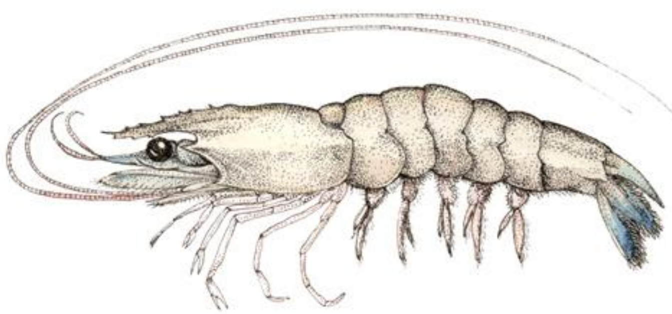
Monterey Bay Aquarium Seafood Watch®

Blue Shrimp, Brown Shrimp, White Shrimp, Pink Shrimp, and Seabob

Litopenaeus stylirostris, *Farfantepenaeus californiensis*, *Farfantepenaeus aztecus, Litopenaeus vannamei, Litopenaeus setiferus, Farfantepenaeus duorarum, Xiphopenaeus kroyeri*



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Mexican Pacific and Gulf of Mexico

Industrial: Bottom Trawl; Artisanal: small trawls, cast net, entanglement net, charanga nets, suripera nets

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Rachelle Fisher, Consulting Researcher

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Final Seafood Recommendation

This report covers blue, brown and white shrimp wild-caught in Mexican Pacific and Gulf of California waters, and brown, pink, seabob and white shrimp wild-caught in Mexican waters of the Gulf of Mexico. Mexico is a leading exporter of shrimp to the United States, although it is unclear what proportion of Mexican shrimp in the U.S. marketplace is wild-caught. All Mexican wild-caught shrimp received an Avoid designation due to ineffective management and poor compliance with regulations. There are also concerns with the abundance of several stocks of shrimp and there are substantial bycatch concerns with many of the methods used to catch shrimp in this fishery.

A portion of the fisheries covered in this report are engaged in a Fishery Improvement Project (FIP).

Mexican Pacific

Stock	**Fishery**	**Impacts on the Stock** Rank (Score)	**Impacts on Other Species** Lowest scoring species Rank*, (Subscore, Score)	**Manage-ment** Rank (Score)	**Habitat and Ecosystem** Rank (Score)	**Overall** Recommendation (Score)
Shrimp, Blue (Sinaloa-Nayarit)	Industrial Fleet (Pacific: Sinaloa-Nayarit)−Trawls	Red (1.41)	Shrimp, Blue (Sinaloa-Nayarit), Shrimp, White Red, (1.41,1.06)	Red (2)	Yellow (2).6	**AVOID (1).67**
Shrimp, Blue (Sinaloa-Nayarit)	Artisanal Fleet (Pacific: Sinaloa-Nayarit)−Entanglement nets	Red (1.41)	Gulf Grouper (Mycteroperca jordani) Red, (1.92,1.72)	Red (2)	Yellow (3.12)	**AVOID (1.97)**
Shrimp, Blue (Sinaloa-Nayarit)	Artisanal Fleet (Pacific: Sinaloa-Nayarit)−Suripera nets	Red (1.41)	Gulf Grouper (Mycteroperca jordani) Red, (1.53,1.37)	Red (2)	Yellow (2.6)	**AVOID (1.78)**
Shrimp, Blue (Sonora Central-South)	Artisanal Fleet (Pacific: Sonora Central-South)−Entanglement nets	Green (3.83)	Gulf Grouper (Mycteroperca jordani) Red, (1.92,1.72)	Red (2)	Yellow (3.12)	**AVOID (2.53)**

Shrimp, Blue (Sonora Central-South)	Industrial Fleet (Pacific: Sonora Central-South)–Trawls	Green (3.83)	Hammerhead, Scalloped (Sphyrna lewini), Sea Turtle, Loggerhead (Caretta caretta), Gulf Grouper (Mycteroperca jordani), Totoaba (Totoaba macdonaldi), Sea Turtle, Olive Ridley (Lepidochelys olivacea) Red, (1.53,1.14)	Red (2)	Yellow (2.6)	**AVOID (2.18)**
Shrimp, Blue (upper Gulf of CA)	Industrial Fleet (Pacific: Upper Gulf of California)–Trawls	Green (3.83)	Hammerhead, Scalloped (Sphyrna lewini), Sea Turtle, Loggerhead (Caretta caretta), Gulf Grouper (Mycteroperca jordani), Totoaba (Totoaba macdonaldi), Sea Turtle, Olive Ridley (Lepidochelys olivacea) Red, (1.53,1.14)	Red (2)	Yellow (2).6	**AVOID (2.18)**
Shrimp, Blue (upper Gulf of CA)	Artisanal Fleet (Pacific: Upper Gulf of CA)–Entanglement nets	Green (3.83)	Vaquita (Phocoena sinus) Critical, (0,0)	Red (2)	Yellow (3.12)	**AVOID (0)**
Shrimp, Blue (west coast of Baja CA)	Artisanal Fleet (Pacific: West Coast of Baja CA)–Magdelena I	Yellow (2.71)	Shrimp, Brown (west coast of Baja CA) Red, (1.41,1.27)	Red (2)	Yellow (2.6)	**AVOID (2.06)**
Shrimp, Blue (west coast of Baja CA)	Industrial Fleet (Pacific: West Coast of Baja California)–Trawls	Yellow (2.71)	Shrimp, Brown (west coast of Baja CA) Red, (1.41,1.06)	Red (2)	Yellow (2.6)	**AVOID (1.97)**
Shrimp, Brown (Gulf of Tehuantepec)	Industrial Fleet (Pacific: Gulf of Tehuantepec)–Trawls	Red (1.73)	Shrimp, White Red, (1.41,1.06)	Red (2)	Yellow (2.6)	**AVOID (1.76)**

Shrimp, Brown (Sinaloa-Nayarit)	Industrial Fleet (Pacific: Sinaloa-Nayarit)–Trawls	Yellow (3.16)	Shrimp, Blue (Sinaloa-Nayarit), Shrimp, White Red, (1.41,1.06)	Red (2)	Yellow (2.6)	**AVOID (2.04)**
Shrimp, Brown (Sonora Central-South)	Industrial Fleet (Pacific: Sonora Central-South)–Trawls	Green (3.83)	Hammerhead, Scalloped (Sphyrna lewini), Sea Turtle, Loggerhead (Caretta caretta), Gulf Grouper (Mycteroperca jordani), Totoaba (Totoaba macdonaldi), Sea Turtle, Olive Ridley (Lepidochelys olivacea) Red, (1.53,1.14)	Red (2)	Yellow (2.6)	**AVOID (2.18)**
Shrimp, Brown (upper Gulf of CA)	Industrial Fleet (Pacific: Upper Gulf of California)–Trawls	Green (4.47)	Hammerhead, Scalloped (Sphyrna lewini), Sea Turtle, Loggerhead (Caretta caretta), Gulf Grouper (Mycteroperca jordani), Totoaba (Totoaba macdonaldi), Sea Turtle, Olive Ridley (Lepidochelys olivacea) Red, (1.53,1.14)	Red (2)	Yellow (2.6)	**AVOID (2.27)**
Shrimp, Brown (west coast of Baja CA)	Industrial Fleet (Pacific: West Coast of Baja California)–Trawls	Red (1.41)	Hammerhead, Scalloped (Sphyrna lewini) Red, (1.53,1.14)	Red (2)	Yellow (2.6)	**AVOID (1.7)**
Shrimp, Brown (west coast of Baja CA)	Artisanal Fleet (Pacific: West Coast of Baja CA)–Magdelena I	Red (1.41)	Seahorse, Pacific (Hippocampus ingens) Red, (2.16,1.94)	Red (2)	Yellow (2.6)	**AVOID (1.94)**
Shrimp, White	Industrial Fleet (Pacific: Gulf of Tehuantepec)–Trawls	Red (1.41)	Hammerhead, Scalloped (Sphyrna lewini) Red, (1.53,1.14)	Red (2)	Yellow (2.6)	**AVOID (1.7)**

Shrimp, White	Industrial Fleet (Pacific: Sinaloa-Nayarit)−Trawls	Red (1.41)	Shrimp, Blue (Sinaloa-Nayarit), Shrimp, White Red, (1.41,1.06)	Red (2)	Yellow (2.6)	**AVOID (1.67)**
white shrimp	Artisanal Fleet (Pacific: Sinaloa-Nayarit)−Cast nets	Red (1.41)	No other main species caught Green, (5,5)	Red (2)	Yellow (3.12)	**AVOID (2.58)**

GOM

Stock	**Fishery**	**Impacts on the Stock** Rank (Score)	**Impacts on Other Species** Lowest scoring species Rank*, (Subscore, Score)	**Manage-ment** Rank (Score)	**Habitat and Ecosystem** Rank (Score)	**Overall** Recommendation (Score)
Shrimp, Brown (GOM)	Artisanal Fleet (GOM−Cast nets	Green (3.83)	No other main species caught Green, (5,5)	Red (1)	Yellow (3.12)	**AVOID (2.78)**
Shrimp, Brown (GOM)	Industrial Fleet (GOM)−Trawls	Green (3.83)	Hammerhead, Scalloped (Sphyrna lewini), Sea Turtle, Loggerhead (Caretta caretta) , Sea Turtle, Green (Chelonia mydas), Sea Turtle, Hawksbill (Eretmochelys imbricate), Sea Turtle, Kemp's Ridley (Lepidochelys kempii) , Sea Turtle, Leatherback (Dermochelys coriacea) , Sea Turtle, Olive Ridley (Lepidochelys olivacea) Red, 1.53,1.22	Red (1.41)	Yellow (2.6)	**AVOID (2.04)**

Shrimp, Brown (GOM)	Artisanal Fleet (GOM)– Charanga nets	Green (3.83)	Shrimp, Pink (GOM), Shrimp, White (GOM) Red, (2.16,2.16)	Red (1)	Yellow (3.12)	**AVOID (2.25)**
Shrimp, Pink (GOM)	Industrial Fleet (GOM)–Trawls	Red (2.16)	Hammerhead, Scalloped (Sphyrna lewini), Sea Turtle, Loggerhead (Caretta caretta) , Sea Turtle, Green (Chelonia mydas), Sea Turtle, Hawksbill (Eretmochelys imbricate), Sea Turtle, Kemp's Ridley (Lepidochelys kempii) , Sea Turtle, Leatherback (Dermochelys coriacea) , Sea Turtle, Olive Ridley (Lepidochelys olivacea) Red, (1.53,1.22)	Red (1.41)	Yellow (2.6)	**AVOID (1.76)**
Shrimp, Pink (GOM)	Artisanal Fleet (GOM)– Charanga nets	Red (2.16)	Shrimp, Pink (GOM), Shrimp, White (GOM) Red, (2.16,2.16)	Red (1)	Yellow (3.12)	**AVOID (1.95)**
Shrimp, Seabob (GOM)	Artisanal Fleet (GOM)-Small trawls–Seabob Fishery	Yellow (3.05)	Hammerhead, Scalloped (Sphyrna lewini), Sea Turtle, Loggerhead (Caretta caretta) Red, (1.53,1.22)	Red (1.41)	Yellow (2.6)	**AVOID (1.92)**

Shrimp, White (GOM)	Industrial Fleet (GOM)−Trawls	Red (2.16)	Hammerhead, Scalloped (Sphyrna lewini), Sea Turtle, Loggerhead (Caretta caretta) , Sea Turtle, Green (Chelonia mydas), Sea Turtle, Hawksbill (Eretmochelys imbricate), Sea Turtle, Kemp's Ridley (Lepidochelys kempii) , Sea Turtle, Leatherback (Dermochelys coriacea) , Sea Turtle, Olive Ridley (Lepidochelys olivacea) Red, (1.53,1.22)	Red (1.41)	Yellow (2.6)	**AVOID (1.76)**
Shrimp, White (GOM)	Artisanal Fleet (GOM)− Charanga nets	Red (2.16)	Shrimp, Pink (GOM), Shrimp, White (GOM) Red, (2.16,2.16)	Red (1)	Yellow (3.12)	**AVOID (1.95)**

Scoring note – scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

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Executive Summary

Although many species of penaeid shrimp are caught in Mexican waters, only the most important species relative to landed weight and value are discussed here. Blue shrimp *(Litopenaeus stylirostris),* brown shrimp *(Farfantepenaeus californiensis),* and white shrimp *(L. Litopenaeus vannamei)* in the Mexican Pacific, including Baja California, the Gulf of California, and the Mexican west coast, will be examined. Additionally, the report also discusses brown shrimp *(Farfantepenaeus aztecus),* white shrimp *(Litopenaeus setiferus*), pink shrimp *(Farfantepenaeus duorarum),* and seabob shrimp *(Xiphopenaues kroyeri)* caught in the Gulf of Mexico. These species have been broken up into two main groups: industrial and artisanal. Gear types associated with these fisheries will be examined. In the Mexican Pacific, large trawls (arrastre) in the industrial fisheries will be examined, as well as suripera nets, cast nets (atarraya), small trawls (Magdalena I), and entanglement nets or gill nets (chinchorro de línea) in the artisanal fisheries. In the Gulf of Mexico, large trawls in the industrial fisheries will be examined, as well as cast nets (atarraya), small trawls, and charanga nets in the artisanal fisheries.

The blue shrimp, brown shrimp, pink shrimp, white shrimp, and seabob in the Mexican Pacific and GOM have a low vulnerability to fishing pressure. Studies by INAPESCA indicate that blue shrimp on the west coast of Baja California and Sinaloa-Nayarit, brown shrimp on the west coast of Baja California, Sinaloa-Nayarit, and the Gulf of Tehuantepec, and white shrimp in the Sinaloa-Nayarit and the Gulf of Tehuantepec were depleted. Pink and white shrimp in the GOM were also depleted. In many of these cases, it is unclear to what degree environmental impacts, as opposed to fishing pressure, are responsible for these declines. In the Mexican Pacific, some stocks, including brown shrimp in the Upper Gulf of California and Sinaloa-Nayarit, are experiencing increasing trends. Fishing mortality on other stocks, especially in the GOM, is a moderate concern. Others, including brown and white shrimp in the Gulf of Tehuantepec, remain in an impaired state and continue to face declining trends. There is a great deal of uncertainty surrounding the level of fishing mortality present in these fisheries.

A wide variety of fish and invertebrate species are caught in the Mexican shrimp fisheries. Many of these species are not of conservation concern and therefore are not assessed in further detail in this report. Species that are assessed in detail include vaquita (*Phocoena sinus)*, Pacific seahorse (*Hippocampus ingens*), northern seahorse *(Hippocampus erectus*), Pacific angel shark (*Squatina californicasea*), shovelnose guitarfish (*Rhinobatos productus*), scalloped hammerhead (*Sphyrna lewini*), golden cownose Ray (*Rhinoptera steindachneri*), sea turtles (including Hawksbill (*Eretmochelys imbricate*), loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*), olive ridley (*Lepidochelys olivacea*), green(*Chelonia mydas*), and Kemp's ridley (*Lepidochelys kempii*)), Totoaba (*Totoaba macdonaldi*), and Gulf grouper (*Mycteroperca jordani*). These species have been selected for discussion because they are of conservation concern. Vaquita are a high vulnerability species located in the Upper Gulf of California that is critically endangered and continues to undergo overfishing with the use of entanglement nets. Although the Mexican government has taken steps to prevent overfishing of the vaquita, the

stock is still in a precarious state. Pacific and Northern seahorses have a low vulnerability but are sometimes caught in the Mexican Pacific and GOM shrimp fisheries and the extent of the impact of shrimp fishing on these species is unknown. Sharks and rays are also commonly found in shrimp trawls. These species are high vulnerability, many are on the IUCN red list as species of concern, but the impact of the shrimp fishery on these species is unknown. Sea turtles have also been identified as bycatch in the shrimp fisheries. However, the regular use of more selective gear and bycatch excluder devices has greatly reduced interactions. Toboaba is an endangered species found in the Upper Gulf of California that is periodically caught with shrimp. However, the extent of these interactions and impact on the toboaba is unknown. The Gulf grouper is also endangered and incidentally caught in shrimp trawls. However, the impact of the shrimp fishery on these populations is unknown.

Mexican fisheries managers, including SAGARPA, CONAPESCA, and INP, employ a variety of management tools to manage shrimp stocks and minimize bycatch. Management, with this use of effort controls such as closed seasons, attrition, and gear modification, has garnered mixed results with some shrimp stocks experiencing rebuilding and others continuing to be depleted. However, brown shrimp in the Upper Gulf of California, Sonora Central-South, and GOM and seabob shrimp stocks in the GOM have consistently maintained productivity. Shrimp fishery managers continue investigating innovative management techniques to improve and maintain shrimp stocks. Although fishery managers continue to reevaluate shrimp management strategies to improve the fisheries, declining stocks and illegal fishing continue to plague the Mexican Pacific and GOM fisheries.

Managers have indicated that bycatch is an important issue in the Mexican Pacific and GOM shrimp fisheries. A range of bycatch reduction programs aimed to reduce the interactions with threatened and endangered species have been employed including gear modifications and closed areas. However, since no targets have been set, it is unclear if these programs are meeting their intended goals. Additionally, noncompliance with gear restrictions and closed areas continue to be an important issue.

Bottom trawling in the Mexican Pacific and GOM shrimp fisheries has adverse effects on a wide variety of ecosystems on which they are employed including: muddy or soft-bottom substrates, rocky seafloor, coral reef, and low-disturbance deepwater habitats. The shrimp trawls of the Pacific coast and the Gulf of Mexico operate mainly in soft sediments at moderate depth. While these habitats may recover more rapidly, analysis of the level of shrimp trawling in the region indicate that the frequency and intensity of bottom trawling in the region leads to substantial impacts even in soft sediment habitats, and management measures to minimize the trawl footprint are lacking. Entanglement nets cause less habitat disturbance than bottom trawls because they are stationary rather than dragged along the bottom, but they still may disturb the seabed where they contact it. The cast net has a low impact on seafloor habitats and marine ecosystems because they contact only the seafloor where they are set. Managers have attempted to mitigate the impacts of fishing through various measures including marine protected areas (MPA) and a fishermen's buyout program. However, MPAs cover a very small portion of fishing area in Mexican waters and the fishermen's buyout program has been insufficient in preventing the expansion of the artisanal fisheries. The Mexican Pacific and GOM industrial and artisanal fisheries generate a high level of bycatch. However, the extent of the impact of removing these bycatch species from the overall ecosystem is unclear.

A portion of the fisheries covered in this report are engaged in a Fishery Improvement Project (FIP). Engagement in a FIP does not affect the Seafood Watch score as we base our assessments on the current situation. Monterey Bay Aquarium is a member organization of the Conservation Alliance for Seafood Solutions. The Alliance has outlined guidelines for credible Fishery Improvement Projects. As such, Seafood Watch will support procurement from fisheries engaged in a FIP provided it can be verified by a third party that the FIP meets the Alliance guidelines. It is not the responsibility of Monterey Bay Aquarium to verify the credibility or progress of a FIP, or promote the fisheries engaged in improvement projects.

Introduction

Scope of the analysis and ensuing recommendation

Although many species of penaeid shrimp are caught in Mexican waters, only the most important species, relative to landed weight and value, are discussed here. Blue shrimp *(Litopenaeus stylirostris),* brown shrimp *(Farfantepenaeus californiensis),* and white shrimp *(L. Litopenaeus vannamei)* in the Mexican Pacific, including Baja California, the Gulf of California and the Mexican west coast, will be examined)(Figure 1). Additionally, the report also discusses brown shrimp *(Farfantepenaeus aztecus),* white shrimp *(Litopenaeus setiferus*), pink shrimp *(Farfantepenaeus duorarum),* and seabob shrimp *(Xiphopenaeus kroyeri)* caught in the Gulf of Mexico (Figure 2). These species have been broken up into two main groups: industrial and artisanal. Gear types associated with these fisheries will be examined. In the Pacific Mexican, large trawls (arrastre) in the industrial fisheries and suripera nets, cast nets (atarraya), small trawls (Magdalena I), and entanglement net (chinchorro de línea) in the artisanal fisheries will be examined. In the Gulf of Mexico, large trawls in the industrial fisheries and cast nets (atarraya), small trawls, and charanga nets in the artisanal fisheries will be examined.

