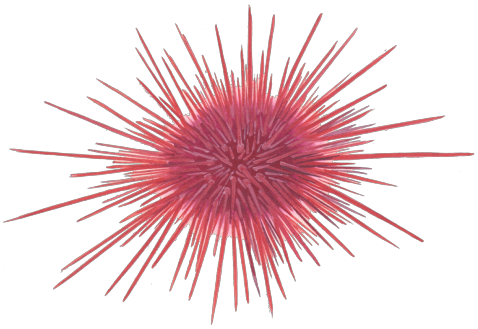
Red Sea Urchin

Strongylocentrotus franciscanus



United States: California, Alaska, Oregon, Washington

Diver

Report ID 27936

Published: November 5, 2018 | Updated: August 1, 2022 – see Appendix for details

Seafood Watch Standard used in this assessment: Fisheries Standard v3

Table of Contents

About Seafood Watch

Monterey Bay Aquarium's Seafood Watch program evaluates the environmental 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. 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.

Seafood Watch's science-based ratings are available at www.SeafoodWatch.org. Each rating is supported by a Seafood Watch assessment, in which the fishery or aquaculture operation is evaluated using the Seafood Watch standard.

Seafood Watch standards are built on our guiding principles, which outline the necessary environmental sustainability elements for fisheries and aquaculture operations. The guiding principles differ across standards, reflecting the different impacts of fisheries and aquaculture.

- Seafood rated Best Choice comes from sources that operate in a manner that's consistent with our guiding principles. The seafood is caught or farmed in ways that cause little or no harm to other wildlife or the environment.

- Seafood rated Good Alternative comes from sources that align with most of our guiding principles. However, one issue needs substantial improvement, or there's significant uncertainty about the impacts on wildlife or the environment.

- Seafood rated Avoid comes from sources that don't align with our guiding principles. The seafood is caught or farmed in ways that have a high risk of causing harm to wildlife or the environment. There's a critical conservation concern or many issues need substantial improvement.

Each assessment follows an eight-step process, which prioritizes rigor, impartiality, transparency and accessibility. They are conducted by Seafood Watch scientists, in collaboration with scientific, government, industry and conservation experts and are open for public comment prior to publication. Conditions in wild capture fisheries and aquaculture operations can change over time; as such assessments and ratings are updated regularly to reflect current practice.

More information on Seafood Watch guiding principles, standards, assessments and ratings are available at www.SeafoodWatch.org.

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, Seafood Watch develops an overall recommendation. Criteria ratings and the overall recommendation are color coded to correspond to the categories on the Seafood Watch pocket guides and online guide:

Best Choice/Green: Buy first; they're well managed and caught or farmed responsibly.

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

Avoid/Red: Take a pass on these for now; they're caught or farmed 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 provides recommendations for the United States fisheries for red sea urchin (*Mesocentrotus franciscanus*, formerly *Strongylocentrotus franciscanus*).

The red sea urchin is found in kelp forest and rocky reef habitats along the West Coast of North America. In the United States, fisheries for this species operate in the coastal waters of all four Pacific coast states: Alaska, California, Oregon, and Washington. The fisheries are managed individually by each state's Department of Fish and Wildlife (DFW) or Department of Fish and Game (DFG).

Criterion 1

There are no biomass reference points for sea urchin in the U.S. Pacific, but the mixed data available do not indicate any particular reason for concern. The species does not have inherent vulnerability to overfishing, and in Oregon, the available data suggest that the stock is healthy. In Alaska and Washington, harvest rates are below what are thought to be sustainable levels. In California, the stock status and the chances of overfishing are unknown.

Criterion 2

Fishery impacts on other species are low for all U.S. red sea urchin fisheries, because they are all diver fisheries, which are highly selective for species and size.

Criterion 3

All U.S. red sea urchin fisheries use some forms of management measures, including a limited-entry system, although only Alaska and Washington have formal fishery management plans and measures to explicitly control fishing mortality. But, scientific advice is also incorporated into management in the California and Oregon fisheries through less rigorous, formal processes. Stakeholder engagement and enforcement are in place for all fisheries.

Criterion 4

The habitat impacts of these diver fisheries are minimal, because harvest is done by hand. All U.S. red urchin fisheries implement some form of area quotas or area closures that can help reduce the risk of localized depletion, but none specifically manage for the ecological role of sea urchins.

Final Seafood Recommendations

SPECIES | FISHERY	CRITERION 1 TARGET SPECIES	CRITERION 2 OTHER SPECIES	CRITERION 3 MANAGEMENT	CRITERION 4 HABITAT	OVERALL RECOMMENDATION
Red sea urchin | Eastern Central Pacific | Diving | United States | California	2.644	5.000	3.000	4.000	**Good Alternative (3.549)**
Red sea urchin | Northeast Pacific | Diving | United States | Alaska	3.413	5.000	5.000	4.000	**Best Choice (4.298)**
Red sea urchin | Northeast Pacific | Diving | United States | Washington	3.413	5.000	5.000	4.000	**Best Choice (4.298)**
Red sea urchin | Northeast Pacific | Diving | United States | Oregon	3.318	5.000	3.000	4.000	**Best Choice (3.756)**

Summary

Red sea urchin caught in Alaska, Oregon, and Washington by divers is a Best Choice. The stock status in Oregon is likely healthy, but it is unknown if overfishing is occurring. Fishing levels are likely sustainable in Alaska and Washington. The stock status and fishing mortality in California are unknown, but the species is not highly vulnerable. Because of frequent assessments and precautionary harvest policies, managements in Alaska and Washington are considered highly effective. In Oregon and California, managements are rated moderately effective overall because their effectiveness is uncertain and the stocks have not been fully assessed. Removing urchin can lead to changes in the ecosystem, the measures that are in place to reduce impacts have not been studied, but spatial management is used in each state. There are no by-catch concerns, and habitat impacts are minimal.

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.

[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

Red sea urchin (*Mesocentrotus franciscanus*, formerly *Strongylocentrotus franciscanus*) ranges along the West Coast of North America from Baja California, Mexico, to southern Alaska (Ebert et al. 1999), and is commercially harvested throughout most of this range. This report provides recommendations for the U.S. Pacific fisheries for red sea urchin. These include fisheries in Alaska, California, Oregon, and Washington states.

Species Overview

The red sea urchin is a large sea urchin species that is found in kelp forest and rocky reef habitats throughout the Pacific coast of North America. It is harvested for its roe, and commercial fisheries exist in Mexico (Baja California), the United States (Alaska, California, Oregon, and Washington), and Canada (British Columbia). These commercial fisheries are all diver fisheries, where sea urchins are hand-harvested by divers on either scuba or surface-supplied air (hookah).

The Alaska red sea urchin fishery operates in the southeastern part of the state and is managed by the Alaska Department of Fish and Game (ADFG) (Figure 1). The fishery management plan is part of the state administrative code, and uses area quotas (Guideline Harvest Levels).

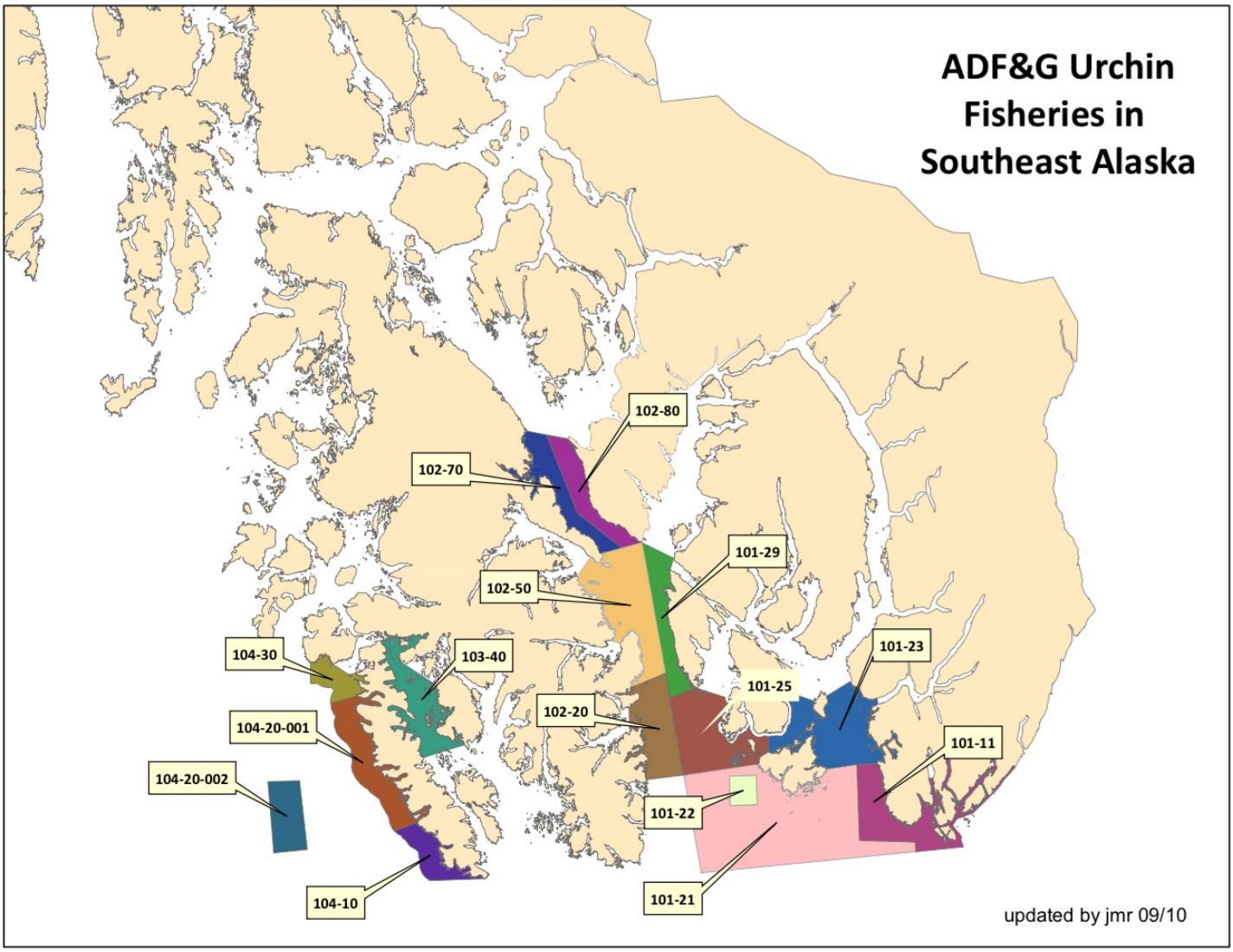


Figure 1. Map of areas open to red sea urchin harvest in southeast Alaska.

The California red sea urchin fishery is managed by the California Department of Fish and Wildlife (CDFW) and includes two fishing regions: Northern California and Southern California (Figure 2). The fishery currently operates without a formal fishery management plan, and management occurs by a consensus-based process with stakeholders, through the California

Sea Urchin Commission. The fishery is managed through limited licenses, a minimum harvest size, and a restricted season.

