Seafood Watch

Seafood Report

MONTEREY BAY AQUARIUM®

Mexican Bay Scallops

Argopecten ventricosus (= *circularis*)

(Image courtesy of José Liétor Gallego)

Magdalena Bay, Baja California Sur (Mexico)

January 6, 2011

Annie J. Yau
Consulting Researcher

About Seafood Watch® and the Seafood Reports

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

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

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

Disclaimer

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

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

Table of Contents

Capture Fisheries Evaluation

Species: *Argopecten ventricosus*	**Region**: *Magdalena Bay, Baja California Sur (Mexico)*
Analyst: *Annie J. Yau*	**Date**: *January 6, 2011*

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 capture fisheries must possess to be considered sustainable by the Seafood Watch program. Species from sustainable capture fisheries:

- have a low vulnerability to fishing pressure, and hence a low probability of being overfished, because of their inherent life history characteristics;
- have stock structure and abundance sufficient to maintain or enhance long-term fishery productivity;
- are captured using techniques that minimize the catch of unwanted and/or unmarketable species;
- are captured in ways that maintain natural functional relationships among species in the ecosystem, conserves the diversity and productivity of the surrounding ecosystem, and do not result in irreversible ecosystem state changes; and
- have a management regime that implements and enforces all local, national and international laws and utilizes a precautionary approach to ensure the long-term productivity of the resource and integrity of the ecosystem.

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

1. Inherent vulnerability to fishing pressure
2. Status of wild stocks
3. Nature and extent of discarded bycatch
4. Effect of fishing practices on habitats and ecosystems
5. Effectiveness of the management regime

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

Each criterion includes:

- Primary factors to evaluate and rank
- Secondary factors to evaluate and rank
- Evaluation guidelines[2] to synthesize these factors
- A resulting **rank** for that criterion

Once a rank has been assigned to each criterion, an **overall seafood recommendation** for the species in question is developed based on additional evaluation guidelines. The ranks for each criterion, and the resulting overall seafood recommendation, are summarized in a table. Criterion ranks and the overall seafood recommendation are color-coded to correspond to the categories of the Seafood Watch pocket guide:

Best Choices/Green: Consumers are strongly encouraged to purchase seafood in this category. The wild-caught species is sustainable as defined by Seafood Watch.

Good Alternatives/Yellow: Consumers are encouraged to purchase seafood in this category, as they are better choices than seafood in the Avoid category. However there are some concerns with how this species is fished and thus it does not demonstrate all of the qualities of a sustainable fishery as defined by Seafood Watch.

Avoid/Red: Consumers are encouraged to avoid seafood in this category, at least for now. Species in this category do not demonstrate enough qualities to be defined as sustainable by Seafood Watch.

[2] Evaluation Guidelines throughout this document reflect common combinations of primary and secondary factors that result in a given level of conservation concern. Not all possible combinations are shown – other combinations should be matched as closely as possible to the existing guidelines.

I. Executive Summary

Also known as catarina scallops, Mexican Bay scallops (*Argopecten ventricosus = circularis*) reside in the North Pacific and South Pacific oceans from the Baja California Peninsula in Mexico south to Peru. Along both coasts of the Baja California Peninsula, these scallops are harvested by divers. A federal law mandates that the National Fisheries Institute (Instituto Nacional de Pesca, INAPESCA) is responsible for performing surveys and stock management, distributing geographically specified permits (required in order to harvest), and setting annual quotas for this fishery. Although the intrinsic rate of population increase is unknown for this species, other life history characteristics of the Mexican Bay scallop have been well studied. These scallops have fast growth rates, a short time to maturity (less than 1 year), short lifespans (2–3 years), high reproductive output, and a broad species range. The habitats of this species in Magdalena Bay and along the coasts of Baja California Sur have been moderately altered, and the species may depend on low temperatures to help establish populations of eelgrass and a certain red crab species that are both beneficial to the Mexican Bay scallop. Eelgrass beds, specifically, provide suitable substrates for larval recruitment. Overall, Seafood Watch® deems Mexican Bay scallops to be inherently resilient to fishing pressure.

The Mexican Bay scallop fishery in the state of Baja California Sur is being harvested at maximum sustainable yield according to the Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food (Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación, SAGARPA). Many fishery measures for assessing the status of wild stocks are unknown, including biomass relative to B_{MSY}, current fishing mortality relative to F_{MSY}, biomass trends, and the current age/size distribution. There is a moderate degree of uncertainty in the status of the stock because only fishery-dependent data were available. Data on biomass landings are not standardized according to effort, and catch-per-unit-effort (CPUE) data are not available for this fishery. Based on fishery-dependent data for annual landings, both the long-term and short-term trends for Mexican Bay scallops in Magdalena Bay are highly variable. Biomass levels and quotas relative to the management reference targets of 40–60% of harvestable biomass could not be evaluated because data on biomass and quotas were not obtainable. The stock status of Mexican Bay scallops is deemed by Seafood Watch® to be a moderate conservation concern because many primary factors remain unknown and trends in landings are highly variable.

The quantity of bycatch from the diver-caught Mexican Bay scallop fishery is minimal because individual scallops are hand harvested by divers using small boats equipped with outboard motors and compressors. As a result of this method, the effects of the Mexican Bay scallop fishery on the population and ecosystem should also be minimal, although direct impact studies have not been conducted. The nature and extent of discarded bycatch in the Mexican Bay scallop fishery is considered to be a low conservation concern.

The shallow mud and sandy bottom habitats of Mexican Bay scallops are moderately resilient; furthermore, the Mexican Bay scallop fishery causes minimal habitat damage because of the nature of the extraction method: hand selection of individual scallops by divers. The ecosystem and food web impacts of this fishing method are unknown; however, impacts are likely low as the fishery causes

minimal habitat damage and the removal of this target species is not known to disrupt the food web. Because habitat damage and ecosystem impacts are likely low, Seafood Watch® considers the Mexican Bay scallop diver-caught fishery to be a low conservation concern for effects on habitats and ecosystems.

The methods and results of annual stock assessments conducted for the Mexican Bay scallop fishery by the National Fisheries Institute (Instituto Nacional de Pesca, INAPESCA) are unobtainable, causing uncertainty in stock status and in whether fishery-independent monitoring is occurring. In 2010, a stock assessment of these scallops in Magdalena Bay was conducted, but the methodology for this assessment is unobtainable. Methods for setting annual quotas based on stock assessment findings are also unobtainable, making it impossible to evaluate whether management exceeds the scientifically recommended catch quotas. Due to the low-impact nature of the extraction method (hand extraction of individual scallops by divers), management actions regarding bycatch and ecosystem status are not applicable. Furthermore, the enforcement status of this fishery is unobtainable. Management seems to respond to the natural annual variability in stock abundance, but without knowledge of the methods and results of stock assessments and the criteria for setting quotas, the track record of management is minimal. The scarcity of information on actual management practices for this fishery causes a high degree of uncertainty about management effectiveness. This uncertainty, combined with the low-impact nature of the extraction method, results in a management regime effectiveness score of moderately effective.

Because stock status and management effectiveness are considered moderate conservation concerns for this fishery, and because the remaining three criteria are of low conservation concern, the diver-caught Mexican Bay scallop fishery in Magdalena Bay, Mexico is deemed to be a **Good Alternative** by Seafood Watch®.

Table of Sustainability Ranks

	Conservation Concern			
Sustainability Criteria	**Low**	**Moderate**	**High**	**Critical**
Inherent Vulnerability	√			
Status of Stocks		√		
Nature of Bycatch	√			
Habitat & Ecosystem Effects	√			
Management Effectiveness		√		

About the Overall Seafood Recommendation:

- A seafood product is ranked **Best Choice** if three or more criteria are of Low Conservation Concern (green) and the remaining criteria are not of High or Critical Conservation Concern.
- A seafood product is ranked **Good Alternative** if the five criteria "average" to yellow (Moderate Conservation Concern) OR if the "Status of Stocks" and "Management Effectiveness" criteria are both of Moderate Conservation Concern.
- A seafood product is ranked **Avoid** if two or more criteria are of High Conservation Concern (red) OR if one or more criteria are of Critical Conservation Concern (black) in the table above.

Overall Seafood Recommendation:

Best Choice | **Good Alternative** | Avoid

II. Introduction

The Mexican Bay scallop, *Argopecten ventricosus* (previously known as *A. circularis*), is known as the catarina scallop (la almeja catarina) in Mexico and as the Pacific Calico Scallop by FAO (Félix-Pico 2006). It is an epibenthic bivalve of the family Pectinidae. Shells vary from almost all white to the inclusion of blotches and streaks of solid dark orange, brown or purple. The maximum shell length is 81 mm, with an average maximum length of 60 mm. At 60 mm long, whole weight is about 70 g with the adductor muscle (the edible part) weighing around 8 g (Félix-Pico 2006). The natural distribution of the Mexican Bay scallop ranges from both sides of the Baja California Peninsula in Mexico down to Peru (Keen 1971). A functional protandrous hermaphrodite, the Mexican Bay scallop spawns twice a year by releasing both eggs and sperm into the water where fertilization occurs. Spawning is seasonal and temperature-dependent, with stocks in warmer waters generally spawning twice a year from April–May and September–December, and stocks in colder waters only spawning once a year, around May–June (Maeda-Martínez et al. 1993). The depth range of these scallops is 6–35 m in the bays where they are harvested and up to 150 m in the open ocean (Félix-Pico 2006).

Mexican Bay scallops are harvested in several locations throughout the states of Baja California and Baja California Sur. This report focuses on the Mexican Bay scallop fishery of Magdalena Bay (Bahía Magdalena) on the Pacific west coast of Baja California Sur. The commercial fishery for these scallops in Magdalena Bay began in 1975 (Felix-Pico et al. 2009). Catch remained at relatively low levels (up to 5,000 tonnes) until the discovery in 1989 and 1990 of two separate stocks at 18–25 m deep, which resulted in a peak harvest of ~33,000 tonnes of live weight per year (Fig. 1) (Maeda-Martínez et al. 1993, Felix-Pico et al. 2009). After 1990, landings of the Mexican Bay scallop returned to previous levels before peaking again in 1996 at ~15,000 tonnes and more recently, in 2005, at ~15,000 tonnes (Felix-Pico et al. 2009).

