Protected Natural Areas (SINAP). Under public provision, the government formed the Agreement Establishing the Refuge Area for the Protection of Vaquita on September 8, 2005 (Fig. 2), a marine protected area (MPA) encompassing 1,263.85 km^2 explicitly prohibiting the use of gillnets (Gerrodette & Rojas-Bracho 2011; SEMARNAT 2008).

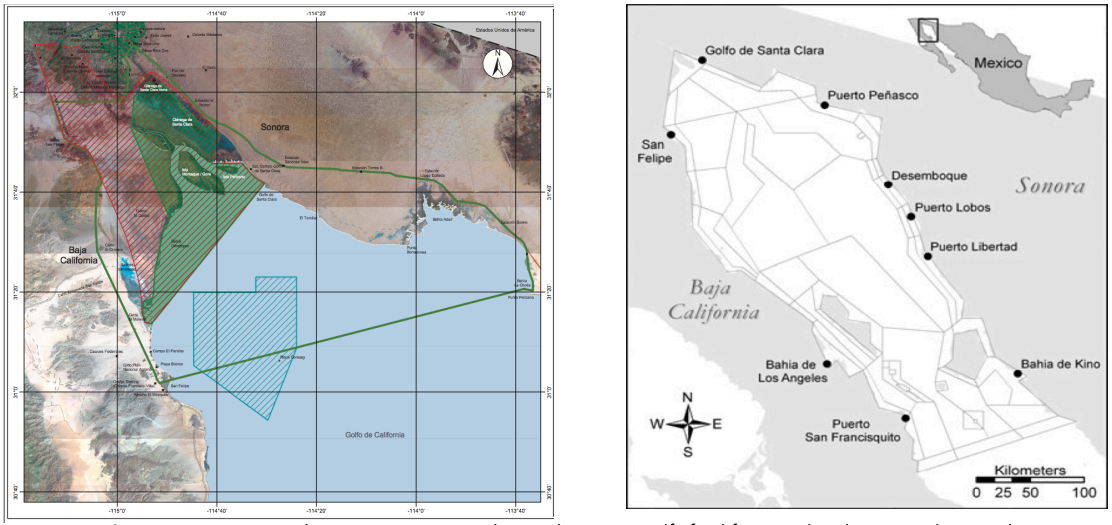


Figure 2: Above: UGCRD region. The green perimeter indicates the Upper Gulf of California Colorado River Delta Biosphere Reserve. Shaded green is the nuclear zone of the Reserve, red is a RAMSAR site, and the turquoise shaded area is the Vaquita Refuge (CONANP 2007) Right: Northern Gulf of California (Ainsworth *et al*. 2012).

Vaquita Conservation & Refuge

The vaquita population is concentrated around 2,235 km^2 near Rocas Consag to the east of the small fishing town of San Felipe (Fig. 3) (Rojas-Bracho *et al*. 2006). The species was first described in 1958 (Norris & McFarland 1958) and has had negative fishery interactions since at least the 1930s. The population was estimated to be 567 individuals in 1997, declining 7.6%/yr. to the 2008 estimate of 245, and reaching the current population estimate of 150 individuals in 2012. This rapid decline is largely due to incidental fisheries mortality (Avila-Forcada *et al.* 2012; CIRVA 2012; Gerrodette & Rojas-Bracho 2011; INAPESCA 2010).

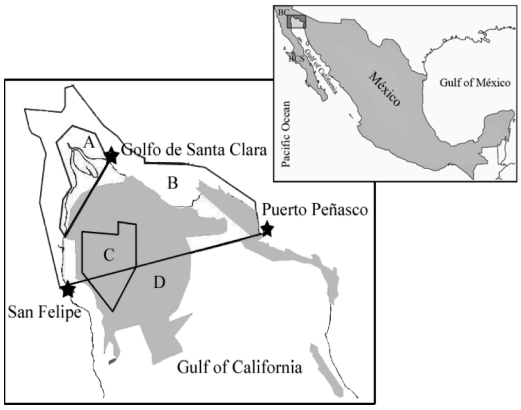


Figure 3: Map of Upper Gulf of California showing proximity of fishing communities to MPAs. A) Biosphere Reserve nuclear zone B) Biosphere Reserve buffer zone C) Vaquita Refuge D) Fishing grounds of three communities (Rodríguez-Quiroz *et al.* 2010)

Vaquita have a maximum population growth rate of less than 4% a year. Combined with a small population size, rare bycatch events affect a significant percentage of the total population and decrease chances for a positive survival outcome (D'Agrosa *et al.* 2000; Rojas-Bracho *et al.* 2006). Recognition of the vaquita's endangered status is evident in its listings in CITES Appendix I, IUCN Red List, and the U.S. Endangered Species Act, and nationally in Mexican NOM-059-SEMARNAT-2010 (D'agrosa *et al*. 2000; DOF 2010; Gerrodette & Rojas-Bracho 2011).

Despite the urgency of the vaquita's status, the difficulty of enforcement and limited ability of the government to deal with and balance environmental concerns with socio-economic factors has inhibited conservation efforts (Barlow *et al.* 1997; Vidal1993). Small-scale fisheries in the Northern Gulf have been growing since the 1980s with a current estimate of 1,600 pangas operating in the area (Moreno-Baez *et al.* 2012). In the UGCRD communities of San Felipe, El Golfo de Santa Clara, and Puerto Peñasco surrounding vaquita habitat, 46,000 people rely on the fishing industry (INAPESCA 2011).

San Felipe looks directly out to Rocas Consag and the vaquita refuge, making primary fishing ground directly in front of the town inaccessible. In 2011 the main species fished in San Felipe in order of tons of volume were: chano (*Micropogonias megalops*), sierra (*Scomberomorus sierra*), Gulf corvina (*Cynoscion spp.*), and blue shrimp (*Litopenaeus stylirostris*). San Felipe also has the highest catch of blue shrimp in the region, an important economic input whose interest has traditionally conflicted with the conservation agenda (Fig. 4). Blue shrimp is the most profitable

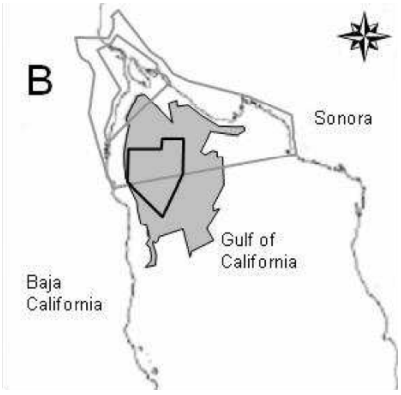


Figure 4: Shaded area represents spatial distribution of San Felipe SSF fleet. Survey data and GIS analysis suggest shrimp fishing occurs within 97% of the Vaquita Refuge (Quiroz-Rodríguez *et al.* 2012)

fishery in San Felipe and was worth $5,176,521 U.S. dollars in 2007 (Rodríguez-Quiroz *et al.* 2012). Overall, Upper Gulf fisheries are in a state of decline with fishers "unlikely to engage in any conscious management effort if they do not believe it will bring some benefit in the future" (Cudney-Bueno *et al*. 2009, p. 215).

Ecolabels

Growing consumer awareness about the environmental impact of our purchasing decisions is changing the way we view food and inform markets. Consumers in developed countries have become more aware about issues such as sustainability, ethics, and quality in regard to seafood, creating demand-side forces that are effecting change in the market place. This effect is expected to increase with a growing middle class in the developing world (Hall 2011). According to Jacquet and Pauly (2007) the extent to which we alter the marine environment is demonstrated by tastes and preferences that mirror changes in marine ecosystems. "Fishing down marine food webs" (Pauly *et al.* 1998; Sala *et* al. 2004) has been described extensively in the literature and highlights both the need for sustainable fisheries management and responsible consumption.

Fish population declines have forced us to redefine our concept of the abundance of the sea and its seemingly unlimited resources. Stocks can take decades to recover and ecological consequences of harmful fishing practices are often slow to manifest and irreparable (Myers and Worm 2003; Worm *et al*. 2006). Consumer education campaigns have been successful initiating a dialogue connecting what we eat to where it came from. The Slow Food movement, organics, localvores, and fair trade are all examples of how consumer ethics can create niche markets.

There is increasing need for clarity and transparency in the information we are provided about our seafood. The lack of reliable information available about the origin of seafood and the manner in which it is caught led to the creation of ecolabels and certification schemes that provide fishery information to make informed decisions. Functionally, ecolabels allow consumers to make decisions about the products they buy based on specific attributes advertised on the label.

Ecolabel vs. Certification

Generally speaking, seafood ecolabels tend to be voluntary while certification differs in that it is usually government mandated in accordance with regional fisheries management organizations to ensure legal harvest (Wessells *et al.* 2001). The goal of mandatory product certification is to prevent IUU fishing, in accordance with the FAO International Plan of Action, and as such does not necessarily include a consumer component. Private certification schemes for seafood (the Marine Stewardship Council, MSC) and environmentally friendly goods (Rainforest Alliance) are becoming more prevalent in the market place (Fig. 5). In the case of private certification, the certifying body is third party and conducts evaluations based on defined parameters. These certification schemes are voluntary and often have an accompanying ecolabel to distinguish products that have passed the certification process in the

marketplace. Of particular importance to certification schemes is the tie-in with management objectives, enforcement, and issues of non-compliance.

Figure 5: Examples of certified ecolabels: Rainforest Alliance (left) and Marine Stewardship Council (right).

The International Organization Standardization (ISO) groups environmental ecolabels into three categories. Type I environmental ecolabels are voluntary, multi-criteria, life-cycle assessments conducted by a third party, under which a vaquita ecolabel would fall. Type II labels are self-declared and Type III give quantified product information in accordance with pre-set indices. These labels can be further specified and divided into first, second, and third party labels. First party labels are a self-declared set of standards created and used by a single company. Second party labels are created by an industry association and applied to its members. Verification is conducted internally or through an external contract. Third party labels are created by an external initiator, usually in response to consumer demand and separate from the industry, which licenses its label to producers that meet label criteria (Wessells *et al*. 2001).

