MEXICAN WHITE SHRIMP (WHITE, BLUE, AND BROWN)

*Litopenaeus vannamei, Litopenaeus stylirostris, Farfantepenaeus californiensis*

Sometimes known as Pacific whiteleg shrimp, yellowleg shrimp

SUMMARY

Mexican White Shrimp is a name given to a group of three related shrimp species: White, Blue and Brown shrimp, found in the eastern Pacific Ocean from Mexico to Peru. All three species grow and sexually mature quickly. Juvenile shrimp generally live in estuaries, lagoons and coastal waters, before migrating offshore to reproduce and complete their life cycle. Some management measures are in place for Mexican White Shrimp, but information on their abundance is generally lacking and there is some indication that they are overexploited in some regions. They are caught by industrial bottom trawlers in offshore locations. This fishing method causes substantial habitat damage and results in high levels of bycatch. They are also caught in artisanal fisheries in inshore areas, using a variety of different nets (e.g., cast nets, small trawls). The artisanal fisheries have lower impacts on habitats and bycatch.

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Points</th>
<th>Final Score</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life History</td>
<td>2.75</td>
<td>2.40 - 4.00</td>
<td>[fish]</td>
</tr>
<tr>
<td>Abundance</td>
<td>1.75</td>
<td>1.60 - 2.39</td>
<td>[yellow]</td>
</tr>
<tr>
<td>Habitat Quality and Fishing Gear Impacts</td>
<td>1.00</td>
<td>0.00 - 1.59</td>
<td>[red]</td>
</tr>
<tr>
<td>Management</td>
<td>1.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bycatch</td>
<td>0.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Final Score</strong></td>
<td><strong>1.55</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LIFE HISTORY

Core Points (only one selection allowed)

If a value for intrinsic rate of increase (’r’) is known, assign the score below based on this value. If no r-value is available, assign the score below for the correct age at 50% maturity for females if specified, or for the correct value of growth rate (’k’). If no estimates of r, age at 50% maturity, or k are available, assign the score below based on maximum age.

1.00 Intrinsic rate of increase <0.05; OR age at 50% maturity >10 years; OR growth rate <0.15; OR maximum age >30 years.

2.00 Intrinsic rate of increase = 0.05-0.15; OR age at 50% maturity = 5-10 years; OR a growth rate = 0.16–0.30; OR maximum age = 11-30 years.

3.00 Intrinsic rate of increase >0.16; OR age at 50% maturity = 1-5 years; OR growth rate >0.30; OR maximum age <11 years.

Mexican White Shrimp is a name given to a group of three related shrimp species: White, Blue, and Brown shrimp. All three shrimp species generally grow fast, mature quickly and die after a year or two.

Growth rates for White Shrimp in Mexico range from 0.21 to 1.21 mm/day (Medina-Reyna 2001), reaching a maximum size of 22 cm (Farfante and Kensley 1997). For Blue Shrimp, growth rates range from 1.80 to 1.92 for females and from 2.16 to 2.28 for males (López-Martínez et al. 2005). Environmental factors like water temperature and salinity greatly affect growth rates of shrimp. For example, Brown Shrimp growth rates, under laboratory conditions, increased as water temperature increased (Villarreal and Hernandez-Llamlas 2005). For White Shrimp, growth of 0.44 mm/day occurred when salinity was low but was 0.61 mm/day when salinity was high (Medina-Reyna 2001).

Water temperature also affects the size at which shrimp mature. In the Gulf of California, size at maturity for Blue Shrimp is inversely correlated to sea surface temperature, with size at sexual maturity increasing from 121 mm total length (TL) in the warm waters (26.20° C) of Mazatlan to 154 mm TL in the cooler waters (22.60° C) of Puerto Penasco (Aragón-Noriega and Alcántara-Razo 2005).

Like most shrimp species, White, Blue and Brown Shrimp live for only a few years. Blue Shrimp, for example, live just under 2 years (López-Martínez et al. 2005).

The life history characteristics of Mexican White Shrimp make them resilient to fishing pressure, so a score of 3 is awarded.
**Points of Adjustment (multiple selections allowed)**

-0.25 Species has special behaviors that make it especially vulnerable to fishing pressure (e.g., spawning aggregations; site fidelity; segregation by sex; migratory bottlenecks; unusual attraction to gear; etc.).

