# Mexican Pacific Shrimp Fishery

# **MSC Fishery Assessment Report**

*Announcement Comment Draft Report*

**Authors**

Enrique Morsan, PhD

Jesús Jurado-Molina, PhD

Alvaro Hernandez, PhD

**Client Contact**

Manuel Marrufo

Cerrada Tabachines #125 Colonia
Arboledas 2 Fovissste
Mazatlan, SIN 82132
Mexico

marrufoh@yahoo.com.mx
+52 669 1936875

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# Glossary

| | |
|---|---|
| ACAP | Agreement on Conservation of Albatross and Petrels |
| ACCOBAMS | Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area |
| AEWA | African-Eurasian Migratory Waterbird Agreement |
| ALDFG | Abandoned, lost or otherwise discarded fishing gear |
| ASCOBANS | Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas |
| B | Biomass |
| BCP | Baja California Peninsula |
| $B_{MSY}$ | Biomass associated to the maximum sustainable yield |
| BRD | Bycatch reduction device |
| C | Catch |
| $\hat{C}$ | Average catch |
| $C_{max}$ | Maximum catch |
| CAB | Conformity Assessment Body |
| CASA | Catch at size analysis |
| CEPA | *Consejos Estatales de Pesca y Acuacultura* (State Councils for Fisheries and Aquaculture) |
| CICESE | *Centro de Investigación Científica y de Educación Superior de Ensenada, Baja California* (Center for Scientific Research and Higher Education in Ensenada, Baja California) |
| CICIMAR | Centro Interdisciplinario de Ciencias Marinas (Interdisciplinary Center for Marine Sciences) |
| CITES | Convention on International Trade in Endangered Species of Wild Fauna and Flora |
| $C_{max}$ | Maximum catch |
| CNP | Carta Nacional Pesquera (National Fisheries Chart) |
| COFEMER | Comisión Federal de Mejora Regulatoria (Federal Commission for Regulatory Improvement) |
| CMS | Convention on Migratory Species |
| CONANP | Comisión Nacional de Áreas Naturales Protegidas (National Commission of Natural Protected Areas) |
| CONAPESCA | Comisión Nacional de Pesca y Acuacultura (National Fisheries and Aquaculture Commission) |
| CPUE | Catch Per Unit Effort |
| CRIP | Centro Regional de Investigación Pesquera (Regional Center for Fisheries Research) |
| DAT | Default Assessment Tree |
| DEP | Dispositivo excluidor de peces (fish excluder device) |
| DET | Dispositivo excluidor de tortugas (turtles excluider device) |
| DOF | Diario Oficial de la Federación (Diary of the Official Gazette) |
| ECOPATH | A static, mass-balanced snapshot of the system |
| ECOSIM | A time dynamic simulation module for policy exploration |
| EEZ | Exclusive Economic Zone |

| | |
|---|---|
| ENSO | El Niño/Southern Oscillation |
| ETP | Endangered, Threatened and Protected species |
| ERA | Ecological Risk Assessment |
| F | Fishing mortality rate |
| FAM | Fisheries Assessment Methodology v2.1 |
| FAO | Food and Agriculture Organization of the United Nations |
| FCM | Fisheries Certification Methodology |
| FFPA | Flora ad Fauna Protected Area |
| FIDEMAR | Fideicomiso de Investigación para el desarrollo del Programa Nacional de Aprovechamiento del Atún y Protección de Delfines (Research Trust for the development of the National Program for the exploitation of Tuna and Dolphin Protection) |
| $F_{MSY}$ | Fishing mortality rate for the maximum sustainable yield |
| GEF | Global Environmental Facility |
| HRC | Harvest control rule |
| IFQ | Individual Fishing Quota |
| INAPESCA | Instituto Nacional de la Pesca (National Fisheries Institute) |
| ITQ | Individual Transferable Quota |
| IUCN | International Union for Conservation of Nature |
| IUU | illegal, unregulated or unreported fishing |
| Kg | Kilogram |
| Lb. | Pound, equivalent to roughly 2.2 kg |
| LFMN | Ley Federal Sobre Metrología y Normalización (Federal Law on Metrology and Standardization) |
| LFRA | Ley Federal de Responsabilidad Ambiental (Federal Environmental Liability Law) |
| LGEEPA | Ley General del Equilibrio Ecológico y la Protección del Ambiente (General Law for the Ecological Equilibrium and the Protection of the Environment) |
| LGPAS | *Ley General de Pesca y Acuacultura Sustentables* (General Law for Sustainable Fishing and Aquaculture) |
| LOA | Length Over-All |
| LRP | Limit reference point |
| M | Million (lbs.) |
| MP | Management Plan |
| MPA | Marine protected area |
| MSC | Marine Stewardship Council |
| MSE | Management Strategy Evaluation |
| nm | nautical mile |
| NGO | Non-Governmental Organization |
| NOAA | National Oceanic and Atmospheric Administration |
| OFL | Over-Fishing Level |
| PI | Performance Indicator |

| | |
|---|---|
| PN | Parque Nacional (National Park) |
| PRI | Point where recruitment can be impaired |
| PROFEPA | Procuraduría Federal de Protección al Ambiente (Federal Attorney for Environmental Protection) |
| PSA | Productivity Susceptibility Analysis |
| RB | Reserva de la Biosfera (Biosphere reserve) |
| S | Santuario (Sanctuary) |
| SAGARPA | *Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación* (Secretariat of Agriculture, Livestock, Fisheries and Food) |
| SCS | SCS Global Services |
| SEMARNAT | Secretaria de Medio Ambiente y Recursos Naturales (Secretary of Environment and Natural Resources) |
| SG | Scoring guidepost |
| SI | Scoring Issue |
| SICG | Servicios Integrales de Consultoría en GeneralComprehensive Consulting Services in General) |
| SSB | Spawning Stock Biomass |
| t and mt | metric ton |
| TAC | Total Allowable Catch |
| TRP | Target reference point |
| UoA | Unit of assessment |
| UoC | Unit of certification |
| USA | United States of America |
| VME | Vulnerable marine ecosystems |
| WWF | World Wildlife Fund |

# 1 Executive Summary

This report presents the Marine Stewardship Council (MSC) assessment of the Blue Shrimp (*Litopenaeus stylirostris*), White Shrimp (*Litopenaeus vannamei*) and Brown Shrimp (*Farfantapenaeus californiensis*) fishery, harvested by fishing gear in Mexican Pacific, considered to be a single Unit of Assessment (UoA). Within the report, the Unit of Assessment will be referred to more simply as the Mexican Pacific Shirmp fishery. The assessment was conducted, and the findings were prepared by SCS Global Services (SCS), an MSC-accredited, independent, third-party conformity assessment body, in accordance with the MSC Principles and Criteria for sustainable fishing. The assessment complies with MSC Fisheries Certification Process v2.1.

**Table 1: Unit of Certification(s) and Unit of Assessment(s)**

| Stock/Species (FCP V2.1 7.5.2.a) | Method of Capture (FCP V2.1 7.5.2.b) | Fishing fleet (FCP V2.1 7.5.2.c) |
|---|---|---|
| Blue shrimp (*Litopenaeus stylirostris*) | Bottom trawl with double rig | Industrial fleet |
| White shrimp (*Litopenaeus vannamei*) | Bottom trawl with double rig | Industrial fleet |
| Brown shrimp (*Farfantepenaeus californiensis*) | Bottom trawl with double rig | Industrial fleet |

### Fishery Operations Overview

Comité Sistema Producto de Camarón de Altamar is a commercial fishing operation with 365 industrial fishing vessels, each with approximately eight fishers' onboard, landing in Mazatlan, Sinaloa all vessels operate within the Pacific coast of Mexico, from Baja California Sur to the Border with Guatemala including the Gulf of California using bottom trawl net "ala de angel". The fleet fishes primarily for Blue shrimp (*Litopenaeus stylirostris*), White shrimp (*Litopenaeus vannamei*), and Brown shrimp (*Farfantepenaeus californiensis*). Blue Shrimp is managed by geographical zones including the states of Baja California Sur, Sonora and Sinaloa. White Shrimp is managed by geographical zones including the states of Sinaloa, Nayarit and Gulf of Tehuantepec. Brown Shrimp is managed by zones in the states of California Sur, Sonora, Sinaloa and Nayarit, and Gulf of Tehuantepec. The target stock(s) = biologically distinct unit(s). There is no evidence that the definition of the stocks used in the management correspond to the biological unit stocks (See 3.3.2 Stock Structure). For purposes of this assessment the team treated each species as a single stock.

## Assessment Overview

The team selected to undertake the assessment includes three team members that collectively meet the requirements for MSC assessment teams. These are:

- Dr. Enrique Morsan, Team Leader and Principle 1 Expert
- Dr. Jesus Jurado Molina, Principle 2 Expert
- Dr. Alvaro Hernandez, Principle 3 Expert

The original announcement for the assessment indicates that the Risk-based framework (RBF) will be not used, in this ACDR the assessment team conducted a desk-based PSA for PI 2.2.1, during the site visit the team would carry out stakeholder consultation and to use this to inform the final PSA scores.

## Summary of Findings

In this report, we provide *draft* scores for each of the Performance Indicators (PIs) under Principle 1 (Stock status and Harvest strategy), Principle 2 (Ecosystem Impact) and Principle 3 (Governance, Policy and Management system) of the MSC Standard.

Since the pre-assessment process, initiated in 2017, to the present there has been positive progress on several aspects, including the stock assessment protocols, the establishment of biological reference points, and defined lines of action reflected in the 2018 Draft Management Plan. Nonetheless, there are still important areas for improvement and the preliminary scores based on the information provided during the ACDR indicate that the fishery is not likely to meet the requirements for certification, particularly for Principle One, where all three shrimp species have potential conditions that fail to reach the minimum Scoring Guidepost (SG) of 60, and have several potential conditions, which are likely to lead to an overall score of below 80 for the overall Principle 1 score for all three species. Likewise, for principle 2, there are several PIs with draft scores below 80, which may result in an overall score below 80 for the overall Principle. The assessment team recommends the fishery addresses these data gaps before it progresses into the full assessment.

In Principle 1, one of the initial limitations identified by the assessment team was the lack of a clear definition of the stock assessment units for the three species that are assessed in Principle 1. Currently, shrimp stocks are assessed and managed as separate sub-populations, corresponding to seven management zones established on the basis of geographical criteria. There is no evidence that genetic and connectivity studies have been actively used to identify stock structure and justify current areas and management strategies. In addition to sectorization based on geographic or political division criteria, an additional difficulty is the unification of the catches of the three shrimp species as a whole, without a database discriminating between those corresponding to each species. For blue and white shrimp two of the PIs (1.1.1 and 1.1.2) received draft scores under SG60, these are related to status of the stock and stock rebuilding. The last stock assessment reveled that the stock of both Blue and White Shrimp are below the Limit Reference Points based in BMSY. The Brown Shrimp stock is over the BRPs in all management zones, then its score is likely to be above 80 for the P1. Also, 3 PIs received draft scores below SG80, and they are related to use of appropriate reference points and the harvest control rules. The last stock assessment carried out in 2018, apply a dynamic biomass model and suggest new indicators in a Management Plan for the shrimp stocks. The plan revealed a significative research effort, allow track of available biomass for the three species for first time, and clarify the status of their stocks. The plan is not in force as of the publication of this report, and proposed actions were not still traslated to harvest strategy.

In relation to Principle 2, given the proportion and diversity of bycatch, the impact of this fishery on the status of individual species (PI 2.2.1) , habitat impacts (2.4.1) and the overall ecosystem structure and function (2.5.1) is of concern. One of the main challenges identified was the lack of information on the status of bycatch species (PI 2.2.3). For these species, information on life history parameters such as size, age, maturity and fecundity is lacking. A preliminary productivity analysis based on sensitivity analysis (PSA) indicated that some major species groups, such as mojarras and lizard fish, are likely to be above biological limits (SG80). However, there are other groups that are more vulnerable, such as rays. The implementation of bycatch reduction devices became mandatory for the entire industrial fleet, which is a strength although the fishery needs to implement performance objectives and periodic reviews of the effectiveness of the devices (PI 2.2.2). . Similar to the Habitat and Ecosystem components, the main challenge is the lack of quantitative information to adequately identify fishery impacts on habitats (PI 2.4.3) and ecosystems (PI 2.5.3). The fishery needs to clearly identify the spatial overlap of the fishery with the main habitats in the area and, based on this, assess the impacts of fishing gears on the structure and function of the main habitats.

The management system, addressed in Principle 3, presents several strengths such as a good set of fishing regulations, general guidelines and regulations that are well defined in the General Law of Sustainable Fishing and Aquaculture, Official Mexican and Mexican Standards and the Pacific Shrimp Management Plan. However, one of the main problems is that the management plan has not yet been approved and implemented (PI 3.2.1). There is also need for evidence of implementaion of sanctions (PI 3.2.3) and regular evaluation of the performance of key elements of the fishery ( PI 3.2.4).

# 2 Report Details

## 2.1 Authorship and peer review details

### Audit Team

**Dr. Enrique Morsan– Centro de Investigación Aplicada y Transferencia Tecnologica en Recursos Marinos "Almirante Storni" – Lead Auditor and Principle 1 Expert**

Dr. Enrique Morsan has 32 years of experience as a fisheries scientist and 19 as a Professor in Fishery Biology and Oceanography in the Universidad Nacional del Comahue, Argentina. He graduated from the Universidad Nacional del Sur in Argentina and has worked as a scientist in the Centro de Investigación Aplicada y Transferencia Tecnológica en Recursos Pesqueros "Alte. Storni" (Universidad Nacional del Comahue, the Río Negro Province Government and CONICET (National Council of Scientific Research)). Since 2000 he has been Director of 10 Doctoral Students, 5 post-doctoral and published 40 scientific papers in international journals. He is a specialist in stock assessment of molluscs and has considerable experience in marine invertebrate biology, ecology and resource assessment, and improved fishing methods, particularly in relation to the overall fishery in the San Matías Gulf, Patagonia Argentina. Dr. Morsan has been responsible for major studies on population dynamics of Purple clam (*Amiantis purpurata*), Southern geoduck (*Panopea abbreviata*), Common mussel (*Mytilus edulis platensis*), Argentine squid (*Illex argentinus*), Tehuelche scallop (*Aequipecten tehuelchu*s) and Yellow clam (*Mesoderma mactroide*s), and conservation of the Puelche oyster (*Ostra puelchana*). Since 2004, Dr. Morsan has participated in various MSC assessment processes of fisheries as Southern Red King Crab (*Lithodes santolla*), Mullet (*Mugil platanus*), Patagonian scallop (*Zygochlamys patagonica*), Argentine hoki (*Macrorunus magellanicus*) and Argentine Patagonian toothfish (*Dissostichus eleginoides*), and has had training in the use of the Risk Based Framework (RBF). He approved the training course of Lead Auditor of International Register of Certified Auditors (IRCA).

**Dr. Jesus Jurado Molina – Sistema Nacional de Investigadores (SIN) – Principle 2 Expert**

Dr. Jesus Jurado-Molina graduated from the University of Washington where he got his PhD (Fisheries). His work has been focused on fisheries, fisheries management, and ecosystem based fisheries management. He is author of sixteen papers, two books and several technical reports. His international experience produced publications on fisheries from the eastern Bering Sea to the South Pacific Ocean on topics ranging from small-scale fisheries to the World's largest tuna fishery. Currently he is member of the Mexican Sistema Nacional de Investigadores (SNI) and works at the Universidad Autonoma Metropolitana as full time professor and does private consulting. Throughout his career, Dr. Jurado-Molina has published a number of scientific journals and symposium proceedings on the management and evaluation of Mexican fisheries.

### Dr. Alvaro Hernandez – Marist University of Merida – Principle 3 Expert

Dr. Alvaro Hernandez Flores earned his PhD from the University of Delaware where he expanded his skills and knowledge in economics, econometrics and fisheries management. During his doctoral career, he managed to acquire important tools for political analysis, marine resource economy, and fisheries design, which he used to defend his thesis "Fish Economy of Marine Protected Areas". Alvaro has been involved for more than 20 years with fisheries research and management, starting as a scientific researcher for the Federal Government in Mexico (INAPESCA) where he was part of several international meetings to discuss the fishing problems of shrimp and finfish. In turn, Alvaro received a Diploma as a Companion of the International Environmental Leadership and Development Program, sponsored by the Rockefeller Foundation. While his interest in bio-economics grew, he was creating models to support the decision on the management of shrimp and red grouper fisheries in Mexico. After receiving his doctorate, Alvaro was hired as director of the Regional Fisheries Research Center (INEPESCA) where he helped solve internal and regional fisheries problems. The following year of working as a director, he was hired by WWF as Senior Fisheries Officer for the Mesoamerican Reef. During his time at WWF he managed to design several projects for best management practices and fisheries sustainability, and was involved in the pre-evaluation of MSC for the artisanal lobster fishery (Caribbean spiny lobster of Mexico). Currently Alvaro is a professor and researcher at the Marist University in Merida, where his research interests focus on small fisheries of shrimp, octopus, groupers and recently recreational fisheries.

## 2.2 Version details

**Table 2: Fisheries program documents versions**

| Document | Version number |
|---|---|
| **MSC Fisheries Certification Process** | **Version 2.1** |
| **MSC Fisheries Standard** | **Version 2.01** |
| **MSC General Certification Requirements** | **Version 2.3** |
| **MSC Reporting Template** | **Version 1.1** |

# 3 Unit(s) of Assessment and Certification and results overview

## 3.1 Unit(s) of Assessment (UoA) and Unit(s) of Certification

### 3.1.1 Unit(s) of Assessment

The Unit of Assessment includes Blue, White, and Brown shrimp caught by 365 industrial fishing vessels licensed by Mexico using bottom trawl net “ala de angel” fishing in the Pacific coast of Mexico, from Baja California Sur to the Border with Guatemala including the Gulf of California. The fishery is managed by the Federal government management  based on a modified escapement strategy.

This assessment includes three Units of Assessment (UoAs): UOA 1, UoA2, and UoA 3 share the same fleet, gear type/operations, and management system, and only differ in regards to the Principle 1 target stock. For this reason both Principle 2 is scored jointly for the three UoAs, and P1 species of UoA1 and UoA2 are not scored a second time as primary species. A target species that are certified under Principle 1 and has obtained an overall score >80 for P1, will have already be assessed under a higher standard of performance than those for main retained/primary under Principle 2, thus it is expected to obtain a score >80 for the relevant Principal Indicators under P2.  If in a subsequent assessment one of the target P1 target species fails and is no longer considered as certified, it will then be scored under Principle 2.

This fishery has been found to meet scope requirements (FCP v2.1 7.4) for MSC fishery assessments as it

- Does not operate under a controversial unilateral exemption to an international agreement, use destructive fishing practices, does not target amphibians, birds, reptiles or mammals and is not overwhelmed by the dispute.  (FCP 7.4.2.1, 7.4.2.2, 7.4.3, 7.4.5)
- The fishery does not engage in shark finning, has mechanisms for resolving disputes (FCP 7.4.5.1), and has not previously failed assessment or had a certificate withdrawn.
- Is not an enhanced fishery, is not based on an introduced species and does not represent an inseparable or practically inseparable species (FCP 7.5.1, 7.5.2, 7.5.8-13)
- Does not overlap with another MSC certified or applicant fishery (7.5.14),
- And does not include an entity successfully prosecuted for violating forced labor laws (7.4.4)
- The Unit of Assessment, the Unit of Certification, and eligible fishers have been clearly defined, traceability risks characterized, and the client has provided a clear indication of their position relative to certificate sharing (7.5.1-7.7.7).

**Table 1: Unit(s) of Assessment (UoA)**

| UoA 1 | Description |
|---|---|
| Species | Blue shrimp (*Litopenaeus stylirostris*) |
| Stock | Blue Shrimp is managed by geographical zones including the states of Baja California Sur, Sonora and Sinaloa. The target stock(s) = biologically distinct unit(s). There is no evidence that the definition of the stocks used in the management correspond to the biological unit stocks (See 3.3.2 Stock Structure). For purposes of this assessment the team treated each species as a single stock. |
| Geographical area | The Pacific coast of Mexico, from Baja California Sur to the Border with Guatemala including the Gulf of California. |
| Harvest method / gear | Bottom trawl net “ala de angel” |
| Client group | Comité Sistema Producto de Camarón de Altamar |
| Other eligible fishers | Other industrial vessels in the fleet that are not part of the Comite Sistema Producto Camaron de Altamar nad the small fleet that operates over the shrimp stocks . |
| **UoA 2** | **Description** |
| Species | White Shrimp *(Litopenaeus vannamei)* |
| Stock | White Shrimp is managed by geographical zones including the states of Sinaloa, Nayarit and Gulf of Tehuantepec. The target stock(s) = biologically distinct unit(s). There is no evidence that the definition of the stocks used in the management correspond to the biological unit stocks (See 3.3.2 Stock Structure). For purposes of this assessment the team treated each species as a single stock. |
| Geographical area | The Pacific coast of Mexico, from Baja California Sur to the Border with Guatemala including the Gulf of California. |
| Harvest method / gear | Bottom trawl net “ala de angel” |
| Client group | Comité Sistema Producto de Camarón de Altamar |
| Other eligible fishers | Other industrial vessels in the fleet that are not part of the Comite Sistema Producto Camaron de Altamar and the small fleet that operates over the shrimp stocks |

| UoA 3 | Description |
|---|---|
| Species | Brown Shrimp (*Farfantepenaeus californiensis*) |
| Stock | Brown Shrimp is managed by zones in the states of California Sur, Sonora, Sinaloa and Nayarit, and Gulf of Tehuantepec. The target stock(s) = biologically distinct unit(s). There is no evidence that the definition of the stocks used in the management correspond to the biological unit stocks (See 3.3.2 Stock Structure). For purposes of this assessment the team treated each species as a single stock. |
| Geographical area | The Pacific coast of Mexico, from Baja California Sur to the Border with Guatemala including the Gulf of California. |
| Harvest method / gear | Bottom trawl net "ala de angel" |
| Client group | Comité Sistema Producto de Camarón de Altamar |
| Other eligible fishers | Other industrial vessels in the fleet that are not part of the Comite Sistema Producto Camaron de Altamar. |

### 3.1.2 Unit(s) of Certification

**Tabla 2: Unit(s) of Certification (UoC)**

| UoC 1 | Description |
|---|---|
| Species | Blue shrimp (*Litopenaeus stylirostris*) |
| Stock | Blue Shrimp is managed by geographical zones including the states of Baja California Sur, Sonora and Sinaloa. The target stock(s) = biologically distinct unit(s). There is no evidence that the definition of the stocks used in the management correspond to the biological unit stocks (See 3.3.2 Stock Structure). For purposes of this assessment the team treated each species as a single stock. |
| Geographical area | The Pacific coast of Mexico, from Baja California Sur to the Border with Guatemala including the Gulf of California. |
| Harvest method / gear | Bottom trawl net "ala de angel" |
| Client group | Comité Sistema Producto de Camarón de Altamar |

| | |
|---|---|
| Other eligible fishers | Other industrial vessels in the fleet that are not part of the Comite Sistema Producto Camaron de Altamar and the small fleet that operates over the shrimp stocks |
| **UoC 2** | **Description** |
| Species | White Shrimp *(Litopenaeus vannamei)* |
| Stock | White Shrimp is managed by geographical zones including the states of Sinaloa, Nayarit and Gulf of Tehuantepec. The target stock(s) = biologically distinct unit(s). There is no evidence that the definition of the stocks used in the management correspond to the biological unit stocks (See 3.3.2 Stock Structure). For purposes of this assessment the team treated each species as a single stock. |
| Geographical area | The Pacific coast of Mexico, from Baja California Sur to the Border with Guatemala including the Gulf of California. |
| Harvest method / gear | Bottom trawl net “ala de angel” |
| Client group | Comité Sistema Producto de Camarón de Altamar |
| Other eligible fishers | Other industrial vessels in the fleet that are not part of the Comite Sistema Producto Camaron de Altamar ad the small fleet that operates over the shrimp stocks |
| UoC 3 | Description |
| Species | Brown Shrimp (*Farfantepenaeus californiensis*) |
| Stock | Brown Shrimp is managed by zones in the states of California Sur, Sonora, Sinaloa and Nayarit, and Gulf of Tehuantepec. The target stock(s) = biologically distinct unit(s). There is no evidence that the definition of the stocks used in the management correspond to the biological unit stocks (See 3.3.2 Stock Structure). For purposes of this assessment the team treated each species as a single stock. |
| Geographical area | The Pacific coast of Mexico, from Baja California Sur to the Border with Guatemala including the Gulf of California. |
| Harvest method / gear | Bottom trawl net “ala de angel” |
| Client group | Comité Sistema Producto de Camarón de Altamar |
| Other eligible fishers | Other industrial vessels in the fleet that are not part of the Comite Sistema Producto Camaron de Altamar |

### 3.1.3 Scope of Assessment in Relation to Enhanced Fisheries or Introduced Fisheries

This fishery is not an enhanced fishery and does not target introduced species.

## 3.2 Assessment results overview

# 4. Evaluation Results

## 4.1 Traceability within the fishery

**Description of Tracking, Tracing and Segregation Systems**

The General Law on Sustainable Fisheries and Aquaculture provides guidelines for Traceability in, article 119 Bis 9 – 14, Section III. Where is stated that The Secretariat shall establish the bases for the implementation of traceability systems for resources, parts and derivatives of fishery or aquaculture origin, for human consumption, from its origin to its destination. It is also mentioned that the agents involved in each link in the value chain must implement and maintain a traceability system and these systems will ensure the traceability throughout the chain of its primary processing and should have the relationship of suppliers and distributors or customers. Information in the traceability system must include: origin, destiny, lot, the date of production, the date of packaging, process or elaboration, expiration or date of preferential consumption, and Individual or group identification according to the specific product.At this juncture, the assessment team has no further documentation on traceability at this time. Should the client group proceed with this assessment, more traceability documentation will need to be provided at a later date. Examples of traceability documentation include bill of lading, purchase orders, fish tickets, invoices, and other documents associated with batches of product being handled.

The following traceability evaluation is for the UoC/UoA covering describe UoC: fleet, gear, and target species. Below we've listed the main stages of the supply chain within the UoC fishery:

1. Capture of product
2. On-board processing
3. Product unloading
4. Product transport
5. Product storage
6. Product sale and first change of ownership

Include evaluation of the robustness of the management systems related to traceability

**Table 4: Traceability within the fishery**

| Factor | Description |
|---|---|
| Will the fishery use gears that are not part of the Unit of Certification (UoC)?<br><br>If Yes, please describe:<br>- If this may occur on the same trip, on the same vessels, or during the same season;<br>- How any risks are mitigated. | Fishery will use bottom trawl nets and will not use other fishing gear. |

| | |
|---|---|
| Will vessels in the UoC also fish outside the UoC geographic area?<br><br>If Yes, please describe:<br>- If this may occur on the same trip;<br>- How any risks are mitigated. | All vessels within the UoC will fish within the geographic areas described in the UoC. |
| Do the fishery client members ever handle certified and non-certified products during any of the activities covered by the fishery certificate? This refers to both at-sea activities and on-land activities.<br><br>- Transport<br>- Storage<br>- Processing<br>- Landing<br>- Auction<br><br>If Yes, please describe how any risks are mitigated. | Client group intends to segregate certified and non-certied product at all stages of production upon receipt of certification both on board vessels and on land. |
| Does transshipment occur within the fishery?<br><br>If Yes, please describe:<br>- If transshipment takes place at-sea, in port, or both;<br>- If the transshipment vessel may handle product from outside the UoC;<br>- How any risks are mitigated. | To our knowledge, vessels land product themselves without transhipment. |
| Are there any other risks of mixing or substitution between certified and non-certified fish?<br><br>If Yes, please describe how any risks are mitigated. | At present, there are no known risks of mixing or substation between certified and non-certified product (in this case, shrimp). |

# 5 Scoring

## 5.1 Summary of Performance Indicator level scores

**Table 5: Summary of Performance Indicator Scores and Associated Weights Used to Calculate Principle Scores.**

| Principle | Component | Wt | Performance Indicator (PI) | | Wt | Blue | White | Brown |
|---|---|---|---|---|---|---|---|---|
| **One** | Outcome | 0.333 | 1.1.1 | Stock status | 1.0 | <60 | <60 | >80 |
| | | | 1.1.2 | Stock rebuilding | 0.0 | <60 | <60 | N/A |
| | Management | 0.667 | 1.2.1 | Harvest strategy | 0.25 | 60-79 | 60-79 | 60-79 |
| | | | 1.2.2 | Harvest control rules & tools | 0.25 | 60-79 | 60-79 | 60-79 |
| | | | 1.2.3 | Information & monitoring | 0.25 | >80 | >80 | >80 |
| | | | 1.2.4 | Assessment of stock status | 0.25 | 60-79 | 60-79 | 60-79 |
| **Two** | Primary species | 0.2 | 2.1.1 | Outcome | 0.333 | >80 | | |
| | | | 2.1.2 | Management strategy | 0.333 | >80 | | |
| | | | 2.1.3 | Information/Monitoring | 0.333 | >80 | | |
| | Secondary species | 0.2 | 2.2.1 | Outcome | 0.333 | 60-79 | | |
| | | | 2.2.2 | Management strategy | 0.333 | 60-79 | | |
| | | | 2.2.3 | Information/Monitoring | 0.333 | 60-79 | | |
| | ETP species | 0.2 | 2.3.1 | Outcome | 0.333 | >80 | | |
| | | | 2.3.2 | Management strategy | 0.333 | >80 | | |
| | | | 2.3.3 | Information strategy | 0.333 | 60-79 | | |
| | Habitats | 0.2 | 2.4.1 | Outcome | 0.333 | 60-79 | | |
| | | | 2.4.2 | Management strategy | 0.333 | 60-79 | | |
| | | | 2.4.3 | Information | 0.333 | 60-79 | | |
| | Ecosystem | 0.2 | 2.5.1 | Outcome | 0.333 | 60-79 | | |
| | | | 2.5.2 | Management | 0.333 | >80 | | |
| | | | 2.5.3 | Information | 0.333 | 60-79 | | |
| **Three** | Governance and policy | 0.5 | 3.1.1 | Legal &/or customary framework | 0.333 | >80 | | |
| | | | 3.1.2 | Consultation, roles & responsibilities | 0.333 | >80 | | |
| | | | 3.1.3 | Long term objectives | 0.333 | >80 | | |
| | Fishery specific management system | 0.5 | 3.2.1 | Fishery specific objectives | 0.25 | 60-79 | | |
| | | | 3.2.2 | Decision making processes | 0.25 | 60-79 | | |
| | | | 3.2.3 | Compliance & enforcement | 0.25 | 60-79 | | |
| | | | 3.2.4 | Monitoring & management performance evaluation | 0.25 | 60-79 | | |

## 5.2 Principle 1

### 5.2.1 Principle 1 background

#### 5.2.1.1 Life History Information (Blue Shrimp – White Shrimp , Brown Shrimp

**Taxonomic classification**

**Class**: Malacostraca
**Order:** Decapoda
**Family**: Penaeidae
**Genus:** *Litopenaus*
**Species**: *L. stylirostris*

**Class**: Malacostraca ·
**Order:** Decapoda
**Family**: Penaeidae
**Genus:** *Litopenaus*
**Species**: *L. vannamei*

**Class**: Malacostraca ·
**Order:** Decapoda
**Family**: Penaeidae
**Genus:** *Farfantepenaus*
**Species**: *L. californiensis*

**Biology**

Penaeid Shrimps from the Mexican Pacific are eurythermic and euryhaline species that inhabits inter-tropical and subtropical coastal system areas. Blue Shrimp *Litopenaeus stylirostris* is distributed from the Gulf of California to Tumbes (Perú) and White Shrimp from Baja California (Mexico) to Bahia Sechura (Perú). Brown Shrimp, *Farfantapenaeus californiensis*, is distributed from San Francisco Bay (USA) to Bahia Sechura (Perú).

Their optimal temperature ranges between 24-28 °C and their optimal salinity between 23-36 ups. They have migratory movements due to the nature of their life cycle, which is dependent on lagoon systems, estuaries or bays, which are used as areas of protection, food, and growth.

Their life cycle is short (Hendrix, 1996); they grow fast with high fecundity. They are benthic organisms as juveniles and adults. Penaeids shrimps prefer soft mud-sandy bottoms and feed on crustaceans, fish, mollusks, annelids, plants and organic detritus.

**Behaviour**

The three species have migratory movements from the coastal lagoons to open but coastal waters. In particular, shrimp from genus *Litopenaeus* spend most of their time in areas influenced or closely related to river deltas, estuaries or coastal lagoons, which are used as areas of protection, food, and growth. On the other hand, shrimps from genus *Farfantepenaeus* are preferentially found in the marine environment. The brown shrimp, Brown Shrimp develops less than 25% of their life cycle in the lagoon systems (Lopez-Martinez, 2000).

**Growth and Natural Mortality**

Shrimp growth is a discontinuous process regulated by the molt cycle, which is made up of short molt periods of rapid growth and of longer intermoult periods when no growth occurs. The duration of the molt cycle depends on species and size, and it influences the morphology, physiology, and behavior of these animals (Bureau et al., 2000; Vega-Villasante et al., 2000). Growth depends on sex, stage and environmental factors such as food quantity and quality, water temperature and salinity (Dall et al., 1990).

The three penaeids species of Mexican Pacific match with these features. They grow fast and their early development phases are sensitive to changes in water salinity. Raining seasons favor the growth of post-larvae and juveniles of Blue Shrimp and White Shrimp due to the decrease of salinity and the increase of water volume in lagoons.

Growth parameters of Brown Shrimp in Sonora was described by several authors (Chávez & Rodriguez de la Cruz, 1971; Galicia, 1976; Lopez, 2000), using the von Bertalanffy growth function (Table 10: von Bertalanffy growth parameters for Brown Shrimp). Lopez (2000) used samples taken on board and from landings for the cohorts of the period 1978 – 1995. The author describes an important variability between cohorts.

**Table 10: von Bertalanffy growth parameters for Brown Shrimp**

| | Chávez & Rodriguez de la Cruz, 1971 | Galicia, 1976 | Lopez, 2000 |
|---|---|---|---|
| ***L∞*** **(mm)** | 242 | 238 | 226.5 |
| ***k*** **($y^{-1}$)** | 1.9944 | 2.832 | 1.88 |

Natural mortality of Brown Shrimp was estimated from three different methods varying among 2.11 – 2.82 $y^{-1}$ (Lopez (2002).

Growth parameters and natural mortality of Blue Shrimp and White Shrimp were not found but could be assumed similar to those estimated for Brown Shrimp.

**Reproduction and Recruitment**

The sexes are separate from sexual dimorphism; females tend to be larger than males. Maturing and reproduction take place in the open sea between five and 20 fathoms deep. For Blue Shrimp and White Shrimp, the conspicuous mature gonadal period is during spring and summer, and for Brown, Shrimpgonadal maturity is seen during all year (Garduño-Argueta & Calderón-Pérez 1994).

Fertilization is external; males and females clasp to copulate and then the female broadcasts fertilized eggs into the water column. All three penaeid shrimps are extremely prolific, releasing between 800 000 and 1.6 million eggs per spawning (Rodriguez de la Cruz & Rosales, 1980). The released eggs are demersal with size ranging from 200 to 500 microns depending on the species. The eggs drift with the plankton and may settle to the seafloor. They hatch within 24 hours. Newly hatched shrimp larvae bear little resemblance to their elders. In the three penaeids species, larvae must undergo 11 molts to attain final form as a juvenile shrimp): five nauplii stages, three protozoea stages and three mysis stages (Figure 1). The tiny shrimp larvae drift with the plankton, where they are an important food for many fishes and invertebrates. The last of these seedlings transforms into a postlarva having already the general adult appearance but its rostral formula is incomplete (Hendrickx, 1996). In the post larva stage, shrimp penetrates estuaries and coastal lagoons thanks to currents and tides (Macías-Regalado et al., 1982), where it virtually begins its growth with semi-continental habits. As it grows (30 to 60 mm per month during the juvenile phase) it moves from the shallow waters of the lagoon to deeper areas. When they reach the sub-adult state (approximately 140 mm in total length), they begin their migration to marine waters to complete their reproductive cycle (Pearson, 1939; Cárdenas, 1951; Signoret, 1974).

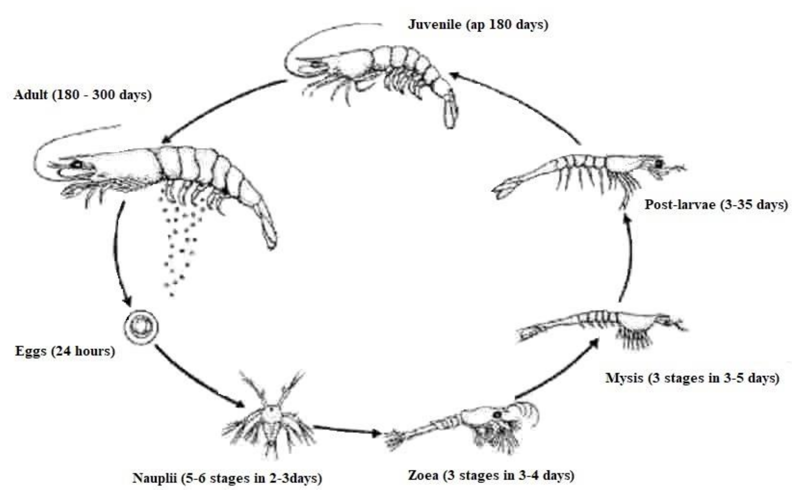



**Figure 1: Shrimp life cycle**

**Distribution and Stock Structure**

The three shrimp species are spatially distributed throughout the Mexican Pacific, from the Upper Gulf of California to the Gulf of Tehuantepec. However, it is important to point out that the stock structure has not been entirely defined for any of the three species. INAPESCA and CONAPESCA use geographical criteria to delineate the management zones (INAPESCA 2016) (Figure 4). A study to assess the genetic structure of white and Blue Shrimp was carried out by de la Rosa-Velez et al. (2000). They found out that a dendrogram generated from Nei's genetic similarities segregated the upper Gulf populations of both species from the other two populations (middle Gulf and mouth of the Gulf). This segregation may be the result of the "Island Barrier" hypothesized as segregating other decapods inhabiting the Gulf of California. However, these results have not been incorporated into their management; therefore, for purposes of this assessment, the team treated each species as a single stock. Further research in stock structure for the three species would be required for the team to adequately assess whether the current stock assessment(s) and management strategies are expected to maintain the sustainability of the stock(s).

The three species of shrimps are distributed from the coast and internal lagoons to 85 m depth. In this fringe, the stocks of shrimp have a spatial pattern that differs between species, regions and years. In general, Blue Shrimp is the most abundant species of Mexican Pacific, and the stock is mainly concentrated in Sonora and Sinaloa, and less in Baja California Sur and Tehuantepec. White shrimp is more abundant in Sinaloa, Nayarit, and Gulf of Tehuantepec. Brown shrimp have a wide distribution and is abundant in Sonora and Sinaloa (INAPESCA, 2016). Under this general scheme of distribution, Meraz-Sanchez (2007) described the inter-annual spatial distribution of available biomass in the Sinaloa, based on data of survey during the closed season for the period 2004 – 2006, and using two interpolation techniques. The author describes a pattern of patchy distribution in all species and an apparent latitudinal stratification in those of genus *Litopenaeus*. The abundance of species has a relation with latitude and bathymetry (Meraz-Sanchez 2007). This information, annually collected from surveys during the closed season, could be used to address the fishing effort and enforce the spatially explicit management as has been proposed in the Management Plan 2018 (INAPESCA 2018).

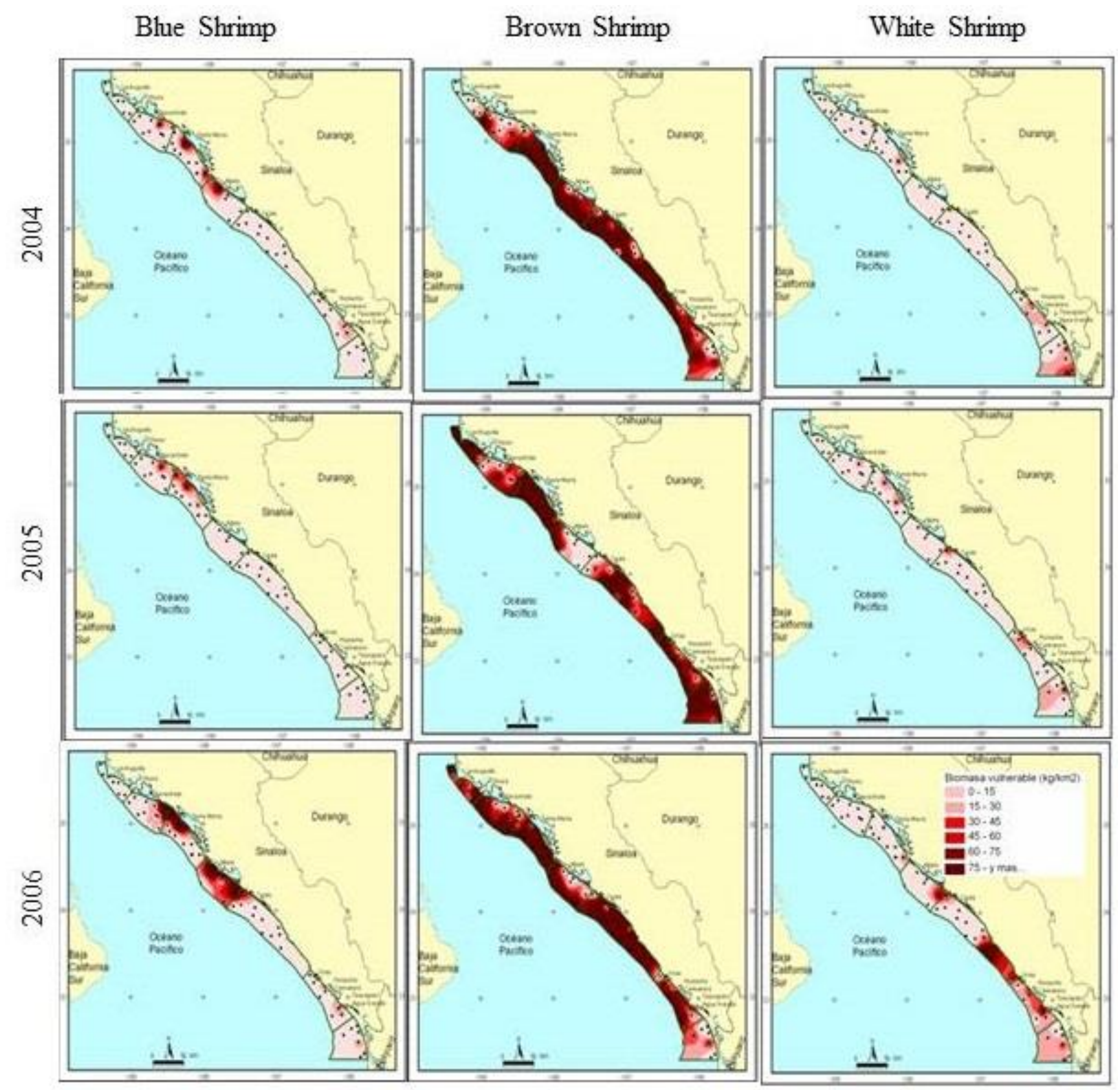



**Figure 2: Spatial distribution of available biomass (kg/km²) of three shrimp species for the period 2004 – 2006 (August), in zones 30 and 40 in Sinaloa (modified from Meraz-Sanchez 2007).**

Based on the available data of catch by species, fishing effort, and a bathymetric model, Meraz Sanchez (2007) estimated the distribution probabilistic of by species in a depth gradient (Figure 3). According to his results, the Blue Shrimp is distributed in the coastal strip (up to 25 m depth), and White Shrimp until 50 m, while the Brown Shrimp has a wide distribution range up to 80 m, prevailing at 47 m.

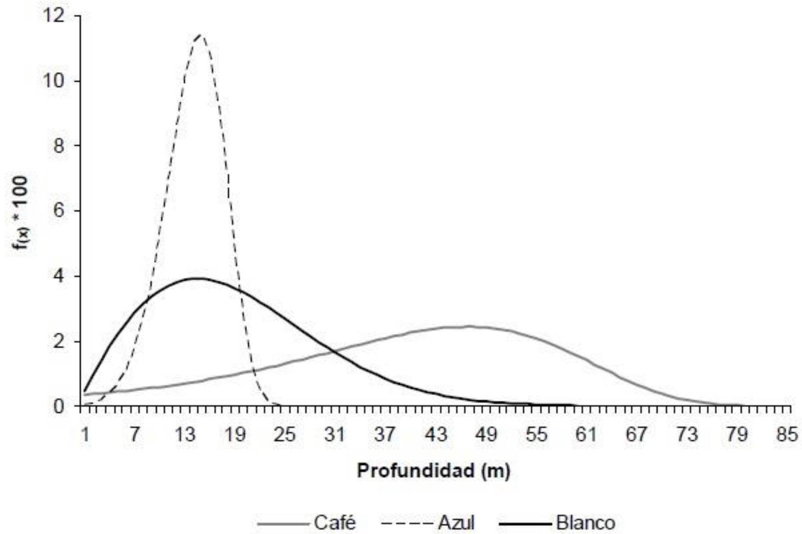



**Figure 3: Distribution of probabilities of abundance by shrimp species in relation with depth (m).**

### 5.2.1.2 Status of stocks

According to the Carta Nacional Pesquera (2012) and INAPESCA (2012), the Pacific Shrimp Fishery is exploited at the maximum sustainable yield. However, it does not differentiate between the three species or stock targeted by the fishery and there is no mention of the methodology to determine this status neither the assessment model used. In recent documents (INAPESCA, 2016, 2018) the species status was determined by two different approaches: i) Catch-based methods using the historical average catch by species and zone, ii) Model-based methods by species and zone, where the outcomes are CPUE trends, Biomass trend in relation with the MSY and Kobe chart using the relation between $F/F_{MSY}$ and $B/B_{MSY}$.

I) Catch-based method

Annual catch by species and zone were used to estimate the relation between the average catch of the last three years divided by the historical average catch (Table11). This procedure smooth the outcome of the original indicator propossed by Branch et al (20011) which takes as reference the maximum catch: "The catch-based method (e.g., Froese & Kesner-Reyes 2002; Pauly 2007, 2008) divides time series of catches into two periods: before and after the year of the maximum catch (Cmax). In the years before the maximum catch, fisheries are classified as either developed (<0.5 Cmax) or fully exploited (≥0.5 Cmax). In the years after the maximum catch, fisheries are classified as either fully exploited (≥0.5 Cmax), overexploited (0.1–0.5 Cmax), or collapsed (<0.1 Cmax)." In the assessment of the shrimp fishery the the time series of catches are not divided into two periods, and the maximum catch was not considered suitable on the basis that the shrimp fishery has high variability in the annual recruitment (INAPESCA, 2016).