Scallop fisheries in general are notoriously variable, going through boom and bust phases (Maeda-Martínez et al. 1993, Félix-Pico 2006), so the high variability in catch is not unusual. Variability in the abundance of harvested scallops may be due to environmental variability and/or a strong stock-recruitment relationship (Maeda-Martínez et al. 2001, Smith and Rago 2004). Abnormally low temperatures in the years preceding 1989 and 1990 may indicate that temperature is responsible for the dramatic increase in abundance (Fig 2), and the presence of aquaculture in Magdalena Bay may also contribute to fluctuations in abundance via increased larval input (Maeda-Martínez et al. 2001). It is likely that the harvested stock in Magdalena Bay is sustained by larvae from a nearby self-sustaining scallop bank on the continental shelf of Baja California between 25 °N and 27 °N latitude and between 13 and 180 m deep (Maeda-Martínez et al. 2001). The status of this scallop bank in deeper waters is unknown.

Commercial landings of the Mexican Bay scallop throughout the Gulf of California began in 1970 (Félix-Pico 2006), five years before commercial fishing officially began in Magdalena Bay (Felix-Pico et al. 2009). The trend in landings data for the Mexican Bay scallop

fishery for all of Baja California Sur follows the same trend as the fishery of Magdalena Bay itself: landings peaked in 1989–90 with smaller peaks in 1996 and 2006 (Fig 3) (Ponce-Díaz et al. 2009).

Landings data available for this species from non-regional sources are often combined with other scallops, or even more generally, with all bivalves. Reports of landings from the Mexican Annual Fishery Statistics Reports provide data for “almejas” (clams) that generally combine all bivalves including scallops, arks, clams, and pens (SAGARPA 2004, Félix-Pico 2006, SAGARPA 2008). The Mexican Bay scallop is the most important scallop to the overall scallop fishery in Mexico in terms of weight landed, followed by the Mexican Sea scallop (AKA Lion’s paw scallop). Harvest of Mexican Bay scallops accounted for over 50% of the total scallop live weight caught in 1986–2001, mostly from Baja California Sur (Fig 4) (SAGARPA 2004, Félix-Pico 2006). Landings data standardized by effort were not obtainable, although there is mention of some landings data available as catch per boat day (Felix-Pico et al. 2009).

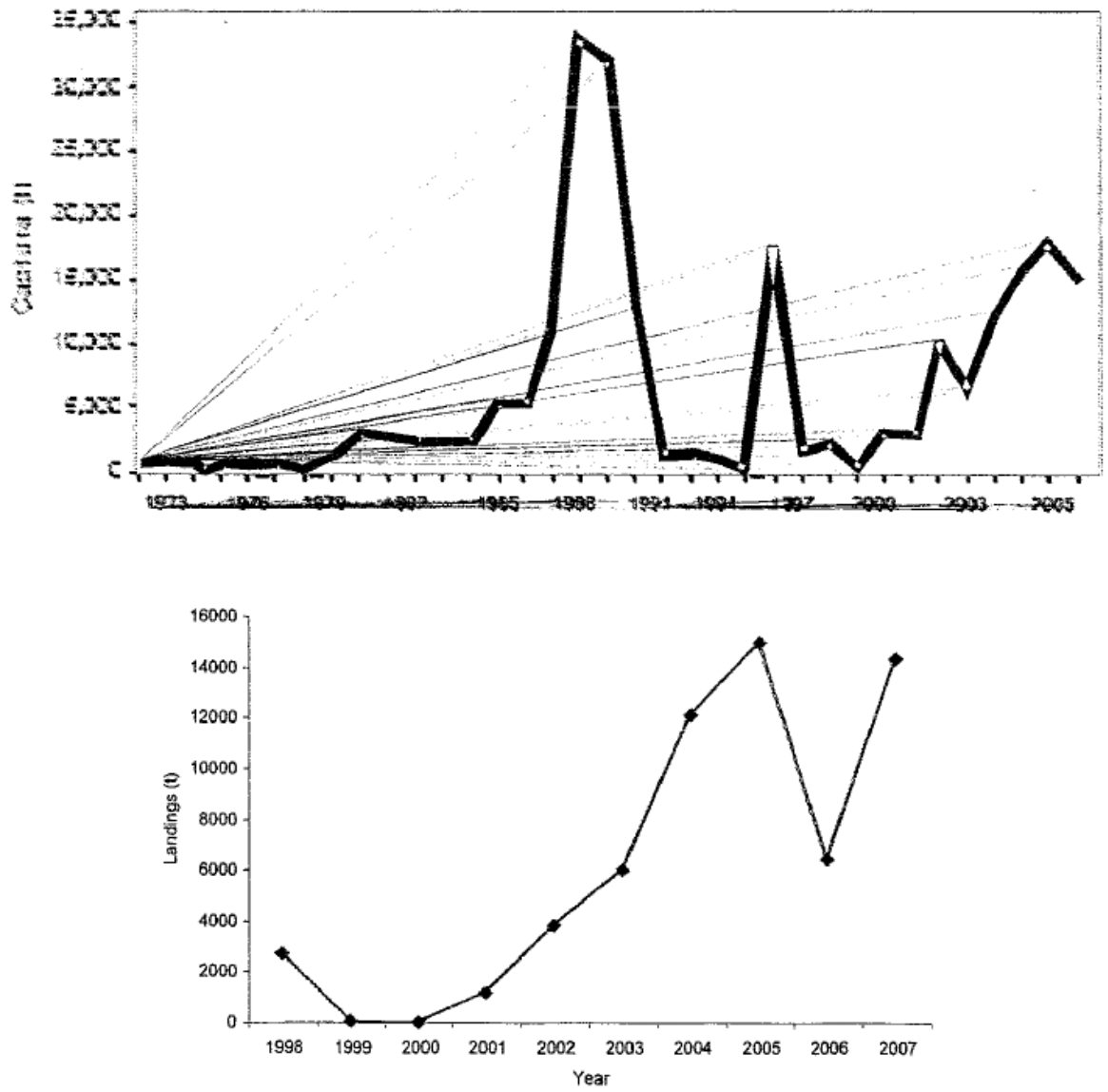


Figure 1. Annual catch (tonnes live weight) of Mexican Bay scallops, *Argopecten ventricosus*, from Bahia Magdalena, Baja California Sur. Top: 1972–2007. Bottom: 1998–2007 (figure from Felix-Pico et al. 2009).

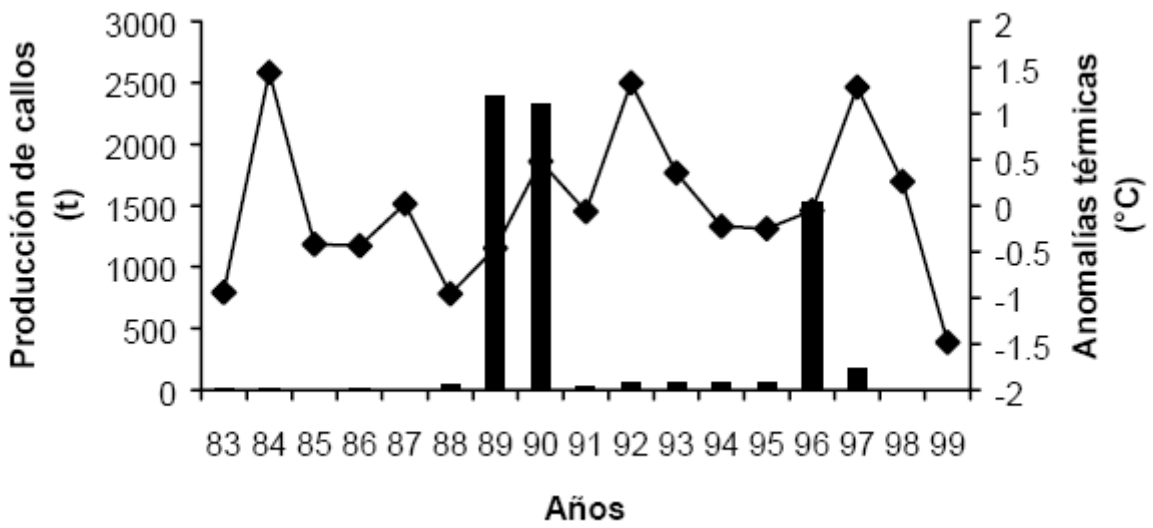


Figure 2. Annual harvest of Mexican Bay scallops (*Argopecten ventricosus*) in tonnes of adductor muscle (left y-axis, bars) and temperature anomalies calculated as the difference between monthly values and the corresponding average annual cycle value (1983–1999) (right y-axis, diamonds) from Magdalena Bay, Baja California Sur. Cold temperatures preceded high harvests in 1989 and 1990 (figure from Maeda-Martínez et al. 2001).

