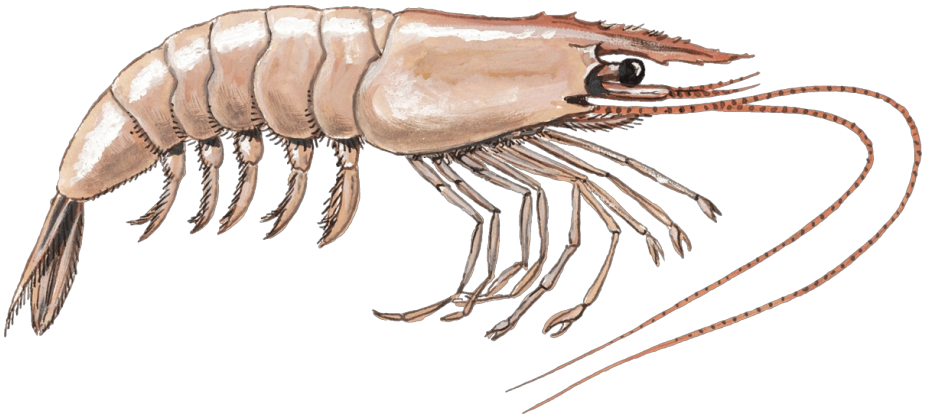
Monterey Bay Aquarium
Seafood Watch

Environmental sustainability of wild-caught shrimp from Mexico caught using bottom trawls, gillnets and entangling nets, suripera, magdalena, and cast nets



Species:	Blue shrimp (*Litopenaeus stylirostris*) Brown shrimp (*Farfantepenaeus aztecus*) Pink shrimp (*Farfantepenaeus duorarum*) Seabob shrimp (*Xiphopenaeus kroyeri*) White shrimp (*Litopenaeus setiferus*) Whiteleg shrimp (*Litopenaeus vannamei*) Yellowleg shrimp (*Farfantepenaeus californiensis*)
Location:	Mexico: Pacific, Gulf of Mexico, Gulf of California
Gear:	Bottom trawls, Gillnets and entangling nets (unspecified), Suripera, Magdalena - Artisanal bottom trawl, Cast nets
Type:	Wild Caught
Author:	Seafood Watch
Published:	March 3, 2025
Report ID:	27877

Assessed using Seafood Watch Fisheries Standard v3

Table of Contents

About Monterey Bay Aquarium Seafood Watch

The mission of the Monterey Bay Aquarium is to inspire conservation of the ocean and enable a future where the ocean flourishes and people thrive in a just and equitable world. To do this, the Aquarium is focused on creating extraordinary experiences that inspire awe and wonder, championing science-based solutions, and connecting people across the planet to protect and restore the ocean. We know that healthy ocean ecosystems are critical to enabling life on Earth to exist, and that our very survival depends on them. As such, our conservation objectives are to mobilize climate action, improve the sustainability of global fisheries and aquaculture, reduce sources of plastic pollution, and restore and protect ocean wildlife and ecosystems.

The aquarium is focused on improving the sustainability of fisheries and aquaculture given the role seafood plays in providing essential nutrition for 3 billion people globally, and in supporting hundreds of millions of livelihoods. Approximately 180 million metric tons of wild and farmed seafood is harvested each year (excluding seaweeds). Unfortunately, not all current harvest practices are sustainable and poorly managed fisheries and aquaculture pose the greatest immediate threat to the health of the ocean and the economic survival and food security of billions of people.

The Seafood Watch program was started 25 years ago as a small exhibit in the Monterey Bay Aquarium highlighting better fishing practices and grew into one of the leading sources of information on seafood sustainability, harnessing the power of consumer choice to mobilize change. The program's comprehensive open-source information and public outreach raises awareness about global sustainability issues, identifies areas for improvement, recognizes and rewards best practices and empowers individuals and businesses to make informed decisions when purchasing seafood.

We define sustainable seafood as seafood from sources, whether fished or farmed, that can maintain or increase production without jeopardizing the structure and function of affected ecosystems, minimize harmful environmental impacts, assure good and fair working conditions, and support livelihoods and economic benefits throughout the entire supply chain. As one aspect of this vision, Seafood Watch has developed trusted, rigorous standards for assessing the environmental impacts of fishing and aquaculture practices worldwide. Built on a solid foundation of science and collaboration, our standards reflect our guiding principles for defining environmental sustainability in seafood.

Seafood Watch Ratings

The Seafood Watch Standard for Fisheries is used to produce assessments for wild-capture fisheries resulting in a Seafood Watch rating of green, yellow, or red. Seafood Watch uses the assessment criteria to determine a final numerical score as well as numerical subscores and colors for each criterion. These scores are translated to a final Seafood Watch color rating according to the methodology described in the table below. The table also describes how Seafood Watch defines each of these categories. The narrative descriptions of each Seafood Watch rating, and the guiding principles listed below, compose the framework on which the criteria are based.

Green	Final Score >3.2, and either criterion 1 or criterion 3 (or both) is green, and no red criteria, and no critical scores	Wild-caught and farm-raised seafood rated green are environmentally sustainable, well managed and caught or farmed in ways that cause little or no harm to habitats or other wildlife. These operations align with all of our guiding principles.
Yellow	Final score >2.2, and no more than one red criterion, and no critical scores, and does not meet the criteria for green (above)	Wild-caught and farm-raised seafood rated yellow cannot be considered fully environmentally sustainable at this time. They align with most of our guiding principles, but there is either one conservation concern needing substantial improvement, or there is significant uncertainty associated with the impacts of the fishery or aquaculture operations.
Red	Final Score ≤2.2, or two or more Red Criteria, or one or more Critical scores.	Wild-caught and farm-raised seafood rated Red are caught or farmed in ways that have a high risk of causing significant harm to the environment. They do not align with our guiding principles and are considered environmentally unsustainable due to either a critical conservation concern, or multiple areas where improvement is needed.

Recommended Citation: Seafood Watch (2025) Environmental sustainability of wild-caught shrimp from Mexico caught using bottom trawls, gillnets and entangling nets, suripera, magdalena, and cast nets. Monterey Bay Aquarium

Guiding Principles

Monterey Bay Aquarium defines sustainable seafood as seafood from sources, whether fished or farmed, that can maintain or increase production without jeopardizing the structure and function of affected ecosystems, minimize harmful environmental impacts, assure good and fair working conditions, and support livelihoods and economic benefits throughout the entire supply chain.

As one aspect of this vision, Seafood Watch has developed trusted, rigorous standards for assessing the environmental impacts of fishing and aquaculture practices worldwide. Environmentally sustainable wild capture fisheries:

1. **Follow the principles of ecosystem-based fisheries management**

   The fishery is managed to ensure the integrity of the entire ecosystem, rather than solely focusing on maintenance of single species stock productivity. To the extent allowed by the current state of the science, ecological interactions affected by the fishery are understood and protected, and the structure and function of the ecosystem is maintained.

2. **Ensure all affected stocks[1] are healthy and abundant**

   Abundance, size, sex, age and genetic structure of the main species affected by the fishery (not limited to target species) is maintained at levels that do not impair recruitment or long-term productivity of the stocks or fulfillment of their role in the ecosystem and food web.

   Abundance of the main species affected by the fishery should be at, above, or fluctuating around levels that allow for the long-term production of maximum sustainable yield. Higher abundances are necessary in the case of forage species, in order to allow the species to fulfill its ecological role.

3. **Fish all affected stocks at sustainable levels**

   Fishing mortality for the main species affected by the fishery 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.

---

[1]"Affected" stocks include all stocks affected by the fishery, no matter whether target or bycatch, or whether they are ultimately retained or discarded.

The cumulative fishing mortality experienced by affected species must be at or below the level that produces maximum sustainable yield for single-species fisheries on typical species that are at target levels.

Fishing mortality may need to be lower than the level that produces maximum sustainable yield in certain cases such as forage species, multispecies fisheries, highly vulnerable species, or fisheries with high uncertainty.

For species that are depleted below target levels, fishing mortality must be at or below a level that allows the species to recover to its target abundance.

4. **Minimize 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.

   The fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss and by efficiently using marine and freshwater resources as bait.

5. **Have no more than a negligible impact on any threatened, endangered or protected species**

   The fishery avoids catch of any threatened, endangered or protected (ETP) species. If any ETP species are inadvertently caught, the fishery ensures and can demonstrate that it has no more than a negligible impact on these populations.

6. **Are managed to sustain the long-term productivity of all affected species**

   Management should be appropriate for the inherent resilience of affected marine and freshwater 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.

   The management strategy has a high chance of preventing declines in stock productivity by taking into account the level of uncertainty, other impacts on the stock, and the potential for increased pressure in the future.

   The management strategy effectively prevents negative population impacts on bycatch species, particularly species of concern.

7. **Avoid negative impacts on the structure, function or associated biota of aquatic habitats where fishing occurs**

The fishery does not adversely affect the physical structure of the seafloor or associated biological communities.

If high-impact gears (e.g. trawls, dredges) are used, vulnerable seafloor habitats (e.g. corals, seamounts) are not fished, and potential damage to the seafloor is mitigated through substantial spatial protection, gear modifications and/or other highly effective methods.

8. **Maintain the trophic role of all aquatic life**

   All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web, as informed by the best available science.

9. **Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts**

   Fishing activities must not result in harmful changes such as depletion of dependent predators, trophic cascades, or phase shifts.

   This may require fishing certain species (e.g., forage species) well below maximum sustainable yield and maintaining populations of these species well above the biomass that produces maximum sustainable yield.

10. **Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks**

    Any enhancement activities are conducted at levels that do not negatively affect wild stocks by reducing diversity, abundance or genetic integrity.

    Management of fisheries targeting enhanced stocks ensures that there are no negative impacts on the wild stocks, in line with the guiding principles described above, as a result of the fisheries.

    Enhancement activities do not negatively affect the ecosystem through density dependent competition or any other means, as informed by the best available science.

Final Ratings

Ratings Details	C 1 Target Species	C 2 Other Species	C 3 Management	C 4 Habitat	Rating
Atlantic seabob Mexico - Gulf of Mexico - Bottom trawls - 1,304 mt	1.000	0.750	2.000	2.449	Red (1.384)
Blue shrimp Mexico - Sinaloa - Gulf of California - Bottom trawls - 12,062 mt	3.318	1.299	2.000	2.449	Red (2.144)
Blue shrimp Mexico - Baja California | Sonora - Gulf of California - Bottom trawls - 4,692 mt	2.644	1.299	2.000	2.449	Red (2.025)
Blue shrimp Mexico - Nayarit | Sinaloa - Gulf of California - Bottom trawls - 20 mt	1.732	1.299	2.000	2.449	Red (1.822)
Blue shrimp Mexico - Sonora - Gulf of California - Bottom trawls - 4,692 mt	1.732	1.299	2.000	2.449	Red (1.822)
Blue shrimp Mexico - Sinaloa - Gulf of California - Gillnets and entangling nets - 12,062 mt	3.318	2.236	2.000	3.000	Yellow (2.583)
Blue shrimp Mexico - Sonora - Gulf of California - Gillnets and entangling nets - 4,692 mt	1.732	2.236	2.000	3.000	Red (2.196)
Blue shrimp Mexico - Baja California - Eastern Central Pacific Ocean - Magdalena - Artisanal bottom trawls - 460 mt	3.318	1.732	3.000	2.449	Yellow (2.549)
Blue shrimp Mexico - Eastern Central Pacific Ocean - Suripera - 460 mt - Flag Country: Mexico - FAO Major Area: Pacific, Eastern Central - Management Unit: West Coast of Baja (Zone 50)	3.318	5.000	3.000	3.000	Green (3.496)
Blue shrimp Mexico - Sinaloa - Gulf of California - Suripera - 12,062 mt	3.318	2.644	3.000	3.000	Yellow (2.981)

Ratings Details	C 1 Target Species	C 2 Other Species	C 3 Management	C 4 Habitat	Rating
Brown shrimp Mexico - Gulf of Mexico - Bottom trawls - 8,495 mt	3.318	0.750	2.000	2.449	Red (1.868)
Brown shrimp Mexico - Gulf of Mexico - Cast nets - 8,495 mt	3.318	5.000	2.000	3.000	Yellow (3.159)
Brown shrimp Mexico - Gulf of Mexico - Traps - 8,495 mt	3.318	2.236	2.000	3.000	Yellow (2.583)
Pink shrimp Mexico - Gulf of Mexico - Bottom trawls - 1,029 mt	2.236	0.750	2.000	2.449	Red (1.693)
Pink shrimp Mexico - Gulf of Mexico - Traps - 1,029 mt	2.236	3.318	2.000	3.000	Yellow (2.583)
White shrimp Mexico - Gulf of Mexico - Bottom trawls - 730 mt - Flag Country: Mexico - FAO Major Area: Atlantic, Western Central	1.000	0.750	2.000	2.449	Red (1.384)
White shrimp Mexico - Gulf of Mexico - Bottom trawls - 730 mt - Flag Country: Mexico - FAO Major Area: Atlantic, Western Central - Specific Fishery: Seabob fishery	1.000	0.750	2.000	2.449	Red (1.384)
Whiteleg shrimp Mexico - Sinaloa - Gulf of California - Bottom trawls - 1,066 mt	3.318	1.299	2.000	2.449	Red (2.144)
Whiteleg shrimp Mexico - Nayarit | Sinaloa - Gulf of California - Bottom trawls - 4,645 mt	1.732	1.299	2.000	2.449	Red (1.822)
Whiteleg shrimp Mexico - Gulf of Tehuantepec - Bottom trawls - 605 mt	3.318	1.299	2.000	2.449	Red (2.144)
Whiteleg shrimp Mexico - Nayarit | Sinaloa - Gulf of California - Cast nets - 4,645 mt	1.732	5.000	2.000	3.000	Red (2.685)

Ratings Details	C 1 Target Species	C 2 Other Species	C 3 Management	C 4 Habitat	Rating
Yellowleg shrimp Mexico - Baja California - Eastern Central Pacific Ocean - Bottom trawls - 460 mt	1.732	1.299	2.000	2.449	Red (1.822)
Yellowleg shrimp Mexico - Nayarit | Sinaloa - Gulf of California - Bottom trawls - 5,243 mt	2.644	1.299	2.000	2.449	Red (2.025)
Yellowleg shrimp Mexico - Sinaloa - Gulf of California - Bottom trawls - 5,243 mt	2.644	1.299	2.000	2.449	Red (2.025)
Yellowleg shrimp Mexico - Sonora - Gulf of California - Bottom trawls - 1,739 mt	2.644	1.299	2.000	2.449	Red (2.025)
Yellowleg shrimp Mexico - Gulf of Tehuantepec - Bottom trawls - 400 mt	2.644	1.299	2.000	2.449	Red (2.025)
Yellowleg shrimp Mexico - Baja California - Eastern Central Pacific Ocean - Magdalena - Artisanal bottom trawls - 460 mt	3.318	1.732	3.000	2.449	Yellow (2.549)

Summary

Several shrimp species inhabit Mexican waters. The fisheries assessed in this report include all the major fisheries in Mexican waters: blue shrimp (P*enaeus stylirostris*), yellowleg shrimp *Penaeus californiensis*), and whiteleg shrimp (*P. vannamei*) in the Pacific/Gulf of California; and brown shrimp (*F. aztecus*), white shrimp (*L. setiferus*), pink shrimp (*F. duorarum*), and seabob shrimp (*Xiphopenaeus kroyeri*) in the Gulf of Mexico. Ratings are broken down by gear, industrial versus artisanal fleets, and in the Pacific, by the regions used by the managers to conduct assessments. In the Pacific/Gulf of California, the gears assessed were: industrial trawlers *(arrastre*), suripera nets, cast nets (*atarraya*), small trawls (Magdalena I), and gillnets (*chinchorro de línea*). In contrast, trawlers, cast nets (atarraya), small trawls, and charanga nets were assessed in the Gulf of Mexico.

Criterion 1: Impacts of the Fisheries on Shrimp Populations

Overall, managers have considered shrimp stocks in the Pacific, to be exploited at their maximum capacity (DOF 2012), with others in the Gulf of Mexico considered deteriorated (DOF 2022). Still, although recent comprehensive stock assessments for shrimp species in Mexico were developed by managers in 2018 (INAPESCA 2018) and {INAPESCA 2019}, these have not been officially released or used for management decisions. In addition, the results of those assessments presented conflicting results. For these reasons, the 2021 abundance monitoring results were used to update the score on Criterion 1 in the Pacific (SADER-INAPESCA 2022) (SADER-INAPESCA b 2022), and the (DOF 2023) and (INAPESCA 2022) in the Gulf of Mexico.

To score Criterion 1, we used the most recent data published by managers, considered the low and medium vulnerability of the species, and included elements provided by those fisheries currently involved in a fishery improvement project (FIP). Based on this, it was found that blue shrimp in Sonora (zone 20), blue and white stocks in the Sinaloa-Nayarit region (zone 40) as well as the off-shore yellowleg stock on the West Coast of Baja (zone 50) are probably below the limit reference points, similar to seabob, and white shrimps in the Gulf of Mexico, that are reported as depleted or deteriorated by managers (INAPESCA 2022). There does not appear to be any specific reason for concern for all others. Still, as reference points have not been determined, current biomass and fishing mortality relative to a sustainable level are unknown.

Criterion 2: Impacts of the Fisheries on Other Species

Most fleets targeting shrimp in Mexico use non-selective gears, leading to the bycatch of numerous other species. The exceptions are cast nets and charangas, which do not appear to have a significant catch of species other than shrimp. The suripera fishery in Sinaloa and the West coast of Baja are also relatively selective, though some other species are still caught. Data on bycatch in the different fisheries comes from off-season surveys, logbooks, and other published literature.

The main species of concern in the trawl fisheries are totoaba (Upper Gulf of California only), sea turtles, seahorse species, and vulnerable sharks and rays. The abundance of some of these is a high concern because they are considered endangered or threatened (totoaba, sea turtles) or otherwise vulnerable due to possible overexploitation or life history characteristics. Implementing mitigation measures in some fleets (most notably turtle excluder devices (TEDs) and fish excluder devices in the trawl fisheries and closed areas in the gillnet fisheries) will likely reduce the fishing mortality of these species. Yet, a comprehensive analysis has yet to be undertaken to determine the impact of these populations on fishing mortality in Mexican shrimp fisheries. Concern over sea turtle bycatch in the Pacific trawl fisheries (including the Gulf of California) is somewhat mitigated by evidence of the increasing abundance of some of those populations, combined with data from the limited observer program that was in place, which suggested TEDs were proving effective at reducing sea turtle mortality. A lack of observer programs in Pacific and the Gulf of Mexico fisheries precludes this reassurance, primarily as similar fisheries are known to be a significant source of mortality for marine turtles.

In recent years, the most severe bycatch concern in the shrimp gillnet fisheries has been of vaquita in the Upper Gulf of California. Gillnetting for everything other than Corvina has been prohibited in the area for many years, so no analysis of the (former) shrimp fishery is presented in this assessment. However, there are reports that gillnet fishing activities still occur in the region {Rojas-Brach et al 2019}(Rojas-Bracho et al 2021), increasing the chances that shrimp catch using these gears might still be commercialized. The primary remaining bycatch concerns in gillnet fisheries are sharks and rays, for the same reasons as in the trawl fisheries described above.

Criterion 3: Management Effectiveness

In the past few years, numerous improvements have been made in the Mexican shrimp fisheries, such as:

- A gillnet ban to protect the (although there are reports of the lack of effective enforcement actions (Rojas-Bracho et al 2019)(Rojas-Bracho et al 2021).
- New research, modeling, expert workshops, and additional management efforts on shrimp.
- Expanded enforcement programs (although evidence of effectiveness is lacking).
- Implementation of fish excluder devices in trawlers and the mandatory TEDs in use for a long time.
- Public transparency includes providing compliance and enforcement data and observer data.
- Better outlook for most turtle populations.
- Fishery Improvement Projects/Fair Trade certification for two fisheries.

C3.1: Management Strategy and Implementation - Moderately effective

In Mexico, three government bodies (SADER -formerly known as SAGARPA-, CONAPESCA,

and IMIPAS, formerly known as INAPESCA) implement a diversity of tools to manage the impacts of fishing on shrimp stocks and bycatch populations. The focus of many of the measures used in the fishery- including temporary closures, permanent closures, gear restrictions, and a buyback program- have been designed to reduce effort on shrimp, which was determined to be too high more than a decade ago. While these measures have reduced the number of vessels in the industrial fishery, it is unclear what impact they've had overall on the combined effort in the industrial and artisanal fisheries. The impacts of the fishery on many of the shrimp populations are also unclear, as robust estimates of current fishing mortality relative to a sustainable level are generally unavailable. While the limited data and analyses suggest some populations may be being fished sustainably, others are not.

C3.2: Bycatch Strategy – Highly effective (suripera, cast net, and traps); Moderately effective (rest of the gears)

There are no concerns over bycatch in the cast net and traps (charangas) fisheries and no severe concerns over bycatch in the suripera and Magdalena I fisheries. Bycatch mitigation measures are in place in the trawl fisheries, including turtle excluder devices for all vessels in the artisanal and industrial trawl fleets and finfish excluder devices in all vessels in the industrial trawl fleets. Also, a ban on fishing within the 0 to 5 fathoms strip has been in place for several years for the industrial fleet. Mitigation measures are also in place in the gillnet fisheries, such as closed areas to protect shark and ray nursery grounds and sea turtle aggregation areas (and the Upper Gulf of California shrimp gillnet fishery is now banned out of concerns for vaquita). Although these are likely effective strategies in reducing bycatch mortality, there has yet to be a thorough assessment of their effectiveness.

C3.3: Scientific Research and Monitoring – Highly effective (charanga, cast net); Moderately effective (suripera and Magdalena I), Ineffective (for industrial and small trawls in the Pacific and all trawls in the Gulf of Mexico)

Shrimp stocks are regularly monitored through commercial catch data and survey data, which are used to set the open season each year. Historically, limited analysis has been conducted on these data regarding identifying a sustainable catch level. Still, analyses to determine these levels were conducted for some stocks (most recently in 2016 as well 2018 and 2019). More work is needed to assess the impacts of the fishery on shrimp populations through more robust and comprehensive stock assessments. Still, enough research and monitoring are occurring on shrimp to be moderately effective in understanding the effects of fishing on these target populations.

Bycatch monitoring is far less developed in most fleets, a significant weakness in the fleets that incidentally catch species of concern (e.g., rare, endangered, threatened, depleted, or overfished species). This includes all fleets except the charanga (which catch only shrimp, though some of those populations are of concern) and cast net fleets in the Gulf of Mexico and the Pacific. Where there are data on bycatch, it is generally collected through logbooks and off-

season surveys, but observer programs are necessary to assess impacts properly.

From 2004 to 2011, an onboard observer program was in place for the industrial fleet in the Pacific (including the Gulf of California) (INAPESCA 2012). Yet, from 2011 to 2015, there was no observer monitoring program in the shrimp fishery except for the fishery improvement project in Sinaloa (suripera). The observer program in the industrial fleet in the Pacific was reinstated for 2015 to 2016 and 2016 to 2017 seasons, with an estimated 1.5% coverage (INAPESCA 2017) . Managers planned to expand it to at least 5%, but instead, the program stopped and has not been in place since the 2018 season. The most recent year when the program was active (or at least we could find evidence, was 2018, and the industry paid for it. Similarly, there is no observer program in the Gulf of Mexico, which is a serious concern given the potential impact of trawl fleets on species of concern such as turtles.

C3.4: Enforcement of Management Regulations – Moderately effective (suripera, and Magdalena I); Ineffective (industrial fleet and other artisanal fleets)

Illegal fishing, including shrimp, has been recognized as a serious and complex problem within fisheries in Mexico. According to official statements, the enforcement program has been strengthened, and the number of enforcement actions has increased. However, an analysis of public data requested through the Freedom to Information Act by Oceana Mexico found that the number of agents and enforcement actions has decreased (Oceana 2024). Official government reports suggest compliance with some of the regulations has improved, thanks to using tools such as the VMS and TED regulations in the industrial fleet. However, reports about vessels fishing in restricted areas {Causa Natura 2022} or not using the excluding devices are still found (Gob Mx 2017). An example of these inconsistencies was reflected in the loss of the certification to export shrimp to the USA (Federal Register 2021). The US embargo of all shrimp from Mexico (Federal Register 2021) resulted in close collaboration and coordination between managers who worked with the industry to demonstrate that turtle protection actions were similar to those in the US. Later that same year, the certification was reinstated (State Gov 2021). These events showed mixed signals about the effectiveness of the enforcement actions with the industrial fleet. Finally, early in 2023, the VMS system for the industrial fleet was inoperative, with managers' statement that it would return to operation later in 2023, but not at total capacity (Algo Que Informar 2023). According to a report released by Oceana Mexico in early 2024, in 2023, only 2.1% of industrial vessels (not only shrimp trawlers) were actively monitored by the VMS (Oceana 2024).

Concerning the small-scale fleet, it is believed that more than enforcement and monitoring might be needed (due to the size of the fleet and the number of active agents). In particular, there are concerns about capturing shrimp using banned gear (i.e., gillnet fishery in the Upper Gulf of California) and that this product can still reach the market. Some active improvement projects have independent enforcement and monitoring programs that aim to comply with special requirements, such as the FairTrade Certification in Sinaloa with the Suripera fishery. For these reasons, and until reports suggest compliance is much improved in the rest of the artisanal fleet, serious concerns remain for the sector.

C3.5: Stakeholder inclusion – Highly effective

Reviewing, evaluating, and revising management regulations is often based on demand by producers and fishermen. In particular, stakeholders (including NGOs, universities, and researchers) can participate in developing Mexican Official Standards (NOMs) for the shrimp fishery. Federal laws govern the public's access to information, including fisheries information. The government generates reports and analyses, which are available to the public. 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.

C4: Habitat and Ecosystem Impacts

Bottom trawling has adverse effects on a wide variety of ecosystems. The Mexican fleet operates mainly in soft sediments at moderate depth. Although these habitats can recover more rapidly, the frequency and intensity of bottom trawling likely substantially impact them. Gillnets cause less habitat disturbance but may still disturb the seabed where they contact it. Cast, charanga, and suripera nets have a low impact on seafloor habitats and marine ecosystems because they contact only the seafloor where they are set, or the contact is minimal.

Managers have tried to mitigate these impacts by reducing fishing efforts, as well as reducing the area of operation for the trawlers close to the coast, and creating marine protected areas (MPAs); however, MPAs cover a very small portion of the fishing area in Mexican waters, and the anglers' buyout program has been focused on the industrial fleet only. The Mexican Pacific and GOM industrial and artisanal fisheries (besides the Suripera, cast nets and charangas) generate a high bycatch. Yet, the impact of removing these bycatch species from the overall ecosystem needs to be clarified.

Information on Certification and Improvement Projects

A portion of the fisheries covered in this report used to be engaged in Fishery Improvement Project (FIP): Currently, the small-scale Suripera fishery in Sinaloa, whose supply chain holds a FairTrade certification in Sinaloa, and the small-scale blue and yellowleg fishery in Magdalena bay (on the West Coast of Baja) have active improvement projects. Engagement in a FIP does not affect the Seafood Watch score because we base our assessments on the current situation. Monterey Bay Aquarium is a member 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 rating

This Seafood Watch assessment covers the main shrimp fisheries in Mexico (Tables I-1 and I-2).

Shrimp species are targeted along the Mexican Pacific coast, divided into protected waters and the high seas. Fishing in protected waters occurs mainly in lagoon systems, estuaries, and bays of Baja California Sur, Sonora, Sinaloa, Nayarit, Oaxaca, and Chiapas. While fishing in marine waters is conducted in the Mexican Pacific Ocean, including the Gulf of California. The Pacific is divided into seven zones:

- Zone 10. That includes the Upper Gulf of California AGC.
- Zone 20. Includes the coastal front of the State of Sonora.
- Zone 30. This includes the north of Mazatlan and Punta Ahome, on the border with the state of Sonora.
- Zone 40. From Mazatlan to Boca de Teacapan on the border with Nayarit.
- Zone 50. Strip between La Paz and Cabo San Lucas in the Gulf of California, as well as the west coast of the Baja California Peninsula.
- Zone 60. Off the coast of Nayarit, from the mouth of Teacapán to the mouth of Custodios.
- Zone 90. The Gulf of Tehuantepec, corresponding to the States of Oaxaca and Chiapas, the area from Punta Chipehua, Oaxaca, to Puerto Madero, Chiapas.

Table I-1: Commercial landings of shrimp species in Mexican shrimp fisheries, by coast and species (2023). The scientific and common names highlighted in blue will be used for each species in this Seafood Watch assessment.

Table 1

Region	Scientific Name (WoRMS)	Scientific Name (FAO)	Scientific Name (FDA)	FDA Common Name	FDA Acceptable Market Name	FAO name	Mexican name	Volume (mt)
Pacific	*Penaeus stylirostris*	*Penaeus stylirostris*	*Litopenaeus stylirostris*	Blue Shrimp	Shrimp	Blue shrimp	Camaron azul	17,719
	Penaeus californiensis	*Penaeus californiensis*	None	None	None	Yellowleg shrimp	Camaron cafe	8,080

	Penaeus vannamei	*Penaeus vannamei*	*Litopenaeus vannamei*	Whiteleg Shrimp	Shrimp	Whiteleg shrimp	Camaron blanco	6,317
Gulf of Mexico	*Penaeus aztecus*	*Penaeus aztecus*	*Farfantepenaeus aztecus*	Brown Shrimp	Shrimp	Northern brown shrimp	Camaron cafe	8,496
	Penaeus setiferus	*Penaeus setiferus*	*Litopenaeus setiferus*	White Shrimp	Shrimp or White Shrimp	Northern white shrimp	Camaron blanco	4,800
	Penaeus duorarum	*Penaeus duorarum*	*Farfantepenaeus duorarum*	Pink Shrimp	Shrimp or Pink Shrimp	Northern pink shrimp	Camaron rosado	1,028
	Xiphopenaeus kroyeri	*Xiphopenaeus kroyeri*	*Xiphopenaeus kroyeri*	Atlantic Seabob	Shrimp or Seabob	Atlantic seabob	Camaron siete barbas	1,304

Table I-2: Mexican shrimp fisheries, by region/state and shrimp fishing zone in the Pacific (see 'overview of species' below for more information), gear type and current target shrimp species. Active fishery improvement projects are also identified - more information on these can be found at fisheryprogress.org.

Table 2

Region/Zone	Gear	Shrimp species	FIP name
Pacific			
Upper Gulf of California (Zone 10)	Bottom trawl	Blue	None
Sonora (Zone 20)	Bottom trawl	Yellowleg	Mexico Gulf of California brown shrimp - trawl
		Blue	None

	Gillnet	Blue	Mexico Sinaloa-Sonora blue shrimp - driftnet/cast net/bottom trawl (Direct Source Seafood)
Sinaloa North Central (Zone 30)	Artisanal Bottom trawl	Blue	Mexico Sinaloa-Sonora blue shrimp - driftnet/cast net/bottom trawl (Direct Source Seafood)
	Suripera	Blue	Mexico Sinaloa artisanal blue shrimp – drift/cast nets (This FIP is currently under the process for MSC certification; an ACDR was released on September 2024)(MSC 2024)
		Whiteleg	None
		Yellowleg	None
	Gillnet	Blue	None
	Bottom trawl	Blue	None
Sinaloa South (Zone 40)	Bottom trawl	Blue, whiteleg, yellowleg	None
	Cast net	Whiteleg	None
West Coast of Baja (Zone 50)	Bottom trawl	Yellowleg	None
	Suripera	Blue	Mexico Baja California Sur blue and brown shrimp – bottom trawl/cast net
	Magdalena (artisanal bottom trawls)	Blue, yellowleg	
Nayarit (Zone 60)	Bottom trawl	Blue, whiteleg, yellowleg	None
	Cast net	Whiteleg	Mexico Marismas Nacionales artisanal whiteleg shrimp - trap/cast-nets
Gulf of Tehuantepec (Zone 90)	Bottom trawl	Whiteleg, yellowleg	
Atlantic			

All Gulf of Mexico shrimp region	Bottom trawl	Atlantic seabob, Brown shrimp, Pink shrimp, White shrimp	None
Northern Gulf of Mexico	Traps	Brown shrimp, Pink shrimp	None
Coastal zones	Castnets	Brown shrimp	None

Species Overview

Shrimp is the most valuable fishing resources in Mexico; it represents the third-highest productive resource in terms of volume, just behind sardine and tuna (SAGARPA 2015). The fishery accounts for 0.31% of employment in the country {Hernandez et al. 2000}.

Between the 2000-2001 and 2018-2019 fishing seasons, the average production of shrimp (all species) was ~53,000 tones. from those, between 43 and 77% were caught in the Mexican Pacific, while the rest in the Gulf of Mexico {INAPESCA 2019}. Over 80% of industrial trawlers in the Mexican Pacific are established in three ports: Mazatlán, Sinaloa; Guaymas, Sonora; and Puerto Peñasco, Sonora (INAPESCA 2000). 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.

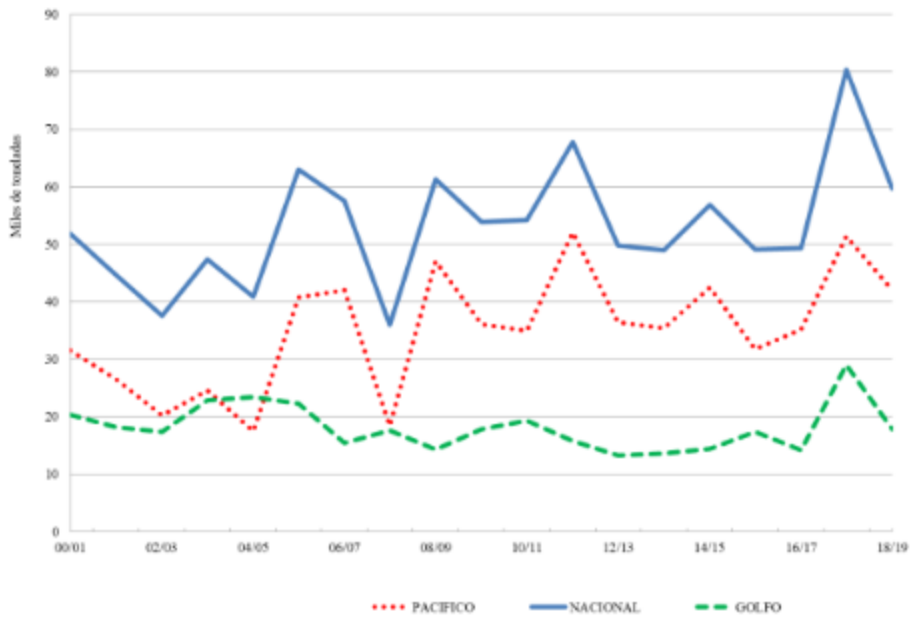


Figure 1: Total reported shrimp landings (blue line), and the proportion in the Pacific (red line) and the Gulf of Mexico (green line){INAPESCA 2019}

The most important shrimp species are captured in the Mexican Pacific: yellowleg shrimp (*Peneaus californiensis*); blue shrimp (*L. stylirostris*); whiteleg shrimp (*L. vannamei*); crystal shrimp (*P. brevirostris* and western white shrimp (*Litopenaeus occidentalis*). Yellowleg, blue, and whiteleg shrimps are caught in the highest quantities in the region and are the species rated in this assessment. The other species are caught and sold as a lower quality product, primarily for local consumption (FAO 2008) (CONAPESCA 2008).

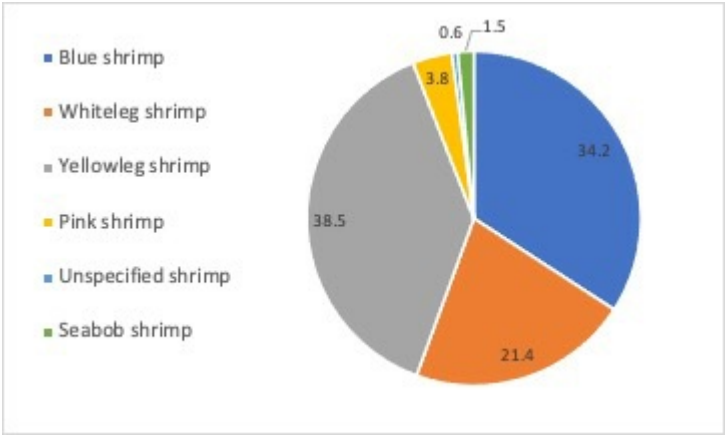


Figure 2: Shrimp species proportions based on official landing data from CONAPESCA 2020

Although trawls are the primary gear type used by industrial fleets in the Mexican Pacific, artisanal (ribereñas or pangas) fleets use a variety of gears, including cast nets (*atarrayas*), entanglement or gillnets (*chinchorro de línea*; one net per pangas with a maximum permitted length of 200 m), suripera nets, and small trawl nets (changos) (CONAPESCA 2008). To better manage these species, managers have parsed these species out into administrative zones along the Pacific Coast, it is important to clarify that these zones do not represent different biological populations : Upper Gulf of California (Zone 10), Sonora (Zone 20), Sinaloa North-Central (Zone 30), Sinaloa South (Zone 40), Nayarit (Zone 60), west coast of Baja California (Zone 50), and Gulf of Tehuantepec (zone 90) (INAPESCA-CONAPESCA 2004) {INAPESCA 2015}.

Figure 3: Shrimp fishing zones base on INAPESCA-CONAPESCA tagging system.

In the Gulf of Mexico, the states of Tamaulipas, Veracruz, and Campeche present the highest landings (CONAPESCA b 2016). As in the Pacific, this fishery represents a big source for employment and income for many families {FAO 2003}. In this region, four species compose the catch: Brown shrimp (*F. aztecus*); Pink shrimp (F. *duorarum*); White shrimp (*L. setiferus*) in the GOM, and in the Caribbean, Red Shrimp *(Farfantepenaeus brasiliensis)* and Pink Shrimp *(Sicyonia brevirostris)* are the target species.

The Campeche Bank was the most important area for the shrimp fishery in the GOM; however, declines in catches have been a constant for several years. Because of this, Tamaulipas and Veracruz have taken over regional importance; in 2014, 58% of the production was landed in these states (CONAPESCA database).

In the northern GOM (Tamaulipas y Veracruz), management regulations for Brown Shrimp are

in place for each fleet to reduce overfishing. As a result, Shrimp landings have remained stable. A no-fishing season in the northern GOM is in place and generally starts from May to July for the small-scale fleet, and from May to August for the industrial trawlers. In the Campeche Bank, the no-fishing season starts in May and ends in October every year. Shrimp production has remained consistent in the Mexican Pacific and GOM over the last two decades (INAPESCA 2014 b). However, some signals of decline have been documented for certain stocks (See Criterion 1) (SAGARPA-INAPESCA 2012) (CONAPESCA 2008) (SAGARPA-INAPESCA 2016).

Management scheme

Shrimp fishery in Mexico is managed by a network of federal agencies (FAO 2008). The Secretary of Agriculture, and Rural Development (SADER in Spanish) is responsible for establishing public policies to ensure optimum development of resources. The National Commission of Aquaculture and Fisheries (CONAPESCA) is the branch of SADER committed to fisheries management, monitoring, and enforcement. As part of the enforcement actions, CONAPESCA coordinates activities with the Mexican navy, as well as local officials of the state and municipal police. CONAPESCA is responsible for administering the sustainable development of fisheries and aquaculture resources, promoting the development of chains of production, distribution, and consumption (CONAPESCA 2016).

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. CONANP operates in coordination with the Secretary of the Environment and Natural Resources (SEMARNAT), the agency responsible for enforcing the use of appropriate fishing gear and establishing fishing regulations inside protected areas and species. The National Fisheries Institute (INAPESCA) is responsible for gathering data and providing the scientific and technical basis for decision-making (FAO 2008) (CONAPESCA 2016). INAPESCA assesses the status of wild stocks and evaluates the impacts of fishing gears. It has a decentralized network of 13 Regional Centers of Fisheries Research or CRIPs. The CRIPs and INAPESCA-Regional Research Directors coordinate with shrimp producers by means of national shrimp fishery-focused workshops (CONAPESCA 2016). The overall mission of these agencies is to promote the long-term sustainability, conservation, and protection of natural resources (FAO 2008).

The shrimp fishery is managed under several laws (INAPESCA-CONAPESCA 2004)

· 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 (Environmental Law) focused on environmental protection.
· A draft of a Management Plan for Shrimp 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; however, this draft is not public and is not in place yet.

· 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 and zone restrictions are regulated by the Mexican Official Standards (*Normas Oficiales Mexicana*s or NOMs); NOM 002-PESC-1993.

In addition to these agencies, the Gulf of California is considered a high conservation priority for 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

In terms of shrimp production, Mexico ranks among the top producers worldwide.

Table I-3: Global shrimp production 2017-2021 (summed), by country and % farmed {(FAO FishstatJ 2023)

Table 3

Country	Total shrimp production (mt)	% farmed
China	12,922,973	76%
Indonesia	4,370,051	87%
India	3,959,617	97%
Ecuador	3,391,207	99%
Viet Nam	2,952,642	100%
Thailand	2,023,496	90%
Mexico	1,311,876	65%
Argentina	1,121,785	0%
United States of America	666,203	1%

Malaysia	398,721	46%
Others	3,563,222	55%
Grand Total	**36,681,793**	**78%**

In Mexico, wild shrimp production averages ~43,000 t, according to the landing data from 2001 to 2021. On 2018, landings reached close to 50,000 t, of which 75% were landed in the Mexican Pacific, and 25% from the GOM (INAPESCA 2021) }. The industrial fleet (offshore) has been the major producer. However, since 2010 both fleets have been showing similar levels of production. No data were available on the volume of shrimp caught by gear type for this assessment.

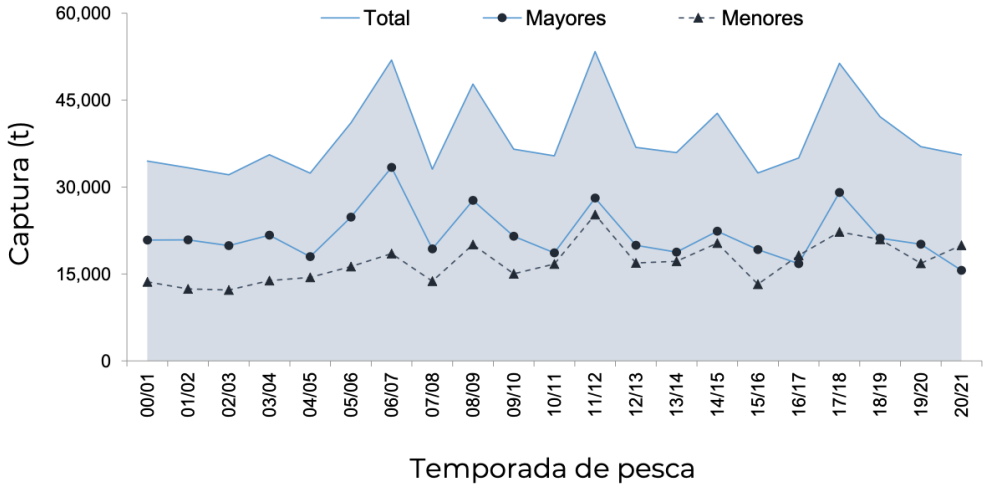


Figure 4: Volume of catch per fleet in the Mexican Pacific, from 2014 to 2021 (INAPESCA 2021)

In terms of species proportions, the artisanal fleet catches mostly blue shrimp within the Gulf of California. The industrial fleet targets mostly yellowleg shrimp (51%) ('brown' shrimp in this figure).

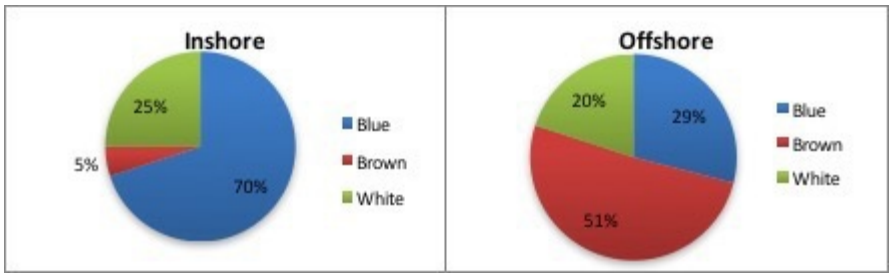


Figure 5: Composition of shrimp catches by species by fleet (inshore= Artisanal; offshore= Industrial) (FAO 2012)

Importance to the US/North American market

Imports of shrimp have been around 700,000 to 900,000 mt in recent years (2018-2022). Imports are dominated by India, Indonesia and Ecuador, with Mexico supplying around 20-30,000mt annually from 2018-2022 (Table I-4). Trade data for shrimp do not specify species or whether the product is farmed or wild, although some imports have been specified as wild or farmed in the most recent years (2021-2022).

Table I-4: Imports of shrimp into the US, by country 2018-2022 (summed) (NOAA FOSS 2023)

Table 4

Country	Volume (mt)	Volume (%)
INDIA	1,464,788	37.73%
ECUADOR	668,467	17.22%
INDONESIA	767,687	19.77%
VIETNAM	326,495	8.41%
THAILAND	214,078	5.51%
MEXICO	121,564	3.13%
ARGENTINA	74,711	1.92%
CHINA	94,991	2.45%
PERU	34,631	0.89%
GUYANA	18,096	0.47%
Others	97,088	2.50%
Total	**3,882,596**	**100%**

Common and market names

In general, the market name for all Mexican species is quite simply “shrimp.” The common name varies by species.

Primary product forms

Most of the Mexican shrimp is exported complete (headed), frozen, and packed in five-pound boxes called “marquetas” with similar sizes that are aimed mostly at the food service industry (pers. comm., Sergio Castro Del Pacifico 2016). Within the national market, mostly small and medium size shrimp is sold fresh, or frozen. In general, the larger sizes are exported and the smaller shrimp remain for the domestic market.

Production volume notes

Landing information regarding shrimp species was available to the common name level and state. However, details on which fleet (small-scale of industrial) as well as gear used, was not available. The metric ton production presented was based on the official public data and analysis developed by the analyst. The tables below show the production reported by each state in 2022 (data from (CONAPESCA 2024).

Zone(s)	State	Blue	Whiteleg	Yellowleg
10	Baja California	486.5		4.5
20	Sonora	4,691.6	0.9	1,739.3
30/40	Sinaloa	12,061.9	1,066.0	5,242.6
50	Baja California Sur	459.7		460.3
60	Colima			1.1
60	Nayarit	8.6	4,644.8	232.8
90	Chiapas	11.1	416.5	113.5
90	Oaxaca		188.8	286.4

Figure 6: Mexican Pacific Shrimp production by state. Zones were included based on the manager's zonification

Zone	State	White	Brown	Pink	Seabob
GOM	Campeche	157.3	255.9	735.3	1,242.9
GOM	Quintana Roo		0.4	6.6	
GOM	Tabasco	17.1	3.6		60.1
GOM	Tamaulipas	166.4	6,807.4	273.2	1.8
GOM	Veracruz	389.0	1,428.0	13.2	
GOM	Yucatan			0.6	

Figure 7: Mexican Gulf of Mexico Shrimp production by state

Assessments

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Standard for Fisheries, available at www.seafoodwatch.org. The specific standard used is referenced on the title page of all Seafood Watch assessments.

Criterion 1: Impacts on the Species Under Assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. When abundance is unknown, abundance is scored based on the species' inherent vulnerability, which is calculated using a Productivity-Susceptibility Analysis. The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

- Score >3.2 = **Green** or Low Concern
- Score >2.2 and ≤3.2 = **Yellow** or Moderate Concern
- Score ≤2.2 = **Red** or High Concern

Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical.

Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level*

Criterion 1 Summary

Atlantic seabob			
Region / Method	**Abundance**	**Fishing Mortality**	**Score**
Mexico - Gulf of Mexico - Bottom trawls - 1,304 mt	1.000 High Concern	1.000 High Concern	**Red (1.000)**

Blue shrimp			
Region / Method	**Abundance**	**Fishing Mortality**	**Score**
Mexico - Sinaloa - Gulf of California - Bottom trawls - 12,062 mt	3.670 Low Concern	3.000 Moderate Concern	**Green (3.318)**
Mexico - Baja California | Sonora - Gulf of California - Bottom trawls - 4,692 mt	2.330 Moderate Concern	3.000 Moderate Concern	**Yellow (2.644)**
Mexico - Nayarit | Sinaloa - Gulf of California - Bottom trawls - 20 mt	1.000 High Concern	3.000 Moderate Concern	**Red (1.732)**
Mexico - Sonora - Gulf of California - Bottom trawls - 4,692 mt	1.000 High Concern	3.000 Moderate Concern	**Red (1.732)**
Mexico - Sinaloa - Gulf of California - Gillnets and entangling nets - 12,062 mt	3.670 Low Concern	3.000 Moderate Concern	**Green (3.318)**
Mexico - Sonora - Gulf of California - Gillnets and entangling nets - 4,692 mt	1.000 High Concern	3.000 Moderate Concern	**Red (1.732)**
Mexico - Baja California - Eastern Central Pacific Ocean - Magdalena - Artisanal bottom trawls - 460 mt	3.670 Low Concern	3.000 Moderate Concern	**Green (3.318)**
Mexico - Eastern Central Pacific Ocean - Suripera - 460 mt - Flag Country: Mexico - FAO Major Area: Pacific, Eastern Central - Management Unit: West Coast of Baja (Zone 50)	3.670 Low Concern	3.000 Moderate Concern	**Green (3.318)**
Mexico - Sinaloa - Gulf of California - Suripera - 12,062 mt	3.670 Low Concern	3.000 Moderate Concern	**Green (3.318)**

Brown shrimp			
Region / Method	**Abundance**	**Fishing Mortality**	**Score**
Mexico - Gulf of Mexico - Bottom trawls - 8,495 mt	3.670 Low Concern	3.000 Moderate Concern	**Green (3.318)**
Mexico - Gulf of Mexico - Cast nets - 8,495 mt	3.670 Low Concern	3.000 Moderate Concern	**Green (3.318)**
Mexico - Gulf of Mexico - Traps - 8,495 mt	3.670 Low Concern	3.000 Moderate Concern	**Green (3.318)**

Pink shrimp			
Region / Method	**Abundance**	**Fishing Mortality**	**Score**
Mexico - Gulf of Mexico - Bottom trawls - 1,029 mt	1.000 High Concern	5.000 Low Concern	**Yellow (2.236)**
Mexico - Gulf of Mexico - Traps - 1,029 mt	1.000 High Concern	5.000 Low Concern	**Yellow (2.236)**

White shrimp			
Region / Method	**Abundance**	**Fishing Mortality**	**Score**
Mexico - Gulf of Mexico - Bottom trawls - 730 mt - Flag Country: Mexico - FAO Major Area: Atlantic, Western Central	1.000 High Concern	1.000 High Concern	**Red (1.000)**
Mexico - Gulf of Mexico - Bottom trawls - 730 mt - Flag Country: Mexico - FAO Major Area: Atlantic, Western Central - Specific Fishery: Seabob fishery	1.000 High Concern	1.000 High Concern	**Red (1.000)**

Whiteleg shrimp			
Region / Method	**Abundance**	**Fishing Mortality**	**Score**
Mexico - Sinaloa - Gulf of California - Bottom trawls - 1,066 mt	3.670 Low Concern	3.000 Moderate Concern	**Green (3.318)**
Mexico - Nayarit | Sinaloa - Gulf of California - Bottom trawls - 4,645 mt	1.000 High Concern	3.000 Moderate Concern	**Red (1.732)**
Mexico - Gulf of Tehuantepec - Bottom trawls - 605 mt	3.670 Low Concern	3.000 Moderate Concern	**Green (3.318)**
Mexico - Nayarit | Sinaloa - Gulf of California - Cast nets - 4,645 mt	1.000 High Concern	3.000 Moderate Concern	**Red (1.732)**

Yellowleg shrimp			
Region / Method	**Abundance**	**Fishing Mortality**	**Score**
Mexico - Baja California - Eastern Central Pacific Ocean - Bottom trawls - 460 mt	1.000 High Concern	3.000 Moderate Concern	**Red (1.732)**
Mexico - Nayarit | Sinaloa - Gulf of California - Bottom trawls - 5,243 mt	2.330 Moderate Concern	3.000 Moderate Concern	**Yellow (2.644)**
Mexico - Sinaloa - Gulf of California - Bottom trawls - 5,243 mt	2.330 Moderate Concern	3.000 Moderate Concern	**Yellow (2.644)**
Mexico - Sonora - Gulf of California - Bottom trawls - 1,739 mt	2.330 Moderate Concern	3.000 Moderate Concern	**Yellow (2.644)**
Mexico - Gulf of Tehuantepec - Bottom trawls - 400 mt	2.330 Moderate Concern	3.000 Moderate Concern	**Yellow (2.644)**
Mexico - Baja California - Eastern Central Pacific Ocean - Magdalena - Artisanal bottom trawls - 460 mt	3.670 Low Concern	3.000 Moderate Concern	**Green (3.318)**

PACIFIC (including the Gulf of California)

Summary

Managers have suggested that environmental conditions rather than the fishery drive the stock-recruitment relationship of the different shrimp species because these populations only live for a year or two. For this reason, no reference points have been calculated for the stocks. Instead,

managers rely on yield data (CPUE) from off-season sampling to indicate relative stock biomass.