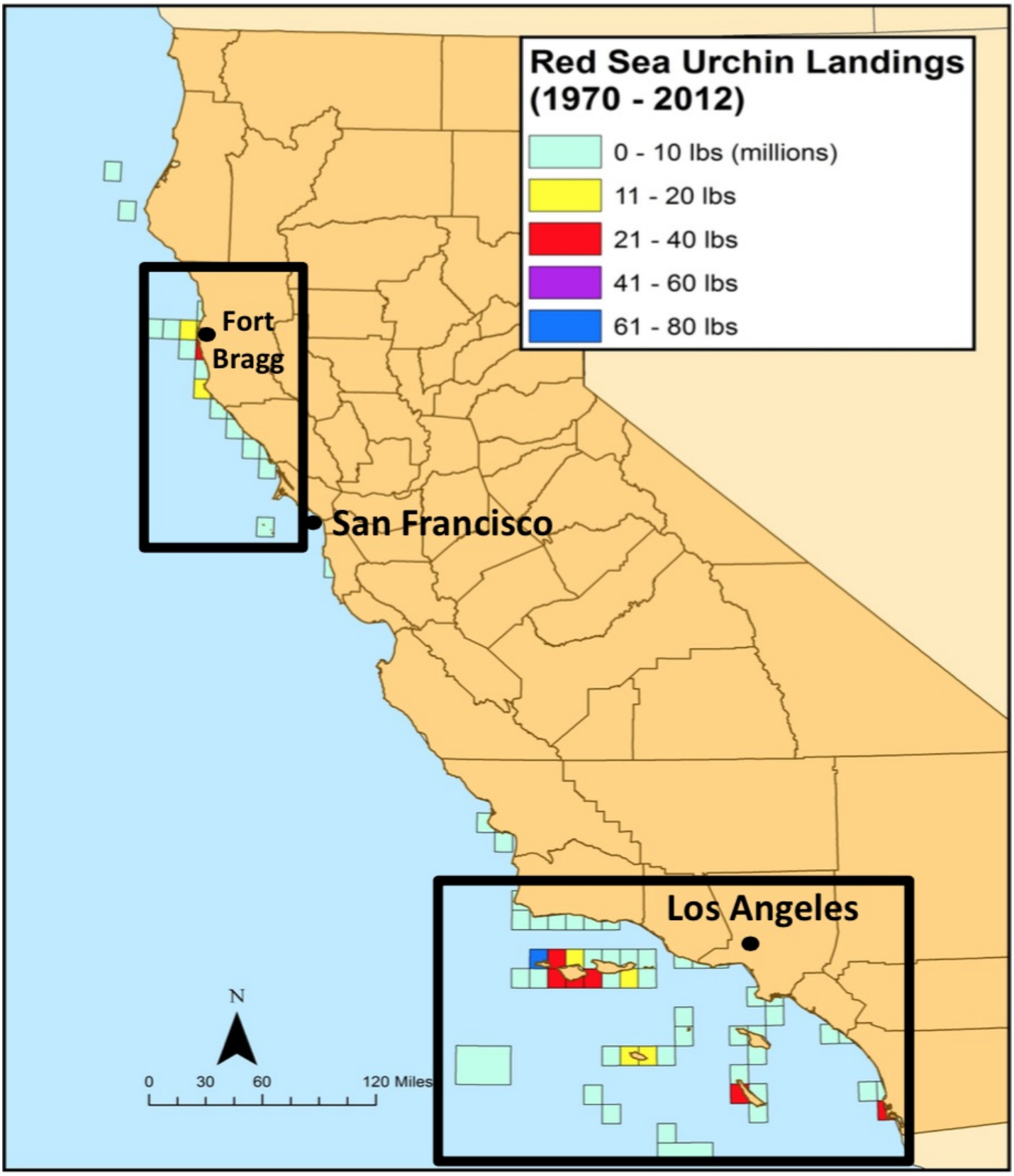


Figure 2. Map of the main harvest areas for red sea urchin in Northern and Southern California.

The Oregon red sea urchin fishery is managed by the Oregon Department of Fish and Wildlife (ODFW) (Figure 3). There is no formal fishery management plan. The fishery is managed with limited licenses, a minimum harvest size, and a minimum harvest depth.

Figure 3. Map of the main sea urchin harvest areas in Oregon. Of all landings, 75% come from the Port Orford and Gold Beach areas.

The fishery in Washington is managed by the Washington Department of Fish and Wildlife (WDFW) and includes five fishing districts (Figure 4). There is a formal fisheries management plan in place, and management measures include a quota (total allowable catch, TAC), minimum and maximum harvest sizes, limited licenses, and a restricted season.

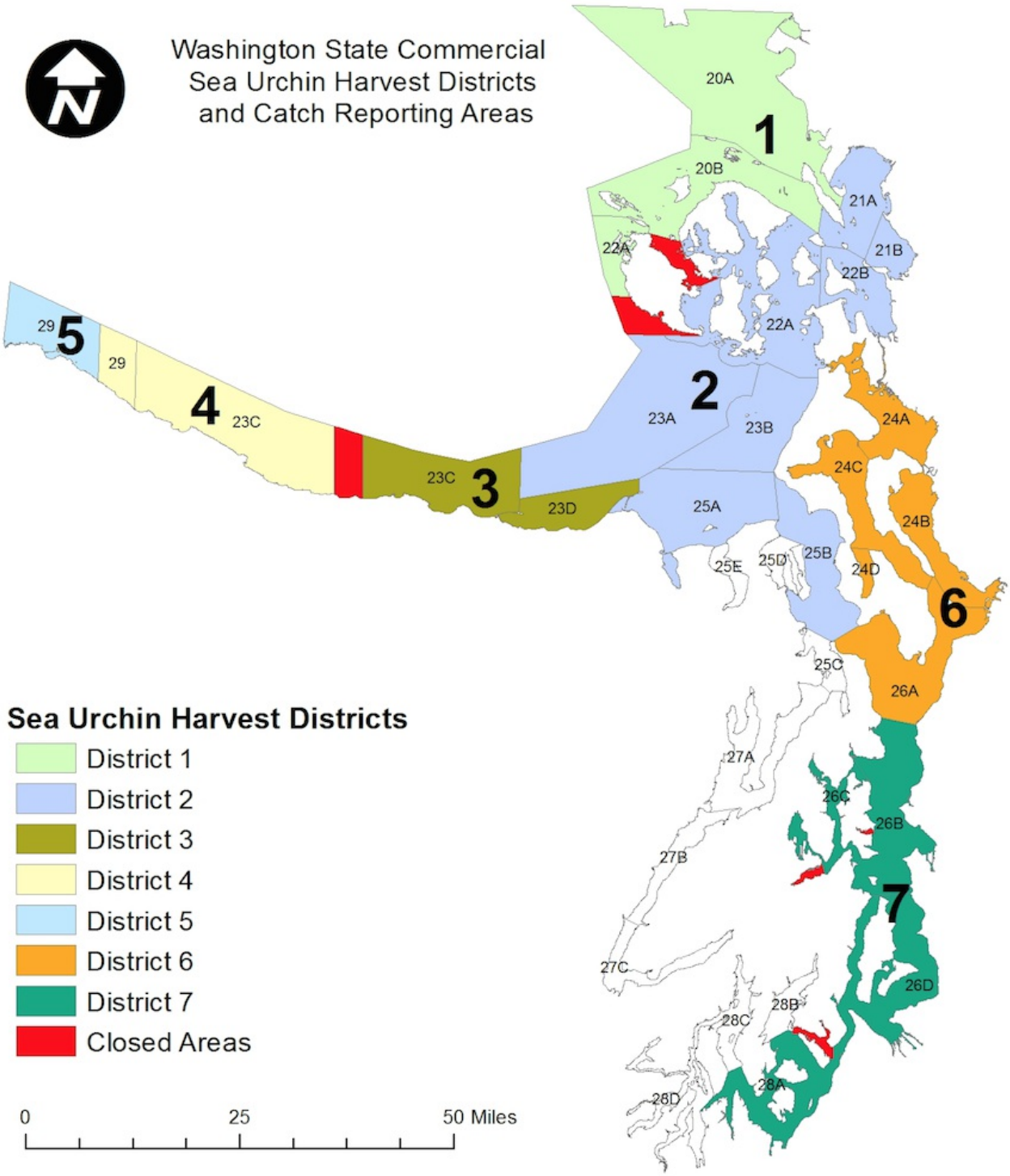


Figure 4. Map of sea urchin harvest districts in Washington. Districts 1 to 4 are open to red sea urchin harvest.

Production Statistics

Global production of sea urchin increased rapidly starting in the mid-1970s with the development and expansion of commercial urchin fisheries outside Japan, particularly in Chile and the United States (Figure 5). Global landings peaked in the mid-1990s.

The Chilean fishery dominates global production, and the Chilean sea urchin has made up over half of all landings in the past decade. Canadian sea urchin fisheries (for green and red sea urchins) represent 5% to 9% of global production in the past decade. Sea urchin commercial aquaculture is mostly limited to China, and represents about 10% of global production.

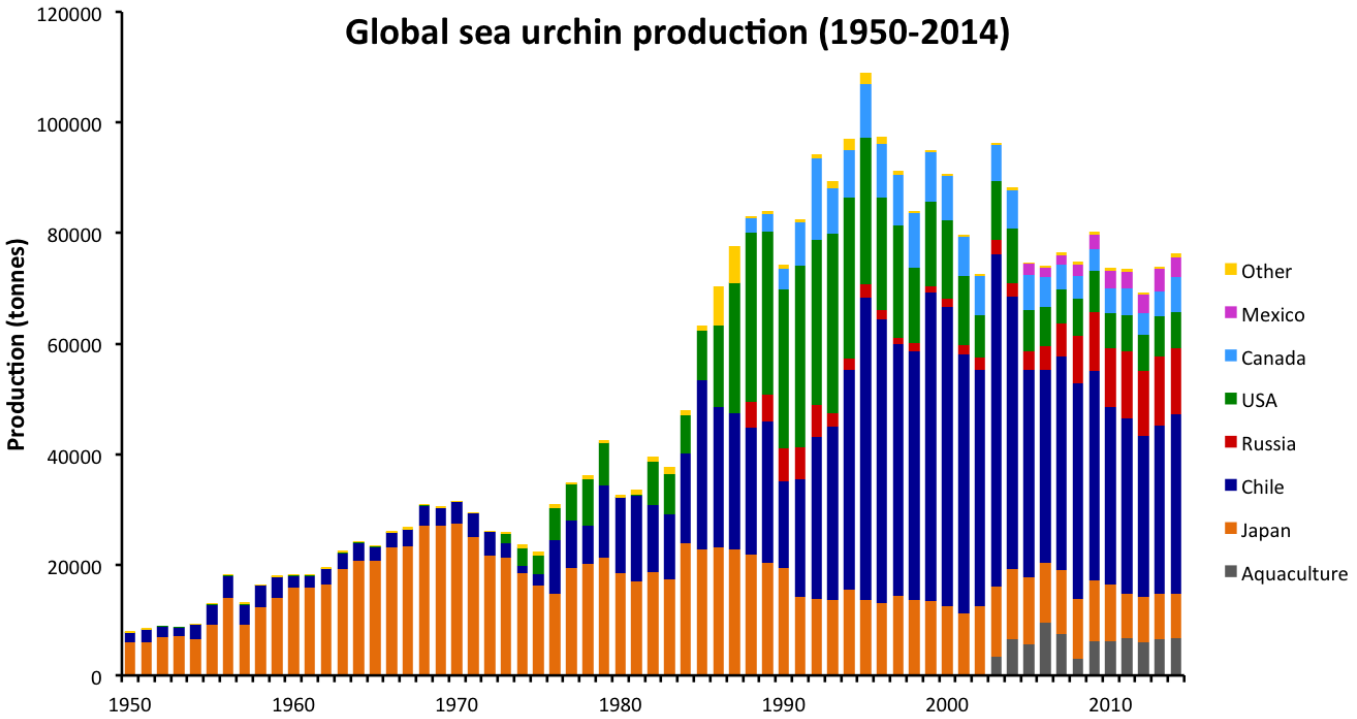


Figure 5. Global sea urchin production by country from 1950 to 2014. This includes multiple sea urchin species.

