Urchin (US Pacific)

Red sea urchin (Strongylocentrotus franciscanus)

California, Alaska, Oregon, Washington

Diver

11/5/18

Seafood Watch Consulting Researcher

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

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

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

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

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

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

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

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

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

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

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

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

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

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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 urchins in the US 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 and Washington the available data suggest the stock is healthy. In Alaska and Washington, harvest rates are below what are thought to be sustainable levels. In California, stock status and the chances of overfishing are unknown.

**Criterion 2**

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

**Criterion 3**

All US red sea urchin fisheries use some forms of management measures including a limited-entry system, though only Alaska and Washington have formal fishery management plans and measures to explicitly control fishing mortality. However, 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 dive fisheries are minimal, since harvest is done by hand. All US 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**

<table>
<thead>
<tr>
<th>SPECIES/FISHERY</th>
<th>CRITERION 1: IMPACTS ON THE SPECIES</th>
<th>CRITERION 2: IMPACTS ON OTHER SPECIES</th>
<th>CRITERION 3: MANAGEMENT EFFECTIVENESS</th>
<th>CRITERION 4: HABITAT AND ECOSYSTEM</th>
<th>OVERALL RECOMMENDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red sea urchin Alaska, Diving, United States of America</td>
<td>Green (3.413)</td>
<td>Green (5.000)</td>
<td>Green (5.000)</td>
<td>Green (4.000)</td>
<td>Best Choice (4.298)</td>
</tr>
<tr>
<td>Red sea urchin California, Diving, United States of America</td>
<td>Yellow (2.644)</td>
<td>Green (5.000)</td>
<td>Yellow (3.000)</td>
<td>Green (4.000)</td>
<td>Good Alternative (3.548)</td>
</tr>
<tr>
<td>Red sea urchin Oregon, Diving, United States of America</td>
<td>Green (3.318)</td>
<td>Green (5.000)</td>
<td>Yellow (3.000)</td>
<td>Green (4.000)</td>
<td>Best Choice (3.756)</td>
</tr>
<tr>
<td>Red sea urchin Washington, Diving, United States of America</td>
<td>Green (4.284)</td>
<td>Green (5.000)</td>
<td>Green (5.000)</td>
<td>Green (4.000)</td>
<td>Best Choice (4.549)</td>
</tr>
</tbody>
</table>

**Scoring Guide**

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

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

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

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

Scope of the analysis and ensuing recommendation

Red sea urchins (*Mesocentrotus franciscanus*, formerly *Strongylocentrotus franciscanus*) range along the west coast of North America from Baja California, Mexico, to southern Alaska (Ebert et al. 1999), and are commercially harvested throughout most of this range. This report provides recommendations for the US fisheries for red sea urchins. This includes 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 US (Alaska, California, Oregon, Washington), and Canada (British Columbia). These commercial fisheries are all diver fisheries, where sea urchins are hand-harvested by divers on 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). 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. The fishery currently operates without a formal fishery management plan, and management occurs through 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.

The Oregon red sea urchin fishery is managed by the Oregon Department of Fish and Wildlife (ODFW). 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. 75% of all landings 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. There is a formal fisheries management plan in place, and management measures include a quota (TAC), minimum and maximum harvest sizes, limited licenses, and a restricted season.
Production Statistics

Global production of sea urchins increased rapidly starting in the mid-1970s with the development and expansion of commercial urchin fisheries outside Japan, particularly in Chile and the US (Fig. 1). 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.
Fisheries for the red sea urchin (*Mesocentrotus franciscanus*) began in the early 1970s in California, Washington (US), 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 (Fig. 2). 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 5 Global sea urchin production by country from 1950 to 2014. This includes multiple sea urchin species.

Figure 6 Global harvest of the red sea urchin (*S. franciscanus*) and the green sea urchin (*S. droebachiensis*) from 1972-1998. Figure from 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.

