Pacific Razor Clam

Siliqua patula

Sometimes known as Pacific razor clam, northern razor clam, giant pod

SUMMARY

Pacific Razor Clams are found in shallow coastal waters from Alaska to central California. Pacific Razor Clams grow quickly, reaching sexual maturity around 2-4 years, and they can produce millions of eggs. They are caught in both commercial and recreational fisheries throughout their range. Fishermen dig for clams by hand, with shovels, or clam tubes. This fishing method is very selective, resulting in minimal to no bycatch, and causes little damage to bottom habitats. The abundance of Pacific Razor Clams varies from year to year, but the abundance in relation to target abundance conservation goals is not known.

Criterion	Points
Life History	3.00
Abundance	2.00
Habitat Quality and Fishing Gear Impacts	3.75
Management	2.50
Bycatch	3.75
Final Score	**3.00**
Color	

Final Score	Color
2.40 - 4.00	
1.60 - 2.39	
0.00 - 1.59	

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.

Pacific Razor Clams grow quickly and can reach a shell length of 160 mm (Jones et al. 2001). However, growth rates vary by location, being faster in the southern extent of the Pacific Razor Clam's range compared to more northern areas (Lassuy and Simons 1989). Growth rates can also vary among specific sites (ADFG 2010; Szarzi et al. 2010) and depend on the position of the clam within the intertidal zone, as this affects food availability (Tegelver 1964; Bourne 1969; Courne and Quayle 1970; Quayle and Bourne 1972). Growth is usually fastest during the warmer months, and then slows in the colder fall/winter months (Weymouth et al. 1925; Hirschorn 1962; Tegelberg 1964). Growth rates in Alaska are estimated to be k=0.58-0.59 (Hirschorn 1962).

All Pacific Razor Clams typically reach sexual maturity by around 100 mm (~4 in) in shell length (Weymouth et al. 1925). Because growth varies by location, the age at which sexual maturity is reached also varies by location (Weymouth et al. 1925; McMullen 1967). For example, in Washington and Oregon, sexual maturity is reached around 2 years, but not until 3-4 years in Alaska (Weymouth et al. 1925). There are also geographical differences in lifespan. In California, Oregon, and Washington the current life span of Pacific Razor Clams ranges from 5-7 years, but historically they were reported to live up to 11 years (Weymouth 1924; Weymouth et al. 1931; Nickerson 1975 Lassuy and Simons 1989). In Alaska, Pacific Razor Clams have been reported to live up to 18 years (ADFG 2013a).

Overall, Pacific Razor clams grow quickly, reach sexual maturity at an early age, and in most areas have a short lifespan. These life history characteristics make Pacific Razor Clams resilient to fishing and therefore a score of 3 is awarded.

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).

Pacific Razor Clams are found from Pismo Beach, California to the Aleutians Islands of Alaska (Lassuy and Simons 1989). Pacific Razor Clams are commonly found in the intertidal zones of beaches made up of fine, firm and damp sands; however some clams are found in the subtidal zone at depths up to 18 m (10 fathom) (McMillian 1924; Bourne 1969; Nickerson 1975; Richard et al. 1986; Link 2000). Because Pacific Razor Clams are restricted to one coastline, we consider this a small range and have therefore subtracted points.

-0.25 **Species exhibits high natural population variability driven by broad-scale environmental change (e.g. El Nino; decadal oscillations).**

Off the west coast of the US and Canada, it has been suggested that broad-scale environmental change may affect Pacific Razor Clam populations. For example, it has been suggested that large storms associated with El Niño events may have had an impact on Pacific Razor Clam populations in northern California in recent decades (CMLPAI 2009). As well, abundances of Pacific Razor Clams in Washington, Oregon and California declined after the 1982-83 El Niño (CDFG 2001). Climate change may also be impacting Pacific Razor Clam populations. Climate change may be one reason for the loss of older Pacific Razor Clams in Cordova, Alaska (Bishop and Powers 2003) and may also have contributed to declines of Pacific Razor Clams on Clatsop Beach, Oregon (Link 2000). However, because the link between broad-scale environmental change and the population size of Pacific Razor Clams is not fully understood and remains speculative, we have not subtracted points.