Only two stock assessments for shrimp species in the Pacific have been completed recently. The assessment of the blue and yellowleg stocks targeted the West Coast of Baja California (INAPESCA b 2021) and the blue shrimp in zone 30 in the Gulf of California (Arreguin-Sanchez et al 2023). These evaluations are part of the actions of Fishery Improvement Projects in those regions (INAPESCA b 2021) (Arreguin-Sanchez et al 2023). During the update of this recommendation, it was confirmed that managers still rely on the stock/recruitment relationship to manage the fisheries in the Pacific and the Gulf of Mexico. Even though managers developed two assessments, these are not officially published and have not been used for management or this evaluation {INAPESCA 2018} {INAPESCA 2019}. Instead, we used the results of the off-season monitoring to inform the biological status of the different species in the Pacific (INAPESCA 2021). The historical trends available and shrimp species' inherent low vulnerability to score the abundance-related factors.

Based on this:

- All blue shrimp stocks are below the limit reference point, except for the West Coast of Baja (low concern), Upper Gulf of California, and Sinaloa (moderate concern) (zones 90, 10, and 30 based on managers' zoning).
- All yellowleg shrimp stocks were rated low or moderately concerned for abundance, except for the outside-the-bay stock of the West Coast of Baja, which scored as high concern).
- Whiteleg shrimp stocks in zones 30 and 90 scored low concern, while zone 40 (Sinaloa South) scored high concern.

For fishing mortality, due to the lack of assessments of F against the F_{MSY}, the abundance tendencies and the yield data (CPUE) were used to score this factor for all the species.

Detailed Rationale

In the past, several researchers have found that fluctuations in wild shrimp abundance are correlated with inter-annual variations in ocean conditions (Lopez-Martinez, J. 2000). El Niño Southern Oscillation (ENSO) years have been described as having negative impacts on several fish populations, but shrimp species appear to respond positively to ENSO events {Leal-Gaxiola et al. 2001} (Aragón-Noriega and Calderón-Aguilera 2000); {Galindo-Bect et al. 2000} {Lopez-Martinez 2000}. Some calculations on the BMSY had been developed (INAPESCA 2000), but no reference points have been defined in the National Fisheries Chart or the Official Norm from shrimp {NOM.002.PESC.1993}. Instead, managers rely on CPUE indices from off-season surveys to indicate relative stock biomass (SAGARPA-INAPESCA 2016).

The last time managers released full stock assessments was in 2000 when INAPESCA evaluated the different shrimp species along the Pacific regions (INAPESCA 2000). This information was presented in the National Fisheries Chart (DOF 2006) and included in a draft of the Shrimp Fisheries Management plan (INAPESCA-CONAPESCA 2004) (not published).

INAPESCA used two stock assessment models: a) The Schaefer Dynamic Biomass model proposed by Hilborn and Walters (1992), which uses catch and effort data, and b) the age structure model with delay recruitment (EERR) by Deriso (1980), which is more complex and includes biological characteristics of the species, like species growth, survival rates, and recruitment. For the assessment, managers assumed that both fleets (artisanal and industrial) had access to all the stock components and that the impacts of the fleets were similar to the species. However, it has been suggested that each fleet's catchability patterns in time and across ages should be considered to improve the harvest rates and reduce the growth and recruitment overfishing (Aranceta-Garza et al 2019).

Based on the evaluation results in 2000, CONAPESCA and INAPESCA indicated that all three penaeid species in the Mexican Pacific — as a whole — were at the maximum sustainable exploitation and confirmed these statuses on the National Fisheries Chart in 2012 (CNP) (DOF 2012) and 2018 (DOF 2018). It has to be noted that 2018 was the last time that the profile was updated for this fishery within the CNP.

As part of the constant monitoring of the species, INAPESCA samples inshore (coastal lagoons) and offshore (marine) waters along the Pacific coast during the off-season. Information collected for each species includes relative abundance (CPUE expressed as kg/hour or area), size, and sex and maturity composition. Though the primary assessment tool had been dynamic production modeling, these models have not been applied to all the shrimp stocks, the species, or regions where fisheries occur along the Pacific Coast of Mexico. The primary tool managers use to assess the status of the stocks and make management decisions is the inter-annual variation in relative abundance. Trends in CPUE over five years, spawning biomass, and changes in size structure are used to determine the beginning and closure of the fishing season and predict when shrimp production will be optimized.

GULF OF MEXICO

Summary

Like the Mexican Pacific shrimp species, stock assessments for the 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 2012). Managers have indicated that all species in the GOM region have shown drastic declines in catches over the last 25 years except brown shrimp, which have maintained stable landings over the last quarter of a decade {SAGARPA 2012b}. Biomass values for the GOM penaeid species were not publicly available; however, in 2018, based on the 2014 off-season report, managers listed pink shrimp as depleted (INAPESCA 2014), and white shrimp as depleted but recovering (INAPESCA 2014). White shrimp stocks have shown some signs of recovery in the past (INAPESCA 2014 b), but in the last report from INAPESCA (INAPESCA 2014 b), managers still considered the stock depleted.

During the 2022 update of this recommendation, it was confirmed that managers still rely on the stock/recruitment relationship to manage the fisheries in the Gulf of Mexico. A March 2022 manager report (INAPESCA 2022) presented results on the four main species in the GOM;

authors confirmed the species' previous status based on production tendencies and CPUE changes for all the species (INAPESCA 2022). Considering the low level of vulnerability and the recent confirmation released by managers, we found no changes to the previous status. Since reference points were not determined, we scored a moderate concern for Brown shrimps. In contrast, pink, seabob, and white shrimp scored as High concern.

Criterion 1 Assessment

Scoring Guidelines

Factor 1.1 - Abundance

Goal: Stock abundance and size structure of native species is maintained at a level that does not impair recruitment or productivity.

- *5 (Very Low Concern) — Strong evidence exists that the population is above an appropriate target abundance level (given the species' ecological role), or near virgin biomass.*
- *3.67 (Low Concern) — Population may be below target abundance level, but is at least 75% of the target level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.*
- *2.33 (Moderate Concern) — Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.*
- *1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

Factor 1.2 - Fishing Mortality

Goal: Fishing mortality is appropriate for current state of the stock.

- *5 (Low Concern) — Probable (>50%) that fishing mortality from all sources is at or below a sustainable level, given the species ecological role, OR fishery does not target species and fishing mortality is low enough to not adversely affect its population.*
- *3 (Moderate Concern) — Fishing mortality is fluctuating around sustainable levels, OR fishing mortality relative to a sustainable level is uncertain.*
- *1 (High Concern) — Probable that fishing mortality from all source is above a sustainable level.*

Atlantic seabob *(Xiphopenaeus kroyeri)*

1.1 Abundance

Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery

High Concern

No reference points have been determined for the Atlantic seabob in the Gulf of Mexico, and no stock assessments have been conducted. Managers instead use yield (kg/trip) status indicator to determine open and closed periods for the fishery. There has been a clear decline in this indicator from 1995-2021 (see Justification below). In lieu of better information, this status indicator suggests a “high concern” is appropriate for abundance.

Supplementary Information

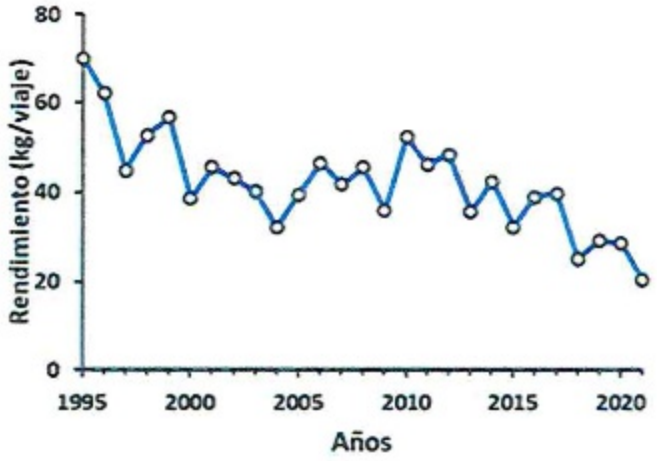


Figure 12: Seabob shrimp yield changes from 1995 to 2021 (INAPESCA 2022)

1.2 Fishing Mortality

Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery

High Concern

Managers have indicated that all species in the GOM region have shown drastic declines in catches over the last 25 years, except brown shrimp, which has maintained stable landings over the last decade (DOF 2012). Regulations such as closures have been established to protect the reproduction process and increase catches of the species (INAPESCA c 2012). Mixed results for the species have been achieved.

There are no quantitative estimates of fishing mortality about F_{MSY} to determine biological reference points for GOM shrimp species. A 2005 study estimated F_{MSY} for seabob shrimp and indicated that two years of landings illustrated that the fishery had exceeded its fishing threshold (Wakida-Kusunoki 2005). In 2011, seabob landings remained below this threshold (INAPESCA c 2012). In the most recent report, managers stated that throughout the history of the fishery, the optimal fishing levels had been surpassed and have had a direct impact on the status of the species (INAPESCA 2022). Within the same report, the authors stated that between 2008 and 2021 high levels of illegal fishing activities took place during the off-season, directly impacting recruitment (INAPESCA 2022). Therefore, fishing mortality for the GOM seabob shrimp is rated as a "high" concern.

Supplementary Information

In 2005 F_{MSY} for seabob shrimp was estimated at 1,700 MT (Wakida-Kusunoki 2005). Fishery-dependent data from the 1998 to 2000 fishing seasons showed catch rates exceeding this number (INAPESCA c 2012); however, catch data from 2011 show landings at 1,211 MT, below the calculated F_{MSY} {CONAPESCA 2012b). So far, it is unclear whether effort and season restrictions prevent overfishing in the GOM seabob fishery (Núñez Márquez, G. and A. T. Wakida 2003).

Blue shrimp *(Litopenaeus stylirostris)*

1.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

Eastern Central Pacific - Mexico - Suripera - West Coast of Baja (Zone 50)

Low Concern

There are two recent assessments of stock health for blue shrimp off the West Coast of Baja (Zone 50).

The first is a data limited assessment of relative abundance, and is the one used by managers to set the start and end dates for the fishery. That assessment showed catch per unit effort (CPUE, expressed in kg/ha) values below the historical average between 2010 and 2021, with an uptick to around the historical average in 2022 (SADER-INAPESCA 2022) (see Justification below).

The second is an assessment conducted by fishery managers as part of the fishery management project for the Magdalena-Almejas bay fishery (INAPESCA b 2021). The authors compared catch and biomass values from 2000 to 2021 against the optimum biomass (K/2), which, while considered the limit reference point by the authors (INAPESCA

b 2021), can be considered a proxy for B_{MSY} in the model used (Shaefer - see e.g. (Shaefer 1954) in (Kokkalis 2024) or (Palomares et al 2020)) and therefore an appropriate target reference point for the purposes of this Seafood Watch assessment. Overall, the results of this assessment showed that the species biomass was between 75% and 100% of K/2 (see Justification below).

A stock assessment where the latest data year is <5 yrs old and a finding that B/B_{MSY} is between 75% and 100% allows for a score of 3.67 (low concern). A stable or increasing CPUE trend over three generations also allows for a score of 3.67 (low concern). Generation time for shrimp species in the Gulf is likely between one and two years, and the CPUE trend suggests a stable but below the average abundance for around 10 years (see Justification below), except for a significant increase in the most recent year (2022). For these reasons, a score of 3.67 (low concern) is appropriate.

Supplementary Information

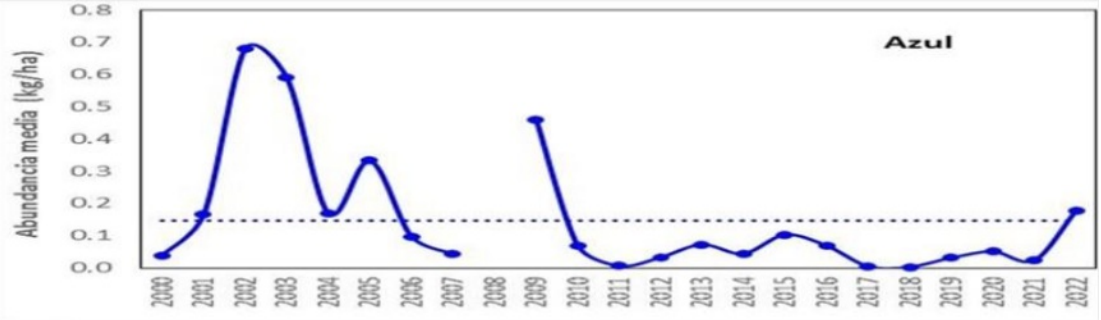


Figure 13: West Coast of Baja coastal Blue shrimp CPUE values. The red line represents the historical average (SADER-INAPESCA 2022)

The estimated biomass for blue shrimp showed wide variability, ranging from 585 to 1,955 t. The figure below shows changes in biomass and catch against the limit reference point (k/2).

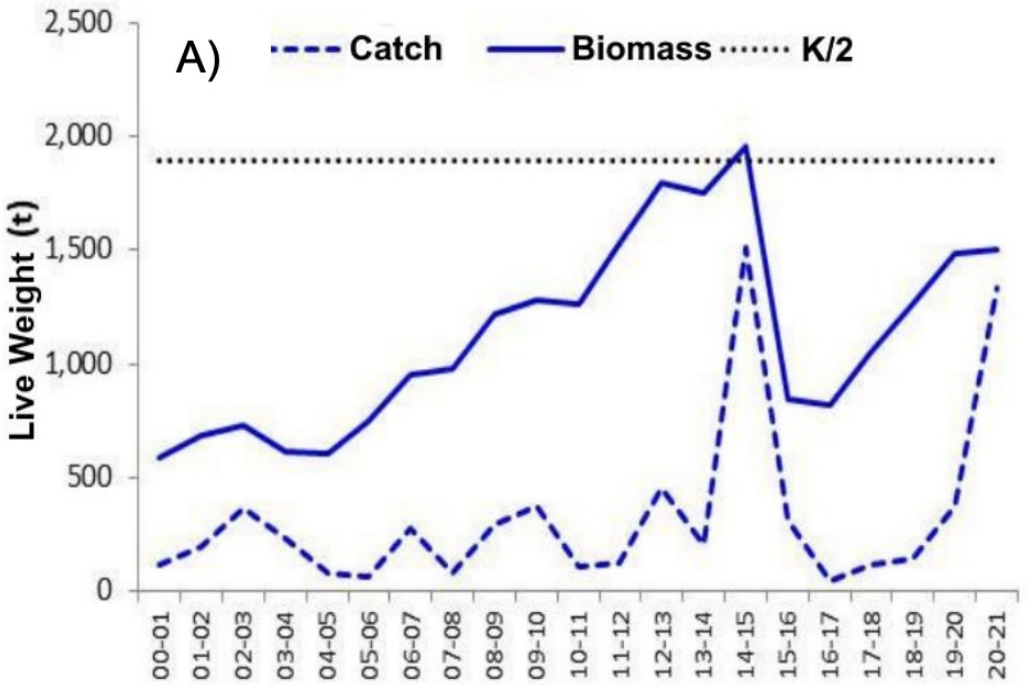


Figure 14: West Coast of Baja Blue shrimp reference points calculated by (INAPESCA b 2021) A) Catch and biomass trajectory; dotted line representes the limit reference point (K/2) (INAPESCA b 2021)

Blue shrimp generation time

Generation time is calculated using the same methods as IUCN assessments: Generation time (G) in an unfished population can be estimated using the formula: G = A + 1/M, where A is the age at 50% maturity and M is the natural mortality rate (IUCN 2024). Age at first maturity is likely less than 1 year (Lopez-Martinez, J. et al 2005), given the maximum age for penaeid shrimp species is 1-2 years (e.g. (García-Borbón et al 2018)). Natural mortality of adult shrimp in the Gulf of California is high (1.63-2.89 depending on species)(Aranceta-Garza et al 2016). A reasonable estimate of generation time is, therefore, 1.5 years.

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Moderate Concern

No stock assessment has been conducted for blue shrimp in the Upper Gulf of California, and no reference points have been determined. CPUE data from 2008-2021 suggest a decline in abundance to timeseries lows in 2015, followed by an uptick since then (but with no data points for 2018 or 2019) (see Justification below) ((INAPESCA 2021) and earlier monitoring reports).

As the species is not highly vulnerable (see PSA results below), there is no stock assessment, no reference points, and no evidence to suggest that stock is either above or below reference points; a score of 2.33 (moderate concern) is given.

Supplementary Information

The figure below was self-built using managers' off-season evaluation reports (INAPESCA 2021). The red line represents the average CPUE value from the last ten seasons. The average value is recalculated by managers using the last 10 seasons (seasons 2010-2011 to 2019-2020). If CPUE values keep a negative trend, the average also goes down.

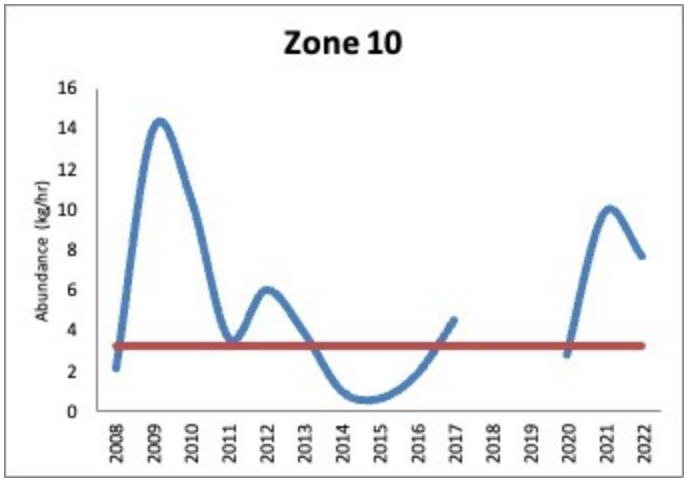


Figure 15: Upper Gulf of California blue shrimp CPUE values from 2008 to 2022 (Data from INAPESCA's annual offseason monitoring reports. Figure self-developed using the most recent reports from INAPESCA.

.

Table 9

Attribute	Score	Justification
Average age of maturity	1	Size at first maturity was 109 mm (abdominal length) (Lopez-Martinez, J. et al 2005) authors conclude that is maturity is achieved within the first year
Average maximum age	1	Fast growth, with a lifespan estimated in 1.7 years (Lopez-Martinez, J. et al 2005)

Fecundity	1	Mean lifetime fecundity estimated on ~550,000 {Aranceta-Garza et al 2006}
Reproductive strategy	1	Shrimps are external brooders
Trophic level	1	<2.75
Density dependence	3	Depensatory dynamics
Quality of habitat	2	Although specific information for the region is not available, literature available shows that non-fishing impacts have moderately altered habitat.

Table 10

Attribute	Score	Justification
Areal overlap	3	The species is targeted along all its areal distribution for industrial or small scale fleets. Some zoning in places (e.g. nursery grounds) are protected either temporally (off-seasons) or by prohibiting the use of specific gears. However, it is not believed it reached more than 30%
Vertical overlap	3	The species' vertical distribution ranges from 0 to 45 meters {Sealife base 2023}; Considering the fleets and gears, there is high overlap .
Selectivity of fishery	2	Species is targeted AND is not likely to escape the gear, but conditions under 'high risk' do not apply

Post-capture mortality	3	The organisms are retained

To calculate the overall score:
Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4, p5, p6, p7, and p8, where p8 is only used for invertebrates)= 1.42
Susceptibility score (S)= product of the susceptibility attribute scores (s1, s2, s3, s4): 1.28
Vulnerability score (V) = the Euclidean distance of 1 and 2 using the following formula: ?? = $v1.42^2 + 2.33^2$
Vulnerability =2.72 (>2.64 and <3.18 =Medium vulnerability)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

High Concern

Managers have yet to conduct a recent stock assessment for blue shrimp in 40 or 60 Sinaloa South and -Nayarit), and no reference points have been determined. During the most recent report related to abundance (expressed as CPUE), managers reported the CPUE values for zones 40 and 60 together (see image below), and based on those results, the values declined when compared to a historical average started in 2015 (SADER-INAPESCA b 2022). As a result, abundance is considered a “high concern”.

Supplementary Information

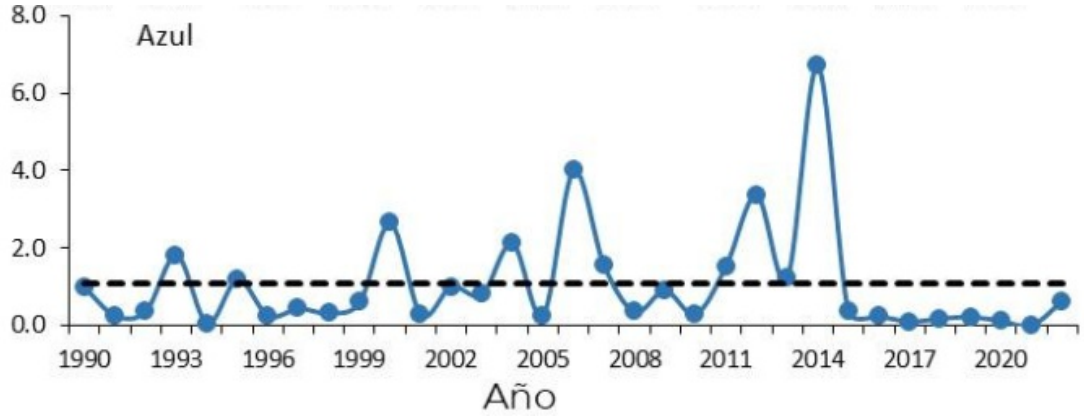


Figure 16: South Sinaloa and Nayarit (zones 40 and 60) CPUE values from 1992 to 2022. The dotted line is the historical average (SADER-INAPESCA b 2022)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Suripera - Sinaloa North Central (Zone 30)

Low Concern

Managers have yet to conduct a recent stock assessment for blue shrimp in zone 30 (Sinaloa North-Central), and no reference points have been determined. For management, CPUE data from 1992-2022 have been used, and data suggest a decline in abundance to time series below the historical average starting in 2019 in Zone 30 (see image below) (SADER-INAPESCA b 2022).

Recently, (Arreguin-Sanchez et al 2023) completed an independent study where a different approach was considered to assess the status of blue shrimp populations of the central-eastern coast of the Gulf of Baja California, particularly Sinaloa North-Central. During their assessment, the authors used the Leslie model that takes into consideration the limited data availability (catch and effort data) and the short-lived (annual) characteristics of the species {Arreguin-Sanchez et al. 2023}. The authors estimated monthly biomass per fishing season, the corresponding harvest rates (HRy), survival ratio (sy, remaining stock at the end of each fishing season), and the fishery's recruitment rate (r_y, at the beginning of the fishing season. With these estimates, the authors identified a limited biological reference point reflecting the replacement level for the shrimp stock, defined as the limit for population renewal rate (PRRLim). Based on their results, the authors reported that blue shrimp fishery on the coasts of Sinaloa was sustainable but required management measures to control fishing mortality and keep it within those sustainable levels (Arreguin-Sanchez et al 2023).

Abundance is scored 3.67 (low concern) based on the independent stock assessment results.

Supplementary Information

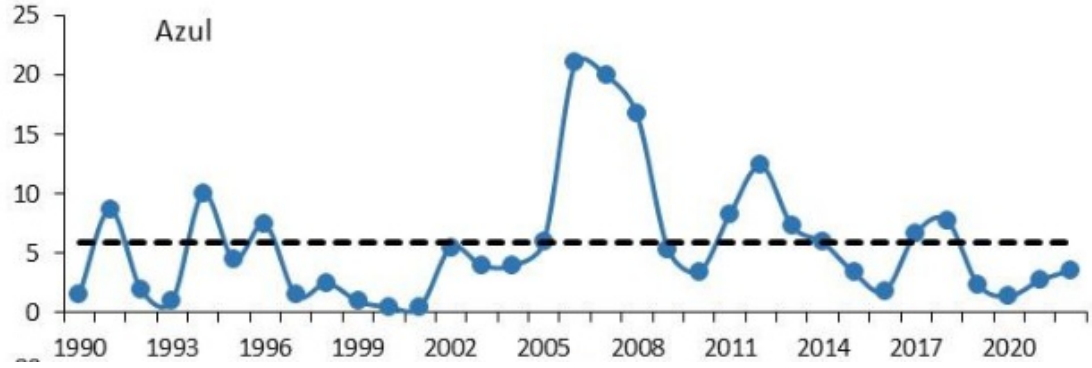


Figure 17: Central and North Sinaloa (zone 30) CPUE values from 1992 to 2022. The dotted line is the historical average

(Arreguin-Sanchez et al 2023) built Kobe diagrams using the harvest rates (Hr) and survival rates (sy) and found that the fishery was within the sustainable levels (see image

below A) and using the recruitment values (ry) instead of survival ratio (sy) with similar findings (see image below B)

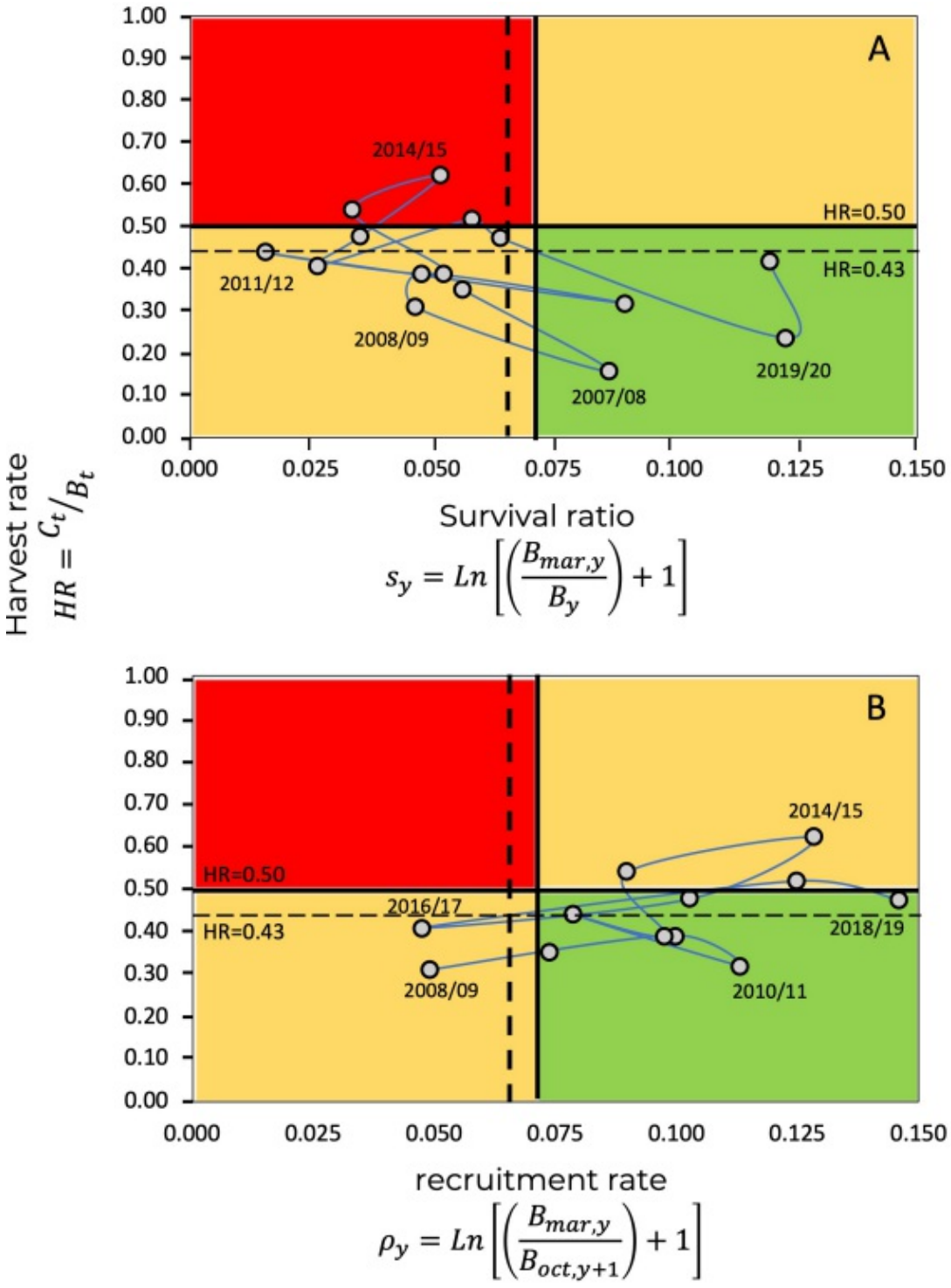


Figure 18: Kobe plots of the responses of blue shrimp stocks compared to changes in harvest rate and survival ratio (upper) and harvest rates and recruitment (lower) Vertical and horizontal dotted lines are the suggested limits

(Arreguin-Sanchez et al 2023)

The authors concluded that for the case study, the limit levels for the survival ratio, sy, and the recruitment rate, ry, fell within the limits of exploitation that permit a sustainable fishery (Arreguin-Sanchez et al 2023) but agreed that although the blue shrimp fishery in the central-eastern region of the Gulf of California is exploited at a level of sustainability close to its maximum production capacity, there is no harvest limit as a reference for management, and recommended that control can be established in the form of a limit harvest rate HR=0.43; which implies, that the proportion of capture regarding the biomass of the population must be a maximum of 43%. In practice, this quantity could be established by estimating the initial size of the population at the beginning of the fishing season (September) and monitoring the decline in abundance until reaching a limit of 10% of the initial abundance, which corresponds to the PRRLim, estimated in this work considering the survival ratio, recruitment rate and the environmental effects.

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

High Concern

No stock assessment has been conducted for blue shrimp in zone 20 (Sonora), and no reference points have been determined. The CPUE data from 1996-2022 suggest a decline in abundance to time-series below the average starting in 2015 (see figure below) (SADER-INAPESCA b 2022), and abundance is scored 1 (high concern) as a result.

Supplementary Information

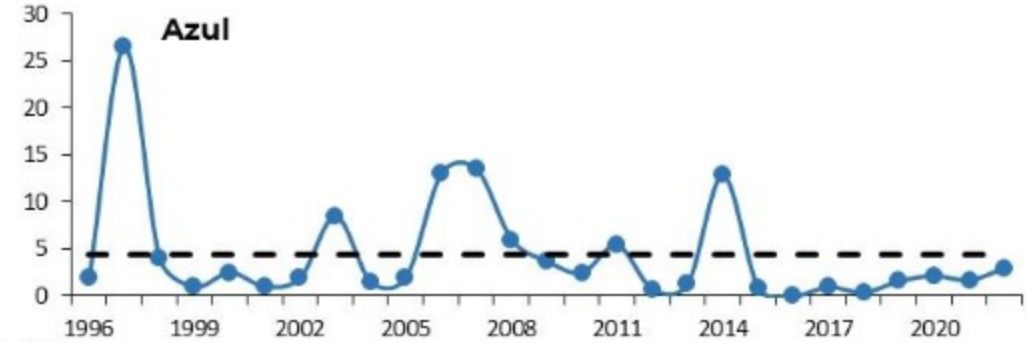


Figure 19: Sonora blue shrimp CPUE values from 1996 to 2022 (Data from INAPESCA's annual offseason monitoring reports) The dotted line represents the historical average (SADER-INAPESCA b 2022)

1.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

Eastern Central Pacific - Mexico - Suripera - West Coast of Baja (Zone 50)

Moderate Concern

No recent fishing mortality estimates concerning MSY have been made officially public. Instead, CPUE data is used as a measure of relative abundance over time, which may provide some indication of fishing mortality, such that if relative abundance is stable or increasing, then fishing mortality may be sustainable.

The 2021 report published by the FIP did not estimate values for fishing mortality; instead, the authors compared the landings versus the MSY, which is used as a target reference point. Based on the analysis, landings only exceed MSY in three seasons (2014-15, 2020-21, and 2012-13), occurring in circumstances where the biomass of blue shrimp increased significantly from the immediate previous abundance. Outside these times of high catches, the mean oscillates around 200 t (INAPESCA b 2021)

For this reason, there is not enough data to indicate fishing mortality relative to a sustainable level, so a score of 3 (moderate concern) is given.

Supplementary Information

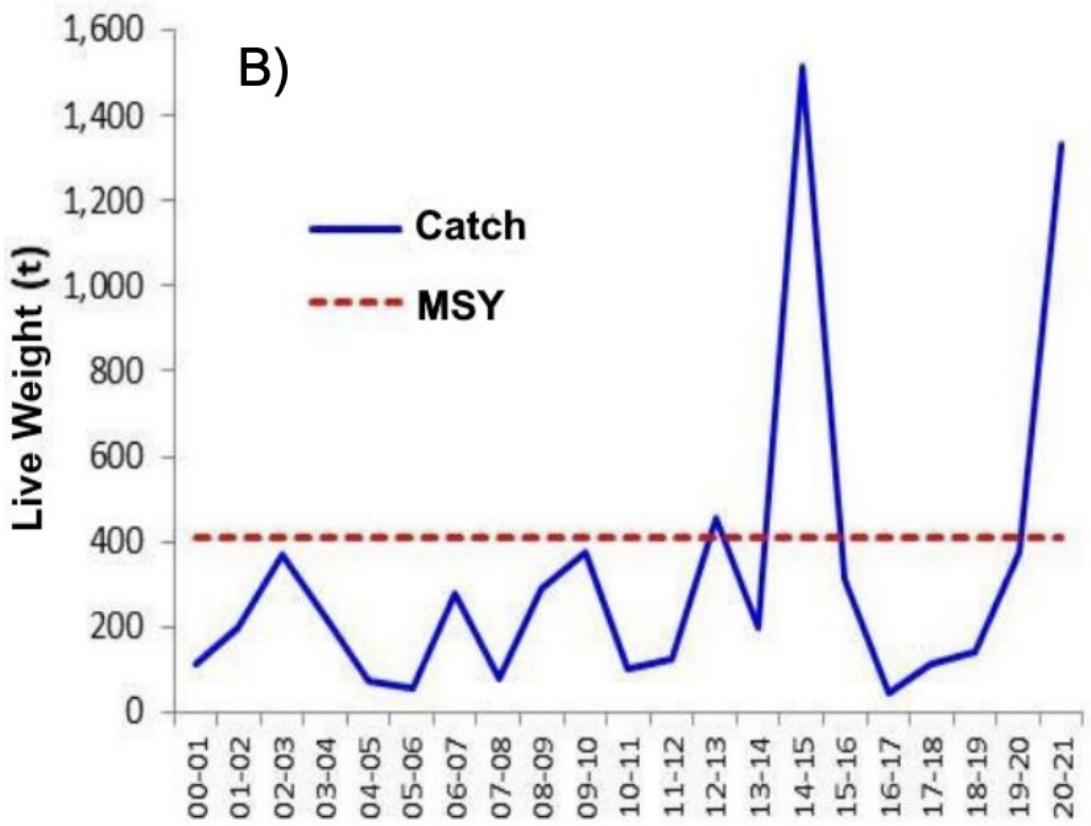


Figure 20: West Coast of Baja Blue shrimp reference points calculated by (INAPESCA b 2021) Catch and target reference point (MSY)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Suripera - Sinaloa North Central (Zone 30)

Moderate Concern

No recent fishing mortality estimates concerning MSY have been officially public. Instead, CPUE data is used to measure relative abundance over time, which may indicate a measure of fishing mortality. If relative abundance is stable or increasing, fishing mortality may be sustainable.

Overall, there is insufficient data to indicate fishing mortality relative to a sustainable level, so a score of 3 (moderate concern) is given.

Brown shrimp *(Penaeus aztecus)*

1.1 Abundance

Gulf of Mexico - Atlantic, Western Central - Bottom trawls
Gulf of Mexico - Atlantic, Western Central - Cast nets
Gulf of Mexico - Atlantic, Western Central - Traps

Low Concern

No reference points have been determined for brown shrimp in the Gulf of Mexico, and no stock assessments have been conducted. Managers instead use yield (kg/trip), landings, and size proportion of the catch (i.e. large shrimp relative to small shrimp) trends as status indicators and to determine open and closed periods for the fishery. All three indicators suggest stable (landings and size proportion) or increasing (yield) relative abundance (see Justification below), which allows for a score of 3.67 (low concern) for abundance.

Supplementary Information

Brown shrimp are the most commercially important species in the northwest Gulf of Mexico accounting for more than 95% of combined shrimp landings (INAPESCA 2000). According to INAPESCA, fishing yield, landings, and size proportion of the catch (*"camaron de linea"*)/smaller size (*"pacotilla"*) trends are direct indicators of the status of the stock (INAPESCA b 2012).

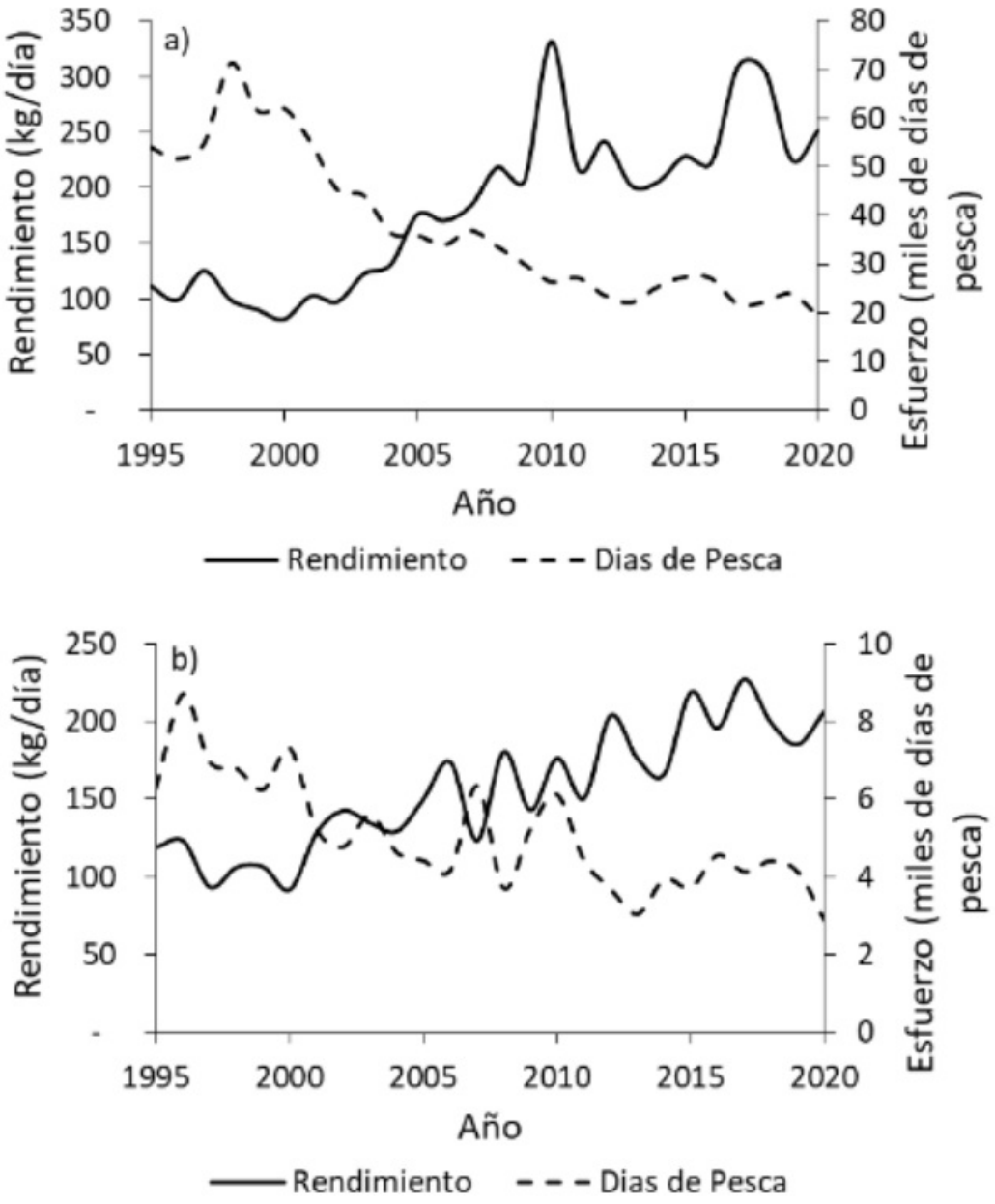


Figure 21: Brown shrimp fishing yield (dark line) in kg/day for Tamaulipas (a) and Veracruz (b) and fishing effort expressed in thousand fishing days (dotted line) in the Gulf of Mexico. (Figure from INAPESCA, 2022)

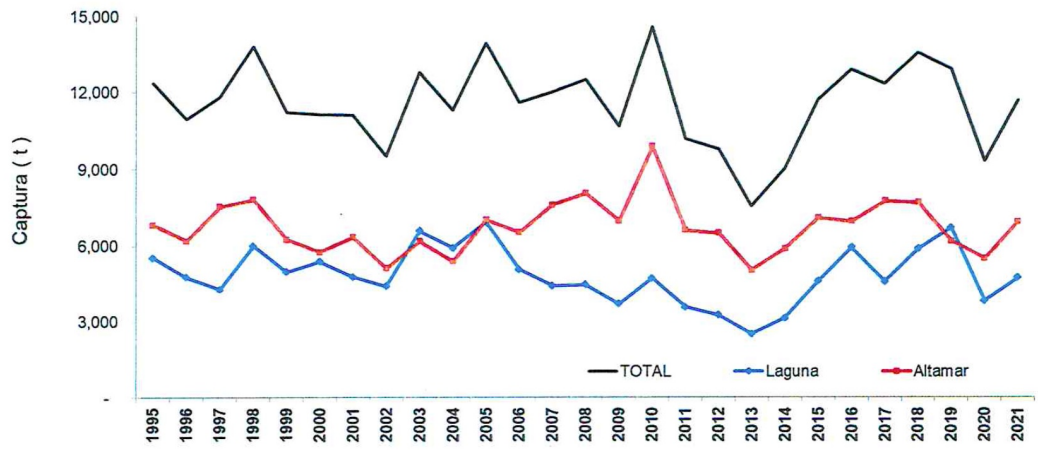


Figure 22: Brown shrimp landings in tonnes (t) in the Gulf of Mexico. The black line is the total landings, while red line just industrial fleet and blue line, artisanal fleet. Figure from (INAPESCA 2022)

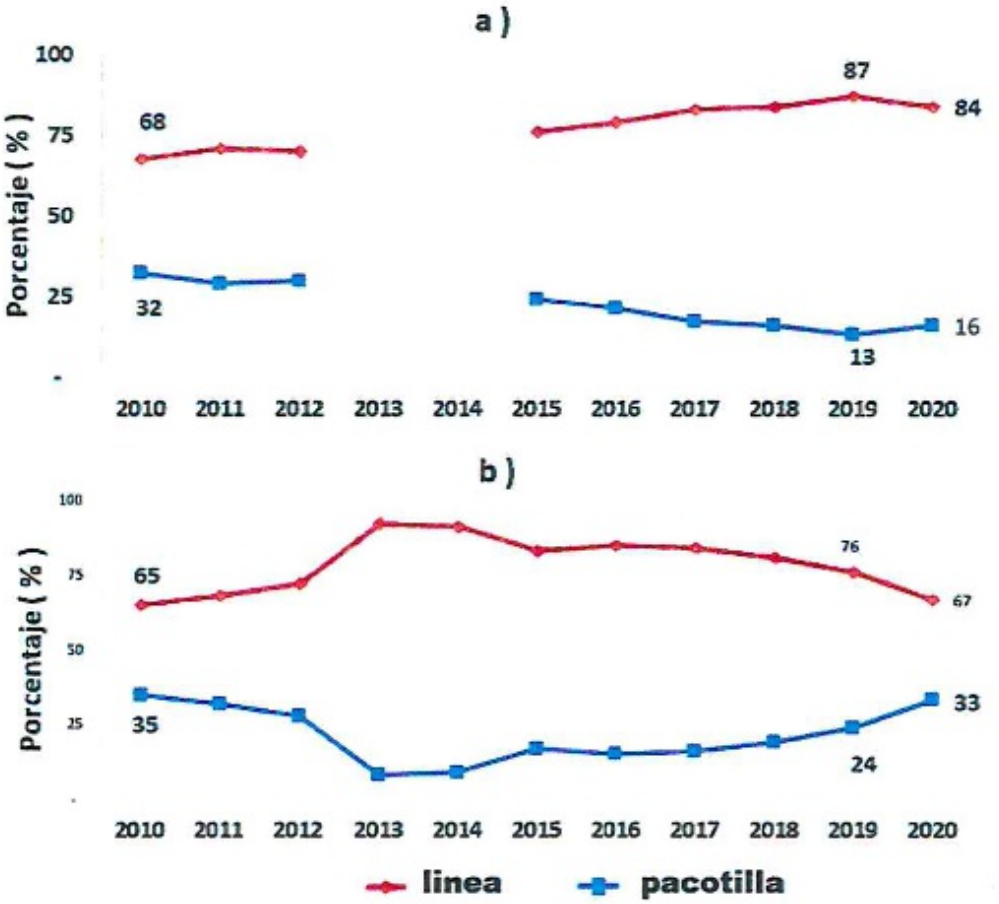


Figure 23: Brown shrimp linea (bigger sizes) and pacotilla proportions in landings from 2010 to 2020 in Tamaulipas (a) and Veracruz (b) (INAPESCA 2022)

1.2 Fishing Mortality

Gulf of Mexico - Atlantic, Western Central - Bottom trawls
Gulf of Mexico - Atlantic, Western Central - Cast nets
Gulf of Mexico - Atlantic, Western Central - Traps

Moderate Concern

There are no quantitative estimates of fishing mortality in relation to F_{MSY} to determine biological reference points for Gulf of Mexico shrimp species. In the 2022 update of the National Fisheries Chart (INAPESCA 2022) managers stated that effective fishing days have been reduced, most likely due to the cost-effective ratio. According to managers, the fishing effort in Tamaulipas was reduced by 18% in 2018 compared to 2016, and in Veracruz, the reduction reached 20% (INAPESCA 2022). Without more comprehensive data on effort and average landings, fishing mortality for the Gulf of Mexico shrimp species is unknown, allowing for a score of 3 (moderate concern).

Supplementary Information

Temporal restrictions for the brown shrimp fishery are in place to reduce the juvenile fishing mortality inside the lagoons and allow recruitment and migration to offshore. The length of the no-fishing season is about 45 days in the lagoons and 100 days offshore. Under this management regime, landings in Tamaulipas and Veracruz have remained stable, averaging more than 6,000 t for offshore waters and more than 4,700 in the coastal lagoons (INAPESCA 2014).

Pink shrimp *(Penaeus duorarum)*

1.1 Abundance

Gulf of Mexico - Atlantic, Western Central - Bottom trawls
Gulf of Mexico - Atlantic, Western Central - Traps

High Concern

Based on the most recent update of the fishery within the National Fisheries Chart (DOF 2023), some positive changes have occurred with the species stock, including the stability of the production and an increase in the production yield (second graph below). However, catch remain low, and fishing efforts have increased (including illegal activity) (see figure in justification). The 2023 update of the National Fisheries Chart includes the estimates of the stock based on the B/B_{MSY}, and managers confirmed that the fishery is still deteriorating (DOF 2023). For these reasons, the “high concern” remains.

Supplementary Information

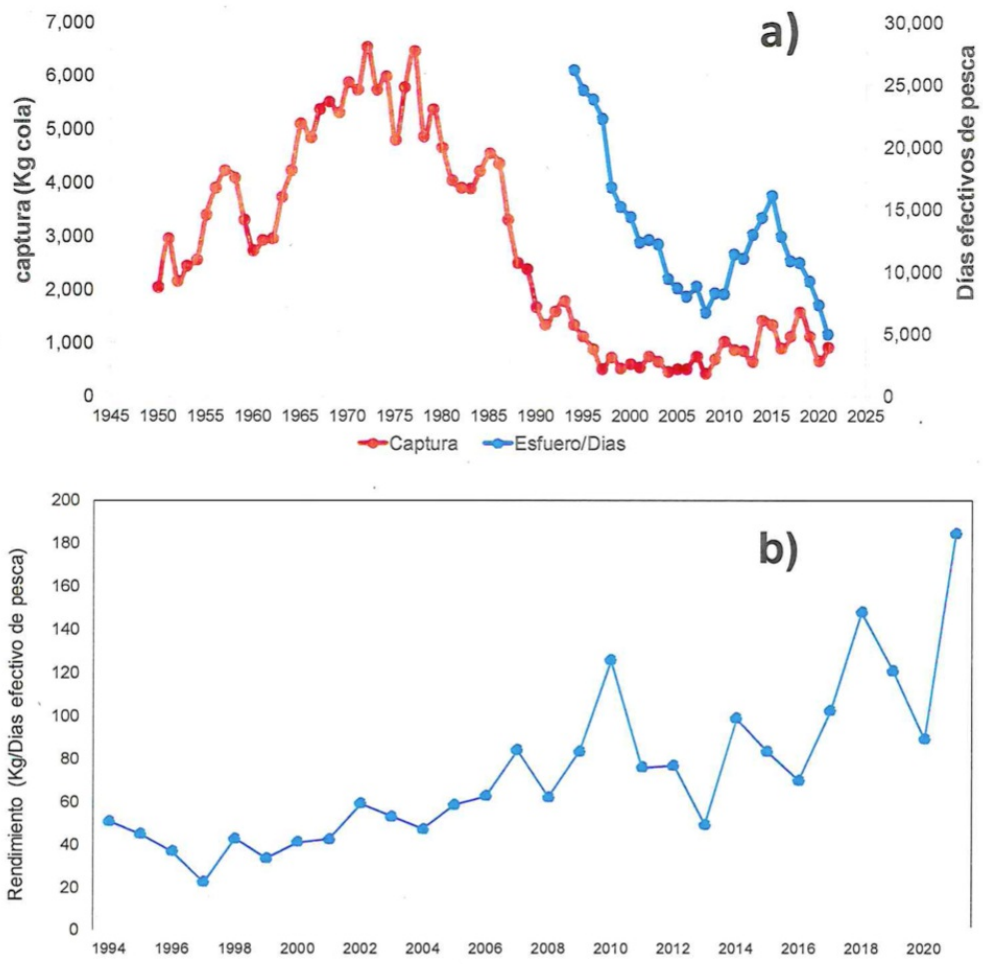


Figure 24: Pink shrimp catch and effort (a) and average production per fishing day (b) in the Campeche region. Figure from (INAPESCA 2022)

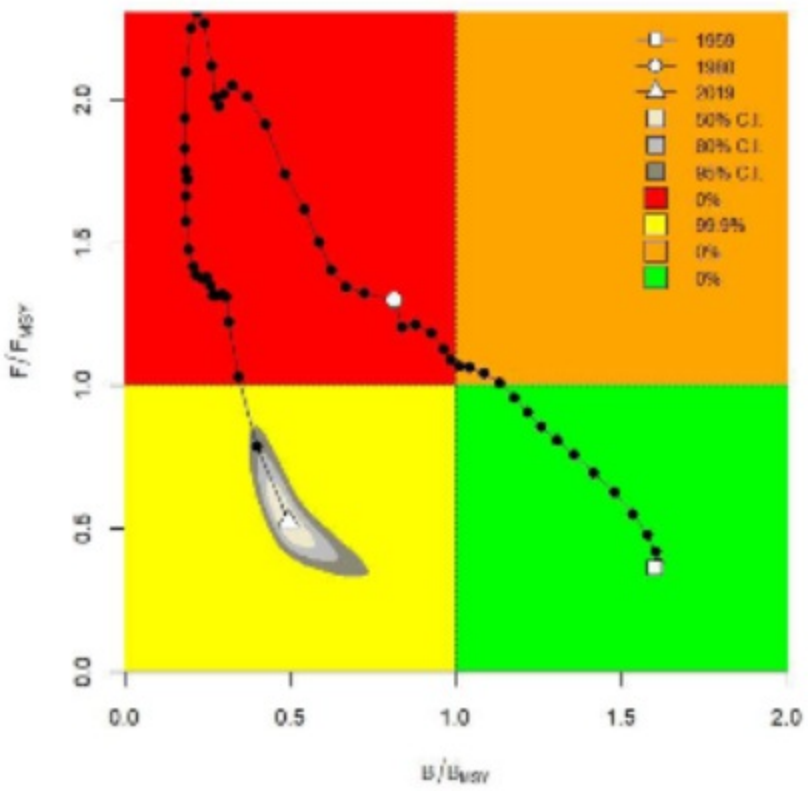


Figure 25: Kobe plot of the Pink shrimp stock status (DOF 2023)

1.2 Fishing Mortality

Gulf of Mexico - Atlantic, Western Central - Bottom trawls
Gulf of Mexico - Atlantic, Western Central - Traps

Low Concern

Managers have indicated that all species in the GOM region have shown drastic declines in catches over the last 25 years except brown shrimp, which has maintained stable landings over the last quarter decade (DOF 2012). Regulations such as closures have been established to protect the reproduction process and increase catches of the species (INAPESCA c 2012). Mixed results for the species have been achieved.

