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RISK ASSESSMENT OF PERMITTED HUMAN ACTIVITIES IN ROCKFISH CONSERVATION AREAS IN BRITISH COLUMBIA

Yelloweye Rockfish (Sebastes ruberrimus). Credit: Terri Bonnet (Fisheries and Oceans Canada)

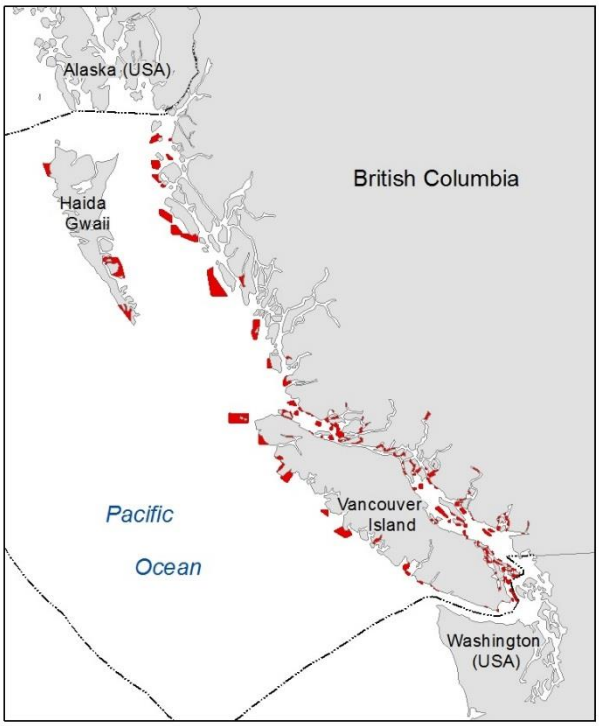

Figure 1: Map of Rockfish Conservation Areas, British Columbia, Canada.

Context:

The Government of Canada committed to reaching domestic marine conservation targets of protecting 10% of Canada's marine and coastal areas by 2020 through marine protected areas (MPAs) and other effective area-based conservation measures (OEABCMs).

Rockfish Conservation Areas (RCAs) in Pacific marine waters were established between 2003 and 2007, to protect inshore rockfish populations from fishing activity and allow stocks an opportunity to rebuild. Currently, there are 164 RCAs covering approximately 4,800 square kilometres. This paper describes whether RCAs contribute to the marine conservation targets as OEABCMs by evaluating the RCAs against the "Operational Guidance for Identifying Other Effective Area-Based Conservation Measures in Canada's Marine Environment" (DFO 2016).

This Science Advisory Report is from the December 12-14, 2018 and May 2-3, 2019 regional peer review on the Risk Assessment of Permitted Human Activities in Rockfish Conservation Areas in British Columbia. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Canada

SUMMARY

- Between 2003 and 2007, 164 Rockfish Conservation Areas (RCAs) were established. A number of fishing activities were not permitted in RCAs at the time of implementation. Commercial and recreational fisheries that were considered a low risk of causing rockfish mortality are permitted, as are First Nations' rights to fish for food, social, and ceremonial (FSC) purposes, and select commercial and recreational fisheries. This review focuses on only currently permitted human activities within RCAs.
- The focus of this review was to determine whether current management measures (i.e. permitted activities) within RCAs inhibit these areas from achieving their conservation objectives and whether RCAs could be considered as other effective area-based conservation measures (OEABCMs).
- OEABCMs are area-based management measures that provide one or more biodiversity conservation benefits. Current DFO guidance identifies five criteria for area-based management measures to be considered OEABCMs: 1) clearly defined geographic location; 2) conservation or stock management objectives; 3) presence of ecological components of interest; 4) long-term duration of implementation; and, 5) ecological components of interest are effectively conserved.
- RCAs were reviewed to determine if the areas met the first four criteria above. To determine if RCAs met the fifth criterion (ecological components of interest effectively conserved), a Level 1 qualitative risk assessment was conducted using a modified version of the Ecological Risk Assessment Framework (ERAF; O et al. 2015).
- The ERAF is an assessment tool that evaluates those permitted activities that may affect the significant ecosystem components (SECs) of RCAs (Inshore Rockfish, inshore rockfish prey, and rocky reef habitats) and assesses the relative risk of harm of those activities and associated stressors, but does not identify levels of acceptable risk or set thresholds.
- This risk assessment addressed currently permitted activities within RCAs to assess the risk of harm across RCAs to inshore rockfish population but did not assess the risk of harm to individual RCAs nor did it identify acceptable levels of risk. This risk assessment could not assess the following permitted activities due to data limitations: Food, Social and Ceremonial (FSC) fishing (except FSC dual fishing groundfish hook and line), and recreational fishing.
- The risk assessment identified eight permitted activities with the potential to prevent RCAs from meeting OEABCM criterion 5: outfalls, commercial crab fishing by trap, coastal infrastructure, oil spills, commercial prawn and shrimp fishing by trap, FSC dual fishing groundfish hook and line, movement and storage of logs, and finfish aquaculture.
- Overall, this review found that RCAs collectively meet OEABCM criteria 1, 2 and 3; whereby criteria 4 needs further work to be met. Further work is also required for criterion 5.
- Recommendations from this peer review process included the development of a management strategy and monitoring plan for the RCA network, which includes ecological indicators, baseline monitoring, catch reporting as well as compliance metrics. To determine risk on a scale of individual RCAs, future risk assessments may be required.

INTRODUCTION

In 2010, the Government of Canada committed to conserving at least ten percent of Canada's coastal and marine areas through protected areas and other effective area-based conservation measures (OEABCM) by 2020. To achieve this goal, Canada has implemented area-based management measures, which are spatially defined management measures that provide one or more biodiversity conservation benefits and meet Fisheries and Oceans Canada's (DFO) *Operational Guidance for Identifying 'Other Effective Area-Based Conservation Measures' in Canada's Marine Environment* (Fisheries and Oceans Canada 2016). In order for a management measure to be considered an OEABCM it must meet the following five criteria:

1. Clearly defined geographic location;
2. Conservation or stock management objectives;
3. Presence of ecological component of interest;
4. Long-term duration of implementation; and
5. Ecological components of interest are effectively conserved.

