GREEN SEA URCHIN – BRITISH COLUMBIA

*Strongylocentrotus droebachiensis*

Sometimes known as Uni, Urchin Roe

**SUMMARY**

Green Sea Urchins, members of the phylum Echinodermata (“spiny skin”) are reasonably abundant along the coasts of northwest Canada. Sea Urchins are prolific breeders and can live over 20 years. They are hand-caught by divers, so bycatch is minimal with no damage to the habitat. Sea Urchins graze on kelp (a type of seaweed) and are eaten by many animals like sea otters, and therefore are an important link in the marine ecosystem. Chef Barton Seaver describes them this way: “They have a soft texture with an intense briny bite. They have a lingering ocean flavor that is quite potent.”

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LIFE HISTORY

Core Points (only one selection allowed)

If a value for intrinsic rate of increase (‘r’) is known, assign the score below based on this value. If no r-value is available, assign the score below for the correct age at 50% maturity for females if specified, or for the correct value of growth rate (‘k’). If no estimates of r, age at 50% maturity, or k are available, assign the score below based on maximum age.

1.00 Intrinsic rate of increase <0.05; OR age at 50% maturity >10 years; OR growth rate <0.15; OR maximum age >30 years.

2.00 Intrinsic rate of increase = 0.05-0.15; OR age at 50% maturity = 5-10 years; OR a growth rate = 0.16–0.30; OR maximum age = 11-30 years.

3.00 Intrinsic rate of increase >0.16; OR age at 50% maturity = 1-5 years; OR growth rate >0.30; OR maximum age <11 years.

The intrinsic rate of increase is unknown for Green Sea Urchins. They become sexually mature at age 3 when the test diameter reaches 25-50 mm (DFO, 2003; Taylor, 2004). Their growth rate (k) is dependent on food supply, with slower rates under food limited conditions (DFO, 2003). Growth rate generally ranges from 0.11-0.25 (Scheibling and Hatcher 2007), and may vary greatly between neighboring Urchins for reasons currently unknown. Maximum size is reached at 100 mm (DFO, 2003), while maximum age is 20-25 years (DFO, undated).

Points of Adjustment (multiple selections allowed)

-0.25 Species has special behaviors that make it especially vulnerable to fishing pressure (e.g., spawning aggregations; site fidelity; segregation by sex; migratory bottlenecks; unusual attraction to gear; etc.).

-0.25 Species has a strategy for sexual development that makes it especially vulnerable to fishing pressure (e.g., age at 50% maturity >20 years; sequential hermaphrodites; extremely low fecundity).

-0.25 Species has a small or restricted range (e.g., endemism; numerous evolutionarily significant units; restricted to one coastline; e.g., American lobster; striped bass; endemic reef fishes).

-0.25 Species exhibits high natural population variability driven by broad-scale environmental change (e.g. El Nino; decadal oscillations).
Species does not have special behaviors that increase ease or population consequences of capture OR has special behaviors that make it less vulnerable to fishing pressure (e.g., species is widely dispersed during spawning).

Green Sea Urchins are widely dispersed in shallow waters. Distribution is patchy compared to red sea urchins, and studies have shown they make seasonal migrations between shallower and deeper waters (DFO, 2003). The environmental cues to spawn include an increase in water temperature and phytoplankton blooms, which are food for urchin larvae. Fertilization success is dependent on urchin density and food availability. Larvae spend 4-8 weeks drifting in the current before settling, enabling a wide distribution (DFO, undated; Taylor, 2004).

Species has a strategy for sexual development that makes it especially resilient to fishing pressure (e.g., age at 50% maturity <1 year; extremely high fecundity).

Green sea urchins are broadcast spawners. Females have high fecundity spawning up to 2 million eggs at a time (Taylor, 2004). Spawning is seasonal and varies by region, occurring from February to March in British Columbia (DFO, 2003).

Species is distributed over a very wide range (e.g., throughout an entire hemisphere or ocean basin; e.g., swordfish; tuna; Patagonian toothfish).

Green Sea Urchins are found in the Pacific and Atlantic oceans. In the Pacific, their range extends from northern Washington State to the Aleutian Islands. In the Atlantic they are distributed from the Canadian Arctic down the northwest Atlantic seaboard to New Jersey (DFO, 2000; DFO 2003).