Ecolabels function based on principles of the economics of information. Seafood, including shrimp harvested by San Felipe's artisanal fleet, is defined as an "experience good", as quality is determined by the experience of the actual product (taste, texture, aroma, etc.). Sustainable or environmentally responsible seafood is a "credence good". Credence goods, as defined by Caswell and Mojduszka (1996), have quality attributes that cannot be experienced or searched for without additional information. By providing the necessary information to allow consumers to compare products and product qualities, ecolabels have the ability to shift environmental aspects of seafood from a credence good to a search good (Wessells *et al*. 2001). Increased information about origin, fishing method, stock health, and farmed fish allows consumers to differentiate between otherwise experientially equivalent products. The value added by this information can be reflected in price premiums. It has been demonstrated that there is a consumer willingness to pay for additional product information. Particularly in the instance of credence goods, in which the attributes of the product cannot be ascertained prior to or after consumption, consumers are willing to pay more for inclusion of information that can allow them to distinguish between products and make informed decisions.

MSC Certification

The process required for MSC certification includes a pre-assessment, full assessment, comment period on established indicators, and final decision. Completion of the assessment does not guarantee that a fishery will be certified. The fishery can be certified, rejected if they don't score adequately against the indicators, or gain conditional certification dependent on addressing areas of concern. Certified fisheries are audited every five years to ensure continued compliance with MSC's principles of

sustainability (Ponte 2008). The significant cost of the certification process, particularly that of MSC, can be prohibitive to small fisheries or low value stocks (Sainsbury 2010). The WWF, in an attempt to make MSC certification more attainable works with SSF through their Community Fisheries program. In addition the MSC created their Developing World Program to provide a forum for developing countries.

In 2004 Mexican red rock lobster was the first community-based fishery to be certified by the MSC. In order to help pay half the $60,000 cost of certification funds were contributed by the WWF and Mexican government. Despite the significant financial investment required, the MSC certification of the fishery increased its national stature and led to increased government support. Interestingly, 90% of lobster caught in the fishery is sold live in Asia. As previously mentioned, Asian markets are not responsive to environmental product attributes and consequently MSC certification did not lead to price premiums (Pérez-Ramírez *et al*. 2012). In this respect the U.S. market as the primary consumer of shrimp from San Felipe is important in pursuing price premiums. Consumers, retailers, and the U.S. government are interested in fisheries that conserve biodiversity and maintain healthy stocks and are historically responsive to eco-friendly products. While the MSC is not a perfect system for sustainability certification, it has demonstrated benefits and can provide strong incentives for sustainable fisheries management.

Non Stock-based Ecolabels: Dolphin/Tuna and Turtle/Shrimp

Both dolphin-safe tuna and turtle-safe shrimp are examples of mandatory, government-backed ecolabels enforced through strict trade measures (Fig. 6). The practice of encircling dolphins by tuna purse seiners in the Eastern Tropical Pacific (ETP) and corresponding high levels of dolphin bycatch caused U.S. Congress to adopt the Marine Mammal Protection Act (MMPA) in 1972. In its current form the MMPA allows the U.S. to embargo tuna products that do not meet marine mammal bycatch requirements (Joyner & Tyler 2010). The 1991 Dolphin Protection Consumer Information Act (DPCI) established conditions for the protection of dolphins in purse seine fisheries and criteria for the use of voluntary dolphin safe labels. In 2001 the Agreement on the International Dolphin Conservation Program (AIDCP) set forth specific guidelines for tuna fleets operating in the Eastern Tropical Pacific (ETP) with the goal of reducing dolphin bycatch associated with the fishery (Wessells *et al*. 2001).

Similarly in 1989 the U.S. amended the Endangered Species Act (ESA) to include Section 609 requiring foreign nations to certify that their shrimp was caught in a manner that didn't harm endangered sea turtles. Such certification was a prerequisite to access to the U.S. market. In order to satisfy the law foreign fleets would have to use turtle excluder devices (TEDs), which allow sea turtles to escape trawl nets. Several countries objected to Section 609 before the World Trade Organization (WTO) causing the Earth Island Institute to create their turtle-safe ecolabel. Unlike the dolphin-safe ecolabel a turtle-safe ecolabel was never widely used. Through negotiations the U.S. was able to form agreements with the nations filing the complaint, upholding the use of TEDs in shrimp fisheries that import to the U.S. (Hunter *et al*. 2007).

Figure 6: Earth Island Institute Turtle-Safe ecolabel and official U.S. Department of Commerce Dolphin-Safe label (© Earth Island Institute & U.S. Department of Commerce

In both instances the government took action to ensure that products entering the U.S. met national environmental laws. In the case of turtle/shrimp, the certification program did not result in an ecolabel. Dolphin/tuna on the other hand has been a more contentious case in the WTO and resulted in the prolonged use of the dolphin safe tuna label. Both instances are marked differences from private sector ecolabeling and certification schemes, as they required changes to U.S. law and policy as well as prevent the importation of any shrimp or tuna products that do not meet U.S. bycatch reduction standards.

Small-scale Fisheries

There is some difficulty in defining the difference between small-scale fisheries (SSF) and artisanal fisheries. Indeed, the two are often used interchangeably to define both small fishing vessels as well as fishers who use traditional methods for subsistence and non-commercial fishing (WWF 2008). It should be noted that neither small-scale nor artisanal fishing precludes commercial activity. Jacquet and Pauly (2008) define small-scale fisheries as those operating boats less than 15m length, with a tendency toward greater economic efficiency due to the use of less gasoline and reduced bycatch. Perhaps surprisingly, SSF catch the same amount of fish for human consumption as industrial fisheries while receiving a fraction of the subsidies (Jacquet & Pauly 2008). Generally defined SSF tend to be multi-species, mixed gear, have various landing sites, and both subsistence and commercial uses. Both SSF and artisanal fisheries tend to be data deficient, as they are often not included in fishery management plans, or are noncompliant due to lax enforcement or ignorance of regulations (Sainsbury 2010). However, this does not mean SSF are by definition more sustainable or environmentally friendly.

Using the above definitions, the fisheries of San Felipe, El Golfo de Santa Clara, and Puerto Peñasco are best described as small-scale. Fishers use open, fiberglass boats called *pangas* about 6 – 8 meters in length with 55 – 150 horsepower outboard motors, a variety of gear, and employing two to three individuals for operation (Moreno-Baez *et al*. 2012). All three communities sell their catch to local, regional, national, and international markets. In Mexico the federal government under CONAPESCA and housed within SAGARPA manage all marine and inland fisheries (Gillet 2008). In the UGCRD fisheries are managed and enforced jointly by CONAPESCA and PROFEPA, especially when fishing is done within the Biosphere Reserve and Vaquita Refuge.

The nature of small-scale and artisanal fisheries makes ecolabeling and product certification difficult for them, putting them at a possible disadvantage in the growing market for sustainable seafood. Mainly, many lack management plans that meet the standards of certifying bodies and the enforcement and monitoring to ensure continued stock health. According to the FAO report on ecolabeling, well managed fisheries have measures in place to prevent overfishing of target or bycatch species, threaten any species with extinction, and plans for the recovery of threatened species (Sainsbury 2010). While many artisanal and SSF do not have management plans in place, it is arguably precisely for this reason that they should be targeted by sustainable fishing certification schemes that can conduct extensive assessments and make recommendations (Ponte 2008). Small-scale fisheries in the UGCRD are covered under the national shrimp fishery law NOM-002-PESC and the Conservation and Management Plan for the Biosphere Reserve putting them in a good position to respond to recommendations from a third party auditor or certifying body.

There remains a need for capacity building and support for SSF to reach sustainability and be included and certification and ecolabeling schemes. In particular the use of different metrics should be considered, including local knowledge, risk-based assessment methods, resilience, empirical indicators, and traditional and/or community based management systems (Ponte 2008; Sainsbury 2010).

Small-scale Shrimp Fleet of San Felipe: The history of management

The fisheries of San Felipe function under *de facto* open access utilizing multi-gear methods (Ainsworth *et al*. 2012; Díaz-Uribe *et al.* 2011). The blue shrimp fishery is the most lucrative with a minimum price per kilo of $170 – 220 pesos (US$14 -18) (Díaz-Uribe *et al.* 2011; López & Mascareñas 2012; SBS 2012). Blue shrimp from the UGCRD is considered Jumbo, signifying a count of 21 to 25 shrimp per pound. Blue shrimp is known for its sweet flavor, firm texture, and light blue tint when live or fresh. Blue shrimp and white leg shrimp (*Litopenaeus vennamei*), which is also found in the Gulf of California, are the preferred species in the U.S. for consumption and are often mixed together and sold along with brown shrimp (*Farfantepenaeus aztecus*) as Western white shrimp (Briggs 2005; Gillet 2008). Every season the Upper Gulf produces an average of 851 tons of shrimp, the majority of which is blue shrimp (INAPESCA 2011). Harvest is divided between San Felipe with 220 permits, El Golfo de Santa Clara with 423 permits, and Puerto Peñasco with 8 permits (CEDO 2012).

Fishing has steadily increased due to rising national and international demand and the panga shrimp fishery is considered at overcapacity with many exports bound for the U.S. and China (SBS 2012). This increase may also be accounted for by government policies and weak management that fail to prevent illegal fishing and poaching within protected areas (Cudney-Bueno *et al*. 2009). A study by SAGARPA and INP in 2001 found that Pacific (including the Gulf of California) stocks of *L. stylirostris* are depleted (Guillet 2008). Sustainable seafood advisory groups such as the Environmental Defense Fund (EDF) and Monterrey Bay Aquarium's Seafood Watch echo this finding.

Fishery and Conservation Interactions

The Mexican government has implemented numerous strategies for the conservation of the vaquita, employing command and control fisheries management and direct and indirect conservation measures. Two command and control fishing standards, NOM-012-PESC-1993 prohibiting the catch of the endemic totoaba (*Totoaba macdonaldi*) and vaquita, and NOM-002-PESC-1993 which regulates shrimp fishing, introduced time-area closures and gear restrictions with the goal of conservation, while NOM-059- SEMARNAT-2006 identifies both species as at risk of extinction (CEC 2008; DOF 1994; 2013). In 2002 the Secretary of the Environment and Natural Resources (SEMARNAT) published the Emergency Mexican Standard NOM-EM-139-2002, prohibiting the use of trawls, trammel, and gillnets with mesh size larger than 6 in. in the buffer zone of the Upper Gulf of California and Colorado River Delta Biosphere Reserve and requiring the trawling fleet to use turtle excluder devices (TEDs) (SEMARNAT 2008).