+0.25 **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).**

Pacific Razor Clams are able to quickly dig into sediment to avoid capture by both predators and fishermen. Their burrowing rate is one of the fastest of all bivalves (McLachlan et al. 1995). However, fishermen are still able to capture them with a variety of gears, so we have not added points.

+0.25 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).

Sexes are separate in Pacific Razor Clams and they are broadcast spawners, releasing their eggs in the water column (Weymouth et al. 1925). Fecundity or egg production has been estimated to range from 300,000 to 118 million eggs (McMillian 1924; Weymouth 1925; Nickerson 1975). Spawning typically occurs in the late spring and summer, although in some areas spawning can continue at lesser amounts throughout the year (Anonymous 2013). The Pacific Razor Clam is considered to have a high fecundity, so we have awarded points.

+0.25 Species is distributed over a very wide range (e.g., throughout an entire hemisphere or ocean basin; e.g., swordfish; tuna; Patagonian toothfish).

+0.25 Species does not exhibit high natural population variability driven by broad-scale environmental change (e.g., El Nino; decadal oscillations).

3.00 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.

Pacific Razor Clams contribute to recreational and commercial fisheries throughout their range. Commercial fisheries occur in Oregon, Washington, British Colombia, and Alaska. In California, commercial fishing is prohibited. Pacific Razor Clams are fished for both human consumption and for use as bait in other fisheries (Hunter 2008).

In Washington State, commercial fishing for Pacific Razor Clams has been occurring since 1900. Historically, commercial fishing occurred on several ocean beaches, but in the 1960's commercial State fisheries were limited to a single location Willapa Spits. However, the Quinault Indian Nation has treaty rights to commercial fish for Pacific

Razor Clams on several beaches in Washington State, including Copalis, Mocrocks and Pt. Grenville beaches. Commercial catches by the State fishery in Willapa Spits have been variable over time, but catches in the 2000's have generally been higher than catches in the 1980's and 1990's. From 2000 to 2010 catches ranged from a low of 8 t (17,474 lbs) to a high of 121 t (266,834 lbs). In 2011 and 2012, 85 t (186,856 lbs) and 60.5 t (133,444 lbs) of Pacific Razor Clams were caught, respectively (WDFW 2013a). The lower catches during 2012 were partly due to poor weather conditions during the fishing season (WDFW 2012c; 2013). Commercial catches by the Quinault Indian Nation (QIN) (converted from numbers to lbs. using 3.3 clams per pound) have ranged from 22.43 t (49,447 lbs.) to 135.8 t (299,358 lbs.) between 2000 and 2013 on Copalis beach and 0 t to 119 t (262,249 lbs.) on Mocrocks Beach (Anonymous 2013). There is also a large recreational fishery for Pacific Razor Clams in Washington State. Recreational fishing occurs on several beaches, including Copalis, Mocrocks, Twin Harbor, Long Beach, and Kalaloch. Catches by recreational fishermen during the 2011/2012 season were around 2.5 million clams (WDFW 2012a).

Abundance surveys to monitor Pacific Razor Clam populations in Washington are conducted by Washington State and the Quinault Indian Nation. Abundance of the Pacific Razor Clam naturally fluctuates from year to year and varies by beach. For instance, Mocrocks beach, which is co-managed by Washington State and Quinault Indian Nation, typically has the largest Pacific Razor Clam populations. In 2012, Pacific Razor Clam abundance on Mocrocks beach was the largest of all beaches and the largest over the past 16 years for that beach (WDFW 2012a). Abundance was also high on Copalis Beach, another co-managed beach. However, for some beaches, abundances were lower than the average abundance over of the past 16 years (WDFW 2012a). In the non-treaty commercial fishery in Willapa Spits, catch rates have been relatively stable over time, but have decreased slightly over the past eight years (2004-2012) (WDFW 2013).

