

Marisa Keefe

Fisheries and Oceans Canada

1420-401 Burrard Street, Vancouver, BC

V6C 3S4

November 16, 2022

Subject: MCC response to draft 2022/2023 Pacific Herring Food & Bait and Special Use
Commercial Fishing Plans

Dear Marisa,

The Pacific Marine Conservation Caucus (MCC) is submitting this letter in response to the draft 2022/2023 Pacific herring Food & Bait and Special Use (FB/SU) commercial fishery plans.

Unlike previous years, the draft 2022/2023 FB/SU plans do not include an initial amount for proposed quota allocations to these fisheries. Therefore, we will instead use this opportunity to outline our position on several key issues for the herring fisheries in the Strait of Georgia (SoG).

1. Management procedure

For several years, the MCC has advocated for the adoption of the **HS30-60_HR10** management procedure (Appendix 1). In 2021/2022, the department reduced the SoG herring harvest rate to 10%, and we were highly supportive of this decision. For 2022/2023, declining biomass and several other indicators of caution emphasize the importance of following the “hockey stick” harvest control rule associated with **HS30-60_HR10**, which requires reducing the total harvest rate to 4% for the upcoming season (Table 32 in CSAS, 2022).

Referring to the 2022/2023 stock status update (CSAS, 2022), for the SoG, spawning biomass declined by 26% between 2020 and 2022, with SB_{2022} estimated at approximately 48.9% of SB_0 . We also note the high degree of uncertainty regarding SB_{2022} (5th and 95th percentile estimates =

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41,600 and 115,208 tons, respectively. Looking ahead, SB_{2023} is projected to decline an additional 13% from 2022 levels. Natural mortality rates have sharply increased in recent years, and are currently higher than at any time since the late 1960s. Finally, for the two most recent years available (2020 and 2021), productivity sharply declined. The 2021 productivity value was negative, and represented the most negative production estimate since estimates began in 1988.

While we understand that natural fluctuations are to be expected in forage fish stock size and productivity, we are also aware that forage fish stocks can rapidly transition into persistent states of low productivity and low biomass (LP-LB), and that such transitions are characterized by brief periods of negative productivity. Here, we quote DFO science (Kronlund et al., 2018), writing of the transition of Central Coast, Haida Gwaii, and West Coast Vancouver Island herring stocks into persistent LP-LB states:

“The transition into the LP-LB state was rapid, usually occurring within 3 years from relatively large spawning biomass levels and coincident with negative production values”
(Kronlund et al., 2018).

Thus, for the 2022-2023 SoG stock, we see a need for continued caution in the face of declining biomass, rising natural mortality, and two years of sharply declining productivity, the latter of which was the most negatively-productive year since at least 1988.

For 2022-2023, we believe that **HS30-60_HR10**, and the associated 4% harvest rate, represents the maximum allowable management procedure for the Strait of Georgia. **HS30-60_HR10** is the only management procedure that achieves DFO’s core conservation objective ($SB_t > 0.3SB_0$, with probability > 75%) across both reference and “robustness” scenarios of natural mortality, while still allowing for commercial harvest (CSAS, 2022). Even then, **HS30-**

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60_HR10 barely achieves the conservation objective in the robustness scenario ($P = 75\%$), underlining the need to view this management procedure as the maximum option during this period of increasing natural mortality.

Furthermore, we note that the probabilities of any management procedure achieving the core conservation objective have declined since last year. As a result, **HS30-60_HR10** for 2022/2023 has a lower probability of achieving the core conservation objective than the department's selected management procedure (minE30_HR10) had for 2021/2022. In other words, last year's selected management procedure carried lower risk than the option we are putting forward for this year. Assuming that the same degree of risk tolerance characterizes the department's decisions this year, the need to select **HS30-60_HR10** is clear. Thus, we reiterate that **HS30-60_HR10** represents the maximum allowable option for 2022-2023.