**Table 11: Classification of status by fishing zone and shrimp species in the Mexican Pacific.; using - the average of the last three years until 2018 divided by the historical average catch (third column) - the ratio proposed by Branch et al (2011), C/Cmax (fifth column). Data were re-calculated from the catch data until 2016 (Baja California Sur and Sonora) and 2018 (Sinaloa-Nayarit and Gulf of Tehuantepec) taken from INAPESCA (2016, 2018).**

| Fishing Zone | Species | $C/\bar{C}$ | Status | $C/C_{max}$ | Status |
|---|---|---|---|---|---|
| Baja California Sur | Blue Shrimp | 1.98 | Full | 0.69 | Full |
| (2016) | Brown Shrimp | 0.93 | Full | 0.97 | Full |
| Sonora | Blue Shrimp | 0.34 | Overexpl | 0.31 | Overexpl |
| (2016) | Brown Shrimp | 0.76 | Full | 0.7 | Full |
| Sinaloa and Nayarit | Blue Shrimp | 0.59 | Full | 0.36 | Overexpl |
| (2018) | White Shrimp | 0.53 | Full | 0.13 | Overexpl |
| | Brown Shrimp | 1.17 | Full | 0.66 | Full |
| Golfo de Tehuantepec | White Shrimp | 0.88 | Full | 0.32 | Overexpl |
| (2018) | Brown Shrimp | 0.75 | Full | 0.44 | Overexpl |

INAPESCA (2018) established the same criteria for classifying the status proposed by Branch et al (2011): fully exploited if >0.5, overexploited if 0.1 <  < 0.5 and collapsed if  < 0.1, but the catch ratio is different. The efficiency of the proposed indicator has not been tested or compared with results from the original catch-based method approach. This status classification was not made based on abundance estimates determined with a stock assessment model; instead, it was made based only on catch data. The MSC criteria state that "Where information is not available on the stock status relative to the Point of Recruitment Impairment (PRI) or MSY levels, proxy indicators and reference points may be used to score PI 1.1.1" (MSC CR v2.0 SA2.2.3). As the values used by INAPESCA to determine the status of the stock under this method are not expressed as default values for the levels of PRI and MSY levels, this index can be considered as "proxy indicator" or a "proxy index". The use of this index assumes that the fleet operates in their entire capacity, not affected by economic reason or other externalities which can reduce the landing and interpret as a reduction of biomass. Also, checks may be needed to ensure, in this case, that spatial changes in fishing or changes in the catchability of gears do not reduce the reliability of the proxy indicators.

Branch et al (2011) found that catch-trends overestimated the percentage of overexploited and collapsed stocks and noted that catch-based estimates are inaccurate as catch data can vary as a result of reasons other than actual stock collapse and this approach is "biased toward assessing stocks as developing in early years and as collapsed in later years" (Branch et al, 2011). Consequently, it's important to understand the mechanisms, such as abundance, changes in effort, policy or data collection, which are driving catch trends.

Proxies changed from 2016 to 2018, in some cases decreasing (Table 11). The status of the stock is uncertain with the information described using the proxies, mainly when catches are frequently referred to as mixed species. Populations of the shrimp species strongly depend on the recruitment, and it is affected by environmental conditions. ENSO has been described to be influenced in recruitment and the abundance of the year classes of shrimps. The use of proxies like catch indexes unable to reduce the uncertainty about if the stock has been reduced to the point where the recruitment would be impaired.

II) Model-based methods

Model-based methods were used in different moments to assess some shrimp species, but until 2018 (Management Plan, INAPESCA 2018) a complete screening by species and zones had not been documented. The first effort to apply a formal methodology to assess the stock status and define MSY-based reference points was carried out by Morales-Bojorquez et al. (2000). They used the fox model with process and observation error to assess the dynamics of the brown shrimp (*F. californiensis*) in the Gulf of California. They concluded that the hypothesis on process error was accepted and calculated model parameters and MSY and $B_{MSY}$. Biomass trends from the process and observation error converge for the last years at a similar level.

Similarly, García-Juárez et al. (2009) used the Schaefer model to Blue Shrimp (*L. stylirostris*) in the upper Gulf of California to simulate a system of catch quotas. The model was fitted to CPUE data using observation error. Results suggest that a quota between 2,200 and 2,400 t was recommended.

Madrid-Vera et al. (2012) used the Pella-Tomlinson model for the stock assessment of the white shrimp (*L. vannamei*) from the South-eastern Gulf of California. They noted that the white shrimp is declining, 50% of the reported catch series are below the estimated MSY value (3600 t), concluding that it is necessary to recover the stock. This result contradicts those by INAPESCA (2016).

Unfortunately, results from these papers have not been incorporated into the management of the shrimp fishery or the HCR. From the information reviewed, we note that there is not a consistent methodology to assess the stock status of each shrimp species and consequently to establish valid reference points.

Posteriorly, in 2016, a biomass dynamic model was used to carry out a stock assessment of two shrimp species:

- Brown shrimp in Sonora. Its biomass has remained stable below the BMSY. The estimated fishing mortality for the brown shrimp in Sonora is 0.8, indicating an excess of fishing mortality in the fishery, that is slightly overexploited (INAPESCA, 2016).

- Blue Shrimp in Sinaloa. A biomass dynamic model was used to estimate the biomass trend, which presents a stable trend up to 2011, and after that year a decreasing trend is observed. Biomass for the last year of the assessment is less than 50% of $B_{MSY}$ (INAPESCA, 2016).

Finally, in 2018, INAPESCA (2018) carried out the same model to assess the stock of three shrimp species in four zones. Data used were a catch, fishing effort in a number of vessels by season and CPUE. Estimations were done with maximum likelihood method and re-sampling techniques (bootstrapping). The outcomes of the new framework are CPUE trends, estimation of Maximum Sustainable Yield (MSY), Effort and Fishing Mortality at MSY ($F_{MSY}$), Biomass trends in relation with the Biomass at MSY ($B_{MSY}$), catchability, and Kobe chart using the relation between $F/F_{MSY}$ and $B/B_{MSY}$. The results showed differences between species and zones.

**Blue Shrimp *(P. stylirostris)* (Figure 4: CPUE and biomass trend of Blue Shrimp by zones, estimated using biomass dynamic model. The horizontal line represents a historical average of CPUE and Biomass at Maximum Sustainable Yield (MSY) (Source: INAPESCA 2018)**

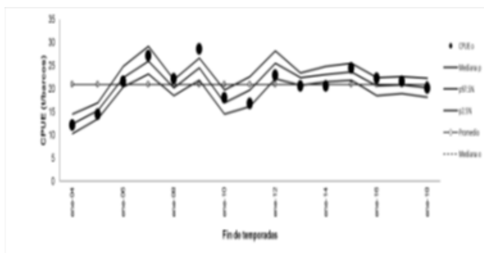
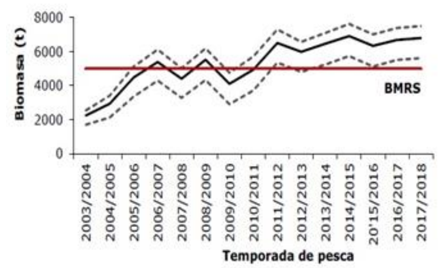
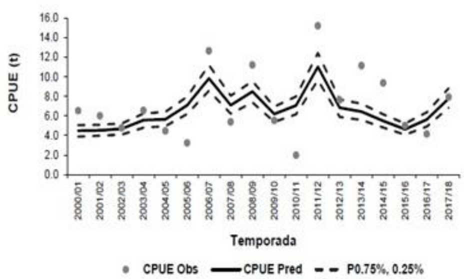
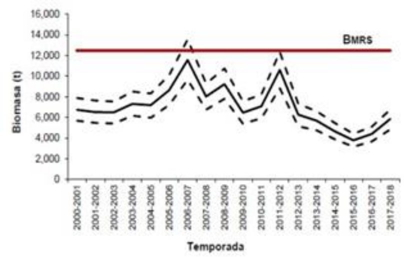
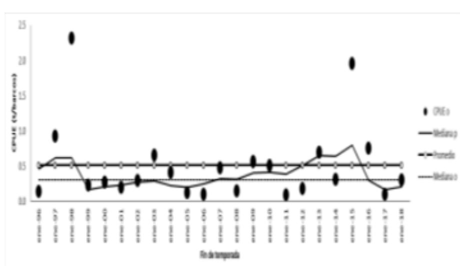
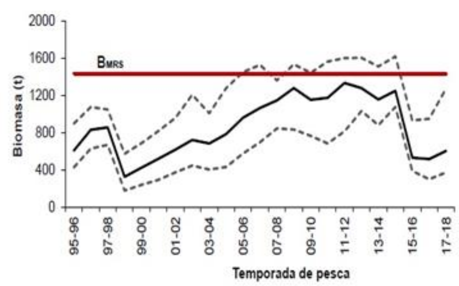
)

In Baja California Sur, Catch per Unit Effort (CPUE) of Blue Shrimp had a stable trend around value for several years, and the trend of Biomass was also fluctuating around $B_{MSY}$ 2010/2011. Then, it's growing slowly over the $B_{MSY}$.

In Sinaloa, growth up to the historical average in the last fishing season 2017-2018, after 4 years of a declining trend. This information could imply an apparent recovery of the population in such a zone. However, biomass decreased since the season 2006-2007 (exception for 2011-2012 with a peak) when it was equal to estimated $B_{MSY}$. A similar situation is observed in the results for the zone of Baja California Sur, where the CPUE is highly variable and biomass is fluctuating, but always below the $B_{MSY}$. Although the landings in this zone are significative lesser than Sinaloa. In Sonora, CPUE is stable and Biomass is above the $B_{MSY}$.

The critical scenario for the Blue Shrimp in Sinaloa, the most productive zone, is consistent with the Kobe diagram. This diagram relates two ratios: $F/F_{MSY}$ and $B/B_{MSY}$. The chart area is divided into four quadrants, with the (1, 1) coordinates in the center, representing $F=F_{MSY}$ and $B=B_{MSY}$ and each point represents one year. When the ratio $F/F_{MSY}$ is up to 1 (upper half of the chart) the fishery is overfishing, and when the ratio $B/B_{MSY}$ is below 1 (left half of the chart) the stock is overfished. The fishery of Blue Shrimp moved inside the critical upper-left quadrant during the last six years. However, no actions were taken to drive the fishery to a more conservative scenario. Fishing effort was maintained in 1138 – 1176 vessels between 2012 – 2016, and the regime of the open-closing fishing season remained without significant variation.

The catch is not an indicator of status stock, which could be affected by migrations, modifications of the artisanal/industrial balance of fishing effort and their intensity. The new analysis using a biomass dynamic model allowed to interpret that the stock of Blue Shrimp is in risk and it can be below the point of the recruitment would be impaired.

<table>
<tr><th colspan="3">Blue Shrimp</th></tr>
<tr><th></th><th>CPUE</th><th>Biomass (t)</th></tr>
<tr><td>Sonora</td><td></td><td>
</td></tr>
<tr><td>Sinaloa</td><td>
</td><td>
</td></tr>
<tr><td>Baja California Sur</td><td></td><td>
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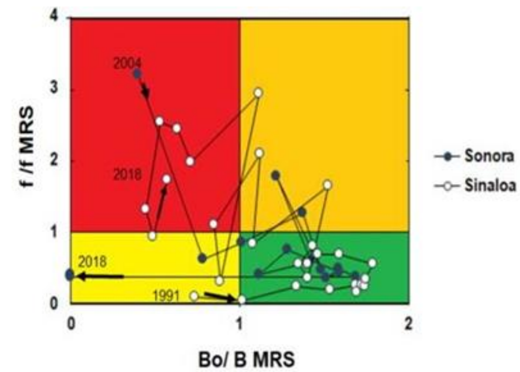



**Figure 4: CPUE and biomass trend of Blue Shrimp by zones, estimated using biomass dynamic model. The horizontal line represents a historical average of CPUE and Biomass at Maximum Sustainable Yield (MSY) (Source: INAPESCA 2018)**

__White Shrimp *(P. vannamei)*__ **(Figure 5: CPUE and biomass trend of White Shrimp by zones, estimated from biomass dynamic model. Horizontal lines represent the historical average of CPUE and Biomass at MSY. (Source: INAPESCA 2018).**

)

Catch per Unit effort in Sinaloa the CPUE, estimated from the biomass dynamic model, had a slowly decreasing trend from 2001 to 2017. Biomass was declining in Sinaloa in this period (2003: 5043 t - 2017: 797 t), and it was below the BMSY (3749 t) since 2005.

This picture is consistent with the fact that catches were also declining (see section 1.1.2. Catch and Effort Profiles), and with the results of Madrid-Vera et al. (2012). They used the Pella-Tomlinson model to assess the white shrimp stock in Sinaloa and Nayarit and find that in the 1992-2010 period catch series, 50% of the reports were below the MSY in spite of the increase of effort. As was explained above, the effort doesn't change between 2012 – 2017. The authors assume that the breeding stock of *L. vannamei* is declining stock affecting the larval and post-larval survival and has in continuous risk.

In the Gulf of Tehuantepec, CPUE showed high interannual variation oscillating around a mean value, and the biomass is stable.

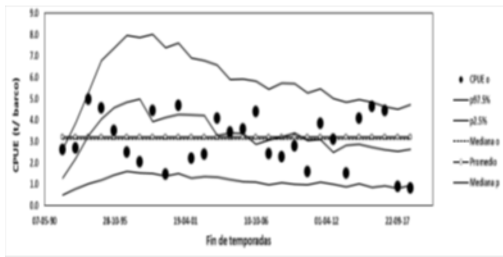
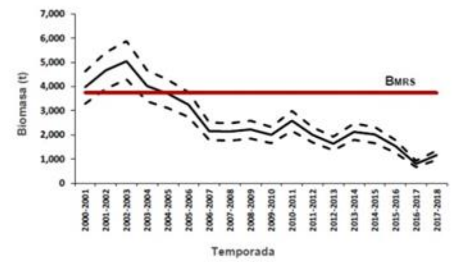
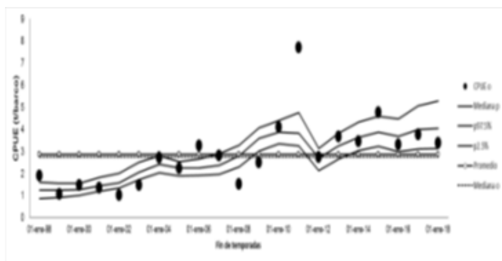
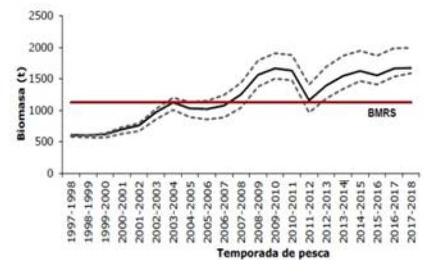
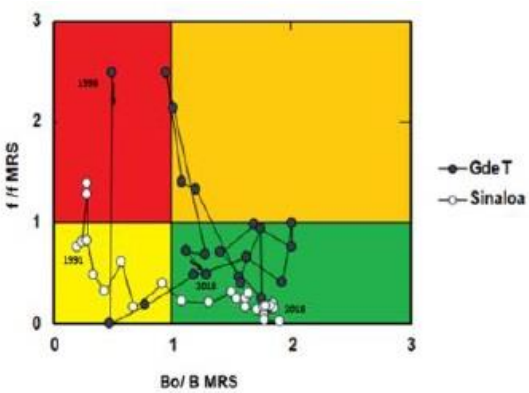
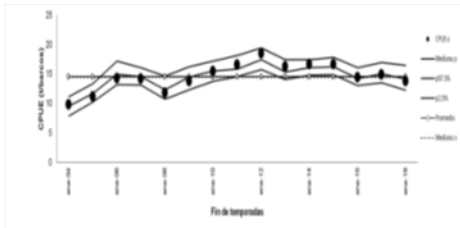
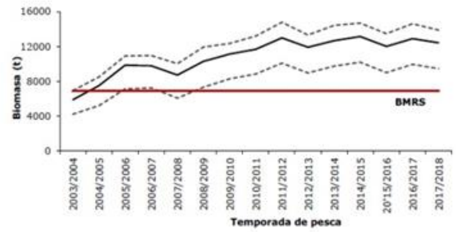
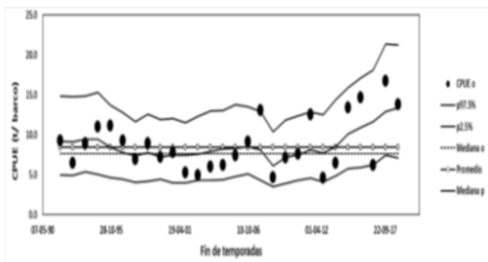
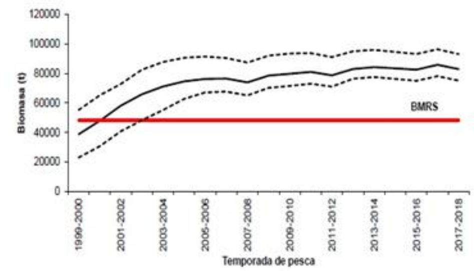
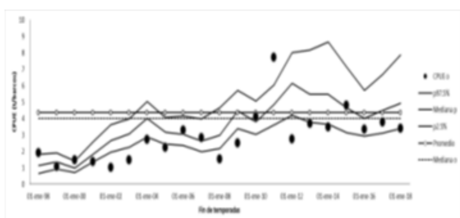
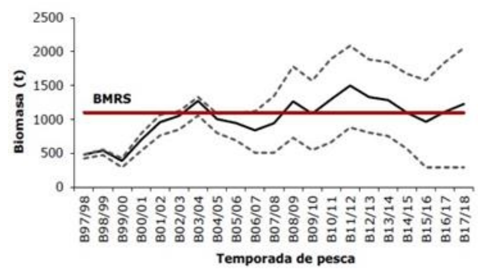
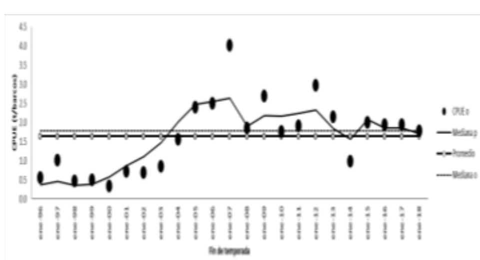
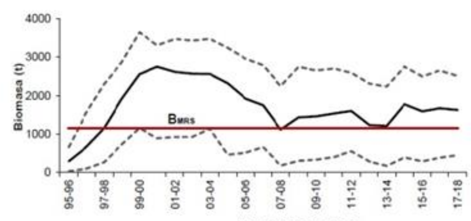
| White Shrimp | | |
|---|---|---|
| | **CPUE** | **Biomass (t)** |
| Sinaloa |   |   |
| G Tehuantepec |  |   |
|   | | |

**Figure 5: CPUE and biomass trend of White Shrimp by zones, estimated from biomass dynamic model. Horizontal lines represent the historical average of CPUE and Biomass at MSY. (Source: INAPESCA 2018).**

<u>**Brown Shrimp *(F. californiensis)***</u> **(Figure 6: CPUE and biomass trend of Brown Shrimp by zones, estimated from biomass dynamic model. Horizontal lines represent historical average of CPUE and Biomass at MSY. (Source: INAPESCA 2018).**

)

The status of this species, deducted from the report of INAPESCA (2018) and the application of dynamic biomass model is acceptable and is highly likely that the stock is above the point where recruitment can be impaired (PRI). In Baja California Sur, Sonora, Sinaloa, and Gulf of Tehuantepec CPUE are variable as the other shrimp species, but stable or increasing, and biomass above the $B_{MSY}$. Catch time series and the indicators/proxies show no trends.

| Brown Shrimp | | |
|---|---|---|
| | CPUE (t/vessel) | Biomass (t) |
| Sonora |  |  |
| Sinaloa |  |  |
| G Tehuantepec |  |  |
| Baja California S |  |  |

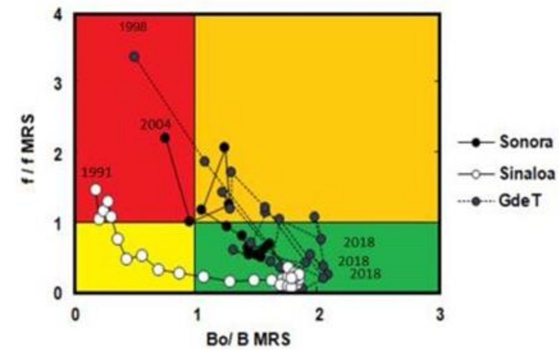



**Figure 6: CPUE and biomass trend of Brown Shrimp by zones, estimated from biomass dynamic model. Horizontal lines represent historical average of CPUE and Biomass at MSY. (Source: INAPESCA 2018).**

The status of the stocks is uncertain with the information described in the documents, mainly due to some of them are refer to catch of mixed species. Populations of the shrimp species strongly depend on the recruitment, and it is affected by environmental conditions. ENSO has been described to be influenced in recruitment and the abundance of the year classes of shrimps (Lopez-Martinez et al, 2002). The use of proxies like catch indexes unable to reduce the uncertainty about if the stock has been reduced to the point where the recruitment would be impaired. The use of model-based approaches introduces additional pieces of information that can be matched with indexes to explore consistency, in order to determine the status of the stocks.

#### 5.2.1.3 Seasonal Operation of the Fishery

The shrimp harvest season lasts between six and seven months, usually from September - October and to March - April. In the months of October, November, and December approximately 70% of the total catch is obtained, and the rest of the time decreases to a third with respect to the start of the season. Seasonality is strongly dependent on the life cycle.

#### 5.2.1.4 Fishing and Management

Shrimp catches in the Mexican Pacific are mainly composed of four species: Blue Shrimp (*L. stylirostris* , Stimpson, 1874); White Shrimp *(L. vannamei*, Boone, 1931); Brown Shrimp (*F. californiensis*, Holmes, 1900), and Crystal Shrimp (*Penaeus brevirostris*, Kingsley, 1878) (INAPESCA, 2017). There are other species at insignificant proportions of shrimps with less commercial value.

**Areas of operation**

Fishing is carried out in two different systems: protected waters and open sea, separated by the line of 5 fathoms depth. Harvest in protected areas is mainly done in lagoon systems, estuaries and bays of Baja California Sur, Sonora, Sinaloa, Nayarit, Oaxaca, Chiapas, Jalisco, and Colima. Fishing in open sea operates in whole Mexican coast, but the stocks differ in bathymetric and latitudinal distribution (see section

For management purposes, based on the type of fleet and fishing zones, INAPESCA (2012) divides the Pacific Coast into seven zones (Figure 7: Fishing zones for shrimp on the Pacific coast of Mexico. CRIP: Centro Regional de Investigación Pesquera (Regional Centre of Fishery Research).). Fishing season closing and opening are based on results from the INAPESCA research. The most productive states, in order of magnitude in the catches, are Sinaloa, Sonora, and Baja California.


**Figure 7: Fishing zones for shrimp on the Pacific coast of Mexico. CRIP: Centro Regional de Investigación Pesquera (Regional Centre of Fishery Research).**

Shrimp management is carried out by the Federal Government through several institutions including CONAPESCA, INAPESCA, SAGARPA, SEMARNAT, PROFEPA, and CONANP. Management is based on a set of guidelines and regulations contained in the General Law on Sustainable Fishing and Aquaculture and the Mexican Official Standards.

The shrimp fishery is regulated by the Official Mexican Standard NOM-002-SAG / PESC-2013, for the management of shrimp species in waters of federal jurisdiction of the United Mexican States. It establishes the conditions of access to the resource as well as the rights and obligations of users. Since 1992, access to the fishery has been determined under a scheme of commercial fishing permits. Current management measures include the implementation of temporary and space closures, restriction of effort and regulation of fishing gear. It also regulates fishing effort, considering boats, equipment and fishing gear. A restricted area was established for trawling operations in the 0 to 9.14 meters (0 to 5 fathoms) depth zone as well as the mandatory use of excluder devices for turtle and fish. It also establishes a maximum power of 85.76 kW (115 horsepower) for outboard motors and authorizes the use of different fishing gears depending on the zone and vessel type.

According to the Statistical Yearbook of Fisheries for the year 2013 (SAGARPA, 2013), approximately 79% of the total shrimp catch in Mexico extracted is from the Mexican Pacific. The shrimp fishery in the Mexican Pacific coast is one of the most important fisheries in Mexico; occupying the first place in the commercial value of the product of its sales. The majority of shrimp (>97%) is sold in frozen form for direct human consumption (INAPESCA, 2012). Approximately 25% of the shrimp catch is exported, principally to the US, Japan, and France. During 2017, shrimp exportation reaches $ 511 million US dollars. In the local market, shrimp per capita consumption increased during 2000-2017 from 0.54 kg a 1.6 kg (SIAP 2018).

In 2014, people employed in the fishing sector were 181,122, which 23.9% are dedicated to shrimp. The most productive zones are Sinaloa, Sonora, and Tabasco (49.8 %) (INEGI, 2014).

**Characteristic of the Fishing Fleet(s)**

The shrimp fishery is sequential; this fishing resource is exploited by different fleets and fishing gear during the two phases of its life cycle. As a juvenile, it is captured by small boats, ranging from 22 to 25 feet in length, in coastal lagoons and estuaries, with *suriperas* (modified cast net) and gill nets. Adult shrimps are captured by the small-scale fleet and larger industrial vessels in the high seas (INAPESCA 2012, 2016). In the open ocean, the small-scale fleet operates up to a depth of about 18 fathoms, using *changos*; a small scale manual bottom trawl (INAPESCA, 2012). The larger industrial fleet operates only in the open sea, in areas between 5 and 60 fathoms of depth. The larger vessels, constructed principally of steel, range from 18 to 25 m in length, possess engines of 240 to 624 CF, a tonnage between 40 and 80t, and most are over 30 years old.

Vessels, in the industrial fleet, are equipped with two trawl nets, which have installed turtle and fish excluder devices (Figure 8). The fishing gear used by the industrial fleet is the bottom trawl nets “ala de angel”, operating to a depth of approximately 60 fathoms (INAPESCA, 2012). The gear is composed of two nets (one per band), each with a set of (2) otter boards. The otter boards are attached to the warp wire through steel cables called bridle, whose length varies between 54 and 108 meters (30 and 60 fathoms). According to NOM_002SAG_PESC_2013, in the Pacific Ocean, mesh size in wings, throat, body, and pannels shall not be less than 50.8 millimeters (2 inches) and at the cod end of 38.1 millimeters (1 1/2 inches).

The otter boards used in shrimp trawlers are rectangular flat type, built of wood, hearth and sheet steel. Its design varies depending on the boat power, net size and its area fluctuate between 1.73 and 3.07 square meters (Figure 9).

During the fishing, season vessels operate 24 hours a day, with continuous sets of 3 to 4 hours of average duration.

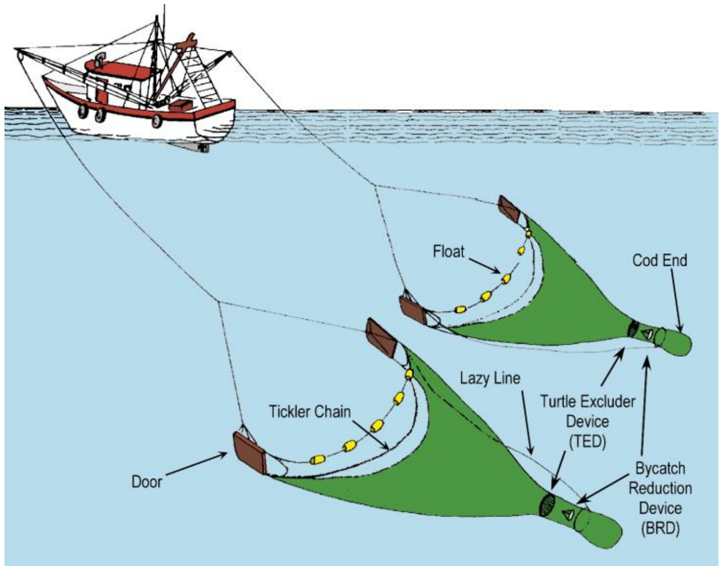



**Figure 8: Fishing gear with double rig used in the Pacific shrimp fishery (Source: www.arcgis.com)**

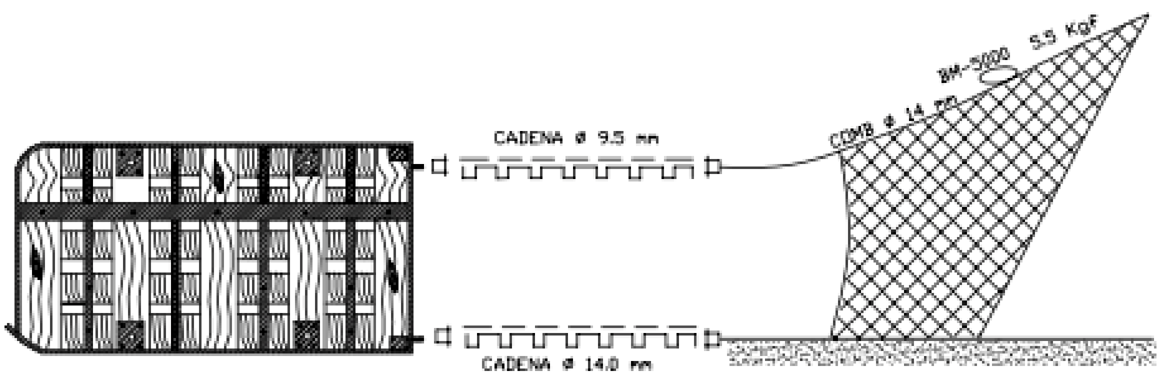



**Figure 9: Union of the otter board with the net's wing.**

In the Pacific Coast, in the high seas shrimp fishery, the effort is regulated through the number of permits. In 2013, the number of large/industrial vessels targeting shrimp was 850 and 88% of these vessels were concentrated in the Sonora and Sinaloa states (INAPESCA, 2016). The main ports are Mazatlán in Sinaloa, Guaymas in Sonora and Salina Cruz in Oaxaca. Due to Strategic Project of Voluntary Retreat of Shrimp Boats, there has been a reduction in the number of vessels in the Pacific Ocean, prior to 2005 there were 1326 boats operating (Cabrera and Gonzalez, 2005), therefore there has been a reduction of 36% in the number of boats operating in the Pacific coast.

On the other hand, in lagoon systems, streams, and bays, the number of fishing permits for small ships is 1,688, authorized for catching shrimp in the Pacific Coast (INAPESCA, 2012). Approximately, 58% of the small vessels registered to catch shrimp are in Sinaloa, 17% in Chiapas, 11% in Sonora, 7% in Nayarit y the remaining 7% is allocated between Baja California Sur, Colima, Jalisco and Oaxaca (INAPESCA, 2012).

The Pacific shrimp fishery occupies the second place in Mexican fishing production and first place considering its commercial value (SAGARPA, 2018). In 2017, the shrimp production value was estimated at $17,707 million pesos (first sale price). In the period 2000/2001 – 2017/2018 the shrimp catch temporal trend fluctuated between 17,515 t in 1991 and 54,284 t in 2011, with three peaks in 1997, 2007 and 2011 with catches above 50,000 t (Figure 10) with an average catch per year of 34,682 t (INAPESCA, 2018). In general, industrial catches are slightly greater than small boats catches for all time period. The highest number of industrial vessels operating in the Pacific coast was 1,668 vessels between 2000 and 2004, a period of time when yields were at their lowest level. In the fishing season 2013/20014, there has been a reduction in the number of large/industrial boats (350), which has produced an increase in the latest catches (INAPESCA, 2018).

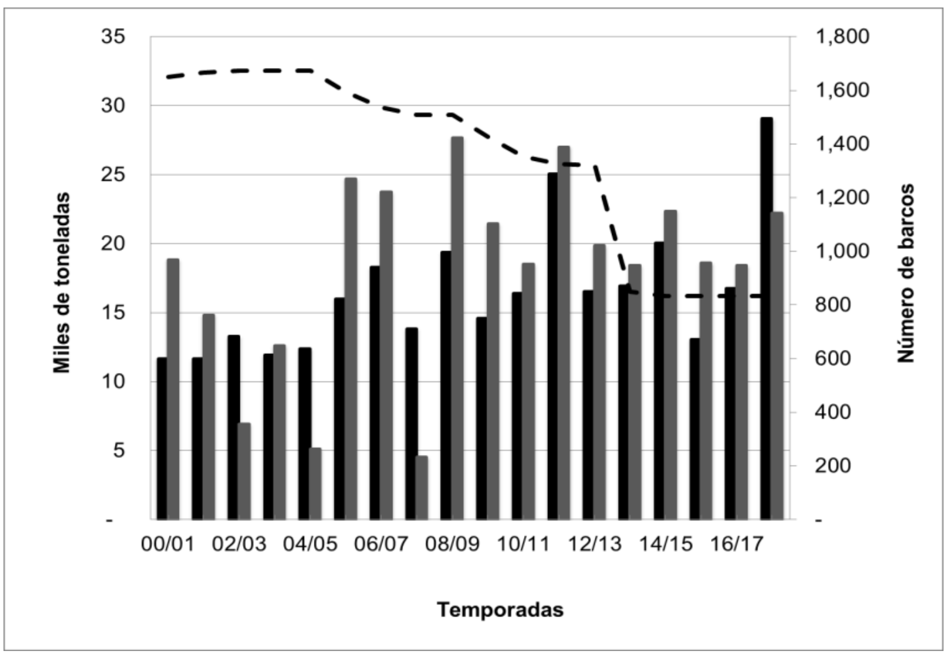



**Figure 10: Shrimp catch a temporal trend in the Pacific Coast; black bars – industrial vessels catch, grey bars – small boats catch, dash line – number of shrimp boats (INAPESCA, 2018)**

**Management**

Management of the Pacific shrimp fishery is mainly based on the General Law of Sustainable Fisheries and Aquaculture and the Official Mexican Standard NOM-002-SAG/PESC-2013. General Law establishes 15 general objectives, where establishes and defines the principles for ordering, promoting and regulating the integral management and sustainable use of fisheries and aquaculture, taking into account social, technological, productive, biological and environmental aspects. NOM-002-SAG/PESC-2013 establishes technical specifications, criteria, and procedures for regulating the shrimp fishery. In particular, it details the provisions applicable to shrimp fisheries in marine waters. It states that the vessels participating in the fishery must have a holding capacity of ten metric tons or more. Fishing gear for catching shrimp authorized for larger vessels in marine waters shall be trawl nets, following specific requirements (See Section). In addition, fishing with trawl nets is prohibited within an area having a depth of 9.25 kilometers (5 nautical miles) around the mouths communicating to the sea in the most important bays, coastal lagoons, and marshes in the Mexican Pacific. The Official Standard also states that in all shrimp fishing operations undertaken in the Mexican Pacific, all vessels must install and use any of the rigid marine turtle excluder devices (TED) approved by SAGARPA and CONAPESCA. Similarly, since 2016 all large vessels must install and use a fish excluder device, also known as a Bycatch Reduction Device (BRD) authorized by SAGARPA, with the purpose of reducing by-catch of non-target species. It also establishes the duties of the permits holders for the commercial catch of shrimp in marine waters.

One of the main tools used in the management of this fishery is season closures. The Standard NOM-002-SAG/PESC-2013 states that in order to induce a sustainable use of shrimp fisheries, SAGARPA will establish periods and closed areas for fishing. In particular, it states that it is necessary to protect spawning and juvenile populations by establishing space-time closures in order to ensure sufficient numbers of individuals to maintain wild populations to be harvested in subsequent fishing seasons. Dates for season closures and opening for fishing seasons are published by SAGARPA based on the technical opinion issued by INAPESCA.

Temporal season closures, as a management strategy, have been used for the purpose of limiting effort, protecting the reproductive period and maximizing yield, and it is considered an appropriate option in shrimp management (INAPESCA 2016). The shrimp season closure in the Mexican Pacific in recent years has been established between March and September, with spatial-temporal variations (INAPESCA, 2016). It is a measure considering both the conservation of the species as well as economic optimization for the fishery since the objective is to protect the reproductive period of the species and to allow its growth to ensure the recruitment of the species in the areas of fishing (economic). For the beginning of the fishing season two main objectives are sought:

1) Ensure that a certain percentage (pre-established) of the stock completes its migration to the marine area.

2) Determine the period in which individuals in the main cohort maximize their size (i.e., yield in weight or value).

Two achieve these two objectives, INAPESCA makes a survey to determine the behavior of reproduction, recruitment, growth, and migration. Samples are made using bottom trawl, species composition, length, total weight, sex, and maturity are recorded during each sample. In order to evaluate the possible dates for the fishing season in marine waters of the Pacific Ocean, a progression analysis of the main shrimp species was carried out by applying a size-structured modal progression model, which uses a multinomial distribution and includes the growth parameters of the V on Bertalanffy model. The projections of the possible dates of the opening of the fishing season are submitted to the National Committee for Sustainable Fisheries. It is important to point out that is not clear what methodology is applied for doing the scenarios because in some technical reports is mentioned that a size-structured modal progression model is used and other technical reports mentioned that the CASA (Catch at Size Analysis) is used. Technical reports do no show the specific methods used to make the projections (equations, how data is used, fitting criteria, software used, etc.).

Closure dates are determined at a meeting of the National Committee for Sustainable Fisheries and Aquaculture, convened by CONAPESCA, based on the technical and scientific information from INAPESCA, with the participation of all representatives of the shrimp fishery stakeholders. At that meeting, INAPESCA presents different options for the beginning and end of the closure, based on biological and fisheries studies, from which the population parameters are estimated by adjusting population models to abundance indices and size composition. The different options are analyzed and discussed technically and agreement is reached on the most appropriate option in terms of sustainability of the resource (INAPESCA, 2016).

The Management Plan 2018 proposes several management and policy actions. The management actions include assesses biological and fishery indicators of shrimp populations, in lagoon system and deep waters, and to revise the applicability of ban season and refuge zones. Policy actions propose census of fishermen, a new automatized records of catches, and revision of fishing permits. These actions could be considered a revision of the harvest strategy common to three species in order to maintain the sustainability of the stocks. The assessment of each shrimp species can vary in relation to their life history features, and their differential dependence of the environmental conditions (e.g. ENSO seems affects more Blue Shrimp than the other two species).

Also, MP 2018 proposes to promote the profitability of the fishery, between other actions oriented to the technological improvement of the fleet or institutional organization, and the objectives of assess the shrimp populations. In order to assess the stock, the MP described the use of a set of seven indicators and potential decisions based on Reference Points: 1) Catch trend; 2) Current catch/Average catch ratio; 3) CPUE; 4) Biomass (MSY); 5) Fishing effort; 6) Stock-Recruitment and ) Kobe plot. Both Limit and Target Reference points were defined for each one (Table 1). Also, several complementary studies were analyzed: Cohort analysis based in sizes, Growth models, Stock – Recruitment models, Yield Per Recruit model, Dynamic biomass, and Stock Synthesis model. The scope and constrains were discussed in the order in order to design a harvest strategy and to establish harvest control rules (INAPESCA 2018b).

**Table 12: Indicators proposed to manage the fishery. TRP: Target reference points; LRP: Limit reference points; (INAPESCA, 2018)**

| | Indicator | TRP | LRP | Decision criteria |
|---|---|---|---|---|
| 1 | Total Catch | Stable | Decreasing | Vessel control<br>Nets control<br>Increase escapement rate |
| 2 | $C/\bar{C}$ | $\geq 0.5$ | 0.1 (overexploited)<br>< 0.1 (collapsed) | Limited catch per vessel |
| 3 | CPUE | Stable | Decreasing | Fleet Modernization |
| 4 | $B_{MSY}$ | $B > B_{MSY}$ | $C < B_{MSY}$ | Spatially explicit management |
| 5 | F | F = M | $F = F_{MSY}$ | Size of the caught stock |
| 6 | $S_{MSY}$<br>S-R relationship | $B_{rem} > S_{MSY}$ | $C < S_{MSY}$ | Spatially explicit management |
| 7 | Kobe Diagram | F/FMSY < 1 and<br>$B / B_{MSY} > 1$ | $F/F_{MSY} > 1$ and<br>$B / B_{MSY} < 1$ | |

**However, there is no description if this harvest control rules or criteria and pre-agreed specific indicators have been used to manage the fishery until the present, considering that two of the shrimp stock have shown trend below the LRP during several years (Figure 4: CPUE and biomass trend of Blue Shrimp by zones, estimated using biomass dynamic model. The horizontal line represents a historical average of CPUE and Biomass at Maximum Sustainable Yield (MSY) (Source: INAPESCA 2018)**

**and Figure 5: CPUE and biomass trend of White Shrimp by zones, estimated from biomass dynamic model. Horizontal lines represent the historical average of CPUE and Biomass at MSY. (Source: INAPESCA 2018).**

). to. Also, how the reference points described in MP link with the effective management actions like trigger opening-closing the fishing seasons. On the other hand, it is not clear how is (or will be) the application of harvest control in three different species, and if they are the same indicators and same management responses.

The proposal will enhance the management in relation with proxies based in capture used until now and can be used to evaluate the stock status and/or fishing mortality from now on and to design a harvest strategy including both Target and limit reference points that trigger actions in response to indicators.

These measures imply a starting point to assess the stocks that need to be discriminated by shrimp species because their life history features, population parameters, and fishing impact vary between them.

**Information and Monitoring**

Information is obtained from monitoring of landings and independent relative abundance and size surveys, which are used to determine the duration of seasonal closures. The information regarding biological features of the stocks, their abundance and fishery removals are regularly collected, but it has not been incorporated into a model to support decisions, until 2018 in the form of Management Plan. This contains a data collection system and suggests reliable reference points and a robust harvest strategy. The components and actions lines can improve the information needed to model the population if they are entirely implemented (INAPESCA, 2018a).

Unregulated or illegal fishing is an important and complex issue, affecting, in particular, the small-scale sector in Mexico as a result of challenges in monitoring small-scale vessels. The effectiveness of control of the small-scale sector participating in the shrimp fishery is perceived as a low (IMCO- EDF, 2013). However, an official estimate quantifying fishery removals from unregulated fishing activities is not available. In 2018, concern about illegal and unregulated catches has been declared in the sectorial meeting between research organizations and the industrial fishing sector.

### 5.2.1.5 Catch profiles

The Pacific shrimp fishery started in 1940 with landings of 7,000 t, from that year the fishery was considered as in development phases with increasing landings each fishing season. The maximum catch was registered in 1987 (84,000t considering the Gulf of Mexico), in subsequent years catches have been stable (Figure 11). In the last 20 years, the average catch has been closet to 48,000 t annually. Currently, reports indicate that landings coming from the Pacific Coast represent between 60% and 70% of the total national yield. The most recent shrimp catch data for the Mexican Pacific by the state are shown below.

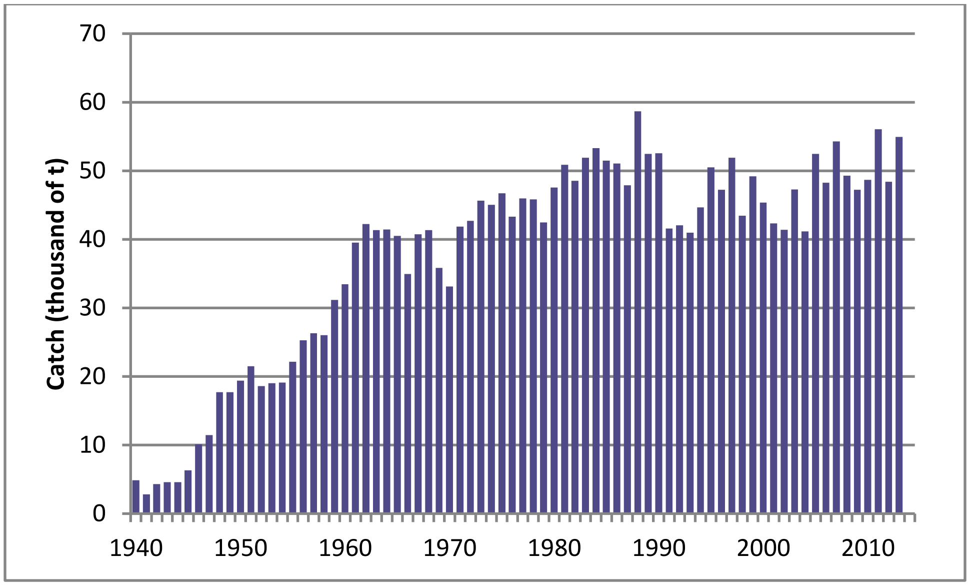



**Figure 11: Catch and effort of Mexican Pacific shrimp fishery since 1940. (Source: INAPESCA, 2016)**

**Catches by states (**Figure 12**)**

In Baja California Sur, most parts of the catches are landed by the minor fleet. For the period 2000/2001 – 2017/2018 it averaged 1329 t / year, and the number of vessels varied among 10 and 28. The fishery is supported by F. californiensis.

In Sonora, the catch fluctuated among 2948 t and 14434 t / year, and the average 8770 t. The open waters fleet was reduced from 684 vessels in 1994 to 272 in 2014. A decrease in the landings was observed from 2008. During the last decade, the minor fleet increased its participation in the fishery, and catch until 5,000 t/year. They catch mainly *L. stylirostris* and *F. californiensis* for open-waters vessels and L.stylirostris in the minor fleet.

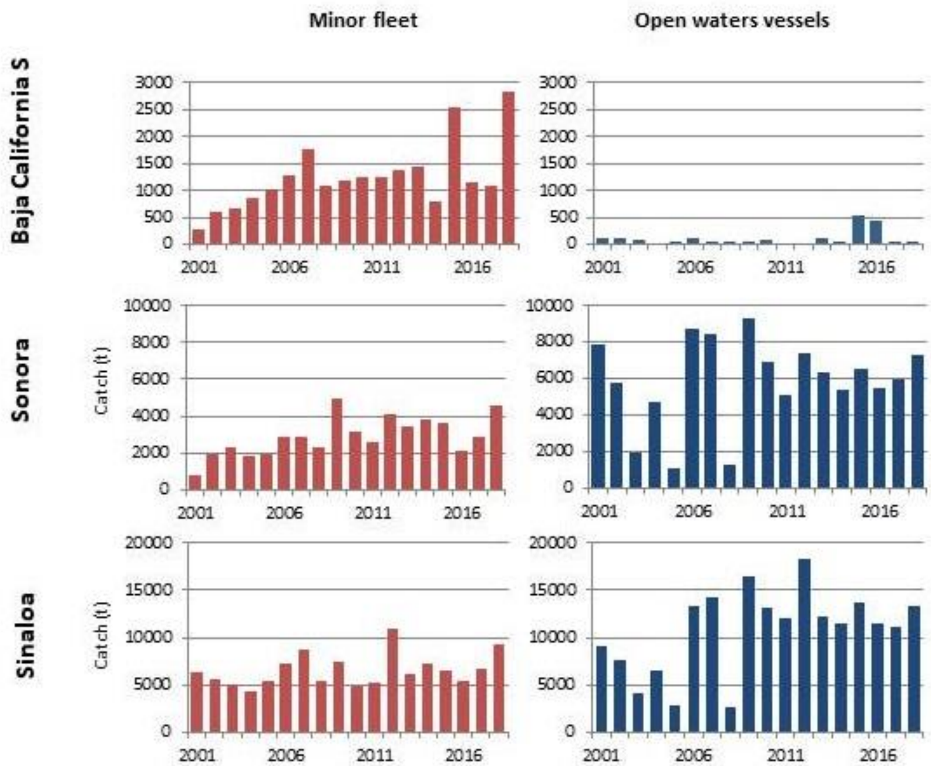



**Figure 12: Catch in Baja California Sur, Sonora and Sinaloa, landed by the minor fleet (boats operating in the inshore waters), and major fleet (vessels operating in open waters) (Source: INAPESCA, 2018)**

Sinaloa is the main region in shrimp catches, which fluctuated among 8,174 t and 29,038 t during the period 2000/2001 – 2017/2018. Like in Sonora, the fleet decreased and at present varied among 469 and 786 vessels. In this region exists almost parity between catches from the minor fleet and the vessels in the open sea, with a slight prevalence of the vessels. The landings of the inshore shrimp fishery reached 11,165 t in 2003/2004 and maintained over the 5,000 t since then. The main species in this component of the fishery are Blue Shrimp and White Shrimp. The main species for the open-waters vessels is the Brown Shrimp.

In Nayarit, the shrimp catches averaged 3,552 t/ year (period 2000/2001 – 2017-2018) and was landed almost exclusively by the inshore fleet. Catches in open waters averaged 58 t/ year, with the participation among 3 – 21 vessels. The main species is White Shrimp and Blue Shrimp.