-0.25 Species has a strategy for sexual development that makes it especially vulnerable to fishing pressure (e.g., age at 50% maturity >20 years; sequential hermaphrodites; extremely low fecundity).

-0.25 Species has a small or restricted range (e.g., endemism; numerous evolutionarily significant units; restricted to one coastline; e.g., American lobster; striped bass; endemic reef fishes).

-0.25 **Species exhibits high natural population variability driven by broad-scale environmental change (e.g. El Niño; decadal oscillations).**

Several studies suggest that White, Blue and Brown Shrimp are affected by broad-scale environmental changes. In Carretas-Pereyra Mexico, the catch per unit effort of White Shrimp increased, with respect to the previous year, after El Niño events in 1984, 1989, 1996 and 1999 (Rivera-Velázquez et al. 2009). In Magdalena Bay and Baja California Sur, a peak in shrimp capture occurred during 1997/98, which was an El Niño event (Chávez-Rosales et al. 2008). During El Niño years, Brown Shrimp appear to have an extended spawning period, with spawning occurring throughout the year instead at two distinct peaks (Leal-Gaxiola et al. 2001).

In San Felipe Mexico, a relationship between total catch and the rate of freshwater discharge was found with catches being higher when the Colorado River flow ran south into Mexican waters (Galindo-Bect et al. 2000). It has been proposed that lower salinity could help improve the survival of shrimp species, such as Blue Shrimp (Garcia 1991). Therefore, broad-scale environmental changes that affect the rate of freshwater discharge (i.e. rain) could affect shrimp populations.

Since these species appear to be affected by broad-scale environmental change, points are subtracted.

+0.25 **Species does not have special behaviors that increase ease or population consequences of capture OR has special behaviors that make it less vulnerable to fishing pressure (e.g., species is widely dispersed during spawning).**

+0.25 **Species has a strategy for sexual development that makes it especially resilient to fishing pressure (e.g., age at 50% maturity <1 year; extremely high fecundity).**

White Shrimp may produce 135,000 to 197,000 eggs per spawning event in the Gulf of Tehuantepec (Medina-Reyna et al. 1999). Spawning occurs year round in the Gulf of
Tehuantepec, with peaks occurring in August, and therefore White Shrimp can produce many hundreds of thousands of eggs over a year (Medina-Reyna et al. 1999).

For Blue Shrimp, there are two spawning populations in the Gulf of California, one that spawns along the Sonora coast and one that spawns close to the peninsula coast (Calderón et al. 2003). Blue Shrimp nurseries are found in the upper Gulf of California and the Colorado Delta from June to August, after which Blue Shrimp migrate to deeper water (Galindo-Bect et al. 2007). In Sonora, Blue Shrimp reproduce from March to October, with peaks occurring from May to July (López-Martínez et al. 2005). In Agiabampo Sonora-Sinaloa, a group of spawning Blue Shrimp can produce 6,000,000 eggs/ha over the spawning period from May through July (Aragón-Noriega 2005).

For Brown Shrimp, the spawning period varies between regions. In Mazatlan Mexico, spawning occurs year round but in Guaymas and Puerto Peñasco there is a single period of increased spawning activity (Arangón-Noriega and Alcantara-Razo 2005). Information on the number of eggs Brown Shrimp produce isn’t available but is likely similar to egg production of White and Blue Shrimp.

Due variations in spawning periods among areas and species, and overall uncertainties in annual egg production, we have not added points.

+0.25 Species is distributed over a very wide range (e.g., throughout an entire hemisphere or ocean basin; e.g., swordfish; tuna; Patagonian toothfish).

All three species of Mexican Shrimp are found in the eastern Pacific Ocean, with distributions stretching from North to South America. Specifically, Brown Shrimp are found from San Francisco Bay, CA to Sachura Bay, Peru and the Galapagos Islands, Ecuador (Rodríguez de la Cruz 1976). Blue Shrimp are found in coastal waters from the upper Gulf of California, Mexico to Tumbes, Peru (CICTUS 1985). White Shrimp are found off Mexico and Central America south to Peru (Wyban and Sweeny 1991; Rosenberry 2002). We consider these medium ranges and have therefore not added any points.