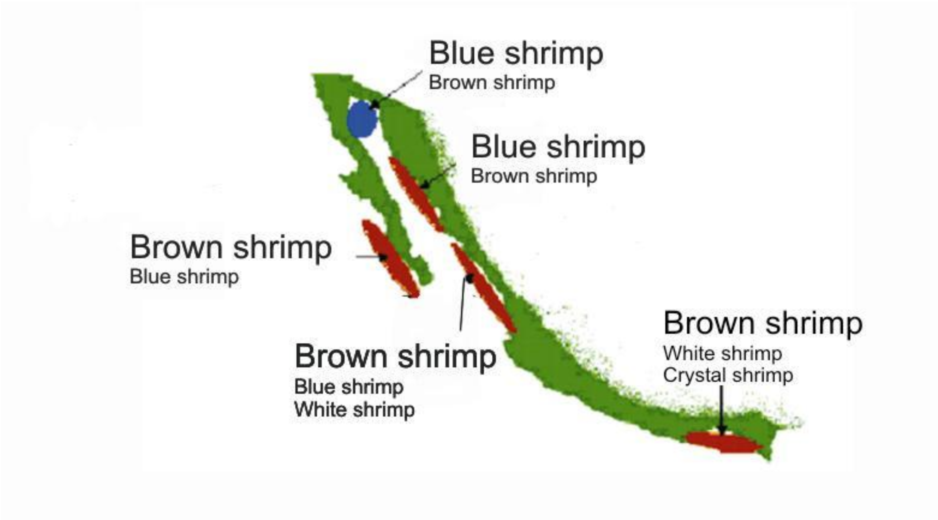
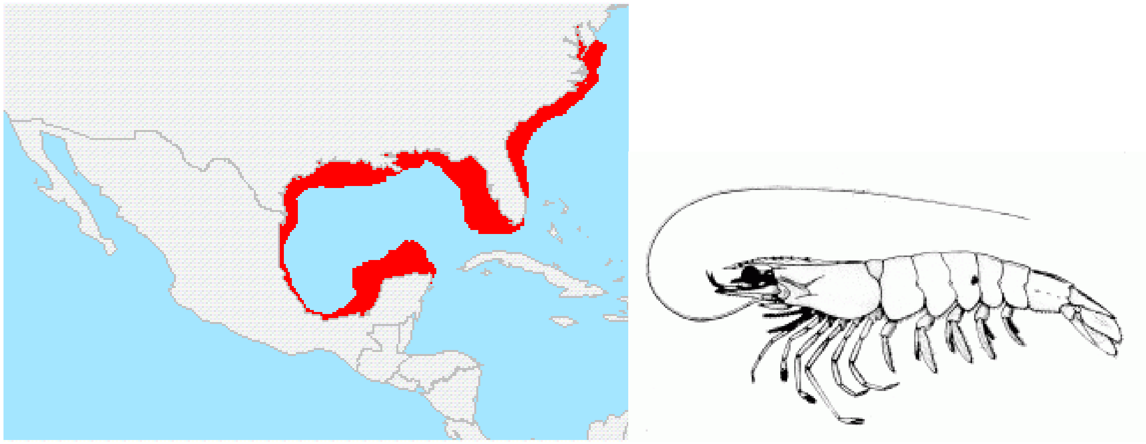
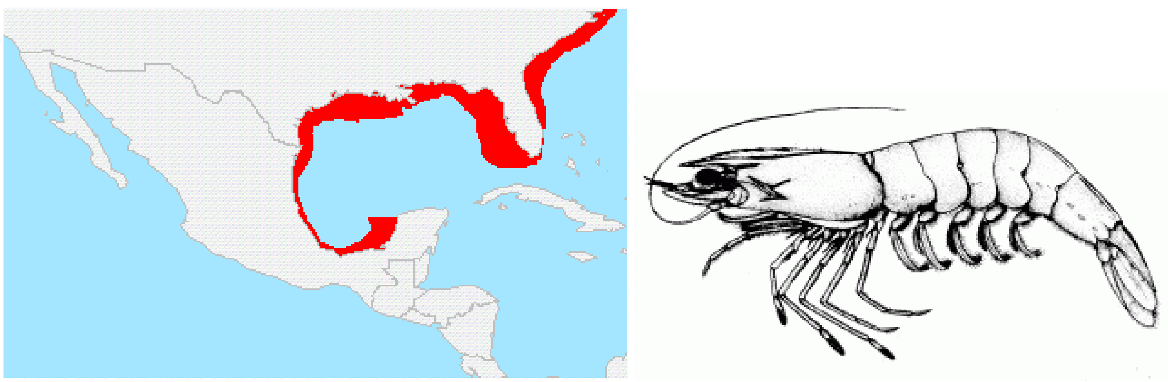


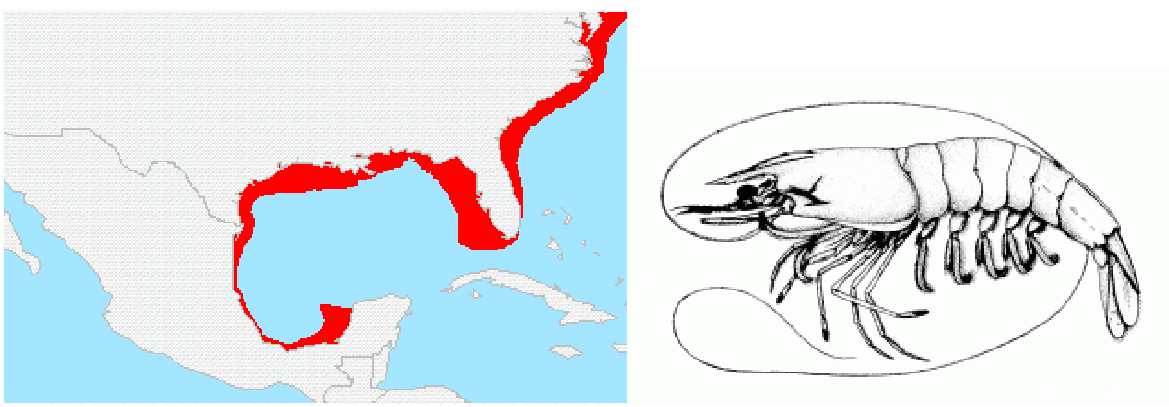
Figure 1. Distribution of penaeid species caught in the Mexican Pacific. Large letters denote principal species caught in the region (INAPESCA-CONAPESCA 2004).



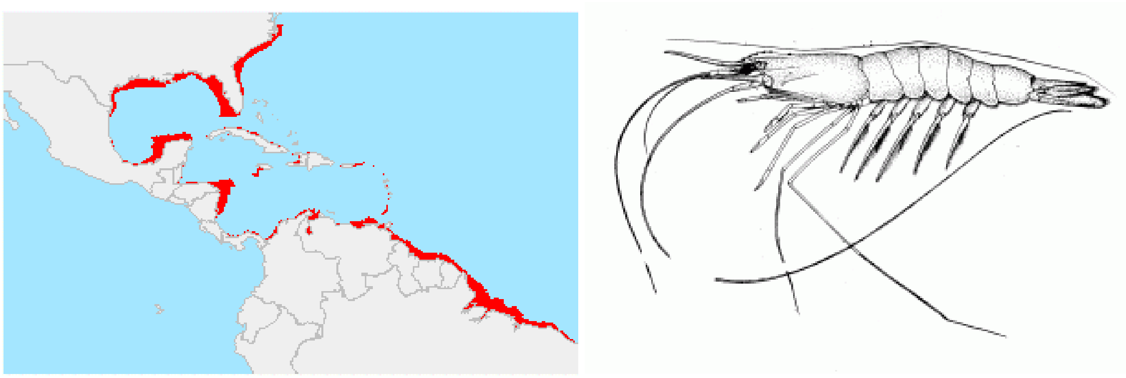
Farfantepenaeus duorarum



Farfantepenaeus aztecus



Litopenaeus setiferus



Xiphopenaeus kroyeri

Figure 2. Distribution of penaeid species caught in the Gulf of México (Maps and illustrations taken from FAO, FIGIS).

Overview of the Species and Management Bodies

The shrimp fishery is the most valuable fishery in Mexico, with third highest production behind sardines and tuna, and is an important source of employment throughout Mexico (FAO 2003, 2008, SAGARPA 2012b). The fishery accounts for 0.31% of employment in the country {Gomez, 2001}. Shrimp production in Mexico occurs in the Gulf of California/Pacific region (Mexican Pacific) and the Gulf of Mexico/Caribbean region (GOM). Shrimp landings in the Mexican Pacific account for approximately 80% of the total wild-caught shrimp production in Mexico with the GOM being responsible for the remainder (FAO 2008, CONAPESCA 2012b).

The Mexican Pacific shrimp fishery is the most important Mexican fishery in terms of foreign exchange and employment (Magallon 1987). The Gulf of California supports more than 80% of the total catch derived from the Mexican Pacific shrimp fishery, whereas 15% is caught in the Gulf of Tehuantepec and less than 5% on the western coast of Baja California and the central Pacific coast of Mexico (Magallon 1987). Over 80% of industrial trawlers in the Mexican Pacific are established in three ports: Mazatlán, Sinaloa; Guaymas, Sonora; and Puerto Peñasco, Sonora (Olivares 2002). In Guaymas, approximately 60% of the shrimp caught is from the industrial fishery and the reported shrimp catch has been variable from the late 1980s to the mid-1990s. There are five shrimp species captured in the Mexican Pacific: brown shrimp (*F. californiensis*); blue shrimp (*L. stylirostris*); white shrimp (*L. vannamei*); crystal shrimp (*Farfantepenaeus brevirostris*) and southern white shrimp *(Litopenaeus occidentalis*) (Figure 4). Brown, blue, and white shrimp are caught in the highest quantities in the region while the other species are caught and sold as a lower quality product, mostly for local consumption (FAO 2008, CONAPESCA 2012a). While trawls are the primary gear type used by industrial fleets in the Mexican Pacific, artisanal (*ribera* or *pangas*) fleets use a variety of gears including cast nets (*atarrayas*), entanglement or gillnets (*chinchorro de línea*; maximum permitted length of 200 m), suripera nets, and small trawl nets (*chango*s) (SAGARPA 2004). Illegal small trawls, also referred to as “changos,” are often used in the Mexican Pacific, but will not be evaluated in this report. To better manage these species, fisheries managers have parsed these species out into regional groups and separate stocks: Upper

Gulf of California, west coast of Baja California, Sonora Central-South, Sinaloa-Nayarit, and Gulf of Tehuantepec (Figure 3)(INAPESCA-CONAPESCA 2004, INAPESCA 2012c).

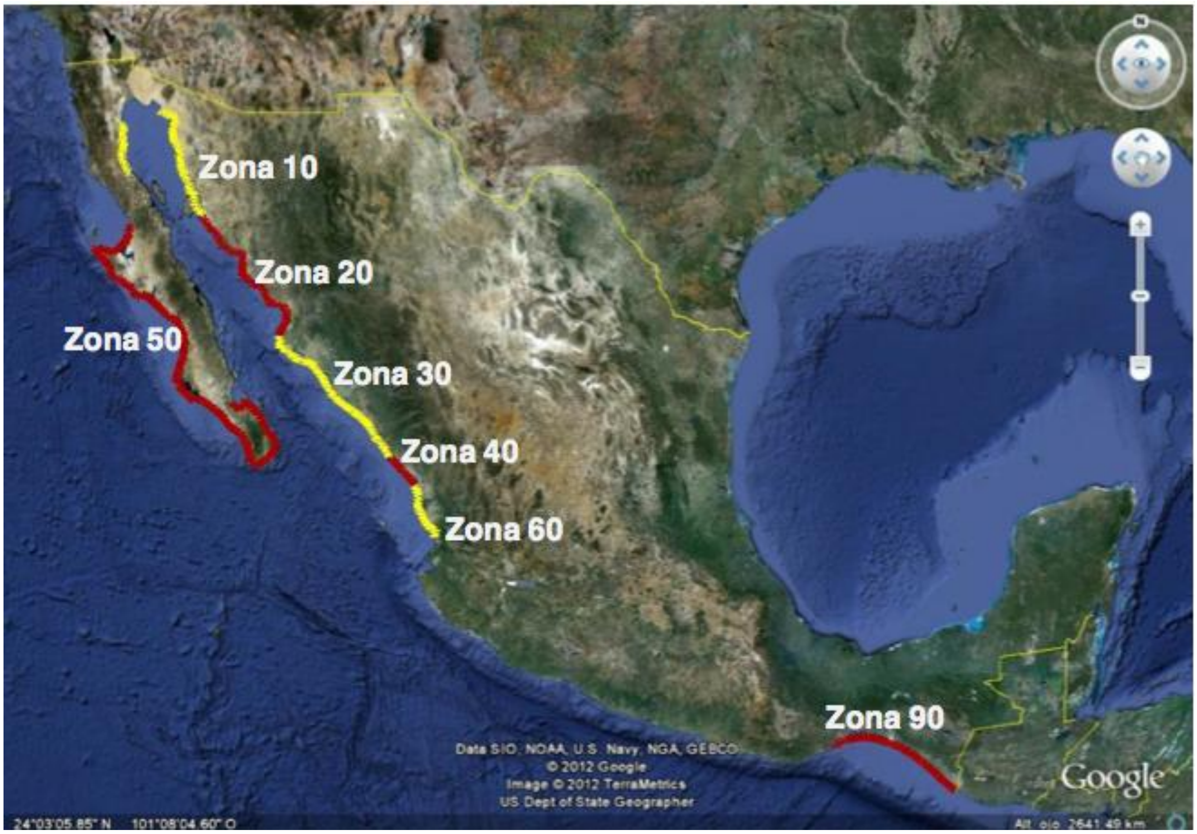


Figure 3. Spatial locations of regions defined for distribution of penaeid specie management and study. Zone 10 (Upper Gulf); Zone 20 (Sonora); Zones 30 and 40 (Sinaloa including Sonora Central-South and Sinaloa-Nayarit); Zone 50 (west coast of Baja California); Zone 60 (Sinaloa-Nayarit.); and Zone 90 (Gulf of Tehuantepec) (INAPESCA 2012c).

In general, shrimp catches in the Mexican Pacific and GOM have remained consistent over the last two decades (Figure 5) (FAO 2008; CONAPESCA 2008) althoughsome shrimp stocks have demostrated signs of decline (SAGARPA/INAPESCA 2000; CONAPESCA 2008; SAGARPA 2012b). Additionally, Brusca and Bryner (2004) note the declining catch per unit effort (CPUE) in the Upper Gulf of California during the 1990s. Since demand for shrimp in Mexico had remained consistent and the fleet continued expanding (FAO 2008, Dubay et al 2010), it is unclear to what degree the deterioration of shrimp stocks is due to environmental factors, fishing effort, or a combination of both.

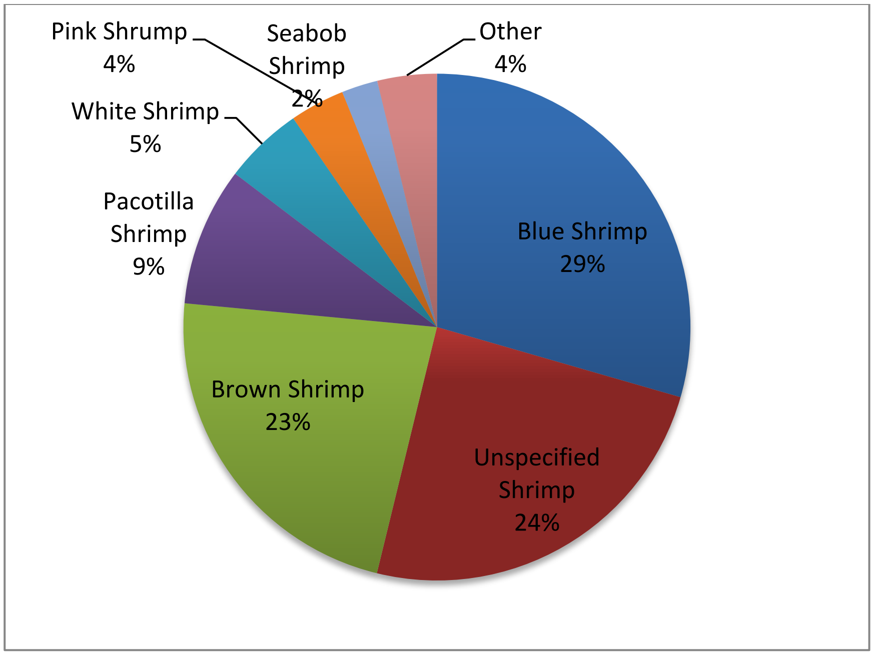


Figure 4. Relative percentage of Penaeid shrimp caught in Mexico in 2012. Note: Pacotilla is a term referring to small, unspecified cocktail shrimp (Data from CONAPESCA 2012).

Shrimp catches in Mexico, 1990–2004

Year	The Gulf and Caribbean	Pacific Ocean	Total
1990	23 847	34 081	57 928
1991	29 284	36 185	65 469
1992	22 715	35 174	57 889
1993	28 058	40 280	68 338
1994	22 709	41 134	63 843
1995	23 435	46 599	70 034
1996	21 450	44 114	65 564
1997	21 984	49 083	71 067
1998	23 170	43 416	66 586
1999	20 155	46 336	66 491
2000	21 288	40 309	61 597
2001	21 847	35 662	57 509
2002	18 533	36 100	54 633
2003	23 697	37 848	61 545
2004	22 320	35 744	58 064

Figure 5. Shrimp catch in the Mexican Pacific and GOM from 1990 to 2004 (Figure from FAO 2008).

Catch in the GOM is highest in the coastal areas of Tamaulipas, Veracruz, and Campeche (CONAPESCA 2012b). Shrimp is the most important fishery in the GOM as it is a source of employment, direct consumption and derived products (FAO 2003). Four penaeid species compose the largest volume of catch in the GOM: brown shrimp (*F. aztecus*); pink shrimp (*F. duorarum*); white shrimp (*L. setiferus*) and red shrimp (*F. brasiliensis*) (Figure 3). Recently, rock shrimp (*Sicyonia brevirostris* and *Xiphopenaeus kroyeri*) have also been targeted, although they are less economically important (CONAPESCA 2012b).

The fishery formally started in 1938 when the main organization of the Mexican fleet began (SAGARPA/INAPESCA 2000). Historically, cooperatives enjoyed exclusive access to the shrimp fishery. A 1992 fisheries law withdrew the cooperatives' historic rights, replacing them with a system of permits and concessions. Soon thereafter, private investors started to participate in the shrimp fishery. There were no privately owned shrimp trawlers in 1990; however, by 1993, 90% of the vessels in the North Pacific offshore shrimp fisheries were privately owned (Thorpe et al. 1999). By 1970, an estimated 850 Mexican trawlers were operating in the Mexican Pacific and 820 in the GOM (Edwards 1978a, Edwards 1978b). From 1970 to 1999, the number of large shrimp boats doubled from 700 to 1,200 boats operating in the Gulf of California (Brusca and Bryner 2004). By 2002, 2,412 trawlers were operating throughout Mexican waters (1,674 in the Pacific) (INAPESCA-CONAPESCA 2004). Fishery managers currently report 1,371 industrial trawlers and 12,339 artisanal shrimp vessels fishing in the Mexican Pacific alone (SAGARPA 2006). While artisanal vessels far outnumber industrial vessels, the latter is responsible for a majority of the shrimp landings, bringing in 59.2% of the total shrimp catch in 2006 (SAGARPA 2006). Fishery managers believed that the fishery was overcapitalized and implemented a federal "effort reduction plan" to promote volunteer retirement of old trawling vessels and reduce the size of the Mexican shrimp fleet (FAO 2008).

The Campeche Bank, historically the most important area for the shrimp fishery in the GOM, has seen declines in catches in recent years; western GOM areas such as Tamaulipas and Veracruz have taken over regional importance, accounting for over 60% of total catches in 2006 (INAPESCA 2006b). Brown shrimp is the species most commonly caught, with catches far exceeding those of pink and white shrimp since the late 1980s (Figure 6).

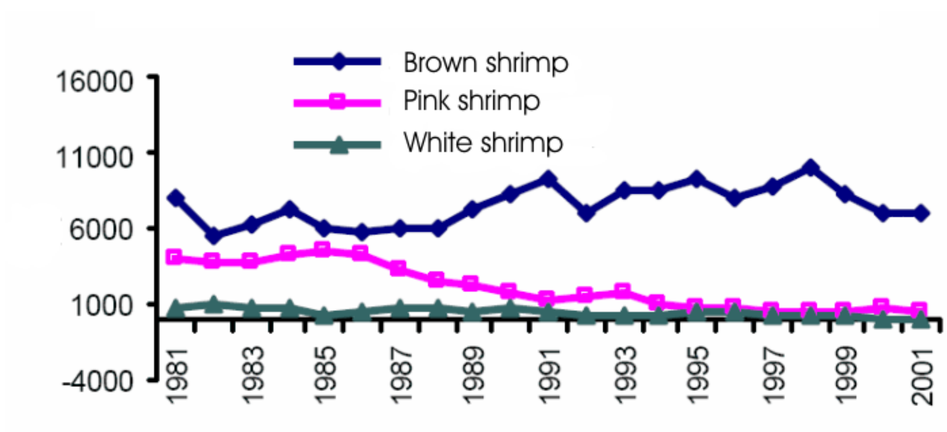


Figure 6. Catch (metric tons) of the main shrimp species in the Gulf of México. (Taken from CNP 2004)

Management Agencies

Shrimp in the Mexican Pacific and GOM is managed by a network of federal agencies (FAO 2008). The Secretaría de Agrucultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA, the Secretary of Agriculture, Livestock, Rural Development, Fisheries and Food) is the agency responsible for establishing public policies to ensure optimum development of resources (CONAPESCA 2012a). Comisión Nacional de Acuacultura y Pesca (CONAPESCA, the National Commission of Aquaculture and Fisheries) is the branch of SAGARPA committed to fisheries management, monitoring and enforcement. CONAPESCA is responsible for administering the sustainable development of fisheries and aquaculture resources, promoting the development of chains of production, distribution and consumption (FAO 2008, CONAPESCA 2012a). At the Upper Gulf of California, the National Commission for Natural Protected Areas (CONANP) has operated public policies for reducing fishing effort and replacing traditional gears for alternative and selective fishing gears. Secretaria de Medio Ambiente y Recursos Naturales (SEMARNAT, Secretary of the Environment and Natural Resources) is responsible for enforcing the use of appropriate fishing gear and establishing fishing regulations inside MPAs. The Instituto Nacional de Pesca (INAPESCA, National Fisheries Institute) is responsible for gathering data and providing the scientific and technical basis for decision making (FAO 2008, CONAPESCA 2012a). INAPESCA assesses the status of wild stocks and evaluates the impacts of fishing gears. It has a decentralized network of 13 Centros Regionales de Investigación Pesquera (CRIPs, Regional Centers of Fisheries Research). CRIPs and INAPESCA-Regional Research Directors coordinate with shrimp producers by means of national shrimp fishery-focused workshops (CONAPESCA 2012a). The overall mission of these agencies is to promote the long-term sustainability, conservation and protection of natural resources.

The shrimp fishery is managed under several laws (INAPESCA-CONAPESCA 2004, FAO 2008, SAGARPA 2012b):

- The General Law of Sustainable Fisheries and Aquaculture defines access rights and obligations for users.
- The General Law for Cooperative Societies regulates fishers' organizations.
- “Ley General del Equilibrio Ecológico y Protección al Ambiente” is focused on environmental protection.
- The Management Plan for Shrimp Fisheries in the Mexican Pacific Ocean focuses on leading the fishery towards maintaining maximum economic profit as well as sustainability yields, biomass, recruitment, and yield. The plan also includes measures for reducing interactions with the environment or other fisheries, promoting economic benefits for the society, and improving the quality of the marine products.
- The National Committee for Fisheries and Aquaculture negotiates management and ordinance policies with fishers and fleet owners.
- “Ley de Metrología y Normalización” regulates the generation of Mexican Official Standards (NOMs). NOMs regulate mesh sizes, types of fishing gear used, spatial-temporal restrictions and other features.
- Gear restrictions are regulated by the Mexican Official standards (Normas Oficiales Mexicanas or NOMs, NOM 002-PESC-1993). Modifications in 2006 of the Mexican

Official standards legalized the use of small boats of up to 115 HP in lagoons, estuaries and bays (DOF 2006).[1]

The overall mission of these agencies is to promote the long-term sustainability, conservation and protection of natural resources (FAO 2008, SAGARPA 2012b). In addition to these agencies, the Gulf of California is considered a high conservation priority to various institutions and national and international NGOs. International foundations and agencies (e.g., The David and Lucile Packard Foundation, World Wildlife Fund, Conservation International, The Walton Family Foundation, and The Nature Conservancy, among others) have made strong, coordinated efforts to promote a comprehensive protection for Gulf of California marine ecosystems.

