Monterey Bay Aquarium

Seafood Watch®

Pacific calico scallop

Argopecten ventricosus

Mexico: Magdalena Bay

Diving

March, 2 2020

Seafood Watch Consulting Researcher

Seafood Watch Standard used in this assessment: Standard for Fisheries vF3

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About Seafood Watch

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

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

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Watch assessments in any way they find useful.

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished[1] or farmed that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

The following guiding principles illustrate the qualities that fisheries must possess to be considered sustainable by the Seafood Watch program (these are explained further in the Seafood Watch Standard for Fisheries):

- Follow the principles of ecosystem-based fisheries management.
- Ensure all affected stocks are healthy and abundant.
- Fish all affected stocks at sustainable levels.
- Minimize bycatch.
- Have no more than a negligible impact on any threatened, endangered or protected species.
- Managed to sustain the long-term productivity of all affected species.
- Avoid negative impacts on the structure, function or associated biota of aquatic habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.

These guiding principles are operationalized in the four criteria in this standard. Each criterion includes:

- Factors to evaluate and score
- Guidelines for integrating these factors to produce a numerical score and rating

Once a rating has been assigned to each criterion, we develop an overall recommendation. Criteria ratings and the overall recommendation are color coded to correspond to the categories on the Seafood Watch pocket guide and online guide:

Best Choice/Green: Are well managed and caught in ways that cause little harm to habitats or other wildlife.

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

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

[1] "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates

Summary

This report assesses the Pacific calico scallop (Mexican bay scallop) fishery in the Magdalena Bay coastal system in Baja California Sur. The gear used is hookah diving.

The fishery is managed by using abundance assessments in order to estimate seasonal quotas. Due to a great decline in abundance, managers did not authorize quotas between 2014 and 2018. However, in 2018, managers assessed and authorized a total quota of 1,543.4 t (scallop muscle weight) (~15,500 t whole weight) based on three different INAPESCA assessments. The first assessment developed in May recommended a quota of 492.2 t in May (INAPESCAa 2018), the second, 369.3 t in June (INAPESCAb 2018), and the third, 592 t in July (INAPESCAc 2018). In order to score the abundance factor, we use a combination of a PSA (that scored the species with low vulnerability) and the 2018 assessments. Based on this approach, we scored the species abundance as a "moderate" concern. Fishing mortality scored as a "moderate" concern because it is unknown whether fishing mortality is above a sustainable level (due to IUU fishing).

Regarding bycatch, the bay scallop fishery has minimal impact on other species; for this reason, no other species were included in Criterion 2.

Management regulations such as catch limits, minimum size limits, and off-season and fishing effort controls (permits) are in place and there is a monitoring system that allows managers to authorize a level of extraction for the season or keep the fishery closed. However, enforcement in this fishery is known to be weak and there are a considerable number of reports that IUU occurs in the fishery.

The bay scallop fishery has an overall low impact on the coastal lagoon habitats and ecosystems since the fishery occurs in highly resilient mud and sandy bottom. Finally, according to information available, it is not likely that the fishery negatively impacts the ecosystem.

Overall, the diving bay scallop fishery in Magdalena Bay in Baja California Sur, Mexico is rated as a "Good Alternative" (yellow).

Final Seafood Recommendations

SPECIES | FISHERY	CRITERION 1: Impacts on the Species	CRITERION 2: Impacts on Other Species	CRITERION 3: Management Effectiveness	CRITERION 4: Habitat and Ecosystem	OVERALL RECOMMENDATION
Pacific calico scallop Mexico/Magdalena Bay | Diving | Mexico	Yellow (2.644)	Green (5.000)	Red (2.000)	Green (3.464)	**Good Alternative (3.093)**

Scoring Guide

Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

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

- **Best Choice/Green** = Final Score >3.2, and no Red Criteria, and no Critical scores
- **Good Alternative/Yellow** = Final score >2.2-3.2, and neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern2, and no more than one Red Criterion, and no Critical scores
- **Avoid/Red** = Final Score ≤2.2, or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

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[2] Because effective management is an essential component of sustainable fisheries, Seafood Watch issues an Avoid recommendation for any fishery scored as a Very High Concern for either factor under Management (Criterion 3).

Introduction

Scope of the analysis and ensuing recommendation

This report focuses on the Pacific calico scallop (Mexican bay scallop) fishery (*Argopecten ventricosus*) carried out in the coastal lagoons on the west coast of the state of Baja California Sur, Mexico. The state produces more than 95% of the bay scallops in the country and producers use a "hooka" diving system to collect the product by hand.

Species Overview

The Mexican bay scallops are epibenthic bivalves of the Pectinidae family. The species distribution extends from Cedros Island on the west side of Baja California, Mexico to Paita in Peru (Keen 1971) (Figure 1). As a functional protandrous hermaphrodite, the species is known to spawn twice a year by releasing both eggs and sperm into the water where fertilization occurs. Regularly these periods are April to May, and September to December (Maeda-Martínez et al. 1993). The depth range of these scallops is 6 to 35 m inside the bays where they are harvested and up to 150 m in the open ocean (Félix-Pico 2006). According to (Felix 2006) the species in the region reaches its sexual maturity between the eighth month to first year of life, with a maturity size between 58 and the 77 mm of shell width (Villalejo and Ochoa 1993).

