Fisheries and Oceans Canada
Pêches et Océans Canada

Cost Benefit Analysis of the Potential Impacts of Adding Thompson River Steelhead and Chilcotin River Steelhead (Oncorhynchus mykiss) to Schedule 1 of the Species at Risk Act as Endangered

June 2019

POLICY BRANCH, ECONOMIC ANALYSIS
FISHERIES AND OCEANS CANADA
PACIFIC REGION

A Cost Benefit Analysis on the Potential Impacts of Adding Thompson River Steelhead and Chilcotin River Steelhead (*Oncorhynchus mykiss*) to Schedule 1 of the *Species at Risk Act* as Endangered

PDF:
DFO/MPO
Cat. No. Fs66-5/180E-PDF
ISBN 978-0-660-31394-8
ISSN 1488-5441

Photo Credit: Fisheries and Oceans Canada / Pêches et Océans Canada

Correct citation for this publication:
Fisheries and Oceans Canada, 2019. A Cost Benefit Analysis on the Potential Impacts of Adding Thompson River Steelhead and Chilcotin River Steelhead (*Oncorhynchus mykiss*) to Schedule 1 of the *Species at Risk Act* as Endangered

Table of Contents

List of Figures

List of Tables

Executive Summary

Thompson River (TR) and Chilcotin River (CR) steelhead trout (*Oncorhynchus mykiss*) were emergency assessed as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in January 2018 and are currently under consideration for addition to Schedule 1 of the *Species at Risk Act* (SARA) as Endangered on an emergency basis. A cost-benefit analysis (CBA) was undertaken to inform decision makers on the impacts of a decision to List Thompson River Designatable Unit (DU), List Chilcotin River DU or List both DUs.

Over the last three generations, the decline of steelhead trout spawners has been 79% for the Thompson River Designatable unit (DU), and 81% for the Chilcotin River DU (DFO, 2018). Without improvements to productivity, the simulation results in the Recovery Potential Assessment (RPA) suggest the Thompson River DU population will likely continue to decline.

Anthropogenic threats to the CR/TR DUs include direct and indirect mortality from fishing (i.e. recreational, commercial, First Nations and science activities), physical habitat degradation (bank erosion, siltation, loss of riparian structure and function) and water quality/pollution in the mouth of the Fraser River estuary (DFO, 2018).

Following the COSEWIC Emergency Assessment, a 27-day closure window in select areas were implemented for commercial, First Nations and recreational fisheries as well as extended closure times for recreational fisheries in the Thompson River through a BC provincial variation order. Further, while harvest of TR and CR steelhead for FSC purposes is not known, Tsilhqot'in National Government announced a voluntary closure of their FSC fishery targeting steelhead on the Chilcotin in March 2018[1].

The possible alternatives for future management of TR and CR DUs include a proposal to Do Not List (scenario 1), or List under SARA as Endangered (scenario 2). Listing includes measures to address SARA prohibitions and other requirements such as recovery planning and critical habitat identification. There are no incremental measures suggested under a Do Not List scenario (scenario 1), which maintains the baseline. Therefore, this analysis provides an overview of the principal impacts that could arise in the event that Thompson

[1] For further details please see Tsilhqot'in Nation website for further details. Last accessed December 2018. http://www.tsilhqotin.ca/Portals/0/PDFs/2018_03_20_SteelheadClosure.pdf

River steelhead DU and the Chilcotin River steelhead DU are listed[2] under SARA[3]. Table A outlines the impacts of listing one or both Chilcotin River DU and/or Thompson River DU under scenario 2.

This CBA is informed by the 2018 DFO Science Advisory Report, *Recovery Potential Assessment (RPA) for Chilcotin River and Thompson River Steelhead Trout (Oncorhynchus Mykiss) Designatable Units*. The RPA provides the science basis for determining the recovery potential and associated benefits of a listing decision and defines whether recovery is achievable and under what circumstances [4]. The RPA provides population projections that use three estimates of future population productivity (1 year, 5 year and 10 year) under various exploitation rates and examines the recovery potential of each DU over 6 generations. The RPA suggests that the most likely productivity projection (2b) is the 1 year mean projection (DFO, 2018: 10). The 5 year mean productivity model (2a) is the most optimistic for recovery of CR DU. And, the 10 year productivity model (2c) is the most optimistic for probability of growth of TR DU[5]. The current exploitation rate is unknown but is expected to be at or below 25% and the exploitation from recreational, commercial and First Nations fisheries under a Listing decision is expected to be zero due to SARA prohibitions[6].

Costs

The present value of total monetized costs of listing are estimated to range between $190.3m to $254.0m over a 20 year period (discounted at 7%) or an annualized value of $17.9m to $24.0m. While some use and non-use costs can be easily monetized, other impacts such as cultural, social and spiritual values of Indigenous Peoples could not be quantitatively valued but are likely to be significant. This CBA acknowledges that loss of access to traditional food sources and the practices associated with the harvesting,

[2] The costs and benefits of "listing under SARA" denote the impacts of the mitigation measures identified under the SARA List management scenario.
[3] This CBA assesses incremental impacts which are determined by comparing the anticipated outcomes of potential measures that have not yet been implemented (as described in the management scenarios) with the outcomes from measures already in place or committed under the baseline.
[4] The RPA suggests a recovery target for Thompson River DU of 938 spawners with distribution maintained in each of the five sub-areas. For the Chilcotin River DUs, the recovery target is identified to be between 562 – 744 spawners distributed over the two sub-areas.
[5] The scope of the CBA is the management scenarios. The management scenarios only propose measures to address human induced threats. Therefore, only the probability models that relate to the threats explored in the RPA (i.e. not limiting factors), are considered relevant to the CBA. Should management measures change, the costs and benefits would also differ.
[6] The management scenarios suggest that section 73 permits will not be issued to commercial, recreational or First Nations fisheries. As such, the exploitation rate from fisheries is expected to be zero under a SARA listing decision. The CBA does not assess the efficacy of the management scenarios.

management and monitoring of these resources could have far reaching impacts on identity, culture, language, knowledge, governance, and self-sufficiency, for example.[7] Assessing impacts from loss of food for nutritional purposes represents only a small fraction of potential impacts to Indigenous peoples, providing a lower bound of costs to help determine the scale of potential impacts (i.e. low or high)."

The present value of monetized costs of Listing CR and TR DUs for First Nations food replacement for nutritional purposes only would be between $17.1m to $23.9m over a 20 year period (discounted at 7%) or an annualized value of $1.6m to $2.3m. Sensitivity analysis was undertaken to examine the possibility of higher replacement values for food and/or higher forgone food in First Nations fisheries.