During the most recent update of the fishery profile in the National Fisheries Chart, an estimate of fishing mortality in relation to F_{MSY} was released (see Kobe plot in justification below). According to the results, managers reported that F values have been constantly decreasing with the most recent two years evaluated (2018 and 2019) showing values of F< the F_{MSY}). Based on the most recent report from the CNP in which current fishing mortality is below F_{MSY}, this factor is scored as 5 (low concern).

Supplementary Information

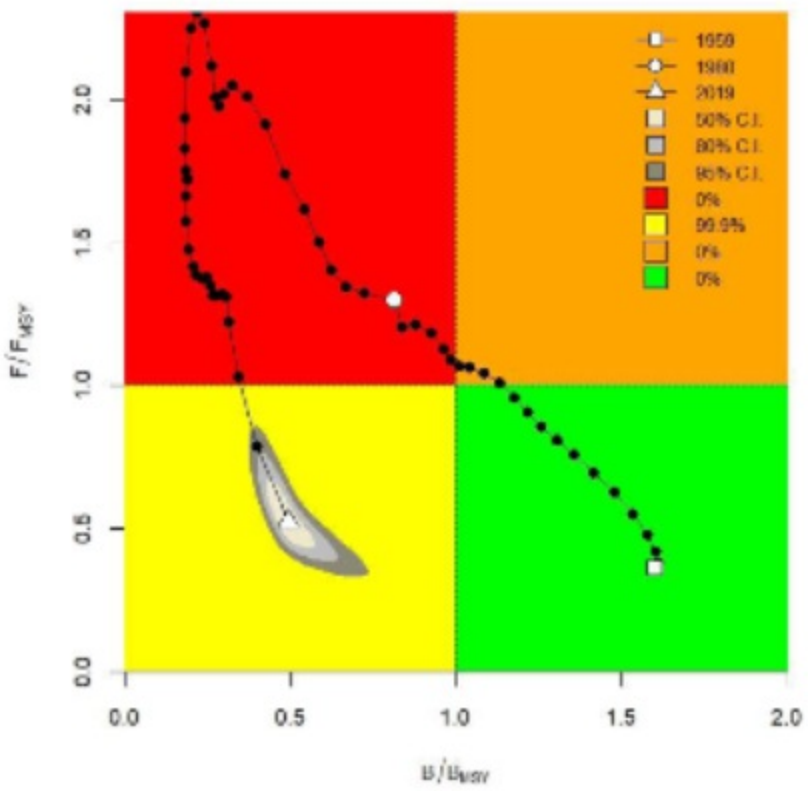


Figure 25: Kobe plot for pink shrimp that shows that in recent years F>FMSY(DOF 2023)

White shrimp *(Penaeus setiferus)*

1.1 Abundance

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery

High Concern

No reference points have been determined for white shrimp in the Gulf of Mexico, and no stock assessments have been conducted. Managers instead use status indicators (see Justification below). Managers currently consider the fishery to remain overfished due to high levels of fishing pressure (INAPESCA 2022). Landings remain close to the historical low, and, although yields (CPUE) have been showing an increasing trend in both industrial and small-scale fleets, these represent a combination of fewer official reports (e.g. one trawler reporting in 2021) and less time fishing. A score of 1 (high concern) is given for abundance based on the official determination.

Supplementary Information

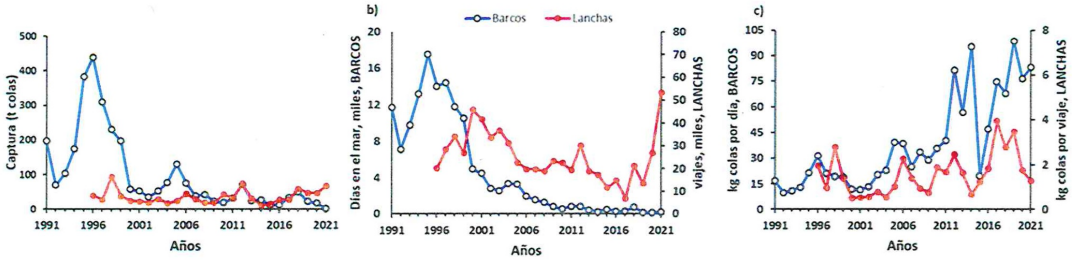


Figure 26: White Shrimp fishery indicators in the GOM from 1991 to 2021, from right is production, fishing effort (day in the sea and # of vessels) and CPUE for industrial vessels (blue) and small vessels (red) (INAPESCA 2022)

1.2 Fishing Mortality

Gulf of Mexico - Atlantic, Western Central - Bottom trawls
Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery

High Concern

Managers consider overfishing (legal and illegal) to be among the main factors for the currently deteriorated state of the stock (other sources were pollution and habitat degradation) (INAPESCA 2022). Therefore, fishing mortality for the white shrimp in the Gulf of Mexico scores 1 (high concern).

Whiteleg shrimp *(Litopenaeus vannamei)*

1.1 Abundance

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)
Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Cast nets - Sinaloa South (Zone 40) | Nayarit (Zone 60)

High Concern

A stock assessment has yet to be conducted for whiteleg shrimp in zones 40 and 60 (Sinaloa South and Nayarit), and no reference points have been determined. Managers presented combined CPUE data from 1992-2021 for the 40 and 60 that suggest a decline in abundance to time-series below the average starting in 2016 and remaining until 2021 (see figure in justification) (SADER-INAPESCA b 2022), allowing for a score of 1 (high concern) for abundance.

Supplementary Information

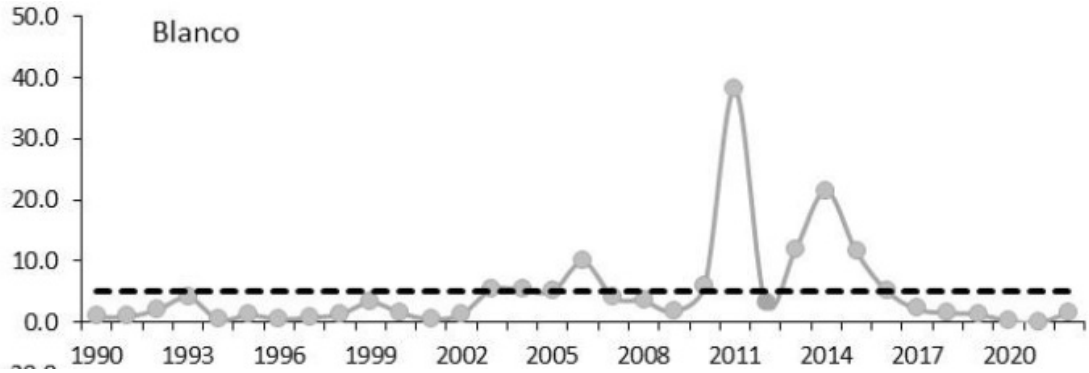


Figure 27: South Sinaloa-Nayarit whiteleg shrimp CPUE values from 1992 to 2021 (Data from INAPESCA's annual offseason monitoring reports) The dotted line represents the historical average (SADER-INAPESCA b 2022)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Low Concern

No stock assessment has been conducted for whiteleg shrimp in zone 30 (Sinaloa North-Central), and no reference points have been determined. CPUE data from 1992-2021 suggest that abundance has fluctuated around the average since 2004 (see Justification below). An index that shows a stable or increasing trend over three generations allows for a score of 3.67 (low concern) for abundance.

Supplementary Information

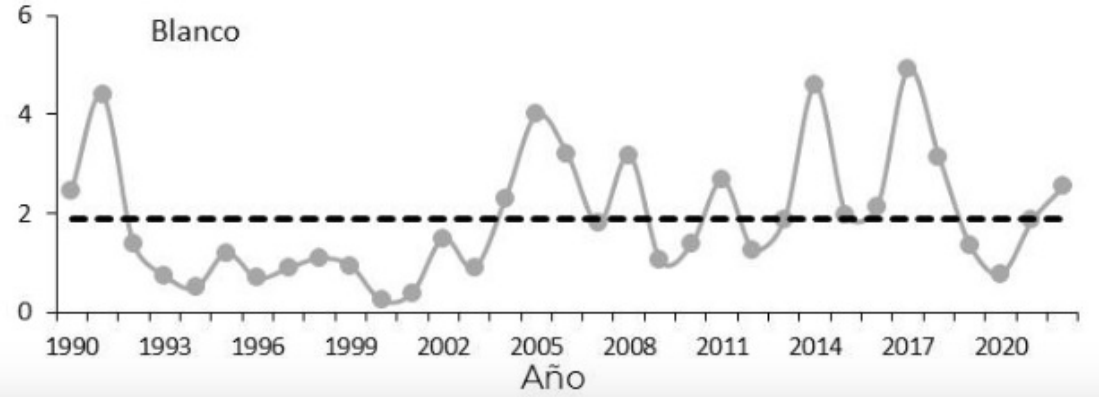


Figure 28: North-central Sinaloa whiteleg shrimp CPUE values from 1992 to 2022 (Data from INAPESCA's annual offseason monitoring reports) The dotted line represents the historical average (SADER-INAPESCA b 2022)

Generation time is calculated using the same methods as IUCN assessments: Generation time (G) in an unfished population can be estimated using the formula: G = A + 1/M, where A is the age at 50% maturity and M is the natural mortality rate (IUCN 2024). Age at first

maturity is likely less than 1 year (Lopez-Martinez, J. et al 2005), given the maximum age for penaeid shrimp species is 1-2 years (e.g. (García-Borbón et al 2018)). Natural mortality of adult shrimp in the Gulf of California is high (1.63-2.89 depending on species)(Aranceta-Garza et al 2016). A reasonable estimate of generation time is, therefore 1.5 years.

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Low Concern

No stock assessment has been conducted for whiteleg shrimp in zone 90 (Gulf of Tehuantepec), and no reference points have been determined. CPUE data from 2000-2021 suggest that abundance has fluctuated around or above the average since 2013 (see justification below) (SADER-INAPESCA b 2022). An index that shows a stable or increasing trend over three generations allows for a score of 3.67 (low concern) for abundance.

Supplementary Information

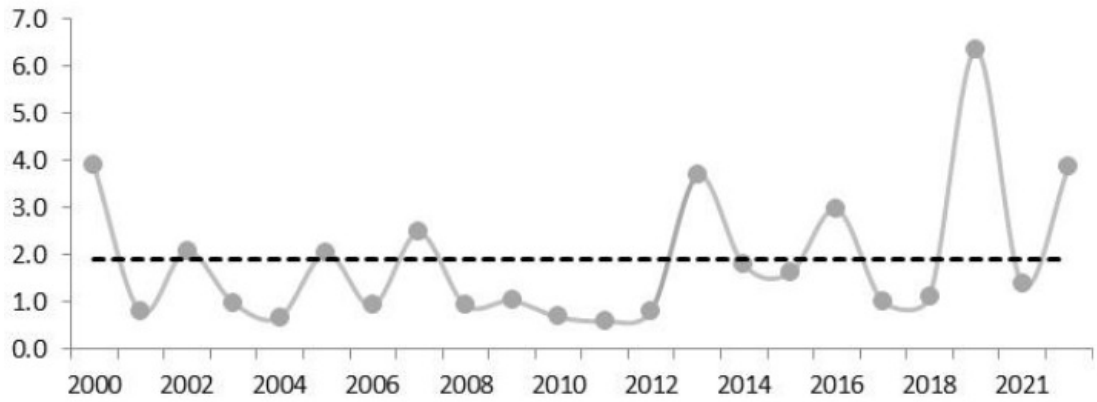


Figure 29: Gulf of Tehuantepec whiteleg shrimp CPUE values from 200 to 2022 (Data from INAPESCA's annual offseason monitoring reports) The dotted line represents the historical average (SADER-INAPESCA b 2022)

Generation time is calculated using the same methods as IUCN assessments: Generation time (G) in an unfished population can be estimated using the formula: G = A + 1/M, where A is the age at 50% maturity and M is the natural mortality rate (IUCN 2024). Age at first maturity is likely less than 1 year (Lopez-Martinez, J. et al 2005), given the maximum age for penaeid shrimp species is 1-2 years (e.g. (García-Borbón et al 2018)). Natural mortality of adult shrimp in the Gulf of California is high (1.63-2.89 depending on species)(Aranceta-Garza et al 2016). A reasonable estimate of generation time is, therefore 1.5 years.

1.2 Fishing Mortality

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Cast nets - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Moderate Concern

No recent fishing mortality estimates concerning MSY have been officially public. Instead, CPUE data is used to measure relative abundance over time, which may indicate a measure of fishing mortality. If relative abundance is stable or increasing, fishing mortality may be sustainable.

Overall, there is insufficient data to indicate fishing mortality relative to a sustainable level, so a score of 3 (moderate concern) is given.

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Moderate Concern

No recent fishing mortality estimates concerning MSY have been made officially public. Instead, CPUE data is used to measure relative abundance over time, which may indicate fishing mortality, such that if relative abundance is stable or increasing, then fishing mortality may be sustainable.

For whiteleg shrimp the CPUE shows values fluctuating around the average in the most recent years for North-Central Sinaloa (Zone 30). Considering the available data, we deem insufficient data to indicate fishing mortality on other stocks relative to a sustainable level, so a score of 3 (moderate concern") is given for this area.

Supplementary Information

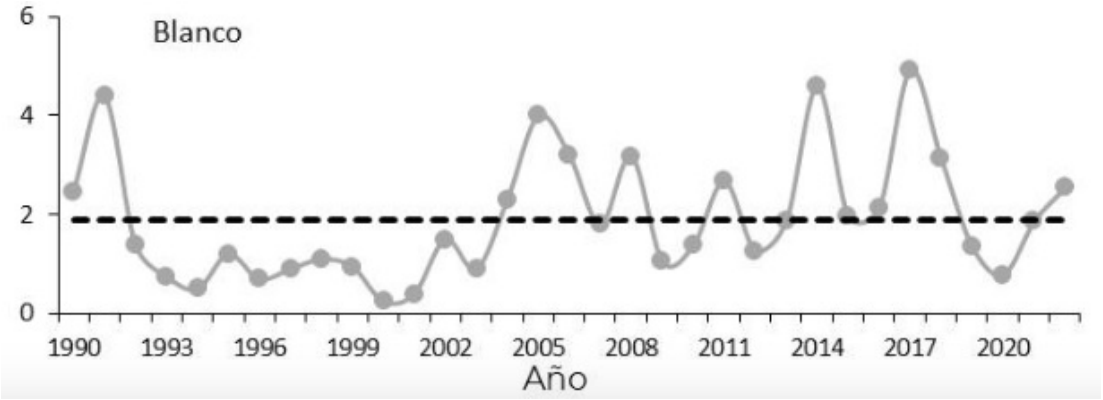


Figure 28: Changes on CPUE trends for whiteleg shrimp in the North-central region (Zone 30)(SADER-INAPESCA 2022)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

No recent fishing mortality estimates concerning MSY have been officially public. Instead, CPUE data is used as a measure of relative abundance over time, which may provide some indication of fishing mortality, such that if relative abundance is stable or increasing, then fishing mortality may be sustainable.

For whiteleg shrimp the CPUE shows values fluctuating around the average since 2013 for the Gulf of Tehuantepec (Zone 90). Considering the available data, we cannot determine fishing mortality relative to a sustainable level, so a score of 3 (moderate concern) is given.

Supplementary Information

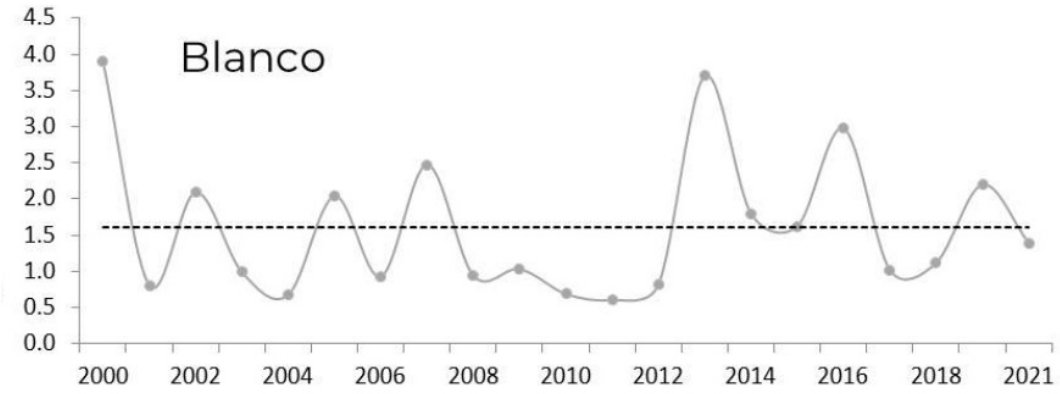


Figure 30: Abundance changes for white shrimp in the Gulf of Tehuantepec (Zone 90) (INAPESCA 2021)

Yellowleg shrimp *(Penaeus californiensis)*

1.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

High Concern

No stock assessment has been conducted recently for yellowleg shrimp on the West Coast of Baja, and no reference points have been determined. Managers reported the CPUE data from 2001 to 2022. The offshore (outside Magdalena bay) yellowleg shrimp CPUE presented values fluctuating around the historical average between 2009 and 2018 (see image below); however, since 2019 and up to 2022, the CPUE values have been

significantly below the historical average (see Justification below)(SADER-INAPESCA b 2022).

As the species is NOT highly vulnerable (see PSA results in trawls zone 40 response), but there is no stock assessment, no reference points, and the evidence shows that CPUE values have been below the average; this factor is scored as high concern.

Supplementary Information

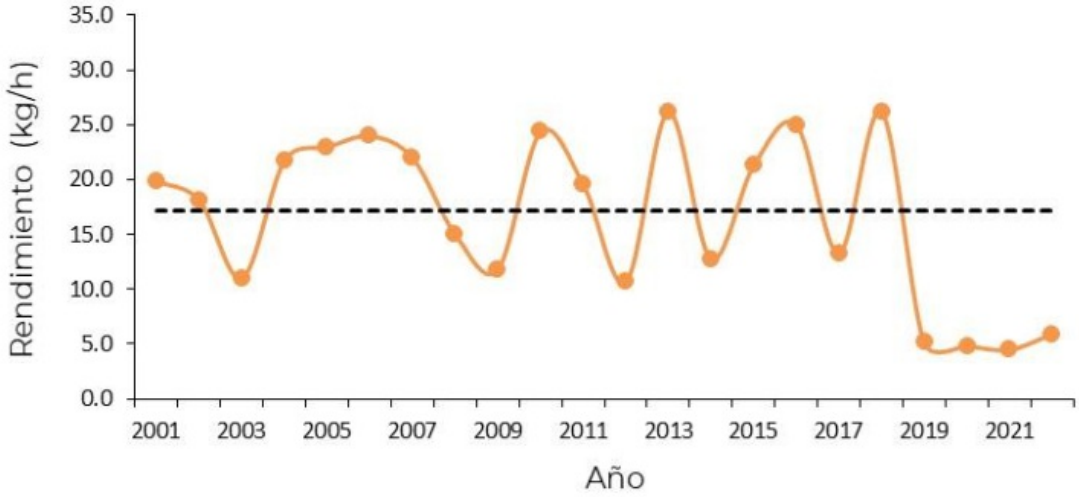


Figure 31: West Coast of Baja yellow leg shrimp off-shore CPUE (zone 50) The dotted line represents the historical average (SADER-INAPESCA b 2022)

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

Low Concern

There are two recent assessments of stock health for yellowleg shrimp off the West Coast of Baja (Zone 50).

The first is a data limited assessment of relative abundance in the Magdalena Bay, and is the one used by managers to set the start and end dates for the fishery. That assessment showed catch per unit effort (CPUE, expressed in kg/ha) valueshave been fluctuating around the historical average (see Justification below) and with a slight positive trend since 2015 (SADER-INAPESCA 2022),

The second is an assessment conducted by fishery managers as part of the fishery management project for the Magdalena-Almejas bay fishery (INAPESCA b 2021). The authors compared estimated catch and biomass values from 2000 to 2021 against the optimum biomass (K/2), which, while considered the limit reference point by the authors (INAPESCA b 2021), can be considered a proxy for $BMSY$ in the model used (Shaefer - see e.g. (Shaefer 1954) in (Kokkalis 2024) or (Palomares et al 2020)) and therefore an appropriate target reference point for the purposes of this Seafood Watch assessment.

Overall, the results of this assessment showed that the species biomass was between 75% and 100% of K/2 (see Justification below).

A stock assessment where the latest data year is <5 yrs old and a finding that B/BMSY is between 75% and 100% allows for a score of 3.67 (low concern). A stable or increasing CPUE trend over three generations also allows for a score of 3.67 (low concern). Generation time for shrimp species in the Gulf is likely between one and two years, and the CPUE trend suggests stable or increasing abundance for around 10 years (see Justification below). For these reasons, a score of 3.67 (low concern) is appropriate.

Supplementary Information

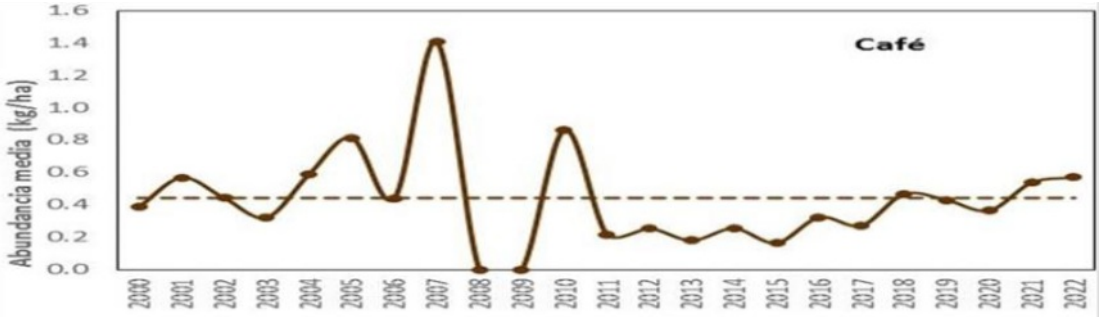


Figure 32: CPUE values for the coastal (inshore) west coast of baja (Zone 50) yellowleg shrimp from 2000 to 2022. The dotted line represents the historical average (SADER-INAPESCA 2022)

The 2021 assessment estimated that total biomass ranged between 630 and 2,049 t, with catches also around the biomass (see figure below, A). The authors reported that for yellowleg, the limit reference point (K/2 = 2.408 t) has not been not exceeded at any time. In addition, catches against the MSY, used as a target reference point, were reported for the 2006-07 and 2011–12 seasons (image below, B).

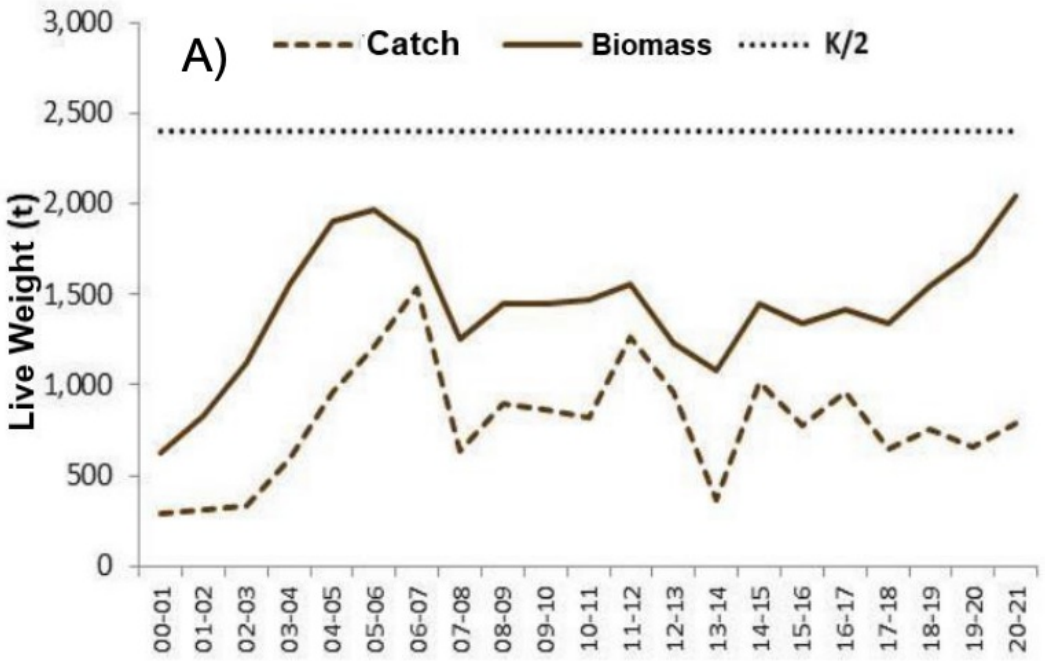


Figure 33: Biomass estimates and catches from the 2000-2001 to the 2020-2021 seasons in the West Coast of Baja, the dotted line represents the limit reference point (k/2) (SADER-INAPESCA 2022)

Yellowleg shrimp generation time

Generation time is calculated using the same methods as IUCN assessments: Generation time (G) in an unfished population can be estimated using the formula: G = A + 1/M, where A is the age at 50% maturity and M is the natural mortality rate (IUCN 2024). Age at first maturity is likely less than 1 year (Lopez-Martinez, J. et al 2005), given the maximum age for penaeid shrimp species is 1-2 years (e.g. (García-Borbón et al 2018)). Natural mortality of adult shrimp in the Gulf of California is high (1.63-2.89 depending on species)(Aranceta-Garza et al 2016). A reasonable estimate of generation time is, therefore 1.5 years.

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Moderate Concern

A stock assessment has not been conducted for yellowleg shrimp in zones 40 and 60 (Sinaloa South and Nayarit), and no reference points have been determined. Managers reported the CPUE data from 1990-2022 by grouping zones 40 and 60. The data suggest that abundance levels fluctuated around the historical average until 2020 (see figure below), although a negative decline trend started in 2017 with the most recent values (2020, 2021, and 2022) below the average (SADER-INAPESCA b 2022)

As the species is NOT highly vulnerable (see PSA results), there is no stock assessment, no reference points, and the evidence shows that CPUE values have been around the average; this factor is scored as a moderate concern.

Supplementary Information

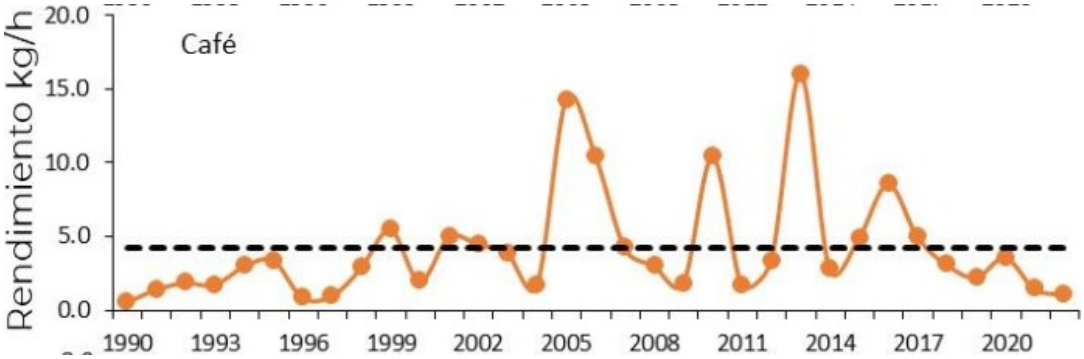


Figure 34: CPUE values for yellowleg shimp in zones 40 and 60 (Sinaloa south and Nayarit) reported by managers (SADER-INAPESCA b 2022). The dotted line represents the historical average.

Table 11

Attribute	Score	Justification
Average age of maturity	1	Maturity for the species has been estimated to be achieved around 12.1 and 15.4 cm of length (Félix-Ortiz et al 2020); authors conclude that maturity is completed within the first year
Average maximum age	1	Fast growth, with a lifespan estimated between 1.5 and 2 years (Meerwasser-Lexikon Team 2020)
Fecundity	1	A mature female can produce between 100,000 to 700,000 eggs per spawning event (Valenzuela-Quiñónez et al 2009)

Reproductive strategy	1	Shrimps are external brooders
Trophic level	1	<2.75
Density dependence	3	Depensatory dynamics
Quality of habitat	2	Although specific information for the region is not available, literature available shows that non-fishing impacts have moderately altered habitat.

Table 12

Attribute	Score	Justification
Areal overlap	3	The species is targeted along all its areal distribution for industrial or small scale fleets. Some zoning in places (e.g. nursery grounds) are protected either temporally (off-seasons) or by prohibiting the use of specific gears. However, it is not believed it reached more than 30%
Vertical overlap	3	The species' vertical distribution ranges from 0 to 200 meters {Sealife base 2024}; considering the fleets and gears, there is high overlap.
Selectivity of fishery	2	Species is targeted AND is not likely to escape the gear, but conditions under 'high risk' do not apply
Post-capture mortality	3	The organisms are retained

To calculate the overall score:
Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4, p5, p6,

p7, and p8, where p8 is only used for invertebrates)= 1.42
Susceptibility score (S)= product of the susceptibility attribute scores (s1, s2, s3, s4): 1.28
Vulnerability score (V) = the Euclidean distance of 1 and 2 using the following formula: ?? = $v1.42^2 + 2.33^2$
Vulnerability =2.72 (>2.64 and <3.18 =Medium vulnerability)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Moderate Concern

No stock assessment has been conducted for yellowleg shrimp in zone 30 (Sinaloa North-Central), and no reference points have been determined. CPUE data from 1992-2022 suggest that abundance levels have fluctuated around the historical average (see figure below) (SADER-INAPESCA b 2022)

As the species is NOT highly vulnerable (see PSA results in trawls zone 40 response), there is no stock assessment, no reference points, and the evidence shows that CPUE values have been around the average; this factor is scored as a moderate concern.

Supplementary Information

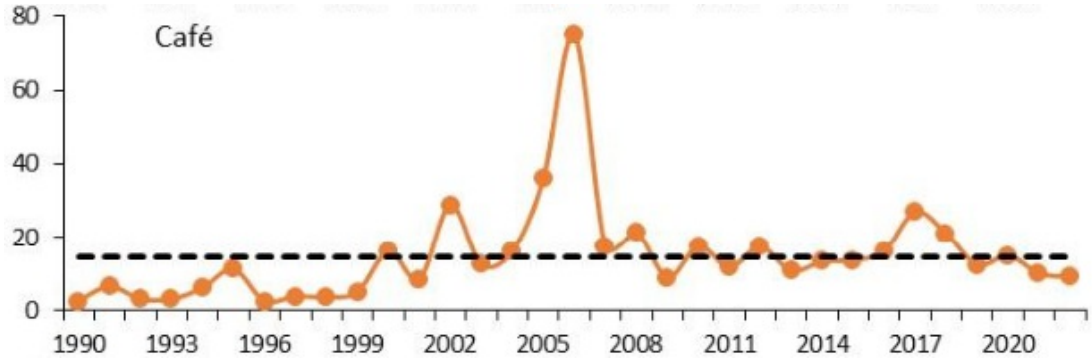


Figure 35: North-central Sinaloa yellowleg shrimp CPUE values from 1992 to 2022 (Data from INAPESCA's annual offseason monitoring reports) The dotted line represents the historical average (SADER-INAPESCA b 2022)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Moderate Concern

No stock assessment has been conducted recently for yellowleg shrimp in Sonora (zone 20), and no reference points have been determined. CPUE data from 1996-2022 suggest that abundance has been around the average values, but a slight negative trend can be seen from 2018 to 2022 values (see figure below) (SADER-INAPESCA b 2022)

The species is NOT highly vulnerable (see PSA results in trawls zone 40 response); there

is no stock assessment or reference points, and the CPUE values trends have been fluctuating around the historical average (although showing a slight negative trend since 2016, about around the historical average (a negative trend can be seen starting around 2016); for these reasons, this factor is scored as a moderate concern.

Supplementary Information

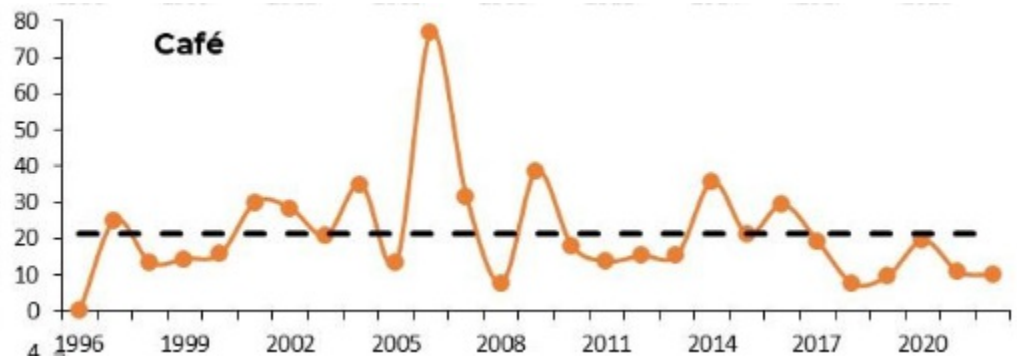


Figure 36: Sonora yellowleg shrimp CPUE values from 1996 to 2022 (Data from INAPESCA's annual offseason monitoring reports) The dotted line represents the historical average (SADER-INAPESCA b 2022)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

No stock assessment has been conducted for yellowleg shrimp in zone 90 (Gulf of Tehuantepec), and no reference points have been determined. CPUE data from 2014 to 2022 suggest that abundance levels have fluctuated around the historical average (see figure below) (SADER-INAPESCA b 2022)

As the species is NOT highly vulnerable (see PSA results in trawls zone 40 response), there is no stock assessment and no reference points, and the evidence shows that CPUE values have been around the average; this factor is scored as a moderate concern.

Supplementary Information

Yellowleg shrimp Gulf of Tehuantepec 2022

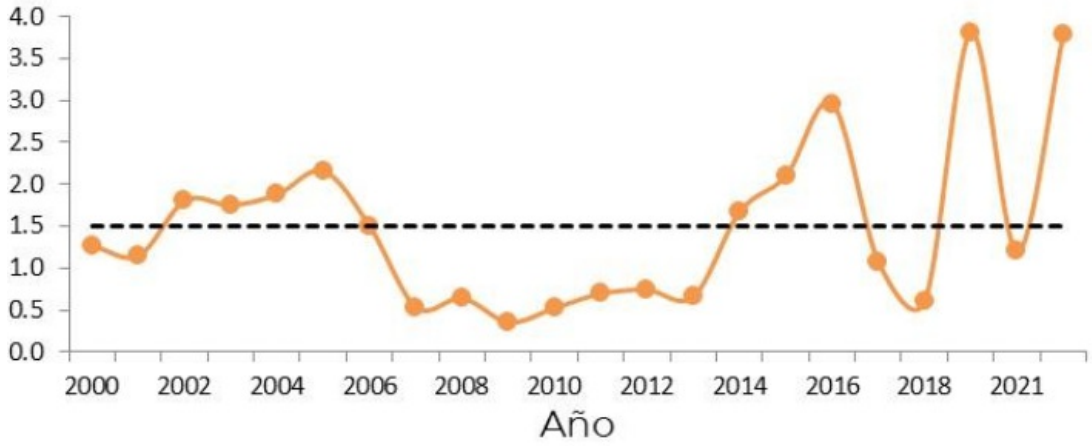


Figure 37: Changes in CPUE values for the Gulf of Tehuantepec yellowleg shrimp. The dotted line represents the historical average (SADER-INAPESCA b 2022)

1.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

Moderate Concern

No recent fishing mortality estimates concerning MSY have been officially public. Instead, CPUE data is used as a measure of relative abundance over time, which may provide some indication of fishing mortality, such that if relative abundance is stable or increasing, then fishing mortality may be sustainable; however, because in the previous recommendation (2017), two zones in the pacific were assessed using a biomass dynamic model, and the results showed that these areas were experiencing overfishing (Sinaloa blue shrimp and Sonoran yellowleg shrimp), and yet have (non-significant) increasing or (non-significant) stable CPUE trends. For this reason, precaution should be used when interpreting these trends.

Overall, there is not enough data to indicate fishing mortality in other stocks relative to a sustainable level, so a "moderate" concern rating is given for all the yellowleg shrimp stocks in the Pacific (including the West coast of Baja).

Supplementary Information

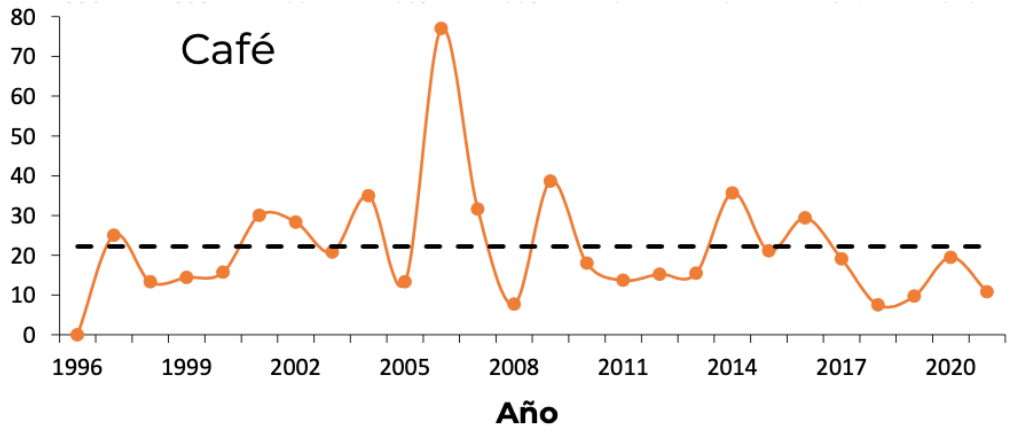


Figure 38: Abundance trends for yellowleg shrimp in zone 20 (Sonora) (INAPESCA 2021)

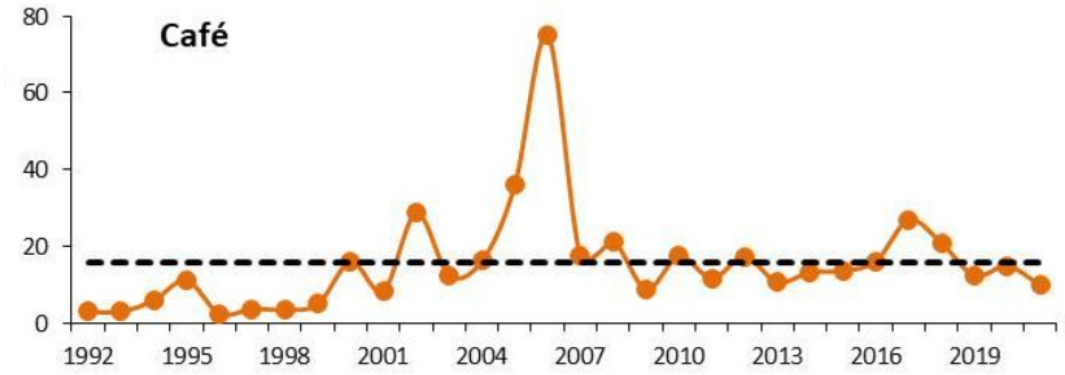


Figure 39: Abundance trends for yellowleg shrimp in zone 30 (Sinaloa) (INAPESCA 2021)

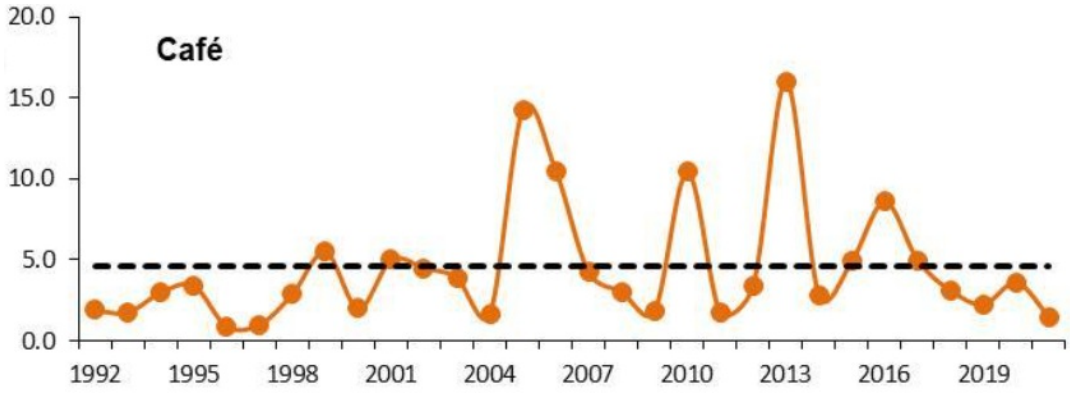


Figure 40: Abundance trends for yellowleg shrimp in zone 40-60 (Sinaloa-Nayarit)

(INAPESCA 2021)

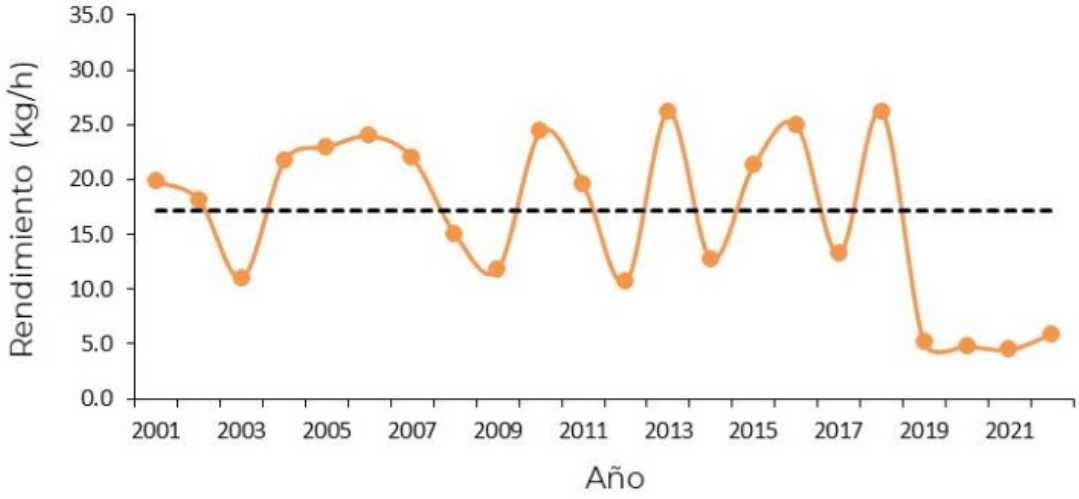


Figure 31: West Coast of Baja yellow leg shrimp off-shore CPUE (zone 50) The dotted line represents the historical average (SADER-INAPESCA b 2022)

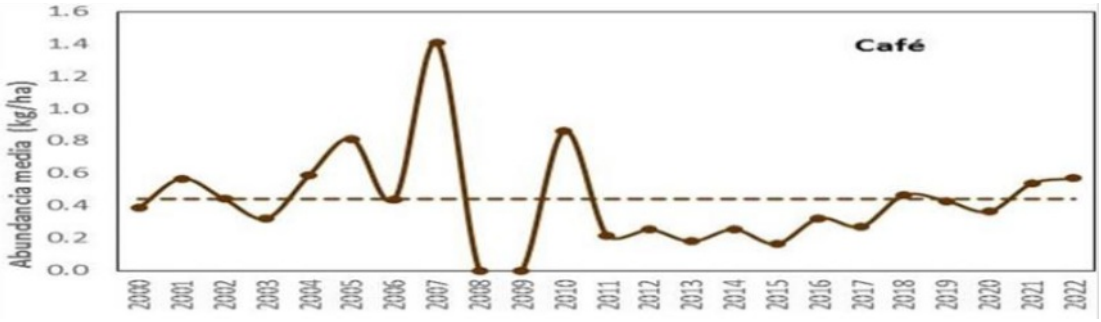


Figure 32: CPUE values for the coastal (inshore) west coast of baja (Zone 50) yellowleg shrimp from 2000 to 2022. The dotted line represents the historical average (SADER-INAPESCA 2022)

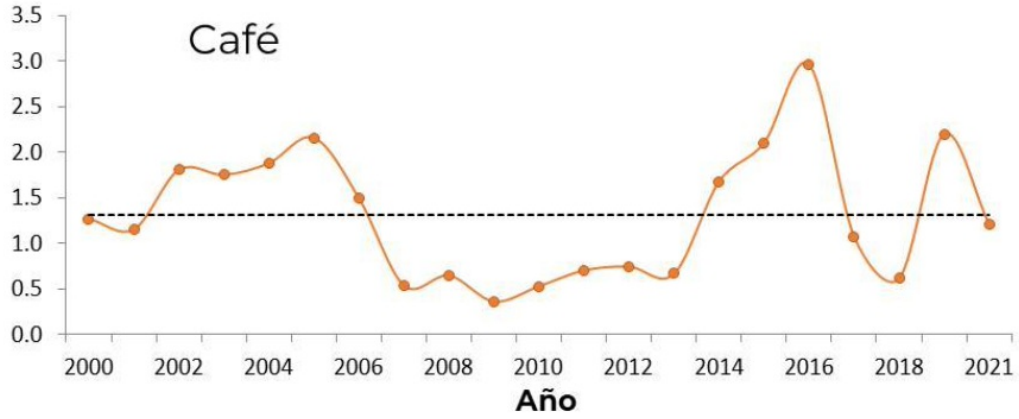


Figure 41: Abundance trends for yellowleg shrimp in zone 90 (Gulf of Tehuantepec) (INAPESCA 2021)

Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated under Criterion 2. Seafood Watch defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait score. The Criterion 2 rating is determined as follows:

- Score >3.2 = **Green** or Low Concern
- Score >2.2 and ≤3.2 = **Yellow** or Moderate Concern
- Score ≤2.2 = **Red** or High Concern

Rating is Critical if Factor 2.3 (Fishing Mortality) is Crtitical

Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level.*
- *Minimize bycatch.*

Criterion 2 Summary

Criterion 2 score(s) overview

This table(s) provides an overview of the Criterion 2 subscore, discards+bait modifier, and final Criterion 2 score for each fishery. A separate table is provided for each species/stock that we want an overall rating for.

Atlantic seabob			
Region / Method	**Sub Score**	**Discard Rate/Landings**	**Score**
Mexico - Gulf of Mexico - Bottom trawls - 1,304 mt	1.000	0.750: >= 100%	Red (0.750)

Blue shrimp			
Region / Method	**Sub Score**	**Discard Rate/Landings**	**Score**
Mexico - Sinaloa - Gulf of California - Bottom trawls - 12,062 mt	1.732	0.750: >= 100%	Red (1.299)
Mexico - Baja California | Sonora - Gulf of California - Bottom trawls - 4,692 mt	1.732	0.750: >= 100%	Red (1.299)
Mexico - Nayarit | Sinaloa - Gulf of California - Bottom trawls - 20 mt	1.732	0.750: >= 100%	Red (1.299)
Mexico - Sonora - Gulf of California - Bottom trawls - 4,692 mt	1.732	0.750: >= 100%	Red (1.299)
Mexico - Sinaloa - Gulf of California - Gillnets and entangling nets - 12,062 mt	2.236	1.000: < 100%	Yellow (2.236)
Mexico - Sonora - Gulf of California - Gillnets and entangling nets - 4,692 mt	2.236	1.000: < 100%	Yellow (2.236)
Mexico - Baja California - Eastern Central Pacific Ocean - Magdalena - Artisanal bottom trawls - 460 mt	1.732	1.000: < 100%	Red (1.732)
Mexico - Eastern Central Pacific Ocean - Suripera - 460 mt - Flag Country: Mexico - FAO Major Area: Pacific, Eastern Central - Management Unit: West Coast of Baja (Zone 50)	5.000	1.000: < 100%	Green (5.000)
Mexico - Sinaloa - Gulf of California - Suripera - 12,062 mt	2.644	1.000: < 100%	Yellow (2.644)

Brown shrimp			
Region / Method	**Sub Score**	**Discard Rate/Landings**	**Score**
Mexico - Gulf of Mexico - Bottom trawls - 8,495 mt	1.000	0.750: >= 100%	Red (0.750)
Mexico - Gulf of Mexico - Cast nets - 8,495 mt	5.000	1.000: < 100%	Green (5.000)
Mexico - Gulf of Mexico - Traps - 8,495 mt	2.236	1.000: < 100%	Yellow (2.236)

Pink shrimp			
Region / Method	**Sub Score**	**Discard Rate/Landings**	**Score**
Mexico - Gulf of Mexico - Bottom trawls - 1,029 mt	1.000	0.750: >= 100%	Red (0.750)
Mexico - Gulf of Mexico - Traps - 1,029 mt	3.318	1.000: < 100%	Green (3.318)

White shrimp			
Region / Method	**Sub Score**	**Discard Rate/Landings**	**Score**
Mexico - Gulf of Mexico - Bottom trawls - 730 mt - Flag Country: Mexico - FAO Major Area: Atlantic, Western Central	1.000	0.750: >= 100%	Red (0.750)
Mexico - Gulf of Mexico - Bottom trawls - 730 mt - Flag Country: Mexico - FAO Major Area: Atlantic, Western Central - Specific Fishery: Seabob fishery	1.000	0.750: >= 100%	Red (0.750)

Whiteleg shrimp			
Region / Method	**Sub Score**	**Discard Rate/Landings**	**Score**
Mexico - Sinaloa - Gulf of California - Bottom trawls - 1,066 mt	1.732	0.750: >= 100%	Red (1.299)
Mexico - Nayarit | Sinaloa - Gulf of California - Bottom trawls - 4,645 mt	1.732	0.750: >= 100%	Red (1.299)
Mexico - Gulf of Tehuantepec - Bottom trawls - 605 mt	1.732	0.750: >= 100%	Red (1.299)
Mexico - Nayarit | Sinaloa - Gulf of California - Cast nets - 4,645 mt	5.000	1.000: < 100%	Green (5.000)

Yellowleg shrimp			
Region / Method	**Sub Score**	**Discard Rate/Landings**	**Score**
Mexico - Baja California - Eastern Central Pacific Ocean - Bottom trawls - 460 mt	1.732	0.750: >= 100%	Red (1.299)
Mexico - Nayarit | Sinaloa - Gulf of California - Bottom trawls - 5,243 mt	1.732	0.750: >= 100%	Red (1.299)
Mexico - Sinaloa - Gulf of California - Bottom trawls - 5,243 mt	1.732	0.750: >= 100%	Red (1.299)
Mexico - Sonora - Gulf of California - Bottom trawls - 1,739 mt	1.732	0.750: >= 100%	Red (1.299)
Mexico - Gulf of Tehuantepec - Bottom trawls - 400 mt	1.732	0.750: >= 100%	Red (1.299)
Mexico - Baja California - Eastern Central Pacific Ocean - Magdalena - Artisanal bottom trawls - 460 mt	1.732	1.000: < 100%	Red (1.732)

Criterion 2 main assessed species/stocks table(s)

This table(s) provides a list of all species/stocks included in this assessment for each 'fishery' (as defined by a region/method combination). The text following this table(s) provides an explanation of the reasons the listed species were selected for inclusion in the assessment.