2. Population structure

We reiterate our concern regarding the winter fishery's potential to interact with the genetic diversity of SoG herring. As noted in our submission for the 2021/2022 fishery (Appendix 1), recent research of Pacific herring in Washington, British Columbia, and Alaska shows a population structured by spawn timing, and then by spatial distribution, with associated genetic differentiation (Petrou et al., 2021). Beyond its potential to yield functional benefits (e.g., through the "portfolio effect", Schindler et al., 2010), such genetic diversity is a key component of biological diversity. Canada has committed to halting and reversing biodiversity loss by 2030, lending this issue even more importance. Here, we note that the draft Haida Gwaii 'iinang | iinang Pacific Herring Rebuilding Plan presents a compelling model for how such considerations can be addressed in herring fisheries.

While the research by Petrou and colleagues spanned an area larger than the SoG, it demonstrates that differences in spawn timing and location may be associated with genetic

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differentiation in Pacific herring. With contraction of the spatial extent of herring spawning in the SoG having occurred across previous decades (Figure 20 in Cleary & Grinnell, 2022), we are concerned that some differentiation may have already been lost. Going forward, we wish to address ongoing concerns that remnants of genetically distinct sub-populations may yet be present and affected by fisheries.

To this end, we are encouraged to know that the department is undertaking a pilot program to conduct genetic analyses of herring samples from at least four SoG spawning sites, selected in part for representing the extremes in herring spawn timing and location in the SoG (and thus most likely to carry associated genetic differentiation). We urge the department to devote the necessary resources to ensure that this pilot project is thorough and successful, and request that the results are made available to the public. Furthermore, we ask that the department strongly consider extending this pilot to include samples drawn from the 2022/2023 food & bait catches, to begin building a baseline of genetic information for this fishery.

3. Summary

The MCC's stated position has been that this species' extraordinary ecological importance requires an ecosystem-based approach. Two key elements of an ecosystem-based approach are to adjust our exploitation of natural systems when their productive capacities are reduced, and to manage exploitation so as to conserve biological diversity.

For SoG herring in 2022-2023, we see ample evidence of the need to reduce our exploitation in the face of rising natural mortality, declining biomass, and recent negative productivity. As such, we urge DFO to recognize **HS30-60_HR10**, and its associated harvest rate of 4%, as representing the maximum allowable harvest option for 2022-2023 SoG herring, and to adjust any quota allocated to the Food & Bait and Special Use fisheries accordingly.

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To improve our shared understanding of the diversity within the SoG herring stock assessment region, we urge the department to begin building a baseline of publicly-available information regarding the genetic composition of SoG spawning sites and herring fishery catches.

Thank you for your time and consideration.

Sincerely,

John Driscoll, PhD

Fisheries Science and Policy Analyst, David Suzuki Foundation
Integrated Herring Harvest Planning Committee, MCC Representative

On behalf of the Pacific Marine Conservation Caucus

Karen Wristen, Living Oceans Society
Misty MacDuffee, Raincoast Conservation Foundation
Aaron Hill, Watershed Watch Salmon Society

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Appendix I: Recent MCC letters regarding Strait of Georgia herring fisheries

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Marisa Keefe
Fisheries and Oceans Canada
1420-401 Burrard Street, Vancouver, BC
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November 10th, 2021

Subject: MCC response to the draft 2021/2022 Pacific Herring Food & Bait and Special Use commercial fishing plans

Dear Marisa,

The Pacific Marine Conservation Caucus (MCC) is submitting this letter in response to the draft 2021/2022 Pacific Herring Food & Bait and Special Use commercial fishing plans for the Strait of Georgia. While we understand the complexity of the timing of the various Pacific Herring fisheries we remain concerned that quotas for the Food & Bait and Special Use fisheries are being set prior to the full consultation on the Integrated Fisheries Management Plan (IFMP), effectively limiting the range of possible Management Procedure (MP) options under consideration in that process.