Fisheries for the red sea urchin (*Mesocentrotus franciscanus*) began in the early 1970s in California and Washington (United States), British Columbia (Canada), and Baja California (Mexico). These fisheries followed similar trajectories of rapid growth in the 1980s, driven by demand from the Japanese market. Global red sea urchin landings peaked in 1989 with 35,000 tons harvested (Figure 6). Subsequent declines in production were driven by a combination of stock depletion (e.g., California) and tighter regulatory control (e.g., British Columbia) {Andrews et al. 2002}.

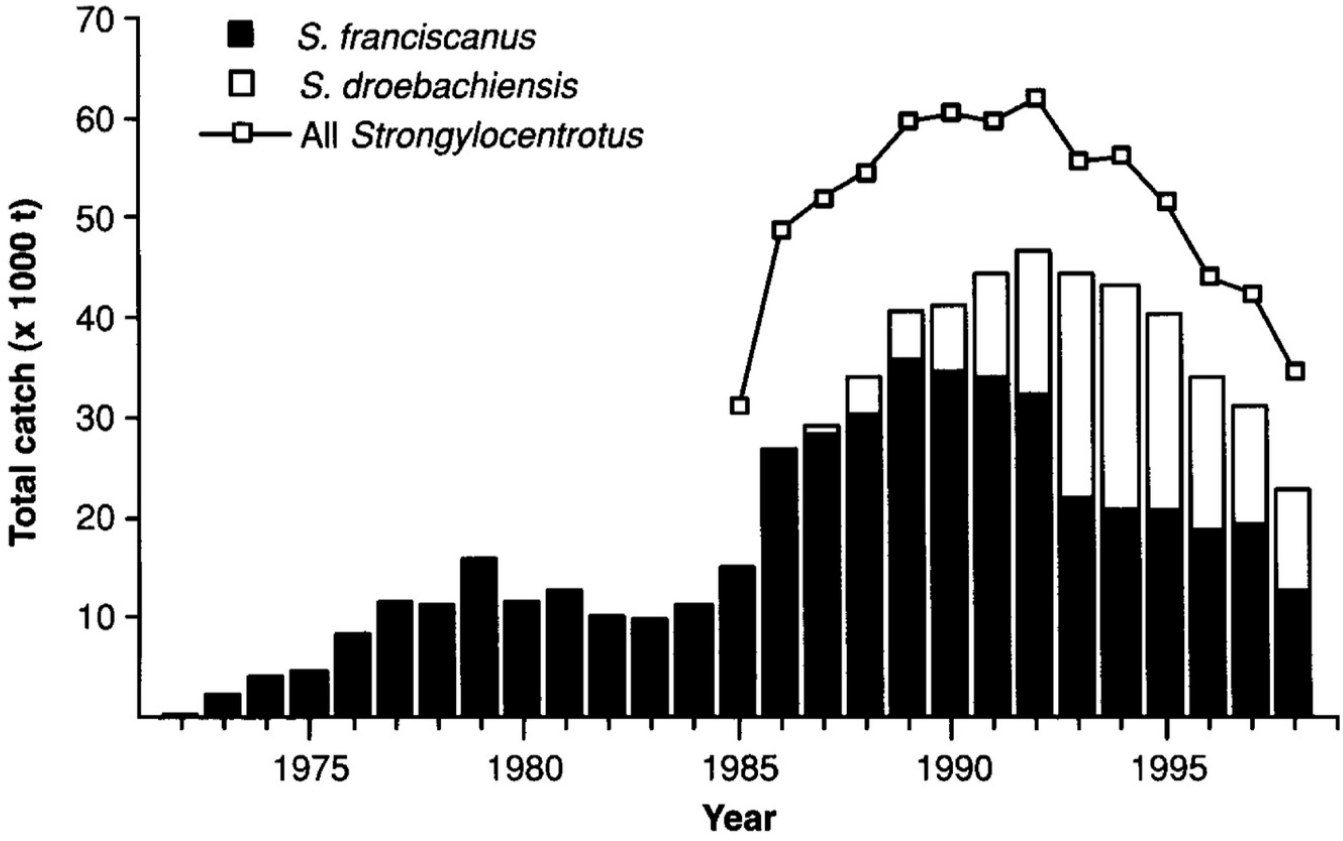


Figure 6. Global harvest of the red sea urchin (*S. franciscanus*) and the green sea urchin (*S. droebachiensis*) from 1972–1998. Figure from Andrew et al. (2002).

Currently, total harvest is at about one-third of peak production numbers. Commercial harvest continues throughout most of the red sea urchin's geographic range. The United States is the biggest producer of red sea urchin, with most production coming from California, but landings from Mexico and Canada have increased in recent years (Figures 7 and 8).

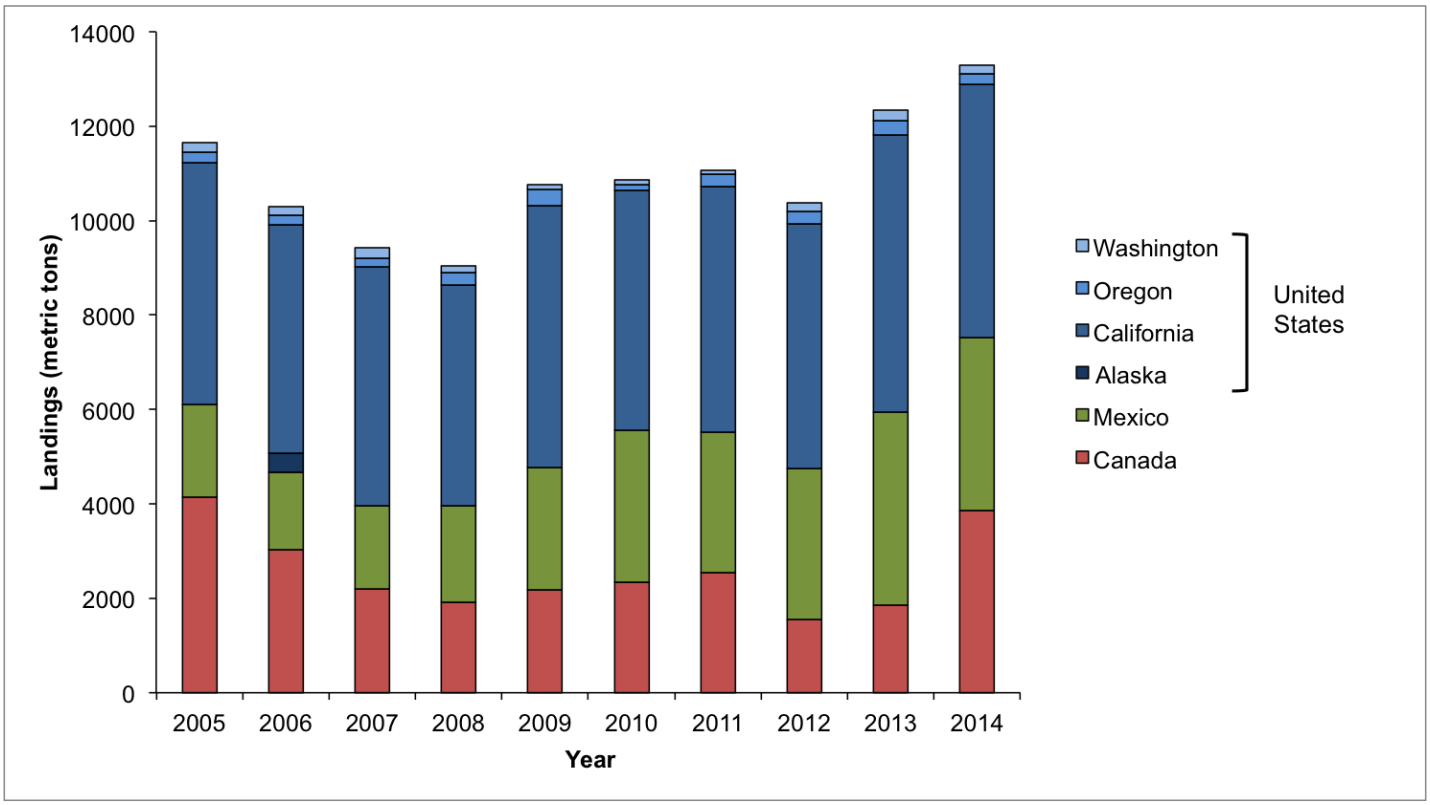


Figure 7. Sea urchin landings for the North American Pacific coast, in metric tons by country from 2005–2014. Data taken from FAO and NMFS. These agencies do not distinguish between sea urchin species in their statistics, so these landings may include small numbers of green and purple sea urchins. But, these other species are minor components of urchin fisheries on the North American Pacific coast.