Other states, like Oaxaca and Chiapas, the inshore landings prevailed over the open waters, and the main species is the White Shrimp in lagoons and Brown Shrimp in deer waters.

**Catches by species**

Blue Shrimp is the main shrimp species in abundance in the Mexican Pacific and shows major landing in the states of Sinaloa and Sonora (8500 t and 2500 t in average, respectively) (INAPESCA, 2016) (Figure 13).

Temporal trend of Blue Shrimp landings by state) suggest that for Baja California Sur landings have been stable fluctuating around the historical average. The same trend is also found for Sinaloa; however, for Sonora, landings have been decreasing in the lasts years and the level of landings is below the historical average. Landings of white shrimp have been stable in the last years, fluctuating around the historical average. In the states of Sinaloa and Nayarit, latest landings are below the historical average (Figure 8). Landings of Brown Shrimp also have been stable for Baja California Sur, Sinaloa and Nayarit. In Sonora, landings present a slightly decreasing trend; on the other hand in the Gulf of Tehuantepec landings have been increasing, probably due to an increase of effort.

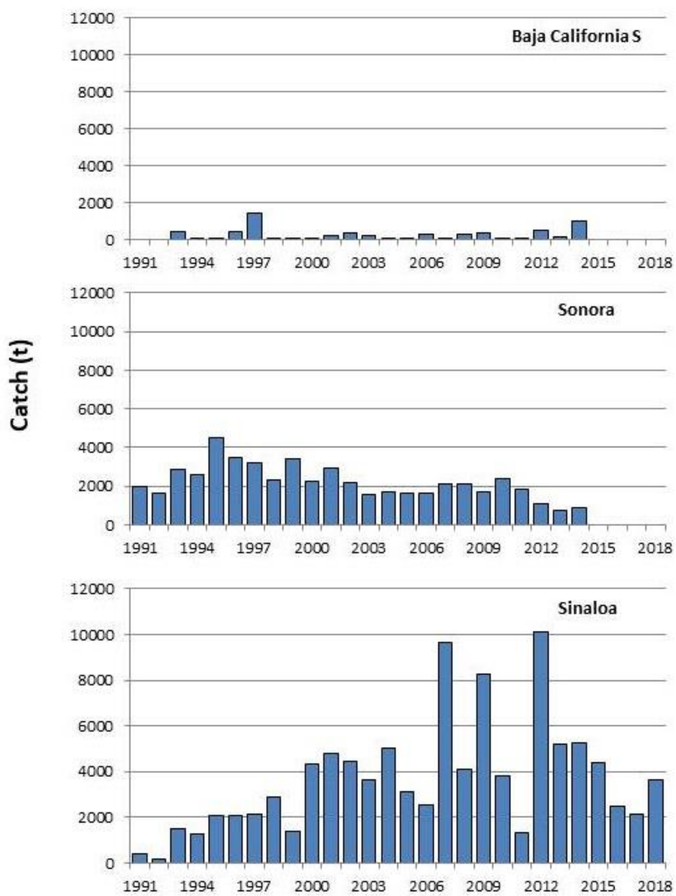



**Figure 13: Catch of Blue Shrimp Blue Shrimp by fishing zone (modified from INAPESCA 2016)**

Major landings of White Shrimp were in Sinaloa, Nayarit, and Gulf of Tehuantepec. In Sinaloa, catch average was 1,780 t /year but in decreasing tren since 2006. The last two fishing seasons catches were 400 t (Figure 14).

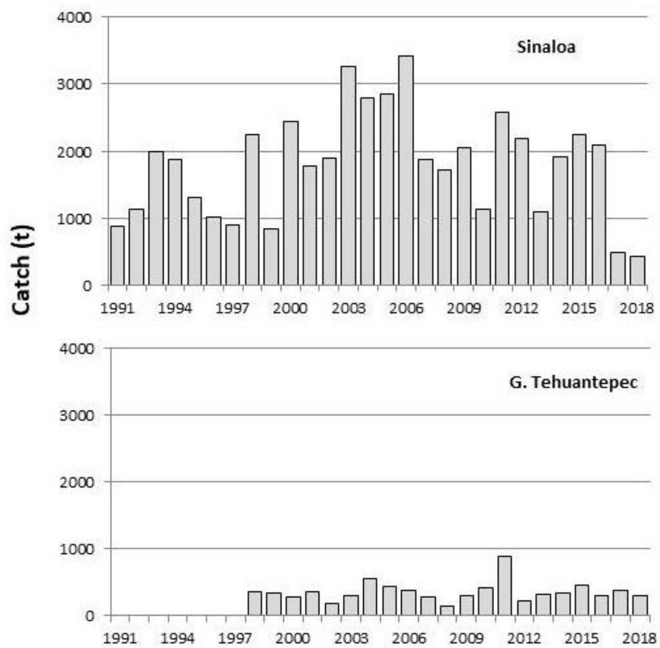



**Figure 14: Catch of White Shrimp by  fishing zone(modified from INAPESCA 2016)**

Brown Shrimp is the most important species in catches given its distribution along the coast of the Mexican Pacific and its bathymetric range. Their catches fluctuated around 4,971 t/year I Sinaloa and 3,550 t/year in Sonora, and the trend is stationary with important interannual variation (Figure 15).

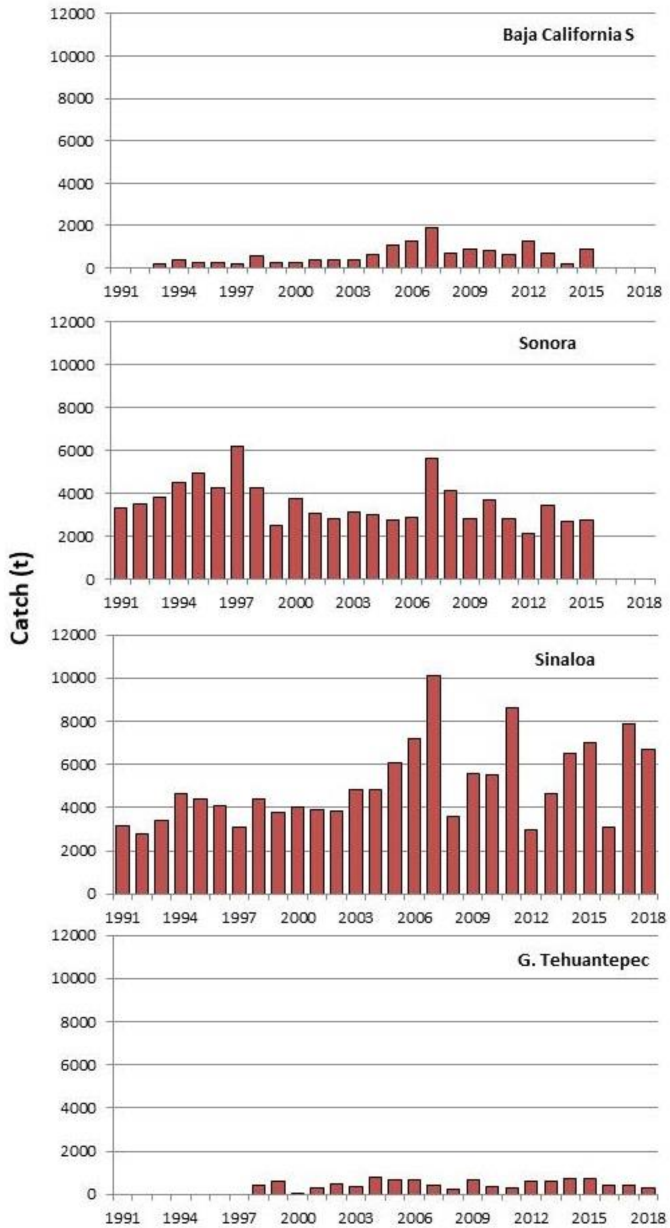



**Figure 15: Catch of Brown Shrimp by fishing zone (modified from INAPESCA 2016)**

**Fishing effort**

A raw measure of fishing effort is the number of vessels by management zones. Between 2004 – 2010, a total of 1673 boats and vessels operated in the Mexican Pacific shrimp fishery, distributed mainly in the NE region: Sinaloa (47%), Sonora 37%), Baja California (2%) Baja California Sur (2%) and Nayarit (1%). The remaining in the South region: Oaxaca (6%), Chiapas (2%) and Colima Michoacan and Guerrero (3%). In all zones, a number of hauls per fishing season averaged 16130, of a duration of 3.21 h (Gonzalez et al, 2012). Esparja-Carbajal (2003) calculated that on average, each vessel trawls 2,971 ha per fishing season.

In general, the fleet size was reduced in all zones in 2013/2014 (Figure 16). In Sinaloa, the number was reduced from 786 to 469. The reduction was similar in Sonora from 634 (in 1994) to 272 (in 2014) (Lopez-Martinez et al 2002).

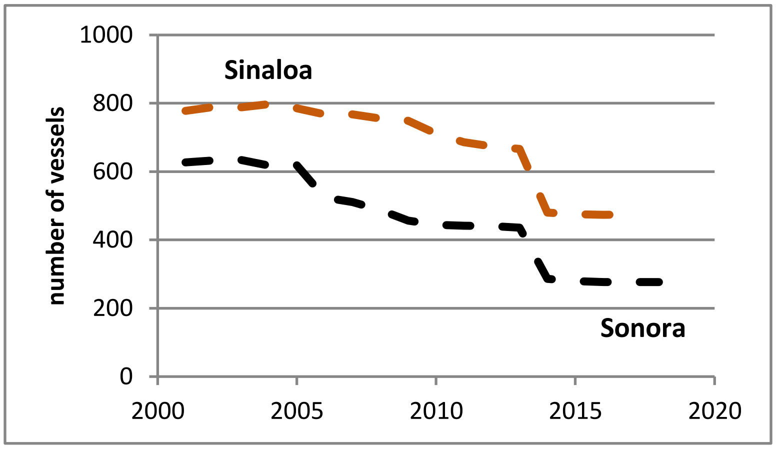



**Figure 16: Number of vessels in Sinaloa and Sonora (Source: INAPESCA 2018).**

The number of boats and others is imprecise and their activities are temporally irregular.

Merraz (2007) has estimated the distribution of fishing effort in a part of the coast of Sinaloa, with the objective to relate it with the stock distribution and environmental variables. The effort density was used by using Sattelite information of position and speed (assume that < 2kt is a fishing position) but did not discriminate in target species. Spatial distribution of fishing effort in Sinaloa was aggregated along the coastal fringe. A fine-scale, areas with a low allocation of fishing effort are coincident with the mouth of bays or river, or rocky seafloor (Figure 17).

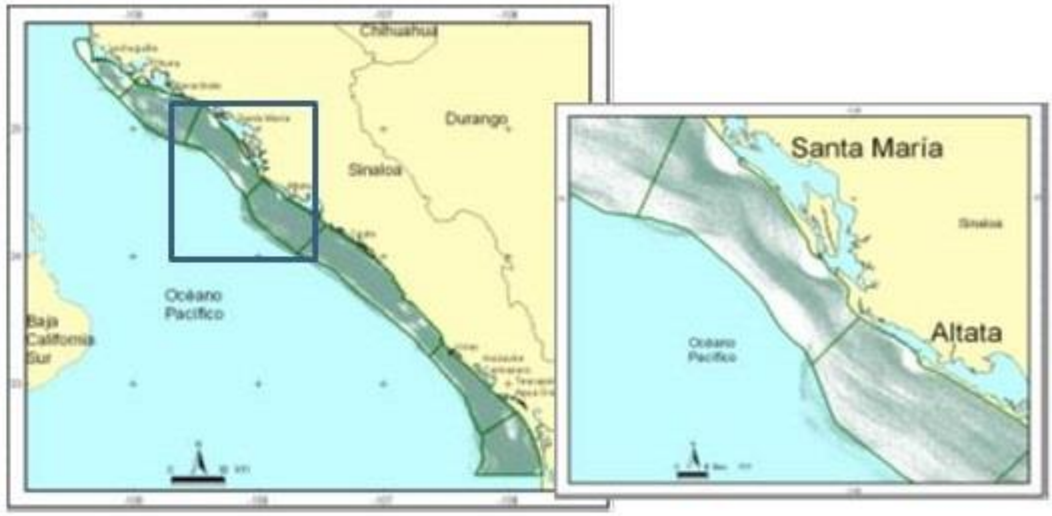



**Figure 17: Spatial distribution of the fishing effort in Sinaloa (period 2006- 2007)**

## 5.2.1.6 Total Allowable Catch (TAC) and catch data

Statistical information by species and state is provided in the Anuario Estadístico de Pesca y Acuacultura. Reported shrimp landings in weight (kg) and value (in Mexican pesos, MX$) are available by state, office, year, and month from 2004 to 2013. Therefore, it is difficult to estimate the share of the UoC (). A total allowable catch system has not been defined yet for this fishery. The team provided the total green weight catch for the whole UoA.

**Table 13. Total Allowable Catch (TAC) and catch data for Blue Shrimp**

| | | | | |
|---|---|---|---|---|
| **TAC** | Year | No TAC Established | Amount | No TAC Established |
| **UoA share of TAC** | Year | NA | Amount | NA |
| **UoA share of total TAC** | Year | NA | Amount | NA |
| **Total green weight catch by UoA** | Year (most recent) | 2018 | Amount | 6130 t (*) (aver: 5859 mt |
| **Total green weight catch by UoC** | Year (second most recent) | 2018 | Amount | 6130 t (*) (aver: 5859 mt |

** Approximate values, taken from Figure 13, Figure 14 and Figure 15.*

*** Only Sinaloa and G. Tehuantepec*

**Table 14. Total Allowable Catch (TAC) and catch data for White Shrimp**

| | | | | |
|---|---|---|---|---|
| **TAC** | Year | No TAC Established | Amount | No TAC Established |
| **UoA share of TAC** | Year | NA | Amount | NA |
| **UoA share of total TAC** | Year | NA | Amount | NA |
| **Total green weight catch by UoA** | Year (most recent) | 2018 | Amount | 721 t (*) (**)<br><br>(aver: 2326 mt) |
| **Total green weight catch by UoC** | Year (second most recent) | 2018 | Amount | 721 t (*) (**)<br>(aver: 2326 mt) |

** Approximate values, taken from Figure 13, Figure 14 and Figure 15.*

*** Only Sinaloa and G. Tehuantepec*

**Table 15. Total Allowable Catch (TAC) and catch data for Brown Shrimp**

| | | | | |
|---|---|---|---|---|
| **TAC** | Year | No TAC Established | Amount | No TAC Established |
| **UoA share of TAC** | Year | NA | Amount | NA |
| **UoA share of total TAC** | Year | NA | Amount | NA |
| **Total green weight catch by UoA** | Year (most recent) | 2018 | Amount | 11,160 t *<br><br>(aver: 9900 mt) |
| **Total green weight catch by UoC** | Year (second most recent) | 2018 | Amount | 11,160 t *<br><br>(aver: 9900 mt) |

** Approximate values, taken from Figure 13,  Figure 14 and Figure 15.*

*** Only Sinaloa and G. Tehuantepec*

## Principle 1 Performance Indicator scores and rationales

## PI 1.1.1 – Stock Status

<table>
<tr><td colspan="2">PI 1.1.1</td><td colspan="3">The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing</td></tr>
<tr><td colspan="2">Scoring Issue</td><td>SG 60</td><td>SG 80</td><td>SG 100</td></tr>
<tr><td rowspan="3">a</td><td colspan="4">Stock status relative to recruitment impairment</td></tr>
<tr><td>Guide post</td><td>It is likely that the stock is above the point where recruitment would be impaired (PRI).</td><td>It is highly likely that the stock is above the PRI.</td><td>There is a high degree of certainty that the stock is above the PRI.</td></tr>
<tr><td>Met?</td><td>Blue Shrimp: NO<br>White Shrimp: NO<br>Brown Shrimp: YES</td><td>Blue Shrimp: NO<br>White Shrimp: NO<br>Brown Shrimp: YES</td><td>Blue Shrimp: NO<br>White Shrimp: NO<br>Brown Shrimp: NO</td></tr>
<tr><td colspan="5">Rationale</td></tr>
</table>

The three shrimp species have a different condition of the status of the stock in relation with sustainable exploitation. In order to evaluate the risk of recruitment would be impaired the most direct way is stock-recruitment relation when the PRI has not been defined by a model as BRPL. Several approaches were done to explore annual relationship between parental stock and recruitiment. They has been considered in several zones, but there are no an evident pattern or it is masked by the high variability. Some reasons emerge as causes: - the division of the coast in sectors with jurisdictional sense, tends to not consider the connectivity between them; - shrimps present high fecundity, fast growth, early sexual maturity, high mortality, short life cycle, and rapid response to favourable/adverse environmental conditions, - activity of minor fleet (boats operating between 0 – 5 ft). Then, INAPESCA has used several proxies indexes/indicators based on catch records (average of the last three years/ historical average, and the ratio between catch / maximum catch, $C/C_{max}$), catch and CPUE trends and Biomass in relation to MSY to evaluate the state of the stocks. If the stock is above or below PRI could be inferred from the these indicators.

**Blue shrimp**:
For Blue Shrimp, in Sinaloa the $C/C_{max}$ indicator (Branch et al 2011) was below 0.5 since 2015, indicationg ovefishing. In Sonora the indicator dropped below 0.5 between 2013 – 2015 (last available catch data), and was considered overexploited in 2016. Catches are also declining in Sinaloa and Sonora, but in Baja California Sur, they have been stable oscillating around the historical average (INAPESCA, 2018). According to INAPESCA (No de Oficio RJL/INAPESCNDGAIPP/1295/2016), the relative index of abundance (CPUE) is below the historical average in three zones (Alto Golfo, Sonora and Sinaloa) and presents a decreasing trend in all of them.

From 2004 to 2012, biomass has been stable in a level below $B_{MSY}$ (12,143 t), recently (2013-2015) biomass presented a negative trend , decreasing up to a level of 3,500 t (INAPESCA, 2016). Therefore, the entire picture suggest that it is likely that the blue shrimp stock is below the point where recruitment would be impaired (PRI).

**White Shrimp:**
The species status defined Branch proxy index $C/C_{max}$, suggests that White Shrimp reached the overfishing condition (0.13) in Sinaloa and the Gulf of Tehuantepec (with catches of less magnitude) where is fluctuating around 0.3 during 2015 – 2018. Also, CPUE is declining in the period 2001 – 2017, which is coincident with the declining trend of catches (INAPESCA, 2018). Madrid-Vera et al (2012) assessed the status of the stock of White Shrimp in Sinaloa and Nayarit applying a biomass dynamic model of Pella-Tomlinson. They find that in the period 1992-2010 catch series, 50% of the reports were below MSY in spite of the increase in effort (50% increase in the fleet size), the catch decreased 65%, and the contribution to total shrimp catches varied from

76% to 12%. And assume that the status of L. vannamei populations off the coast of Sinaloa and Nayarit may be deteriorating. Since this study, the biomass continued in the decreasing trend showed from 2003.
This scenario drives to consider that it is possible that the blue shrimp stock is below the point where recruitment would be impaired (PRI).

**Brown Shrimp:**
These species are fully exploited in all management zones. Although biomass levels (2004-2015) are below the level of $B_{MSY}$ (6,000 t), its biomass is slightly increasing in the years 2013-2015 (INAPESCA, 2016). It presents a CPUE index above the historical average in the lasts years (No de Oficio RJL/ INAPESCNDGAIPP/ 1295/ 2016) or oscillating around it. Brown shrimp catches have been above the historical average in all management zones except Sonora (INAPESCA, 2016).
Due to Brown Shrimp has the same life history features detailed above, and proxies used to estimate the status stock do not show a negative trend ($C/C_{max}$ fluctuate around 0.5), it is likely that their stock is above the point where recruitment would be impaired. Uncertainties related to use of CPUE and average catch as a tool to determine the status of the stock unable to provide precision about PRI. However, the trend of biomass is growing (Sinaloa and Sonora) or stable (Baja California Sur and Gulf of Tehuantepec), above the BMSY, during the last 20 years. Then, it can be said that is a high degree of certainty that the stock is above the PRI**.**

For three species, there is no specific indicator to assess PRI, but its use was proposed ($B_{crit}$) for application in the future. For this reason, there is a high degree of certainty that the stock is above the PRI.
It is necessary to comment that the recruitment of shrimp is highly dependent of the environmental variables (especially ENSO or other climatic oscillations), and working together with the potential of an r-strategist (high fecundity, early sexual maturity) give the illusion of no apparent relation between stock and recruitment. Then, occasional pulses of recruitment can occur when the spawning stock is at a low level, and relax the control on the fishing actions. However, this relation exists, even when the attempt to model it can fail repeatedly.

| **b** | Stock status in relation to achievement of Maximum Sustainable Yield (MSY) | | | |
|---|---|---|---|---|
| | Guide post | | The stock is at or fluctuating around a level consistent with MSY. | There is a high degree of certainty that the stock has been fluctuating around a level consistent with MSY or has been above this level over recent years. |
| | Met? | | Blue Shrimp: NO<br>White Shrimp: NO<br>Brown Shrimp: YES | Blue Shrimp: NO<br>White Shrimp: NO<br>Brown Shrimp: NO |

**Rationale**

**Blue shrimp**:

Since 2006-2007, biomass estimation in the state of Sinaloa showed a decreasing trend (exception for 2011-2012 with a peak), below the $B_{MSY}$ during the last 2 decades. In Baja California Sur the biomass trend is fluctuating, but always below the $B_{MSY}$. In Sonora, CPUE is stable and Biomass is above the BMSY.
During the last 30 years, the situation in Sonora and Sinaloa (as an integrated region) was overfished ($B < B_{MSY}$) during 12 of them (42%) (INAPESCA, 2018). The current condition of the stock evidence that the biomass is low (lesser than $B_{MSY}$) and the fishing mortality exceed the $F_{MSY}$. This condition was maintained during the last 6 years.

**White Shrimp:**

In Sinaloa, the MSY was estimated around 2,382 t. Since 2006, the annual catches are declining with fluctuations and only in 2011/2012 fishing season landings reach MSY. In 2017/2018, catches were around 400 t. The stock had a biomass of 5,043 t in 2002/2003 and decline since then until 797 t in 2016/2017 and was below the $B_{MSY}$ during the last 12 year in a clear declining trend (INAPESCA, 2018).

The stocks of Blue and White Shrimps are not fluctuating around a level consistent with MSY.

**Brown Shrimp:**

In Baja California Sur, Gulf of Tehuantepec, Sonora, and Sinaloa the biomass trend, deduced from time series of catch and CPUE and the application of dynamic model (INAPESCA, 2018), is above the BMSY.

**References**

Madrid-Vera, J., Chavez-Herrera, D., Melchor-Aragon J., Meraz-Sanchez, R., and Rodríguez-Preciado, J.A. 2012. Management for the White Shrimp (*Litopenaeus vannamei*) from the Southeastern Gulf of California through Biomass Models Analysis. Open Journal of Marine Science, 2012, 2, 8-15

INAPESCA. 2016. Evaluación y Manejo de la pesquería de camarón del Pacífico Mexicano (captura, puntos de referencia, biomasa, edad, medio ambiente, fauna de acompañamiento.

INAPESCA. 2018. Plan de manejo de la pesquería de camarón del Pacifico mexicano. **88 p**

**Stock status relative to reference points**

| | Type of reference point | Value of reference point | Current stock status relative to reference point |
|---|---|---|---|
| **Reference point used in scoring stock relative to PRI (SIa)** | --- | -- | -- |
| **Reference point used in scoring stock relative to MSY (SIb)** | $B_{MSY}$. | Blue: 18,898 t (Sin, Son, BCS)<br>White: 4,867 t (Sin, GT)<br>Brown: 18,221 t (Sin, Son, GT, BCS)<br><br>Sin: Sinaloa<br>Son: Sonora<br>GT: Gulf Tehuantepec<br>BCS: Baja California Sur | $Bt/B_{MSY}$<br>Blue: 0.69 (Sin, Son, BCS)<br>White: 0.54 (Sin, GT)<br>Brown: 1.24 (Sin, Son, GT, BCS) |

## Draft scoring range and information gap indicator added at Announcement Comment Draft Report

| | |
|---|---|
| **Draft scoring range** | Blue Shrimp: <60<br>White Shrimp: < 60<br>Brown Shrimp: <80 |
| **Information gap indicator** | Information sufficient to score PI |

## Overall Performance Indicator scores added from Client and Peer Review Draft Report

| | |
|---|---|
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 1.1. 2 – Stock rebuilding

| **PI 1.1.2** | | **Where the stock is reduced, there is evidence of stock rebuilding within a specified timeframe** | | |
|---|---|---|---|---|
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | **Rebuilding timeframes** | | | |
| | **Guide post** | A rebuilding timeframe is specified for the stock that is the shorter of 20 years or 2 times its generation time. For cases where 2 generations are less than 5 years, the rebuilding timeframe is up to 5 years. | | The shortest practicable rebuilding timeframe is specified which does not exceed one generation time for the stock. |
| | **Met?** | Blue and White Shrimp: NO<br>Brown Shrimp: N/A | | Blue and White Shrimp: NO<br>Brown Shrimp: N/A |
| **Rationale** | | | | |
| **Blue Shrimp - White Shrimp:** The stocks of both species are not depleted, but the indicators highlight that they are deteriorating and in an oversfishing condition: the biomass is below the BMSY, the catches are below the MSY and below the historical average catch.<br>No stock rebuilding proposals have been included in the information supplied.<br><br>**Brown Shrimp:** The stock is not depleted according to the model used by INAPESCA (2018), also catches have been fluctuating around the historical average catch, therefore, this performance indicator does not apply. | | | | |
| **b** | **Rebuilding evaluation** | | | |
| | **Guide post** | Monitoring is in place to determine whether the rebuilding strategies are effective in rebuilding the stock within the specified timeframe. | There is evidence that the rebuilding strategies are rebuilding stocks, or it is likely based on simulation modelling, exploitation rates or previous performance that they will be able to rebuild the stock within the specified timeframe. | There is strong evidence that the rebuilding strategies are rebuilding stocks, or it is highly likely based on simulation modelling, exploitation rates or previous performance that they will be able to rebuild the stock within the specified timeframe. |
| | **Met?** | Blue and White Shrimp: NO<br>Brown Shrimp: N/A | Blue and White Shrimp: NO<br>Brown Shrimp: N/A | Blue and White Shrimp: NO<br>Brown Shrimp: N/A |
| **Rationale** | | | | |
| There is no rebuilding strategy. Just the traditional measures to open-close the fishery, but they are part of the management, not a rebuilding strategy. | | | | |
| **References** | | | | |

| | |
|---|---|
| INAPESCA. 2018. Plan de manejo de la pesquería de camarón del Pacifico mexicano. **88 p** | |
| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | |
| **Draft scoring range** | Blue and White: <60<br>Brown: NA |
| **Information gap indicator** | Rebuilding timeframe for blueshrimp and white shrimp was not provided |
| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 1.2.1 – Harvest strategy

| PI 1.2.1 | | There is a robust and precautionary harvest strategy in place | | |
|---|---|---|---|---|
| Scoring Issue | | SG 60 | SG 80 | SG 100 |
| a | Harvest strategy design | | | |
| | Guide post | The harvest strategy is expected to achieve stock management objectives reflected in PI 1.1.1 SG80. | The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy **work together** towards achieving stock management objectives reflected in PI 1.1.1 SG80. | The harvest strategy is responsive to the state of the stock and is designed to achieve stock management objectives reflected in PI 1.1.1 SG80. |
| | Met? | All species: YES | All species: NO | All species: NO |

**Rationale**

MSC defines a harvest strategy as *the combination of monitoring, stock assessment, harvest control rules (HCRs) and management actions that are required to bring about the sustainable management of the fishery. The harvest strategy sets out the management actions necessary to attain defined ecological and sometimes economic objectives in a particular fishery, including achieving the management objectives expressed in the target and limit reference points. It should specify a process for conducting assessments and monitoring the biological and economic attributes of the fishery as well as specific rules (i.e. HCRs) that control the fishing effort. An HCR is a set of pre-agreed rules or actions used for determining a management action in response to changes in indicators of stock status with respect to defined 'trigger' reference points. HCRs should be designed to achieve a medium or long-term target reference point while also safely avoiding a limit reference point. HCRs can also be based on simple rules, supported by plausible argument and monitored by means of appropriate indicators.*

The actions proposed by INAPESCA (2018) included assess biological and fishery indicators of shrimp populations, in the lagoon system and deep waters, and to revise the applicability of ban season and refuge zones. These actions could be considered a revision of the harvest strategy oriented to maintain the sustainability of the stocks. It includes:

Assessment of biological populations of shrimp

- determination of spawning and recruitment zones
- estimation of spatial-temporal abundance
- design reproductive indicators
- determination of spawning and recruitment zones
- calculation of current biomass, MSY, and $B_{MSY}$
- Set yield indicators as the form of target and limit BRPs: Average Catch ratio, CPUE, BMSY, FMSY.

Assessment of the fishing effort in the lagoon system and deeper waters

- Determination of optimum level fo fishing effort
- Management measures to modify fishing effort accordingly

Analysis of the biological and social relevance of ban implementation in lagoon systems

The timeframe for this Plan is 3 years from now on, but some components have been initiated (model-based indicators like $B_{MSY}$, $F_{MSY}$) and others are used as current practice. The current harvest strategy in place is common to three species and is considered a specific part of the plan. It is based on a modified escapement

strategy, implemented via seasonal closures, which includes monitoring of landings, catch per unit of effort and size surveys, which are used to determine the duration of seasonal closures (No de Oficio RJL/INAPESCNDGAIPP/1295/2016). A constant escapement harvest strategy is one of the most common strategies, in which an attempt is made to maintain the spawning stock size near some constant level.
Fishing closures have the following objectives (INAPESCA, 2017):
1.- Guarantee the renewal of populations, protecting the reproductive process.
2.- Identify the zones and periods of recruitment by species during the season closure in the Mexican Pacific.
3.- Ensure that the recruits generated during the reproductive period acquire sizes of greater commercial value.
4.- Encourage the recovery of breeding stocks of shrimp species.

Monitoring takes place at open seas, lagoon systems and adjacent channels and streams along the Mexican Pacific coast. Data collected included species composition; length, weight, sex and maturity of each organism. Size composition is used to carry out a size progression analysis for blue and brown shrimp using the CASA (Catch at Size Analysis) model to evaluate the potential dates to start the fishing season. It has recommended opening the fishing season when blue shrimp average size reaches 135 mm, white shrimp size reaches 150 mm in Sinaloa and 120 mm in Nayarit, and brown shrimp reaches 160-170 mm. The assessment team considered the size indicators as management trigger points for the opening on the season.
On the contrary, based on the documents available, there appear to be no consistent criteria to establish dates for the season closure (DOF, 03/15/2017; DOF, 02/19, 2016).
Additional tools of the harvest strategy are the implementation of non-fishing zones in the range of 0 to 5 fathoms depth is stipulated in the current shrimp fishing regulations in Mexico (NOM-002-SAG / PESC-2013). This regulation aims to protect the reproduction of shrimp and other species that takes place in that zone.
This modified escapement strategy has been used for several years and has not collapsed the fishery and has maintained catch levels. In addition, the strategy assures the escapement of a proportion of the stock and allows for juveniles to migrate to open seas and reproduce. An escapement strategy that ensures sufficient spawning biomass is left is each season is believed to be appropriate for short-lived species such as shrimp (Garcia, 1996). Therefore this strategy is *expected* to achieve stock management objectives reflected in PI 1.1.1 (Meeting SG60).

The tools/control rules in the harvest strategy to control effort (season closures) seem to be based on management trigger points (average size) that are collected through systematic surveys. These management trigger points are based on the shrimp's life cycle dynamics and environmental conditions MSC allows the use of proxy indicators instead of explicit estimates of BMSY-based reference points. However, it's not clearly understood how the management trigger points employed to designate the opening of the season, work in combination with the catch-based proxy indicators (C/C), used to measure the status of the stock, to ensure the fishery avoids the PRI and fluctuates around a level consistent with MSY. The team did not receive evidence that the management trigger points adopted are consistent with target or limit reference points. For this reason, the team cannot conclude that the harvest strategy is responsive to the state of the stock, for this reason, the SG80 is not met.
The harvest strategy needs to improve in such a way that is responsive to the state of the stock and that monitoring, assessment, and HCR work together to achieve management objectives with increased integration of management actions.

The Management Plan proposed by INAPESCA (2018) include explicit Target and Limit Reference Points to be used together with indicators, and actions triggered as a consequence of the current status of the stock:
Target Reference Points:
- **$B>B_{MSY}$**
- **$F = M$**
- **$F/F_{MSY} <1$ and $B/B_{MSY} <1$ (evaluated in the Kobe plot)**

Limit Reference points:
- **$C<B_{MSY}$**
- **$F<F_{MSY}$**

| | | | | |
|---|---|---|---|---|
| **- $C<B_{crit}$**<br>These reference points will be matched with the average catch ratio, total catch, and CPUE, to apply action decision like catch limit per vessel or protection of recruitment zones or, in a more general way, spatially explicit management.<br>All these elements of the harvest strategy have not yet proven to work together to make the management system responsive to the state of the stock. Several limit reference points were overpassed in many years and the open/closure system seems to be not enough to avoid that the stock drop below the limit reference point. For this reason, the SG80 is not met. | | | | |
| **b** | **Harvest strategy evaluation** | | | |
| | **Guide post** | The harvest strategy is likely to work based on prior experience or plausible argument. | The harvest strategy may not have been fully **tested** but evidence exists that it is achieving its objectives. | The performance of the harvest strategy has been fully evaluated and evidence exists to show that it is achieving its objectives including being clearly able to maintain stocks at target levels. |
| | **Met?** | YES | NO | NO |
| **Rationale** | | | | |
| This strategy has been implemented for several years for managing the fishery and has not produced collapse; therefore, it could be observed that the strategy is likely working based on experience. Thus, the SG60 level is met.. The escapement strategy by closed season has been used in shrimp fisheries and other short-life cycle species like squids. In order to prevent growth overfishing, several approaches has been attempted by reducing fishing effort and through technical measures such as closed seasons, closed areas, mesh size regulations and minimum landing sizes (Gillet 2008). In shrimp fisheries, closed seasons and areas are generally thought to be more appropriate than mesh sizes (Garcia, 1989; Iversen et al., 1993). Based on the international experience, the choice of this strategy has enough support to be applied in this fishery, even when it has not been fully tested. "Tested" at SG80 requires the involvement of some sort of structured logical argument and analysis that supports the choice of strategy (MSC standard v2.01 and FCP v2.1). However, there is no clear evidence that is achieving its objectives in terms of guarantee the renewal of populations or allow the recovery of breeding stocks of shrimp species. Stocks of Blue and White Shrimps, the most coastal species, have dropped below the limit reference points. Thus, the SG80 is not achieved. | | | | |
| **c** | **Harvest strategy monitoring** | | | |
| | **Guide post** | Monitoring is in place that is expected to determine whether the harvest strategy is working. | | |
| | **Met?** | YES | | |
| **Rationale** | | | | |
| Monitoring takes place at open seas, lagoon systems and adjacent channels and streams along the Mexican Pacific coast. Data collected included species composition; length, weight, sex and maturity of each organism. | | | | |

| | | | | |
|---|---|---|---|---|
| Catch per unit of effort is also determined for each species. This information is provided regularly and is used to inform the harvest strategy. | | | | |
| **d** | **Harvest strategy review** | | | |
| | **Guide post** | | | The harvest strategy is periodically reviewed and improved as necessary. |
| | **Met?** | | | YES |
| **Rationale** | | | | |
| The management plan for shrimp is updated periodically. In each updated version there are a redefinition (if necessary) of the objectives, actions and assessment results with the current status of the stocks. A revision of the Management Plan has been agreed every 3 years. The escapement strategy is reviewed annually and some aspects have been improved as necessary. | | | | |
| **e** | **Shark finning** | | | |
| | **Guide post** | It is likely that shark finning is not taking place. | It is highly likely that shark finning is not taking place. | There is a high degree of certainty that shark finning is not taking place. |
| | **Met?** | NA | NA | NA |
| **Rationale** | | | | |
| There is a high degree of certainty that shark finning is not taken place in this fishery because it does not target shark species. | | | | |
| **f** | **Review of alternative measures** | | | |
| | **Guide post** | There has been a review of the potential effectiveness and practicality of alternative measures to minimize UoA-related mortality of unwanted catch of the target stock. | There is a regular review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock and they are implemented as appropriate. | There is a biennial review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock, and they are implemented, as appropriate. |
| | **Met?** | NA | NA | NA |
| **Rationale** | | | | |
| Unwanted catch are defined in MSC Standard SA3 1.6 as as the part of the catch that a fisher did not intend to catch but could not avoid, and did not want or chose not to use. The harvest strategy in shrimp fishery is based in open the fishing season in realtion with the size reached by the individuals. In this case, there are no mortality associated to unwanted catches. As consequence, the team considers that this Scoring Issue does not apply. | | | | |
| **References** | | | | |
| DOF. 2016. Acuerdo de veda temporal. Febrero 19, 2016. México<br>DOF. 2017. Acuerdo de veda temporal. Marzo 15, 2017. México<br>INAPESCA. 2018. Plan de manejo de la pesquería de camarón del Pacifico mexicano. 88 p | | | | |

INAPESCA. 2017. Dictamen de inicio de veda. Análisis del comportamiento de la pesquería de camarón en el litoral del Pacifico Mexicano en la temporada 2016-2017, para la implementación del inicio de veda en el 2017.

| | |
|---|---|
| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | |
| **Draft scoring range** | Blue Shrimp: 60-79<br>White Shrimp: 60-79<br>Brown Shrimp: 60-79 |
| **Information gap indicator** | Information sufficient to score PI |
| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 1.2.2 – Harvest control rules and tools

| PI 1.2.2 | | There are well defined and effective harvest control rules (HCRs) in place | | |
|---|---|---|---|---|
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | **HCRs design and application** | | | |
| | **Guide post** | Generally understood HCRs are in place or available that are expected to reduce the exploitation rate as the point of recruitment impairment (PRI) is approached. | Well defined HCRs are in place that ensure that the exploitation rate is reduced as the PRI is approached, are expected to keep the stock fluctuating around a target level consistent with (or above) MSY, or for key LTL species a level consistent with ecosystem needs. | The HCRs are expected to keep the stock fluctuating at or above a target level consistent with MSY, or another more appropriate level taking into account the ecological role of the stock, most of the time. |
| | **Met?** | YES | NO | NO |

**Rationale**

*An HCR is a set of pre-agreed rules or actions used for determining a management action in response to changes in indicators of stock status with respect to defined 'trigger' reference points. HCRs should be designed to achieve a medium or long-term target reference point while also safely avoiding a limit reference point. HCRs can also be based on simple rules, supported by plausible argument and monitored by means of appropriate indicators.*

All three shrimp species shared the same HCRs. Pacific shrimp fishery is managed with a modified escapement strategy based on closure seasons. These have been implemented in this fishery for several years, and they have two main objectives: 1) to assure a pre-established percentage of the stock completes its migration to the marine zone and; 2) to determine the period of time needed for the main cohort to maximize their size to increase its value. Monitoring is carried out to provide information for the definition of two dates: starting of the fishing season and starting of closure season. To determine the start of the fishing season, information from surveys on size structure is used to stimulate growth and estimate the dates when blue shrimp will reach the size that is considered economically important (135 mm for blue shrimp and 160-170 mm for brown shrimp). These simple pre-agreed rules can be considered HCRs with the defined sizes as triggering index used to start a management action (start of the fishing season).

For the starting of the closure season, there are no clear criteria to start this management action (DOF, 02/19/2016, DOF, 03/15/2017); There is no available documentation on what are the pre-agreed specific indicators and trigger levels used to implement the management action (closure season). However, personal communications from INAPESCA staff describe that the closure occurs when the mature females are over 5%, but it is not a pre-agreed rule. It could be considered that there are 'generally understood' HCRs, that have been applied in the past to maintain the stock at healthy levels. Thus SG60 is met.

This strategy has been applied for several years and has not collapsed the fishery although catch levels of Blue and White Shrimps are declining. In addition, closure season are designed to assure that a percentage of the stock completes its migration to the marine zone and reproduce, this action is expected to reduce the exploitation rate as the point of recruitment impairment (PRI) is approached.

However, some weakness were detected: i) there is no description of criteria and pre-agreed specific indicators to trigger opening-closing the fishing seasons; ii) how are connected the reference points described in Management Plan with the effective management actions; iii) how is (or will be) the application of harvest

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|---|---|---|---|---|
| control in three different species, and if they are the same indicators and same management responses; iv) HCRs applied for many years to maintain catch levels but they was not useful to maintain the stock fluctuating around a reference point Therefore, the HCRs in place are not be considered as well defined and the SG80 is not achieved. | | | | |
| **b** | **HCRs robustness to uncertainty** | | | |
| | **Guide post** | | The HCRs are likely to be robust to the main uncertainties. | The HCRs take account of a wide range of uncertainties including the ecological role of the stock, and there is evidence that the HCRs are robust to the main uncertainties. |
| | **Met?** | | YES | NO |
| **Rationale** | | | | |
| The size of shrimp populations is strongly dependent on the recruitment, and in a short-living and fecund species, it is highly variable and dominated by environmental variables. Climatic oscillations, temperature cycle variation operates over the number of shrimp already recruited any year, and spawning stock affecting the maturation process. The simple HCR based in direct observation of the catch at size prior to open the fishery seems to be reasonable to manage the uncertainty at short term, and it is likely to be robust, even when the closure criteria must be formally documented. Thus, the SG80 is met. The study about how the uncertainties affect renewal in the populations is ongoing. Therefore, there is no evidence that the HCRs take account a wide range of uncertainties and are robust to the main uncertainties. Thus, the SG100 is not met. | | | | |
| **c** | **HCRs evaluation** | | | |
| | **Guide post** | There is some evidence that tools used or available to implement HCRs are appropriate and effective in controlling exploitation. | Available evidence indicates that the tools in use are appropriate and effective in achieving the exploitation levels required under the HCRs. | The evidence clearly shows that the tools in use are effective in achieving the exploitation levels required under the HCRs. |
| | **Met?** | YES | NO | NO |
| **Rationale** | | | | |
| There is some evidence that tools (season closures) used to implement the HCR has had relative effectiveness in controlling exploitation. The opening and closure of the fishing season are respected.<br>At present, other pieces of information are available to implement HCR from now on, derived of application of mode-based approach and definition of reference points (limit and target), BMSY, CPUE and biomass trends, and decision criteria to be used. It is necessary because for many years the biomass of Blue and White Shrimps were below the BMSY which was defined as one of the BRPL, and no actions were taken. However, the proposed actions need to demonstrate that they are appropriate and effective. Thus, the SG 80 is not met. | | | | |
| **References** | | | | |
| DOF. 2016. Acuerdo de veda temporal. Febrero 19, 2016. México<br>DOF. 2017. Acuerdo de veda temporal. Marzo 15, 2017. México<br>INAPESCA. 2018. Plan de manejo de la pesquería de camarón del Pacifico mexicano. 88 p | | | | |
| | | | | |

| Draft scoring range and information gap indicator added at Announcement Comment Draft Report | |
|---|---|
| **Draft scoring range** | Blue Shrimp: 60-79<br>White Shrimp: 60-79<br>Brown Shrimp: 60-79 |
| **Information gap indicator** | Information sufficient to score PI |
| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 1.2.3 – Information and monitoring