Commercial landings began in the Gulf of California in 1970 (Felix-Pico 2006). In Magdalena Bay the fishery did not start until 1975 (Felix-Pico et al. 2009).

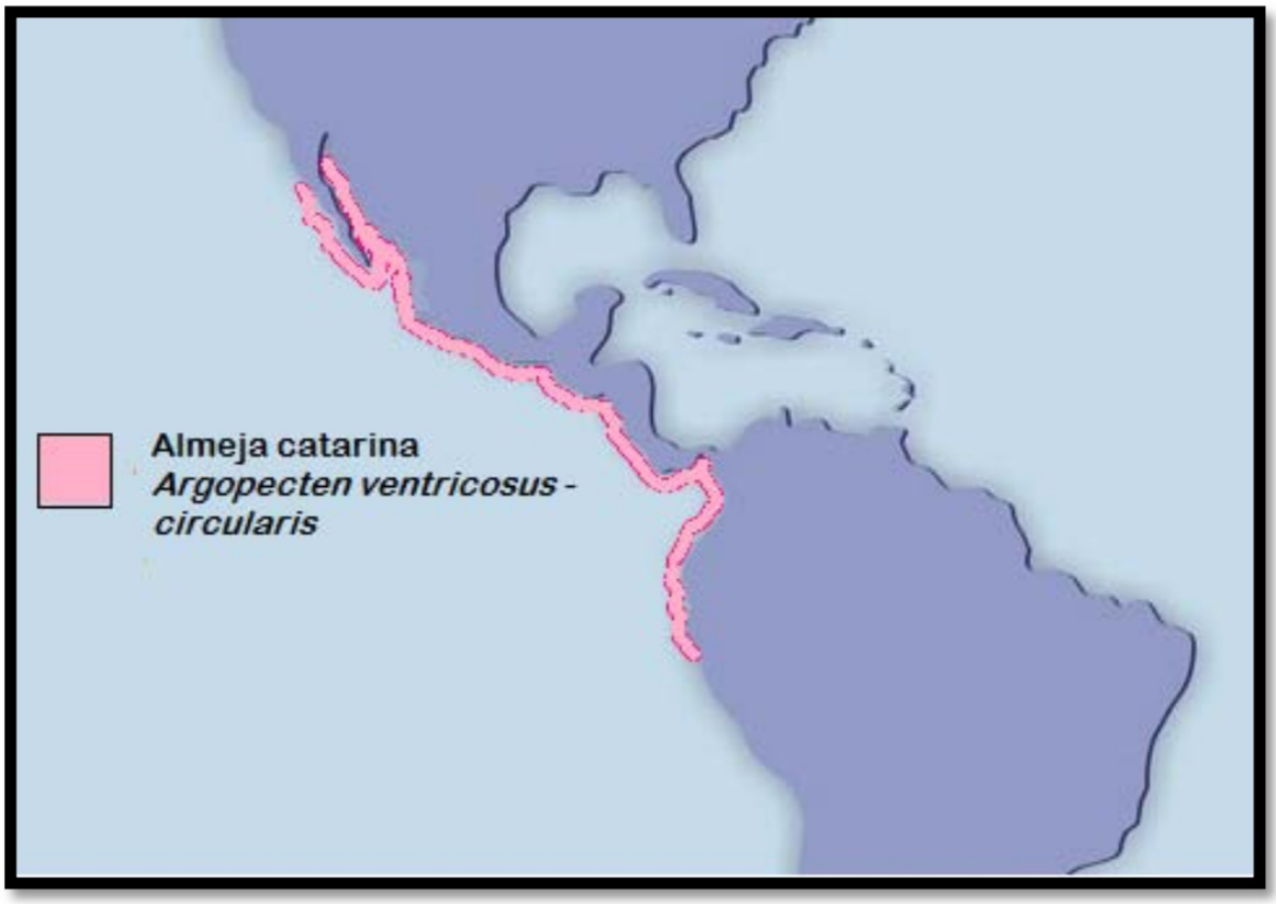

Figure 1 Argopecten ventricosus distribution.

Production Statistics

As mentioned above, the commercial fishery for bay scallops in Magdalena Bay began in 1975 (Felix-Pico et al 2009). Production levels remained relatively low during the first years until the discovery of two separate stocks at 18 to 25 m depth in 1990, which resulted in a peak harvest of ~33,000 tonnes (MT) of live weight per year (Figure 2) (Maeda-Martínez et al 1993) (Felix-Pico et al 2009). Since then, landings have returned to previous levels in 1996 at ~15,000 MT and more recently, in 2005, at ~15,000 MT (Felix-Pico et al 2009).

Figure 2 Baja California Sur landings (DOF 2018)

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Scallop fisheries, in general, have big variations through boom and bust phases (Maeda-Martínez et al 1993) (Felix-Pico 2006), and these may be driven by environmental variability and/or a strong stock-recruitment relationship (Maeda-Martínez et al. 200). According to (Maeda-Martinez et al. 2001) the abnormally low temperatures before 1990 may be responsible for the dramatic increase in abundance (Figure 3).