There is a small commercial fishery for Pacific Razor Clams in Clatsop Beach, Oregon. From 2000 to 2011 catches in this fishery have been variable, ranging from 0.2 t (431 lbs.) to 17.8 t (39,340 lbs.) (NMFS 2013). During 2011, only 3.2 t (7,135 lbs.) were caught in the commercial fishery (NMFS 2013). In the recreational fishery, catches have varied from a low of 451,000 clams to a high of 1,916,000 clams over the past 10 years, with an average catch of 1,008,300 clams. During 2012, 824,000 Pacific Razor Clams were caught in the recreational fishery (ODFW 2012a). The abundance of Pacific Razor Clams in Clatsop Beach can vary greatly from year to year. Abundance estimates of the number of clams per meter square from 2004 to 2012 have ranged from a low of 0.17 clams per meter square to a high of 1.33 clams per meter square. In 2012, abundance was estimated to be 0.72 clams per meter square (ODFW 2013a). The last available population assessment was conducted in 2006, and at that time, the total Razor Clam population was estimated to be 5.37 million clams (Hunter 2008).

Alaska has had a commercial fishery for Pacific Razor Clams since the early 1900's in two principal areas: Cordova and Cook Inlet. Commercial catches where historically very high, reaching over 454 t (1 million lbs). In 1964, an earthquake occurred which negatively impacted the Cordova Pacific Razor Clam population. Today commercial

catches of Pacific Razor Clam are much less than historical levels, with commercial fishing occurring in Upper Cook Inlet. Over the past ten years (2003-2012), catches in the commercial fishery in Cook Inlet have ranged from 85 t (189,172 lbs) to 139 t (307,409 lbs) (Shields and Dupuis 2012; ADFG 2013c). Recreational fishers caught 356,685 and 435,855 Pacific Razor Clams in 2010 and 2011 respectively, primarily in the south central region (ADFG 2013b). Based on sampling programs conducted on the east side of Cook Inlet, Pacific Razor Clams populations are considered to be very healthy. For example, during 2005, 2.5 million clams were estimated at Ninilchik beaches and 3.6 million clams were estimated at Clam Gulch beach in 2008 (ADFG 2010). In addition, a large number of small Pacific Razor Clams were found at Ninilchik beaches during 2009, suggesting that the population is healthy, and successfully reproducing (ADFG 2010).

In British Columbia, Pacific Razor Clams, a shared resource with the Haida Nation, were historically caught for bait use in the crab fishery but have become more popular as a food product in recent years (PRCHNFOC 2012). Catches of Pacific Razor Clams (commercial, recreational and Haida non-commercial) have been variable over time due to both changes in market demand and abundance. Catches reached a record low in 2000 (20 t (44,090 lbs)) but a record high in 2008 (205 t (451,500 lbs)) (PRCHNFOC 2012). Currently catch limits are determined based on a maximum catch rate of 22% of the available population, but if abundance falls below 510 t (1,124,000 lbs) the catch rate is lowered; and no catches will be allowed if abundance falls below 255 t (496,000 lbs) (PRCHNFOC 2012). The estimated population size at the end of 2011 was 475 t, which was below the threshold level and therefore the catch limit for 2012 was reduced by 19% of available biomass to 87 t (192,000 lbs) (PRCHNFOC 2012).

We have awarded a medium score because the abundance of Pacific Razor Clams varies from year to year, and there no estimates of abundance in relation to target abundance reference points.

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).**

There have been changes to the age structure of Pacific Razor Clams over time. Surveys of Pacific Razor Clams at multiple sites in Alaska (Orca Inlet, Hinchinbrook Island and W. Cooper River Delta) between 2001 and 2002 indicated ages of 3-5.4 (Bishop and Powers 2003). However, during the 1950's, when fishing still occurred in these areas, the average age was 7-9 years (Nickerson 1975; Bishop and Powers 2003). In Rock Quarry, where fishing is popular, the largest proportion of Pacific Razor Clams in

2001/02 was 3.6 years, compared to 4.5 years in 1969 (Nickerson 1952; Bishop and Powers 2003). In addition, very few Pacific Razor Clams larger than 5.5 years were found during the 2001/02 survey but they were present during 1969 (Nickerson 1952; Bishop and Powers 2003). Previous research has suggested that in Washington and Oregon, the life span of Pacific Razor Clams was reduced from 11 years to 7 years over time due to increased fishing and higher natural mortality rates (Lassuy and Simons 1989). Because there is uncertainty/debate as to whether the changes in the age structure of Pacific Razor Clams were caused by fishing or natural forces, we have not subtracted points.