<table>
<tr><td colspan="2">PI 1.2.3</td><td colspan="3">Relevant information is collected to support the harvest strategy</td></tr>
<tr><td colspan="2">Scoring Issue</td><td>SG 60</td><td>SG 80</td><td>SG 100</td></tr>
<tr><td rowspan="3">a</td><td colspan="4">Range of information</td></tr>
<tr><td>Guide post</td><td>Some relevant information related to stock structure, stock productivity, and fleet composition is available to support the harvest strategy.</td><td>Sufficient relevant information related to stock structure, stock productivity, fleet composition and other data are available to support the harvest strategy.</td><td>A comprehensive range of information (on stock structure, stock productivity, fleet composition, stock abundance, UoA removals and other information such as environmental information), including some that may not be directly related to the current harvest strategy, is available.</td></tr>
<tr><td>Met?</td><td>YES</td><td>YES</td><td>NO</td></tr>
<tr><td colspan="5">Rationale</td></tr>
<tr><td colspan="5">Some relevant information related to stock structure for Blue, Brown and White shrimp exists (García-Juárez et al., 2009; Madrid-Vera et al., 2012; Morales-Bojorquez et al., 2001, Merraz-Sanchez 2007), and there is some information on population genetic structure for Blue Shrimp (De la Rosa-Vélez et al. 2000). However, this information has not been incorporated into its management. The structure of the stock is surveyed through surveys that monitor the evolution of sizes and reproductive condition (spawning females). Information on the productivity of the stocks is reported by species and area, sectoring by depth in terms of kg per area. They are historical averages over an acceptable time-scale. Catches are documented by zone and species but at the sectorial meeting between research organizations and the industrial fishing sector, there has been concern about illegal and unregulated catches. Stock abundance is only reported in the form of indicators of relative abundance such as catch per unit of effort.<br><br>On the other hand, according to INAPESCA (2017) the main sources of information used in the establishment of fishing and season closures are:<br><br>1.- Sampling in protected waters. It is carried on small boats, in the network of stations established in each of the estuaries and lagoons with a methodology established by the Pacific shrimp program.<br>2.- Sampling at the bank. On small boats equipped with the fishing gear (chango), biological samples are taken from shrimp populations in the state of Sinaloa in the bay mouths of Santa María-La Reforma, Navachiste and Teacapán, Sinaloa and in Nayarit at the mouth of the Cuautla Canal in the strata of 3, 5, 8 and 12 fathoms deep.<br>3.- Biological sampling in plants. It takes place in the landing ports of Guaymas, Sonora, and Mazatlán, Sinaloa. A boat is randomly selected at the time of unloading, a five-kilogram sample is taken from the catch to estimate the composition by species, size, sex, and gonadal maturity. In addition, the total catch of the vessel and the catch zone are registered.<br>4.- Biological sampling at landing sites. As in the previous sampling, a composition by species, size, weight, sample weight, sex, gonadal maturity, and density are registered.<br>5.- Official statistical information on catch and effort contained in CONAPESCA log sheets.<br>6.- Commercial statistical information from reports provided by the plants.</td></tr>
</table>

| | | | | |
|---|---|---|---|---|
| With these information monthly and weekly estimates of catch and CPUE are obtained by fleet, species, and region; composition by species, structure by sex and size, as well as the evaluation of the reproductive cycle by estimating the proportions of degrees of maturity.<br><br>Therefore, stock abundance is monitored using a relative index of abundance (CPUE) measured during surveys at lagoon systems and adjacent streams and channels and open sea (No de Oficio RJL/INAPESCNDGAIPP/1295/2016). Landings are monitored for every zone of management defined (INAPESCA, 2012). To our knowledge, CPUE is the only indicator monitored with sufficient frequency to support the harvest control rule. All this information is adequate to support the HCR.<br><br>Regarding productivity, recently (2018) recruitment has been analyzed, and a stock spawning - recruit relationship has been estimated, and information on the productivity of the stock is available. The fleet composition is well monitored by satellite positioning and fishery licenses. However, even when the information can be considered sufficient to support the harvest strategy, it needs to be translated into effective actions in the face of some concern of status of the shrimp stocks. As consequence, the SG80 is reached. | | | | |
| **b** | **Monitoring** | | | |
| | **Guide post** | Stock abundance and UoA removals are monitored and at least one indicator is available and monitored with sufficient frequency to support the harvest control rule. | Stock abundance and UoA removals are regularly monitored at a level of accuracy and coverage consistent with the harvest control rule, and one or more indicators are available and monitored with sufficient frequency to support the harvest control rule. | All information required by the harvest control rule is monitored with high frequency and a high degree of certainty, and there is a good understanding of inherent uncertainties in the information [data] and the robustness of assessment and management to this uncertainty. |
| | **Met?** | YES | YES | NO |
| **Rationale** | | | | |
| During the fishing closed season information on size structure is monitored in order to establish the opening of fishing. During the fishing season, fleet composition for the large (industrial) shrimp fishery is controlled due to satellite monitoring, and landings are recorded regularly. A proxy or indicator based on catch is monitored frequently, and CPUE is used as proxy for stock abundance. As consequence, the SG80 is considered achieved. The stock assessment to modelthe biomass In 2018, a formal stock assessment was rehearsed using a dynamic biomass model and proposing target and limit reference points. Biomass was tracked contrasting with the $B_{MSY}$ estimation by species and management zones. Several action lines were proposed but not yet applied into the management and do not translated to HCR. Thus the SG100 is not reached. | | | | |
| **c** | **Comprehensiveness of information** | | | |
| | **Guide post** | | There is good information on all other fishery removals from the stock. | |
| | **Met?** | | YES | |

| **Rationale** | |
|---|---|
| There is no good information on all other fishery removals from the stock. In particular, information from Illegal Unreported and Unregulated (IUU) removals is not available. The activity of the minor fleet, composed by 2,512 boats that operate in the lagoons and bays In the Mexican Pacific, is less formal and removals are not well monitored. Catches are slightly lesser than the industrial fleet, and in some states (e.g. Nayarit) they proceed almost exclusively from the boats. Fishermen use basic installations on the coast to receipt catch in many of the improvised ports, and to transport the product to direct consumption (many times without industrial process). Therefore, stock abundance and UoA removals are not regularly monitored at a level of accuracy and coverage consistent with the harvest control rule. | |
| **References** | |
| García-Juárez, A.R., Rodríguez-Domínguez, G., and Lluch-Cota, D.B. 2009. Blue shrimp (*Litopenaeus stylirostris*) catch quotas as a management tool in the Upper Gulf of California. Ciencias Marinas (2009), 35(3): 297–306<br>Madrid-Vera, J., Chavez-Herrera, D., Melchor-Aragon J., Meraz-Sanchez, R., and Rodríguez-Preciado, J.A. 2012. Management for the White Shrimp (*Litopenaeus vannamei*) from the Southeastern Gulf of California through Biomass Models Analysis. Open Journal of Marine Science, 2012, 2, 8-15<br>Morales-Bojorquez, E., Lopez-Martinez, J. and Hernández-Vázquez, S. 2001. Dynamic catch-effort model for Brown Shrimp *Farfantepenaeus californiensis* (Holmes) from the Gulf of California, Mexico. Ciencias Marinas, 27(1): 105–124.<br>Merraz- Sanchez, S. R. 2007. Modelación espacial de la pesca industrial de camarón en el sureste del Golfo de California, utilizando un sistema de información geográfica . Tesis para obtener el grado de Maestro en Ciencias. Centro de Investigación en Alimentación y Desarrollo, A. C.<br>De la Rosa-Vélez, J., Escobar-Fernández, R., Correa, F., Maqueda-Cornejo, M., and Torre-Cueto, J. 2000. Genetic structure of two comercial penaeids (*Penaeus californiensis* and *P. stylirostris*) from the Gulf of California, as revealed by allozime variation. Fish. Bull. 98:674-683.<br>INAPESCA. 2012. Plan de Manejo de la pesquería del camarón del Pacífico Mexicano. DRAFT<br>INAPESCA. 2017. Dictamen de inicio de veda. Análisis del comportamiento de la pesquería de camarón en el litoral del Pacifico Mexicano en la temporada 2016-2017, para la implementación del inicio de veda en el 2017. | |
| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | |
| **Draft scoring range** | Blue Shrimp: >80<br>White Shrimp: >80<br>Brown Shrimp: >80 |
| **Information gap indicator** | Information sufficient to score PI |
| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 1.2.4 – Assessment of stock status

| PI 1.2.4 | | There is an adequate assessment of the stock status | | |
|---|---|---|---|---|
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | **Appropriateness of assessment to stock under consideration** | | | |
| | **Guide post** | | The assessment is appropriate for the stock and for the harvest control rule. | The assessment takes into account the major features relevant to the biology of the species and the nature of the UoA. |
| | **Met?** | | NO | NO |
| **Rationale** | | | | |
| In the Shrimp fishery has been used catch-based proxy indicators (INAPESCA, 2016, 2018) to provide understanding of status stock and the effectiveness of the harvest strategy. The indicators was modified from the originals proposed by Branch et al (2011). On this point, the MSC Fisheries Standard 2.01, GSA2.7 establish "*Some harvest strategies assess stock status using empirical indicators and do not require use of quantitative assessment models. In such cases, the assessment PI will be scored relative to the robustness of that indicator".*<br>The proxy based on catch could be considered an empiric indicator, which together with the pre-season monitoring are sufficient for the harvest control rules, on the base of the fishery has not collapsed. However, there are evidende that this fishery requieres of quantitative sotck assessment. Some of available quantitative stock assessments (Garcia-Juárez et al. 2014; Madrid-Vera et al. 2012; and Bojorquez et al. 2001) warn about of overfishing but they have not been used to enable harvest control rules.<br>On the other hand, the last stock assessment (INAPESCA, 2018) allowed to define and estimate key parameters like $B_{MSY}$, MSY, $F_{MSY}$ and derived target and limit reference points (BRPs). They revealed the serious condition of the status of the stocks, demostrating that this kind of analysis are necessary. This assessment is tha base of the Management Plan 2018, but it is not in still in force. If this new approach became official (e.g. be incoporated into DOF and is in force) and the derived BRPs would be connected with effective measures demonstrating that they trigger concrete actions (ban a management zone, reduction of fishing effort until a recovery is verified) the assessment can be considered appropriate for the current HCR used in the fishery. Therefore, SG80 is not met. | | | | |
| **b** | **Assessment approach** | | | |
| | **Guide post** | The assessment estimates stock status relative to generic reference points appropriate to the species category. | The assessment estimates stock status relative to reference points that are appropriate to the stock and can be estimated. | |
| | **Met?** | YES | YES | |
| **Rationale** | | | | |
| The INAPESCA report (2016) provides stock status for Brown Shrimp in Sonora and Blue Shrimp in Sinaloa. A brief description of the methodology was provided: Population estimates were calculated with a biomass dynamic model using an index of relative abundance (CPUE) from independent surveys carried out during the season closure. Model fitting was carried out using a maximum likelihood estimation approach. Parameter | | | | |

| | | | | |
|---|---|---|---|---|
| uncertainty was estimated using bootstrapping. MSY and $B_{MSY}$ were estimated based on results from those models.<br>The same methodology was applied in the update report (INAPESCA, 2018), but extensive to Blue Shrimp (Sinaloa, Sonora, Baja California Sur), White Shrimp (Sinaloa, Gulf of Tehuantepec) and Brown Shrimp (Sinaloa, Sonora, Baja California Sur and Gulf of Tehuantepec). Current biomasses were matched with BMSY and the other traditional indicators based on catch information.<br>Other studies where biomass-dynamic models have been previously applied for shrimp stock assessment include Garcia-Juárez et al. (2014), Madrid-Vera et al. (2012) and Bojorquez et al. (2001). **Garcia-Juárez et al.** (2014) used the Schaefer model for the reserve area of the upper Gulf of California, to estimate model parameters and MSY and $B_{MSY}$ and to simulate three quota scenarios for the blue shrimp. For White Shrimp, Madrid-Vera et al. (2012) used the Pella-Tomlinson model for the Southeastern Gulf of California, to estimate model parameters and MSY and $B_{MSY}$. Morales-Bojorquez et al. (2001) applied the Fox model to the Brown Shrimp fishery in the Gulf of California to estimate model parameters, MSY and $B_{MSY}$; they also assessed the influence of observation and process error. It has been implied that shrimp recruitment is driven by environmental conditions. Some results suggest that oceanographic events, such as ENSO might have a potential influence on brown shrimp abundance fluctuations (López-Martínez et al., 2002).<br><br>In INAPESCA (2016) there is a section called “Reference points” but that section does not include target or limit reference points derived from a stock assessment. It includes a proxy indicator based on catch data. This indicator is a modification of the one reviewed by Branch et al (2011). However, this modification seems to be arbitrary and not well justified and the efficiency of this indicator has not been tested or compared with results from the original indicator.<br><br>It is important to point out that the stock assessment (INAPESCA, 2016; Garcia-Juárez et al., 2014; Madrid-Vera et al., 2012; Bojorquez et al., 2001) was carried out one time and have not been applied continuously at appropriate time intervals. The stock assessment carried out in 2018, which include explicit reference points, was also done one time, but is expected that will be updated in a continuous way. This assessment estimates stock status relative to reference points that are appropriate to the stock (BMSY, FMSY, CPUE) and the parameters of the model can be estimated. It is relevant to comment that these assessments and the proxy indicator based on catches have not been yet applied directly in the management of the shrimp fishery because there is no action derived from it. Currently, this fishery is managed with a modified escapement strategy, where the dates for the opening of the fishing season are determined with size structure and there are no documented criteria to establish the start of the season closure (although the percentage of 5% of mature females was commented) (Madrid-Vera, Pers Comm). | | | | |
| **c** | **Uncertainty in the assessment** | | | |
| | **Guide post** | The assessment identifies major sources of uncertainty. | The assessment takes uncertainty into account. | The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a probabilistic way. |
| | **Met?** | YES | YES | NO |
| **Rationale** | | | | |
| Regarding the identification of the major sources of uncertainty, Madrid-Vera et al (2012) included only observation error in their assessment; Garcia-Juarez et al. (2014) and Bojorquez et al. (2001) included process and observation error. | | | | |

<table>
<tr><td colspan="5">In the official assessment utilized to inform management actions (INAPESCA, 2018), uncertainty derived from the ENSO was taken into account in the Ricker model, for this reason, the SG80 is met. The evaluation of stock status relative to reference points do not include a probabilistic way, for this reason, the SG100 is not met.</td></tr>
<tr><td rowspan="3">d</td><td colspan="4">Evaluation of assessment</td></tr>
<tr><td>Guide post</td><td></td><td></td><td>The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.</td></tr>
<tr><td>Met?</td><td></td><td></td><td>NO</td></tr>
<tr><td colspan="5">Rationale</td></tr>
<tr><td colspan="5">Only Garcia-Juarez et al. (2014) and Bojorquez et al. (2001) explored some alternative hypothesis but they do not carry out rigorous testing of the alternative hypothesis, consequently, those assessments have not been demonstrated to be robust.</td></tr>
<tr><td rowspan="3">e</td><td colspan="4">Peer review of assessment</td></tr>
<tr><td>Guide post</td><td></td><td>The assessment of stock status is subject to peer review.</td><td>The assessment has been internally and externally peer reviewed.</td></tr>
<tr><td>Met?</td><td></td><td>NO</td><td>NO</td></tr>
<tr><td colspan="5">Rationale</td></tr>
<tr><td colspan="5">The available work focus on stock assessments of the Pacific shrimp fishery has not been submitted to any peer review process. However, it can be considered to be a workshop of specialists involved in the evaluation of the fishery. If this initiative is carried out regularly can be considered as internal revision. The SG 80 is not met.</td></tr>
<tr><td colspan="5">References</td></tr>
<tr><td colspan="5">García-Juárez, A.R., Rodríguez-Domínguez, G., and Lluch-Cota, D.B. 2009. Blue shrimp (Litopenaeus stylirostris) catch quotas as a management tool in the Upper Gulf of California. Ciencias Marinas (2009), 35(3): 297–306<br>Madrid-Vera, J., Chavez-Herrera, D., Melchor-Aragon J., Meraz-Sanchez, R., and Rodríguez-Preciado, J.A. 2012. Management for the White Shrimp (Litopenaeus vannamei) from the Southeastern Gulf of California through Biomass Models Analysis. Open Journal of Marine Science, 2012, 2, 8-15Morales-Bojorquez, E., Lopez-Martinez, J. and Hernández-Vázquez, S. 2001. Dynamic catch-effort model for Brown Shrimp Farfantepenaeus californiensis (Holmes) from the Gulf of California, Mexico. Ciencias Marinas, 27(1): 105–124.<br>INAPESCA. 2016. Evaluación y Manejo de la pesquería de camarón del Pacífico Mexicano (captura, puntos de referencia, biomasa, edad, medio ambiente, fauna de acompañamiento.<br>INAPESCA. 2018. Plan de manejo de la pesquería de camarón del Pacifico mexicano. 88 p</td></tr>
</table>

| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | |
|---|---|
| **Draft scoring range** | Blue Shrimp: 60-79<br>White Shrimp: 60-79<br>Brown Shrimp: 60-79 |
| **Information gap indicator** | Information sufficient to score PI |

| Overall Performance Indicator scores added from Client and Peer Review Draft Report | |
|---|---|
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## 5.3 Principle 2

### 5.3.1 Principle 2 background

#### 5.3.1.1 Overview of Non-target Catch

All species that are affected by the fishery and that are not part of the Unit of Certification are considered under Principle 2. This includes species that are retained for sale or personal use (assessed under Performance Indicator 2.1), bycatch species that are discarded (Performance Indicator 2.2), and species that are considered endangered, threatened or protected by the government in question or are listed by the Convention of International Trade of Endangered Species (CITES) (Performance Indicator 2.3). This section contains an evaluation of the total impact of the fishery on all components in P2 and includes both observed and unobserved fishing mortality. Unobserved mortality may occur from illegal, unregulated or unreported (IUU) fishing, biota that are injured and subsequently die as a result of coming in contact with fishing gear, ghost fishing, waste, or biota that are stressed and die as a result of attempting to avoid being caught by fishing gear. This section also considers impacts on marine habitats (Performance Indicator 2.4) and the ecosystem more broadly (Performance Indicator 2.5).

**Primary species**

For the purposes of a MSC evaluation, primary species are those in the catch, and within the scope of the MSC program (fishes or shellfish), and not defined by the client as the target – which by definition is evaluated under Principle 1. Primary species will usually be species of commercial value to either the UoA or fisheries outside the UoA, with management tools controlling exploitation as well as known reference points in place. In addition, the institution or arrangement that manages the species (or its local stock) will usually have some overlap in a jurisdiction with the UoA fishery.

**Secondary species**

Species associated with the target that is harvested under some management regime, where measures are in place intended to achieve management, and these are reflected in either limit or target reference points are evaluated as Primary species within Principle 2. In contrast, secondary species include fish and shellfish species that are **not** managed according to reference points. Secondary species are also considered to be all species that are out of the scope of the standard (birds/ mammals/ reptiles/ amphibians) and that are not ETP species. These types of species could in some cases be landed intentionally to be used either as bait or as food for the crew or for other subsistence uses, but may also in some cases represent incidental catches that are undesired but somewhat unavoidable in the fishery. Given the often unmanaged status of these species, there are unlikely to be reference points for biomass or fishing mortality in place, as well as a general lack of data availability.

**Main species**

For Primary and Secondary species, species may be considered "Main" based on either resilience/vulnerability and catch volume. Species that are not "Main" are Minor. Main and Minor species must meet different Performance Indicators (PIs) in P2.

**Resilience/vulnerability:**

If the species is considered "less resilient" and it is ≥ 2% of the catch, then it is considered Main, otherwise it is considered Minor.

**Catch Volume:**

If the species is not considered "less resilient" and it is ≥ 5% of the catch, then it is considered Main, otherwise, it is considered Minor.

**ETP Species**

The team shall assign ETP (endangered, threatened or protected) species as follows:
Species that are recognised by national ETP legislation;
SA3.1.5.2

Species listed in the binding international agreements given below:

a. Appendix 1 of the Convention on International Trade in Endangered Species (CITES), unless it can be shown that the particular stock of the CITES listed species impacted by the UoA under assessment is not endangered.
b. Binding agreements concluded under the Convention on Migratory Species (CMS), including:
ii. Annex 1 of the Agreement on Conservation of Albatross and Petrels (ACAP);
iii. Table 1 Column A of the African-Eurasian Migratory Waterbird Agreement (AEWA);
iv. Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS);
v. Annex 1, Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS);
vi. Wadden Sea Seals Agreement;
vii. Any other binding agreements that list relevant ETP species concluded under this Convention

#### 5.3.1.2 Overview of Species Classification

The analysis for P2 is made considering that the UoA and the UoC (to be determined) are the same and consist of the White, Brown, and Blue Shrimp harvested by the industrial fleet with bottom trawl gear in the Mexican Pacific Coast.

The team obtained data, on catch composition and non-target species, from three years of the voluntary observer program financed by the industry (2015, 2016 and 2017). For more details on the observer program see Section 7.3.1.3. The catch volumes for the species was averaged across the three years to determine 'main' and 'minor' designations. The observer program provided information at the family level, grouping several species. A complete list of all species can be found in Annex 1: Species Table. Although a total number of recorded species was not available, previous studies based on the FIDEMAR observer program recorded 240 species (Rodríguez-Romero et al. 2012). The designations of P2 species is considered preliminary, as the voluntary observer program did not provide information at the species level. Certain aspects of species identification and data quality need to be resolved for a full assessment.

Results, from numerous assessments of bycatch in the Pacific shrimp fishery, show that the shrimp: bycatch ratio is highly variable depending on zones, gear type, and seasons of the year; with the amounts of bycatch drastically decreasing as the fishing season progresses (López-Martínez et al. 2012). Studies ranging from the 1980s to early 2000's record a wide range of shrimp to bycatch ratios; from 1:9 to 1:69 (INAPESCA 2010). Averaging, across years, seasons and zones, the shrimp-bycatch ratio has remained around 1:10 from the 1960s to the early 2000s (INAPESCA 2010). The proportion of shrimp to bycatch recorded in the voluntary observer program was lower than historical records, ranging from 1:8.89 in 2015, 1:3.19 in 2016 and 1:5:21 in 2017. On average across the three years ~90% of bycatch was discarded.

No primary species were designated; none of the listed P2 species have in place a full stock assessment, a scientifically established TAC or known reference points. All bycatch species were classified as secondary species (Table 3). The team designated as 'main' 22 species which represented >5% of the catch composition of the observed trips. These species were grouped in nine families: Gerreidae, Dasyatidae, Gymnuridae, Mobulidae, Rhinobatidae, Portunidae, Synodontidae, Achiridae and Bothidae (Table 3). Only two of these species (swimming crabs) had available reference points. In order to score the outcome PI of the remaining 20 secondary main species; the assessment team conducted a preliminary desk-based Productivity Susceptibility Analysis (PSA). The RBF scoring tables can be found in Annex 2: RBF Scoring Table.

**Table 3. Summary of Non-target Species as Categorized for Evaluation**

| Common name | Scientific name | Managed ? | Less Resilient? | % UoA Catch | Data Deficient (RBF) | MSC Classification |
|---|---|---|---|---|---|---|
| Mojarras | *Diapterus aureoles, Diapteurs peruvianus* | No | No | 8.5% | Yes | Secondary-main |
| Rays | *Dasyatis dipterura, Dasyatis longa, Dasyatis violacea, Gymnura crebripunctata, Gymnura marmorata,* | No | No | 5.5% | Yes | Secondary-main |

| | | | | | | |
|---|---|---|---|---|---|---|
| | *Rhinobatos glaucostigma* | | | | | |
| Swimming crabs | *Callinectes Bellicosius*<br>*Callinectes Arcuatus* | No | No | 8.7% | Yes | Secondary-main |
| Grunts | *Haemulon steindachneri, Haemulon scudderii* | No | No | 5.0% | Yes | Secondary-main<br>(RBF for outcome) |

### 5.3.1.3 Observer Programs/Information Sources

Several efforts have contributed to gathering bycatch composition information from the industrial shrimp fleet in the Mexican Pacific. The on-board Scientific Observers Program (Programa de Observadores Cientificos a Bordo), operated by FIDEMAR with support from INAPESCA and CONAPESCA, operated for six consecutive fishing seasons from 2004 to 2010. The program included the entire industrial fleet. Coverage for the observer program was <5%; decreasing in the latter seasons (López-González et al. 2012). The main objective of this program was to characterize the spatial and temporal distribution of target shrimp species (López-González et al. 2012). Complete results from this program are not publicly available and were not made available to the assessment team.

Starting in 2015, the client group worked with the consulting company "Servicios Integrales de Consultoría en General" (SICG), in coordination with INAPESCA and CONAPESCA, to implement a voluntary program of Technical Observers (SICG, 2015; SICG, 2018). The main program objective is collecting information on bycatch composition. For the last season (2017-2018), estimated observer coverage was ~3.8% (50 trips observed out of 1,300 in the season). Data from 2018-2019 is being processed (Manuel Marrufo, personal communication). Currently, 365 industrial fishing vessels in the industrial fleet are participating in the voluntary Observer Program. These are the vessels considered to be part of the Unit of Assessment (UoA).

Regarding observer training and hiring, an announcement is made every year within academic institutions and fishing piers in order to select the most competent staff to be part of the observer program. Observers are certified by CONAPESCA and INAPESCA. Currently, 30 observers participated in the program. The information registered by observers is delivered to SICG, who will capture and analyze the information, then it is sent to INAPESCA, for its evaluation, they will be responsible for issuing technical and scientific reports. Finally, the reports and technical recommendations are sent to CONAPESCA (SICG, 2017).

One of the conclusions on the 2017 pre-assessment was "The designations of P2 species is considered preliminary, as the voluntary observer program did not provide information at the species level. Certain aspects of species identification and data quality need to be resolved for a full assessment." It is important to point out that despite the previous recommendation, the assessment team received the same bycatch information provided for the 2017 pre-assessment without the improvements required. Therefore, the catch composition and resulting species classification are still preliminary.

INAPESCA through the CRIP in Mazatlán since 2012 has carried out fishery independent oceanographic cruises aboard the research vessel INAPESCA I; these cruises were focus on analyzing information on bycatch associated to the shrimp catch for five zones (INAPESCA, 2016a; INAPESCA 2016b; INAPESCA, 2016c; INAPESCA, 2016d; INAPESCA, 2016e; INAPESCA, 2017a; INAPESCA, 2017b; INAPESCA, 2017c; INAPESCA, 2017d): Baja California Continental Shelf (Zone 50); Baja California Continental Shelf (Zones 30, 40 and 60); Macapule river Mouth in Navachiste, Sinaloa; Santa María Bay, Sinaloa; Teacapán river mouth, Sinaloa. A large portion of the research cruise data collected were form The river mouths, which are regions where the industrial fleet does not operate due to regulations. Thus, because the research cruise data may not be fully representative of the industrial shrimp fleet bycatch, research cruise data was not included in the P2 analysis in this report. .

#### 5.3.1.4 Primary Species

No primary species were designated as there is no stock assessment, scientifically established TAC or known reference points for any of the P2 species.

#### 5.3.1.5 Secondary Species

Although the team acquired catch composition data for three years from the SICG voluntary observer program (2015, 2016 and 2017) and two years (2016-2017) from INAPESCA research cruises, the team decided using only the SICG data (see section 7.3.1.3). Based on the SICG observer program, the catch volumes for the species groups were averaged across the three years to determine 'main' and 'minor' designations. The observer program provided information grouping several species. A complete list of all species groups can be found in Annex 1: Species Table. Although a total number of recorded species was not available from SICG Observer Program database, previous studies based on the FIDEMAR observer program recorded 240 species (Rodríguez-Romero et al. 2012). The designations of P2 species is considered preliminary, as the voluntary observer program did not provide information at the species level.

Results from numerous assessments of bycatch in the Pacific shrimp fishery show that the shrimp bycatch ratio is highly variable depending on zones, gear type, and seasons of the year; quantities of bycatch drastically decrease as the fishing season progresses (López-Martínez et al. 2012). Studies ranging from the 1980s to early 2000's record a wide range of shrimp to bycatch ratios from 1:9 to 1:69 (INAPESCA 2010). Averaging, across years, seasons and zones, the shrimp-bycatch ratio has remained around 1:10 from the 1960s to the early 2000s (INAPESCA 2010). The shrimp-bycatch proportion has declined in recent years, ranging from 1:8.89 in 2015, 1:3.19 in 2016 and 1:5.21 in 2017 based on data collected by the SIG Voluntary Observer Program, with an average of ~85% of the bycatch was discarded.

There were no primary species identified in this fishery as there are no management tools and measures are in place. All bycatch species were classified as secondary species (Table 4). There are 12 main primary species which were organized into four species groups that represented >5% of the catch composition of the observed trips. These 12 main species come from seven families: Gerreidae, Dasyatidae, Gymnuridae, Mobulidae, Rhinobatidae, Portunidae, and Haemulidae (Table 4). Only eight of these species (i.e.swimming crabs and rays) have management regulations and the current status is only known for the swimming crabs (DOF, 2018). Because of the limited information available for 10 of the main secondary species, the assessment team conducted a desk-based Productivity Susceptibility Analysis (PSA). The RBF scoring tables can be found in Annex 2.

**Table 4. Summary of Secondary Main Species as Categorized for Evolution**

| Scoring Group | Common name | Family | Scientific name | Reference Points | RBF* |
|---|---|---|---|---|---|
| **1** | Mojarras | Gerreidae | *Diapterus aureoles*<br>*Diapterus peruvianus* | No | Yes |
| **2** | Rays<br>(Rayas y Mantarrayas) | Dasyatidae,<br>Gymnuridae,<br>Mobulidae,<br>Rhinobatidae | *Dasyatis dipterura*<br>*Dasyatis longa*<br>*Dasyatis violácea*<br>*Gymnura crebripunctata*<br>*Gymnura marmorata*<br>*Rhinobatos glaucostigma* | No | Yes |
| **3** | Swimming crab<br>(Jaiba) | Portunidae | *Callinectes Bellicosius*<br>*Callinectes Arcuatus* | Yes | No |
| **4** | Grunts (Burros, roncadores) | Haemulidae | *Haemulon steindachneri,*<br>*Haemulon scudderii* | No | Yes |

## 5.3.1.6 Mojarras

**Species**

*Diapterus aureoles & Diapterus peruvianus*

**Biology**

The genus *Diapterus* is classified within the Gerreidae family. These are fish that are commonly known as mojarras and can be identified by their protruding mouths. The genus occurs on both coasts of the Americas, with five species on the Atlantic and two species (i.e.*D. aureoles* and *D. peruvianus*) on the Pacific side.Both species are tropical benthopelagic and are distributed from the Baja California Peninsula and the Gulf of California to the coasts of Peru (fishbase.org). The maximum length for *D. aureoles* is 15 cm (Bussing, 1995), while *D. peruvianus* can reach up to 30 cm (Jimenez-Prado and Béarez, 2004). Little is known about the biology of *D. aureoles*aside from being commonly found in coastal areas, but very rarely seen in in coastal lagoons. *D. aureoles* is a common discarded bycatch species in shrimp trawls (Vergara-

Solana et al., 2014). *D. peruvianus* is also common in coastal waters. Juveniles inhabit lagoons of mangrove areas and tidal streams andadults are found over the soft bottoms of deeper waters. The primary diet of *D. peruvianus* are benthic invertebrates and fishes. Its flesh is considered of good quality (Bussing, 1995). Both species are listed as Least concern by IUCN (IUCN, 2018).

**Status**

The status for both species on the IUCN Red List is the Least concern (IUCN, 2018). Based on the RBF, both species were graded with ≥ 80 (Table 9).

**Management**

No regulations issued for the management of mojarras

#### 5.3.1.7 Rays (rayas y mantarrayas)

**Species**

*Dasyatis dipterura*

*Dasyatis longa*

*Dasyatis violacea*

*Gymnura crebripunctata*

*Gymnura marmorata*

*Rhinobatos glaucostigma*

**Biology**

Rays, like sharks, belong to a specialized group of cartilaginous structure species with a similar reproductive pattern. Its life strategy is characterized by slow growth, low fertility, late maturity, high longevity and prolonged gestation periods (Marquez-Farias and Blanco-Parra, 2005). Regarding reproduction, all elasmobranchs (sharks and rays) use internal fertilization through paired coupling organs called gonopterigia (Wourms (1977 and 1981). Wourms and Demski (1993) point out that at least five forms of reproduction have been recognized among sharks and rays, while Compagno (1990) recognizes six types of reproduction variations. In rays, the reproductive characteristics are varied. With the exception of the Rajiformes, which are oviparous, the rest of ray orders are ovoviviparous (Marquez-Farias and Blanco-Parra, 2005). Rays live in temperate and tropical shallow waters from the tidal zone to more than 30 m depth. The common habitat includes soft sandy, muddy bottoms, and seagrasses. During the summer most benthic species move to shallow water coastal areas to spawn. When these rays approach the coast, they become extremely vulnerable to the nets used in artisanal fishing and other near shore fisheries. The majority of ray species use beaches and bays as breeding areas as these areas offer security and food to newborns which enable them to reach adulthood (Castro, 1993). The birth season of most rays is spring and summer. Newborn rays, due to their small size, are not initially vulnerable to artisanal fishing nets, however small animals of some species are impacted by shrimp trawling (Marquez-Farias and Blanco-Parra, 2005). Demersal rays usually inhabit a sandy environment with abundant marine vegetation but perform seasonal vertical migrations for reproduction purposes. For example, the *Dasyatis brevis* (semi-swimmer ray) and *R. steindachneri* (swimmer ray), are very abundant in the upper water column when they are caught during migrations to the interior of the Gulf of California. Rays are an important part of the diversity that makes up the bycatch caught by shrimp trawlers, and use of trawlers has increased in recent years. The impact caused by ray bycatch in the shrimp fishery has not been formally quantified; however, preliminary estimates suggest that in the Gulf of California, rays bycatch from shrimp trawlers may be larger than catches from the artisanal rays fishery (Márquez-Farias 2002).

**Status**

The stock status of rays caught in the fishery is unknown because of the lack of quantitative studies (Marquez-Farias and Blanco-Parra, 2005). The most recent update of the National Fishing Chart (DOF, 2018) does not include an assessment of the status of the ray stocks. IUCN lists the ray species as either data deficient or least concern. Based on the RBF, two species (Diamond stingray and Longtail stingray) were assumed as representatives of this taxonomic group (both species were graded with 60-79 (Table 9).

<u>IUCN Red List Status</u>

| | |
|---|---|
| *Dasyatis dipterura*. | Data deficient (DD) |
| *Dasyatis longa*. | Data deficient (DD) |
| *Dasyatis violacea* | Least Concern (LC) |
| *Gymnura crebripunctata* | Data deficient (DD) |
| *Gymnura marmorata* | Least Concern (LC) |
| *Rhinobatos glaucostigma* | Data deficient (DD) |

**Management**

Ray and shark species are regulated by the NOM-029-PESC-2006 (responsible fishing of sharks and rays), NOM-009-PESC-1993 (zones and season closures) and NOM-059-ECOL-2001 (ETP species). In particular, the NOM-029-PESC-2006 establishes the fishing gear allowed in the elasmobranchs capture and shark finning is prohibited, whole bodies must remain in the boat. Catch of the following species is also prohibited: *Rhincodon typus*, *Cetorhinus maximus*, *Carcharodon carcharias*, *Pristis perotteti*, *P. pectinata* y *P. microdon, Manta birostris, Mobula japanica, M. thurstoni, M. munkiana, M. hypostomata and Mobula tarapacana;* season closures; fishing permits; zones where elasmobranchs fishing is prohibited, etc.

#### 5.3.1.8 Swimming crabs (jaibas)

**Species**

*Callinectes bellicosity*

*Callinectes arcuatus*

**Biology**

*C. bellicosus*, *C. arcuatus* and *C. toxotes* present different geographical distribution; however, they share habitats in lagoon systems, on their banks and in the marine area (Hendrickx 1984). they present a complex life cycle, which includes planktonic, nectonic and benthic stages, which are carried out between the two environments (in the lagoon systems and the marine area), in a wide variety of habitats (Ramírez-Félix et al. 2003).

Labastida-Che and Núñez-Orozco (2015) determined biological parameters for *Callinectes arcuatus* and *Callinectes bellicosus* in the Mar Muerto lagoon system in Oaxaca-Chiapas. They used the Bhattacharya method (1967), the empiric Pauly equation (1979), and the von Bertalanffy equation to estimate growth. Growth parameters were used to estimate mortality rates using Pauly's empirical equation (1984) for tropical species. According to the authors, for *C. arcuatus* the exploitation rate E = 0.61, might indicate that the resource is exceeded with respect to optimal exploitation levels. On the other hand, for *C. bellicosus* the exploitation rate (E=0.44) suggests that the resource is below the optimal levels of exploitation.

The swimming crab *Callinectes arcuatus* inhabits the Pacific Ocean from Los Angeles, California, to Mollenda, Peru, and the Galapagos Islands (Hendrickx 1984). Adults live and mate in coastal lagoons and estuaries (Hernández-Moreno 2000); females carrying eggs migrate towards the mouths of these systems where the liberation of fertilized eggs is presented, for their hatching. Subsequently, the Zoea larvae disperse into the open sea and become mega-larvae, which enter the coastal systems where they grow until they reach adulthood (Sánchez-Ortiz and Gómez-Gutiérrez, 1992). Regarding population parameters, first maturity length (CW50) has been registered between 64.8 and 95 mm, with females reaching the CW50 with shorter lengths than males (Fischer y Wolff 2006, Ortega-Lizárraga 2012, Rodríguez-Domínguez 2014). Ortega-Lizarraga et al. (2016) determined the weight – carapace width (CW) relationship. They also estimated the growth parameters ($CW_\infty$ = 137.3 mm and *K = 0.83/year*) using the Akaike criterion to select the best growth model. They also used the logistic model to estimate the length of first maturity (CW50 = 79.7 mm for males and CW50=78.7 for females).

**Status**

According to the National Fishing Chart (INAPESCA, 2012), in the states of the Gulf of California, the swimming crab fishery is at the maximum sustainable yield, in the rest of the states, it has the potential of development.

**Management**

These species are managed under the permitting strategy since 2006 and is regulated through NOM-039-PESC-2003. Minimum carapace width is in force for each crab species (95 mm for C. arcuatus, 115 mm for C. bellicosus and 120 mm for C. toxotes). There is also a ban on landing juveniles and landing or removing berried female eggs. Regarding the fishing gear, pots must have at least escape openings (100×50mm) for small organisms and lift nets have a minimum mesh size. Restrictions also apply in terms of fishing effort (e.g. limit of gears by boat) and gear types in use. If deemed necessary, closed seasons and areas may also be put in place to protect these species during the reproduction period (SAGARPA, 2012).

#### 5.3.1.9 Grunts (burros, roncadores)

**Species**

*Haemulon steindachneri, Haemulon scudderii*

**Biology**

Several species of the haemulidae family penetrate the continental waters; They are common in rocky and reef areas and are often caught in shrimp trawlers (Castro, 1978). 25 species from this family have been reported in the Gulf of California, out of those, ten species are caught in the shrimp trawlers (Van der Heiden (1985). When extracted from their natural environment these fish emit loud sounds, which has given them their common name “grunts” (roncadores in Spanish). According to Thomson et al. (1979), most of them are grouped in small schools and live associated with rocky areas and reefs during the day and move to more sandy areas at night, to feed mainly on benthonic invertebrates (shrimp, clams and polychaete worms). The chere-chere grunt (*Haemulon steindachneri*) is a tropical marine reef-associated species, its depth range is 0-50 m. In the eastern Pacific it is distributed from Mexico to Peru (Chirichigno, 1974). Their maximum total length is 30 cm (Robins and Ray, 1986). Juveniles encountered near the shore, over sandy bottoms near seagrass beds (Cervigón, 1993). They Feed on benthic invertebrates (Courtenay and Sahlman, 1978). On the other hand, the gray grunt (*Haemulon scudderii*) is distributed in the Eastern Pacific from Mexico to Ecuador, including the Galapagos Islands. It is a tropical marine reef-associated species, its depth range is 3-40 m (Humann and Deloach, 1993). Its maximum total length is 35 cm (Mckay and Schneider, 1995). It forms schools above rocky, boulder strewn reefs, slopes, and hard substrate with good water movement (Humann and Deloach, 1993) and they are oviparous, distinct pairing during breeding (Breder and Rosen, 1966). No information on fecundity and maturity or maximum age for the Chere-chere and the Gray grunts were found. However, fecundity for the white grunt (Haemulon plumieri) has been determined between 19,873 and 535,039 eggs (Palazón-Fernández,2007). Tomtate grunt (Haemulon aurolineatum) on Campeche Bank mature when about 3 yr old, and all of the commercial catch on the Bank is sexually mature (Sokolova 1965). The maximum observed age of H. plumierii along the central coast of Brazil was 28 years old (Neves-Araújo and Silva-Martins, 2007).

**Status**

Grey grunt: IUCN Red List, Least concern

Chere chere grunt: IUCN Red List, Least concern

Based on the RBF, two species (Chere-chere grunt and Gray grunt) were assumed as representatives of this taxonomic group, both species were graded with ≥ 80 (Table 9).

**Management**

As mentioned, the swimming crabs are managed through the NOM-039-PESC-2003 and rays are managed through the NOM-029-PESC-2006. There are some measures designed to manage the remaining main secondary species (mojarras and grunts) and minor secondary species identified in this fishery. The main regulation for the management of the shrimp fishery is the NOM-002-SAG/PESC-2013. Among the included regulations, the following apply to bycatch (primary and secondary) species in the Gulf of California:

Trawling is prohibited regardless of the species to be caught, within the marine range between 0 and 9.14 meters deep (0 and 5 fathoms deep). Trawls is prohibited regardless of the species that is to be captured within an area that has a radius of 9.25 kilometers (5 nautical miles) around the mouths that connect the sea with the following bays, coastal lagoons and estuaries, in The Mexican Pacific:

a) Magdalena Bay, Baja California Sur.

b) Kino Bay, Sonora.

c) Agiabampo, Sonora-Sinaloa.

d) Topolobampo, Sinaloa.

e) Agua Brava, Nayarit.

All ships with capacity greater than 10 tons should use the satellite tracking system

The fish excluder device (DEP) authorized by this Secretariat shall be installed and used, with the purpose of reducing bycatch of non-target species in the trawl nets used in the operations of commercial and didactic shrimp fishing in the waters of federal jurisdiction of the Mexican Pacific Ocean.

Fishermen must participate on research programs focused on shrimp, sea turtles and on-board observers, carried out by the Secretariat, as well as those focused on the assessment of the status of shrimp populations, the incidental catch of marine turtles and fauna, monitoring of commercial shrimp catches, monitoring and updating on the operational efficiency of sea turtle excluder devices (DET) and fish excluder devices (DEP), and the use of different devices to improve selectivity and their effects on production volumes, as well as establishing the operational conditions of the fleet.

More details on management measures for the Pacific shrimp fishery can be found in the NOM-002-SAG/PESC-2013.

As mentioned above, the main measure implemented in the fishery to mitigate impact on bycatch species is the Bycatch Reduction Device (BRD). In 1992 INAPESCA initiated experimental fishing with different BRD in the Gulf of California. Results from tests indicated a reduction in bycatch volumes (INAPESCA 2010). The national standard NOM-002-SAG/PESC-2013 made mandatory the use of BRD for all the industrial fleet (DOF, 2013).

**Information**

The information on the shrimp fishery bycatch is very broad. Some papers are focus on determining the bycatch composition globally (Kelleher, 2005; Guillet, 2008), while others are aimed to study bycatch locally (Pérez-Mellado and Finley, 1985; Rábago-Quiroz et al., 2011; López-Martínez et al., 2010; Madrid-Vera et al., 2007; Madrid-Vera et al., 2010). Additional literature is focused on decreasing bycatch volumes using BRDs and TEDs (Aguilar-Ramírez et al., 2001; INAPESCA, 2010; Watson, 1986; Watson y Taylor 1990; Kenelly and Broadhurst 1995; Aguilar-Ramirez and Grande-Vidal, 1996). In December 2000 GEF funded a global project called "Reducing the Ecological Impact of Shrimp Trawls Using Bycatch Reduction Technologies and Management Change". Mexico participated in this project working on the evaluation of the prototype net “RS-INP-MEX” (Aguilar-Ramírez et al. 2001) adapted for the use of the industrial shrimp fleet.

There are three sources for bycatch information, the on-board Scientific Observers Program operated by FIDEMAR with support from INAPESCA and CONAPESCA (2004-2010), the SICG on-board Observers Program, operated in coordination with INAPESCA and CONAPESCA (2015-2018) and bycatch information from independent oceanographic cruises operated by INAPESCA (2016-2017). The complete results from the FIDEMAR program are not publicly available and were not made available to the assessment team. The assessment team received the 2015-2017 SICG Observer Program data base; unfortunately, this data base did not provide information at species level as required in the 2017 pre-assessment.

The assessment team carried out a PSA for ten species; however, the information required for the RBF is not considered sufficient. The client provided some information for the family hamulidae (Cruz-Romero et al., 1993), the swimming crabs (Ortega-Lizarraga et al., 2016), for mojarras (Castro-Aguirre, unpublished) but some species are missing required information on life history parameters, such as size, maximum age, maturity at age and fecundity.

### Endangered, Threatened and Protected (ETP) Species

Records of the voluntary observer program showed that only the Giant seahorse, King angelfish, several species of sea turtles, the Short-beaked common dolphin, and the California sea lion have been found to interact with the fishery (Table 5). There are 15 total potential ETP species, and all organisms were caught by the trawling net and were released. A few species recorded in other bycatch reports of the fleet, or for which there no records of known interactions with the fishery but are highly vulnerable and known to be occurring in the geographic area, were also included.

**Table 5. List of Potential ETP species**

| English Common Name | Spanish Name | Species | National legislation |
|---|---|---|---|
| Giant seahorse | Caballito de mar | *Hippocampus ingens* | NOM-059-SEMARNAT-2010 (A) |
| Cortez angelfish* | Ángel de Cortés | *Pomacanthus zonipectus** | NOM-059-SEMARNAT-2010 (Pr) |
| King angelfish | Pez Angel | *Holacanthus passer* | NOM-059-SEMARNAT-2010 (Pr) |
| Totoaba (juveniles) | Totoaba | *Totoaba macdonaldi* | NOM-059-SEMARNAT-2010 (P) |
| Smoothtail mobula** | Manta diabla | *Mobula munkiana* | NOM-029-PESC-2006 |
| Giant Manta* | Manta Gigante | *Manta birostris* | NOM-029-PESC-2006<br>NOM-059-SEMARNAT-2010 |
| Sea turtles | Tortugas Marinas | *Lepidochelys kempii* | NOM-059-SEMARNAT-2010<br>NOM-162-SEMARNAT-2012 |

| | | | |
|---|---|---|---|
| | | *Eretmochelys imbricate*<br>*Caretta caretta*<br>*Lepidochelys olivacea*<br>*Chelonia mydas agassizii*<br>*Dermochelys coriacea* | |
| Short-beaked common dolphin | Delfín común | *Delphinus* capensis | NOM-059-SEMARNAT-2010 (Pr) |
| Californian Sea Lion | Lobo marino | *Zalophus californianus* | NOM-059-SEMARNAT-2010 (Pr) |
| Vaquita* | Vaquita marina | *Phocoena sinus* | NOM-059-SEMARNAT-2010 (P) |

* *No interactions for these species were recorded by the observer program, ** Observer Program data resolution does not allow assessing if the fishery interact with this species*

In 1992, the Instituto Nacional de la Pesca started a "National Program for the evaluation of the incidental catch of sea turtles and the technical and economic impact of the use of turtle exclusion devices". The research tested seven TED designs (INP, 1991). The efficiency for catching shrimp and reducing bycatch depended on the operation zone and TED type. TEDs were found to result in a reduction of 95% of the sea turtle catches (Aguilar-Ramirez and Grande-Vidal, 1996; Aguilar-Ramirez, 1998)

Although the industrial shrimp fishery does not interact with adult totoaba (*Totoaba macdonaldi*), the trawl net catches totoaba juveniles (García-Caudillo et al., 2000). The decline of the once important Totoaba fishery has been attributed in part to the incidental catch of totoaba juveniles (Barrera-Guevara, 1990; Cisneros-Mata et al., 1995). However, the inclusion of the BRD in trawl nets has increased the exclusion of totoaba juveniles.According to Torres-Jimenez and Balmori-Ramirez (1994) the BRD type fisheye produced an exclusion of juvenile totoaba of 65%; Similarly, García-Caudillo et al. (2000) tested the efficiency of the Square Mesh/Extended Funnel BRD and reported exclusion rates of 81%. They suggested that this measure would help the recovery of endangered species, in particular, totoaba.

No totoaba interaction with the shrimp fishery was recorded by the Observer Program. For the giant seashore the % bycatch was very low (0.01%). The observer database does not provide information at a species level, so it is not possible to quantify the amount of Smoothtail Mobula and the Giant Manta caught by the industrial shrimp fishery. Information was available on the number of dolphins, sea turtles and sea lions that were captured during fleet operations and later released. The recorded interactions (catch and release) were very low. In the 2015-2016 season the Observer Program recorded three interactions with turtles. In 2016-2017 the voluntary observer program recorded six interactions with sea turtles and one dolphin. In 2017-2018 season the observer program recorded interactions with twelve sea turtles and one sea lion. All protected species were returned to the sea, no information was provided as to post-capture mortality of protected species. In average there were seven interactions by year. It is important to point out that the Observer Program coverage is about 3.8% (50 trips observed out of 1,300 in the season). A gross estimate would suggest 184 interactions with turtles per year. However, it is difficult to make an inference of how how many turtles interact with the fishery by species because there are six turtle species inhabiting the Gulf of California and the information data is not provided at species level. Similarly, the post release mortality is by species is not known. Some preliminary studies suggest a 66% survival of olive ridley sea turtle when caught by demersal trawl fishery. These inferences suggest a low fishery impact on sea turtle populations.

**Species**

Giant seahorse (*Hippocampus ingens*)

**Biology**

Seahorses are subtropical teleost fish, non-migratory with a depth range from 0 to 60 m (Lourie et al., 1999). In the eastern Pacific, their distribution ranges from San Diego, California to Perú, including the Galapagos Islands (Fishbase.org). They belong to the order Syngnathiformes, they belong to the family Syngnathidae that has 295 species and is comprised of the subfamilies Syngnathinae (pipa fish) and Hippocampinae (seahorses), the latter includes the genus Hippocampus which contains 36 species (Lourie et al., 2004; Nelson, 2006). Seahorses have an affinity to stenohalin marine environments, particularly to areas with macroalgae cover or seagrasses adjacent to coral or rocky reefs (Aguilar-Barrón, 2009). It is not easy to find them, because due to their camouflage capacity they are not noticed in rocky areas or in the seaweed beds (De la Cruz-Agüero et al., 1997). Seahorses are monogamous. The female lays her eggs inside the male's incubation bag for fertilization and protection. The duration of pregnancy is completed from 14 to 15 days and usually, have litters of more than 400 individuals. The development they present is direct, juvenile newborns resemble small adults and are completely independent after birth (Lourie et al., 2004). It is estimated that the life cycle of the seahorse ranges from 1 to 5 years (Bisso-Bustamante, 2006).

**Status**

According to the IUCN Red List Status, they are classified as Vulnerable. Regarding local legislation, they are included in the NOM-059-SEMARNAT-2010 as a species at risk.