In 2016, an evaluation of Rockfish Conservation Areas (RCAs) was conducted to determine if they met the five criteria above to be eligible as an OEABCM. At that time, the preliminary analysis suggested that RCAs met criteria one through four but that further work was needed to determine whether they would meet criterion five. The focus of this current assessment was to determine whether current management measures (i.e. permitted activities) within RCAs inhibit these areas from achieving their conservation objectives and whether RCAs could be considered OEABCMs.

RCAs are area-based management measures established between 2003 and 2007 by DFO with the goal to protect Inshore Rockfish populations from fishing activity to allow for rebuilding of Inshore Rockfish stocks. Activities that pose a moderate to high risk to rockfish mortality were prohibited while activities that were considered to pose a low risk were permitted. Prohibited fisheries included, but were not limited to, recreational and commercial hook-and-line, commercial longline, commercial shrimp and groundfish bottom trawl, recreational and commercial salmon trolling, commercial Sablefish trap, and recreational spearfishing.

The primary goal of RCAs is the long-term protection and conservation of a portion of Inshore Rockfish populations and their habitat (Yamanaka and Logan 2010). There are currently 164 RCAs that cover 4,819 square kilometres, which were implemented under the *Fisheries Act* by Variation Order for fisheries management measures (Figure 2).

Inshore Rockfish inhabit nearshore areas in shallow depth ranges (0 to 200 metres) with high-relief rocky habitat (Frid et al. 2018; Love et al. 2002), kelp forests (Love et al. 2002), glass sponge reefs (Dunham et al. 2018) and juveniles inhabit eelgrass beds (Love et al. 2002). There are eight species of Inshore Rockfish in the Canadian Pacific: Yelloweye Rockfish (*Sebastes ruberrimus*), Quillback Rockfish (*S. maliger*), Copper Rockfish (*S. caurinus*), Black Rockfish (*S. melanops*), Tiger Rockfish (*S. nigrocinctus*), China Rockfish (*S. nebulosus*), Deacon Rockfish (*S. diaconus*), and Brown Rockfish (*S. auriculatus*).

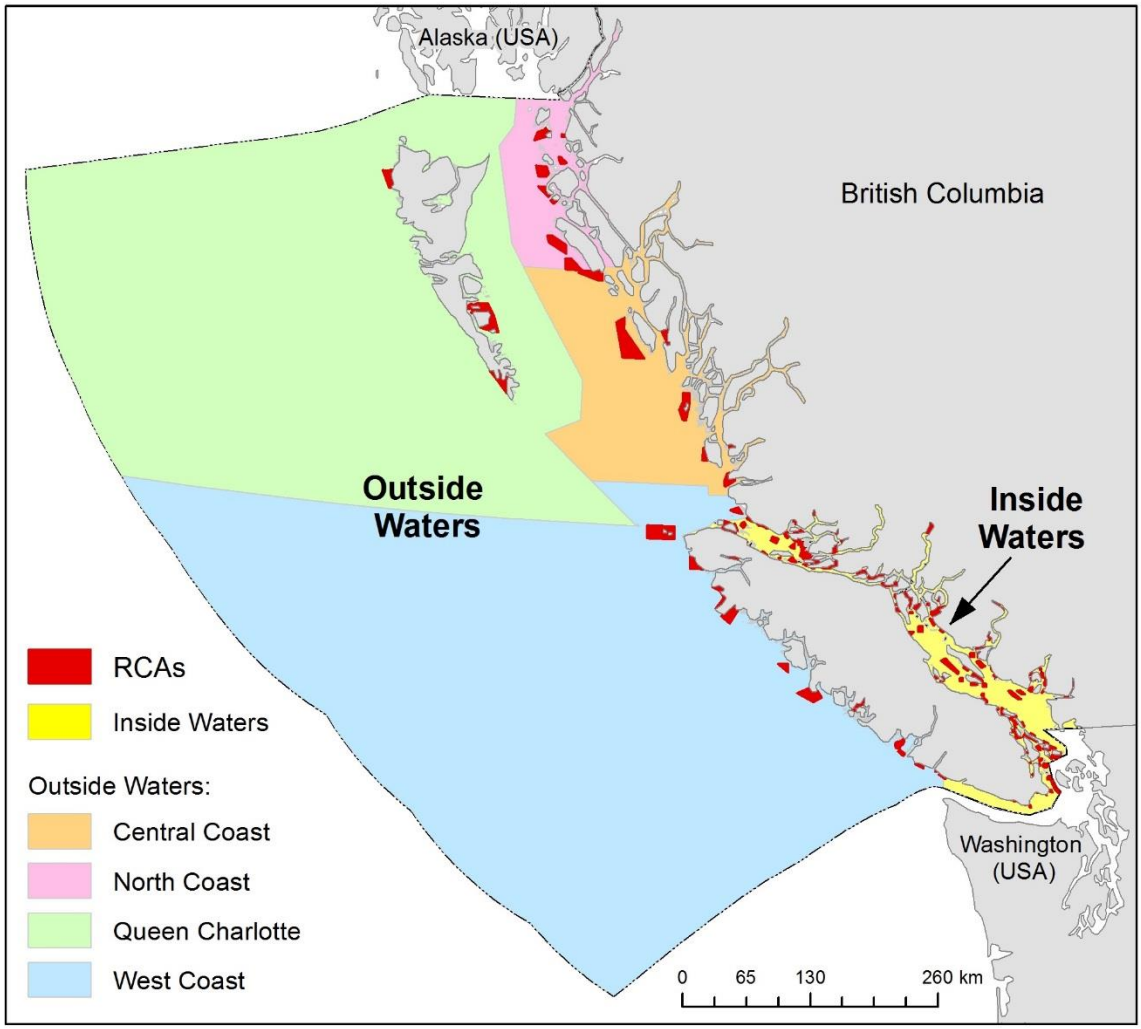

Figure 2: Location of Rockfish Conservation Areas in inside and outside waters. Inside Waters include area shown in yellow; Outside Waters include Central Coast (orange), North Coast (pink), Queen Charlotte (green), and West Coast (blue).