We therefore wish to use this opportunity to reiterate our recommendation to adopt MP **HS30-60_HR10** in the IFMP for the Strait of Georgia and to adjust the quota for the Food & Bait and Special Use fisheries accordingly. In the following we will summarize our rationale for adopting **HS30-60_HR10** provided in more detail in previous submissions (Appendices I-II) and highlight additional scientific context that has emerged over the last 12 months and provides a heightened sense of urgency to applying a truly precautionary, ecosystem-based approach to this culturally and ecologically important forage fish species.

Given the critical importance of Pacific Herring in the coastal and marine ecosystems of British Columbia and in the culture of many First Nations, the fishery warrants management to a higher standard than applying the current conservation objective of maintaining the stock above the critical level ($0.3SB_0$) with a high probability ($P \geq 75\%$). The species requires an ecosystem-based management approach that accounts for its disproportionate ecosystem role and reduces the risk caused by uncertainties around spatial structuring of the population within the major stock assessment regions. This can be achieved by aiming to grow and maintain the stock in the healthy zone ($SB_t \geq 0.6SB_0$) with a high probability ($P \geq 75\%$). As outlined in our submission from January 2021 (Appendix I) this would be in line with the full intent of the precautionary approach under the Sustainable Fisheries Framework (SFF) and its application

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by the Minister under the Fisheries Act. It would also be consistent with the Policy on New Fisheries for Forage Species under the SFF which, albeit only applicable to new fisheries, clearly recognizes the ecosystem importance of forage fish species such as herring and the enhanced requirements for fisheries management associated with it (Appendix II). While the stock status update for 2021 (DFO, 2021) shows that maintaining the spawning biomass above $0.6SB_0$ with a high probability is not possible, even if commercial fishing were to cease, applying a more conservative MP with a lowered harvest rate and operational control points that maintain the biomass at a higher level as represented by **HS30-60_HR10** has the best chance of rebuilding the stock to the healthy zone in the long term while maintaining fishing opportunities under an ecosystem-based management approach.

We have advocated for the adoption of this more precautionary MP for the last two herring seasons, however, scientific outputs from the past 12 months have added further impetus to our recommendation. While we have previously raised concerns around the uncertainty of the spatial structure of Pacific herring populations, a recent study of Pacific herring genetics (Petrou et al. 2021) has revealed a population structured by both spawn timing and location at a scale that is not reflected in the current stock assessment models. The winter fishery may place a particular risk to maintaining the genetic diversity of the stock as there is no way of knowing the final spawning area or timing of the catch. Since further research is required before these results can be accounted for in the fisheries management plan, the precautionary approach requires a more conservative harvest rate to reduce the risk of loss of genetic diversity and associated ability to adapt to a changing climate.

Additionally, the uncertainty around the spawning biomass estimate for the Strait of Georgia for 2021/22 is very large with estimates ranging from 48.0 to 131.9 kt (DFO, 2021). The 2021 stock update explicitly states that one of the lessons learned from the Management Strategy Evaluation analyses is that the catch-at-age stock assessment model can produce large assessment errors which can cause an over-estimation of spawning biomass and result in over-harvest. The stock update also confirms that a reduction in harvest rate from 20% to 10%, as recommended by the MCC, would be the most effective means of mitigating those stock assessment errors.

The 2021 stock update furthermore shows a continued increase in estimated natural mortality since 2016 reaching a level in 2021/22 last seen in the 1960s. In the 1960s the increase in natural mortality was followed by a precipitous decline in spawning biomass below the limit reference point.

In light of these findings, we feel it is long overdue for DFO to consider a truly precautionary approach and transition the Strait of Georgia herring fishery toward Canada's first ecosystem-based fishery by

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applying Management Procedure **HS30-60_HR10**. We request a written response to our submission including explanations where our recommendations are not enacted. We have provided similar input in the past 2 years and have not received an adequate response from DFO.

Sincerely,

Kilian Stehfest, Ph.D.