**Management**

Species *Hippocampus erectus, H. ingens, H. reidi y H. zosterae* are included in the NOM-059-ECOL-2010 within the category “Subject to Special Protection (Pr)”, species included in this category could be threatened by factors that negatively affect their viability, so it is necesary to promote its recovery and conservation or the recovery and conservation of populations of associated species (NOM-059-ECOL-2010). The management of these species is done under the scheme of the Management Unit System for wildlife conservation. the General Wildlife Law (LGVS) states that it is of Federal competence regulate the use of all species listed in NOM-059-SEMARNAT-2010, and considering that seahorse species are considered within the category of “Special Protection” in the mentioned standard, are regulated under the LGVS. It is important to mention that of the ornamental species in Mexico, only seahorses are listed in CITES, in Appendix II. SEMARNAT developed the “Plan de Manejo Tipo Para Peces Marinos de Ornato (Management Plan For Ornamental Marine Fish). This plan is a standardized and simplified guide, and describes the elements necessary to carry out good practices by determining the appropriate levels for its sustainable use and promoting its conservation in the short, medium and long term. As mentioned, seahorses are bycatch in the industrial shrimp fishery, thus they are regulated through the NOM-002-SAG/PESC-2013 that contains specific regulations for bycatch.

**Information**

General information (biology, identification keys, distribution, habitat, growth, reproduction) on seahorses species is found in the Management Plan For Ornamental Marine Fish (SEMARNAT, 2012). Basic information on seahorses species is also found in www.Fishbase.org. Information on seahorses bycatch was provided by the SICG Observer Program for 2015-2017 fishing seasons.

**Species**

*Lepidochelys kempii*—Kemp's ridley sea

*Eretmochelys imbricate*—Hawksbill sea turtle

*Caretta caretta*—Loggerhead sea turtle

*Lepidochelys olivacea*—Olive ridley sea turtle

*Chelonia mydas agassizii*—Green sea turtle)

*Dermochelys coriacea*—Leatherback sea turtle

**Biology**

Five species of sea turtle occur in waters of the Baja California peninsula. The most common species, the green turtle (*Chelonia mydas*) and the loggerhead turtle (Caretta caretta), use the region primarily as developmental and foraging habitat. They originate on nesting beaches as far away as southern Mexico and Japan, respectively. The two species known to nest in Baja California are the olive ridley turtle (Lepidochelys olivacea) and the leatherback turtle (Dermochelys coriacea). The Baja California coast represents the northern extreme of the nesting range for both species. The hawksbill turtle has become exceedingly rare in waters along the peninsula due to the fishery for its shell. The region provides critical feeding and developmental grounds for all five sea turtle species as they feed on the abundant marine algae, seagrass, and invertebrates (Nichols, 2003).

The green turtle Chelonia mydas is a circumglobal species that is susceptible to over-exploitation as a food resource and incidental mortality in fisheries. Efforts to recover regional green turtle populations have been hampered by a lack of information on their biology. In particular, turtle movements and home ranges in neritic foraging habitats are not well understood. Green turtles Chelonia mydas occur in tropical and subtropical regions throughout the world's oceans. Due to overexploitation of eggs and turtles as a food resource and, to a lesser extent, incidental mortality relating to marine fisheries and degradation of marine and nesting habitats, populations have declined throughout the world (Groombridge & Luxmoore, 1989; Limpus, 1995). Despite a worldwide increase in research andconservation of green turtles, their foraging biology and habitat requirements remain poorly understood(Bjorndal 1997). In the eastern Pacific Ocean, green turtles have experienced important declines due to human overexploitation (Caldwell, 1963; Cliffton et al., 1982; Figueroa et al., 1993). Despite calls for increased protection (National Marine Fisheries Service and US Fish and Wildlife Service 1998), conservation efforts have been hindered by a poor understanding of the critical foraging grounds and the patterns of habitat use in this region (Seminoff et al., 2002).

Loggerhead turtles (Caretta caretta) are characterized by their transoceanic migratory patterns in the North Pacific Ocean, as individuals of this species originating from nesting beaches in Japan are known to forage along the Baja California Peninsula (BCP), Mexico. The nearshore waters of BCP serve as important foraging habitat for growth and development; however, the implementation of appropriate management strategies has been hindered by the paucity of data on the biology and distribution of the species, particularly for juveniles during their developmental migrations (Zavala-Norzagaray et al., 2017).

Olive ridley turtles (Lepidochelys olivacea) are the most abundant sea turtle species worldwide. The turtles nesting on the Pacific coasts of Mexico and Costa Rica average the smallest, include the smaller recorded nesters, and have the smallest average clutch (Hirt, 1980). The largest known nesting aggregations of L. olivacea are on mainland beaches (Mexico, Costa Rica and India). During arribadas a large number of eggs are destroyed by nesting females, with a resulting low reproductive rate, in terms off-spring produced by a female, may be compensated by a hatchling success in escaping shallow-water predators when large numbers of them enter the water about the same time (Hirt, 1980).

Reliable data on sea turtle abundance and on the numerous causes of turtle deaths, which are necessary for accurate population assessments, are generally not available. In addition to a lack of data, it has proved difficult to identify all the factors that influence the abundance of sea turtles. As mentioned, because of the highly sea turtles´ migratory nature and the large number of hatchlings coupled with low survival rates, it is difficult to estimate overall populations (FAO, 2009).

**Status**

All species are included in the NOM-059-SEMARNAT-2010 as a species at risk.

**Management**

In 1994 the Fisheries Secretariat established a total and indefinite ban for different species, among them the sea turtles in waters of federal jurisdiction of the Pacific Ocean, including the Gulf of California. Currently, these species are considered as species at risk in the NOM-059-SEMARNAT-2010. The Secretariat, after conducting studies on the selectivity of fishing gear, considered it necessary to incorporate the use of marine turtle excluder devices (TEDs) (DOF, 2013).

In Mexico Turtle Excluder Devices (TED) has been mandatory since 1995. Each year vessel inspections are carried out by CONAPESCA personal before starting the fishing season to ensure compliance with Mexican regulation for proper installation of TEDs. On basis of these inspections, the US certifies that Mexico's TEDs program is comparable in effectiveness to the U.S. program. On May 1, 2017, the Department certified Mexico on the basis that their sea turtle protection programs is comparable to that of the United States (NOAA, 2017). Similarly, BDR are also mandatory as

**Information**

There are three sources for bycatch information, the on-board Scientific Observers Program operated by FIDEMAR with support from INAPESCA and CONAPESCA (2004-2010), the SICG on-board Observers Program, operated in coordination with INAPESCA and CONAPESCA (2015-2018) and bycatch information from independent oceanographic cruises operated by INAPESCA (2016-2017). The complete results from the FIDEMAR program are not publicly available and were not made available to the assessment team. In particular the SICG on-board Observers Program reports the number of interactions between marine mammals and turtles. According to the Observers Program data, in the period 2015-2018 only one dolphin interacted with the fishery and was released. Similarly, 21 turtles interacted with the fishery in the same period of time, unfortunately the data do not include species information. All data are grouped by taxonomic group, turtles and dolphins. No totoaba interaction was registered in the Observers Program data. Because the Observers Program data does provide only the common name is difficult assessing if the fishery interacted with other ETP species (Table Table 5).

The information collected sporadically is not sufficient to support measures to manage main secondary species. There appear to be limitation in the rigor of the data collection protocols and training of observers, as evidence by confusion on whether some species were actually caught as bycatch (mantas). The observer program needs to be certified. In particular, protocols for observer allocation are unclear, no evidence of evaluation of whether the observer program is meeting goals.

## Habitat Impacts

### Overview

When assessing the status of habitats and the impacts of fishing, teams are required to consider the full area managed by the local, regional, national, or international governance body(s) responsible for fisheries management in the area(s) where the UoA operates (this is called the “managed area” for assessment purposes).

According to MSC FCPV2.1 GSA 3.13.3, the assessment team must determine and justify which habitats are commonly encountered, vulnerable marine ecosystems (VMEs), and minor (i.e., all other habitats) for scoring purposes, [where]:

“A commonly encountered habitat shall be defined as a habitat that regularly comes into contact with a gear used by the UoA, considering the spatial (geographical) overlap of fishing effort with the habitat’s range within the management area(s) covered by the governance body(s) relevant to the UoA; and

A VME shall be defined as is done in paragraph 42 subparagraphs (i)-(v) of the FAO Guidelines (definition provided in GSA 3.13.3.21) [as having one or more of the following characteristics: uniqueness or rarity,

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[1] According to MSC FCPV2.1 GSA 3.13.3.2: VMEs have one or more of the following characteristic, as defined in paragraph 42 of the FAO Guidelines:

- Uniqueness or rarity – an area or ecosystem that is unique or that contains rare species whose loss could not be compensated for by similar areas or ecosystems functional significance, fragility, Life-history traits of component species that make recovery difficult, and/or structural complexity]. This definition shall be applied both inside and outside EEZs and irrespective of depth."

Both commonly encountered and VME habitats are considered 'main' habitats for scoring purposes (GSA 3.13.3).

The Gulf of California is a 1,130 km long and 80 to 209 km wide semi-enclosed sea located between the mainland of Mexico and the Baja California peninsula (Lluch-Cota et al. 2007). Due to its high productivity, the Gulf of California supports a number of important commercial fisheries. In addition to the shrimp fishery, other fisheries include the small pelagic fishery and the artisanal fisheries that catch numerous species of bony fishes, elasmobranchs, mollusks, and crustaceans.

The area over which the fishery operates in the central and northern sections of the Gulf of Californiaare dominated by sandy, clay and silt substrates (Figure 18).

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- Functional significance of the habitat – discrete areas or habitats that are necessary for survival, function, spawning/reproduction, or recovery of fish stocks; for particular life-history stages (e.g., nursery grounds, rearing areas); or for ETP species
- Fragility – an ecosystem that is highly susceptible to degradation by anthropogenic activities
- Life-history traits of component species that make recovery difficult – ecosystems that are characterized by populations or assemblages of species that are slow growing, are slow maturing, have low or unpredictable recruitment, and/or are long lived
- Structural complexity – an ecosystem that is characterized by complex physical structures created by significant concentrations of biotic and abiotic features"

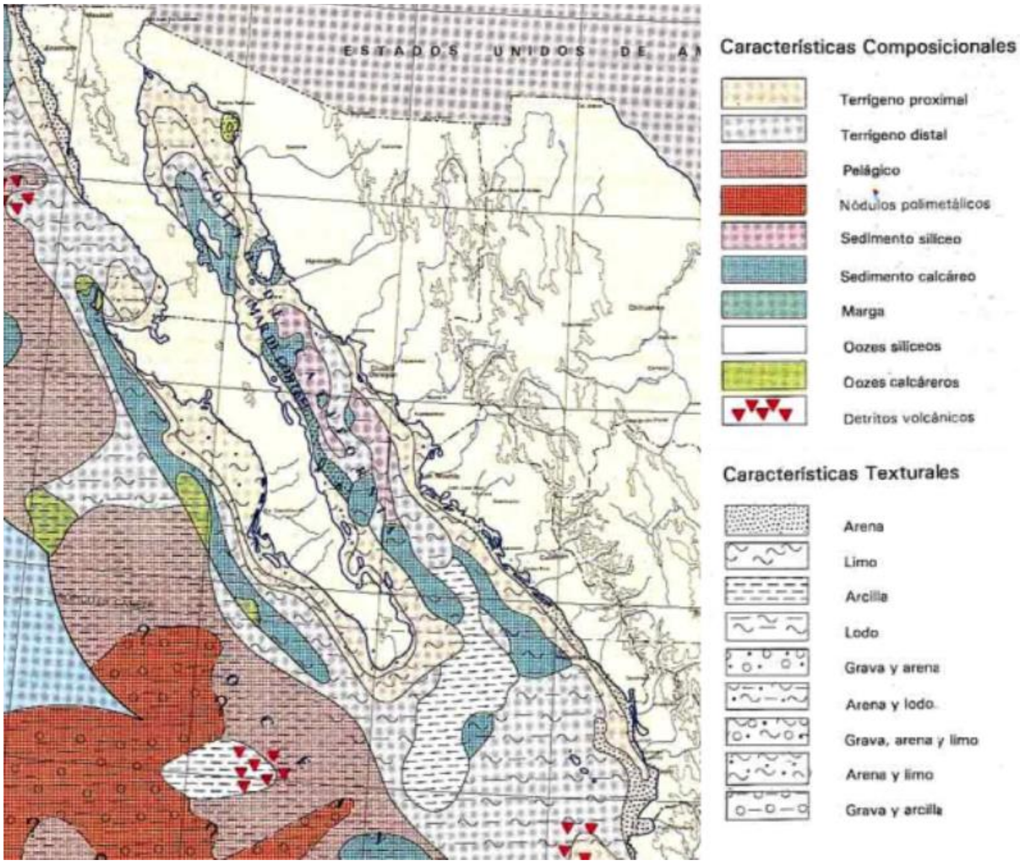


**Figure 18. Spatial distribution of the sediment types in the Gulf of California. (Reproduced from Carranza-Edwards y Aguayo-Camargo 1991 in Comisión Nacional de Áreas Naturales Protegidas. 2011).**

According to Sala et al. (2003), the major habitat types on the rocky coasts of the Gulf of California to a depth of 50 m are shallow algal (*Sargassum spp*.) beds, boulders, vertical walls, black coral beds, rhodolith beds, sandy bottoms, seamounts, and mangroves. Rare habitats are coral communities and seagrass beds. Although corals are found throughout the Gulf of California, they only develop extensive communities in two sites in the southern gulf. Seagrass (*Zostera marina*) beds are found in only two places in the central and southern Gulf.

**Habitat Type: Vulnerable Marine Ecosystems (VME)**

Many fish species rely on different habitats during their life-cycle stages. Juveniles often confine themselves to structurally complex habitats where they can find shelter and feed, moving further offshore when they are large enough to evade common predators. The knotted, complex roots systems of mangrove forests provide sanctuary for the juveniles of many commercial species, which migrate to rocky reefs during their adult lives (Aburto-Oropeza et al., 2015; Costa et al., 2015). For species following this life-cycle pattern, the abundance and health of such habitats, including Sargasso beds, are directly linked to adult population numbers and are echoed clearly in fisheries catches. A healthier habitat means more healthy fish and therefore more opportunities for productive fisheries. This ultimately leads to better local and regional livelihoods and economies.

The Gulf of California Marine Program at the Scripps Institution of Oceanography in San Diego, in collaboration with The Nature Conservancy, developed a map for the marine habitat distributions in the Gulf of California (Johnson, et al., 2016). Out of the habitats they mapped, several could be considered VME, including the rocky reefs that dominate the Gulf of California, the majority of them occurring along the Baja Peninsula. Seamounts are sparse but appear mainly in the southeast of the Gulf, whilst sargassum is present largely in the northeast. Coral habitats are rare and occur only at the tip of the peninsula, at the northern end of their distribution.

Due to the potential lost of expensive fishing gear, the industrial shrimp fishery opertes in sandy habitats avoiding VMEs, thus fishery – VMEs interactions are not of concern.

**Status**

The status of VMEs in the Gulf of California is unknown. Most of the research is focused on fisheries and their impact. One of the claims has been that fish and shellfish resources in the Gulf of California are over-exploited. The Federal Government makes a thorough assessment and derives management actions that may include limitations to fishing effort and fishing mortality, minimum size/age limits, mesh limitations, time and space closures, etc. It is much harder to state the current status of overexploitation of the Gulf of California as an entire ecosystem, or even regions within it. In fact, even when the institutions recognize the need of an ecosystem-based approach to management, still no equivalent of the ‘‘Carta Nacional Pesquera’’ exists at an ecosystem level. However, some actions and proposals are pointing to that direction, particularly considering: (a) the implementation of Marine Protected Areas and (b) the design of ecosystem health proxies (Lluch-Cota et al., 2007).

**Management**

Management is based on the designation of several marine protected areas in the Gulf of California by the Comisión Nacional de Areas Nacionales Protegidas (CONANP). These are multi-purpose zones, with only a small percentage of their marine surface area protected from fishing activities. There are five biosphere reserves, five national parks, two fauna and flora protected areas, one sanctuary and one refuge area for the vaquita (Table 6). Main regulations are included in the “Ley General de Equilibrio Ecológico y la Protección al Ambiente (General Law of Ecological Equilibrium and Environmental Protection)”.

**Information**

There is a review of several aspects of the ecosystems in the Gulf of California (Lluch-Cota et al., 2007) and some interactive sites focused on several aspects of species, habitats and ecosystems (Aburto-Oropeza et al., 2015; Costa et al., 2015; Johnson, et al., 2016).

**Habitat Type: Commonly Encountered**

**Status**

Due to the potential net loss, trawlers operate in sandy habitats avoiding coral reefs, rocky bottoms etc,. According to Lopez-Martinéz et al (2012), trawling affects seabed habitats throughout the world. However, these consequences are not uniform, since they depend on the spatial and temporal distribution of the fishery and vary with the type of habitat and the environment in which they occur (Kaiser et al., 2003). Due to the trawl net design that includes two otter boards and chains at the footrope, the fishing gear negatively impacts the bottom. Bottom trawl fishing gear causes the upper layers of the sedimentary habitat to return to suspension and thus mobilize nutrients, pollutants and fine particles back into the water column. The ecological significance of these fishing effects has not yet been determined (Kaiser et al, 2001).

While studies  trawling impacts the benthic substrate, most ecosystems affected by the shrimp fishery recover fast. An experiment off the Great Banks of New England to evaluate the effects of repetitive trawling in sandy bottom ecosystems found that the greatest impact to habitat was the immediate impact after trawling, but that these impacts were short-lived and the  ecosystem recovered in a year or less (Gordon et al., 2002). Likewise, experiments  comparing non-trailed areas and trailed areas determined that the shrimp trawl did not have long-term impacts on the infauna (Drabrisch et al., 2001). Other studies have determined that trawling modified the marine ecosystem both in abundance (Diamond et al., 1999), and the species diversity, modifying succession processes (Hansson et al., 2000), although the population dynamics of some affected fish species did not change greatly, while for other species were affected (Diamond et al., 1999). Other studies also agree with the general trend mentioned: trawling could continually impact habitat, but trophic relationships and biodiversity does not get affected greatly and recovery is achieved after reasonable period of time (Jennings et al., 2001; De Biasi, 2004).

In particular, research carried out in 2004 by CRIP with Support from SAGARPA-CONACYT evaluated the impact of bottom trawlers from the shrimp and demersal finfish fisheries in the bottom substrates in the Gulf of California. Despite the changes in sediment structure as a result of the suspension and redisposition of organic matter, the study did not find significant changes in benthic communities affected by bottom trawls (López-Martínez et al. 2010).  The study suggested that this was due to the high energy process in this area where benthic communities are capable of absorbing the impact of the bottom trawls (Sanchez et al. 2009).

**Management**

Currently there is a regulation prohibiting fishing on the five fathoms depth zone along the coast; in addition, fishing also bans at river mouths communicating with the sea (DOF, 2013). Both regulations are the focus on protecting the habitat where reproduction, spawning, and juvenile growth take place.

In 2000, the Global Environmental Facility (GEF) funded a project called "Reducción del Impacto Ecológico de Los Arrastres Camaroneros Usando Tecnologías de Reducción de Bycatch y Cambio de Manejo", INAPESCA participated in the development and testing of new fishing gear called "RS-INP-MEX" that would have less impact on the benthic habitat (Aguilar-Ramirez et al., 2001). This fishing gear is characterized by being lighter, with better aerodynamics. These two characteristics should result in less impact on the bottom habitat, however, this aspect has not been tested. Testing has been focused on bycatch reduction and some economic aspects. Its technical characteristics are (Figure 19): differential mesh size in the net, 3 "in the wings, 2 1/2" in the rest of the body, and 2 "in the code-end, use of hydrodynamic otter doors of 3 $m^2$ surface, turtle excluder type Super Shooter, fish excluder device type fisheye; spectra cloth material; double footrope; and short tunnel network design (Aguilar-Ramirez, 2001). Evaluations of this fishing gear suggest that it is possible to achieve stability in the ecological cost / economic benefit of fishing (INAPESCA/WWF, 2010). Current regulations (DOF, 2013) state that in the Upper Gulf of California, small-scale shrimp fishing is authorized through smaller boats with an outboard motor and RS-INP-MEX trawl. Due to high costs, for the industrial fleet this fishing gear is not mandatory, but its use is encouraged as mentioned in the NOM-002-SAG/PESC-2013: In the Buffer Zone of the Upper Gulf of California and the Colorado River Delta Biosphere Reserve, it is important that shrimp capture with larger and smaller vessels be carried out with fishing gears that have a lower impact on the seabed, using light trawls nets. The assessment team has no further information regarding voluntary use of gear.

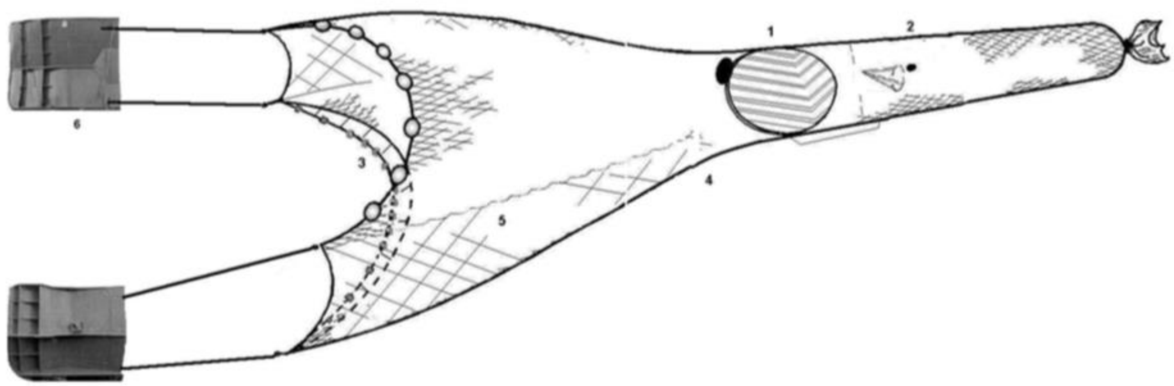


**Figure 19. Schematic design of the RS-INP-MEX trawl net prototype; 1 – TED type Super Shooter, 2 – BRD type fisheye, 3 – double footrope, 4 – Short tunnel design, 5 – differential mesh size, 6 – hydrodynamic otter boards (taken from INAPESCA, 2010).**

Additionally, there are a number of marine protected areas in the Gulf of California. These are multi-purpose zones, with only a small percentage of their marine surface area protected from fishing activities. A biosphere reserve is characterized by being sites that are not exclusively protected (such as national parks) but can house human communities, who live on sustainable economic activities that do not endanger the ecological value of the site (https://www.gob.mx/semarnat/es/articulos/reservas-de-la-biosfera-areas-que-se-preservan-se-disfrutan-y-se-aprovechan-sustentablemente?idiom=es). In national parks, only activities related to the preservation of ecosystems and their elements are allowed, as well as research, recreation, tourism and ecological education (https://www.gob.mx/semarnat/articulos/parques-nacionales-de-mexico). In the flora and fauna protected areas FFPA, activities related to the preservation, repopulation, propagation, acclimatization, refuge, research and sustainable use are allowed, as well as those related to education and dissemination in the matter (https://www.gob.mx/semarnat/articulos/areas-de-proteccion-de-flora-y-fauna-en-mexico?idiom=es). Sanctuaries are areas in zones characterized by a considerable richness of flora and fauna, or by the presence of species, subspecies or habitat of restricted distribution. The activities allowed in sanctuaries are scientific research, environmental education, and Scientific collection that does not adversely affect the habitat (https://www.conanp.gob.mx/programademanejo/resumenes/DOFVENTILAS.pdf). It is important to mention that the location of most MPAs does overlap with the areas of operation of the shrimp fleet (Bourillón & Torres, 2012). MPAs in the Gulf of California may also be ineffective in protecting rare habitats (Sala et al. 2003).

**Table 6. List of protected areas in the Gulf of California. RB: Biosphere Reserve; PN: National Park; S: Sanctuary; FFPA: Flora and Fauna Protected Area. Data Modified from (Bourillón & Torres, 2012). Only the protected areas shaded overlaps with fishing areas for the UoA.**

| Category | Official Name | Surface Area (h) | Marine Area (km2) | No fish area (km2) | % of No fish area | Year established |
|---|---|---|---|---|---|---|
| RB | Alto Golfo de California y delta del río Colorado, Sonora y Baja California | 934,756 | 5,608.53 | 800 | 14.26% | 1993 |
| RB | Zona marina Bahía de los Ángeles, canales de Ballenas y Salsipuedes, Baja California | 387,957 | 3,879.57 | 2.07 | 0.05% | 2007 |
| RB | El Vizcaíno, Baja California Sur | 2,546,790 | 404.51 | 0 | 0% | 1988 |
| RB | Isla San Pedro Mártir, Sonora | 30,165 | 298.76 | 8.21 | 2.74% | 2002 |
| RB | Islas Marías, Nayarit | 641,285 | 6,173 | 0 | 0% | 2000 |
| PN | Zona marina del Archipiélago de San Lorenzo | 58,443 | 584.42 | 88.05 | 15.06% | 2005 |
| PN | Zona marina del Archipiélago de Espíritu Santo | 48,655 | 486.55 | 6.66 | 1.36% | 2007 |

| Category | Official Name | Surface Area (h) | Marine Area (km2) | No fish area (km2) | % of No fish area | Year established |
|---|---|---|---|---|---|---|
| PN | Cabo Pulmo, Baja California Sur | 7,111 | 71.11 | 24.76 | 34.81% | 1995 |
| PN | Bahía de Loreto, Baja California Sur | 206,581 | 1,820 | 1.5 | 0.008% | 1996 |
| PN | Islas Marietas, Nayarit | 1,383 | 13.11 | 0 | 0 | 2005 |
| S | Ventilas hidrotermales de la Cuenca de Guaymas y de la Dorsal del Pacífico Oriental | 145,565 | * | * | * | 2009 |
| APFF | Balandra, Bahia de La Paz Baja California Sur | 2,513 | * | * | * | 2012 |
| APFF | Cabo San Lucas | 3,996 | 38.75 | 38.75 | 100% | 1973 |
| Área de Refugio para la vaquita marina | zona de exclusión (por decreto) | | 1,263.85 | 1,263.85 | 100% | |

**Information Not Found*

**Information**

There are several studies focused on the shrimp fishery impact on habitats (De Biasi, 2004; Drabrishc et al., 2001; Hansson et al., 2000; Jennings et al., 2001; Kaiser et al., 2003) and measures taken to reduce such impact (Aguilar-Ramirez, 2001; Bourillon and Torre; 2012; INAPESCA/WWF, 2010; INAPESCA, 2010)

## Ecosystem Impacts

**Status**

The Gulf of California is one of the mega-diverse regions of the planet and with strong endemism, facts that serve as a basis for considering it a priority conservation area by several governmental institutions (SEMARNAT, CONAPESCA, CONANP, INAPESCA, PROFEPA) and non-governmental organizations (NGOs) at national and international level. Due to its high primary productivity, 65% of the country's fish catch are extracted in its waters (Lopez-Martínez, 2008).

<u>Trophic interactions</u>

Some studies have been done to model trophic interactions in the Gulf of California region. Arreguin-Sanchez et al. (2002) built a mass-balanced model of a benthic ecosystem exploited by shrimp trawlers in that region. The model was built with the software ECOPATH with ECOSIM, which takes into account the contribution of functional groups to bycatch. The model represents the state of the ecosystem in 1978 /1979 and reflects the shrimp exploitation rate at that time. 27 bycatch groups were included in the model, and it was assumed that fish died on-board the trawlers while macroinvertebrates were returned to the sea alive, though there may be an impact on their survival from predation. The most important fish families in the bycatch were Haemulidae, Serranidae, Paralichthydae, which accounted for 75% of the total fish catch. These families include important shrimp predators, suggesting that fish mortality produced by bycatch could have a positive impact on the shrimp stock. The total system production was almost equal to its consumption as was net primaty production to respiration. It is suggested that ecosystem efficiency (relationship between production and respiration) was relatively low. Ecosystem overhead was 2.4 times the ascendency, indicating that the shrimp-trawl ecosystem was in a developed stage, probably as a result of fishing. Because a decrease in biomass causes a loss of ascendency, they hypothesized that the previous ecosystem state (unexploited or with low exploitation rate) was more developed, and probably had a higher production. The models showed that there had been a loss in productivity because of shrimp trawling when compared to unexploited or low exploitation rates.

Similarly, regarding the fishing impact on the ecosystem, Salcido-Guevara et al. (2012) used ECOPATH and ECOSIM to explore the response of three ecosystem indicators under two different exploitation scenarios: 30% and 80% of shrimp biomass removal. The indicators were relative ecosystem biomass distribution as a function of trophic level and trophic replacement and interaction strength. Their results suggest that the moderate fishing scenario (30%) would not cause major changes in either indicator while the strong fishing pressure (80%) scenario increases the variability in the fish biomass as well as overall biomass, hence potentially reducing ecosystem stability.

Another ECOPATH-ECOSIM application was carried out by Morales-Zarate et al. (2004), who built a trophic structure model of the Northern Gulf of California to represent the main biomass flows in the system. It was based mostly on bibliographic data and provides a snapshot of how the ecosystem operates. The model consisted of 29 functional groups. The total system throughput was 6633 tons/km$^2$ per year, from which 51.7% are for internal consumption, 20.0% are for respiration, 16.0% becomes detritus, and 12.2% are removed through commercial fishing. Main results show that most groups were impacted more by predation and competition than by fishing pressure, and that there are some characteristics that indicate that use of the ecosystem is balanced.

The last three studies using trophic interactions models do not show important perturbances in this type of interactions and suggest that low levels of exploitation would not cause major changes in ecosystem indicators (Salcido-Guevara et al., 2012). It is also pointed out that predation and competition are the interactions causing the greatest impact on the species group and that the use of the ecosystem is balanced (Morales-Zarate et al., 2004). It is also noted that the fishery is taking some shrimp large predators and that would benefit the shrimp population (Arreguin-Sánchez et al., 2012). Therefore, we could assume that trophic interactions have not been disturbed in such a way that negative effects such as cascade effects could occur.

Biodiversity

Several studies have suggested that the shrimp fishery impacts could have a negative impact on long-lived benthic species, but some positive effects on small opportunistic species have been observed (Thrush et al., 1998). Benthic species feeding on these small species have shown an increase in their grow rate (Rijnsdorp and van Beek, 1991; Rijnsdorp and van Leeuwen, 1996). This increase could be the result of the increase of benthic food available in areas where the fishery operates intensively, keeping profitable trawling (Rijnsdorp et al., 1998). In a study on recolonization after dragging operations It was found that the benthic fauna diversity and the biomass of the affected area are practically recovered one year after having completed dragging activities. In a short period of time after dragging is finished, the diversity of the affected area increases due to the colonization of new species. However, three or four months later, the diversity decreases progressively due to the increase of the dominance of some species (Lopez-Jamar and Mejuto, 1988). Similarly, Løkkeborg (2005) discusses that the degree of trawling impact is different depending on the seabed physical composition, but that there is no evidence that these disturbances produce long-term changes in the structure of the benthic community, so these habitats may be resistant to this activity given the disturbance and great natural variability to which they are subjected.

Bycatch can change the availability of prey and predators, which affects marine ecosystems and fisheries productivity. Aspects in the technical debate imply that discarded and killed bycatch have a significant impact on the ecosystem when it is associated with intense fishing and there is an accumulated effect over time. In this regard, a set of technological alternatives can contribute significantly to shrimp trawling being more environmentally efficient and contributing to sustainable fisheries (Villasseñor-Talavera, 2012). In Mexico, turtle excluders have been used since 1996 in the Pacific Ocean, giving good results in terms of their contribution to sea turtle conservation. They also allow the escape of demersal species including large fish mollusks, crustaceans other than shrimp and echinoderms, depending on the seasons and fishing grounds, reaching in some cases to more than 65% as referred to for the Gulf of Tehuantepec (Villaseñor-Talavera, 1997).

Indirect impacts

Among indirect impacts, some aspects could be considered important: prey availability, invasive species and pollution. An invasive species is an organism that causes ecological or economic harm in a new environment where it is not native. Invasive species can harm both the ecosystem natural resources as well as threaten human use of these resources. An invasive species can be introduced to a new area via the ballast water of ocean-going ships, intentional and accidental releases of aquaculture species, aquarium specimens or bait, and other means. Invasive species are capable of causing extinctions of native plants and animals, reducing biodiversity, competing with native organisms for limited resources, and altering habitats. This can result in huge economic impacts and fundamental disruptions of coastal and Great Lakes ecosystems (https://oceanservice.noaa.gov/facts/invasive.html ). Regarding invasive species, due to the nature of their operations (lack of bait and local operations), the Mexican Pacific shrimp fishery does not introduce any invasive species in the ecosystem.

With respect to pollution, the abandoned, lost or otherwise discarded fishing gear ALDFG has negative impacts on marine ecosystems, wildlife, fisheries resources, and coastal communities. Some ALDFG continues to catch both target and non-target species and entangles or kills marine animals, including endangered species ("ghost fishing"). Some near-bottom ALDFG can cause physical damage to the seabed and coral reefs. Surface ALDFG often presents a navigation and safety hazard for ocean users (FAO, 2018). ALDFG is not of concern in the shrimp fishery; due to the high cost of the fishing gear, fishermen are very careful, avoiding risky zones (rocks, sunken ships, etc), with the help of technology. The loss of fishing gear is a rare event (personal Communication, CONAPESCA personnel); therefore, this fishery does not contribute to the "ghostfishing" problem.

**Management**

As mentioned, there is a no-fishing zone at five fathoms depth along the coast; in addition, fishing also bans at the river mouths near the sea (DOF, 2013). Both regulations are the focus on protecting the habitat where reproduction, spawning, and juvenile's growth take place.

Additionally, there are 14 marine protected areas in the Gulf of California (Table 6). These are multi-purpose zones, with only a small percentage of their marine surface area protected from fishing activities. There are five biosphere reserves, five national parks, one sanctuary, two flora and fauna protected areas and the refuge area for the vaquita.

**Information**

Several efforts have contributed to gathering information on the bycatch composition on the industrial fleet in the shrimp fishery in the Mexican Pacific. The on-board Scientific Observers Program (*Programa de Observadores Cientificos a Bordo*), operated by FIDEMAR[2] with support of INAPESCA and CONAPESCA; operated for six consecutive fishing seasons from 2004 to 2010. The program included the entire industrial fleet. Coverage for the observer program was <5%; decreasing in the latter seasons (López-González et al. 2012). The main objective of this program was to characterize the spatial and temporal distribution of target shrimp species (López-González et al. 2012). The complete results of this program are not publically available and were not made available to the assessment team.

Starting in 2015, the client group worked with the consulting company SICG, in coordination with INAPESCA and CONAPESCA, to implement a voluntary program of Technical Observers. The primary focus of the technical observer program is gathering information on bycatch composition. For the last season, estimated observer coverage was ~3.8% (50 trips observed out of 1,300 in the season). Until now, only 365 industrial fishing vessels in the industrial fleet are participating in the technical observer program. These are the vessels considered to be part of the Unit of Assessment (UoA). Reports (SICG, 2015; SICG,

[2] Fideicomiso de Investigación para el desarrollo del Programa Nacional de Aprovechamiento del Atún y Protección de Delfines y otros en torno a especies Acuáticas Protegidas.

2018) and the original data base from the voluntary Observer Program were available to the assessment team.

INAPESCA through the CRIP in Mazatlán since 2012 carried out fishery independent oceanographic cruises aboard the research vessel INAPESCA I; these cruises were focus on analyzing information on bycatch associated to the shrimp catch for four zones during 2016 (INAPESCA, 2016a; INAPESCA 2016b; INAPESCA, 2016c; INAPESCA, 2016d; INAPESCA, 2016e): Baja California Continental Shelf (Zone 50); Baja California Continental Shelf (Zones 30, 40 and 60); Macapule river Mouth in Navachiste, Sinaloa; Santa María Bay, Sinaloa; Teacapán river mouth, Sinaloa.

Regarding trophic interactions there are some studies based on the use of ECOPATH and ECOSIM for the Gulf of California (Arreguin-Sanchez et al., 2002; Salcido-Guevara et al., 2012; Morales-Zarate et al., 2004), whose results do not show important perturbances in this type of interactions, suggesting that low exploitation levels would not cause major changes in ecosystem indicators (Salcido-Guevara et al., 2012). It is also pointed out that predation and competition are the interactions causing the greatest impact on the species group and that the use of the ecosystem is balanced (Morales-Zarate et al., 2004). It is also noted that the fishery is taking some shrimp large predators and that would benefit the shrimp population (Arreguin-Sánchez et al., 2012). Therefore, we could assume that trophic interactions have not been disturbed in such a way that negative effects such as cascade effects could occur.

On respect to the efficiency of Teds and BRDs, there are several national and international studies focused on this subject (INP, 1991; Aguilar-Ramirez and Grande-Vidal, 1996; Aguilar-Ramirez, 1998; García-Caudillo et al., 2000; Barrera-Guevara, 1990; Cisneros-Mata et al., 1995; Torres-Jimenez and Balmori-Ramirez, 1994)

### 5.3.2 Principle 2 Performance Indicator scores and rationales

#### PI 2.1.1 – Primary species outcome

| **PI 2.1.1** | | **The UoA aims to maintain primary species above the point where recruitment would be impaired (PRI) and does not hinder recovery of primary species if they are below the PRI** | | |
|---|---|---|---|---|
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | Main primary species stock status | | | |
| | Guide post | Main primary species are likely to be above the PRI.<br><br>OR<br><br>If the species is below the PRI, the UoA has measures in place that are expected to ensure that the UoA does not hinder recovery and rebuilding. | Main primary species are highly likely to be above the PRI.<br><br>OR<br><br>If the species is below the PRI, there is either evidence of recovery or a demonstrably effective strategy in place between all MSC UoAs which categorise this species as main, to ensure that they collectively do not hinder recovery and rebuilding. | There is a high degree of certainty that main primary species are above the PRI and are fluctuating around a level consistent with MSY. |
| | Met? | Yes | Yes | Yes |
| **Rationale** | | | | |
| **b** | Minor primary species stock status | | | |
| | Guide post | | | Minor primary species are highly likely to be above the PRI.<br><br>OR<br><br>If below the PRI, there is evidence that the UoA does not hinder the recovery and rebuilding of minor primary species. |
| | Met? | | | Y |
| **Rationale** | | | | |
| Per SA3.2.1, if a team determines that a UoA has no impact on a particular component, it shall receive a score of 100 under the Outcome PI. As there are no main or minor primary species, the score for primary species PIs is 100. | | | | |
| **References** | | | | |
| List any references here, including hyperlinks to publicly-available documents. | | | | |
| | | | | |

| Draft scoring range and information gap indicator added at Announcement Comment Draft Report | |
|---|---|
| **Draft scoring range** | >80 |
| **Information gap indicator** | Information sufficient to score PI |
| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 2.1.2 – Primary species management strategy

| | | | | |
|---|---|---|---|---|
| **PI 2.1.2** | | **There is a strategy in place that is designed to maintain or to not hinder rebuilding of primary species, and the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of unwanted catch** | | |
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | **Management strategy in place** | | | |
| | **Guide post** | There are measures in place for the UoA, if necessary, that are expected to maintain or to not hinder rebuilding of the main primary species at/to levels which are likely to be above the PRI. | There is a partial strategy in place for the UoA, if necessary, that is expected to maintain or to not hinder rebuilding of the main primary species at/to levels which are highly likely to be above the PRI. | There is a strategy in place for the UoA for managing main and minor primary species. |
| | **Met?** | Y | Y | N |
| **Rationale** | | | | |
| According to GSA3.5.1, as there is no (or negligible) impact on this component, scoring issue (a) does not need to be scored for SG60 and SG80. While there are no main or minor primary species, given the low level of observer coverage, it cannot be concluded that no primary species interact with this fishery nor can it be said that **there is a high degree of certainty that main primary species are above the PRI and are fluctuating around a level consistent with MSY. SG100 is not met.** | | | | |
| **b** | **Management strategy evaluation** | | | |
| | **Guide post** | The measures are considered likely to work, based on plausible argument (e.g., general experience, theory or comparison with similar fisheries/species). | There is some objective basis for confidence that the measures/partial strategy will work, based on some information directly about the fishery and/or species involved. | Testing supports high confidence that the partial strategy/strategy will work, based on information directly about the fishery and/or species involved. |
| | **Met?** | Y | Y | N |
| **Rationale** | | | | |
| See SIa. According to GSA3.5.1 and the intent of the MSC[3], SG 60 and 80 are automatically met as there are no main or minor primary species and the 'if necessary' clause applies to scoring issue b and c. **But, as there are no management strategies in place, testing does not occur. SG100 is not met.** | | | | |
| **c** | **Management strategy implementation** | | | |

[3] https://mscportal.force.com/interpret/s/article/Use-of-if-necessary-in-P2-management-PIs-2-1-2-2-2-2-2-4-2-2-5-2-PI-2-1-2-1527262011402

| | | | | |
|---|---|---|---|---|
| | **Guide post** | | There is some evidence that the measures/partial strategy is being implemented successfully. | There is clear evidence that the partial strategy/strategy is being implemented successfully and is achieving its overall objective as set out in scoring issue (a). |
| | **Met?** | | Y | N |
| **Rationale** | | | | |
| **d** | **Shark finning** | | | |
| | **Guide post** | It is likely that shark finning is not taking place. | It is highly likely that shark finning is not taking place. | There is a high degree of certainty that shark finning is not taking place. |
| | **Met?** | NA | NA | NA |
| **Rationale** | | | | |
| No primary species are sharks and this SI is not scored (SA3.5.1) | | | | |
| **e** | **Review of alternative measures** | | | |
| | **Guide post** | There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main primary species. | There is a regular review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main primary species and they are implemented as appropriate. | There is a biennial review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of all primary species, and they are implemented, as appropriate. |
| | **Met?** | Y | Y | N |
| **Rationale** | | | | |
| The efficiency of different types of TEDs (INP, 1991; Aguilar-Ramirez and Grande-Vidal, 1996; Aguilar-Ramirez, 1998; Schick, 1991) and BRDs (Balmori-Ramirez, 2003; Garcia-Cauridllo et al., 2000;Torres-Jimenez, 1992; Watson et al., 1992) has been reviewed several times. Thus, there is a regular review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main secondary species and they are implemented as appropriate. **The SG80 level is met. However, these reviews are not carried out in biennial form therefore the SG100 level is not reached** | | | | |
| **References** | | | | |
| | | | | |

| | |
|---|---|
| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | |
| **Draft scoring range** | >80 |
| **Information gap indicator** | Information sufficient to score PI |

| Overall Performance Indicator scores added from Client and Peer Review Draft Report | |
|---|---|
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 2.1.3 – Primary species information

| PI 2.1.3 | | Information on the nature and extent of primary species is adequate to determine the risk posed by the UoA and the effectiveness of the strategy to manage primary species | | |
|---|---|---|---|---|
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | **Information adequacy for assessment of impact on main primary species** | | | |
| | **Guide post** | Qualitative information is adequate to estimate the impact of the UoA on the main primary species with respect to status.<br><br>OR<br><br>If RBF is used to score PI 2.1.1 for the UoA: Qualitative information is adequate to estimate productivity and susceptibility attributes for main primary species. | Some quantitative information is available and is adequate to assess the impact of the UoA on the main primary species with respect to status.<br><br>OR<br><br>If RBF is used to score PI 2.1.1 for the UoA: Some quantitative information is adequate to assess productivity and susceptibility attributes for main primary species. | Quantitative information is available and is adequate to assess with a high degree of certainty the impact of the UoA on main primary species with respect to status. |
| | **Met?** | Yes / No/NA | NA | N |
| **Rationale** | | | | |
| There are no main primary species in the UoA.<br><br>Per SA3.3.1, the information PI shall still be scored despite the team determining that the UoA has no impact on a particular component.<br><br>The low levels of observer coverage prevents the availability of quantitative information from being adequate to assess the impact of the UoA on main primary species with a high degree of certainty. | | | | |
| **b** | **Information adequacy for assessment of impact on minor primary species** | | | |
| | **Guide post** | | | Some quantitative information is adequate to estimate the impact of the UoA on minor primary species with respect to status. |
| | **Met?** | | | Y |
| **Rationale** | | | | |
| **c** | **Information adequacy for management strategy** | | | |
| | **Guide post** | Information is adequate to support measures to | Information is adequate to support a partial strategy to | Information is adequate to support a strategy to |

| | | | | |
|---|---|---|---|---|
| | | manage main primary species. | manage main primary species. | manage all primary species, and evaluate with a high degree of certainty whether the strategy is achieving its objective. |
| | **Met?** | Y | Y | N |

| |
|---|
| **Rationale** |
| No main primary species were identified in this fishery and the ongoing collection of data at processing plants means information is adequate to support a partial strategy, thus meeting SG80. However, the limited observer coverage means this cannot be concluded with a high degree of certainty. |
| **References** |
| List any references here, including hyperlinks to publicly-available documents. |

| | |
|---|---|
| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | |
| **Draft scoring range** | >80 |
| **Information gap indicator** | Information sufficient to score PI |

| | |
|---|---|
| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
| **Overall Performance Indicator score** | 90 |
| **Condition number (if relevant)** | |

## PI 2.2.1 – Secondary species outcome

<table>
<tr><td colspan="2">PI 2.2.1</td><td colspan="3">The UoA aims to maintain secondary species above a biologically based limit and does not hinder recovery of secondary species if they are below a biological based limit</td></tr>
<tr><td colspan="2">Scoring Issue</td><td>SG 60</td><td>SG 80</td><td>SG 100</td></tr>
<tr><td rowspan="3">a</td><td colspan="4">Main secondary species stock status</td></tr>
<tr><td>Guide post</td><td>Main secondary species are likely to be above biologically based limits.<br><br>OR<br><br>If below biologically based limits, there are measures in place expected to ensure that the UoA does not hinder recovery and rebuilding.</td><td>Main secondary species are highly likely to be above biologically based limits.<br><br>OR<br><br>If below biologically based limits, there is either evidence of recovery or a demonstrably effective partial strategy in place such that the UoA does not hinder recovery and rebuilding.<br>AND<br>Where catches of a main secondary species outside of biological limits are considerable, there is either evidence of recovery or a, demonstrably effective strategy in place between those MSC UoAs that have considerable catches of the species, to ensure that they collectively do not hinder recovery and rebuilding.</td><td>There is a high degree of certainty that main secondary species are above biologically based limits.</td></tr>
<tr><td>Met?</td><td>Yes</td><td>No</td><td>No</td></tr>
<tr><td colspan="5">Rationale</td></tr>
<tr><td colspan="5">Numerous bycatch assessments in the Pacific shrimp fishery, show that the shrimpbycatch ratio is highly variable depending on zones, gear type, and seasons of the year (López-Martínez et al. 2012). In Mexico, INAPESCA carried out studies on bycatch from 1956 to 1996 (Chapa, 1976; Rosales, 1967; Chávez and Arvizu, 1972; Corripio, 1979; Grande-Vidal, 1987; Aguilar and Grande-Vidal,1996; Grande-Vidal, 1996). The average ratio of bycatch to shrimp was maintained at 9:1 in the Pacific, but there were major differences by zone: Sonora 3.9:1, Sinaloa 3.76:1 and the Gulf of Tehuantepec 24:1. The proportion of shrimp to bycatch recorded by the voluntary observer program was lower than historical records, the average (2015-2017) was 1:3.9. Recent results (2015-2017) from the Observer Program (approximately 5% of coverture) for the shrimp fishery suggest the inclusion of four groups in the category of main secondary species as they represent more than 5% of the catch (Table 3). Because catch was not identified to the species level in the observer reports, catch was grouped across genus. The team</td></tr>
</table>

designated as ‘main’ 22 species which represented >5% of the catch composition of the observed trips. These species were grouped in nine families: Gerreidae, Dasyatidae, Gymnuridae, Mobulidae, Rhinobatidae, Portunidae, Synodontidae, Achiridae and Bothidae (Table 3). For mojarras, 2.5% is retained and 97.5% discarded; for rays, 14.3% is retained and 85.7% discarded, for crabs 3% was retained and 97% was discarded; 90% of grunts were discarded.