Production Statistics

Approximately 3.4 million tons of shrimp are caught worldwide each year with 60% of shrimp production attributed to wild-caught fisheries and 40% attributed to aquaculture (FAO 2008, SDAP 2012). Mexico is the 6th largest producer of shrimp worldwide—both wild caught and via aquaculture (Figure 7)(FAO 2008, SAGARPA 2012b).

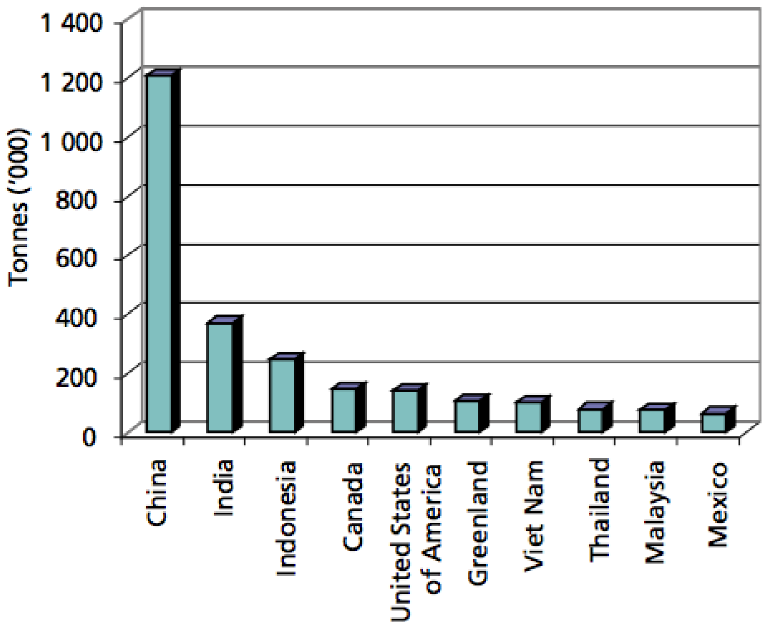


Figure 7. Average annual shrimp catches by country (FAO 2008)

Importance to the US/North American Market

Mexico is a net seafood exporter; a recent Office of Economic and Community Development (OECD) report listed the 2003 export/import ratio at 2:1 (OECD 2006). During 2003, Mexico exported 26,402 mt of shrimp and imported 9,912 mt (Anuario Estadístico de Pesca, 2003). In 2008, Mexico was the sixth-largest shrimp exporter to the U.S. in terms of export weight and the fourth-largest exporter to the U.S. in terms of value. According the statistics from the United States National Marine Fisheries Service, approximately 34,494 mt of shrimp (wild-caught and farmed), valued at over US$340 million, was sent to the U.S. in 2008 (NMFS 2012). In the U.S.

[1] Magdalena Bay BCS is the single exception and boats of 75 HP or less must be used instead.

market, Mexico accounts for approximately 5.6% of total seafood supply and 8.3% of shrimp imports (Ardjosoediro and Bourns 2009, NMFS 2012). Imports to the U.S. via Nogales, Arizona are dominated by shrimp from Mexico, at 62% of total seafood imports (NMFS 2012). In 2008, Mexican shrimp accounted for nearly 44% of the value of U.S. imports (Ardjosoediro and Bourns 2009). It is unclear which species or the quantities of each species are imported into the U.S., as Mexico does not record by species but rather by size. It is also unclear as to what proportion of the imports comes from industrial versus artisanal fleets (Arriaga Haro 2012).

Common and Market Names
The market name for all Mexican species is quite simply "shrimp." The common name varies by species (see Table 1).

Table 1. Main species caught in the Mexican Pacific and GOM.

Mexican Pacific: Common Name (English, Spanish)	Scientific Name
Brown shrimp or yellow leg shrimp, camarón café	*Farfantepenaeus californiensis* Holmes, 1900
Blue shrimp, camarón azul	*Litopenaeus stylirostris* Stimpson, 1874
White shrimp, camarón blanco	*Litopenaeus vannamei* Boone, 1931
GOM: Common name (English, Spanish)	**Scientific name**
Brown shrimp or northern brown shrimp, camarón café	*Farfantepenaeus aztecus* Perez-Farfante, 1969
Pink shrimp or northern pink shrimp, camarón rosado	*Farfantepenaeus duorarum* Burkenroad, 1939
White shrimp or northern white shrimp, camarón blanco	*Litopenaeus setiferus* Linnaeus, 1767
Atlantic seabob, camarón siete barbas	*Xiphopenaeus kroyeri* Smith, 1869.

Primary Product Forms
Mexican shrimp is exported headed, frozen, and packed in five-pound boxes (García and Gómez 2005). The national market offers small and medium size shrimp in the fresh, frozen, cooked, dry and pounded product forms. Most larger shrimp are exported and the smaller shrimp (especially camarón pacotillo) remain for the domestic market.

Analysis

Scoring guide

- All scores result in a zero to five final score for the criterion and the overall final rank. A zero score indicates poor performance, while a score of five indicates high performance.
- The full Seafood Watch Fisheries Criteria that the following scores relate to are available on our website at www.seafoodwatch.org.

Criterion 1: Stock for Which You Want a Recommendation

Guiding Principles

- The stock is healthy and abundant. Abundance, size, sex, age and genetic structure should be maintained at levels that do not impair the long-term productivity of the stock or fulfillment of its role in the ecosystem and food web.
- Fishing mortality does not threaten populations or impede the ecological role of any marine life. Fishing mortality should be appropriate given current abundance and inherent resilience to fishing while accounting for scientific uncertainty, management uncertainty, and non-fishery impacts such as habitat degradation.

Summary

Mexican Pacific

Stock	**Fishery**	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Criterion 1** Rank (Score)
Shrimp, Blue (Sinaloa-Nayarit)	Artisanal Fleet (Pacific: Sinaloa-Nayarit)−Suripera nets	Low	High Concern (2)	High Concern (1)	Red (1.41)
Shrimp, Blue (Sinaloa-Nayarit)	Artisanal Fleet (Pacific: Sinaloa-Nayarit)−Entanglement nets	Low	High Concern (2)	High Concern (1)	Red (1.41)
Shrimp, Blue (Sinaloa-Nayarit)	Industrial Fleet (Pacific: Sinaloa-Nayarit)−Trawls	Low	High Concern (2)	High Concern (1)	Red (1.41)

Shrimp, Blue (Sonora Central-South)	Artisanal Fleet (Pacific: Sonora Central-South)–Entanglement nets	Low	Low Concern (4)	Low Concern (3.67)	Green (3.83)
Shrimp, Blue (Sonora Central-South)	Industrial Fleet (Pacific: Sonora Central-South)–Trawls	Low	Low Concern (4)	Low Concern (3.67)	Green (3.83)
Shrimp, Blue (upper Gulf of CA)	Artisanal Fleet (Pacific: Upper Gulf of CA)–Entanglement nets	Low	Low Concern (4)	Low Concern (3.67)	Green (3.83)
Shrimp, Blue (upper Gulf of CA)	Industrial Fleet (Pacific: Upper Gulf of California)–Trawls	Low	Low Concern (4)	Low Concern (3.67)	Green (3.83)
Shrimp, Blue (west coast of Baja CA)	Artisanal Fleet (Pacific: West Coast of Baja CA)–Magdelena I	Low	High Concern (2)	Low Concern (3.67)	Yellow (2.71)
Shrimp, Blue (west coast of Baja CA)	Industrial Fleet (Pacific: West Coast of Baja California)–Trawls	Low	High Concern (2)	Low Concern (3.67)	Yellow (2.71)
Shrimp, Brown (Gulf of Tehuantepec)	Industrial Fleet (Pacific: Gulf of Tehuantepec)-Trawls	Low	Moderate Concern (3)	High Concern (1)	Red (1.73)
Shrimp, Brown (Sinaloa-Nayarit)	Industrial Fleet (Pacific: Sinaloa-Nayarit)–Trawls	Low	High Concern (2)	Very Low Concern (5)	Yellow (3.16)
Shrimp, Brown (Sonora Central-South)	Industrial Fleet (Pacific: Sonora Central-South)–Trawls	Low	Low Concern (4)	Low Concern (3.67)	Green (3.83)
Shrimp, Brown (upper Gulf of CA)	Industrial Fleet (Pacific: Upper Gulf of California)–	Low	Low Concern (4)	Very Low Concern (5)	Green (4.47)

	Trawls				
Shrimp, Brown (west coast of Baja CA)	Industrial Fleet (Pacific: West Coast of Baja California)–Trawls	Low	High Concern (2)	High Concern (1)	Red (1.41)
Shrimp, Brown (west coast of Baja CA)	Artisanal Fleet (Pacific: West Coast of Baja CA)–Magdelena I	Low	High Concern (2)	High Concern (1)	Red (1.41)
Shrimp, White	Industrial Fleet (Pacific: Sinaloa-Nayarit)–Trawls	Low	High Concern (2)	High Concern (1)	Red (1.41)
Shrimp, White	Industrial Fleet (Pacific: Gulf of Tehuantepec)–Trawls	Low	High Concern (2)	High Concern (1)	Red (1.41)
white shrimp	Artisanal Fleet (Pacific: Sinaloa-Nayarit)–Cast nets	Low	High Concern (2)	High Concern (1)	Red (1.41)

GOM

Stock	**Fishery**	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Criterion 1** Rank (Score)
Shrimp, Brown (GOM)	Artisanal Fleet (GOM)–Cast nets	Low	Low Concern (4)	Low Concern (3.67)	Green (3.83)
Shrimp, Brown (GOM)	Industrial Fleet (GOM)–Trawls	Low	Low Concern (4)	Low Concern (3.67)	Green (3.83)

Shrimp, Brown (GOM)	Artisanal Fleet (GOM)–Charanga nets	Low	Low Concern (4)	Low Concern (3.67)	Green (3.83)
Shrimp, Pink (GOM)	Industrial Fleet (GOM)–Trawls	Low	High Concern (2)	Moderate Concern (2.33)	Red (2.16)
Shrimp, Pink (GOM)	Artisanal Fleet (GOM)–Charanga nets	Low	High Concern (2)	Moderate Concern (2.33)	Red (2.16)
Shrimp, Seabob (GOM)	Artisanal Fleet (GOM)- Small trawls–Seabob Fishery	Low	Low Concern (4)	Moderate Concern (2.33)	Yellow (3.05)
Shrimp, White (GOM)	Industrial Fleet (GOM)–Trawls	Low	High Concern (2)	Moderate Concern (2.33)	Red (2.16)
Shrimp, White (GOM)	Artisanal Fleet (GOM)–Charanga nets	Low	High Concern (2)	Moderate Concern (2.33)	Red (2.16)

Justification of Ranking

Mexican Pacific: blue shrimp (L. stylirostris), brown shrimp (F. californiensis), white shrimp (L. vannamei)—all gear types, all regions
GOM: brown shrimp (F. aztecus), pink shrimp F. duorarum), seabob (X. kroyeri), and white shrimp (L. setiferus)—all gear types

Factor 1.1 Inherent Vulnerability

Key relevant information:
FishBase does not provide vulnerability scores for shrimp and other invertebrates. However, all 7 penaeid species have a low inherent vulnerability (see table below).

Detailed rationale
Blue, brown, white, pink, and seabob shrimp are generally short-lived and very fecund. An analysis of their productivity attributes yields an overall vulnerability score of 3, indicating that these species have a high resilience to fishing pressure.

Factor	Blue, brown, white, pink, and seabob shrimp	Score	Source
Average Age at Maturity	Within 1 and 12 months	3	(FAO 2000, SAGARPA/INAPESCA 2000, Flordia Fish and Wildlife Conservation Commission 2010)
Average Maximum Age	1.5-2 years	3	(López et al. 2005)
Reproductive Strategy	Broadcast Spawner	3	(Palomares and Pauly 2012)
Density Dependence	Compensatory dynamics demonstrated	3	(Pérez-Castañeda and Defeo 2005)
	Overall Vulnerability Score	3	

Mexican Pacific: blue shrimp (L. stylirostris), white shrimp (L. vannamei), brown shrimp (F. californiensis)— all gear types

Factor 1.2 Stock Status
Blue and brown shrimp in the Upper Gulf of California and Sonora Central-South: Low Concern
Blue and brown shrimp in the west coast of Baja California and Sinaloa-Nayarit: High Concern
White shrimp in Sinaloa-Nayarit and Gulf of Tehuantepec: High Concern
Brown shrimp in the Gulf of Tehuantepec: Moderate Concern

Key relevant information:
Managers have indicated that all three penaeid species in the Mexican Pacific, as a whole, are at maximum sustainable exploitation (SAGARPA 2012b). However, regionally, stock status of each species differs such that blue and brown shrimp in the Upper Gulf of California, and Sonora Central-South are believed to be at MSY (CONAPESCA 2008, INAPESCA 2012c) and have therefore been deemed a low concern stock status by Seafood Watch®. Blue and brown shrimp in the west coast of Baja California and Sinaloa-Nayarit and white shrimp in Sinaloa-Nayarit and the Gulf of Tehuantepec are deteriorated (CONAPESCA 2008, Madrid-Vera et al 2012) and Seafood Watch® deems these stocks a high concern. Brown shrimp in the Gulf of Tehuantepec is impaired and at risk for overfishing (CONAPESCA 2008) and are labeled as a moderate concern by Seafood Watch®.

Detailed rationale:
Stock assessments are performed by INAPESCA using as a dynamic version of the Schafer model proposed by Hilborn and Walters (1992) and an age-structured model showing delay in the recruitment (EERR, Deriso 1980; INAPESCA /CONAPESCA 2004). Using the precautionary principle as a framework, Mexican shrimp fishery managers defined reference points for each of these three penaeid species (SAGARPA/INAPESCA 2000). These reference points contain a great deal of uncertainty since they are based on fishery-dependent data and modeling without a thorough stock assessment (SAGARPA/INAPESCA 2000). Developing reference points for a particular fishery

is complex and their accuracy and appropriateness depend on the type, quantity and quality of available data (Hilborn 2002).

Changes in habitat quality have had both positive and negative impacts on wild stocks. One example is the Colorado River Delta habitat in the Gulf of California, which has changed dramatically since the river was dammed in 1935. Since then, freshwater flow to the Gulf of California has been reduced to 1% of its virgin flow (Aragón-Noriega and Calderón-Aguilera 2000). While the ecological effects of river damming have not been properly documented, the quality of estuarine Colorado River delta habitat has been negatively affected by reduced freshwater input. Despite this severe habitat disturbance, blue shrimp have been observed in abundance in this region. Aragón-Noriega (2000) also observed increased blue shrimp abundance during years with higher levels of fresh water input, such as El Niño Southern Oscillation (ENSO) years with strong rainy seasons. It has also been shown that total catch of shrimp in San Felipe is significantly correlated to freshwater flow from the Colorado River (Aragón-Noriega and Calderón-Aguilera 2000; Galindo-Bect et al. 2000).

Additionally, fluctuations in wild shrimp abundance and landings have been observed in the Gulf of California and are thought to be driven by inter-annual variations in ocean conditions (Figure 8) (López-Martínez 2000). ENSO years have been described as having negative impacts on a number of fish populations, but shrimp species appear to respond positively to ENSO events, exhibiting higher levels of recruitment and increased total length (TL) of individual shrimp. Leal-Gaxiola (1999) found the highest TL for *F. californiensis* during fishing seasons 1982/1983, 1983/1984, 1987/1988, 1991/1992, 1992/1993, and 1993/1994, all corresponding to ENSO years. Smaller TLs were observed during La Niña periods.

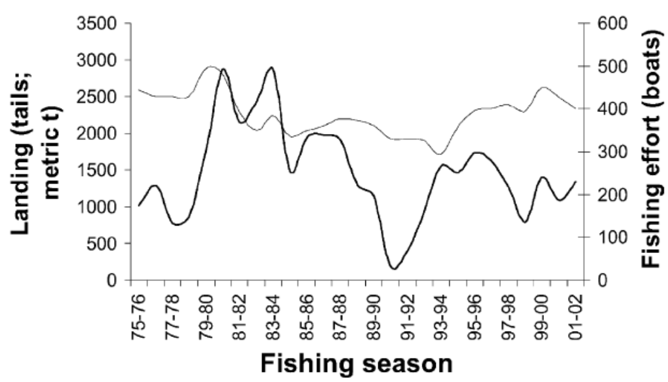


Figure 8. Catch (metric tons) and fishing effort for blue shrimp in Sonora, México (Figure from López-Martínez et al. 2005)

Blue shrimp is monitored throughout the Mexican Pacific during the closed season. Managers have determined that the stock is either at B_{MSY}, in decline and/or heavily exploited throughout the Mexican Pacific and Gulf of California depending on the region (SAGARPA 2000, CONAPESCA 2008, INAPESCA 2009b, SAGARPA 2012b). In INAPESCA's 2000 release, B_{MSY} was calculated for each shrimp species caught in the Mexican Pacific (SAGARPA/ INAPESCA 2000). INAPESCA estimated that the blue shrimp stock biomass was generally below B_{MSY} (SAGARPA/ INAPESCA 2000) and low abundances of reproductive females have impaired reproductive success on the west coast of Baja California and in Sinaloa-Nayarit (CONAPESCA 2008, INAPESCA 2009b). However, along the west coast of Baja California, blue shrimp may be showing signs of recovery (CONAPESCA 2008). In other areas such as the Upper Gulf of California and Sonora Central-South blue shrimp stocks are at B_{MSY}. To improve depleted stocks, managers have implemented various strategies aimed at recovering stocks (INAPESCA 2009b, SAGARPA 2012b). For these reasons, the blue shrimp in the Upper Gulf of California and Sonora Central-South are considered to be a low concern while stocks on the west coast of Baja California and in Sinaloa-Nayarit are considered overfished or depleted and are of high concern.

Brown shrimp exhibit faster growth rates than other shrimp species in the region, are not subject to the high rates of artisanal exploitation in the lagoon systems, and are generally not fished illegally in the coastal region unlike blue and white shrimp (Sierra-Rodríguez 2000). Brown shrimp populations monitored throughout the Pacific and in the Upper Gulf of California and Sonora Central-South are believed to be exploited at their maximum level (SAGARPA 2000, CONAPESCA 2008, INAPESCA 2009b, SAGARPA 2012b). However, recent studies indicate a decrease in the reproductive process and a reduced number of mature specimens in various regions in the Mexican Pacific including the west coast of Baja California, Sinaloa-Nayarit, and the Gulf of Tehuantepec (CONAPESCA 2008, INAPESCA 2009b). In the Gulf of Tehuantepec, brown shrimp are believed to be near MSY, but “impaired.” Therefore, the brown shrimp stocks in the Upper Gulf of California and Sonora Central-South are considered of low concern. Brown shrimp in the west coast of Baja California, Sinaloa-Nayarit are considered overfished and of high concern. Brown shrimp in the Gulf of Tehuantepec at risk of being overfished considered a moderate concern.

The most recent stock assessment for **white shrimp** suggests that the species has deteriorated in much of the Mexican Pacific, possibly related to environmental changes in coastal lagoons (SAGARPA/INAPESCA 2000, CONAPESCA 2008). The management program for the shrimp fishery (INAPESCA-CONAPESCA 2004) notes that white shrimp stocks in the Mexican Pacific are depleted and will require management actions to protect the reproductive biomass at the end of upcoming fishing seasons (CONAPESCA 2008, SAGARPA 2012b). Landings have been below the historical average for the industrial, artisanal and coastal fisheries in recent years (INAPESCA 2009b, INAPESCA 2012c). Additionally, studies have shown that reproductive outputs are below their historical averages in white shrimp (Figure 9)(INAPESCA 2009b) and the number of recruits-to-spawners is in decline (Cervantes-Hernández et al. 2008). A recent study compared white shrimp biomass from 1993 to 1994 and 2008 to 2009. The study showed that biomass decreased approximately 65% (Madrid-Vera et al. 2011). Since white shrimp stocks in the Mexican Pacific are depleted and continue exhibiting declining abundance trends, the stock is deemed a high concern.

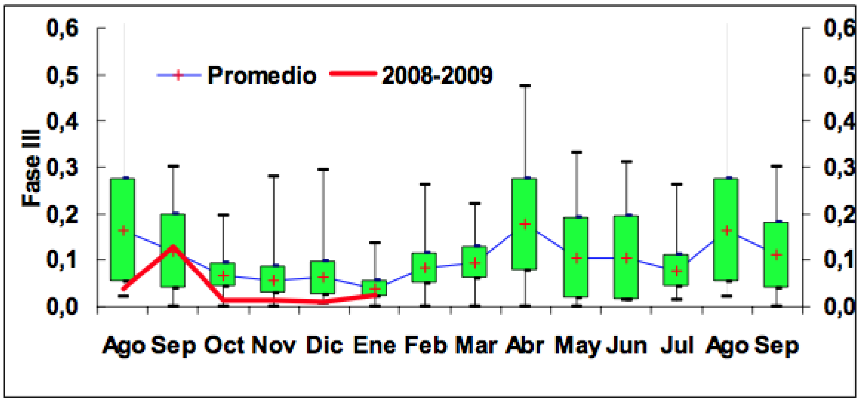


Figure 9. Reproductive cycle in the white shrimp (*L. vannamei*) in the coast of Sinaloa, seasons 1981-82/2008-09. The historical average is indicated by the line labeled as "promedio" (INPESCA 2009b).