+0.25 Species does not exhibit high natural population variability driven by broad-scale environmental change (e.g., El Nino; decadal oscillations).

2.75 Points for Life History
ABUNDANCE

Core Points (only one selection allowed)

Compared to natural or un-fished level, the species population is:

1.00 Low: Abundance or biomass is <75% of BMSY or similar proxy (e.g., spawning potential ratio).

2.00 Medium: Abundance or biomass is 75-125% of BMSY or similar proxy; OR population is approaching or recovering from an overfished condition; OR adequate information on abundance or biomass is not available.

In Mexico, the majority of the shrimp catch (70%) comes from the Pacific (Ruiz-Luna et al. 2010). Catches of Shrimp on the Pacific coast of Mexico have varied with environmental conditions and availability of species. Periods of high catches occurred from 1979-1987, 1995-1999, and in recent years (2007-2009). From 2000-2009 catches have average around 60,000 tons (SAGARPA 2012). Species composition varies by area. In offshore areas, Brown Shrimp are typically the most abundant species in the catch, followed by Blue shrimp and then White shrimp (Arangón-Noriega and Alcantara-Razo 2005; Ruiz-Luna et al. 2010; SAGARPA 2012). However in inshore bays and lagoons, Blue Shrimp typically account for the majority of the catch, followed by White Shrimp (Garduno-Argueta 1974; Marquez-Tiburcio 1976; Magallon-Barajas 1987; Arreola-Lizarraga 1995; SAGARPA 2012).

Mexico has determined that catches of Pacific Shrimp is at the maximum limit of sustainability and fishing effort should not be increased, and that some populations are at levels below maximum production levels (Gillett 2008; SAGARPA 2012). Specifically, an analysis of White Shrimp populations from the southeastern Gulf of California indicated a decrease in population size of around 65% from the 1993/94 season to the 2008/09 season (Madrid-Vera et al. 2012). It is believe that this population needs to be recovered. Another analysis of abundance of shrimp in this region, found Brown Shrimp to be much more abundant than either Blue Shrimp or White Shrimp (Ruiz-Luna et al. 2010). In Magdalena Bay, shrimp catches appeared to be constant between 1991 and 2000, but the status of the resource could not to be determined due to limited population data (Chávez-Rosales et al. 2008). There are concerns about the catches of small, immature shrimp in inshore areas resulting in reduced shrimp production (Garcia 1995; Chávez-Rosales et al. 2008). In the Gulf of Tehuantepec in southern Mexico, catches of White Shrimp fell below 58% of the maximum sustainable yield (MSY) in 2000 and fishing effort was 45% above that needed to produce MSY, suggesting overexploitation of this population (Rivera-Velázquez et al. 2009). On the other hand, Brown Shrimp in the Gulf of Tehuantepec was found to have a stable abundance between 1993 and 1997, and the fishing level was found to be at a sustainable level (Cervantes-Hernández et al. 2008). Population assessments have not been completed for Blue or Brown Shrimp in recent years.
In Guatemala, catches have remained steady at 915 mt (2,017,000 lbs) from 2005 through 2009, which is considerably lower than historical catches, suggesting overfishing of shrimp in this area (Velasco 2009).

We have assigned a medium score to account for the lack of information, specifically in recent years, on actual population sizes of all three Mexican Shrimp species throughout much of their ranges. There are indications that in some areas, Shrimp populations may be declining or overexploited.

3.00 High: Abundance or biomass is >125% of BMSY or similar proxy.

Points of Adjustment (multiple selections allowed)

-0.25 The population is declining over a generational time scale (as indicated by biomass estimates or standardized CPUE).

Information on the abundance of Mexican Shrimp is only available for a few regions. White Shrimp populations from the southeastern Gulf of California decreased in population size by around 65% from the 1993/94 season to the 2008/09 season (Madrid-Vera et al. 2012). In the Gulf of Tehuantepec, Mexico, the abundance of White Shrimp also shows a substantial declined from 1987 through 2006 (Rivera-Velázquez et al. 2009). Recent information on abundance trends of Blue and Brown Shrimp is sparse. Since White Shrimp populations are declining, points are subtracted.