The present value costs for the commercial and recreational sectors (including First Nations commercial fisheries, lodges, charters, and processors) are estimated to be between $173.2m to $230.1m per year in 2016 dollars (or an annualized value of $16.3m to $21.7m) irrespective of whether only one DU is listed or if both TR DU and CR DU are listed.

Further, there may be additional costs to proponents with projects occurring near freshwater. Proponents of activities that could result in harm to steelhead, or its habitat, could potentially incur costs <u>if</u> (i) mitigation beyond that required to avoid *serious harm to fish* (i.e. *Fisheries Act*) is required; (ii) SARA permits are required of proponents that did not previously need DFO review; or, (iii) insufficient allowable harm is available to permit on-going or future activities. All three considerations would apply under a Listing (scenario 2) decision. However, information on which proponents and/or projects may need mitigation was not available for this analysis; hence, costs cannot be assessed. Finally, First Nations and the Province of B.C. could incur low direct and in-kind costs to participate in collaborative processes in the support of management of steelhead. The federal government may also incur costs from existing funds to support research, preparation of recovery documents and administrative activities related to reducing potential impacts on steelhead habitat; these are not incremental costs.

[7] DFO recognizes that a CBA, other than for quantifying the replacement value of food, may not be the appropriate framework to assess the impacts on First Nations cultural and social values, traditions and practices. The CBA is only one input into the overall decision process which may consider more customized information provided by Indigenous Peoples. Hence, the Species at Risk Program undertook a parallel process to gather information on non-consumptive values, such as cultural, social and historical significance of steelhead and salmon which will be impacted.

Benefits

Measures under the SARA list scenario include prohibitions on activities that result in the killing, harming or harassing, or capturing (among others) of steelhead including all fishing. Therefore, it is reasonable to assume that there would be a further reduction of steelhead mortality, beyond what will be achieved under the baseline. A Recovery Strategy and a subsequent Action Plan would also be developed. Usually, the implementation of the measures outlined in these documents provide additional benefits as they identify critical habitat, outline measures to recover the species that could also result in faster recovery of the species and raise the profile of the species.

Incremental direct use benefits would occur if recovery measures for TR and CR steelhead result in higher future targeted harvest opportunities (for recreational fisheries or First Nations FSC fisheries) than those suggested by the baseline, or if recovery measures result in a change of species status to a lower risk level, and/or if recovery is achieved at a faster pace. In this case, the management scenarios are static and do not suggest potential for higher direct use of the species after recovery is achieved[8]. And, while recovery is unlikely under the most likely productivity model (i.e. 1 year mean productivity), for either TR or CR DU (i.e., suggested to be 1% and 0%, respectively), the most optimistic model (the 5 year mean productivity) suggests that recovery of CR DU under a Listing is possible. Hence, sensitivity analysis was undertaken to explore if adaptive management following recovery resulted in a change in the scale of impacts. Specifically, benefits of direct use increases in the recreational fishery and market benefits of recovery for the commercial salmon fishery where steelhead are intercepted, were explored. Also, changes in consumptive and non-consumptive benefits for First Nations FSC are discussed. Results show sensitivity analysis assuming higher use values after recovery under the most optimistic scenario (i.e. 5 year mean productivity) do not alter to scale of impacts.

In addition to direct use benefits, if measures lead to recovery or if abundance increased or if growth is expected, incremental benefits for Canadians more broadly would result from changes to ecosystem goods and services supported by steelhead (i.e. indirect use), as well as option and non-use benefits such as bequest and existence values. Several studies are available to help monetize the non-market benefits of steelhead recovery.

Wallmo and Lew (2016) compared regional and national household values for recovering Southern California steelhead which is considered endangered under the US *Endangered Species Act* (ESA). In that study, respondents were asked to choose their most and least

[8] See recovery target discussion in the Recovery Potential Assessment (DFO, 2018: 8) for definition of recovery for each DU.

preferred options to improve the *Endangered Species Act* (ESA) listing status of one or more species, including options that would result in incremental costs to households over a ten year timeframe. The national estimated mean willingness-to-pay for the Southern California steelhead ranged from USD $66.29 - $75.96 in 2013 $s per household over ten years. After adjusting for the exchange rate[9] and inflation, the range is from CAD $69.44 to CAD$79.57 (in 2016 $s). This shows that if recovery is achievable, the economic benefits would be significant.

The Recovery Potential Assessment indicates that the most likely productivity model is the current, 1 year model (DFO, 2018). Under the 1 year model (scenario 2b), the RPA suggests that recovery of either CR and/or TR DUs is not achievable (0% and 1% probability of recovery, respectively) under zero exploitation. In other words, the 1 year model suggests that if all fishing activity that resulted in direct or incidental harm to CR and TR steelhead ceased (commercial salmon fishing, First Nations fishing and recreational fishing), there is a 0% to 1% probability that the species would reach the recovery target set out in the RPA. The probability of increased abundance is also unlikely as the RPA suggests that the probability of achieving species' growth in the next 6 generations is 0% and 4% under zero fishing mortality, for CR and TR DUs respectively. Hence, benefits are not anticipated for either DU under 2b. Further, economic benefits associated with increased abundance (i.e. ecosystem service benefits) are also not anticipated for either CR or TR DUs as the probability of growth is poor. Therefore, under the most likely productivity model, it is expected that there may be only negligible economic benefits associated with Listing CR and TR DUs. These benefits could occur from raising the species profile by adding it to SARA, increased monitoring, and research to identify critical habitat to address threats in fresh water, for example, should these actions reduce mortality beyond what is achievable under zero fishing exploitation. Further, there may be additional funding opportunities for SARA listed species through the Habitat Stewardship Program (HSP) and the Aboriginal Fund for Species at Risk (AFSAR). These projects could aid in First Nations capacity building and may provide incremental economic benefits, if mortality was reduced or productivity increased as a result of projects implemented under these programs. Incremental measures to increase steelhead productivity through reducing limiting factors are not included in the management scenarios[10]. Hence, these are not examined in this CBA.