Marine Conservation Specialist, David Suzuki Foundation
Integrated Herring Harvest Planning Committee, Interim MCC Representative

On behalf of the Pacific Marine Conservation Caucus
Karen Wristen, Living Oceans Society

Cc:

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January 20, 2021

Subject: MCC response to the draft 2020/2021 Pacific herring IFMP

Dear Marisa Keefe,

The *Pacific Marine Conservation Caucus* (MCC) is submitting this letter in response to the draft 2020/2021 Pacific Herring IFMP. This letter contains additional points and a reiteration of our position described in our previous letters (November 13, 2020, January 17, 2020 and November 22, 2019).

In short we continue to recommend the transition of the Strait of Georgia herring fishery toward a precautionary harvest strategy with a primary aim to grow and maintain the stock in the “Healthy Zone” ($SBt \geq 0.6SB0$). Maintaining the stock in the healthy zone (1) upholds the requirements of DFO’s precautionary approach policy and recent fish stock rebuilding provisions, (2) reflects the intentions of the management strategy evaluation process, (3) transitions the fishery toward an ecosystem approach, and (4) considers uncertainties in spatial structure of herring populations.

Recommendation for 2020/21 Pacific Herring Integrated Fisheries Management Plan:

The MCC recommends an intentional transition of Pacific herring management toward an ecosystem based fishery through lowering the harvest rate and implementing operational control points to maintain the biomass at a higher level (Healthy Zone). This approach will reduce risk to herring and reliant predators, acknowledge uncertainties in the population structure, and maintain fishing opportunities within the context of an ecosystem based fishery. For the 2020/21 Strait of Georgia herring fishery the MCC MP (HS30-60_HR.1) is the best-suited option to achieve these objectives.

First Nations Rights and Titles

Participating organizations of the MCC support the government of Canada upholding the legal and constitutionally enshrined rights of Indigenous peoples. To that end we acknowledge that the government of Canada must work with First Nations that have an interest in Pacific herring, recognizing that a single approach may not be suitable for all Nations.

DFO's Precautionary Approach Policy and Fisheries Act Fish Stock Rebuilding Provisions

The Pacific Herring IFMP purports to follow the guidance of the '[Precautionary Approach](#)' policy under DFO's Sustainable Fisheries Framework. The proposed harvest strategy and resultant quotas in the draft 2020/2021 IFMP reflect the minimal conservation intent of this policy. That is, avoid driving the stock below the LRP or 'critical zone'. The only stated justification in the draft IFMP for the current harvest strategy for the Strait of Georgia (SoG) population is summarized in one sentence "all tested MPs [management procedures] could maintain the spawning biomass above the LRP with 75 to 85% probability across all natural mortality (M) scenarios" (pg. 91). What this means is that the fishery is being managed with a 3 out of 4 chance of not entering the critical zone. While this goal provides moderate assurance that the stock will not fall below the LRP, it does not reflect the ecosystem importance of this species and does not uphold DFO's primary policy directive for sustainable fisheries.

The full intent of the precautionary approach policy is to maintain or grow stocks above the Upper Stock Reference (USR) point (i.e., healthy zone) through applying appropriate management procedures. Currently the SoG herring population is in the cautious zone below the 2020/2021 acknowledged USR ($SBt \geq 0.6SB0 \geq 0.5$). When a stock is below the USR, the PA policy states that harvest rate should "progressively decrease from the established maximum and should promote stock rebuilding to the Healthy Zone". Furthermore, the recent [Regulatory Impact Analysis Statement](#) in the Canada Gazette 1 fish stock rebuilding provisions (Part I, V.155 (1)) adds additional interpretation of the PA policy and states that stocks in the cautious zone are to be managed with the goal toward the "growth of the stock towards the healthy zone" and "existing policies recommend that a fisheries management plan should aim to continue the stock's regrowth towards the healthy zone if *possible*". In the case of Strait of Georgia herring, maintaining the stock in the healthy zone is *possible* but it will require consideration of alternative management procedures, such as those identified in the MSE process, to increase the likelihood.

The draft 2020/21 IFMP interpretation of DFO's PA Policy is a continuance of a focus on the low end of the conservation guidance. There has been no discussion or consideration of alternative management procedures that would maintain/grow the stock toward the healthy zone and no effort to implement a "progressive reduction in removals" (i.e., hockey stick MPs).

