

Rockfish Recovery in the Southern Salish Sea: Are Conservation Areas Impacted by the Proximity of Cargo Ship Anchorages?

EXECUTIVE SUMMARY

Rockfish populations in the northwestern Pacific have been severely overharvested and have declined. Once an important commercial fishery and valuable traditional harvest for First Nations, some species are now recognized as endangered and threatened by COSEWIC (Committee on the Status of Endangered Wildlife in Canada).

Recovery efforts have given priority to reducing fishing mortality. Since 2004, 162 Rockfish Conservation Areas (RCAs) have been established in BC with the purpose of limiting fishing activity. However, RCAs are vulnerable to habitat degradation.

Little attention has been given to environmental factors that are changing rapidly with human influence. Nevertheless, such factors may limit the recovery of these long-lived fish that live in sensitive marine habitats. Recent studies have found that Rockfish Conservation Areas along the major shipping routes in the Salish Sea are exposed to noise impact from marine traffic and risks of pollution.

Some rockfish species form genetically unique populations in the Salish Sea. Over half of the RCAs in the southern Salish Sea are located in the Southern Gulf Islands. This area is of rare biodiversity but in recent years has experienced a massive increase in use by cargo ships anchoring in the immediate vicinity of RCAs. The result is a large number of new impacts, of which we are listing some as threats to rockfish.

A conservation strategy may only succeed if a large number of RCAs can be isolated from impacts of marine traffic and anchorage impacts. The elimination of cargo ship anchorages from the Southern Gulf islands could be achieved by applying efficient marine traffic management technology as is practiced by other ports worldwide.

The Southern Gulf Islands may be the only place in the Southern Salish Sea where separation of a large number of RCAs from marine shipping and anchorages is possible. Rockfish Recovery in the Southern Salish Sea may require such steps to achieve the objective of the management plan under SARA (Species at Risk Act).

BACKGROUND

Inefficient marine traffic management by the Vancouver Fraser Port Authority has resulted in cargo ships being directed to anchor in environmentally sensitive areas. Thirty-three such anchorage sites are located among the ecologically sensitive Southern Gulf Islands of British Columbia, which is home to some 300 species at risk and

which has been proposed for designation of a National Marine Conservation Area.¹ The past decade has seen an annual increase in anchorage days from 1,000 to 6,000, and individual ships may anchor for weeks at a time. Gulf Islands anchorages are in close proximity to Rockfish Conservation Areas established to protect marine life and habitat,² as seen in Figure 1.