Alternatively, the potential economic listing benefits could be higher under the more optimistic productivity models, i.e. the 5 year and 10 year productivity models, explored in

[9] See https://fred.stlouisfed.org/data/EXCAUS.txt for the average annual exchange rate of 1.029 in 2013.
[10] According to the RPA Table A2.p.g 23, limiting factors for productivity include altered ocean and freshwater conditions, predation, competition and parasites or pathogens. As the scope of the CBA is determined by the management scenarios, the CBA does not explore recovery impacts under alternate measures not considered in the scenarios.

the RPA. The economic benefits could be significant under scenario 2a (the 5 year mean productivity model). This model suggests that, in addition to incurring some unknown but positive ecosystem benefits of higher steelhead abundance, incremental non-market recovery benefits from SARA Listing the Chilcotin DU would incur in 2 generations with a high (97%) probability under zero exploitation. Based on the Wallmo and Lew (2010) study, it is reasonable to assume that Canadians could place a much higher non-market value on steelhead recovery than would be required for benefits to equal monetized costs. Based on the estimated incremental costs of the Listing decision, Canadians' WTP for steelhead recovery would need to be $1.80 to $2.41 per household, per year for 10 years to equal the incremental costs if both CR and TR DU were listed or if only CR DU was listed. This value is well below the WTP value for steelhead recovery estimated in the Wallmo study which ranges from about CAD $69.44 to CAD$79.57 per household, per year for 10 years. However, the 5 year productivity model shows that recovery is not expected for the TR DU. And, while there may be unknown but positive ecosystem benefits expected from increased growth of TR DU, the probability of growth at a zero exploitation rate under Listing is low (41%).

The 10 year productivity model (2c) is the most optimistic for the TR DU. While probability of recovery is low (17%) under zero exploitation, this shows high probability of growth for TR DU (81%). Similarly, while recovery benefits are not anticipated for CR DU due to low probability of recovery (33%), there is a high probability of growth for CR DU (88%) under the 10 year mean productivity model. Therefore, there may be some unknown positive economic benefits associated with higher abundance and distribution for both DUs under this model, including higher ecosystem benefits compared to the baseline.

Sensitivity Analysis

As mentioned above, sensitivity analysis was undertaken on the benefits of faster recovery under 2a to see the effect on the scale of impacts. The recreational fishing benefits of recovery could range depending on the level of historic CR DU steelhead recreational fishing in the mainstem and Chilcotin River that could be reinstated at, i.e. angling similar to 10 years ago, 20 years ago or 30 years ago. Sensitivity analysis shows that if recovery of CR DU steelhead were to allow an all-time high level of recreational fishing effort as was realized 30 years ago, the recreational economic benefits could be up to $7.6m present value (over 7 years[11]). If effort returned to levels that occurred 20 years ago, the benefits would be lower (i.e. up to $2.4m present value over 7 years if harvest levels 20 years ago could be re-established). Angling levels 10 years ago were lower than CR DU angling in

[11] If recovery is achieved in 13 years under the scenario 2c assumptions, then the present value market benefits are calculated for the remaining 7 years of the analysis timeframe (i.e. 20 year analysis timeframe).

2016. This sensitivity analysis shows that alternate management following recovery does not materially change the expected scale of impacts under scenario 2c (i.e. the level of willingness to pay (WTP) for faster recovery required to break-even with costs remains similar). Similarly, sensitivity analysis on the cost savings (i.e. benefits of reduced costs) of recovery after 13 years for commercial sector and consumptive and non-consumptive benefits for FSC fisheries only minimally changes the required break-even WTP (where benefits equal monetized costs) for recovery to $1.57 to $2.08 (compared to $1.80 and $2.41). This sensitivity examines assumptions that allow for the prohibitions to be lifted prior to the end of the 20 year timeframe used in this analysis; thereby, reducing the costs for commercial fisheries and FSC food fisheries that would otherwise continue to incur costs beyond 13 years. Under this sensitivity analysis, the incremental present value cost savings for commercial fisheries (including EO/Demo/ESSR fisheries) and First Nations food fisheries under 2a (5 year productivity) could be up to $27.9m present value (i.e. present value costs of Listing the CR DU only would be $27.9m lower) as a result of a shorter recovery timeframe. Cost savings would not be realized for the commercial and First Nations food fisheries if listing only the TR DU or listing both the CR and TR DUs. Under this sensitivity analysis, costs would be between $23.5m and $34.4m lower (or present value of $166.8m to $219.6m over 20 years)

On the costs side, sensitivity analysis was also undertaken to examine the possibility of higher replacement values for food and/or higher forgone food in First Nations fisheries. While the intent of this CBA is to provide a scale of impacts to decision-makers, it is important to note that there may be several reasons that the estimate of harvest in closures periods could under represent actual FSC harvest. Therefore, these estimates should be used mainly as a way to understand the scale of food replacement impacts (i.e. low (<$1m annualized) and high (over $1m annualized)). Sensitivity analysis was undertaken to see what the impacts would be if base case harvest levels were increased by 10% and 20% or if replacement costs were 25% and 50% higher to account for any underestimation of food replacement costs. The present value loss is estimated to be between $2.4m to $3.3m and between $4.8m and $6.6m, respectively under the 10% and 20% harvest adjustments. Further, the present value of the loss is estimated to be between $6.0m to $8.3m and between $12.1m and $16.6m under 25% and 50% retail price adjustments, respectively. While higher overall costs would be expected under the sensitivity analysis, the scale of impacts which is already shown to be significant does not change.

Conclusion

Under **2b** (1 year mean productivity), the most likely mean productivity model, there may be some positive but negligible economic benefits of Listing associated with other recovery

activities (e.g. increased research on threats in freshwater, prohibitions on projects that result in harm in freshwater, higher monitoring, raising the profile of the species, etc.), should these activities reduce mortality beyond what is expected from zero fishing exploitation. However, recovery and/or increased abundance of either TR or CR steelhead are not anticipated as a result of zero fishing mortality, as per the RPA.

Under the two alternate productivity models, economic benefits would be higher compared to what is achievable with zero fishing mortality under the most likely productivity model (2b). Under the most optimistic of these other two models (**2a**, using a 5 year mean productivity), the economic benefits of Listing could be significant and are associated with recovery of CR DU as a result of zero fishing exploitation, ecosystem service benefits due to increased species abundance and additional potential benefits from other recovery activities (as noted above for 2b). And, while the economic benefits are significant under the most optimistic model, given the high monetized costs of $190.3m to $254.0m present value ($17.9m to $24.0m annualized; 20 years at 7%) and likely significant non-monetized costs (i.e. First Nations non-consumptive values), Canadians would need to place a high value on recovery of steelhead for net benefits to be realized.

For the benefits to equal the monetized costs, WTP for recovery would need to be $1.80 to $2.41 if listing both TR and CR DUs or listing TR DU only. These values are well below the WTP values estimated in the Wallmo and Lew (2010) study (estimated to range from about CAD $69.44 to CAD$79.57 per household). This suggests that the monetized benefits far exceed the monetized costs under 2a. However, it is not possible to assess whether these high non-market benefits exceed the total costs of Listing including the likely significant non-monetized costs related to First Nations food, social and ceremonial values that will be impacted by a Listing decision.