ASSESSMENT

RCAs were reviewed to determine whether the areas met the OEABCM criteria one to four based on the DFO operational guidance described above (DFO 2016).

The Ecological Risk Assessment Framework (ERAF; O et al. 2015) was used to evaluate whether RCAs met the fifth criterion that ecological components of interest are effectively conserved. The ERAF is used to prioritize the single and cumulative threats from multiple anthropogenic activities and their associated stressors on significant ecosystem components (SECs) and identify knowledge gaps (O et al. 2015). SECs are environmental elements that have ecological importance to the ecosystem and can be a species, habitat, or community. The ERAF supports three levels of assessment: Level 1 qualitative; Level 2 semi-quantitative; and Level 3 quantitative. A Level 1 qualitative risk assessment was used to assess RCAs against OEABCM criterion five on three SECs: Inshore Rockfish, rocky reef habitat, and Inshore Rockfish prey species. Rocky reefs were selected as a habitat SEC in this assessment (Figure

3). The SEC's are intended to include the substrate and the ecological communities which inhabit these areas. The OEABCM operational guidance states that a habitat must be important to biodiversity conservation and the relatively high spatial overlap of rocky reefs in RCAs compared with other habitat types such as eelgrass beds, kelp forests, and glass sponge reefs within RCAs.

Figure 3: RCAs and modelled rocky reef habitat.

When RCAs were established, the decision about which fishing activities would be prohibited was based on a review of available fishery data (e.g. direct and incidental catch of rockfish) and feedback from fishing sectors and other interest groups. A formal risk assessment was not conducted at the time. Fisheries that are spatially or temporally limited, intensively monitored, and/or those which removed rockfish prey were allowed to continue in the RCAs (Yamanaka and Logan 2010).

The Level 1 qualitative risk assessment was chosen because it has the ability to assess large areas with many anthropogenic activities, ranks risks on a relative scale, and highlights data and knowledge gaps. The activities identified for consideration in the risk assessment are presented in Table 1. A total of 21 permitted and currently occurring activities were scored in the final assessment, while activities that are prohibited, occurred in the past but no longer occur, and non-compliance issues were not considered in this assessment.

*Table 1: Activities occurring within RCAs. * denotes activities that are not currently permitted and were not included in this risk assessment.*

Human Activity		
Fisheries	Bottom contact	Crab by trap
		Prawn and shrimp by trap
		Scallop by trawl
	Pelagic	Euphausiid (krill) by mid-water trawl
		Groundfish by mid-water trawl
		Herring gillnet
		Herring spawn-on-kelp
		Herring seine net
		Opal squid seine net*
		Salmon by gillnet
		Salmon by seine
		Sardine seine net*
		Sardine gillnet*
		Smelt by gillnet (recreational only)
	Handpicking of invertebrates	Geoduck, sea urchin, sea cucumber
	FSC dual fishing	Groundfish by hook and line
	Aquaculture	Finfish
		Shellfish
Other Activities	Coastal infrastructure	Wharves, marinas, etc.
	Extractive Research	Invasive (bottom long-line) fishery surveys
	Land-use	Outfalls
	Log dumps	Movement and storage of logs
	Petroleum	Infrastructure and tenures*
	Vessel use	Vessel discharge
		Oil spill

The stressors included in the assessment are listed in Table 2: disturbance (noise); removal of biological material; entanglement/entrapment; introductions (aquatic invasive species); introductions (nutrients/biological material); contaminants; oil; substrate disturbance (crushing); substrate disturbance (foreign object); and substrate disturbance (sediment resuspension).

Table 2: Stressors described in this assessment.

Stressor	Description
Disturbance (noise)	Artificial noise associated with vessels. Noise can range from pervasive low frequency sound from vessel engines to short-term noise from anchor deployment and retrieval. Also includes the vibration associated with sound. This stressor could potentially impact all SECs, but has a more significant impact on species SECs.
Removal of biological material	This stressor includes biological material (flora and fauna) that is removed as targeted catch, bycatch, sampling, etc. and other activities that remove biological material from the environment. This stressor can impact all SECs.
Entrapment/entanglement	The entrapment or entanglement of organisms can occur from discarded or lost fishing gear. Ghost fishing is included as part of this stressor. This stressor is specific to species SECs.
Introductions (aquatic invasive species)	An organism introduced to an area outside the natural range and distribution that can become established and have a negative impact on the native environment. This stressor refers to the establishment of an aquatic invasive species, rather than exposure to a vector, which may not become established. This stressor is specific to all SECs.
Introductions (nutrients/biological material)	Biological material, including as nutrient rich raw sewage and bycatch/by-product from commercial vessels. This stressor is capable of impacting all SECs.
Contaminants	Contaminants are specific to the activity producing them. For example, the contaminants associated with operational discharge from vessels (ballast) are different from the contaminants associated with outfalls. This stressor is capable of impacting all SECs.
Oil	This stressor is specific to oil spill and can consist of a range of oil types. This stressor is capable of impacting all SECs.
Substrate disturbance (crushing)	Crushing of benthic substrate and communities from traps, anchors, etc. This stressor is specific to habitat SECs only.
Substrate disturbance (foreign object)	An obstacle affecting or altering habitat that would not naturally occur. This stress is specific to habitat SECs only.
Substrate disturbance (resuspension)	The resuspension of sediment particles into the water column from interaction with benthic substrates. The amount of resuspended sediment will be specific to the activity that produces the stressor.