-0.25 Age, size or sex distribution is skewed relative to the natural condition (e.g., truncated size/age structure or anomalous sex distribution).

Both juvenile and adult shrimp are caught in the Mexican Shrimp fisheries. Juveniles are caught in inshore areas, while adults are caught in offshore areas (Rivera-Velázquez et al. 2009; Dubay et al. 2010).

In Sonora-Sinaloa, a female to male sex ratio for Blue Shrimp of 6:5 for all individuals sampled and of 1:2 for only mature Blue Shrimp was found (Aragón-Noiega 2005). However, there is no indication as to whether this is a normal or skewed sex ratio. Due to the limited information, points are not subtracted or added.

-0.25 Species is listed as "overfished" OR species is listed as "depleted", "endangered", or "threatened" by recognized national or international bodies.

-0.25 Current levels of abundance are likely to jeopardize the availability of food for other species or cause substantial change in the structure of the associated food web.

+0.25 The population is increasing over a generational time scale (as indicated by biomass estimates or standardized CPUE).

+0.25 Age, size or sex distribution is functionally normal.
Species is close to virgin biomass.

Current levels of abundance provide adequate food for other predators or are not known to affect the structure of the associated food web.

It is unknown if the current level of abundances of White, Blue or Brown Shrimp provide adequate food for their predators. Shrimp are bottom feeders, feeding on worms, shrimp, and mollusks. In turn, all three shrimp species are preyed upon by fish, crabs and larger shrimp. No points are added.

1.75 Points for Abundance

HABITAT QUALITY AND FISHING GEAR IMPACTS

Core Points (only one selection allowed)

Select the option that most accurately describes the effect of the fishing method upon the habitat that it affects

1.00 The fishing method causes great damage to physical and biogenic habitats (e.g., cyanide; blasting; bottom trawling; dredging).

In Mexico, the shrimp fishery is one of the most economically important fisheries (FAO 2003), accounting for around 40% of the value of the national fishery production (Lluch-Cota et al. 2007; SAGARPA 2012). From 2000 to 2009, catches have averaged around 60,000 tons (SAGARPA 2012). Shrimp are targeted by bottom trawlers in the deep waters of the Gulf of California and the Pacific Ocean, while artisanal fishermen use small trawl nets, suripera nets, cast nets and gill nets in shallower lagoons, bays and estuaries (Dubay et al. 2010; Rivera-Velázquez et al. 2009). Some shrimp traps are also placed in migratory channels to capture juveniles (Rivera-Velázquez et al. 2009). Brown Shrimp are the primary target of the industrial offshore fleet, while Blue and White Shrimp are primarily caught in lagoons, bays and estuaries (Dubay et al. 2010; SAGARPA 2012).

Bottom trawling for shrimp is common elsewhere. In Costa Rica, Blue Shrimp are targeted using otter trawls that fish in estuaries (Rostad and Hansen 2001). In Colombia, shrimp, primarily Brown Shrimp, are targeted by the deep set fishery, which uses double bottom trawl gear in depths of 73 m (240 ft) and deeper (Fyson 1982). In Guatemala, fishermen target White, Brown and Blue Shrimp in the Pacific Ocean with bottom trawls (Velasco 2009).
Impact to the seafloor differs greatly between fishing methods. Cast nets, for example, have a very low impact on shrimp habitat and the ecosystem as a whole but suripera nets drag along the bottom floor and could cause some damage (Amezcua et al. 2006; Dubay et al. 2010). A suripera net is a net tied to two poles that extend out from each side of the boat. One side of the net is open that forms a mouth through which the shrimp enter (Leon and McGuire 1994). Bottom trawls can negatively impact bottom habitat by compressing the upper sediment layers, flattening or disturbing surface structures, and breaking up the sedimentary layer (Prado and Valdemarsen 2001). Trawling reduces habitat complexity and repeated trawling can result in changes to the benthic communities as well as reduce the productivity of these habitats (NRC 2002). In addition, it appears the effects are cumulative and a function of how often trawling occurs in a specific area (NRC 2002). In response to concerns about the negative impacts of bottom trawls on ocean habitat, some vessels in the Mexican industrial fleet have made changes, such as using nets that help decrease fuel consumption and drag on the bottom, to reduce negative ecological impacts to the ocean floor (Dubay et al. 2010). However, this is not the norm for the industry. Because the majority of Mexican Shrimp are caught using bottom trawls, which can cause substantial damage to the seafloor, we have awarded a low score of 1.