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

-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).**

The abundance of Pacific Razor Clams varies naturally over time. This is likely due to oceanographic and weather conditions, which impact reproductive success from year to year (Szarsi et al. 2010, WDFW 2012a). For example, catch rate data from five beaches recreationally fished for Pacific Razor Clams in Washington shows natural variations over time (WDFW 2012a). The catch per unit effort of Pacific Razor Clams in the non-treaty commercial fishery has been fairly stable over time but over the past eight years there has been a slight decrease, partly due to poor weather conditions during the commercial season (WDFW 2013). In Oregon, the estimated number of clams per meter square from 2004 to 2012 ranged from a low of 0.17 clams per meter square in 2010 to a high of 1.33 clams per meter square in 2008 (ODFW 2013b). In the British Columbia-Haida Nation commercial fishery, abundance doubled between 1994 and 2000, subsequently declining but remaining stable and near long term averages from 2004 to 2006. In 2007, good reproductive success led to high abundance levels, but abundance has subsequently declined some (PRCHNFOC 2012). We have not added points because abundance varies naturally from year to year.

+0.25 Age, size or sex distribution is functionally normal.

+0.25 Species is close to virgin biomass.

+0.25 **Current levels of abundance provide adequate food for other predators or are not known to affect the structure of the associated food web.**

Pacific Razor Clams, like other bivalves, are filter feeders, feeding on various algae in the water (Lassuy and Simons 1989). Seabirds, including seagulls, ducks, and sandpipers, Dungeness crabs, surfperch and other fish actively feed on Pacific Razor Clams (McMillian 1924; Tegelberg and Magoon 1969; Hogue and Carey 1982). Sea otters are

also major predators of adult Razor Clams (Kvitek and Oliver 1988). There is no information on whether the abundance levels of Pacific Razor Clams are sufficient or not to provide food to predators so we have not added points.

2.00 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).

Pacific Razor Clams were historically principally caught in commercial fisheries, but today more are caught in recreational fisheries (Lassuy and Simons 1989). Commercial and recreational fisheries exist in Washington, Oregon, Alaska, and British Columbia, while in California only recreational fishing occurs. Fishermen dig for Pacific Razor Clams by hand, with hand shovels or clam tubes (except in Oregon); mechanical methods are not used (Hunter 2008; ADFG 2010; PRCHNFOC 2010; WDFW 2012d; ODFW 2012b; ODFW 2013c).

In Washington, there are 50-100 fishers or ‘clam diggers’ in the Pacific Razor Clam State commercial fishery. They fish in only one location, Willapa Spits (WDFW 2012c). Members of the Quinault Indian Nation also commercially fish for Pacific Razor Clams in Washington State off of Copalis, Mocrocks and Pt. Grenville beaches and are the largest commercial fishery on the coast (Anonymous 2013). Recreational fishers fish in five locations, Long Beach, Twin Harbors, Copalis, Mocrocks, and Kalaloch (WDFW 2012a). In Oregon, 90% of Pacific Razor Clams are caught on Clatsop Beach, which is the only beach clams can be fished and sold for human consumption (Hunter 2008; ODFW 2013b). In Alaska, most fishing for Pacific Razor Clams occurs in Upper Cook Inlet, with commercial fishing occurring on the west side and recreational fishing on the

east side (ADFG 2010; ADFG 2013a; Shields and Dupuis 2012). There are two major Pacific Razor Clam populations in British Columbia that are fished, North Beach in Haida Gwaii (the largest) and at Long Beach on the west coast of Vancouver Island (Bourne 1969; FOC 2009).