This assessment analyzed four types of risk: relative risk to a SEC from an individual stressor within RCAs; cumulative risk to a SEC from all stressors within RCAs; potency of stressors impacting SECs within RCAs; and potency of activities impacting SECs within RCAs. A first

screening to identify potential negative interactions between identified SECs and activities/stressors was completed using an interaction matrix. Those activities that were determined to have no potential negative interactions were filtered out of the assessment. Indirect effects were not included in the scoring of the risk assessment of RCAs. Some potential positive interactions (where the SEC benefits for a period of time from interaction with the stressor) were identified. However, these positive interactions were not included in the matrix, as this type of interaction is not accounted for in the ERAF scoring rubric.

Seventy-nine unique stressors were included in the assessment. Sixty-two of these were found to have a potential negative impact on a SEC or multiple SECs. One hundred and twenty-seven negative SEC-stressor interactions were identified out of 237 potential interactions.

Relative risk to a SEC is a product of its exposure to a stressor and the consequence of that exposure to the SEC (O et al. 2015). Exposure is scored independently of SECs, which means that the scoring is common across all SECs that interact with a particular stressor. The scoring bins used in this assessment (Table 3) were developed in order to capture those stressors that occur for less than 3.5 days per year to those that occur for more than six months of the year.

Table 3: Qualitative scoring bins for sub-terms of Exposure (Temporal Scale, Spatial Scale, and Load) (adapted from Murray et al. 2016 and O et al. 2015).

Temporal scale

Score	Description	Definition
1 (low)	Very low	<3.5 days (0.1-1% of the year)
2 (low / moderate)	Low	3.5 days to 2.5 months (1-20% of the year)
3 (moderate / high)	Medium	2.5-6 months (20-50% of the year)
4 (high)	High	>6 months (>50% of the year)

Spatial scale

Score	Description	Definition
1 (low)	Few restricted locations	1-24 RCAs (1-15% of total RCAs)
2 (moderate)	Localized	25-49 RCAs (15-30% of total RCAs)
3 (high)	Widespread	50> RCAs (>30% of total RCAs)

Load

Score	Description	Definition
1 (low)	Low	Low density and low persistence
2 (moderate)	Moderate	High density or persistence
3 (high)	High	High density and persistence

Consequence was scored based on the consequence of exposure of a stressor to a SEC. It was scored for each SEC-stressor combination identified in the SEC-stressor interaction matrix as having a potential direct negative effect. Consequence scores range from one (negligible effects) to six (intolerable effects) (Table 4). Consequence scoring was based on the potential effect on the collective SECs across RCAs and not the effects on SECs within single RCAs. If more than one species within the SEC was impacted, scoring was based on the most sensitive ecological component.

Table 4: Qualitative scoring bins for scoring Consequence (adapted from O et al. 2015).

Score	Effect	Definition
1 (low)	Negligible	Negligible effect on population/habitat/community
2 (low / moderate)	Minor	Minimal effect on population/habitat/ community structure or dynamics
3 (moderate)	Moderate	Maximum effect that still meets an objective (e.g. sustainable level of impact such as a full exploitation rate for a target species; maintaining levels of critical habitat)
4 (moderate / high)	Major	Wider and longer term effects (e.g. long-term decline in CPUE)
5 (high)	Severe	Very serious effects occurring, with a relatively long time period likely to be needed to restore to an acceptable level (e.g. serious decline in spawning biomass limiting population increase)
6 (very high)	Intolerable	Widespread and permanent/irreversible damage or loss will occur – unlikely to ever be fixed (e.g. local extinction)

Uncertainty was scored for each exposure and consequence factor scored on a scale between one (low uncertainty) and five (high uncertainty) (Table 5). Two types of uncertainty are inherent in the risk scoring: the amount of literature available and the scientific consensus, which was not explicitly represented in Table 5. However, when scientific consensus was not available, the score for uncertainty was increased by one.

Table 5: Definitions of uncertainty scoring bins, based on categories outlined in Therriault and Herborg (2007) and Therriault et al. (2011) and adapted by O et al. (2015).

Score	Evidence	Description
1	Extensive	Extensive scientific information; peer-reviewed information; data specific to the location; supported by long-term datasets (10 years or more)
2	Substantial	Substantial scientific information; non-peer-reviewed information; data specific to the region; supported by recent data (within the last 10 years) or research
3	Moderate	Moderate level of information; data from comparable regions or older data (more than 10 years) from the area of interest
4	Limited	Limited information; expert opinion based on observational information or circumstantial evidence
5	Little to none	Little or no information; expert opinion based on general knowledge

Median Risk

Median risk scores and associated uncertainties were determined for each SEC. The five stressors that have the highest estimated risk scores for each SEC are presented in Table 6 along with the median Exposure and Consequence scores used to create the risk score.

Stressors with the highest median risk score affecting the Inshore Rockfish SEC were: removal of biological material from FSC dual fishing groundfish hook and line; removal of biological material crab by trap fishing; oil from vessel oil spills; contaminants from outfalls; and contaminants from log storage (Table 6). These relative risk scores were driven by high Exposure scores (temporal and/or spatial overlap) with the exception of oil from vessel oil spills, which had a low Exposure score but a high Consequence score. Each of these stressors has high uncertainty associated with the median risk score.

Stressors with the top median risk score affecting the rockfish prey SEC were: removal of biological material from prawn and shrimp by trap; introductions of aquatic invasive species from coastal infrastructure; oil from oil spill; contaminants from outfalls; and contaminants from the movement and storage of logs (Table 6).

Stressors with the highest median risk score affecting rocky reef habitat SEC were: contaminants from outfalls; introduction of aquatic invasive species from coastal infrastructure; oil from oil spills; substrate disturbance sediment resuspension from crab by trap fishery; and contaminants from coastal infrastructure (Table 6)

Table 6: The top five stressors with the highest median estimated Risk for each SEC showing 10/90% Quantiles, and the associated median Exposure and Consequence scores.