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 and thus these landings may include small numbers of green and purple sea urchins. However, these other species are minor components of urchin fisheries on the North American Pacific coast.
**Importance to the US/North American market.**

Although most US 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 US west coast sea urchins are consumed domestically. Sea urchins are also imported into the US, primarily from Canada and Chile. This includes sea urchins that are 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 urchins are harvested for their 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 urchins may also be sold as fresh or live whole animals, with the test 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

<table>
<thead>
<tr>
<th>Region</th>
<th>Method</th>
<th>Abundance</th>
<th>Fishing Mortality</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska</td>
<td>Diving</td>
<td>United States of America</td>
<td>2.33: Moderate Concern</td>
<td>5.00: Low Concern</td>
</tr>
<tr>
<td>California</td>
<td>Diving</td>
<td>United States of America</td>
<td>2.33: Moderate Concern</td>
<td>3.00: Moderate Concern</td>
</tr>
<tr>
<td>Oregon</td>
<td>Diving</td>
<td>United States of America</td>
<td>3.67: Low Concern</td>
<td>3.00: Moderate Concern</td>
</tr>
<tr>
<td>Washington</td>
<td>Diving</td>
<td>United States of America</td>
<td>3.67: Low Concern</td>
<td>5.00: Low Concern</td>
</tr>
</tbody>
</table>

Criterion 1 Assessment

SCORING GUIDELINES

Factor 1.1 - Abundance

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

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

**Factor 1.2 - Fishing Mortality**

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

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

**RED SEA URCHIN**

**Factor 1.1 - Abundance**

**ALASKA, DIVING, UNITED STATES OF AMERICA**

**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 Productivity-Susceptibility Analysis: V = √(1.672 + 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 as "moderate" concern.

**Justification:**

**Productivity-Susceptibility Analysis**

<table>
<thead>
<tr>
<th>PRODUCTIVITY ATTRIBUTE</th>
<th>RELEVANT INFO</th>
<th>REFERENCE</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average age at maturity</td>
<td>1-2 years</td>
<td>(Bernard and Miller 1973)</td>
<td>1</td>
</tr>
<tr>
<td>Average maximum age</td>
<td>&gt;100 years</td>
<td>(Ebert and Southon 2003)</td>
<td>3</td>
</tr>
<tr>
<td>Fecundity</td>
<td>&gt;1 million eggs</td>
<td>(Kalvass and Rogers-Bennett 2001)</td>
<td>1</td>
</tr>
<tr>
<td>Reproductive strategy</td>
<td>Broadcast spawner</td>
<td>(Kalvass and Rogers-Bennett 2001)</td>
<td>1</td>
</tr>
<tr>
<td>Trophic level</td>
<td>&lt;2.75</td>
<td>(Rogers-Bennett 2013)</td>
<td>1</td>
</tr>
</tbody>
</table>
Density dependence | Allee effects exist | (Lundquist and Botsford 2011) | 3

**Productivity score** | | 1.67

### SUSCEPTIBILITY ATTENTION

<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>RELEVANT INFO</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Areal overlap</td>
<td>Unknown; default score used (&gt;30% across their geographic range)</td>
<td>3</td>
</tr>
<tr>
<td>Vertical overlap</td>
<td>Red sea urchins are a targeted species</td>
<td>3</td>
</tr>
<tr>
<td>Selectivity of fishery</td>
<td>Red sea urchins are a targeted species, but gear type and size limits reduce susceptibility</td>
<td>2</td>
</tr>
<tr>
<td>Post-capture mortality</td>
<td>Data not available; default score used.</td>
<td>3</td>
</tr>
<tr>
<td><strong>Susceptibility score</strong></td>
<td></td>
<td><strong>2.325</strong></td>
</tr>
</tbody>
</table>

### CALIFORNIA, DIVING, UNITED STATES OF AMERICA

**Moderate Concern**

There is no current quantitative stock assessment in place for the California fishery. 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). Based on the Productivity-Susceptibility Analysis, the species has medium vulnerability (see above). Because the stock status is uncertain and the species is not highly vulnerable, abundance is scored as "moderate" concern.