Factor 1.3 Fishing Mortality
Blue shrimp in the Upper Gulf of California, west coast of Baja California, and Sonora Central-South: Low Concern
Blue shrimp in Sinaloa-Nayarit and Gulf of Tehuantepec: High Concern
Brown shrimp in Upper Gulf of California and Sinaloa-Nayarit: Very Low Concern
Brown shrimp on the west coast of Baja California and Gulf of Tehuantepec: High Concern
Brown shrimp in Sonora Central-South: Low Concern
White shrimp in Sinaloa-Nayarit and Gulf of Tehuantepec: High Concern

Key relevant information:
Management has indicated that fishing effort is at the limit of sustainability throughout the Mexican Pacific as a whole, and fishing mortality should not be increased but instead decreased (SAGARPA 2012b). Although fishing mortality estimates in relation to F_{MSY} are not publicly available, there have been some studies that have shed light on fishing mortality of the three shrimp species for each region. The relative abundance of blue shrimp in the Upper Gulf of California, west coast of Baja California, and Sonora Central-South has remained consistent in recent years (INPAPESCA 2012c) and, therefore, fishing mortality is deemed a low concern. Blue shrimp in Sinaloa-Nayarit and Gulf of Tehuantepec have decreased in abundance recently, indicating that overfishing is occurring such that fishing mortality is considered a high concern. In the Upper Gulf of California and Sinaloa-Nayarit fishery, brown shrimp are showing signs of recovery (INAPESCA 2012c, Meraz-Sánchez et al 2013). Therefore, fishing mortality on Upper Gulf of California and Sinaloa-Nayarit brown shrimp is considered a very low concern. Abundances of brown shrimp on the west coast of Baja California and Gulf of Tehuantepec continue to decline while they have been maintained in Sonora Central-South and therefore are deemed a high concern and low concern, respectively. In the white shrimp fishery in Sinaloa-Nayarit and the Gulf of Tehuantepec, fishing mortality continues to threaten the recovery of white shrimp (INAPESCA 2012c, Madrid-Vera et al. 2012). Therefore, fishing mortality on white shrimp in Sinaloa-Nayarit and the Gulf of Tehuantepec is considered a high concern.

Detailed rationale:

Although various anthropogenic factors, such as fishing pressure, pollution, and climatic fluctuations have had an impact on shrimp populations in the Mexican Pacific, landings for all shrimp species in this region have averaged around 42,000 mt over a sustained period (Figure 10). While this demonstrates the capacity of the overall fishery to cope with human and natural pressures, all three shrimp stocks have exhibited signs of deterioration in various regions (see Factor 1.2, above) (SAGARPA/INAPESCA 2000, CONAPESCA 2008, INAPESCA 2012c, Madrid-Vera et al. 2012, Meraz-Sánchez et al. 2013).

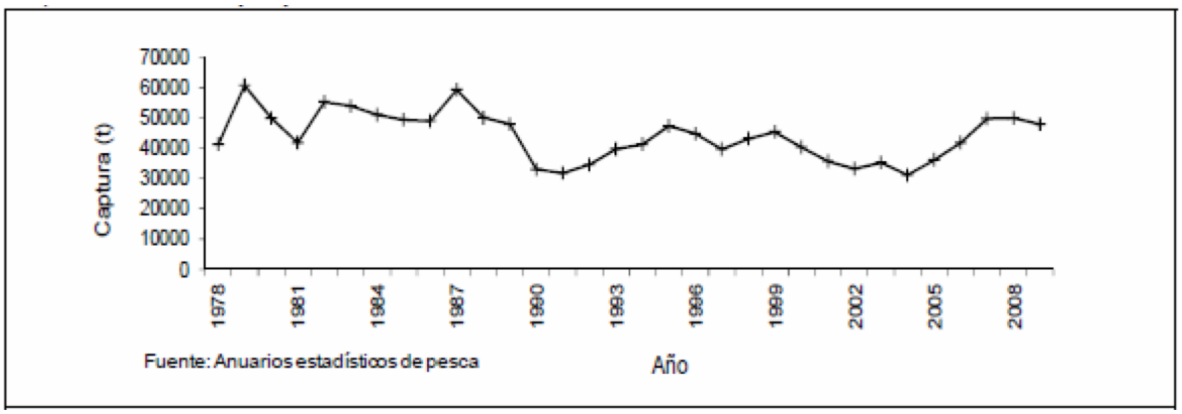


Figure 10. Trend of shrimp catch from 1978 to 2002 in the Mexican Pacific Ocean from the industrial and artisanal fleets (SAGARPA 2012b)

The main shrimp port in the Mexican Pacific, Mazatlán, Sinaloa, shows a large decline in CPUE (with all three species grouped together) from the early 1970s until present (Figure 11). This change in CPUE is the result of stable landings combined with growth of the shrimp fleet (Figure 11)(FAO 2008) indicating that the fishery is fished at capacity (Gillett 2008).

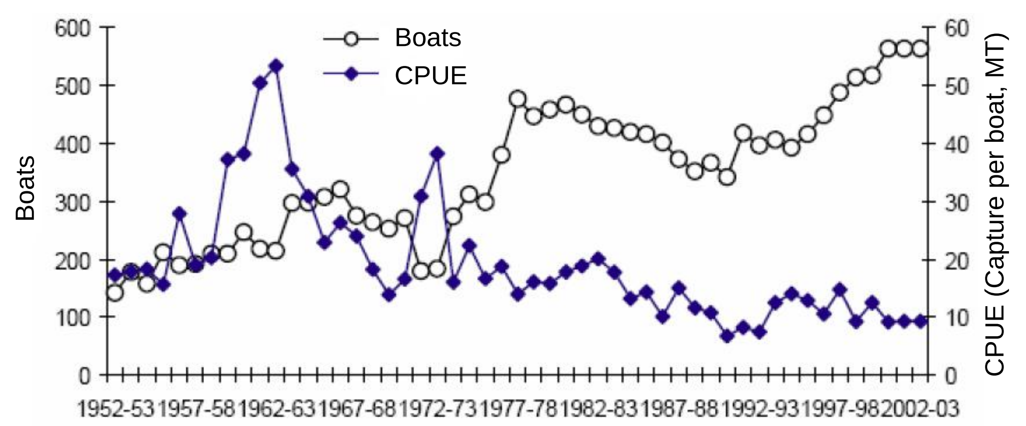


Figure 11. Increased trend in the number of boats and declining CPUE in the Mazatlán, Sinaloa shrimp fishery from 1952/53 to 2002/03 (Figure from INAPESCA-CONAPESCA 2004)

There was some evidence of increased **blue shrimp** landings for the artisanal fleet in Sinaloa-Nayarit during the 2008/2009 fishing season as compared to past seasons (INPAESCA 2009b, INAPESCA 2012c). The industrial fleet also saw an increase in CPUE, possibly due to a decrease in the number of large fishing vessels and a decrease in fishing days that season (INAPESCA 2009b, INAPESCA 2012c). It is unclear whether fishing pressure or habitat changes have contributed to these declines of blue shrimp in Sinaloa-Nayarit (CBO 2004; INAPESCA/CONAPESCA 2004). There have also been signs of decreasing relative abundances of blue shrimp in the Gulf of Tehuantepec while relative abundances of the species in the Upper Gulf of California, the west coast of Baja California, and Sonora Central-South have remained constant (INAPESCA 2012).

In Sinaloa-Nayarit, fishing mortality remains below MSY such that **brown shrimp** populations are showing signs of recovery (INAPESCA 2012c, Meraz-Sánchez et al 2013). Quantitative fishing mortality estimates in relation to MSY for brown shrimp in all other regions of the Mexican Pacific are lacking. However, a recent study by INAPESCA scientist indicated that brown shrimp populations in the Upper Gulf of California showed increasing trends and decreasing trends on the west coast of Baja California and the Gulf of Tehuantepec (INAPESCA 2012c) In Sonora Central-South, brown shrimp stocks have maintained relative abundance indicating that overfishing is not likely occurring.

The maximum **white shrimp** size sampled in Sonora between September 2008 and January 2009 was 145 mm, with average of 110 mm (INAPESCA 2009b). These measurements are small compared to the maximum size in other regions (210 mm and above in the Upper Gulf of California), suggesting that size distribution may be skewed in the Sonora region and, therefore, the white shrimp stock (and possibly others) may be experiencing more pressure in Sonora than in other regions (INAPESCA 2009b). A recent study indicated that white shrimp fishing mortality in Sinaloa-Nayarit is too high to allow the fishery to recover (Madrid-Vera et al. 2012). In the Gulf de Tehuantepec, research found that white shrimp are not responding to closed areas, indicating that environmental factors may be also be contributing to the stock's decline (Cervantes-Hernández et al. 2008).

GOM: Brown Shrimp (F. aztecus), Pink Shrimp F. duorarum), Seabob (X. kroyeri), and White Shrimp (L. setiferus)—All gear types

Factor 1.2 Stock Status
Pink and White Shrimp: High Concern
Brown and Seabob Shrimp: Low Concern

Key relevant information:
The current biomass and B_{2012}:B_{MSY} for all four GOM penaeid species is not publicly available. However, based on regular sampling during the closed season, management has listed pink shrimp as depleted (SAGARPA/INAPESCA 2000, INAPESCA 2008, CONAPESCA 2008) and white shrimp as depleted but recovering (SAGARPA/INAPESCA 2000, INAPESCA 2008). Although the uncertainty surrounding the stock trends is high, brown shrimp and seabob are generally by management

considered to be healthy, with the stock at or near B_{MSY} (SAGARPA/INAPESCA 2000, INAPESCA 2008). For these reasons pink shrimp and white shrimp stocks in the GOM are deemed a high concern, while brown and seabob shrimp stock status is deemed a low concern.

Detailed rationale:
Like the Mexican Pacific penaeid species, stock assessments for Gulf of Mexico penaeids are performed by INAPESCA using the same models that provide results with a high degree of uncertainty {EERR, Deriso 1980; SAGARPA/INAPESCA, 2000; INAPESCA-CONAPESCA, 2004). Additionally, these assessments rely heavily on fishery-dependent data since there is very little fisheryindependent data available for these fisheries (INAPESCA, 2012b). Managers have indicated that all species in the GOM region have shown drastic declines in catches over the last 25 years with the exception of brown shrimp which have maintained stable landings over the last quarter decade (SAGARPA 2012b). Management measures such as closures have been established in an attempt to protect the main biological events (such as reproduction) and increase catches of the species (INAPESCA 2012a). However, these attempts have been met with mixed results by brown, pink, seabob, and white shrimp stocks in the GOM.

Brown shrimp is the most important species in northwest Gulf of Mexico as more than 95% of landings are composed of this species (SAGARPA/INAPESCA 2000). The highest abundance is observed from June to August and October to December (INAPESCA 2008, 2012a). The brown shrimp stock in the northwest Gulf of Mexico is believed to be at levels close to the maximum sustainable yield (Arreguín-Sánchez et al. 1997, Fernández et al. 2001, SAGARPA 2012b). However, without biomass estimates in relation to B_{MSY} and use of the Schafer model, uncertainty is high. Therefore, brown shrimp stocks in the GOM are deemed a low concern.

The **pink shrimp** fishery was characterized by strong effort in both fishing days and by fleet capacity in the 1960s and 1970s. Declines in landings due to anthropogenic and environmental factors in the mid-1980s ended this fishery's importance, and stock levels have not rebounded since then (Figure 12) (Ramírez-Rodríguez et al. 2000, SAGARPA 2012). Though there is no evidence that the shrimp population has recovered from overexploitation, annual landings have stabilized at around 500 mt per year, with the highest CPUE in October, November and December (Figure 12b) (INAPESCA 2008). Continued protection of developing female shrimp is crucial to maintain stock viability. Since pink shrimp stocks in the Gulf of Mexico are depleted, considered to be overexploited by managers (SAGARPA 2012) and landings have remained stable, the stock is deemed a high concern.

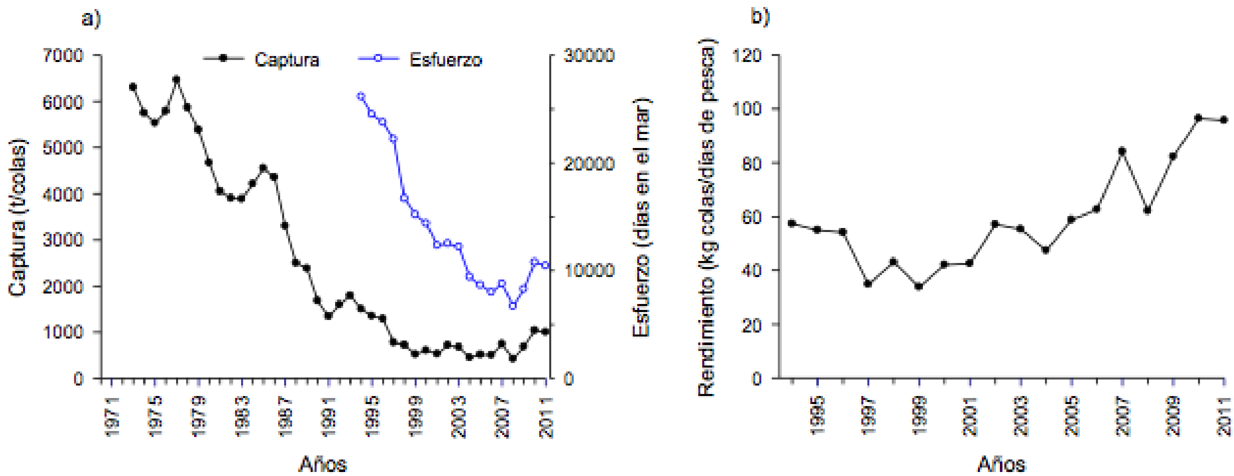


Figure 12. Indicators of pink shrimp fishing fleet in the Bay of Campeche, (a) landings (indicated by the closed circles) and effort (indicated by the open circles) (b) performance (INAPESCA 2012a).

The Atlantic **seabob shrimp** fishery is an artisanal fishery with great socioeconomic importance in Campeche, producing around 1,200 mt per year (Figure 13)(CONAPESCA 2012b). The fishery was closed in 1993 and reopened in 1997 with a number of restrictive regulatory measures to ensure continued sustainability of the stock, including a closed season to protect the stock during the major spawning period (Núñez-Márquez and Wakida 2003). Managers believe that the stock may be at or near B_{MSY} (SAGARPA/INAPESCA 2000, INAPESCA 2008), but have indicated that without quantitative biomass estimates, uncertainty is high (SAGRAPA 2012). Therefore, seabob shrimp stocks in the GOM are deemed a low concern.

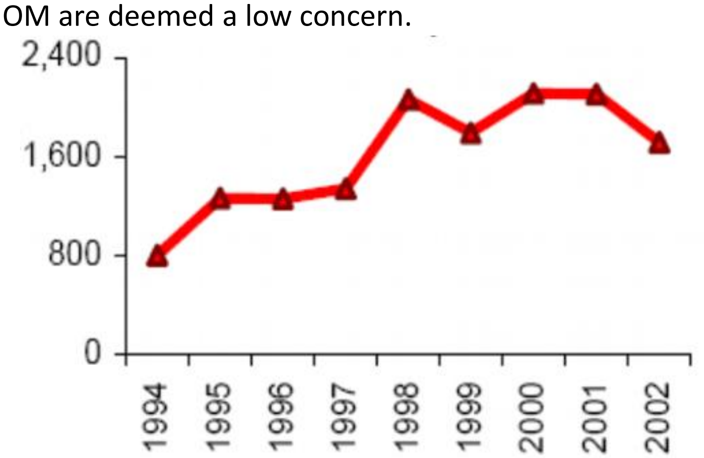


Figure 13. Catch of seabob shrimp (mt) in Campeche (Figure from CONAPESCA 2006).

The GOM **white shrimp** is taken incidentally in the seabob fishery and has seen variable landings in the last two decades (INAPESCA 2012a). At present, the fishery is sustaining a low level of landings (Figure 14)(INAPESCA 2012a). A study on recruitment and fisheries mortality showed that overall stock recruitment has been depressed because of spawning female mortality in the small vessel coastal fishery between May and October of each year (INAPESCA 2008). These findings, in addition to INAPESCA's assertion that the white shrimp fishery in the GOM is depleted,(SAGARPA/INAPESCA 2000) lends itself to rating the stock as a high concern.

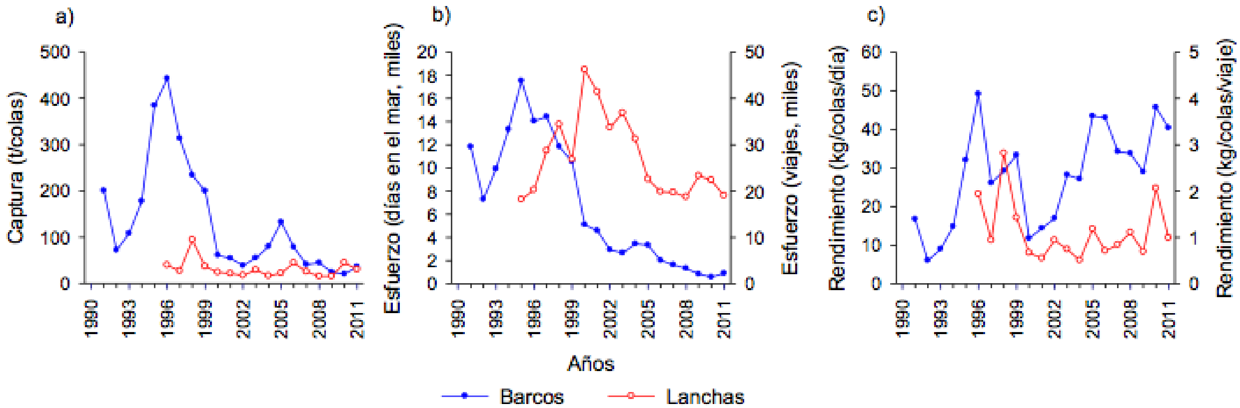


Figure 14. (a) Landings (tons/tail), (b) fishing days/trips (thousands), and (s) CPUE in kg/day; for large vessels (blue line, open circles) and small vessels (red line, closed circles) participating in the white shrimp fishery in Ciudad del Carmen, Campeche. Figure from INAPESCA 2012a.

Factor 1.3 Fishing mortality
Pink, Seabob and White Shrimp: Moderate Concern
Brown Shrimp: Low Concern

Key relevant information:
There are no quantitative estimates of fishing mortality in relation to F_{MSY} to determine biological reference points for GOM brown, pink, and white shrimp. A 2005 study estimated F_{MSY} for seabob shrimp and indicated that two years of landings illustrated that the fishery had exceeded this fishing threshold (Wakida-Kusunoki 2005). However, last year, seabob landings remained below this threshold (SAGARPA 2012b). Without more comprehensive data on effort and average landings, fishing mortality for the seabob, pink and white shrimp fisheries is unknown. Therefore, fishing mortality for GOM brown, pink, seabob, and white shrimp is unknown deemed a moderate concern. However, since brown shrimp stocks have remained stable for more than 25 years and there are increasing trends in CPUE, brown shrimp is deemed a low concern.

Detailed rationale:
There are no quantitative estimates of fishing mortality in relation to F_{MSY} for GOM brown, pink, or white shrimp species. Various studies have been documented showing the relationship between the abundance of shrimp and environmental variables such as salinity and temperature (Bielsa et al. 1983, Larson et al. 1989, Gracia et al. 1997). Although these studies have shown a relationship between shrimp distribution and juvenile growth, there is little information on how these factors impact species' biomass. Therefore, without quantitative fishing mortality estimates in relation to F_{MSY}, it is difficult to decipher whether stock reductions are due to fishing effort or environmental factors.

Brown shrimp landings in the northwestern Gulf of Mexico have been fairly stable since the establishment of seasonal closures in 1993 (annual catch around 12,000 mt), though there is no information on fishing effort to corroborate that this stability is independent of changes in fishing pressure (INAPESCA 2008, 2012a). Available short-term CPUE data, however, is encouraging. Since 2000, CPUE off Tamaulipas and Veracruz has increased by 123% and 52%, respectively (Figure 15) (INAPESCA 2008). In addition, economic profits have maximized due to landings of larger, more commercially viable shrimp. There is no information on the sex distribution of the observed landings. Since short-term trends in CPUE are increasing, and the fishery's stock has remained stable for more than 25 years, fishing mortality of GOM brown shrimp is deemed a low concern.

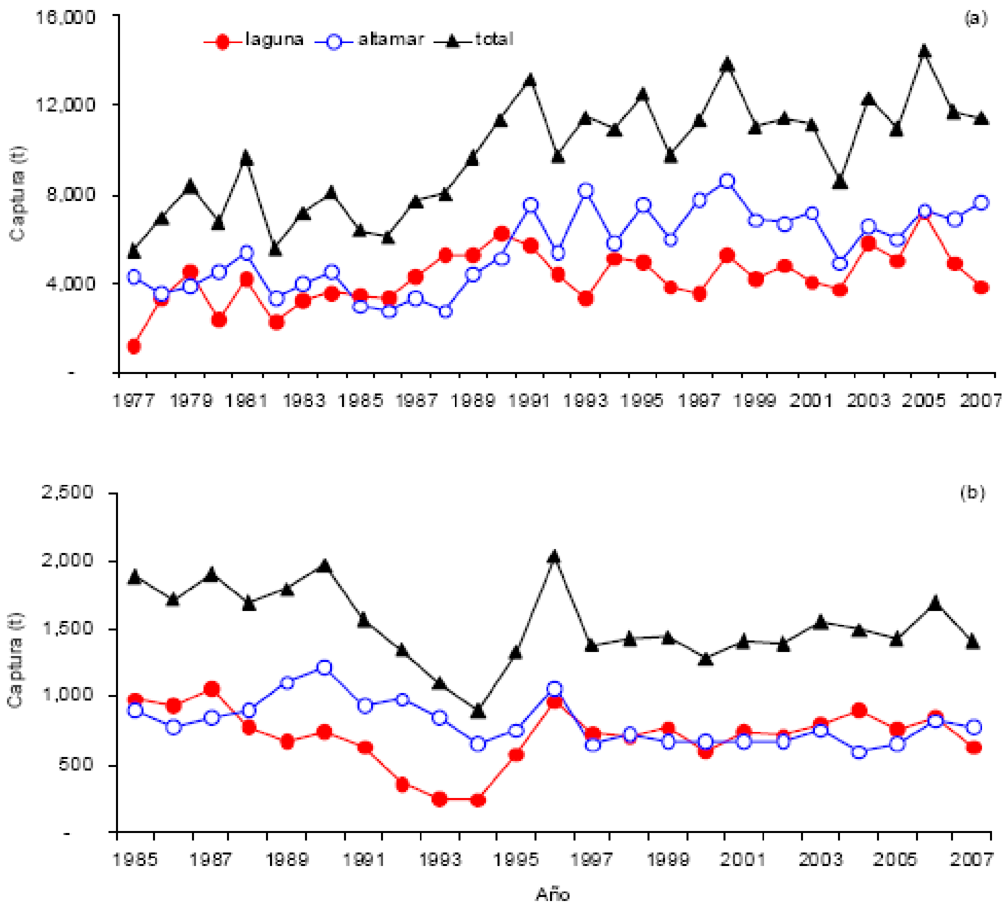


Figure 15. Catch (metric tons) of brown shrimp in Tamaulipas (a) and Veracruz (b). Open ocean landings are denoted by the blue line with open circles, estuarine landings are denoted by the red line with closed circles, and total landings are shown in the black line with closed triangles. Figure from INAPESCA 2008.