In 2008, the Mexican government introduced PACE-Vaquita, a Species Conservation Action Plan for Vaquita, the first comprehensive protection and recovery effort for vaquita, which included efforts to reduce over-capacity in the panga fishery with buy-out, switch-out, and rent-out programs. However, it was found that fishers who exited the fishery were at retiring age or had other economic opportunities (Avila-Forcada *et al*. 2011). This is potentially due to the cultural significance fishing holds in the UGCRD. A social analysis conducted by Rodríguez-Quiroz et al. (2012) found that 56% of UGCRD panga fishermen would continue to fish regardless of extensive fishery closures.

The unpopularity of the Vaquita Refuge amongst people working within the fisheries sector can predominantly be explained by its location within the fishing grounds and its proximity to San Felipe. While most fishing effort has shifted to areas closer to the coast, the Vaquita Refuge includes prime fish habitat and represents the closure of an economically important area. Sparse enforcement cannot cover the entire area of the refuge, let alone the entire Biosphere Reserve.

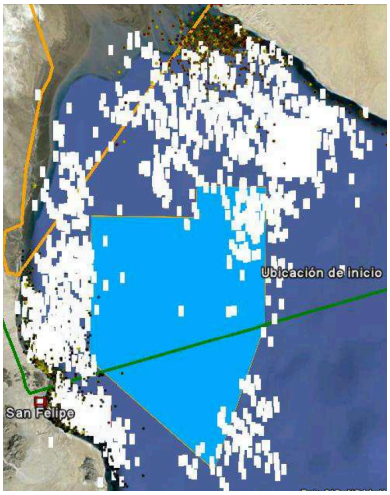


Figure 7: One-day composite of maximum fishing effort around the edges of the Vaquita Refuge in the 2008-09 shrimp season, based on observer data, courtesy of Daniel Aguilar (CIRVA 2012).

Non-Compliance & IUU Fishing

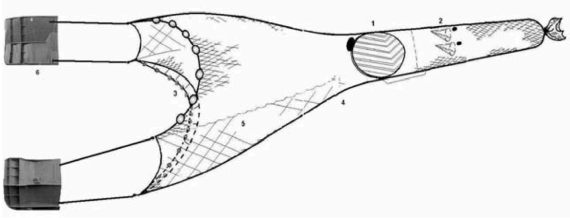
Non-compliance and illegal, unreported, and unregulated (IUU) fishing are issues that undermine both conservation efforts as well as attempts by fishing collectives to move toward sustainability. Reports show shrimp fishers continue to set nets in the Vaquita Refuge (Fig. 7) (INAPESCA 2011)). In their 2012 report CIRVA included information from Daniel Aguilar of the Mexican National Institute of Fisheries

(INAPESCA), stating that fishermen continue to use gillnets up to 2,500 m long and often set multiple nets at a time.

Fishers themselves identify the problem of IUU fishing as a major concern (Aragón-Noriega *et al*. 2010). In a survey of all Mexican fisheries Cisneros-Montemayor et al. (2013) found that IUU fishing represents 40-60% of the national catch, and that actual landings are almost twice as high as those reported to the FAO. PROFEPA recently arrested several men illegally fishing totoaba with gillnets 600m in length (PROFEPA 2013). Totoaba swim bladders or *buche*, as they are locally known, are used in a traditional Chinese soup and have a black market price of US$2,000-5,000 per kilo with most being exported to China and Hong Kong (http://www.latimes.com/local/lanow/la-me-ln-fish-smuggle20130425,0,1293538.story; PROFEPA 2013). The high price paid for totoaba *buche* creates a strong incentive to behave illegally, particularly when the price is compared with a legally harvested *buche* from corvina (*Cynoscion othonopterus*) that sells for US$56 /kg (Abaroa Silva 2012; http://www.quiminet.com/productos/buche-seco-de-pescado-11871711074/precios.htm). Despite the declining state of Gulf fisheries, the potential gains from overfishing, low probability of enforcement, mismanagement, and free riders has actually incentivized unreported catches (Cisneros-Montemayor *et al.* 2013). Furthermore, fishers are not adequately informed about the harm caused by fishing practices and are motivated by self interest to increase profit (Bobadilla *et al.* 2011). Non-compliance with gillnet fishing regulations combined with IUU fishing places additional pressure on the vaquita population, increasing the likelihood of bycatch while possibly skewing estimated mortality, as well as interfering with responsible fishery management efforts.

Development of Alternative Gear

In October 2008 the Mexican National Commission of Fisheries and Aquaculture (CONAPESCA) announced that it would begin testing experimental lightweight trawls, prototype RS-INP-MEX (Fig. 8) known locally as *changos*. The RS-INP-MEX includes a TED and a "fish eye" to reduce bycatch of finfish. It is suggested that the TED could allow for a vaquita to escape in the event that it enters the net (CIRVA 2012). Tests of RS-INP-MEX conducted during 2010-2011 shrimp fishing seasons compared the effectiveness of RS-INP-MEX and *chinchorros de línea* (traditionally used gillnets) over 21 days of fishing, 610 trips, and 2,076 sets (Fig. 9) (INAPESCA 2011).



1. "Super Shooter" turtle excluder devise
2. "Fish Eye" bycatch reduction devise
3. Second footrope lader with rubber rollers
4. Knotless webbing pannel made of polyethylene high tenacity fibres
5. Mesh size gradient along the net (wing=3", body=2 1/4"; end= 2")
6. Hydrodynamic stainless steel trawl doors

Figure 8: Illustration of the prototype RS-INP-MEX for industrial trawlers. For small-scale fisheries the trawl doors (6) are replaced by lightweight fiberglass (Aguilar-Ramírez & Rodríguez-Valencia 2010)

While the RS-INP-MEX reduces bycatch of vaquita, the issue of bycatch remains for other species. The composition of fisheries

catches is divided between target species (that meet stipulated management requirements) and bycatch. Bycatch is the unintended capture of non-target species (i.e. outside the fishery) that are incidentally caught and can further be distinguished as commercially viable bycatch and discards. Commercially viable bycatch are species that are not directly targeted in the stated fishery, but that have a market value and are retained for sale. Discards are species of no commercial importance that are thrown overboard, including commercially viable species that do not meet size requirements. Generally speaking, the less discriminate the gear used, the higher proportion of bycatch that is caught.

EFFORT				SHRIMP CATCH Kg			BYCATCH Kg		
Location	Pangas	Trips	Sets	Blue Shrimp	Brown Shrimp	Total	Commercial	Discard	Total
San Felipe	95	455	1,365	158.62	2,361.41	2,520.03	7,010.00	7,787.00	14,797.00
Santa Clara & Puerto Peñasco	31	205	711	337.30	924.60	1,261.90	730.00	4,755.00	5,485.00
Totals	Sets		2,076	Shrimp Catch		3,781.93	Bycatch		20,282.00

Figure 9: Effort and catch results from RS-INP-MEX testing during the 2009/2010 season (INAPESCA 2011)

Like any trawl, RS-INP-MEX risks ecological trade-offs such as, increased bycatch of non-commercial benthic invertebrates, non-commercial fish, and juveniles of commercially important fish species. Of particular concern to fishers in the Upper Gulf small-scale shrimp fisheries is the species composition of shrimp caught using the RS-INP-MEX. Tests of the RS-INP-MEX yielded a total shrimp catch of 3,781.93kg. The results show a reduction in the catch of blue shrimp (495.92kg) and an increase in the less valuable brown shrimp (3,286.01kg) (Fig. 9). On a finer time scale the tests found that, on average in October, 80 kg/day of brown shrimp were caught while the average blue shrimp catch in November was 7 kg/day. In comparison with gillnets, RS-INP-MEX has a 66% reduction in catch of blue shrimp. It should be mentioned, the aforementioned tests were conducted when longer gillnets were in the water, limiting the maneuverability of the RS-INP-MEX, reducing the testing area, forcing their use at night and possibly altering the efficiency of capturing shrimp. Commercially viable bycatch was 7,740kg while discards were 12,542kg, creating a bycatch ratio of roughly 5.36:1 kg shrimp (INAPESCA 2011).

In their economic analysis of various scenarios of gear changes, INAPESCA factored an overall loss for fishers with the use of the RS-INP-MEX (INAPESCA 2011). The practice among fishers of using illegally lengthened gillnets could falsely inflate the average profits and widen the gap of profitability between gillnets and RS-INP-MEX. A 1.3 km long gillnet can cover 1,690 ha/hour versus the RS-INP-MEX which covers three ha/hour, signifying that gillnets can cover 563 times more area than the RS-INP-MEX (Aguilar-Ramírez & Rodríguez-Valencia 2010).

In comparing gear selectivity it is important to consider the bycatch of industrial trawls used in the Upper Gulf. However, comparisons of bycatch and efficacy are difficult as bycatch is affected by season and geography (Aguilar-Ramírez & Rodríguez-Valencia 2010). In his 2011 study, Dr. Calderón-Aguilera of the Center for Scientific Research and Higher Education, Ensenada (CICESE) analyzed data from 514 trawl sets from the 2010-2011 shrimp fishing season. The sets recorded 24,091 organisms caught as bycatch from 134 species, weighing 2,107.5 kg. Twenty-two species made up 80% of all bycatch, of which twelve have commercial value. Shorthead lizardfish (*Synodus scituliceps*; 220 kg), grouper (*Epinephelinae*), common searobin (*Prionotus ruscarius*; 178 kg), Haller's round stingray (*Urolophus halleri*; 145 kg), bluestreak drum (*Elattarchus archidium*; 134 kg), Gulf corvina (*Cynoscion othonopterus*; 128 kg), darkedge midshipman or Gulf-saddled toadfish (*Porichthys anlis*; 123 kg), squid (116 kg) bigeye croaker or chano comprised 50% of the total biomass (Calderón-Aguilera 2011). In general their study found the bycatch ratio of commercially viable bycatch to blue shrimp to be 5:1 kg and 20:1 kg for discards. The Intercultural Center for the Study of Deserts and Oceans (CEDO) is currently conducting a study on the bycatch of traditional gillnets. This important study will provide comparative information on the ecosystem impacts of the gear.