Rockfish

Stressor	Median Risk	10% Q	90% Q	*Exposure*	*Consequence*
FSC dual fishing groundfish hook and line (removal of biological material)	151.99	47.48	301.27	17.01	8.92
Crab by trap (Removal of biological material)	101.91	46.43	172.90	23.07	4.41
Vessels oil spill (Oil)	95.60	10.17	220.76	5.72	16.64
Outfalls (Contaminants)	71.98	18.20	162.20	16.14	4.40
Movement and storage of logs (Contaminants)	71.18	23.53	119.60	16.40	4.44

Rockfish prey

Stressor	Median Risk	10% Q	90% Q	*Exposure*	*Consequence*
Prawn and shrimp by trap (Removal of biological material)	112.16	67.90	164.46	12.40	9.10
Coastal infrastructure (Introductions AIS)	106.97	50.66	169.77	11.68	9.38
Vessels oil spill (Oil)	86.04	20.01	157.63	5.24	16.52
Outfalls (Contaminants)	76.02	10.78	161.82	16.29	4.50
Movement and storage of logs (Contaminants)	75.86	17.71	140.01	16.00	4.61

Rocky reefs

Stressor	Median Risk	10% Q	90% Q	*Exposure*	*Consequence*
Outfalls (Contaminants)	141.87	53.57	242.05	15.37	9.49
Coastal infrastructure (Introductions AIS)	111.21	43.26	197.62	11.86	9.27
Vessels oil spill (Oil)	104.32	20.00	213.34	6.29	16.16

Stressor	Median Risk	10% Q	90% Q	*Exposure*	*Consequence*
Crab by trap (Substrate disturbance sediment resuspension)	62.03	7.41	115.73	12.67	4.79
Coastal infrastructure (Contaminants)	38.46	8.15	85.33	8.00	4.69

Cumulative Risk

Cumulative risk was calculated by summing the risk scores of all stressors that affect an SEC. Overall, the rockfish prey SEC received the highest cumulative risk score (Figure 4) and had the highest number of SEC-stressor interactions contributing to this score (54). Rockfish received the second highest cumulative risk score, with 42 SEC-stressor interactions contributing to the score (Figure 4). The rocky reef SEC received the lowest cumulative risk score, with the lowest number of SEC-stressor interactions contributing to this score (31; Figure 4). The 10 and 90% quantiles for each cumulative risk score overlap between SECs, indicating little differentiation on a relative scale.

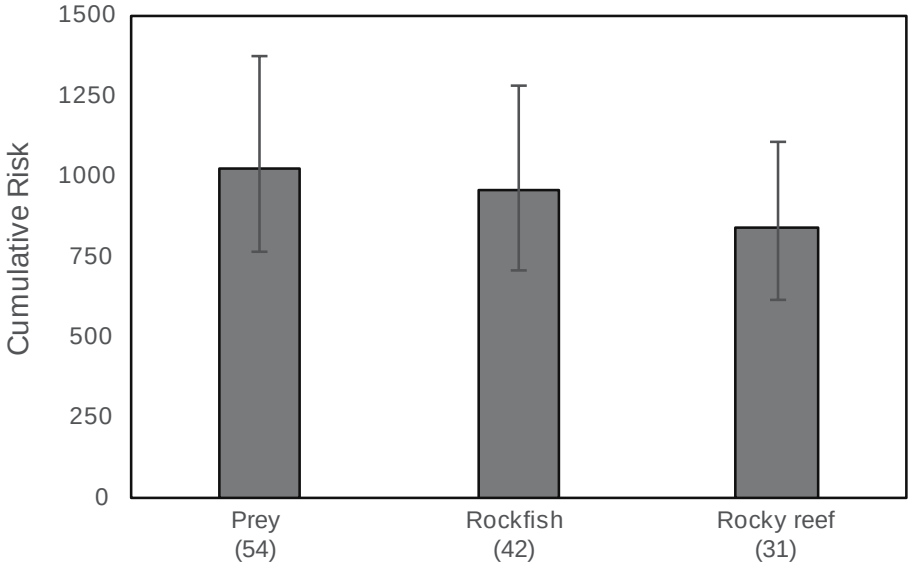

Figure 4: Estimated cumulative risk for each SEC, ranked in descending order with 10/90% error bars.

Potency of stressors and activities

Potency is defined as the cumulative (additive) risk of an activity or stressor presented on a relative scale across all values in the assessment. The potency of each stressor was calculated by adding the relative risk scores for each SEC that the stressor interacts with, which allowed for comparison across individual stressors that impact SECs. The potency by activity was calculated by adding the risk scores from all SEC-stressor interactions from that activity which allowed for comparison between activities.

The 15 activity-specific stressors with the highest relative potency scores are shown in Figure 5. Contaminants from outfalls and oil from vessel oil spills had the highest potency scores with all SECs contributing to their estimated potency score followed by introduction of aquatic invasive species from coastal infrastructure and removal of biological material from both FSC dual fishing

groundfish hook and line fishing and prawn and shrimp by trap fishing. The highest uncertainty scores were associated with the stressors with the highest potency scores.