The Mexican government has placed temporal and spatial restrictions on the GOM **pink shrimp** fishery to promote stock recovery. In particular, there is an annual ban on pink shrimp fishing from May to October or November to allow female shrimp to mature to spawning age, and a ban on fishing in the coastal region from 0 to 15 miles to protect juvenile habitat (INAPESCA 2008). Even with these efforts, there is no evidence that the shrimp population has recovered from overexploitation (INAPESCA 2008, SAGARPA 2012). Additionally, there are no publicly available quantitative estimates of biomass or of fishing mortality in relation to MSY, making it difficult to discern whether the depressed stock is due to fishing pressure or environmental factors. For these reasons, fishing mortality of pink shrimp stocks in the GOM is deemed a moderate concern.

A 2005 study estimated **seabob shrimp**'s F_{MSY} to be approximately 1,700 mt with a maximum of 41,000 fishing trips per year (Wakida-Kusunoki 2005). Fishery-dependent data from the 1998-2000 fishing seasons showed catch rates exceeding this number (INAPESCA 2012a). However, catch data from 2011 show landings to be at 1,211 mt, below the calculated F_{MSY} (CONAPESCA 2012b). Despite the effort and season restrictions, it is unclear if overfishing is occurring in the GOM seabob fishery (Núñez-Márquez and Wakida 2003). There are no recent quantitative estimates of fishing mortality and landings have shown signs of stability. Due to this uncertainty, seabob shrimp mortality is deemed a moderate concern.

White shrimp annual landings have averaged 57 metric tons per year since 2000, though there has been a notable increase since 2001 (INAPESCA 2012a). The observed decline in landings in Campeche during the late-1990s was originally thought to be attributable to decreased fishing effort by the large vessel fleet. However, a study on recruitment and fisheries mortality was able to show that fisheries mortality from the large fleet was actually constant between 1998 and 2000, but that overall stock recruitment was depressed because of spawning female mortality in the small vessel coastal fishery between May and October of each year (INAPESCA 2008). A fishing ban covering this period has been in place since 2001; until 2006, fishing yield per boat had been steadily increasing (Figure 16) and the stock was believed to be showing signs of recovery. However, since that time, landings have decreased and have remained at low levels (Figure 16). The cause of the decreased landings is unclear. Without a clear understanding of the fishing mortality or the cause of the suppressed landings, white shrimp is considered a moderate concern.

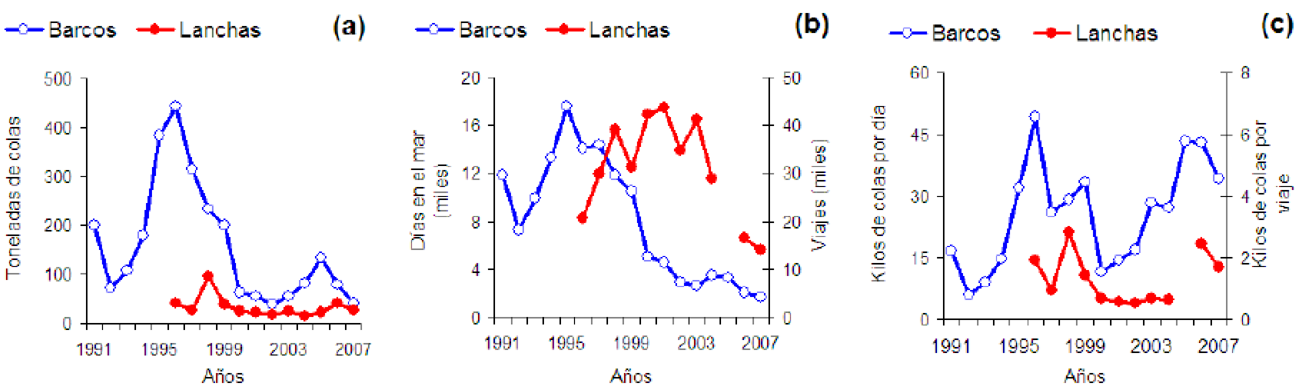


Figure 16. Landings (a) fishing days/trips (b) and CPUE in kg/day (c) for large vessels (blue line, open circles) and small vessels (red line, closed circles) participating in the white shrimp fishery in Ciudad del Carmen, Campeche. Figure from INPESCA 2008.

Criterion 2: Impacts on Other Retained and Bycatch tocks

Guiding Principles

- The fishery minimizes bycatch. Seafood Watch® defines bycatch as all fisheries-related mortality or injury other than the retained catch. Examples include discards, endangered or threatened species catch, pre-catch mortality and ghost fishing. All discards, including those released alive, are considered bycatch unless there is valid scientific evidence of high post-release survival and there is no documented evidence of negative impacts at the population level.
- Fishing mortality does not threaten populations or impede the ecological role of any marine life. Fishing mortality should be appropriate given each impacted species' abundance and productivity, accounting for scientific uncertainty, management uncertainty and non-fishery impacts such as habitat degradation.

Summary

Industrial Fleet (Pacific: Upper Gulf of California)—Trawls

Stock	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Subscore**	**Score** (subscore*discard modifier)	**Rank** (based on subscore)
Hammerhead, Scalloped (Sphyrna lewini)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Sea Turtle, Loggerhead (Caretta caretta)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Gulf Grouper (Mycteroperca jordani)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Totoaba (Totoaba macdonaldi)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Sea Turtle, Olive Ridley (Lepidochelys olivacea)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Angel Shark, Pacific (Squatina californica)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red

Guitarfish, Shovelnose (Rhinobatos productus)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red
Seahorse, Pacific (Hippocampus ingens)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red
Sea Turtle, Hawksbill (Eretmochelys imbricate)	High	Very High Concern (1)	Very Low Concern (5)	2.24	1.68	Yellow
Sea Turtle, Leatherback (Dermochelys coriacea)	High	Very High Concern (1)	Very Low Concern (5)	2.24	1.68	Yellow
Sea Turtle, Green (Chelonia mydas)	High	Very High Concern (1)	Very Low Concern (5)	2.24	1.68	Yellow
Guitarfish, Speckled (Rhinobatos glaucostigma)	High	Moderate Concern (3)	Moderate Concern (2.33)	2.64	1.98	Yellow
Ray, Haller's round (Urobatis halleri)	High	Moderate Concern (3)	Moderate Concern (2.33)	2.64	1.98	Yellow
Ray, Golden Cownose (Rhinoptera steindachneri)	Medium	Moderate Concern (3)	Moderate Concern (2.33)	2.64	1.98	Yellow
Ray, Chilean Round (Urotrygon chilensis)	High	Moderate Concern (3)	Moderate Concern (2.33)	2.64	1.98	Yellow
Ray, Dwarf Round (Urotrygon nana)	High	Moderate Concern (3)	Moderate Concern (2.33)	2.64	1.98	Yellow
Flounder, Oval (Syacium ovale)	Low	Low Concern (4)	Moderate Concern (2.33)	3.05	2.29	Yellow
Puffer, Bulleye (Sphoeroides annulatus)	Medium	Low Concern (4)	Moderate Concern (2.33)	3.05	2.29	Yellow

Grunt, Panama (Pomadasys panamensis)	Medium	Low Concern (4)	Moderate Concern (2.33)	3.05	2.29	Yellow
Majorra, Dark-spot (Eucinostomus entomelas)	Low	Low Concern (4)	Moderate Concern (2.33)	3.05	2.29	Yellow
Halibut ({aralichthys californicus)	Medium	Low Concern (4)	Low Concern (3.67)	3.83	2.87	Green
Shrimp, Blue (upper Gulf of CA)	Low	Low Concern (4)	Low Concern (3.67)	3.83	2.87	Green
Pacific flagfin mojarra (Eucinostomus currani)	Low	Very Low Concern (5)	Low Concern (3.67)	4.28	3.21	Green
Shrimp, Brown (upper Gulf of CA)	Low	Low Concern (4)	Very Low Concern (5)	4.47	3.35	Green

Industrial Fleet (Pacific: West Coast of Baja California)—Trawls

Stock	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Subscore**	**Score** subscore*discard modifier	**Rank** (based on subscore)
Shrimp, Brown (west coast of Baja CA)	Low	High Concern (2)	High Concern (1)	1.41	1.06	Red
Hammerhead, Scalloped (Sphyrna lewini)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Sea Turtle, Loggerhead (Caretta caretta)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Gulf Grouper (Mycteroperca jordani)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Sea Turtle, Olive Ridley (Lepidochelys	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red

olivacea)						
Angel Shark, Pacific (Squatina californica)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red
Guitarfish, Shovelnose (Rhinobatos productus)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red
Seahorse, Pacific (Hippocampus ingens)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red
Sea Turtle, Hawksbill (Eretmochelys imbricate)	High	Very High Concern (1)	Very Low Concern (5)	2.24	1.68	Yellow
Sea Turtle, Leatherback (Dermochelys coriacea)	High	Very High Concern (1)	Very Low Concern (5)	2.24	1.68	Yellow
Sea Turtle, Green (Chelonia mydas)	High	Very High Concern (1)	Very Low Concern (5)	2.24	1.68	Yellow

Industrial Fleet (Pacific: Sonora Central-South)- Trawls

Stock	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Subscore**	**Score** subscore*discard modifier)	**Rank** (based on subscore)
Hammerhead, Scalloped (Sphyrna lewini)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Sea Turtle, Loggerhead (Caretta caretta)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Gulf Grouper (Mycteroperca jordani)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Totoaba (Totoaba macdonaldi)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red

Sea Turtle, Olive Ridley (Lepidochelys olivacea)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Angel Shark, Pacific (Squatina californica)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red
Guitarfish, Shovelnose (Rhinobatos productus)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red
Seahorse, Pacific (Hippocampu s ingens)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red
Sea Turtle, Hawksbill (Eretmochely s imbricate)	High	Very High Concern (1)	Very Low Concern (5)	2.24	1.68	Yellow
Sea Turtle, Leatherback (Dermochelys coriacea)	High	Very High Concern (1)	Very Low Concern (5)	2.24	1.68	Yellow
Sea Turtle, Green (Chelonia mydas)	High	Very High Concern (1)	Very Low Concern (5)	2.24	1.68	Yellow

Industrial Fleet (Pacific: Sinaloa-Nayarit)—Trawls

Stock	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Subscore**	**Score** subscore*discard modifier)	**Rank** (based on subscore)
Shrimp, Blue (Sinaloa-Nayarit)	Low	High Concern (2)	High Concern (1)	1.41	1.06	Red
Shrimp, White	Low	High Concern (2)	High Concern (1)	1.41	1.06	Red
Hammerhead , Scalloped (Sphyrna lewini)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Sea Turtle, Loggerhead (Caretta	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red

caretta)						
Gulf Grouper (Mycteroperca jordani)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Totoaba (Totoaba macdonaldi)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Sea Turtle, Olive Ridley (Lepidochelys olivacea)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Angel Shark, Pacific (Squatina californica)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red
Guitarfish, Shovelnose (Rhinobatos productus)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red
Seahorse, Pacific (Hippocampus ingens)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red
Sea Turtle, Hawksbill (Eretmochelys imbricate)	High	Very High Concern (1)	Very Low Concern (5)	2.24	1.68	Yellow
Sea Turtle, Leatherback (Dermochelys coriacea)	High	Very High Concern (1)	Very Low Concern (5)	2.24	1.68	Yellow
Sea Turtle, Green (Chelonia mydas)	High	Very High Concern (1)	Very Low Concern (5)	2.24	1.68	Yellow

Industrial Fleet (Pacific: Gulf of Tehuantepec)— Trawls

Stock	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Subscore**	**Score** subscore*discard modifier)	**Rank** (based on subscore)
Shrimp, White	Low	High Concern (2)	High Concern (1)	1.41	1.06	Red
Hammerhead, Scalloped	High	Very High Concern (1)	Moderate Concern	1.53	1.14	Red

(Sphyrna lewini)			(2.33)			
Sea Turtle, Loggerhead (Caretta caretta)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Sea Turtle, Olive Ridley (Lepidochelys olivacea)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Shrimp, Brown (Gulf of Tehuantepec)	Low	Moderate Concern (3)	High Concern (1)	1.73	1.30	Red
Seahorse, Pacific (Hippocampus ingens)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red
Sea Turtle, Hawksbill (Eretmochelys imbricate)	High	Very High Concern (1)	Very Low Concern (5)	2.24	1.68	Yellow
Sea Turtle, Leatherback (Dermochelys coriacea)	High	Very High Concern (1)	Very Low Concern (5)	2.24	1.68	Yellow
Sea Turtle, Green (Chelonia mydas)	High	Very High Concern (1)	Very Low Concern (5)	2.24	1.68	Yellow

Artisanal Fleet (Pacific: Upper Gulf of CA)—Entanglement Nets

Stock	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Subscore**	**Score** subscore*discard modifier)	**Rank** (based on subscore)
Vaquita (Phocoena sinus)	High	Very High Concern (1)	Critical (0)	0.00	0.00	Critical
Totoaba (Totoaba macdonaldi)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.37	Red
Angel Shark, Pacific (Squatina californica)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.94	Red

Artisanal Fleet (Pacific: Sinaloa-Nayarit)— Entanglement Nets

Stock	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Subscore**	**Score** subscore*discard modifier)	**Rank** (based on subscore)
Shrimp, Blue (Sinaloa-Nayarit)	Low	High Concern (2)	High Concern (1)	1.41	1.27	Red
Gulf Grouper (Mycteroperca jordani)	High	Very High Concern (1)	Low Concern (3.67)	1.92	1.72	Red
Angel Shark, Pacific (Squatina californica)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.94	Red
Anchovy, Longnose (Anchoa nasus)	Low	Moderate Concern (3)	Moderate Concern (2.33)	2.64	2.38	Yellow
Bonefish, Threadfin (Albula nemoptera)	Medium	Moderate Concern (3)	Moderate Concern (2.33)	2.64	2.38	Yellow

Artisanal Fleet (Pacific: Sonora Central-South)—Entanglement Nets

Stock	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Subscore**	**Score** subscore*discard modifier)	**Rank** (based on subscore)
Gulf Grouper (Mycteroperca jordani)	High	Very High Concern (1)	Low Concern (3.67)	1.92	1.72	Red
Angel Shark, Pacific (Squatina californica)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.94	Red

Artisanal Fleet (Pacific: West Coast of Baja CA)—Magdelana I Trawl

Stock	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Subscore**	**Score** subscore*discard modifier)	**Rank** (based on subscore)
Shrimp, Brown (west coast of Baja CA)	Low	High Concern (2)	High Concern (1)	1.41	1.27	Red
Seahorse, Pacific (Hippocampus ingens)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.94	Red

Artisanal Fleet (Pacific: Sinaloa-Nayarit*)— Suripera nets*

Stock	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Subscore**	**Score** subscore*discard modifier)	**Rank** (based on subscore)
Shrimp, Blue (Sinaloa-Nayarit)	Low	High Concern (2)	High Concern (1)	1.41	1.27	Red
Gulf Grouper (Mycteroperca jordani)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.37	Red
Sea Turtle, Hawksbill (Eretmochelys imbricate)	High	Very High Concern (1)	Very Low Concern (5)	2.24	2.01	Yellow
Sea Turtle, Leatherback (Dermochelys coriacea)	High	Very High Concern (1)	Very Low Concern (5)	2.24	2.01	Yellow
Sea Turtle, Green (Chelonia mydas)	High	Very High Concern (1)	Very Low Concern (5)	2.24	2.01	Yellow
Sea Turtle, Olive Ridley (Lepidochelys olivacea)	High	Very High Concern (1)	Very Low Concern (5)	2.24	2.01	Yellow

Artisanal Fleet (Pacific: Sinaloa-Nayarit)—Cast nets

Stock	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Subscore**	**Score** subscore*discard modifier)	**Rank** (based on subscore)
No other main species caught				5.00	5.00	Green

Industrial Fleet (GOM)—Trawls

Stock	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Subscore**	**Score** subscore*discard modifier)	**Rank** based on subscore
Hammerhead, Scalloped (Sphyrna lewini)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Sea Turtle, Loggerhead (Caretta caretta)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Sea Turtle, Green (Chelonia mydas)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Sea Turtle, Hawksbill (Eretmochelys imbricate)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Sea Turtle, Kemp's Ridley (Lepidochelys kempii)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Sea Turtle, Leatherback (Dermochelys coriacea)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Sea Turtle, Olive Ridley (Lepidochelys olivacea)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red

Northern seahorse (Hippocampus erectus)	High	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red
Shrimp, Pink (GOM)	Low	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red
Shrimp, White (GOM)	Low	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red

Artisanal Fleet (GOM)—Small Trawl—Seabob Fishery

Stock	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Subscore**	**Score** subscore*discard modifier)	**Rank** based on subscore
Hammerhead, Scalloped (Sphyrna lewini)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Sea Turtle, Loggerhead (Caretta caretta)	High	Very High Concern (1)	Moderate Concern (2.33)	1.53	1.14	Red
Shrimp, Pink (GOM)	Low	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red
Shrimp, White (GOM)	Low	High Concern (2)	Moderate Concern (2.33)	2.16	1.62	Red

Artisanal Fleet (GOM)—Cast Nets

Stock	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Subscore**	**Score** subscore*discard modifier)	**Rank** (based on subscore)
Shrimp, Brown (GOM)	Low	Low Concern (4)	Low Concern (3.67)	3.83	3.83	Green
No other main species caught				5.00	5.00	Green

Artisanal Fleet (GOM)—Charanga nets

Stock	**Inherent Vulnerability** Rank	**Stock Status** Rank (Score)	**Fishing Mortality** Rank (Score)	**Subscore**	**Score** subscore*discard modifier	**Rank** (based on subscore)
Shrimp, Pink (GOM)	Low	High Concern (2)	Moderate Concern (2.33)	2.16	2.16	Red
Shrimp, White (GOM)	Low	High Concern (2)	Moderate Concern (2.33)	2.16	2.16	Red
Shrimp, Brown (GOM)	Low	Low Concern (4)	Low Concern (3.67)	3.83	3.83	Green

A wide variety of fish and invertebrate species are caught in the Mexican shrimp fisheries. The tables above are merely a small sample of the species richness caught in the Mexican shrimp fisheries including red snapper, brown rock shrimp, crystal shrimp, bigscale anchovies, Walker's anchovy, threadfin bonefish, Gulf butterfish, longspined crab, Atlantic croaker, oval flounder, sand bass, halibut, yellowfin herring, lesser blue crab, swimming crabs, brown crabs, majorra, pufferfish, and a variety of other fish and invertebrates. Many of these species are not of conservation concern and therefore are not assessed in further detail in this report. Retained and bycatch species that are analyzed in this assessment include vaquita (*Phocoena sinus)*, Pacific seahorse (*Hippocampus ingens*), the northern seahorse *(Hippocampus erectus*), Pacific angel shark (*Squatina californicasea*), shovelnose guitarfish (*Rhinobatos productus*), scalloped hammerhead (*Sphyrna lewini*), golden cownose ray (*Rhinoptera steindachneri*), sea turtles (including hawksbill (*Eretmochelys imbricate*), loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*), olive ridley (*Lepidochelys olivacea*), green(*Chelonia mydas*), and Kemp's ridley (*Lepidochelys kempii*)), totoaba (*Totoaba macdonaldi*), and Gulf grouper (*Mycteroperca jordani*) . These species have been selected for discussion because they are of conservation concern.

Justification of Ranking

Vaquita (Phocoena sinus)

Factor 2.1 Inherent Vulnerability: High Vulnerability

Key relevant information:
Vaquita are of high vulnerability (Seafood Watch 2012).

Factor 2.2 Stock Status: Very High Concern

Key relevant information:
Vaquita are listed as critically endangered by the International Union for Conservation of Natural Resources (IUCN) (Rojas-Bracho et al. 2008). Therefore, Seafood Watch® deems vaquita as a very high concern.

Detailed rationale:
The vaquita is a critically endangered cetacean species endemic to the Upper Gulf of California (north of Puertocitos and Puerto Peñasco). While flow and pollution for the Colorado River has caused habitat degradation and is a main source of the decline of the species (Rojas-Brancho and Taylor 1999), vaquita mortality is also due to entanglement nets or gillnets in the artisanal fishery (D'Agrosa et al. 2000, Rojas-Bracho et al. 2008). Fishing pressure from fisheries such as the Mexican shrimp fishery puts the vaquita at risk for extinction (D'Agrosa et al. 2000, Rojas-Bracho et al. 2008). Although vaquita mortality in fisheries is an important concern, Murguía (2002) discussed that genetic and evolutionary information currently available suggests that the vaquita population had been low prior to fishing pressure. It is important to continue implementing protective measures, including less fishing pressure with gears that catch vaquitas, the maintenance of freshwater inflow through the Colorado, the reduction of pollution and eradication of illegal fishing activity.

Factor 2.3 Fishing Mortality
Entanglement Net Fishery in Upper Gulf of California: Critical Concern
Other Fisheries: Not Assessed

Key relevant information:
Incidental catch of vaquita in the entanglement net or gillnet shrimp fishery is estimated at 30-40 individuals per year (Ardjosoediro and Bourns 2009). Experts have declared "acceptable" bycatch rates for vaquita to be less than one individual per year (D'Agrosa et al. 2000, Ardjosoediro and Bourns 2009). Since it is estimated that catch rates are far exceeding these acceptable thresholds, fishing mortality for vaquita in the entanglement net or gillnet shrimp fishery in the upper Gulf of California is of critical concern. The distribution of vaquita is limited to the upper Gulf of California, and vaquita are not known to be affected by other gear types, therefore, vaquita are not assessed for the other fisheries.