NOM-002-PESC-1993

On February 8, 2013 the Secretary of Agriculture, Livestock, Rural Development, Fisheries and Alimentation (SAGARPA) and SEMARNAT published a plan to modify the shrimp fishing law (NOM-002-PESC-1993), identifying the RS-INP-MEX as the only net than can be used to fish shrimp by the artisanal panga fleet. Fishing is prohibited in the nuclear zone of the Biosphere Reserve and the Vaquita Refuge. The revision also calls for time-area closures and the implementation of catch limits and bans (DOF 2013; Sarmiento 2013). In response to the publication, fishers and their elected representatives have been vocal in their concern about the loss of jobs and income. The San Felipe Federation of Shrimp Fishing Cooperatives submitted a comment requesting the use of gillnets longer than 200 m length and outboard motors with more than 115 hp. The Secretary of Fisheries and Aquaculture of Baja California reiterated the request for gillnets longer than 200 m (the Secretary requested 800 m length). All requests for increased fishing effort were denied by INAPESCA. CONANP successfully submitted a revision stating the RS-INP-MEX is suitable for use in the buffer zone of the Biosphere Reserve, and gradual elimination of gillnets in the buffer zone of the Biosphere Reserve. The proposed plan calls for 30% of gillnets to be removed from the buffer zone and replaced by alternative gear in the first two years. The third year the remaining gillnets will be replaced, making use of gillnets in the buffer zone prohibited from that time on (DOF 2013). What remains to be seen is if the passing of the NOM will affect actual effort and not incentivize IUU fishing.

To remedy serious economic losses, modifications to the RS-INP-MEX need to be made to increase output of the good (i.e. blue shrimp) simultaneously decreasing the bad (i.e. bycatch, increased catch of brown shrimp). The risk of extinction means that there can be no vaquita mortality (i.e. vaquita quotas). An alternative is to find a mechanism to absorb the opportunity cost of using less effective

gear. The popularity of sustainable seafood has been harnessed by non-profits who have increased pressure on fishers to adopt sustainable fishing practices (Catalina Lopez, personal communication), making ecolabeling an attractive solution.

San Felipe Shrimp Market Systems

San Felipe fisheries function within a cooperative system that sells the catch as a group to processing plants and buyers. In considering a Vaquita-Safe ecolabel it is important to consider the existing infrastructure how shrimp will move through the system, ensuring that traceability is maintained. The current shrimp market is dominated by local buyers who set the prices based on the current market and act as intermediaries between the cooperatives and larger processing plants throughout Baja and Baja Sur (Fig. 10) (SBS 2012). The primary difficulties of fishers in San Felipe are financing and entrance into new markets. Fishers who prioritize finance seek government aid to help them break their dependence on local buyers while those who want entry into new markets are less interested in aid. Currently the greatest problems affecting fishers in the UGCRD Biosphere Reserve are IUU fishing and unregulated entry into the fishery (SBS 2012).

From 1998 – 2010 the production of blue shrimp in San Felipe has averaged 500 tons a year. With two high years in 2006 and 2007, the production of shrimp declined to around 242 tons in 2010. In San Felipe shrimp is 21/25 or Jumbo shrimp with a price range of $170 – 220 pesos depending on size (roughly $15 - $18 US dollars). Whole Foods market sells Ocean Conservancy rated green, jumbo wild shrimp from the U.S. at $19.99/lbs.

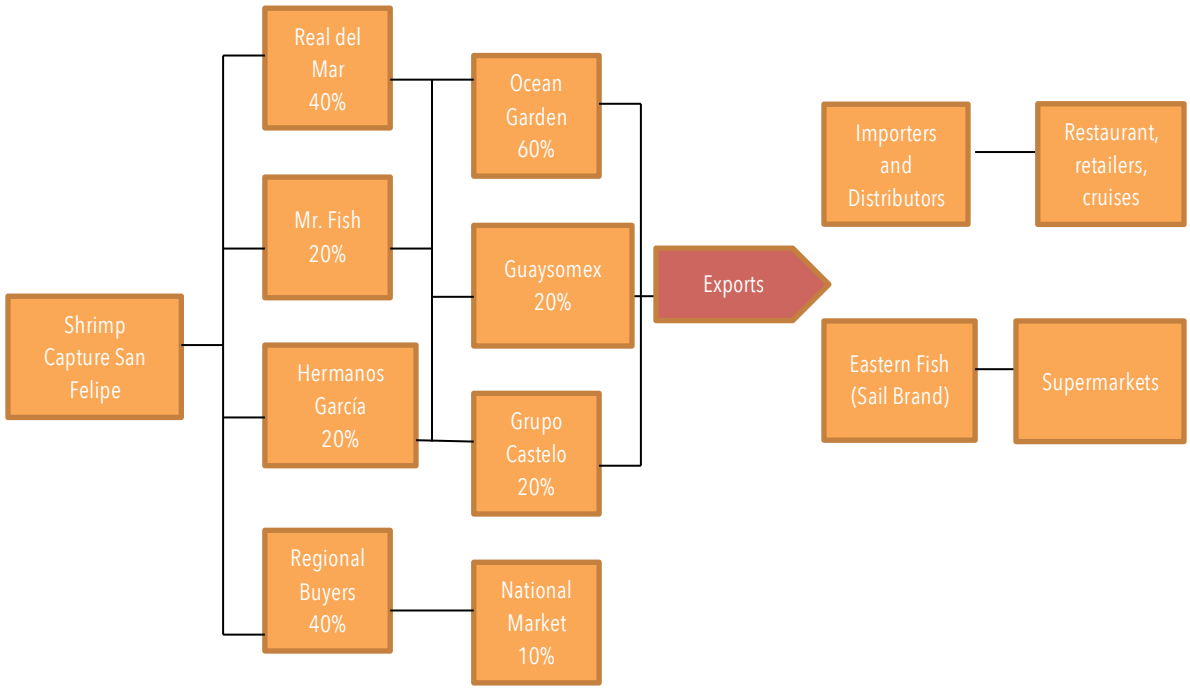


Figure 10: Production Chain of San Felipe shrimp fishery

Buyers

Currently buyers finance fishers, allowing buyers to set the buying price, regardless of the market value of the product. This is done in two ways: through provisioning in which buyers finance the purchase of essential tools and items for fishing such as nets, weights, paint, repairs, etc. Financing is offered for exclusive rights to the catch brought in during the season, requiring collectives or permit holders to use designated regional or local buyers. Local buyers are either processing plants or marketing companies. Another practice is consignment. In this system shrimp is purchased at 87.5% of its market value, while the remainder is divided with 7.5% used to cover the cost of transportation, promotion, and sales while 5% is used to cover costs when the price is low or in the case of premium prices (SBS 2012).

Processing

In San Felipe there are three processing plants (Fig. 11). *Hermanos Garcia* processes 30% of the shrimp and has the capacity to store between 140 and 160 tons of seafood, compete with a landing and shipping area. The plant produces whole shrimp with the head and tail, head-on and shell-on, and shelled headless shrimp in 5lbs. blocks. *Real del Mar* processes 40% of the shrimp and is the largest processor. The plant has the capacity to store 300 tons and is USDA certified as well as certified to export to Europe, Asia, and Russia. The plant produces whole head-on and shell-on shrimp and head-less shrimp with shell in 5lbs. blocks. The smallest plant is *Mr. Fish*, which processes 20% of the shrimp in San Felipe and is owned by a local buyer.

Processing Plant	Percent of SF Catch Processed	Storing Facilities (tons)	Shrimp Products	USDA Certification
Real del Mar	40	300	Head-on/shell-on; headless/shell on	Yes
Mr. Fish	20	n/a	n/a	No
Hermanos Gonzalez	30	140 - 160	Whole; head-on/shell-on; shelled/headless	No

Figure 11: Capacity of processing plants of San Felipe (SBS 2012)

Two main buyers have been buying shrimp from the San Felipe panga fleet for the past XXX years. Until 2011, Ocean Gardens was the largest buyer of shrimp but began to reduce its presence in 2012. In previous years they had used the three local processing plants. A second large buyer is Golsomax, the business arm of a Santa Clara fishing cooperative of the same name, which uses Mr. Fish and Real del Mar processing plants. In 2012 they reportedly bought 50% of the shrimp in San Felipe, filling in the gap made by Ocean Gardens. Regional buyers are from Mexicali, Tijuana, and Ensenada and shrimp is nationally distributed in the markets in Guadalajara and Mexico City.

Affiliation	Cooperatives	Pangas	% Shrimp Catch
Federation	12	242	82.9
Unaffiliated Cooperatives	8	52	11.8
Permit Holders	n/a	20	6.3
Total	20	314	100

Figure 12: Percent share of total shrimp catch in San Felipe (SBS 2012)

US Market

The US shrimp market is the most valuable in the world known for its stable prices, with a worth of $5 billion dollars in 2011. Mexican shrimp occupies sixth place for U.S. imports with a value of $289 million dollars (SBS 2012). Americans eat more shrimp than any other seafood item, averaging 4 lbs. per person (NOAA 2010). Processors add value to shrimp products predominantly for supermarkets while distributors sell products to industrial food services (i.e. restaurants, hotels, etc.). The most important preparation of shrimp in the US is peeled frozen, making up 37% of the market worth $1,939,519,732 US dollars in 2011. This is followed by headless shell on (HLSO) with 38% of the market share, and other frozen forms making up 18% of the market (SBS 2012).