2.00 The fishing method does moderate damage to physical and biogenic habitats (e.g., bottom gillnets; traps and pots; bottom longlines).

3.00 The fishing method does little damage to physical or biogenic habitats (e.g., hand picking; hand raking; hook and line; pelagic long lines; mid-water trawl or gillnet; purse seines).

Points of Adjustment (multiple selections allowed)

-0.25 Habitat for this species is so compromised from non-fishery impacts that the ability of the habitat to support this species is substantially reduced (e.g., dams; pollution; coastal development).

Penaeid shrimp, which include White, Blue and Brown Shrimp, spawn offshore as adults. Young shrimp use estuaries and coastal areas as nurseries during early development (Cowx et al. 1998). Juveniles migrate offshore to complete their life cycle (Cowx et al. 1998).

Adult Brown shrimp are found in waters up to 220 m (720 ft) deep, with peak abundance occurring at 55 m (180 ft) depth (Rodriguez de la Cruz and Rosales 1970). Adults are typically found over silt-clay or sand-silt habitat (Rodriguez de la Cruz and Rosales 1970).

Blue Shrimp adults are found in shallow waters up to 40 m (130 ft) deep, typically around lagoons (CICTUS 1985).
White Shrimp are typically found in waters that are over 20°C (68° F) throughout the year (Wyban and Sweeny 1991; Rosenberry 2002). Juveniles use lagoons and migrate offshore to reproduce (Garcia and Le Reste 1981). Juveniles leave lagoons in southern Mexico at around 60-80 mm (2.4-3.2 in) in length (Medina-Reyna 2001). Migration appears to be related to salinity and not water temperature (Medina-Reyna 2001).

Urban development in places such as Magdalena Bay could result in the loss of mangroves which are important nurseries for many shrimp species (Chávez-Rosales et al. 2008). Also, the diversion of the Colorado River may have impacted shrimp populations, but we will likely never know the full effects of this (Anonymous 2012a). In addition, there has been an expansion of aquaculture facilities into shrimp nursery grounds, leading to a depletion of shrimp recruits (Cruz-Torres 2000; Páez-Osuna 2001; Anonymous 2012b). However, due to overall uncertainties on the health of current shrimp habitats, we have not subtracted any points.

-0.25 Critical habitat areas (e.g., spawning areas) for this species are not protected by management using time/area closures, marine reserves, etc.

-0.25 No efforts are being made to minimize damage from existing gear types OR new or modified gear is increasing habitat damage (e.g., fitting trawls with roller rigs or rockhopping gear; more robust gear for deep-sea fisheries).

-0.25 If gear impacts are substantial, resilience of affected habitats is very slow (e.g., deep water corals; rocky bottoms).

+0.25 Habitat for this species remains robust and viable and is capable of supporting this species.

+0.25 **Critical habitat areas (e.g., spawning areas) for this species are protected by management using time/area closures, marine reserves, etc.**

In Mexican waters, closed seasons are used to protect the main spawning event and area closures are used to protect small shrimp until they reach commercial sizes (FAO 2003). There is also the Colorado River Delta Biosphere Reserve, which is an important nursery ground for several shrimp species (Galindo-Bect et al. 2007). However, enforcement of closed seasons and areas has been problematic (Anonymous 2012a, b); therefore, no points will be added.

+0.25 **Gear innovations are being implemented over a majority of the fishing area to minimize damage from gear types OR no innovations necessary because gear effects are minimal.**

In Mexico, some of the industrial fleet has made gear changes, such as using nets that help decrease fuel consumption and drag on the bottom, to reduce negative ecological impacts to the ocean floor (Dubay et al. 2010). However, these do not represent changes over the majority of the fishing area and so we have not added any points.
+0.25 If gear impacts are substantial, resilience of affected habitats is fast (e.g., mud or sandy bottoms) OR gear effects are minimal.