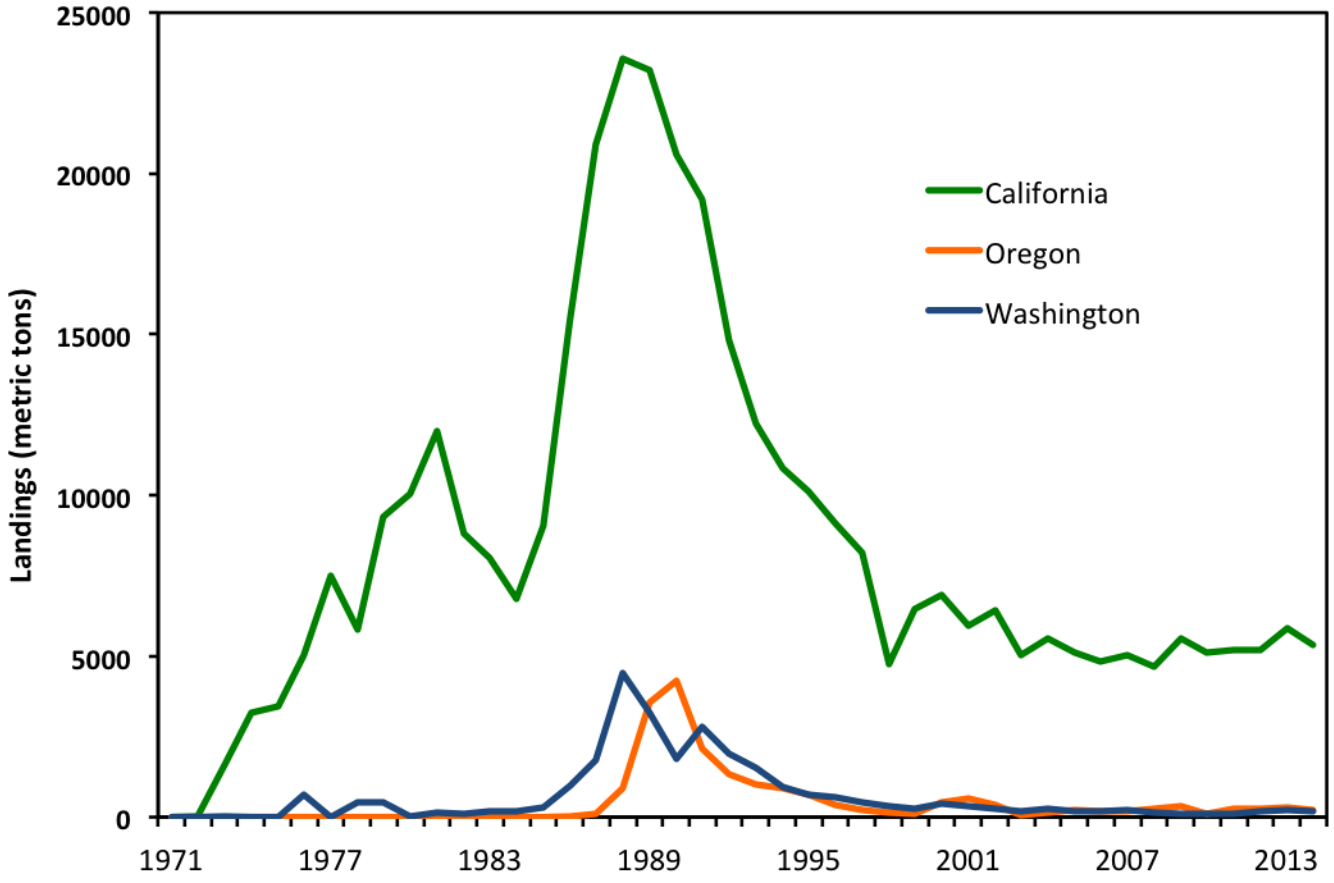


Figure 8. Landings of sea urchin from U.S. West Coast fisheries, by state, from 1971 to 2014.

Importance to the US/North American market.

Although most U.S. sea urchin production is exported to Japan and other East Asian markets, domestic consumption of sea urchin has grown in recent years. An increasing proportion of U.S. West Coast sea urchin is consumed domestically. Sea urchin is also imported into the United States, primarily from Canada and Chile. This includes sea urchin that is processed and re-exported (Sun and Chiang 2015).

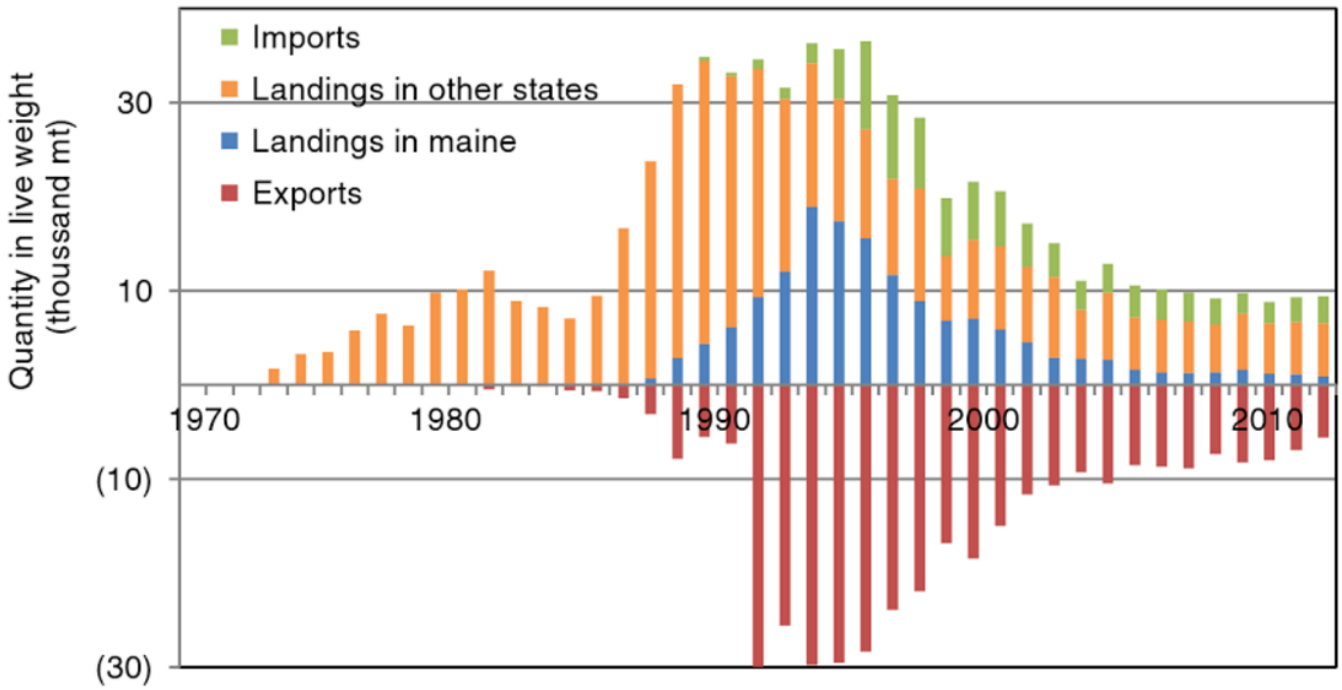


Figure 9. Landings and imports in comparison to exports of sea urchins in the United States, from 1970 to 2012. Figure from Sun and Chiang (2015).

Common and market names.

Mesocentrotus franciscanus is commonly known as the red sea urchin and its roe is marketed as *uni*. The genus was recently reclassified from *Strongylocentrotus* to *Mesocentrotus* {Kroh, A. & Mooi, R. 2018} following {Tatarenko, D.E. & Poltaraus, A.B. 1993}, but its old scientific name, *Strongylocentrotus franciscanus,* is still commonly used in literature and reports.

Primary product forms

Red sea urchin is harvested for its reproductive organs (gonads) or roe. Sea urchin is typically sold in the form of roe (uni). Uni can also be sold fresh, frozen, or preserved. Sea urchin may also be sold as a fresh or live whole animal, with the test (shell) and spines intact.

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

RED SEA URCHIN			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Eastern Central Pacific | Diving | United States | California	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Northeast Pacific | Diving | United States | Alaska	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Northeast Pacific | Diving | United States | Washington	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Northeast Pacific | Diving | United States | Oregon	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

Criterion 1 Assessments

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.*

Red sea urchin

Factor 1.1 - Abundance

Eastern Central Pacific | Diving | United States | California

Moderate Concern

There is neither a current quantitative stock assessment in place for the California fishery nor relative estimates of abundance (CDFW 2019). There is evidence of a declining trend in abundance, but a more detailed analysis of monitoring data is needed (CDFW 2019). Declines in statewide kelp beds in 2013–2014 led to a gradual decline in red sea urchin and other invertebrates that feed upon bull and giant kelp (CDFW 2019). Multiple datasets on sea urchin biomass exist through CDFW and academic research programs, but only some fishery-dependent data are used in fishery management (pers. comm., Kalvass 2017). CDFW considers the fishery to be fully exploited, with some evidence that overfishing has previously occurred in parts of both the south and north (CDFG 2003). Overall, Seafood Watch considers the status of red sea urchin in California as uncertain.

Based on the productivity-susceptibility analysis, the species has medium vulnerability (see Justification). Because the stock status is uncertain and the species is not highly vulnerable, abundance is scored a moderate concern.

Justification:

Red sea urchin is monitored by a variety of stakeholder groups, which provide the following information on abundance of this resource (all data summaries are from (CDFW 2019)):

- Reef Check collects density data statewide. There has been little change in red sea urchin density from 2013–2017 within harvest areas, but purple sea urchin densities increased dramatically over the time period.
- The Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) and the Kelp Forest Monitoring Program (KFMP) collect data from inside and outside marine protected areas (MPAs). Red sea urchin densities inside and outside MPAs were similar from 2013–2018, with densities reaching time-series lows in 2017 and 2018.
- The MSE conducted in 2017 suggests that the stock is not heavily depleted.

Productivity-Susceptibility Analysis

Productivity Attribute	Relevant Info	Reference	Score
Average age at maturity	1–2 years	(Bernard and Miller 1973)	1
Average maximum age	>100 years	(Ebert and Southon 2003)	3
Fecundity	>1 million eggs	(Kalvass and Rogers-Bennett 2001)	1
Reproductive strategy	Broadcast spawner	(Kalvass and Rogers-Bennett 2001)	1
Trophic level	<2.75	(Rogers-Bennett 2013)	1
Density dependence	Allee effects exist	(Lundquist and Botsford 2011)	3
Productivity score			**1.67**

Susceptibility Attribute	Relevant Info	Score
Areal overlap	Unknown; default score used (>30% across their geographic range)	3
Vertical overlap	Red sea urchins are a targeted species	3
Selectivity of fishery	Red sea urchins are a targeted species, but gear type and size limits reduce susceptibility	2
Post-capture mortality	Data not available; default score used.	3
Susceptibility score		**2.325**

Northeast Pacific | Diving | United States | Alaska

Moderate Concern

Surveys of sea urchin populations are conducted every 3 to 6 years; however, due to declining effort and landings in the fishery, formal stock assessments have not been published since 2001 (AFDG 2001). Assessing the impact of this fishery on red sea urchin populations is also difficult because sea otter range expansions have led to drastic declines in red sea urchin abundance in some management districts in the outer coastal areas (portions of ADF&G management districts 1, 2, 3, 4, 5, 9, and 13). This is not a highly vulnerable species, based on a productivity-susceptibility analysis: $V = \sqrt{(1.67^2 + 2.325^2)} = 2.86$ (medium vulnerability). Because the stock abundance relative to a reference point is unknown and the species is not highly vulnerable, abundance is scored a moderate concern.