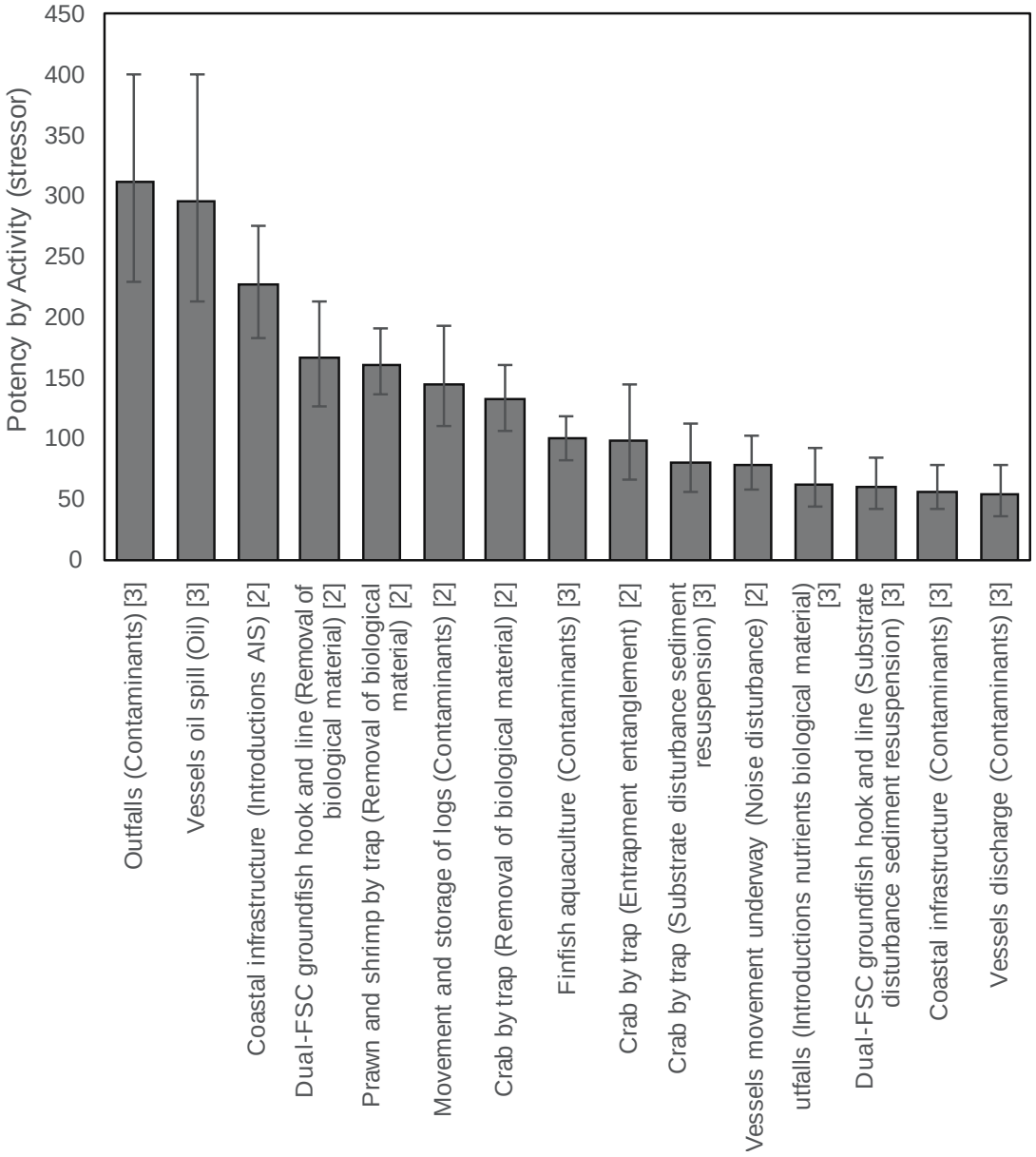

Figure 5: Estimated cumulative risk by stressor-activity (Potency) for the 15 stressors with the highest scores ranked in descending order with 10/90% quantiles that indicate the uncertainty associated with the score. The number of SECs each stressor-activity impacts is denoted by square brackets.

Ten stressor categories were considered in the risk assessment. The potency by stressor analysis identified contaminants as having the highest potency by stressor scores, followed by the removal of biological material (Figure 6). The introduction of aquatic invasive species, sediment resuspension, and oil were identified as having the third to fifth highest potency scores. The number of SEC-stressor interactions contributing to the potency score varied across stressors, and the highest number of interactions did not correlate to the highest potency scores (Figure 6).