Detailed rationale:
A study by D'Agrosa et al. (2000) found that gillnet fisheries from just one fishing community, namely El Golfo de Santa Clara, Sonora, resulted in 39 vaquita mortalities per year, which is greater than 17% of the total population. Because the potential biological removal (PBR) rate for this species is 0.012 animals per year, this rate of morality, in conjunction with fishing pressure from other regional communities, is forcing the vaquita near extinction (D'Agrosa et al. 2000). A recent analysis suggests that, assuming this mortality rate is continuing, the vaquita will go extinct within two years due to high bycatch mortality (Jamarillo-Legorreta et al. 2007). To address these issues, managers have established MPAs in the Upper Gulf of California (SAGARPA 2012b, Gerrodette 2011). While MPAs have reduced bycatch of vaquita to some degree, vaquita populations are likely to continue to decline if managers do not implement stricter controls by

banning entanglement nets and gillnets and by requiring more selective gear throughout the vaquita's range (Gerrodette 2011). Although managers have taken some action to protect this species (SAGARPA 2012b), it is insufficient to effectively protect this species (Gerrodette 2011). Therefore, fishing mortality from the use of entanglement nets in the Upper Gulf of California of vaquita is considered of critical concern.

Pacific Seahorse (Hippocampus ingens) and Northern Seahorse (Hippocampus erectus)

Factor 2.1 Inherent Vulnerability: Low Vulnerability

Key relevant information:
The Pacific seahorse, which is found in the Mexican Pacific, has a FishBase vulnerability score of 27. The northern seahorse, which found in the Atlantic, has a FishBase vulnerability score of 31. Therefore, the inherent vulnerability of the Pacific and Northern seahorses is deemed low.

Factor 2.2 Stock Status: High Concern

Key relevant information:
Both seahorse species are listed as vulnerable by the IUCN (Project Seahorse 2003, Czembor et al. 2012). Therefore, Seafood Watch® deems Pacific and Northern seahorses as a high concern.

Factor 2.3 Fishing Mortality
Mexican Pacific (Trawls): Moderate Concern

Key relevant information:
Pacific and Northern seahorses have been recorded as bycatch in the Pacific and GOM Mexican shrimp fisheries (Baum and Vincent 2005). It is estimated that between 1999 and (date missing) 380,000 seahorses were incidentally caught along the Pacific coast each year (INAPESCA 2000b, Baum and Vincent 2005). Studies have shown that incidental catch of Pacific seahorse in the Mexican Pacific and Northern seahorses in the GOM shrimp fisheries may impact species abundances in these regions (Czembor et al. 2012; Project Seahorse 2003). However, the extent of these impacts is unknown. For these reasons, fishing mortality of Pacific and Northern seahorses for the Mexican Pacific (in all regions with all trawls and the west coast of Baja California using Magdalena I trawls) and the GOM trawl fishery is deemed a moderate concern.

Sharks and Rays: Pacific Angel Shark, Shovelnose Guitarfish, Scalloped Hammerhead

Factor 2.1 Inherent Vulnerability: High Vulnerability

Key relevant information:
The FishBase vulnerability score for Pacific angel sharks is 65. The FishBase vulnerability score for shovelnose guitarfish is 77. The FishBase vulnerability score for scalloped hammerhead is 81. Therefore, the inherent vulnerability of angel shark, shovelnose guitarfish and scalloped hammerhead is deemed high.

Factor 2.2 Stock Status
Pacific Angel Sharks: High Concern
Shovelnose Guitarfish: High Concern
Scalloped Hammerhead: Very High Concern

Key relevant information:
The Pacific angel shark stock experienced severe declines in the 1980s which caused the ban of gillnets along the California coast (Cailliet 2005). There is no evidence to indicate that the population has recovered and IUCN deems the species near threatened (Cailliet 2005). Therefore, Pacific angel sharks are considered a high concern.

Shovelnose guitarfish are targeted in the Mexican elasmobranch fishery and are vulnerable to bottom gillnets in the artisanal shrimp fishery (Márquez et al 2006). Due to effort increases in the 1990s, abundances of shovelnose guitarfish declined and do not appear to have rebounded (Márquez et al 2006). Since IUCN also deems shovelnose guitarfish as near threatened (Márquez et al 2006), therefore, Seafood Watch® considers the stock to be a high concern.

Studies show that scalloped hammerhead populations in the Northwest Atlantic decreased 98% from 1972 to 2003 (Baum et al. 2007). In the Gulf of California and Eastern Pacific, scalloped hammerhead stocks have sharply declined due to fishing pressure at adult aggregation sites (Baum et al 2007). Scalloped hammerhead sharks are being considered for inclusion in the Endangered Species Act (National Oceanic and Atmospheric Administration (NOAA) 2012d) and IUCN indicates that scalloped hammerhead sharks are endangered (Baum et al. 2007). Therefore, scalloped hammerhead sharks are deemed a very high concern.

Factor 2.3 Fishing Mortality
Mexican Pacific Trawl Fisheries: Moderate Concern

Key relevant information:
Shrimp trawls have been shown to be a source of mortality for sharks and rays, and coastal shark bycatch in the Mexican Pacific shrimp fishery (López-Martínez et al 2010). However, the rate at which Pacific Angel sharks, Shovelnose guitarfish, scalloped hammerheads are caught as bycatch in the shrimp fishery is unknown. Therefore, the impacts of the fishing mortality on these three elasmobranch species in the shrimp trawl fishery are considered a moderate concern.

Hawksbill Sea Turtles, Loggerhead Sea Turtles, Leatherback Sea Turtles, Olive Ridley Sea Turtles, Green Sea Turtles, and Kemp's Ridley Sea Turtles

Factor 2.1 Inherent Vulnerability: High Vulnerability

Key relevant information:
Hawksbill sea turtles, loggerhead sea turtles, leatherback sea turtles, olive ridley sea turtles, green sea turtles, and Kemp's ridley sea turtles are of high vulnerability (Seafood Watch 2012).

Factor 2.2 Stock Status: Very High Concern

Key relevant information:
Loggerhead sea turtles and leatherback sea turtles are listed as 'threatened' by the National Oceanic and Atmospheric Administration (NOAA) (NOAA 2012 b,c). Hawksbill, olive ridley, green, and Kemp's ridley sea turtles have been listed on the U.S. Endangered Species Act list in since 1970, 1978, 1978, and 1970, respectively, as endangered or threatened depending on the source of the breeding populations (NOAA 2012a). Therefore, Seafood Watch® deems all six sea turtle stocks as a very high concern.

Factor 2.3 Fishing Mortality
Trawl Fisheries in Mexican Pacific and GOM: Moderate Concern

Key relevant information:
Hawksbill sea turtles, green sea turtles, olive ridley sea turtles , and Kemp's ridley sea turtles have shown signs of recovery (Marquez 1994; Turtle Expert Working Group 2000, Garduño-Andrade et al. 1999; INP 2000; CITES 2001; Márquez et al. 2002, Guzmán-Hernández 2003) while loggerhead sea turtles still show signs of decline (Arauz 1996; SAGARPA 2004). However, since sea turtle bycatch rates are largely unknown in the shrimp fishery, it is difficult to decipher if these impacts are attributable to fishing pressure in Mexican Pacific and GOM shrimp fisheries or if other factors are at play (Abarca-Arenas et al. 2003). Therefore, fishing mortality is deemed a moderate concern.

Detailed rationale:
Trawls, longlines and gillnets have been discussed as the major sources of mortality for sea turtles around the world (Lewison and Crowder 2006). There is a technological solution that can reduce the take of sea turtles in shrimp trawls: a trap-door grate, called a turtle excluder device (TED), which allows turtles to push free of the net. The proper use of TEDs on shrimp trawl nets can reduce sea turtle bycatch by more than 90% (IAC 2007). INP (2000) reports that the Mexican shrimp fishery no longer poses an extinction threat to sea turtles, as the use of TEDs can reduce bycatch by 98%. However, realized reductions in mortality may be quite a bit less, depending on compliance with regulations and the suitability of TED designs to specific turtle species captured in the region (Lewison et al. 2003; Moore et al. 2009, Witherington et al. 2009). The actual mortality rate of sea turtles in the Mexican shrimp fisheries is unknown.

Toboaba

Factor 2.1 Inherent Vulnerability: High Vulnerability

Key relevant information:
The FishBase vulnerability score for totoaba is 82. Therefore, the inherent vulnerability of totoaba is deemed high.

Factor 2.2 Stock Status: Very High Concern

Key relevant information:
Totoaba are considered critically endangered by the IUCN (Findley 2010) and, in 1979, was listed as endangered under the US Endangered Species Act. Therefore, totoaba are considered a very high concern.

Factor 2.3 Fishing Mortality
Upper Gulf of California, Trawls and Entanglement Nets: Moderate Concern

Key relevant information:
There is evidence that this species is expanding its geographic range, suggesting positive strides towards population recovery (SAGARPA 2004). However, illegal poaching of totoaba continues (SAGARPA 2012) and catch rates both in and outside of the Mexican Pacific shrimp fisheries in the Upper Gulf of California is unknown. Therefore, fishing mortality using trawls and entanglement nets in the Upper Gulf of California is deemed a moderate concern.

Detailed rationale:
In 1989, 92% of juvenile totoaba mortalities were attributed to the shrimp trawl fishery operating in a totoaba nursery area in the upper Gulf of California (Barrera-Guevara 1990). In addition to fishing pressure, habitat degradation from the Colorado River has impacted the fishery (Findley 2010). To reduce fishing pressure and improve habitat quality, the Upper Gulf of California and Colorado River Delta Biosphere Reserve was established to protect the spawning and nursery habitat of many fish species, including totoaba. Additionally, fishing pressure from shrimp trawls and entanglement nets have been greatly reduced in this region (Román-Rodríguez and Hammann 1997). Current mortality rates are currently unknown.

Gulf Grouper

Factor 2.1 Inherent Vulnerability: High Vulnerability

Key relevant information:
The FishBase vulnerability score for the Gulf grouper is 85. Therefore, the inherent vulnerability of the Gulf grouper is deemed high.

Factor 2.2 Stock Status: Very High Concern

Key relevant information:
Gulf grouper stocks have experienced a 50% decline over the last 30 years (Craig et al. 2008). IUCN has put the Gulf grouper on their red list and classified it as endangered (Craig et al. 2008). Therefore, the Gulf grouper is considered a very high concern.

Factor 2.3 Fishing mortality
Upper Gulf of California Trawl: Moderate Concern
Upper Gulf of California Entanglement net: Low Concern

Key relevant information:
Gulf groupers are incidentally caught in shrimp trawls in the Mexican Pacific and entanglement nets in the Gulf of California (Craig et al. 2008, Balmori Ramírez and Morales Azpeitia 2012). The extent of incidental catch in these shrimp fisheries is unknown, therefore, the impacts of the fishing mortality on Gulf groupers using industrial trawls in the Upper Gulf of California is considered a moderate concern. Data from entanglement net use in the Upper Gulf of California show very occasional catch of Gulf groupers, and are considered a low concern.

Factor 2.4 Overall Discard Rate

Key relevant information:
When information about the specific impacts of the various gear types used to catch shrimp in the Mexican Pacific and Gulf of Mexico were not available, generalizations were made based on gear studies in other regions. The discard to landings ratio in the shrimp fisheries are as follows:

Mexican Pacific		Seafood Watch Category
Industrial Fleet—Trawls	900% (Grande-Vidal and Arias (1996)	>100%
Artisanal Fleet– Entanglement nets/gillnets	50% (Balmori Ramírez and Morales Azpeitia 2012)	40%–60%
Artisanal Fleet—Cast nets	high selectivity, low discard mortality (Garcia-Caudillo 2013)	0%–20%
Artisanal Fleet—Magdelena I Trawl	55.6% of catch (INAPESCA 2000b)	40%–60%
Artisanal Fleet—Suripera nets	50% (Balmori Ramírez and Morales Azpeitia 2012)	40%–60%
Gulf of Mexico		
Industrial Fleet–Trawls	300% to 600% (INAPESCA 2006b)	>100%
Artisanal Fleet—Small trawl- Seabob Fishery	600% (Wakida-Kusuoski 2005)	>100%
Artisanal Fleet—Cast nets	high selectivity, low discard mortality (Garcia-Caudillo 2013)	0%–20%
Artisanal Fleet—Charanga nets	high selectivity, low discard mortality (SAGARPA 2004)	0%–20%

Criterion 3: Management Effectiveness

Guiding Principle

- The fishery is managed to sustain the long-term productivity of all impacted species. Management should be appropriate for the inherent resilience of affected marine life and should incorporate data sufficient to assess the affected species and manage fishing mortality to ensure little risk of depletion. Measures should be implemented and enforced to ensure that fishery mortality does not threaten the long-term productivity or ecological role of any species in the future.

Summary

Mexican Pacific

Fishery	**Management: Retained Species** Rank (Score)	**Management: Non-retained species** Rank (Score)	**Criterion 3** Rank (Score)
Industrial Fleet (Pacific: Upper Gulf of California)–Trawls	High Concern (2)	High Concern (2)	Red (2)
Industrial Fleet (Pacific: West Coast of Baja California)–Trawls	High Concern (2)	High Concern (2)	Red (2)
Industrial Fleet (Pacific: Sonora Central-South)–Trawls	High Concern (2)	High Concern (2)	Red (2)
Industrial Fleet (Pacific: Sinaloa-Nayarit)–Trawls	High Concern (2)	High Concern (2)	Red (2)
Industrial Fleet (Pacific: Gulf of Tehuantepec)–Trawls	High Concern (2)	High Concern (2)	Red (2)
Artisanal Fleet (Pacific: Upper Gulf of CA)–Entanglement nets	High Concern (2)	High Concern (2)	Red (2)

Artisanal Fleet (Pacific: Sinaloa-Nayarit)–Entanglement nets	High Concern (2)	High Concern (2)	Red (2)
Artisanal Fleet (Pacific: Sonora Central-South)–Entanglement nets	High Concern (2)	High Concern (2)	Red (2)
Artisanal Fleet (Pacific: West Coast of Baja CA)–Magdelena I	High Concern (2)	High Concern (2)	Red (2)
Artisanal Fleet (Pacific: Sinaloa-Nayarit)–Suripera nets	High Concern (2)	High Concern (2)	Red (2)
Artisanal Fleet (Pacific: Sinaloa-Nayarit)–Cast nets	High Concern (2)	All Species Retained (N/A)	Red (2)

GOM

Fishery	**Management: Retained Species** Rank (Score)	**Management: Non-retained species** Rank (Score)	**Criterion 3** Rank (Score)
Industrial Fleet (GOM)–Trawls	Very High Concern (1)	High Concern (2)	Red (1.41)
Artisanal Fleet (GOM)- Small trawls–Seabob Fishery	Very High Concern (1)	High Concern (2)	Red (1.41)
Artisanal Fleet (GOM)–Cast nets	Very High Concern (1)	All Species Retained (N/A)	Red (1)

Artisanal Fleet (GOM)– Charanga nets	Very High Concern (1)	High Concern (2)	Red (1.41)

Justification of Ranking

Factor 3.1 Management of Fishing Impacts on Retained Species
GOM: Very High Concern
Mexican Pacific: High Concern

Key relevant information:
Mexican fisheries managers, including SAGARPA, CONAPESCA, and INAPESCA, employ a variety of management tools to manage shrimp stocks. Management has a poor track record of improving some blue, white and pink shrimp stocks in the Mexican Pacific and GOM but has been successful in maintaining various brown and seabob shrimp stocks. Blue shrimp in Sinaloa-Nayarit and white shrimp in the Gulf of Tehuantepec remain overfished despite management's attempts to control effort through closed seasons, attrition, and gear modifications (David and Lucile Packard Foundation 2008, David and Lucile Packard Foundation 2012, FAO 2008, Dubay et al. 2010). However, managers are investigating new options in the Mexican Pacific with the establishment of a pilot quota system for blue shrimp (Dubay et al. 2010, INAPESCA 2010, SAGARPA 2012b). Pink and white shrimp in the GOM also remain overexploited. However, it is unclear if these stocks remain depressed due primarily to environmental factors or overfishing (CONAPESCA 2008, INAPESCA 2008, INAPESCA 2009b, SAGARPA 2012b). Regardless, management's efforts to improve these two stocks have been ineffective. On the other hand, brown shrimp in the Mexican Pacific and GOM and seabob shrimp in the GOM have generally maintained a steady stock status through time (INAPESCA-CONAPESCA 2004, INAPESCA 2008, 2009a, SAGARPA 2012a) indicating that management's efforts have been successful in some shrimp stocks. There are regular assessments of all shrimp species, but biomass and fishing mortality estimates in relation to MSY are not available. Illegal fishing continues to be one of the most complex problems facing the shrimp fishery in Mexico and other Mexican fisheries (SAGARPA/INAPESCA 2000, INAPESCA-CONAPESCA 2004). Illegal fishing, (i.e., fishing out of season, unpermitted vessels, the use of banned techniques, and fishing inside of MPAs), is estimated to be around 30 to 50 percent of the catch for all Mexican fisheries (SAGARPA/INAPESCA 2000, INAPESCA-CONAPESCA 2004, Godoy 2012, Cisneros-Montemayor et al. 2013). To combat these issues, managers have implemented a few "fixes" such as observer surveillance programs, vessel monitoring systems (VMS), and a program to identify the number of artisanal and unregistered vessels fishing in Mexican waters, to help enforce management measures (FAO 2008, Dubay et al. 2010). For these reasons, management is of a very high concern.

Detailed rationale:
Management Strategy and Implementation: Management measures for the shrimp fishery include gear specifications, seasonal closures, areas closures, the mandatory use of fish exclusion devices (FEDs), also called bycatch reduction devices (BRDs), and TEDs, as well as regulations regarding marine mammal bycatch (FAO 2003, FAO 2012). Gear type specifications, such as catch

size limits, mesh size, fishing gear prohibitions and spatiotemporal restrictions, are regulated throughout Normas Oficiales Mexicanas (NOMs, or Mexican Official Standards, the Mexican equivalent to the U.S. Federal Register), and the Carta Nacional Pesquera (CNP, “the National Marine Chart”). During the 2010/2011 season, a catch share system was implemented in the West Coast Mexican shrimp fisheries (INAPESCA 2010, SAGARPA 2012a).

Although closed seasons have been used in the Mexican Pacific for decades, it was not until 1993 that they began to be established in the Gulf of Mexico (FAO 2003). Closed seasons vary by coast and fishing area. The Mexican Pacific shrimp fishery is closed between March and September for all fishing areas. The GOM is generally closed between May and September, with small variations in closure dates for coastal and oceanic fisheries (DOF 2006).

In 2005, CONAPESCA allocated approximately 27 million pesos (US$2.54 million) to producers in the Mexican Pacific and GOM to help reduce fishing pressure on the shrimp fisheries and to implement a voluntary decommissioning of the Mexican fleet (FAO 2008). The program sought to reduce the quantity of industrial vessels by 30% between 2005 and 2010 (Dubay et al. 2010). Overall, the program was effective in reducing the industrial shrimp fleet by 50% from 1594 in 2005 to 761 in 2011 (SAGARPA 2005, FAO 2008, IDubay et al. 2010, SAGARPA 2011).

The Mexican Federal Government has implemented several actions to promote sustainable fisheries, including the Sustainability Law for Fisheries enacted in 2007. NOM-064-PESC-2006 establishes regulations on fishing gears, including a ban on trawls in estuaries, lagoons and bays, a ban of all gear types and nets on reefs, and a ban on trawling at depths less than 9.2 meters (NOM-002-PESC-1993). According to a recent study on shrimp fisheries funded by the Packard Foundation, there is also an increasing interest on the part of fishermen in improving the sustainability of fishing practices. In particular, industrial fishermen have agreed to the use of BRDs, and fishermen in both sectors have agreed to use more efficient, lightweight nets and to abide by legal bans on trawling in bays and MPAs (David and Lucile Packard Foundation 2008, PROFEPA 2012).

In 2008, a new national program and strategy (Programa Rector Nacional de Pesca y Acuacultura) was developed to guide and improve sustainable fisheries development, account for a socioeconomic and technological development, update management strategies, establish more tight-knit coordination between the federal agencies and state governments and allocate the benefits of Mexican natural resource between conservation, economic, and social aims (CONAPESCA 2008). To accomplish these objectives, the plan established updated and improved strategies and guidelines for responsible forms of fishing and draft regional management strategies for commercial species (CONAPESCA 2008).

According to the 2007 General Law of Sustainable Fishing and Aquaculture, the National Fisheries Institute must implement management plans for some fisheries, including the shrimp fishery. Management plans should include a life history and stock status and appropriate levels of harvest for the target species, as well as management objectives and habitat restoration strategies. The management plan for the shrimp fishery (INAPESCA-CONAPESCA 2004) is focused on maximizing economic profit while leading the fishery towards sustainable yields, maintaining biomass and recruitment, reducing interactions with the environment or other fisheries and improving the quality of the marine products.

Other tools, such as quotas, are also being examined to determine whether they can improve shrimp stocks (García Juárez 2009). Fisheries managers have, and continue to use, a wide range of management tools to protect the biological and economic sustainability of the Mexican Pacific and GOM shrimp fisheries. While some of these management techniques have been effective at protecting many penaeid species, some stocks continue to decline and there is a need for increased precaution to achieve the goals of reducing fishing mortality and improving stocks (SAGARPA 2012b). Therefore, management strategy and implementation for **Mexican Pacific and GOM industrial and artisanal shrimp fisheries** is considered moderately effective.

Recovery of Stocks of Concern: Establishing closed seasons has been an especially effective management strategy for certain shrimp species (INAPESCA 2006b, INAPESCA 2008, INAPESCA 2012a). Similar to the GOM, closed areas have been widely utilized in the Mexican Pacific as a means of protecting the spawning period of important penaeid species (INAPESCA 2009a, INAPESCA 2009b, SAGARPA 2012b). Studies have shown that while white shrimp recruits in the Gulf of the Tehuantepec were well protected during the closed season (Cervantes-Hernández et al. 2008), blue shrimp show little response to closed areas in Sinaloa-Nayarit (INAPESCA 2009b, INAPESCA 2012c). It is unclear to what extent the Sinaloa-Nayarit blue and white shrimp and Gulf of Tehuantepec stocks are depressed due to overfishing, environmental factors, or a combination of both (SAGARPA 2012b, INAPESCA 2012c). As a result, management is considering a new set of area closures (NOM-002-PESC-1993 (12/31/93 DOF) and its amendment (07.30.97 DOF)) and modifying closed areas and times as appropriate (NOM-009-PESC-1993 (04/03/94 DOF)). Managers have also implemented measures to reduce fishing effort including restricting trawling in the area of 0 to 9.14 meters (0-5 fathoms) deep, and establishing a maximum power for outboard motors. Managers have proposed other methods of decreasing fishing mortality including improved enforcement of illegal fishing, reduction of bycatch, continued studies aimed at improving selectivity of fishing gear, and implementing catch quotas nationwide (Dubay et al. 2010, INAPESCA 2010, SAGARPA 2012b). While some stocks have not responded to these management measures, blue and brown shrimp on the west coast of Baja California have shown signs of improving trends (CONAPESCA 2008, INAPESCA 2012c). Since management measures have been met with mixed results, management in **Mexican Pacific industrial and artisanal fisheries** is considered moderately effective.