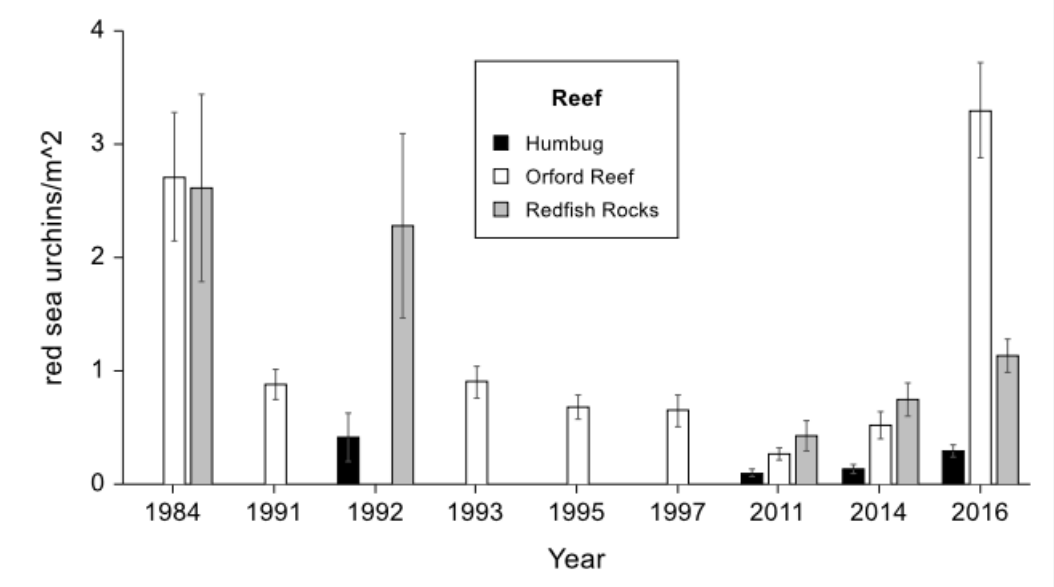
Justification:
Productivity-Susceptibility Analysis

Productivity Attribute	Relevant Info	Reference	Score
Average age at maturity	1–2 years	(Bernard and Miller 1973)	1
Average maximum age	>100 years	(Ebert and Southon 2003)	3
Fecundity	>1 million eggs	(Kalvass and Rogers-Bennett 2001)	1
Reproductive strategy	Broadcast spawner	(Kalvass and Rogers-Bennett 2001)	1
Trophic level	<2.75	(Rogers-Bennett 2013)	1
Density dependence	Allee effects exist	(Lundquist and Botsford 2011)	3
Productivity Score			**1.67**

Susceptibility Attribute	Relevant Info	Score
Areal overlap	Unknown; default score used (>30% across their geographic range)	3
Vertical overlap	Red sea urchin is a targeted species	3
Selectivity of fishery	Red sea urchin is a targeted species, but gear type and size limits reduce susceptibility	2
Post-capture mortality	Data not available; default score used.	3
Susceptibility Score		**2.325**

Northeast Pacific | Diving | United States | Oregon

Low Concern
Long-term stock data are available primarily from the Orford Reef, which accounts for about half of all Oregon landings. Surveys started in 1984, before commercial fishing, and show a decline in urchin populations until 2014, when red sea urchin was at about 25% of its original abundance. Recent recruitment events have led to a significant population increase to levels above the 1984 pre-fished population densities, with a corresponding shift to a size distribution dominated by sub-legal individuals (ODFW 2016). At two other sites with historical data (Humbug and Redfish Rocks), populations are lower than historical levels, but have increased consistently since 2011. CPUE has remained stable since the early 2000s. Although the fishery does not have a full quantitative stock assessment, the species is not highly vulnerable and there are multiple data-limited stock indicators that suggest the stock is healthy, so abundance is scored a low concern.
Justification:



Abundance of red sea urchin from 1984 to 2014 at Orford Reef and two other nearby reefs in Oregon. Figure from ODFW (2016).

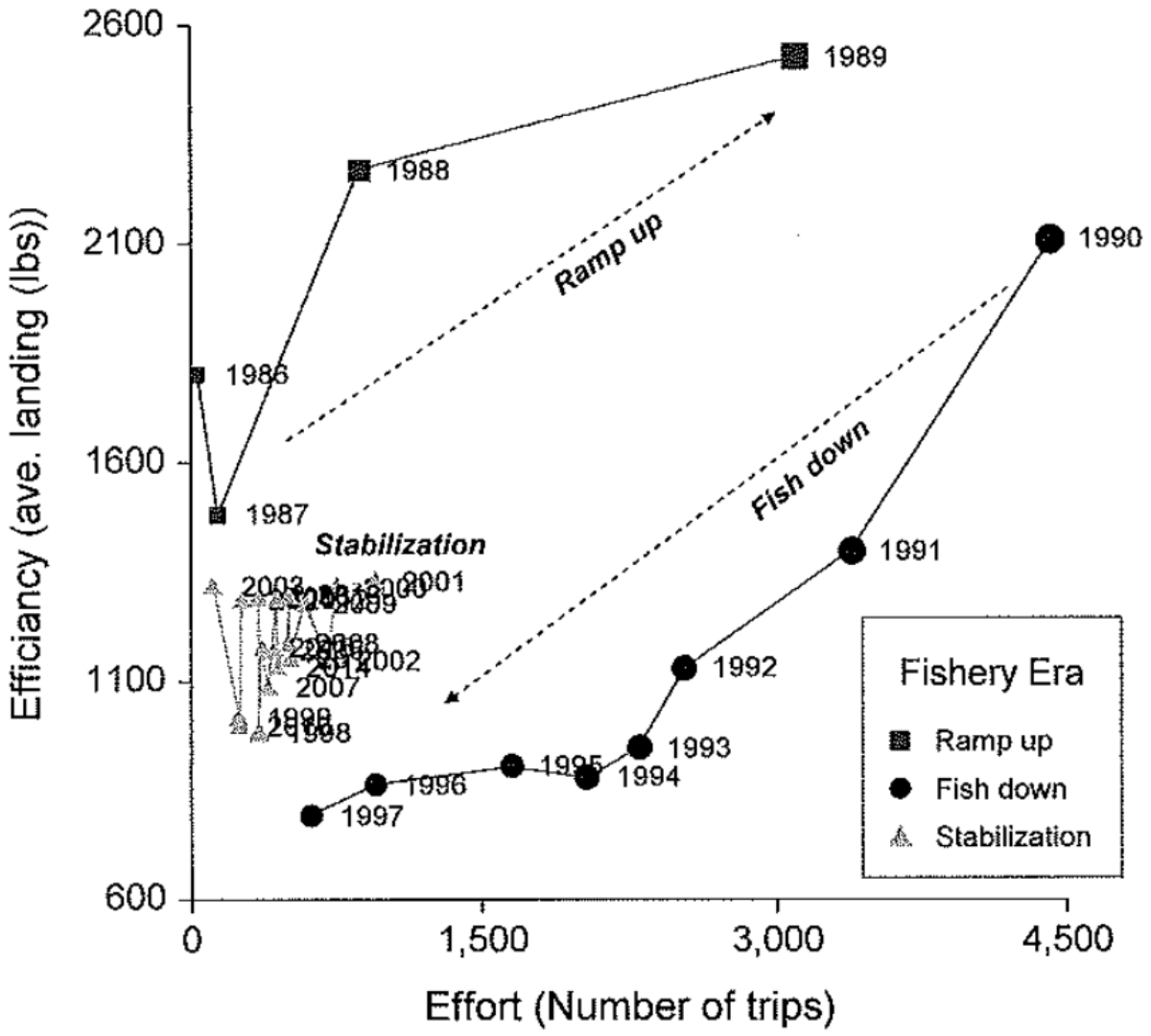


Figure 1: CPUE for the Oregon red sea urchin fishery from 1986 to 2015.

Northeast Pacific | Diving | United States | Washington

Moderate Concern

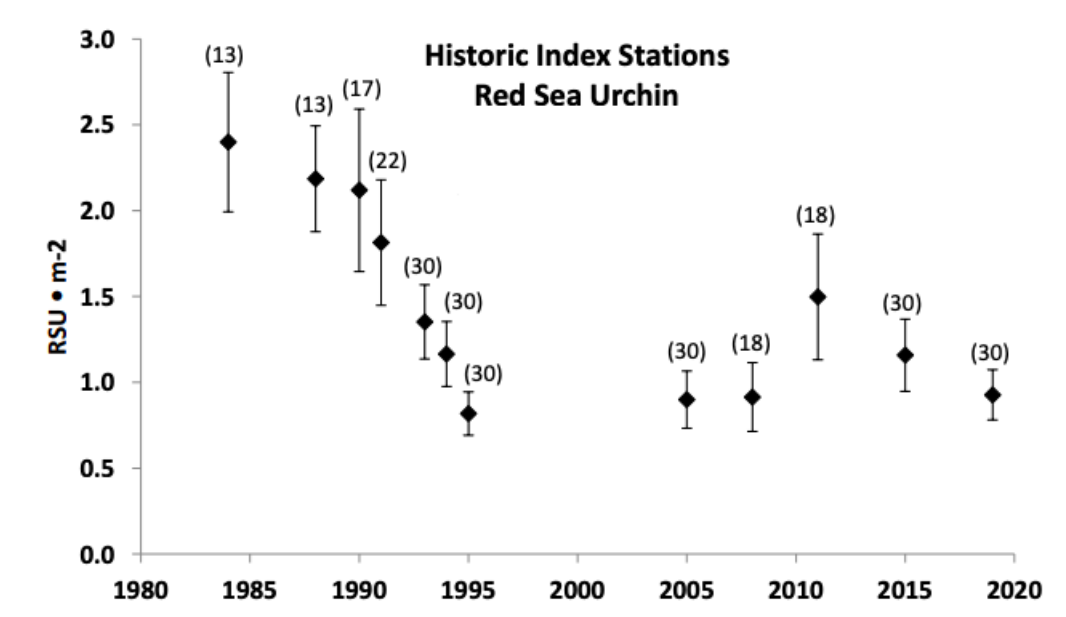
Long-term stock data are available for the San Juan Islands (Districts 1 and 2), which account for two-thirds of all landings; there is also an assessment of the Western Strait of Juan de Fuca stock (Districts 3, 4, and 5).

San Juan Islands: Surveys in these districts have been conducted at 13 to 30 index stations since 1984, before intensive harvesting began. Survey data suggest that the average density of legal-sized red sea urchin (RSU) has declined since previous surveys. In 2019, RSU density is estimated at 0.56 RSU/m^2, which is above the candidate limit reference point (B_{LIM} = 0.23 RSU/m^2, the lowest density observed in 2008), but below the candidate target reference point (B_{TAR} = 0.80 RSU/m^2, the density observed in 1988, just before the historic overexploitation) (WDFW 2020). Because the current density is less than 75% of the target values, the San Juan Islands population drives the score of this factor. The average density of RSU in closed areas is nearly double that of shallow stations in open harvest areas, and well above the target reference point (WDFW 2020). But, closed areas and size limits may not be enough to offset infrequent recruitment (WDFW 2020).

Western Strait of Juan de Fuca: The 2019 assessment report provides a harvestable biomass estimate based on strata densities from each district. Detailed results of the assessment for each district are provided in the Justification section. Overall, the populations of legal-sized red sea urchin in areas open to harvest (Districts 3 and 4) are either stable or increasing.