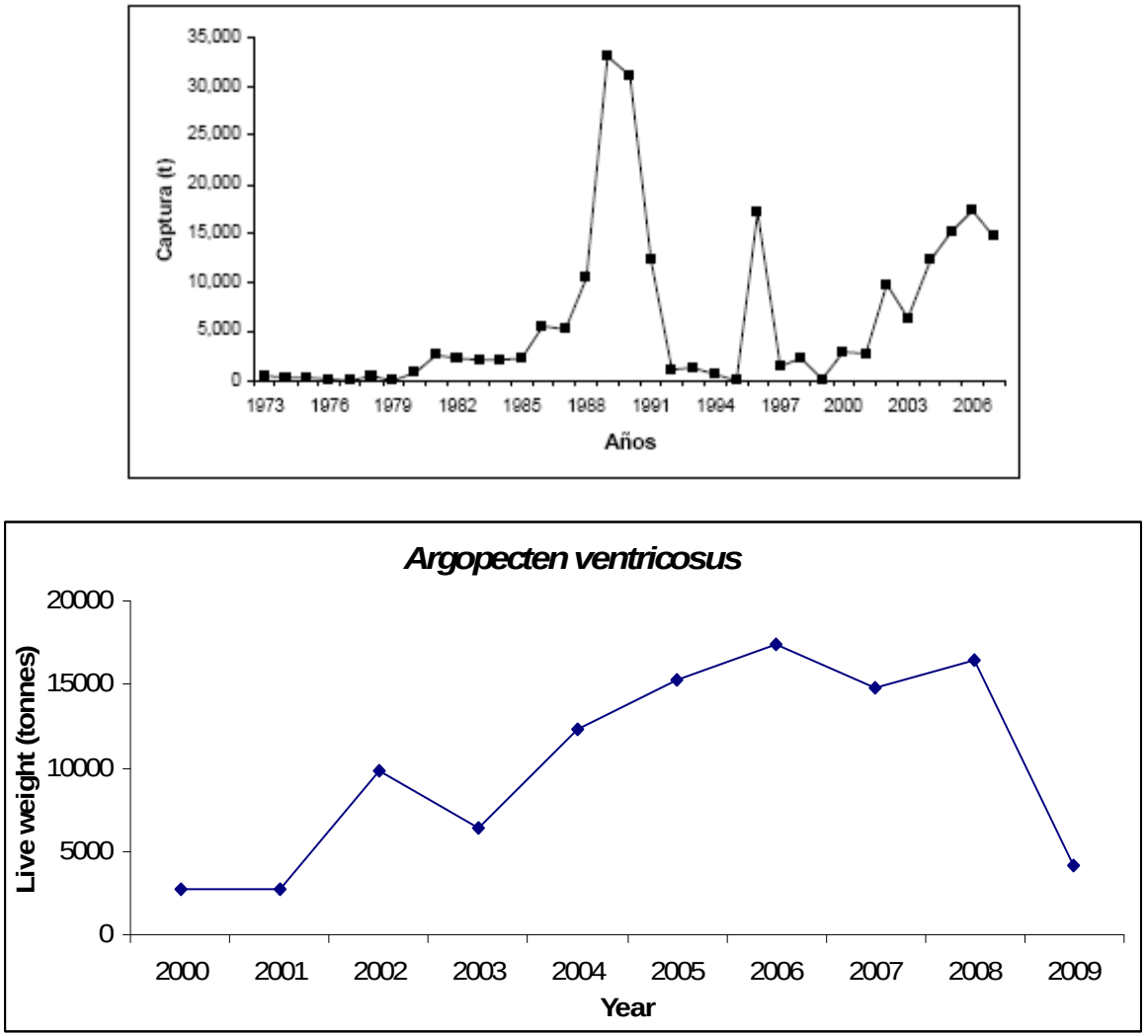


Figure 3. Total live weight (tonnes) of harvest from the Mexican Bay scallop fishery (*Argopecten ventricosus*), Baja California Sur. Harvest covers all Bay scallop fisheries in Baja California Sur, not just Magdalena Bay. Top: harvest from 1973–2007. From 2004–2008, harvest remained near 15,000 tonnes, mostly from Magdalena Bay (figure from Ponce-Díaz et al. 2009). Bottom: harvest from 2000-2009. The value for 2009 is an estimate. Data were obtained from Unidad de Enlace/Transparencia CONAPESCA.

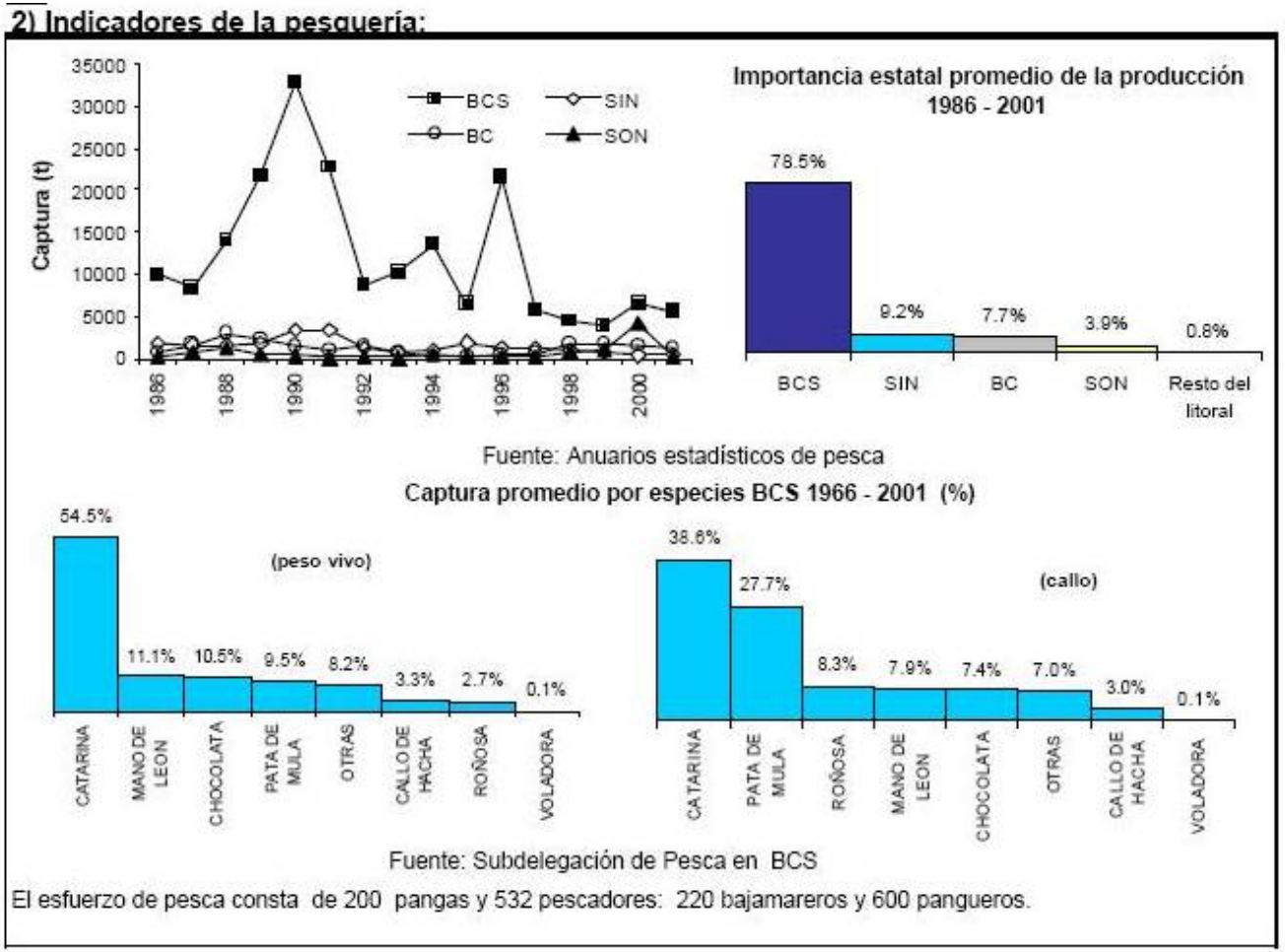


Figure 4. (top left) Capture trends of scallops and other bivalves (almejas) in different states of Mexico. "BCS" = Baja California Sur, "BC" = Baja California, "SIN" = Sinaloa, "SON" = Sonora. Top right: average production of scallops by state. Bottom left: average capture by species for Baja California Sur, by live weight. "Catarina" indicates the Mexican Bay scallop. Bottom right: average capture by species for Baja California Sur, by muscle weight (figure from SAGARPA 2004).

The Mexican Bay scallop fishery is regulated by a federal law established in 1993 that set a minimum size limit of 60 mm shell length (NORMA Oficial Mexicana 004-PESC-1993 1993). This law also prohibits harvesting these scallops during the spawning season, December 15 – March 31, and specifies that the National Fisheries Institute (Instituto Nacional de Pesca, INAPESCA) is responsible for performing surveys and stock management, setting quotas based on stock assessments, and distributing geographically specified permits that are required in order to harvest. In practice, surveys and stock assessments are completed the by Regional Fishery Centers (Centro Regional de Investigación Pesquera, CRIP) that are subdivisions of INAPESCA (Félix-Pico 2006).

Organizations or cooperatives apply annually for a permit, and each permit comes with a specified quota. With the help of fishermen, CRIP conducts stock assessments that include data on densities and size compositions. Using this data, the maximum sustainable yield (MSY) and resulting quotas are calculated and permits are distributed. The management reference point for harvest is 40% of the harvestable biomass each year (Ponce-Díaz et al. 2009) and no more than 60% of the total harvestable biomass from legal-size clams (over 60 mm long) (Felix-Pico et al. 2009). INAPESCA then sets rules of operation, and inspectors enforce the quotas (Felix-Pico et al. 2009). Permit holders are required to report their daily catch by weight to INAPESCA (NORMA Oficial Mexicana 004-PESC-1993 1993). Results from annual stock assessments, annual quotas, and the enforcement status of this fishery are all unobtainable, and thus the occurrence of fishery-independent stock assessments and enforcement could not be verified. The administrative process for determining the number of permits and the extension of the fishing season are also not well documented (Felix-Pico et al. 2009). SAGARPA considers the fishery for Mexican Bay scallops in Magdalena Bay to be at maximum sustainable yield (Ponce-Díaz et al. 2009), and recommends against increasing the current fishing effort for Mexican Bay scallops (SAGARPA 2004).

Permits are granted to organizations or fishing cooperatives and specify the number of boats and fishing days granted. Permits generally limit catch to 100 kg of scallop live weight per boat per day. Individual fishermen apply to work for permit-holding organizations or cooperatives. The total quota varies annually based on the current stock abundance level assessed by CRIP (Felix-Pico et al. 2009, Ponce-Díaz et al. 2009). The fishery may even be closed in certain years depending on the status of the stock, which occurred in 1994 (Felix-Pico et al. 1997, Medina et al. 2007). The total quota can vary from 130 kg of meat per boat day (Félix-Pico 2006) to the high of 1,815 kg of meat per boat day seen in 2010 (López 2010). In 2008, there were 55 individual permits and 97 fishing cooperative permits, totaling 152 permits (Ponce-Díaz et al. 2009). In 2009, there were 162 total licenses covering 349 boats (Felix-Pico et al. 2009), and in 2010, INAPESCA authorized 379 boats to remove 688 tonnes of Mexican Bay scallops from Magdalena Bay (López 2010).

The only authorized equipment for harvesting this species consists of a small boat with an outboard motor and a compressor to supply air for one diver (also referred to as semi-autonomous or “hookah diving”). Diving is the only approved method of extraction, and the harvest of scallops by walking out at low tide is prohibited (NORMA Oficial Mexicana 004-PESC-1993 1993). Dredging has never been used in this scallop fishery (SAGARPA 2004, Félix-Pico 2006), minimizing both general habitat destruction and bycatch. In

most cases, each boat has enough equipment to send down one diver while two others remain on the boat; one driver and another to operate the compressor and assist the diver (Ponce-Díaz et al. 2009). Open season is generally between May and June (Felix-Pico et al. 1997). The duration of the open season depends on the annual abundance of the Mexican Bay scallop and ranges from just a few months up to eight months of the year (open all year except for the closed season) (Maeda-Martínez et al. 2001).

Recommendations have been made to establish rotating banks, limit divers to one per boat, give permits to fishermen in communities closest to the resource, and develop a management plan for the species. Some illegal fishing occurs, and it is recommended that inspection and monitoring activities be strengthened in order to reduce illegal fishing and guarantee the recovery of the scallop banks (Ponce-Díaz et al. 2009). It is also recommended to establish mechanisms encouraging compulsory filing and the timely delivery of logbooks.