Under scenario **2c** (10 year mean productivity), recovery benefits for TR/CR DUs are not anticipated. However, there will likely be positive but unknown economic benefits associated with greater abundance of TR DU which are incremental to benefits described under 2b. As well, additional ecosystem services benefits which greater species abundance provides will also occur. Overall under 2c, market benefits are not anticipated and non-market benefits, while positive, are anticipated to be lower than under 2a but higher than the most likely productivity model (2b).

In conclusion, the monetized costs under all the list scenarios (i.e. list CR only, list TR only or list both DUs) and each productivity assumption falls in the high range (above $100m present value over 20 years) irrespective of whether one or both DUs (TR and CR) are listed. However, the economic benefits differ under the relevant productivity parameters

and vary under each Listing option (i.e. List CR DU only, List TR DU only or List Both DU's). While the economic benefits are likely to be positive under all three models, they are likely negligible under the most likely probability model (2b) and the highest under 2a due to the high probability of recovery of the CR DU under this productivity model. The economic benefits are significantly higher than the monetized costs under 2a given the significant non-market benefits associated with steelhead recovery. However, as the non-monetized costs (i.e. First Nations non–consumptive values) are also expected to be significant, net benefits of Listing cannot be determined under the most optimistic model (2a).

Under the most likely productivity model (2b), economic benefits, while positive, are the lowest of all productivity assumptions. In 6 generations, the most likely productivity model shows that if all commercial, first nations and recreational fishing activity affecting these two steelhead DUs ceased, the probability of recovering CR and TR DUs would be 0% and 1%, respectively. Further, the probability of growth of these DUs also remains very low (4% for TR DU and 0% for CR DU) under productivity assumptions that the Recovery Potential Assessment deems as the most likely productivity. Considering the most likely productivity model of 1 year mean productivity (2b), Listing CR and TR DUs is expected to result in negligible non-market benefits with significant monetized and non-monetized costs. This CBA examines impacts over 20 years, or roughly 3 generations[12]. If impacts were assessed over a longer time frame, for example over 40 years, the resulting costs would be higher under the most likely productivity model while the benefits would remain the same, i.e. negligible[13]. Overall, given the low probability of species recovery and high monetized and non-monetized costs, it is unlikely that net economic benefits would result under 2b. Net economic benefits under 2a and 2c are unknown.
There are no incremental costs or benefits associated with the Do Not List scenario, as no additional management measure would be undertaken in addition to those already in place under the baseline. Therefore, analysis was not conducted for the Do Not List scenario.

[12] One generation for TR and CR DU is 6 year and 7 years, respectively.
[13] The Recovery Potential Assessment for Chilcotin and Thompson River Steelhead only provides information on species future potential for recovery up to 6 generations (or 36 and 42 years for TR and CR, respectively). Therefore, potential for recovery benefits beyond this timeframe under the model described in the RPA as "the most likely" productivity model cannot be assessed.

Table A: Cost-Benefit Statement – Listing Scenario 2 with Scientific Permits for Both TR and CR Steelhead DUs (unless otherwise specified) *(in Million 2016 C$)*

Incremental Costs and Benefits	1st Year Impacts	5th Year Impacts	10th Year Impacts	Last Year Impacts	Present Value over 20 years	Annualized over 20 years
A. Quantified Impacts $						
Incremental Costs $:						
Business/Industry						
• Commercial Salmon Fishery (discounted at 7% over 20 years)	7.2	5.5	3.9	2.0	82.0	7.7
• First Nation EO, Demo Fishery (discounted at 7% over 20 years)	0.3	0.3	0.2	0.1	3.9	0.4
• Seafood Processing Sector (linearly discounted at 7% over 10 years)	1.5	0.3	0	0	4.8	0.4
• Lodge/Charter Businesses (linearly discounted at 7% over 5 years)	6.9	0.2	0	0	16.2	1.5
Sub-Total	***15.9***	***6.3***	***4.1***	***2.1***	***106.9***	***10.0***
Canadians						
• Tidal Angler Surplus (linearly discounted at 7% over 3 years)	36.2 to 65.7	0	0	0	65.4 to 118.7	6.17 to 11.2
• Freshwater Angler Surplus (linearly discounted at 7% over 3 years)	0.5 to 2.5	0	0	0	0.9 to 4.5	0.08 to 0.4
• First Nations Food Replacement (discounted at 7% over 20 years)	1.5 to 2.1	1.2 to 1.6	0.8 to 1.1	0.4 to 0.6	17.1 to 23.9	1.6 to 2.3
Sub-Total	**38.2 to 70.3**	**1.2 to 1.6**	**0.8 to 1.1**	**0.4 to 0.6**	***83.4 to 147.1***	***7.85 to 13.9***
Total	**54.1 to 86.2**	**7.5 to 7.9**	**4.9 to 5.2**	**2.5 to 2.7**	**190.3 to 254.0**	**17.9 to 24.0**
B. Quantified Impacts in Non-$						
Negative Impacts:						
Business/Industry						
• Commercial Fish Harvester (including First Nations)	• Almost 1150 commercial marine vessel crew members will be impacted directly. Estimates of jobs impacted in EO/Demo fisheries are not available. • This translates to a 1 year direct household income impact of $4.2M for commercial harvesters (including First Nations EO/Demo fisheries).					
• Recreational Sector	• About 1171 direct jobs related to the recreational sector are expected to be lost with a 1 year income impact of $25.5M.					
• Seafood Processing Sector	• Approximately 120 direct jobs are anticipated to be lost with an associated 1 year income impact of approximately $4.2M for processing sector.					