Because the San Juan Island population may be less than 75% of a target reference point, this factor is scored a moderate concern.

Justification:



Abundance (measured in average density) of red sea urchin from 1984 to 2019 for index stations in the San Juan Islands (Districts 1 and 2) in Washington. Figure from (WDFW 2020).

The results of the 2018 survey in District 3 suggest that the population of legal-sized urchins has increased since the 2014 surveys, but the difference was not significant (WDFW 2019). There is no estimate of baseline densities before historic overharvest, so it is challenging to interpret current population levels relative to a recovery target. Nonetheless, a fishery closure from 2004–2014 may help explain the improving trends (WDFW 2019). The harvestable biomass estimate for District 3 in 2019 is 3,421,864 lbs.

In District 4, the 2018 surveys suggest that the red sea urchin population is stable, but there is no sign of recovery from historic overharvest (WDFW 2019). The harvestable biomass estimate for District 4 in 2019 is 1,743,892 lbs (WDFW 2019).

District 5 is not open to harvest, and the biomass estimate of 766,695 lbs suggests that District 5 cannot support a viable and sustainable fishery at present (WDFW 2019). The fishery has been closed since 1997 and the decline since 1990 has been primarily attributed to sea otter predation (WDFW 2019).

Factor 1.2 - Fishing Mortality

Eastern Central Pacific | Diving | United States | California

Moderate Concern

There is no quantitative stock assessment or commercial catch limit for the California red sea urchin fishery. Although

there are effort limitations in the commercial fishery, the current capacity of 300 permits is exceeding the goal of 150 permits (CDFW 2019). The recreational harvest is not tracked, subject to size restrictions, or subject to seasonal closures (CDFW 2019).

Total fishing mortality relative to sustainable levels is not known, and this factor is scored a moderate concern.

Justification:

Minimum size limits are in place to allow red sea urchin to reach sexual maturity, which typically occurs at 2 in when it is approximately 2 years old (CDFW 2019). The current limits in Northern (3.5 in) and Southern (3.25 in) California are set on the assumption that all individuals are fully mature by the legal-size limits and have had the opportunity to spawn before entering the fishery (CDFW 2019). In addition, it is estimated that marine protected areas (MPA) cover 15–25% of the red sea urchin habitat in Southern California, which offers protection from fishing mortality (Hordyk et al. 2017). There are no similar analyses for red sea urchin populations in other parts of the state. California's MPA network covers currently covers 852.02 mi^2, or 16.12% of the state's coastal waters (CDFW 2022), including 41.25 mi^2 of hard bottom habitat between 0 and 30 m (the typical maximum depth for dive fishers) (CDFW 2019). Seafood Watch requires at least 50% of all representative habitat to be protected from fishing mortality in order to score a low concern for fishing mortality for data-poor stocks.

Northeast Pacific | Diving | United States | Alaska

Low Concern

Fishing mortality is restricted by annual harvest guidelines, which are set at 6% of estimated stock biomass, based on a surplus production model (Marshall et al. 1991). Due to declining effort in the fishery, actual landings in the past decade have been <20% of the annual harvest guidelines. Total landings in the 2019/20 season were 194,312 lbs, or 6% of the guideline harvest level (GHL) (Smith 2021). The fishery is only opened if a biomass survey has been conducted in the previous 6 years (Smith 2021).

Because fishing mortality is expected to be at or below a sustainable level, it is scored a low concern.

Northeast Pacific | Diving | United States | Oregon

Moderate Concern

There is no quantitative stock assessment for the Oregon fishery. Because fishing mortality is not known, it is scored a moderate concern.

Northeast Pacific | Diving | United States | Washington

Low Concern

Fishing mortality is restricted by a total allowable catch (TAC), which is set based on a target fishing mortality of 4% of legal biomass (WDFW 2015). But, half of the TAC is allocated to tribal groups, who have harvested only a portion of their allotted catch. Although the 2021 District 1 survey report has not been published, the results were used to take precautionary action: the 2021–22 state quota in District 1 is 100,000 lbs (WDFW 2022) and tribal fisheries took a >40% precautionary cut to their quotas for the 2021–22 fishing year, with continued reductions planned unless assessments show otherwise (pers. comm., Carson 2022). Following the 2019 survey results, WDFW recommended a precautionary 3.5% harvest rate for the District 3 fishery and a 3.2% harvest rate for District 4, resulting in a quota of 120,000 lbs and 57,500 lbs in Districts 3 and 4, respectively (WDFW 2019).

WDFW manages the red sea urchin fishery under a precautionary approach, with quotas set by low harvest rates. Because fishing mortality is expected to be at or below a sustainable level, it is scored a low concern.

Justification:

In District 1, the previous quota was based on a randomly designed visual survey in 2010–11, which overlapped with a major recruitment event (WDFW 2020). The 2019 index data suggest that there may have been only one unsubstantial recruitment event since 2010, and a more recent harvestable biomass should be assessed before setting future quotas (WDFW 2020). The 2010–11 survey estimated harvestable biomass between depths of 0–120 ft, but logbook data show minimal effort in depths <15 ft and >55 ft, suggesting that nearly all the quota had been removed from shallower depths in District 1 and the previous quota (350,000 lbs) may have allowed the 4% harvest rate to be exceeded (WDFW 2020). The District 1 quota has been reduced for 2021–22.

Criterion 2: Impacts on Other Species

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

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

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

Guiding principles

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

Criterion 2 Summary

Criterion 2 score(s) overview

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

RED SEA URCHIN			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
Eastern Central Pacific | Diving | United States | California	5.000	1.000: < 100%	Green (5.000)
Northeast Pacific | Diving | United States | Alaska	5.000	1.000: < 100%	Green (5.000)
Northeast Pacific | Diving | United States | Washington	5.000	1.000: < 100%	Green (5.000)
Northeast Pacific | Diving | United States | Oregon	5.000	1.000: < 100%	Green (5.000)

Criterion 2 main assessed species/stocks table(s)

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

EASTERN CENTRAL PACIFIC | DIVING | UNITED STATES | CALIFORNIA			
SUB SCORE: 5.000	DISCARD RATE: 1.000	**SCORE: 5.000**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Red sea urchin	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)

NORTHEAST PACIFIC | DIVING | UNITED STATES | ALASKA			
SUB SCORE: 5.000	DISCARD RATE: 1.000	**SCORE: 5.000**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Red sea urchin	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

NORTHEAST PACIFIC | DIVING | UNITED STATES | OREGON			
SUB SCORE: 5.000	DISCARD RATE: 1.000	**SCORE: 5.000**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Red sea urchin	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

NORTHEAST PACIFIC | DIVING | UNITED STATES | WASHINGTON			
SUB SCORE: 5.000	DISCARD RATE: 1.000	**SCORE: 5.000**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Red sea urchin	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Abundance
(same as Factor 1.1 above)

Factor 2.2 - Fishing Mortality
(same as Factor 1.2 above)

Factor 2.3 - Modifying Factor: Discards and Bait Use
Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

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

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

Factor 2.3 - Discard Rate/Landings

Eastern Central Pacific | Diving | United States | California
Northeast Pacific | Diving | United States | Alaska
Northeast Pacific | Diving | United States | Washington
Northeast Pacific | Diving | United States | Oregon

< 100%
The Alaska, Washington, Oregon, and California red sea urchin fisheries are diver-only fisheries, and sea urchin is selectively harvested by hand. Discard of undersized sea urchin is expected to be small (<100%).

Criterion 3: Management Effectiveness

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

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

The Criterion 3 rating is determined as follows:

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

Rating is Critical if Management Strategy and Implementation is Critical.

Guiding principle

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

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

Criterion 3 Summary

FISHERY	MANAGEMENT STRATEGY	BYCATCH STRATEGY	RESEARCH AND MONITORING	ENFORCEMENT	INCLUSION	SCORE
Eastern Central Pacific | Diving | United States | California	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Highly effective	**Yellow (3.000)**
Northeast Pacific | Diving | United States | Alaska	Highly effective	Highly effective	Highly effective	Highly effective	Highly effective	**Green (5.000)**
Northeast Pacific | Diving | United States | Oregon	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Highly effective	**Yellow (3.000)**
Northeast Pacific | Diving | United States | Washington	Highly effective	Highly effective	Highly effective	Highly effective	Highly effective	**Green (5.000)**

There were no major management changes between the original publication and the report review. CDFW recently published the Enhanced Status Report for red sea urchin, which identifies information gaps and management needs for the fishery. Current high priorities for management of red sea urchin in California include:

Table 5-1. Informational needs for the red sea urchin fishery and their priority for management.

Type of information	Priority for management	How essential fishery information would support future management
Size structure of harvested individuals statewide	High	Information used to determine trends in harvest correlated to effort and changing environmental conditions as well as spatial differences with different levels of fleet effort. Increasing the size minimum statewide and especially in the south is a consideration for future management, so it is imperative to start collecting size frequency data from processors and vessels.
Biomass available in harvest areas, MPAs, and barrens	High	Provides an indication on total stock available to harvest and can be used to develop a Total Allowable Catch or Individual Fishery Quota.
Statewide comparison of size and density from independent monitoring and landings trends	High	Using existing monitoring data, complete an in-depth comparison of independent monitoring and correlate to landings trends. Investigate MPA and non-MPA areas.

Figure 2: CDFW management and information needs categorized as "high" priority (CDFW 2019).

Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1 - Management Strategy and Implementation

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

Factor 3.2 - Bycatch Strategy

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

Factor 3.3 - Scientific Research and Monitoring

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

Factor 3.4 - Enforcement of Management Regulations

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

Factor 3.5 - Stakeholder Inclusion

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

Factor 3.1 - Management Strategy And Implementation

Eastern Central Pacific | Diving | United States | California

Moderately Effective

No formal fishery management plan is in place for the California fishery. Management strategies include a minimum harvest size and a restricted season. Fishing effort has been controlled through limits on the number of permits (there is an ongoing effort to reduce permit numbers and the length of the fishing season, but there are no explicit measures in place to control fishing mortality (CDFW 2019). There is a current effort to decrease the number of permits as a precautionary measure to reduce the latent harvesting capacity represented in inactive permits (CSUC 2015). There are also no-take reserves in place that protect part of the reproductive stock. Management strategy and implementation in the fishery is scored moderately effective, because it includes measures that are expected to control fishing intensity but the effectiveness is unknown.

Northeast Pacific | Diving | United States | Alaska

Highly effective

A fisheries management plan exists as part of the state administrative code. Fishing mortality is controlled through quotas, which are set at 6% of estimated stock biomass, based on fisheries-independent biomass surveys (ADFG 2014). The fishery is only opened in areas that have been recently surveyed in the past 6 years. Subdistricts are closed to fishing if the annual quota becomes too low to manage cost-effectively (pers. comm., M. Donnellan 2017). Effectiveness is hard to assess because the increasing presence of sea otter has negatively affected sea urchin populations and led to fishery closures in multiple subdistricts. Management strategy in this fishery is scored highly effective, because it includes measures that monitor stock health and control fishing intensity, and appears to be effective where sea otter is not present.

