

MSC Canada 3LN redfish fishery re-assessment, RBF background information for stakeholder use

Context

Greenland shark has been categorised a main secondary species in the Canada 3LN redfish fishery re-assessment. Despite the 5-year average value being 0.46% of total catches and below the MSC 2% threshold for less resilient species, the % in 2018 was just less than 1% (0.871%) and it's possible that the quantity may increase within the next 5 years. However, the reasoning for classifying this species as main is the following. Greenland sharks have an extremely conservative life history, with longevity estimated to be the highest documented for any vertebrate (392 ± 120 yrs) and therefore, bycatch is a concern. NAFO is paying close attention to the bycatch of this species due to its vulnerability, as can be seen through recent studies¹, and the species is listed as Vulnerable to extinction on the IUCN Red List (global stock, Kulka et al. 2020²), where the authors highlight key life history information, namely that the median maximum intrinsic rate of population increase, r_{max} , of Greenland Shark is 0.032 year⁻¹ (95th percentile = 0.025–0.044). This is nearly half the lowest r_{max} previously calculated for any shark or ray. For comparison, the lowest shark r_{max} is 0.054 for the Leafscale Gulper Shark (*Centrophorus squamosus*) and the lowest ray r_{max} is 0.067 for the Manta Ray (*Mobula birostris*). Accordingly, and in line with the precautionary approach and with MSC Guidance GSA 3.4.2³, the species is assessed as secondary main.

MSC requirements for the use of RBF tools

As per MSC Fishery Certification Process (FCC) v2.2, 7.7.3: The CAB shall use the criteria in Table 3 (see below) to decide whether a fishery may or may not be data-deficient with respect to 1 or more scoring element(s) within a Performance Indicator (PI).

Table 1. MSC Fisheries Certification Process v2.2 §Table 3: Criteria for triggering the use of the RBF.

Performance Indicator	Criteria	Consideration	Notes
2.2.1 Secondary species outcome	Biologically based limits are available, derived either from analytical stock assessment or using empirical approaches.	Yes	Use default Performance Indicator Scoring Guideposts within default assessment tree for this PI.
		No	Use Annex PF (RBF) for this PI.

¹ Hedges et al, 2021. Greenland shark bycatch data in NAFO Subareas 0+1. and Simpson et al, 2021. Spatial-temporal variation in Greenland shark (*Somniosus microcephalus*) bycatch in the NAFO Regulatory Area.

² Kulka, D.W., Cotton, C.F., Anderson, B., Derrick, D., Herman, K. & Dulvy, N.K. 2020. *Somniosus microcephalus*. The IUCN Red List of Threatened Species 2020: e.T60213A124452872. <https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T60213A124452872.en>. Accessed on 12 January 2022. <https://www.iucnredlist.org/ja/species/60213/124452872>

³ MSC Guidance to the Fisheries Standard v2.01: GSA3.4.2 Designation of 'main' species. In all cases teams may still designate species as main, even though it falls under the designated weight thresholds of 5% or 2%, as long as a plausible argument is provided as to why the species should warrant that consideration. For example, a stock might be in such a poor state, that all impact by the UoA is important enough to consider, even in cases where the catch proportion is so low that it would normally be classified as a minor species (also see GSA3.4.2.2).

Purpose of the RBF meeting

A key purpose of the site visit is to collect information and speak to stakeholders with an interest in the fishery. For those parts of the assessment involving the MSC's Risk-Based Framework (RBF, see [msc.org](https://www.msc.org)), we will be using a stakeholder-driven, qualitative and semi-quantitative analysis during the site visit. To achieve a robust outcome from this consultative approach, we rely heavily on participation of a broad range of stakeholders with a balance of knowledge of the fishery. We encourage any stakeholders with experience or knowledge of the fishery to participate in these meetings. We note that a notice of Use of RBF as well as the Fishery Announcement and Announcement Comment Draft Report (ACDR) were all published on the MSC website on the 22nd of February 2022, and listed stakeholders were notified accordingly via email.