There is enough information for the swimming crabs to assess their status. According to the National Fishing Chart (DOF, 2018), in the states of the Gulf of California the swimming crab fishery is at the maximum sustainable yield. For the remaining three groups, their status, biological limits, and state of recovery are unknown. The information available permits only define minor and main secondary species. Therefore, a desk-based productivity-susceptibility analysis (PSA) was carried out to assess their status (See Annex 3: RBF Scoring Table).

The MSC automated score for PI 2.2.1 PSA was of 75 (Pass with condition). The species group that were in the Low Risk Category and received an MSC scoring guidepost ≥80 were: mojarras (Gerreidae), and grunts (Haemulidae). The species groups that were in the Medium Risk Category and received and MSC scoring guidepost of 60-79, were: rays (Dasyatidae, Gymnuridae, Mobulidae, Rhinobatidae).

Information for swimming crabs (***C. arcuatus***, ***C. Bellicosus*** and ***C. toxotes***) indicated that in the Gulf of California they are fully exploited (INAPESCA 2018) or the exploitation rate does not indicate a significant degree of overexploitation for neither of the three species (Lopéz-Martínez et al., 2014). In the rest of the Mexican Pacific Coast the fishery has just started operating and the fishing effort level is low; therefore, is likely to be within biologically based limits.

While the RBF scores suggest that most main secondary species are likely to be above biologically based limited, rays received a draft score between 60 and 79, thus the overall score for all elements fails to reach SG80.

| | | | | |
|---|---|---|---|---|
| **b** | **Minor secondary species stock status** | | | |
| | **Guide post** | | | Minor secondary species are highly likely to be above biologically based limits.<br><br>OR<br><br>If below biologically based limits’, there is evidence that the UoA does not hinder the recovery and rebuilding of secondary species |
| | **Met?** | | | No |

**Rationale**

According to the SICG Observer Program, there are 128 group of species classified as secondary minor captured in the Mexcan Shrimp Pacific fishery. Thus, there is a relatively high proportion of bycatch, with, most of it is composed of secondary minor species whose status and productivity is not well known and the impact of the shrimp fishery upon the bycatch species is not well understood. Thus, the SG100 level is not met.

| References |
|---|


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Chávez H. & Arvizu-Martinez, J. 1972. Estudio de los recursos pesqueros demersales del Golfo de California, 1968–1969. III Fauna de acompañamiento del camarón (peces finos y basura). Memorias del IV Congreso Nal. de Oceanografía, México DF, México.

Corripio, C.E. 1979. Aspectos biotecnológicos de la FAC en la región noreste del Golfo de México. Mem. De Reunión sobre Aprovechamiento de la FAC. Guaymas, Sonora, México.

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Grande-Vidal, J.M. 1996. Optimización de redes camaroneras con bolsos de malla cuadrada y excluidores de tortugas. Research report. SEMARNAP/INP.

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López-Martinez, J., López-Herrera, L., Valdez-Holguín, J. E. and C. H. Rábago-Quiroz. 2014. Population dynamics of the swimming crabs Callinectes (Portunidae) components of shrimp bycatch in the eastern coast of the Gulf of California. Revista de Biología Marina y Oceanografía 49(1)17-29.

Rosales, J.F. 1967. Fauna que acompaña al camarón comercial de altamar en la costa de Sinaloa, México. México, Universidad Autónoma de Nuevo León. (thesis)


| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | |
|---|---|
| **Draft scoring range** | 60-79 |
| **Information gap indicator** | A better assessment requieres that information from the Observer Program is provided at species level. The data base should include the species information, not only the common name to avoid potential errors. Currently some information is provided by taxonomic groups so the classification of species as main or minor secondary species is difficult and could include some biass. |

| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
|---|---|
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

| Element | SI a | SI b | Element score | PI score |
|---|---|---|---|---|
| | | | | |

| | | | | |
|---|---|---|---|---|
| Golden mojarra | ≥80 | NA | ≥80 | 60-79 |
| Peruvian mojarra | ≥80 | NA | ≥80 | |
| Group 1 Rays: Diamond stingray | 60-79 | NA | 60-79 | |
| Group 1 Rays: Longtail stingray | 60-79 | NA | 60-79 | |
| Group 2:<br>Grunts: Chere-chere grunt | -≥80 | NA | -≥80 | |
| Group 2:<br>Grunts: Gray grunt | ≥80 | NA | ≥80 | |
| Swimming Crab | 80 | NA | 80 | |

## PI 2.2.2 – Secondary species management strategy

| PI 2.2.2 | | There is a strategy in place for managing secondary species that is designed to maintain or to not hinder rebuilding of secondary species and the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of unwanted catch | | |
|---|---|---|---|---|
| Scoring Issue | | SG 60 | SG 80 | SG 100 |
| a | Management strategy in place | | | |
| | Guide post | There are measures in place, if necessary, which are expected to maintain or not hinder rebuilding of main secondary species at/to levels which are highly likely to be above biologically based limits or to ensure that the UoA does not hinder their recovery. | There is a partial strategy in place, if necessary, for the UoA that is expected to maintain or not hinder rebuilding of main secondary species at/to levels which are highly likely to be above biologically based limits or to ensure that the UoA does not hinder their recovery. | There is a strategy in place for the UoA for managing main and minor secondary species. |
| | Met? | Yes | Yes | No |
| Rationale | | | | |
| There are measures in place that are expected to maintain or not hinder rebuilding main secondary species at levels which are highly likely to be within biologically based limits. Several measures such as the use Bycatch Reduction Device (BRD), fishing season closures, free fishing zone (0-5 phantoms depth along the coast and around the mouths connecting the sea with several bays, coastal lagoons, and estuaries, in the Mexican Pacific (DOF, 2013), which are considered nursing areas, and creation of several protected marine areas have been established with different objectives and issued by two different secretariats (SAGARPA and SEMARNAT). All these measures are the focus and work cohesively to protect reproduction, spawning, and juveniles of several species. In addition, there's is the observer program that monitors catch of secondary species, which in theory, may detect if the Bycatch Reduction Devices are effectively reducing bycatch. NOM 002 requires the installation of the BRDs with the goal to reduce bycatch of non-target species.<br><br>The measures in place (mainly BRD) are considered to work to achieve an outcome (reduce bycatch) and the monitoring should provide information to change the measures if these are not effective, meeting the requirements for a partial strategy, meeting SG80. Post release mortality is not well known so there is not a clear understanding of how these measures work to reduce mortality thus the SG100 is not met<br><br>There is a lack of information available to adequately assess the impact of the UoA on main secondary species with respect to status, which hinders the evaluation of effectiveness of the partial strategy in maintaining secondary main species at levels which are highly likely to be above biologically based limits, however, this is scored in PI 2.2.3. | | | | |
| b | Management strategy evaluation | | | |
| | Guide post | The measures are considered likely to work, based on plausible argument (e.g. general experience, | There is some objective basis for confidence that the measures/partial strategy will work, based on some information directly about | Testing supports high confidence that the partial strategy/strategy will work, based on information |

| | | | | |
|---|---|---|---|---|
| | | theory or comparison with similar UoAs/species). | the UoA and/or species involved. | directly about the UoA and/or species involved. |
| | **Met?** | Yes | Yes | No |
| **Rationale** | | | | |

Regarding BRDs, in 1992 testing on the efficiency of BRD (fisheye) started. In 1997 the BRD type Jones-Davies was evaluated, a reduction of 40.2% in bycatch was estimated (Balmori-Ramirez et al., 2003). Further testing was carried out in 1997 (Garcia-Caudillo et al., 2000) and 2000 (Hannah, 2003). INAPESCA carried out experimental fishing with different BRD in the Gulf of California in 1992. Results from the tests indicated a reduction of bycatch volumes (INAPESCA, 2010). In addition, BRD are mandatory (DOF, 2013). These technologies are improving the way shrimp is caught and facilitating the release of other species of fish, mollusks and crustaceans, or avoiding their capture and retention. Mexico has actively participated in the FAO/GEF/UNDP project "Reduction of the Environmental Impact from Tropical Shrimp Trawling through the Introduction of Bycatch Technologies and Change of Management". This participation has included gear technology development and testing, training of observers and transfer of technology to other Latin American countries (Gillet, 2008). Therefore, there is some objective basis for confidence that the measures will work, based on information directly about the UoA and/or species involved. **Measures are not considered a partial strategy and post-release mortality is not well known so the SG100 is not met.**

| | | | | |
|---|---|---|---|---|
| **c** | **Management strategy implementation** | | | |
| | **Guide post** | | There is some evidence that the measures/partial strategy is being implemented successfully. | There is clear evidence that the partial strategy/strategy is being implemented successfully and is achieving its objective as set out in scoring issue (a). |
| | **Met?** | | Yes | No |
| **Rationale** | | | | |

Currently, the use of TEDs and BRD is mandatory for all shrimp fleet operating in the Mexican Pacific as the NOM-002-SAG/PESC-2013 states (DOF, 2013). CONAPESCA officers check the compliance with these regulations at the port. In addition, observers also report compliance with these regulations. In addition, CONAPESCA has a satellite surveillance and monitoring system working the whole year to identify ships and their position and could easily detect if a vessel infringes the free fishing zones (5 phantoms along the coast and around mouths connecting the sea). Thus, there is *some* evidence that the measures are being implemented successfully. The SG80 level is met. Measures do not constitute a partial strategy so the SG100 level is not met.

| | | | | |
|---|---|---|---|---|
| **d** | **Shark finning** | | | |
| | **Guide post** | It is likely that shark finning is not taking place. | It is highly likely that shark finning is not taking place. | There is a high degree of certainty that shark finning is not taking place. |
| | **Met?** | Yes | Yes | No |
| **Rationale** | | | | |

| | | | | |
|---|---|---|---|---|
| Shark bycatch in this fishery is very low; for example, in 2016 in Macapule, the greatest percentage in the total catch was represented by Mustelus Lunatus with 0.6%; the remaining species had a negligible percentage (INAPESCA, 2016). This scenario is repeated in other locations during different years. Thus, the number of sharks caught does not represent a profitable option to carry out shark finning. Data from the voluntary Observer Program suggested that in three seasons 5 t of different species of shark where caught and 22% were discarded, confirming that shark finning does not represent a profitable option. In addition, personal from CONAPESCA confirmed that shark finning does not take place in this fishery. **Thus, its is highly likely that shark finning is not taking place. The SG80 level is met.** | | | | |
| **e** | **Review of alternative measures to minimise mortality of unwanted catch** | | | |
| | **Guide post** | There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main secondary species. | There is a regular review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main secondary species and they are implemented as appropriate. | There is a biennial review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of all secondary species, and they are implemented, as appropriate. |
| | **Met?** | Yes | No | No |
| **Rationale** | | | | |
| The shrimp-bycatch proportion has declined in recent years, ranging from 1:8.89 in 2015, 1:3.19 in 2016 and 1:5.21 in 2017 based on data collected by the SIG Voluntary Observer Program, with an average of ~85% of the bycatch was discarded.<br><br>The efficiency of different types of TEDs (INP, 1991; Aguilar-Ramirez and Grande-Vidal, 1996; Aguilar-Ramirez, 1998; Schick, 1991) and BRDs (Balmori-Ramirez, 2003; Garcia-Cauridllo et al., 2000;Torres-Jimenez, 1992; Watson et al., 1992) has been reviewed several times. Thus, there is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main secondary species. The SG60 level is met. However, there is no evidence that these reviews are carried out regularly, nor that they evaluate the effectiveness of the measures to minimise UoA-related mortality, and whether they are implemented appropriately, the SG80 is not met. | | | | |
| **References** | | | | |
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| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | |
|---|---|
| **Draft scoring range** | 60-79 |
| **Information gap indicator** | More information sought on reviews of the effectiveness and implemetation of the Bycatch Reduction Devices. |

| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
|---|---|
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 2.2.3 – Secondary species information

<table>
<tr><td colspan="2">PI 2.2.3</td><td colspan="3">Information on the nature and amount of secondary species taken is adequate to determine the risk posed by the UoA and the effectiveness of the strategy to manage secondary species</td></tr>
<tr><td colspan="2">Scoring Issue</td><td>SG 60</td><td>SG 80</td><td>SG 100</td></tr>
<tr><td rowspan="3">a</td><td colspan="4">Information adequacy for assessment of impacts on main secondary species</td></tr>
<tr><td>Guide post</td><td>Qualitative information is adequate to estimate the impact of the UoA on the main secondary species with respect to status.<br><br>OR<br><br>If RBF is used to score PI 2.2.1 for the UoA:<br><br>Qualitative information is adequate to estimate productivity and susceptibility attributes for main secondary species.</td><td>Some quantitative information is available and adequate to assess the impact of the UoA on main secondary species with respect to status.<br><br>OR<br><br>If RBF is used to score PI 2.2.1 for the UoA:<br><br>Some quantitative information is adequate to assess productivity and susceptibility attributes for main secondary species.</td><td>Quantitative information is available and adequate to assess with a high degree of certainty the impact of the UoA on main secondary species with respect to status.</td></tr>
<tr><td>Met?</td><td>Yes</td><td>Yes</td><td>No</td></tr>
<tr><td colspan="5">Rationale</td></tr>
<tr><td colspan="5">Information available from the SICG Observer Program and INAPESCA research cruises (INAPESCA, 2016a; INAPESCA 2016b; INAPESCA, 2016c; INAPESCA, 2016d; INAPESCA, 2016e; INAPESCA, 2017a; INAPESCA, 2017b; INAPESCA, 2017c; INAPESCA, 2017d) includes only the group of species or species proportion bycatch in the industrial shrimp fleet; however, most of the bycatch species have not been studied or assessed and the impact of the shrimp fishery upon the bycatch species is not well understood. Recent Information from an observer program has provided enough information to classify some group of species as main secondary species, including mojarras, swimming crabs, rays, and grunts. However, only for some group of species (mojarras, rays, and swimming crabs), there is some biological information that could be used for productivity-susceptibility analysis (PSA). It is important to mention that the information used for the RBF is not considered sufficient, some species are missing required information on life history parameters, such as size, age, maturity, fecundity. When there is insufficient data for a species, a higher risk score is automatically assigned. Thus, some quantitative information is adequate to assess productivity and susceptibility attributes for main secondary species. The SG80 level is met. The available information is not adequate to assess with a high degree of certainty the impact of the UoA on main secondary species with respect to status. Thus, the SG100 level is not met.</td></tr>
<tr><td>b</td><td colspan="4">Information adequacy for assessment of impacts on minor secondary species</td></tr>
</table>

| | | | | |
|---|---|---|---|---|
| | **Guide post** | | | Some quantitative information is adequate to estimate the impact of the UoA on minor secondary species with respect to status. |
| | **Met?** | | | No |
| **Rationale** | | | | |
| Recent Information from an observer program has provided enough information to classify 128 groups of species as minor secondary species, including species from taxonomic groups such as bony fishes, sharks, crustaceans, echinoderms, and mollusks. However, for the majority of the group of species the status and the productivity are not known, the impact of the shrimp fishery on these minor secondary species is not well understood and there is not complete biological information that could be used for productivity-susceptibility analysis (PSA). It is important to mention that the information used for the RBF is not considered sufficient, some species are missing required information on life history parameters, such as size, age, maturity, fecundity. When there is insufficient data for a species, a higher risk score is automatically assigned. Thus, the SG100 level is not met. | | | | |
| **c** | **Information adequacy for management strategy** | | | |
| | **Guide post** | Information is adequate to support measures to manage main secondary species. | Information is adequate to support a partial strategy to manage main secondary species. | Information is adequate to support a strategy to manage all secondary species, and evaluate with a high degree of certainty whether the strategy is achieving its objective. |
| | **Met?** | Yes | No | No |
| **Rationale** | | | | |
| The information collected sporadically is sufficient to support measures to manage the main secondary species. Thus, SG60 is met. There appears to be a limitation in the rigor of the data collection protocols and observers training, as evidenced by confusion on whether some species were actually caught as bycatch (mantas).. In particular, protocols for observer allocation are unclear, no evidence of evaluation of whether the observer program is meeting goals. In addition, information of size, age, maturity, fecundity for main secondary species needs to be improved. Information should be provided at the species level. At this point, the available information is not adequate to support a partial strategy to manage the main secondary species. Thus, SG80 is not met. | | | | |
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| INAPESCA. 2016a. Especies asociadas a la captura de camarón en la plataforma continental de Baja California sur, durante junio-julio de 2016. Informe Técnico. Instituto Nacional de Pesca, Centro Regional de Investigación Pesquera de Mazatlán.<br>INAPESCA. 2016b. Fauna de acompañamiento del camarón en la plataforma continental de las zonas 30, 40 y 60 durante el 2016. Informe Técnico. Instituto Nacional de Pesca, Centro Regional de Investigación Pesquera de Mazatlán.<br>INAPESCA. 2016c. Fauna de acompañamiento del camarón presente en los muestreos de la ribera adyacente a la boca de Macapule Navachiste, Sinaloa, 2016. Informe Técnico. Instituto Nacional de Pesca, Centro Regional de Investigación Pesquera de Mazatlán. | | | | |

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INAPESCA. 2017b. Fauna asociada al camarón de la ribera adyacente a la boca de Macapule Navachiste, Sinaloa, 2017. Informe Técnico. Instituto Nacional de Pesca, Centro Regional de Investigación Pesquera de Mazatlán.

INAPESCA. 2017c. Fauna asociada a la captura de camarón en la plataforma continental adyacente a la boca sur del sistema Santa María, Sinaloa, 2017. Informe Técnico. Instituto Nacional de Pesca, Centro Regional de Investigación Pesquera de Mazatlán.

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| | |
|---|---|
| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | |
| **Draft scoring range** | 60-79 |
| **Information gap indicator** | More information sought / Information sufficient to score PI |
| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 2.3.1 – ETP species outcome

| PI 2.3.1 | | The UoA meets national and international requirements for the protection of ETP species<br>The UoA does not hinder recovery of ETP species | | |
|---|---|---|---|---|
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | **Effects of the UoA on population/stock within national or international limits, where applicable** | | | |
| | **Guide post** | Where national and/or international requirements set limits for ETP species, the effects of the UoA on the population/ stock are known and likely to be within these limits. | Where national and/or international requirements set limits for ETP species, the combined effects of the MSC UoAs on the population /stock are known and highly likely to be within these limits. | Where national and/or international requirements set limits for ETP species, there is a high degree of certainty that the combined effects of the MSC UoAs are within these limits. |
| | **Met?** | NA | NA | NA |
| **Rationale** | | | | |
| There are no national or international requirements. | | | | |
| **b** | **Direct effects** | | | |
| | **Guide post** | Known direct effects of the UoA are likely to not hinder recovery of ETP species. | Direct effects of the UoA are highly likely to not hinder recovery of ETP species. | There is a high degree of confidence that there are no significant detrimental direct effects of the UoA on ETP species. |
| | **Met?** | Yes | Yes | No |
| **Rationale** | | | | |
| According to the on-board observer program data, there were a few interactions with ETP species (Table 8). There were 21 interactions with sea turtles and one with a sea lion and one dolphin during a period of two years; all organisms were returned to the sea. Post release mortality/survival is not well known. it is also important mentioning that the Observer Program coverture is only 5% so there is not an accurate estimate of interactions of ETP species with the fishery. Similarly, measures taken by the Mexican government have proved to be effective for the exclusion of juvenile totoaba (García-Caudillo et al., 2000; Balmori-Ramirez, 1994); the exclusion of juvenile totoaba varies from 65 to 81% according to studies on the efficiency of BRD (García-Caudillo et al., 2000; Balmori-Ramirez, 1994) so there is a percentage of juvenile totoaba still caught in the trawl net, the effect of this fact on the totoaba recovery and survival are not well known; However, recent data from the Observer Progam do not register juvenile totoaba in the fishery bycatch. On the other hand, there is no information on post release mortality and handling methods that could potentially improve survival; bycatch percentage of the remaining ETP species is very low. The observer coverage shows small catch volumes of the ETP species meaning that direct impacts are highly unlikely to hinder recovery of the species but this cannot be said with a high degree of confidence given the limited observer coverage. **Thus SG60 and SG80 are met, SG100 is not.** | | | | |

| c | Indirect effects | | | |
|---|---|---|---|---|
| | **Guide post** | | Indirect effects have been considered for the UoA and are thought to be highly likely to not create unacceptable impacts. | There is a high degree of confidence that there are no significant detrimental indirect effects of the UoA on ETP species. |
| | **Met?** | | Yes | No |

**Rationale**

Considering invasive species, the industrial fleet operates locally so there is no threat of introducing species via ballast water, similarly bait is not used in fishing operations, so the industrial fleet does not introduce any invasive species in the ecosystem. ALDFG is not of concern in the shrimp fishery; due to the high fishing gear cost, fishermen are very careful, avoiding risky zones (coral reefs, rocks, sunken ships, etc), with the help of technology. The loss of fishing gear is a rare event (personal Communication, CONAPESCA personnel); therefore, this fishery does not contribute to the "ghost fishing" problem. Regarding prey availability, Ecopath and Ecosim simulations do not suggest a prey decrease availability due to shrimp fishing operations (Salcido-Guevara et al., 2012). Thus, it is highlighly likely that there are no significant detrimental indirect effects of the UoA on ETP species. The SG80 is met.

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**Draft scoring range and information gap indicator added at Announcement Comment Draft Report**

| | |
|---|---|
| **Draft scoring range** | >80 |
| **Information gap indicator** | Information sufficient to score PI |

**Overall Performance Indicator scores added from Client and Peer Review Draft Report**

| | |
|---|---|
| **Overall Performance Indicator score** | |

| | |
|---|---|
| **Condition number (if relevant)** | |

### PI 2.3.2 – ETP species management strategy

| PI 2.3.2 | | The UoA has in place precautionary management strategies designed to:<br>- meet national and international requirements;<br>- ensure the UoA does not hinder recovery of ETP species.<br><br>Also, the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of ETP species | | |
|---|---|---|---|---|
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | **Management strategy in place (national and international requirements)** | | | |
| | **Guide post** | There are measures in place that minimise the UoA-related mortality of ETP species, and are expected to be highly likely to achieve national and international requirements for the protection of ETP species. | There is a strategy in place for managing the UoA's impact on ETP species, including measures to minimise mortality, which is designed to be highly likely to achieve national and international requirements for the protection of ETP species. | There is a comprehensive strategy in place for managing the UoA's impact on ETP species, including measures to minimise mortality, which is designed to achieve above national and international requirements for the protection of ETP species. |
| | **Met?** | NA | NA | NA |
| **Rationale** | | | | |
| There are no national or international requirements, this SI is not applicable. | | | | |
| **b** | **Management strategy in place (alternative)** | | | |
| | **Guide post** | There are measures in place that are expected to ensure the UoA does not hinder the recovery of ETP species. | There is a strategy in place that is expected to ensure the UoA does not hinder the recovery of ETP species. | There is a comprehensive strategy in place for managing ETP species, to ensure the UoA does not hinder the recovery of ETP species. |
| | **Met?** | Yes | No | No |
| **Rationale** | | | | |
| Mexico in 1994, an indefinite prohibition for the capture of sea turtles was established. Sea turtle species are considered as species at risk in the national standard NOM-059-SEMARNAT-2010. With the purpose of reducing the incidental catch of sea turtles in Mexico Turtle Excluder Devices (TED) have been mandatory since 1995. According to the on-board observer program during the period of 2016-2017 nine interactions with sea turtles were recorded; all organisms were returned to the sea. Totoaba was included in the NOM-059-SEMARNAT-2010 and CITES as an endangered species so it capture is ban. There is a total ban of the capture of Vaquita in the Gulf of California; however the industrial shrimp fishery does not inteact with this marine mammal. Thus, there are | | | | |

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| measures in place expected to ensure the UoA does not hinder the recovery of ETP species, meeting SG60. The observer program serves to evaluate the effectiveness of these measures, meeting the SG80. | | | | |
| **c** | **Management strategy evaluation** | | | |
| | **Guide post** | The measures are considered likely to work, based on plausible argument (e.g., general experience, theory or comparison with similar fisheries/species). | There is an objective basis for confidence that the measures/strategy will work, based on information directly about the fishery and/or the species involved. | The strategy/comprehensive strategy is mainly based on information directly about the fishery and/or species involved, and a quantitative analysis supports high confidence that the strategy will work. |
| | **Met?** | Yes | Yes | No |
| **Rationale** | | | | |
| The use of TEDs and BRDs is mandatory in all Pacific shrimp fleet operating in the Pacific Ocean and the Gulf of California (DOF, 2013). There is evidence that these measures are being implemented successfully and that their efficiency has been reviewed. Each year vessel inspections are carried out by CONAPESCA personal before the start of the fishing season to ensure compliance with Mexican regulation for proper installation of TEDs. Regarding the efficiency of TEDs, there is a great amount of international and national literature (Aguilar-Ramirez and Grande-Vidal, 1996; Aguilar-Ramirez, 1998; Kennelly y Broadhurst 1995; NOAA, 2017; Watson y Taylor 1990). Similarly, there are several studies assessing the efficiency of BRDs (Balmori-Ramirez et al., 2003; García-Caudillo et al., 2000; Hannah et al., 2003). Thus, there is an objective basis for confidence that the measures/strategy will work, based on information directly about the fishery and/or the species involved. Therefore, the SG80 level is met. However, these studies are focused on the release efficiency of organisms, but they do not estimate the post-release mortality or carried out a quantitative risk assessment or quantitative modelling, therefore, the SG100 level is not reached. | | | | |
| **d** | **Management strategy implementation** | | | |
| | **Guide post** | | There is some evidence that the measures/strategy is being implemented successfully. | There is clear evidence that the strategy/comprehensive strategy is being implemented successfully and is achieving its objective as set out in scoring issue (a) or (b). |
| | **Met?** | | Yes | No |
| **Rationale** | | | | |
| Each year vessel inspections are carried out by CONAPESCA personal before the start of the fishing season to ensure compliance with Mexican regulation for proper installation of TEDs and BRD. Similarly, the onboard observer program has a coverage of around 5% to confirm the proper use of TEDs and BRDs. Thus, there is some evidence that the measures/strategy is being implemented successfully. As mentioned, these measures do not represent a strategy/comprehensive strategy thus, the SG100 cannot be reached. | | | | |
| **e** | **Review of alternative measures to minimize mortality of ETP species** | | | |

| | | | | |
|---|---|---|---|---|
| | **Guide post** | There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of ETP species. | There is a regular review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of ETP species and they are implemented as appropriate. | There is a biennial review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality ETP species, and they are implemented, as appropriate. |
| | **Met?** | Yes | Yes | No |

**Rationale**

Regarding the efficiency of TEDs there is a great amount of international and national literature reviewing the efficiency of several types of the device (Aguilar-Ramirez and Grande-Vidal, 1996; Aguilar-Ramirez, 1998; Kennelly y Broadhurst 1995; NOAA, 2017; Watson y Taylor 1990, INAPESCA, 2010); similarly, the efficiency of BRD has been reviewed and tested (Torres-Jimenez, 1992; Garcia-Caudillo et al, 2000; Balmori-Ramirez et al, 2003; Hanna and Jones, 2000; Hanna et al., 2003). The use of TEDs and BRDs is mandatory in all industrial fleet (DOF, 2013) and their implementation is reviewed before the season fishing starts. Thus, there is a regular review of the potential effectiveness and practicality of alternative measures to minimize UoA-related mortality of ETP species and they are implemented as appropriate. Therefore, the SG80 level is met. However, the reviews are not biennial so the level SG100 is not reached.

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| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | |
|---|---|
| **Draft scoring range** | >80 |
| **Information gap indicator** | Information sufficient to score PI |

| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
|---|---|
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 2.3.3 – ETP species information

| PI 2.3.3 | | Relevant information is collected to support the management of UoA impacts on ETP species, including:<br>- **Information for the development of the management strategy;**<br>- **Information to assess the effectiveness of the management strategy; and**<br>- **Information to determine the outcome status of ETP species** | | |
|---|---|---|---|---|
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | **Information adequacy for assessment of impacts** | | | |
| | **Guide post** | Qualitative information is adequate to estimate the UoA related mortality on ETP species.<br><br>OR<br><br>If RBF is used to score PI 2.3.1 for the UoA:<br>Qualitative information is adequate to estimate productivity and susceptibility attributes for ETP species. | Some quantitative information is adequate to assess the UoA related mortality and impact and to determine whether the UoA may be a threat to protection and recovery of the ETP species.<br><br>OR<br><br>If RBF is used to score PI 2.3.1 for the UoA:<br>Some quantitative information is adequate to assess productivity and susceptibility attributes for ETP species. | Quantitative information is available to assess with a high degree of certainty the magnitude of UoA-related impacts, mortalities and injuries and the consequences for the status of ETP species. |
| | **Met?** | Yes | Yes | No |
| **Rationale** | | | | |
| There is information from the on-board Observer Program (SICG, 2015; SICG, 2018) and INAPESCA (INAPESCA, 2017a; INAPESCA, 2017b; INAPESCA, 2017c; INAPESCA, 2017d; INAPESCA, 2017e) suggesting that there are a few interactions between ETP species (turtles and marine mammals) and the industrial fishery, all ETP species were released but no information on post-release mortality is available. The remaining ETP species had a small bycatch percentage. Thus, some quantitative information is adequate to assess the UoA related mortality and impact and to determine whether the UoA may be a threat to the protection and recovery of the ETP species. Therefore, the SG80 level is met. However, the onboard Observer Program has a coverage < 5% so mortality for the entire fleet can be inferred but it cannot be calculated exactly. Thus, we cannot assess with a high degree of certainty the magnitude of UoA-related impacts, mortalities, and injuries and the consequences for the status of ETP species. The level SG100 is not reached. | | | | |
| **b** | **Information adequacy for management strategy** | | | |
| | **Guide post** | Information is adequate to support measures to manage the impacts on ETP species. | Information is adequate to measure trends and support a strategy to manage impacts on ETP species. | Information is adequate to support a comprehensive strategy to manage impacts, minimize mortality and injury of ETP species, and |

| | | | | |
|---|---|---|---|---|
| | | | | evaluate with a high degree of certainty whether a strategy is achieving its objectives. |
| | **Met?** | Yes | No | No |

| |
|---|
| **Rationale** |
| Information from the voluntary onboard observer program (SICG, 2015; SICG, 2018) and INAPESCA (INAPESCA, 2017a; INAPESCA, 2017b; INAPESCA, 2017c; INAPESCA, 2017d; INAPESCA, 2017e) and Madrid et al., (unpublished) provides information on fishery interactions with turtles, marine mammals, sharks and rays to suggest that the mortality caused by the fishery is very low. In addition, research has been done on the potential benefits of BRDs on the exclusion of juvenile totoabas (81%). Therefore, Information is adequate to measure trends and support measures to manage impacts on ETP species. Thus, the SG80 level is met. |
| References |
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|---|---|
| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | |
| **Draft scoring range** | >80 |
| **Information gap indicator** | Information sufficient to score PI |
| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
| **Overall Performance Indicator score** | |

| | |
|---|---|
| **Condition number (if relevant)** | |

## PI 2.4.1 – Habitats outcome

| PI 2.4.1 | | The UoA does not cause serious or irreversible harm to habitat structure and function, considered on the basis of the area covered by the governance body(s) responsible for fisheries management in the area(s) where the UoA operates | | |
|---|---|---|---|---|
| Scoring Issue | | SG 60 | SG 80 | SG 100 |
| a | Commonly encountered habitat status | | | |
| | Guide post | The UoA is unlikely to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm. | The UoA is highly unlikely to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm. | There is evidence that the UoA is highly unlikely to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm. |
| | Met? | Yes | No | No |
| Rationale | | | | |
| Several studies carried out on sandy habitats show that trawling could continually impact habitat, but trophic relationships and biodiversity do not get affected greatly and recovery is achieved after a reasonable period of time (De Biasi, 2004; Diamond et al., 1999; Gordon et al., 2002; Jennings et al., 2001). An experiment off the Great Banks of New England to evaluate the effects of repetitive trawling in sandy bottom ecosystems found that the greatest impact to habitat was the immediate impact after trawling, but that these impacts were short-lived and the ecosystem recovered in a year or less (Gordon et al., 2002). The shrimp fishery has operated in the region for a long period of time without reducing the structure and function of sandy habitats. Thus, there is information suggesting that the UoA is unlikely to reduce the structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm. Thus, the SG60 level is met. However, without more specific information on the fishing operations spatial overlap with different habitat types and assessments of the impacts of bottom trawls on encountered habitats, a high degree of certainty is not achieved. Thus, the SG80 level is not achieved. | | | | |
| b | VME habitat status | | | |
| | Guide post | The UoA is unlikely to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm. | The UoA is highly unlikely to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm. | There is evidence that the UoA is highly unlikely to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm. |
| | Met? | NA | NA | NA |
| Rationale | | | | |
| None of the habitats commonly encountered by the industrial fishery are considered VME; therefore, this guidepost is not applicable. | | | | |

| c | Minor habitat status | | | |
|---|---|---|---|---|
| | Guide post | | | There is evidence that the UoA is highly unlikely to reduce structure and function of the minor habitats to a point where there would be serious or irreversible harm. |
| | Met? | | | Yes |

| Rationale |
|---|
| Beaches and mangroves could be classified as minor habitats. The NOM-002-SAG/PESC-2013 prohibit fishing operations within the marine range between 0 and 9.14 meters deep (0 and 5 fathoms deep); therefore, the fishery does not interact with these minor habitats. The team concluded there is evidence that the UoA is highly unlikely to reduce structure and function of the minor habitats to a point where there would be serious or irreversible harm. The SG100 level is met. |
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| Draft scoring range and information gap indicator added at Announcement Comment Draft Report | |
|---|---|
| Draft scoring range | 60-79 |
| Information gap indicator | More information sought on:<br>specific information on the fishing operations spatial overlap with different habitat types and assessments of the impacts of bottom trawls on encountered habitats |

| Overall Performance Indicator scores added from Client and Peer Review Draft Report | |
|---|---|
| Overall Performance Indicator score | |
| Condition number (if relevant) | |

## PI 2.4.2 – Habitats management strategy

| PI 2.4.2 | | There is a strategy in place that is designed to ensure the UoA does not pose a risk of serious or irreversible harm to the habitats | | |
|---|---|---|---|---|
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | **Management strategy in place** | | | |
| | **Guide post** | There are measures in place, if necessary, that are expected to achieve the Habitat Outcome 80 level of performance. | There is a partial strategy in place, if necessary, that is expected to achieve the Habitat Outcome 80 level of performance or above. | There is a strategy in place for managing the impact of all MSC UoAs/non-MSC fisheries on habitats. |
| | **Met?** | Yes | No | No |
| **Rationale** | | | | |
| In particular, in Mexico, the NOM-061-SAG-PESC/SEMARNAT-2016 (DOF, 2016) suggest, as an option, the use of double bottom ruler that helps to separate the net from the bottom allowing the exclusion of benthic organisms that are not the fishing target. It also requires that in the buffer zone of the upper Gulf of California and Colorado River Biosphere Reserve, the shrimp trawling (large and small vessels) be carried out with fishing gear that has a smaller impact on the seabed, using light nets.<br><br>Other measures in place include the no-fishing zone within the five fathoms depth along the coast and in front of river mouths (DOF, 2013) and the designation of marine protected areas in the Gulf of California. However, the effectiveness of MPAs in mitigating impacts of the UoA on habitat is unclear, as only a small fraction of MPAs are no take-zones for fishing, there is no evidence that MPAs effectively protect rare habitats; additionally, there is little overlap between MPAs with the areas of operation of the shrimp fleet. Therefore, we can say that there are measures in place that are expected to achieve the Habitat Outcome 80 level of performance. However, these are isolated measures issued by different Secretariats and there is not a clear understanding of how they work to achieve an outcome. Thus, they do not constitute a partial strategy and the level SG80 is not reached. | | | | |
| **b** | **Management strategy evaluation** | | | |
| | **Guide post** | The measures are considered likely to work, based on plausible argument (e.g. general experience, theory or comparison with similar UoAs/habitats). | There is some objective basis for confidence that the measures/partial strategy will work, based on information directly about the UoA and/or habitats involved. | Testing supports high confidence that the partial strategy/strategy will work, based on information directly about the UoA and/or habitats involved. |
| | **Met?** | Yes | Yes | No |
| **Rationale** | | | | |
| As mentioned, the exclusion efficiency of TEDs (Aguilar-Ramirez and Grande-Vidal, 1996; Aguilar-Ramirez, 1998; Kennelly y Broadhurst 1995; NOAA, 2017; Watson y Taylor 1990, INAPESCA, 2010) and BRDs (Torres-Jimenez, 1992; Garcia-Caudillo et al, 2000; Balmori-Ramirez et al, 2003; Hanna and Jones, 2000; Hanna et al., 2003) has been tested. However, the remaining measures (suggestion of using the double bottom ruler and lighter nets, the five fathoms no-fishing zone, the mouth river no-fishing zone, a designation of MPAs) are considered likely to | | | | |

| | | | | |
|---|---|---|---|---|
| work, based on a plausible argument (e.g. general experience, theory or comparison with similar UoAs/habitats). Direct Information collected about the habitat distribution in the areas, provides objective confidence to meet SG80. | | | | |
| c | Management strategy implementation | | | |
| | Guide post | | There is some quantitative evidence that the measures/partial strategy is being implemented successfully. | There is clear quantitative evidence that the partial strategy/strategy is being implemented successfully and is achieving its objective, as outlined in scoring issue (a). |
| | Met? | | Yes | No |
| Rationale | | | | |
| There is quantitative evidence of the mandatory implementation of TEDs and BRDs because CONAPESCA officials inspect the fishing boats to check for compliance with this regulation. Similarly, the no-fishing zones (five fathoms zone and river mouths) are enforced via VMS; however, the implementation of double bottom rule and lighter nets is not mandatory (DOF, 2016) and the effectiveness of MPAs in mitigating impacts of the UoA on habitat is unclear, as only a small fraction of MPAs are no take-zones for fishing, there is no evidence that MPAs effectively protect rare habitats. Therefore, there is some quantitative evidence that the measures/partial strategy is being implemented successfully, only the level SG80 is reached | | | | |
| d | Compliance with management requirements and other MSC UoAs'/non-MSC fisheries' measures to protect VMEs | | | |
| | Guide post | There is qualitative evidence that the UoA complies with its management requirements to protect VMEs. | There is some quantitative evidence that the UoA complies with both its management requirements and with protection measures afforded to VMEs by other MSC UoAs/non-MSC fisheries, where relevant. | There is clear quantitative evidence that the UoA complies with both its management requirements and with protection measures afforded to VMEs by other MSC UoAs/non-MSC fisheries, where relevant. |
| | Met? | Yes | Yes | No |
| Rationale | | | | |
| Because the shrimp fishery operates only on sandy habitats due to the potential net loss, none of the habitats commonly encountered by the industrial fleet are considered VME. However there is not clear quantitative evidence that the UoA complies with both its management requirements and with protection measures afforded to VMEs by other MSC UoAs/non-MSC fisheries, where relevant. Thus SG100 is not met. | | | | |
| References | | | | |
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Kennelly, S.J. y M.K. Broadhurst. 1995. Fishermen and scientist solving bycatch problems: examples from Australia and possibilies for the northeastern United States. Pages 121-128 in solving Bycatch: Considerations for Today and Tomorrow Alaska Sea Grant. Collage Program Report No. 96-03. University of Alaska Fairbanks

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| Draft scoring range and information gap indicator added at Announcement Comment Draft Report | |
|---|---|
| Draft scoring range | 60-79 |
| Information gap indicator | More information sought |

| Overall Performance Indicator scores added from Client and Peer Review Draft Report | |
|---|---|
| Overall Performance Indicator score | |
| Condition number (if relevant) | |

## PI 2.4.3 – Habitats information

| PI 2.4.3 | Information is adequate to determine the risk posed to the habitat by the UoA and the effectiveness of the strategy to manage impacts on the habitat | | | |
|---|---|---|---|---|
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | **Information quality** | | | |
| | **Guide post** | The types and distribution of the main habitats are broadly understood.<br><br>OR<br><br>If CSA is used to score PI 2.4.1 for the UoA:<br>Qualitative information is adequate to estimate the types and distribution of the main habitats. | The nature, distribution and vulnerability of the main habitats in the UoA area are known at a level of detail relevant to the scale and intensity of the UoA.<br><br>OR<br><br>If CSA is used to score PI 2.4.1 for the UoA:<br>Some quantitative information is available and is adequate to estimate the types and distribution of the main habitats. | The distribution of all habitats is known over their range, with particular attention to the occurrence of vulnerable habitats. |
| | **Met?** | Yes | Yes | No |
| **Rationale** | | | | |
| Some information is available regarding the types and distribution of habitats of the Gulf of California (Sala et al., 2003; Johnson et al., 2016) and the types of sediments found in the Gulf (Carranza-Edwards and Aguayo-Camargo, 1991). As mentioned, the fishery operates in sandy bottoms avoiding other types of substrate that could damage the fishing gear; in particular, the fishery does not operate in some habitats that could be considered as VMEs. The team considers that there is information to broadly understand the nature, distribution, and vulnerability of the main habitats in the UoA area at a level of detail relevant to the scale and intensity of the UoA. Thus, the level of SG80 is met. However, the distribution of the effort of the UoA is not well known and provides a challenge to reliably identify the main impacts of the fishery on main habitats; thus, the SG100 level is not met. | | | | |
| **b** | **Information adequacy for assessment of impacts** | | | |
| | **Guide post** | Information is adequate to broadly understand the nature of the main impacts of gear use on the main habitats, including spatial overlap of habitat with fishing gear.<br><br>OR<br><br>If CSA is used to score PI 2.4.1 for the UoA: | Information is adequate to allow for identification of the main impacts of the UoA on the main habitats, and there is reliable information on the spatial extent of interaction and on the timing and location of use of the fishing gear.<br><br>OR<br><br>If CSA is used to score PI 2.4.1 for the UoA: | The physical impacts of the gear on all habitats have been quantified fully. |

| | | | | |
|---|---|---|---|---|
| | | Qualitative information is adequate to estimate the consequence and spatial attributes of the main habitats. | Some quantitative information is available and is adequate to estimate the consequence and spatial attributes of the main habitats. | |
| | **Met?** | Yes | No | No |

**Rationale**

There is numerous literature about the impact of trawling on diversity and physical structure, and the recovery of sandy habitats where the fishery operates (Lopez-Martinez et al., 2012; Kaiser et al., 2001; Kaiser et al., 2003; Gordon et al., 2002; Drabrish et al., 2001, Diamond et al., 1999, Hansson et al., 2000; Jennings et al., 2001; De Biasi, 2004). It is well known that the industrial shrimp fishery operates in sandy bottoms avoiding other types of substrate to avoid fishing gear loss. Therefore, the team considers Information is adequate to broadly understand the nature of the main impacts of gear used on the main habitats, including the spatial overlap of habitat with fishing gear. Thus, the SG60 level is met. However, there is no reliable information on the spatial extent of interaction and on the timing and location of use of the fishing gear. Thus, the SG80 level is not met.

| | | | | |
|---|---|---|---|---|
| **c** | **Monitoring** | | | |
| | **Guide post** | | Adequate information continues to be collected to detect any increase in risk to the main habitats. | Changes in all habitat distributions over time are measured. |
| | **Met?** | | Yes | No |

**Rationale**

Two sources of information regarding bycatch from the shrimp fishery exist and will continue to provide information in the following years. The SICG voluntary Observer Program and the independent scientific cruises operated by INAPESCA. These databases provide information on the species available, their relative abundance, the richness of species and diversity. They also provide information on the efficiency of Teds and BRDs. The team considers that Adequate information continues to be collected to detect any increase in risk to the main habitats. Thus, the SG80 level is met. However, changes in all habitat distributions over time are not measured. Therefore, SG100 is not met.

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| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | |
|---|---|
| **Draft scoring range** | 60-79 |
| **Information gap indicator** | More information sought |

| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
|---|---|
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 2.5.1 – Ecosystem outcome

| PI 2.5.1 | | The UoA does not cause serious or irreversible harm to the key elements of ecosystem structure and function | | |
|---|---|---|---|---|
| Scoring Issue | | SG 60 | SG 80 | SG 100 |
| a | Ecosystem status | | | |
| | Guide post | The UoA is unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm. | The UoA is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm. | There is evidence that the UoA is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm. |
| | Met? | Yes | No | No |
| Rationale | | | | |

The shrimp fleet fishing gear can affect the ecosystem through bycatch and bottom habitat impact. Shrimp fisheries are carried out in coastal areas where a large number of marine species are concentrated, a significant amount of bycatch is produced, with consequences not yet known for these species (Kaiser and de Groot, 2001). Bycatch is either discarded or partially kept on board. Bycatch is one of the most pressing and controversial aspects of shrimp fishing and much of the shrimp fishery management is focused on reducing it (Gillet, 2008). Discarded bycatch is a serious conservation problem because valuable living resources are wasted, populations of endangered and rare species could be threatened, stocks that are already heavily exploited are further impacted and ecosystem changes in the overall structure of trophic webs and habitats may result (Harrington, Myers and Rosenberg, 2005). In particular, for Mexico, the amount of discards from Mexico's shrimp fisheries, 133 000 *t* annually, is considered to be large.

In addition, trawling may continue to negatively impact habitat, but trophic relationships and biodiversity does not get affected greatly and recovery is achieved after reasonable period of time (Jennings et al., 2001; De Biasi, 2004). An experiment off the Great Banks of New England to evaluate the effects of repetitive trawling in sandy bottom ecosystems found that the greatest impact to habitat was the immediate impact after trawling, but that these impacts were short-lived and the ecosystem recovered in a year or less (Gordon et al., 2002)

With respect to trophic interactions, for the Gulf of California, results from modelling with ECOPATH and ECOSIM (Salcido-Guevara et al., 2012) suggest that moderate fishing scenario (30%) would not cause major changes in either indicator whilst the scenario of strong fishing pressure (80%) seems to increase not only the fish resources variability at the population level but also the variability of the overall biomass, hence potentially reducing ecosystem stability. Similarly, Morales-Zarate et al. (2004) main results show that most groups were impacted more by predation and competition than by fishing pressure, and that there are some characteristics that indicate that use of the ecosystem is balanced.