Northeast Pacific | Diving | United States | Oregon

Moderately Effective

No formal fishery management plan is in place for the Oregon fishery. Management strategies include a minimum harvest size and a minimum harvest depth. Effort is controlled primarily through limits on the number of permits. There are no measures in place to directly control fishing mortality, but ODFW has decreased the number of permits and restricted the use of mixed-gas diving in response to concerns about declining sea urchin populations (ODFW 2016). There are also no-take reserves in place that protect part of the reproductive stock. Management strategy and implementation in this fishery is scored moderately effective, because it includes measures that monitor stock health and control fishing intensity but the overall effectiveness is uncertain.

Northeast Pacific | Diving | United States | Washington

Highly effective
There is a formal fisheries management plan in place. Management strategies include minimum and maximum harvest sizes, limited licenses, and a restricted season. A total allowable catch (TAC) is used to restrict fishing mortality, and is determined using a size-based model and regular fisheries-independent survey data (using divers or ROVs). The fishery has previously responded to decreases in red sea urchin biomass by implementing TAC reductions and/or area closures. Except for one district that is affected by sea otter, sea urchin populations in most districts show stable or increasing trends. Some areas are permanently closed to harvest, and these are used as a reproductive reservoir and to buffer against uncertainty. The fishery also uses both minimum and maximum size limits to protect immature sea urchin and the larger, most fecund individuals (WDFW 2015)(WDFW 2016). Management strategy and implementation in this fishery is scored highly effective, because there are appropriate targets and management strategies based on scientific advice, and there is evidence of effectiveness.

Factor 3.2 - Bycatch Strategy

Eastern Central Pacific | Diving | United States | California
Northeast Pacific | Diving | United States | Alaska
Northeast Pacific | Diving | United States | Washington
Northeast Pacific | Diving | United States | Oregon

Highly effective
Harvest of sea urchin by divers is highly selective and produces minimal or no by-catch of nontarget species. Because by-catch is minimal and does not include species of concern, by-catch strategy is scored highly effective.

Factor 3.3 - Scientific Research And Monitoring

Eastern Central Pacific | Diving | United States | California

Moderately Effective
No formal stock assessments exist for this fishery. Management has generally relied on long-term fishery-dependent data (landings and CPUE) in decision-making. Other relevant fishery-independent data on stock health exist (e.g., PISCO data, CDFW surveys of abalone index sites), but there is no formal process of using them for management. The industry has also funded some abundance monitoring and basic urchin biology research, such as recruitment and settlement studies (particularly in Southern California). But, there is no formal process for incorporating these into management. CDFW is also currently working with nongovernmental organizations to develop a Data-Limited Methods Toolkit approach to formally incorporate available data into the management of the fishery (pers. comm., P. Kalvass, D. Stein 2017). Scientific research and monitoring is scored moderately effective, because some data on stock health are collected and analyzed but may not be effectively incorporated into management.

Northeast Pacific | Diving | United States | Alaska

Highly effective
Stock biomass assessments of fishing subdistricts are conducted regularly, and these are directly used to set guideline harvest levels. Because of sea otter impacts and declining levels of effort and harvest in the fishery, stock assessments have become less frequent (every 6 years). ADFG also monitors "control" areas where sea urchin is not harvested. Because the fishery collects appropriate data and uses an up-to-date stock assessment, scientific research and monitoring is scored highly effective.

Northeast Pacific | Diving | United States | Oregon

Moderately Effective
No formal stock assessments exist, but fishery-independent data (diver surveys of abundance and size frequency) are used together with fishery-dependent data to make recommendations at stakeholder meetings, and to the Oregon Fish and Wildlife Commission (ODFW 2016) (pers. comm., S. Groth 2017). Scientific research and monitoring is scored moderately effective, because some data on stock health are collected and analyzed but there is no formal, peer-reviewed stock assessment in place.

Northeast Pacific | Diving | United States | Washington

Highly effective
Regular stock assessments are conducted using fishery-independent data (biomass estimation from diver and ROV surveys, relative abundance indicators at index sites, and size-structure analysis) and fishery-dependent data (CPUE and harvest depth and location). These data are incorporated into a catch-at-size analysis model and used in setting total allowable catches (TAC) for the fishery (WDFW 2015) (pers. comm., H. Carson 2017). Stock assessment reports undergo internal peer review and external review. Because the fishery collects appropriate data and uses an up-to-date, peer-reviewed stock assessment, scientific research and monitoring is scored highly effective.

Factor 3.4 - Enforcement Of Management Regulations

Eastern Central Pacific | Diving | United States | California

Highly effective
Logbooks are required and are submitted regularly to CA DFW. Fish tickets are submitted by urchin buyers, which allow for verification of landings. The law enforcement division of DFW directly enforces regulations on the water and dockside. Enforcement of management regulations is scored highly effective, because enforcement measures are in place and there is a process for verification.

Northeast Pacific | Diving | United States | Alaska

Highly effective
Permit holders are required to submit fish tickets with catch weight and dive times, and processors also submit processing records to ADFG within 30 days. Onboard processing of sea urchin requires an onboard observer or a special permit. The Alaska Wildlife Troopers in the Department of Public Safety are responsible for direct enforcement of regulations {ADFG 2016}. Enforcement of management regulations is scored highly effective, because enforcement measures are in place and there is a process for verification.

Northeast Pacific | Diving | United States | Oregon

Highly effective
Logbooks are required for harvesters and are submitted electronically to ODFW. Fish tickets are submitted by urchin buyers, which allow for cross-verification of landings. Oregon State Police are involved in enforcing regulations. Enforcement of management regulations is scored highly effective, because enforcement measures are in place and there is a process for verification.

Northeast Pacific | Diving | United States | Washington

Highly effective
Harvesters are required to keep and submit detailed monthly logbooks to WDFW. WDFW also collects landings data in the form of fish slips that are submitted by urchin buyers when sales are made. Landings are cross-verified between these reports (pers. comm., H. Carson 2017). The law enforcement division of WDFW also directly enforces regulations. Enforcement of management regulations is scored highly effective, because enforcement measures are in place and there is a process for verification.

Factor 3.5 - Stakeholder Inclusion

Eastern Central Pacific | Diving | United States | California

Highly effective
Fishery review and management decisions are made through the California Sea Urchin Commission, which includes representatives from industry (harvesters and handlers), DFW, and the California Sea Grant (CSUC 2017). Stakeholder inclusion is scored highly effective, because the management process is transparent and includes stakeholder input.

Northeast Pacific | Diving | United States | Alaska

Highly effective
The Southeast Alaska Regional Dive Fisheries Association (SARDFA) represents the interests of multiple stakeholders, including permit holders, divers, and processors. SARDFA has a good working relationship with ADFG, and low-level management decisions occur with both formal and informal communications between ADFG and SARDFA. Larger management decisions (involving changes to the fishery management plan) can be proposed by ADFG, permit holders, or members of the public, and go through formal consideration by the Alaska Board of Fisheries. Proposals are reviewed by ADFG and are also open to public comment periods (pers. comm., M. Donnellan 2017). Stakeholder inclusion is scored highly effective, because the management process is transparent and includes stakeholder input.

Northeast Pacific | Diving | United States | Oregon

Highly effective
Management decisions are made by the Oregon Fish and Wildlife Commission. ODFW managers develop proposals for fishery actions through meetings with stakeholders, and these are proposed to the Commission. Stakeholder meetings are open to the public. Public meetings and solicitation of comments are also held before Commission decisions (pers. comm., S. Groth 2017). Stakeholder inclusion is scored highly effective, because the management process is transparent and includes stakeholder input.

Northeast Pacific | Diving | United States | Washington

Highly effective
General management decisions are made by WDFW fishery managers, with input from stakeholders. Regular meetings are held between managers and licensed sea urchin harvesters, in which harvesters collectively provide their recommendations on fishery actions. Other stakeholders (buyers/processors) are not formally represented at these meetings, but communicate their interests through the harvesters. Major management decisions (involving changes to the state fishery laws) are made by the Washington Fish and Wildlife Commission, and involve formal public meetings to solicit stakeholder input (pers. comm., H. Carson 2017). Stakeholder inclusion is scored highly effective, because the

management process is transparent and includes stakeholder input.

Criterion 4: Impacts on the Habitat and Ecosystem

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

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

Guiding principles

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

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

FISHERY	FISHING GEAR ON THE SUBSTRATE	MITIGATION OF GEAR IMPACTS	ECOSYSTEM-BASED FISHERIES MGMT	SCORE
Eastern Central Pacific | Diving | United States | California	4	0	Low Concern	**Green (4.000)**
Northeast Pacific | Diving | United States | Alaska	4	0	Low Concern	**Green (4.000)**
Northeast Pacific | Diving | United States | Oregon	4	0	Low Concern	**Green (4.000)**
Northeast Pacific | Diving | United States | Washington	4	0	Low Concern	**Green (4.000)**

Sea urchins are ideal candidates for ecosystem-based fisheries management (EBFM) because of their key role in community structure (Rogers-Bennett 2007). The creation of no-take marine protected areas (MPA) is a recommended tool for managing red sea urchin (Rogers-Bennett 2007) and, when coupled with kelp restoration, MPAs can increase the reproductive potential of red sea urchin by protecting larger individuals (Claisse et al. 2013). Although red sea urchin is an important component of nearshore rocky ecosystems, high densities of purple sea urchin (*Strongylocentrotus purpuratus*) are largely responsible for overgrazing kelp forests and maintaining urchin barrens (Dudley et al. 2021)(Rogers-Bennett and Catton 2019). In addition, fishing pressure on urchin predators (e.g., California spiny lobster and California sheephead) is thought to drive trophic cascades in southern California rock reef ecosystems, and decreasing the fishing mortality on predators increases the resilience of kelp forests (Dunn et al. 2017). Declines in sea otter populations also result in urchin barrens (Estes and Palmisano 1974). A number of factors may cause kelp forests to convert to alternative stable states, but the likelihood of trophic cascades resulting from the fishery is low, and spatial management is used to protect ecosystem function in Alaska, California, Oregon, and Washington.

Finally, it is important to distinguish the ecological roles and the potential impacts of U.S. fisheries for red sea urchin on the

Pacific coast from those of the green sea urchin (*Strongylocentrotus droebachiensis*) on the Atlantic coast. Green sea urchin is the only herbivorous sea urchin in shallow coastal waters (Scheibling 1996), is the only benthic grazer capable of controlling algal abundance in the North Atlantic (Steneck et al. 2013), and largely determines the structure and dynamics of nearshore rocky ecosystems (Scheibling 1996). Overfishing of this keystone species in Maine led to alternative stable states (Steneck et al. 2013). Therefore, the evaluation of ecosystem-based fisheries management is different for the green sea urchin fishery. See the Seafood Watch Atlantic Urchin report for more details.