The majority of Mexican Bay scallops are processed immediately after harvest; the edible adductor muscle is removed and the rest of the organism is generally discarded. Processing occurs in nearby factories, some of which are makeshift factories constructed annually close to fishing camps whose locations change every year depending on the location of the stocks. These makeshift factories usually consist of a concrete floor and four walls, accessible only by dirt road, and providing no basic services. The byproducts of processing (remaining tissue and shell) are often left out in the open just outside the factory, resulting in insect infestation and environmental degradation (Maeda-Martínez et al. 2001).

Scope of the analysis and the ensuing recommendation: This report focuses on diver-caught Mexican Bay scallops (*Argopecten ventricosus*) in Magdalena Bay, Baja California Sur, Mexico. The fishery for Mexican Bay scallops is the most important to the overall scallop fishery in Mexico in terms of weight landed, and it accounts for over 50% of the scallop fishery of Baja California Sur. Seafood Watch® has ranked this fishery as a **Good Alternative**.

Availability of Science

Primary literature on the basic biology and best aquaculture methods for this species are moderately abundant. Several book sections and graduate student theses also offer biological information on the Mexican Bay scallop. No studies on population-level processes, such as intrinsic growth rates, have been published. Population-level studies of natural populations are rare and generally consist of surveys of densities and/or size distributions covering given geographic areas at specific points in time.

Annual landings of Mexican Bay scallops in Magdalena Bay and in Baja California Sur are available from a conference proceeding and government report (Felix-Pico et al. 2009, Ponce-Díaz et al. 2009). Landings at the state and national level, which combine

several bivalve species, are available from SAGARPA in their annual report, “Anuario Estadístico de Acuacultura y Pesca” (SAGARPA 2008). This report also contains data on human consumption of bivalves in Mexico and the proportion of the national capture fishery contributed by bivalves. INAPESCA conducts surveys and stock assessments of the Mexican Bay scallop before determining annual quotas, but the results of these assessments are not made available. None of these data sources on landings provide landings standardized according to effort.

Several details regarding the management of the Mexican Bay scallop fishery were not obtainable, including information on the methodology of stock assessment surveys, actual annual quotas, and the extent of enforcement. This creates a moderate degree of uncertainty about management effectiveness.

Market Availability

Common and market names: The Mexican Bay scallop is also known as the catarina scallop and Pacific calico scallop. It is often marketed simply as bay scallop, diver bay scallop, or diver-caught bay scallop, and may or may not be labeled as a product of Mexico.

Seasonal availability: The Mexican Bay scallop is available year-round in the form of the adductor muscle, mostly frozen but occasionally canned.

Product forms: The Mexican Bay scallop is sold as the adductor muscle, mostly frozen but occasionally canned. The annual report from SAGARPA includes data on the amount of scallops (“almejas”) frozen versus canned (SAGARPA 2008).

Import and export sources and statistics: Approximately 80% of all scallop production from Mexico is processed (the adductor muscle is separated) and approximately 82% of this processed muscle meat is exported to the United States with some consumption in Mexico (Félix-Pico 2006). When exported, scallops are sold in the form of the frozen adductor muscle (Félix-Pico 2006, SAGARPA 2008). Import and export data sources that provide information specifically on Mexican Bay scallops are not available.
.

III. Analysis of Seafood Watch® Sustainability Criteria for Wild-caught Species

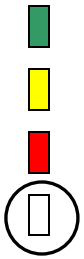
Criterion 1: Inherent Vulnerability to Fishing Pressure

Guiding Principle: Sustainable wild-caught species have a low vulnerability to fishing pressure, and hence a low probability of being overfished, because of their inherent life history characteristics.

Primary factors[3] to evaluate

Intrinsic rate of increase ('r')

- High (> 0.16)
- Medium (0.05–0.16)
- Low (< 0.05)
- Unavailable/Unknown



Key relevant information

There are no population-level studies assessing the intrinsic rate of increase for populations of Mexican Bay scallops.

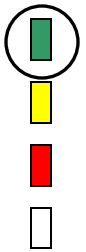
Reference(s)

Other notes

[3] These primary factors and evaluation guidelines follow the recommendations of Musick et al. (2000). Marine, estuarine, and diadromous fish stocks at risk of extinction in North America (exclusive of Pacific salmonids). Fisheries 25:6-30.

Age at 1st maturity

- Low (< 5 years)
- Medium (5–10 years)
- High (> 10 years)
- Unavailable/Unknown



Key relevant information

Under favorable environmental conditions, the Mexican Bay scallop reaches its first sexual maturity (defined as 50% or more of a population being fully mature, stage IV) at 4–5 months and an approximate size of 2 cm (Cruz et al. 2000). Another estimate places first sexual maturity at 8–12 months of age and 30 mm length (Félix-Pico 2006). First spawning occurs at 12–14 months of age (Hernandez-Llamas and Gomez-Muñoz 1996). In Magdalena Bay, the size at first maturity is reported to be 40 mm in length, reached at approximately 1 year of age (Ponce-Díaz et al. 2009).

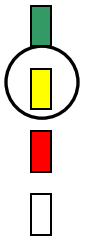
Reference(s)

Hernandez-Llamas and Gomez-Muñoz 1996, Cruz et al. 2000, Félix-Pico 2006, Ponce-Díaz et al. 2009

Other notes

Von Bertalanffy growth coefficient ('k')

- High (> 0.16)
- Medium (0.05–0.15)
- Low (< 0.05)
- Unavailable/Unknown



Key relevant information:

The estimated von Bertalanffy growth coefficient for the Mexican Bay scallop in Magdalena Bay is 0.117 (Felix-Pico et al. 1994). Other estimates of "k" for this species in other locations range across 0.28–0.53 (Hernandez-Llamas and Gomez-Muñoz 1996). This scallop species can grow up to 6 cm long (market size) within 12 months of spawning, depending on temperature and food availability (Maeda-Martínez et al. 1997).

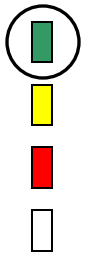
Reference(s)

Felix-Pico et al. 1994, Hernandez-Llamas and Gomez-Muñoz 1996, Maeda-Martínez et al. 1997

Other notes

Maximum age

- Low (< 11 years)
- Medium (11–30 years)
- High (> 30 years)
- Unavailable/Unknown



Key relevant information

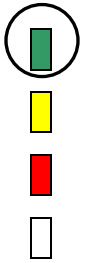
The Mexican Bay scallop is relatively short-lived with a lifespan of approximately 2-3 years (Maeda-Martínez et al. 1993, Félix-Pico 2006).

Reference(s)

Maeda-Martínez et al. 1993, Félix-Pico 2006

Reproductive potential (fecundity)

- High (> 100 inds./year)
- Moderate (10–100 inds./year)
- Low (< 10 inds./year)
- Unavailable/Unknown



Key relevant information

The Mexican Bay scallop is a functional hermaphrodite, reproducing by releasing both eggs and sperm into the water where fertilization occurs. Spawning is seasonal and temperature-dependent, with stocks in warmer waters generally spawning twice a year in April–May and September–December, and stocks in colder waters only spawning once a year around May–June (Maeda-Martínez et al. 1993). An average scallop produces 12 million oocytes (eggs) (Villalejo-Fuerte and Ochoa-Baez 1993).

Reference(s)

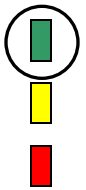
Maeda-Martínez et al. 1993, Villalejo-Fuerte and Ochoa-Baez 1993

Other notes

Secondary factors to evaluate

Species range

- Broad (e.g., species exists in multiple ocean basins, has multiple intermixing stocks or is highly migratory)
- Limited (e.g., species exists in one ocean basin)
- Narrow (e.g., endemism or numerous evolutionary significant units or restricted to one coastline)



Key relevant information

The Mexican Bay scallop resides in the North and South Pacific oceans, ranging from the Baja California Peninsula in Mexico down to Peru (Keen 1971, Felix-Pico et al. 1997, Medina et al. 2007).

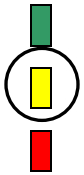
Reference(s)

Keen 1971, Felix-Pico et al. 1997, Medina et al. 2007

Other notes

Special Behaviors or Requirements: Existence of special behaviors that increase ease or population consequences of capture (e.g., migratory bottlenecks, spawning aggregations, site fidelity, unusual attraction to gear, sequential hermaphrodites, segregation by sex, etc., OR specific and limited habitat requirements within the species' range).

- No known behaviors or requirements OR behaviors that decrease vulnerability (e.g., widely dispersed during spawning)
- Some (i.e., 1–2) behaviors or requirements
- Many (i.e., > 2) behaviors or requirements



Key relevant information

The formation of Mexican Bay scallop aggregations inside Magdalena Bay occurs only in years of favorable environmental conditions. Such conditions include cold temperatures and increased wind speeds that facilitate larval transport inside the bay, the temperature-dependent inshore migration of the red crab (*Pleuroncodes planipes*), and the formation of eelgrass beds that provide substrate available for larval recruitment (Maeda-Martínez et al. 1993, Santamaria et al. 1999, Maeda-Martínez et al. 2001).

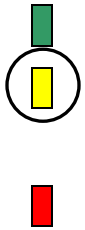
Reference(s)

Maeda-Martínez et al. 1993, Santamaria et al. 1999, Maeda-Martínez et al. 2001

Other notes

Quality of Habitat: Degradation from non-fishery impacts

- Habitat is robust
- Habitat has been moderately altered by non-fishery impacts
- Habitat has been substantially compromised from non-fishery impacts and thus has reduced capacity to support this species (e.g., from dams, pollution, or coastal development)



Key relevant information

Some domestic and cannery sewage exists along with limited pesticide runoff from agricultural areas, but no industrial sewage.

Testing in Magdalena Bay for aquaculture purposes has revealed the waters to be of good quality (Félix-Pico 2006).

Reference(s)

Félix-Pico 2006

Other notes

Synthesis

Although the intrinsic rate of increase is unknown, other life history characteristics of the Mexican Bay scallop have been well studied. These scallops have fast growth rates, a short time to maturity, short lifespans, high reproductive output, and a broad species range. The habitat of this species in Magdalena Bay and along the coasts of Baja California Sur has been moderately altered, and the species may depend on low temperatures to help establish populations of eelgrass and a certain red crab species that are both

beneficial to the Mexican Bay scallop. Eelgrass beds, specifically, provide suitable substrates for larval recruitment. Overall, the biology of this species results in Seafood Watch® deeming it inherently resilient to fishing pressure.

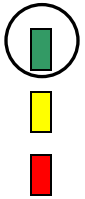
Evaluation Guidelines

1) Primary Factors
   a) If 'r' is known, use it as the basis for the rank of the Primary Factors.
   b) If 'r' is unknown, then the rank from the remaining Primary Factors (in order of importance, as listed) is the basis for the rank.