1.00 Points for Habitat Quality and Fishing Gear Impacts

MANAGEMENT

Core Points (only one selection allowed)

Select the option that most accurately describes the current management of the fisheries of this species.

1.00 Regulations are ineffective (e.g., illegal fishing or overfishing is occurring) OR the fishery is unregulated (i.e., no control rules are in effect).

2.00 Management measures are in place over a major portion of the species' range but implementation has not met conservation goals OR management measures are in place but have not been in place long enough to determine if they are likely to achieve conservation and sustainability goals.

In Mexico, fishery management goals are to: 1) exploit fishery resources in a sustainable way, 2) increase economic and social profitability of fisheries and aquaculture, 3) increase legal certainty in fishing and aquaculture activities, and 4) promote and support programs for fishing and aquaculture activities (FAO 2003). Fisheries management, monitoring and enforcement in Mexico are the responsibility of the National Commission of Aquaculture and Fisheries (CONAPESCA) (FAO 2003). The National Fisheries Institute (INP) is responsible for assessments of fish populations and evaluation of fishing gear (FAO 2003). The Mexican Federal Fisheries Law gives guidelines to regulate fisheries and the Mexican Official Standards deal with things such as gear and spatial restrictions (FAO 2003). The shrimp fishery in Mexico has been regulated since 1994 through gear specifications and seasonal and area closures (FAO 2003). Turtle-excluder devices are also required on all industrial trawl vessels. Artisanal fishermen generally belong to cooperatives, which are organized into federations, which are part of the Confederación Nacional, and are responsible for planning, promoting, implementing, monitoring and coordinating fishing activities (Dubay et al. 2010). CONAPESCA initiated a new program in 2009, Ordenamiento, to help monitor the artisanal shrimp fishing fleet by assigning permits to restrict access and identifying legal fishermen (Dubay et al. 2010). This involved equipping boats with a microchip that identifies the cooperative the ship belongs to, their permit, and the landing sites they use (Dubay et al.
Fishing vessels larger than 10.5 m (~35 ft) must also have a satellite monitoring system onboard (CONAPESCA 2011).

However, there are some management issues with enforcement, illegal fishing, and reliable monitoring of catches (Dubay et al. 2010; Madrid Vera et al. 2012; Anonymous 2012b). Additionally, management does not take into account differences among shrimp populations. Subsequently, management measures may work for some populations but not others (Anonymous 2012b).

In Guatemala, UNIPESCA is in charge of the application of fishery laws, while the Ministry of Agriculture, live Stock and Food (MAGA) is responsible for the rules, promotion and planning of fishing (Velasco 2009). Commercial fishing is divided into five categories; inshore, small scale, medium scale, large scale and tuna fishing and permits and licenses are used (Velasco 2009).

While some management measures are in place, there are still management issues that need to be addressed. Additionally, the status of Mexican Shrimp populations is unclear throughout their range. We have therefore awarded a medium score. 3.00 Substantial management measures are in place over a large portion of the species range and have demonstrated success in achieving conservation and sustainability goals.

Points of Adjustment (multiple selections allowed)

-0.25 There is inadequate scientific monitoring of stock status, catch or fishing effort.

There is monitoring of catches in the Mexican Shrimp fisheries, but there is concern surrounding the accuracy and quality of recorded fish landings, both current and historical (Dubay et al. 2010; Madrid Vera et al. 2012; Anonymous 2012b). Tracking the artisanal fisheries have been particularly challenging, but programs are being implanted to improve monitoring of this fleet (Dubay et al. 2010). In some areas, monitoring programs are in place to monitor abundance of shrimp populations (Ruiz-Luna et al. 2010). However, in many areas there remains insufficient information to determine the status of shrimp populations. We have therefore subtracted points.

-0.25 Management does not explicitly address fishery effects on habitat, food webs, and ecosystems.

Management does not effectively address fishery effects on habitat, food webs or the ecosystem. Bycatch and habitat concerns remain significant. Therefore, points are subtracted.

-0.25 This species is overfished and no recovery plan or an ineffective recovery plan is in place.
1.50 Points for Management

-0.25 Management has failed to reduce excess capacity in this fishery or implements subsidies that result in excess capacity in this fishery.

+0.25 There is adequate scientific monitoring, analysis and interpretation of stock status, catch and fishing effort.