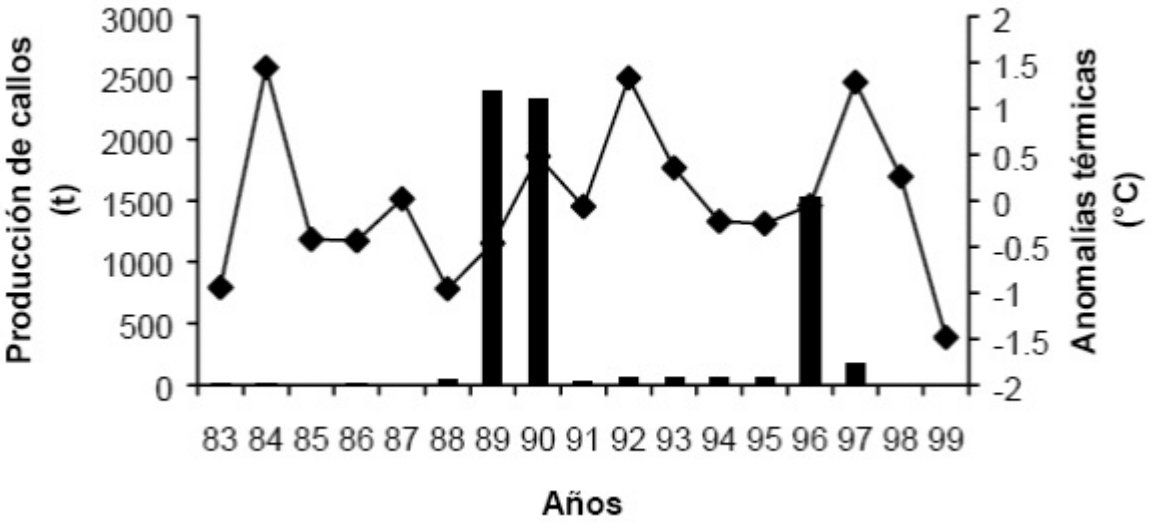

Figure 3 The annual harvest of Bay scallops (kg of adductor muscle on left y-axis, bars) and temperature anomalies calculated as the difference between monthly values and the corresponding average annual cycle value (1983–1999) (right y-axis, diamonds) from Magdalena Bay, Baja California Sur. Cold temperatures preceded high harvests in 1989 and 1990 (figure from Maeda-Martínez et al. 2001).

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According to different researchers and managers declining in production can be explained by a combination of overexploitation, diseases, and environmental factors (Ruiz-Verdugo et al 2016) (DOF 2018). (Osuna-Castro 2012) stated that, since its beginning the demand for catarina scallops increased over the years, first to meet the needs of the local market, then the national market, and finally the export market. Currently, the US market is the source of the biggest demand. According to the author ,buyers from different parts of Mexico and the United States attend meetings where they meet with the fishing sector and authorities, with the objective of setting the price that the product will have in the market (Osuna-Castro 2012).

Importance to the US/North American market.

According to (Osuna-Castro 2012), in recent years, the primary demand for bay scallops is from the export market, particularly the US. The author mentioned that every year, producers, managers, and buyers held meetings to establish a price on the market. According to the NMFS data, in 2017, more than 75 MT of scallops were imported from Mexico, with a great spike in 2018 with more than 1,800 MT mostly live / fresh (1,700 MT) (NMFS-NOAA 2019). However, it is unclear how much of the production is related to bay scallops.

Common and market names.

In Mexico, the species is known as Catarina clam, while in the US it is known as either Mexican bay scallop, scallop, or Pacific calico scallop (FDA 2019).

Primary product forms

The most common form is as live/fresh; however, it can also be found frozen and dried/salted or in brine (NMFS-NOAA 2019).

Assessment

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

Criterion 1: Impacts on the Species Under Assessment

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

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

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

Guiding Principles

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

Criterion 1 Summary

PACIFIC CALICO SCALLOP			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Mexico/Magdalena Bay | Diving Mexico	2.33: Moderate Concern	3.00: Moderate Concern	Yellow (2.644)

Criterion 1 Assessment

SCORING GUIDELINES

Factor 1.1 - Abundance

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

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

Factor 1.2 - Fishing Mortality

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

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

PACIFIC CALICO SCALLOP

Factor 1.1 - Abundance

MEXICO/MAGDALENA BAY
Diving | Mexico

Moderate Concern

According to the most recent version of the National Fisheries Chart (CNP for its name in Spanish), published in 2018, the bay scallop fishery in Baja California Sur was identified as deteriorated by managers (DOF 2018). This statement was made based on the annual abundance assessment program developed by the National Fisheries Institute (INAPESCA), which recommends an annual quota based on underwater surveys that collect abundance (densities) information and estimates biomass (DOF 2015). Although the causes have not yet been established, large oscillations in scallop catch have occurred several times in the past decades due to a combination of overfishing (which is driven by a high market demand, mostly from the US (Osuna-Castro 2012), diseases, and climatic variations (El Niño/La Niña). Researchers pointed out that scallop catch is favored by negative temperature anomalies (La Niña) whereas positive anomalies (Niño periods) have a negative influence on the fishery (Maeda-Martinez et al. 1993) (Felix-Pico 2006).