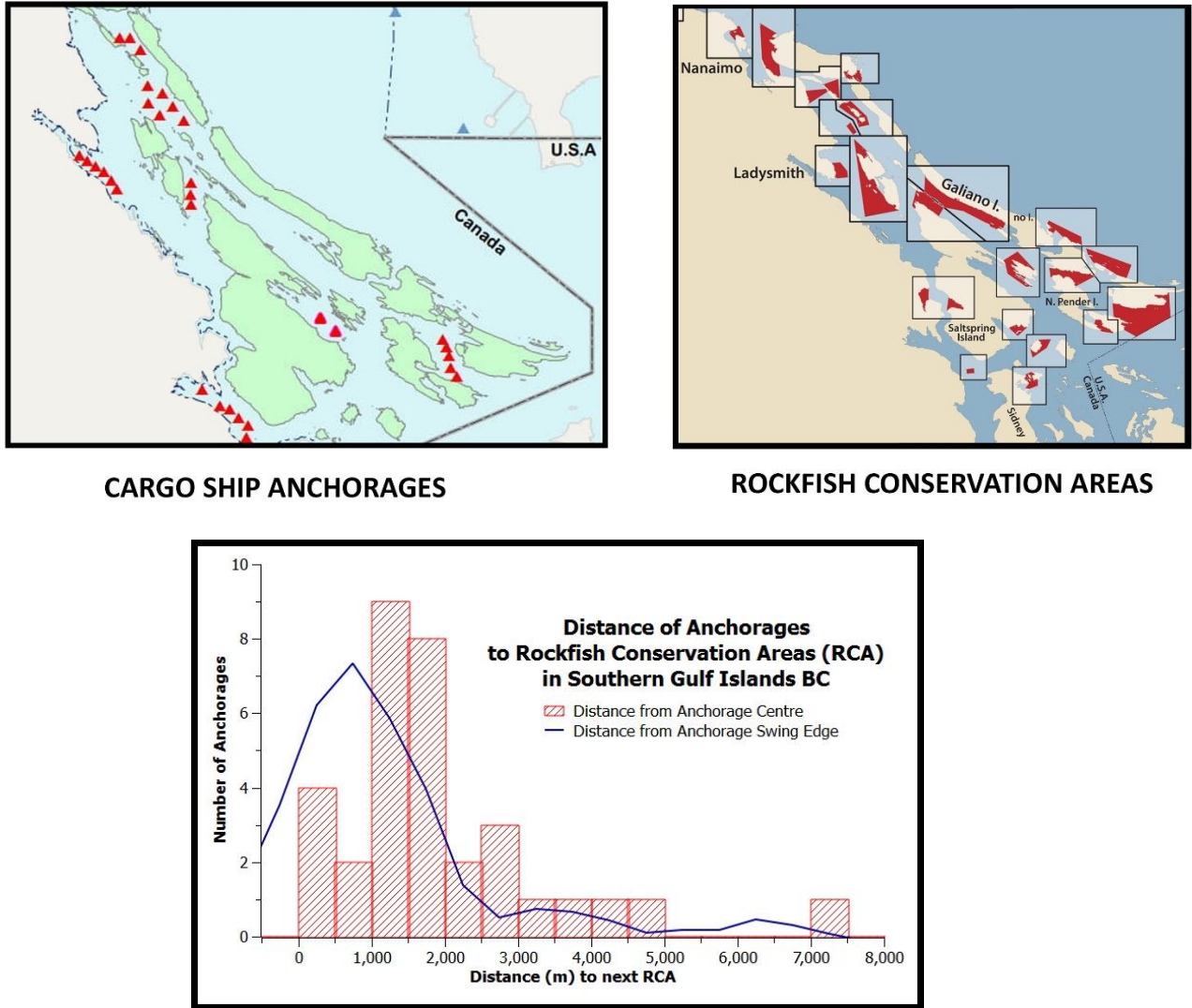


Figure 1. Proximity of cargo ship anchorages to Rockfish Conservation Areas among the Southern Gulf Islands.
 (Source: Protect the Islands Sea, and Fisheries and Oceans Canada, Centre for Marine Affairs)

ROCKFISH AT RISK

Thirty-six species of rockfish inhabit the coast of British Columbia and are important to recreational and commercial fisheries and are of cultural significance to indigenous communities, for which historically rockfish formed a substantial food source and their bones and spines were used as cutlery and hardware.

A rockfish species inhabiting waters of the Southern Gulf Islands that is listed as of **Special Concern** under Schedule 1 of the Species at Risk Act is the **Yelloweye Rockfish** (*Sebastes ruberimus*). The Yelloweye is also listed as **Threatened** by the Committee on the Status of Endangered Wildlife in Canada (as is the Quillback Rockfish of the Southern Gulf Islands).

Rockfish can be long-lived (100+ years) but with a low recruitment rate, as they are late to mature. Rockfish are vulnerable to overfishing and to habitat destruction, as they may show strong fidelity to a particular site.³ Yelloweye Rockfish in the Southern Gulf Islands belong to a Salish Sea population that is genetically unique and of high conservation value.⁴ Like other rockfish species, they have a closed swim bladder, and therefore suffer barotrauma when fished from deep water, so catch-and-release fishing methods do not aid conservation of bycatch.