Canadians	
• First Nation Groups	• About 51 and 93 First Nations groups harvest for Food Social, Ceremonial purposes in the South Coast and Fraser areas, respectively, that would be closed under Listing. • Further, additional impacts anticipated to other Nations. Nations may trade with those that directly harvest in affected areas or they may be gifted harvest from the affected closure areas.
Positive Impacts:	
Quantified Benefits of Steelhead Recovery	
Productivity Model 2b: 1 Year Productivity Model (Most Likely) Under zero exploitation mortality f rom fishing is expected to be 0% • TR DU: growth abundance is not likely at 4% probability in 6 generations and recovery not likely at 1% probability • CR DU: growth abundance is not likely at 0% probability in 6 generations years and recovery not likely at 0% probability	• The probability of Recovery of TR or CR DU is not anticipated under the 1 year mean productivity model. See "other qualitative impacts" for discussion of Listing benefits below in section "C. Qualitative Impacts".
Productivity Model 2a: 5 Year Mean Productivity Model (Best Case) Under zero exploitation mortality from fishing is expected to be 0% • TR DU: 41% probability of growth abundance in 6 generations and recovery not likely at 2% probability • CR DU: 100% probability of growth abundance in 6 generations and recovery is highly likely at 97% probability	***Applies to Only CR DU or Both TR and CR DU Listing Decision:*** • For the benefits to equal the monetized costs, WTP for recovery would need to be $1.80 to $2.41 for listing CR or both TR and CR DUs. • Based on values from Wallmo and Lew (2010), benefits of recovery far exceed this value (estimated to range from about CAD $69.44 to CAD$79.57 per household). This demonstrates that the monetized benefits of recovery under a listing decision are anticipated to be significantly higher than the monetized costs under this productivity model.
Productivity Model 2c: 10 Year Mean Productivity Model (Positive Growth) Under zero exploitation mortality from fishing is expected to be 0% • TR DU: growth abundance is likely at 81% probability in 6 generations and recovery not likely at 17% probability • CR DU: growth abundance is likely at 88% probability in 6 generations and recovery not likely at 33% probability	• Recovery of TR or CR DU is not anticipated under the 10 year mean productivity model. See "other qualitative impacts" for discussion of Listing benefits below in section "C. Qualitative Impacts".
C. Qualitative Impacts	
Positive Impacts:	
Productivity Scenarios – Steelhead Recovery and/or Growth Outcomes	
Productivity Model 2b: 1 Year Productivity Model (Most Likely) Under zero exploitation mortality from fishing is expected to be 0% • TR DU: growth abundance is not likely at 4% probability in 6 generations and recovery not likely at 1% probability	• Some positive but unknown economic benefits are anticipated as a result of additional recovery actions expected under listing (i.e. increased monitoring, reporting and prohibitions on activities in freshwater and raising species profile). Should these recovery measures lead to reduced mortality or increased productivity beyond what can be achieved through zero fishing exploitation, positive benefits would accrue. While benefits of these types of activities may be positive, they would likely to be negligible.

• CR DU: growth abundance is not likely at 0% probability in 6 generations years and recovery not likely at 0% probability	
Productivity Model 2a: 5 Year Mean Productivity Model (Best Case) Under zero exploitation mortality from fishing is expected to be 0% • TR DU: 41% probability of growth abundance in 6 generations and recovery not likely at 2% probability • CR DU: 100% probability of growth abundance in 6 generations and recovery is highly likely at 97% probability	***Applies to only TR DU Listing Decision:*** • Recovery of TR DU is not likely (2% probability). Hence, benefits of "recovery" cannot be ascribed. However, there is an increased probability of growth for TR DU compared to the baseline (going from 1% to 41%). However, probability of growth remains low. ***Applies to only CR DU Listing Decision:*** • There is a 97% probability of species recovery. The monetized benefits will be significant (see section B: Quantified Impacts in Non-$). • Canadians value not only a wildlife species itself, but also the ecosystem to which it contributes. However, benefits attributable to the role of Steelhead in ecosystem health are not known but are anticipated to be positive. ***Applies to Both TR and CR DU Listing Decision:*** • In addition to recovery benefits of CR DU and ecosystem service benefits of higher growth of CR DU (see section B: Quantified Impacts in Non-$), there is an increased probability of growth for TR DU. However, as the probability of growth is low (< 50%), hence, the probability of increased benefits related to higher abundance are also low for TR DU and may not be realized.
Productivity Model 2c: 10 Year Mean Productivity Model (Positive Growth) Under zero exploitation mortality from fishing is expected to be 0% • TR DU: growth abundance is likely at 81% probability in 6 generations and recovery not likely at 17% probability • CR DU: growth abundance is likely at 88% probability in 6 generations and recovery not likely at 33% probability	***Applies to only TR DU Listing Decision:*** • Recovery of TR DU is not likely (17% probability). Hence, benefits of "recovery" cannot be ascribed. However, there is an increased probability of growth for TR DU compared to the baseline (going from 8% to 81%). Canadians value not only a wildlife species itself, but also the ecosystem to which it contributes. However, benefits attributable to the role of Steelhead in ecosystem health are not known but are anticipated to be positive. • Therefore, the listing scenario may have some unquantified, positive impact on the abundance and distribution of steelhead. ***Applies to only CR DU Listing Decision:*** • There is an increased probability of growth (going from 6% to 88%), as a consequence there may be some unquantified, positive impact on the abundance and distribution of CR steelhead under the listing scenario. However, recovery would take longer than the 6 generation timeframe explored by the RPA. Hence benefits of "recovery" cannot be ascribed. ***Applies to Both TR and CR DU Listing Decision:*** • RPA suggests a low recovery potential of both DUs under this productivity model. However, the increase in probability of growth for Chilcotin and for Thompson shows there may be some unknown positive benefits associated with higher abundance and distribution of TR and CR DUs.
Negative Impacts	
Business/Industry	• Impacts to proponents with projects near water may be expected as s. 74 permits would not be made available for any projects that may incidentally capture, handle or harm CR or TR DU's. However, there was no information made available for this analysis on the types of projects that are occurring where steelhead can be found.
First Nations	• Based on the significance of salmon and steelhead, it is likely that any level of forgone FSC harvest will have significant (non-use) impacts on First Nations. As heard through consultations, the value of the steelhead is beyond measure to some Nations and their culture. Because of its prominence, prevention of salmon and steelhead harvest for those dependent on the resource, either for sustenance, ceremony, or economic well-being, would have major implications.