Species does not exhibit high natural population variability driven by broad-scale environmental change (e.g., El Nino; decadal oscillations).

3.75 Points for Life History
ABUNDANCE

Core Points (only one selection allowed)

Compared to natural or un-fished level, the species population is:

1.00 Low: Abundance or biomass is <75% of BMSY or similar proxy (e.g., spawning potential ratio).

2.00 Medium: Abundance or biomass is 75-125% of BMSY or similar proxy; OR population is approaching or recovering from an overfished condition; OR adequate information on abundance or biomass is not available.

The Green Sea Urchin population in British Columbia is considered to be healthy, and sustainable after recovering from crisis in the early-mid 1990's (DFO, 2003), due to effective management measures (Perry et al., 2002).

Catch per unit effort (CPUE) has increased since 1993 and used to set maximum sustainable yields (MSY) at 321 tons in the Queen Charlotte Strait and Johnstone Strait, and 86 tons in the Gulf Islands-Victoria region (DFO, 2003).

3.00 High: Abundance or biomass is >125% of BMSY or similar proxy.

Points of Adjustment (multiple selections allowed)

-0.25 The population is declining over a generational time scale (as indicated by biomass estimates or standardized CPUE).

-0.25 Age, size or sex distribution is skewed relative to the natural condition (e.g., truncated size/age structure or anomalous sex distribution).

-0.25 Species is listed as "overfished" OR species is listed as "depleted", "endangered", or "threatened" by recognized national or international bodies.

The Green Sea Urchin is not listed as overfished, depleted, endangered or threatened, thus no points were subtracted.

-0.25 Current levels of abundance are likely to jeopardize the availability of food for other species or cause substantial change in the structure of the associated food web.

+0.25 The population is increasing over a generational time scale (as indicated by biomass estimates or standardized CPUE).

+0.25 Age, size or sex distribution is functionally normal.
Species is close to virgin biomass.

Current levels of abundance provide adequate food for other predators or are not known to affect the structure of the associated food web.

Current levels of Green Sea Urchins provide adequate food for their predators and the structure of the food web is not affected. Sea otters are a major predator of Green Sea Urchins and can reduce the population to a level where a fishery is no longer viable (DFO, 2007).

Sea Urchins need to remain above a ‘critical’ density level to maintain their optimal habitats. When their density falls below the critical level, their grazing rate is insufficient to control algae growth and their habitat will be lost or become one favored by their predators such as crabs (Chen 2008). Current levels of Sea Urchins in British Columbia are sufficient to prevent this ‘habitat switch’.

2.25 Points for Abundance

HABITAT QUALITY AND FISHING GEAR IMPACTS

Core Points (only one selection allowed)

Select the option that most accurately describes the effect of the fishing method upon the habitat that it affects

1.00 The fishing method causes great damage to physical and biogenic habitats (e.g., cyanide; blasting; bottom trawling; dredging).

2.00 The fishing method does moderate damage to physical and biogenic habitats (e.g., bottom gillnets; traps and pots; bottom longlines).

3.00 The fishing method does little damage to physical or biogenic habitats (e.g., hand picking; hand raking; hook and line; pelagic long lines; mid-water trawl or gillnet; purse seines).

In the commercial fishery Green Sea Urchins are hand-picked off rocks by scuba divers or by using an urchin rake, and measured to confirm they are above legal size. Urchins are stored in brailer nets or mesh bags and lifted to the surface where they are tagged, stored and processed. This method does little damage to the physical environment.

Green Sea Urchins are harvested for their gonads, referred to as roe in the fishing
industry and ‘uni’ in Japan (Taylor, 2004). Most Urchins are harvested between November and March when roe quantity and quality is greatest (DFO, 2003). Green Sea Urchins are shipped live and whole, with Japan importing most of the catch (DFO, undated).

Points of Adjustment (multiple selections allowed)

-0.25  Habitat for this species is so compromised from non-fishery impacts that the ability of the habitat to support this species is substantially reduced (e.g., dams; pollution; coastal development).

-0.25  Critical habitat areas (e.g., spawning areas) for this species are not protected by management using time/area closures, marine reserves, etc.