Figure 2. *The Yelloweye Rockfish may live to 100+ years but is vulnerable to diminishing habitat quality.*
(Image: Oregon Department of Fish and Wildlife)

Yelloweye larvae may drift in open water for months after birth, feeding on invertebrate larvae and eggs and dispersing among the network of Rockfish Protection Areas. Juvenile rockfish settle near the seabed and continue to feed on invertebrates such as crustaceans, then shifting to fish. Preferred habitats are rocky outcrops, ridges, and crevices. Small rockfish are vulnerable to predation from larger fish and from marine birds. Yelloweye Rockfish prefer habitats that are rocky and complex, with caves and crevices, but have been observed inhabiting muddy/sandy seabed conditions.^{5 6}

ROCKFISH CONSERVATION AREAS

Rockfish Conservation Areas are map units set aside to protect rockfish and their habitat, with limits to the extent of ocean harvesting. They conserve not just rockfish species, but a wide spectrum of biodiversity. Species recorded within BC Rockfish Conservation Areas include some 90 kinds of fish and 75 kinds of invertebrates.⁷ Rockfish thus act as “umbrella” species, in that protection of rockfish affords protection to many other species. Also, a wide range of life forms benefit from the protection afforded to corals and sponges, as they are habitat-forming species.

THREATS TO ROCKFISH FROM ANCHORAGE PROXIMITY

Anchorage threats to rockfish health and habitat include prolonged bouts of generator noise from idle ships, repeated anchor chain abrasion of the seabed, light pollution, discharge of contaminants, release of invasive species, local ocean acidification from exhaust gases, and fuel spills from groundings and collisions.

The Species at Risk Act Section 65 management plan for the Yelloweye Rockfish⁸ (listed as a “species of special concern”) does not include cargo ship anchorage as a threat. It does not mention prolonged exposure of fish to

noise, repeated chain scour of the seabed, light pollution, or focal ocean acidification. As to chemical contamination in general, the plan states that the impact is “unknown.”

Noise Pollution: Effects on Fish Behaviour and Population Health

Anchored ships require constant power for lighting, instrumentation, ventilation, heat and sometimes refrigeration. This necessitates operation of noisy diesel generators for hours at a time. Recordings at Cowichan Bay revealed a 2.5 x increase in median sound pressure level from a vessel anchored at a distance of 700 m.⁹

Noise impacts on fish may include physiological stress, masking of fish communication, increased predation vulnerability, avoidance migration, and masking of environmental acoustic signatures used in habitat selection.^{10 11} The observed frequency bandwidth of rockfish communication sounds of less than 800 Hz¹² overlaps the spectrum of ship generator noise (Figure 3).

Measurements of noise at Salish Sea Rockfish Conservation Areas remote from the Southern Gulf Islands anchorages have demonstrated intermittent noise pollution^{5b} from passing marine traffic that may “impact rockfish recovery”. The acoustic environment of Rockfish Recovery Areas the Southern Gulf Islands would be expected to more severe, as noise from a single anchored vessel may be broadcast continuously for long periods of time from onboard generators, and from a vessel that may remain at anchor for weeks.