Vaquita Ecolabel

A premium price on Vaquita-Safe shrimp would create a market incentive for compliance with fisheries laws and reduce the opportunity costs associated with alternative gear and reductions in the more valuable blue shrimp species. Currently local providers (i.e. San Felipe, El Golfo de Santa Clara, & Puerto Peñasco) are bearing the cost of conservation through loss of direct use values provided by the marine environment. An ecolabeling scheme could therefore reconcile localized cost with the non-market benefits gained in developed countries. Price premiums and market benefits that reach the producers (fishers) is dependent on the consumer perceived utility of consuming a product that has no vaquita bycatch (Gudmundsson & Wessells 2000). This relates directly to education campaigns that inform the general public about the seafood trade, lack of regulation, and actual costs of consumption.

Beginning in August a third phase of testing of the RS-INP-MEX net will begin in San Felipe. The WWF reports that they have swapped out 56 gillnet permits for RS-INP-MEX (Sarah Mesnick, personal communication). Participating fishers will use RS-INP-MEX in field tests, making a supply of blue shrimp available early in the market season that is observer guaranteed free of vaquita bycatch. As an INAPESCA program in conjunction with the WWF observers will be present on pangas. The availability of this shrimp presents a unique opportunity to explore the value-add of shrimp that does not produce marine mammal and turtle bycatch.

In addition to the nets that will be used in the new trial period, there are already a group of fishers operating the RS-INP-MEX to whom a Vaquita-Safe ecolabel could benefit. The goal of the proposed ecolabel is to provide a positive incentive for quicker adoption of alternative gear (and abandonment of

gillnets). A price premium and access to the environmentally conscious U.S. market is important for fishers to see a tangible benefit to endangered species conservation. The vaquita's existence value hasn't previously been accounted for. Policies for the conservation of the vaquita (establishment of the MPA and buy-out) laid the cost of those efforts on fishers.

Before any employment of an ecolabel for Vaquita-Safe shrimp, it must be made explicitly clear what the ecolabel covers. A Vaquita-Safe ecolabel would be a single-issue label solely related to the bycatch of vaquita. Reduction of vaquita bycatch will be resolved by the use of the alternative gear; however the ecosystem impacts of the RS-INP-MEX compared to those of gillnets is still being assessed. The sustainability of the blue shrimp fishery in the UGCRD is the long-term goal of fisheries management but at this time stocks are indicated to be in decline and need of management action.

Due to the risk of vaquita bycatch in gillnets the Vaquita-Safe label would not be extended to fisheries using gillnets. While an observer program could potentially verify that shrimp caught in gillnets is vaquita free, providing the ecolabel to these fisheries would eliminate the incentive to switch gear. Additionally, in the event that a vaquita was caught, the catch could not be verified complicating the buying and processing process. Furthermore, the presence of observers is dependent on funding from NGOs and donors. As it stands most interest are in the conservation of vaquita, making outside funding unlikely.

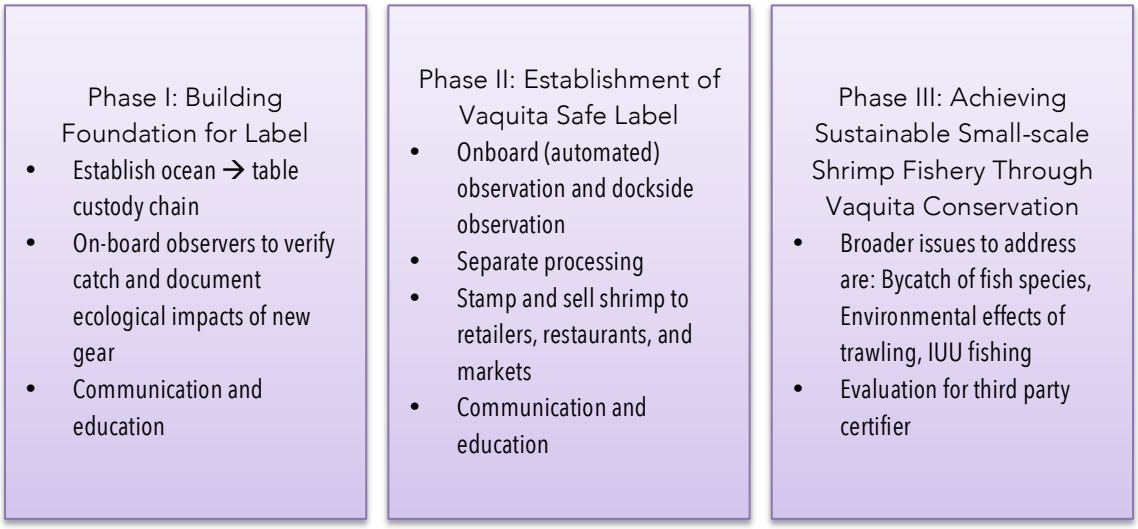


Figure 13: Phases of development for vaquita ecolabel

Introduction of Vaquita Ecolabel: Truth, Traceability, and Transparency

The long-term goal of the Vaquita-Safe ecolabel is to promote a new philosophy of fishing in the region based on truth, transparency, and traceability. Rolled out in three phases (Fig. 13) each phase will have a main deliverable: 1) the creation of partnerships with U.S. sustainable seafood buyers and suppliers 2) recognition of the vaquita safe ecolabel by non-profits and a listing as a "good alternative" or

"yellow" on sustainable seafood lists 3) expansion of the ecolabel to El Golfo de Santa Clara and Puerto Peñasco, and shift of focus to broader sustainability issues in the fishery.

Phase I

Phase I of the ecolabel will begin in the summer of 2013 during the testing period of the RS-INP-MEX. Testing of the gear by fishers will provide a small amount of Vaquita-Safe verified shrimp. Because the testing period is only during the month of August, there will not be an adequate and consistent supply of Vaquita-Safe shrimp to sell to large distributors. Promotional focus should thus be in Southern California. Similar to events held in the past, partnerships and one-off dining events with chefs and restaurants will provide "buzz" for Vaquita-Safe shrimp and introduce more people to the vaquita and concept behind the ecolabel. However, unlike previous restaurant events, the WWF and other groups should be encouraged to cast a wider net, so to speak, making the events less exclusive. While the price of jumbo shrimp connotes a demographic that is fairly well to-do, the goal of the fist phase is educate as many people as possible about the vaquita. More accessible events that focus on quality, local, and environmentally conscious food in a relaxed atmosphere a lá farmers markets, food trucks, taco stands, mom and pop restaurants etc., will not only increase the profile and visibility of Vaquita-Safe shrimp, but it will also allow people from the communities of the UGCRD to participate and interact with people enjoying their product.

Events should include a communication and educational component, engaging guests on the broader topics in sustainable seafood and bycatch. This should be complimented by a media campaign directed at international audiences, aimed at increasing consumer awareness of vaquita conservation and highlighting the history of the community and conservation efforts taken by San Felipe fishermen.

During this initial phase an ocean to table chain of custody will need to be established. Shrimp will have to be kept separate prior to processing while post-processed shrimp will need to have a label attached. Processed shrimp is frozen in five-pound blocks and then packaged for shipment. Packages will be sealed with the label and shipped to U.S. wholesalers who can display the label to their customers. A list of restaurants buying Vaquita-Safe shrimp can be provided on whole seller websites and promoted in-store.

Chain of Custody and Traceability

Chain of custody certification is important for a Vaquita-Safe label, ensuring that certified shrimp is not mixed with other shrimp. The processing of shrimp caught using RS-INP-MEX or other alternative gear that prevents the bycatch of vaquita should utilize the existing framework of fishing collectives and processors. Verification could be by shrimp collective, however the necessity of unanimous agreement and the current unpopularity of the RS-INP-MEX make its adoption by an entire collective unlikely. Under the law, all fishers must weigh their catch upon landing it. Typically fishers bring their catch to their collective at the dock where everything is weighed together, an initial sort is conducted for quality,

and shrimp are trucked to the processing plants. Rather than grouping their catch with the rest of the collective's batch, fishers using the RS-INP-MEX could weigh their shrimp in a separate designated area. Dock-side observers can then record the fishers collective association when they come in, weigh the shrimp and record the catch for the collectives' records, and send all Vaquita-Safe shrimp to the processing plant to be processed together. The total RS-INP-MEX catch will be recorded and broken down into percent catch per collective. Money can be sent to the collective by processers who then distribute to the fishers recorded in the observer logbooks. Processed shrimp could then be stamped and sold to buyers as Vaquita-Safe, with the goal of passing the label on to the eventual, individual consumer. Ideally, this would be accomplished through agreements with a processor/buyer such as Mr. Fish or a co-producer deal with a US company that is capable of handling imports such as CleanFish.

The outcome of phase I will be the creation of partnerships with a group of retailers and buyers that have the capacity to work within the San Felipe market system. In California there are several wholesalers who specialize in sustainable and/or local seafood who are aware of the issue of vaquita bycatch and are familiar with Gulf of California shrimp. Catalina Offshore Products and CleanFish have worked with Gulf of California fishers previously and are familiar with the market chain. Building on the knowledge of these companies, which have established company philosophies and a base clientele, a fair price can be negotiated. Phase I and II will likely start small, building momentum in the first two years as the majority of fishers will still be using gillnets and the vaquita ecolabel gains traction.

Phase II

Phase II of the ecolabel will take place from 2013-2017 after the implementation of NOM-002-PESC. During this period gillnets will be sequentially replaced by RS-INP-MEX, switching out 30% the first and second years and 40% the final year. Verification will be conducted by camera systems that ensure correct use of alternative gear, compliance with fishing regulations, and no vaquita bycatch. Depending on the number of fishers that adopt the new net in the season, and hence the supply of shrimp, sale of Vaquita-Safe shrimp can be expanded, supplying retailers and restaurants more consistently. Reports on sales of the ecolabel can be used to sharpen communication, promotion, and marketing, promote participation and feedback from fishers, and enlists new participants into the program. Recognition from federal agencies such as SEMARNAT can help to foster national pride while promotional support from non-profits can increase support internationally. Ideally, the introduction of the new gear and observer program will allow San Felipe Vaquita-Safe shrimp to gain recognition from sustainable seafood entities such as the aquarium of the Pacific, highlighting the efforts of fishers to become more sustainable.