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)			
Sub Score: 1.732	**Discard Rate: 0.750**		**Score: 1.299**
Species	**Abundance**	**Fishing Mortality**	**Score**
California Butterfly Ray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Scalloped hammerhead	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Rooster Hind	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Pacific seahorse	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Pacific angel shark	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Olive Ridley turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Monterrey Spanish Mackerel	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Shovelnose guitarfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Mazatlan Butterfly Ray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Loggerhead turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Hawksbill turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Green turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Giant sea bass	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Diamond Stingray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Longtail stingray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Yellowleg shrimp	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Golden mojarra	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Pacific seabob	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Peruvian mojarra	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Crystal shrimp	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)			
Sub Score: 1.732	**Discard Rate: 1.000**		**Score: 1.732**
Species	**Abundance**	**Fishing Mortality**	**Score**
Pacific seahorse	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Shovelnose guitarfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Blue shrimp	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Yellowleg shrimp	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

Eastern Central Pacific - Mexico - Suripera - West Coast of Baja (Zone 50)			
Sub Score: 5.000	**Discard Rate: 1.000**		**Score: 5.000**
Species	**Abundance**	**Fishing Mortality**	**Score**
Blue shrimp	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)			
Sub Score: 1.732	**Discard Rate: 0.750**		**Score: 1.299**
Species	**Abundance**	**Fishing Mortality**	**Score**
Mazatlan Butterfly Ray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Scalloped hammerhead	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Rooster Hind	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Pacific seahorse	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Pacific angel shark	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Olive Ridley turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Monterrey Spanish Mackerel	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Shovelnose guitarfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Longtail stingray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Totoaba	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Hawksbill turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Green turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Giant sea bass	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Diamond Stingray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
California Butterfly Ray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Loggerhead turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Golden mojarra	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Pacific seabob	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Peruvian mojarra	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Crystal shrimp	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Blue shrimp	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)			
Sub Score: 1.732	**Discard Rate: 0.750**		**Score: 1.299**
Species	**Abundance**	**Fishing Mortality**	**Score**
Blue shrimp	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Shovelnose guitarfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Scalloped hammerhead	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Pacific seahorse	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Olive Ridley turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Monterrey Spanish Mackerel	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Mazatlan Butterfly Ray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Whiteleg shrimp	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Longtail stingray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Hawksbill turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Green turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Giant sea bass	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Diamond Stingray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
California Butterfly Ray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Loggerhead turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Golden mojarra	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Pacific seabob	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Peruvian mojarra	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Crystal shrimp	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Yellowleg shrimp	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Cast nets - Sinaloa South (Zone 40) | Nayarit (Zone 60)			
Sub Score: 5.000	**Discard Rate: 1.000**		**Score: 5.000**
Species	**Abundance**	**Fishing Mortality**	**Score**
Whiteleg shrimp	1.000: High Concern	3.000: Moderate Concern	Red (1.732)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)			
Sub Score: 1.732	**Discard Rate: 0.750**		**Score: 1.299**
Species	**Abundance**	**Fishing Mortality**	**Score**
Mazatlan Butterfly Ray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
California Butterfly Ray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Shovelnose guitarfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Diamond Stingray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Giant sea bass	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Scalloped hammerhead	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Green turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Hawksbill turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Loggerhead turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Longtail stingray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Rooster Hind	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Monterrey Spanish Mackerel	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Olive Ridley turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Pacific seahorse	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Peruvian mojarra	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Yellowleg shrimp	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Golden mojarra	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Crystal shrimp	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Pacific seabob	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Whiteleg shrimp	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Blue shrimp	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)			
Sub Score: 2.236	**Discard Rate: 1.000**		**Score: 2.236**
Species	**Abundance**	**Fishing Mortality**	**Score**
Shovelnose guitarfish	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Bullseye puffer	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Blue shrimp	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Suripera - Sinaloa North Central (Zone 30)			
Sub Score: 2.644	**Discard Rate: 1.000**		**Score: 2.644**
Species	**Abundance**	**Fishing Mortality**	**Score**
Bullseye puffer	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Blue shrimp	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)			
Sub Score: 1.732	**Discard Rate: 0.750**		**Score: 1.299**
Species	**Abundance**	**Fishing Mortality**	**Score**
Blue shrimp	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Shovelnose guitarfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Scalloped hammerhead	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Rooster Hind	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Pacific seahorse	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Pacific angel shark	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Olive Ridley turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Monterrey Spanish Mackerel	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Totoaba	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Mazatlan Butterfly Ray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Loggerhead turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Hawksbill turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Green turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Giant sea bass	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Diamond Stingray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
California Butterfly Ray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Longtail stingray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Golden mojarra	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Pacific seabob	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Peruvian mojarra	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Crystal shrimp	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Yellowleg shrimp	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)			
Sub Score: 2.236	**Discard Rate: 1.000**		**Score: 2.236**
Species	**Abundance**	**Fishing Mortality**	**Score**
Blue shrimp	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Shovelnose guitarfish	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Spotted sand bass	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Arched swimming crab	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Cortez swimming crab	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Gulf of Mexico - Atlantic, Western Central - Bottom trawls			
Sub Score: 1.000	**Discard Rate: 0.750**		**Score: 0.750**
Species	**Abundance**	**Fishing Mortality**	**Score**
Green turtle	1.000: High Concern	1.000: High Concern	Red (1.000)
Kemp's ridley turtle	1.000: High Concern	1.000: High Concern	Red (1.000)
Leatherback turtle	1.000: High Concern	1.000: High Concern	Red (1.000)
Loggerhead turtle	1.000: High Concern	1.000: High Concern	Red (1.000)
White shrimp	1.000: High Concern	1.000: High Concern	Red (1.000)
Hawksbill turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Lined seahorse	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Scalloped hammerhead	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Pink shrimp	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Brown shrimp	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery			
Sub Score: 1.000	**Discard Rate: 0.750**		**Score: 0.750**
Species	**Abundance**	**Fishing Mortality**	**Score**
Atlantic seabob	1.000: High Concern	1.000: High Concern	Red (1.000)
White shrimp	1.000: High Concern	1.000: High Concern	Red (1.000)
Scalloped hammerhead	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Gulf of Mexico - Atlantic, Western Central - Cast nets			
Sub Score: 5.000	**Discard Rate: 1.000**		**Score: 5.000**
Species	**Abundance**	**Fishing Mortality**	**Score**
Brown shrimp	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

Gulf of Mexico - Atlantic, Western Central - Traps			
Sub Score: 2.236	**Discard Rate: 1.000**		**Score: 2.236**
Species	**Abundance**	**Fishing Mortality**	**Score**
Pink shrimp	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Brown shrimp	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)			
Sub Score: 1.732	**Discard Rate: 0.750**		**Score: 1.299**
Species	**Abundance**	**Fishing Mortality**	**Score**
California Butterfly Ray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Shovelnose guitarfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Scalloped hammerhead	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Rooster Hind	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Pacific seahorse	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Olive Ridley turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Monterrey Spanish Mackerel	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Longtail stingray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Mazatlan Butterfly Ray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Hawksbill turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Green turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Giant sea bass	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Diamond Stingray	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Loggerhead turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Pacific seabob	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Golden mojarra	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Peruvian mojarra	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Crystal shrimp	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Yellowleg shrimp	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Whiteleg shrimp	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

Criterion 2 is an assessment of the population impacts of the fisheries on all species caught other than those assessed in Criterion 1. Criterion 2 also assesses the impacts of bait use and discards.

Determining 'main species' for each fishery

The SFW standard (v4) defines 'main species,' those to be included in the fishery (i.e., in Criterion 1 or 2), as those that meet any of the following criteria:

- A common component of the catch (as guidance, >5% of the catch in most cases) or
- Overfished, endangered, threatened, undergoing overfishing, or otherwise a species of concern, where catch occurs regularly and may significantly contribute to the conservation concern (i.e., more than a negligible and/or sporadic catch level). As guidance, the mortality of the species caused by this fishery is >5% of a sustainable level or
- Fishery under assessment is one of the species' main sources of fishing mortality, including bait species if known (as guidance, approximately 20% or more of total fishing mortality).

Main species for each fishery are determined below. Due to the high number of species of concern caught, and in some cases, the scarcity of data about the impact of the assessed fisheries on specific species, these taxa have been assessed as groups: marine mammals, sea turtles, skates, and rays and sharks.

Bottom trawl fishery - All Zones

The bottom trawl fishery does not currently have an observer program, which severely curtails understanding of the impacts of the fishery on the many taxa caught (see Criterion 3.3). Furthermore, the observer program that ran for the industrial fleet through the 2017-2018 season had less than 5% coverage, which is insufficient to have confidence in the catch numbers, especially of rare taxa. Thus, precise application of the main species filters above is impossible; instead, they are used as guidelines in interpreting the available observer data (2015-2017, see Appendix A) and regional studies in the Upper Gulf of California (Calderon-Aguilera 2011), Sonora {Meltzer et al. 2012}, Sinaloa {Amezcua et al. 2006} {Nieto-Navarro et al. 2013} {Madrid-Vera et al. b 2012} {Madrid-Vera et al. 2010}, BCS {Aguilar-Ramirez et al. 2010}, the Gulf of Tehuantepec (Penagos-Garcia, F. et al 2011), as well as industrial trawlers {Rabago-Quiroz et al. 2012}, and the Gulf of Mexico {Wakida.Kusunoki et al 2005} for all the different gears used in the shrimp fisheries. Based on the most recent data, the mojarras species (grouped) are included as C2 species, as they are >5% of the catch (combined) (*Diapterus peruvianus* (Peruvian mojarra) and *Diapterus aureolus)*. Similarly, the associated shrimp species (*Penaeus brevirostri*s and *Xiphopenaeus riveti*) were included as part of C2, due to their catch proportion (>5% of the catch). Finally, the 'rays' group comprised several species (>5% (combined)), with some listed as Vulnerable or Threatened by the IUCN. Concerning sea turtles, shrimp trawlers are known to directly impact these species. The Mexican industrial fleet has a mandatory use of TEDs, and the country has obtained the annual certification granted by the US government for fisheries that have in place a protection program comparable to the one in the US. However, the most recent report released for an onboard observers program (in 2019) included incomplete data on fleet interactions with sea turtles. Based on this, sea turtles were included as C2 species for the assessment.

Magdalena 1 artisanal trawl fishery - Zone 50

No observer program exists in the Magdalena trawl fishery operating on the West Coast of Baja (Zone 50). However, surveys conducted as part of the fishery improvement project (Mexico Baja California Sur blue and brown shrimp – bottom trawl/cast net) provide catch composition data from both the closed season and from commercial vessels during the open season from 2014 to 2022 (INAPESCA 2023). The overall ratio of kg of shrimp caught to kg of other species was 1:5. Fish accounted for 85% of the non-shrimp catch, with crustaceans and mollusks accounting for 5% each and echinoderms 2%. Most (85%) of the non-shrimp catch was returned to the ocean alive (though there is no mention of post-release mortality in the study). The complete list of fish species is presented in Appendix 5; the study did not provide lists of species of the other groups. Of the 126 species identified (Appendix 5), 17 were sharks and rays (*Chondrichthyes*), and 109 were bony fishes (*Actinopterygii*). The vast majority of species are considered Least Concern by IUCN. Still, several rays and sharks, as well as white snout guitarfish (*Pseudobatos oncorhynchus*) and giant seahorse (*Hippocampus ingens*), are IUCN Near Threatened or Vulnerable (see Appendix 5). No sea turtles were reported to be caught or have some level of interaction with this gear. The West Coast of Baja California Sur, particularly the Gulf of Ulloa, has been constantly reported as a high-risk area for sea turtle mortality, either targeted or as bycatch from small-scale fisheries; however, it has been reported that bottom-set gillnet fisheries that operate seasonally in BCS coastal waters are the higher source of sea turtle mortality (Peckham et al 2007) (Shester & Micheli 2011) (Peckham et al 2013) (Koch et al 2013). The active FIP did not report any information regarding interactions with sea turtles, but by law, a mandatory TED has to be installed due to the nature of the gear.

Suripera cast net - Zone 30

An observer program has operated in the suripera fishery in the coastal bay of Sinaloa (Zone 30) since the 2019-2020 fishing season. A recent report from that program provides aggregated catch composition information for the 2019/2020 through 2022/2023 seasons (COSOREMA 2023). Of the more than 32 species observed caught (Appendix 6), penaeid shrimp species accounted for 69.3% of the catch by weight (shrimp to non-shrimp bycatch ration was 1.9:1). This was dominated by blue shrimp, which accounted for 55% of the catch. Finfish accounted for 22.3%, other crustaceans 6.9%, and invertebrates 1.5%. As part of the most recent data available, seahorses were not part of the catch, and interactions with other ETP species were not recorded.

Gillnets - Zone 20

No observer program is active in the gillnet fishery in Sonora. However, during 2018 and 2019, catch data were collected in Sonora to re-assess the impact of the gillnet shrimp fishery on bycatch species, using the 2012 assessment developed by {Balmori et al 2012}. {Balmori-Ramirez and Cervantes-Higuera 2019} conducted a study on the bycatch of the coastal shrimp fishery in Guaymas Bay, Sonora, during the beginning of the 2018-2019 shrimp fishing season as a follow-up to previous work in 2012. Bycatch samples were collected, organisms were identified at species level, and sizes were recorded. The total composition of 51 identified

species was greater than in previous work; the most diverse group was fish, but the dominant species was the Warrior crab (*Callinectes bellicosus*). The total shrimp-bycatch ratio was estimated at 1:025, varying between 1:0 and 1:9.9, and the average ratio was 1:1.0 proportion lower than that reported at 1:8 (Amezcua et al. 2006) and 1:22 (Suenaga, 2010) but higher than that reported in the previous study (1:0.5; Balmori et al. 2012). No bycatch species were reported as threatened, endangered, or under special protection. It was concluded that the impacts of shrimp fishing were low for the study area due to the proportion of bycatch shrimp found and the species captured.

Cast nets - Zone 60

Currently, a Fishery Improvement Project operates on the borders of Sinaloa and Nayarit. A monthly data collection system is in place that includes information related to catch composition. The 2023 report showed cast nets presented a 1:1.3 shrimp-bycatch proportion, with Pacific fat sleeper (*Dormitator latifrons*) as the main bycatch species with 5.2% of the catch. The other seven species were identified, but 0.8% was present at most. No ETP species are known to be impacted, nor were reported in the most recent report {Granados-Amores et al 2023}.

Traps

Currently, no observer program is in place that monitors the impact of the “charangas”. These (traps) are used to aggregate shrimp in the Gulf of Mexico, and a “spoon” net is used to collect the shrimp from the bottom with mostly no other species in the catch. For this reason, the gear is considered highly selective.

Criterion 2 Assessment

Scoring Guidelines

Factor 2.1 - Abundance

(same as Factor 1.1 above)

Factor 2.2 - Fishing Mortality

(same as Factor 1.2 above)

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

Ratio of bait + discards/landings	**Factor 2.3 score**
<100%	1
>=100	0.75

Arched swimming crab *(Callinectes arcuatus)*

2.1 Abundance

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Low Concern

No comprehensive stock assessments have been conducted for arched swimming crab in Mexican waters, and no reference points have been defined. A data-limited stock assessment based on the Catch-MSY method and using commercial catch data from 1980 to 2018 found the stock to be above B_{MSY} albeit with significant uncertainty around B_{MSY} (see Justification below) (Balmori et al 2021b).

A data-limited stock assessment using data from <10 yrs ago that finds biomass over B_{MSY} allows for a score of 3.67 (low concern).

Supplementary Information

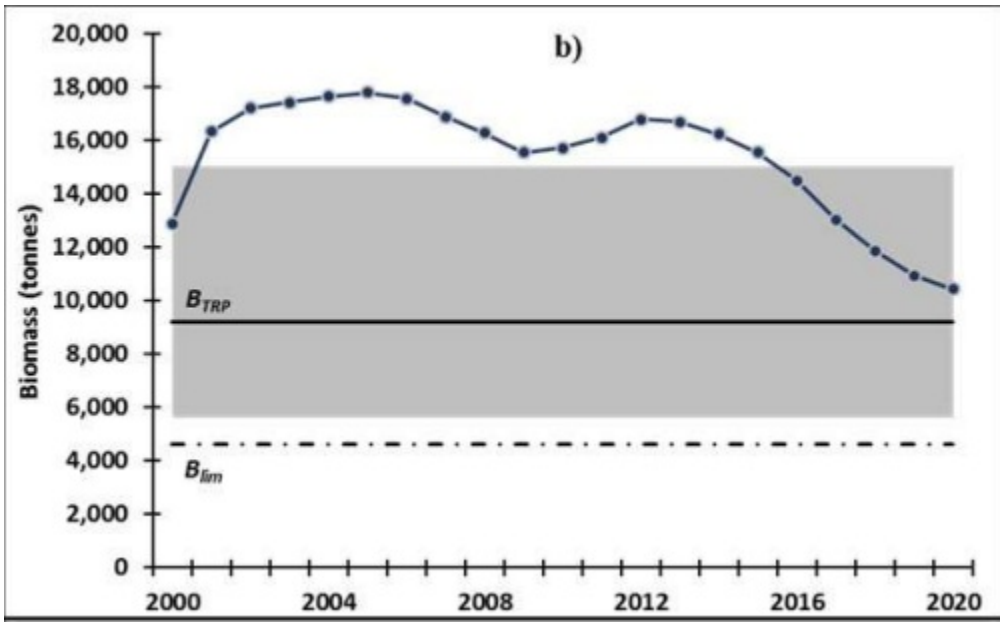


Figure 42: Arched swimming crab biomass in the Gulf of California from 2000 to 2020. B_{TRP} is the candidate reference point and is set at B_{MSY}. The gray shading illustrates the 95% confidence interval around B_{MSY}. Source: {Balmori et al. 2021}.

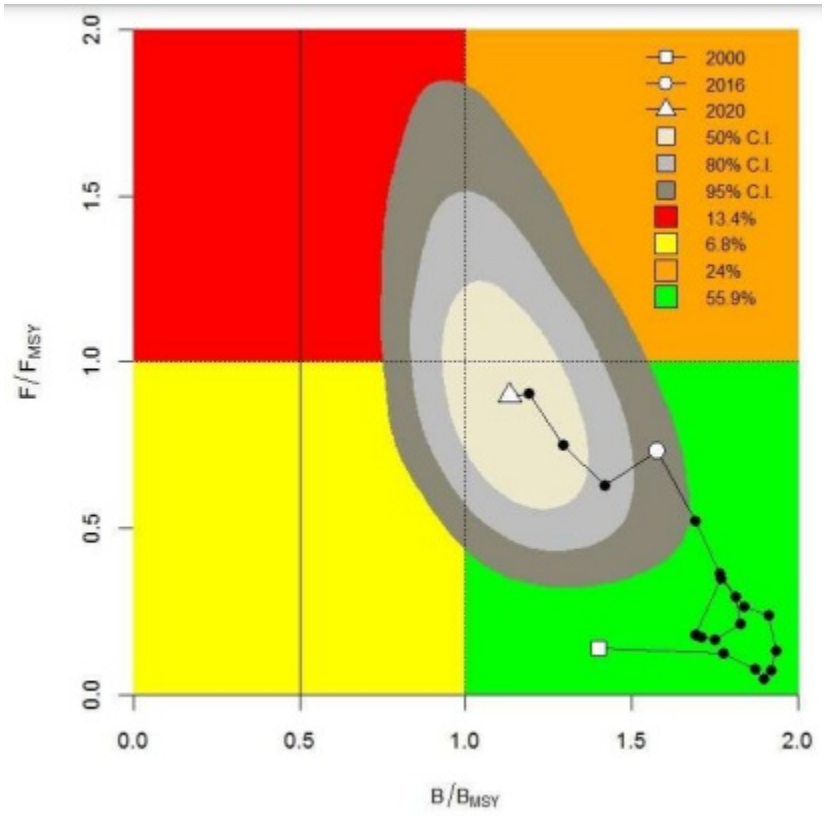


Figure 43: Kobe plot for arched swimming crab in the Gulf of California. Source: {Balmori et al. 2021}.

2.2 Fishing Mortality

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Moderate Concern

Balmori et al. (2021) estimated the fishing mortality values for the arched swimming crab in the Gulf of California. According to the landings data, there was a growing increment from 2012 until 2020 near the estimated fishing mortality reference limit (F_{LIM}), which is set in the assessment at F_{MSY} (Figure 10). The authors reported values of fishing mortality throughout most of the time series that were far below the F_{MSY} value. Still, since 2012, fishing mortality increased markedly, reaching a maximum value in 2019 (F_{2020}) of 0.540, which equals approximately 90% of F_{MSY} ($F_{CURRENT}/F_{MSY}$ = 0.54/0.596 = 0.91) (Balmori et al 2021b)

The Kobe plot placed the arched swimming crab stocks close (within a 50% confidence interval) to the overfishing zone for the most recent year assessed (2020) (see Figure 9 in Abundance section above). The authors reported a 59.9% probability that arched swimming crab was in the green quadrant {Balmori et al. 2021}. The authors also reported that the

number of boats in the Gulf of California participating in the swimming crab fishery increased by 42% from 2011 to 2017, with exploitation rates in recent years close to FMSY.

Based on the most recent information available, values of F have been below FMSY, which would allow a score of 5 (low concern). But, fishing mortality has been increasing toward FMSY in recent years, and is now above the lower 95% CI bound for the estimate of FMSY. In addition, arched swimming crab is reported to be caught as bycatch for shrimp industrial and artisanal fisheries {Lopez-Martinez, J. et al. 2014}, and these sources of mortality are not included in the stock assessment. For these reasons, the score is modified to 3 and a rating of moderate concern..

Supplementary Information

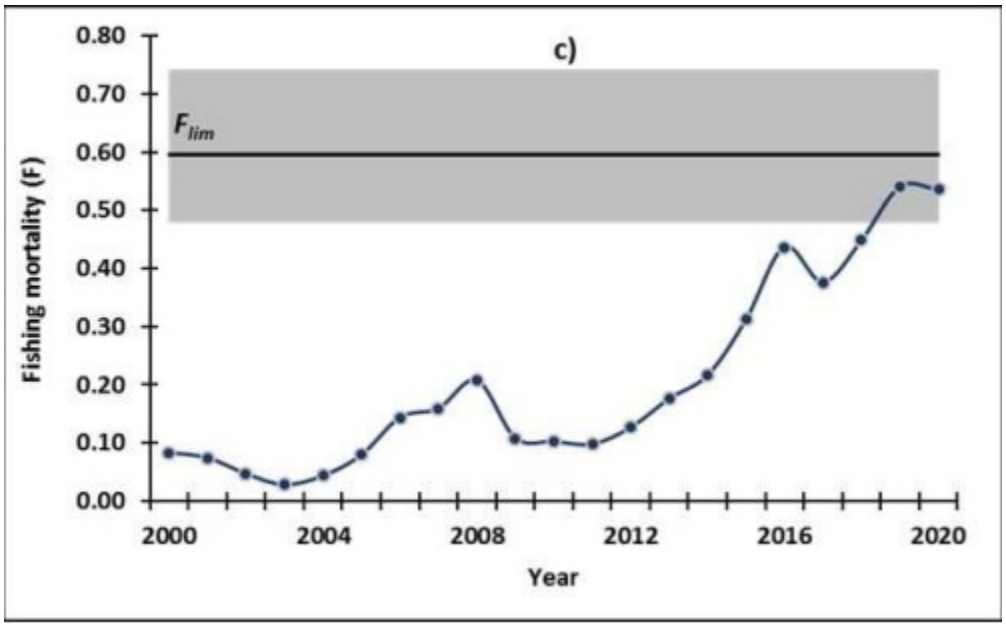


Figure 44: Arched crab fishing mortality from 2000 to 2020; $F_{LIM} = F_{MSY}$. Source: {Balmori et al. 2021}.

Bullseye puffer *(Sphoeroides annulatus)*

2.1 Abundance

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Suripera - Sinaloa North Central (Zone 30)

Moderate Concern

A stock assessment relative to reference points is not available for this species. This

species is listed as "Least Concern" by the IUCN {Nielsen et al. 2010}, but that assessment is over 10 years old and cannot be used for scoring. Inherent vulnerability was assessed using a Productivity-Susceptibility Analysis (PSA) (see Justification), which determined the species has a low vulnerability. Abundance is scored 2.33 (moderate concern) based on the PSA results.

Supplementary Information

PSA score = 1.98. For this reason, the species is deemed “low” vulnerability (based on PSA scoring tool). Detailed scoring of each attribute is shown below.

Productivity Attribute	**Relevant Information**	**Score (1 = low risk, 2 = medium risk, 3 = high risk)**
Average age at maturity	N/A	
Average maximum age	N/A	
Average maximum size	44cm {Bussing 1995}	1
Fecundity	<20,000 per year {Ibarra-Zatarian 2016}	1
Reproductive strategy	Broadcast spawner	1
Trophic level	3.1 {Froese and Pauly 2016}	1

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Areal overlap (Considers all fisheries)	Common on rocky reefs and adjacent sand patches {Nielsen et al. 2010}. Areas that are not worked by the gears.	2
Vertical overlap (Considers all fisheries)	Often seen in mid-water high off the bottom or at the surface. Juveniles inhabit the high and middle salinity portions of estuaries {Bussing 1995; Cooke 1992}	2
Selectivity of fishery (Specific to fishery under assessment)	Species is incidentally encountered and is not likely to escape the gear, but conditions under 'high risk' do not apply. Default value.	2
Post-capture mortality (Specific to fishery under assessment)	Unknown Default value.	3

2.2 Fishing Mortality

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Suripera - Sinaloa North Central (Zone 30)

Moderate Concern

Bullseye puffer is a common species along the Pacific, and can be found from southern California to Pisco, Peru and the Galapagos islands {Nielsen et al. 2010}. It is considered an associated species for the finfish fishers in the Pacific coast (DOF 2012). Despite its availability in Mexican waters, its exploitation for human consumption is recent, given that tetraodontids are widely known for being a poisonous food due to the tetrodoxin content {Ahasan et al. 2004}. Sanchez-Cardenas et al. indicated that younger organisms are distributed in different habitats than older ones, where juveniles inhabit mixohaline systems and adults the neritic zone {Sanchez-Cardenas et al. 2007}. Such behavior favors the conservation of this resource, given that it protects juveniles from fishing. Bullseye pufferfish have been reported as a rare species in the Suripera and Gillnet fisheries in Sinaloa (Del Pacifico 2016).

Since there are no reference points or stock assessments for the species, so current fishing mortality relative to a sustainable level is unknown. This factor is thus scored 3 (moderate concern).

California Butterfly Ray *(Gymnura marmorata)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

High Concern

No reference points have been defined or stock assessment conducted for California butterfly rays in Mexican waters. A recent IUCN assessment found the species “Near Threatened," (Pollom et al 2020) which requires a score of 1 (High Concern) for abundance.

Supplementary Information

The species range is almost entirely in Mexican waters, though it is also found in southern California waters (Pollom et al 2020).

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

With no reference points or stock assessments for California butterfly rays in Mexican waters, fishing mortality relative to a sustainable level is unknown, which requires a score of 3 (Moderate Concern).

Cortez swimming crab *(Callinectes bellicosus)*

2.1 Abundance

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Low Concern

Balmori et al. (2021) developed a stock assessment for Cortez swimming crab in the

Mexican Pacific Ocean (Balmori et al 2021b). The authors fed official landings data from 1980 to 2020 into a catch-maximum sustainable yield (C-MSY) method, to estimate the maximum sustainable yield (MSY), the biomass associated with MSY (B_{MSY}), and the fishing mortality associated with maximum sustainable yield (F_{MSY}) for *C. bellicosus* in the Gulf of California (Table 4).

The authors declared B_{MSY} as the target reference point for the species, based on its ecology. As a result of the analysis, the authors calculated MSY for the arched swimming crab as 24,687 t and B_{MSY} as 41,448 t. The results showed that Cortez swimming crab biomass has been above B_{MSY} (Figure 14). In addition, managers estimated B_{LIM} at 50% of the B_{MSY} as a reference point for future management decisions.

Table 4. Stock assessment estimates for Cortez swimming crab.

Table 13

Species	Reference points			Candidate Reference Points for Management		
	Median (CI = 95%)			Target	Limit	
	MSY (t)	B_{MSY} (t)	F_{MSY}	B_{MSY}	0.5 B_{MSY}	F_{MSY}
Cortez swimming crab	24,687 (14,031–43,437)	41,448 (24,969–68,800)	0.596	41,448	20,724	0.596

A recent stock assessment (i.e., using data <5 years old) that found current biomass to be above B_{MSY} would allow for a score of 5 (very low concern). But, there is great uncertainty in the estimate of B_{MSY}, and the assessment has not yet completed peer review (though it has been accepted). This modifies the score to 3.67 and a rating of low concern.

Supplementary Information

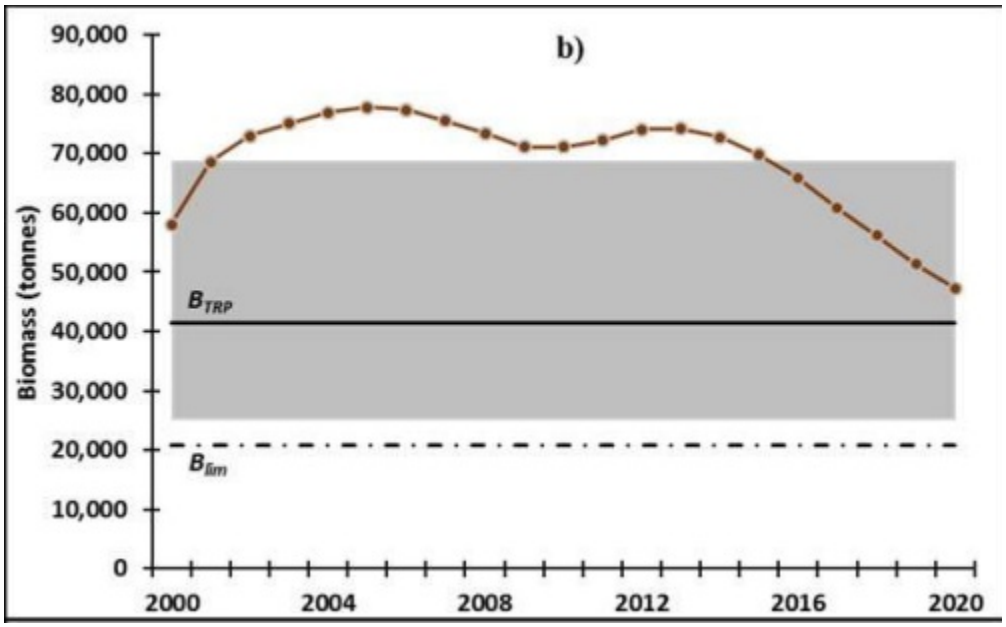


Figure 45: Cortez swimming crab biomass estimates for 2000 to 2020 in the Gulf of California. B_{TRP} is the candidate reference point and is set at B_{MSY}. The grey area represents the 95% confidence intervals around B_{MSY}. Source: {Balmori et al. 2021b}.

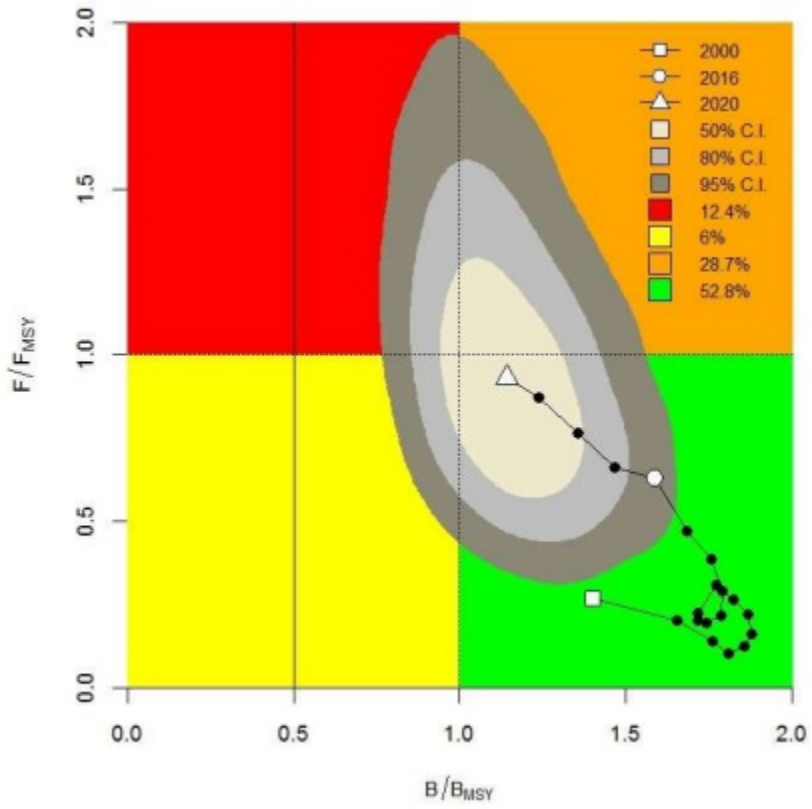


Figure 46: Kobe plot of Cortez swimming crab in the Gulf of California. Source: {Balmori et al. 2021b}.

2.2 Fishing Mortality

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Low Concern

Balmori et al. (2021) estimated the fishing mortality values for the Cortez swimming crab in the Gulf of California. According to the landings' data, there was a growing increment from 2012 until 2015 near the estimated fishing mortality reference limit (FLIM), which is set in the assessment at FMSY (see Figure in justification). The authors reported values of fishing mortality throughout the time series that were far below the FMSY value (Balmori et al 2021b)

The Kobe plot placed the Cortez swimming crab stocks close (within a 50% confidence interval) to the overfishing zone for the most recent year assessed (2020) (see Figure 9 in Abundance section above). The authors reported a 52.8% probability that Cortez swimming crab was in the green quadrant {Balmori et al. 2021b}. Based on the most recent information available, values of F have been below FMSY, which allows a score of 5 (low concern).

Crystal shrimp *(Penaeus brevirostris)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

A stock assessment relative to reference points is not available for this species, and there is no IUCN assessment. To assess this factor, the inherent vulnerability was assessed using a Productivity-Susceptibility Analysis (PSA) (see justification). Crystal shrimp has a medium vulnerability, but no quantitative stock assessment or reference point exists. For these reasons, abundance is deemed a "moderate" concern.

Supplementary Information

Table 14

Table 15

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = m risk, 3 = high risk)
Average age at maturity	< 5 years	1
Average maximum age	< 10 years	1
Fecundity		1
Reproductive strategy	Broadcast spawner	1
Density dependence		
Quality of habitat	Habitat has been moderately altered by non-fishing impacts	2

Table 16

Table 17

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Areal overlap (Considers all fisheries)	The species is usually found at depths between 10 and 100 meters and prefers mud and sandy mud bottoms (Holthuis 1980)	2

Vertical overlap (Considers all fisheries)	Often found at the bottom or close to the surface (Holthuis 1980) considering the trawlers have a direct contact with the surface, this factor is scores as high risk	3
Seasonal availability (Considers all fisheries)	The shrimp season in the Mexican Pacific normally runs from the end of September to the beginning of March; the fisheries overlap with species 3-6 months/per year.	2
Selectivity of fishery (Specific to fishery under assessment)	Species are incidentally encountered and are not likely to escape the gear, but conditions under 'high risk' do not apply.	2
Post-capture mortality (Specific to	Due to the nature of the gears used, and the value, this	3

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

With no reference points or stock assessments for crystal shrimp in Mexican waters, fishing mortality relative to a sustainable level is unknown, which requires a score of 3 (Moderate Concern).

Diamond Stingray *(Hypanus dipterurus)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

High Concern

There is no stock assessment nor reference points for diamond stingray in Mexican waters. According to the IUCN, the species is listed as vulnerable (Pollom et al d 2020); for these reasons, this factor is scored as a high concern.

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

According to the data available by the onboard observers report, due to the limited presence in the catch, the species was listed as a secondary minor species under the MSC standard (a vulnerable species that lacks management and represents <2% of the total catch). However, specific details of the trawler's fishing mortality relative to a sustainable level are unknown. Therefore, a "moderate" concern is appropriate.

Giant sea bass *(Stereolepis gigas)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

High Concern

The International Union for the Conservation of Nature (IUCN) first listed giant sea bass as “Critically Endangered” in 1996 and updated this assessment in 2004 with the same category (Cornish 2004). The effective population size was estimated at 500 individuals,

with evidence that the population is expanding in the region (Chabot et al. 2015). It has been found that the effective population size of species may be considered as 10% of the census population size, meaning the population may be around 5,000 individuals, although there is some uncertainty about how this value may be applied, because of varying life history characteristics across species and the suggested growth of this population (Chabot et al. 2015). Sampling of the Mexican commercial fleet's landings suggests that this is an underestimate (Ramírez-Valdez et al. 2021). The study suggests that the actual population size may be large enough to no longer be treated as "Critically Endangered" by the IUCN, but it ultimately advocates for treating the population size as unknown (Ramírez-Valdez et al. 2021)(House et. al. 2016). But because of the uncertainties surrounding stock data and reference points, abundance is considered a high concern

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

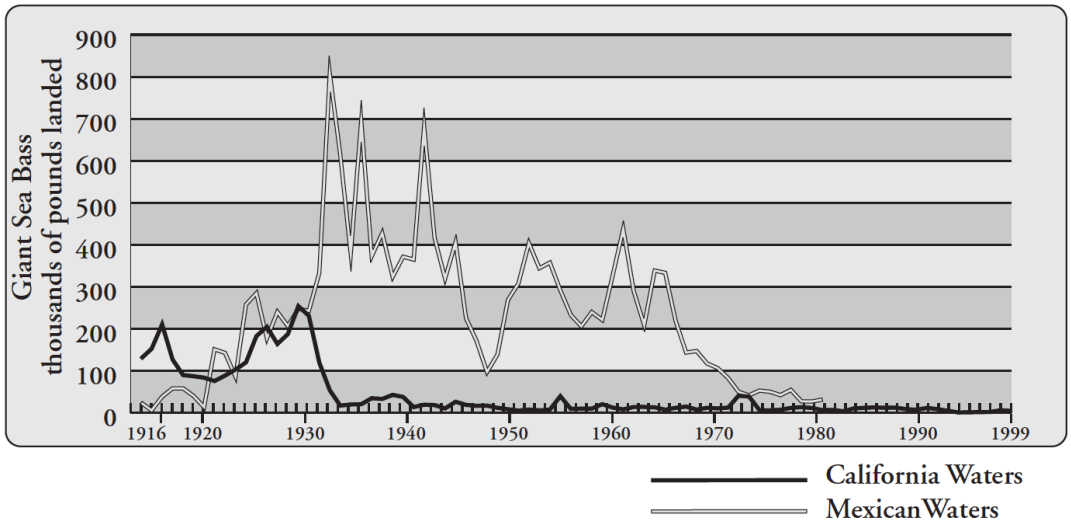
Moderate Concern

Fishing mortality for giant sea bass is unknown because no scientific research has been done to establish population trends (CDFG 2010b). There is no estimate of F, so it follows that there are no reference points for fishing mortality. Because giant sea bass fishing mortality is unknown, fishing mortality is deemed a moderate concern.

Supplementary Information

Giant sea bass was heavily exploited in the United States and Mexico in the early 1900s. In the U.S., commercial landings peaked in 1932 at 115 mt and rapidly declined the following year. Commercial landings in Mexico had a similar decline, though it occurred more gradually. As described in the Introduction, current law prohibits the take of giant sea bass except one fish per trip as incidental catch in the commercial gillnet and trammel net fisheries (FGC §8380). Consequently, commercial landings since 2000 have consistently

remained between 1 and 4 mt annually. CDFW has reported that anecdotal evidence from sightings by scuba divers off La Jolla, Anacapa Island, and Catalina Island indicates that there may be an increase in abundance (CDFG 2010b). The current effective population size is estimated at 500 individuals, with evidence that the population is expanding in the region (Chabot et al. 2015). But that may be an underestimate, and the actual population size is being treated as unknown (Ramírez-Valdez et al. 2021). A 2014–15 survey at Catalina Island also suggests that giant sea bass is recovering, when compared to historical data for the island {House et al. 2016}.



Commercial Landings by Location 1916-1999, Giant Sea Bass

Landings separated by location of catch. All landings were recorded at California ports.

Data Source: DFG Catch Bulletins and commercial landing receipts.

Figure 47: Commercial landings of giant sea bass by location, 1916–1999.

Golden mojarra *(Diapterus aureolus)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

A stock assessment relative to reference points is unavailable for either of the mojarra species. There is a IUCN assessment for each species, but they are both more than ten years old and so cannot be used for scoring (van der Heiden et al 2010)(Cotto et al 2010). To assess this factor, the inherent vulnerability was assessed using a Productivity-Susceptibility Analysis (PSA) (see justification). Considering the lack of information, the PSA was used for both species, and the results showed that the species have a low vulnerability. For these reasons, abundance is deemed a "moderate" concern.

Supplementary Information

Table 18

Table 19

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = m risk, 3 = high risk)
Average age at maturity	No information is available for D. aureoles. Estimate of fecundity based on a study by {Gallardo-Cabello et al 2015} in the Mexican Pacific Coast, of similar species (Diapterus brevirostris), observed sexual maturation of males and females at one and two years old	1
Average maximum age	Inferred from average age at maturity.	1

Fecundity	More information needed to be available for D. aureoles “ Fecundity values [for Diapterus brevirostris] ranged from 16,695 to 807,954 oocytes in females of 1 to 6 years of age and lengths of 12.06 cm to 30.00 cm, and 23 g to 349.6 g of weight” (Gallardo-Cabello et al. 2015)	2
Average maximum size	D. aureolus max length: 15.0 cm (Fishbase)	1
Average size at maturity	There was no information available for D. aureoles for similar species (Diapterus brevirostris): Average length of sexual maturity (L50) was 14.20 cm in males and 14.26 the females (Gallardo-Cabello et al. 2015)	1
Reproductive strategy	Broadcast spawner	1
Density dependence	N / A	
Quality of habitat	Habitat has been moderately altered by non-fishing impacts	2

Table 20

Table 21

Susceptibility Attribute	**Relevant Information**	**Score (1 = low risk, 2 = medium risk, 3 = high risk)**

Areal overlap (Considers all fisheries)	Based on the broad distribution of the species (from Baja California Sur and Sinaloa in Mexico to northern Peru) and the relatively high probability of occurrence throughout most of its range (Fishbase), it is estimated overlap of fishing effort with species concentration of the stock to be between 10-30%	2
Vertical overlap (Considers all fisheries)	According to the study and analysis of shrimp bycatch conducted by INAPESCA (2016), the relative abundance index (IAR): D. aureoles was classified as frequent (IAR = 0.4954)	3
Seasonal availability (Considers all fisheries)	The shrimp season in the Mexican Pacific normally runs from the end of September to the beginning of March; the fisheries overlap with species 3-6 months/per year.	2
Selectivity of fishery (Specific to fishery under assessment)	Evaluations of the efficiency and selectivity of the ala de angel ¾ inch bottom trawl net capture mojarras of the average size of 14.90 cm and that this type of net is efficient, releasing approximately 50% of organisms below the size of 15 cm (Aguilar Ramirez et al. 2000).	2
Post-capture mortality (Specific to fishery under assessment)	No information on discard mortality was available, team assumed higher risk factor	3

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

According to the data available from the onboard observers report, the two mojarra species were grouped (Morsan et al 2019). There are no reference points or stock assessments for either species, so current fishing mortality relative to a sustainable level is unknown. This factor is thus scored 3 (moderate concern).

Green turtle *(Chelonia mydas)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

High Concern

The East Pacific DPS of the green sea turtle is listed as “Threatened,” while the North Atlantic Ocean DPS is listed as Endangered under the Endangered Species Act {81 FR 20057}. Therefore, abundance is rated a high concern.All sea turtles are listed as Endangered or Threatened under the U.S. Endangered Species List, and so all are deemed a "high" concern for abundance. Some populations have shown improvements in recent years (see Detailed Rationale below); this is taken into account under fishing mortality.

Supplementary Information

The 2020 evaluation of the North Pacific Ocean, NMFS and USFWS concluded that despite some reports on nesting increases in the best data available showed that the DPS continues to be endangered by intense fisheries bycatch and climate change, as well as habitat loss and modification, and predation). Based on these reasons, the authors conclude that the status of the species should remain endangered {NMFS & USFWS 2022} In the report of the status for green turtle in 2015, NOAA officials analyzed nesting information for Mexico, particularly in Michoacán — the largest nesting aggregation in the East Pacific DPS (NOAA 2017). The report concluded that the green turtle population has improved, as compared with data from 1980. Authors suggest that protection regulations played a big role on this increase in abundance in Mexico (NOAA 2017). In addition, another important green turtle population — in Costa Rica — also reported a stable status on the nesting data, confirming that this section of the population is also increasing as well (NOAA 2017).

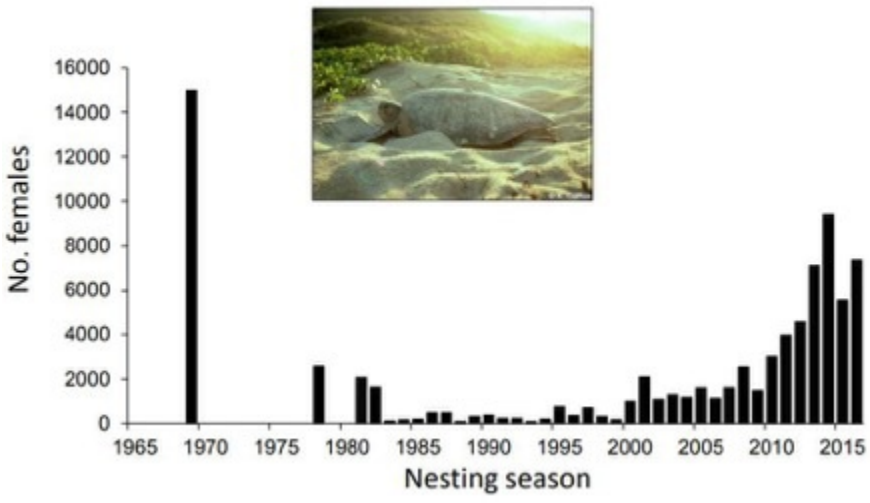


Figure 48: Change in nesting abundance of green turtles at Playa Colola,

Michoacan, Mexico (chart from IATTC 2017).

In the case on the DPS on the Atlantic, a nesting-trend monitoring program that been in place in Florida since 1989 with consistent data collection (including location, fixed dates, and annual training of surveyors) (FFWCC 2022). Such data include both the Atlantic and Gulf coasts of Florida. For green sea turtle, the nest counts have increased from less than 300 in 1989 to almost 41,000 in 2019 (FFWCC 2022).

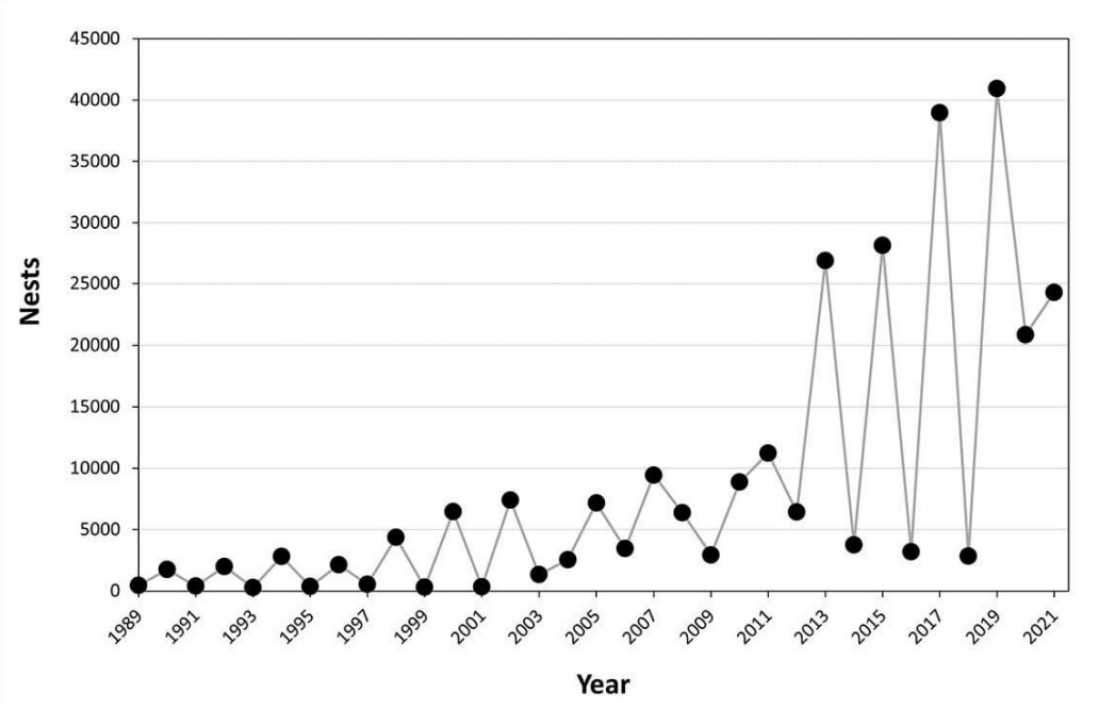


Figure 49: Number of green turtle nests counted on core index beaches in Florida, from 1989 to 2021 (FFWCC 2022).

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

The last time that the INAPESCA observer program publicly released information on turtle interactions was on the 2017 report (INAPESCA 2017). The document included details on the number of turtle interactions and species with the industrial fleet (caught 87 olive ridleys, 32 greens, 2 loggerheads, and 1 unconfirmed hawksbill turtle) over nine seasons (INAPESCA 2017). Managers mentioned that, according to the observer's program data, no sea turtle mortalities werehave been reported; and managers believe that the fishery does not jeopardize the recovery of these species populations {INAPESCA, 2017}. However, it is unclear if the onboard observer's program has been reactivated. The last report released was in 2019, which included incomplete data on fleet interactions with sea turtles. The report that summarized the results of the observer's program for three seasons (2015-2016, 2016-2017, and 2017-2018) mentioned that there were interactions with sea turtles, but details about number of interactions or which species are not included (SICG 2019)

Finally, the annual certification granted by the US government for fisheries that have in place a protection program comparable to the one in the US, which includes the correct use of turtle excluder devices, has been granted to Mexico, every year, except in 2011 and 2021 (although recovered it later that same year) because it was found some irregularities with the use of the TEDs.

Overall, fishing mortality is considered a "high" concern under the Seafood Watch standard when cumulative mortality is too high, and the contribution of the fishery being assessed to mortality is unknown. Considering the increasing abundance in the distinct population segments of green, olive ridley and loggerhead turtles. That the fleet seems to have limited interactions with these species (at least until recent data was available) and cumulative fishing mortality may not jeopardize the ability of these DPSs to recover, especially considering that the use of TEDs seems appropriate, a "moderate" concern is deemed appropriate for now.

Supplementary Information

Trawls, longlines, and gillnets have been discussed as the major sources of mortality for sea turtles around the world {Lewison et al. 2003}. A technological solution 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. Using TEDs on shrimp trawl nets can reduce sea turtle bycatch by more than 90% (IAC 2006). INAPESCA reported 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}.

Coverage by the INAPESCA observer program coverage has not been homogeneous along the different seasons (see table below). On average, the program has covered 3% of the fishing effort in the number of trips; the estimates of turtle interaction are made in turtles by the number of sets (1 in every 887 sets) (INAPESCA 2017). The analysis of the program's data showed that in 106,393 fishing sets (during nine fishing seasons), the probability of interaction with sea turtles was estimated atin 0.1%, or one sea turtle per 887 fishing sets {INAPESCA, 2017}.

Percentage of coverage for the onboard observer's program (Source: INAPESCA 2017). Note, there was no observer program for the 2011/12 to 2014/15 seasons, in addition in most recent years it is unclear is a program remains in place, since the information has not been released.

Table 22

Season	No. of Total	fishing trips W/Observer	Coverage %
2004–05	5,547	52	0.9
2005–06	5,505	208	3.8
2006–07	5,583	239	4.3
2007–08	4,948	206	4.2
2008–09	5,233	185	3.5
2009–10	4,540	159	3.5
2010–11	4,201	167	4.0
2015–16	4,078	11	0.3
2016–17	4,680	98	2.1
Total	44,315	1,334	3.0

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

High Concern

The actual mortality rate of sea turtles in the Mexican shrimp fisheries in the GOM is

unknown. There is no current observer program for the Gulf of Mexico shrimp trawl fishery. The SFW standard considers fishing mortality as a "high" when cumulative mortality is too high and the contribution of the fishery being assessed to mortality is unknown. Although some DPSs appear to be improving (green, Kemp's ridley, loggerhead, leatherback), the Kemp's ridley DPS does not; further analysis is necessary to be confident that cumulative fishing mortality is not too high. A lack of observer data compounds these concerns, especially given the number of turtles estimated to be caught in the U.S. Gulf of Mexico shrimp trawl fishery (>100,000 interactions, and >3000 mortalities) {Finkbeiner et al. 2011}. Therefore, fishing mortality is deemed a "high" concern for all the sea turtles for the industrial fleet in the GOM.

Hawksbill turtle *(Eretmochelys imbricata)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

High Concern

The Hawksbill turtle is listed as "Endangered" throughout its range by the under the Endangered Species Act {81 FR 20057}. Therefore, abundance is rated a high concern.All sea turtles are listed as Endangered or Threatened under the U.S. Endangered Species List, and so all are deemed a "high" concern for abundance. Some populations have shown improvements in recent years (see Detailed Rationale below); this is taken into account under fishing mortality.