Due to the declines in abundance, a fishing quota was not released between 2014 and 2018 (INAPESCAb 2018). In 2018 scallop densities were high enough authorize a fishing quota (BCSNoticias 2018).

In 2018, managers carried out three assessments (April, May, and June) in different aggregations (banks) within Magdalena Bay (see list below). Densities during the first assessment ranged from 9.8 to 68.5 organisms/square m (see table below) (INAPESCAa 2018). Subsequent assessments monitored the changes in abundance considering continuous recruitment (INAPESCAb 2018) (INAPESCAc 2018). According to the 2018 reports, managers authorized only 60% of the biomass of adults (organisms >60 mm shell length) in order to guarantee the species recruitment. Following these guidelines, the first assessment authorized 492.2 t (scallop weight (INAPESCAa 2018), the second 369.3 t (INAPESCAb 2018), and the third 592 t (INAPESCAc 2018) for a total of 1,453.5 t of scallops or roughly 15,500 t of total weight (shells included) for the season.

To help score this factor, we ran a PSA to assess the species' vulnerability. The bay scallop has a low vulnerability to fishing. Overall, considering that there are no robust stock assessments available, the fishery does not have reference points, the species is not vulnerable but the most recent data-limited assessment showed increases in abundance comparable to pre-closure years, this factor scores as a "moderate" concern.

Justification:

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Average age at maturity	Sexual maturity is reached between 6 and 12 months (Villalejo-Fuerte 1995)	1
Average maximum age	Mexican bay scallops grow quickly and live for two years (Villalejo-Fuerte 1995)	1
Fecundity	Bay scallops are hermaphrodites; spawning can occur over several months, with maximum activity between December to March. Scallops can produce between 2 to 3 million eggs (Villalejo-Fuerte 1995)	1
Reproductive strategy	Broadcast spawner	1
Trophic level	1	1
Density dependence (invertebrates only)	According to researchers, there is a need for some levels of abundance (densities) that are linked to the recruitment levels of the species (Maeda-Martinez et al. 2000)	3
Habitat quality	N/A	
Total Productivity (average)	1.33	

Susceptibility Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)
Areal overlap (Considers all fisheries)	Bay scallops are distributed from Cedros Island and the Gulf of California to Paita, Peru in the Pacific Ocean (Coan and Valentich 2012) In BCS, it is believed that its distribution is not only inside Magdalena Bay but also outside on deeper waters, although it is unclear how much of the distribution is fished. Considering that other regions along the peninsula report landings, we scored as "high overlap."	3
Vertical overlap (Considers all fisheries)	Vertical distribution range from 1 to 135 m deep (Coan and Valentich 2012). Inside the Bay, producers are limited to 30 m, based on management regulations (DOF 2015). However, the scallops are also reported to be caught as part of the incidental catch of other fisheries, in particular the shrimp fishery that is developed outside the Bay (INAPESCA 2016). According to a bycatch report, Catarina scallop is a common part of the catch of these trawlers (INAPESCA 2016). For this reason, we scored this factor as "high overlap."	3
Selectivity of fishery (Specific to fishery under assessment)	Producers target the species when is aggregated in banks to reproduce; however, the use of quotas allows them to limit the impact on these banks (DOF 2015). For this reason, a score of "mid risk" is deemed.	2
Post-capture mortality (Specific to fishery under assessment)	All organisms are retained, although regulations in place required producers to return those organisms that are below the minimum size (DOF 2015). Bivalve species can survive for some time after being taken out of the water. The PSA methodology requires evidence that a majority of captured individuals (>66%) are released and survive post-capture. For this reason, we scored "2" since evidence of released is not available.	2
Total Susceptibility (multiplicative)		1.87

PSA score for bay scallop fishery is calculated as follows:

Vulnerability (V) =√(P^2+ S^2)

V = √1.33 〖〗 ^2+ 〖1.33^2+(1.87^2))

V = 2.3

Banco/Zona	Densidad (No/m²)	Prop >TML (60 mm)	B.S.C. (Ton)
Atrás de la Roch	37.2	62%	77
Canalito Isla de Patos	26.1	63%	20
Boca de San Buto	27.2	66%	99
El Blanquizcal	49.3	74%	97
El Caídero	23.3	35%	34
Estero de Magdalena	68.5	48%	30
Frente a San Buto	89.6	70%	75
Frente a Curry	98.3	61%	88
Las Palmas	92.1	4%	0
Las Palmas Cordillera	87.3	3%	0
Frente a Herradura	102.3	58%	72
TOTAL	63.7	49%	592

Figure 4 Table 1. Densities (number of organims/m2), percentage of adults (organimss >60mm) and biomass suceptible to be catch in 11 banks in Magdalena bay. (INAPESCA 2018)

Factor 1.2 - Fishing Mortality

MEXICO/MAGDALENA BAY
Diving | Mexico

Moderate Concern

The Mexican bay scallop fishery is the most important scallop fishery in BCS (see figure 1). The historical production ranged from less than 5,000 t during the initial years (total weight) to a maximum of ~30,000 t (total weight) in 1990. Since then, production declined with an average of 15,000 t (total weight) between

2004 and 2011. After those years, landings plummeted to less than 2,500 t and managers closed the fishery in 2014 (see figure 2). Both managers and researchers believe that the decline was due to a combination of heavy exploitation and environmental conditions (CNP 2018) (Maeda-Martinez et al 2000); for these reasons, no quota was authorized until the summer of 2018. During that year, three different assessments were developed and a total of 1,453 t (shucked weight) or 15,517 t (total weight) were authorized (INAPESCAa 2018) (INAPESCAb 2018) ((INAPESCAc 2018).