Greenland shark assessed using the Productivity Susceptibility Analysis (PSA)

Greenland shark (*Somniosus microcephalus*) has been categorised as a main secondary species in the Canada 3LN redfish ACDR (published on the MSC website on the 22nd of February 2022, see <https://fisheries.msc.org/en/fisheries/canada-3ln-redfish/@assessments>).

Since this species has no biologically based limits available, derived either from analytical stock assessment or using empirical approaches, the use of the RBF is triggered for this species. Therefore, a Productivity Susceptibility Analysis is to be used for Performance Indicator, as per MSC requirements for secondary main species.

If you have expertise on Greenland shark, its bycatch or the fishery under assessment and its interaction with this species we would like to talk with you at the RBF meeting (planned for the 5th of April 2022, 11.00 am to 12.00 noon, NL time, Canada), or if you cannot attend, get your written or oral input on the preliminary evidence drafted in the PSA analysis (see attached document). The objective evidence and expert input provided by stakeholders is used to calculate the final scores on each productivity and susceptibility attribute of the PSA analysis. Please contact the Lead Assessor, Vito Romito, at vromito@nsf.org, if you want to participate or submit your input. Stakeholder input on the RBF can be taken until the last day of the site visit audit, the 8th of April 2022.

During the RBF meeting, stakeholders in attendance will review collectively the productivity and susceptibility parameters of the PSA (see below) drafted for Greenland shark. The goal is to discuss and agree the evidence and scores in each productivity and susceptibility attributes below.

PSA Scoring tables PF4 & PF5 from the MSC Fishery Certification Process v2.2 (see also guidance⁴)

Table PF4: PSA productivity attributes and scores ■

Productivity attribute	High productivity (Low risk, score = 1)	Medium productivity (medium risk, score = 2)	Low productivity (high risk, score = 3)
Average age at maturity	<5 years	5-15 years	>15 years
Average maximum age	<10 years	10-25 years	>25 years
Fecundity	>20,000 eggs per year	100-20,000 eggs per year	<100 eggs per year
Average maximum size (not to be used when scoring invertebrate species)	<100 cm	100-300 cm	>300 cm
Average size at maturity (not to be used when scoring invertebrate species)	<40 cm	40-200 cm	>200 cm
Reproductive strategy	Broadcast spawner	Demersal egg layer	Live bearer
Trophic Level	<2.75	2.75-3.25	>3.25
Density dependence II (to be used when scoring invertebrate species only)	Compensatory dynamics at low population size demonstrated or likely.	No density or compensatory dynamics demonstrated or likely.	Density dynamics at low population sizes (Allee effects) demonstrated or likely.

Table PF5: PSA susceptibility attributes and scores

Susceptibility attribute	Low susceptibility (Low risk, score = 1)	Medium susceptibility (medium risk, score = 2)	High susceptibility (high risk, score = 3)
Areal overlap (availability): Overlap of the fishing effort with a species concentration of the stock	<10% overlap	10-30% overlap	>30% overlap
Encounterability: The position of the stock/species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	Low overlap with fishing gear (low encounterability).	Medium overlap with fishing gear.	High overlap with fishing gear (high encounterability). Default score for target species (Principle 1).
Selectivity of gear type: Potential of the gear to retain species	a Individuals < size at maturity are rarely caught.	a Individuals < size at maturity are regularly caught.	a Individuals < size at maturity are frequently caught.
	b Individuals < size at maturity can escape or avoid gear.	b Individuals < half the size at maturity can escape or avoid gear.	b Individuals < half the size at maturity are retained by gear.
Post-capture mortality (PCM): The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Evidence of majority released post-capture and survival.	Evidence of some released post-capture and survival.	Retained species or majority dead when released. Default score for retained species (Principle 1 or Principle 2).