It is important to also recognize that the Fisheries Act (s. 2.5(a)) identifies the "application of the precautionary approach and an ecosystem approach" as the first mentioned considerations for the Minister when making a decision. The draft 2020/2021 IFMP only reflects the minimum conservation intent of the PA policy and has no measures toward an ecosystem approach.

With the fish stock rebuilding provisions coming into effect, it is becoming increasingly apparent that there is an internal inconsistency within DFO to continue with the conservation objective for herring to be the same level as the rebuilding threshold (i.e., LRP ($SBt \geq 0.3SB0 \geq 0.75$)). Stated another way, the

current primary management objective is to avoid hitting the rebuilding threshold. It is clear that the PA policy and the rebuilding provisions are intended to keep stocks healthy while providing a regulatory backstop for when management has failed.

Management Strategy Evaluation

Since 2017 a considerable portion of DFO's herring science effort has been directed toward the Management Strategy Evaluation process. The MSE process is characterized by DFO as an iterative process allowing for diverse and varying perspectives to be evaluated and measured against other ecological and societal values. Despite this effort, the Strait of Georgia management procedure adopted and presented in the draft 2020/2021 IFMP is a continuation of long-standing conventional fisheries management approaches. There has been no consideration of ecosystem based objectives, reduced risk profiles, or selecting management procedures to grow and maintain the population into the healthy zone.

In our previous letter, the MCC voiced our support of the MP which best characterizes the transition toward an ecosystem based, lower risk fishery referred to as HS30-60_HR.1. It should be noted that none of the MPs with the exception of 'NoFish_FSC' are able to keep the population above the USR under all scenarios. The MCC scenario provides the best option for maintaining and possibly growing the biomass while allowing for the continuation of a viable commercial fishery.

At a minimum, if DFO is using MSE processes and the PA policy as intended to guide management decisions, then the harvest strategy should reflect a management procedure that progressively decreases from the established maximum (i.e., hockey stick). Both the HS30-60_HR.15 and HS30-60_HR.20 would at least be more in line with the 'progressive decrease' aspect of the PA policy.

Toward an Ecosystem Approach

As mentioned in this letter and in previous submissions, the harvest strategy proposed in the draft IFMP has no objectives toward maintaining the ecosystem role of herring as part of the strategy. The simplified long-standing justification of how the IFMP maintains the ecosystem role of herring, going back at least 15 years, is that a harvest rate of 20% of the spawning stock leaves 80% of the adult biomass and all juveniles to support ecosystem processes. This explanation falls short in several ways, but most notably, it assumes that the ecosystem role is somehow maintained through a species-specific harvest rate of the SSB with no consideration of the stock status relative to reference points, future trajectory of the stock, or spatial structure. Similar to the 'progressive decrease' provision of the PA policy to maintain the stock in the healthy zone, a similar approach is required to accommodate for impacts to the ecosystem. Again, the PA policy recognizes that there are "resultant impacts to the ecosystem" as the stock declines.

Spatial Structure

The harvest strategy in the draft 2020/2021 IFMP has not attempted to address any spatial objectives. The "Ecosystem Risks" section in the draft recognizes the "uncertain impact of the fishery on smaller spatial areas". In our previous letters we have explained how a more precautionary harvest strategy is the best approach to address uncertainty in the spatial structure. Again in this letter the MCC is recommending that DFO chooses a harvest strategy that maintains and grows the stock into the 'Healthy Zone' as the most practical immediate course of action to take. In particular a harvest strategy

that maintains and grows the biomass through a reduced harvest rate and a progressive decline in harvest rate with respect to the SSB, in combination with closed areas is the best way to address the uncertainty in the spatial structure. The MCC continues to recommend the management procedure HS30-60_HR.1 to achieve this objective.