We have awarded a high score because clam digging causes little damage to bottom habitats.

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.**

Pacific Razor Clams are commonly found on beaches were water moves quickly and continuously over clam beds, aiding in the delivery of oxygen (Browning 1980). Populations of Pacific Razor Clams are densest in lower intertidal zones (McMillian 1924; Bourne 1969; Nickerson 1975), but are also found in subtidal areas and have been reported at depths of up to 18 m (10 fathom) (McMillian 1924; Richard et al. 1986; Link 2000). Specifically, larval Pacific Razor Clams are found in fine, firm and damp sands of the intertidal zone and during this phase they are still able to move small distances (30 cm) laterally (Bourne and Quayle 1970). Juveniles are found in larger quantities in the lower section of the intertidal zone (McMillan 1924; Rickard et al. 1986), while adults are typically found 30.5 cm (1 ft) below the surface of the lower intertidal zone, and while they can no longer move laterally they can move vertically very quickly (McMillian 1924; Bourne 1969).

Activities such as dredging near Pacific Razor Clam beds can increase the amount of silt in the sand and negatively impact recently settled Pacific Razor Clams (Nickerson 1975). In Oregon studies have shown that Pacific Razor Clams can survive a range of burial depths resulting from dredging when materials are disposed of once in single locations (Vavrinec et al. 2007). However, when multiple disposals were made over a short time

period in the same location, mortality of Pacific Razor Clams increased (Vavrinec et al. 2007). Winter storms, beach erosion, and presence of rain water on beaches, can also impact Pacific Razor Clam populations (McMillian 1924; Tegelberg and Magoon 1969; Bourne and Quayle 1970; Link 2000). In addition, Pacific Razor Clams can contain three biological toxins, Paralytic Shellfish Poisoning (PSP), Dinophysis (DSP), and Domoic Acid (DA) and these toxins can be harmful to humans (Hunter 2008). These toxins are monitored by individual state agencies and tribes, and beaches are closed to fishing once toxin levels reach a certain threshold (i.e. Hunter 2008).

The current status of Pacific Razor Clam habitat throughout its range is uncertain, so we have not added points.

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

There are many areas closed to Pacific Razor clam fishing throughout their range. In Washington, there are Pacific Razor Clam sanctuaries that include ¼ miles sections of coastal ocean beaches in each: Copalis Beach, Twin Harbors and Long Beach (WDFW 2012c,d). In addition, the fishing season is closed (state and tribal) during the primary summer spawning period, June to September. The State commercial fishery in Wilapa Spits only occurs from May 1 to June 20; during the rest of the year fishing is not allowed in this area (WDFD 2012d,e).

In Oregon there is a closed Pacific Razor Clam season from July 15 through September 30 north of Tillamook Head in Clatsop County. No clams can be taken commercially in Little Nestucca Bay, Big Nestucca Bay, Netarts Bay, Salmon River and Bay, Siletz River and Bay or within state parks south of Tillamook Head or the Shellfish Preserve in Yaquina Bay (ODFW 2013d). In addition, shellfish, including Pacific Razor Clams, cannot be taken from certain areas in the Marine Garden, designated Intertidal and Subtidal Research Reserves, designated Habitat Refuges, within 300 m (1000 ft.) of Pyramid Rock from May through August, or within 150 m (500 ft.) of the main rock in Three Arch Rocks National Wildlife Refuge from May through September 15 (ODFW 2013d).

In Alaska there are some areas that are completely closed to Pacific Razor Clam fishing such as Sitka Sound (Shields and Dupuis 2012; ADFG 2013d).

In British Columbia, commercial Pacific Razor Clam fishermen are restricted to a single license area and recreational fishermen are restricted to certain areas as well (PRCHNFOC 2012).

In California, there are a number of Marine Protected areas that provide different levels of protection. Specifically, the Pyramid Point state marine reserve, which runs from the Oregon border to Smith River, protects a number of species including Pacific Razor Clams. In addition, the South Humboldt Bay state marine conservation area restricts fishing for clams in the intertidal area (NRO 2010).