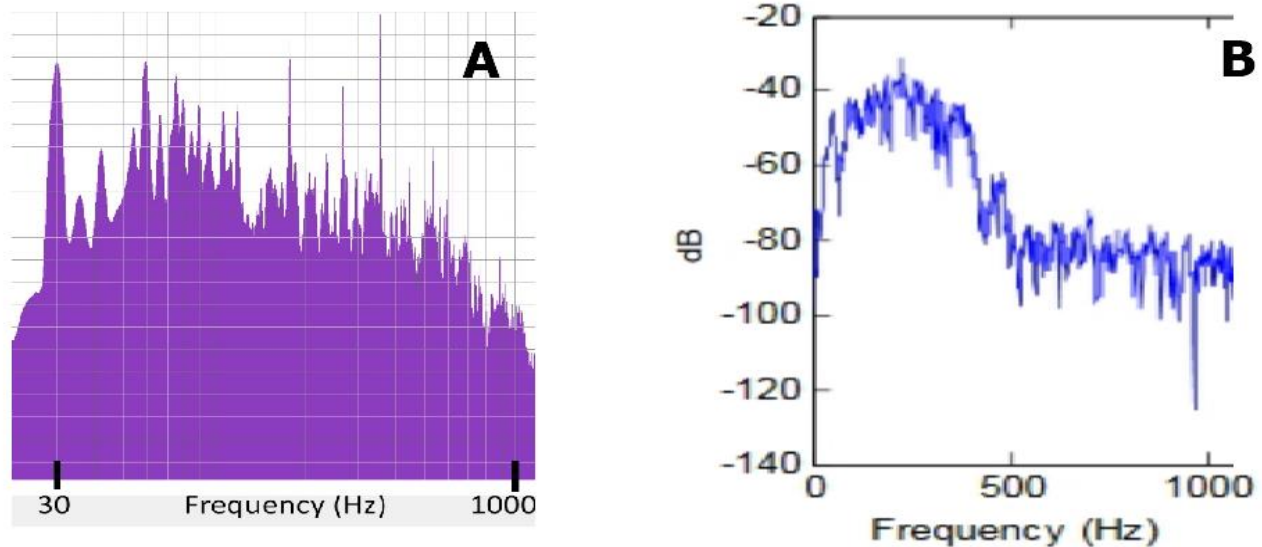


Figure 3. A: Frequency spectrum of ship generator noise recorded at a distance of 1500 m. (Source: Centre for marine Affairs); **B: Frequency spectrum of rockfish vocalizations** (*Sebastes nebulosus*) at Vancouver Island (Source: Nichols B. 2005. *Characterizing Sound Production in Nearshore Rockfishes (Sebastes spp.)*. Master's Thesis, University of South Florida.)

Seabed Abrasion and Release of Contaminants Trapped in Sediment

Recent research¹³ has shown extensive scouring of the seabed by cargo ship anchors and anchor chains in the Southern Gulf Islands. Anchor chain scouring may create sediment plumes, destroy habitat, and mobilize contaminants.

Sediment plume drift can progressively degrade rocky habitat crevices used by rockfish, it can impair vision and feeding by aquatic organisms, and intermittently reduce dissolved oxygen levels.¹⁴

Seabed scouring may mobilize entrapped contaminants such as lead, mercury, PCBs, and pesticides, which then enter food chains, leading to bioaccumulation in rockfish. Salish Sea sediments are vulnerable to contamination from the Fraser River, from marine traffic, and from historic industrial discharge from communities such as at Crofton and Nanaimo. Rockfish sampling has shown contamination of tissue.¹⁵

Although anchor deployment may avoid rugose habitat preferred by rockfish, anchor chain scouring may destroy nearby benthic ecosystems on which rockfish depend for food, as they are opportunistic feeders with a wide-ranging diet. But rockfish may also experience direct habitat destruction, as they are known to inhabit areas of muddy and sandy bottom, which is ideal for anchoring.¹⁶ Seabed degradation has been associated with a decline in rockfish numbers.¹⁷

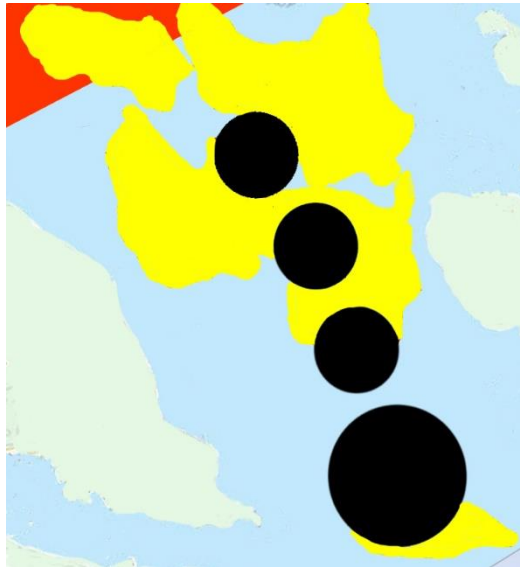


Figure 4. Seabed anchor chain abrasion zones (yellow) overlapping Rockfish Conservation Area (red) at Plumper Sound in the Southern Gulf Islands, showing four current anchorages (black), of nine different anchorages used at Plumper Sound over the years.