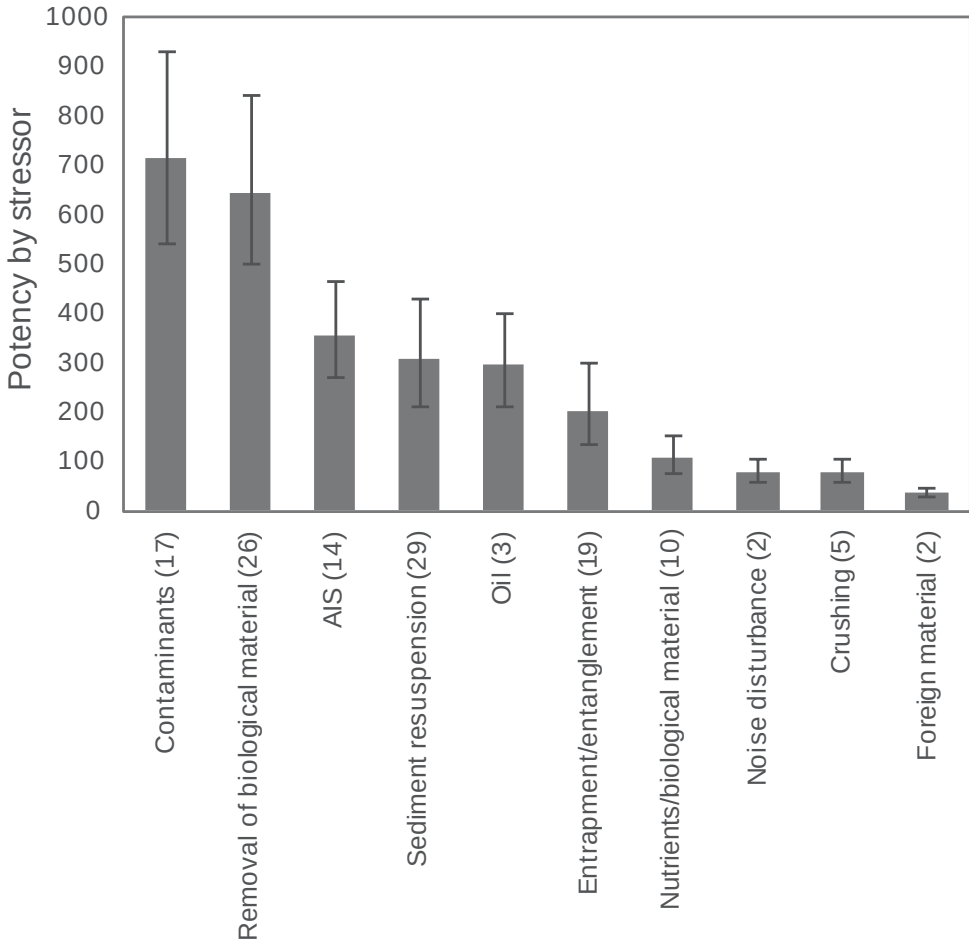

Figure 6: Estimated potency (cumulative risk) of stressors included in the risk assessment, ranked in descending order with 10/90% quantiles that indicate the uncertainty associated with the score. The number of SEC-stressor interactions per stressor is denoted in brackets.

The activities with highest estimated potency scores were outfalls, crab by trap, coastal infrastructure, vessel oil spill, prawn and shrimp by trap, and FSC dual fishing groundfish hook and line (Figure 7). The highest uncertainty scores were associated with the highest potency scores (Figure 7).

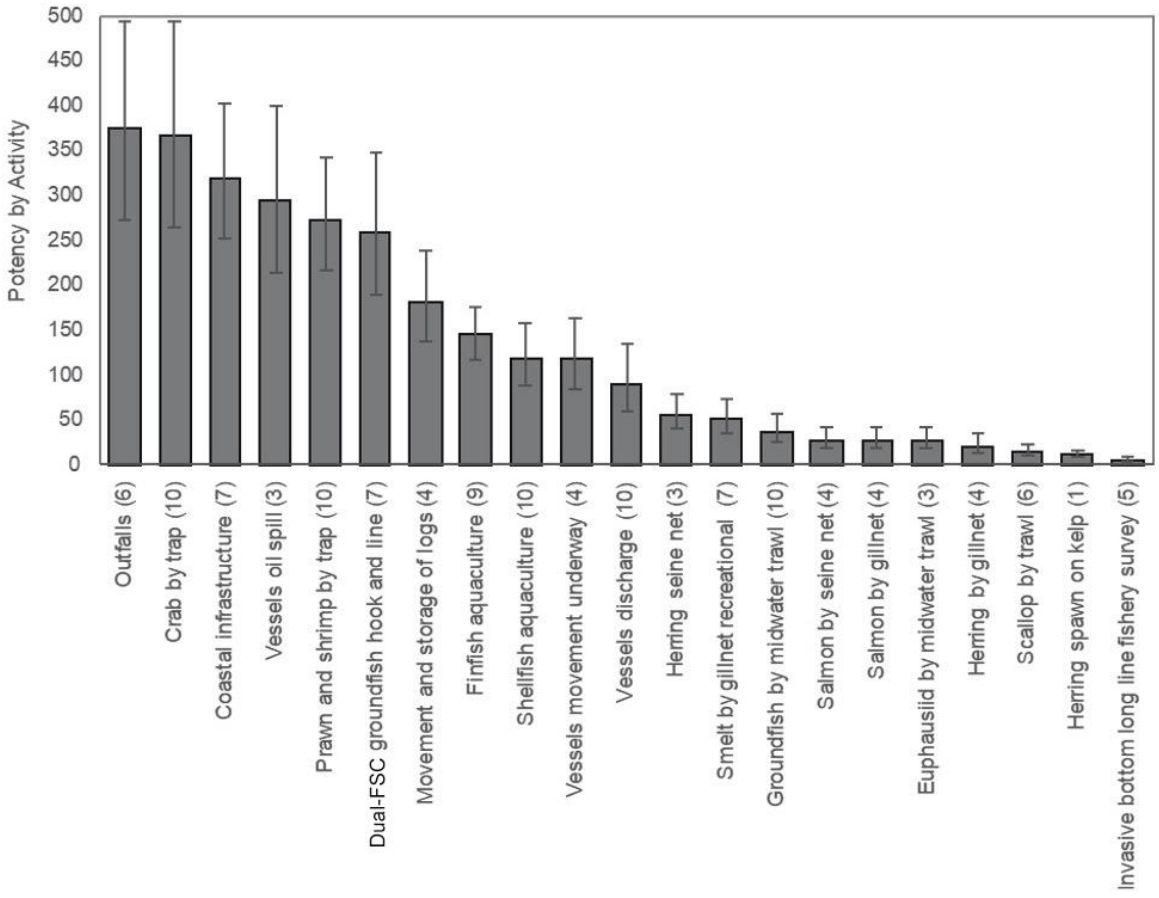

Figure 7: Estimated potency (cumulative risk) of activities included in the risk assessment, ranked in descending order with 10/90% quantiles that indicate the uncertainty associated with the score. The number of SEC-stressor interactions that each activity produces is denoted in brackets.

Sources of Uncertainty

Limitations of the ERAF

A Level 1 qualitative risk assessment can be used to identify potential threats within RCAs but does not identify levels of acceptable risk or set thresholds that may prevent them from meeting criterion 5. The Level 1 risk assessment assessed RCAs collectively and not on an individual basis. Therefore, stressors that occur in a small number of RCAs that may pose a high risk for an individual RCA, may not be captured in this analysis. Further risk assessments may be required to determine if the areas meet criterion 5.

Data and knowledge gaps

Precautionary scoring was used for those stressors that were unpredictable in nature with unknown impacts, therefore, they may not reflect the actual risk of harm. Broad assumptions about how stressors interact with SECs were made in the absence of scientific understanding of the true impacts. For example, the impact of AIS on inshore rockfish was considered to be negative, when in reality, the hypothetical nature of this threat is such that we do not know the direction of the interaction which could alternatively be positive, neutral or negative.