The catch taken by the major fleet in Tamaulipas (GOM) showed a negative trend in the 1980s. Since the establishment of closed seasons in 1993, there has been a marked increase in stocks (INAPESCA 2006a). This strategy has not been effective for the pink shrimp fishery, which has also not responded to any attempts at stock recovery. There is some speculation that the sustained depression of pink shrimp populations may be related to environmental changes such as temperature and salinity rather than to fishing pressure (Ramírez-Rodríguez 2003, INAPESCA 2006b). INAPESCA suggests that the closed season has been beneficial in supporting reproduction and growth, which may encourage stock recovery. However, recruitment continues to be low

(INAPESCA 2011). Efforts targeting the recovery of GOM white shrimp have also been put into place, and include the deterrence of illegal fishing activities and the protection of nursery areas, such as Laguna de Términos, Campeche, to encourage white shrimp recovery (INAPESCA 2006a). These results suggest that additional measures are needed to encourage stock recovery of pink and white shrimp in the GOM. Carta Nacional Pesquera suggests that further reductions in landings of pink and white shrimp in the GOM are necessary to encourage stock recovery (SAGARPA 2012b). A 30% reduction in fishing mortality, moratorium on new fishing licenses, increased enforcement, reevaluation of closed periods, and redefining benchmarks were all suggested as strategies for improving these stocks (SAGARPA 2012b). Since the status of these stocks has been unchanged since it was first defined in 2000 (SAGARPA/INAPESCA 2000) and a robust recovery plan has not yet been developed or implemented, recovery of stocks of concern in the **GOM industrial and artisanal fisheries** is considered ineffective.

Scientific Research and Monitoring: The National Fisheries Institute regularly conducts scientific monitoring to evaluate the status of wild stocks and the impacts of management measures. The most important effort for maintaining the sustainability of shrimp stocks involves protection of annual spawning and recruitment periods. As such, scientific monitoring for these stocks is undertaken to guide the establishment of open and closed fishing seasons (INAPESCA 2006a, 2008, 2009a). Periods for closed-open seasons are reviewed every year and change according to suggestions made by the National Fisheries Institute.

Quantitative assessments of biomass and fishing mortality in relation to MSY are lacking, particularly those in the GOM, but there are regular assessments of relative abundance and size structure, and spawning stock potential is examined annually during the closed season. Since management regularly evaluates penaeid stocks, but does not provide information in relation to MSY, management in **Mexican Pacific and GOM industrial and artisanal shrimp fisheries** is deemed moderately effective.

Scientific Advice: Seasonal closures are based on the results of investigations by INAPESCA (National Institute of Fishing and Aquaculture) who utilize both internal and external scientists. INAPESCA shares its expert opinion with decision-makers (SAGARPA 2012b). This coordination appears to be commonplace in all aspects of shrimp fishery management in the Mexican Pacific and GOM. For this reason, scientific advice of **Mexican Pacific and GOM industrial and artisanal shrimp fisheries** is deemed highly effective.

Enforcement: Illegal fishing is one of the most important and complex problems facing the shrimp fishery in Mexico (SAGARPA/INAPESCA 2000, INAPESCA-CONAPESCA 2004, Cisneros-Montemayor et al. 2013). There are *mapacheros* who engage in the infringement of spatial and seasonal closures, *pescadores libres* who engage in entry violations, *changueros* who use illegal gear (including changos) and *guaterismo* who engage in black market activity (Vasquez 1994). There is also illegal overcapitalization of fixed gear. Although there are a fixed number of "charangas" authorized for fishing in Laguna Madre, Tamaulipas, a number of unauthorized charangas (or artisanal) fishermen in the Mexican Pacific have been observed contributing to the increase in fishing pressure (Fernández-Mendez and Escarpín-Hernández 2003, SAGARPA/INAPESCA 2000, INAPESCA-CONAPESCA 2004, FAO 2008). A recent study revealed that actual catches may be as much as twice as high as official reports due to illegal fishing (Cisneros-Montemayor et al. 2013). In 2009, CONAPESCA began implementing a program to identify the number of artisanal and unregistered vessels fishing in Mexican waters to help enforce management measures (Dubay et al. 2010). Still, illegal fishing continues to be one of the most complex problems facing the shrimp fishery and many other fisheries in Mexico (SAGARPA/INAPESCA 2000, INAPESCA-CONAPESCA 2004, SAGARPA 2012b, Godoy 2012, Cisneros-Montemayor et al. 2013).

Observer, inspection and surveillance programs such as an onboard observer program and the VMS have been enacted to, among other things, combat illegal activities associated with fisheries and marine protected areas (CONAPESCA 2006, FAO 2008). The Program for Sustainable Fishing and Species Protection in the Gulf of California has enacted an onboard observer program, in which trained observers gather information on target catch, bycatch, and fishing techniques to verify compliance with federal fishing regulations. The National Fish Inspection and Surveillance Program under the Program for Sustainable Fishing and Species Protection checks the legal origin of fishing products in observance with applicable NOMs. The National Verification Program controls imports and distribution of national fishing products, byproducts and live organisms and ensures that all of the above meet aquatic standards. UNEP (2004) discussed that a moderate, positive change can be expected if the fishery industry and local fisherman respect fisheries legislation.

Despite these efforts, management has identified eliminating illegal fishing practices as a high priority (SAGARPA 2012b), which has been mentioned in various reports as a continuing issue (INAPESCA 2006b, FAO 2008, SAGARPA 2012b). Therefore, enforcement in the **Mexican Pacific and GOM industrial and artisanal shrimp fisheries** is deemed ineffective.

Track Record: Management has a mixed track record in regards to status of shrimp stocks in both the Mexican Pacific and GOM. While brown and seabob shrimp stocks in the Mexican Pacific and GOM are generally believed to be healthy, white shrimp in the Mexican Pacific and pink shrimp stocks in the GOM have been overfished and are not rebuilding. In the Mexican Pacific a catch share system was implemented in the 2010/2011 (INAPESCA 2010, CONAPESCA 2012a) to help manage overexploitation of blue and white shrimp and prevent any increases in fishing pressure on brown shrimp. The results of this program are unknown since the program has not been in place long enough. Therefore, the track record in the **Mexican Pacific industrial and artisanal fisheries** is deemed moderately effective. Since no detailed rebuilding plans of fishery management have been developed in the GOM fisheries to prevent increases in fishing pressure and to help rebuild stocks, the track record in the **GOM industrial and artisanal fisheries** is deemed ineffective.

Stakeholder Inclusion: Review, evaluation, and revision of laws by management is often based on demand by producers and fishermen (CONAPESCA 2012a). It should be noted that stakeholders (including NGOs, universities and researchers) are allowed to participate in the development process of NOMs the extent to which is unknown. Federal laws govern the public's access to information, including fisheries information. The government will make reports and analyses available to the public so long as it does not compromise national security and governmental investigations, impair negotiations and international relations, or damage the financial stability or economic or monetary policy of the country (CONAPESCA 2012a). Since the management process is transparent and includes some stakeholder consultation, stakeholder inclusion of the **Mexican Pacific and GOM industrial and artisanal shrimp fisheries** is deemed highly effective.

Factor 3.2 Management of Fishing Impacts on Bycatch Species: High Concern

Key relevant information:
Fisheries managers have employed a variety of bycatch reduction programs to target threatened and endangered species {Garica-Caudillo, 2000; García and Gómez, 2005; IAC, 2006; Ardjosoediro, 2009}. While there have been innovations in gear modifications and uses (INAPESCA-CONAPESCA 2004, CONAPESCA 2012a, SAGARPA 2012b), it is unclear whether bycatch numbers have been reduced to appropriate levels since no targets have been set. Noncompliance with fisheries regulations also continues to be an issue. For these reasons, management of fishing impacts on bycatch species in the Mexican Pacific and GOM industrial and artisanal shrimp fisheries is rated as a high concern.

Detailed rationale:
Management Strategy and Implementation: Bycatch reduction programs are targeted at a number of threatened and endangered marine species, as well as at native finfish populations (Garica-Caudillo and Gómez 2000, García and Gómez 2005; IAC 2011, Ardjosoediro 2009). The Mexican fisheries managers have used a variety of tools to address these problems including gear restrictions and modifications, closed areas, and onboard observer systems (Fernández-Mendez and Escarpín-Hernández 2003, FAO 2008 2011, SAGARPA 2012b).

Development of more selective gear has been an important focus for managers in reducing bycatch. Currently, the installation of FEDs have been mandated in the GOM and in the Mexican Pacific on all shrimp vessels fishing with any type of trawl gear and on all vessels fishing in vaquita habitat (INAPESCA-CONAPESCA 2004, SAGARPA 2012b). FEDs and BRDs have the potential to reduce bycatch by 30% and 60% when properly used (Dubay et al. 2010). García and Gómez (García and Gómez 2005) observed that “fisheye” type and “extended tunnel” type FEDs decrease bycatch by 24% and 37%, respectively, without significantly decreasing shrimp catches (0% for “extended tunnel” type and 7% for “fisheye” type). INAPESCA studies (2004) studies observed that the use of FEDs resulted in a 45% decline in bycatch (SAGARPA 2004). The advantages of using these excluding devices are undeniable as they might decrease the ecological impacts of the shrimp fishery.

In addition to FEDs, TEDs have been required on all trawl vessels in the Mexican Pacific and GOM since 1992 (SAGARPA 2012b). While reports suggest that TEDs have been effective in mitigating turtle bycatch in the Mexican shrimp fishery, there are no reliable estimates for the overall effect of this gear modification. However, in recent years, some turtle populations have shown signs of recovery including olive ridley turtle (*Lepidochelys olivacea*) in the Mexican Pacific and the Kemp ridley turtle (*Lepidochelys kempii*) in the GOM (IAC 2011).

Vaquita

A vaquita protection program has been developed under the Program for Sustainable Fishing and Species Protection to formulate guidelines for the operation of industrial and artisanal fleets in areas open to fishing, and to define and validate the limits of fisheries exclusion areas designated for vaquita protection. There are also non-governmental initiatives to promote vaquita conservation in the Gulf of California. Ocean Garden, the leading shrimp exporter to the U.S., the Natural Resources Defense Council (NRDC) and a number of other NGOs have signed an agreement with fishermen to create a monitoring program to protect the vaquita by eradicating illegal fishing and ensuring sustainability of fisheries (Rojas-Bracho et al. 2006). This agreement resulted in the formation of a further coalition, Alto Golfo Sustentable, also including representatives of artisanal fisherman cooperatives, shrimp trawlers from Puerto Peñasco and several other NGOs, to promote sustainability and social fairness in the Gulf of California. As part of this effort, a recent study conducted in San Felipe and Golfo de Santa Clara (WWF-INE 2006) reports that fishermen in the Upper Gulf of California understand the importance of protecting the vaquita and agree with the proposal of not using gillnets with mesh size greater than six inches.

Gillnet fishing pressure in the Upper Gulf of California was somewhat reduced in 1993 following the establishment of the Upper Gulf of California and Colorado River Delta Biosphere Reserve (Román Rodríguez 1997). Additionally, progress has been made on the development of alternative fishing gears and improving the selectivity of current gears (e.g., suripera nets) (WWF-INE 2006, Ardjosoediro and Bourns 2009). In addition, the present vaquita protection strategy includes several instruments, namely the prohibition of gillnets with greater than six-inch mesh size[2], closed fishing areas, decreased fishing effort (both in terms of vessel number and season length) and a VMS Program (Rojas-Bracho et al. 2006).

Meetings to analyze issues surrounding declines in the vaquita population have been encouraged to aid in the implementation of a management plan. Additional actions include the evaluation of the Secretarial Resolution for the Vaquita Refuge, the application of strategies (in conjunction with CONAPESCA) to eradicate gillnet use, joint operations with PROFEPA and the Navy to ensure compliance with protected area regulations, and the dedication of funds to establish a Sustainable Development Program for the upper Gulf of California (SEMARNAT official letter SFNA/DGSPRNR/121/01 available at http://www.vaquitamarina.org/english/noticia007.php). A community surveillance program has also been established to eliminate illegal fishing (http://www.vaquitamarina.org/grupoalto.php; last accessed March 30 2008).

Although bycatch limits have not been set and bycatch catch rates are unknown, managers continue to require gear modifications and, in the case of the vaquita and sea turtles, have implemented management programs to reduce the incidence of bycatch. For these reasons,

[2] Artisanal and industrial fishermen (Federaciones del Golfo de Santa Clara; Armadores Unidos de Peñasco and Camara Pesquera de Puerto Peñasco; in: http://www.vaquitamarina.org/ags/CartasdeSantaClarayPuertoPenasco.pdf; last accessed March 20; 2008) signed an agreement on April 2006 accepting the ban against gillnets with a mesh size greater than six inches to ensure the protection of the Vaquita. Fisherman displayed interest in getting involved with federal agencies to help implement the management plan.

management strategy and implementation of bycatch in the **Mexican Pacific and GOM industrial and artisanal shrimp fisheries** is deemed moderately effective.

Scientific Research and Monitoring: As mentioned in the section above, managers continue investigating gear efficiency and modifications (INAPESCA 2012b). Observer coverage and robust monitoring data sets that provide insights into the impacts of shrimp fishing on species of concern and other rare species are lacking, but gear modification has shown a decrease in the incidence of bycatch (SAGARPA/INAPESCA 2000). Due to mixed results, scientific research and monitoring in the **Mexican Pacific and GOM industrial and artisanal shrimp fisheries** is considered moderately effective.

Scientific Advice: Area and seasonal closures are based on the results of investigations of the INAPESCA, who utilize both internal and external scientists. INAPESCA shares their expert opinion with decision makers (CONAPESCA 2012a). This coordination appears to be commonplace in all aspects of shrimp fishery management in the Mexican Pacific and GOM. For this reason, scientific advice of **Mexican Pacific and GOM industrial and artisanal shrimp fisheries** is deemed highly effective.

Enforcement: In recent years, the greatest challenge to bycatch reduction has been the lack of enforcement of fisheries regulations intended to protect threatened and endangered species (Fernández-Mendez and Escarpín-Hernández 2003, FAO 2008). The primary effort to address this lack of enforcement is the Onboard Observer Program and the VMS (CONAPESCA 2006). These systems have shown satisfactory results and are expected to ensure compliance with federal protected species regulations (CONAPESCA 2012a). However, other studies have shown a great deal of continued noncompliance with federal regulations. Aragón-Noriega et al. (Aragón-Noriega et al.) discovered that despite the buyout programs implemented by the federal government, 23% of fishermen in the Upper Gulf of California region continued fishing. Other research found fishermen illegally fishing in spatial and seasonal closures areas and using illegal gear (Vasquez 1994). Since compliance is inadequate, enforcement in the **Mexican Pacific and GOM industrial and artisanal shrimp fisheries** is deemed ineffective.

Criterion 4: Impacts on the Habitat and Ecosystem

Guiding Principles

- The fishery is conducted such that impacts on the seafloor are minimized and the ecological and functional roles of seafloor habitats are maintained.
- Fishing activities should not seriously reduce ecosystem services provided by any fished species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity.

Summary

Mexican Pacific

Fishery	Gear type and substrate Rank (Score)	Mitigation of gear impacts Rank (Score)	EBFM Rank (Score)	Criterion 4 Rank (Score)
Industrial Fleet (Pacific: Upper Gulf of California) – Trawls	Moderate Concern (2)	Minimal mitigation (0.25)	Moderate Concern (3)	Yellow (2.6)
Industrial Fleet (Pacific: West Coast of Baja California) – Trawls	Moderate Concern (2)	Minimal mitigation (0.25)	Moderate Concern (3)	Yellow (2.6)
Industrial Fleet (Pacific: Sonora Central-South) – Trawls	Moderate Concern (2)	Minimal mitigation (0.25)	Moderate Concern (3)	Yellow (2.6)
Industrial Fleet (Pacific: Sinaloa-Nayarit) – Trawls	Moderate Concern (2)	Minimal mitigation (0.25)	Moderate Concern (3)	Yellow (2.6)
Industrial Fleet (Pacific: Gulf of Tehuantepec) – Trawls	Moderate Concern (2)	Minimal mitigation (0.25)	Moderate Concern (3)	Yellow (2.6)

Artisanal Fleet (Pacific: Upper Gulf of CA)–Entanglement nets	Low Concern (3)	Minimal mitigation (0.25)	Moderate Concern (3)	Yellow (3.12)
Artisanal Fleet (Pacific: Sinaloa-Nayarit)–Entanglement nets	Low Concern (3)	Minimal mitigation (0.25)	Moderate Concern (3)	Yellow (3.12)
Artisanal Fleet (Pacific: Sonora Central-South)–Entanglement nets	Low Concern (3)	Minimal mitigation (0.25)	Moderate Concern (3)	Yellow (3.12)
Artisanal Fleet (Pacific: West Coast of Baja CA)–Magdelena I	Moderate Concern (2)	Minimal mitigation (0.25)	Moderate Concern (3)	Yellow (2.6)
Artisanal Fleet (Pacific: Sinaloa-Nayarit)-Suripera nets	Moderate Concern (2)	Minimal mitigation (0.25)	Moderate Concern (3)	Yellow (2.6)
Artisanal Fleet (Pacific: Sinaloa-Nayarit)–Cast nets	Low Concern (3)	Minimal mitigation (0.25)	Moderate Concern (3)	Yellow (3.12)

GOM

Fishery	**Gear type and substrate** Rank (Score)	**Mitigation of gear impacts** Rank (Score)	**EBFM** Rank (Score)	**Criterion 4** Rank (Score)
Industrial Fleet (GOM)–Trawls	Moderate Concern (2)	Minimal mitigation (0.25)	Moderate Concern (3)	Yellow (2.6)

Artisanal Fleet (GOM)– Small trawls– Seabob Fishery	Moderate Concern (2)	Minimal mitigation (0.25)	Moderate Concern (3)	Yellow (2.6)
Artisanal Fleet (GOM)– Cast nets	Low Concern (3)	Minimal mitigation (0.25)	Moderate Concern (3)	Yellow (3.12)
Artisanal Fleet (GOM)– Charanga nets	Low Concern (3)	Minimal mitigation (0.25)	Moderate Concern (3)	Yellow (3.12)

Justification

Industrial Fleet (Pacific)—Trawls, small trawl, and suripera nets
Industrial Fleet (GOM)—Trawls, small trawl
Factor 4.1 Impact of the Fishing Gear on the Substrate: Moderate Concern

Key relevant information:
Blue, brown, white, pink, and seabob shrimp caught with large trawls in the industrial fleet and small trawls (including the Magdalena I and illegal changos) and suripera nets in the artisanal fleets are often found on a variety of bottom substrate types in the Mexican Pacific and GOM. The effects of bottom contact trawl gear on marine benthic habitats have been well documented and are known to vary depending on gear configuration and benthic habitat type (Watling and Norse 1998, NRC 2002, Steele 2002). The shelf areas in the GOM, where shrimp are commonly fished, are shallow sand and mud environments scattered with coral reef assemblages that are thought to be affected primarily by sedimentation after trawl passes (Barnette 2001). In the Mexican Pacific, offshore areas between 9-64 meters in depth are targeted (FAO 2008). There is evidence that industrial trawls have had impacts on soft-bottom environments, epibethnic communities and meiobenthic communities (INAPESCA-CONAPESCA 2004). Therefore, the impact of fishing gear in trawls in the Pacific and GOM industrial and artisanal fleets is deemed a moderate concern.

Detailed rationale:
The Gulf of California and the Mexican Pacific are characterized by a diverse range of habitats, including algal beds, mangroves, rhodolith beds (unattached coralline reefs), reef walls, black coral, seamounts, boulders, and rocky shores (Sala et al. 2002, Morgan et al. 2005). Trawling in the Gulf of California negatively affects rhodolith beds via sedimentation and increases in burial rates (Steller et al. 2003). Studies conducted by Godínez-Domínguez (2003) found chronic disturbance due to shrimp trawl fishing in the Mexican Pacific, just south of the Gulf of California. Overall, there is a lack of evidence about the specific impacts of industrial and artisanal trawls and suripera nets on the seafloor in Mexican Pacific waters, but because the fishing grounds for this fleet cover a large spatial scale, any associated impacts are multiplied accordingly (Figure 17).

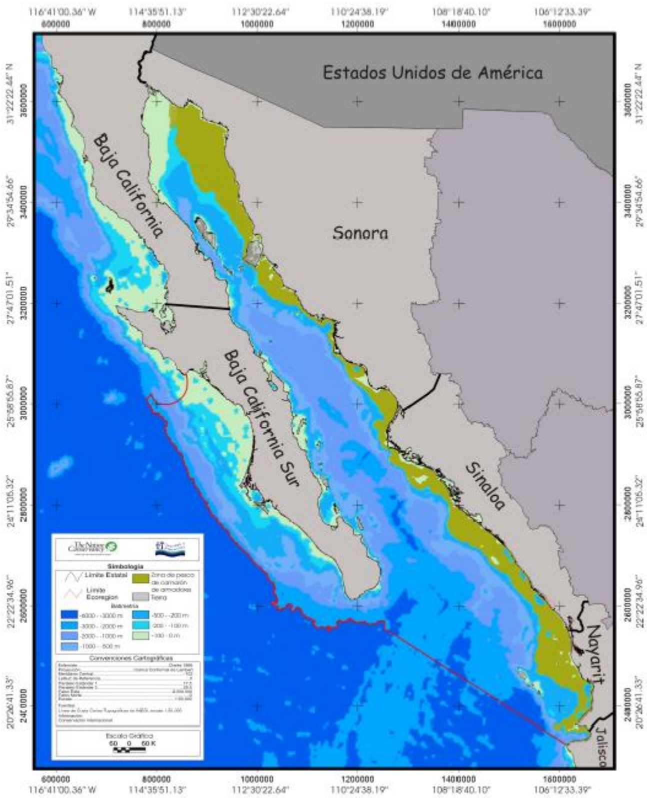


Figure 17. Fishing areas for the industrial shrimp fishery are depicted in green on the map. Fishing areas for the artisanal fishery are depicted in orange. Taken from: Ulloa et al. (2006).