-0.25  No efforts are being made to minimize damage from existing gear types OR new or modified gear is increasing habitat damage (e.g., fitting trawls with roller rigs or rockhopping gear; more robust gear for deep-sea fisheries).

-0.25  If gear impacts are substantial, resilience of affected habitats is very slow (e.g., deep water corals; rocky bottoms).

+0.25  Habitat for this species remains robust and viable and is capable of supporting this species.

Shallow coastal areas are thought to be robust and capable of supporting this specie.

+0.25  Critical habitat areas (e.g., spawning areas) for this species are protected by management using time/area closures, marine reserves, etc.

Permanent and seasonal closures exist in British Columbia to aid in Green Sea Urchin management and recovery of the population (DFO, 2003).

+0.25  Gear innovations are being implemented over a majority of the fishing area to minimize damage from gear types OR no innovations necessary because gear effects are minimal.

Gear effects on the habitat are minimal.

+0.25  If gear impacts are substantial, resilience of affected habitats is fast (e.g., mud or sandy bottoms) OR gear effects are minimal.

Gear effects on the habitat are minimal.

4.00 Points for Habitat Quality and Fishing Gear Impacts
MANAGEMENT

Core Points (only one selection allowed)

Select the option that most accurately describes the current management of the fisheries of this species.

1.00 Regulations are ineffective (e.g., illegal fishing or overfishing is occurring) OR the fishery is unregulated (i.e., no control rules are in effect).

2.00 Management measures are in place over a major portion over the species' range but implementation has not met conservation goals OR management measures are in place but have not been in place long enough to determine if they are likely to achieve conservation and sustainability goals.

3.00 Substantial management measures are in place over a large portion of the species range and have demonstrated success in achieving conservation and sustainability goals.

The British Columbia Green Sea Urchin population is managed by the Department of Fisheries and Oceans in Canada (DFO). The fishery is based in two regions in the south: Queen Charlotte Strait and Gulf Islands/Victoria (DFO, 2003).

The Green Sea Urchin dive fishery began in 1987, and peaked in 1992 at 978 tonnes. It is an important small dive fishery with the Total Allowable Catch (TAC) set at 175 tonnes since 1996 due to management concerns. Since 1995 the annual catch has averaged 157 tonnes (DFO, 2003).

Various management measures are in affect including permanent and seasonal closures, dockside monitoring, and a limited number of dive permits with individual quotas and compulsory logbooks. There is a minimum size requirement for harvesting; Urchins must have a minimum test (shell) diameter of 50mm which allows at least one spawning event before harvesting (DFO, 2003; Muse, 1998).

Fishery surveys indicate the British Columbia Green Sea Urchin population is increasing since introducing quotas and reducing fishing pressure. The DFO suggests this fishery can be expanded (DFO, 2003) as successful management strategies are in effect. Precautionary frameworks are being used to develop a sustainable fishery (Perry et al., 2002).

Points of Adjustment (multiple selections allowed)

-0.25 There is inadequate scientific monitoring of stock status, catch or fishing effort.
Management does not explicitly address fishery effects on habitat, food webs, and ecosystems.

Sea Urchins have an important relationship with kelp and sea otters. Sea Urchins feed on kelp and are prey upon by sea otters. If the majority of kelp diminishes the food web collapses. Urchins can reach low numbers if over-preyed upon by sea otters, and otter numbers can be reduced if the Urchin is overfished. This food web relationship is known, but not integrated into management plans.

In addition, Sea Urchin density determines the amount or biomass of algae, and thus determines habitat type. The density parameter is not considered in the assessment and management of Sea Urchins.

This species is overfished and no recovery plan or an ineffective recovery plan is in place.

Management has failed to reduce excess capacity in this fishery or implements subsidies that result in excess capacity in this fishery.

There is adequate scientific monitoring, analysis and interpretation of stock status, catch and fishing effort.

Integrated Fishery Management Plans (IFMP) are developed every three years (currently 2006-2009). The most recent stock assessment used biomass dynamic models and concluded that the Green Sea Urchin population is healthy (DFO2, 2006). Landings are monitored using logbooks where divers record the number of Urchins harvested and the amount of time spent fishing. Data shows there is low fishing pressure as the catch per unit effort is now at the same as pre-fishery levels. This could partially be due to product competition with other nations, as Japan is now importing more roe from Russia (DFO, 2006).