2) Secondary Factors
   a) If a majority (2 out of 3) of the Secondary Factors rank as Red, reclassify the species into the next lower rank (i.e., Green becomes Yellow, Yellow becomes Red). No other combination of Secondary Factors can modify the rank from the Primary Factors.
   b) No combination of primary and secondary factors can result in a Critical Conservation Concern for this criterion.

Conservation Concern: Inherent Vulnerability

- Low (Inherently Resilient)
- Moderate (Moderately Vulnerable)
- High (Highly Vulnerable)



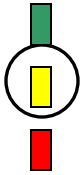
Criterion 2: Status of Wild Stocks

Guiding Principle: Sustainable wild-caught species have stock structure and abundance sufficient to maintain or enhance long-term fishery productivity.

Primary factors to evaluate

Management classification status

- Underutilized OR close to virgin biomass
- **Fully fished** OR recovering from overfished OR unknown
- Recruitment or growth overfished, overexploited, depleted or "threatened"



Key relevant information

SAGARPA considers the fishery for Mexican Bay scallops in Magdalena Bay to be harvesting at maximum sustainable yield (Ponce-Díaz et al. 2009) and recommends against increasing the current fishing effort for Mexican Bay scallops (SAGARPA 2004).

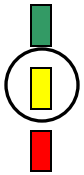
Reference(s)

SAGARPA 2004, Ponce-Díaz et al. 2009

Other notes

Current population abundance relative to B_{MSY}

- At or above B_{MSY} (> 100%)
- Moderately Below B_{MSY} (50–100%) OR **unknown**
- Substantially below B_{MSY} (< 50%)



Key relevant information

The value of B_{MSY} is unknown; therefore, current biomass relative to B_{MSY} is unknown. The management reference point is 40% of the harvestable biomass each year (Ponce-Díaz et al. 2009) and no more than 60% of the total harvestable biomass from legal-size clams (over 60 mm long) (Felix-Pico et al. 2009). The results of stock assessments conducted by Regional Fishery Centers (Centro Regional de Investigación Pesquera, CRIP) and annual quotas were not obtainable, so the relationship between stock assessments and established quotas could not be assessed.

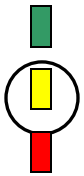
Reference(s)

Felix-Pico et al. 2009, Ponce-Díaz et al. 2009

Other notes

Occurrence of overfishing (current level of fishing mortality relative to overfishing threshold)

- Overfishing not occurring ($F_{curr}/F_{msy} < 1.0$)
- Overfishing is likely/probable OR fishing effort is increasing with poor understanding of stock status OR **Unknown**
- Overfishing occurring ($F_{curr}/F_{msy} > 1.0$)



Key relevant information

The values of F and F_{MSY} are not known. The management reference point is 40% of the harvestable biomass each year (Ponce-Díaz et al. 2009) and no more than 60% of the total harvestable biomass from legal-size clams (over 60 mm long) (Felix-Pico et al. 2009). The results of stock assessments conducted by Regional Fishery Centers (Centro Regional de Investigación Pesquera, CRIP) and annual quotas were not obtainable, so the fishing mortality rate could not be assessed.

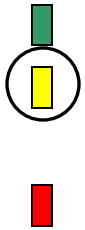
Reference(s)

Felix-Pico et al. 2009, Ponce-Díaz et al. 2009

Other notes

Overall degree of uncertainty in status of stock

- Low (i.e., current stock assessment and other fishery-independent data are robust OR reliable long-term fishery-dependent data are available)
- Medium (i.e., only limited, fishery-dependent data on stock status are available)
- High (i.e., little or no current fishery-dependent or independent information on stock status OR models/estimates broadly disputed or otherwise out-of-date)



Key relevant information

While INAPESCA is responsible for conducting annual surveys and stock assessments in order to determine quotas (NORMA Oficial Mexicana 004-PESC-1993 1993), the methods and results of these studies have not been made available. Fishery-dependent data on annual landings of Mexican Bay scallopa in Magdalena Bay are available (Felix-Pico et al. 2009, Ponce-Díaz et al. 2009)

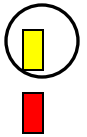
Reference(s)

NORMA Oficial Mexicana 004-PESC-1993 1993, Felix-Pico et al. 2009, Ponce-Díaz et al. 2009

Other notes

Long-term trend (relative to species' generation time) in population abundance as measured by either fishery-independent (stock assessment) or fishery-dependent (standardized CPUE) measures

- Trend is up



- Trend is flat or **variable** (among areas, over time or among methods) OR unknown
- Trend is down

Key relevant information

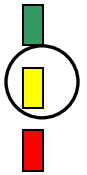
Measurements of population abundance from stock assessments were not obtainable, even though stock assessments are conducted annually by the Regional Fishery Center (Centro Regional de Investigación Pesquera, CRIP) (Félix-Pico 2006). Landings data for Mexican Bay scallops in Magdalena Bay indicate an extremely variable long-term trend (1972–2007), ranging from zero tonnes of live weight in years when the fishery is closed up to ~33,000 tonnes (Fig 1) (Felix-Pico et al. 2009). Scallop fisheries in general are notoriously variable, often going through boom and bust phases (Maeda-Martínez et al. 1993, Félix-Pico 2006). Data on landings are not standardized according to effort; CPUE data are not available for this fishery.

Reference(s)

Maeda-Martínez et al. 1993, Félix-Pico 2006, Felix-Pico et al. 2009

Other notes

Short-term trend in population abundance as measured by either fishery-independent (stock assessment) or fishery-dependent (standardized CPUE) measures



- Trend is up
- Trend is flat or **variable** (among areas, over time or among methods) OR unknown
- Trend is down

Key relevant information

Measurements of population abundance from stock assessments were not obtainable, even though stock assessments are conducted

annually by the Regional Fishery Center (Centro Regional de Investigación Pesquera, CRIP) (Félix-Pico 2006). Landings data for Mexican Bay scallops in Magdalena Bay indicate a variable short-term trend (2003–2007) ranging from 6,000 to almost 16,000 tonnes of live weight (Fig. 1) (Felix-Pico et al. 2009). Scallop fisheries in general are notoriously variable, often going through boom and bust phases (Maeda-Martínez et al. 1993, Félix-Pico 2006). Data on landings are not standardized according to effort; CPUE data are not available for this fishery.

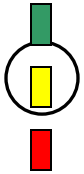
Reference(s)

Maeda-Martínez et al. 1993, Félix-Pico 2006, Felix-Pico et al. 2009

Other notes

Current age, size or sex distribution of the stock relative to natural condition

- Distribution(s) is(are) functionally normal
- Distribution(s) unknown
- Distribution(s) is(are) skewed



Key relevant information

While INAPESCA is responsible for conducting annual surveys and stock assessments in order to determine quotas (NORMA Oficial Mexicana 004-PESC-1993 1993), the methods and results of these studies were unobtainable. Surveys include size distribution data (Corona 2010), but the distributions remain unknown as these data have not been made available.

Reference(s)

NORMA Oficial Mexicana 004-PESC-1993 1993, Corona 2010

Other notes

Synthesis

SAGARPA considers the fishery for Mexican Bay scallops in Magdalena Bay to be at maximum sustainable yield; however, many criteria remain unknown including biomass relative to B_{MSY}, current fishing mortality relative to F_{MSY}, biomass trends, and the current age/size distribution. There is a moderate degree of uncertainty in the status of the stock because only fishery-dependent data were obtainable. Data on biomass landings are not standardized according to effort, and catch-per-unit-effort (CPUE) data are not available for this fishery. Based on fishery-dependent data for annual landings, both the long-term and short-term trends for Mexican Bay scallops in Magdalena Bay are highly variable. The biomass levels and quotas relative to the management reference targets of 40–60% of harvestable biomass could not be evaluated because data on biomass and quotas were not obtainable. The stock status of Mexican Bay scallops is deemed by Seafood Watch® to be a moderate conservation concern because many primary factors are unknown and the trends in landings are highly variable.

Evaluation Guidelines

A "Healthy" Stock:

1) Is underutilized (near virgin biomass)
2) Has a biomass at or above B_{MSY} AND overfishing is not occurring AND distribution parameters are functionally normal AND stock uncertainty is not high

A "Moderate" Stock:

1) Has a biomass at 50–100% of B_{MSY} AND overfishing is not occurring
2) Is recovering from overfishing AND short-term trend in abundance is up AND overfishing not occurring AND stock uncertainty is low
3) Has an Unknown status because the majority of primary factors are unknown.

A "Poor" Stock:

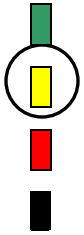
1) Is fully fished AND trend in abundance is down AND distribution parameters are skewed
2) Is overfished, overexploited or depleted AND trends in abundance and CPUE are up.
3) Overfishing is occurring AND stock is not currently overfished.

A stock is considered a **Critical Conservation Concern** and the species is ranked "Avoid**"**, regardless of other criteria, if it is:

1) Overfished, overexploited or depleted AND trend in abundance is flat or down
2) Overfished AND overfishing is occurring
3) Listed as a "threatened species" or similar proxy by national or international bodies

Conservation Concern: Status of Stocks

- Low (Stock Healthy)
- Moderate (Stock Moderate or Unknown)
- High (Stock Poor)
- Stock Critical



Criterion 3: Nature and Extent of Bycatch

Seafood Watch® defines sustainable wild-caught seafood as marine life captured using fishing techniques that successfully minimize the catch of unwanted and/or unmarketable species (i.e., bycatch). Bycatch is defined as species that are caught but subsequently discarded (injured or dead) for any reason. Bycatch does not include incidental catch (non-targeted catch) if it is utilized, accounted for and managed in some way.

Guiding Principle: A sustainable wild-caught species is captured using techniques that minimize the catch of unwanted and/or unmarketable species.

Primary factors to evaluate

Quantity of bycatch, including any species of "special concern" (i.e., those identified as "endangered", "threatened" or "protected" under state, federal or international law)

- Quantity of bycatch is low (< 10% of targeted landings on a per number basis) AND does not regularly include species of special concern 
- Quantity of bycatch is moderate (10–100% of targeted landings on a per number basis) AND does not regularly include species of special concern OR Unknown 
- Quantity of bycatch is high (> 100% of targeted landings on a per number basis) OR bycatch regularly includes threatened, endangered or protected species 

Key relevant information

Mexican Bay scallops are individually hand extracted by divers, so minimal bycatch occurs (NORMA Oficial Mexicana 004-PESC-1993 1993). Dredging has never been used to harvest Mexican Bay scallops (Félix-Pico 2006).