Phase III

At the end of Phase II (end of 2017) a survey should be conducted on the status of the vaquita population. In conjunction with a growing vaquita population efforts should shift towards establishing a sustainable fishery in the UGCRD region. Using the vaquita ecolabel as a positive example of how

conservation and fisheries interest can dovetail, initiatives can be developed by fishers to identify the greatest barriers to sustainability and threats to long-term profitability. This will require participation from all three fishing communities and will need to address issues such as: bycatch of finfish species in the RS-INP-MEX; environmental impact of continued trawling; non-compliance and IUU fishing; and enforcement. In addition to government and NGO support, exploration of sustainable seafood certification should be considered to capitalize on previous media campaigns and recognition of the vaquita ecolabel and UGCRD communities.

The World Wide Fund for Nature (WWF) and MSC

Important to consumers is the credibility of the certifying body (Wessells *et al*. 1999). While there has been ample criticism of the MSC from fisher groups and academics alike, there are several reasons why MSC certification would be beneficial (Ponte 2008; Jackson paper). First, MSC is a globally recognized ecolabel easily identified on "consumer facing" products. The extensive regulations for use of the ecolabel ensure that customers who buy MSC certified products are aware of the scope, mission, and intention of the ecolabel (MSC 2013). This is possibly the most powerful attribute of the MSC is it is a certifying agency as well as powerful ecolabel. The requirement of capital investment from the entire market chain ensures buy-in and defense of the label against fraud. Adoption of the MSC label by huge cooperate conglomerates including WalMart, McDonalds, and Whole Foods are evidence of consumer demand for responsibly produced seafood. Evidence suggests that the MSC ecolabel and certification scheme has proven economic benefits, an objective that has eluded other ecolabels (Philips *et al*. 2003). Furthermore, as a MSC certified fishery, San Felipe and UGCRD shrimp could be distinguished from other wild-caught Mexican shrimp which is currently on the Red lists of the Monterrey Bay Aquarium's Seafood Watch, EDF, Ocean Conservancy, Oceana, Aquarium of the Pacific, and other responsible seafood programs. There are only eight shrimp fisheries certified by MSC, none of which fish for *L. stylirostris* or other premium, large species of shrimp (http://www.msc.org/track-a-fishery/fisheries-in-the-program/fisheries-by-species/fisheries-by-species#shrimp-prawn). Most of the MSC certified shrimp fisheries use otter trawls signifying that a trawl doesn't necessarily preclude a fishery from MSC certification. The current RS-INP-MEX is only the first iteration of alternative gear options in the UGCRD region. As more tests are conducted and fishers become familiar with the new technique there is possibility for adjustments and further innovations. Other forms of small-scale shrimp fishing can also be explored upon assessing the ecosystem impacts of continued trawling by pangas.

As a founding member of the MSC, the WWF has had a demonstrable impact on seafood sustainability worldwide. As the largest international conservation organization the WWF has a tremendous membership and existing social network to aid SSF in the funding process for MSC via their Community Fisheries Program. However, attitudes towards the WWF by fishers tend to be negative due to the major role the WWF has played in promoting vaquita conservation to the Mexican government. Their heavy involvement in modifications to NOM-OO2-PESC, development of RS-INP-MEX, and buy-out

programs has made them unpopular with fishers who feel that the WWF has pushed for a conservation agenda that has undervalued the participation of the fisheries sector.

Promotion

Finding appropriate means of communication that demonstrate value and utility of products to unreached customers can extend existing markets. In the case of the vaquita, which is unfamiliar to most consumers, the task is not only educating people about it's threat of extinction but also the utility of a Vaquita-Safe purchase. Vaquita-Safe ecolabel should be viewed as an informative aspect of the product but is not sufficient to be deemed a marketing tool. Traditional marketing's role is to identify consumer's needs (i.e. seafood) and convince them that a given product (i.e. Vaquita-Safe seafood) is the best way to satisfy that need. The strength of this approach to promoting an ecolabel is that it is able to "transform consumer need into product specific wants" (Rex & Haumann 2006, p. 573). Expanding marketing to include messages relevant to non-green consumers is essential to create market growth (Rex & Hausmann 2006).

There is a need for market information regarding the willingness of U.S. consumers to purchase "vaquita safe" shrimp at a premium price. Specifically this information should account for willingness to pay based on no vaquita bycatch rather than the status of the stock and whether or not it is being managed sustainably. Recent campaigns have begun to educate consumers about the severe effects of trawling on the benthos as well as the potential hazards and environmental degradation due to aquaculture, specifically shrimp farming in open ponds. A frank and honest approach will be necessary when promoting the RS-INP-MEX. Results from CEDO's bycatch study will play an important role is educating consumers on the different types of gear and ecological tradeoffs between gillnets, the RS-INP-MEX, and industrial trawls. Additionally a distinction can be made between small-scale fishers and large commercial trawlers that explores socio-economic matrix such as employment, cultural values, etc.

Price Premium: What Vaquita-Safe Buys

There are many existing products that leverage environmental campaigns and attributes to gain purchasing power. Campaigns such as FEED (http://www.feedprojects.com/) and 1% for the Planet (http://www.onepercentfortheplanet.org/en/) are designed to include fundraising in the cost of the product. FEED LLC works in partnership with the United Nations World Food Program to provide funds for the School Feeding Program. Donations are built into the price of bags and other products where a number displayed on the products quantifies the impact. 1% for the Planet is a group of business owners that agree to donate 1% of their revenue to environmental groups. Similarly, a price premium placed on Vaquita-Safe shrimp would be used to make up the difference in income suffered by fishers using the new net (Fig. 14).

Shrimp Size	Current Price of Jumbo Shrimp	Price per ton	10% Price Premium	10% Price Premium/ ton	24% Price Premium	24% Price Premium/ ton	Total Production of San Felipe @ 10% Premium	Total Production of San Felipe @ 24% Premium
21/25	$18 – 19	$18,000	$19.99 – 20.99	$19,990	$23.50	$23,500	$999,500	$11,750,000

Figure 14: Price premium scenarios for UG blue shrimp based on 2013 costs of jumbo blue shrimp in markets

Caveats

While ecolabels are a useful policy and market tool for environmentally friendly practices, they should not be considered a golden bullet. Studies of forestry products found that while there isn't evidence of economic benefits of certification, there are more intangible benefits such as human capital and improved forestry management (Blackman & Rivera 210).

The vaquita conflict, unlike the dolphin-tuna issue, is unknown to the general public. Despite being a charismatic mammal, there are little to no possibilities for direct human interaction. Vaquitas are shy and the sediment heavy waters of the Upper Gulf make opportunities for underwater footage limited. The experiential qualities of shrimp caught from gillnet and from prototype RS-INP-MEX are identical, making the preservation of vaquita the sole reason for buying a certified product.

It is also significant to mention that previous labeling schemes based on the ecological impacts of a fishery versus the health of the actual exploited stock were both remedied through the application of U.S. law and trade sanctions requiring the use of new gear and fishing methods that significantly *reduced*, not eliminated, bycatch of species of interest. Both the tuna/dolphin and shrimp/turtle cases are examples of trade sanctions used to implement U.S. environmental policy. The effectiveness of these trade measures made "dolphin safe tuna" a de facto ecolabel, as any tuna imported from the ETP is required to use the back down method. This is equally true for turtle safe shrimp through the implementation of trade embargos against fisheries that don't use TEDs. The importance of both of these points is that the ecolabeling is a reflection of policy and gear changes that were mandated by the U.S. government and not a reflection of consumer willingness to pay for an ecolabeled product. In the case of San Felipe, the mandate for new gear is coming from the Mexican government in order to protect a national endemic species. In this case trade sanctions by the U.S. government would be counter-productive as conservation measures and fisheries policy are being adapted to eliminate vaquita bycatch. U.S. trade sanctions against Upper Gulf of California shrimp would shift the market to Asian countries such as China and Japan where environmentally responsible fishing is less of a priority.

The goal of a Vaquita-Safe label is to encourage responsible behavior along the production chain of shrimp products. The failure of a Vaquita-Safe ecolabel to take hold in the market or the formation of negative sentiment about Mexican wild-caught shrimp could drive the market towards Asia where very few consumers purchase according to environmental issues and sustainability (Jacquet & Pauly 2007). Asia consumes two thirds of the world's seafood and is the second largest importers of San Felipe shrimp after the U.S. (SBS 2012).

Label reliability is a valid concern with ecolabels as a study conducted by Kangun et al. (1991) showed more than 50% of environmental labeling was misleading or deceptive. Wessells et al. (1999) found that consumers are less willing to pay for frozen ecolabeled seafood. However, the Johnston et al. (2001) study on the economics of information found that consumers, when faced with a certified seafood alternative, would choose the certified product over uncertified seafood. This effect may put Vaquita-Safe shrimp from the Upper Gulf at an advantage over other shrimp sold due to the lack of environmentally friendly shrimp options available.

Success Story for Gulf of California Shrimp

In the U.S. there exist a market for responsibly trawled shrimp from the Gulf of California. CleanFish (www.cleanfish.com), a company based in San Francisco works with aquaculture and wild caught fisheries producers to promote their responsible fishery products in the U.S. and Europe. Acting as a broker, co-producer, and advisor, CleanFish has created the CleanFish Index, used to assess the practices and state of a fishery, while their Ecological Advisory and Vetting group works with producers to create best practices for a responsible fishery. Products are sold to distributors, markets, and some restaurant groups under the CleanFish label or under distinct labels created with the producer. A hopeful example of this is Fisherman's Daughter shrimp from Guaymas, Sonora in the Gulf of California. Fisherman's Daughter shrimp is produced by a group of industrial trawlers using the RS-INP-MEX. The Valcer family made initial contact with CleanFish and negotiated business dealings. As participants in the Packard Foundation's Sustainable Shrimp Initiative, the Valcer's had gone through the appropriate training for RS-INP-MEX and had observers onboard satisfying the vetting and responsibility index required by CleanFish. After the completion of the project, CleanFish continued to purchase from trawlers using RS-INP-MEX using the honor system rather than observers to verify the catch. As a co-producer of Fisherman's Daughter, CleanFish buys directly from the fishers and does not need to use a middleman. Somewhat discouraging is the difficulty in obtaining a price premium. CleanFish uses the Urner Barry Comtell service to determine their pricing with $0.25 markups considered a very good price.