Supplementary Information

The 2013 "5-Year Review" report for the hawksbill turtle by NOAA and the USFWS,

examined hawksbill populations at 88 nesting sites among 10 regions around the world (NOAA-USFWS 2013). The report found a decrease in nesting abundance, although it does not have recent estimates for Mexico. Compared with the 2007 review, authors found that some populations in the eastern Pacific and Nicaragua in the Caribbean improved, but concluded that the overall trend has not changed (NOAA-USFWS 2013). In the Mexican Pacific, a small number (around 15) of females is estimated to nest each year {Seminoff et al. 2003} in remnant populations; the NOAA report concluded that, despite international cooperation to protect hawksbills (e.g., East Pacific Hawksbill Initiative, Inter-American Convention for the Protection and Conservation of Sea Turtles), threats from manmade and natural sources remain important factors on the recovery of this species (NOAA-USFWS 2013). Some of these threats include tortoiseshell trade, poaching, incidental capture in commercial and artisanal fisheries, climate change, and coastal development (NOAA-USFWS 2013). The report concludes that, based on a review of the best available information since the 2007 "5-Year Review," hawksbill sea turtles remain in danger of extinction throughout all, or a significant portion, of its range and should retain their endangered status.

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

The INAPESCA observer program has documented that the industrial fleet caught 87 olive ridleys, 32 greens, 2 loggerheads, and 1 unconfirmed hawksbill turtle over nine seasons (INAPESCA 2017). In addition, managers mentioned that, according to the observer’s program data, since the 2007 to 2008 season, no sea turtle mortalities have been reported; managers believe that the fishery does not jeopardize the recovery of these species populations (INAPESCA 2017).

However, it is unclear if the onboard observer's program has been reactivated. The last report released was in 2019, that included incomplete data related to the fleet interactions with sea turtles. The report that summarized the results of the observer's program for three seasons (2015-2016, 2016-2017, and 2017-2018) mentioned that there were interactions with sea turtles, but details about the number of interactions or which species are not included (SICG 2019)

Finally, the annual certification granted by the US government for fisheries that have in place a protection program comparable to the one in the US, which includes the correct use of turtle excluder devices, has been granted to Mexico every year, except in 2011 and 2021 (although recovered it later that same year) because it was found some irregularities with the use of the TEDs.

Overall, fishing mortality is considered a "high" concern under the Seafood Watch standard when cumulative mortality is too high, and the contribution of the fishery being assessed to mortality is unknown. Considering the increasing abundance in the distinct population segments of green, olive ridley and loggerhead turtles. That the fleet seems to have limited interactions with these species (at least until recent data was available) and cumulative fishing mortality may not jeopardize the ability of these DPSs to recover, especially considering that the use of TEDs seems appropriate, a "moderate" concern is deemed appropriate for now.

Supplementary Information

See detail under green sea turtles

Kemp's ridley turtle *(Lepidochelys kempii)*

2.1 Abundance

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

High Concern

In the Gulf of Mexico, green, hawksbill, The Kemp’s ridley turtle is listed as “Endangered” throughout its range under the Endangered Species Act {35 FR 18319}, so abundance is rated a high concern.

Supplementary Information

The Kemp’s ridley turtle population has been recovering since the 1985 season, with more stable numbers since 2009 (Bevan et al 2016). But, the number of annual nests is still much lower than historical abundance (Bevan et al. 2016), which results in the species being listed as “Critically Endangered” by the International Union for the Conservation of Nature (IUCN) (Wibbels and Bevan 2019). In addition, a higher by-catch may be expected

due to increased species abundance (Putman et al. 2020). Lastly, researchers have suggested that a recent nesting setback of Kemp's ridley turtle could have been caused by the declining carrying capacity of a greatly altered Gulf of Mexico, compared to historical conditions that could support much higher abundance (Caillouet et al. 2018).

2.2 Fishing Mortality

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

High Concern

The actual mortality rate of sea turtles in the Mexican shrimp fisheries in the GOM is unknown. There is no current observer program for the Gulf of Mexico shrimp trawl fishery. The SFW standard considers fishing mortality as a "high" when cumulative mortality is too high and the contribution of the fishery being assessed to mortality is unknown. Although some DPSs appear to be improving (green, Kemp's ridley, loggerhead, leatherback), the Kemp's ridley DPS does not; further analysis is necessary to be confident that cumulative fishing mortality is not too high. A lack of observer data compounds these concerns, especially given the number of turtles estimated to be caught in the U.S. Gulf of Mexico shrimp trawl fishery (>100,000 interactions, and >3000 mortalities) {Finkbeiner et al. 2011}. Therefore, fishing mortality is deemed a "high" concern for all the sea turtles for the industrial fleet in the GOM.

Leatherback turtle *(Dermochelys coriacea)*

2.1 Abundance

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

High Concern

The leatherback turtle is listed as "Endangered" throughout its range under the Endangered Species Act {35 FR 8491}, so abundance is rated a high concernIn the Gulf of Mexico, green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles, are all likely to be adversely affected by shrimp trawlers. These species migrate through areas subject to shrimp trawling (NOAAb 2017); however, some species are more likely to be affected by other factors (e.g., exploitation of eggs, harvesting of adults for meat) than for incidental bycatch by shrimp activities, like Kemp's ridley and green turtles (NOAAb 2017). All sea turtles are listed as Endangered or Threatened under the U.S. Endangered Species List, and so all are deemed a "high" concern for abundance. Some populations have shown improvements in recent years (see Detailed Rationale below); this is taken into account under fishing mortality.

Supplementary Information

Stock-level (annual geometric mean change in nest counts) trends for Northwest Atlantic leatherback turtle have varied by relative abundance and data availability, and have a negative trend (Northwest Atlantic Leatherback Working Group 2018). Potential drivers for such declines in nesting abundance include habitat loss, anthropogenic impacts, and life history/demographic factors (Northwest Atlantic Leatherback Working Group 2018).In the Caribbean, Atlantic, and Gulf of Mexico, leatherback populations have been reported to be increasing (NOAA 2017). In the United States, the Atlantic coast of Florida is one of the main nesting areas in the country. Data from this area shows a general increase with some fluctuations (NOAA 2017). In 2014, the Florida index nesting data indicate that the number of nests ranged from 27 to 641 between 1989 and 2014 (NOAA 2017). In the status review of 2013 (NOAA-USFWS 2013), the authors concluded that leatherback populations in the Atlantic appeared to be stable or increasing, suggesting that high reproductive output and consistent and high quality foraging areas in the Atlantic have contributed to the stable or recovering populations of the species (NOAA-USFWS 2013).

2.2 Fishing Mortality

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

High Concern

The actual mortality rate of sea turtles in the Mexican shrimp fisheries in the GOM is unknown. There is no current observer program for the Gulf of Mexico shrimp trawl fishery. The SFW standard considers fishing mortality as a "high" when cumulative mortality is too high and the contribution of the fishery being assessed to mortality is unknown. Although some DPSs appear to be improving (green, Kemp's ridley, loggerhead, leatherback), the Kemp's ridley DPS does not; further analysis is necessary to be confident that cumulative fishing mortality is not too high. A lack of observer data compounds these concerns, especially given the number of turtles estimated to be caught in the U.S. Gulf of Mexico shrimp trawl fishery (>100,000 interactions, and >3000 mortalities) {Finkbeiner et al. 2011}. Therefore, fishing mortality is deemed a "high" concern for all the sea turtles for the industrial fleet in the GOM.

Lined seahorse *(Hippocampus erectus)*

2.1 Abundance

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

High Concern

The IUCN lists the Northern seahorse as Vulnerable (Pollom, R 2017). Therefore, abundance is scored 1 (high concern).

2.2 Fishing Mortality

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

Moderate Concern

Northern seahorses have been recorded as bycatch in the GOM Mexican shrimp fishery (Baum, J., and A. Vincent 2005). Studies have shown that incidental catch of northern seahorses in the GOM shrimp fisheries may impact species abundance in these regions (Czembor, C. et al 2012) (Project Seahorse 2003). On the coast of Mexico, 21 of the 29 fishers in five locations reported declines in seahorses due to the shrimp trawl fishery. Of the 14 fishers who provided quantified catch estimates, 8 estimated declines between 75 to 90% in the past 10 to 30 years(Baum, J. et al 2003); however, the extent of these impacts is unknown. For these reasons, the fishing mortality of northern seahorses, the GOM trawl fishery, is deemed a "moderate" concern.

Loggerhead turtle *(Caretta caretta)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

High Concern

All sea turtles are listed as Endangered or Threatened under the U.S. Endangered Species List, so all are deemed a "high" concern for abundance. Some populations have shown improvements in recent years (see Detailed Rationale below); this is taken into account under fishing mortality.

Supplementary Information

The most recent update to the status of the Pacific DPS was by the IUCN in 2015. That report included a population viability analysis (PVA) This analysis estimated a 6% probability that the North Pacific loggerhead DPS will decline at 50% of the most recent abundance during the next 100 years {Van Houtan K.S. 2011}. The IUCN assessment found that abundance has increased over the past three generations and that both geographic distribution and population size are relatively large, thus classifiying it as "Least Concern" (Casale and Matsuzama 2015). Note that this conclusion is very different than the earlier status report by NOAA in the Endangered and threatened species report of 2010 (NOAA 2010). That report was found to have significant errors, which led to a new approach to assessing sea turtle status {Van Houtan and Halley 2011} {Van Houtan 2011} and {Ascani 2016}.

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

High Concern

The Northwest Atlantic Ocean DPS of the loggerhead turtle is listed as “Threatened", while the North Pacific Ocean DPS as “Endangered” under the Endangered Species Act {76 Federal Register 58867}, so abundance is rated a high concern.In the Gulf of Mexico, green, hawksbill, Kemp’s ridley, leatherback, and loggerhead sea turtles, are all likely to be adversely affected by shrimp trawlers. These species migrate through areas subject to shrimp trawling (NOAAb 2017); however, some species are more likely to be affected by other factors (e.g., exploitation of eggs, harvesting of adults for meat) than for incidental bycatch by shrimp activities, like Kemp’s ridley and green turtles {NOAAb, 2017}. All sea turtles are listed as Endangered or Threatened under the U.S. Endangered Species List, and so all are deemed a "high" concern for abundance. Some populations have shown improvements in recent years (see Detailed Rationale below); this is taken into account under fishing mortality.

Supplementary Information

According to the most recent review of the status of the species by NOAA and the USFWS, the Northwest Atlantic loggerhead DPS appears to be stable or increasing (NOAA-USFWS 2013). The data used for the IUCN analysis indicated a positive overall trend for the North West Atlantic subpopulation (+2%) {Ceriani and Meylna 2015}. The IUCN used the most recent available long-term series of nest counts, and reported an overall increase over the past three generations for the Northwest Atlantic loggerhead subpopulation {Ceriani and Meylna 2015} and for these reasons, categorized the Northwest Atlantic loggerhead subpopulation as "Least Concern" under current IUCN criteria {Ceriani and Meylna 2015}. In the case of the North Pacific, as part of the 2020 evaluation report conducted by NMFS & USFWS (2020), authors concluded that data available was not enough to change the current endangered status on the DPS (NMFS & USFWS 2020)

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

The INAPESCA observer program has documented that the industrial fleet caught 87 olive ridleys, 32 greens, 2 loggerheads, and 1 unconfirmed hawksbill turtle over nine seasons (INAPESCA 2017). In addition, managers mentioned that, according to the observer’s program data, since the 2007 to 2008 season, no sea turtle mortalities have been reported; managers believe that the fishery does not jeopardize the recovery of these species populations (INAPESCA 2017).

However, it is unclear if the onboard observer's program has been reactivated. The last report released was in 2019, that included incomplete data related to the fleet interactions with sea turtles. The report that summarized the results of the observer's program for three seasons (2015-2016, 2016-2017, and 2017-2018) mentioned that there were interactions with sea turtles, but details about the number of interactions or which species are not included (SICG 2019)

Finally, the annual certification granted by the US government for fisheries that have in place a protection program comparable to the one in the US, which includes the correct use of turtle excluder devices, has been granted to Mexico every year, except in 2011 and 2021 (although recovered it later that same year) because it was found some irregularities with the use of the TEDs.

Overall, fishing mortality is considered a "high" concern under the Seafood Watch standard when cumulative mortality is too high, and the contribution of the fishery being assessed to mortality is unknown. Considering the increasing abundance in the distinct population segments of green, olive ridley and loggerhead turtles. That the fleet seems to have limited interactions with these species (at least until recent data was available) and cumulative fishing mortality may not jeopardize the ability of these DPSs to recover, especially considering that the use of TEDs seems appropriate, a "moderate" concern is deemed

appropriate for now.

Supplementary Information

See detail under green sea turtles

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

High Concern

The actual mortality rate of sea turtles in the Mexican shrimp fisheries in the GOM is unknown. There is no current observer program for the Gulf of Mexico shrimp trawl fishery. The SFW standard considers fishing mortality as a "high" when cumulative mortality is too high and the contribution of the fishery being assessed to mortality is unknown. Although some DPSs appear to be improving (green, Kemp's ridley, loggerhead, leatherback), the Kemp's ridley DPS does not; further analysis is necessary to be confident that cumulative fishing mortality is not too high. A lack of observer data compounds these concerns, especially given the number of turtles estimated to be caught in the U.S. Gulf of Mexico shrimp trawl fishery (>100,000 interactions, and >3000 mortalities) {Finkbeiner et al. 2011}. Therefore, fishing mortality is deemed a "high" concern for all the sea turtles for the industrial fleet in the GOM.

Longtail stingray *(Hypanus longus)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

High Concern

Longtail stingray was last reported as Vulnerable by IUCN in 2020 (Pollom et al c 2020), no other information about the status of the stocks in the region is available, and a deep concern score is deemed for the species.

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

According to the data available by the onboard observers report, due to the limited presence in the catch, the species was listed as a secondary minor species under the MSC standard (a vulnerable species that lacks management and represents <2% of the total catch). However, specific details of the trawler's fishing mortality relative to a sustainable level are unknown. Therefore, a "moderate" concern is appropriate.

Mazatlan Butterfly Ray *(Gymnura crebripunctata)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

High Concern

Mazatlan butterfly ray was last reported as Near-threatened by IUCN in 2020 (Pollom et al b 2020); no other information about the status of the stocks in the region is available, and a score of 1 (high concern) is given.

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

Shrimp trawls are a source of mortality for various elasmobranch species. The most recent onboard observer's data showed that the species (grouped with five other rays) accounted for up to 5.5% of the catch. However, there are no reference points or stock assessments for the species, so current fishing mortality relative to a sustainable level is unknown. This factor is thus scored 3 (moderate concern).

Monterrey Spanish Mackerel *(Scomberomorus concolor)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

High Concern

Scomberomorus concolor stock was determined to be near threatened by the IUCN (Collette et al 2024). The justification for the assessment team was based on the fact of a reduction greater than 80% was inferred over the past 40 years and analysis by the Mexican Fisheries Institute in 2002 showed that fishing effort outside the MPA was expected to lead to a decline of at least 40%. That, combined with the lack of confirmed records of this species over the past decade, led to the Near Threatened classification {Collete et al 2024}.

Considering that the stock is determined to be a stock threatened by IUCN listings and there is no more information available. This factor is scored as high concern.

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

The most recent onboard observer's data showed the Monterrey Spanish Mackerel as part of the bycatch species (grouped with three other species of the Scombridae family) accounted for < 0.4% of the catch. There are no reference points or stock assessments for either species, so current fishing mortality relative to a sustainable level is unknown. This factor is thus scored 3 (moderate concern).

Olive Ridley turtle *(Lepidochelys olivacea)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

High Concern

The International Union for Conservation of Nature (IUCN) considers Olive Ridley sea turtles to be Vulnerable globally with a decreasing population trend {Abreu-Grobis and Plotkin 2008}. Olive Ridley turtles have been listed as Threatened on the United States Endangered Species Act (ESA) since 1978 {FR 1978}. Overall, in the Western and Central Pacific Ocean there has been a decrease in annual nesting females of 92%, from 1,412 to 108 {Abreu-Grobis and Plotkin 2008}. More recent information by Wallace et al. (2011), however, shows that the West Pacific olive ridley sea turtle RMU is at low risk of population decline but has a high threat (Wallace et al. 2011). The breeding population off the coast of Mexico is considered Endangered under the US ESA, and all other populations in the region as considered Threatened under the ESA. Despite historic declines, they are highly abundant and largely stable (Wallace pers. comm). We have awarded a score of 1 (high

concern), however, because abundance is unknown, and sea turtles are highly vulnerable to the effects of fishing mortality.

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

The INAPESCA observer program has documented that the industrial fleet caught 87 olive ridleys, 32 greens, 2 loggerheads, and 1 unconfirmed hawksbill turtle over nine seasons (INAPESCA 2017). In addition, managers mentioned that, according to the observer’s program data, since the 2007 to 2008 season, no sea turtle mortalities have been reported; managers believe that the fishery does not jeopardize the recovery of these species populations (INAPESCA 2017).

However, it is unclear if the onboard observer's program has been reactivated. The last report released was in 2019, that included incomplete data related to the fleet interactions with sea turtles. The report that summarized the results of the observer's program for three seasons (2015-2016, 2016-2017, and 2017-2018) mentioned that there were interactions with sea turtles, but details about the number of interactions or which species are not included (SICG 2019)

Finally, the annual certification granted by the US government for fisheries that have in place a protection program comparable to the one in the US, which includes the correct use of turtle excluder devices, has been granted to Mexico every year, except in 2011 and 2021 (although recovered it later that same year) because it was found some irregularities with the use of the TEDs.

Overall, fishing mortality is considered a "high" concern under the Seafood Watch standard when cumulative mortality is too high, and the contribution of the fishery being assessed to

mortality is unknown. Considering the increasing abundance in the distinct population segments of green, olive ridley and loggerhead turtles. That the fleet seems to have limited interactions with these species (at least until recent data was available) and cumulative fishing mortality may not jeopardize the ability of these DPSs to recover, especially considering that the use of TEDs seems appropriate, a "moderate" concern is deemed appropriate for now.

Supplementary Information

See detail under green sea turtles

Pacific angel shark *(Squatina californica)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

High Concern

The Pacific angel shark (*Squatina californica*) grows slowly and matures late in life (8-13 years). It has an estimated generation length of 11.7-17.0 years, and produces an average of six pups per year {Cailliet et al 2020}. These characteristics put the stocks of Pacific Angel Shark as vulnerable to heavy localized fishing pressure.

The IUCN report of 2020 found the species to be ‘Near Threatened’ and that the landing data from Mexico (2003-2015) showed a declining trend and if fishing effort remains, declines in landing will be reported within three generations. Based on the fact that the species is taken in targeted by the elasmobranch fishery in Mexico, and that landings have declined under stable fishing pressure, assesors considered the species as Near Threatened, with a suspected population decline approaching 30% over three generations. For this reason, a “high concern” for abundance is deemed.

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Moderate Concern

Shrimp trawls and gillnets are a source of mortality for various elasmobranchs in Mexico. Based on the most recent analysis of the onboard observer data, managers reported minimal presence of these species in the bycatch (with values <1% of a Relative Abundance Index (INAPESCA 2016) They concluded that shrimp fisheries do not represent a risk to these species (INAPESCA 2016). There have been no updates about the interactions of these gears with the species; for this reason, mortality from shrimp fishing relative to a sustainable level is unknown, so a "moderate" concern is appropriate.

Supplementary Information

Shrimp trawls are a source of mortality for sharks and rays, and coastal shark bycatch in the Mexican Pacific shrimp fishery {Lopez-Martinez et al. 2010}; however, the relative contribution of the shrimp trawl fisheries to overall mortality of Pacific angel shark, shovelnose guitarfish, and scalloped hammerhead is unknown.

INAPESCA analyzed bycatch data from the Pacific shrimp trawls during the seasons 1982 to1983, 1985, 1989 to1990, 1992 to 1993, 1995 to 1996 and 2006. As a result, INAPESCA's researchers found that *S. californica* is captured only in the Upper Gulf of California {Palacios-Salgado 2011} in (INAPESCA 2016). Managers confirmed that the species was considered abundant as bycatch four decades ago {Saldaña-Ruiza et al. 2017}; however, in most recent years, its presence is minimal {Lopez-Martinez et al. 2010}. A more recent analysis of observer data — also by INAPESCA — found that during 2004 to 2010, six hammerheads were reported to be caught by the industrial fleet in the Pacific during 222 fishing sets {INAPESCA 2015}. In the case of angel shark, during the same period of time, 20 organisms were reported to be caught by the fleet in the Pacific; researchers estimated the catch per unit of area (CPUA) for the species in 1 organism/km 2. Finally, the ratio for shovelnose guitar in the industrial shrimp fisheries in the Pacific was estimated by managers in 22 organisms by km 2 during the 2004 to 2010 time frame. Managers add that, since the inclusion of the square mesh/extended funnel bycatch reduction device of the trawl nets, bycatch of some species, in particular, elasmobranchs, like the shovelnose guitarfish, has been reduced by approximately 40% {Garcia-Caudillo et al 2000}.

Similarly, there is evidence that shovelnose guitarfish are caught as bycatch in the gillnet fisheries in low quantities. {Balmori-Ramirez et al. 2012} reported only nine organisms in 420 sampling sets, during a study of the bycatch in Sonora and Sinaloa with small-scale shrimp fisheries. It is unclear if the low number of organisms caught was due to high

selectivity of the gillnets or low abundance of the species. According to the National Fisheries Chart (DOF 2010) the largest interactions of these elasmobranch species (shovelnose guitar, speckled guitar, electric guitar, etc.) with artisanal gillnets are observed in the spring and summer months (DOF 2010). Considering that the shrimp season is developed during the fall and winter, interactions might be reduced for shovelnose guitarfish.

In Mexico, some fisheries target these species, using different gears (longlines, bottom longlines and gillnets) (DOF 2012). Baja California Sur, Baja California, Sonora and Sinaloa are the most important states in terms of landings for all three species (CONAPESCA 2008). Currently, managers consider the fisheries targeting this species to be at their maximum sustainable level and recommend not to increase effort (DOF 2012). It is unclear what this designation is based on; however, no more recent status reports are available. Reported landings of these fisheries have remained stable, according to CONAPESCA data. Some increases can be seen in the hammerhead shark landings. There have not been updates on these type of assessments since these 2012 reports were generated.

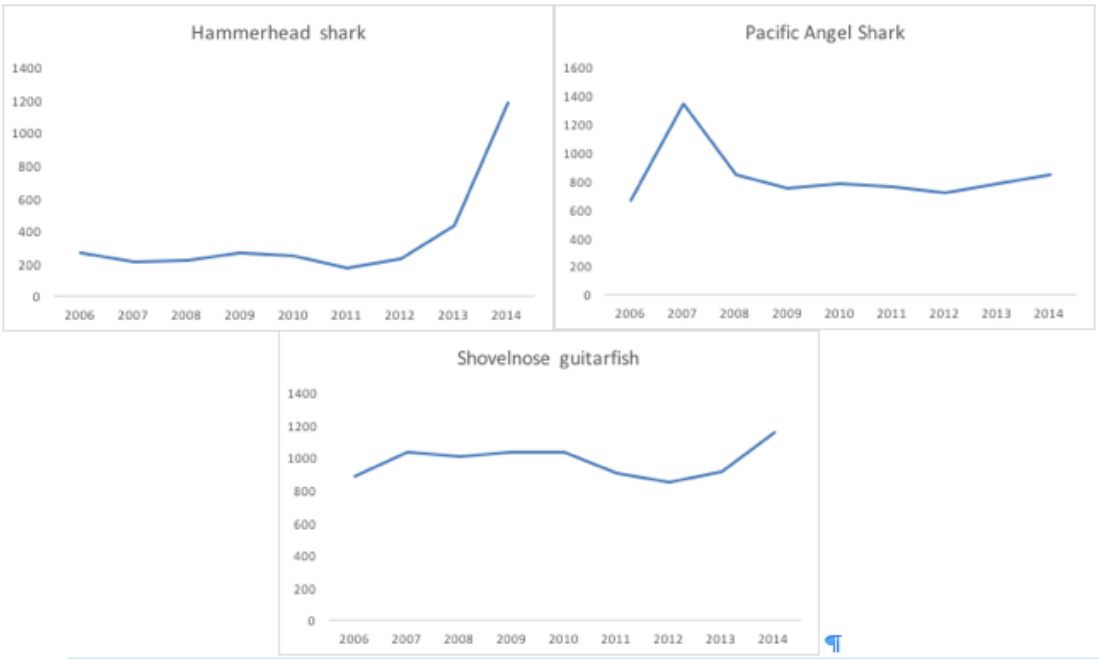


Figure 50: Reported landings of hammerhead shark, Pacific angel shark, and shovelnose guitarfish by Mexican fisheries that target these species (Data source CONAPESCA, 2014)

Nonetheless, the impacts of fishing mortality of the shrimp fisheries on these species have not been assessed. Managers analyzed the onboard observer's program data from the

2011 to 2014 seasons. Based on the analyses, managers concluded that angel shark, scalloped hammerhead, and shovelnose guitarfish represented a small component of the bycatch of shrimp fishing in the Mexican Pacific, particularly if compared to other groups such as teleosts or invertebrates that exceed them in number and relative weight, and compared to other groups of elasmobranchs such as rounded rays, which are not of commercial importance {INAPESCA Shark Program report 2016} (see table below). The report also states that the impact on angel shark occurred principally in the Upper Gulf of California, but in the rest of the Mexican Pacific, this species is not impacted.

Table. Results of CPUE and CPUA on Hammerhead, Angel shark, Shovelnose guitarfish, and Mantas from onboard observer's program data (Source: INAPESCA's shark group report).

Table 23

Fishing area	Group of species	Total landings	Positive landings	CPUE			CPUA (catch per area)		
				Media	Error	ANOVA	Media	Error típico	ANOVA
UGC	Hammerhead	147	2	0.1	0.1	p = 0.442	0.0	0.0	p = 0.388
	Angel		0	0.0	0.0	p = 0.429	0.0	0.0	p = 0.429
	Shovelnose		62	39.7	31.9	p = 0.246	16.6	12.6	p = 0.204
	Mantas		68	34.2	21.0	p = 0.095	12.7	7.5	p = 0.080
SONORA	Hammerhead	25	2	0.2	0.2	p = 0.442	0.1	0.1	p = 0.388
	Angel		0	0.0	0.0	p = 0.429	0.0	0.0	p = 0.429
	Shovelnose		4	0.8	0.5	p = 0.246	0.4	0.2	p = 0.204
	Mantas		14	5.1	4.5	p = 0.095	2.0	1.6	p = 0.080
SINALOA	Hammerhead	30	2	0.4	0.3	p = 0.442	0.2	0.1	p = 0.388

	Angel		0	0.0	0.0	p = 0.429	0.0	0.0	p = 0.429
	Shovel nose		1	0.9	0.9	p = 0.246	0.6	0.6	p = 0.204
	Mantas		1	0.1	0.1	p = 0.095	0.0	0.0	p = 0.080
BCS	Hammerhead	20	0	0.0	0.0	p = 0.442	0.0	0.0	p = 0.388
	Angel		20	5.2	5.2	p = 0.429	4.1	4.1	p = 0.429
	Shovel nose		0	0.0	0.0	p = 0.246	0.0	0.0	p = 0.204
	Mantas		0	0.0	0.0	p = 0.095	0.0	0.0	p = 0.080

Pacific seabob *(Xiphopenaeus riveti)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

Xiphopenaeus riveti (Bouvier, 1907), or “camarón botalon” can be found from the Gulf of California, Mexico, to Peru (Hendrickx, 1995). It is occasionally abundant in catches from

Sinaloa and the Gulf of Tehuantepec (SAGARPA-INAPESCA 2012) . The species is considered part of the catch of shrimp fisheries, but there are no stock assessments or data-limited evaluations to confirm its status. For this reason, a Productivity Susceptibility Analysis was conducted (see justification). The species is not highly vulnerable, so this factor is considered a moderate concern.

Supplementary Information

Table 24

Table 25

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = m risk, 3 = high risk)
Average age at maturity	< 5 years	1
Average maximum age	< 10 years	1
Fecundity		1
Reproductive strategy	Broadcast spawner	1
Density dependence		
Quality of habitat	Non-fishing impacts have moderately altered habitat	2

Table 26

Table 27

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)

Areal overlap (Considers all fisheries)	The species is usually found at depths between 10 and 100 meters and prefers mud and sandy mud bottoms (Holthuis 1980)	2
Vertical overlap (Considers all fisheries)	Benthic behavior with a depth range between the 0 to 70 m (Holthuis 1980) and a average of 27 m, al within the range of the shrimp trawlers this factor scores as high-risk	3
Seasonal availability (Considers all fisheries)	The shrimp season in the Mexican Pacific normally runs from the end of September to the beginning of March; the fisheries overlap with species 3-6 months/per year.	2
Selectivity of fishery (Specific to fishery under assessment)	Species are considered as targeted and are not likely to escape the gear, but conditions under 'high risk' do not apply.	2
Post-capture mortality (Specific to	Due to the nature of the gears used, and the value, this	3

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

With no reference points or stock assessments for Seabob shrimp in Mexican waters, fishing mortality relative to a sustainable level is unknown, which requires a score of 3 (Moderate Concern).

Pacific seahorse *(Hippocampus ingens)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

High Concern

Pacific Seahorse is listed as "Vulnerable" by the IUCN (Pollom, R 2017). Therefore, Seafood Watch deems Pacific seahorse abundance a "high" concern.

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

Moderate Concern

Pacific seahorses have been recorded as bycatch in the Mexican Pacific shrimp fisheries {Baum and Vincent 2005} {Meltzer et al. 2012} (INAPESCA 2016) (see appendices). Listed on Mexico's NOM-059-SEMARNAT-2001 as a species subject to special protection, intentional capture and trade of wild seahorses is prohibited. Also, the ban of trawling activities in shallow waters (five fathoms or less) may afford some protection as such areas have been recognized as main habitat for the species (INAPESCA 2016). Studies have shown that incidental catch of Pacific seahorse in the Mexican Pacific 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 seahorse for the Mexican Pacific (in all regions with all trawls and the west coast of Baja California using Magdalena I) is deemed a "moderate" concern.

Peruvian mojarra *(Diapterus peruvianus)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

A stock assessment relative to reference points is unavailable for either of the mojarra species. There is a IUCN assessment for each species, but they are both more than ten years old and so cannot be used for scoring (van der Heiden et al 2010)(Cotto et al 2010). To assess this factor, the inherent vulnerability was assessed using a Productivity-Susceptibility Analysis (PSA) (see justification). Considering the lack of information, the PSA was used for both species, and the results showed that the species have a low vulnerability. For these reasons, abundance is deemed a "moderate" concern.

Supplementary Information

Table 18

Table 19

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = m risk, 3 = high risk)
Average age at maturity	No information is available for D. aureoles. Estimate of fecundity based on a study by {Gallardo-Cabello et al 2015} in the Mexican Pacific Coast, of similar species (Diapterus brevirostris), observed sexual maturation of males and females at one and two years old	1
Average maximum age	Inferred from average age at maturity.	1

Fecundity	More information needed to be available for D. aureoles “ Fecundity values [for Diapterus brevirostris] ranged from 16,695 to 807,954 oocytes in females of 1 to 6 years of age and lengths of 12.06 cm to 30.00 cm, and 23 g to 349.6 g of weight” (Gallardo-Cabello et al. 2015)	2
Average maximum size	D. aureolus max length: 15.0 cm (Fishbase)	1
Average size at maturity	There was no information available for D. aureoles for similar species (Diapterus brevirostris): Average length of sexual maturity (L50) was 14.20 cm in males and 14.26 the females (Gallardo-Cabello et al. 2015)	1
Reproductive strategy	Broadcast spawner	1
Density dependence	N / A	
Quality of habitat	Habitat has been moderately altered by non-fishing impacts	2

Table 20

Table 21

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)

Areal overlap (Considers all fisheries)	Based on the broad distribution of the species (from Baja California Sur and Sinaloa in Mexico to northern Peru) and the relatively high probability of occurrence throughout most of its range (Fishbase), it is estimated overlap of fishing effort with species concentration of the stock to be between 10-30%	2
Vertical overlap (Considers all fisheries)	According to the study and analysis of shrimp bycatch conducted by INAPESCA (2016), the relative abundance index (IAR): D. aureoles was classified as frequent (IAR = 0.4954)	3
Seasonal availability (Considers all fisheries)	The shrimp season in the Mexican Pacific normally runs from the end of September to the beginning of March; the fisheries overlap with species 3-6 months/per year.	2
Selectivity of fishery (Specific to fishery under assessment)	Evaluations of the efficiency and selectivity of the ala de angel ¾ inch bottom trawl net capture mojarras of the average size of 14.90 cm and that this type of net is efficient, releasing approximately 50% of organisms below the size of 15 cm (Aguilar Ramirez et al. 2000).	2
Post-capture mortality (Specific to fishery under assessment)	No information on discard mortality was available, team assumed higher risk factor	3

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

According to the data available from the onboard observers report, the two mojarra species were grouped (Morsan et al 2019). There are no reference points or stock assessments for either species, so current fishing mortality relative to a sustainable level is unknown. This factor is thus scored 3 (moderate concern).

Rooster Hind *(Hyporthodus acanthistius)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

High Concern

The IUCN (Erisman and Craig 2018) lists the Rooster hind as Vulnerable. Therefore, Seafood Watch deems the species abundance a "high" concern.

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

There are no reference points or stock assessments for Rooster hind in Mexican waters; fishing mortality relative to a sustainable level is still being determined. Available onboard observer data suggest limited interactions with the species. Data indicated that the Rooster hind -grouped with the other four species of the Serranidae family- represented ~1.5% of the catch (Morsan et al 2019). For these reasons, this factor is scored 3 (moderate concern).

Scalloped hammerhead *(Sphyrna lewini)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

High Concern

All elasmobranchs reviewed in the assessment are considered a "high concern" for abundance, based on U.S. ESA listing (scalloped hammerheads in the Eastern Pacific), populations trend data, and stock assessment (scalloped hammerheads in the Gulf of Mexico), or IUCN classification (Pacific angel sharks, shovelnose guitarfish).

Supplementary Information

Scalloped hammerheads in the Gulf of Mexico are from the Northwest Atlantic and Gulf of Mexico's distinct population segment (DPS). This DPS is not listed under the U.S. Endangered Species Act, because the main threat of over-utilization will decrease in the foreseeable future (NOAA-NMFS 2015). Nonetheless, according to the most recent stock assessment {NMFS 2015}, the DPS has significantly declined since the early 1980s (approximately 83%). Earlier studies also indicate significant declines; e.g., {Baum et al. 2003} found an 89% decline in abundance based on longline Catch Per Unit Effort data. The DPS is thus considered a "high" concern for abundance.

Scalloped hammerheads and sphyna lewini in particular, is considered critically endangered by the 2019 IUCN report (Rigby et al. 2019) . Thus, this DPS is also considered a "high concern" for abundance.

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Moderate Concern

Shrimp trawls and gillnets are a source of mortality for various elasmobranchs in Mexico. Managers reported minimal presence of these species in the bycatch, based on the most recent analysis of the onboard observer data, based on the analysis, the species had a relative abundance index of <1% (INAPESCA 2016) , leading managers to conclude that shrimp fisheries represented no risk to these species (INAPESCA 2016). Nonetheless, mortality from shrimp fishing relative to a sustainable level is unknown; and there are no available reference points to determine whether F is at an appropriate level. Therefore a "moderate" concern is appropriate.

Supplementary Information

For a full account, see Pacific angel shark.

Shovelnose guitarfish *(Pseudobatos productus)*

2.1 Abundance

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

High Concern

All elasmobranchs reviewed in the assessment are considered a "high" concern for abundance, based on U.S. ESA listing (scalloped hammerheads in the Eastern Pacific), populations trend data and stock assessment (scalloped hammerheads in the Gulf of Mexico), or IUCN classification (Pacific angel sharks, shovelnose guitarfish).

Supplementary Information

Shovelnose guitarfish are found from San Francisco Bay, California, to the southern Gulf of California, and Mexico. They are targeted in the Mexican elasmobranch fishery and are vulnerable to bottom gillnets in the artisanal shrimp fishery {Farrugia et al. 2016}. Due to effort increases in the 1990s, abundances of shovelnose guitarfish declined and do not appear to have rebounded (Farrugia, T. et al 2016). IUCN classifies shovelnose guitarfish as "Near Threatened" (Farrugia, T. et al 2016). Abundance of this population is therefore deemed a "high" concern.

Although shovelnose guitarfish is the focus of this assessment, due to information available about the fisheries, it may also reflect concern about other guitarfish (such as the speckled guitarfish) because they are a taxon that is highly vulnerable to over-exploitation, identification to the species level is often difficult, existing assessments of guitarfish generally are very old (60% of IUCN assessments are 10 or more years old), and the majority (70%) are either in threatened or data-deficient categories (Moore 2017).

2.2 Fishing Mortality

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

Moderate Concern

Shrimp trawls and gillnets are a source of mortality for various elasmobranchs in Mexico. Managers reported minimal presence of these species in the bycatch, based on the most recent analysis of the onboard observer data, based on the analysis, the species had a relative abundance index of <1% (INAPESCA 2016) , leading managers to conclude that shrimp fisheries represented no risk to these species (INAPESCA 2016). Nonetheless, mortality from shrimp fishing relative to a sustainable level is unknown; and there are no available reference points to determine whether F is at an appropriate level. Therefore a "moderate" concern is appropriate.

Supplementary Information

For a full account, see Pacific angel shark.

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)

Low Concern

There is evidence that shovelnose guitarfish is caught as bycatch in the gillnet fisheries in low quantities. (Balmori-Ramirez, A. et al 2012) reported only nine organisms in 420 sampling sets, during a study of the bycatch in Sonora and Sinaloa with small-scale shrimp fisheries. It is not clear if the low number of organisms caught was due high selectivity of the gillnets or low abundance of the species. According to the National Fisheries Chart (DOF 2010) the largest interactions of these elasmobranch species (shovelnose guitar, speckled guitar, electric guitar, etc) with artisanal gillnets are observed in the spring and summer months (DOF 2010) considering that the shrimp season is developed during the fall and winter months, there is a high chance that the shrimp fishery is not a substantial contributor to fishing mortality for shovelnose guitar fish, for this reason a low concern is deemed.

Spotted sand bass *(Paralabrax maculatofasciatus)*

2.1 Abundance

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Moderate Concern

A stock assessment relative to reference points is not available for this species. The species is listed as "Least Concern" by the IUCN {Smith-Vaniz et al. 2010}. Given the age

of the IUCN assessment (2010), inherent vulnerability was evaluated using a Productivity-Susceptibility Analysis (PSA) (see justification). Although spotted sand bass has a medium vulnerability and IUCN "Least Concern" status, there is no quantitative stock assessment for this stock. For these reasons, abundance is deemed a "moderate" concern.

Supplementary Information

PSA score = 2.72. For this reason, the species is deemed “medium” vulnerability (based on PSA scoring tool). Detailed scoring of each attribute is shown below.

Productivity Attribute	**Relevant Information**	**Score (1 = low risk, 2 = medium risk, 3 = high risk)**
Average age at maturity	18 months {Shanks and Eckert 2005}	1
Average maximum age	20 (Froese and Pauly 2016)	2
Fecundity	68,000 {Shanks and Eckert 2005}	1
Reproductive strategy	Broadcast spawner	1
Trophic level	4.2 (Froese and Pauly 2016)	3

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Areal overlap (Considers all fisheries)	This species inhabits reefs adjacent to sandy bottoms along the Gulf of California (Froese and Pauly 2016), areas used by the gillnets shrimp fishery.	3
Vertical overlap (Considers all fisheries)	Associated to reefs and sandy areas from the coast up to 60 m depth. {Eschemeyer et al. 1983}	3
Selectivity of fishery (Specific to fishery under assessment)	Species is incidentally caught and is not likely to escape the gear; however, conditions under "high risk" do not apply.	2
Post-capture mortality (Specific to fishery under assessment)	Unknown Default value.	3

2.2 Fishing Mortality

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Moderate Concern

Spotted sand bass is considered an associated species for gillnet fisheries that target other species (e.g., snappers, groupers) (DOF 2012). During the most recent analysis of the Sonora gillnet shrimp fishery bycatch, spotted sand bass represented ~5% of the total

bycatch of the fishery {Garcia-Caudillo 2015}; however, the impact that gillnets have on the stocks is unclear. The species is listed as "Least Concern" by the IUCN {Smith-Vaniz et al. 2010}, and considering the species "medium" vulnerability, fishing mortality is deemed "moderate" concern for gillnets in Sonora.

Totoaba *(Totoaba macdonaldi)*

2.1 Abundance

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

High Concern

Totoaba are considered "Vulnerable" by the IUCN (Cisneros-Mata et al 2021)} and are still listed as "endangered" under the U.S. Endangered Species Act (NOAA 2023). Therefore, totoaba abundance is considered a "high" concern.

Supplementary Information

The IUCN assessment has improved the status of the species from critically endangered to vulnerable (Cisneros-Mata et al 2021). For the update, assessors considered some evidence from genetic diversity and the age-size structure of samples that suggests population stability. In addition, they used poaching severity as the basis for the Red List assessment. They mentioned a suspect of a past and future three-generation decline (1993–2029) of at least 30% based on estimated annual removals by poaching, an increase in the mortality rate of Totoaba from the mid-1980s to 1991–1993, a decline in spawning grounds, as well as an increase in annual average seizures of illegal Totoaba swim bladders. Finally, the authors considered the inconsistencies in the available data and recommended updating the evaluation when additional information is available. Overall, concluded that the status from the previous assessment is non-genuine and reflects an improved application of the IUCN Red List Categories and Criteria, as well as improved availability of data.

2.2 Fishing Mortality

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Moderate Concern

Due to overfishing and a dramatic decline in the species abundance, a permanent ban for totoaba has been in place since 1975 in Mexico. In 2004, there was some evidence that the species was expanding its geographic range, suggesting positive steps towards population recovery {INAPESCA 2004}. However, since then, no further status review has been undertaken. According to research by De Anda-Montañez et al in 2013, the level of illegal poaching of totoaba is unknown. Valenzuela-Quiñonez et al. (2015) estimated the level of illegal catch based on the estimation of total mortality (Z) against natural mortality (M). Considering the difference of these two values as the result of illegal poaching. The authors found that illegal fishing has been increasing since 2013 {Valenzuela-Quiñonez, et al., 2015}. Fishers are encouraged by the high price of the totoaba bladder, with a value of up to US$5000 kg−1 on the local black market {F. Valenzuela- Quiñonez pers. obs. fishermen interview 2013}.

There are reports that the species is still caught as bycatch in the Mexican Pacific trawls {Cisneros-Montemayor and Vincent, 2016} (INAPESCA 2016). According to the IUCN, heavy fishing pressure continues on juveniles ("machorros," 20-25 cm) due to the active shrimp trawl fishery in the upper Gulf of California (Findley 2010). Observer data suggest its presence in shrimp trawls is rare, with less than 0.01% in the catch (INAPESCA 2016). An update on the IUCN report, mentions that the most urgent conservation need is to stop illegal fishing and trafficking of swimbladders and added that although conservation measures that have reduced fishing by the commercial fleet and provided protections of the spawning ground improvements in fishery data collection and research on the efficacy of those measures are needed {Cisneros-Mat et al 2021}.The consequential ‘unknown’ status of fishing mortality relative to a sustainable level, and a lack of analysis determining that shrimp fishery bycatch is not substantial relative to total mortality, a score of moderate is warranted.

Supplementary Information

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. The management plan for the reserve established a core zone (closed to the Colorado river mouth) where any extraction activity –including fishing - is prohibited {CONANP, 2007}. Other subzones, that include the waters close to the coast as well as marine waters (with the exception of the vaquita refugee zone), allow fishing using low impact gears (hook and line, diving, traps, etc.). {CONANP 2007}. The fishing pressure from shrimp trawls and gillnets have been greatly reduced in this region {Román-Rodríguez and Hammann 1997}.

2.3 Discard Rate/Landings

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

Eastern Central Pacific - Mexico - Suripera - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Suripera - Sinaloa North Central (Zone 30)

Gulf of Mexico - Atlantic, Western Central - Cast nets

Gulf of Mexico - Atlantic, Western Central - Traps

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Cast nets - Sinaloa South (Zone 40) | Nayarit (Zone 60)

< 100%

See table above.

Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

< 100%

Table 28

Fishery	Estimate (reference)	SFW category
Mexican Pacific		
Industrial Fleet — Trawls	400% (INAPESCA 2017)	>100%
Artisanal Fleet — Gillnets	50% {Balmori-Ramirez et al. 2012}	<100%
Artisanal Fleet — Cast nets	High selectivity, low discard mortality {Garcia-Caudillo 2016}	<100%
Artisanal Fleet — Magdalena l Trawl	55.6% of catch (INAPESCA b 2000)	<100%
Artisanal Fleet — Suripera nets	50% {Balmori-Ramirez et al. 2012}	<100%
Gulf of Mexico		
Industrial Fleet — Trawls	300% to 600% (INAPESCA 2014 b)	>100%
Artisanal Fleet — Small trawl - Seabob Fishery	600% (Wakida-Kusunoki 2005)	>100%
Artisanal Fleet — Cast nets	High selectivity, low discard mortality (Garcia-Caudillo, J. M. 2016)	<100%
Artisanal Fleet — Charanga nets	high selectivity, low discard mortality (SAGARPA 2004)	<100%

Criterion 3: Management Effectiveness

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

- *5 (Very Low Concern) — Meets the standards of 'highly effective' for all five factors considered.*
- *4 (Low Concern) — Meets the standards of 'highly effective' for 'management strategy and implementation' and at least 'moderately effective' for all other factors.*
- *3 (Moderate Concern) — Meets the standards for at least 'moderately effective' for all five factors.*
- *2 (High Concern) — At a minimum, meets standards for 'moderately effective' for Management Strategy and Implementation and Bycatch Strategy, but at least one other factor is rated 'ineffective.'*
- *1 (Very High Concern) — Management Strategy and Implementation and/or Bycatch Management are 'ineffective.'*
- *0 (Critical) — Management Strategy and Implementation is 'critical'.*

The Criterion 3 rating is determined as follows:

- Score >3.2 = **Green** or Low Concern
- Score >2.2 and ≤3.2 = **Yellow** or Moderate Concern
- Score ≤2.2 = **Red** or High Concern

Rating is Critical if Management Strategy and Implementation is Critical.

Guiding principle

- The fishery is managed to sustain the long-term productivity of all impacted species.

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

Criterion 3 Summary

Fishery	Management Strategy And Implementation	Bycatch Strategy	Scientific Research And Monitoring	Enforcement Of Management Regulations	Stakeholder Inclusion	Score
Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)	Moderately Effective	Moderately Effective	Ineffective	Ineffective	Highly effective	Red (2.000)
Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Highly effective	Yellow (3.000)
Eastern Central Pacific - Mexico - Suripera - West Coast of Baja (Zone 50)	Moderately Effective	Highly effective	Moderately Effective	Moderately Effective	Highly effective	Yellow (3.000)
Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)	Moderately Effective	Moderately Effective	Ineffective	Ineffective	Highly effective	Red (2.000)
Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)	Moderately Effective	Moderately Effective	Ineffective	Ineffective	Highly effective	Red (2.000)
Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Cast nets - Sinaloa South (Zone 40) | Nayarit (Zone 60)	Moderately Effective	Highly effective	Highly effective	Ineffective	Highly effective	Red (2.000)
Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)	Moderately Effective	Moderately Effective	Ineffective	Ineffective	Highly effective	Red (2.000)
Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)	Moderately Effective	Moderately Effective	Ineffective	Ineffective	Highly effective	Red (2.000)
Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Suripera - Sinaloa North Central (Zone 30)	Moderately Effective	Highly effective	Moderately Effective	Moderately Effective	Highly effective	Yellow (3.000)

Fishery	Management Strategy And Implementation	Bycatch Strategy	Scientific Research And Monitoring	Enforcement Of Management Regulations	Stakeholder Inclusion	Score
Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)	Moderately Effective	Moderately Effective	Ineffective	Ineffective	Highly effective	Red (2.000)
Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)	Moderately Effective	Moderately Effective	Ineffective	Ineffective	Highly effective	Red (2.000)
Gulf of Mexico - Atlantic, Western Central - Bottom trawls	Moderately Effective	Moderately Effective	Ineffective	Ineffective	Highly effective	Red (2.000)
Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery	Moderately Effective	Moderately Effective	Ineffective	Ineffective	Highly effective	Red (2.000)
Gulf of Mexico - Atlantic, Western Central - Cast nets	Moderately Effective	Highly effective	Highly effective	Ineffective	Highly effective	Red (2.000)
Gulf of Mexico - Atlantic, Western Central - Traps	Moderately Effective	Highly effective	Highly effective	Ineffective	Highly effective	Red (2.000)
Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)	Moderately Effective	Moderately Effective	Ineffective	Ineffective	Highly effective	Red (2.000)

Criterion 3 Assessment

Scoring Guidelines

Factor 3.1 - Management Strategy and Implementation

Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? Do manages follow scientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.

Factor 3.2 - Bycatch Strategy

Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? How

successful are these management measures? To achieve a Highly Effective rating, the fishery must have no or low bycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.

Factor 3.3 - Scientific Research and Monitoring

Considerations: How much and what types of data are collected to evaluate the fishery's impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments must be conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.

Factor 3.4 - Enforcement of Management Regulations

Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.

Factor 3.5 - Stakeholder Inclusion

Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.

3.1 Management Strategy And Implementation

Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

Eastern Central Pacific - Mexico - Suripera - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Suripera - Sinaloa North Central (Zone 30)

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

Gulf of Mexico - Atlantic, Western Central - Cast nets

Gulf of Mexico - Atlantic, Western Central - Traps

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Cast nets - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Moderately Effective

Shrimp fisheries in Mexico are managed based on the studies and recommendations of INAPESCA through temporary closures to protect juvenile shrimp and maintain a minimum level of broodstock. INAPESCA’s recommendations are implemented through CONAPESCA with fishing permits and updates to the Mexican Official Standard NOM-002-SAG/PESC-2013.

The focus of many of the measures used in the fishery — including these temporary closures, but also permanent closures, gear restrictions, and a buyback program — was designed to reduce the fishing effort for shrimp, which was determined to be too high more than a decade ago (INAPESCA 2016). Although these measures have reduced the number of vessels in the industrial fishery, it is unclear what impact they've had overall on the combined effort in the industrial and artisanal fisheries. The impacts of the fishery on many of the shrimp populations are also unclear because robust estimates of current fishing mortality relative to a sustainable level are generally unavailable. Although the limited data and analyses suggest some populations are being fished sustainably, others are not (see Criterion 1). Therefore, management strategy and implementation for Mexican Pacific and GOM industrial and artisanal shrimp fisheries is considered only "moderately" effective.

Supplementary Information

The Mexican Government has implemented several actions to promote sustainable fisheries, including the Sustainability Law for Fisheries enacted in 2007. This law regulates all the activities related to extracting marine products for commercial or recreational purposes (DOF 2007). It provides the power to SADER (formerly SAGARPA) and CONAPESCA to generate the guidelines for these activities. The NOM-002-PESC-1993 is the management tool that regulates particular aspects of the fishing activities for shrimp in the whole country. Several amendments have been developed since it was enacted in 1993. This NOM regulates all the fleets (Industrial and Artisanal).

Controlling fishing pressure

Previously, managers indicated that all shrimp stocks were fully exploited and that fishing mortality should be decreased (INAPESCA 2016). Various regulations are designed to reduce effort, including:

Gear specifications

- In inshore waters of the Pacific and the Gulf of Mexico, only small-scale boats with engines up to 85.76 kilowatts of power could be used (115 Horsepower)

The only gears authorized for the artisanal fleet and its restrictions are:

- Cast net (Mesh size of 1 ½ inches)

- Suripera (only allowed in Coastal lagoons of North of Sinaloa and Magdalena Bay

- Gillnets only permitted in:

    - Coastal zones of Sonora (from the border with Sinaloa to Puerto Peñasco, Sonora)

    - Inside the coastal lagoons and bays of Sonora and Sinaloa

    - Within the buffer zone of the biosphere Reserve of the Upper Gulf of California

(except the Vaquita protection area, where a permanent ban was recently announced to be effective in September 2016).

- Light trawler net (RS-INP-MEX) in the Upper Gulf of California

For offshore waters, the industrial fleet restrictions are:

- Within the buffer zone of the Biosphere Reserve of the Upper Gulf of California (except the Vaquita Refuge), the vessels are authorized to use only trawling nets with the characteristics specified in Appendix C of the NOM-002-1993.

- In the Gulf of Mexico and the Caribbean, the limits on the mesh size are 1¾ inch in the collecting bag and 1½ in the body of the net.

Seasonal Closures

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 all fleets for coastal and oceanic fisheries (DOF 2006).

Year-round closures

Industrial trawling is prohibited completely within the marine section between 0 and 9.14 meters of depth, with the only exception of the Seabob fishery in the marine areas of Campeche and Tabasco in the Gulf of Mexico. All trawling activity (industrial or artisanal) is also prohibited within the 9.25 km (5 miles) distance from the mouth of coastal lagoons and estuaries in the Mexican Pacific. Official norm NOM-064-PESC-2006 establishes regulations on fishing gears, including a ban on trawls in estuaries, lagoons and bays, a ban on all gear types and nets on reefs, and a ban on trawling at depths less than 9.2 meters (NOM-002-PESC-1993).