According to Gillet (2008), there are mechanisms, instruments and models to enable effective mitigation of many of the difficulties associated with shrimp fishing, taking a precautionary and ecosystem approach to fisheries. In the industrial shrimp fishery several measures have been issued. The inference is that, with an appropriate implementation capacity, shrimp fishing, including shrimp trawling, is indeed manageable. Similarly, Arreguín-Sánchez (2002) states that the shrimp fishery can operate in the Gulf of California and be fully compatible with

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| biodiversity conservation policies. However, depending on the particular objectives of each region, the controls to be implemented on fisheries at the ecosystem level will be differential. In addition, the shrimp fishery has operated for a long period of time without disrupting key ecosystem elements. Therefore, the UoA is unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm. Thus, the SG60 level is met. However, most of the research findings on trophic models have not been incorporated directly in the management of this fishery; there is not a clear idea of the organisms post-release mortality; the proposed double footrope to minimize potential impacts on bottom habitats is still not mandatory; **therefore, there is not enough evidence to assure that the UoA is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm. Level SG80 is not reached.** |
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| Draft scoring range and information gap indicator added at Announcement Comment Draft Report | |
|---|---|
| Draft scoring range | 60-79 |
| Information gap indicator | More information sought |

| Overall Performance Indicator scores added from Client and Peer Review Draft Report | |
|---|---|
| Overall Performance Indicator score | |
| Condition number (if relevant) | |

## PI 2.5.2 – Ecosystem management strategy

| PI 2.5.2 | | There are measures in place to ensure the UoA does not pose a risk of serious or irreversible harm to ecosystem structure and function | | |
|---|---|---|---|---|
| Scoring Issue | | SG 60 | SG 80 | SG 100 |
| a | Management strategy in place | | | |
| | Guide post | There are measures in place, if necessary which take into account the potential impacts of the UoA on key elements of the ecosystem. | There is a partial strategy in place, if necessary, which takes into account available information and is expected to restrain impacts of the UoA on the ecosystem so as to achieve the Ecosystem Outcome 80 level of performance. | There is a strategy that consists of a plan, in place which contains measures to address all main impacts of the UoA on the ecosystem, and at least some of these measures are in place. |
| | Met? | Yes | Yes | No |
| Rationale | | | | |
| In the Mexican Pacific, there is not an explicit management strategy for removing or reducing the risk of fishery impacts on the ecosystem. However, there are some measures taken aimed to minimize the impact of the fishery on key ecosystem elements and consequently to protect the structure and function of the ecosystem. NOM-002-SAG/PESC-2013 states the implementation of a no-fishing zone from 0 to 5 phantom depths and it is applied strictly. According to INAPESCA (2016), this zone is well recognized as a reproduction zone, refuge and feeding zone of different species. Similarly, fishing is prohibited in the river mouths connecting to the sea. It is important to mention that regulations require (DOF,2013) all shrimp fleets to use a satellite system that allows the surveillance of the fishing prohibition in this zone and other closed areas. The same Mexican Official Standard requires the use of TED's and BRD´s in all shrimp fleets with the purpose of reducing bycatch. In addition, fishing season closures and area closures seem to have an indirect, positive effect on several ecosystem components, even if that was not an intended effect of the regulation. For example, the peak reproductive season of several species overlaps with the shrimp closure in the summer months. Therefore, this measure also protects spawners and other species recruits. The CANANP administrates several closed areas and reserves at the Baja California Peninsula and the North Pacific, Northwest and high Gulf of California, west and Central Pacific. Thus, the team considers there is a partial strategy in place, which takes into account most of the available information and is expected to restrain impacts of the UoA on the ecosystem so the level SG80 of performance is reached. | | | | |
| b | Management strategy evaluation | | | |
| | Guide post | The measures are considered likely to work, based on the plausible argument (e.g., general experience, theory or comparison with similar UoAs/ ecosystems). | There is some objective basis for confidence that the measures/ partial strategy will work, based on some information directly about the UoA and/or the ecosystem involved. | Testing supports high confidence that the partial strategy/ strategy will work, based on information directly about the UoA and/or ecosystem involved. |
| | Met? | Yes | Yes | No |

| **Rationale** | | | | |
|---|---|---|---|---|
| There are several studies proving the efficiency of TED´S and BRD´s on reducing bycatch and releasing turtles (INP, 1991; Aguilar-Ramirez and Grande-Vidal, 1996; Aguilar-Ramirez, 1998; García-Caudillo et al., 2000; Barrera-Guevara, 1990; Cisneros-Mata et al., 1995; Torres-Jimenez, 1992; Torres-Jimenez and Balmori-Ramirez, 1994). Thus, there is some objective basis for confidence that the measures will work, based on some information directly about the UoA and/or the ecosystem involved. Thus, the SG80 level is met. However, other measures, such as the MPAs, the five fathoms depth no-fishing zone and the fishing ban at the river mouth have not been tested so the level SG100 is not reached. | | | | |
| **c** | **Management strategy implementation** | | | |
| | **Guide post** | | There is some evidence that the measures/partial strategy is being implemented successfully. | There is clear evidence that the partial strategy/strategy is being implemented successfully and is achieving its objective as set out in scoring issue (a). |
| | **Met?** | | Yes | No |
| **Rationale** | | | | |
| Each year vessel inspections are carried out by CONAPESCA personnel before starting the fishing season to ensure compliance with Mexican regulation for proper installation of TEDs and BRDs. On May 1, 2017, the Department **of State** certified Mexico on the basis that its sea turtle protection programs are comparable to that of the United States (NOAA, 2017). Similarly, the onboard Observer program contributes to review the compliance with regulations. The surveillance for the no-fishing zones at the five fathoms depth zone and the river mouths is carried out by the satellite surveillance and monitoring system. Season closures are also surveilled by the VMS and CONAPESCA and NAVY personal. Thus, there is some evidence that the measures are being implemented successfully. However, as mentioned, there is not an explicit management strategy for removing or reducing the risk of fishery impacts on the ecosystem so the SG100 level is not reached. | | | | |
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| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | |
|---|---|
| **Draft scoring range** | >80 |
| **Information gap indicator** | Information sufficient to score PI |

| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
|---|---|
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 2.5.3 – Ecosystem information

| PI 2.5.3 | | There is adequate knowledge of the impacts of the UoA on the ecosystem | | |
|---|---|---|---|---|
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | **Information quality** | | | |
| | **Guide post** | Information is adequate to identify the key elements of the ecosystem. | Information is adequate to broadly understand the key elements of the ecosystem. | |
| | **Met?** | Yes | Yes | |
| **Rationale** | | | | |
| Some information in relation to key elements of the Gulf of California ecosystem structure and function is provided in (Arreguín-Sánchez and Arcos-Huitron, 2011; Arreguin-Sánchez, 2002, Lluch-Cota, 2007, Morales et al., 2004). Information on the effects of temperature and other environmental forcing on recruitment are analyzed by (Madrid-Vera et al., 2002; Lopez-Martínez, 2002). This information is adequate to broadly understand key elements of the ecosystem such as community composition, trophic structure and function (prey/predator relationships), productivity patterns and diversity on the Mexican Pacific area. Thus, the SG80 level is reached. | | | | |
| **b** | **Investigation of UoA impacts** | | | |
| | **Guide post** | Main impacts of the UoA on these key ecosystem elements can be inferred from existing information, but have not been investigated in detail. | Main impacts of the UoA on these key ecosystem elements can be inferred from existing information, and some have been investigated in detail. | Main interactions between the UoA and these ecosystem elements can be inferred from existing information, and have been investigated in detail. |
| | **Met?** | Yes | No | No |
| **Rationale** | | | | |
| Main fishery impacts on key ecosystem elements can be assessed from available information (INP, 1991; García-Caudillo et al., 2000; Kaiser and de Groot, 2000; Torres-Jiménez and Balmori-Ramírez, 1994) and the use of ECOPATH and ECOSYM trophic models. On the other hand, main impacts of the fishery on key elements are summarized in Gillet (2008) including the global impacts of shrimp fisheries on seabed habitats and bycatch species. There also exists a chapter where these aspects are reviewed specifically for Mexico and the Gulf of California (Lopez-Martinez et al., 2007). However, the post-release mortality and the impact of the fishery on bycatch species and ETP species population dynamics have not been investigated in detail. Thus, only the SG60 level is met. | | | | |
| **c** | **Understanding of component functions** | | | |
| | **Guide post** | | The main functions of the components (i.e., P1 target species, primary, secondary and ETP species and | The impacts of the UoA on P1 target species, primary, secondary and ETP species and Habitats are identified and the main functions of |

| | | | | |
|---|---|---|---|---|
| | | | Habitats) in the ecosystem are known. | these components in the ecosystem are understood. |
| | **Met?** | | Yes | No |
| **Rationale** | | | | |

The biology, ecology and function of shrimp species in the ecosystem is well known (Hendrickx, 1996; Macías-Regalado et al., 1982; Signoret, 1974; Aragón & Alcántara, 2005; Aragón-Noriega, 2007). Regarding secondary species, Information on benthic species, the dominant taxa and their diversity in the Gulf of California has been provided (Lluch—Cota et al., 2007), However, the highest quality data is related to well-studied groups as Euphausiacea and benthic Dendrobranchiata. There is a well-documented knowledge of the systematics of the Gulf fishes; over 900 species have been recorded included tropical and temperate species. The diversity, biology, behavior and ecology of fishes (bony fishes and elasmobranchs) from the Gulf of Mexico is well-known (Hastings et al., 2010; Hobson, 1968; Villavicencio-Garayzar, 1996; Montgomery et al., 1980; Strand, 1988). For ETP species, in particular marine mammals, there is a total of 36 species of marine mammals in this inner sea (Aurioles-Gamboa, 1993). Among them, La vaquita (Phocoena sinus) is an endemic permanent resident in the Gulf (Jaramillo-Legorreta et al., 1999) and is considered endangered due to its declining abundance (Barlow et al., 1997). Another endemic species is the totoaba which is also considered as critically endangered (Lluch-Cota et al., 2007). These are some of the most studied species in the Gulf of California. The federal government in 1975 created the Technical Committee for the Protection of the Totoaba and the Vaquita, with the purpose of evaluating, studying, and monitoring their populations (Lluch-Cota et al., 2007). With respect to turtles, five species inhabit the Gulf of California, their roles in the ecosystem are known (Lluch-Cota et al., 2007). Although all species remain classified as endangered (Lluch-Cota et al., 2007), some have successfully recovered to pre-exploitation numbers (Genus Lepidochelys). Habitats and their characteristics are known, several descriptions have been published (Lluch-Cota et al., 2007; Ortiz-Lozano et al., 2005; Johnson et al., 2016). The main functions of the components (target species secondary and ETP species and Habitats) in the ecosystem are known. The level SG80 is met. Although The impacts of the UoA on target species, secondary and ETP species and Habitats are identified, main functions of these components in the ecosystem are not understood, for example it is not well known the effects of bycatch and discarding on several secondary species populations and mortality, therefore the level SG100 is not met.

| | | | | |
|---|---|---|---|---|
| **d** | **Information relevance** | | | |
| | **Guide post** | | Adequate information is available on the impacts of the UoA on these components to allow some of the main consequences for the ecosystem to be inferred. | Adequate information is available on the impacts of the UoA on the components and elements to allow the main consequences for the ecosystem to be inferred. |
| | **Met?** | | Yes | No |
| **Rationale** | | | | |

Three observer programs (FIDEMAR, INAPESCA and SICG) have provided sufficient information on the potential impacts of the fishery on ecosystem components to allow some of the main consequences for the ecosystem to be inferred, but they have not been investigated in detail. No indirect effects of fishing have been analysed. The impact of interactions with non-target species including fish taken as bycatch and retained species as well as ETP species is not known with a detail that facilitates the ability to assess the consequences for these components. There is not sufficient information available in relation to the shrimp fishery to infer the likely

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|---|---|---|---|---|
| consequences of the impact of bycatch and discarding. No information on post-release mortality of bycatch and ETP species is known. Consequences for seabed habitats has not been extensible researched in Mexico but can be inferred from general knowledge of the impact that is likely to result from the gear types in use, scale and spatial location of the fishery, as well as seabed habitats affected and the mechanisms of interaction. Thus, the level SG100 is not met. | | | | |
| **e** | **Monitoring** | | | |
| | **Guide post** | | Adequate data continue to be collected to detect any increase in risk level. | Information is adequate to support the development of strategies to manage ecosystem impacts. |
| | **Met?** | | Yes | No |
| **Rationale** | | | | |
| SICG onboard Observer Program continues to gather shrimp catch, bycatch and ETP data. Most of the information reported is allocated by taxonomic groups, no information of weight percentage in the catch at species level is provided. Similarly, INAPESCA continues carrying out independent research cruises aimed to analyzed bycatch. Information on weight percentage in the catch is presented at level species for crustaceans, elasmobranchs, echinoderms and mollusks. However, the most abundant taxonomic group, bony fishes, is not reported at species level. The team considers that adequate data continue to be collected to detect any increase in risk level, but it is not adequate to support the development of strategies to manage ecosystem impacts. | | | | |
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| Draft scoring range and information gap indicator added at Announcement Comment Draft Report | |
|---|---|
| **Draft scoring range** | 60-79 |
| **Information gap indicator** | More information sought on: post-release mortality and the impact of the fishery on bycatch species |

**Overall Performance Indicator scores added from Client and Peer Review Draft Report**

| | |
|---|---|
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## 5.4 Principle 3

### 5.4.1 Principal 3 Background

#### 5.4.1.1 Area of Operation and Relevant Jurisdictions

The Unit of Assessment covers the marine area offshore, estuaries and coastal lagoons of the Mexican Pacific Ocean and the Gulf of California, except in marine protected areas. The most productive areas are Sinaloa, Sonora and Baja California (INAPESCA, 2018). The fishery falls within a single jurisdiction category. The stock does not have an indigenous component, is not a straddling stock or highly migratory species, it's not considered a stock shared with other countries for demographic supply purposes, nor does it take place on the high seas.

**National Level Management**

#### 5.4.1.2 Decision Making Processes

The Consejo Nacional de Pesca y Acuacultura (National Council of Fisheries and Aquaculture) organizes periodical meetings that are the official forum for consulting all issues related to the shrimp fishing in the Pacific Ocean (Hernández and Kempton, 2003; DOF, 2018a). The chairman of the Consejo Nacional de Pesca y Acuacultura is the Secretariat of Secretaría de Agricultura y Desarrollo Rural (SADER) (Agriculture and Rural Development,) and the secretary of the Council is the Director of CONAPESCA (DOF, 2018a). The representatives of fishers, i.e. the Unión de Armadores del Litoral del Pacífico (Union of Ship-owners of the Pacific Coast) and the Confederación Mexicana de Cooperativas Pesqueras y Acuícolas (Conmecoop) (Mexican Federation of Fisheries and Aquaculture Cooperatives), have the right to voice, and after they expose their claims and manifest their arguments, the chairman and the secretary disclose the final decision, which shall be signed by consensus. Other participants in the Council are INAPESCA, research centers and universities. CONAPESCA keeps records of all the minutes of the meetings of the National Council of Fisheries and Aquaculture.

#### 5.4.1.3 Roles and Responsibilities

The main groups of interest in the Unit of Assessment include the Unión de Armadores del Litoral del Pacífico (Union of Ship-owners of the Pacific Coast), which brings together all the largest vessels that target shrimp offshore in the Ocean Mexican Pacific. The other group of interest is the National

Other key institutions in the Mexcian Pacific Shrimp Fishery are CONAPESCA that is the federal agency in charge of fisheries management, INAPESCA that is the federal research institution for fisheries, universities and international and national NGO.

Confederation of Fishers' Cooperatives (CONACOOP), which brings together most small-scale fishers engaged in catching shrimp in estuaries and lagoons in the Mexican Pacific Ocean (INAPESCA, 2018).

To enforce the law, CONAPESCA has a Dirección General de Inspección y Vigilancia (DGIS) (Directorate General of Inspections and Surveillance) and the Judicial Unit that issues final judgments on legal actions.

The Secretaría de Medioambiente y Recursos Naturales (SEMARNAT) (Secretariat of Environment and Natural Resources) via the Procuraduría Federal de Protección al Ambiente (PROFEPA) (Federal Attorney for Environmental Protection) also has interference in the matters related to the use of TED. Mexican Navy, and federal and state police also coordinate surveillance activities with CONAPESCA.

### 5.4.1.4 Fishery-Specific Management

#### Objectives for the Fishery

Although the Pacific Shrimp Fishery Management Plan has not been adopted, its objective is: to improve the quality of life of fishers and their families, and increase the shrimp catches (INAPESCA, 2018). However, for 30 years, the pacific shrimp fishery management has been guided by the NOM-002-SAG/PESC-2013, whose objective is: to establish the technical specifications, criteria and procedures to regulate shrimp fishing, with the purpose of contributing to the preservation, conservation and sustainable use of the populations of the different shrimp species in the estuarine lagoon systems, bays, marshes and marine waters of federal jurisdiction of the United Mexican States.

#### Fisheries Regulations to Meet Objectives

To achieve the objective of the fishery of contributing to the preservation, conservation and sustainable use of the populations of the different shrimp species in the Pacific Ocean, the main regulation that has been developed is the control of fishing mortality through the establishment of fishing seasons and closed seasons for fishing. This management scheme requires constant monitoring of shrimp populations, so that the INAPESCA scientific staff can timely estimate the optimal times to open and close the fishing seasons. The seasons closed for fishing has two purposes: ensure an adequate spawner biomass escapement for reproduction, and distribute the catches between the two fleets (larger vessels and small-scale fishers) that participate in the fishery. The season closed for fishing may vary according to the stock monitoring results by INAPESCA, but in the last years it has been from March to September.

In order to achieve the objective, the NOM-002-SAG/PESC-2013 includes also additional regulations, like area closed for fishing, fishing gear restrictions per area, use of turtle excluder device and satellite monitoring systems for larger vessels. For more than 25 years, this strategy, which also includes fleet reduction, control of illegal fishing and the restriction of harmful fishing gear, has been applied to achieve the objectives of the fishery. All these measures have been consulted and agreed with fishermen under the NCFA.

#### Access Rights

Two types of fishermen participate in the Pacific Ocean shrimp fishery, those who work on larger vessels of 20 m length (average), made of iron hull, with autonomy for more than 30 days operating on the high seas in deeper waters at 5 fathoms; and the small-scale fishers, who use 25-foot-long (7.6 m) fiberglass boats with outboard motors. The latter operate in the estuaries and coastal lagoons of the states of

Sonora, Sinaloa, Nayarit, Colima, Oaxaca and Chiapas. There are 845 larger vessels operating in the fishery and 9,979 small-scale boats (INAPESCA, 2018).

Most of the larger vessels have their home port in Mazatlan, Sinaloa, but other are in the ports of Guaymas, Puerto Peñasco, Topolobampo, and other nine ports. Most of these vessels holds fishing permits that can be renewed every five years. 58% of the small-scale boats are in Sinaloa, 17% in Chiapas, 8% in Sonora and 6% in Nayarit, and the rest in other states. The small-scale boats have permits of five years. The permits are issued in favor of one or more vessels, and these mention the areas, type of vessel, engine, fishing gears, and methods allowed to perform the activity. The permit and the arrival notice at the end of each fishing trip are key documents that certify the lawful origin of the catch. The permit grants the holder to fish and marketing the shrimp caught in the terms established by law, and the arrival notice states the quantity and type of product for sale and transport, both documents are required to extend the corresponding invoice to any buyer (DOF, 2018a, Art. 63). The law establishes different penalties for infractions, including revocation of the permit.

## Review and Audit of the Management Plan

Although there is a drafted Mexican Pacific Shrimp Fishery Management Plan (inapesca, 2018), it has not been officially published, so there has not been consultation processes on it. However, the fishery has been managed with an Official Mexican Standard NOM-002-PESC-1993, since 1993 to the present. The NOM-002-PESC-1993 contains details of species, areas of distribution, authorized fishing gear in particular zones, type of vessels, season closed for fishing, bycatch procedures, use of TED, and other (DOF, 1993). Therefore, NOM-002-PESC-1993 can be considered as the predecessor of the management plan. Because the Federal Law of Metrology and Standardization requires that the committee in charge of creating a NOM must wait a period of 60 calendar days for consultation before it is promulgated, this NOM followed that consultation process. In some occasions the NOM-002-PESC-1993 has been amended, for instance on 30 July 1997 and 28 November 2006. The most recent amendment was in 2013.

The Draft Amendment to Official Mexican Standard NOM-002-PESC-1993 was published in the Official Gazette of the Federation on 21 December 2011, so that within 60 calendar days, interested parties submitted their comments to the National Advisory Committee on Normalization of Responsible Fisheries. 46 comments were received from 21 promoters, to which the response was prepared through a document, which was presented to the committee for its analysis. It was approved for its publication on May 18th, 2012. A new period of 60 natural days was established for the interested parties to make comments on the Standard project. During the consultation period all documents were available at CONAPESCA. Finally, the National Consultative Committee for Agri-Food Standardization of SADER at the session of 8 February 2013, approved the sending of the Draft Modification of NOM-002-SAG/PESC-2013 to the Official Gazette of the Federation for publication (DOF, 2013).

Because the NOM-002-SAG/PESC-2013 recommends the implementation of temporary and space closures for fishing, it specifies that the dates of this fishing closures and fishing seasons must be officially published prior to the enter into force. To do this, the managers expose and consult with the interested parties about the dates of the opening and closing season for fishing (DOF, 2018). This and other type of consultations are made in a regular forum known as the National Council of Fisheries and Aquaculture (NCFA) (DOF, 2018a, Art. 22). This Council is an intersectoral forum to coordinate, consult and advice; whose objective is to propose policies, programs, projects and instruments aimed at support, promote productivity, regulate and control fishing and aquaculture activities, as well as to increase competitiveness of the productive sectors. NCFA is formed by representatives of federal and state offices related to fishing and aquaculture, and representatives of producers of the fishing and aquaculture sectors. In this forum, the different parties, through their representatives, can present claims and controversies so that the members of the Council analyze them to propose possible solutions to the authority for a final resolution (DOF, 2018a). So far there are no dates to review and enact the Management Plan, but the next meeting to announce the dates to initiate the fishing season is scheduled by September 2019 (CONAPESCA, 2019).

#### 5.4.1.5 Recognized Interest Groups

**Arrangements for On-going Consultations**

Depending on the dates, the most common arrangements for ongoing consultations are related to the definition of the dates for the fishing closing season or the dates for opening the fishery. The months during the year in which this happens are usually in April and August.

**Planned Education and Training for Interest Groups**

CONAPESCA offers regular training courses to its staff to provide adequate attention to fishermen's requests. The last course was held in March 2019 (https://www.gob.mx/conapesca/prensa/capacita-conapesca-a-personal-para-atender-con-eficiencia-a-productores-pesqueros-y-acuicolas-del-pais-195776?idiom=es). CONAPESCA and INAPESCA also offer training courses to fishers in the use of new fishing technologies. The Management Plan also contains a Training Program aimed at fishers, ship-owners, and officers. Some training courses mentioned in the program are:

- Training course for proper production registration.
- Training course in fishing and environmental laws.
- Training for maintenance and repair of fishing equipment.
- Environmental education program to prevent pollution of estuaries and coastal lagoons.
- Training course for fishermen leaders, in administrative and accounting procedures.

However, since the Plan has not been officially approved, these training courses have not been implemented. Within the Mexican Pacific Shrimp Fishery Management Plan, six training courses for quality control have been scheduled for the first three years after the plan goes into effect, two per year. Similarly, fifteen groups will be trained on product management in the first three years. It is planned that 90% of children in the corresponding coastal states will be trained to raise awareness in the care of fishing and natural resources. Also there will be twenty training courses on disclosure of care of resources to fisherman and fishing grounds and finally 20 courses on mitigation and rehabilitation of lagoon systems will be offered in the first three years. All this training courses will be carried out when the plan goes into effect.

### Non-fishery Uses or Activities and Arrangements for Liaison and Coordination

Other groups that could affect the Unit of Assessment comprises either international and/or domestic wildlife conservation organizations. In the region of the Gulf of California there are several conservation NGO, many of them making activities to protect endangered species such as the marine vaquita (*Phocoena sinus*) in the upper Gulf of California (DOF, 2018b). Other non-users related with the fishery are the shrimp farmers, grouped in the Comité Sistema Producto Camarón de Cultivo. Sometimes they can accidentally release shrimps into the wild or discharge water in estuaries and coastal lagoons, which can pollute and modify the water. There are also other activities that can alter the marine environment, such as marine shipping transportation, tourism and infrastructure coastal development.

## 5.4.2 Principle 3 Performance Indicator scores and rationales

### PI 3.1.1 – Legal and/or customary framework

| **PI 3.1.1** | | **The management system exists within an appropriate legal and/or customary framework which ensures that it:**<br>- **Is capable of delivering sustainability in the UoA(s);**<br>- **Observes the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood; and**<br>- **Incorporates an appropriate dispute resolution framework** | | |
|---|---|---|---|---|
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | **Compatibility of laws or standards with effective management** | | | |
| | **Guide post** | There is an effective national legal system and a framework for cooperation with other parties, where necessary, to deliver management outcomes consistent with MSC Principles 1 and 2 | There is an effective national legal system and organised and effective cooperation with other parties, where necessary, to deliver management outcomes consistent with MSC Principles 1 and 2. | There is an effective national legal system and binding procedures governing cooperation with other parties which delivers management outcomes consistent with MSC Principles 1 and 2. |
| | **Met?** | Yes | Yes | Yes |
| **Rationale** | | | | |
| At national level, the Ley General de Pesca y Acuacultura Sustentables (LGPAS) (General Law of Sustainable Fisheries and Aquaculture) published in 2007 dictates the principles and general guidelines for the fisheries policy. This law arose from the Art. 27 of the Constitución Política de los Estados Unidos Mexicanos (Political Constitution of the United Mexican States). The law is regularly amended, according to the changes that occur in the sector, and to changes in the economy of the country. The LGPAS recognizes that marine and coastal living resources belong to the nation, but they can be subject to exploitation by any Mexican citizen who hold a | | | | |

<table>
<tr><td colspan="5">permit or concession (DOF, 2018a, Art. 40 and 41). The LGPAS contemplates the participation of other parties like: other fishers, environmentalist groups, the Secretaría del Medio Ambiente y Recursos Naturales (SEMARNAT) (Secretary of Environment and Natural Resources) and the Comisión Naiconal de Áreas naturales Protegidas (National Commission of Protected Natural Areas).<br><br>There is evidence that there is an effective legal system and binding procedures governing cooperation with other parties to deliver management outcomes. Therefore, SG 100 is met.</td></tr>
<tr><td rowspan="3">b</td><td colspan="4">Resolution of disputes</td></tr>
<tr><td>Guide post</td><td>The management system incorporates or is subject by law to a mechanism for the resolution of legal disputes arising within the system.</td><td>The management system incorporates or is subject by law to a transparent mechanism for the resolution of legal disputes which is considered to be effective in dealing with most issues and that is appropriate to the context of the UoA.</td><td>The management system incorporates or is subject by law to a transparent mechanism for the resolution of legal disputes that is appropriate to the context of the fishery and has been tested and proven to be effective.</td></tr>
<tr><td>Met?</td><td>Yes</td><td>Yes</td><td>No</td></tr>
<tr><td colspan="5">Rationale</td></tr>
<tr><td colspan="5">There are transparent procedures required by law to address and resolve disputes related to the fishery. The controversies or disputes that do not imply legal actions, are attended in the Consejo Nacional de Pesca y Acuacultura (CNPA) (National Council for Fisheries and Aquaculture) (DOF, 2018a, Art. 22), which is an intersectoral forum to support, coordinate, consult and advice; whose objective is to propose policies, programs, projects and instruments aimed at support, promote productivity, regulate and control fishing and aquaculture activities, as well as to increase competitiveness of the productive sectors. CNPA is formed by representatives of federal and state offices related to fishing and aquaculture, and representatives of producers of the fishing and aquaculture sectors. In this forum, the different parties, through their representatives, can present controversies so that the members of the Council analyze them to propose possible solutions and manage the cases before the competent authority for their solution. CONAPESCA keeps records of the meetings minutes. Because the procedures to dictate the opening and closing dates of the shrimp fishing seasons are discussed in specific fora according to the Ley de Metrología y Normalización (Law of Metrology and Standardization), the agendas of these meetings contemplate time to discuss any other controversy or even disputes. If there are legal actions, disputes and controversies can be presented to CONAPESCA that has implemented procedures for these cases: Dirección General de Inspeccion y Vigilancia (DGIV) (Directorate General for Inspections and Surveillance), and the Departamento Jurídico (Legal Unit). The Office of DGIV coordinates actions with the Secretaria de Marina (The Mexican Navy) and State and Federal Police.<br><br>Though transparent mechanisms for legal dispute resolution exist, thus meeting SG80, it cannot be said that these have been tested and proven to be effective. SG100 is not met.</td></tr>
<tr><td rowspan="2">c</td><td colspan="4">Respect for rights</td></tr>
<tr><td>Guide post</td><td>The management system has a mechanism to generally respect the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a</td><td>The management system has a mechanism to observe the legal rights created explicitly or established by custom of people dependent on fishing for food or livelihood in a manner consistent with the</td><td>The management system has a mechanism to formally commit to the legal rights created explicitly or established by custom of people dependent on fishing for food and livelihood in a</td></tr>
</table>

| | | | | |
|---|---|---|---|---|
| | | manner consistent with the objectives of MSC Principles 1 and 2. | objectives of MSC Principles 1 and 2. | manner consistent with the objectives of MSC Principles 1 and 2. |
| | Met? | Yes | Yes | Yes |

| |
|---|
| **Rationale** |
| The Ley General de Pesca y Acuacultura Sustentables (LGPAS) (General Law of Sustainable Fisheries and Aquaculture) and its regulations are formally committed to safeguard the rights of fishermen. According to the GLSFA, the only instruments that protect the legal rights of people who depend on fishing for their livelihood are permits and concessions (Article 40), so that the management system recognizes and support any holder of a permit. As for the people who depend on fishing for their food, the law does not require a special permit (DOF, 2018a, Art. 72), but such people do not have permission to sell their catches, since it is only for the personal consumption as food. The National Council of Fisheries and Aquaculture includes Producers Chambers (CANAIPESCA) and the Small-Scale Fishermen Federation, ***inter allia***.<br><br>**The rights for indigenous peoples to fish as food and for cultural rituals are given priority and special considerations and are recognized and allowed (OECD 2013). This meets the SG 100.** |
| **References** |
| DOF, 2018a. Ley General de Pesca y Acuacultura Sustentables. Nueva Ley publicada en el Diario Oficial de la Federación el 24 de julio de 2007. Última reforma publicada en el Diario Oficial de la Federación el 24 de abril de 2018. Cámara de Diputados del H. Congreso de la Unión, Secretaría General, Secretaría de Servicios Parlamentarios. http://www.diputados.gob.mx/LeyesBiblio/pdf/LGPAS_240418.pdf |

| | |
|---|---|
| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | |
| **Draft scoring range** | >80 |
| **Information gap indicator** | Information sufficient to score PI |
| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 3.1.2 – Consultation, roles and responsibilities

| PI 3.1.2 | | The management system has effective consultation processes that are open to interested and affected parties<br>The roles and responsibilities of organisations and individuals who are involved in the management process are clear and understood by all relevant parties | | |
|---|---|---|---|---|
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | **Roles and responsibilities** | | | |
| | **Guide post** | Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are generally understood. | Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are explicitly defined and well understood for key areas of responsibility and interaction. | Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are explicitly defined and well understood for all areas of responsibility and interaction. |
| | **Met?** | Yes | Yes | Yes |
| **Rationale** | | | | |
| CONAPESCA explicitly expose all the offices in charge of the shrimp fisheries management process, as well as their functions, roles and responsibilities; so they are perfectly identified by all the parties (e.g. INAPESCA is in charge of scientific studies, Direccion General de Inspeccion y Vigilancia, DGIV is in charge of surveillance, Direccion General de Ordenamento Pesquero, DGOP is in charge of establishing the regulations; SEMARNAT-CONANP is in charge of managing natural protected areas, SEMARNAT-PROFEPA is in charge of enforcing environmental regulations, including the use of TED by large vessels (DOF, 2016).<br><br>**Because individual organization functions, roles and responsibilities are explicitly defined and well understood for all areas of responsibility and interaction, SG100 is met.** | | | | |
| **b** | **Consultation processes** | | | |
| | **Guide post** | The management system includes consultation processes that obtain relevant information from the main affected parties, including local knowledge, to inform the management system. | The management system includes consultation processes that regularly seek and accept relevant information, including local knowledge. The management system demonstrates consideration of the information obtained. | The management system includes consultation processes that regularly seek and accept relevant information, including local knowledge. The management system demonstrates consideration of the information and explains how it is used or not used. |
| | **Met?** | Yes | Yes | No |
| **Rationale** | | | | |

<table>
<tr><td colspan="5">During INAPESCA's sampling campaigns, scientific personnel obtain information from different sources, including fishers' information. This information can be incorporated into the analysis, but it is not explicitly mentioned how it is incorporated. Because the main regulation that has been developed for managing the fishery is the control of fishing mortality through the establishment of fishing seasons and closed seasons for fishing, CONAPESCA has appointed the Consejo Nacional de Pesca y Acuacultura (CNPA) as the proper forum for consultation. CNPA is formed by representatives of federal and state offices related to fishing and aquaculture, and representatives of producers of the fishing and aquaculture sectors (DOF, 2018a, Art. 22). In this forum, the different parties, through their representatives, can present claims and controversies so that the members of the Council analyze them to propose possible solutions. The representatives of fishers, i.e. the Unión de Armadores de la Costa del Pacífico (Union of Ship-owners of the Pacific Coast) and the Confederación Mexicana de Cooperativas Pesqueras y Acuícolas (Conmecoop) (Mexican Federation of Fisheries and Aquaculture Cooperatives), have the right to voice, and after they expose their claims and manifest their arguments, the chairman and the secretary disclose the final decision, which shall be signed by consensus.<br><br>The Management Plan of Shrimp of the Mexcian Pacific (unpublished) compiled the opinion of the fishermen on different aspects of the fishery and the management plan through a survey. The results are exposed in the proposal of Management Plan, and in coordination with fishers, managers elaborated the actions.<br><br>However, as the Management Plan of Shrimp of the Mexcian Pacific remains unpublished, it cannot be said that the management system demonstrates consideration of the information and explains how it is used or not used if it is not publicly visible. Thus, SG100 is not met.</td></tr>
<tr><td rowspan="3">c</td><td colspan="4">Participation</td></tr>
<tr><td>Guide post</td><td></td><td>The consultation process provides opportunity for all interested and affected parties to be involved.</td><td>The consultation process provides opportunity and encouragement for all interested and affected parties to be involved, and facilitates their effective engagement.</td></tr>
<tr><td>Met?</td><td></td><td>Yes</td><td>No</td></tr>
<tr><td colspan="5">Rationale</td></tr>
<tr><td colspan="5">The National Committee for Fisheries and Aquaculture is integrated by representatives of the Federal and states government and representatives of industrial fishermen and small-scale fishermen and its main objective is to establish the dates agreed for season closures and fishing season opening. These meetings are convened at least twice a year and are well attended by the main stakeholders. Thus, this consultation process provides opportunity for all interested and affected parties to be involved and facilitates their effective engagement, meeting the SG80. However, the assessment team did not receive evidence of encouragement for all interested parties to be involved thus the SG100 is not reached.</td></tr>
<tr><td colspan="5">References</td></tr>
<tr><td colspan="5">DOF, 2018a. Ley General de Pesca y Acuacultura Sustentables. Nueva Ley publicada en el Diario Oficial de la Federación el 24 de julio de 2007. Última reforma publicada en el Diario Oficial de la Federación el 24 de abril de 2018. Cámara de Diputados del H. Congreso de la Unión, Secretaría General, Secretaría de Servicios Parlamentarios. http://www.diputados.gob.mx/LeyesBiblio/pdf/LGPAS_240418.pdf</td></tr>
<tr><td colspan="5">Draft scoring range and information gap indicator added at Announcement Comment Draft Report</td></tr>
</table>

| | |
|---|---|
| **Draft scoring range** | >80 |
| **Information gap indicator** | Information sufficient to score PI, to reach a higher score, please provide evidence of *encouragement* for all interested parties to be involved in consultation processes. |
| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
| **Overall Performance Indicator score** | 85 |
| **Condition number (if relevant)** | |

## PI 3.1.3 – Long term objectives

| PI 3.1.3 | | The management policy has clear long-term objectives to guide decision-making that are consistent with MSC Fisheries Standard, and incorporates the precautionary approach | | |
|---|---|---|---|---|
| Scoring Issue | | SG 60 | SG 80 | SG 100 |
| a | Objectives | | | |
| | Guide post | Long-term objectives to guide decision-making, consistent with the MSC Fisheries Standard and the precautionary approach, are implicit within management policy. | Clear long-term objectives that guide decision-making, consistent with MSC Fisheries Standard and the precautionary approach are explicit within management policy. | Clear long-term objectives that guide decision-making, consistent with MSC Fisheries Standard and the precautionary approach, are explicit within and required by management policy. |
| | Met? | Yes | Yes | Yes |

**Rationale**

Article 2 of the LGPAS presents 15 long-term objectives, among them objective I states: to establish and define the principles for ordering, promoting and regulating the integral management and sustainable use of fisheries and aquaculture, taking into account social, technological, productive, biological and environmental aspects. Similarly, objective III states: To establish the bases for the management, conservation, protection, repopulation and sustainable use of fishery and aquaculture resources, as well as the protection and rehabilitation of the ecosystems in which these resources are found. Mexico is a signatory of the FAO Code of Conduct for Responsible Fisheries and compliance with its principles is embedded in the ***Plan Sectorial*** (SAGARPA, 2013. Mexican regulations therefore do have long-term objectives consistent with the MSC criteria and the precautionary approach and these regulations are explicit within management policy. Therefore, the SG100 is met.

This PI focuses on the long-term objectives at the broader management level, the operational limitations of the implementation of the harvest strategy and harvest control rules are not score here, but rather in the relevant PIs under Principle 1.

**though explicit long-term objective are in place, the precautionary approach is not explicitly included in the technical reports.**

**References**

DOF, 2013. Norma Oficial Mexicana NOM-002-SAG/PESC-2013, para ordenar el aprovechamiento de las especies de camarón en aguas de jurisdicción federal de los Estados Unidos Mexicanos. Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación. Diario Oficial de la Federación, 11 de Julio de 2013, México.
https://www.conapesca.gob.mx/work/sites/cona/dgop/2018/normas/2_NOM_002_SAG_PESC_2013.pdf

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|---|---|
| DOF, 2018a. Ley General de Pesca y Acuacultura Sustentables. Nueva Ley publicada en el Diario Oficial de la Federación el 24 de julio de 2007. Última reforma publicada en el Diario Oficial de la Federación el 24 de abril de 2018. Cámara de Diputados del H. Congreso de la Unión, Secretaría General, Secretaría de Servicios Parlamentarios. http://www.diputados.gob.mx/LeyesBiblio/pdf/LGPAS_240418.pdf | |
| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | |
| **Draft scoring range** | >80 |
| **Information gap indicator** | Information sufficient to score PI |
| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 3.2.1 – Fishery-specific objectives

| **PI 3.2.1** | | **The fishery-specific management system has clear, specific objectives designed to achieve the outcomes expressed by MSC's Principles 1 and 2** | | |
|---|---|---|---|---|
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | **Objectives** | | | |
| | **Guide post** | Objectives, which are broadly consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are implicit within the fishery-specific management system. | Short and long-term objectives, which are consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are explicit within the fishery-specific management system. | Well defined and measurable short and long-term objectives, which are demonstrably consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are explicit within the fishery-specific management system. |
| | **Met?** | Yes | Partial | No |
| **Rationale** | | | | |
| The fishery long-term objective as stated in the Norma Oficial Mexicana (NOM) (Official Mexican Standard) NOM-002-SAG/PESC-2013 is: To contribute to the preservation, conservation and sustainable use of the populations of the different shrimp species in the estuarine lagoon systems, bays, marshes and marine waters of federal jurisdiction of the United Mexican States.<br><br>The draft of the Pacific Shrimp Management Plan (2012) states clear short-term objectives that is consistent with achieving the outcomes expressed by MSC's Principles 1 and 2. However, the management plan has yet to be approve and implemented. Until this management plan is implemented, long-term and short-term goals cannot be considered explicit. **Because there are long term objectives, but no short-term objectives in place, a partial score is awarded to the SG80** | | | | |
| **References** | | | | |
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| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | | | | |

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|---|---|
| **Draft scoring range** | 60-79 |
| **Information gap indicator** | Information sufficient to score PI |
| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 3.2.2 – Decision-making processes

<table>
<tr><td>PI 3.2.2</td><td colspan="4">The fishery-specific management system includes effective decision-making processes that result in measures and strategies to achieve the objectives, and has an appropriate approach to actual disputes in the fishery</td></tr>
<tr><td colspan="2">Scoring Issue</td><td>SG 60</td><td>SG 80</td><td>SG 100</td></tr>
<tr><td>a</td><td colspan="4">Decision-making processes</td></tr>
<tr><td></td><td>Guide post</td><td>There are some decision-making processes in place that result in measures and strategies to achieve the fishery-specific objectives.</td><td>There are established decision-making processes that result in measures and strategies to achieve the fishery-specific objectives.</td><td></td></tr>
<tr><td></td><td>Met?</td><td>Yes</td><td>Yes</td><td></td></tr>
<tr><td colspan="5">Rationale</td></tr>
<tr><td colspan="5">The Consejo Nacional de Pesca y Acuacultura (National Council of Fisheries and Aquaculture) is the forum where scientists expose the findings, results and conclusions of research related with the status of the shrimp stocks in the Pacific. This is a hearing forum, where fishers express their points of view related with the fishery management, and CONAPESCA analyzes all recommendations and points of view in the decision-making process, to enact the agreed regulations.<br><br>Thus, the decision-making processes respond to serious and other important issues and use the precautionary approach and are based on best available information. SG80 is met.</td></tr>
<tr><td>b</td><td colspan="4">Responsiveness of decision-making processes</td></tr>
<tr><td></td><td>Guide post</td><td>Decision-making processes respond to serious issues identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take some account of the wider implications of decisions.</td><td>Decision-making processes respond to serious and other important issues identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take account of the wider implications of decisions.</td><td>Decision-making processes respond to all issues identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take account of the wider implications of decisions.</td></tr>
<tr><td></td><td>Met?</td><td>Yes</td><td>No</td><td>No</td></tr>
<tr><td colspan="5">Rationale</td></tr>
<tr><td colspan="5">During meetings to define the dates of the fishing season or for the closure, CONAPESCA considers all the information, opinions and any issue exposed during the hearings for decision making. This information is contained in the minutes of the meetings. However, one serious issue is the overexploited status of white and blue shrimp stocks, recently identified (INAPESCA, 2018); because the management strategy has not been sufficient to avoid this overexploitation the management response has not been adequeate to achieve the overall objective of the management system. As there is no evidence that CONAPESCA has implemented specific activities or strategies to reverse the overexploited status of the stocks, SG80 is not met.</td></tr>
</table>

<table>
<tr><td rowspan="3">c</td><td colspan="4">Use of precautionary approach</td></tr>
<tr><td>Guide post</td><td></td><td>Decision-making processes use the precautionary approach and are based on best available information.</td><td></td></tr>
<tr><td>Met?</td><td></td><td>No</td><td></td></tr>
<tr><td colspan="5">Rationale</td></tr>
<tr><td colspan="5">INAPESCA has a permanent research project and a monitoring program for the shrimp fishery in the Pacific. The project produces all the biological information of the three shrimp stocks and the fishery. INAPESCA delivers a technical report to CONAPESCA every time a fishing season closure or an opening fishing season is established. Before CONAPESCA announces any regulation for the fishery in the federal gazette, the law requires that CONAPESCA must consider the INAPESCA Technical Reports, which are officially delivered. However, it is unclear how the precautionary approach is employed in the decision-making process based on the information about the status of the stock.</td></tr>
<tr><td rowspan="3">d</td><td colspan="4">Accountability and transparency of management system and decision-making process</td></tr>
<tr><td>Guide post</td><td>Some information on the fishery’s performance and management action is generally available on request to stakeholders.</td><td>Information on the fishery’s performance and management action is available on request, and explanations are provided for any actions or lack of action associated with findings and relevant recommendations emerging from research, monitoring, evaluation and review activity.</td><td>Formal reporting to all interested stakeholders provides comprehensive information on the fishery’s performance and management actions and describes how the management system responded to findings and relevant recommendations emerging from research, monitoring, evaluation and review activity.</td></tr>
<tr><td>Met?</td><td>Yes</td><td>Yes</td><td>No</td></tr>
<tr><td colspan="5">Rationale</td></tr>
<tr><td colspan="5">INAPESCA and CONAPESCA produce formal reports that provide information on the opening and closing dates of the fishing season. Those reports can be provided to anyone who requests them. The main results of the reports are presented during the meetings of the Consejo Nacional de Pesca y Acuacultura, and are published in the Federal Gazette. However, only recently a stock assessment conducted by INAPESCA (2018) showed the performance of the fishery, showing an overexploited state of white and blue shrimp. There are no specific indicators used in the management to monitor the performance of the fishery The SG80 is met.</td></tr>
<tr><td rowspan="2">e</td><td colspan="4">Approach to disputes</td></tr>
<tr><td>Guide post</td><td>Although the management authority or fishery may be subject to continuing court challenges, it is not indicating a disrespect or defiance of the law by repeatedly violating the same law or regulation</td><td>The management system or fishery is attempting to comply in a timely fashion with judicial decisions arising from any legal challenges.</td><td>The management system or fishery acts proactively to avoid legal disputes or rapidly implements judicial decisions arising from legal challenges.</td></tr>
</table>

| | | | | |
|---|---|---|---|---|
| | | necessary for the sustainability for the fishery. | | |
| | **Met?** | Yes | Yes | Yes |

**Rationale**

The Directorate General for Inspections and Surveillance has a website with information related to all judicial reports, and their resolutions. If during a routine inspection, a DGIS officer takes a judicial report with any possible irregularity or illegal action, the official must submit the report to the DGIS that delivers the case to the Judicial Unit. The potential offender has a deadline to appeal the accusation, after which the Judicial Unit issues the final judgment. It is mandatory for the Legal Unit of CONAPESCA to satisfactorily and punctually resolve all judicial decisions arising from legal challenges. In the event that the Legal Unit of CONAPESCA does not respond, the claim does not proceed.

Most legal disputes are between illegal fishers and the authority. The most common form of legal dispute is illegal fishing, which must follow a pre-established procedure: CONAPESCA officials are the only ones authorized to prepare an official report on illegal fishing. Other types of legal disputes could be between two private parties, which must be sanctioned in court. By-catch of rays is not precisely illegal, as the permit establishes a limit of 10% of the weight of by-catch species, with respect to shrimp capture. Because the guidepost says "avoid legal disputes or rapidly implements judicial decisions", that is exactly what CONAPESCA does. There are no disputes unattended by the authority.