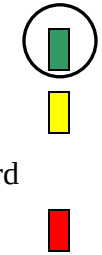
Reference(s)

NORMA Oficial Mexicana 004-PESC-1993 1993, Félix-Pico 2006

Other notes

Population consequences of bycatch

- Low: Evidence indicates quantity of bycatch has little or no impact on population levels
- Moderate: Conflicting evidence of population consequences of bycatch OR unknown
- Severe: Evidence indicates quantity of bycatch is a contributing factor in driving one or more bycatch species toward extinction OR is a contributing factor in limiting the recovery of a species of "special concern"



Key relevant information

Mexican Bay scallops are individually hand extracted by divers, so minimal bycatch occurs (NORMA Oficial Mexicana 004-PESC-1993 1993). Bycatch has little or no impact on population levels, and dredging has never been used to harvest Mexican Bay scallops (Félix-Pico 2006).

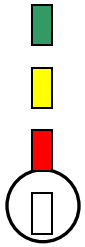
Reference(s)

NORMA Oficial Mexicana 004-PESC-1993 1993, Félix-Pico 2006

Other notes

Trend in bycatch interaction rates (adjusting for changes in abundance of bycatch species) as a result of management measures (including fishing seasons, protected areas, and gear innovations):

- Trend in bycatch interaction rates is down
- Trend in bycatch interaction rates is flat OR unknown
- Trend in bycatch interaction rates is up
- Not applicable because quantity of bycatch is low



Key relevant information

Mexican Bay scallops are individually hand extracted by divers, so minimal bycatch occurs (NORMA Oficial Mexicana 004-PESC-

1993 1993). Dredging has never been used to harvest Mexican Bay scallops (Félix-Pico 2006).

Reference(s)

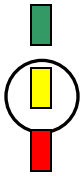
NORMA Oficial Mexicana 004-PESC-1993 1993, Félix-Pico 2006

Other notes

Secondary factor to evaluate

Evidence that the ecosystem has been or likely will be substantially altered (relative to natural variability) in response to the continued discard of the bycatch species

- Studies show no evidence of ecosystem impacts
- Conflicting evidence of ecosystem impacts OR **unknown**
- Studies show evidence of substantial ecosystem impacts



Key relevant information

There have been no studies assessing the ecosystem impacts of the discard of bycatch species in the Mexican Bay scallop fishery. Nevertheless, minimal bycatch is associated with the extraction method used in this fishery, and so there are likely few or no ecosystem impacts.

Reference(s)

Other notes

Synthesis

The quantity of bycatch from the diver-caught Mexican Bay scallop fishery is minimal because of the harvesting practice of removing individual scallops by hand. As a result, the population and ecosystem should experience minimal effects, although direct studies assessing ecosystem impacts have not been conducted. The nature and extent of discarded bycatch for Mexican Bay scallops is considered a low conservation concern.

Evaluation Guidelines

Bycatch is **"Minimal"** if:

1) Quantity of bycatch is <10% of targeted landings AND bycatch has little or no impact on population levels.

Bycatch is **"Moderate"** if:

1) Quantity of bycatch is 10–100% of targeted landings
2) Bycatch regularly includes species of "special concern" AND bycatch has little or no impact on the bycatch population levels AND the trend in bycatch interaction rates is not up.

Bycatch is "Severe" if:

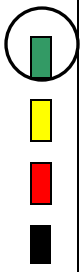
1) Quantity of bycatch is > 100% of targeted landings
2) Bycatch regularly includes species of "special concern" AND evidence indicates bycatch rate is a contributing factor toward extinction or limiting recovery AND trend in bycatch is down.

Bycatch is considered a **Critical Conservation Concern** and the species is ranked "Avoid", regardless of other criteria, if:

1) Bycatch regularly includes species of special concern AND evidence indicates bycatch rate is a factor contributing to extinction or limiting recovery AND trend in bycatch interaction rates is not down.
2) Quantity of bycatch is high AND studies show evidence of substantial ecosystem impacts.

Conservation Concern: Nature and Extent of Discarded Bycatch

- Low (Bycatch Minimal)
- Moderate (Bycatch Moderate)
- High (Bycatch Severe)
- Bycatch Critical



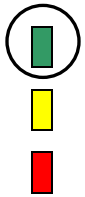
Criterion 4: Effect of Fishing Practices on Habitats and Ecosystems

Guiding Principle: Capture of a sustainable wild-caught species maintains natural functional relationships among species in the ecosystem, conserves the diversity and productivity of the surrounding ecosystem, and does not result in irreversible ecosystem state changes.

Primary habitat factors to evaluate

Known (or inferred from other studies) effect of fishing gear on physical and biogenic habitats

- Minimal damage (i.e., pelagic longline, midwater gillnet, midwater trawl, purse seine, hook & line, or spear/harpoon)
- Moderate damage (i.e., bottom gillnet, bottom longline or some pots/traps)
- Great damage (i.e., bottom trawl or dredge)



Key relevant information

Mexican Bay scallops are individually hand extracted by divers working from small boats, so minimal habitat damage occurs (NORMA Oficial Mexicana 004-PESC-1993 1993). Dredging has never been used to harvest Mexican Bay scallops (Félix-Pico 2006).

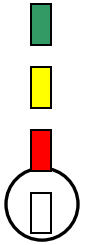
Reference(s)

NORMA Oficial Mexicana 004-PESC-1993 1993, Félix-Pico 2006

Other notes

For specific fishery being evaluated, resilience of physical and biogenic habitats to disturbance by fishing method

- High (e.g., shallow water, sandy habitats)
- Moderate (e.g., shallow or deep water mud bottoms, or deep water sandy habitats)
- Low (e.g., shallow or deep water corals, shallow or deep water rocky bottoms)
- Not applicable because gear damage is minimal



Key relevant information

Mexican Bay scallops are found in shallow (18–25 m) mud and sandy bottoms (Maeda-Martínez et al. 1993) with shell or eelgrass underneath (Félix-Pico 2006). Gear damage is minimal, however, so the resilience of the habitat is not applicable in this case.

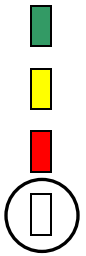
Reference(s)

Maeda-Martínez et al. 1993, Félix-Pico 2006

Other notes

If gear impacts are moderate or great, spatial scale of the impact

- Small scale (e.g., small, artisanal fishery or sensitive habitats are strongly protected)
- Moderate scale (e.g., modern fishery but of limited geographic scope)
- Large scale (e.g., industrialized fishery over large geographic areas)
- Not applicable because gear damage is minimal



Key relevant information

Mexican Bay scallops are individually hand extracted by divers working from small boats, so minimal habitat damage occurs (NORMA Oficial Mexicana 004-PESC-1993 1993). Dredging has never been used to harvest Mexican Bay scallops (Félix-Pico 2006).

Reference(s)

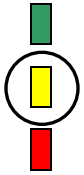
NORMA Oficial Mexicana 004-PESC-1993 1993, Félix-Pico 2006

Other notes

Primary ecosystem factors to evaluate

Evidence that the removal of the targeted species or the removal/deployment of baitfish has or will likely substantially disrupt the food web

- The fishery and its ecosystem have been thoroughly studied, and studies show no evidence of substantial ecosystem impacts
- Conflicting evidence of ecosystem impacts OR **unknown**
- Ecosystem impacts of targeted species removal demonstrated



Key relevant information

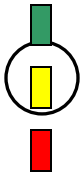
Ecosystem impacts and food web impacts resulting from removal of Mexican Bay scallops by the Baja California Sur commercial fishery are unknown.

Reference(s)

Other notes

Evidence that the fishing method has caused or is likely to cause substantial ecosystem state changes, including alternate stable states

- The fishery and its ecosystem have been thoroughly studied, and studies show no evidence of substantial ecosystem impacts
- Conflicting evidence of ecosystem impacts OR **unknown**
- Ecosystem impacts from fishing method demonstrated



Key relevant information

Ecosystem impacts from the fishing method are unknown; however, impacts are probably low because minimal habitat damage is associated with the extraction method in this fishery.

Reference(s)

Other notes

Synthesis

The shallow mud and sandy bottom habitats of Mexican Bay scallops are moderately resilient, but the Mexican Bay scallop fishery causes minimal habitat damage due to the nature of the extraction method: hand removal of individual scallops by divers. The ecosystem impacts and food web impacts of this fishing method are unknown; however, the impacts are likely low as minimal habitat damage caused by this fishery. Because the habitat damage from hand removal by divers and ecosystem impacts are likely low, Seafood Watch® considers the Mexican Bay scallop diver-caught fishery to be a low conservation concern for effects on habitats and ecosystems.

Evaluation Guidelines

The effect of fishing practices is **"Benign"** if:

1) Damage from gear is minimal AND resilience to disturbance is high AND neither Ecosystem Factor is red.

The effect of fishing practices is **"Moderate"** if:

1) Gear effects are moderate AND resilience to disturbance is moderate or high AND neither Ecosystem Factor is red.
2) Gear results in great damage AND resilience to disturbance is high OR impacts are small scale AND neither Ecosystem Factor is red.
3) Damage from gear is minimal and one Ecosystem factor is red.

The effect of fishing practices is **"Severe"** if:

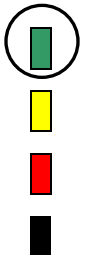
1) Gear results in great damage AND the resilience of physical and biogenic habitats to disturbance is moderate or low.
2) Both Ecosystem Factors are red.

Habitat effects are considered a **Critical Conservation Concern** and a species receives a recommendation of "**Avoid"**, regardless of other criteria if:

- Four or more of the Habitat and Ecosystem factors rank red.

Conservation Concern: Effect of Fishing Practices on Habitats and Ecosystems

- Low (Fishing Effects Benign)
- Moderate (Fishing Effects Moderate)
- High (Fishing Effects Severe)
- Critical Fishing Effects



Criterion 5: Effectiveness of the Management Regime

Guiding Principle: The management regime of a sustainable wild-caught species implements and enforces all local, national and international laws and utilizes a precautionary approach to ensure the long-term productivity of the resource and integrity of the ecosystem.

Primary factors to evaluate

Stock Status: Management process utilizes an independent scientific stock assessment that seeks knowledge related to the status of the stock

- Stock assessment complete and robust
- Stock assessment is planned or underway but is incomplete OR stock assessment complete but out-of-date or otherwise **uncertain**
- No stock assessment available now and none is planned in the near future

Key relevant information

The National Fisheries Institute (Instituto Nacional de Pesca, INAPESCA) is responsible for performing annual surveys and setting quotas (NORMA Oficial Mexicana 004-PESC-1993 1993). In practice, surveys and stock assessments are conducted by the Regional Fishery Centers (Centro Regional de Investigación Pesquera, CRIP) that are subdivisions of INAPESCA (Félix-Pico 2006). In 2010, an assessment of the Mexican Bay scallop stock in Magdalena Bay surveyed densities and size compositions (Corona 2010). The methods and results of these annual stock assessments are unobtainable, and thus robustness cannot be assessed.