List of Acronyms and Abbreviations

2016$CAD: 2016 Canadian Dollars
AFS: Aboriginal Fisheries Strategy
ATP: Allocation Transfer Program
BC: British Columbia
BCSFR: British Columbia Sport Fishing Regulations
CAD: Canadian Dollars
CBA: Cost Benefit Analysis
CDR: Cabinet Directive on Regulations
CFE: Commercial Fishing Enterprise
COSEWIC: Committee on the Status of Endangered Wildlife in Canada
CPI: Consumer Price Index
CR: Chilcotin River
CVM: Contingent Valuation Method
Demo: Demonstration
DFO: Department of Fisheries and Oceans
DMP: Dockside Monitoring Program
DU: Designatable Unit
EA: Emergency Assessment
EBITDA: Earnings Before Taxes, Depreciation and Amortization
ECCC: Environment and Climate Change Canada
EO: Economic Opportunity
ESA: Endangered Species Act
ESSR: Excess Salmon to Spawning Requirements
FGR: Fishery (General) Regulations
FN: First Nation
FSC: Food, Social and Ceremonial
FTE: Full Time Equivalent
GDP: Gross Domestic Product
GiC: Governor in Council
GPV: Gross Processed Value
HA: Harvest Agreement
I/O: Input-Output
IFMP: Integrated Fisheries Management Plan
iREC: Internet Recreational Effort and Catch survey
KG: Kilogram
km: Kilometre

LFR: Lower Fraser River
M: Million
N/A: Not Applicable
NAICS: North American Industry Classification System
PFMA: Pacific Fisheries Management Area
PFR: Pacific Fishery Regulations
PICFI: Pacific Integrated Commercial Fisheries Initiative
PSR: Post Season Review
RIAS: Regulatory Impact Analysis Statement
RPA: Recovery Potential Assessment
RUVD: Recreation Use Values Database
SARA: Species at Risk Act
SSCP: Steelhead Stream Classification Policy
TAC: Total Allowable Catch
TBS: Treasury Board Secretariat
TCM: Travel Cost Method
TR: Thompson River
US: United States
WCVI: West Coast Vancouver Island
WTP: Willingness-to-pay

1. Introduction

1.1 Context

As a result of international commitments under the United Nations Convention on Biological Diversity[14] and, subsequently, the Canadian Biodiversity Strategy, the *Species at Risk Act* (SARA, the Act) was enacted in Canada in 2003. The Act aims to prevent Canadian wildlife species from becoming extirpated or extinct, to provide for the recovery of extirpated, threatened or endangered species and to encourage the management of other species of special concern to prevent them from becoming further at risk. Under the Act, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was established to advise the Canadian government on the status (Special Concern, Threatened, Endangered, Extirpated or Extinct, as per the Act) of wildlife species.

COSEWIC performed an emergency assessment of the Thompson River and Chilcotin River steelhead trout populations (or Designatable Units [DUs]) and designated them both as endangered. As required by the Act, the Government of Canada is undertaking an emergency process to determine whether or not to list either or both of these DUs on Schedule I of SARA.

Endangered status indicates a wildlife species that is facing imminent extirpation or extinction. Once a species is listed as Endangered, it benefits from legal protection and other requirements under SARA (e.g., recovery documents, critical habitat identification).

Under the emergency listing process, the Minister of Environment and Climate Change Canada (ECCC) must first form an opinion on the imminent threat to each of the Thompson River steelhead trout DU (TR DU) and Chilcotin River steelhead trout DU (CR DU). If the Minister of ECCC is of the opinion there is an imminent threat to the survival of one or both of the Thompson River or Chilcotin River steelhead trout populations, a recommendation is made to Governor in Council (GiC) that the population(s) be listed on an emergency basis. Following such a recommendation, the GiC makes the final emergency listing decision. To reach a decision, the GiC considers scientific information and Indigenous knowledge provided by the Minister of ECCC, and may consider additional information including: alternative management activities that would mitigate threats to the species in question; a cost benefit analysis of the potential impacts of the alternatives; and, the results of any consultations with Indigenous Peoples and stakeholders.

[14] United Nations (1992), Convention on Biological Diversity

1.2 Purpose of Study

This report provides an overview of the principal costs and benefits that could be expected to arise for Canadians and the Canadian economy if one or both of the TR and/or CR DUs are listed under the *Species at Risk Act* (SARA), or if one or both of the DUs remain under existing legislation (e.g. *Fisheries Act*).

Listing a species under the SARA requires a regulatory order and, thus triggers the need for a cost-benefit as per the Government of Canada (2018) *Cabinet Directive on Regulations* (CDR). The CDR requires an analysis of the costs and benefits of regulations. For a regulatory action where the costs are anticipated to be significant, the Regulatory Impact Analysis Statement (RIAS) requires a robust quantitative assessment of the expected benefits and costs.[15]

A cost-benefit analysis (CBA) identifies, quantifies and monetizes where possible, the incremental economic costs and benefits of the proposed management scenarios (or alternatives) on participants in the commercial, recreational and Indigenous fisheries, as well as all Canadians. Impacts are described qualitatively where they cannot be quantified. Incremental impacts were determined by comparing the anticipated outcomes under the management scenarios to outcomes anticipated under the baseline, which includes management measures that are already in place or committed to under existing legislation (i.e. the 2018 measures). The management scenarios are analyzed as presented (i.e. this analysis does not assess the effectiveness of the measures outlined in the scenarios in the recovery of Thompson and Chilcotin River steelhead, nor the likelihood of implementation of specific actions). Should measures proposed in the management scenarios change due to additional Science information, the costs and benefits would also be different. For each DU two alternatives are considered:

1) to not add the DUs to Schedule 1 of SARA (Do Not List scenario 1);
2) to add the DUs to Schedule 1 as an endangered species with permits for science activities and test fisheries (scenario 2: List with scientific permits);

As the Do Not List scenario presents no additional measures to the baseline measures already implemented, there are no incremental impacts to assess under scenario 1.

[15] The Treasury Board Secretariat uses a triage system to suggest scales of analysis proportion to potential impacts. Triage statement (*http://www.tbs-sct.gc.ca/rtrap-parfa/temp-gabar/tsf-fet-eng.asp*). Regulatory proposals expected to impose $1 million or more in average annual costs are considered significant-cost-impact proposals. Departments are to quantify and monetize both costs and benefits for such proposals. If it is not possible to quantify the benefits or costs, a rigorous qualitative analysis of costs or benefits of the proposed regulation is required, with the concurrence of TBS.

Further, an additional list scenario, (scenario 3) was also initially discussed. However, the management details were not further developed to allow for an assessment of this Listing alternative.

Under scenario 3, s. 73[16] permits would not be issued for scientific activities, or for other incidental fisheries. Under scenario 3, test fisheries that are likely to intercept Thompson and Chilcotin River steelhead are assumed to close for the 60 closure window. If the inability of salmon test fisheries to continue operating in the 60 day period results in further closures of salmon fishery areas that would otherwise be unaffected (under scenario 2), the cost could be higher. Further, if research gaps in abundance estimates required lower coast wide salmon TACs to ensure for conservation under this scenario, this would also result in additional costs. Finally, there may also be economic consequences for International Treaty obligations. However, as no information on how temporal displacement of the test fisheries would impact fisheries is provided, an assessment of this Listing alternative is not possible. As such, this scenario is not further explored. Generally, it can be assumed that the impacts under this scenario would be incremental to scenario 2 and associated impacts could vary but are expected to remain high.