⁴ <https://www.msc.org/docs/default-source/default-document-library/for-business/program-documents/fisheries-program-documents/msc-fisheries-certification-process-v2-2.pdf>

Greenland shark preliminary PSA (results to be agreed at RBF meeting during site visit period)

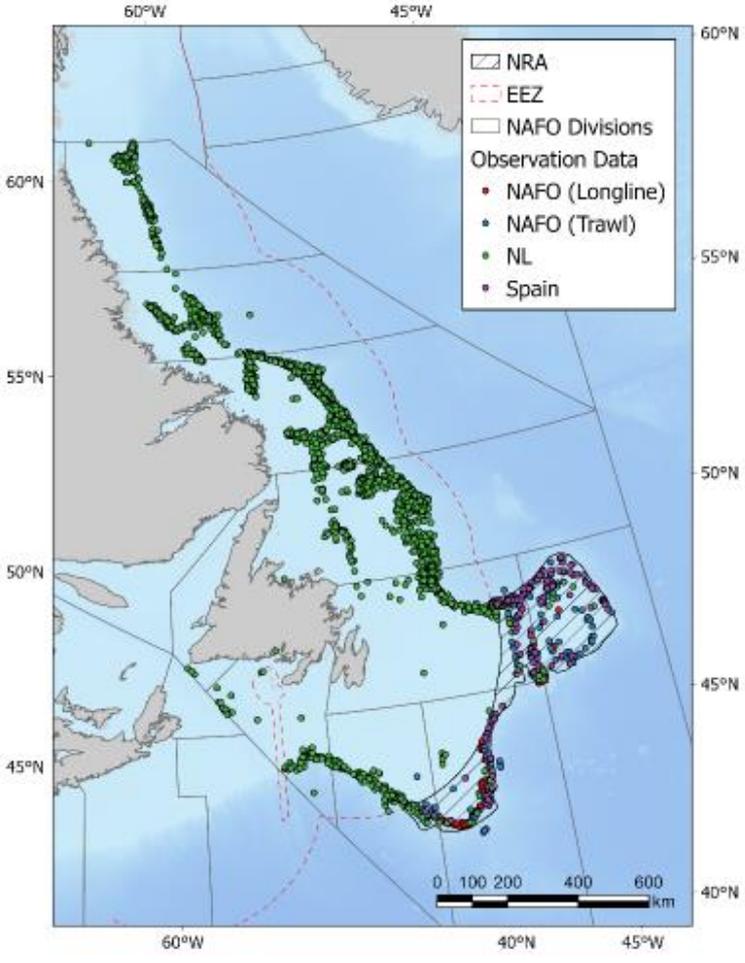
Table 3. PSA productivity attributes and scores - Greenland shark		
Performance Indicator	2.2.1 – Secondary Main Status	
Productivity		
Scoring element (species)	<i>Somniosus microcephalus</i> . Data has been taken from Fishbase ⁵ the IUCN red list page ⁶ for this species, and from Nielsen et al. 2020 ⁷ . Please refer to these references.	
Attribute	Rationale	Score
Average age at maturity	Females reach sexual maturity no earlier than 134 years of age. Score > 15 years	3
Average maximum age	Radiocarbon dating of eye lens nuclei from 28 caught female Greenland sharks (81-502 cm TL) revealed a life span of at least 272 years, the oldest being nearly 400 years. Score > 25 years	3
Fecundity	200–324 pups per pregnancy (depending on maternal size) with a body length-at-birth of 35–45 cm. However the fecundity is not yearly and it may not occur for at least 134 years. Score <100 eggs per year	3
Average maximum size Not scored for invertebrates	4-5 m. Score > 300 cm	3
Average size at maturity Not scored for invertebrates	Body length-at-first maturity for males is 2.7 m TL and TL50 2.86 m. For females, body length-at-first maturity is found to be 3.9 m TL and TL50 4.19 m, revealing that Greenland shark females not only attain greater maximum size, but also mature at greater lengths than males. Score >200 cm	3
Reproductive strategy	Live bearer	3
Trophic level	4.2 estimated from diet data Score >3.25	3
Density dependence Invertebrates only	Not applicable	
Susceptibility		
Fishery Only where the scoring element is scored cumulatively	<p>Not applicable. As per MSC FCP v2.2 PF4.4.3:</p> <p><i>PF4.4.3 When scoring susceptibility, the team shall take into account the impacts of fisheries other than the UoA according to the following requirements:</i></p> <p><i>c. When scoring PI 2.2.1, if the UoA has main species with catches at 10% or more of the total catch by weight of the UoA, all MSC UoAs having a catch of the same species that is 10% or more of the total catch of the UoAs shall be identified and listed separately.</i></p> <p><i>d. If the UoA does not have main species with catches at 10% or more of the total catch by weight of the UoA, the team may elect to conduct the PSA on the UoA only.</i></p>	