**References**

CONAPESCA: **Actions and Results of fishing and aquaculture inspection and surveillance activities**. **Data and Resources**. Open Data at: **https://datos.gob.mx/busca/dataset/acciones-y-resultados-de-las-actividades-de-inspeccion-y-vigilancia-pesquera-y-acuicola**

**Draft scoring range and information gap indicator added at Announcement Comment Draft Report**

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| **Draft scoring range** | 60-79 |
| **Information gap indicator** | More information sought |

**Overall Performance Indicator scores added from Client and Peer Review Draft Report**

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| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 3.2.3 – Compliance and enforcement

| PI 3.2.3 | | Monitoring, control and surveillance mechanisms ensure the management measures in the fishery are enforced and complied with | | |
|---|---|---|---|---|
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | **MCS implementation** | | | |
| | **Guide post** | Monitoring, control and surveillance mechanisms exist, and are implemented in the fishery and there is a reasonable expectation that they are effective. | A monitoring, control and surveillance system has been implemented in the fishery and has demonstrated an ability to enforce relevant management measures, strategies and/or rules. | A comprehensive monitoring, control and surveillance system has been implemented in the fishery and has demonstrated a consistent ability to enforce relevant management measures, strategies and/or rules. |
| | **Met?** | Yes | Yes | No |
| **Rationale** | | | | |
| The Directorate General of Inspections and Surveillance has a comprehensive system that includes: VMS tracking system for industrial vessels (Sistema de Monitoreo Satelital de Embarcaciones Pesqueras SISMEP - Fisheries Satellite Monitoring System), Dock Inspection Program, Surveillance Program with boat trips to patrol any illicit fishing activity in estuaries, lagoons and coast to identify. In coordination with the Road Police, the DGIS inspects the legal origin of the seafood transported in any land vehicle, and also inspections in frozen quarters and seafood warehouses. The Directorate General of Inspections and Surveillance has a website with information related with all judicial and legal challenges, and their resolutions. **The MCS system has demonstrated an ability to enforece some of the relevant measures, including the closures, no fishing zones in coastal areas and MPAs, thus meeting the SG80. However, there is no evidence of *consistent* enforcement, thus the SG100 is not met.**<br>thus SG 80 is not met. | | | | |
| **b** | **Sanctions** | | | |
| | **Guide post** | Sanctions to deal with non-compliance exist and there is some evidence that they are applied. | Sanctions to deal with non-compliance exist, are consistently applied and thought to provide effective deterrence. | Sanctions to deal with non-compliance exist, are consistently applied and demonstrably provide effective deterrence. |
| | **Met?** | Yes | No | No |
| **Rationale** | | | | |
| Legal Unit of CONAPESCA keeps files of all the legal actions executed by its officers. The Legal Unit put a summary of all these actions in the CONAPESCA website, under the section: Actions and Results of Fisheries and Aquaculture Inspection and Surveillance Activities (only from 2009 to 2014). Additional analysis is necessary to demonstrate the effectiveness of this program in deterring non-compliance. As for industrial ships, the VMS program and the Harbor Master Authority and PROFEPA prepare periodic reports that show fleet compliance. **Sanctions to deal with non-complianc exist, however, based on anectodal evidence from the pre-assessment** | | | | |

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| **onsite visit, the team received some evidence that sanctions are applied, however, the team did not receive evidence that thesanctions are consistently applied, thus theSG80 is not met.** | | | | |
| **c** | **Compliance** | | | |
| | **Guide post** | Fishers are generally thought to comply with the management system for the fishery under assessment, including, when required, providing information of importance to the effective management of the fishery. | Some evidence exists to demonstrate fishers comply with the management system under assessment, including, when required, providing information of importance to the effective management of the fishery. | There is a high degree of confidence that fishers comply with the management system under assessment, including, providing information of importance to the effective management of the fishery. |
| | **Met?** | Yes | Yes | No |
| **Rationale** | | | | |
| Reports of the regular surveillance and monitoring activities in the fishing areas by CONAPESCA. Fishermen deliver the logbook after each trip therefore some evidence exists to demonstrate fishers comply with the management system under assessment, including, when required, providing information of importance to the effective management of the fishery. Thus, SG80 is met. | | | | |
| **d** | **Systematic non-compliance** | | | |
| | **Guide post** | | There is no evidence of systematic non-compliance. | |
| | **Met?** | | Yes | |
| **Rationale** | | | | |
| According to the reports of non-compliance with the provisions of the law presented to the auditors, there are no systematic infractions in the fishery. These reports integrate the information of all the minutes sent to the Legal Unit of all illegal fishing activities in the country, so it was necessary to take a sample (n = 199) to identify the most common infractions in shrimp fishing in the Pacific coast. According to the report, from 2011 to 2018, the sample showed that 10% of infractions issued were related to illegal shrimp fishing and 52% were due to illegal fishing gear in general. However, these data are not sufficient to estimate systematic non-compliance. The official reports (CONAPESCA, 2019) show that only in Sinaloa, in 2018 the Direccion General de Inspeccion y Vigilancia carried out 7,843 surveillance acts (3,632 water patrols, 3,353 land patrol, 306 check points and 522 inspections). It is necessary to systematize all this information to generate the appropriate indicators on illegal fishing and systematic non-compliance.<br><br>**There is no evidence of systematic non-compliance and SG80 is met.** | | | | |
| **References** | | | | |
| The Sistema de Monitoreo Satelital de Embarcaciones Pesqueras SISMEP (Fisheries Satellite Monitoring System) consists of the necessary set of hardware and software and data processing to provide the required **service** **http://207.248.54.212/MonitoreoSatelital/** | | | | |
| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | | | | |

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| **Draft scoring range** | 60-79 |
| **Information gap indicator** | PRovide the following additional evidence:<br>Evidence of consistent implementation of sanctions. |
| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

## PI 3.2.4 – Monitoring and management performance evaluation

| PI 3.2.4 | | There is a system of monitoring and evaluating the performance of the fishery-specific management system against its objectives<br>There is effective and timely review of the fishery-specific management system | | |
|---|---|---|---|---|
| **Scoring Issue** | | SG 60 | SG 80 | SG 100 |
| **a** | **Evaluation coverage** | | | |
| | **Guide post** | There are mechanisms in place to evaluate some parts of the fishery-specific management system. | There are mechanisms in place to evaluate key parts of the fishery-specific management system. | There are mechanisms in place to evaluate all parts of the fishery-specific management system. |
| | **Met?** | Yes | No | No |
| **Rationale** | | | | |
| Because shrimp fishery in the Pacific is one of the most important fisheries in Mexico, historically it has had the full support of Mexico's fisheries management system (DOF, 1997), which includes landings records, stock assessments, fleet composition, VMS tracking system, bycatch records, use of TED and other key elements of the fishery. However, all this information, which could be useful for assessing the performance of the fishery, is not organized systematically, nor is its purpose to determine the performance of the fishery. The Fishery Management Plan of the Pacific Shrimp (INAPESCA, 2018) incorporates two types of indicators: 1) indicators for compliance and 2) performance indicators. The plan includes all compliance indicators, but the performance indicators are not included in the current version of the plan, that is why the plan establishes that they will be developed by the National Committee. Because the Fishery Management Plan has not been published in the Federal Gazette, it cannot yet be considered a binding instrument.<br><br>**There are mechanisms in place to evaluate some parts of the fishery-specific management system. In particular the Official Standards are reviewed. The original NOM-002-PESC-1993 has been reviewed recently and all changes due to technological and scientific knowledge have been incorporated in the new NOM-002-SAG/PESC-2013. SG60 is met, however, it cannot be concluded that key parts of the management system are evaluated. As consequence, the SG80 is not met.** | | | | |
| **b** | **Internal and/or external review** | | | |
| | **Guide post** | The fishery-specific management system is subject to occasional internal review. | The fishery-specific management system is subject to regular internal and occasional external review. | The fishery-specific management system is subject to regular internal and external review. |
| | **Met?** | Yes | No | No |
| **Rationale** | | | | |
| No evidence was found to demonstrate that the fisheries management system is subject to periodic internal reviews. It was not possible to demonstrate that the management system is reviewed by external referees. There is no evidence to show an external review either for the results of the stock assessment or for the decision-making process. Thus SG80 is not met. | | | | |

| References | |
|---|---|
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| **Draft scoring range and information gap indicator added at Announcement Comment Draft Report** | |
| **Draft scoring range** | 60-79 |
| **Information gap indicator** | More information sought / Information sufficient to score PI |
| **Overall Performance Indicator scores added from Client and Peer Review Draft Report** | |
| **Overall Performance Indicator score** | |
| **Condition number (if relevant)** | |

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# 7 Appendices

[4] MSC FCPV2.1 7.10.7: In Principle 1 or 2, the team shall score PIs comprised of differing scoring elements (species or habitats) that comprise part of a component affected by the UoA.

## 7.2 Harmonised fishery assessments

Because there are no other MSC certified overlapping fisheries for P1 and P2, harmonization assessment was made only for P3. The CAB identified some P3 scores from other certified fisheries, such as the small pelagic in the southern Gulf of California and the small pelagic fishery in Sonora, Gulf of California, which coincided with the scores of the fishery assessed here. Therefore, efforts for harmonization were conducted by team members through reviews of reports from those certified fisheries. The following paragraphs discuss the overlaps for each PI.

**Principle 1:** No other certified fishery in the Mexican Pacific targets the same biological unit as the one targeted by the UoA assessed here. The Pacific shrimp fishery and small pelagic fisheries operate in completely different areas; Small pelagic vessels operate offshore at depths greater than 30 feet, while the shrimp fleet operates in coastal areas less than 30 feet deep.

Differences in the distribution of the Opisthonema complex of the small pelagics fisheries dominated by *O. libertate,* with small amounts of *O. bulleri* and *O. medirastre* are not present in the shrimp fisheries by-catch. The two fisheries are managed in separate regions established by CRIP – INAPESCA offices, with different information, stock assessments and implementation of management measures.

**Principle 2:** There are no other MSC-certified fisheries that fall within the geographical range of this fishery. As this fishery is certified against FCP v2.1, it is not yet subject to the MSC cumulative P2 impacts approach.

**Principle 3:**

*Governance and Policy component:* there are several other MSC certified fisheries in Mexico. All fisheries in Mexico are subject to Federal regulatory mandates under the overarching Fisheries Law (LGPAS). This law defines the general long term goal of sustainability and the organizational and procedural structure to achieve the general goal. Elements in Principle 3 that pertain to the general goals, governance and management that are common to all fisheries in Mexico should therefore have consistent background, scores and rationales. Scores for the Pacific shrimp fishery were considered for P3 harmonization.

*Fisheries Specific Management System:* The Pacific shrimp fishery does not share specific elements with the Fisheries Specific Management System Component (3.2.1-3.2.4) with Southern Gulf of California small pelagics fishery, since this is regulated by NOM-PESC-003-1993, while shrimp fisheries are regulated by NOM-002-SAG/PESC2013. It is important to note that the small pelagics fisheries received conditions for the following PIs under P3: PI 3.2.2, 3.2.3, 3.2.4, 3.2.5.

## Annex 1: Species Table

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.

**Table 8. Species Table**

| Common Name (Spanish) | Family | Scientific Name | Total Catch (t) | Discarded Catch (t) | % TC | MSC class. |
|---|---|---|---|---|---|---|
| Camarón Café | Penaeidae | *Farfantepenaeus californiensis* | 226.3 | 0 | 11% | Target P1 |
| Camarón azul | Penaeidae | *Litopenaeus stylirostris* | 67.2 | 0 | 3.4 | Target P1 |
| Camarón blanco | Penaeidae | *Litopenaeus vannamei* | 24.9 | 0 | 1.3% | Target P1 |
| Otros Camarones Y Camaron Café Talla Chica | Penaeidae | *Farfantepenaeus brevirostris, Xiphopenaeus riveti, Farfantepenaeus californiensis* | 194.9 | 0 | 5.2% | Target P1 (IPI) |
| Mojarras | Gerreidae | *Diapterus aureolus, Diapterus peruvianus* | 167.9 | 163.7 | 8.5% | Secondary - Main |
| Rayas Y Mantarrayas | Dasyatidae, Gymnuridae, Mobulidae, Rhinobatidae | *Dasyatis dipterura, Dasyatis longa, Dasyatis violacea, Gymnura crebripunctata, Gymnura marmorata, Rhinobatos glaucostigma* | 109.4 | 93.8 | 5.54% | Secondary - Main |
| Jaiba | Portunidae | *Callinectes Bellicosius,* *Callinectes Arcuatus* | 171.3 | 165.9 | 8.7% | Secondary - Main |
| Burros | Haemulidae | *Haemulon steindachneri, Haemulon scudderii* | 98.7 | 88.4 | 5% | Secondary - Main |
| Chiles | Synodontidae | *Synodus evermanni, Synodus lucioceps, Synodus scituliceps, Synodus sechurae* | 95.6 | 85.3 | 4.8% | Secondary - Minor |
| Lenguados | Achiridae, Bothidae | *Achirus klunzingeri, Achirus mazatlanus, Achirus scutum, Bothus constellatus, Bothus leopardinus, Engyophrys sanctilaurentia* | 82.8 | 48.9 | 4.2% | Secondary - Minor |
| Chivos | Mullidae | *Mulloidichthys dentatus, Pseudupeneus grandisquamis* | 68.8 | 68.0 | 3.5% | Secondary - Minor |

| Common Name (Spanish) | Family | Scientific Name | Total Catch (t) | Discarded Catch (t) | % TC | MSC class. |
|---|---|---|---|---|---|---|
| Vacas, Rubios | Triglidae | *Bellator gymnostethus, Bellator loxias, Prionotus albirostris, Prionotus birostratus* | 48.1 | 44.6 | 2.4% | Secondary - Minor |
| 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* | 72.4 | 68.0 | 3.7% | Secondary - Minor |
| Camaròn Azul | Penaeidae | *Litopenaeus stylirostris* (AZUL) | 67.2 | 0 | 3.4% | Target P1 (IPI) |
| Estrellas De Mar | Asteriidae | *Henricia levisuscula, Leptasterias hexactis, Patiria miniata, Pisaster brevipinus, Pisaster giganteus, Pisaster ochraceus, Pycnopodia helianthoides* | 58.5 | 58.0 | 2.9% | Secondary - Minor |
| Corvinas, Berrugatas | Sciaenidae | *Bairdiella armata, Atractoscion nobilis, Bairdiella ensifera, Bairdiella incistia, Cheilotrema saturnum, Cynoscion albus, Cynoscion nannus, Cynoscion reticulatus, Elattarchus archidium, Isopisthus remifer* | 54.2 | 27.9 | 2.7% | Secondary - Minor |
| Bagre | Ariidae | *Ariopsis guatemalensis, Notarius kessleri, Occidentarius platypogon* | 39.2 | 36.8 | 2.0% | Secondary - Minor |
| Pargos | | *Pargos spp* | 37.2 | 18.5 | 1.9% | Secondary - Minor |
| Cabrillas, Mero, Baquetas | Moronidae, Serranidae | *Stereolepis gigas, Alphestes immaculatus, Alphestes multiguttatus, Hyporthodus acanthistius, Epinephelus analogus* | 30.3 | 27.1 | 1.5% | Secondary - Minor |
| Escorpiones, Rocotes | Scorpaenidae | *Pontinus furcirhinus, Pontinus sierra, Pontinus vaughani, Scorpaena guttata, Scorpaena histrio, Scorpaena mystes, Scorpaena sonorae,* | 26.5 | 25.3 | 1.3% | Secondary - Minor |

| Common Name (Spanish) | Family | Scientific Name | Total Catch (t) | Discarded Catch (t) | % TC | MSC class. |
|---|---|---|---|---|---|---|
| | | *Scorpaenodes xyris, Sebastes cortezi, Sebastes macdonaldi* | | | | |
| Sardinas | Clupeidae | *Etrumeus teres, Harengula thrissina, Lile stolifera, Lile gracilis, Opisthonema bulleri, Opisthonema libertate, Opisthonema medirastre* | 26.3 | 26.2 | 1.3% | Secondary - Minor |
| Camarón Blanco Del Pacífico | | *Litopenaeus occidentalis* (BLANCO) | 24.9 | 0 | 1.3% | Target P1 (IPI) |
| Botetes | Tetraodontidae | *Arothron hispidus, Arothron meleagris, Lagocephalus lagocephalus* | 22.6 | 4.8 | 1.1% | Secondary - Minor |
| Peces Sapo | Batrachoididae | *Batrachoides waltersi, Porichthys analis* | 21.8 | 21.7 | 1.1% | Secondary - Minor |
| Camaron Mantis | Hemisquillidae, Lysiosquillidae | *Hemisquilla ensigera californiensis, Lysiosquilla desaussurei* | 20.3 | 20.3 | 1.0% | Secondary - Minor |
| Morenas | Muraenidae | *Gymnothorax castaneus, Gymnothorax mordax* | 19.4 | 19.4 | 1.0% | Secondary - Minor |
| Caracol | | *Caracol spp* | 14.5 | 11.4 | 0.7% | Secondary - Minor |
| Cochis | Balistidae | *Balistes polylepis, Pseudobalistes naufragium, Sufflamen verres* | 17.9 | 5.4 | 0.9% | Secondary - Minor |
| Lenguas | Cynoglossidae | *Symphurus atramentatus, Symphurus atricaudus, Symphurus callopterus, Symphurus chabanaudi, Symphurus elongatus, Symphurus gorgonae* | 14.3 | 14.1 | 0.7% | Secondary - Minor |
| Medusa Bola De Cañon | Rhizostomatidae | *Stomolophus meleagris* | 13.5 | 13.5 | 0.7% | Secondary - Minor |
| Agujones | | *Tylosurus pacificus, Tylosurus crocodilus, Ablennes hians* | 13.0 | 12.4 | 0.7% | Secondary - Minor |
| Robalos | Centropomidae | *Centropomus armatus, Centropomus medius, Centropomus nigrescens* | 12.8 | 5.7 | 0.6% | Secondary - Minor |

| Common Name (Spanish) | Family | Scientific Name | Total Catch (t) | Discarded Catch (t) | % TC | MSC class. |
|---|---|---|---|---|---|---|
| Cangrejos Cajeta | Calappidae | *Calappa saussurei, Hepatus kossmanni, Hepatus lineatus, Platymera gaudichaudii* | 12.3 | 10.9 | 0.6% | Secondary - Minor |
| Raton | | *Cheilotrema saturnum* | 11.4 | 10.4 | 0.5% | Secondary - Minor |
| Calamar | Loliginidae, Ommastrephidae | *Loligo opalescens, Loliolopsis diomedeae, Dosidicus gigas* | 10.7 | 0.3 | 0.5% | Secondary - Minor |
| Algas Rojas | Gigartinaceae, Florideophyceae, Gelidiaceae, Bangiaceae | *Gigartina canaliculata, Eucheuma uncinatum, Gelidium robustum* | 9.9 | 9.9 | 0.5% | Secondary - Minor |
| Peluqueros | Ephippidae | *Parapsettus panamensis, Chaetodipterus zonatus* | 9.1 | 7.9 | 0.5% | Secondary - Minor |
| Piernas, Conejo | Malacanthidae, Caulolatilus affinis, Caulolatilus cabezon | *Caulolatilus hubbsi, Caulolatilus princeps, Caulolatilus affinis* | 8.6 | 7.8 | 0.4% | Secondary - Minor |
| Palometas | Stromateidae | *Peprilus medius, Peprilus simillimus, Peprilus snyderi* | 8.2 | 4.9 | 0.4% | Secondary - Minor |
| Sierra | Scombridae | *Acanthocybium solandri, Scomber japonicus, Scomberomorus concolor, Scomberomorus sierra* | 7.9 | 1.1 | 0.4% | Secondary - Minor |
| Conchas | | Conchas | 7.4 | 7.4 | 0.4% | Secondary - Minor |
| Anchoveta | Engraulidae | *Anchoa analis, Anchoa argentivittata, Anchoa lucida , Anchoa helleri* | 6.6 | 6.6 | 0.3% | Secondary - Minor |
| Cangrejo | (blank) | *Cangrejo Spp* | 6.2 | 4.1 | 0.3% | Secondary - Minor |
| Caracol Chino | Muricidae | *Hexaplex nigritus, Phyllonotus erhythostoma, Phyllonotus regius, Haustellum recurvirostris* | 6.1 | 1.1 | 0.3% | Secondary - Minor |

| Common Name (Spanish) | Family | Scientific Name | Total Catch (t) | Discarded Catch (t) | % TC | MSC class. |
|---|---|---|---|---|---|---|
| Pejerrey | Atherinidae | *Atherinella eriarcha* | 5.6 | 5.5 | 0.3% | Secondary - Minor |
| Tiburon | | tiburon spp | 5.1 | 1.1 | 0.3% | Secondary - Minor |
| Lapa | Patellidae | *Patella mexicana* | 4.8 | 4.8 | 0.2% | Secondary - Minor |
| Brotulas, Cong | Ophidiidae | *Lepophidium microlepis* | 3.9 | 3.8 | 0.2% | Secondary - Minor |
| Cangrejo Ermitaño | Diogenidae | *Petrochirus californiensis* | 3.7 | 3.7 | 0.2% | Secondary - Minor |
| Cangrejo De Piedra | Xanthidae | *Menippe frontalis, Ozius verreauxii* | 3.5 | 2.9 | 0.2% | Secondary - Minor |
| Galleta De Mar | Clypeasteridae | *Clypeaster rotundus, Encope grandis, Mellita longifissa* | 3.4 | 3.4 | 0.2% | Secondary - Minor |
| Chupapiedra | Gobiesocidae | *Tomicodon eos, Tomicodon zebra* | 3.1 | 3.1 | 0.2% | Secondary - Minor |
| Camaron Roca | Sicyoniidae | *Sicyonia Disdorsalis* | 3.0 | 0.6 | 0.2% | Secondary - Minor |
| Congrios | Congridae | *Ariosoma gilberti, Rhynchoconger nitens, Chiloconger dentatus* | 2.9 | 2.8 | 0.1% | Secondary - Minor |
| Langosta | Palinuridae | *Panulirus gracilis, Panulirus inflatus, Panulirus interruptus, Panulirus penicillatus* | 2.7 | 1.7 | 0.1% | Secondary - Minor |
| Sargazos | Alariaceae, Lessoniaceae, Sargassaceae | *Eisenia arborea, Macrocystis pyrifera, Sargassum sinicola* | 2.7 | 2.5 | 0.1% | Secondary - Minor |
| Cangrejos Araña | Majidae | *Maiopsis panamensis, Mithrax armatus* | 2.5 | 2.5 | 0.1% | Secondary - Minor |
| Chopas | Kyphosidae | *Girella nigricans, Kyphosus analogus* | 2.4 | 2.3 | 0.1% | Secondary - Minor |
| Almeja Blanca | | *Dosinia ponderosa* | 2.1 | 2.0 | 0.1% | Secondary - Minor |
| Dormilonas | Lobotidae | *Lobotes pacificus* | 2.0 | 2.0 | 0.1% | Secondary - Minor |
| Erizo | Echinometridae, Arbaciidae | *Echinometra vanbrunti, Strongylocentrotus franciscanus, Strongylocentrotus purpuratus* | 2.0 | 2.0 | 0.1% | Secondary - Minor |

| Common Name (Spanish) | Family | Scientific Name | Total Catch (t) | Discarded Catch (t) | % TC | MSC class. |
|---|---|---|---|---|---|---|
| Calamar Dedal | Loliginidae | *Loligo opalescens, Loliolopsis diomedeae* | 1.8 | 0.01 | 0.1% | Secondary - Minor |
| Langostino | Palaemonidae | *Macrobrachium americanum* | 1.7 | 1.7 | 0.1% | Secondary - Minor |
| Concha, Joyero | Chamidae | *Chama buddiana* | 1.6 | 1.6 | 0.1% | Secondary - Minor |
| Caracol Menongena | Melongenidae | *Melongena patula* | 1.5 | 0.02 | 0.1% | Secondary - Minor |
| Gobios | Gobiidae | *Gobionellus microdon, Barbulifer pantherinus, Microgobius miraflorensis, Barbulifer pantherinus, Bathygobius ramosus, Bollmania stigmatura, Bollmannia chlamydes, Bollmania ocellata* | 1.5 | 1.3 | 0.1% | Secondary - Minor |
| Lisas | Monacanthidae, Mugilidae | *Aluterus monoceros, Mugil cephalus, Mugil curema* | 1.4 | 1.2 | 0.1% | Secondary - Minor |
| Angel | Pomacanthidae | *Holacanthus passer* | 1.4 | 0.8 | 0.1% | Secondary - Minor |
| Jaiba de Roca | Portunidae | *Euphylax robustus* | 1.2 | 1.2 | 0.1% | Secondary - Minor |
| Viejas | Labridae | *Bodianus diplotaenia, Decodon melasma, Halichoeres dispilus* | 1.2 | 1.1 | 0.1% | Secondary - Minor |
| Cintas, Sables | Trichiuridae | *Lepidopus fitchi, Trichiurus lepturus, Trichiurus nitens* | 1.2 | 1.2 | 0.1% | Secondary - Minor |
| Barracudas | Sphyraenidae | *Sphyraena argentea* | 1.2 | 1.0 | 0.1% | Secondary - Minor |
| Almeja Catarina | Pectinidae | *Argopecten ventricosus* | 1.1 | 1.1 | 0.1% | Secondary - Minor |
| Barbudo | Polynemidae | *Polydactylus opercularis* | 1.0 | 1.0 | 0.0% | Secondary - Minor |
| Culebras | | | 1.0 | 1.0 | 0.0% | Secondary - Minor |
| Caracol Burro | Strombidae | *Strombus peruvianus, Strombus galeatus* | 1.0 | 0.3 | 0.1% | Secondary - Minor |
| Antenados | Antennariidae | *Antennarius sanguineus* | 0.9 | 0.8 | 0.0% | Secondary - Minor |

| Common Name (Spanish) | Family | Scientific Name | Total Catch (t) | Discarded Catch (t) | % TC | MSC class. |
|---|---|---|---|---|---|---|
| Mariposas | Chaetodontidae | *Chaetodon humeralis* | 0.9 | 0.9 | 0.0% | Secondary - Minor |
| Pulpo | Octopodidae | *Octopus bimaculatus, Octopus digueti, Octopus vulgaris* | 0.9 | 0.3 | 0.0% | Secondary - Minor |
| Tiesos | Ophicthidae | *Ophichthus zophochir* | 0.8 | 0.8 | 0.0% | Secondary - Minor |
| Ronco | | | 0.8 | 0.8 | 0.0% | Secondary - Minor |
| Escolares | Gempylidae | *Gempylus serpens, Lepidocybium flavobrunneum, Ruvettus pretiosus* | 0.7 | 0.4 | 0.0% | Secondary - Minor |
| Cangrejo tractor | | | 0.7 | 0.7 | 0.0% | Secondary - Minor |
| Caracol Trompeta | Fasciolariidae | *Pleuroploca princeps, Pleuroploca granosa, Pleuroploca salmo* | 0.7 | 0.7 | 0.0% | Secondary - Minor |
| Esponja | | Phylum: Porifera | 0.6 | 0.6 | 0.0% | Secondary - Minor |
| Calamar Gigante | Ommastrephidae | *Dosidicus gigas* | 0.6 | 0.2 | 0.0% | Secondary - Minor |
| Catalufas | Priacanthidae | *Heteropriacanthus cruentatus, Priacanthus alalaua, Pristigenys serrula* | 0.6 | 0.6 | 0.0% | Secondary - Minor |
| Tortugas | | tortugas spp | 0.6 | 0.6 | 0.0% | ETP |
| Almeja Roñosa | Veneridae | *Chione californiensis* | 0.5 | 0.4 | 0.0% | Secondary - Minor |
| Picudos | Istiophoridae, Xiphiidae | *Xiphias gladius, Istiophorus platypterus, Makaira indica, M. nigricans* | 0.5 | 0.4 | 0.0% | Secondary - Minor |
| Almeja China | Veneridae | *Chione californiensis* | 0.4 | 0.4 | 0.0% | Secondary - Minor |
| Machete | Elopidae | *Elops affinis* | 0.3 | 0.3 | 0.0% | Secondary - Minor |
| Coral | Pocilloporidae | *Pocillopora damicornis* | 0.3 | 0.3 | 0.0% | Secondary - Minor |
| Caballitos De Mar | | *Hippocampus ingens* | 0.3 | 0.3 | 0.0% | Secondary - Minor |

| Common Name (Spanish) | Family | Scientific Name | Total Catch (t) | Discarded Catch (t) | % TC | MSC class. |
|---|---|---|---|---|---|---|
| Cardenales | Apogonidae | *Apogon pacificus* | 0.2 | 0.2 | 0.0% | Secondary - Minor |
| Poliquetos | | poliquetos spp | 0.2 | 203 | 0.0% | Secondary - Minor |
| Murcielago | Opistognathidae | *Opistognathus rosenblatti, Opistognathus punctatus* | 0.2 | 158 | 0.0% | Secondary - Minor |
| Camaron rosado | Penaeidae | *Farfantepenaeus duorarum* | 0.2 | 0.2 | 0.0% | Secondary - Minor |
| Almeja Chocolata | | *Megapitaria aurantiaca* | 0.2 | 0.2 | 0.0% | Secondary - Minor |
| Almeja Pata De Mula | Arcidae | *Anadara grandis* | 0.2 | 0.1 | 0.0% | Secondary - Minor |
| Callo De Hacha | Pinnidae | *Atrina maura, Pinna rugosa, Atrina oldroydii* | 0.2 | 0.1 | 0.0% | Secondary - Minor |
| Abulon | Haliotidae | *Haliotis assimilis* | 0.2 | 0.1 | 0.0% | Secondary - Minor |
| Enteromorpha | Luvaridae, Ulvaceae | *Luvarus imperialis, Enteromorpha clathrata, Enteromorpha compressa, Enteromorpha intestinalis* | 0.1 | 0.1 | 0% | Secondary - Minor |
| Castañetas | Pomacentridae | *Hypsypops rubicundus, Abudefduf concolor, Chromis alta* | 0.1 | 0.1 | 0.0% | Secondary - Minor |
| Almeja Voladora | | *Pecten vogdesi* | 0.1 | 0.1 | 0.0% | Secondary - Minor |
| Delfines | Delphinidae | *Delphinus capensis* | 0.1 | 0.1 | 0.0% | ETP |
| Berberechos | Cardiidae | *Laevicardium elatum, Trachycardium panamense* | 0.1 | 0.1 | 0.0% | Secondary - Minor |
| Candiles | Holocentridae | *Myripristis leiognathus* | 0.1 | 0.1 | 0.0% | Secondary - Minor |
| Munidas | Galatheidae | *Munida hispida, Munida refulgens* | 0.1 | 0.1 | 0.0% | Secondary - Minor |
| Halcones, Mero Chino | Cirrhitidae | *Cirrhitus rivulatus* | 0.1 | 0.01 | 0.0% | Secondary - Minor |
| Almejas | Almejas spp. | (blank) | 0.1 | 0.1 | 0.0% | Secondary - Minor |
| Lobo Marino | Otariidae | *Zalophus californianus* | 0.1 | 0.1 | 0.0% | ETP |

| Common Name (Spanish) | Family | Scientific Name | Total Catch (t) | Discarded Catch (t) | % TC | MSC class. |
|---|---|---|---|---|---|---|
| Atun | | *Thunnus alalunga, Thunnus albacares, Thunnus obesus* | 0.1 | .04 | 0.0% | Secondary - Minor |
| Cangrejos Abuetes | Grapsidae | *Sesarma sulcatum* | 0.1 | 0.1 | 0.0% | Secondary - Minor |
| Pepino De Mar | Holothuriidae, Stichopodidae | *Isostichopus fuscus, Parastichopus parvimensis, Pollicipes elegans* | 0.1 | 0.1 | 0.0% | Secondary - Minor |
| Molas | Molidae | *Mola mola* | 0.1 | 0.1 | 0.0% | Secondary - Minor |
| Pericos | Scaridae | *Nicholsina denticulata, Scarus compressus, Scarus ghobban* | 0.1 | 0.1 | 0.0% | Secondary - Minor |
| Dorado | Coryphaenida e | *Coryphaena hippurus* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Purpuras | | *purpuras spp* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Cirujanos | Acanthuridae | *Acanthurus triostegus, Acanthurus xanthopterus, Prionurus punctatus* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Hueva | | hueva | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Pajaritos | | | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Guavinas | Eleotridae | *Dormitator latifrons* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Mejillon | Mytilidae | *Choromytilus palliopunctatus, Modiolus americanus* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Borrachos | Blenniidae | *Hypsoblennius brevipinnis* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Caracol Panocha | Turbinidae | *Turbo fluctuosus* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Tiburon Cazon | | *Galeorhinus galeus* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Cangrejos Moros De Mangle | | *Cangrejo spp.* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Cangrejos jaiba de roca | | | 0.0 | 0.0 | 0.0% | Secondary - Minor |

| Common Name (Spanish) | Family | Scientific Name | Total Catch (t) | Discarded Catch (t) | % TC | MSC class. |
|---|---|---|---|---|---|---|
| Madreperla | Pteriidae | *Pinctada mazatlanica* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Conos | | | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Coquinas | | | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Pipas | Syngnathidae | *Cosmocampus arctus, Syngnathus californiensis* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Bacalao | Anoplopomatidae | *Anoplopoma fimbria* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Espadas | Belonidae | *tylosurus fodiator* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Almeja De Fango | Corbiculidae | *Anadara mazatlanica* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Almeja Generosa | Hiatellidae | *Panopea generosa* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Almeja pismo | Verenidae | *Tivela stultorum* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Almeja Mano De Leon | | *Nodipecten subnodosus* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Pez Remo | Regalecidae | *Regalecus glesne* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Voladores | Exocoetidae | *Cypselurus callopterus* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| Almeja Burra | Spondylidae | *Spondylus calcifer* | 0.0 | 0.0 | 0.0% | Secondary - Minor |
| | | Total | 1,971.9 | 1321.4 | 100% | |

# Annex 2: RBF Scoring Table

Following Annex PF, the team elected to employ the option to group species according to similar taxonomies, ( MSC FCP v2.01 PF4.1.5). The team listed all  species within each taxonomic group, identify at least the two most at-risk species determined by selecting the species with the highest when scoring the productivity part of the PSA for all species

PF4.1.5.4 If the team decides to group species according to similar taxonomies, the final PI score shall be adjusted downwards according to clause PF5.3.2. ◙

**Table 9. Species grouped by similar taxonomies**

| Species Scientific name | Species Common name (if known) | Taxonomic grouping | Most at-risk in group? | MSC Scoring guidepost |
|---|---|---|---|---|
| *Diapterus aureolus* | Golden mojarra | Gerreidae | Y | ≥80 |
| *Diapterus peruvianus* | Peruvian mojarra | Gerreidae | Y | ≥80 |
| *Dasyatis (Hypanus) dipterura* | Diamond stingray | Group 1: Rays | Y | 60-79 |
| *Dasyatis (Hypanus) longus* | Longtail stingray | | Y | 60-79 |
| *Gymnura marmorata* | California butterfly ray | | N | - |
| *Gymnura crebripunctata* | Longsnout butterfly ray | | N | - |
| *Dasyatis violacea* | Pelagic stingray | | N | - |
| *Rhinobatos glaucostigma* | Speckled guitarfish | | N | - |
| *Haemulon steindachneri* | Chere-chere grunt | Group 2: Grunts | N | ≥80 |
| *Haemulon scudderii* | Gray grunt | | Y | ≥80 |

Automated MSC Score: 75 Pass with condition.

**Table 10. PSA Rationale Table for PI 2.2.1, for scoring element #2: *Diapterus peruvians***

| **A. Productivity** | | |
|---|---|---|
| **Scoring element** | Golden mojarra (*Diapterus aureoles*) | |
| **Attribute** | **Rationale** | **Score** |
| **Average age at maturity.** | High productivity: <5 years: No information available for Golden mojarra (*D. aureoles*). Estimate of fecundity based on 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** | High productivity: <10 years; inferred from average age at maturity. | 1 |
| **Fecundity** | Medium productivity: 100-20,000 eggs per year: No information 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** | High productivity: < 100 cm: *D. aureolus* max length: 15.0 cm (Fishbase) [For reference *D. brevirostris* max length : 38.0 cm (Fishbase)] | 1 |
| **Average size at maturity** | High productivity: < 40 cm: 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** | High productivity: Broadcast spawner: Evidence from reproductive strategy of other species in the same genus suggests "broadcast spawner" *Diapterus brevirostris* (Gallardo-Cabello et al. 2015) and *Diapterus rhombeus* (Costa et al. 2012) | 1 |
| **Trophic level** | Low productivity: >3.25: *D. aureolus*: 3.7 ±0.7 (Fishbase) | 3 |
| **B. Susceptibility** | | |
| **Fishery only where the scoring element is scored cumulatively:** The UoA does not have main species with catches at 10% or more of the total catch by weight of the UoA, the team elected to conduct the PSA on the UoA only | | |
| **Attribute** | **Rationale** | **Score** |
| **Areal Overlap** | Medium Susceptibility: 10-30% overlap: Based on the broad distribution of the species (from Baja California Sur and Sinaloa in Mexico to northern Peru) and the relative high probability of occurrence throughout most of its range (Fishbase) — team estimates overlap of fishing effort with species concentration of the stock to be between 10-30%. | 2 |
| **Encounterability** | High Susceptibility: high overlap with fishing gear: 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 |
| **Selectivity of gear type** | Medium Susceptibility: Individuals < half the size at maturity can escape or avoid gear Evaluations of the efficiency and selectivity of the *ala de angel* ¾ inch bottom trawl net, captures mojarras of average size of 14.90 cm, and that this type of net that it's efficient releasing approximately 50% of organisms below the size of 15 cm (Aguilar-Ramirez et al. 2000). | 2 |
| **Post capture mortality** | High Susceptibility: Retained species or majority dead when released: No information on discard mortality was available, team assumed higher risk factor | 3 |
| **Catch (weight)** | Only where the scoring element is scored cumulatively, Not Applicable | NA |

**Table 11. PSA Rationale Table for PI 2.2.1, for group 1, scoring element # 3 *Dasyatis (Hypanus) dipterura***

| **A. Productivity** | | |
|---|---|---|
| **Scoring element** | *Dasyatis (Hypanus) dipterura*<br>High to very high vulnerability (72 of 100) (Fishbase) | |
| **Attribute** | **Rationale** | **Score** |
| **Average age at maturity.** | Medium productivity: 5-15 years: *Dasyatis dipterura:* 10 years in females and seven years in males (Smith et al. 2016a) | **2** |
| **Average maximum age** | Low productivity: <25 years: Dasyatis dipterura: 28 years (Smith et al. 2016a) | **3** |
| **Fecundity** | Low productivity: <100 eggs per year *Dasyatis dipterura: "*Reproduction appears to be annual and litter sizes range from one to four pups" (Smith et al. 2016a) | **3** |
| **Average maximum size** | Medium productivity: 100-300 cm: *Dasyatis dipterura* max length: 122 cm (Fishbase) | **2** |
| **Average size at maturity** | Medium productivity: 40-200 cm: *Dasyatis dipterura: 58.5 cm DW (males) and 43.4 cm DW (females)* (Smith et al. 2016s) | **2** |
| **Reproductive strategy** | Low productivity: Live bearer | **3** |
| **Trophic level** | Low productivity >3.25: *Dasyatis dipterura:* 3.5 ± 0.50 *(FishBase)* | **3** |
| **B. Susceptibility** | | |
| **Fishery only where the scoring element is scored cumulatively:** The UoA does not have main species with catches at 10% or more of the total catch by weight of the UoA, the team elected to conduct the PSA on the UoA only | | |
| **Attribute** | **Rationale** | **Score** |
| **Areal Overlap** | Medium Susceptibility: 10-30% overlap: Based on the broad distribution of the species (confirmed range from southern California, USA to Chile (where it is occasional only); including the Galápagos and Hawaiian Islands) Smith et al. (2016a)) — team estimates overlap of fishing effort with species concentration of the stock to be between 10-30%. | **2** |
| **Encounterability** | Low overlap with fishing gear (low encounterability): According to the study and analysis of shrimp bycatch conducted by INAPESCA (2016), the relative abundance index (IAR): *Dasyatis dipterura* was classified as rare (IAR = 0.0005)<br>Smith et al. (2016a): "*Hypanus dipterurus* is a demersal stingray known primarily from relatively shallow, inshore waters over sand and mud bottoms or near rocky outcrops and kelp beds (Feder et al. 1974, Eschmeyer et al. 1983). Off southern California, the species has been reported to occupy shallow waters (intertidal to 7 m) in the summer and moves to depths of 13 to 17.7 m during the late fall and winter months (Feder et al. 1974)."<br>The industrial fleet cannot operate in areas < 5 fathoms (~9 mt) in depth, and they operate up to a depth of approximately 60 fathoms ( ~109 mt) | **1** |
| **Selectivity of gear type** | High Susceptibility: Individuals < half the size at maturity can escape or avoid gear<br>No information on size of individuals caught, team assumed higher risk factor | **3** |
| **Post capture mortality** | High Susceptibility: Retained species or majority dead when released: No information on discard mortality was available, team assumed higher risk factor | **3** |
| **Catch (weight)** | Only where the scoring element is scored cumulatively, Not Applicable | **NA** |

**Table 12. PSA Rationale Table for PI 2.2.1, for group 1, scoring element # 4 *Dasyatis (Hypanus) longus***

| **A. Productivity** | | |
|---|---|---|
| **Scoring element** | *Dasyatis (Hypanus) longus*<br>High to very high vulnerability (74 of 100) (Fishbase) | |
| **Attribute** | **Rationale** | **Score** |
| **Average age at maturity.** | Low productivity: >15 yearsNo information on age at maximum maturity available, team assumed higher risk factor | **3** |
| **Average maximum age** | Low productivity: <25 years:<br>No information on maximum age available, team assumed higher risk factor | **3** |
| **Fecundity** | Low productivity: <100 eggs per year: Average annual fecundity or litter size: 1 to 5 pups/litter. (Smith et al. 2016b) | **3** |
| **Average maximum size** | Medium productivity: 100-300 cm: max length: 260 cm (Fishbase), Maximum size (disc width): at least 156 cm DW (Smith et al. 2016b) | **2** |
| **Average size at maturity** | Medium productivity: 40-200 cm: *D. longus:* Female: ~110 cm DW; Male: ~80 cm DW. (Smith et al. 2016b) | **2** |
| **Reproductive strategy** | Low productivity: Live bearer | **3** |
| **Trophic level** | Low productivity >3.25: *Dasyatis dipterura:* 3.5 ± 0.37 (FishBase) | **3** |
| **B. Susceptibility** | | |
| **Fishery only where the scoring element is scored cumulatively:** The UoA does not have main species with catches at 10% or more of the total catch by weight of the UoA, the team elected to conduct the PSA on the UoA only | | |
| **Attribute** | **Rationale** | **Score** |
| **Areal Overlap** | Medium Susceptibility: 10-30% overlap: Based on the broad distribution of the species (central Pacific coast of Baja California, México to Colombia including the Galapágos Islands) Smith et al. (2016b)) — team estimates overlap of fishing effort with species concentration of the stock to be between 10-30%. | **2** |
| **Encounterability** | Low overlap with fishing gear (low encounterability): According to the study and analysis of shrimp bycatch conducted by INAPESCA (2016), the relative abundance index (IAR): *D. longus* was classified as rare (IAR = 0.0070)<br>Smith et al. (2016b): “occurring on the continental shelf to at least 90 m”<br>The industrial fleet cannot operate in areas < 5 fathoms (~9 mt) in depth, and they operate up to a depth of approximately 60 fathoms ( ~109 mt) | **1** |
| **Selectivity of gear type** | High Susceptibility: Individuals < half the size at maturity can escape or avoid gear<br>No information on size of individuals caught, team assumed higher risk factor | **3** |
| **Post capture mortality** | High Susceptibility: Retained species or majority dead when released: No information on discard mortality was available, team assumed higher risk factor | **3** |
| **Catch (weight)** | Only where the scoring element is scored cumulatively, Not Applicable | **NA** |

**Table 13.PSA Rationale Table for PI 2.2.1, for Group 2, scoring element # 5 Chere-chere grunt (Haemulon steindachneri)**

| **A. Productivity** | | |
|---|---|---|
| **Scoring element** | Chere-chere grunt (*Haemulon steindachneri*)<br>Low to moderate vulnerability (34 of 100). (Fishbase) | |
| **Attribute** | **Rationale** | **Score** |
| **Average age at maturity.** | High productivity: <5 years: No information available for Chere-chere grunt. Estimate of fecundity based on study of Tomtate grunt "*Haemulon aurolineatum* on Campeche Bank mature when about 3 yr old (Sokolova 1965)" | **1** |
| **Average maximum age** | Low productivity: >25 years. No information available for Chere-chere grunt (*Haemulon steindachneri*). Estimate of maximum age for H. plumierii in Brazil was found to be 28 years (Neves-Araújo and Silva-Martins, 2007) | **3** |
| **Fecundity** | High productivity: >20,000 eggs per year: No information available for Chere-chere grunt (*Haemulon steindachneri*), Estimate of fecundity based on study for the white grunt (*Haemulon plumieri*): "Fecundity for the white grunt (Haemulon plumieri) has been determined between 19,873 and 535,039 eggs" (Palazón-Fernández,2007) | **1** |
| **Average maximum size** | High productivity: < 100 cm: *Haemulon steindachneri* 30.0 cm TL male/unsexed (FishBase) | **1** |
| **Average size at maturity** | High productivity: < 40 cm: based on average maximum size (30 cm), size at maturity must be <40 cm | **1** |
| **Reproductive strategy** | Spawning type is unknown for all grunt species reviewed (FishBase), thus a score of 3 is assigned | **3** |
| **Trophic level** | Low productivity: >3.25: *Haemulon steindachneri 3.7 ± 0.2 (FishBase)* | **3** |
| **B. Susceptibility** | | |
| **Fishery only where the scoring element is scored cumulatively:** The UoA does not have main species with catches at 10% or more of the total catch by weight of the UoA, the team elected to conduct the PSA on the UoA only | | |
| **Attribute** | **Rationale** | **Score** |
| **Areal Overlap** | Medium Susceptibility: 10-30% overlap: Based on the broad distribution of the species from Mexico to Peru in the eastern Pacific (Chirichigno, 1974), — team estimates overlap of fishing effort with species concentration of the stock to be between 10-30%. | **2** |
| **Encounterability** | Medium Susceptibility: medium overlap with fishing gear: depth range 0 - 50 m According to Observer Program data % bycatch was 5%; However, this percentage corresponded to all grunt species, this value could change if the information was classified to species level | **2** |
| **Selectivity of gear type** | High Susceptibility: Individuals < half the size at maturity can escape or avoid gear No information on size of individuals caught, team assumed higher risk factor | **3** |
| **Post capture mortality** | High Susceptibility: Retained species or majority dead when released: No information on discard mortality was available, team assumed higher risk factor | **3** |
| **Catch (weight)** | Only where the scoring element is scored cumulatively. Not Applicable | **NA** |

**Table 14. PSA Rationale Table for PI 2.2.1, for Group 2, scoring element # 6 California lizardfish (Synodus lucioceps)**

| | | |
|---|---|---|
| **A. Productivity** | | |
| **Scoring element** | Gray grunt (Haemulon scudderii)<br>Low to moderate vulnerability (34 of 100) (Fishbase) | |
| **Attribute** | **Rationale** | **Score** |
| **Average age at maturity.** | High productivity: <5 years: No information available for Gray grunt. Estimate of fecundity based on study of Tomtate grunt "Haemulon aurolineatum on Campeche Bank mature when about 3 yr old, and all of the commercial catch on the Bank is sexually mature (Sokolova 1965)" | **1** |
| **Average maximum age** | Low productivity: >25 years. No information available for Gray grunt. Estimate of maximum age for *H. plumierii* in Brazil was found to be 28 years (Neves-Araújo and Silva-Martins, 2007) | **3** |
| **Fecundity** | High productivity: >20,000 eggs per year: No information available for Chere-chere grunt (*Haemulon steindachneri*), Estimate of fecundity based on study for the white grunt (*Haemulon plumieri*): "Fecundity for the white grunt (Haemulon plumieri) has been determined between 19,873 and 535,039 eggs" (Palazón-Fernández,2007) | **1** |
| **Average maximum size** | High productivity: < 100 cm: *Haemulon scudderii* 35.0 cm TL male/unsexed (FishBase) | **1** |
| **Average size at maturity** | High productivity: < 40 cm: based on average maximum size (35 cm), size at maturity must be <40 cm | **1** |
| **Reproductive strategy** | Spawning type is unknown for all grunt species reviewed (FishBase), thus a score of 3 is assigned | **3** |
| **Trophic level** | Low productivity: >3.25: *Haemulon scudderii* 4.2 ± 0.73 (FishBase) | **3** |
| **B. Susceptibility** | | |
| **Fishery only where the scoring element is scored cumulatively:** The UoA does not have main species with catches at 10% or more of the total catch by weight of the UoA, the team elected to conduct the PSA on the UoA only | | |
| **Attribute** | **Rationale** | **Score** |
| **Areal Overlap** | Medium Susceptibility: 10-30% overlap: Based on the broad distribution of the species from Mexico to Ecuador including the Galapagos Islands) (Fishbase)— team estimates overlap of fishing effort with species concentration of the stock to be between 10-30%. | **2** |
| **Encounterability** | Medium Susceptibility: medium overlap with fishing gear: depth range 3 - 40 m According to Observer Program data % bycatch was 5%; However, this percentage corresponded to all grunt species, this value could change if the information was classified to species level | **2** |
| **Selectivity of gear type** | High Susceptibility: Individuals < half the size at maturity can escape or avoid gear<br>No information on size of individuals caught, team assumed higher risk factor | **3** |
| **Post capture mortality** | High Susceptibility: Retained species or majority dead when released: No information on discard mortality was available, team assumed higher risk factor | **3** |
| **Catch (weight)** | Only where the scoring element is scored cumulatively. Not Applicable | **NA** |