(Schematic based on Natural Resources Canada open government licence data and resources, Douglas, K., 2023. *British Columbia coastal anchor marks*. NRCan: Natural Resources Canada.)

Light Pollution: Disturbance of Biological Processes

Anchored ships may employ considerable deck lighting despite a Transport Canada “interim protocol”¹⁸ requesting anchored ships to have minimal lighting and to aim deck lights downward (Figure 3).

Light pollution is considered to be “an urgent concern for marine ecosystems because marine organisms have tight relationships with their natural light environment,”¹⁹ and light pollution effects can “reverberate on entire communities through trophic and non-trophic interactions.”²⁰

Light pollution may impact behaviour and reproduction of rockfish prey species, and it is possible that light pollution impacts rockfish directly. Yelloweye Rockfish vertical migration and preferred depths may vary with season and time of day.²¹ If light penetration is used as a migratory cue, artificial lighting from ships may disrupt this behaviour.



Figure 5. *Lighting from an anchored ship may impact marine ecology.*

Effluent Pollution from Daily Ship Operations

The average cargo ship at anchor emits some 10 tonnes of greenhouse gasses per day²² (Figure 4), which can contribute locally to ocean acidification,²³ which can have multiple consequences to marine ecosystems, and which has been shown to alter rockfish behaviour.²⁴

Other sources of ocean contamination from anchored ships include discharge of ballast water, bilge water, and scrubber water. Scrubber water contributes carcinogenic hydrocarbons and many tonnes of heavy metals²⁵ such as cadmium, copper, mercury, and nickel to BC coastal waters.^{26 27} Collisions and groundings may result in catastrophic fuel spills. Since 2015, there have been 102 reports of anchor dragging along our BC coastline.²⁸



Figure 6. *GHG emissions may contribute to local ocean acidification.*

MANAGEMENT IMPLICATIONS: CONSIDERING EFFECTS OF MARINE SHIPPING

The Species at Risk Act requires preparation of a management plan for Yelloweye Rockfish. The existing plan includes a table of threats, but does not evaluate the impact of cargo ship anchorage proximity to rockfish habitat. The plan acknowledges pollution and habitat degradation as threats, but ranks the evidence availability as medium to low. However, ongoing research indicates that cargo ship anchorages may facilitate convergence of a spectrum of threats in rockfish habitat at a high intensity and long duration, and research has emphasized that “the fundamental attribute that will determine the success of any RCA [Rockfish Conservation Area] is the quality of habitat they contain.”²⁹

The Southern Gulf Islands has been proposed by Fisheries and Oceans Canada for designation as an Environmentally and Biologically Significant Area (EBSA),³⁰ and the island waters have been proposed as a National Marine Conservation Area Reserve. A prudent rockfish conservation strategy in application of the Species at Risk Act to rockfish conservation would involve closure of the Southern Gulf Islands anchorages as provided under subsection 136(1) of the Canada Shipping Act.³¹

Southern Gulf Islands cargo ship anchorages would **not** be needed by the Vancouver Fraser Port Authority if it were required by Transport Canada to adopt an efficient digitized vessel arrival management system as used at other ports worldwide. The port has recently been ranked second to last in efficiency of 348 ports worldwide, with “some of the world’s longest vessel wait times.”²¹ The federal ministries of Transport, Fisheries, Environment, Parks, and Indigenous Relations could then honour their mandates for environmental protection, and the “measures for the conservation of the species,” required by section 65 of the Species at Risk Act to be in the management plan, would be significantly improved.

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