Management explicitly and effectively addresses fishery effects on habitat, food webs, and ecosystems.

This species is overfished and there is a recovery plan (including benchmarks, timetables and methods to evaluate success) in place that is showing signs of success OR recovery plan is not needed.

Recovery is not needed as the Green Sea Urchin is not overfished.

Management has taken action to control excess capacity or reduce subsidies that result in excess capacity OR no measures are necessary because fishery is not overcapitalized.

British Columbia has issued 49 harvesting permits a year since 1993, with a Total Allowable Catch (quota) of 3.6 metric tonnes each (DFO, 2003). Logbooks have to be
surrendered (containing information on harvesting locations, water depth, number of urchins captured and length of time spent diving) to calculate the catch per unit effort.

3.50 Points for Management

BYCATCH

Core Points (only one selection allowed)

Select the option that most accurately describes the current level of bycatch and the consequences that result from fishing this species. The term, "bycatch" used in this document excludes incidental catch of a species for which an adequate management framework exists. The terms, "endangered, threatened, or protected," used in this document refer to species status that is determined by national legislation such as the U.S. Endangered Species Act, the U.S. Marine Mammal Protection Act (or another nation's equivalent), the IUCN Red List, or a credible scientific body such as the American Fisheries Society.

1.00 Bycatch in this fishery is high (>100% of targeted landings), OR regularly includes a "threatened, endangered or protected species."

2.00 Bycatch in this fishery is moderate (10-99% of targeted landings) AND does not regularly include "threatened, endangered or protected species" OR level of bycatch is unknown.

3.00 Bycatch in this fishery is low (<10% of targeted landings) and does not regularly include "threatened, endangered or protected species."

Bycatch is very low because the fishery is highly selective. Green Sea Urchins are harvested by divers either via hand-picking or using urchin rakes. Some Urchins are destroyed while trying to remove them from the rocks, and others need to be broken open to check gonad quality. Without including breakage to check for gonad quality, breakage accounts for about 10% of what is harvested off British Columbia (Muse, 1998). As long as the Urchin is not damaged undersized individuals can be placed back on the rock and will survive.

Points of Adjustment (multiple selections allowed)

-0.25 Bycatch in this fishery is a contributing factor to the decline of "threatened, endangered, or protected species" and no effective measures are being taken to reduce it.
-0.25 Bycatch of targeted or non-targeted species (e.g., undersize individuals) in this fishery is high and no measures are being taken to reduce it.

-0.25 Bycatch of this species (e.g., undersize individuals) in other fisheries is high OR bycatch of this species in other fisheries inhibits its recovery, and no measures are being taken to reduce it.

-0.25 The continued removal of the bycatch species contributes to its decline.

+0.25 Measures taken over a major portion of the species range have been shown to reduce bycatch of "threatened, endangered, or protected species" or bycatch rates are no longer deemed to affect the abundance of the "protected" bycatch species OR no measures needed because fishery is highly selective (e.g., harpoon; spear).

No measures are needed because the fishery is highly selective. Urchins are harvested via hand-picking or using urchin rakes.

+0.25 There is bycatch of targeted (e.g., undersize individuals) or non-targeted species in this fishery and measures (e.g., gear modifications) have been implemented that have been shown to reduce bycatch over a large portion of the species range OR no measures are needed because fishery is highly selective (e.g., harpoon; spear).

No measures are needed because the fishery is highly selective. Urchins are measured once picked, and as long as not damaged the undersized individuals can be placed back on the rock and will survive. In British Columbia about 10% of individuals are lost due to breakage (Muse, 1998).

+0.25 Bycatch of this species in other fisheries is low OR bycatch of this species in other fisheries inhibits its recovery, but effective measures are being taken to reduce it over a large portion of the range.

Bycatch of this species in other fisheries is generally low. However, studies have found that sea urchins in general suffer high mortality in fishing industries that use beam trawls (Kaiser and Spencer, 1995).

+0.25 The continued removal of the bycatch species in the targeted fishery has had or will likely have little or no impact on populations of the bycatch species OR there are no significant bycatch concerns because the fishery is highly selective (e.g., harpoon; spear).

There are no significant bycatch concerns because the fishery is highly selective.

4.00 Points for Bycatch
REFERENCES