According to the CNP, 154 active scallop permits cover 384 vessels and ~1,100 fishers (DOF 2018). This fishing effort information is included in INAPESCA's biological opinion and is reportedly based on their abundance estimates.(INAPESCAb 2018) However, managers also reported that the fishery in BCS is deteriorated (CNP 2018) and recommended not to increase fishing effort (i.e., number of vessels) and established a landing monitoring system for the Magdalena Bay quota (by far the biggest source of production in the state).

The 2018 quota (shucked weight 1,453 t in 2018) represented 60% of the surveyed adult population. Managers state that the 60% threshold guarantees recruitment and is appropriate and sustainable (INAPESCAb 2018), although it is not clear how this 60% was estimated as sustainable.

Considering that bay scallops are relatively resilient to fishing pressure, the fishery targets bay scallops that have previously spawned (minimum size) (CNP 2018), and there is a cap on the number of permits, fishing mortality may be fluctuating around $F_{MSY.}$ However, the presence of unauthorized vessels harvesting scallops is a constant concern (El Independiente 2018) (El Independiente 2017) (El Independiente 2016) (El Sudcaliforniano 2018) (El Sudcaliforniano a 2019) (El Sudcaliforniano b 2019) (El Sudcaliforniano c 2019) (Peninsula digital 2014) (Uniradio 2018). In the most recent season (2019), at least 120 unauthorized vessels were reported to be harvesting scallops (abcnoticias Jul 2019), which led to a premature closure of the fishing season, a fall in prices (Inforural May 2019), and management denied the authorization of an anticipated third quota, arguing that the status of the stock was not healthy (InfoRural December 2019).

In addition, high levels of misreporting are common in the country (Young 2001), the region (IMCO et al 2013), and in the fishery (Corpuz et al 2014) (FONMAR 2019) (J. Ulibarria, FONMAR enforcement agent, pers. comm. 2019). IUU of scallops fisheries in the region were reported to be up to 40% a decade ago (Agnew et al. 2009) and local NGOs experts (i.e., Niparaja, Noroeste Sustentable, Smartfish, and the Center of Marine Biodiversity of California Scripps in La Paz) agree that illegal fishing is still a current problem that is constantly reported in regional media (see Enforcement) (InforRural 2020) (BCSnoticias 2019) (Sudcaliforniano 2019).

Based on the available information, it is unclear if the level of fishing mortality places the species at risk of overfishing. For this reason, this factor scores as a "moderate" concern.

Justification:

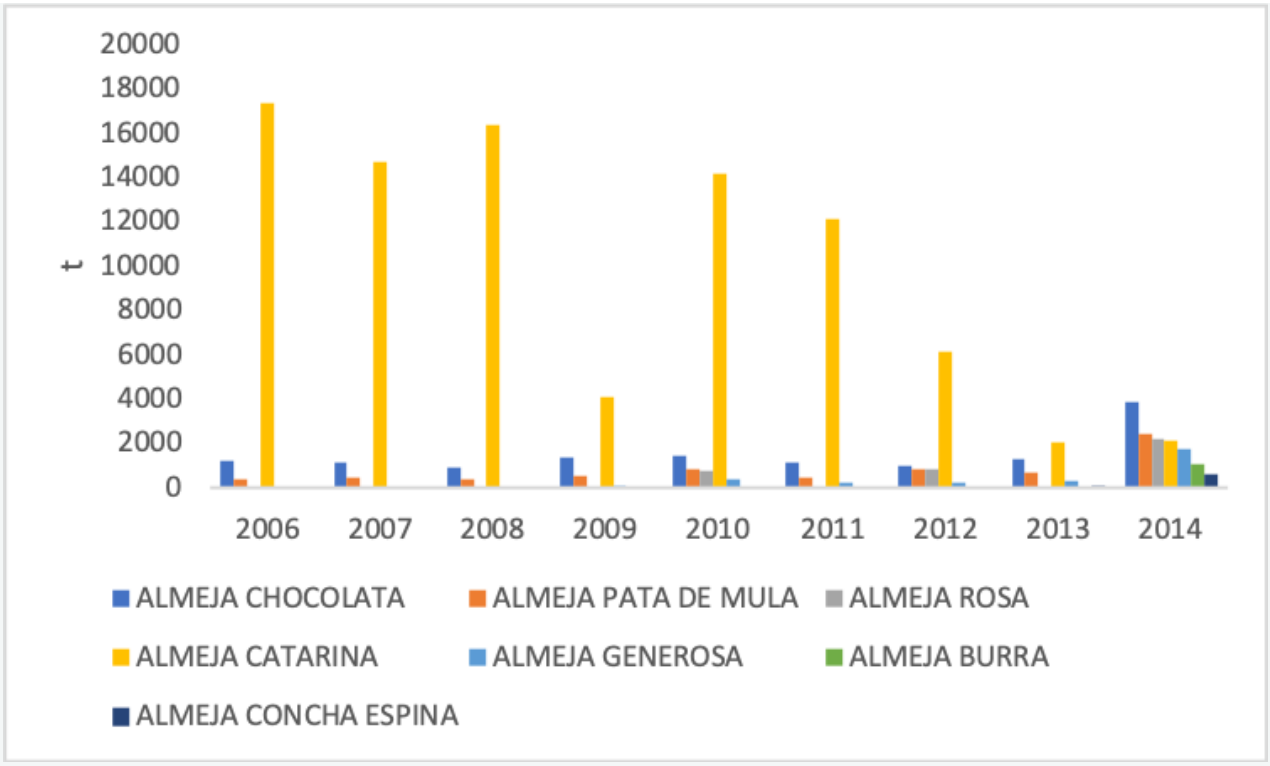

Figure 5 Bay scallops and other bivalves production in BCS from 2006 to 2014 (Source: CNP 2018)

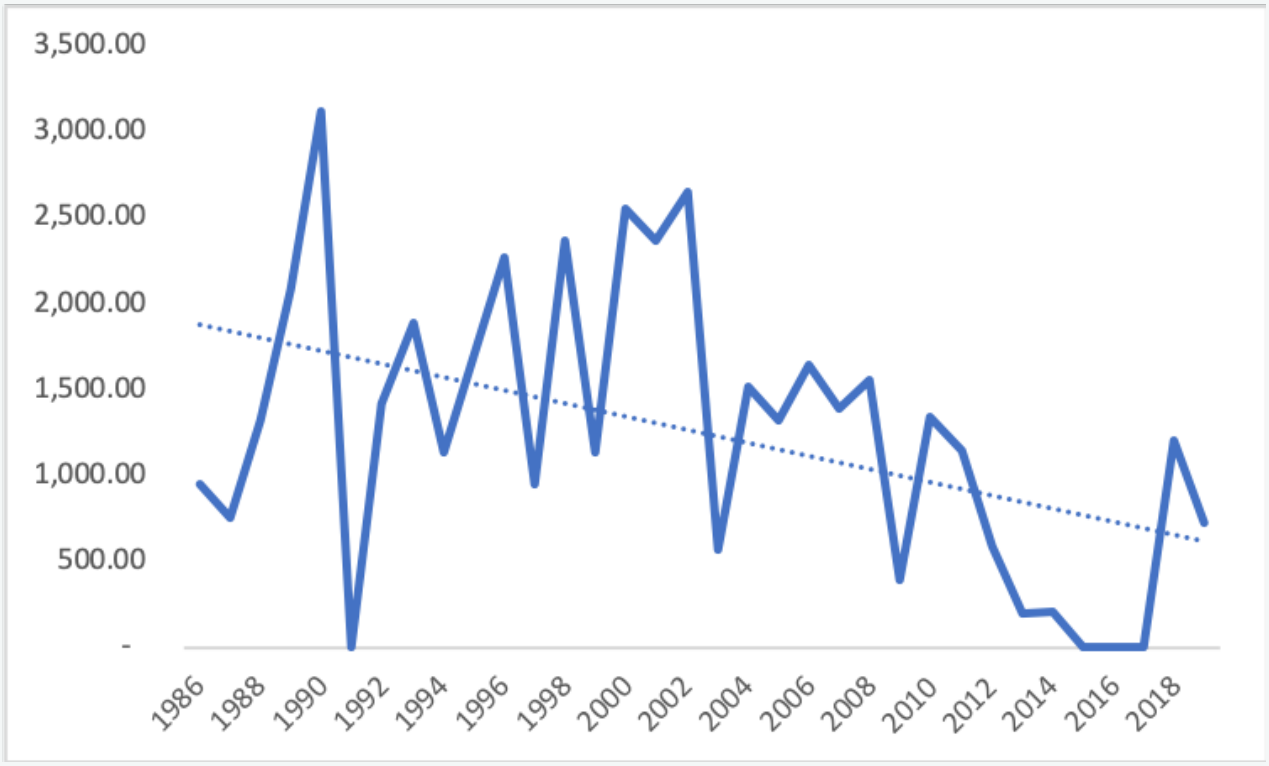

Figure 6 BCS Bay Scallop production (Sources: CNP 2018, Mexican Annual reports 1986-2017)

Criterion 2: Impacts on Other Species

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

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

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

Guiding Principles

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

Criterion 2 Summary

Only the lowest scoring main species is/are listed in the table and text in this Criterion 2 section; a full list and assessment of the main species can be found in Appendix A.

PACIFIC CALICO SCALLOP Mexico/Magdalena Bay | Diving | Mexico					
Subscore:	**5.000**	**Discard Rate:**	**1.00**	**C2 Rate:**	**5.000**
Species | Stock		**Abundance**	**Fishing Mortality**	**Subscore**	
No other main species caught					

Fishers capture bay scallops by diving with hooka systems. No other species are caught within the fishery. It was reported that some producers collect other bivalve species (e.g., pen shells, *Atrina maura*) opportunistically (A. Rodriguez, pers. comm. 2019). This other catch is not significant and is generally retained for personal consumption (Alejandro Rodriguez, pers. comm. 2019). For these reasons, no other species were included in the section.