Buyback program

In 2005, CONAPESCA began to allocate money (around 27 million pesos or US$2.54 million) to help reduce fishing pressure on the shrimp fisheries and to implement a voluntary decommissioning of the Mexican fleet. 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 1,536 vessels in 2006 to 757 in 2013 (Dubay, K. S. et al 2010) (Table II). The artisanal fleet seems to remain constant {Dubay et al. 2010}

*Table II Vessel reduction program (*RNP = National Fisheries Register in Mexico that has information about the fleets, mandatory to access permits)*

Table 29

State	# of Industrial vessels					Reduction (2006 to 2018)
	2006	2010	2011-RNP*	2013 RNP*	2023 Pescando datos*	
Baja California	41	38	8	10	4	0.90
Baja California Sur	27	27	4	1	1	0.96
Sonora	521	454	243	244	176	0.66
Sinaloa	767	682	449	463	453	0.41
Nayarit	20	16	7	6	4	0.80
Colima	34	31	14	1		0.97
Michoacán	1	1				1
Guerrero	6	6				1
Oaxaca	86	72	33	30	35	0.59
Chiapas	33	25	3	2		1
Total	**1536**	**1352**	**76**	**757**	673	**0.56**

Artisanal fleet

According to a draft of the unpublished Mexican Shrimp management plan, about 56,412 small-scale boats were registered in Mexico in 2012, and of these, about 85% were fished for shrimp (INAPESCA-CONAPESCA 2004). In Sinaloa, a census developed in 2011 found that around 11,300 boats were involved in the shrimp fishery in the state (INAPESCA 2012). According to the Registro Nacional Pesquero (RNP, National Fisheries Registry; a system that gathers the authorized vessels in Mexico), in 2015, the number of artisanal vessels registered in the Mexican Pacific was about 27,968 (Table III) (CONAPESCA website database 2016).

Table III. Number of small-scale boats registered in the Mexican Pacific by state (CONAPESCA database)

Table 30

State	# Vessels Registered
SINALOA	8,892
JALISCO	3,582
BAJA CALIFORNIA SUR	3,155
SONORA	2,797
GUERRERO	2,714
CHIAPAS	2,638
MICHOACAN	2,461
NAYARIT	1,312
BAJA CALIFORNIA	1,162
OAXACA	1,055

Since one of the recommendations in the National Fisheries Chart is to reduce effort, it is unclear if this is happening with the small-scale fleet. According to the information available by the organization Causa Natura within their platform “Pescando datos” 671 permits for industrial vessels were active in 2021 in the Pacific and around 1,470 permits for small-scale vessels. The specific number of vessels that are actively fishing and targeting shrimp remains unclear , because some permits included several vessels, and this level of detail is not available.

3.2 Bycatch Strategy

Eastern Central Pacific - Mexico - Suripera - West Coast of Baja (Zone 50)

Highly effective

The Suripera fishery, on the West coast of Baja, can be considered highly selective. Some evidence of this was generated by {Gutierrez-Sanchez 2010}. The author analyzed the catches and identified up to 61 species as part of the fishery bycatch. The author reported a 1 to .75 shrimp-bycatch ratio. Among the most important species found in the bycatch, were the silver mojarra (*Eucinostomus argenteus*), the sand perch (*Diplectrum pacficum*), the target rock shrimp (*Sicyonia penicillata*) Xantus Swimming Crab (*Portunus xantusii*), and fringed flounder (*Etropus crossotus)*.

The FIP was inactive but was recently reactivated. Among the information released was an

update on the shrimp bycatch ratio and an update on the blue and yellowleg shrimp stocks in the region (see blue and yellowleg West coast of Baja Abundance) (INAPESCA b 2021). Based on the available information, the fishery has a very low (<5%) bycatch and no interactions with ETP species have been identified, for these reasons this factor is scored as highly effective.

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Moderately Effective

The greatest bycatch concern in the Mexican gillnet shrimp fisheries is vaquita, which has been reported to be caught incidentally in gillnet fisheries in the Upper Gulf of California (UGC), including those for shrimp. Gillnetting for shrimp in the region is now banned to protect the vaquita. This fishery will switch to alternative gears that will not interact with vaquita (i.e. light trawl, currently in the experimental phase). Because the gillnet fishery is banned, it is not included in this report; later versions of this report may cover the light trawl fishery as data become available for it).

In other shrimp gillnet fisheries operating in Sonora and Sinaloa, the main bycatch concern is sharks and rays. Some efforts to mitigate the impact on these species are in place through the Mexican Official Norm (NOM) NOM-029-PESC-2006. This norm stipulates specific rules to reduce or eliminate the use of gillnets in known important reproductive areas (i.e., coastal lagoons of La Reforma and Altata in Sinaloa and Almejas Bay in B.C.S) (NOM-029-PESC-2006), the creation of sanctuaries (i.e., a five-km radius of Espiritu Santo Island in BCS), and places limits on mesh size along the coast (NOM-029). The strategies have been in place, however, there is no certainty of their effectiveness. For these reasons, bycatch management is deemed "moderately" effective for all gillnet fisheries.

Supplementary Information

Gillnets are used by the artisanal fleets in Sinaloa-Nayarit and Sonora Central-South. Fishing shrimp with gillnets in the Upper Gulf of California has been banned since April 2015 due to the catch of the critically endangered vaquita; however, there is one exception — fishing for corvina, which potentially allows access to gillnet fishing for other species, using different mesh size nets (CIRVA 2016). The newly announced permanent ban on gillnets does not specify the ban for corvina fishing using nets, but it is believed that alternative gears will be implemented in the region.

The main bycatch species of concern in the other areas of the Pacific are elasmobranchs such as rays (including guitarfish) and sharks. In 2006, an official norm that regulates the catch of sharks and rays was enacted by Mexican managers (NOM-029-PESC-2007). Under this norm, a set of regulations were put in place designed to guarantee the

sustainable use of these species, some of these regulations are:

- A no fishing season from May to July (spawning season).
- A ban on the use of gillnets within the five-km wide zone around coral reefs, river mouths, known turtle nesting beaches, and sea lion communities.
- In the Baja Peninsula, gillnets and longlines are also banned from December to April and in Nayarit and Jalisco all year around.

Refugee areas, where the use of gillnets is prohibited in June every year to protect reproductive areas for sharks and rays, were created (NOM-029-PESC-2007) in:

- Bagdad Beach in Tamaulipas
- Terminos Lagoon in Campeche
- Usumacinta and Grijalva Rivers in Tabasco
- Yalahau Lagoon in Quintana Roo
- Magdalena Bay in Baja California Sur
- Santa Maria la Reforma coastal lagoon in Sinaloa.

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Suripera - Sinaloa North Central (Zone 30)

Highly effective

The proportion of shrimp-bycatch for the suripera fishery has been reported to be as low as 1 kg of shrimp to 0.1 kg of bycatch to up to 1:1 by {Amezcua et al. 2006}. The authors recognized the gear as a highly selective net; however, in 2009, {Amezcua et al. 2009} recognized that although no species of concern were found to be caught in the suripera fishery, the gear could interact with species that use the areas as nursery grounds, and this should be studied {Amezcua et al. 2009}. Despite this, authors concluded that considering the small proportion of bycatch — against other gears like small trawls or gillnets — they recommended the use of suripera inside the coastal lagoon; {Amezcua et al. 2009} encourage the implementation of a program to monitor bycatch levels constantly to understand better the changes and discard practices.

Two supply chains, where fishers use mainly Suripera, have had Fair Trade USA certification since 2016. Cooperatives included in that certification implemented a bycatch monitoring process in 2011, collaborating with INAPESCA (SFP 2016). The results supported the earlier findings by (Amezcua, F. et al 2006) described above, where a small amount of bycatch was present within the fishery. During the FIP implementation, a bycatch monitoring program was in place in coordination with auditors. After the certification was granted (January, 2016), the client hired scientists from the National University of Mexico in Mazatlán to support the program (pers. comm., Sergio Castro, Certification holder 2016). For these reasons, the bycatch management is deemed "moderately" effective for suripera in Sinaloa.

Since the previous certification, the FIP that covers the Suripera in Sinaloa has produced

evidence based on a bycatch monitoring program that confirms the low levels of impact that the gear present to other species. Based on the report released on November 2021, the most important species present as bycatch were the swimming crab (*Callinectes bellicosus*) 4%, finescale triggerfish (*Balistes polylepis*) with 3.6%, white mullet (*Mugil curema*) 3.4%, Pacific sierra (*Scomberomorus sierra*) 3.4%, dark spot mojarra (*Eucinostomus entomelas*) 3.4%, and Peruvian mojarra (*Diapterus peruvianus*) 3.3%. Based on these results, the gear and fishery can be considered highly selective, and this factor scored highly effective.

Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Moderately Effective

The main concerns in the trawl fisheries are the direct impacts and catch of marine turtles, elasmobranch species (particularly sharks), and many different types of finfish (including the critically endangered totoaba in the Upper Gulf of California). All shrimp trawl fisheries have been required to use turtle excluder devices for more than 20 years, and they have been required to use finfish excluder (FEDs) devices since 2016 (many were using them voluntarily before 2016; this includes the Magdalena I trawl fishery in the West Coast of Baja California). These measures are likely to be effective in mitigating bycatch.

The 2016–2017 season was the first where FEDs were mandatory. According to observer data, changes in the bycatch composition allowed for increased retention of some of the bycatch. For example, Pacific grunt, which in 2014 was reported to generate an extra $25,000 income for the fleet (Rodriguez-Preciado, J.A. et al 2014).

Concerning the fleets on the Gulf of Mexico, there was no information available regarding efforts. Recently, the FAO-supported project Sustainable management of bycatch in Latin America and Caribbean trawl fisheries (REBYC-II LAC)" was completed. However, despite the recommendations, no specific strategies are in place other than the ones included within the current legislation.

Overall, trawler gears have direct interactions with species of concern; however, based on the certification granted by the US, Mexico has in place a program that aims to mitigate impacts on these species, but it effectiveness is under debate or uncertain, since Mexico lost the certifications twice in the last 15 years, due to irregularities with the use of TEDs found during inspections, concerning other species of the bycatch, although the FEDs are in place the effectiveness of these are unknown, for these reasons, we deemed bycatch management in the trawl fisheries as "moderately effective."

Supplementary Information

Turtles

Cooperative international efforts to protect and restore sea turtle populations and habitats have existed for several years. The Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC) is one of these international efforts. Through the collaboration with IAC, the U.S. government, through NOAA designed the modern turtle excluder device (TED). TEDs were found to be 97% effective in excluding turtles when used properly {Henwood et al. 1992}

Following the rules of the U.S. government, which requires that export nations should fish in conditions that minimize the impact on turtle populations to be eligible for export to the U.S. market, mandatory use of TEDs for trawl nets (industrial and artisanal) has been in place since 1997. An annual certification program is in place for nations that seek to import shrimp into the US. NOAA inspects portions of the nation’s fleets for adequate use of TEDs. A positive certification indicates that the country has adopted a program governing the incidental capture of sea turtles in its shrimp fisheries; it is comparable to that of the program in effect in the US and has an incidental take rate comparable to that of the US. Mexico in the past was consistently certified to import shrimp since the program's implementation in 1996. However, there have been two exceptions, one in 2010, and most recently in 2021, when NOAA inspectors detected issues with the use of the TEDs by the Mexican fleet. Mexico regained the certification in 2011 and October 2021 (US DOS 2016)(State Gov 2021) (Federal Register 2021).

Finfish

Most recently, managers and the industrial sector have been working together to implement Fish Excluder Devices (FEDs), which were mandatory for all trawl gears for the 2016–2017 season (NOM-002-PESC-1993). The FEDs have been tested and proved to be highly effective in reducing finfish bycatch in other fisheries {Jackson and Spalinger 2007}.

However, whether bycatch numbers have been reduced to appropriate levels is unclear. No targets have been set, and data on volume and species catch as incidental catch data are unavailable. Cooperative international efforts to protect and restore sea turtle populations and habitats have existed for several years.

Gulf of Mexico - Atlantic, Western Central - Cast nets

Gulf of Mexico - Atlantic, Western Central - Traps

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Cast nets - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Highly effective

There are no particular bycatch concerns in cast net fisheries or charangas fisheries (see Criterion 2), so bycatch management is deemed "highly effective" for these gears.

3.3 Scientific Research And Monitoring

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

Eastern Central Pacific - Mexico - Suripera - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Suripera - Sinaloa North Central (Zone 30)

Moderately Effective

See text under trawls below.

Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Ineffective

Shrimp stocks are regularly monitored through commercial catch data and survey data, which are used to set the open season each year. Historically, limited analysis has been conducted on these data regarding identifying a sustainable catch level. Still, analyses were conducted for some stocks in (INAPESCA 2016) to determine these levels. More work is needed to assess the impacts of the fishery on shrimp populations through more robust and comprehensive stock assessments. Still, enough research and monitoring are occurring on shrimp to be moderately effective in understanding the effects of fishing on these target populations.

Bycatch monitoring is far less developed in most fleets, a major weakness in those fleets that incidentally catch species of concern (e.g., rare, endangered, threatened, depleted, or overfished species). This includes all fleets except the charanga (which catch only shrimp, though some of those populations are of concern) and cast net fleets in the Gulf of Mexico and the Pacific. Where there are data on bycatch, it is generally collected through logbooks and off-season surveys. Neither method can provide robust enough data to assess the impacts on bycatch species' populations properly.

There are few observer programs in place in Mexican shrimp fisheries. The industrial fleet in the Pacific (including the Gulf of California) had one run by a technical body of INAPESCA called FIDEMAR, from 2004 to 2010 with a variable percentage coverage from 1 to 4.3% of the fleet; this program was restarted for the 2015–2016 (0.5% coverage) and 2016–2017 season (1.5%) (INAPESCA 2017). The program did not continue operating for the shrimp fishery and only remained for the tuna fishery. The 2018 program financed by the industry was in place; however, the coverage was small, and the results related to the impacts on associated species were vague. Overall, higher levels of coverage will ultimately be needed to have more confidence in the accuracy of the data (INAPESCA's goal is to have at least 5% coverage).

The Magdalena I and suripera fisheries are in fishery improvement projects that have established monitoring programs, including observer programs, in those fleets. Approximately 90% of the Suripera and Magdalena I producers are part of an FIP project or already part of a Fair Trade-certified supply chain. The data generated by these efforts has been used to monitor bycatch and will continue to be used to detect changes in bycatch and retained species, including monitoring the status of the bycatch populations. For these

reasons, bycatch research and monitoring for charanga and cast nets are deemed "highly effective," moderately effective for suripera, and ineffective for the other fisheries, including trawls in the Pacific.

Overall, monitoring efforts for stock abundance are still in place. However, although recent stock assessments were developed by managers (2018 as part of the drafted management plan and 2019, as part of the “red book” document by INAPESCA)(INAPESCA 2018) {INAPESCA 2019}, these have not been officially released and have not been used for management decisions. Bycatch monitoring remains undeveloped, mainly because the onboard observer program on industrial vessels is not in place anymore. The data on bycatch generally collected through logbooks and off-season surveys remains not robust enough to assess the impacts on bycatch species. The importance of fishery is reflected in the amount of work developed by managers and academics. However, in terms of official documents for management, these are often outdated, and many are not public. For example, the draft management plan is about six years old being a draft, and this information (that is not public) is no longer valid based on the changes in the fishery.

For these reasons, bycatch research and monitoring scores remained as follows: charanga and cast nets are deemed "highly effective," “moderately effective” for suripera in Sinaloa and West Coast of Baja, and “ineffective” for the rest of the fisheries

Supplementary Information

Shrimp

INAPESCA monitors and researches the species during the fishing season and off-season in the Gulf of Mexico and Pacific. INAPESCA researchers developed periodic monitoring and systematic assessments of the most important fisheries. Since shrimp is one of the most important fisheries in Mexico, it is also one of the most studied fisheries in the country. It receives a huge proportion of INAPESCA’s human and financial resources (INAPESCA 2000). Most recently, increased interaction with other institutions provides the capacity to address the identified research gaps effectively. In recent years, collaboration with other research institutions (CIBNOR, CICESE, CICIMAR, UABC, USON, UAS, UAN, ICMyL, ITMAR), government agencies (SEMARNAT, CONANP, INE), and NGOs (WWF, NOS, EDF) has been developed. However, the translation of this information into management is still lacking.

Bycatch

The industrial fleet must report bycatch in logbooks and provide a copy of the report to local fisheries offices along the coast. An onboard observer program was in place within the industrial fleet from 2004 to 2010 (INAPESCA 2012) and was not in place for five seasons until the 2015–2016, 2016–2017, and 2017–2018 seasons. As part of the constant monitoring of abundance data, INAPESCA also records bycatch during the off-season surveys. Some of these data have been available to the public (see Appendix 1), which was shared in 2017.

Table 31

Season	No. of sets Total	fishing trips W/Observer	Coverage %
2004–05	5,547	52	0.9
2005–06	5,505	208	3.8
2006–07	5,583	239	4.3
2007–08	4,948	206	4.2
2008–09	5,233	185	3.5
2009–10	4,540	159	3.5
2010–11	4,201	167	4.0
2015–16	4,078	11	0.3
2016–17	4,680	98	2.1
2017-2018	4,458*	48*	~1%
2018-2019			
2019-2020			
2020-2021			
Total	44,315	1,334	3.0

** data from the 2019 report (SICG 2019)

In the case of the artisanal fleets, some groups are participating in fisheries improvement projects (Magdalena I fishery in Magdalena Bay) or are part of a FairTrade certified supply chain (suripera fishery in Sinaloa). As part of these projects, bycatch levels have been constantly monitored and reported. In these fisheries, bycatch composition and volumes continue to be monitored. In the suripera fishery in Sinaloa, from the 56 species identified in the bycatch, no species of particular concern were reported (Del Pacifico 2016). In Magdalena Bay in 2014, the bycatch information collected showed nine fish species as predominant in the fishery bycatch; in terms of volume, the fishery generates an average of 1 kg of shrimp per kg of bycatch, as one of the trawl fisheries with the lowest shrimp-to-bycatch ratio (Magdalena Bay 2016). As part of the FIP strategy, bycatch is continually monitored to assess changes in bycatch proportion and inform improved management.

Gulf of Mexico - Atlantic, Western Central - Cast nets

Gulf of Mexico - Atlantic, Western Central - Traps

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Cast nets - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Highly effective

See text under trawls above.

3.4 Enforcement Of Management Regulations

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

Eastern Central Pacific - Mexico - Suripera - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Suripera - Sinaloa North Central (Zone 30)

Moderately Effective

See text under trawls above.

Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

Gulf of Mexico - Atlantic, Western Central - Cast nets

Gulf of Mexico - Atlantic, Western Central - Traps

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Cast nets - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Ineffective

Illegal fishing has been identified as one big and complex problem within fisheries in Mexico, including shrimp {SAGARPA-INAPESCA 2000} {Cisneros-Montemayor et al. 2013}. Cisneros-Montemayor et al. (2013) analyzed landings from 1950 to 2010 and estimated that total landings for shrimp in Mexico could be as much as twice as high as official reports due to illegal fishing {Cisneros-Montemayor et al. 2013}. More conservative estimations calculated illegal fishing could have accounted for 30% of the registered catch across all species (not just shrimp), and that high-value species like shrimp were part of these findings {Cisneros-Montemayor et al. 2013}. In the Gulf of Mexico, SADER and INAPESCA reported high noncompliance when fishing for white shrimp in 2012 (87% of vessels had illegal nets onboard) {SAGARPA-INAPESCA 2014). Illegal fishing is a particular concern in countries like Mexico, where there is a very long coastline and an artisanal fleet that numbers on the order of 100,000 vessels (including perhaps 50,000 that fish for shrimp), factors that make monitoring very difficult {CCC et al. 2013}.

In terms of enforcement activities, the following are in place:

Industrial fleets: All industrial fleets (including shrimp trawlers) are subject to the following regulations:

- A satellite vessel monitoring system for all industrial vessels (however, the program went inoperative on February 2023, with managers stating it will become fully operational later in the year)(Algo Que Informar 2023) (Oceana 2024) reported that during 2022 there was a change in the VMS provider of this service so during that year no vessel was monitored and based on contracts consulted, by 2023, there were only 1,616 monitored vessels, although the national registry reported more than 2,300 fishing vessels were operating (Oceana 2024).
- Mandatory use of TEDs for all trawlers (although, as mentioned in Criterion 2, some irregularities have been detected and drove Mexico to lose its certification to export to the USA in 2021, although recovered later that same year).
- Pre-departure inspection to corroborate that fishing gear specs are complying with the specifications of the official norm (NOM-002), and that TEDs are in place and working properly (NOM-061)
- Random water enforcement activities to revise the correct use of the TEDs while fishing

Managers' reports indicate that the number of enforcement actions has increased over the

last few years and that compliance in the industrial fleet with at least some regulations has increased (see detailed rationale below for more information). The number of vessels operating inside closed areas declined from 80 in 2013 to 12 in 2015 (CONAPESCA 2016). CONAPESCA also reported that more than 4,000 inspection actions around TED compliance were conducted between 2013 and 2015, and as a result, 17 sanctions and catch confiscations were reported (CONAPESCA 2016). Most recent information regarding these actions was not available. However, some efforts to analyze the level of enforcement are in place (Pescando datos initiative by the organization Causa Natura). As a result of this analysis, the organization found that shrimp trawlers “might” be operating within areas that are not authorized. The report used VMS data and detected these activities by selecting those points matching potential fishing operations speeds (Causa Natura 2023).

The TED program is also verified annually by NMFS (this includes compliance checks) and has been certified as being comparable to the one implemented in the US from 1997 to 2016 (failing only in a single year: 2010) {DOS, 2010}. However, the NMFS verifier reported several issues using TEDs in recent years. In early 2021, a ban on shrimp was issued by the state department (this ban included all shrimp fisheries in Mexico not just industrial)(State Gov 2021). Managers and the industry worked together to reinstate training programs and TED verification, and by October 2021, the certification was reinstated.

Although enforcement and monitoring actions are in place, their effectiveness is uncertain. Considering that as this report is finalized, a VMS system is not in place (Algo Que Informar 2023) or at least do not monitors the entirety of the fleet (Oceana 2024), that illegal actions are an important threat on the White shrimp fishery in the GoM (INAPESCA 2022) and that (Causa Natura 2023) report found some potential use of non-authorized areas by trawlers, **this factor is scored as ineffective for industrial trawlers.**

Artisanal Fleets

TEDs are also mandatory for small-scale fleet that uses trawl systems (NOM-002-PESC-1997).

However, there is no VMS in place, except for the small-scale, vessels operating in the upper Gulf of California, for the fleet within the Vaquita zone (Blust 2018) , although it was unclear if this project remained active. In 2016, CIRVA's assessment of enforcement in the Upper Gulf of California related to the ban on gillnet fishing to protect the critically endangered vaquita (CIRVA 2016), provided evidence that illegal fishing is still occurring in the region and indicated illegal fishing is still likely a problem in at least some artisanal fisheries in the area.

Like the industrial fleet, random water enforcement activities, landing sites, highway checkpoints, and storage units, are in place to check on licenses, correct use of gear, and production.

In the case of the Gulf of Mexico, managers have reported that overfishing occurs for

white, pink, and seabob species, including during the off-season, a sign that enforcement is not adequate (INAPESCA 2022).

Although there is some evidence that compliance has improved in the artisanal fleet, due to the nature of the fishery, with thousands of landings sites, and reports of limited capacity by managers, we deem enforcement ineffective for all artisanal fisheries except the suripera fishery in Sinaloa, currently certified as Fair Trade since 2016; and the West Coast of Baja fishery, that reported enforcement actions in place in close collaboration with local authorities in the state (FONMAR).

The Fair Trade-certified suripera fishery in Sinaloa had a pilot satellite system on its vessels to monitor the areas where the fishers work as part of the traceability and enforcement efforts. In the past, members of the cooperatives were ejected during part of the certification after they were found guilty of fishing in areas that were not authorized (pers. comm., Carlos Ivan Perez Quinones, Del Pacifico 2022).

In addition, FIPs were in place to also pursue the MSC certification; among the internal regulations within the FIP are:

- Monitoring of launch and arrival of the boats from single dock points
- Continuing satellite monitoring (partial fleet)
- Review all members' permits and other fishing regulations before the season.
- During the off-season, the buyer provides funding as a credit to cover enforcement patrolling costs in collaboration with local authorities
- Internal enforcement committees within the cooperatives are in place, which enforces their members' conduct (pers. comm., Ruben Castro, Certification holder 2022).

Enforcement for the Suripera fishery in Sinaloa and the West Coast of Baja is scored as "moderately effective."

Supplementary Information

CONAPESCA recognizes enforcement as a high priority (CONAPESCA 2016), and has implemented some measures over the years to improve compliance with fishing regulations (DOF 2007). CONAPESCA and the Mexican Navy implement these measures through the National Program of Enforcement and Monitoring (CONAPESCA 2016), in close coordination with local state offices and the U.S. NOAA fisheries' Office of Law Enforcement (NOAA 2015).

Since 2011, CONAPESCA also opened the opportunity for fishing organizations to be part of the efforts providing federally accessible funds to the fishing industry through the "Enforcement and Monitoring Fishing and Aquaculture Program," which allows fishers to apply for funds up to 6 million pesos/year (approx. USD 320,000) as a group, or 2 million (USD 108,000) as a single person to cover costs of enforcement activities (CONAPESCA 2016).

Artisanal and industrial fishing organizations have thus been collaborating with CONAPESCA in enforcement activities since 2013. The industry provides the use of their vessels on the water, which act like motherships for smaller vessels along the coast, with a particular focus on the most productive areas (Sinaloa coastal lagoons and Sonoran coast). The funds are used to cover the cost of operation of the vessels, mostly fuel, but also technical services as well as campaigns to inform the public about enforcement actions and to report illegal activities. This program has increased the involvement of fishers in enforcement activities.

Vessel monitoring

VMS has been in place since 2004 for the industrial fleet operating in the Gulf of Mexico, the Gulf of California, and the Pacific coast of Mexico. It was made mandatory in 2008 (CONAPESCA 2006). The regulations of this program are contained in the Mexican official norm, which regulates the use of the satellite systems and defines which vessels must have VMS (NOM062-SAG/PESC-2014). Among other things, it allows CONAPESCA to know the exact location of the route taken by boat along the trip and the fishing area; improve the information for technical and scientific fisheries research; improve the management of fisheries resources and verify respect for closures, as well as areas that are restricted or prohibited; and capture the degree of incidence or recurrence of boats. In 2015, there were 1,981 vessels monitored (not just shrimp vessels), of which 98% were recorded as transmitting appropriately (up from 34% in 2007) (CONAPESCA 2016). GPS data are provided every hour, 24 hours a day, to CONAPESCA through the Sistema Satelital de Monitoreo de Embarcaciones Pesqueras (SISMEP) alert is given to the SISMEP and vessel operators when a vessel enters a closed area. The number of vessels found to be operating in a closed area has declined from 80 in 2013 to 12 in 2015 (CONAPESCA 2016). However, the system went inoperative early in 2023, the current plan is unclear, but managers have mentioned that it will be reactivated gradually in 2023 (Algo Que Informar 2023).

VMS is not in place for most artisanal fleets because it is impractical for tens of thousands of vessels. The only exception for shrimp fisheries is the suripera fishery in Sinaloa, which has an autonomous tracking vessel system managed by Del Pacifico company and only covers the cooperatives involved in the certification. This system, run by a third-party company called Pelagic Data Systems, records the boat's positions every second and monitors compliance with enforcement and traceability issues required within the Fair Trade certification process and workplan (Del Pacifico 2016).

Turtle Excluder Device compliance

As a signatory to the Inter-American Convention for the Promotion and Conservation of Sea Turtles, Mexico implemented measures for the protection of sea turtles with the use of turtle excluder devices (TEDs), which are required by law (NOM-002-SAG/PESC-2013) (DOF 1993).

Managers in CONAPESCA collaborate with the Secretary of Environment and its enforcement agents in the field, PROFEPA (Environmental Protection Agency) and the Mexican Navy, to develop enforcement actions on the correct use of TEDs in the water (CONAPESCA 2016). According to the 2010 to 2012 enforcement plan and the inter-agencies collaboration, at least 70% of enforcement activities must be conducted while vessels are fishing, and 30% of these actions should be conducted during night operations. CONAPESCA reported that between 2013 and 2015, more than 4,000 inspection actions were conducted with the industrial fleet in the Pacific and Gulf of Mexico combined (See Appendix 1); as a result, 17 sanctions were issued (four in 2013, four in 2014, and eight in 2015) and around 22 t of shrimp caught was confiscated (CONAPESCA 2016).

In addition, Section 609 of U.S. Public Law prohibits imports of shrimp into the U.S. unless the export nation has been certified by NOAA that it has a program that reduces incidental capture of sea turtles comparable to the one implemented in the U.S. The certification was issued for Mexico from 1997 to 2016 (US DOS 2016), with the exceptions of — 2010 and 2021, when NOAA officials reported misuse of the excluding devices during inspections.

Off-season enforcement

In 2013, coordination efforts between the CONAPESCA and the Mexican Navy were formalized by creating the “Enforcement plan for the shrimp fishery during the off-season” {INAPESCA, 2015}. This plan is implemented during the off-season along the Pacific and Gulf of Mexico coasts. This campaign aims to prevent illegal fishing acts during the off-season {INAPESCA 2015} (See Appendix 1). Specific measures are applied to both industrial and artisanal fisheries, and include:

- Random inspections to small-scale vessels and trawlers on the sea
- Road checkpoints along most of the most important landings sites
- Inspect storage and processing plants and other infrastructure existing at the beginning and end of the ban, to verify the inventory of shrimp and random inspections during the closed season to verify that inventory reports are accurate.

Compliance on 2022-2023

Despite the enforcement effort implemented (particularly in recent years), there are concerns that illegal fishing may still occur in some regions. For example, in the Campeche region, managers reported that among activities that still impact the recovery of the White shrimp is overfishing and illegal fishing (INAPESCA 2022). Another region and perhaps one of the best studied is continued gillnet fishing in the Upper Gulf of California, which was closed to all gillnetting except for corvina from April 2015 to protect the critically endangered vaquita (see Criterion 2) {DOF, 2017}.

In May 2016, CIRVA experts reported their concerns about the continuous findings of illegal activities in the region despite the vast amount of enforcement by Mexican authorities {CIRVA, 2016}. During the meeting, the Mexican Navy reported that more than 122 boats were seized as part of their operations, more than 70 people were detained and 177

totoaba swim bladders were recovered last year. Meanwhile, Sea Shepherd Conservation Society (SSCS) which coordinates with CIRVA and Mexican authorities, gathered evidence reported in the same meeting that “The greatest threat to the vaquita is the continuing demand for totoaba swim bladders in China” (CIRVA 2016) (Sea Sheperd 2022)

SSCS filmed poachers hauling nets, retrieved more than 40 illegal gillnets and 16 illegals longlines, and reportedly encountered at least two dead vaquitas in March 2016. The SSCS concluded that, despite the investment of the government of Mexico, the high value of the swim bladder represents a big incentive for fishers to risk being caught. According to official reports, in December 2015, one trawler was detected by CONAPESCA’s VMS system and was detained by Environmental Protection Agency staff (PROFEPA) (PROFEPA 2015).

The shrimp fishery in Mexico is one of the most enforced fisheries in the country due to its economic and social value (CONAPESCA 2015). Since 2007, CONAPESCA has been improving coordination efforts with local authorities (state and municipal) to support the enforcement activities of their agents, who have received the support of state and municipal police during their operations (SAGARPA 2015). Between 2007 and 2012, 28 state enforcement committees were created (SAGARPA 2015), more than 5,000 t of the illegal product was confiscated, and more than 7,000 individual fishing gear were retained (SAGARPA 2013). In 2015, more than 300 small vessels, 380 vehicles and 130 people were detained due to the enforcement processes along the Pacific and Gulf of Mexico (PROFEPA 2015). Most recent information regarding these results was unavailable when this report was released

3.5 Stakeholder Inclusion

Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

Eastern Central Pacific - Mexico - Suripera - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Suripera - Sinaloa North Central (Zone 30)

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

Gulf of Mexico - Atlantic, Western Central - Cast nets

Gulf of Mexico - Atlantic, Western Central - Traps

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Cast nets - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Highly effective

Due to the high economic value and the number of fishers (artisanal and industrial) that depend on the fishery, its management has long been complicated and controversial. In 2012, Vasquez-Leon stated that, even though fisheries reforms have been implemented and accepted in the name of sustainability, small-scale fishers have a disadvantage and find themselves more vulnerable as the state withdraws support from their sector in favor of industrial producers in offshore fisheries (Vasquez-Leon, M. 2012). It has also been noted that small-scale fishers are a more complex sector to manage because landing sites are far more along the coast, the groups are dispersed, and there are (in some cases) limited institutional capacities (Aranceta-Garza et al 2021)

Managers have established an open process to review, evaluate, and revise management regulations, often based on demand by producers and fishermen(DOF 2006). In particular, for the shrimp fishery, stakeholders (including NGOs, universities, and researchers) are allowed to participate in the development process of Mexican Official Norms (NOMs). In addition, the Consejo Nacional de Pesca y Acuacultura (National Council of Fisheries and Aquaculture), a consultative body, meets twice a year to discuss issues related to the shrimp fishery in the pacific, includes participants of the confederations that represent fishermen for the artisanal and industrial fisheries. Finally, although the stakeholders must consult management plans, the 2018 shrimp management plan draft has not been socialized with the industry. It has been delayed since its first draft version in 2012 and the newest version in 2018.

Federal laws govern the public's access to information, including fisheries information. The government generates reports and analyses available to the public (CONAPESCA b 2016) . Since the management process is defined and includes some stakeholder consultation, stakeholder inclusion of the Mexican Pacific and GOM industrial and artisanal shrimp fisheries are deemed "highly effective."

Criterion 4: Impacts on the Habitat and Ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment. The final score is the geometric mean of the impact of fishing gear on habitat score (factor 4.1 + factor 4.2) and the Ecosystem Based Fishery Management score. The Criterion 4 rating is determined as follows:

- Score >3.2 = **Green** or Low Concern
- Score >2.2 and ≤3.2 = **Yellow** or Moderate Concern
- Score ≤2.2 = **Red** or High Concern

Guiding principles

- Avoid negative impacts on the structure, function or associated biota of marine habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.
- Follow the principles of ecosystem-based fisheries management.

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

Fishery	Impact of Fishing Gear on the Habitat/Substrate	Modifying Factor: Mitigation of Gear Impacts	Ecosystem-based Fisheries Management	Score
Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)	Score: 2	Score: 0	Moderate Concern	Yellow (2.449)
Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)	Score: 2	Score: 0	Moderate Concern	Yellow (2.449)
Eastern Central Pacific - Mexico - Suripera - West Coast of Baja (Zone 50)	Score: 3	Score: 0	Moderate Concern	Yellow (3.000)
Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)	Score: 2	Score: 0	Moderate Concern	Yellow (2.449)
Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)	Score: 2	Score: 0	Moderate Concern	Yellow (2.449)
Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Cast nets - Sinaloa South (Zone 40) | Nayarit (Zone 60)	Score: 3	Score: 0	Moderate Concern	Yellow (3.000)
Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)	Score: 2	Score: 0	Moderate Concern	Yellow (2.449)
Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)	Score: 3	Score: 0	Moderate Concern	Yellow (3.000)
Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Suripera - Sinaloa North Central (Zone 30)	Score: 3	Score: 0	Moderate Concern	Yellow (3.000)
Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)	Score: 2	Score: 0	Moderate Concern	Yellow (2.449)
Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)	Score: 3	Score: 0	Moderate Concern	Yellow (3.000)

Fishery	Impact of Fishing Gear on the Habitat/Substrate	Modifying Factor: Mitigation of Gear Impacts	Ecosystem-based Fisheries Management	Score
Gulf of Mexico - Atlantic, Western Central - Bottom trawls	Score: 2	Score: 0	Moderate Concern	Yellow (2.449)
Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery	Score: 2	Score: 0	Moderate Concern	Yellow (2.449)
Gulf of Mexico - Atlantic, Western Central - Cast nets	Score: 3	Score: 0	Moderate Concern	Yellow (3.000)
Gulf of Mexico - Atlantic, Western Central - Traps	Score: 3	Score: 0	Moderate Concern	Yellow (3.000)
Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)	Score: 2	Score: 0	Moderate Concern	Yellow (2.449)

Criterion 4 Assessment

Scoring Guidelines

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate

Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*
- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.*
- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)*
  Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable

seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

- *+1 —>50% of the habitat is protected from fishing with the gear type. Or fishing intensity is very low/limited and for trawled fisheries, expansion of fishery's footprint is prohibited. Or gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage. Or there is an effective combination of 'moderate' mitigation measures.*
- *+0.5 —At least 20% of all representative habitats are protected from fishing with the gear type and for trawl fisheries, expansion of the fishery's footprint is prohibited. Or gear modification measures or other measures are in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing that are expected to be effective.*
- *0 —No effective measures are in place to limit gear impacts on habitats or not applicable because gear used is benign and received a score of 5 in factor 4.1*

Factor 4.3 - Ecosystem-Based Fisheries Management

Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

- *5 — Policies that have been shown to be effective are in place to protect species' ecological roles and ecosystem functioning (e.g. catch limits that ensure species' abundance is maintained at sufficient levels to provide food to predators) and effective spatial management is used to protect spawning and foraging areas, and prevent localized depletion. Or it has been scientifically demonstrated that fishing practices do not have negative ecological effects.*
- *4 — Policies are in place to protect species' ecological roles and ecosystem functioning but have not proven to be effective and at least some spatial management is used.*
- *3 — Policies are not in place to protect species' ecological roles and ecosystem functioning but detrimental food web impacts are not likely or policies in place may not be sufficient to protect species' ecological roles and ecosystem functioning.*
- *2 — Policies are not in place to protect species' ecological roles and ecosystem functioning and the likelihood of detrimental food impacts are likely (e.g. trophic cascades, alternate stable states, etc.), but conclusive scientific evidence is not available for this fishery.*
- *1 — Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

4.1 Impact of Fishing Gear on the Habitat/Substrate

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Eastern Central Pacific - Mexico - Suripera - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Suripera - Sinaloa North Central (Zone 30)

Gulf of Mexico - Atlantic, Western Central - Cast nets

Gulf of Mexico - Atlantic, Western Central - Traps

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Cast nets - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Score: 3

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) (INAPESCA 2000). Cast nets are retrieved rapidly after deployment, and only come into contact with the seafloor where they are set (DOF 2012). The suripera net has a really low impact of sediment removal and bottom interaction (Dr. Antonio Calderon ICMyL-UNAM Mazatlan pers. Comm. 2016). Recent research on the impact of this gear has been developed by independent research from the Institute of Marine Sciences in Mazatlán, Sinaloa. The fixed charanga net, used by artisanal fisherman in the GOM, is set in coastal lagoons from Tamaulipas to northern Veracruz (INAPESCA c 2012). Shrimp enter the wedge-shaped net as they migrate offshore and are concentrated into a smaller net known as 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 (INAPESCA 2000). Shrimp gillnets or gillnets, though not mobile, do come into contact with the seafloor (SAGARPA 2012b). These gears all score 3.

Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Score: 2

Blue, brown, white, pink, seabob, whiteleg and yellowleg shrimp caught with large trawls in the industrial fleet and small trawls (including the Magdalena I) 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 {Steele 2002). In the Mexican Pacific, offshore areas between 9 and 64 meters in depth are targeted (FAO 2008). There is evidence that industrial trawls have impacted had impacts on soft-bottom environments and epibenthic communities (INAPESCA-CONAPESCA 2004) Most recently, (Pedrin-Aviles et al 2014) reported that trawling impacts granulometry, slightly increasing the grain size where the net passes (as fine sediments are displaced). However, no differences in biogeochemical variables have been reported between trawled and no trawled areas (Sanchez et al 2009). On the other hand, recovery from the impact has been considered relatively fast, considering that the fishery has operated in the same areas with the same fishing gear for decades, and likely, the structure and functionality of the habitats have not been modified by the fishery.

Overall, the impact of fishing gear in the Pacific and GOM industrial and artisanal fleets scored 2, based on the nature of the fishery and the SFW standard.

Supplementary Information

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 around 1% of the Mexican coast. Permanent protected areas and temporary closed seasons protect the main spawning season {Lopez, M. J. et al. 2005}, promote the growth of pre-adult life stages (SAGARPA-INAPESCA 2012) and protect threatened and endemic species {Aragon-Noriega et al. 2010}. Although Sala et al. suggests that these areas should be expanded to cover 40% of the rocky reef habitat in the Gulf of California {Sala et al. 2004}, it is important to note that existing MPAs and restricted areas have not

been as effective as expected in recovering and conserving artisanal fishing resources. According to Rife et al., these areas become problematic when they are poorly enforced and when they displace fisherman in areas where there are no alternative fishing grounds {Rife et al. 2012}.

4.2 Modifying Factor: Mitigation of Gear Impacts

Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

Eastern Central Pacific - Mexico - Suripera - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Suripera - Sinaloa North Central (Zone 30)

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

Gulf of Mexico - Atlantic, Western Central - Cast nets

Gulf of Mexico - Atlantic, Western Central - Traps

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Cast nets - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Score: 0

Managers have established some areas for specific management throughout the Mexican Pacific and GOM (CONAPESCA 2008). Some of these areas, like the Biosphere Reserve of the Upper Gulf and Cabo Pulmo, are Marine Protected Areas that limit or prohibit fishing activities, and regulate the use of some gear within their borders, according to their management plans.

Other areas that limit the use of some gears are the river mouths and coastal lagoons; any trawling gear (Artisanal or industrial) inside the lagoons and within 5 miles of river mouths is prohibited (NOM-002-PESC-1993)(DOF 2006).

In addition, NOM-002-PESC-1993 prohibits any trawling activity within 0 to 9 meters of depth along the whole Mexican coast. It is important to recognize that these regulations help protect some zones from degradation; however, these areas represent only about 1% of the Exclusive Economic Zone of Mexico (INAPESCA 2016).

Efforts have also been made to reduce the fishing effort throughout Mexico through a buyback program (see Criterion 3.1) (FAO 2008) (Dubay, K. S. et al 2010). Although the industrial fleet was successfully reduced by more than 50% (from 1594 vessels in 2005 to 761 vessels in 2013; refer to Table III) it is currently unknown with certainty if there has been a reduction in the level of effort for the artisanal fleet. INAPESCA tested new net designs for the industrial fleet to reduce the impacts on the bottom. The lighter net, called RS-INP-MEX, is manufactured with lighter material (spectra) and a double-foot rope and has proven to mitigate the impacts. However, the fleet has not adopted it due to its higher cost (Villaseñor-Talavera 2012).

For these reasons, the Mexican Pacific and GOM industrial and artisanal fisheries do not meet the standards for +0.5 for mitigation measures.

Supplementary Information

SEMARNAT and CONAPESCA have shared responsibilities for administering MPAs and regulate fisheries activities in those areas. Current MPAs and no-take zones cover around 1% of the Mexican coast. Permanently protected areas and temporarily closed seasons protect the main spawning season (Lopez, J. et al 2005), promote the growth of pre-adult life stages (SAGARPA-INAPESCA 2012) , and protect threatened and endemic species {Aragon-Noriega et al. 2010}. Though Sala et al. suggest that these areas should be expanded to cover 40% of the rocky reef habitat in the Gulf of California (Sala, E. et al 2004) , it is important to note that existing MPAs and restricted areas have not been as effective as expected in recovering and conserving artisanal fishing resources. According to Rife et al., these areas become problematic when poorly enforced and when they displace fishermen in areas without alternative fishing grounds {Rife et al. 2012}.

4.3 Ecosystem-based Fisheries Management

Gulf of Mexico - Atlantic, Western Central - Bottom trawls - Seabob fishery

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Bottom trawls - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Baja California | Sonora - Bottom trawls - Upper Gulf of California (Zone 10)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Bottom trawls - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Bottom trawls - Sonora (Zone 20)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Gillnets and entangling nets - Sinaloa North Central (Zone 30)

Gulf of California - Pacific, Eastern Central - Mexico - Sonora - Gillnets and entangling nets - Sonora (Zone 20)

Eastern Central Pacific - Mexico - Baja California - Magdalena - Artisanal bottom trawls - West Coast of Baja (Zone 50)

Eastern Central Pacific - Mexico - Suripera - West Coast of Baja (Zone 50)

Gulf of California - Pacific, Eastern Central - Mexico - Sinaloa - Suripera - Sinaloa North Central (Zone 30)

Gulf of Mexico - Atlantic, Western Central - Bottom trawls

Gulf of Mexico - Atlantic, Western Central - Cast nets

Gulf of Mexico - Atlantic, Western Central - Traps

Gulf of Tehuantepec - Atlantic, Western Central - Mexico - Bottom trawls - Gulf of Tehuantepec (Zone 90)

Gulf of California - Pacific, Eastern Central - Mexico - Nayarit | Sinaloa - Cast nets - Sinaloa South (Zone 40) | Nayarit (Zone 60)

Eastern Central Pacific - Mexico - Baja California - Bottom trawls - West Coast of Baja (Zone 50)

Moderate Concern

Ecosystem-based management has not been formally implemented at any fishery in Mexico. However, some policies are in place for shrimp to protect ecosystem functioning (restricted areas, ban of certain practices, TEDs and FEDs use, etc.). Also, some initiatives have been implemented to promote better fishing gear with lower environmental impacts (e.g., experimental nets in the Upper Gulf of California).

Nonetheless, the Mexican shrimp fisheries generate a high level of bycatch, including key

ecological species such as sharks (Lopez-Martinez, J. et al 2010) (Meltzer, L. et al 2012). The diversity of species caught as bycatch creates impacts on the overall ecosystem (Jennings, S. and Kaiser, M 1998), but the extent and nature of those impacts remain unclear. Therefore, management of the fishery's ecosystem and food web impacts is deemed a "moderate" concern.

Supplementary Information

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 weighing 45 kg (an almost 89% decrease in weight from typical weight chains) were used on trawl footropes (Balmori-Ramirez, A. et al 2012). This decrease in weight allowed the net to remain 10 to 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 using 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 Lopez-Martinez et al. (1996) suggest that bycatch reductions of 10%, 25%, and 50% could lead to increased predation on shrimp, corresponding to 0.8% and 5.5%, respectively, and 10.7% reductions in shrimp populations. (Garcia-Caudillo, J.M. et al 2000) pointed out that these predicted historical landings in the Gulf of California do not support ecosystem effects. 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 to high levels of ecosystem disturbance and long-term stability. Limited scientific and anecdotal evidence suggests that marine ecosystems in Mexican waters have changed dramatically over the last 40 years. In particular, (Nava-Romo, J. 1994) observed a decrease in the diversity and biomass of bycatch in Mexican fisheries. (Sala, E. et al 2004) 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, several theoretical studies suggest that Mexican ecosystems have maintained relative stability despite inter-annual climatic 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, M.V. et al 2004). Several studies have been generated to understand the ecosystems where shrimp fisheries are developed. However, the information is hardly used for management.

Acknowledgements

Scientific review does not constitute an endorsement of the Seafood Watch® program, or its seafood recommendations, on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

Seafood Watch would like to thank the consulting researcher and author of this report and five anonymous reviewer for graciously reviewing this report for scientific accuracy.

References

Algo Que Informar, 2023. Sistema de Monitoreo Satelital de Conapesca deja de operar. https://www.algoqueinformar.com/sistema-monitoreo-satelital-conapesca-deja-operar

Amezcua, F., J. Madrid-Vera, and H. Aguirre-Villaseñor. 2006. Efecto de la pesca artesanal de camarón sobre la ictiofauna en el sistema lagunar de Santa Maria la Reforma, suroeste del Golfo de California. Ciencias Marinas 32(1B):97-109.

Aranceta-Garza, F., Francisco Arreguín-Sánchez, Germán Ponce-Díaz, Juan Carlos Seijo, 2016. Natural mortality of three commercial penaeid shrimps (Litopenaeus vannamei, L. stylirostris and Farfantepenaeus californiensis) of the Gulf of California using gnomonic time divisions. Scientia Marina 80(2) June 2016, 199-206, Barcelona (Spain).

Aranceta-Garza, F., Seijo, J. C., & Vergara-Solana, F. (2021). Bioeconomics of technological interdependencies in a sequential shrimp fishery: optimal size of the industrial fleet in southern Gulf of California. CICIMAR Oceánides, 36(1-2), 1–18. https://doi.org/10.37543/oceanides.v36i1-2.254

Aranceta-Garza, Fernando & Arreguín-Sánchez, Francisco & Seijo, Juan Carlos & Ponce-Díaz, Germán & Lluch-Cota, Daniel & del Monte-Luna, Pablo. (2019). Determination of catchability-at-age for the Mexican Pacific shrimp fishery in the southern Gulf of California. Regional Studies in Marine Science. 33. 10.1016/j.rsma.2019.100967.

Arreguín-Sánchez F, Pérez-Quiñónez CI, Hernández-López A and Chávez-Herrera D (2023) The challenge of assessing the state of exploitation of short-lived fishery resources with limited data: the blue shrimp (Penaeus stylirostris) fishery in the Gulf of California, Mexico. Front. Mar. Sci. 10:1245657. doi: 10.3389/fmars.2023.1245657

Balmori, A., Rivera-Parra, G., Morales-Azpeitia, R., and Seefoo-Ramos, A. 2021. EVALUATION AND ESTIMATION OF REFERENCE POINTS FOR THE CRAB STOCKS (Callinectes spp.) FROM THE GULF OF CALIFORNIA AND WEST COAST OF BAJA CALIFORNIA SUR, MEXICO

Balmori-Ramirez, A., Mendez-Gomez H. I., y Morales-Azpeitia, R. 2012. Eficiencia de captura objetivo e incidental de redes de arrastre modificadas para la pesca de arrastre de camarón en el litoral del Estado de Sonora, México. SAGARPA, SAGARPA.INAPESCA. INFORME DE INVESTIGACION. 59 p

Baum, J., and A. Vincent. 2005. Magnitude and inferred impacts of the seahorse trade in Latin America. Environmental Conservation. 32 (4): 305–319.

Baum, J., J. Meewig and A.C.J. Vincent, 2003. Bycatch of lined seahorses (Hippocampus erectus) in a Gulf of Mexico shrimp trawl fishery. Fish. Bull. 101:721-731.

Bevan E, Wibbels T, Najera BMZ, Sarti L, Martinez FI, Cuevas JM, Gallaway BJ, Pena LJ, Burchfield PM. 2016. Estimating the population's historic size and current status of the Kemp's ridley sea turtle (Lepidochelys kempii). Ecosphere 7(3):e01244. 10.1002/ecs2.1244

Blust, K. 2018. Satellite Monitoring Could Help Protect Rare Vaquita Marina Dolphin In Mexico's Sea Of Cortez. https://fronterasdesk.org/content/704823/satellite-monitoring-could-help-protect-rare-vaquita-marina-dolphin-mexicos-sea

Caillouet CW, Raborn SW, Shaver DJ, Putman NF, Gallaway BJ, Mansfield KL. 2018. Did Declining Carrying Capacity for the Kemp's Ridley Sea Turtle Population Within the Gulf of Mexico Contribute to the Nesting Setback in 2010−2017? Chelonian Conservation and Biology, 17(1):123-133 (2018). https://doi.org/10.2744/CCB-1283.1

Calderón-Aguilera, A. 2011. Evaluación piloto de los impactos potenciales de las redes de arrastre sobre el ecosistema del Alto Golfo de California durante la temporada de pesca 2010-2011. (Margarita Caso coord.). Convenio N° INE/A1-038/2010. Centro de Investigación Científica y de Educación Superior de Ensenada, Baja California. México, D.F. 82 pp in VARIACIÓN MENSUAL DE LA PROPORCIÓN FAUNA DE ACOMPAÑAMIENTO: CAMARÓN Y SU POSIBLE USO PARA EL MANEJO

Causa Natura, 2023. Pesca de arrastre en áreas restringidas, los riesgos en la búsqueda de camarón

CDFG 2020b. California Department of Fish and Game. Status of the fisheries report, an update through 2008.

Chabot, C.L., H.A. Hawk, and L.G. Allen. 2015. Low contemporary effective population size detected in the Critically Endangered giant sea bass, *Stereolepis gigas*, due to fisheries overexploitation. Fisheries Research 72 (2015) 71-78.

CIRVA, 2016. Seventh Meeting of the Comite´ Internacional para la Recuperacio´n de la Vaquita Caracol Museo de Ciencias y Acuario. May 10-13, 2016. Ensenada, B.C. Mexico

Cisneros-Mata, M.Á., True, C., Enriquez-Paredes, L.M., Sadovy, Y. & Liu, M. 2021. *Totoaba macdonaldi*. *The IUCN Red List of Threatened Species* 2021: e.T22003A2780880. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T22003A2780880.en.