Discussion

The creation and success of a vaquita safe ecolabel is 100% dependent upon the use of alternative gear that doesn't have vaquita bycatch. In this sense what is at stake with the revisions to NOM-002-PESC-1993 become clear. While there is a group of fishers in San Felipe already using the RS-INP-MEX, this gear cannot be used at the same time as gillnets in the water. Fishers' clear preference for gillnets, their higher margin of profitability, lower overhead costs, and relative ease of use make a mass voluntary shift to a new form of fishing more than unlikely. While the proposed change to the shrimp fishery regulation is more stick than carrot, the ongoing hostility between fisheries and conservation interests highlight the need for increased stakeholder involvement and exploration of socio economic factors that are not traditionally considered in conservation policy.

In this conflict both sides are heavily invested in the outcome as each has something tremendous to loose. The goal of this proposal is twofold: to use blue market incentives to help save the vaquita and support fishermen in a transition to ecologically sustainable and profitable fisheries. A disconnect between the regulations imposed for vaquita conservation and direct benefits received by fishers via healthier fish stocks, stronger fisheries enforcement etc. has caused conservationists and vaquita related regulations to be viewed with hostility. There is a need to shift perceptions and introduce the existence of vaquita as a valuable commodity. The existence value of vaquita has previously been unaccounted for. Fishers see the direct economic benefit of harvesting large quantities of shrimp and are incentivized to increase yield. On the other hand they have yet to see environmental groups, NGOs, and individuals literally put their money where their mouth is and show, through their purchasing decisions, exactly how much the vaquita is worth.

In this way the vaquita can be used to bring about positive change for the fishery rather than the closing of it. If fishers can learn the value of preserving the vaquita and the boost it gives to their product, perhaps in the future there will be greater collaboration between seemingly disparate interests. The introduction of demand-side interest in sustainable and/or responsible fishing practices in San Felipe can aid in the elaboration of better management and increase stakeholder involvement. As a stakeholder group with considerable collective power, fishers have the potential to influence the formation of national fisheries policy. If the economic gains of certification, ecolabels, and strong enforcement of management plans can be made visible to fishers there will be greater incentive to work together with scientists and federal agencies to develop strategies that not only ensure the continued health of Mexican fish and shrimp stocks, but also gain international recognition for responsible fisheries. Focus and efforts can then be shifted from vaquita to tackling IUU fishing, non-compliance, and better enforcement. The aim is to see the continued existence of the vaquita as well as the communities that make the Upper Gulf their home.

A successful vaquita ecolabel could be used to increase participation in the gear switch in El Golfo de Santa Clara, which has had low participation in trials of alternative gear and has been very vocal in

opposing constricting regulations. An isolated community, El Golfo de Santa Clara is wholly reliant on fishing as its main economic activity. Alternative livelihoods that have been explored in San Felipe such as tourism and sport fishing are not viable options for El Golfo de Santa Clara. Consumer demand for a vaquita safe ecolabel and the possibility for a higher ranking on sustainable seafood lists have the possibility to demonstrate not only ecological benefits but also prove that environmentally friendly practices can be profitable. Fisher to fisher knowledge exchange can be used in workshops where San Felipe fishermen share their techniques, best practices, tips, and advice on use of the RS-INP-MEX with fishermen from El Golf de Santa Clara. Workshops can also include business skills and educational resources for public commenting and participation in government processes. Collaboration between the UG communities is necessary to return commercially important stocks such as blue shrimp and corvina to healthier levels. While the current focus is on shrimp gillnets for the conservation of vaquita, there remains the task of looking at the system as a whole and the efficacy and ecosystem impacts of finfish gillnets and possibilities for alternative gear in those fisheries. The issue of noncompliance should be addressed on a regional level and different management approaches explored.

It is the role of NGOs to support the Upper Gulf communities in the pursuit of sustainability goals. This is particularly true for the WWF, which has been a presence in the communities for years. With their involvement with MSC program and their Community Fisheries Project, the WWF is poised to re-establish their commitment to conservation and sustainable livelihoods. Other national and international non-profits can work to introduce the concepts of environmental economics and the green market to fishermen, underlining the possibility for financial gains and/or market access. Emphasis should be placed on marketing strategies, negotiation, basic finance, promotion, and value-added products. This would provide producers and local buyers the necessary skills to compete on the international market. Non-profits can also offer support for much-needed funding so that the Mexican government, scientists, fishermen and conservationists continue exploring alternative gear, and establish monitoring and evaluation programs. Within the governmental system non-profits can provide expertise and lobbying power to pursue national policies in-line with strong and healthy fisheries that meet national and international standards.

Educational campaigns and communication will play an important part in the shift towards a sustainable fishery and success of a vaquita ecolabel on both sides of the border. In the U.S. non-profits play a key role in educating their members and initiating widespread media campaigns that highlight environmental issues. There is much that needs to be done to inform the U.S. public about the existence of the vaquita, threats to its survival, and what the fishermen in Mexico are doing to address these issues. By making a direct connection between consumption, conservation, and the fishers who are working to make a change, there is an opportunity to present conservation as an individual action that has a tangible impact. Connecting consumers to producers is a growing trend in the food sector and an area that needs to be elaborated upon in seafood. Moving beyond the vaquita, it is important that U.S. consumers identify the UGCRD as an area with good fisheries management and enforcement.

By highlighting the efforts of San Felipe, El Golfo de Santa Clara, and Puerto Peñasco as they move towards sustainability, consumers can actively seek out their products on the market and support them in the transition.

Communication and collaboration techniques for scientists and stakeholders are areas that can be elaborated upon in all UGCRD communities. Sustainable fisheries require sound scientific data. Fishers have a wealth of knowledge that can be used to establish baselines and narratives as well as aid in the collection of species biological data. Relationships between scientist and fishermen can be fostered through transparency and data sharing. An excellent example of collaborative research is the Gulf of California Program, a group that includes the participation of scientists from Scripps Institution of Oceanography, UCMEXUS- University of California Riverside, and Mexico. Together the group works to generate and communicate information in a collaborative manner with scientists, fishermen, government groups, NGOs, and other interested parties (http://www.gocmarineprogram.org/). Opacity and gaps in reporting have hindered trust and allowed rumors to flourish. Shared information allows for clarity in communication and equality during negotiations. Availability of scientific data to all interested parties encourages trust and the formation of long-term partnerships that can inform management and conservation measures built upon mutual respect.

In the broader context, ecolabels have the potential to change the way consumers view seafood and make their purchasing decisions. Informed consumers can increase demand for seafood products that are more environmentally responsible. In response, retailers and wholesalers can use their massive buying power to seek out fisheries that meet the environmental criteria of their clients. Leveraging a vaquita safe label to gain traction in the green market, the fisheries of the UGCRD can position themselves in the expanding sustainable seafood sector. This in turn can have a positive impact in the communities of the UGCRD beyond those working in the fishing sector. Evidence from the MSC certified red rock lobster fishery in Baja California indicates sustainability certification can empower fishing collectives, increase negotiating power, government support and buy-in, improve infrastructure, elevate the national and international profile of the fishery making it distinguishable in the marketplace, and positively affect autonomy and decision making (Pérez-Ramírez *et al*. 2012). In the Upper Gulf such positive outcomes can be expected. The vaquita is a high profile case and both Mexican and foreign governments, NGOs, and communities have been searching for a positive outcome. Certification of the UGCRD fisheries as vaquita safe and sustainable could be used by fisherman to increase their negotiating power and autonomy in a fishery that has historically been dominated by interest in Mexico City.

References:

Abaroa Silva, S.I. (2012) Especial de precios de pescados y mariscos. http://www.profeco.gob.mx/encuesta/brujula/bruj_2012/bol213_pescados.asp. Accessed on 3/15/13.

Aguilar-Ramírez, D. & Rodríguez-Valencia, J.A. (2010) Reducing bycatch with better technology in the Gulf of California shrimp fishery. Final Technical and Financial Report to the Walton Family Foundation, submitted by World Wildlife Fund. January 15, 2010

Ainsworth, C.H. et al. (2012) Full compliance with harvest regulations yields ecological benefits: Northern Gulf of California case study. *Journal of Applied Ecology* 49: 63-72

Alvarez L.G. & Jones S.E. (2004) Short-term observations of suspended particulate matter in a macro-tidal inverse estuary: the Upper Gulf of California. *Journal of Coastal Research* 20(0): 85-94.

Aragon-Noriega, E.A. et al. (2010) Managing a protected marine area for the conservation of critically endangered vaquita (*Phocoena sinus* Norris 1958) in the Upper Gulf of California. *International Journal of Sustainable Development & World Ecology* 17(5): 410-416.

Avila-Forcada S., Martinez-Cruz A.L., Muñoz-Piña, C. (2012) Conservation of vaquita marine in the Northern Gulf of California. *Marine Policy* 36: 613-622.

Barlow, J. et al. (1997) First estimates of vaquita abundance. *Marine Mammal Science* 13(1): 44-58.

Blackman, A. & Rivera, J. (2010) Producer-level benefits of sustainability certification. *Conservation Biology* 25(6): 1176-1185.

Bobadilla M. et al. (2011) Evolution of environmental policy instruments implemented for the protection of totoaba and the vaquita porpoise in the Upper Gulf of California. *Environmental Science & Policy* 14: 998-1007.

Briggs M., et al. (2005) Introductions and movement of two penaeid shrimp species in Asia and the Pacific. FAO Fisheries Technical Paper 476. Rome. ISBN 92-5-105362-6.

Calderón-Aguilera, L. (2011) Evaluación piloto de los impactos potenciales de las redes de arrastre sobre el ecosistema del Alto Golfo de California durante la temporada de pesca 2010-2011. (Margarita Caso coord.). Convenio N° INE/A1- 038/2010. Centro de Investigación Científica y de Educación Superior de Ensenada, Baja California. México, D.F. 82 pp.

(CEC) Commission for Environmental Cooperation (2008) North American Conservation Action Plan. Commission for Environmental Cooperation: 54-87.

(CEDO) Intercultural Center for the Study of Deserts and Oceans (2012) Manifestación de impacto ambiental para la pesca ribereña responsable en la Reserva de la Biosfera Alto Golfo de California y Delta del Río Colorado: Costa Oeste.