The shelf areas in the GOM are shallow sand and mud environments scattered with coral reef assemblages that are thought to be primarily affected by sedimentation after trawl passes (Barnette 2001). While these environments predominately lack three-dimensional fauna, further studies should be conducted on similar environments to evaluate the impacts of sand and muddy substrate trawling on marine infauna (small organisms that live within the upper few inches of seafloor sediment) and ecosystem productivity (Gillett 2008).

Artisanal fleet (pacific)—cast nets
Artisanal Fleet (GOM)—Cast nets and Charanga Nets
Factor 4.1 Impact of the Fishing Gear on the Substrate: Low Concern

<u>Key relevant information:</u>
Cast nets are a gear type used by artisanal fishermen in both the Mexican Pacific and GOM due to their low cost and simple operability (FAO 2008, SAGARPA 2012b). Cast nets are retrieved rapidly after deployment, and only come into contact with the seafloor where they are set (SAGARPA 2012b). The fixed *charanga* net, used by artisanal fisherman in the GOM, is set in coastal lagoons from Tamaulipas to northern Veracruz (SAGARPA 2012b). Shrimp enter the wedge-shaped net as they migrate offshore and are concentrated into a smaller net known as a

yagual. Fishermen land the shrimp using a small boat and a hand-held net. The *charanga*, while fixed, does come in contact with the ocean floor but with a small footprint, and little bycatch is observed when using this gear type (SAGARPA 2000). Therefore, these gear types are considered of low concern.

Artisanal Fleet (Pacific)—Entanglement Nets
Factor 4.1 Impact of the Fishing Gear on the Substrate: Low Concern

Key relevant information:
Shrimp entanglement nets or gillnets, though not mobile, do come into contact with the seafloor (SAGARPA 2012b). These gear types are considered of low concern.

Mexican Pacific and GOM industrial and artisanal: all gear types
Factor 4.2 Modifying Factor: Mitigation of Fishing Gear Impacts: Minimal Mitigation

Key relevant information:
Managers have established a network of MPAs throughout the Mexican Pacific and GOM (Hernández Carballo and Macías 1996, SAGARPA 2012b). However, the extent of these MPAs is unknown and likely covers less than <5% of federal waters. Efforts have also been made to reduce the shrimp fleet throughout Mexico through a buyback program (FAO 2008, Dubay et al. 2010). While the industrial fleet was successfully reduced by more than 50% (from 1594 vessels in 2005 to 761 vessels in 2011), the artisanal fleet continues to expand (SAGARPA 2005, FAO 2008, INAPESCA 2009b, Aragón-Noriega et al. 2010, Dubay et al. 2010, SAGARPA 2011). For these reasons, the Mexican Pacific and GOM industrial and artisanal fisheries are deemed to have minimal mitigation measures in place.

Detailed rationale:
SEMARNAT and CONAPESCA have shared responsibilities for administering MPAs and are responsible for regulating fisheries activities in those areas. Current MPAs and no-take zones cover only 0.2% of the Gulf of California coast. The percent coverage of MPAs in the GOM and the rest of the Mexican Pacific is unknown. However, a list of all MPAs and no-take zones can be found in Carta Nacional Pesquera (SAGARPA 2012b). Permanent protected areas and temporary closed seasons protect the main spawning season (López et al. 2005), promote the growth of pre-adult life stages (FAO 2003, SAGARPA 2012b), and protect threatened and endemic species (Aragón-Noriega et al. 2010). While Sala et al. (Sala et al.) suggests that these areas should be expanded to cover 40% of the rocky reef habitat in the Gulf of California, it is important to note that existing MPAs have not been as effective as expected in recovering and conserving artisanal fishing resources. According to OECD (2006) these areas become problematic when they are poorly enforced and when they displace fisherman in areas where there are no alternative fishing grounds.

Recently, an Ecosystem-Based Management (EBM) Initiative, funded by the David and Lucile Packard Foundation, has been set up in the Gulf of California (Foundation 2012). This initiative draws on knowledge from artisanal and industrial fishermen to provide scientific knowledge to guide resource management. Such an effort aimed for maximizing the fishing industry's profitability while promoting the optimum ecosystem health. Nevertheless, after almost four years of work in the Gulf of California, EBM has not been formally implemented at any fishery. Although EBM is considered mandatory by the current Mexican General Law for Sustainable Fisheries and Aquaculture, its practical application has not been codified or defined. At present, there is an ongoing EBM-based program (PANGAS) geared toward understanding and analyzing the dynamics of the small-scale fisheries in the northern Gulf of California (PANGAS 2012).

A number of federal programs are targeted at promoting fishing gears with low environmental impact and reducing vessel capacity in fisheries. The Fishing Method Substitution Program under the Gulf of California's Program for Sustainable Fishing and Species Protection encourages environmentally friendly fishing methods that reduce seafloor impact and are technically and financially viable. Another management strategy is the "effort reduction plan" which promotes the voluntary retirement of old trawling vessels (FAO 2008, Dubay et al. 2010). Since its inception in 2005, this program has resulted in the retirement of 307 industrial vessels (135 in the Gulf of Mexico and 172 in the Mexican Pacific) (Dubay et al. 2010). However, the number of artisanal fishermen continues to increase (INAPESCA 2009b, Aragón-Noriega et al. 2010).

Mexican Pacific and GOM industrial and artisanal: all gear types

Factor 4.3 Ecosystem and Food Web Considerations: Moderate Concern

Key relevant information:

The Mexican Pacific and GOM industrial and artisanal fisheries generate a high level of bycatch that includes keystone and exceptional species (Alverson et al. 1994, Lopez-Martinez et al. 2010, Meltzer et al. 2012). While removing these species clearly has impacts on the overall ecosystem (Watling and Norse 1998) the extent and nature of those impacts remains unclear. Ongoing research and management actions are aimed at addressing bycatch in shrimp fisheries. For these reasons, management of the ecosystem and food web impacts of the fishery is deemed a moderate concern.

Detailed rationale:

A range of bycatch reduction modifications is being tested to reduce the impact of trawl gear on habitats and ecosystems. In a study by the Packard Foundation (Foundation), lighter weight chains weight 45 kg (an almost 89% decrease in weight from typical weight chains) were used on trawl footropes (Balmori-Ramirez et al, 2012). This decrease in weight allowed the net to remain 10-12 inches off the floor during trawl drags, resulting in no capture of species associated with the seabed, including soft coral, sponges and rays. Other modifications commonly used to reduce trawl impact on seafloors include the use of lighter trawl nets (Dyneema® and Spectra® brands) and smaller, more hydrodynamic trawl doors to reduce both fuel reduction and drag on sensitive seafloor habitats.

However, scenarios evaluated by Martinez et al. (1996) suggest that bycatch reductions of 10%, 25% and 50% could lead to increased predation on shrimp, resulting corresponding 0.8%, 5.5% and 10.7% reductions in shrimp populations. Garcia-Caudillo et al. (1999) make the point that these predicted ecosystem effects are not supported by historical landings in the Gulf of California. Demersal fish that prey on shrimp have been subject to fishing pressure for the last five decades and shrimp populations have yet to show any increase associated with reduced predation.

Studies of ecosystem impacts associated with industrial scale fishing in the Mexican Pacific and Gulf of Mexico point alternately to high levels of ecosystem disturbance and long-term ecosystem stability. Limited scientific and anecdotal evidence suggest that marine ecosystems in Mexican waters have changed dramatically over the last 40 years. In particular Nava-Romo (Nava-Romo) observed a decrease in the diversity and biomass of bycatch in Mexican fisheries. Sala et al. (Sala et al.) documented marked shifts in fisheries in the Gulf of California. Historically, large, high trophic level species were the target catch in artisanal fisheries in the Gulf of California; in recent years, fishermen have instead been targeting small species at much lower trophic levels.

On the other hand, a number of theoretical studies suggest that Mexican ecosystems have maintained relative stability despite inter-annual climactic fluctuations and increased anthropogenic pressure. The outputs of an Ecopath with Ecosim model, a mass-balance model that simulates biomass changes in interacting populations of marine species in the northern Gulf of California under different exploitation scenarios, suggest that functional groups were impacted more by predation and competition than by fishing pressure (Morales-Zarate et al. 2004).

Overall Recommendation

Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

The overall recommendation is as follows:

– **Best Choice** = Final score ≥ 3.2 **and** scores for Criteria 1, 3 and 4 are all ≥ 2.2 **and** Criterion 2 *subscore* ≥ 2.2

– **Some Concerns** = Final score ≥ 2.2 **and** Criterion 3 ≥ 2.2 **and** **(**Final score ≤ 3.2 **or** scores for Criteria 1 &4 ≤ 2.2 **or** Criterion 2 *subscore* ≤ 2.2)

- **Red**= Final score < 2.2 **or** score for Criterion 3 < 2.2 **or** any one criterion has a critical score **or** two or more of the following are < 2.2: Criterion 1 score, Criterion 2 *subscore*, Criterion 4 score

Mexican Pacific

Stock	**Fishery**	**Impacts on the Stock** Rank (Score)	**Impacts on Other Species** Lowest scoring species Rank*, (Subscore, Score)	**Manage-ment** Rank (Score)	**Habitat and Ecosystem** Rank (Score)	**Overall** Recommendation (Score)
Shrimp, Blue (Sinaloa-Nayarit)	Industrial Fleet (Pacific: Sinaloa-Nayarit)–Trawls	Red (1.41)	Shrimp, Blue (Sinaloa-Nayarit), Shrimp, White Red, (1.41,1.06)	Red (2)	Yellow (2).6	**AVOID (1).67**
Shrimp, Blue (Sinaloa-Nayarit)	Artisanal Fleet (Pacific: Sinaloa-Nayarit)–Entanglement nets	Red (1.41)	Gulf Grouper (Mycteroperca jordani) Red, (1.92,1.72)	Red (2)	Yellow (3.12)	**AVOID (1.97)**
Shrimp, Blue (Sinaloa-Nayarit)	Artisanal Fleet (Pacific: Sinaloa-Nayarit)–Suripera nets	Red (1.41)	Gulf Grouper (Mycteroperca jordani) Red, (1.53,1.37)	Red (2)	Yellow (2.6)	**AVOID (1.78)**
Shrimp, Blue (Sonora Central-South)	Artisanal Fleet (Pacific: Sonora Central-South)–Entanglement nets	Green (3.83)	Gulf Grouper (Mycteroperca jordani) Red, (1.92,1.72)	Red (2)	Yellow (3.12)	**AVOID (2.53)**

Shrimp, Blue (Sonora Central-South)	Industrial Fleet (Pacific: Sonora Central-South)–Trawls	Green (3.83)	Hammerhead, Scalloped (Sphyrna lewini), Sea Turtle, Loggerhead (Caretta caretta), Gulf Grouper (Mycteroperca jordani), Totoaba (Totoaba macdonaldi), Sea Turtle, Olive Ridley (Lepidochelys olivacea) Red, (1.53,1.14)	Red (2)	Yellow (2.6)	**AVOID (2.18)**
Shrimp, Blue (upper Gulf of CA)	Industrial Fleet (Pacific: Upper Gulf of California)–Trawls	Green (3.83)	Hammerhead, Scalloped (Sphyrna lewini), Sea Turtle, Loggerhead (Caretta caretta), Gulf Grouper (Mycteroperca jordani), Totoaba (Totoaba macdonaldi), Sea Turtle, Olive Ridley (Lepidochelys olivacea) Red, (1.53,1.14)	Red (2)	Yellow (2).6	**AVOID (2.18)**
Shrimp, Blue (upper Gulf of CA)	Artisanal Fleet (Pacific: Upper Gulf of CA)–Entanglement nets	Green (3.83)	Vaquita (Phocoena sinus) Critical, (0,0)	Red (2)	Yellow (3.12)	**AVOID (0)**
Shrimp, Blue (west coast of Baja CA)	Artisanal Fleet (Pacific: West Coast of Baja CA)–Magdelena I	Yellow (2.71)	Shrimp, Brown (west coast of Baja CA) Red, (1.41,1.27)	Red (2)	Yellow (2.6)	**AVOID (2.06)**
Shrimp, Blue (west coast of Baja CA)	Industrial Fleet (Pacific: West Coast of Baja California)–Trawls	Yellow (2.71)	Shrimp, Brown (west coast of Baja CA) Red, (1.41,1.06)	Red (2)	Yellow (2.6)	**AVOID (1.97)**
Shrimp, Brown (Gulf of Tehuantepec)	Industrial Fleet (Pacific: Gulf of Tehuantepec)–Trawls	Red (1.73)	Shrimp, White Red, (1.41,1.06)	Red (2)	Yellow (2.6)	**AVOID (1.76)**

Shrimp, Brown (Sinaloa-Nayarit)	Industrial Fleet (Pacific: Sinaloa-Nayarit)−Trawls	Yellow (3.16)	Shrimp, Blue (Sinaloa-Nayarit), Shrimp, White Red, (1.41,1.06)	Red (2)	Yellow (2.6)	**AVOID (2.04)**
Shrimp, Brown (Sonora Central-South)	Industrial Fleet (Pacific: Sonora Central-South)−Trawls	Green (3.83)	Hammerhead, Scalloped (Sphyrna lewini), Sea Turtle, Loggerhead (Caretta caretta), Gulf Grouper (Mycteroperca jordani), Totoaba (Totoaba macdonaldi), Sea Turtle, Olive Ridley (Lepidochelys olivacea) Red, (1.53,1.14)	Red (2)	Yellow (2.6)	**AVOID (2.18)**
Shrimp, Brown (upper Gulf of CA)	Industrial Fleet (Pacific: Upper Gulf of California)−Trawls	Green (4.47)	Hammerhead, Scalloped (Sphyrna lewini), Sea Turtle, Loggerhead (Caretta caretta), Gulf Grouper (Mycteroperca jordani), Totoaba (Totoaba macdonaldi), Sea Turtle, Olive Ridley (Lepidochelys olivacea) Red, (1.53,1.14)	Red (2)	Yellow (2.6)	**AVOID (2.27)**
Shrimp, Brown (west coast of Baja CA)	Industrial Fleet (Pacific: West Coast of Baja California)−Trawls	Red (1.41)	Hammerhead, Scalloped (Sphyrna lewini) Red, (1.53,1.14)	Red (2)	Yellow (2.6)	**AVOID (1.7)**
Shrimp, Brown (west coast of Baja CA)	Artisanal Fleet (Pacific: West Coast of Baja CA)−Magdelena I	Red (1.41)	Seahorse, Pacific (Hippocampus ingens) Red, (2.16,1.94)	Red (2)	Yellow (2.6)	**AVOID (1.94)**
Shrimp, White	Industrial Fleet (Pacific: Gulf of Tehuantepec)−Trawls	Red (1.41)	Hammerhead, Scalloped (Sphyrna lewini) Red, (1.53,1.14)	Red (2)	Yellow (2.6)	**AVOID (1.7)**

Shrimp, White	Industrial Fleet (Pacific: Sinaloa-Nayarit)−Trawls	Red (1.41)	Shrimp, Blue (Sinaloa-Nayarit), Shrimp, White Red, (1.41,1.06)	Red (2)	Yellow (2.6)	**AVOID (1.67)**
white shrimp	Artisanal Fleet (Pacific: Sinaloa-Nayarit)−Cast nets	Red (1.41)	No other main species caught Green, (5,5)	Red (2)	Yellow (3.12)	**AVOID (2.58)**

GOM

Stock	**Fishery**	**Impacts on the Stock** Rank (Score)	**Impacts on Other Species** Lowest scoring species Rank*, (Subscore, Score)	**Manage-ment** Rank (Score)	**Habitat and Ecosystem** Rank (Score)	**Overall** Recommendation (Score)
Shrimp, Brown (GOM)	Artisanal Fleet (GOM−Cast nets	Green (3.83)	No other main species caught Green, (5,5)	Red (1)	Yellow (3.12)	**AVOID (2.78)**
Shrimp, Brown (GOM)	Industrial Fleet (GOM)−Trawls	Green (3.83)	Hammerhead, Scalloped (Sphyrna lewini), Sea Turtle, Loggerhead (Caretta caretta) , Sea Turtle, Green (Chelonia mydas), Sea Turtle, Hawksbill (Eretmochelys imbricate), Sea Turtle, Kemp's Ridley (Lepidochelys kempii) , Sea Turtle, Leatherback (Dermochelys coriacea) , Sea Turtle, Olive Ridley (Lepidochelys olivacea) Red, 1.53,1.22	Red (1.41)	Yellow (2.6)	**AVOID (2.04)**

Shrimp, Brown (GOM)	Artisanal Fleet (GOM)−Charanga nets	Green (3.83)	Shrimp, Pink (GOM), Shrimp, White (GOM) Red, (2.16,2.16)	Red (1)	Yellow (3.12)	**AVOID (2.25)**
Shrimp, Pink (GOM)	Industrial Fleet (GOM)−Trawls	Red (2.16)	Hammerhead, Scalloped (Sphyrna lewini), Sea Turtle, Loggerhead (Caretta caretta) , Sea Turtle, Green (Chelonia mydas), Sea Turtle, Hawksbill (Eretmochelys imbricate), Sea Turtle, Kemp's Ridley (Lepidochelys kempii) , Sea Turtle, Leatherback (Dermochelys coriacea) , Sea Turtle, Olive Ridley (Lepidochelys olivacea) Red, (1.53,1.22)	Red (1.41)	Yellow (2.6)	**AVOID (1.76)**
Shrimp, Pink (GOM)	Artisanal Fleet (GOM)−Charanga nets	Red (2.16)	Shrimp, Pink (GOM), Shrimp, White (GOM) Red, (2.16,2.16)	Red (1)	Yellow (3.12)	**AVOID (1.95)**
Shrimp, Seabob (GOM)	Artisanal Fleet (GOM)-Small trawls−Seabob Fishery	Yellow (3.05)	Hammerhead, Scalloped (Sphyrna lewini), Sea Turtle, Loggerhead (Caretta caretta) Red, (1.53,1.22)	Red (1.41)	Yellow (2.6)	**AVOID (1.92)**

Shrimp, White (GOM)	Industrial Fleet (GOM)−Trawls	Red (2.16)	Hammerhead, Scalloped (Sphyrna lewini), Sea Turtle, Loggerhead (Caretta caretta) , Sea Turtle, Green (Chelonia mydas), Sea Turtle, Hawksbill (Eretmochelys imbricate), Sea Turtle, Kemp's Ridley (Lepidochelys kempii) , Sea Turtle, Leatherback (Dermochelys coriacea) , Sea Turtle, Olive Ridley (Lepidochelys olivacea) Red, (1.53,1.22)	Red (1.41)	Yellow (2.6)	**AVOID (1.76)**
Shrimp, White (GOM)	Artisanal Fleet (GOM)− Charanga nets	Red (2.16)	Shrimp, Pink (GOM), Shrimp, White (GOM) Red, (2.16,2.16)	Red (1)	Yellow (3.12)	**AVOID (1.95)**

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Appendix A: Review Schedule

A stock assessment is currently underway for Mexican Pacific shrimp species and should be available in 2013.

About Seafood Watch®

Monterey Bay Aquarium's Seafood Watch® program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch® defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. Seafood Watch® makes its science-based recommendations available to the public in the form of regional pocket guides that can be downloaded from www.seafoodwatch.org. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Each sustainability recommendation on the regional pocket guides is supported by a Seafood Report. Each report synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's conservation ethic to arrive at a recommendation of "Best Choices," "Good Alternatives" or "Avoid." The detailed evaluation methodology is available upon request. In producing the Seafood Reports, Seafood Watch® seeks out research published in academic, peer-reviewed journals whenever possible. Other sources of information include government technical publications, fishery management plans and supporting documents, and other scientific reviews of ecological sustainability. Seafood Watch® Research Analysts also communicate regularly with ecologists, fisheries and aquaculture scientists, and members of industry and conservation organizations when evaluating fisheries and aquaculture practices. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, Seafood Watch®'s sustainability recommendations and the underlying Seafood Reports will be updated to reflect these changes.

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Reports in any way they find useful. For more information about Seafood Watch® and Seafood Reports, please contact the Seafood Watch® program at Monterey Bay Aquarium by calling 1-877-229-9990.

Disclaimer
Seafood Watch® strives to have all Seafood Reports reviewed for accuracy and completeness by external scientists with expertise in ecology, fisheries science and aquaculture. Scientific review, however, does not constitute an endorsement of the Seafood Watch® program or its recommendations on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

Seafood Watch® and Seafood Reports are made possible through a grant from the David and Lucile Packard Foundation.

Guiding Principles

Seafood Watch™ defines sustainable seafood as originating from sources, whether fished or farmed, that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

The following **guiding principles** illustrate the qualities that capture fisheries must possess to be considered sustainable by the Seafood Watch program:

- *Stocks are healthy and abundant.*
- *Fishing mortality does not threaten populations or impede the ecological role of any marine life.*
- *The fishery minimizes bycatch.*
- *The fishery is managed to sustain long-term productivity of all impacted species.*
- *The fishery is conducted such that impacts on the seafloor are minimized and the ecological and functional roles of seafloor habitats are maintained.*
- *Fishing activities should not seriously reduce ecosystem services provided by any fished species or result in harmful changes such as trophic cascades, phase shifts, or reduction of genetic diversity.*

Based on these guiding principles, Seafood Watch has developed a set of four sustainability **criteria** to evaluate capture fisheries for the purpose of developing a seafood recommendation for consumers and businesses. These criteria are:

1. Impacts on the species/stock for which you want a recommendation
2. Impacts on other species
3. Effectiveness of management
4. Habitat and ecosystem impacts

Each criterion includes:

- Factors to evaluate and rank
- Evaluation guidelines to synthesize these factors and to produce a numerical score
- A resulting numerical score and **rank** for that criterion

Once a score and rank has been assigned to each criterion, an overall seafood recommendation is developed on additional evaluation guidelines. Criteria ranks and the overall recommendation are color-coded to correspond to the categories on the Seafood Watch pocket guide:

Best Choices/Green: Are well managed and caught or farmed in environmentally friendly ways.

Good Alternatives/Yellow: Buy, but be aware there are concerns with how they're caught or farmed.

Avoid/Red: Take a pass on these. These items are overfished or caught or farmed in ways that harm other marine life or the environment.