+0.25 Management explicitly and effectively addresses fishery effects on habitat, food webs, and ecosystems.

+0.25 This species is overfished and there is a recovery plan (including benchmarks, timetables and methods to evaluate success) in place that is showing signs of success OR recovery plan is not needed.

+0.25 Management has taken action to control excess capacity or reduce subsidies that result in excess capacity OR no measures are necessary because fishery is not overcapitalized.

In Mexico, no new permits for the shrimp fishery are being awarded (FAO 2003). Starting in 2005, the Shrimp Vessel Decommissioning Scheme was initiated due to excess capacity of industrial shrimp fishing vessels in the Pacific and Gulf of California (Dubay et al. 2010). The goal of this program was to reduce the number of industrial vessels by 30% by 2010 (Dubay et al. 2010). In the Gulf of California 211 vessels have been retired through this program, which is around 15-20% of Mexico’s shrimp fishing fleet (Dubay et al. 2010). However, there has been limited control of the artisanal fleets. Additionally, Mexico still considers catches in the shrimp to being exploited to the maximum level (SAGARPA 2012), and there is evidence that some shrimp species are being overexploited in various areas (Rivera-Velázquez et al. 2009; Madrid-Vera et al. 2012). As a result, no points will be added.
BYCATCH

Core Points (only one selection allowed)

Select the option that most accurately describes the current level of bycatch and the consequences that result from fishing this species. The term, "bycatch" used in this document excludes incidental catch of a species for which an adequate management framework exists. The terms, "endangered, threatened, or protected," used in this document refer to species status that is determined by national legislation such as the U.S. Endangered Species Act, the U.S. Marine Mammal Protection Act (or another nation's equivalent), the IUCN Red List, or a credible scientific body such as the American Fisheries Society.

1.00 Bycatch in this fishery is high (>100% of targeted landings), OR regularly includes a "threatened, endangered or protected species."

Bycatch in the Mexican Pacific Shrimp trawl fisheries is high. It has been estimated that the Mexican shrimp fishery discards approximately 133,000 t (2.9X 10^8 lbs) each year (Gillett, 2008). Bycatch to shrimp ratios have been estimated to be 9:1 in the Pacific, but bycatch can vary among areas. For instance, bycatch to shrimp ratios were estimated to be 4:1 in Sinaloa and Sonora and 24:1 in the Gulf of Tehuantepec (Grande-Vidal and Díaz 1981; Grande-Vidal 1996). In the Gulf of California, the ratio of bycatch to shrimp is estimated to be 10:1 (Dubay et al. 2010). More than 600 different bycatch species can be caught in these fisheries, including fish, crustaceans, mollusks, and echinoderms (Grande-Vidal and Díaz 1981; SAGARPA 2012). In the Gulf of California, observers on industrial shrimp fishing vessels identified that between 2004 and 2005, 70% of the catch was made up of fish (López-Martínez et al. 2010). The bycatch can also include endangered/threatened species including the totoaba (Totoaba macdonaldi, IUCN: “Critically Endangered”), pacific seahorse (Hippocampus ingens, IUCN: “Vulnerable”), and sea turtles (SFP 2012). The Mexican shrimp fishing fleet is required to use turtle excluder devices (TEDs), which reduce the number of interactions with sea turtles (Christian and Harrington 1987; Renaud et al. 1997).

Bycatch in the artisanal shrimp fleets is generally considered to be low (SFP 2012). These fishermen use cast nets, gill nets, suripera nets, and small trawl (chango) nets. The chango nets have higher levels of bycatch than the other net types (Amezcua 2006; Dubay et al. 2010). In both the industrial and artisanal fisheries there are some concerns about the use of illegal fishing gears (SFP 2012).

In other Shrimp trawl fisheries in this region, bycatch levels are also high. For example in the Colombian deep net shrimp fishery, 54 fish species and 11 crustacean species were observed caught as bycatch between 1993 and 1994 (Puentes et al. 2007).

Because bycatch in the Mexican White Shrimp fisheries is high, and does include endangered animals like sea turtles, a score of 1 is awarded.
2.00 Bycatch in this fishery is moderate (10-99% of targeted landings) AND does not regularly include "threatened, endangered or protected species" OR level of bycatch is unknown.