**Justification:**

### OREGON, DIVING, UNITED STATES OF AMERICA

**Low Concern**

Long-term stock data are available primarily from Orford Reef, which accounts for about half of all Oregon landings. Surveys started in 1984, prior to commercial fishing, and show a decline in urchin populations until 2014, when red sea urchins were at about 25% of their 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 2000’s [REF]. 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 as "low" concern.

**Justification:**

![Graph showing Abundance of red sea urchins from 1984 to 2014 at Orford Reef and two other nearby reefs in Oregon. Figure from ODFW (2016).](image-url)
WASHINGTON, DIVING, UNITED STATES OF AMERICA

Low Concern

Long-term stock data are only available for the San Juan Islands (districts 1 and 2) which account for two thirds of all landings. Surveys in these districts have been conducted at 13 to 30 index stations since 1984, before intensive harvesting began. Survey data suggest that red sea urchin populations are currently at around 50% of their unfished 1984 abundance, but have been increasing consistently from their historic low in 1995. Reference points are not available for this fishery. Fished to unfished index sites show no significant differences in sea urchin densities (WDFW 2016) (Carson et al. 2016). Shorter-term abundance data from the other open fishery districts (3 and 4) indicate that red sea urchin abundances there have increased since 2003 to 2004 (WDFW 2014) (WDFW 2013). The species is considered to have medium vulnerability under the Productivity-Susceptibility Analysis (see above). 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 as "low" concern.

Justification:
Factor 1.2 - Fishing Mortality

ALASKA, DIVING, UNITED STATES OF AMERICA

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

CALIFORNIA, DIVING, UNITED STATES OF AMERICA

Moderate Concern

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

Figure 12 Abundance of red sea urchins from 1984 to 2015 for index stations in the San Juan Islands (district 1 and 2) in Washington. Figure from WDFW (2015).
**OREGON, DIVING, UNITED STATES OF AMERICA**

**Moderate Concern**

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

**WASHINGTON, DIVING, UNITED STATES OF AMERICA**

**Low Concern**

Fishing mortality is restricted by Total Allowable Catch (TAC), which is set based on a target fishing mortality of 4% of legal biomass (WDFW 2015). However, half of TAC is allocated to tribal groups, who have harvested only a portion of their allotted catch. Therefore, actual fishing mortality recently has been less than 4% (pers. comm., H. Carson 2017). Because fishing mortality is expected to be at or below a sustainable level, it is scored as "low" concern.
**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 Critical

**Guiding Principles**

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

**Criterion 2 Summary**

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

### RED SEA URCHIN - ALASKA - DIVING - UNITED STATES OF AMERICA

<table>
<thead>
<tr>
<th>Subscore: 5.000</th>
<th>Discard Rate: 1.00</th>
<th>C2 Rate: 5.000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td>Abundance</td>
<td>Fishing Mortality</td>
</tr>
<tr>
<td>No other main species caught</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### RED SEA URCHIN - CALIFORNIA - DIVING - UNITED STATES OF AMERICA

<table>
<thead>
<tr>
<th>Subscore: 5.000</th>
<th>Discard Rate: 1.00</th>
<th>C2 Rate: 5.000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td>Abundance</td>
<td>Fishing Mortality</td>
</tr>
<tr>
<td>No other main species caught</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### RED SEA URCHIN - OREGON - DIVING - UNITED STATES OF AMERICA

<table>
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<th>Discard Rate: 1.00</th>
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</thead>
<tbody>
<tr>
<td>Species</td>
<td>Abundance</td>
<td>Fishing Mortality</td>
</tr>
<tr>
<td>No other main species caught</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.4 - Discards + Bait / Landings

The Alaska, Washington, Oregon, and California red sea urchin fisheries are diver-only fisheries, and sea urchins are selectively harvested by hand. Discard of undersized sea urchins 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.