Recommendation for 2020/21 Pacific Herring Integrated Fisheries Management Plan:

The MCC recommends an intentional transition of Pacific herring management toward an ecosystem based fishery through lowering the harvest rate and implementing operational control points to maintain the biomass at a higher level (Healthy Zone). This approach will reduce risk to herring and reliant predators, acknowledge uncertainties in the population structure, and maintain fishing opportunities within the context of an ecosystem based fishery. For the 2020/21 Strait of Georgia herring fishery the MCC MP (HS30-60_HR.1) is the best-suited option to achieve these objectives.

Thank you for considering these options. We feel it is long overdue for DFO to consider other conservation objectives and transition the Strait of Georgia herring fishery toward Canada's first ecosystem-based fishery. We are also requesting a full explanation as to how our points are being considered in advance of any decision for the 2021 roe herring fishery.

Sincerely,



Scott Wallace, Ph.D.

Senior Research Scientist, David Suzuki Foundation
Integrated Herring Harvest Planning Committee, MCC Representative

On behalf of the Pacific Marine Conservation Caucus

Karen Wristen, Living Oceans Society
Misty MacDuffee, Raincoast Conservation Foundation
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November 22, 2019

Victoria Postlethwaite
Fisheries and Oceans Canada
1420-401 Burrard Street, Vancouver, BC
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Subject: Toward a “low risk” ecosystem based Pacific herring fishery

Dear Victoria Postlethwaite,

As the *Pacific Marine Conservation Caucus* (MCC) representative on the *Integrated Herring Harvest Planning Committee* (IHHPC) I am submitting this letter to highlight concerns with respect to the proposed harvest for the 2019/2020 Pacific Herring Integrated Fisheries Management Plan and to recommend considerations toward a “low risk” ecosystem based fishery.

I have held a seat on the IHHPC for 13 years. Throughout this tenure, I have endeavoured to understand the strengths and limitations of the management system, complexities of ecosystem considerations, and the breadth of socioeconomic and cultural values associated with herring.

Concerns first raised with the Committee over a decade ago (i.e., in-season management, population structure, risk of over-harvest, and ecosystem considerations) are still present today and many of these concerns are fueling the public opposition to the Strait of Georgia component of the fishery. There is a range of First Nation’s perspectives which we acknowledge and respect.

The growing public concern reflects a perspective that the fishery imposes too large a risk to herring populations and the associated ecosystem linkages than what is deemed appropriate through the lens of an ecosystem based fishery.

Toward a low risk ecosystem based fishery

The management of herring requires addressing challenges not apparent in most other commercial fisheries in Canada’s Pacific waters, in particular, the widely held scientific and public understanding of the ecological importance of herring. While the precise ecological linkages are impossible to ascertain due to the complexity and non-linearity of marine ecosystems, the public interest reflects the findings borne out in ecosystem models, that herring, in comparison to other species, disproportionately transfer

ecosystem energy into higher trophic levels. Higher trophic levels tend to be comprised of species that interface with public value (e.g., seabirds, marine mammals, other harvested fish).

When using conventional fisheries management metrics to evaluate the sustainability of the Pacific herring fishery, such as those identified by DFO's *Sustainable Fisheries Framework* [precautionary approach](#) or even eco-certification schemes like the Marine Stewardship Council (MSC) or Seafood Watch, the performance of the Pacific herring fishery generally meets these criteria. However, these sustainability rubrics are primarily a measure of conventional fisheries management and not ecosystem based fisheries management. For a species like herring with high public value stemming from its role in maintaining ecological values at other trophic levels, conventional fisheries management is insufficient.

The revised *Fisheries Act* states that the "Minister may consider, among other things, (a) the application of a precautionary approach and an ecosystem approach" as the first listed considerations for decision making. These considerations come before the "sustainability of fisheries" (s. 2.5(a) (b)). The challenge is to transition toward an ecosystem approach to fisheries management in the absence of policy guidance.

A practical way to translate the best practices of ecosystem based fisheries management into feasible implementation is to utilize the management strategy evaluation (MSE) process for herring with a view toward managing the herring fishery as if it were an emerging fishery under DFO's [Policy on New Fisheries for Forage Species](#).