We have awarded points to account for the variety of time and area closures in place to protect Pacific Razor Clams.

+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.

No gear modifications are needed because the effects of clam digging on bottom habitats 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 are minimal so we have awarded points.

3.75 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.

Management measures are in place throughout the Pacific Razor Clams' range. For Washington State's commercial fishery in Willapa Spits, there is a six week season that is open access. The opening of the season depends on when the recreational fishery ends, biotoxin levels and tides (WDFG 2012c). A license is needed for fishing (WDFW 2012c, e). Recreational fishing occurs on Long Beach, Twin Harbors, Copalis, Mocrocks, and Kalaloch beaches (WDFW 2012a). Several of these beaches are co-managed with the Quinault Indian Nation, which has been guaranteed 50% of all catch in their usual and accustomed fishing grounds since the Boldt Decision in 1974. The Quinault Indian Nation commercially fishes for Pacific Razor Clams in Washington on Copalis,

Mocrocks, and Pt. Grenville beach (Anonymous 2013). Copalis and Mocrocks are co-managed beaches while Pt. Grenville beach is managed solely by the Quinault Indian Nation (WDFG 2012a, Anonymous 2013). Joint population assessments are conducted annually to determine the total allowable catches on co-managed beaches. Total allowable catches (TAC) are set at 30% of the total number of clams over 7.6 cm (3 in), and are split 50/50 between the Quinault Indian Nation and Washington State. Kalaloch Beach is also a co-managed beach between Washington State, the Quinault Indian Nation, and Hoh Tribe. On this beach, the State gets 50% of the total allowable catch and Quinault Indian Nation, and Hoh Tribe each get 25% (Anonymous 2013). For the recreational fisheries, there also gear restrictions, daily limits and closed areas (WDFW 2012d). The Tribal fisheries and recreational fisheries are conducted and managed so as not to interfere with each other (WDFW 2012a).

In Oregon, special permits are required in the commercial fishery to take Pacific Razor Clams and there is a minimum size of 9.5 cm (3-3/4 in) (ODFW 2013d). Commercial inter-tidal fishermen are required to be licensed, complete logbooks, and there are gear restrictions, area restrictions, handling requirements and closed seasons (ODFW 2013d). There is a daily limit and gear restrictions in the recreational fishery (ODFW 2013c).

In Cook Inlet, Alaska the recreational Pacific Razor Clam fishery is managed by the Alaska Department of Fish of Game (ADFG 2010). Recreational fishers must hold licenses, there is a daily limit on the east side of Cook Inlet and in some other areas there are also daily limits and size limits (ADFG 2010; ADFG 2013d,e). During the season, fishery managers can open/close fisheries based on current biological information, fishery performance, and personal judgment (ADFG 2013a). In the commercial fishery, fishermen are restricted to areas approved for taking clams for human consumption, and while there are no catch limits, managers try to keep catches below 158-181 t (350,000-400,000 lbs) (Shields and Dupuis 2012).

In British Columbia, Canada, there is a joint management plan between the Haida Nation and Fisheries and Oceans Canada for Pacific Razor Clams (PRCHNFOC 2012). For the commercial fishery, there is a size limit of 90 mm (3.5 in), seasons, area restrictions, limited entry license system, and catch limits. Currently catch limits are determined based on a maximum catch rate of 22% of the available population, but if abundance falls below 510 t (1,124,000 lbs) the catch rate is lowered; and no catches will be allowed if abundance falls below 255 t (496,000 lbs) (PRCHNFOC 2012). Each year the Haida Nation selects individuals who can participate in the commercial fishery. Recreational fishermen must have a valid license, there is a daily limit of 50 clams and a possession limit of 100 clams. In addition, recreational fishermen are urged to respect the 90 mm commercial size limit (PRCHNFOC 2012). The Haida non-commercial fishery does not have any daily/possession limits but is also urged to respect the commercial size limit (PRCHNFOC 2012).

Although management measures are in place throughout the Pacific Razor Clam's range, conservation and sustainability targets have not been determined in all areas. Therefore, a score of 2 is awarded.

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.