Reference(s)

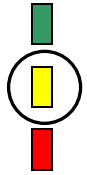
NORMA Oficial Mexicana 004-PESC-1993 1993, Félix-Pico 2006, Corona 2010

Other notes

The fishery mangement process is displayed in Figure 5.

Scientific Monitoring: Management process involves regular collection and analysis of data with respect to the short and long-term abundance of the stock

- Regular collection and assessment of both fishery-dependent and independent data
- Regular collection of fishery-dependent data only
- No regular collection or analysis of data



Key relevant information

The methods and results of annual stock assessments conducted by INAPESCA are unobtainable, but stock assessments may be performed in collaboration with fishermen (Felix-Pico et al. 2009) so it is unclear whether these assessments are fishery-independent or not. Permit holders are required to report their daily catch by weight to INAPESCA (NORMA Oficial Mexicana 004-PESC-1993 1993), so fishery-dependent landings data for Mexican Bay scallops in Magdalena Bay are available (Felix-Pico et al. 2009).

Reference(s)

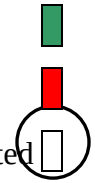
NORMA Oficial Mexicana 004-PESC-1993 1993, Felix-Pico et al. 2009

Other notes

The fishery mangement process is displayed in Figure 5.

Scientific Advice: Management has a well-known track record of consistently setting or exceeding catch quotas beyond those recommended by its scientific advisors and other external scientists:

- No
- Yes
- **Not enough information** available to evaluate OR not applicable because little or no scientific information is collected



Key relevant information

The management reference point is 40% of the harvestable biomass each year (Ponce-Díaz et al. 2009) and no more than 60% of the total harvestable biomass of legal-size clams (over 60 mm long) (Felix-Pico et al. 2009). However, as the methods and results of annual stock assessments and the methods for setting annual quotas based on these stock assessments are unobtainable, there is not enough information to evaluate this criterion.

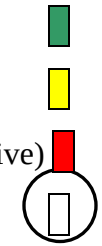
Reference(s)

Felix-Pico et al. 2009, Ponce-Díaz et al. 2009

Other notes

Bycatch: Management implements an effective bycatch reduction plan

- Bycatch plan in place and reaching its conservation goals (deemed effective)
- Bycatch plan in place but effectiveness is not yet demonstrated or is under debate
- No bycatch plan implemented or bycatch plan implemented but not meeting its conservation goals (deemed ineffective)
- Not applicable because bycatch is “low”



Key relevant information

Mexican Bay scallops are individually hand extracted by divers and minimal bycatch occurs (NORMA Oficial Mexicana 004-PESC-1993 1993). Dredging has never been used to harvest Mexican Bay scallops (Félix-Pico 2006).

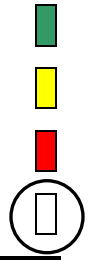
Reference(s)

NORMA Oficial Mexicana 004-PESC-1993 1993, Félix-Pico 2006

Other notes

Fishing practices: Management addresses the effect of the fishing method(s) on habitats and ecosystems

- Mitigative measures in place and deemed effective
- Mitigative measures in place but effectiveness is not yet demonstrated or is under debate
- No mitigative measures in place or measures in place but deemed ineffective
- Not applicable because fishing method is moderate or benign



Key relevant information

The shallow mud and sandy bottom habitats of Mexican Bay scallops are moderately resilient, but the Mexican Bay scallop fishery causes minimal habitat damage due to the nature of the extraction method: hand removal of individual scallops by divers (NORMA Oficial Mexicana 004-PESC-1993 1993). Dredging has never been used to harvest Mexican Bay scallops (Félix-Pico 2006). The ecosystem impacts of this scallop fishery are currently unknown.

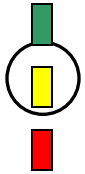
Reference(s)

NORMA Oficial Mexicana 004-PESC-1993 1993, Félix-Pico 2006

Other notes

Enforcement: Management and appropriate government bodies enforce fishery regulations

- Regulations regularly enforced by independent bodies, including logbook reports, observer coverage, dockside monitoring and similar measures
- Regulations enforced by fishing industry or by voluntary/honor system or **unknown**
- Regulations not regularly and consistently enforced



Key relevant information

The Mexican Bay scallop fishery is regulated by a federal law established in 1993 that set a minimum size limit of 60 mm shell length (NORMA Oficial Mexicana 004-PESC-1993 1993). This law also prohibits harvesting these scallops during the spawning season, December 15 – March 31, and specifies that the National Fisheries Institute (Instituto Nacional de Pesca, INAPESCA) is responsible for performing surveys and stock management, setting quotas based on stock assessments, and distributing geographically specified permits that are required in order to harvest. Quotas are supposed to be enforced by inspectors (Felix-Pico et al. 2009), and federal law mandates that permit holders report their catch by weight to the National Fisheries Institute (Instituto Nacional de Pesca, INAPESCA) (NORMA Oficial Mexicana 004-PESC-1993 1993). Recommendations were made to establish rotating banks, limit divers to per boat, provide permits to fishermen in communities closest to the resource, and develop a management plan for the species. Some illegal fishing occurs, and it is recommended that inspection and monitoring activities be strengthened in order to reduce illegal fishing and guarantee recovery of the banks (Ponce-Díaz et al. 2009). It is also recommended to establish mechanisms encouraging compulsory filing and the timely delivery of logbooks.

Information about the effectiveness of enforcement measures in this fishery is unobtainable and remains unknown.

Reference(s)

NORMA Oficial Mexicana 004-PESC-1993 1993, Felix-Pico et al. 2009

Other notes

The fishery mangement process is displayed in Figure 5.

Management Track Record: Conservation measures enacted by management have resulted in the long-term maintenance of stock abundance and ecosystem integrity

- Management has maintained stock productivity over time OR has fully recovered the stock from an overfished condition 
- Stock productivity has varied and management has responded quickly OR stock has not varied but management has not been in place long enough to evaluate its effectiveness OR **unknown** 
- Measures have not maintained stock productivity OR were implemented only after significant declines and stock has not yet fully recovered 

Key relevant information

Because stock abundance estimates from annual assessments were not obtainable, landings data serve as a proxy for stock abundance (Felix-Pico et al. 2009). The management reference point is 40% of the harvestable biomass each year (Ponce-Díaz et al. 2009) and no more than 60% of the total harvestable biomass of legal-size clams (over 60 mm long) (Felix-Pico et al. 2009). The trend in landings data is highly variable, but reported landings of zero tonnes for several years since 1972 suggest that management closes the fishery during years of low stock abundance. As the methods and results of stock assessments and the criteria for setting annual quotas have all proven unobtainable, actual stock productivity and management actions are unknown.

Reference(s)

(Felix-Pico et al. 2009, Ponce-Díaz et al. 2009)

Other notes

The fishery mangement process is displayed in Figure 5.

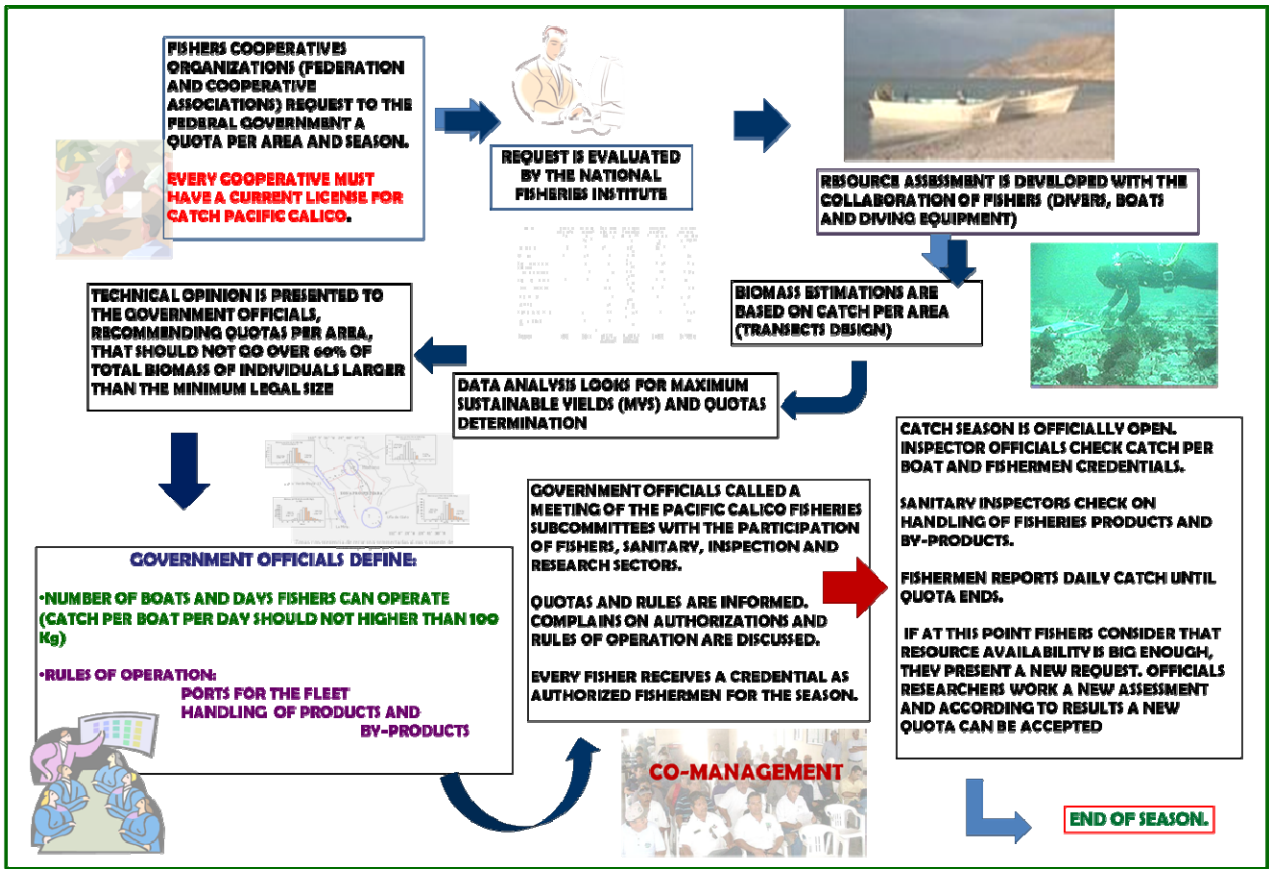


Figure 5. Summary of the fishery management process for Mexican Bay scallops in Magdalena Bay, Baja California Sur (figure from Felix-Pico et al. 2009)

Synthesis

For the Mexican Bay scallop fishery, INAPESCA has not made the methods and results of its annual stock assessments available, which has caused uncertainty both in stock status and in whether fishery-independent monitoring occurs. In 2010, a stock assessment of scallops in Magdalena Bay was conducted, but the methodology is unobtainable. Methods for setting annual quotas based on stock assessment are also unobtainable, making it impossible to evaluate whether management had exceeded the scientifically recommended catch quotas. Due to the low-impact nature of the extraction method (hand harvesting of individual scallops by divers), there are no management actions relevant to bycatch and ecosystem status. The enforcement status of this fishery has also proven to be unobtainable. Management appears to respond to the natural annual variability in stock abundance but without knowing the methods

and results of stock assessments and the criteria for setting quotas, management lacks a track record. The scarcity of data on actual management in this fishery leaves a high degree of uncertainty about management effectiveness. This uncertainty, combined with the low-impact nature of the extraction method, result in a management regime effectiveness score of moderately effective.