The forage species policy has never been applied in Canada as it was intended for "new" fisheries. It is unlikely that any new forage fish worthy of a fishery will spontaneously appear in our ecosystems. The policy sits idle as a reminder of what Fisheries and Oceans would do differently if it were to start managing a new forage fish fishery. If the Pacific herring fishery were to be hypothetically considered as a *new* fishery using the principles of DFO's policy for new forage fisheries, the herring fishery would necessarily be managed under a more risk averse management regime. We recognize that if the policy was implemented to its full intent, it would be difficult to ascertain the knowledge requirements to undertake the fishery at all. But the policy provides important guidance on how to move the fishery so that ecosystem considerations become a primary focus.

The MCC believes that the fishery needs to be managed so that ecosystem requirements are the primary objective. This requires reducing the harvest risk profile which by proxy elevates the ecosystem considerations. The 2018/19 IFMP acknowledges that there is a "moderate likelihood that herring fisheries are driving the status of stocks" and that there is "a moderate to high potential to over-harvest in this fishery". This level of risk would necessarily be reduced through the lens of an ecosystem approach.

In this submission we are proposing five considerations toward a "low risk" ecosystem based fishery using the structure of the MSE and the more practical (i.e., implementable) principles of the SFF forage fish policy to guide our immediate recommendation for the 2019/2020 IFMP and provide context for future discussion and changes to management.

1. Increase the lower LRP to reflect an ecosystem based conservation objective

Upholding a minimum spawning biomass is a key principle of the *Policy on New Fisheries for Forage Species* (Principle 3) and a central aspect of any fisheries management regime. The present guiding conservation biomass objective of a lower limit reference point of $0.30B_0$ with 75-95% probability is too low a starting point for managing a forage fish species with an ecosystem based approach. Under the guidance of the SFF forage fish principles, the biomass LRPs should ensure both that *future recruitment of the target species is not impaired, and that food supply for closely linked or ecologically dependent marine predators is not depleted* (Principle 4).

There are no broadly accepted numerical translations of this principle to use as guidance. A reflection of this principle as a conservation objective using the current MSE would be something along the lines of $B_t > B_{ave}$ with a 75% or greater possibility under all plausible natural mortality scenarios. In other words, the overall conservation and lower limit reference point objective would be aligned to maintain the average long-term observed biomass of the herring population with a high degree of likelihood under modeled conditions.

We recommend that the Department re-evaluate the reference points and exploitation rates with an objective toward maintaining the average long-term biomass with a high degree of certainty.

2. Lower the exploitation rate

Pacific herring are currently managed with a target harvest rate of 20% of the spawning stock biomass. While this management approach may serve the purposes of managing herring as a conventional single species fishery, it is too high of a harvest rate and too rigid to meet the principles of ecosystem based fisheries management. Target exploitation rates approaching 20% may be appropriate under extremely high biomass and recruitment conditions in combination with other management procedures but in a scenario of declining biomass with poor in-season monitoring, this rate imposes a high risk of over-harvesting. Forage fish fisheries globally are managed with a wide range of exploitation rates, however those recognized as being more precautionary and ecosystem based have maximum rates around 12% (e.g., Norway herring, $F=0.05-0.125$). We recommend further exploration of appropriate management procedures and reference points that would utilize a linear decline ratio (i.e., hockey stick harvest rate) centred around meeting the conservation objective described above to reduce the likelihood of causing further declines to the spawning stock biomass. As further discussed in (4) below, the harvest rate needs to be adjusted to appropriate spatial scales of spawning locations.