Cinner, J.E. & Pollnac, R.B. (2004) Poverty, perceptions and planning: why socioecomics matter in the management of Mexican reefs. *Ocean and Coastal Management* 47: 479-493.

Cinti, A. et al. (2009) The unintended consequences of formal fisheries policies: Social disparities and resource overuse in a major fishing community in the Gulf of California, Mexico. *Marine Policy* doi:10.1016/j.marpol.2009.08.002.

Cisneros-Montemayor, A.M. et al. (2013) Extent and implications of IUU catch in Mexico's marine fisheries. *Marine Policy* 39: 283-288.

Cudney-Bueno, R. & Basurto, X. (2009) Lack of cross-scale linkages reduces robustness of community based fisheries management. *PLoS ONE* 4(7): e6253.

Cudney-Bueno, R. et al. (2009) Governance and effects of marine reserves in the Gulf of California, Mexico. *Ocean & Coastal Management* 52: 207-218.

D'agrosa, C., Lennert-Cody, C.E., Vidal, O. (2000) Vaquita bycatch in Mexico's artisanal gillnet fisheries: driving a small population to extinction. *Conservation Biology* 14(4): 1110-1119.

Deere, Carolyn L. (1999) Eco-labelling and Sustainable Fisheries, IUCN: Washington, D.C. and FAO: Rome.

Díaz-Uribe, J.G. et al. (2011) An integrated ecosystem trophic model for the Northern and Central Gulf of California: An alternative view for endemic species conservation. *Ecological Modelling* 230: 71-91.

DOF (1994) Norma Oficial Mexicana NOM-012-PESC-1993, Por la que se establecen medidas para la protecció n de las especies de totoaba y ''vaquita" en aguas de jurisdicción federal del Golfo California. June 29, 1994.

DOF (2010) Norma Oficial Maxicana NOM-059-SEMARNAT-2010, Proteción ambiental especies nativas de México de flora y fauna silvestre, categorías de riesgo y especificationes para su inclusión, exclusión o cambio, lista de especies en riesgo. December 30, 2010.

DOF (2013) Diario Oficial de la Federación 2013. Proyecto de Modificación a la Norma Oficial Mexicana NOM-002-PESC-1993. February 8, 2013.

Dutton, P.H. & Squires, D. (2005) Reconciling biodiversity with fishing: A holistic strategy for Pacific turtle recovery.

Gerrodette T. & Rojas-Bracho L. (2011) Estimating the success of protected areas for the vaquita, *Phocoena sinus*. *Marine Mammal Science*: 1-25.

Gudmundsson, E. & Wessells, C.R. (2000) Ecolabeling seafood for sustainable production: implications for fisheries management. *Marine Resource Economics* 15: 97-113.

Hall, S.J. (2011) Climate change and other external drivers in small-scale fisheries: practical steps for responding. *Small-scale Fisheries Management*. CAB International. Ed. Pomeroy, R.S. & Andrew, N.

Hallstein, E. & Villas-Boas, S. B. (2013) Can household consumers save the wild fish? Lessons from sustainable seafood advisory. *Journal of Environmental Economics and Management*. http://dx.doi.org/10.1016/j.jeem.2013.01.003

Hunter, D. et al. (2007) International Environmental Law and Policy. Foundation Press Third Edition.

Iles, A. (2007) Making the seafood industry more sustainable: creating production chain transparency and accountability. *Journal of Cleaner Production.*15: 577-589.

INAPESCA/WWF (2009) Evaluación de las atarrayas "Suriperas" como opción para la captura comercial de camarón en el Alto Golfo de California. Informe Técnico Final de las Campañas 2007-2008 y 2008-2009. 34 p. Disponible en: http://www.wwf.org.mx.

INAPESCA (2010) Pesca Experimental de Camarón con la Red de Arrastre Prototipo RS-INP-MEX en el Alto Golfo de California: Capacitación al Sector Productivo en la Construcción, Operación y Mantenimiento de la Red y Colecta de Información en Campo. Informe Ejecutivo de la Campaña 2009-2010. Doc. Interno. INAPESCA, 2010 28.

INAPESCA (2011) Evaluación Biotecnológica de la Red de Arrastre Prototipo "RS-INP-MEX" Para Captura de Camarón en el Alto Golfo de California. 22p. y 12 Anexos. SAGARPA. INAPESCA, México. Disponible en: http://www.inapesca.gob.mx.

Jacinto, E.R. & Pomeroy, R.S. (2011) Developing markets for small-scale fisheries: utilizing the value chain approach. *Small-scale Fisheries Management.* CAB International. Ed. Pomeroy, R.S. & Andrew, N.

Jacquet, J. & Pauly, D. (2007) The rise of seafood awareness campaigns in an era of collapsing fisheries. *Marine Policy* 31: 308–313.

Jacquet, J. & Pauly, D. (2008) Funding priorities: big barriers to small-scale fisheries. *Conservation Biology* 22 (4): 832–835.

Jaramillo-Legoretta, A.M. et al. (2007). Saving the vaquita: immediate action not more data. *Conservation Biology* 21: 1653-1655.

Joyner, C.C. & Tyler, Z. (2010) Marine conservation versus international free trade: Reconciling dolphins with tuna and sea turtles with shrimp. *Ocean Development & International Law* 31 (1-2): 127-150.

Lopez Sagastegui, C. & Mascareñas, I. (2012) Pesquería de Camarón. Gulf of California Program Blog. http://www.gocmarineprogram.org/blog/?p=554. Accessed on 3/19/13.

Lozano-Montes, H.M. et al. (2008) Shifting environmental and cognitive baselines in the Upper Gulf of California. *Frontiers in Ecology and the Environment* 6 (2): 75-80.

MSC (2013) MSC ecolabel userguide. Marine Stewardshjip Council. January 2013.

Myers. R.A. & Worm, B. (2003) Rapid worldwide depletion of predatory fish communities. *Nature* 423: 280-283.

NOAA (2010) Per capita consumption of seafood. (http://www.st.nmfs.noaa.gov/st1/fus/fus10/08_perita2010.pdf). Accessed on 5/22/13.

Pauly, D. et al. (2002) Towards sustainability in world fisheries. *Nature* 418(8): 689-695.

Pérez-Ramírez, M. et al. (2012) The role of MSC certification in the empowerment of fishing cooperatives in Mexico: The case-study of red rock lobster co-managed fishery. *Ocean and Coastal Management* 63: 24-29.

PROFEPA (2013) Realizó la PROFEPA operativa contra la pesca de especies en riesgo de extinción en el Alto Golfo de California. http://www.profepa.gob.mx/innovaportal/v/4937/1/mx/realizo_la_profepa_operativo_contra_la_pesca_de_especies_en_riesgo_de_extincion_en_el_alto_golfo_de_california.html. Accessed on 3/12/13.

Ponte, S. (2008) Greener than thou: The political economy of fish ecolabeling and its local manifestations in South Africa. *World Development* 36(1): 159–175.

QuimNet.com (2012) http://www.quiminet.com/productos/buche-seco-de-pescado-11871711074/precios.htm. Accessed on 3/19/13.

Osuna A.P. & Ramos L.A. (1998) Atlas pesquedero de la fauna de acompañamiento de camarón del Alto Golfo de California. SEMARNAP, Instituto Nacional de la Pesca: 29-85.

Ramirez-Rojo, R. & Aragon-Noriega, E. (2006) Postlarval ecology of the blue shrimp (*Litopenaeus stylirostris*) and brown shrimp (*Farfantepenaeus californiensis*) in the Colorado River Estuary. Ciencias Marinas 32(1A): 45-52.

Rojas-Bracho L., Reeves R., Jaramillo-Legorreta A. (2006) Conservation of the vaquita *Phocoena sinus*. *Mammal Review* 36: 179-216.

Rochas-Bracho, L. et al. (2012) Report of the Fourth meeting of the International Committee for the Recovery of Vaquita (CIRVA). Ensendada, Baja California. 47pp.

Rodríguez-Quiroz, G. et al. (2012) Fisheries and biodiversity in the Upper Gulf of California, Mexico, Oceanography, Prof. Marco Marcelli (Ed.), ISBN: 978-953-51-0301-1, InTech, DOI: 10.5772/23064. Available from: http://www.intechopen.com/books/oceanography/fisheries-and-biodiversity-in-the-upper-gulf-of-california-mexico

Ruelas-Peña J.H. et al. (2012) A quantitative approach to shrimp fishery in a marine protected area. *Crustaceana* 85(2): 139-150.

Sainsbury, K. (2010) Review of ecolabelling schemes for fish and fishery products from capture fisheries. *FAO Fisheries and Aquaculture Technical Paper* 533. Rome, FAO: 93 p.
Sala, E. et al. (2004) Fishing down coastal food webs in the Gulf of California. *Fisheries* 29(3): 19-25.

Salas, S. et al. (2007) Challenges in the assessment and management of small-scale fisheries in Latin America and the Caribbean. *Fisheries Research* 87: 5–16.

Sarmiento, L.A. (2013) Pescadores se manifestan en Centro de Gobierno de Mexicali. Uniradio Informa. http://uniradioinforma.com/noticias/bajacalifornia/articulo177868.html. Accessed on 3/21/13.

(SBS) Seafood Business Solutions (2012) Estudio de cadena productiva de camarón y escama en la zona de San Felip Baja California: Perspectivas del mercado y oportunidades de negocio.

SEMARNAT (2008) Action program for the conservation of the species: vaquita (*Phocoena sinus*). 9-73.

SEMARNAT
http://dgeiawf.semarnat.gob.mx:8080/approot/dgeia_mce/html/RECUADROS_INT_GLOS/D2_PESCA/D2_PESCA04/Chinchorro.jpg. Accessed on 2/27/13.

Vidal O. (1993) Mammal conservation in Latin America: problems and perspectives. *Conservation Biology* 7(4): 788-795.

Wessells, C.R. (2002) The economics of information: markets for seafood attricutes. *Marine Resource Economics* 17:153-162.

Worm, B. et al. (2006) Impacts of biodiversity loss on ocean ecosystem services. *Science* 314(5800): 787-790.