2. Species Background and Threats

This section summarizes key points about the species considered relevant to this socio-economic analysis and is based on the assessment (COSEWIC, 2018) and the 2018 Recovery Potential Assessment for Chilcotin River and Thompson River steelhead trout DUs (DFO, 2018). Please consult the referenced documents for original citations and analysis.

2.1 Species Assessment

In January 2018, COSEWIC conducted an emergency assessment of Thompson and Chilcotin River steelhead trout due to a public request. Both Designatable Units (DUs) were assessed as Endangered[17].

[16] Section 73 and 74 of the *Species at Risk Act* (SARA) addresses the powers of the Minister to enter into an agreement or issue a permit to authorize activities affecting a listed wildlife species, or its critical habitat, or its residences. *See:* *https://laws-lois.justice.gc.ca/PDF/S-15.3.pdf*

[17] COSEWIC Assessment can be accessed at: *http://www.cosewic.gc.ca/rpts/detailed_species_assessments_e.html*

The reason for designation of the Thompson River population is:

> "This species faces a number of threats, including declining habitat quality both in marine and freshwater environments, and bycatch mortality from Pacific salmon fisheries. The number of spawning fish was variable with little trend prior to 2000. Since then, the population has declined dramatically (79%) over the last three generations and it is now the lowest on record. The 177 mature fish observed in the most recent survey are only about 9.5% of the pre-2000 mean. If the current rate of decline persists for another three generations, the number of spawning fish will decline to 37, which is 2.0% of the pre-2000 abundance." (COSEWIC, 2018: 2)

The reason for designation of the Chilcotin River population is:

> "This species faces a number of threats, including declining habitat quality both in marine and freshwater environments, and bycatch mortality from Pacific salmon fisheries. The population has declined dramatically (81%) over the last three generations and it is now the lowest on record. The number of spawning fish was variable with little trend prior to 2000. The 58 mature fish observed in the most recent survey are only about 5% of the pre-2000 mean. If the current rate of decline persists for another three generations, the number of spawning fish will decline to 11, which is 0.9% of the pre-2000 abundance." (COSEWIC, 2018: 2)

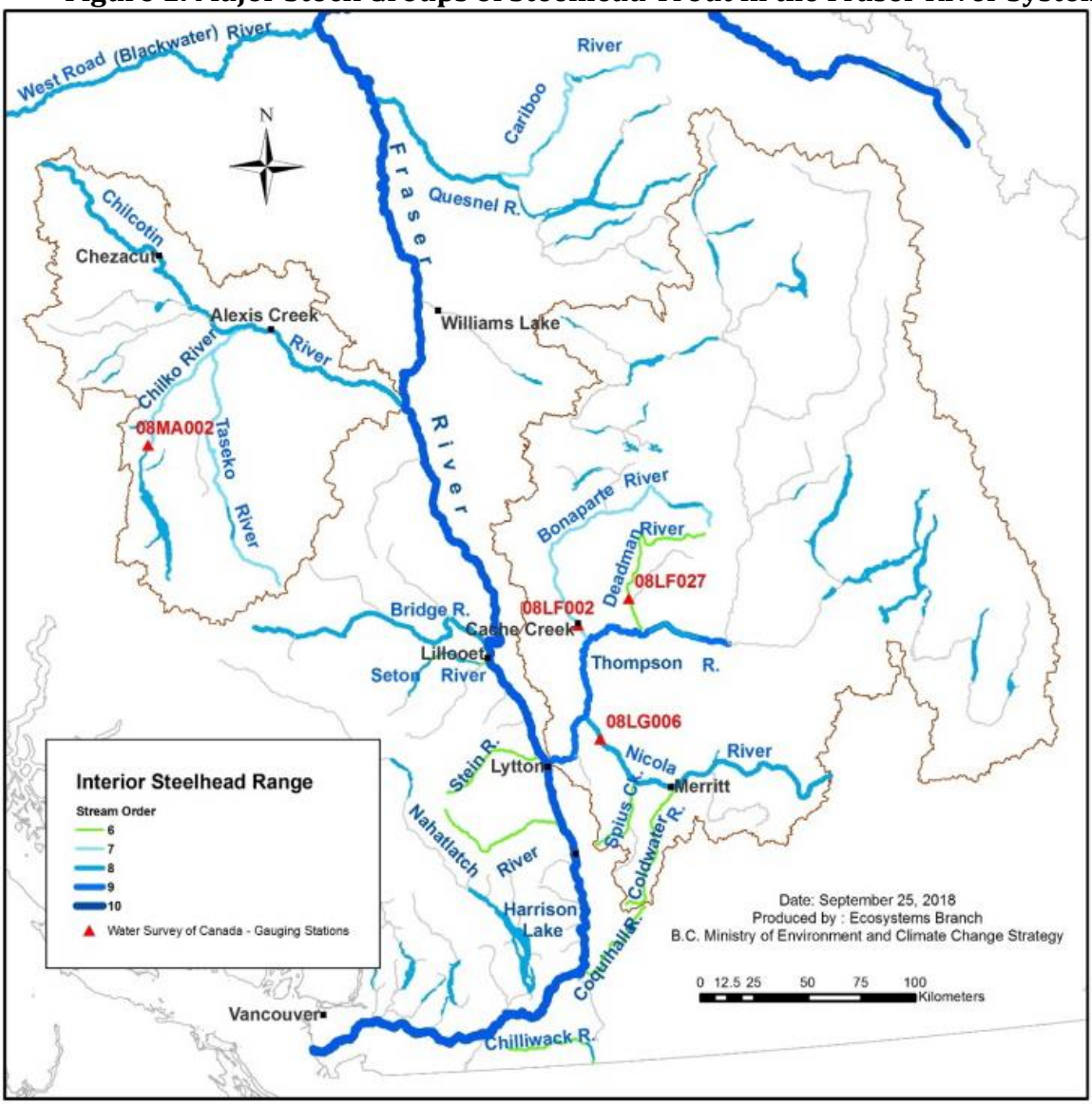
2.2 Species Profile

In North America, the common name for the fresh water type of *Oncorhynchus mykiss* (resident) is rainbow trout and steelhead for its ocean run type (anadromous). It is estimated that in BC there are over 400 wild, locally adapted stocks of steelhead (FLNRO, 2016). These stocks comprise three ecotypes: coastal summer, coastal winter and interior summer. Coastal winter steelhead ecotype is the most common for BC. Coastal steelhead stocks are those that generally migrate less than 150 km upstream whereas inland stocks migrate on distances higher than 150km. The major steelhead producing areas in BC are: Vancouver Island, Haida Gwaii, Fraser, Thompson, Dean, Skeena and Nass Rivers (BC MOE, 2016). Most steelhead stocks in BC originate from small and relatively unproductive systems (FLNRO, 2016).