Evaluation Guidelines

Management is deemed to be "**Highly Effective**" if the majority of management factors are green AND the remaining factors are not red.

Management is deemed to be "**Moderately Effective**" if:

1) Management factors "average" to yellow
2) Management factors include one or two red factors

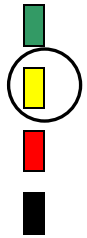
Management is deemed to be "**Ineffective**" if three individual management factors are red, including especially those for Stock Status and Bycatch.

Management is considered a **Critical Conservation Concern** and a species receives a recommendation of "**Avoid"**, regardless of other criteria if:

1) There is no management in place
2) The majority of the management factors rank red.

Conservation Concern: Effectiveness of Management

- Low (Management Highly Effective)
- Moderate (Management Moderately Effective)
- High (Management Ineffective)
- Critical (Management Critically Ineffective)



IV. Overall Evaluation and Seafood Recommendation

Overall Guiding Principle: Sustainable wild-caught seafood originates from sources that can maintain or increase production in the long term without jeopardizing the structure or function of affected ecosystems.

Evaluation Guidelines

A species receives a recommendation of "**Best Choice**" if:
1) It has three or more green criteria and the remaining criteria are not red.

A species receives a recommendation of "**Good Alternative**" if:
1) Criteria "average" to yellow
2) There are four green criteria and one red criteria
3) Stock Status and Management criteria are both ranked yellow and remaining criteria are not red.

A species receives a recommendation of "**Avoid**" if:
1) It has a total of two or more red criteria
2) It has one or more Critical Conservation Concerns.

Table of Sustainability Ranks

	Conservation Concern			
Sustainability Criteria	**Low**	**Moderate**	**High**	**Critical**
Inherent Vulnerability	√			
Status of Stocks		√		
Nature of Bycatch	√			
Habitat & Ecosystem Effects	√			
Management Effectiveness		√		

Overall Seafood Recommendation:

Best Choice 

Good Alternative 

Avoid 

Acknowledgements

Seafood Watch® thanks Dr. Alfonso N. Maeda-Martínez (Researcher, Centro de Investigaciones Biológicas del Noroeste, La Paz, B.C.S., México) and Dr. Esteban F. Félix-Pico (Researcher, Centro Interdisciplinario de Ciencias Marinas – Instituto Politécnico Nacional, La Paz, B.C.S., México) for graciously reviewing this paper for scientific accuracy.

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.

Supplemental Information

Several species of toxic dinoflagellates, responsible for paralytic shellfish poisoning, have been found along the Pacific coast of Mexico (see Félix-Pico 2006) and in the Gulf of California (Morquecho-Escamilla 1996) during the spring and summer seasons. Mexican Bay scallops collected from Bahia Concepcion in the Gulf of California in March and June of 1993 showed levels of paralytic shellfish toxins that exceeded the maximum allowable limit in shellfish for human consumption (Morquecho-Escamilla 1996). It is unknown whether any regular testing of Mexican Bay scallops occurs.

V. References

Corona, A. R. 2010. Aun no hay fechas para el inicio de temporada de la captura de almeja catarina en Comondú. El Sudcaliforniano, La Paz, Mexico, April 8, 2010.

Cruz, P., C. Rodriguez-Jaramillo, and A. M. Ibarra. 2000. Environment and population origin effects on first sexual maturity of catarina scallop, *Argopecten ventricosus* (Sowerby II, 1812). Journal of Shellfish Research 19:89-93.

Felix-Pico, E., J. L. Castro-Ortiz, and A. Tripp-Quezada. 1994. Some aspects of the growth, recruitment and mortality of the catarina scallop, *Argopecten circularis* (Sowerby, 1835) in Bahia Magdalena, Baja California Sur, Mexico. Pages 145-153 *in* Proceedings of the 9th International Pectinid Workshop. Nanaimo, B.C., Canada.

Felix-Pico, E., M. Ramirez-Rodriguez, M. Arellano-Martinez, and A. Velez-Barajas. 2009. Management strategies of *Argopecten ventricosus* fisheries in Bahia Magdalena, Mexico. *in* Western Society of Malacologists Annual Meeting. California State University at Fullerton.

Félix-Pico, E. F. 2006. Chapter 29 Mexico. Pages 1337-1390 in S. E. Shumway and G. J. Parsons, editors. Scallops: Biology, Ecology, and Aquaculture. Elsevier, San Diego, CA. USA.

Felix-Pico, E. F., A. Tripp-Quezada, J. L. Castro-Ortiz, G. Serrano-Casillas, P. G. Gonzalez-Ramirez, M. Villalejo-Fuerte, R. Palomares-Garcia, F. A. Garcia-Dominguez, M. Mazon-Suastegui, G. Bojorquez-Verastica, and G. Lopez-Garcia. 1997. Repopulation and culture of the Pacific Calico scallops in Bahia Concepcion, Baja California Sur, Mexico. Aquaculture International 5:551-563.

Hernandez-Llamas, A., and V. M. Gomez-Muñoz. 1996. Growth and survival response of the Catarina scallop Argopecten circularis (Sowerby) to stocking density and length of culture period. Aquaculture Research 27:711-719.

Keen, A. M. 1971. Sea shells of tropical West America, Second edition. Stanford University Press, Stanford, California. USA.

López, J. M. 2010. Sin fecha captura de almeja Catarina, y Será en la reunión del Subcomité de Pesca cuando se defina la misma. El Sudcaliforniano, La Paz, Mexico, April 14, 2010.

Maeda-Martínez, A. N., T. Reynoso-Granados, P. Monsalvo-Spencer, M. T. Sicard, J. M. Mazón-Suástegui, O. Hernández, E. Segovia, and R. Morales. 1997. Suspension culture of catarina scallop Argopecten ventricosus (=circularis) (Sowerby II, 1842), in Bahia Magdalena, Mexico, at different densities. Aquaculture 158:235-246.

Maeda-Martínez, A. N., T. Reynoso-Granados, F. Solís-Marín, A. Leija-Tristán, D. Aurioles-Gamboa, C. Salinas-Zavala, D. Lluch-Cota, P. Ormart-Castro, and E. Felix-Pico. 1993. A model to explain the formation of catarina scallop, Argopecten circularis (Sowerby, 1835), beds, in Magdalena Bay, Mexico. Aquaculture Research 24:323-339.

Maeda-Martínez, A. N., M. T. Sicard, L. Carvalho, S. E. Lluch-Cota, and D. B. Lluch-Cota. 2001. Las poblaciones de almeja catarina Argopecten ventricosus en el centro de actividad biologica de Bahia Magdalena, Mexico Pages 219-228 in D. B. Lluch-Cota, J. F. Elorduy-Garay, S. E. Lluch-Cota, and G. Ponce Díaz, editors. Centros de Actividad Biologica del Pacifico Mexicano. CIBNOR, Mexico.

Medina, B., H. M. Guzman, and J. M. Mair. 2007. Failed recovery of a collapsed scallop (Argopecten ventricosus) fishery in Las Perlas Archipelago, Panama. Journal of Shellfish Research 26:9-15.

Morquecho-Escamilla, M. L. 1996. Fitoplancton tóxico y actividad de ficotoxinas en la almeja catarina Argopecten circularis (Sowerby, 1835) en Bahía Concepción, Golfo de California. CICIMAR-IPN, La Paz, BCS, Mexico.
NORMA Oficial Mexicana 004-PESC-1993. 1993.
Ponce-Díaz, G., M. M. C. Valdez, M. R. Rodríguez, D. L. Belda, J. L. C. Ortiz, G. D. L. C. Agüero, A. M. d. l. Torre, A. V. Barajas, F. G. Magaña, R. F. Uraga, R. E. M. Pecero, E. B. Páez, R. G. Armas, L. S. Mercier, J. N. Paramo, S. R. M. Zapata, R. d. l. R. Pacheco, G. M. Flores, S. M. Mejía, V. M. Zárate, L. V. R. López, M. C. Fernández, and O. E. Sánchez. 2009. Propuesta de Carta Estatal Pesquera y Acuícola del Estado de Baja California Sur. SAGARPA-CONAPESCA, Gobierno del Estado de Baja Californa Sur - Sec. Pesca, CIBNOR-CONACyT, CICIMAR-IP.
SAGARPA. 2004. Diario Oficial, Carta Nacional Pesquera. Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación, Mexico City, Mexico.
SAGARPA. 2008. Anuario Estadístico de Acuacultura y Pesca. Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación, México.
Santamaria, N. A., E. F. Felix-Pico, J. L. Sanchez-Lizaso, J. R. Palomares-Garcia, and M. Mazon-Suastegui. 1999. Temporal coincidence of the annual eelgrass Zostera marina and juvenile scallops Argopecten ventricosus (Sowerby II, 1842) in Bahia Concepcion, Mexico. Journal of Shellfish Research 18:415-418.
Smith, S. J., and P. Rago. 2004. Biological reference points for sea scallops (Placopecten magellanicus): the benefits and costs of being nearly sessile. Canadian Journal of Fisheries and Aquatic Sciences 61:1338-1354.
Villalejo-Fuerte, M., and R. I. Ochoa-Baez. 1993. El ciclo reproductivo de la almeja catarina, Argopecten circularis (Sowerby 1835), en relación con temperatura y fotoperíodo, en Bahía Concepción, Baja California Sur, México. Ciencias Marinas 19:181–202.