**Criterion 3 Summary**

<table>
<thead>
<tr>
<th>Fishery</th>
<th>Management Strategy</th>
<th>Bycatch Strategy</th>
<th>Research and Monitoring</th>
<th>Enforcement</th>
<th>Stakeholder Inclusion</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishery 1: Alaska</td>
<td>Highly Effective</td>
<td>Highly Effective</td>
<td>Highly Effective</td>
<td>Highly Effective</td>
<td>Highly Effective</td>
<td>Green (5.000)</td>
</tr>
<tr>
<td>Diving</td>
<td>United States of America</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fishery 2: California</td>
<td>Moderately Effective</td>
<td>Highly Effective</td>
<td>Moderately Effective</td>
<td>Highly Effective</td>
<td>Highly Effective</td>
<td>Yellow (3.000)</td>
</tr>
<tr>
<td>Diving</td>
<td>United States of America</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fishery 3: Oregon</td>
<td>Moderately Effective</td>
<td>Highly Effective</td>
<td>Moderately Effective</td>
<td>Highly Effective</td>
<td>Highly Effective</td>
<td>Yellow (3.000)</td>
</tr>
<tr>
<td>Diving</td>
<td>United States of America</td>
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<td></td>
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</tr>
<tr>
<td>Fishery 4: Washington</td>
<td>Highly Effective</td>
<td>Highly Effective</td>
<td>Highly Effective</td>
<td>Highly Effective</td>
<td>Highly Effective</td>
<td>Green (5.000)</td>
</tr>
<tr>
<td>Diving</td>
<td>United States of America</td>
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</tbody>
</table>

**Criterion 3 Assessment**

**Factor 3.1 - Management Strategy and Implementation**
**Considerations:** What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? Do managers 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.

<table>
<thead>
<tr>
<th>Location</th>
<th>Rating</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ALASKA, DIVING, UNITED STATES OF AMERICA</strong></td>
<td><strong>Highly Effective</strong></td>
<td>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 otters has negatively impacted sea urchin populations and led to fishery closures in multiple subdistricts. Management strategy in this fishery is scored as &quot;highly effective&quot; because it includes measures that monitor stock health and control fishing intensity, and appears to be effective where sea otters are not present.</td>
</tr>
<tr>
<td><strong>CALIFORNIA, DIVING, UNITED STATES OF AMERICA</strong></td>
<td><strong>Moderately Effective</strong></td>
<td>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, e.g., Tiemann 2017), and the length of the fishing season, but there are no explicit measures in place to control fishing mortality. 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 as &quot;moderately effective&quot; because it includes measures that are expected to control fishing intensity, but effectiveness is unknown.</td>
</tr>
<tr>
<td><strong>OREGON, DIVING, UNITED STATES OF AMERICA</strong></td>
<td><strong>Moderately Effective</strong></td>
<td>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 as &quot;moderately effective&quot; because it includes measures that monitor stock health and control fishing intensity, but the overall effectiveness is uncertain.</td>
</tr>
<tr>
<td><strong>WASHINGTON, DIVING, UNITED STATES OF AMERICA</strong></td>
<td><strong>Highly Effective</strong></td>
<td>There is a formal fisheries management plan in place. Management strategies include minimum and maximum harvest sizes, limited licenses, and a restricted season. Total allowable catch (TAC) is used to</td>
</tr>
</tbody>
</table>

25
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. With the exception of one district that is impacted by sea otters, sea urchin populations in most districts show stable or increasing trends. Some areas are permanently closed to harvest, which 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 urchins and the larger, most fecund individuals (WDFW 2015) (WDFW 2016). Management strategy and implementation in this fishery is scored as "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**

*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.*

**ALASKA, DIVING, UNITED STATES OF AMERICA**
**CALIFORNIA, DIVING, UNITED STATES OF AMERICA**
**OREGON, DIVING, UNITED STATES OF AMERICA**
**WASHINGTON, DIVING, UNITED STATES OF AMERICA**

**Highly Effective**

Harvest of sea urchins by divers is highly selective and produces minimal or no bycatch of non-target species. Because bycatch is minimal and does not include species of concern, bycatch strategy is scored as "highly effective."

**Factor 3.3 - Scientific Research and Monitoring**

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

**ALASKA, DIVING, UNITED STATES OF AMERICA**

**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 urchins are not harvested. Because the fishery collects appropriate data and uses an up-to-date stock assessment, scientific research and monitoring is scored as "highly effective."