2.4 - Discards + Bait / Landings

MEXICO/MAGDALENA BAY
Diving | Mexico

< 100%

According to managers (DOF 2018) and information found (Narchi et al 2018), producers keep 100% of their

catch. No bait is used in this fishery.

Criterion 3: Management Effectiveness

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

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

The Criterion 3 rating is determined as follows:

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

Rating is Critical if Management Strategy and Implementation is Critical.

GUIDING PRINCIPLE

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

Criterion 3 Summary

Fishery	Management Strategy	Bycatch Strategy	Research and Monitoring	Enforcement	Stakeholder Inclusion	Score
Fishery 1: Mexico/Magdalena Bay | Diving | Mexico	Moderately Effective	Highly Effective	Moderately Effective	Ineffective	Moderately Effective	Red (2.000)

Criterion 3 Assessment

Factor 3.1 - Management Strategy and Implementation

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

MEXICO/MAGDALENA BAY Diving | Mexico
Moderately Effective

The fishery is managed by the Norma Oficial Mexicana 004-PESC-1993 (DOF 2015), which includes basic regulations such as a minimum size limit of 56 mm shell length for bay scallops taken from the coastal lagoons of Baja California Sur and 60 mm for the rest of the state and Baja California. To access the fishery, bay scallop specific permits are granted individually or to a group of producers. Gear specifications are described as a small-scale vessel with a maximum of three fishers onboard (one diver, one onboard support and one captain) (DOF 2015). In addition, the National Fisheries Institute (INAPESCA) is responsible for performing annual surveys and setting quotas based on them. The survey methodology used for the 2018 season was available; however, the biomass estimation model was not described; therefore, its robustness cannot be assessed. Based on these surveys, managers closed the fishery for five years in order to allow the species to recover. Based on the version 3.2 of the SFW, the management strategy is scored as "highly effective" if appropriate conservation targets (e.g., reference points) are defined. Currently, a set of measures are in place but no reference points or targets have been defined.

In addition, although the management framework is in place, it was noted by one of the peer reviewers that, due to its high economic importance, and the fact that the fishery represents one of the few sources of income for local communities, the quota authorization sometimes responds to social pressure from producers and not the actual status of the stocks (A. Rodriguez, per. comm. 2019). In addition, the effectiveness of the quota monitoring system is unknown and it is unclear how quickly the fishery is closed after the quota is reached.

Recognizing that there are management measures, but their effectiveness may be undermined by social pressures to keep the fishery open at low abundance levels, the fishery is scored as "moderately effective." There is a need for increased precaution, for example, for quicker reactions to changes in population and close monitoring of the quota.

Factor 3.2 - Bycatch Strategy

Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? How successful are these management measures? To achieve a Highly Effective rating, the fishery must have no or low bycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.

MEXICO/MAGDALENA BAY
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Highly Effective

The fishery does not have an impact on other species. For this reason, the factor is scored as "highly effective."

Factor 3.3 - Scientific Research and Monitoring

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

MEXICO/MAGDALENA BAY
Diving | Mexico

Moderately Effective

According to the NOM-004, managers monitor the resource to assess the stock abundance and set quotas (DOF 2015). Abundance is estimated based on underwater surveys that measure the density of organisms per square meter and the population size structure. These assessments are fishery independent and are carried out in coordination with producers (INAPESCAa 2018).

Producers are required to report catches (weight) to managers, so fishery dependent landings data for Mexican bay scallops in Magdalena Bay are available. In theory, landings should be used to monitor production against the assigned quota, but it is unclear if this actually occurs.

Despite the fact that managers use abundance indicators to keep the fishery closed, it is unclear how robust these assessments are, in particular since the assessments are not peer-reviewed and it is not clear if all relevant sources of fishing mortality are included (e.g., reports of illegal catches are common, see enforcement and compliance), for these reasons, this factor is scored as "moderately effective."

Factor 3.4 - Enforcement of Management Regulations

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

MEXICO/MAGDALENA BAY
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Ineffective

Enforcement actions in Mexico are under the jurisdiction of the National Fisheries Commission federal agents (CONAPESCA). However, it has been recognized that the number of active agents (~200) is not enough to cover Mexican coastal and inland waters (IMCO et al 2013). In order to improve coverage, CONAPESCA has been building collaboration agreements with other federal bodies (army and navy) as well as local and state enforcement agencies (local police officials) to increase their presence on the field (CONAPESCA blog 2019). However, illegal fishing and lack of effective enforcement still remains one of the biggest issues in the country, as stated by the IUU in Mexico report generated in 2013 (IMCO et al. 2013) by a group of environmental NGOs that have been working in Mexico for several decades.