Furthermore, if a potential stressor has high spatial or temporal overlap with the RCAs (i.e. the Crab fishery and Outfalls) then the relative risk, despite being uncertain, will be conflated to appear high. This could lead to an inflation of scores for some stressors. For this reason, FSC (except for FSC dual fishing groundfish hook and line) and recreational fishing were not included in the risk assessment.

CONCLUSIONS AND ADVICE

RCAs and OEABCM Criteria

RCAs meet criterion 1 as they are spatially well-defined with clearly delineated geographic boundaries.

RCAs meet criterion 2. While RCAs lack a single unifying DFO document, publicly available documents contain RCA conservation and stock management objectives (DFO 2002).

The presence of Inshore Rockfish and rockfish habitat within RCAs through modelled and catch data support that criterion 3 is met. However, collection of further empirical observations would strengthen this assessment.

RCAs currently do not meet criterion 4. RCAs were intended to be in place for the long-term. In order to meet criterion 4, RCAs would need to be entrenched in legislation or regulation or an official DFO publication stating long-term intention (i.e. a minimum of 25 years) and should be available in publicly available documents.

To determine if RCAs meet the fifth criterion of ecological components of interest being effectively conserved, a Level 1 qualitative risk assessment was conducted using a modified version of the Ecological Risk Assessment Framework (ERAF; O et al. 2015). The objective of which was to assess the relative risk of harm to Inshore Rockfish, their prey, and their rocky reef habitat from permitted activities within the collective network of RCAs (i.e. not on an individual RCA basis). The ERAF identified permitted activities with higher relative risk that may prevent RCAs from meeting this criterion. However, further information is required to definitively determine if RCAs meet this criterion by effectively conserving the ecological components of interest. Additionally, future risk assessments on the scale of individual RCAs could be conducted to determine if each RCA meets OEABCM criterion 5.

Activities

Eight of the activities reviewed have the highest relative potential to prevent RCAs from meeting the OEABCM criteria. These activities are outfalls, crab by trap, coastal infrastructure, oil spills, prawn and shrimp by trap, dual-FSC groundfish hook and line, movement and storage of logs, and finfish aquaculture (Figure 7). However, considerable uncertainty exists on whether these activities impact RCA effectiveness. Furthermore, the participants at this review agreed that although these were the eight activities with highest relative risk, the overall risk they present is likely moderate to low risk. Further investigation would be required.

Outfalls

Outfalls was the activity in this assessment with the highest level of relative risk, which was largely due to the year-round exposure of RCAs to outfalls along with the potential impact of contaminants. Two stressors linked to outfalls are the introduction of contaminants and introduction of nutrients/biological material which affect all three SECs. There was moderate uncertainty related to the potential load of these stressors due to the unknown contaminant type, amount and consequences on RCAs but low uncertainty related to temporal and spatial overlap of this stressor.

Crab by Trap

Crab by trap fishing had the second highest relative risk score identified in this assessment and produced the highest number of SEC-stressor interactions. Crab by trap fishing is considered a likely threat to the conservation of Inshore Rockfish through the removal of biological material and entrapment/entanglement, although the data concerning rockfish bycatch is very uncertain. The score is driven by high exposure. Some RCAs will be impacted by crab by trap fishing more than others as this activity is permitted year-round in some RCAs while not in others. It is expected that those RCAs not exposed to crab by trap fishing year-round would have lower risk scores.

Coastal Infrastructure

Coastal infrastructure had the third highest risk score impacting RCAs and was largely driven by high exposure and consequence to benthic communities through the introduction of aquatic invasive species, introduction of contaminants, and the introduction of foreign material. The introduction of aquatic invasive species risk score is likely inflated due to the precautionary scoring used to score this stressor and the moderate to high level of uncertainty associated with this stressor.

Oil Spills

Potential oil spills from vessels were the fourth highest risk activity impacting RCAs although occurrence cannot be accurately predicted. Only one stressor is associated with this activity (oil), and the relative risk score is high due to the consequence score on all three SECs. The risk scores are also inflated due to the uncertainty related to oil types that could be spilled from these vessels.

Prawn and Shrimp by Trap Fishing

Prawn and shrimp by trap fishing was the fifth highest risk activity and produced the same number of interactions as Crab by trap. The relative risk score is largely driven by a number of minimal or low interactions with SECs and moderate exposure scores as well as the moderate consequence score to Inshore Rockfish Prey SEC. While the sizes of the prawns removed as part of this fishery are generally too large to be inshore rockfish prey, smaller prawns and shrimp do make up a small proportion of Inshore Rockfish diet. The prawn and shrimp by trap fishery may also affect individual RCAs with high fishing effort.

FSC Dual Fishing Groundfish Hook and Line

FSC dual fishing for groundfish hook and line poses a risk to Inshore Rockfish as both directed and incidental bycatch in that fishery and there are high uncertainties associated with this activity. Due to the absence of reporting data for the location and timing of fishing events and the potential for these fisheries to operate more than six months of the year in most areas, the risk was largely driven by exposure scores. The effects of gear could potentially damage sensitive benthic communities but the full effect of this is not known.

Movement and Storage of Logs

Movement and storage of logs affects RCAs through the introduction of contaminants and the resuspension of sediment while producing four SEC-stress interactions. The relative risk score was driven by high exposure scores as the activity takes place year-round along with the associated uncertainty related to this stressor. The high exposure to this stressor could result in negative impacts on Inshore Rockfish and Inshore Rockfish Prey SEC.

Finfish Aquaculture

Finfish aquaculture was found to have a negligible or minor impact on the SECs within RCAs and provided nine SEC-stressor interactions. The temporal overlap of this activity with RCAs was what largely drove this score. Finfish aquaculture takes place year-round. There is low uncertainty associated with this activity and was not currently considered a risk to the network of RCAs but could contribute to the cumulative effects of multiple activities and stressors.

LIST OF MEETING PARTICIPANTS

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SOURCES OF INFORMATION

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