Collette, B.B. & Hastings, P.A. 2024. Scomberomorus concolor. The IUCN Red List of Threatened Species 2024: e.T20047A170082489.

CONAPESCA 2024. Datos Abiertos: Produccion Pesquera. https://datos.gob.mx/busca/dataset/produccion-pesquera/resource/257015cc-be59-4bbb-a940-11edfe3ba57c

CONAPESCA b, 2016. Consulta Especifica por Especie. http://www.conapesca.sagarpa.gob.mx/wb/cona/consulta_especifica_por_produccion.

CONAPESCA, 2016. Comision Nacional de Pesca y Acuacultura, Mision y Vision.

CONAPESCA. 2006. PROYECTO de Norma Oficial Mexicana NOM-062-PESC-2005, Para la utilización del Sistema Satelital de Monitoreo de Embarcaciones Pesqueras.

CONAPESCA. 2008. Programa Rector Nacional de Pesca y Acuacultura, in SAGARPA, editor.

Cornish, A. (Grouper & Wrasse Specialist Group). 2004. *Stereolepis gigas*. *The IUCN Red List of Threatened Species* 2004: e.T20795A9230697. https://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T20795A9230697.en

COSOREMA 2023. Catch composition analysis. Confirm primary and secondary species in accordance to MSC standard. Update November 2023. Accessed 3/8/24 from https://fisheryprogress.org/sites/default/files/indicators-documents/Suripera%20%28Cast%20net%29%20Catch%20composition%20and%20primary%20and%20secondary%20species%20based%20on%20MSC%202023_0.pdf

Cotto, A., Acero, A., Rojas, P., Betancur, R., Collette, B. 2010. *Diapterus peruvianus*. *The IUCN Red List of Threatened Species* 2010. Accessed on 24 May 2024 from https://www.iucnredlist.org/species/183874/8192692

Czembor, C. A., A. Rojas, and A. Acero. 2012. Hippocampus ingens. In: IUCN 2012. IUCN Red List of Threatened Species.

Del Pacifico, 2016. Gulf of California Sinaloa Artisanal Shrimp Fishery Improvement Project.

DOF 1993. NORMA Oficial Mexicana de Emergencia NOMEM-008-PESC-1993, por la que se establece el uso obligatorio de dispositivos excluidores de tortugas marinas en las redes de arrastre camaroneras durante las operaciones de pesca comercial de camarón en el Golfo de México y mar Caribe mexicanos.

DOF 2007. DECRETO por el que se expide la Ley General de Pesca y Acuacultura Sustentables

DOF 2018. ACUERDO por el que se da a conocer la actualización de la Carta Nacional Pesquera. (Continúa en la Tercera Sección).

DOF 2022 **ACUERDO mediante el cual se da a conocer la actualización de la Carta Nacional Pesquera. DOF: 26/07/2022**

DOF 2023. ACUERDO mediante el cual se da a conocer la Actualización de la Carta Nacional Pesquera.

DOF, 2010. Acuerdo mediante el cual se da a conocer la actualizacio´n de la Carta Nacional Pesquera.SAGARPA, Diciembre del 2010.

DOF, 2012. Acuerdo mediante el cual se da a conocer la actualizacion de la Carta Nacional Pesquera. Agosto 2012.

DOF. 2006. Modificacio´n a la Norma Oficial Mexicana 002-PESC-1993, Para ordenar el aprovechamiento de las especies de camarón en aguas de jurisdicción federal de los Estados Unidos Mexicanos, publicada el 31 de diciembre de 1993, para establecer la potencia nominal máxima de los motores fuera de borda utilizados por embarcaciones menores. Diario Oficial de la Federación

Dubay, K., S. Tokuoka, and G. Gereffi. 2010. A Value Chain Analysis of the Sinaloa, México Shrimp Fishery. in G. C. Center on Globalization, Duke University, editor. http://www.cggc.duke.edu/environment/CGGC_SinaloaShrimp_Report.pdf.

Erisman, B. & Craig, M.T. 2018. Hyporthodus acanthistius. The IUCN Red List of Threatened Species 2018: e.T132730A100569342. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T132730A100569342.en

Eugenio Alberto Aragón-Noriega, and Luis Eduardo. Does damming of the Colorado River affect the nursery area of blue shrimp Litopenaeus stylirostris(Decapoda: Penaeidae) in the Upper Gulf of California? Rev. biol. trop vol.48 n.4 San José Dec. 2000

FAO FishStatJ 2023. FishStatJ software: Global Production by production source 1950-2021 (Release date: March 2023). Accessed 08/24/23 from https://www.fao.org/fishery/en/topic/166235/en

FAO. 2008. Global Study of Shrimp Fisheries.

Farrugia, T.J., Márquez-Farías, F., Freedman, R.M., Lowe, C.G, Smith, W.D. & Bizzarro, J.J. 2016. Pseudobatos productus. The IUCN Red List of Threatened Species 2016: e.T60171A104004394. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T60171A104004394.en.

Federal Register 2021. Bureau of Oceans and International Environmental and Scientific Affairs; Annual Certification of ShrimpHarvesting Nations

Félix-Ortiz, José & Aragon-Noriega, Eugenio & Lomas, Nicolás & RODRIGUEZ DOMINGUEZ, GUILLERMO & Valenzuela-Quiñónez, Wenceslao & Vargasmachuca, Sergio. (2020). Individual growth analysis of the Pacific yellowlegs shrimp Penaeus californiensis via multi-criteria approach. Latin American Journal of Aquatic Research. 48. 768-778. 10.3856/vol48-issue5-fulltext-2555.

FFWCC 2022. Index Nesting Beach Survey Totals (1989-2021).

Findley, L. 2010. Totoaba macdonaldi. The IUCN Red List of Threatened Species 2010: e.T22003A9346099.

Froese, R. and D. Pauly. Editors. 2017. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2017).

Gallardo-Cabello, M., Espino-Barr, E., Puente-Gómez, M., Garcia-Boa, A. and G. Cabral-Solís, E. 2015. Reproduction of Diapterus brevirostris (Percoidei: Gerreidae) in the Mexican Pacific coast. ISSN: 2408-5464 Vol. 3 (5), pp. 221-229, July, 2015. http://www.globalscienceresearchjournals.org/

García-Borbón, Antonio & Morales-Bojórquez, Enrique & Aguirre, Hugo. (2018). Long-Term Changes in the Fraction of Mature Brown Shrimp Farfantepenaeus californiensis (Holmes, 1900) Females and Their Impact on Length at First Maturity. Journal of Shellfish Research. 37. 1103-1111

García-Caudillo, J., M. Cisneros-Mata, and A. Balmori-Ramirez. 2000. Performance of a bycatch reduction device in the shrimp fishery of the Gulf of California, México. Biological Conservation 92:199-205.

Garcia-Caudillo, J.M. Personal communication. SFP Fisheries improvement project bycatch reports from Magdalena Bay in the West Coast of Baja and Sonora.

Geoffrey G. Shester, Fiorenza Micheli, Conservation challenges for small-scale fisheries: Bycatch and habitat impacts of traps and gillnets, Biological Conservation, Volume 144, Issue 5, 2011, Pages 1673-1681, ISSN 0006-3207, https://doi.org/10.1016/j.biocon.2011.02.023.

Gobierno de Mexico, 2017. ASEGURA PROFEPA BARCO CAMARONERO POR PESCA ILEGAL EN ÁREA DE REFUGIO DE LA VAQUITA MARINA, B.C.

Holthuis 1980. FAO Species Catalogue. Vol. 1. Shrimps and prawns of the world. An annotated catalogue of species of interest to fisheries. FAO Fish. Synop. 125(1):271 p. Rome: FAO.

House, P., B.L.F. Clark, and L.G Allen. 2016. The return of the king of the kelp forest: distribution, abundance, and biomass of giant sea bass (*Stereolepis gigas*) off Santa Catalina Island, California, 2014-2015. Bull. Southern California Acad. Sci. 115(1), 2016, pp1-14.

IAC. 2006. Report of the Third Meeting of the Scientific Committee. Inter-American Convention for the Protection and Conservation of Sea Turtles. III. San José´, Costa Rica, June 6-9, 2006.

INAPESCA (Instituto Nacional de la Pesca). 2000. Sustentabilidad y pesca responsable en

México. Evaluación y Manejo 1999-2000. Secretaria de Medio Ambiente, Recursos Naturales y Pesca. México.

INAPESCA 2017. SFW Wild Mexican Shrimp Draft Report Review. June 15, 2017.

INAPESCA 2018. Plan de Manejo de la Pesqueria de Camaron del Pacifico Mexicano. Direccion General Adjuntade Investigacion Pesquera en el Pacifico.

INAPESCA 2019. Draft Chapter for Camarón del Océano Pacífico for the "Sustentabilidad y Pesca Responsable en México" Evaluación y Manejo

INAPESCA 2021. Informe técnico: Evaluación Biológica de las poblaciones de Camarón de altamar en el litoral del Pacífico durante la veda 2021. Dirección General Adjunta de Investigación Pesquera en el pacífico. Agosto de 2021

INAPESCA 2021. Mexico Baja California Sur blue and brown shrimp – bottom trawl/cast net] Fishery Improvement Project (FIP) Technical report on the status, productivity, and management recommendations for the Bahía Magdalena-Almejas shrimp fishery, B.C.S. Mexico Baja California Sur blue and brown shrimp – bottom trawl/cast net

INAPESCA 2022 Dictamen Técnico sobre el estado de las especies de camarón en el Golfo de México y Mar Caribe. Dirección de Investigación Pesquera en el Atlántico. https://cofemersimir.gob.mx/expediente/27106/mir/53567/anexo/6610829

INAPESCA 2023. Mexico Baja California Sur blue and brown shrimp – bottom trawl/cast net. Fishery Improvement Project (FIP). Fishery impacts data collection and analysis. One year progress report. October 2023. Accessed 3/8/24 from https://fisheryprogress.org/sites/default/files/indicators-documents/Mexico%20Baja%20California%20Sur%20blue%20and%20brown%20shrimp_FisheryImpacts_FACReport_0.pdf

INAPESCA b, 2012 . Plan de Manejo para la Pesquería de Camarón en el Litoral del Océano Pacífico Mexicano

INAPESCA b, 2014. La Pesquería de camarón del Golfo de México y el Mar Caribe. Sustentabilidad y Pesca Responsable en México Evaluación y Manejo.

INAPESCA, 2012. Analisis del Esfuerzo Pesquero. Programa de Observadores Cientificos a bordo de la flota camaronera de altamar en el Oceano Pacifico mexicano. (temporadas 2004-2005 a 2009-2010).

INAPESCA, 2014. FUNDAMENTO TECNICO PARA EL ESTABLECIMIENTO DE VEDAS A LA PESCA DE CAMARON EN EL GOLFO DE MEXICO Y MAR CARIBE (2014)

INAPESCA, 2016. Space-temporal characterization of Shrimp Bycatch in the Mexican Pacific

Shrimp Fishery. May, 2017

INAPESCA. 2000b. EVALUACIO´N DE LA EFICIENCIA Y SELECTIVIDAD DE LA RED DE ARRASTRE MAGDALENA I, PARA LA CAPTURA DE CAMARON CAFE´, EN BAHIA MAGDALENA, B.C.S. Informe de Investigacio´n. La Paz, B.C.S.

INAPESCA. 2012c. DICTAMEN TE´CNICO: FUNDAMENTO TE´CNICO PARA EL ESTABLECIMIENTO DE VEDAS PARA LA PESCA DE CAMARO´N EN EL GOLFO DE ME´XICO Y MAR CARIBE in SAGARPA/INP. Accessed September 3, 2012.

INAPESCA-CONAPESCA 2004. Plan de manejo para la pesqueria de Camaron en el Litoral del Pacifico Mexicano.

IUCN 2024. IUCN Standards and Petitions Committee. 2024. Guidelines for Using the IUCN Red List Categories and Criteria. Version 16. Prepared by the Standards and Petitions Committee. Downloadable from https://www.iucnredlist.org/documents/RedListGuidelines.pdf

Jennings, S. and Kaiser, M 1998. The Effects of Fishing on Marine Ecosystems. Advances in Marine Biology · December 1998

Koch, V., Peckham, H., Mancini, M., Eguchi, T., 2013. Estimating at-sea mortality of marine turtles from stranding frequencies and drifter experiments. PLoS ONE 8 (2), e56776. http://dx.doi.org/10.1371/journal.pone.0056776

Kokkalis, A., C.W. Berg, M.S. Kapur, H. Winker, N.S. Jacobsen, M.H. Taylor, M. Ichinokawa, M. Miyagawa, W. Medeiros-Leal, J.R. Nielsen, T.K. Mildenberger 2024. Good practices for surplus production models. Fisheries Research, Volume 275, 2024.

Lo´pez, M. J., C. Rabago, M. Nevarez, A. Garcia, G. Rivera, and J. Chavez. 2005. Growth, reproduction, and size at first maturity of blue shrimp, Litopenaeus stylirostris (Stimpson, 1874) along the east coast of the Gulf of California, Mexico. Fisheries Research (71): 93–102.

Lo´pez-Martinez, J., Rabago, M. Nevarez, A. García, G. Rivera, and Chávez. 2009. Growth, reproduction, and size at first maturity of blue shrimp, Litopenaeus stylirostris (Stimpson, 1874) along the east coast of the Gulf of California, México. Fisheries Research (71): 93–102.

Lopez Martínez J. 2000. Dinámica de la pesquería de camarón café (Penaeus californiensis) en el litoral sonorense y su relación con algunos parámetros oceano-atmosfericos. Tesis Doctoral. CICIMAR, IPN. La Paz, B. C. S. 161 pp.

López-Martinez, J., E. Herrera-Valdivia, J. Rodríguez-Romero, and S. Hernandez-Vazquez. 2010. Bycatch fish species from shrimp industrial fishery in the Gulf of California, México. Revista de biología tropica

Magdalena Bay 2016. Fishery Improvement project.

Meerwasser-Lexikon Team 2020. Penaeus californiensis Brown Shrimp, Yellow-legged Shrimp. https://www.reeflex.net/tiere/13094_Penaeus_californiensis.htm#:~:text=They%20are%20dimorphic%20with%20females,the%20green%20microalgae%2C%20Ulva%20clatharata.

Meltzer, L., N. Blinick, and A. Fleishman. 2012. Management Implications of the Biodiversity and Socio-Economic Impacts of Shrimp Trawler Bycatch in Bahia de Kino, Sonora, México. PLoS ONE 7(6): e35609. doi:10.1371/journal.pone.0035609.

Moore, A.B.M. 2017. Are guitarfishes the next sawfishes? Extinction risk and an urgent call for conservation action. Endangered Species Research. v34, p75-88

Morales-Zarate, M. V., F. Arreguin-Sanchez, J. López-Martinez, and S. Lluch-Cota. 2004. Ecosystem trophic structure and energy flux in the upper Gulf of California, México. Ecological Modeling 174(4):331 -345.

Morsan, E., Jurado-Molina, J. and Hernandez, A. 2019. Mexican Pacific Shrimp Fishery MSC Fishery Assessment Report.

MSC 2024. Mexican Pacific artisanal shrimp fishery.

Nava-Romo, J. M. 1994. Impactos a corto y largo plazo en la diversidad y otras caracteri´sticas ecolo´gicas de la comunidad be´ntico-demersal capturada por la pesqueri´a de camaro´n en el Norte del Alto Gulfo de California, Me´xico, unpublished thesis. Instituto Tecnolo´gico y de Estudios Superiores de Montererry, Campus Guayamas, Sonora, Me´xico.

NMFS & USFWS 2020. Loggerhead Sea Turtle (Caretta caretta) North Pacific Ocean DPS 5-Year Review: Summary and Evaluation 2020.

NOAA 2015. NOAA Technical Memorandum NMFS. Status review of the Green turtle (Chelonia mydas) under the Endangered Species Act. March, 2015.

NOAA FOSS 2023. NOAA Fisheries Office of Science and Technology, Commercial Landings Query, Available at: www.fisheries.noaa.gov/foss, Accessed 08/24/23

NOAA, 2017. Green Sea Turtle (Chelonia mydas).

NOAA, 2017. Hawksbill Turtle (Eretmochelys imbricata)

NOAA-NMFS, 2015. Scalloped Hammerhead Shark (Sphyrna lewini)

NOAA-USFWS 2013. National Marine Fisheries Service. Office of Protected Resources and U.S. Fish and Wildlife Service. Hawksbill sea turtle (Eretmochelys imbricata) 5-year review: Summary and Evaluation. June 2013

Núñez Márquez, G. and A. T. Wakida 2003. Efecto de las vedas del 2000 y 2001 sobre la poblacio´n y la pesca de camaro´n siete barbas (Xiphopenaeus kroyeri) de Campeche, Me´xico. In: Wakida et al. Memorias del tercer foro de camaro´n del Golfo de Me´xico y Mar Caribe. Instituto Nacional de la Pesca. Me´xico. Accessed 9/11/23 from https://www.inapesca.gob.mx/portal/documentos/publicaciones/11Tercer+foro+de+camaron.pdf

Oceana 2024. Pesca Ilegal en Mexico: Soluciones desde la Politica Pesquera

Palomares, M.L.D. , R. Froese, B. Derrick, J.J. Meeuwig, S.-L. Nöel, G. Tsui, J. Woroniak, D. Zeller, D. Pauly, 2020. Fishery biomass trends of exploited fish populations in marine ecoregions, climatic zones and ocean basins, Estuarine, Coastal and Shelf Science, Volume 243, 2020.

Peckham, S.H., Maldonado, D., Senko, J., Esliman, A., 2013. Bycatch mass mortality of loggerhead turtles at NW Mexico. In: Paper presented at the 33rd International Symposium on Sea Turtle Biology and Conservation. Baltimore, MD, USA.

Peckham, S.H., Maldonado-Diaz, D., Walli, A., Ruiz, G., Crowder, L.B., Nichols, W.J., 2007. Small-scale fisheries bycatch jeopardizes endangered Pacific loggerhead turtles. PLoS ONE: e1041. doi: 10.1371/journal.pone.0001041.

Pedrin-Aviles, S., Lopez-Martinez, J., and Garcia-Hinostro, P. 2014. Granulometría y materia orgánica de áreas pesqueras rastreables y no rastreables en la costa central de Sonora, México.

Penagos Garcia, F., Tapia García, M., Espinoza Medinilla, E., and del Carpio Penagos C. 2011. Ictiofauna de la Plataforma Continental de la Región Soconusco, Chiapas, México. LACANDONIA, Vol. 5

Pollom, R. 2017. *Hippocampus erectus*. *The IUCN Red List of Threatened Species* 2017: e.T10066A20191442. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T10066A20191442.en.

Pollom, R., Avalos, C., Bizzarro, J., Burgos-Vázquez, M.I., Cevallos, A., Espinoza, M., González, A., Herman, K., Mejía-Falla, P.A., Morales-Saldaña, J.M., Navia, A.F., Pérez Jiménez, J.C. & Sosa-Nishizaki, O. 2020. *Hypanus longus*. *The IUCN Red List of Threatened Species* 2020: e.T60157A124445324. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T60157A124445324.en

Pollom, R., Avalos, C., Bizzarro, J.J., Burgos-Vázquez, M.I., Cevallos, A., Espinoza, M., González, A., Herman, K., Mejía-Falla, P.A., Morales-Saldaña, J.M., Navia, A.F., Pérez Jiménez, J.C., Sosa-Nishizaki, O. & Velez-Zuazo, X. 2020. Gymnura crebripunctata. The IUCN Red List of Threatened Species 2020: e.T14134431A124549206. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T14134431A124549206.en

Pollom, R., Bizzarro, J., Burgos-Vázquez, M.I., Cevallos, A., Velez-Zuazo, X., Avalos, C., Espinoza, M., González, A., Herman, K., Mejía-Falla, P.A., Navia, A.F., Pérez Jiménez, J.C. & Sosa-Nishizaki, O. 2020. Hypanus dipterurus. The IUCN Red List of Threatened Species 2020: e.T60152A80677563. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T60152A80677563.en. Accessed on 10 May 2024.

Pollom, R., Bizzarro, J.J., Burgos-Vázquez, M.I., Avalos, C., Herman, K., Pérez Jiménez, J.C. & Sosa-Nishizaki, O. 2020. *Gymnura marmorata*. *The IUCN Red List of Threatened Species* 2020: e.T14134429A124548901. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T14134429A124548901.en. Accessed on 01 March 2024.

PROFEPA 2015. EMBARCACIÓN CAMARONERA POR PESCAR EN ÁREA DE REFUGIO DE VAQUITA MARINA

Project Seahorse. 2003. Hippocampus erectus. In: IUCN 2012. IUCN Red List of Threatened Species.

Putman NF, Hawkins J, Gallaway BJ 2020. Managing fisheries in a world with more sea turtles. Proc. R. Soc. B 287: 20200220.

Ramírez-Valdez, A., Rowell, T. J., Dale, K. E., Craig, M. T., Allen, L. G., Villaseñor-Derbez, J. C., Cisneros-Montemayor, A. M., Hernández-Velasco, A., Torre, J., Hofmeister, J., & Erisman, B. E. 2021. Asymmetry across international borders: Research, fishery and management trends and economic value of the giant sea bass (*Stereolepis gigas*). Fish and Fisheries 22:1392–1411.

Rigby, C.L., Dulvy, N.K., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. Sphyrna lewini. The IUCN Red List of Threatened Species 2019: e.T39385A2918526.

Rodríguez-Preciado JA, Amezcua F, Bellgraph B y Madrid-Vera J, 2014 Feeding Habits and Trophic Level of the Panama Grunt Pomadasys panamensis, an Important Bycatch Species from the Shrimp Trawl Fishery in the Gulf of California, The Scientific World Journal. In press

Rojas-Bracho L, Taylor BL, Jaramillo-Legorreta A, Barlow J and others (2021) Survey report for vaquita research 2021. https://iucn-csg.org/wp-content/uploads/2022/02/Survey-report-for-Vaquita-research-2021-final.pdf

Rojas-Bracho, L., Taylor, B., Jaramillo-Legorreta, A., Olson, P., Ruiz, D., Hidalgo, E., Gerrodette, T., and Henry A. Survey report for vaquita. Photographic identification research 2019. https://iucn-csg.org/wpcontent/uploads/2020/03/2020-Vaquita-Field-Report.pdf

SADER-INAPESCA 2022 Informe técnico: Evaluación Biológica de las Poblaciones de Camarón de Aguas Protegidas de Baja California Sur, Sonora, Sinaloa y Nayarit para iniciar la

temporada de captura 2022-2023

SADER-INAPESCA b 2022. Informe técnico: Evaluación biológica de las poblaciones de camarón de altamar en el litoral del Pacífico Mexicano durante la veda 2022

SAGARPA 2004. Carta Nacional Pesquera, in SAGARPA/INAPESCA, editor.

SAGARPA 2015. ACUERDAN CONAPESCA Y PRODUCTORES UN PLAN DE OPERACIÓN DE INSPECCIÓN Y VIGILANCIA PARA LA VEDA DEL CAMARÓN EN SINALOA

SAGARPA-INAPESCA 2012. Evaluacion biologica de las poblaciones de camaron durante la veda de 2012 en el litoral del Pacifico Mexicano. Dictamen de Fin de veda. SAGARPA-INAPESCA, 109.

SAGARPA-INAPESCA, 2016. Evaluacion biologica de las poblaciones de camaron en el litoral del Pacifico Mexicano durante la veda 2016. Direccion General Adjunta de Investigacion pesquera en el Pacifico. Informe Tecnico.

Sala, E., O. Aburto-Oropeza, G. Paredes, I. Parra, J. Barrera, and P. Dayton. 2002. A general model for designing networks of marine reserves. Science. December 6, 2002. 298(5600):1991-3

Sánchez, A., Aguíñiga, S., Lluch-Belda, D., Camalich-Carpizo, J., Del Monte-Luna, P., Ponce-Díaz, G., and Arreguín-Sánchez, F. 2009. Geoquímica sedimentaria en áreas de pesca de arrastre y no arrastre de fondo en la costa de Sinaloa-Sonora, Golfo de California https://ipn.elsevierpure.com/en/publications/geoqu%C3%ADmica-sedimentaria-en-%C3%A1reas-de-pesca-de-arrastre-y-no-arrast

Schaefer, M.B. 1954. Some aspects of the dynamics of populations important to the management of the commercial marine fisheries. Bull. Inter-Am. Trop. Tuna Comm., 1 (1954), pp. 27-56

SCS Global Services 2019. Mexican Pacific Shrimp Fishery. MSC Fishery Assessment Report. Announcement Comment Draft Report. December 20 2019. Downloaded 3/1/24 from https://cert.msc.org/FileLoader/FileLinkDownload.asmx/GetFile?encryptedKey=ioeO0vfePjCMlGQ4q87HNVLRSf8tPOyOuJlLFFUBxmJkiEJRSDw8qxwfA4lB/hF3

Sea Sheperd, 2022. Illegal Fishing Vessel Report Vaquita Refuge

SICG 2019. Programa de Tecnicos Abordo Resumen Temporadas 2015-2016, 2016-2017 y 2017-2018

State Department, 2021. The United States Certifies Mexico's Shrimp Imports. MEDIA NOTE OFFICE OF THE SPOKESPERSON. OCTOBER 21, 2021

US DOS. 2016. Annual Certification of Shrimp-Harvesting Nations

Valenzuela-Quiñónez, Wenceslao & Aragon-Noriega, Eugenio & ALVARADO-ROMERO, DULCE & Zavala, César A. & GARCÍA-JUÁREZ, ALMA. (2009). Application of an egg production index to determine reproductive period of the brown shrimp Farfantepenaeus californiensis near Agiabampo, Sonora-Sinaloa, Mexico. Journal of Shellfish Research. 25. 123-127. 10.2983/0730-8000(2006)25[123:AOAEPI]2.0.CO;2.

van der Heiden, A., Rojas, P., Cotto, A. 2010. *Diapterus aureolus*. *The IUCN Red List of Threatened Species* 2010. Accessed on 24 May 2024 from https://www.iucnredlist.org/species/183973/8209244

Vasquez-Leon M. 2012. Policies of conservation and sustainable development: Fishing communities in the Gulf of California. BARA: Bureau of Applied Research in Anthropology. The University of Arizona.

Villaseñor-Talavera 2012. Pesca de camarón con sistema de arrastre y cambios tecnológicos implementados para mitigar sus efectos en el ecosistema. En López-Martínez J y E. Morales-Bojórquez (Eds.) Efectos de la pesca de arrastre en el Golfo de California. Centro de Investigaciones Biológicas del Noroeste, S.C. y Fundación Produce, Sonora, México, pp. 281-313.

Wakida-Kusunoki. 2005. Seabob Shrimp Small-scale Fishery in Southeastern of Mexico. GCFI 56. Watling, L., and E. Norse. 1998. Disturbance of the seabed by mobile fishing gear: a comparison to forest clearcutting. Conservation Biology. 12(6).

Wallace, B.P., A.D. DiMatteo, A.B. Bolten, M.Y. Chaloupka, B.J. Hutchinson, F. A. Abreu-Grobois, J. A. Mortimer, J. A. Seminoff, D. Amorocho, K.A. Bjorndal, J. Bourjea, B.W. Bowen, R. Briseño Dueñas, P. Casale, B.C. Choudhury, A. Costa, P.H. Dutton, A. Fallabrino, E.M. Finkbeiner, A. Girard, M. Girondot, M. Hamann, B.J. Hurley, M. López-Mendilaharsu, M.A. Marcovaldi, J.A. Musick, R. Nel, N.J. Pilcher, S. Troëng, B. Witherington, R.B. Mast. 2011. Global conservation priorities for marine turtles. PLos ONE 6(9): e24510.

Wibbels T and Bevan E 2019. Lepidochelys kempii (errata version published in 2019). The IUCN Red List of Threatened Species 2019: e.T11533A155057916.

Appendix A: Main species determination tables (bottom trawl for shrimp)

Table A1: List of all species recorded by the SICG observer program for the Pacific shrimp fishery, with averages of catch and discarded weight volumes (t) for 2015, 2016 and 2017 seasons. Information for most species was provided grouping most species at the family level. MSC classification is provided in the last column, based on volume and protection status. From MSC Fishery Assessment Report (SCS Global Services 2019).

Table 5

Common Name (Spanish)	Family	Scientific Name - Reported	Scientific Name - IUCN	Total Catch (t)	Discarded Catch (t)	Tot Cat (%)
Camarón Café	*Penaeidae*	*Farfantepenaeus californiensis*	*Farfantepenaeus californiensis*	226.3	0	10.
Otros Camarones Y Camaron Café Talla Chica	*Penaeidae*	*Farfantepenaeus brevirostris, Xiphopenaeus riveti, Farfantepenaeus californiensis*	*Farfantepenaeus brevirostris, Xiphopenaeus riveti, Farfantepenaeus californiensis*	194.9	0	9.3
Jaiba	*Portunidae*	*Callinectes Bellicosius, Callinectes Arcuatus*	*Callinectes Bellicosius, Callinectes Arcuatus*	171.3	165.9	8.2
Mojarras	*Gerreidae*	*Diapterus aureolus, Diapterus peruvianus*	*Diapterus aureolus, Diapterus peruvianus*	167.9	163.7	8

Rayas Y Mantarrayas	*Dasyatidae, Gymnuridae, Mobulidae, Rhinobatidae*	*Dasyatis dipterura, Dasyatis longa, Dasyatis violacea, Gymnura crebripunctata, Gymnura marmorata, Rhinobatos glaucostigma*	*Hypanus dipterurus, Hypanus longus, Pteroplatytrygon violacea, Gymnura crebripunctata, Gymnura marmorata, Pseudobatos glaucostigmus*	109.4	93.8	5.2
Burros	*Haemulidae*	*Haemulon steindachneri, Haemulon scudderii*	*Haemulon steindachneri, Haemulon scudderii*	98.7	88.4	4.7
Chiles	*Synodontidae*	*Synodus evermanni, Synodus lucioceps, Synodus scituliceps, Synodus sechurae*	*Synodus evermanni, Synodus lucioceps, Synodus scituliceps, Synodus sechurae*	95.6	85.3	4.6
Lenguados	*Achiridae, Bothidae*	*Achirus klunzingeri, Achirus mazatlanus, Achirus scutum, Bothus constellatus, Bothus leopardinus, Engyophrys sanctilaurentia*	*Achirus klunzingeri, Achirus mazatlanus, Achirus scutum, Bothus constellatus, Bothus leopardinus, Engyophrys sanctilaurentii*	82.8	48.9	4

Jureles, Pampanos, Medregales	*Nematistiidae, Carangidae*	*Nematistius pectoralis, Naucrates ductor, Oligoplites altus, Oligoplites refulgens, Alectis ciliaris, Caranx caballus, Caranx caninus, Caranx lugubris, Caranx melampygus, Caranx orthogrammus*	*Nematistius pectoralis, Naucrates ductor, Oligoplites altus, Oligoplites refulgens, Alectis ciliaris, Caranx caballus, Caranx caninus, Caranx lugubris, Caranx melampygus, Carangoides orthogrammus*	72.4	68	3.5
Chivos	*Mullidae*	*Mulloidichthys dentatus, Pseudupeneus grandisquamis*	*Mulloidichthys dentatus, Pseudupeneus grandisquamis*	68.8	68	3.3
Camarón azul	*Penaeidae*	*Litopenaeus stylirostris*	*Litopenaeus stylirostris*	67.2	0	3.2
Estrellas De Mar	*Asteriidae*	*Henricia levisuscula, Leptasterias hexactis, Patiria miniata, Pisaster brevipinus, Pisaster giganteus, Pisaster ochraceus, Pycnopodia helianthoides*	*Henricia levisuscula, Leptasterias hexactis, Patiria miniata, Pisaster brevipinus, Pisaster giganteus, Pisaster ochraceus, Pycnopodia helianthoides*	58.5	58	2.8

Corvinas, Berrugatas	*Sciaenidae*	*Bairdiella armata, Atractoscion nobilis, Bairdiella ensifera, Bairdiella incistia, Cheilotrema saturnum, Cynoscion albus, Cynoscion nannus, Cynoscion reticulatus, Elattarchus archidium, Isopisthus remifer*	*Bairdiella armata, Atractoscion nobilis, Bairdiella ensifera, Bairdiella icistia, Cheilotrema saturnum, Cynoscion albus, Cynoscion nannus, Cynoscion reticulatus, Elattarchus archidium, Isopisthus remifer*	54.2	27.9	2.6
Vacas, Rubios	*Triglidae*	*Bellator gymnostethus, Bellator loxias, Prionotus albirostris, Prionotus birostratus*	*Bellator gymnostethus, Bellator loxias, Prionotus albirostris, Prionotus birostratus*	48.1	44.6	2.3
Bagre	*Ariidae*	*Ariopsis guatemalensis, Notarius kessleri, Occidentarius platypogon*	*Ariopsis guatemalensis, Notarius kessleri, Occidentarius platypogon*	39.2	36.8	1.9
Pargos		*Pargos spp*	*Pargos spp*	37.2	18.5	1.8
Cabrillas, Mero, Baquetas	*Moronidae, Serranidae*	*Stereolepis gigas, Alphestes immaculatus, Alphestes multiguttatus, Hyporthodus acanthistius, Epinephelus analogus*	*Stereolepis gigas, Alphestes immaculatus, Alphestes multiguttatus, Hyporthodus acanthistius, Epinephelus analogus*	30.3	27.1	1.5

Escorpiones, Rocotes	*Scorpaenidae*	*Pontinus furcirhinus, Pontinus sierra, Pontinus vaughani, Scorpaena guttata, Scorpaena histrio, Scorpaena mystes, Scorpaenodes xyris, Sebastes cortezi, Sebastes macdonaldi Scorpaena sonorae,*	*Pontinus furcirhinus, Pontinus sierra, Pontinus vaughani, Scorpaena guttata, Scorpaena histrio, Scorpaena mystes, Scorpaenodes xyris, Sebastes cortezi, Sebastes macdonaldi, Scorpaena sonorae,*	26.5	25.3	1.3
Sardinas	*Clupeidae*	*Etrumeus teres, Harengula thrissina, Lile stolifera, Lile gracilis, Opisthonema bulleri, Opisthonema libertate, Opisthonema medirastre*	*Etrumeus sadina, Harengula thrissina, Lile stolifera, Lile gracilis, Opisthonema bulleri, Opisthonema libertate, Opisthonema medirastre*	26.3	26.2	1.3
Camarón blanco	*Penaeidae*	*Litopenaeus vannamei*	*Litopenaeus vannamei*	24.9	0	1.2
Camarón Blanco Del Pacífico		*Litopenaeus occidentalis (BLANCO)*	*Litopenaeus occidentalis*	24.9	0	1.2
Botetes	*Tetraodontidae*	*Arothron hispidus, Arothron meleagris, Lagocephalus lagocephalus*	*Arothron hispidus, Arothron meleagris, Lagocephalus lagocephalus*	22.6	4.8	1.1
Peces Sapo	*Batrachoididae*	*Batrachoides waltersi, Porichthys analis*	*Batrachoides waltersi, Porichthys analis*	21.8	21.7	1

Camaron Mantis	*Hemisquillidae, Lysiosquillidae*	*Hemisquilla ensigera californiensis, Lysiosquilla desaussurei*	*Hemisquilla ensigera californiensis, Lysiosquilla desaussurei*	20.3	20.3	1
Morenas	*Muraenidae*	*Gymnothorax castaneus, Gymnothorax mordax*	*Gymnothorax castaneus, Gymnothorax mordax*	19.4	19.4	0.9
Cochis	*Balistidae*	*Balistes polylepis, Pseudobalistes naufragium, Sufflamen verres*	*Balistes polylepis, Pseudobalistes naufragium, Sufflamen verres*	17.9	5.4	0.9
Caracol		*Caracol spp*	*Caracol spp*	14.5	11.4	0.7
Lenguas	*Cynoglossidae*	*Symphurus atramentatus, Symphurus atricaudus, Symphurus callopterus, Symphurus chabanaudi, Symphurus elongatus, Symphurus gorgonae*	*Symphurus atramentatus, Symphurus atricaudus, Symphurus callopterus, Symphurus chabanaudi, Symphurus elongatus, Symphurus gorgonae*	14.3	14.1	0.7
Medusa Bola De Cañon	*Rhizostomatidae*	*Stomolophus meleagris*	*Stomolophus meleagris*	13.5	13.5	0.6
Agujones		*Tylosurus pacificus, Tylosurus crocodilus, Ablennes hians*	*Tylosurus pacificus, Tylosurus crocodilus, Ablennes hians*	13	12.4	0.6

Robalos	*Centropomidae*	*Centropomus armatus, Centropomus medius, Centropomus nigrescens*	*Centropomus armatus, Centropomus medius, Centropomus nigrescens*	12.8	5.7	0.6
Cangrejos Cajeta	*Calappidae*	*Calappa saussurei, Hepatus kossmanni, Hepatus lineatus, Platymera gaudichaudii*	*Calappa saussurei, Hepatus kossmanni, Hepatus lineatus, Platymera gaudichaudii*	12.3	10.9	0.6
Raton		*Cheilotrema saturnum*	*Cheilotrema saturnum*	11.4	10.4	0.5
Calamar	*Loliginidae, Ommastrephidae*	*Loligo opalescens, Loliolopsis diomedeae, Dosidicus gigas*	*Doryteuthis opalescens, Loliolopsis diomedeae, Dosidicus gigas*	10.7	0.3	0.5
Algas Rojas	*Gigartinaceae, Florideophyceae, Gelidiaceae, Bangiaceae*	*Gigartina canaliculata, Eucheuma uncinatum, Gelidium robustum*	*Gigartina canaliculata, Eucheuma uncinatum, Gelidium robustum*	9.9	9.9	0.5
Peluqueros	*Ephippidae*	*Parapsettus panamensis, Chaetodipterus zonatus*	*Parapsettus panamensis, Chaetodipterus zonatus*	9.1	7.9	0.4
Piernas, Conejo	*Malacanthidae, Caulolatilus affinis, Caulolatilus cabezon*	*Caulolatilus hubbsi, Caulolatilus princeps, Caulolatilus affinis*	*Caulolatilus hubbsi, Caulolatilus princeps, Caulolatilus affinis*	8.6	7.8	0.4
Palometas	*Stromateidae*	*Peprilus medius, Peprilus simillimus, Peprilus snyderi*	*Peprilus medius, Peprilus simillimus, Peprilus snyderi*	8.2	4.9	0.4

Sierra	*Scombridae*	*Acanthocybium solandri, Scomber japonicus, Scomberomorus concolor, Scomberomorus sierra*	*Acanthocybium solandri, Scomber japonicus, Scomberomorus concolor, Scomberomorus sierra*	7.9	1.1	0.4
Conchas		*Conchas*	*Conchas*	7.4	7.4	0.4
Anchoveta	*Engraulidae*	*Anchoa analis, Anchoa argentivittata, Anchoa lucida , Anchoa helleri*	*Anchoa analis, Anchoa argentivittata, Anchoa lucida , Anchoa helleri*	6.6	6.6	0.3
Cangrejo	*(blank)*	*Cangrejo Spp*	*Cangrejo Spp*	6.2	4.1	0.3
Caracol Chino	*Muricidae*	*Hexaplex nigritus, Phyllonotus erhythostoma, Phyllonotus regius, Haustellum recurvirostris*	*Hexaplex nigritus, Phyllonotus erhythostoma, Phyllonotus regius, Haustellum recurvirostris*	6.1	1.1	0.3
Pejerrey	*Atherinidae*	*Atherinella eriarcha*	*Atherinella eriarcha*	5.6	5.5	0.3
Tiburon		*tiburon spp*	*tiburon spp*	5.1	1.1	0.2
Lapa	*Patellidae*	*Patella mexicana*	*Patella mexicana*	4.8	4.8	0.2
Brotulas, Cong	*Ophidiidae*	*Lepophidium microlepis*	*Lepophidium microlepis*	3.9	3.8	0.2
Cangrejo Ermitaño	*Diogenidae*	*Petrochirus californiensis*	*Petrochirus californiensis*	3.7	3.7	0.2
Cangrejo De Piedra	*Xanthidae*	*Menippe frontalis, Ozius verreauxii*	*Menippe frontalis, Ozius verreauxii*	3.5	2.9	0.2
Galleta De Mar	*Clypeasteridae*	*Clypeaster rotundus, Encope grandis, Mellita longifissa*	*Clypeaster rotundus, Encope grandis, Mellita longifissa*	3.4	3.4	0.2

Chupapiedra	*Gobiesocidae*	*Tomicodon eos, Tomicodon zebra*	*Tomicodon eos, Tomicodon zebra*	3.1	3.1	0.1
Camaron Roca	*Sicyoniidae*	*Sicyonia Disdorsalis*	*Sicyonia Disdorsalis*	3	0.6	0.1
Congrios	*Congridae*	*Ariosoma gilberti, Rhynchoconger nitens, Chiloconger dentatus*	*Ariosoma gilberti, Rhynchoconger nitens, Chiloconger dentatus*	2.9	2.8	0.1
Langosta	*Palinuridae*	*Panulirus gracilis, Panulirus inflatus, Panulirus interruptus, Panulirus penicillatus*	*Panulirus gracilis, Panulirus inflatus, Panulirus interruptus, Panulirus penicillatus*	2.7	1.7	0.1
Sargazos	*Alariaceae, Lessoniaceae, Sargassaceae*	*Eisenia arborea, Macrocystis pyrifera, Sargassum sinicola*	*Eisenia arborea, Macrocystis pyrifera, Sargassum sinicola*	2.7	2.5	0.1
Cangrejos Araña	*Majidae*	*Maiopsis panamensis, Mithrax armatus*	*Maiopsis panamensis, Mithrax armatus*	2.5	2.5	0.1
Chopas	*Kyphosidae*	*Girella nigricans, Kyphosus analogus*	*Girella nigricans, Kyphosus analogus*	2.4	2.3	0.1
Almeja Blanca		*Dosinia ponderosa*	*Dosinia ponderosa*	2.1	2	0.1
Dormilonas	*Lobotidae*	*Lobotes pacificus*	*Lobotes pacificus*	2	2	0.1
Erizo	*Echinometridae, Arbaciidae*	*Echinometra vanbrunti, Strongylocentrotus franciscanus, Strongylocentrotus purpuratus*	*Echinometra vanbrunti, Strongylocentrotus franciscanus, Strongylocentrotus purpuratus*	2	2	0.1

Calamar Dedal	*Loliginidae*	*Loligo opalescens, Loliolopsis diomedeae*	*Doryteuthis opalescens, Loliolopsis diomedeae*	1.8	0.01	0.1
Langostino	*Palaemonidae*	*Macrobrachium americanum*	*Macrobrachium americanum*	1.7	1.7	0.1
Concha, Joyero	*Chamidae*	*Chama buddiana*	*Chama buddiana*	1.6	1.6	0.1
Caracol Menongena	*Melongenidae*	*Melongena patula*	*Melongena patula*	1.5	0.02	0.1
Gobios	*Gobiidae*	*Gobionellus microdon, Barbulifer pantherinus, Microgobius miraflorensis, Barbulifer pantherinus, Bathygobius ramosus, Bollmania stigmatura, Bollmannia chlamydes, Bollmania ocellata*	*Gobionellus microdon, Barbulifer pantherinus, Microgobius miraflorensis, Barbulifer pantherinus, Bathygobius ramosus, Bollmannia stigmatura, Bollmannia chlamydes, Bollmannia ocellata*	1.5	1.3	0.1
Lisas	*Monacanthidae, Mugilidae*	*Aluterus monoceros, Mugil cephalus, Mugil curema*	*Aluterus monoceros, Mugil cephalus, Mugil curema*	1.4	1.2	0.1
Angel	*Pomacanthidae*	*Holacanthus passer*	*Holacanthus passer*	1.4	0.8	0.1
Jaiba de Roca	*Portunidae*	*Euphylax robustus*	*Euphylax robustus*	1.2	1.2	0.1

Viejas	*Labridae*	*Bodianus diplotaenia, Decodon melasma, Halichoeres dispilus*	*Bodianus diplotaenia, Decodon melasma, Halichoeres dispilus*	1.2	1.1	0.1
Cintas, Sables	*Trichiuridae*	*Lepidopus fitchi, Trichiurus lepturus, Trichiurus nitens*	*Lepidopus fitchi, Trichiurus lepturus*	1.2	1.2	0.1
Barracudas	*Sphyraenidae*	*Sphyraena argentea*	*Sphyraena argentea*	1.2	1	0.1
Almeja Catarina	*Pectinidae*	*Argopecten ventricosus*	*Argopecten ventricosus*	1.1	1.1	0.1
Barbudo	*Polynemidae*	*Polydactylus opercularis*	*Polydactylus opercularis*	1	1	0
Culebras				1	1	0
Caracol Burro	*Strombidae*	*Strombus peruvianus, Strombus galeatus*	*Strombus peruvianus, Strombus galeatus*	1	0.3	0
Antenados	*Antennariidae*	*Antennarius sanguineus*	*Antennatus sanguineus*	0.9	0.8	0
Mariposas	*Chaetodontidae*	*Chaetodon humeralis*	*Chaetodon humeralis*	0.9	0.9	0
Pulpo	*Octopodidae*	*Octopus bimaculatus, Octopus digueti, Octopus vulgaris*	*Octopus bimaculatus, Paroctopus digueti, Octopus vulgaris*	0.9	0.3	0
Tiesos	*Ophicthidae*	*Ophichthus zophochir*	*Ophichthus zophochir*	0.8	0.8	0
Ronco				0.8	0.8	0

Escolares	*Gempylidae*	*Gempylus serpens, Lepidocybium flavobrunneum, Ruvettus pretiosus*	*Gempylus serpens, Lepidocybium flavobrunneum, Ruvettus pretiosus*	0.7	0.4	0
Cangrejo tractor				0.7	0.7	0
Caracol Trompeta	*Fasciolariidae*	*Pleuroploca princeps, Pleuroploca granosa, Pleuroploca salmo*	*Pleuroploca princeps, Pleuroploca granosa, Pleuroploca salmo*	0.7	0.7	0
Esponja		*Phylum: Porifera*	*Phylum: Porifera*	0.6	0.6	0
Calamar Gigante	*Ommastrephidae*	*Dosidicus gigas*	*Dosidicus gigas*	0.6	0.2	0
Catalufas	*Priacanthidae*	*Heteropriacanthus cruentatus, Priacanthus alalaua, Pristigenys serrula*	*Heteropriacanthus cruentatus, Priacanthus alalaua, Pristigenys serrula*	0.6	0.6	0
Tortugas		*tortugas spp*	*tortugas spp*	0.6	0.6	0
Almeja Roñosa	*Veneridae*	*Chione californiensis*	*Chione californiensis*	0.5	0.4	0
Picudos	*Istiophoridae, Xiphiidae*	*Xiphias gladius, Istiophorus platypterus, Makaira indica, M. nigricans*	*Xiphias gladius, Istiophorus platypterus, Istiompax indica, Makaira nigricans*	0.5	0.4	0
Almeja China	*Veneridae*	*Chione californiensis*	*Chione californiensis*	0.4	0.4	0
Machete	*Elopidae*	*Elops affinis*	*Elops affinis*	0.3	0.3	0
Coral	*Pocilloporidae*	*Pocillopora damicornis*	*Pocillopora damicornis*	0.3	0.3	0

Caballitos De Mar		*Hippocampus ingens*	*Hippocampus ingens*	0.3	0.3	0
Cardenales	*Apogonidae*	*Apogon pacificus*	*Apogon pacificus*	0.2	0.2	0
Poliquetos		*poliquetos spp*	*poliquetos spp*	0.2	203	0
Murcielago	*Opistognathidae*	*Opistognathus rosenblatti, Opistognathus punctatus*	*Opistognathus rosenblatti, Opistognathus punctatus*	0.2	158	0
Camaron rosado	*Penaeidae*	*Farfantepenaeus duorarum*	*Farfantepenaeus duorarum*	0.2	0.2	0
Almeja Chocolata		*Megapitaria aurantiaca*	*Megapitaria aurantiaca*	0.2	0.2	0
Almeja Pata De Mula	*Arcidae*	*Anadara grandis*	*Anadara grandis*	0.2	0.1	0
Callo De Hacha	*Pinnidae*	*Atrina maura, Pinna rugosa, Atrina oldroydii*	*Atrina maura, Pinna rugosa, Atrina oldroydii*	0.2	0.1	0
Abulon	*Haliotidae*	*Haliotis assimilis*	*Haliotis kamtschatkana*	0.2	0.1	0
Enteromorpha	*Luvaridae, Ulvaceae*	*Luvarus imperialis, Enteromorpha clathrata, Enteromorpha compressa, Enteromorpha intestinalis*	*Luvarus imperialis, Enteromorpha clathrata, Enteromorpha compressa, Enteromorpha intestinalis*	0.1	0.1	0
Castañetas	*Pomacentridae*	*Hypsypops rubicundus, Abudefduf concolor, Chromis alta*	*Hypsypops rubicundus, Abudefduf concolor, Chromis alta*	0.1	0.1	0
Almeja Voladora		*Pecten vogdesi*	*Pecten vogdesi*	0.1	0.1	0
Delfines	*Delphinidae*	*Delphinus capensis*	*Delphinus delphis*	0.1	0.1	0

Berberechos	*Cardiidae*	*Laevicardium elatum, Trachycardium panamense*	*Laevicardium elatum, Trachycardium panamense*	0.1	0.1	0
Candiles	*Holocentridae*	*Myripristis leiognathus*	*Myripristis leiognathus*	0.1	0.1	0
Munidas	*Galatheidae*	*Munida hispida, Munida refulgens*	*Munida hispida, Munida refulgens*	0.1	0.1	0
Halcones, Mero Chino	*Cirrhitidae*	*Cirrhitus rivulatus*	*Cirrhitus rivulatus*	0.1	0.01	0
Almejas	*Almejas spp.*	*(blank)*	*(blank)*	0.1	0.1	0
Lobo Marino	*Otariidae*	*Zalophus californianus*	*Zalophus californianus*	0.1	0.1	0
Atun		*Thunnus alalunga, Thunnus albacares, Thunnus obesus*	*Thunnus alalunga, Thunnus albacares, Thunnus obesus*	0.1	0.04	0
Cangrejos Abuetes	*Grapsidae*	*Sesarma sulcatum*	*Sesarma sulcatum*	0.1	0.1	0
Pepino De Mar	*Holothuriidae, Stichopodidae*	*Isostichopus fuscus, Parastichopus parvimensis, Pollicipes elegans*	*Isostichopus fuscus, Apostichopus parvimensis, Pollicipes elegans*	0.1	0.1	0
Molas	*Molidae*	*Mola mola*	*Mola mola*	0.1	0.1	0
Pericos	*Scaridae*	*Nicholsina denticulata, Scarus compressus, Scarus ghobban*	*Nicholsina denticulata, Scarus compressus, Scarus ghobban*	0.1	0.1	0
Dorado	*Coryphaenidae*	*Coryphaena hippurus*	*Coryphaena hippurus*	0	0	0
Purpuras		*purpuras spp*	*purpuras spp*	0	0	0

Cirujanos	*Acanthuridae*	*Acanthurus triostegus, Acanthurus xanthopterus, Prionurus punctatus*	*Acanthurus triostegus, Acanthurus xanthopterus, Prionurus punctatus*	0	0	0
Hueva		*hueva*	*hueva*	0	0	0
Pajaritos				0	0	0
Guavinas	*Eleotridae*	*Dormitator latifrons*	*Dormitator latifrons*	0	0	0
Mejillon	*Mytilidae*	*Choromytilus palliopunctatus, Modiolus americanus*	*Choromytilus palliopunctatus, Modiolus americanus*	0	0	0
Borrachos	*Blenniidae*	*Hypsoblennius brevipinnis*	*Hypsoblennius brevipinnis*	0	0	0
Caracol Panocha	*Turbinidae*	*Turbo fluctuosus*	*Turbo fluctuosus*	0	0	0
Tiburon Cazon		*Galeorhinus galeus*	*Galeorhinus galeus*	0	0	0
Cangrejos Moros De Mangle		*Cangrejo spp.*	*Cangrejo spp.*	0	0	0
Cangrejos jaiba de roca				0	0	0
Madreperla	*Pteriidae*	*Pinctada mazatlanica*	*Pinctada mazatlanica*	0	0	0
Conos				0	0	0
Coquinas				0	0	0
Pipas	*Syngnathidae*	*Cosmocampus arctus, Syngnathus californiensis*	*Cosmocampus arctus, Syngnathus californiensis*	0	0	0

Bacalao	*Anoplopomatidae*	*Anoplopoma fimbria*	*Anoplopoma fimbria*	0	0	0
Espadas	*Belonidae*	*tylosurus fodiator*	*tylosurus fodiator*	0	0	0
Almeja De Fango	*Corbiculidae*	*Anadara mazatlanica*	*Anadara mazatlanica*	0	0	0
Almeja Generosa	*Hiatellidae*	*Panopea generosa*	*Panopea generosa*	0	0	0
Almeja pismo	*Verenidae*	*Tivela stultorum*	*Tivela stultorum*	0	0	0
Almeja Mano De Leon		*Nodipecten subnodosus*	*Nodipecten subnodosus*	0	0	0
Pez Remo	*Regalecidae*	*Regalecus glesne*	*Regalecus glesne*	0	0	0
Voladores	*Exocoetidae*	*Cypselurus callopterus*	*Cypselurus callopterus*	0	0	0
Almeja Burra	*Spondylidae*	*Spondylus calcifer*	*Spondylus calcifer*	0	0	0

Table A2: Results of species match from Table A1 with the IUCN database (Downloaded 2/28/24). Blank cells for the rightmost four columns indicates the species has not been assessed by IUCN.