3. Plan for a lower biomass and harvest rate until validated with in-season management

A continued criticism of the fisheries management system for herring is the lack of a dependable in-season methodology to validate the mid-range of the forecast used to determine the harvest. The 2019 season exemplified this problem. While forecast errors go in both directions, the consequences of an under-harvest do not compromise an ecosystem based conservation objective. Some accepted variability between the expected and actual spawning biomass is a reality of any fisheries model and management system. However, during a period of declining SSB and increasing natural mortality, as is

the current situation, overestimating the SSB can have negative long term consequences to the herring population and consequently their ecosystem role. A moderate risk of over-harvest is acknowledged by the Department's own risk assessment tool. In the absence of reliable in-season indicators, a lowered harvest rate as the starting expectation for the fishery is the only practical way to meet the conservation objective described above (1).

4. Assume there is a mechanism for persistent geographic population structure

One of the central objectives of the *Policy on New Fisheries for Forage Species* is the "maintenance of full reproductive potential of the forage species (including genetic diversity and geographic population structure, whether genetically resolvable or not)". The objective is not clearly reflected in the current management of Pacific herring. Understanding the implications of harvesting within the natural variation of spawning distribution over annual and longer time scales will not be resolved in the near future. Furthermore, a retrospective understanding of the extent of unique stocks, resident populations, and/or spawning locations is also unlikely to be easily resolved given the amount of effort already expended toward pursuing a widely held common understanding.

Management of herring must move forward with the precautionary understanding that there is at minimum semi-persistent spatial structuring of herring spawning locations. In the absence of reliable information, the most practical way of increasing the likelihood of maintaining spawning locations in the short term, is to maintain and add spatial closures but also reduce the overall harvest which by proxy will increase the likelihood of maintaining the mechanisms which contribute to the population structure. Assuming that there is some level of persistence in spawning locations based on genetic or behavioural mechanisms then the fishery should primarily target terminal spawning locations. The winter fishery may place additional risk to maintaining spawning locations as there is no way of knowing the final spawning area of these fish. In the longer term, a comprehensive approach to enable a distributed and reduced harvest across spawning locations is required.

5. Ecosystem and economy trade-offs

The herring fishery is unique in that unlike any other fishery on Canada's Pacific coast, there is a growing vocal public who recognize that there is a legitimate trade-off to consider between ecosystem and economic values. These trade off decisions are beyond the role of the IHHPC but are relevant and justified from a public resource point of view. The revised Fisheries Act enables the Minister discretion to consider "social, economic and cultural factors in the management of fisheries".

Canadian law is clear with respect to constitutional protections of First Nations, but for other end users, Canadian law and policy has no specific rules. Similar to the other aspects of implementing an ecosystem approach to herring discussed previously, there is no practical way of deciding what a moral, social and ethical end use of herring ought to be, who should benefit economically and how much economic benefit is worth the ecological trade off. Again, the best approach for these debates is to ensure that the fishery is rooted in an ecosystem approach with a greatly reduced risk profile and a long term conservation objective toward maintaining a high level of stock biomass with a broad spawning distribution.


Recommendation for 2019/20 Pacific Herring Integrated Fisheries Management Plan:

As an initial step toward a more ecosystem based fisheries management system we recommend Fisheries and Oceans Canada uses the modeled management procedure (MP) that would use a minimum escapement threshold and a harvest rate of 10% (MP#2) for setting the 2019/2020 Strait of Georgia total allowable herring catch. This harvest rate may be modified in subsequent years once a more entrenched ecosystem approach to management has been implemented and alternative harvest control rules have been decided. The recommended management procedure is consistent with the stock assessment forecast document that has acknowledged that a reduction to 10% is the most effective means of mitigating stock assessment errors.

The commercial industry and the Department do need to be recognized for their efforts for managing a conventional fishery, but as public values change, herring biology is better understood and ecological knowledge improves so must the Department's approaches to these complex issues. Management of herring requires the humility of accepting the notion that we understand less than we know, which leads to the recommendation to lower the risk profile of the fishery.

We recognize that the discussion points in this submission cannot be fully addressed for this year's IFMP and require subsequent conversations. For this year we recommend that the Department take a more precautionary harvest strategy as a step toward adopting an ecosystem approach to the fishery. We look forward to discussing these matters with you before the 2019/20 management plan is finalized.

Sincerely,



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