3.00 Bycatch in this fishery is low (<10% of targeted landings) and does not regularly include "threatened, endangered or protected species."

Points of Adjustment (multiple selections allowed)

-0.25 Bycatch in this fishery is a contributing factor to the decline of "threatened, endangered, or protected species" and no effective measures are being taken to reduce it.

-0.25 Bycatch of targeted or non-targeted species (e.g., undersize individuals) in this fishery is high and no measures are being taken to reduce it.

Shrimp trawl fisheries have high levels of bycatch. For example, the proportion of bycatch to shrimp has been estimated at 9:1 in the Pacific region (Grande-Vidal and Díaz 1981). However, bycatch can be even higher in some areas. In the Gulf of California, the ratio of bycatch to shrimp is estimated to be 10:1 (Dubay et al. 2010). Bycatch ratios as high as 24:1 have been reported in Gulf of Tehuantepec (Grande-Vidal and Díaz 1981; Grande-Vidal 1996). Around 600 different species may be caught as bycatch, including fish, crustaceans, mollusks, and echinoderms (Grande-Vidal and Díaz 1981; SAGARPA 2012). Some companies involved in Fishery Improvement Projects (FIPs) are working with conservations and scientists on utilizing bycatch reduction or fish excluder devices but these have not yet been fully implemented (SEP 2012).

In the artisanal fisheries, fishermen fish for Shrimp with a variety of small nets and bycatch is much lower.

Since bycatch in the Mexican Shrimp trawl fisheries is high, and effective measures to reduce bycatch are not yet in place, points are subtracted.

-0.25 Bycatch of this species (e.g., undersize individuals) in other fisheries is high OR bycatch of this species in other fisheries inhibits its recovery, and no measures are being taken to reduce it.

-0.25 The continued removal of the bycatch species contributes to its decline.

+0.25 Measures taken over a major portion of the species range have been shown to reduce bycatch of "threatened, endangered, or protected species" or bycatch rates are no longer deemed to affect the abundance of the "protected" bycatch species OR no measures needed because fishery is highly selective (e.g., harpoon; spear).

Turtle Excluder Devices (TEDs) are required on industrial Mexican Shrimp trawl fleets in the Pacific region. In 2009, Mexico initiated the “Immediate Action Plan” to help
implement advice from the US government on the use of TED’s. This included strengthening the TED verification program by increasing the number of shrimp vessel inspections, courtesy visits to ships at port, advising vessels before departing on a fishing trip, training inspections on TED verification, navigational ability, and use of information technologies (allows determination of location of shrimp fishing fleet before they begin fishing) (CONAPESCA 2011). In 2010, Mexico started the “Working Program of TED Verification 2010-2012” (CONAPESCA 2011). This program made a number of the above mentioned measures permanent as well as trained captains and crews in new design technologies, construction and installation of TEDs, certification of TED before vessels are issued permits, and implemented a zero tolerance policy (fines, confiscation of vessels, suspension of permits etc.) for vessels that violate the law (CONAPESCA 2011).

The bycatch may also include other endangered species, such as totoaba (*Totoaba macdonaldi*, IUCN: “Critically Endangered”) and the pacific seahorse (*Hippocampus ingens*, IUCN: “Vulnerable”) (SFP 2012).

Although measures have been implemented to reduce sea turtle catches, there remain uncertainties as to whether the fishery still has an impact on sea turtles or any other threatened/endangered species. Therefore, no points are added.

+0.25 There is bycatch of targeted (e.g., undersize individuals) or non-targeted species in this fishery and measures (e.g., gear modifications) have been implemented that have been shown to reduce bycatch over a large portion of the species range OR no measures are needed because fishery is highly selective (e.g., harpoon; spear).

+0.25 Bycatch of this species in other fisheries is low OR bycatch of this species in other fisheries inhibits its recovery, but effective measures are being taken to reduce it over a large portion of the range.

+0.25 The continued removal of the bycatch species in the targeted fishery has had or will likely have little or no impact on populations of the bycatch species OR there are no significant bycatch concerns because the fishery is highly selective (e.g., harpoon; spear).

0.75 Points for Bycatch
References