In BCS, the illegal catch of bay scallops ranges from catch of illegal fishers (non-permit producers), misreporting on reports from legal producers, and fishing in closed areas and seasons for both producers with and without permits (Osuna-Castro 2012) (Narchi et al 2018). Regional media has been reporting this as a common practice for years (El Independiente 2018) (Inforural 2019) (El Sudcaliforniano a 2019) (El Sudcaliforniano b 2019) (El Sudcaliforniano c 2019), including during the years when fishing was not allowed (Peninsula digital 2014) (El Independiente 2016) (El Independiente 2017).

Despite the fact that enforcement actions in coordination with legal producers have reported some positive results (Uniradio 2018) (BCSnoticias 2019), it is believed that misreporting and illegal catches still represent a significant amount of the production (IMCO et al 2013) and more resources are needed in order to improve these actions, as stated by an active enforcement agent (J. Ulibarria, FONMAR, pers. comm. 2019). For these reasons, this factor is scored as "ineffective."

Factor 3.5 - Stakeholder Inclusion

Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management

process is transparent, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.

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Moderately Effective

Managers, local authorities, and producers participate in the annual surveys used to estimate stock status and for setting the fishery's quota, according to the article 4.1.1.7 of the official norm (DOF 2015). Considering that producers actively participate in the surveys, but it's unclear if all stakeholder groups are considered or participate in the management of the fishery, this factor is scored as "moderately effective."

Criterion 4: Impacts on the Habitat and Ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment. The final score is the geometric mean of the impact of fishing gear on habitat score (factor 4.1 + factor 4.2) and the Ecosystem Based Fishery Management score. The Criterion 4 rating is determined as follows:

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

GUIDING PRINCIPLES

- Avoid negative impacts on the structure, function or associated biota of marine habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.
- Follow the principles of ecosystem-based fisheries management.

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

Region | Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Score
Mexico/Magdalena Bay | Diving Mexico	4	0	Moderate Concern	Green (3.464)

Criterion 4 Assessment

SCORING GUIDELINES

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate

Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*
- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is*

known trampling of coral reef habitat.

- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)*
  Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

- *+1 —>50% of the habitat is protected from fishing with the gear type. Or fishing intensity is very low/limited and for trawled fisheries, expansion of fishery's footprint is prohibited. Or gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage. Or there is an effective combination of 'moderate' mitigation measures.*
- *+0.5 —At least 20% of all representative habitats are protected from fishing with the gear type and for trawl fisheries, expansion of the fishery's footprint is prohibited. Or gear modification measures or other measures are in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing that are expected to be effective.*
- *0 —No effective measures are in place to limit gear impacts on habitats or not applicable because gear used is benign and received a score of 5 in factor 4.1*

Factor 4.3 - Ecosystem-Based Fisheries Management

Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

- *5 — Policies that have been shown to be effective are in place to protect species' ecological roles and ecosystem functioning (e.g. catch limits that ensure species' abundance is maintained at sufficient levels to provide food to predators) and effective spatial management is used to protect spawning and foraging areas, and prevent localized depletion. Or it has been scientifically demonstrated that fishing practices do not have negative ecological effects.*
- *4 — Policies are in place to protect species' ecological roles and ecosystem functioning but have not proven to be effective and at least some spatial management is used.*
- *3 — Policies are not in place to protect species' ecological roles and ecosystem functioning but detrimental food web impacts are not likely or policies in place may not be sufficient to protect species' ecological roles and ecosystem functioning.*
- *2 — Policies are not in place to protect species' ecological roles and ecosystem functioning and the likelihood of detrimental food impacts are likely (e.g. trophic cascades, alternate stable states, etc.), but conclusive scientific evidence is not available for this fishery.*
- *1 — Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate

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4

The bay scallops in Magdalena Bay are found in mud and sandy bottoms (Maeda-Martinez et al. 2000) with shell or eelgrass underneath (Felix-Pico 2006). Considering that collection is by hooka system (see figure below) where contact with the bottom is minimal, this factor is scored as "4."

Justification:

Figure 7 Figure Hooka diving technique to collect bay scallops (from DOF 2018)

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

MEXICO/MAGDALENA BAY
Diving | Mexico

0

Other than the use of a TAC, and authorization of hooka dive system as the only legal fishing method for bay scallops, no mitigation actions are currently in place for the fishery. For this reason, no bonus points are added.

Factor 4.3 - Ecosystem-Based Fisheries Management

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Diving | Mexico

Moderate Concern

The Magdalena Bay ecosystem has been identified as one of the most important and rich areas in Baja California Sur (Ruiz-Luna and Acosta-Velasquez 2009). For this reason, in 2013 (Cruz-Escalona et al. 2013) described the structure and functioning of the estuarine ecosystem using the model ECOPATH with ECOSIM. The researchers found 24 functional groups and found that one-third of the ecosystem biomass was produced by secondary and tertiary trophic levels. In addition, the authors ordered the different components of the system in a hierarchy arrangement, based on their contribution to the function of the system, and identified the benthic primary producers and detritus as the main contributors (53%) to the total function of the system. They conclude that the energy control within the Bay is the top-down type, suggesting that high-trophic level species negatively affect other groups in the system (Cruz-Escalona et al 2013); in this case, it is unlikely that impacts on bay scallops would have a detrimental impact on the food web. Based on this, we scored this factor as a "moderate concern."

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Scientific review does not constitute an endorsement of the Seafood Watch® program, or its seafood recommendations, on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

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