⁵ <https://www.fishbase.in/summary/Somniosus-microcephalus.html>

⁶ <https://www.iucnredlist.org/species/60213/124452872#assessment-information>

⁷ Nielsen J, Hedeholm RB, Lynghammar A, McClusky LM, Berland B, Steffensen JF, et al. (2020) Assessing the reproductive biology of the Greenland shark (*Somniosus microcephalus*). PLoS ONE 15(10): e0238986. <https://doi.org/10.1371/journal.pone.0238986>.

Table 3. PSA productivity attributes and scores - Greenland shark

	<p>The average catch of Greenland shark in the UoA 1 has been <0.5% of total catch (yearly average between 2016-2020) and the team elects to conduct the PSA on the UoA only.</p> <p>We note that while the Canada OAB 2+3KLMNO Greenland Halibut Bottom Trawl and Gillnet fishery overlaps with this fishery and has also categorised Greenland shark as a main secondary species, the Greenland shark catches in their UoA 1 and 3 were 1.7% of total catches in each UoA, respectively. This amounts to less than 10% of total catches by any UoA.</p>	
Attribute	Rationale	Score
Areal Overlap	<p>As can be seen below in Figure 1 (of the Announcement Comment Draft Report), Greenland shark bycatch records in the region occur in NAFO Divisions 0, 2 and 3.</p>  <p>Figure 1. Greenland shark occurrences used in the MaxEnt model⁸.</p> <p>Considering that this fishery only occurs in Division 3L, and the wider geographical distribution of the catch record (e.g. Canada, Greenland, Iceland,</p>	1

⁸ Simpson et al, 2021. Spatial-temporal variation in Greenland shark (*Somniosus microcephalus*) bycatch in the NAFO Regulatory Area. <https://www.nafo.int/Portals/0/PDFs/sc/2021/scr21-028.pdf>

Table 3. PSA productivity attributes and scores - Greenland shark

	<p>Norway, see below resident population in orange) it is estimated that the overlap of the UoA fishing effort with the distribution of the stock is <10%.</p>  <p><small>IUCN SSC Shark Specialist Group 2020. Somniosus microcephalus. The IUCN Red List of Threatened Species. Version 2021-3</small></p>	
Encounterability	<p>Encounterability is defined as the position of the stock/species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear. Given that the Greenland shark is a benthic species largely caught with demersal gear and the fishery in question operates bottom trawl gear, there is a high overlap with fishing gear (high encounterability).</p>	3
Selectivity of gear type	<p>Given the large size of this shark (2 - 4 m in length), and the relatively small size of the trawl mesh size (130 mm), and the lack of excluder grids in the trawl net: a) Individuals < size at maturity would be frequently caught and b) Individuals < half the size at maturity would be retained by gear.</p>	3
Post capture mortality	<p>Post-release mortality of any live-released Greenland Shark bycatch remains unknown; although Canadian At-Sea Fisheries Observers (ASOs) have reported 100% mortality of larger, ram-breathing sharks caught by gillnets and otter bottom trawls (regardless of fishing depth)⁹. The species is not retained and there is anecdotal indication of post capture mortality in the region of 30-40% (pers. comm. 4th Surveillance audit Client meeting, 17th Jan 2022) but due to the lack of more objective information we have to assume the majority of individuals would be considered dead when released.</p>	3
Catch (weight) Only where the scoring element is scored cumulatively	<p><i>Not applicable</i></p>	

PSA Preliminary Results : Pass with Condition (MSC PSA Derived score of 61)

- **Follow up with stakeholders to communicate final scores agreed during the RBF meeting**
- **Closing the meeting: Summary of Findings/Conclusions, Follow Up and Next Step**

⁹ Simpson et al. 2018. Distribution and Analysis of Canadian Greenland Shark (*Somniosus microcephalus*) bycatch in the NAFO Regulatory Area. NAFO SCR Doc. 18/026 <https://www.nafo.int/Portals/0/PDFs/sc/2018/scr18-026.pdf>