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 - Impact of Fishing Gear on the Habitat/Substrate

Eastern Central Pacific | Diving | United States | California
Northeast Pacific | Diving | United States | Alaska
Northeast Pacific | Diving | United States | Washington
Northeast Pacific | Diving | United States | Oregon

4
Diver harvest of red sea urchin is generally done with small, hand-held tools such as rakes. Although these tools may make contact with algae and invertebrate communities on rocky reef bottoms in shallow waters, they do not drag over them. They do not affect sensitive species such as corals or sponges. The impacts of hand raking have not been formally assessed, but are expected to be very low or negligible (DFO 2016) (pers. comm., H. Carson 2017), so physical impacts of the fisheries are scored 4 (low concern).

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Eastern Central Pacific | Diving | United States | California
Northeast Pacific | Diving | United States | Alaska
Northeast Pacific | Diving | United States | Washington
Northeast Pacific | Diving | United States | Oregon

0
There are no existing measures aimed at limiting gear impacts on habitats.

Factor 4.3 - Ecosystem-based Fisheries Management

Eastern Central Pacific | Diving | United States | California

Low Concern
The California red sea urchin fishery does not directly manage for the ecological role of sea urchin; however, there are areas closed to harvest, thus allowing for the protection of sea urchin populations and ecological function. This includes a statewide network of marine protected areas (MPA). Ecosystem-based fisheries management is scored a low concern, because the fishery uses spatial management measures that are expected to protect ecosystem functioning but there is no clear evidence of how effective these are.

Northeast Pacific | Diving | United States | Alaska

Low Concern
The Alaska red sea urchin fishery does not explicitly manage for the ecological role of sea urchin; however, quotas are set to avoid any population depletion, thus maintaining the current ecological role of sea urchin. Area-specific stock assessments and quotas are used to prevent localized depletion and maintain sea urchin populations. Ecosystem-based fisheries management is scored a low concern, because the fishery uses spatial management measures that expected to maintain population levels and protect ecosystem functioning but there is no clear evidence of how effective these are.

Northeast Pacific | Diving | United States | Oregon

Low Concern
The Oregon red sea urchin fishery does not directly manage for the ecological role of sea urchin; however, there are areas closed to harvest, thus allowing for the protection of sea urchin populations and ecological function. This includes a statewide network of marine protected areas (MPA). Ecosystem-based fisheries management is scored a low concern, because the fishery uses spatial management measures that are expected to protect ecosystem functioning but there is no clear evidence of how effective these are.

Northeast Pacific | Diving | United States | Washington

Low Concern
The Washington red sea urchin fishery does not explicitly manage for the ecological role of red sea urchin; however, quotas are set to avoid any population depletion, thus maintaining the current ecological role of sea urchin. Area-specific stock assessments and quotas are used to prevent localized depletion and maintain sea urchin populations. There are also areas closed to harvest, allowing for the protection of sea urchin populations and ecological function. Ecosystem-based fisheries management is scored a low concern, because the fishery uses spatial management measures that are expected to maintain population levels and protect ecosystem functioning but there is no clear evidence of how effective these are.

Acknowledgements

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

Seafood Watch would like to thank Mike Donnellan, Henry Carson, Scott Groth, Dave Rudie, and Derek Stein for graciously reviewing this report for scientific accuracy.

References

151875&inline

591102 on 2018-10-31

Alaska Department of Fish and Game (ADFG) 2001. Red sea urchin assessment surveys: Districts 101, 102, and 104

Alaska Department of Fish and Game (ADFG) 2015. 2015-2018 Commercial Fishing Regulations: Shrimp, Dungeness Crab and Miscellaneous Shellfish

Alaska Department of Fish and Game (ADFG). 2014. Report to the Board of Fisheries, Miscellaneous Shellfish Fisheries. Fishery Management Report No. 14-46

Bernard F.R., Miller D.C. 1973. Preliminary Investigation on the red sea urchin resources of British Columbia (Strongylocentrotus francisancus (Agassiz)). Fish. Res. Board Can. Tech. Rep. 400: 37pp.

California Department of Fish and Game (CDFG). 2003. Red Sea Urchin. In: Annual Status of the Fisheries Report. Available at: www.dfg.ca.gov/marine/status/report2003/redsu.pdf

California Sea Urchin Commission (CSUC). "About Us". California Sea Urchin Commission website. Available from: http://www.calurchin.org/calurchin_aboutus.html, accessed 21 May 2017.

California Sea Urchin Commission (CSUC). 2015. Capacity reduction proposal: Improved regulations for the California sea urchin fishery.

Carson H.S., Ulrich M., Lowry D., Pacunski R.E., Sizemore R. 2016. Status of the California sea cucumber (Parastichopus californicus) and red sea urchin (Mesocentrotus franciscanus) commercial dive fisheries in the San Juan Islands, Washington State, USA. Fisheries Research 179 (2016) 179–190

CDFW (California Department of Fish and Wildlife). 2019. Red Sea Urchin, *Mesocentrotus franciscanus*, Enhanced Status Report.

CDFW. 2022. Regional MPA Statistics.

Claisse, J. T., J. P. Williams, T. Ford, D. J. Pondella II, B. Meux, and L. Protopapadakis. 2013. Kelp forest habitat restoration has the potential to increase sea urchin gonad biomass. Ecosphere 4(3):38.

DFO 2016. Pacific Region Integrated Fisheries Management Plan: Red Sea Urchin. August 1, 2016 to July 31, 2017

Dudley, P.N., Rogers, T.L., Morales, M.M., Stoltz, A.D., Sheridan, C.J., Beulke, A.K., Pomeroy, C., and Carr, M.H. 2021. A More Comprehensive Climate Vulnerability Assessment Framework for Fisheries Social-Ecological Systems. *Front. Mar. Sci.*, 14 June 2021.

Dunn, R.P., Baskett, M.L., and Hovel, K.A. 2017. Interactive effects of predator and prey harvest on ecological resilience of rocky reefs. *Ecological Applications*, 27(6), 2017, pp. 1718–1730.

Ebert T.A., Southon J.R. 2003. Red sea urchins (Stroungylocentrotus franciscanus) can live over 100 years: confirmation with A-bomb 14-Carbon. Fish. Bull 101: 915-922

Estes J, Palmisano J. 1974. Sea otters: their role in structuring nearshore communities. *Science* 185, 1058-1060.

Hordyk A, Newman D, Carruthers T, Suatoni L. 2017. Applying Management Strategy Evaluation to California Fisheries: Case Studies and Recommendations. University of British Columbia and Natural Resources Defense Council. 238 p.

Kalvass P., Rogers-Bennett L. 2001. Red sea urchin. In: Leet W.S., Dewees C.M., Klingbeil R., Larson E.J. (Eds.) California"s Living Marine Resources: A Status Report. California Department of Fish and Game, Sacramento, 101-104

Lundquist C.J., Botsford L.W. 2011. Estimating larval production of a broadcast spawner: the influence of density, aggregation, and the fertilization Allee effect. Can. J. Fish. Aquat. Sci. 68(1):30-42

Marshall S., Larson R. Woodby D. 1991. Interim management measures for the red sea urchin in southeast Alaska for the 1990-1991 season. Alaska Department of Fish and Game Regional Information Report No. 1J91-08

Oregon Department of Fish and Wildlife (ODFW). 2016. Analysis of red sea urchin fishery and survey data for March 18, 2015 OFWC commission meeting.

Oregon Department of Fish and Wildlife (ODFW). 2016. Progress Report: 2016 Sea Urchin Surveys

Rogers-Bennett L. 2013. Strongylocentrotus franciscanus and Strongylocentrotus purpuratus. In: Lawrence J.M. (Ed.) Sea Urchins: Biology and Ecology 413-432

Rogers-Bennett, L. and C.A. Catton. 2019. Marine heat wave and multiple stressors tip bull kelp forest to sea urchin barrens. *Scientific Reports* (2019) 9:15050

Rogers-Bennett, L., 2007. The ecology of *Strongylocentrotus franciscanus* and *Strongylocentrotus purpuratus*. In: Lawrence, J.M. (Ed.), Edible Sea Urchins: Biology and Ecology. Elsevier, Amsterdam, pp. 393–425

Scheibling, R.E. 1996. The role of predation in regulating sea urchin populations in eastern Canada. *Oceanologica Acta* 19 (1996): 421-430.

Smith, Q. 2021. Southeast Alaska 2019/2020 miscellaneous shellfish fisheries management report. Alaska Department of Fish and Game, Fishery Management Report No. 21-21, Anchorage.

Steneck R.S., Leland A., McNaught D.C., Vavrinec J. 2013. Ecosystem flips, locks, and feedbacks: the lasting effects of fisheries on Maine's kelp forest ecosystem. Bull. Mar. Sci. 89(1):31-55.

Sun J., Chiang F-S. 2015. Use and Exploitation of Sea Urchins. In: Brown N., Eddy S. (eds). Echinoderm Aquaculture. Wiley-Blackwell: New Jersey

Tatarenko, D.E. & Poltaraus, A.B. 1993. Affiliation of sea urchin Pseudocentrotus depressus to the family Strongylocentrotidae and description of a new genus Mesocentrotus belonging to the group based on DNA-DNA hybridization and comparative morphological data. Zoologicheskii Zhurnal 72(2), 61-72.

Washington Department of Fish and Wildlife (WDFW). 2013. Summary of the 2013 stock assessment of red sea urchins (Mesocentrotus franciscanus) in Sea Urchin Management District 4, the Sekiu Area

Washington Department of Fish and Wildlife (WDFW). 2014. Summary of the 2014 stock assessment of red sea urchins (Mesocentrotus franciscanus) in Sea Urchin Management District 3, the Port Angeles Area

Washington Department of Fish and Wildlife (WDFW). 2015. Sea urchin harvest management plan. September 1, 2015-August 31, 2016.

Washington Department of Fish and Wildlife (WDFW). 2016. Summary of the 2015 survey of red sea urchin (Mesocentrotus franciscanus) and sea cucumber (Parastichopus californicus) index stations in the San Juan Islands.

Washington Department of Fish and Wildlife (WDFW). 2020. Summary of the 2019 survey of red sea urchin (*Mesocentrotus franciscanus*) index stations in Management District 1, the San Juan Islands.

WDFW. 2019. Summary of the 2018 stock assessment of red sea urchin (*Mesocentrotus franciscanus*) in Management Districts 3, 4, and 5 (Western Strait of Juan de Fuca).

WDFW. 2022. Commercial sea urchin fishery harvest quotas and landings for the 2021-2022 season.

Appendix A: Report Review and Update

Updates to the U.S. Pacific Red Sea Urchin Report

Overall Recommendations for red sea urchin caught by divers in Alaska, California, Oregon, and Washington remain unchanged. Information and criterion updates are outlined below.

This report was reviewed in July 2022 for any significant stock status and management updates to the fishery. None was found that would indicate that the final rating is no longer accurate. But, information updates were added to the synthesis sections of Criteria 3 and 4.

C1.1 Washington: Abundance downgraded from "low" to "moderate" concern because the population in District 1 is less than 75% of a potential target reference point.