Points of Adjustment (multiple selections allowed)

-0.25 There is inadequate scientific monitoring of stock status, catch or fishing effort.

-0.25 Management does not explicitly address fishery effects on habitat, food webs, and ecosystems.

-0.25 This species is overfished and no recovery plan or an ineffective recovery plan is in place.

-0.25 Management has failed to reduce excess capacity in this fishery or implements subsidies that result in excess capacity in this fishery.

+0.25 There is adequate scientific monitoring, analysis and interpretation of stock status, catch and fishing effort.

In Washington, the total allowable catch limit for the State recreational and Tribal fisheries is determined through annual population assessments, made using the "Pumped Area Technique" for each of the five managed beaches (WDFW 2012a). All five management areas are surveyed each year between May and September during which time clams are counted and measured and catch data is monitored during the season to ensure the fishery remains below the total allowable catch (WDFW 2012a). In the state commercial fishery, catch rates are monitored to estimate clam abundance (WDFW 2012c).

In Oregon, monitoring of the commercial fishery at Clatsop beaches, where 90% of the fishery effort for Pacific Razor Clams occurs, has been conducted by the Oregon Department of Fish and Wildlife since 1935 (Hunter 2008). Monitoring of the recreational fishery has been ongoing since 1955 (Hunter 2008). Monitoring includes sampling, interviews with fisherman (effort, catch, age composition and harvest area), age and length analysis, how many clams are wasted due to breakage during harvesting, tests for biological toxins, and abundance estimates (Hunter 2008).

In Alaska, the recreational fishery is monitored by looking at the age and size of clams, estimating fishing levels from individual beaches, and estimating the number of clams on the two beaches with the largest populations (Clam Gulch and Ninilchik) (ADFG 2010). The amount of Pacific Razor Clams taken by recreational fishermen is estimated from fishermen surveys, along with aerial surveys that are used to count the number of fishermen or diggers on different beaches (ADFG 2010). The number of clams on a beach are estimated by using water pumps and calculating the average number of clams in a sample, which is then expanded to the total beach area (ADFG 2010).

In British Columbia, the Haida Fisheries Program has been doing beach surveys to check the health of Pacific Razor Clams since 1994 and assessments have been conducted on a beach-by-beach basis since 2001 (PRCHNFOC 2010). Annual catch limits are determined prior to the start of the season based on the current abundance level. Information on fishing and catches is reported by beach (PRCHNFOC 2012).

We have awarded points because in the majority of areas there is adequate scientific monitoring of Pacific Razor Clam populations.

+0.25 Management explicitly and effectively addresses fishery effects on habitat, food webs, and ecosystems.

+0.25 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.

There is no indication that Pacific Razor Clams are overfished, so a recovery plan is not needed. Points are thus added.

+0.25 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.

2.50 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."

Pacific Razor Clams are collected by hand, hand shovel and clam tube This type of fishing method is very selective and results in minimal bycatch of other species. Pacific Razor Clams may be discarded or reburied when they are below a certain size limit, but, in most locations, fishermen are required to keep all of the clams dug regardless of size and condition (i.e. if they are broken) (i.e. WDFW 2012d; ADFG 2013d; ODFW 2013c). There is little to no bycatch associated with clam digging and there are no interactions with threatened, endangered or protected species, so we have awarded a high score.

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).

Measures are not needed because this fishery is highly selective so we have added points.

+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).

Pacific Razor Clams may be discarded or reburied when they are below a certain size limit. Discarded clams are more susceptible to predators or may die due to injuries sustained during the fishing process. It has been estimated that as much as 80% of clams that are discarded have major damage and even minor damage has been shown to reduce survival rates by 50% (Link 1979; Link 2000). However, in most locations, fishermen are required to keep all of the clams dug regardless of size and condition (i.e. broken) (i.e. WDFW 2012d; ADFG 2013d; ODFW 2013c).

We have added points because this fishery is highly selective and there are no significant bycatch concerns.

+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.

+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 Pacific Razor Clam fishery is highly selective, so we have awarded points.

3.75 Points for Bycatch

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