**CALIFORNIA, DIVING, UNITED STATES OF AMERICA**

**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). However, there is also no formal process for incorporating these into management. CDFW is also currently working with NGOs in developing 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 as "moderately effective" because some data on stock health are collected and analyzed, but may not be very effectively incorporated into management.

OREGON, DIVING, UNITED STATES OF AMERICA

**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 as "moderately effective" because some data on stock health are collected and analyzed, but there is no formal, peer-reviewed stock assessment in place.

WASHINGTON, DIVING, UNITED STATES OF AMERICA

**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, harvest depth and location). These data are incorporated into a catch-at-size-analysis model and used in setting TACs 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 as "highly effective."

**Factor 3.4 - Enforcement of Management Regulations**

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

ALASKA, DIVING, UNITED STATES OF AMERICA

**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. On-board processing of sea urchins 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 as "highly effective" because enforcement measures are in place and there is a process for verification.

CALIFORNIA, DIVING, UNITED STATES OF AMERICA

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

OREGON, DIVING, UNITED STATES OF AMERICA

**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 as "highly effective" because enforcement measures are in place and there is a process for verification.

WASHINGTON, DIVING, UNITED STATES OF AMERICA

**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 as "highly effective" because enforcement measures are in place and there is a process for verification.

**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.*

ALASKA, DIVING, UNITED STATES OF AMERICA

**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 as "highly effective" because the management process is transparent and includes stakeholder input.
CALIFORNIA, DIVING, UNITED STATES OF AMERICA

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 as "highly effective" because the management process is transparent and includes stakeholder input.

OREGON, DIVING, UNITED STATES OF AMERICA

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 prior to Committee decisions (pers. comm., S. Groth 2017). Stakeholder inclusion is scored as "highly effective" because the management process is transparent and includes stakeholder input.

WASHINGTON, DIVING, UNITED STATES OF AMERICA

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 as "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**

<table>
<thead>
<tr>
<th>Region / Method</th>
<th>Gear Type and Substrate</th>
<th>Mitigation of Gear Impacts</th>
<th>EBFM</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska / Diving / United States of America</td>
<td>4</td>
<td>0</td>
<td>Low Concern</td>
<td>Green (4.000)</td>
</tr>
<tr>
<td>California / Diving / United States of America</td>
<td>4</td>
<td>0</td>
<td>Low Concern</td>
<td>Green (4.000)</td>
</tr>
<tr>
<td>Oregon / Diving / United States of America</td>
<td>4</td>
<td>0</td>
<td>Low Concern</td>
<td>Green (4.000)</td>
</tr>
<tr>
<td>Washington / Diving / United States of America</td>
<td>4</td>
<td>0</td>
<td>Low Concern</td>
<td>Green (4.000)</td>
</tr>
</tbody>
</table>

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

Diver harvest of red sea urchins 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 impact sensitive species like 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 as 4 ("low" concern).

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

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

Factor 4.3 - Ecosystem-Based Fisheries Management

The Alaska red sea urchin fishery does not explicitly manage for the ecological role of sea urchins; however, quotas are set to avoid any population depletion, thus maintaining the current ecological role of sea urchins. Area-specific stock assessments and quotas are used to prevent localized depletion and maintain sea urchin populations. Ecosystem-based fisheries management is scored as "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.

The California red sea urchin fishery does not directly manage for the ecological role of sea urchins; 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. Ecosystem-based fisheries management is scored as "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.
OREGON, DIVING, UNITED STATES OF AMERICA

Low Concern

The Oregon red sea urchin fishery does not directly manage for the ecological role of sea urchins; 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. Ecosystem-based fisheries management is scored as "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.

WASHINGTON, DIVING, UNITED STATES OF AMERICA

Low Concern

The Washington red sea urchin fishery does not explicitly manage for the ecological role of red sea urchins; however, quotas are set to avoid any population depletion, thus maintaining the current ecological role of sea urchins. 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 as "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.
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