Table 6

Common Name (Spanish)	English name (IUCN)	SciName - corrected original	ScientificName (IUCN)	redlistCategory	scopes
Tiburon Cazon	Tope	Galeorhinus galeus	Galeorhinus galeus	Critically Endangered	Global
Pepino De Mar		Apostichopus parvimensis	Apostichopus parvimensis	Vulnerable	Global
Pepino De Mar		Isostichopus fuscus	Isostichopus fuscus	Endangered	Global
Molas	Ocean Sunfish	Mola mola	Mola mola	Vulnerable	Global

Sierra	Monterrey Spanish Mackerel	Scomberomorus concolor	Scomberomorus concolor	Near threatened	Global
Cabrillas, Mero, Baquetas	Giant Sea Bass	Stereolepis gigas	Stereolepis gigas	Critically Endangered	
Picudos	Swordfish	Xiphias gladius	Xiphias gladius	Near Threatened	Global
Picudos	Sailfish	Istiophorus platypterus	Istiophorus platypterus	Vulnerable	Global
Atun	Bigeye Tuna	Thunnus obesus	Thunnus obesus	Vulnerable	Global
Picudos	Blue Marlin	Makaira nigricans	Makaira nigricans	Vulnerable	Global
Caballitos De Mar	Giant Seahorse	Hippocampus ingens	Hippocampus ingens	Vulnerable	Global
Abulon	Pinto Abalone	Haliotis kamtschatkana	Haliotis kamtschatkana	Endangered	Global
Rayas Y Mantarrayas	Diamond Stingray	Hypanus dipterurus	Hypanus dipterurus	Vulnerable	Global
Cabrillas, Mero, Baquetas	Rooster Hind	Hyporthodus acanthistius	Hyporthodus acanthistius	Vulnerable	Global
Rayas Y Mantarrayas	Longtail Stingray	Hypanus longus	Hypanus longus	Vulnerable	Global
Rayas Y Mantarrayas	Speckled Guitarfish	Pseudobatos glaucostigmus	Pseudobatos glaucostigmus	Vulnerable	Global
Rayas Y Mantarrayas	California Butterfly Ray	Gymnura marmorata	Gymnura marmorata	Near Threatened	Global
Rayas Y Mantarrayas	Mazatlan Butterfly Ray	Gymnura crebripunctata	Gymnura crebripunctata	Near Threatened	Global
Estrellas De Mar	Sunflower Sea Star	Pycnopodia helianthoides	Pycnopodia helianthoides	Critically Endangered	Global
Rayas Y Mantarrayas	Pelagic Stingray	Pteroplatytrygon violacea	Pteroplatytrygon violacea	Least Concern	Global

Calamar	Opalescent Inshore Squid	Doryteuthis opalescens	Doryteuthis opalescens	Least Concern	Global
Calamar Dedal	Opalescent Inshore Squid	Doryteuthis opalescens	Doryteuthis opalescens	Least Concern	Global
Cirujanos	Convict Surgeonfish	Acanthurus triostegus	Acanthurus triostegus	Least Concern	Global
Cirujanos	Yellowfin Surgeonfish	Acanthurus xanthopterus	Acanthurus xanthopterus	Least Concern	Global
Pulpo		Octopus vulgaris	Octopus vulgaris	Least Concern	Global
Guavinas	Pacific Fat Sleeper	Dormitator latifrons	Dormitator latifrons	Least Concern	Global
Peces Sapo	Multipored Toadfish	Batrachoides waltersi	Batrachoides waltersi	Least Concern	Global
Gobios	Estuary Goby	Gobionellus microdon	Gobionellus microdon	Least Concern	Global
Lenguados	Mazatlan Sole	Achirus mazatlanus	Achirus mazatlanus	Least Concern	Global
Jureles, Pampanos, Medregales	Longjaw Leatherjacket	Oligoplites altus	Oligoplites altus	Least Concern	Global
Gobios	Miraflores goby	Microgobius miraflorensis	Microgobius miraflorensis	Least Concern	Global
Pulpo		Paroctopus digueti	Paroctopus digueti	Least Concern	Global
Pulpo		Octopus bimaculatus	Octopus bimaculatus	Least Concern	Global
Botetes	Guineafowl Puffer	Arothron meleagris	Arothron meleagris	Least Concern	Global
Botetes	White-spotted Puffer	Arothron hispidus	Arothron hispidus	Least Concern	Global
Morenas	California Moray	Gymnothorax mordax	Gymnothorax mordax	Least Concern	Global

Robalos		Centropomus medius	Centropomus medius	Least Concern	Global
Lisas	Flathead Mullet	Mugil cephalus	Mugil cephalus	Least Concern	Global
Dorado	Common Dolphinfish	Coryphaena hippurus	Coryphaena hippurus	Least Concern	Global
Jureles, Pampanos, Medregales	African Pompano	Alectis ciliaris	Alectis ciliaris	Least Concern	Global
Piernas, Conejo	Hubbs' Tilefish	Caulolatilus hubbsi	Caulolatilus hubbsi	Least Concern	Global
Piernas, Conejo	Bighead Tilefish	Caulolatilus affinis	Caulolatilus affinis	Least Concern	Global
Langostino		Macrobrachium americanum	Macrobrachium americanum	Least Concern	Global
Mariposas		Chaetodon humeralis	Chaetodon humeralis	Least Concern	Global
Angel	King Angelfish	Holacanthus passer	Holacanthus passer	Least Concern	Global
Langosta	Pronghorn Spiny Lobster	Panulirus penicillatus	Panulirus penicillatus	Least Concern	Global
Langosta	California Spiny Lobster	Panulirus interruptus	Panulirus interruptus	Least Concern	Global
Langosta	Blue Spiny Lobster	Panulirus inflatus	Panulirus inflatus	Least Concern	Global
Sierra	Wahoo	Acanthocybium solandri	Acanthocybium solandri	Least Concern	Global
Dormilonas		Lobotes pacificus	Lobotes pacificus	Least Concern	Global
Catalufas		Pristigenys serrula	Pristigenys serrula	Least Concern	Global
Halcones, Mero Chino	Giant Hawkfish	Cirrhitus rivulatus	Cirrhitus rivulatus	Least Concern	Global
Peluqueros	Pacific Spadefish	Chaetodipterus zonatus	Chaetodipterus zonatus	Least Concern	Global

Peluqueros		Parapsettus panamensis	Parapsettus panamensis	Least Concern	Global
Catalufas	Alalaua	Priacanthus alalaua	Priacanthus alalaua	Least Concern	Global
Barracudas	Pacific Barracuda	Sphyraena argentea	Sphyraena argentea	Least Concern	Global
Chiles		Synodus lucioceps	Synodus lucioceps	Least Concern	Global
Chopas		Kyphosus analogus	Kyphosus analogus	Least Concern	Global
Murcielago		Opistognathus punctatus	Opistognathus punctatus	Least Concern	Global
Chupapiedra		Tomicodon zebra	Tomicodon zebra	Least Concern	Global
Escorpiones, Rocotes	Red Scorpionfish	Pontinus furcirhinus	Pontinus furcirhinus	Least Concern	Global
Cochis	Stone Triggerfish	Pseudobalistes naufragium	Pseudobalistes naufragium	Least Concern	Global
Jureles, Pampanos, Medregales	Pacific Crevalle Jack	Caranx caninus	Caranx caninus	Least Concern	Global
Sardinas	Pacific Piquitinga	Lile stolifera	Lile stolifera	Least Concern	Global
Palometas		Peprilus simillimus	Peprilus simillimus	Least Concern	Global
Palometas	Pacific Harvestfish	Peprilus medius	Peprilus medius	Least Concern	Global
Castañetas		Hypsypops rubicundus	Hypsypops rubicundus	Least Concern	Global
Bagre	Widehead Sea Catfish	Ariopsis guatemalensis	Ariopsis guatemalensis	Least Concern	Global
Cardenales	Pink Cardinalfish	Apogon pacificus	Apogon pacificus	Least Concern	Global
Vacas, Rubios		Bellator loxias	Bellator loxias	Least Concern	Global

Borrachos	Barnacle Blenny	Hypsoblennius brevipinnis	Hypsoblennius brevipinnis	Least Concern	Global
Candiles		Myripristis leiognathus	Myripristis leiognathus	Least Concern	Global
Anchoveta	Bright Anchovy	Anchoa lucida	Anchoa lucida	Least Concern	Global
Morenas		Gymnothorax castaneus	Gymnothorax castaneus	Least Concern	Global
Castañetas		Abudefduf concolor	Abudefduf concolor	Least Concern	Global
Congrios	Sharpnose Conger	Ariosoma gilberti	Ariosoma gilberti	Least Concern	Global
Burros		Haemulon scudderii	Haemulon scudderii	Least Concern	Global
Escorpiones, Rocotes	Pacific Spotted Scorpionfish	Scorpaena mystes	Scorpaena mystes	Least Concern	Global
Bagre	Cominate Sea Catfish	Occidentarius platypogon	Occidentarius platypogon	Least Concern	Global
Congrios		Chiloconger dentatus	Chiloconger dentatus	Least Concern	Global
Chivos		Pseudupeneus grandisquamis	Pseudupeneus grandisquamis	Least Concern	Global
Cochis	Finescale Triggerfish	Balistes polylepis	Balistes polylepis	Least Concern	Global
Congrios		Rhynchoconger nitens	Rhynchoconger nitens	Least Concern	Global
Jureles, Pampanos, Medregales	Green Jack	Caranx caballus	Caranx caballus	Least Concern	Global
Chupapiedra		Tomicodon eos	Tomicodon eos	Least Concern	Global
Viejas		Bodianus diplotaenia	Bodianus diplotaenia	Least Concern	Global
Agujones		Tylosurus pacificus	Tylosurus pacificus	Least Concern	Global

Gobios	Panamic Frillfin	Bathygobius ramosus	Bathygobius ramosus	Least Concern	Global
Antenados	Bloody Frogfish	Antennatus sanguineus	Antennatus sanguineus	Least Concern	Global
Bagre		Notarius kessleri	Notarius kessleri	Least Concern	Global
Sardinas		Opisthonema libertate	Opisthonema libertate	Least Concern	Global
Tiesos		Ophichthus zophochir	Ophichthus zophochir	Least Concern	Global
Cochis	Orangeside Triggerfish	Sufflamen verres	Sufflamen verres	Least Concern	Global
Vacas, Rubios		Bellator gymnostethus	Bellator gymnostethus	Least Concern	Global
Escorpiones, Rocotes	Sonora Scorpionfish	Scorpaena sonorae	Scorpaena sonorae	Least Concern	Global
Viejas		Halichoeres dispilus	Halichoeres dispilus	Least Concern	Global
Sardinas	Graceful Piquitinga	Lile gracilis	Lile gracilis	Least Concern	Global
Mojarras		Diapterus peruvianus	Diapterus peruvianus	Least Concern	Global
Brotulas, Cong		Lepophidium microlepis	Lepophidium microlepis	Least Concern	Global
Sardinas	Pacific Flatiron Herring	Harengula thrissina	Harengula thrissina	Least Concern	Global
Escorpiones, Rocotes	Player Scorpionfish	Scorpaena histrio	Scorpaena histrio	Least Concern	Global
Escorpiones, Rocotes		Pontinus sierra	Pontinus sierra	Least Concern	Global
Mojarras		Diapterus aureolus	Diapterus aureolus	Least Concern	Global
Barbudo		Polydactylus opercularis	Polydactylus opercularis	Least Concern	Global

Piernas, Conejo		Caulolatilus princeps	Caulolatilus princeps	Least Concern	Global
Escorpiones, Rocotes	Rainbow Scorpionfish	Scorpaenodes xyris	Scorpaenodes xyris	Least Concern	Global
Jureles, Pampanos, Medregales	Shortjaw Leatherjack	Oligoplites refulgens	Oligoplites refulgens	Least Concern	Global
Pejerrey		Atherinella eriarcha	Atherinella eriarcha	Least Concern	Global
Chopas	Rudderfish	Girella nigricans	Girella nigricans	Least Concern	Global
Peces Sapo		Porichthys analis	Porichthys analis	Least Concern	Global
Chiles		Synodus evermanni	Synodus evermanni	Least Concern	Global
Palometas	Salema Butterfish	Peprilus snyderi	Peprilus snyderi	Least Concern	Global
Chiles		Synodus sechurae	Synodus sechurae	Least Concern	Global
Chiles		Synodus scituliceps	Synodus scituliceps	Least Concern	Global
Escorpiones, Rocotes	Spotback Scorpionfish	Pontinus vaughani	Pontinus vaughani	Least Concern	Global
Castañetas		Chromis alta	Chromis alta	Least Concern	Global
Vacas, Rubios		Prionotus albirostris	Prionotus albirostris	Least Concern	Global
Vacas, Rubios		Prionotus birostratus	Prionotus birostratus	Least Concern	Global
Viejas		Decodon melasma	Decodon melasma	Least Concern	Global
Gobios	Orangespotted Goby	Bollmannia chlamydes	Bollmannia chlamydes	Least Concern	Global
Voladores	Ornamented flyingfish	Cypselurus callopterus	Cypselurus callopterus	Least Concern	Global

Cintas, Sables	Largehead Hairtail	Trichiurus lepturus	Trichiurus lepturus	Least Concern	Global
Enteromorpha	Louvar	Luvarus imperialis	Luvarus imperialis	Least Concern	Global
Pez Remo	Oarfish	Regalecus glesne	Regalecus glesne	Least Concern	Global
Escolares	Oilfish	Ruvettus pretiosus	Ruvettus pretiosus	Least Concern	Global
Jureles, Pampanos, Medregales	Pilotfish	Naucrates ductor	Naucrates ductor	Least Concern	Global
Botetes	Oceanic Puffer	Lagocephalus lagocephalus	Lagocephalus lagocephalus	Least Concern	Global
Atun	Albacore Tuna	Thunnus alalunga	Thunnus alalunga	Least Concern	Global
Agujones	Hound Needlefish	Tylosurus crocodilus	Tylosurus crocodilus	Least Concern	Global
Agujones	Flat Needlefish	Ablennes hians	Ablennes hians	Least Concern	Global
Sardinas	West Atlantic Round Herring	Etrumeus sadina	Etrumeus sadina	Least Concern	Global
Escolares	Escolar	Lepidocybium flavobrunneum	Lepidocybium flavobrunneum	Least Concern	Global
Escolares	Snake Mackerel	Gempylus serpens	Gempylus serpens	Least Concern	Global
Pericos	Blue-barred Parrotfish	Scarus ghobban	Scarus ghobban	Least Concern	Global
Pericos	Loosetooth Parrotfish	Nicholsina denticulata	Nicholsina denticulata	Least Concern	Global
Pericos	Azure parrotfish	Scarus compressus	Scarus compressus	Least Concern	Global
Cirujanos	Yellowtail Surgeonfish	Prionurus punctatus	Prionurus punctatus	Least Concern	Global
Lisas	Unicorn Leatherjacket Filefish	Aluterus monoceros	Aluterus monoceros	Least Concern	Global

Lobo Marino	Californian Sea Lion	Zalophus californianus	Zalophus californianus	Least Concern	Global
Atun	Yellowfin Tuna	Thunnus albacares	Thunnus albacares	Least Concern	Global
Coral	Cauliflower Coral	Pocillopora damicornis	Pocillopora damicornis	Least Concern	Global
Pipas	Snubnose Pipefish	Cosmocampus arctus	Cosmocampus arctus	Least Concern	Global
Pipas	Kelp Pipefish	Syngnathus californiensis	Syngnathus californiensis	Least Concern	Global
Lenguados	Pacific Eyed Flounder	Bothus constellatus	Bothus constellatus	Least Concern	Global
Lisas	White Mullet	Mugil curema	Mugil curema	Least Concern	Global
Catalufas	Glasseye Snapper	Heteropriacanthus cruentatus	Heteropriacanthus cruentatus	Least Concern	Global
Jureles, Pampanos, Medregales	Black Jack	Caranx lugubris	Caranx lugubris	Least Concern	Global
Cabrillas, Mero, Baquetas	Pacific Mutton Hamlet	Alphestes immaculatus	Alphestes immaculatus	Least Concern	Global
Cabrillas, Mero, Baquetas	Rivulated Mutton Hamlet	Alphestes multiguttatus	Alphestes multiguttatus	Least Concern	Global
Cabrillas, Mero, Baquetas	Spotted Grouper	Epinephelus analogus	Epinephelus analogus	Least Concern	Global
Sardinas		Opisthonema bulleri	Opisthonema bulleri	Least Concern	Global
Anchoveta	Silverstripe Anchovy	Anchoa argentivittata	Anchoa argentivittata	Least Concern	Global
Anchoveta	Heller's Anchovy	Anchoa helleri	Anchoa helleri	Least Concern	Global

Burros	Latin Grunt	Haemulon steindachneri	Haemulon steindachneri	Least Concern	Global
Chivos	Mexican Goatfish	Mulloidichthys dentatus	Mulloidichthys dentatus	Least Concern	Global
Jureles, Pampanos, Medregales	Island Trevally	Carangoides orthogrammus	Carangoides orthogrammus	Least Concern	Global
Corvinas, Berrugatas		Atractoscion nobilis	Atractoscion nobilis	Least Concern	Global
Corvinas, Berrugatas		Bairdiella armata	Bairdiella armata	Least Concern	Global
Corvinas, Berrugatas		Bairdiella ensifera	Bairdiella ensifera	Least Concern	Global
Corvinas, Berrugatas		Bairdiella icistia	Bairdiella icistia	Least Concern	Global
Corvinas, Berrugatas		Cynoscion reticulatus	Cynoscion reticulatus	Least Concern	Global
Corvinas, Berrugatas		Elattarchus archidium	Elattarchus archidium	Least Concern	Global
Corvinas, Berrugatas		Isopisthus remifer	Isopisthus remifer	Least Concern	Global
Sardinas		Opisthonema medirastre	Opisthonema medirastre	Least Concern	Global
Escorpiones, Rocotes	Cortez Rockfish	Sebastes cortezi	Sebastes cortezi	Least Concern	Global
Murcielago		Opistognathus rosenblatti	Opistognathus rosenblatti	Least Concern	Global
Jureles, Pampanos, Medregales	Bluefin Trevally	Caranx melampygus	Caranx melampygus	Least Concern	Global
Corvinas, Berrugatas		Cynoscion nannus	Cynoscion nannus	Least Concern	Global

Lenguados	Pacific Leopard Flounder	Bothus leopardinus	Bothus leopardinus	Least Concern	Global
Lenguados	Speckled-tail Flounder	Engyophrys sanctilaurentii	Engyophrys sanctilaurentii	Least Concern	Global
Lenguas	Inkspot Tonguefish	Symphurus atramentatus	Symphurus atramentatus	Least Concern	Global
Lenguas	California Tonguefish	Symphurus atricaudus	Symphurus atricaudus	Least Concern	Global
Lenguas	Chocolate Tonguefish	Symphurus callopterus	Symphurus callopterus	Least Concern	Global
Lenguas	Chabanaud's Tonguefish	Symphurus chabanaudi	Symphurus chabanaudi	Least Concern	Global
Lenguas		Symphurus elongatus	Symphurus elongatus	Least Concern	Global
Lenguas		Symphurus gorgonae	Symphurus gorgonae	Least Concern	Global
Lenguados	Brown Sole	Achirus klunzingeri	Achirus klunzingeri	Least Concern	Global
Robalos	Black Robalo	Centropomus nigrescens	Centropomus nigrescens	Least Concern	Global
Lenguados	Network Sole	Achirus scutum	Achirus scutum	Least Concern	Global
Sierra	Pacific Chub Mackerel	Scomber japonicus	Scomber japonicus	Least Concern	Global
Sierra	Pacific Sierra	Scomberomorus sierra	Scomberomorus sierra	Least Concern	Global
Robalos		Centropomus armatus	Centropomus armatus	Least Concern	Global
Delfines	Common Dolphin	Delphinus delphis	Delphinus delphis	Least Concern	Global
Calamar	Humboldt Squid	Dosidicus gigas	Dosidicus gigas	Data Deficient	Global

Calamar Gigante	Humboldt Squid	Dosidicus gigas	Dosidicus gigas	Data Deficient	Global
Gobios	Tailspot Goby	Bollmannia stigmatura	Bollmannia stigmatura	Data Deficient	Global
Langosta	Green Spiny Lobster	Panulirus gracilis	Panulirus gracilis	Data Deficient	Global
Gobios	Pennant Goby	Bollmannia ocellata	Bollmannia ocellata	Data Deficient	Global
Gobios	Panther Bearded-goby	Barbulifer pantherinus	Barbulifer pantherinus	Data Deficient	Global
Gobios	Panther Bearded-goby	Barbulifer pantherinus	Barbulifer pantherinus	Data Deficient	Global
Escorpiones, Rocotes		Scorpaena guttata	Scorpaena guttata	Data Deficient	Global
Picudos	Black Marlin	Istiompax indica	Istiompax indica	Data Deficient	Global
Corvinas, Berrugatas		Cheilotrema saturnum	Cheilotrema saturnum	Data Deficient	Global
Raton		Cheilotrema saturnum	Cheilotrema saturnum	Data Deficient	Global
Corvinas, Berrugatas		Cynoscion albus	Cynoscion albus	Data Deficient	Global
Machete	Ladyfish	Elops affinis	Elops affinis	Data Deficient	Global
Anchoveta	Longfin Pacific Anchovy	Anchoa analis	Anchoa analis	Data Deficient	Global
Camarón Café		Penaeus californiensis			
Otros Camarones Y Camaron Café Talla Chica		Penaeus californiensis			

Otros Camarones Y Camaron Café Talla Chica	Penaeus brevirostris
Otros Camarones Y Camaron Café Talla Chica	Xiphopenaeus riveti
Jaiba	Callinectes Bellicosius
Jaiba	Callinectes Arcuatus
Jureles, Pampanos, Medregales	Nematistius pectoralis
Camarón azul	Penaeus stylirostris
Estrellas De Mar	Henricia levisuscula
Estrellas De Mar	Leptasterias hexactis
Estrellas De Mar	Patiria miniata
Estrellas De Mar	Pisaster brevipinus
Estrellas De Mar	Pisaster giganteus
Estrellas De Mar	Pisaster ochraceus
Pargos	Pargos spp
Escorpiones, Rocotes	Sebastes macdonaldi

Camarón blanco	Litopenaeus vannamei
Camarón Blanco Del Pacífico	Litopenaeus occidentalis
Camaron Mantis	Hemisquilla ensigera californiensis
Camaron Mantis	Lysiosquilla desaussurei
Caracol	Caracol spp
Medusa Bola De Cañon	Stomolophus meleagris
Cangrejos Cajeta	Calappa saussurei
Cangrejos Cajeta	Hepatus kossmanni
Cangrejos Cajeta	Hepatus lineatus
Cangrejos Cajeta	Platymera gaudichaudii
Calamar	Loliolopsis diomedeae
Calamar Dedal	Loliolopsis diomedeae
Algas Rojas	Gigartina canaliculata
Algas Rojas	Eucheuma uncinatum
Algas Rojas	Gelidium robustum
Conchas	Conchas
Cangrejo	Cangrejo Spp

Caracol Chino	Hexaplex nigritus
Caracol Chino	Phyllonotus erhythostoma
Caracol Chino	Phyllonotus regius
Caracol Chino	Haustellum recurvirostris
Tiburon	tiburon spp
Lapa	Patella mexicana
Cangrejo Ermitaño	Petrochirus californiensis
Cangrejo De Piedra	Menippe frontalis
Cangrejo De Piedra	Ozius verreauxii
Galleta De Mar	Clypeaster rotundus
Galleta De Mar	Encope grandis
Galleta De Mar	Mellita longifissa
Camaron Roca	Sicyonia Disdorsalis
Sargazos	Eisenia arborea
Sargazos	Macrocystis pyrifera
Sargazos	Sargassum sinicola
Cangrejos Araña	Maiopsis panamensis
Cangrejos Araña	Mithrax armatus

Almeja Blanca	Dosinia ponderosa
Erizo	Echinometra vanbrunti
Erizo	Strongylocentrotus franciscanus
Erizo	Strongylocentrotus purpuratus
Concha, Joyero	Chama buddiana
Caracol Menongena	Melongena patula
Jaiba de Roca	Euphylax robustus
Cintas, Sables	Lepidopus fitchi
Almeja Catarina	Argopecten ventricosus
Caracol Burro	Strombus peruvianus
Caracol Burro	Strombus galeatus
Caracol Trompeta	Pleuroploca princeps
Caracol Trompeta	Pleuroploca granosa
Caracol Trompeta	Pleuroploca salmo
Esponja	Phylum: Porifera
Tortugas	tortugas spp
Almeja Roñosa	Chione californiensis
Almeja China	Chione californiensis

Poliquetos	poliquetos spp
Camaron rosado	Farfantepenaeus duorarum
Almeja Chocolata	Megapitaria aurantiaca
Almeja Pata De Mula	Anadara grandis
Callo De Hacha	Atrina maura
Callo De Hacha	Pinna rugosa
Callo De Hacha	Atrina oldroydii
Enteromorpha	Enteromorpha clathrata
Enteromorpha	Enteromorpha compressa
Enteromorpha	Enteromorpha intestinalis
Almeja Voladora	Pecten vogdesi
Berberechos	Laevicardium elatum
Berberechos	Trachycardium panamense
Munidas	Munida hispida
Munidas	Munida refulgens
Almejas	(blank)
Cangrejos Abuetes	Sesarma sulcatum
Pepino De Mar	Pollicipes elegans

Purpuras	purpuras spp
Hueva	hueva
Mejillon	Choromytilus palliopunctatus
Mejillon	Modiolus americanus
Caracol Panocha	Turbo fluctuosus
Cangrejos Moros De Mangle	Cangrejo spp.
Madreperla	Pinctada mazatlanica
Bacalao	Anoplopoma fimbria
Espadas	tylosurus fodiator
Almeja De Fango	Anadara mazatlanica
Almeja Generosa	Panopea generosa
Almeja pismo	Tivela stultorum
Almeja Mano De Leon	Nodipecten subnodosus
Almeja Burra	Spondylus calcifer

Appendix B: Enforcement actions from official reports of CONAPESCA (Analized and published by OCEANA Mexico 2024)

Active Official Agents between 2009 and 2023 were reported to have remained relatively constant during this timeline; however, as mentioned, the number seems low for the amount of land that needs to be covered (~11,000 km of coastal line).

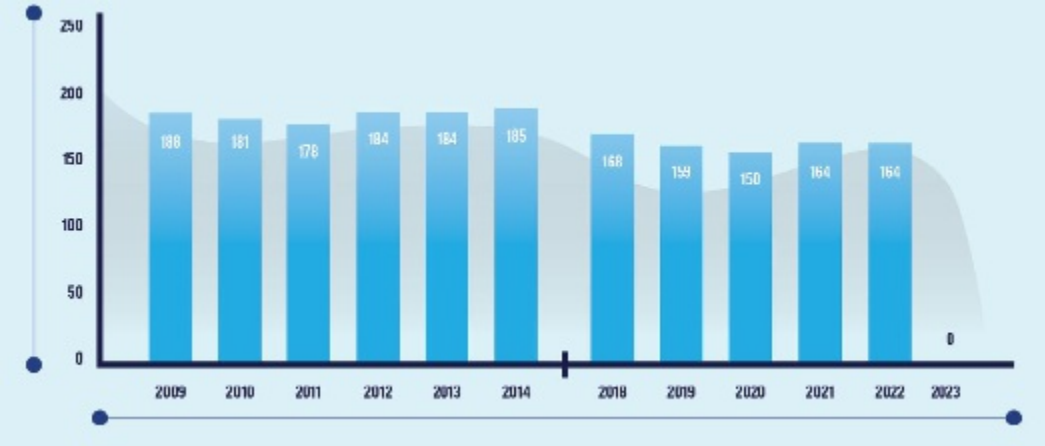


Figure 8: Number of CONAPESCA active agents (Oceana 2024)

Data about the amount of Mexican Navy support in recent years was unavailable. Oceana Mexico's report showed a decreasing trend from 2009 to 2014 (Oceana 2024)

Figure 9: Number of Navy agents that supported fishing enforcement activities (Oceana 2024)

The number of enforcement actions on water and land also presented a negative trend in recent years (2018-2023) compared to previous years.

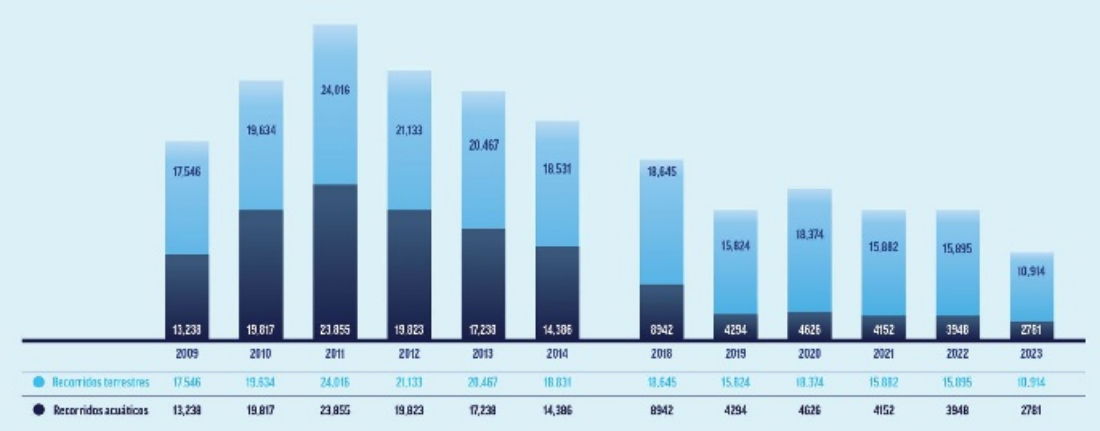


Figure 10: Land (light blue) and on-water (dark blue) enforcement actions deployed by authorities per year (Oceana 2024)

Industrial vessels are monitored via VMS. In 2022, a transition to a different service provider led to a coverage loss that was not fully completed (at least until the Oceana report was published).

NÚMERO Y PORCENTAJE DE EMBARCACIONES MONITOREADAS CON EL SISMEP															
Año	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Embarcaciones monitoreadas por el SISMEP	1595	2018	2045	2039	2036	2047	1729	1973	2008	2018	2016	2026	2051	0	1616
Embarcaciones pesqueras totales[15]	103,104	95,012	50,626	67,615	70,634	71,929	72,411	72,198	72,439	74,738	73,630	73592	72,276	N/A	75,326
Porcentaje de embarcaciones	1.5	2.1	4.0	3.0	2.8	2.8	2.3	2.7	2.7	2.7	2.7	2.7	2.8	N/A	2.1

Figure 11: Number of vessels monitored by the VMS versus the total number of ships and the percentage coverage (Oceana 2024)

Appendix C: Tryouts in the Upper Gulf of California with Suripera Net

Implementing the Vaquita Refuge in 1998 has not been enough to protect the Vaquita. The International Committee for the Recovery of the Vaquita (*Comité Internacional para la Recuperación de la Vaquita or CIRVA*) urged the Mexican Government to generate alternative fishing methods (CIRVA 2016) in the region that do not interact with the species. In 2007, a first experimental net was tested in the region [INAPESCA-WWF 2007]. Since then CIRVA and INAPESCA have collaborated with a modified version of the light-weight trawl (RS-INP) in the northern Gulf of California from 2009 to 2013. At the end of this period, the small trawl was announced as part of the Mexican Standard for shrimp fishing (DOF 2012).

By 2013, the Mexican authorities released a mandate explaining the small trawl use for the Upper Gulf of California shrimp fishery, with a testing phased over three years {CIRVA 2015}. The plan pursued the removal of 30% of gillnets during the first year, 30% in the second year and 40% in the third year; however, it was found that the new gear was not compatible and could not be used in the presence of gillnets. Also, fishermen were reluctant to change, among other reasons due to the high cost (fuel consumption and engine depreciation) for their equipment. In addition, further tests were necessary to prove the effectiveness of the gear in the El Golfo de Santa Clara region. On December 2015, tests started in the region, but no results have been published. Trawl nets in fisheries still represent concern because of the bycatch level and damage to the benthos that can result from trawling. Considering this, the RS-INP incorporated devices that look to improve its environmental performance, like the inclusion of turtle and fish excluder devices, double rope to avoid damaging the seabed, progressive reduction in the mesh size along the net, hydrodynamic trawl doors to reduce resistance and increase efficiency (CIRVA 2016) (INAPESCA 2012). During the 2017–2018 season, tryouts of suripera nets will be conducted. Managers believe that suripera represents the best chance to continue artisanal shrimp fishing in the Upper Gulf and protect the vaquita and totoaba populations.

Appendix D: Updates to the Mexican Shrimp recommendation 2024

Updates to this Mexican Shrimp assessment and ratings were made in July 2024:

The number of recommendations between the 2017 report and the 2024 update changed based on a review of the management strategy; the changes are as follows:

- The Yellowleg trawl shrimp Sinaloa South and Nayarit were integrated into one recommendation: Yellowleg shrimp bottom trawl Nayarit.
- The Yellowleg trawl shrimp in the Upper Gulf of California was deleted because there is no significant production from that fishery.
- The Blue trawl shrimp Sinaloa South and Nayarit were integrated into one recommendation: Blue shrimp trawl Nayarit.
- The Blue trawl shrimp, West Coast of Baja, was deleted because there is no significant production from that fishery.
- The Whiteleg cast net fisheries recommendations for Sinaloa South, and Nayarit were integrated into one recommendation: Whiteleg shrimp Nayarit-Sinaloa cast nets
- The Whiteleg trawl fisheries recommendations for Sinaloa South and Nayarit were integrated into one recommendation: Whiteleg shrimp Nayarit-Sinaloa bottom trawl
- The Blue shrimp suripera fishery on the West Coast of Baja was included based on available information (scored as Best Choice)

The recommendations for the Mexican Pacific changed as follows:

- Blue Shrimp gillnet zone 30 was upgraded from Avoid to Good Alternative
- Yellowleg Shrimp trawls zone 50 and 90 were downgraded from Good Alternative to Avoid
- Whiteleg Shrimp trawls zone 90 was downgraded from Good Alternative to Avoid

The recommendations for the Gulf of Mexico stayed the same.

Significant updates Included:

Mexican Pacific fisheries:

Criterion 1

Yellowleg shrimp

- Sonora (zone 20) upgraded from “high” to “moderate” concern because the species is NOT highly vulnerable, and available appropriate data-limited assessment methods suggest the status is not of concern.
- West Coast of Baja (zone 50 offshore) stock downgraded from “moderate” to “high” concern based on the most recent CPUE data.

- West Coast of Baja (zone 50 coastal) stock upgraded from “high” to “low” concern based on a recent Stock Assessment

Blue shrimp

- Sinaloa North-Central stock (zone 30) upgraded from “high” to “low” concern based on a recent Stock Assessment
- Upper Gulf of California stock (zone 10) upgraded from “high” to “moderate” concern based on the most recent CPUE data.
- West coast of Baja (zone 50 coastal) upgraded from “moderate” to “low” concern based on a recent Stock Assessment

Whiteleg shrimp

- Sinaloa North-Central and Gulf of Tehuantepec stocks (zones 30 and 90) upgraded from “moderate” to “low” concern based on the most recent CPUE data.

Criterion 2

Blue Shrimp

- Sinaloa North-Central stock (zone 30) downgraded from “low” to “moderate” concern

Criterion 3

- C3.2. Sinaloa North-Central Suripera fishery upgrade from “moderate” to “highly” effective.
- C3.3 Research and monitoring downgraded from “moderately effective” to “ineffective” for all industrial bottom trawlers because, although some data related to stock abundance are collected and analyzed to monitor the stock, the onboard observer program is not in place anymore, and the bycatch monitoring is insufficient given the potential bycatch impacts of the fishery.

Gulf of Mexico fisheries

All fisheries in the Gulf of Mexico remained with no changes in scores.

Appendix E: Magdalena 1 trawl catch composition data tables -(the information in the table contains data from Magdalena I and Cast net combined)

List of species caught with shrimp during the 2014 to 2022 closed and open seasons, in the lagoon complex Bahía Magdalena-Almejas, Baja California Sur. Abu= abundance (number of organisms), IVB= index of biological value, IAR= index of relative abundance. A= abundant, F= frequent, C= common, R= rare (INAPESCA 2023). Sorted by Abundance (numbers of individuals). IUCN fields added by Seafood Watch.

Table 7

Scientific name (original document)	Scientific Name (IUCN)	English name (IUCN)	IUCN redlistCategory	IUCN scopes	IUCN Latest Assessment Year	IV
Eucinostomus dowii	*Eucinostomus dowii*		Least Concern	Global	2007	28
Eucinostomus gracilis	*Eucinostomus gracilis*		Least Concern	Global	2007	22
Paralabrax maculatofasciatus	*Paralabrax maculatofasciatus*		Least Concern	Global	2008	34
Etropus crossotus	*Etropus crossotus*	Fringed Flounder	Least Concern	Global	2013	29
Etropus peruvianus	*Etropus peruvianus*	Peruvian Flounder	Least Concern	Global	2021	26
Diplectrum pacificum	*Diplectrum pacificum*		Least Concern	Global	2008	25
Haemulopsis axillaris	*Haemulopsis axillaris*		Least Concern	Global	2007	11
Occidentarius platypogon	*Occidentarius platypogon*	Cominate Sea Catfish	Least Concern	Global	2007	49
Haemulopsis nitidus	*Haemulopsis nitidus*		Least Concern	Global	2007	63
Orthopristis reddingi	*Orthopristis reddingi*		Least Concern	Global	2007	80

Achirus mazatlanus	*Achirus mazatlanus*	Mazatlan Sole	Least Concern	Global	2018	11
Pleuronichthys ritteri	*Pleuronichthys ritteri*	Spotted Turbot	Least Concern	Global	2021	69
Urobatis halleri	*Urobatis halleri*	Round Stingray	Least Concern	Global	2014	46
Porichthys analis	*Porichthys analis*		Least Concern	Global	2007	37
Balistes polylepis	*Balistes polylepis*	Finescale Triggerfish	Least Concern	Global	2008	35
Orthopristis chalceus	*Orthopristis chalceus*		Least Concern	Global	2007	26
Haemulopsis elongatus	*Haemulopsis elongatus*		Least Concern	Global	2007	19
Sphoeroides lobatus	*Sphoeroides lobatus*	Longnose Puffer	Least Concern	Global	2008	23
Pseudupeneus grandisquamis	*Pseudupeneus grandisquamis*		Least Concern	Global	2007	22
Prionotus stephanophrys	*Prionotus stephanophrys*		Least Concern	Global	2007	14
Synodus scituliceps	*Synodus scituliceps*		Least Concern	Global	2007	21
Paralichthys californicus	*Paralichthys californicus*	California Halibut	Least Concern	Global	2007	13
Prionotus ruscarius	*Prionotus ruscarius*		Least Concern	Global	2007	9
Syacium ovale	*Syacium ovale*	Oval Flounder	Least Concern	Global	2019	17
Diplobatis ommata	*Diplobatis ommata*	Pacific Dwarf Numbfish	Least Concern	Global	2019	9
Ophidion galeoides	*Ophidion galeoides*		Least Concern	Global	2007	5
Calamus brachysomus	*Calamus brachysomus*	Pacific Porgy	Least Concern	Global	2009	13

Synodus lucioceps	*Synodus lucioceps*		Least Concern	Global	2007	15
Sphoeroides annulatus	*Sphoeroides annulatus*	Bullseye Puffer	Least Concern	Global	2008	6
Pleuronichthys guttulatus	*Pleuronichthys guttulatus*	Diamond Turbot	Least Concern	Global	2021	8
Symphurus williamsi	*Symphurus williamsi*	William's Tonguefish	Least Concern	Global	2020	0
Chaetodipterus zonatus	*Chaetodipterus zonatus*	Pacific Spadefish	Least Concern	Global	2008	10
Symphurus fasciolaris	*Symphurus fasciolaris*		Least Concern	Global	2020	6
Orthopristis cantharinus	*Orthopristis cantharina*	Galápagos Sheephead Grunt	Least Concern	Global	2022	6
Hippoglossina bollmani	*Hippoglossina bollmani*	Spotted Flounder	Least Concern	Global	2021	2
Heterodontus francisci	*Heterodontus francisci*	Horn Shark	Data Deficient	Global	2014	0
Cynoscion parvipinnis	*Cynoscion parvipinnis*		Data Deficient	Global	2019	0
Citharichthys xanthostigma	*Citharichthys xanthostigma*	Longfin Sanddab	Least Concern	Global	2019	6
Xystreurys liolepis	*Xystreurys liolepis*	Fantail Flounder	Least Concern	Global	2019	5
Urotrygon rogersi	*Urotrygon rogersi*	Rogers' Round Ray	Near Threatened	Global	2020	7
Anchoa nasus	*Anchoa nasus*	Longnose Anchovy	Least Concern	Global	2019	15
Bagre panamensis	*Bagre panamensis*	Chilhuil Sea Catfish	Least Concern	Global	2007	6
Elattarchus archidium	*Elattarchus archidium*		Least Concern	Global	2019	1

Urobatis maculatus	*Urobatis maculatus*	Spotted Round Ray	Least Concern	Global	2019	1
Mustelus henlei	*Mustelus henlei*	Brown Smoothhound	Least Concern	Global	2014	3
Scorpaena sonorae	*Scorpaena sonorae*	Sonora Scorpionfish	Least Concern	Global	2008	5
Anchoa ischana	*Anchoa ischana*	Sharpnose Anchovy	Least Concern	Global	2019	2
Diodon holocanthus	*Diodon holocanthus*	Long-spine Porcupinefish	Least Concern	Global	2011	1
Paralichthys woolmani	*Paralichthys woolmani*	Dappled Flounder	Data Deficient	Global	2007	0
Zapteryx exasperata	*Zapteryx exasperata*	Banded Guitarfish	Data Deficient	Global	2015	4
Pleuronichthys verticalis	*Pleuronichthys verticalis*	Hornyhead Turbot	Least Concern	Global	2021	5
Ariosoma gilberti	*Ariosoma gilberti*	Sharpnose Conger	Least Concern	Global	2007	0
Myliobatis californica	*Myliobatis californicus*	Bat Ray	Least Concern	Global	2014	1
Mustelus lunulatus	*Mustelus lunulatus*	Sicklefin Smoothhound	Least Concern	Global	2015	0
Gymnura marmorata	*Gymnura marmorata*	California Butterfly Ray	Near Threatened	Global	2019	2
Hippocampus ingens	*Hippocampus ingens*	Giant Seahorse	Vulnerable	Global	2016	2
Urotrygon aspidura	*Urotrygon aspidura*	Spinytail Round Ray	Near Threatened	Global	2020	0
Pleuronichthys ocellatus	*Pleuronichthys ocellatus*	Ocellated Turbot	Least Concern	Global	2021	0
Sphoeroides lispus	*Sphoeroides lispus*	Naked Puffer	Least Concern	Global	2008	8

Sphoeroides sechurae	*Sphoeroides sechurae*	Peruvian Puffer	Least Concern	Global	2008	0
Prionotus birostratus	*Prionotus birostratus*		Least Concern	Global	2007	0
Chaetodon humeralis	*Chaetodon humeralis*		Least Concern	Global	2009	0
Symphurus atramentatus	*Symphurus atramentatus*	Inkspot Tonguefish	Least Concern	Global	2020	0
Alectis ciliaris	*Alectis ciliaris*	African Pompano	Least Concern	Global	2009	0
Pseudobatos leucorhynchus	*Pseudobatos leucorhynchus*	Whitesnout Guitarfish	Vulnerable	Global	2019	0
Eucinostomus currani	*Eucinostomus currani*	Pacific Flagfin Mojarra	Least Concern	Global	2007	2
Scomber japonicus	*Scomber japonicus*	Pacific Chub Mackerel	Least Concern	Global	2022	0
Mustelus californicus	*Mustelus californicus*	Gray Smooth-hound	Least Concern	Global	2014	0
Bothus leopardinus	*Bothus leopardinus*	Pacific Leopard Flounder	Least Concern	Global	2019	3
Xenichthys xanti	*Xenichthys xanti*		Least Concern	Global	2007	0
Pristigenys serrula	*Pristigenys serrula*		Least Concern	Global	2007	0
Selene peruviana	*Selene peruviana*	Pacific Moonfish	Least Concern	Global	2008	0
Halichoeres semicinctus	*Halichoeres semicinctus*		Least Concern	Global	2007	0
Caulolatilus affinis	*Caulolatilus affinis*	Bighead Tilefish	Least Concern	Global	2007	0
Symphurus atricauda	*Symphurus atricaudus*	California Tonguefish	Least Concern	Global	2020	2

Deckertichthys aureolus			Not assessed			0
Heterodontus mexicanus	*Heterodontus mexicanus*	Mexican Hornshark	Least Concern	Global	2019	0
Eucinostomus entomelas	*Eucinostomus entomelas*	Darkspot Mojarra	Least Concern	Global	2007	0
Menticirrhus undulatus	*Menticirrhus undulatus*		Data Deficient	Global	2020	0
Porichthys margaritatus	*Porichthys margaritatus*		Least Concern	Global	2007	8
Sardinops sagax	*Sardinops sagax*		Least Concern	Global	2018	0
Syacium latifrons	*Syacium latifrons*	Beach Flounder	Least Concern	Global	2019	0
Hypanus dipterurus	*Hypanus dipterurus*	Diamond Stingray	Vulnerable	Global	2019	0
Diplectrum euryplectrum	*Diplectrum euryplectrum*	Bighead Sand Perch	Least Concern	Global	2008	0
Diplectrum eumelum	*Diplectrum eumelum*	Orange-spotted Sand Perch	Least Concern	Global	2008	0
Cheilotrema saturnum	*Cheilotrema saturnum*		Data Deficient	Global	2020	0
Lutjanus guttatus	*Lutjanus guttatus*		Least Concern	Global	2007	5
Brachygenys californiensis			Not assessed			0
Rhinoptera steindachneri	*Rhinoptera steindachneri*	Pacific Cownose Ray	Near Threatened	Global	2019	0
Hippoglossina tetrophthalma	*Hippoglossina tetrophthalma*	Fourspot Flounder	Least Concern	Global	2021	0
Narcine entemedor	*Narcine entemedor*	Cortez Numbfish	Vulnerable	Global	2019	0
Opisthonema libertate	*Opisthonema libertate*		Least Concern	Global	2007	0

Pareques viola	*Pareques viola*		Least Concern	Global	2020	0
Myrophis vafer	*Myrophis vafer*		Least Concern	Global	2007	1
Opistognathus punctatus	*Opistognathus punctatus*		Least Concern	Global	2007	0
Prionotus horrens	*Prionotus horrens*		Least Concern	Global	2007	0
Sphyraena ensis	*Sphyraena ensis*	Mexican Barracuda	Least Concern	Global	2008	0
Trachinotus paitensis	*Trachinotus paitensis*	Paloma Pompano	Least Concern	Global	2008	3
Sphoeroides sp. 1						0
Scorpaena mystes	*Scorpaena mystes*	Pacific Spotted Scorpionfish	Least Concern	Global	2008	0
Peprilus simillimus	*Peprilus simillimus*		Least Concern	Global	2008	0
Haemulon maculicauda	*Haemulon maculicauda*		Least Concern	Global	2007	0
Diapterus brevirostris			Not assessed			3
Apogon pacificus	*Apogon pacificus*	Pink Cardinalfish	Least Concern	Global	2008	0
Hyporthodus niphobles	*Hyporthodus niphobles*	Star-studded Grouper	Least Concern	Global	2016	0
Synodus lacertinus	*Synodus lacertinus*		Least Concern	Global	2007	0
Haemulon steindachneri	*Haemulon steindachneri*	Latin Grunt	Least Concern	Global	2020	0
Carangoides otrynter	*Carangoides otrynter*	Threadfin Jack	Least Concern	Global	2008	3
Lophiodes caulinaris	*Lophiodes caulinaris*		Least Concern	Global	2007	0
Oligoplites saurus	*Oligoplites saurus*		Least Concern	Global	2018	3

Prionotus albirostris	*Prionotus albirostris*		Least Concern	Global	2008	0
Chloroscombrus orqueta	*Chloroscombrus orqueta*	Pacific Bumper	Least Concern	Global	2008	0
Scorpaena guttata	*Scorpaena guttata*		Data Deficient	Global	2008	3
Paralabrax nebulifer	*Paralabrax nebulifer*		Least Concern	Global	2008	3
Fistularia corneta	*Fistularia corneta*	Pacific Cornetfish	Least Concern	Global	2016	0
Umbrina roncador	*Umbrina roncador*	Yellowfin Croaker	Least Concern	Global	2020	0
Umbrina analis	*Umbrina analis*		Least Concern	Global	2020	0
Opisthonema medirastre	*Opisthonema medirastre*		Least Concern	Global	2019	0
Diplectrum macropoma	*Diplectrum macropoma*		Least Concern	Global	2008	0
Umbrina wintersteeni	*Umbrina wintersteeni*		Data Deficient	Global	2020	0
Menticirrhus elongatus	*Menticirrhus elongatus*		Least Concern	Global	2020	0
Bairdiella armata	*Bairdiella armata*		Least Concern	Global	2019	0
Bellator gymnostethus	*Bellator gymnostethus*		Least Concern	Global	2007	0
Bairdiella icistia	*Bairdiella icistia*		Least Concern	Global	2019	0
Larimus pacificus	*Larimus pacificus*		Least Concern	Global	2020	0
Cynoscion reticulatus	*Cynoscion reticulatus*		Least Concern	Global	2019	0

Appendix F: Suripera catch composition data

Catch composition of the suripera fishery in Zone 30 aggregated across the 2019/2020 through

2022/2023 seasons (COSOREMA 2023). “Other” species aggregated in the study. IUCN fields added by Seafood Watch.

Table 8

Scientific name (original)	Common name (original)	% of catch by weight	IUCN redlistCategory	IUCN scope	IUCN Latest Assessment Year
Litopenaeus stylirostris	Blue shrimp	55	Not Assessed		
Eucinostomus entomelas	Dark spot mojarra	3.8	Least Concern	Global	2007
Callinectes bellicosus	Warrior swimming crab	3.8	Not Assessed		
Diapterus peruvianus	Peruvian mojarra	3.3	Least Concern	Global	2007
Litopenaeus vannamei	White shrimp	3.1	Not Assessed		
Mugil curema	White mullet	2.7	Least Concern	Global	2018
Farfantepenaeus californiensis	Yellowleg shrimp	2.3	Not Assessed		
Balistes polylepis	Finescale triggerfish	1.9	Least Concern	Global	2008
Anisotremus interruptus	Burrito grunt	1.9	Least Concern	Global	2022
Pomadasys panamensis	Grunts	1.8	Least Concern	Global	2007
Brotula clarkae	Pacific bearded brotula	1.8	Data Deficient	Global	2007
Scomberomorus sierra	Pacific sierra	1.6	Least Concern	Global	2022
Hexaplex nigritus	Black murex	1.5	Not Assessed		

Sphoeroides annulatus	Bullseye puffer	1.5	Least Concern	Global	2008
Oligoplites altus	Longjaw leatherjack	1.5	Least Concern	Global	2019
Anchoa walkerii	Persistent anchovy	1.5	Not Assessed		
Anchoa nasus	Longnose anchovy	1.5	Least Concern	Global	2020
Symphurus elongatus	Elongate tonguefish	1.5	Least Concern	Global	2021
Anchoa mundeola	False panama anchovy	1.4	Least Concern	Global	2010
Pliosteostoma lutipinnis	Yellowfin herring	1.3	Least Concern	Global	2020
Menticirrhus elongatus	Pacific king-croaker	1.2	Least Concern	Global	2020
Albula pacifica	Bonefish	1.1	Not Assessed		
Selene brevoorti	Hairfin lookdown	1.1	Least Concern	Global	2008
Chaetodipterus zonatus	Pacific spadefish	1.1	Least Concern	Global	2008
Anchovia macrolepidota	Bigscale anchovy	1.0	Least Concern	Global	2008