Thompson and Chilcotin River steelhead are genetically discrete from all other steelhead trout in Canada and also differ from each other (DFO, 2018). There are 11 spatially discrete spawning areas. In the Thompson River watershed, the spawning areas include the Nicola River downstream of Nicola Lake, the Bonaparte River downstream of Young Lake, and the Deadman River downstream of Mowich Lake and its tributary Criss Creek. The spawning

areas in the Chilcotin watershed include in the Chilko River, the Taseko River downstream of Taseko Lake and its tributary Elkin Creek (DFO, 2018). Figure 1 shows the range of the major stock groups of steelhead in the Fraser River.

Figure 1: Major Stock Groups of Steelhead Trout in the Fraser River System



Source: Recovery Potential Assessment for Chilcotin River and Thompson River steelhead trout (*Oncorhynchus mykiss*) designatable units (DFO 2018, pg. 1)

2.2.1 Species Residence

Under the Species At Risk Act (SARA), a residence is defined as "*a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating*" (s.2(1)). The Directive on the Application of SARA Section 33 (Residence) to Aquatic Species at Risk uses a set of conditions to determine when the concept of a residence applies to an aquatic species. Based on the guidelines, redds produced during spawning most closely match the criteria for a residence because they are constructed (DFO, 2018). Redds have a structural form and function of a nest, the female has invested energy in its creation, redds are essential for successful incubation and hatching of the eggs, and redds can contain hundreds to several thousand eggs from a female steelhead trout.

2.2.2 Population Trends

One generation, or the maximum age-at-return, is six years for Thompson River DU and maximum age-at-return is seven years for Chilcotin River DU (DFO, 2018). Historically, the peak emergence of Thompson River steelhead has been occurring from mid-June to early July. In the last 3 decades, the DUs of Thompson and Chilcotin River steelhead have been following a downward trajectory (Levy and Parkinson, 2014). In 2017, the Province of BC forecasted that the total spawning forecast for steelhead in Thompson River would be 165 fish and 50 fish for Chilcotin River[18] (Pacific Marine Conservation Caucus, November 23, 2017).

2.2.3 Threats

The RPA has defined threats as any anthropogenic activity or process that has caused, is causing, or may cause harm, death or behavioural changes to a species, or the destruction, degradation, and/or impairment of its habitat, to the extent that population – level effects occur (DFO, 2018, 17). This section outlines the threats to TR and CR DUs[19].

By-catch in Commercial Fisheries

There are no directed commercial fisheries for TR/CR DU steelhead trout in BC but there is bycatch of returning mature fish commercial salmon fisheries, particularly associated with commercial chum and sockeye fisheries (COSEWIC, 2018). However, bycatch rates vary by

[18] These estimates of steelhead abundance are based on Thompson River monitoring of about 41 years and about 47 years of monitoring of Chilcotin River.

[19] The RPA states, "General categories of threats and limiting factors were agreed to, however the rationale and scoring for level of impact, causal certainty, and threat risk had greater uncertainty and will require further input and evaluation." (DFO, 2018: 17)

location and gear type (e.g. gillnet, purse seine and troll) (DFO, 2018). Although over the last 40 years the commercial bycatch has been significantly reduced as a result of various salmon management programs (e.g. presence of survival tanks for bycatch, time and area closures of commercial fisheries), it remains an important element. According to COSWEIC (2018), the estimated mortality rate from all bycatch in commercial fisheries is in the range of 15% to 25% annually (COSEWIC, 2018, 8).

Angling Pressures

Since 1997, the BC wild steelhead recreational fishery has operated on a catch-and-release basis. The combined exploitation rates from salmon fishing bycatch and through targeted sport fishing range from 7% to 26% (average of 18%) over the last 10 years (DFO, 2018)[20]. Steelhead stocks are managed at provincial, regional, and river-specific basis via the Allocation of Angling Opportunity Policy, Steelhead Stream Classification Policy, and the Provincial Framework for Steelhead Management in BC.

About 16 steelhead hatcheries are being used to increase angling opportunities in BC (FLNRO, 2016)[21]. In 2005 province of BC introduced Steelhead Stream Classification Policy (SSCP) to manage the risk of hatchery-augmentation to maintain a healthy stock of wild steelhead. The streams that contain hatchery-augmented steelhead are clearly distinguished from streams containing only wild steelhead. Further, BC also defines approaches for management for wild and hatchery-augmented classifications in the Provincial Framework for Steelhead Management.

Steelhead are intercepted in the tidal recreational fisheries and other freshwater recreational fisheries that bycatch steelhead trout, such as salmon (DFO, 2018). According to the BC Ministry of Forests, Lands, Natural Resource Operations & Rural Development (Dr. Trevor Davies, Stock Assessment Scientist, personal communications, Nov. 2018), days spent freshwater angling for trout and char in the Fraser River mainstem or lakes and tributaries when Thompson and Chilcotin River steelhead DUs are present, are negligible.

Habitat Degradation

The severity of the freshwater habitat-based threats in the Thompson and Chilcotin Rivers is not well understood. Water extraction (associated with irrigation for agriculture, mining, domestic water licensing, and management of storage dams), riparian vegetation clearing and channel modification (associated with livestock grazing, agriculture, forestry, linear projects, and urban development), and introduction of deleterious substances (associated

[20] Estimates of mortality solely from recreational fisheries are not provided in the RPA.
[21] These hatcheries are located on Vancouver Island, Lower Mainland and North Coast.

with agricultural, mining, and other industrial effluents, and seepage from private septic systems) are human activities that may contribute to freshwater habitat degradation.

Science & Conservation Activities

Research studies that require the capture of juvenile steelhead fry and parr occur periodically and result in some capture mortality and sub-lethal effects of TR and CR steelhead DUs. Habitat restoration activities may require temporary fish salvaging during in-stream works which could result in capture. Finally, salmon test fisheries conducted for stock assessment purposes encounter steelhead that can result in some mortality and sub-lethal effects to captured steelhead.

Food, Social, Ceremonial Fisheries

Direct Aboriginal fisheries for food, social and ceremonial purposed (FSC) on TR and CR steelhead trout have diminished due to run declines and it is unclear how much harvest continues. Catch monitoring programs are generally not in place during the winter and spring; hence, catch estimates rely on harvester reports. Further, FSC fisheries for salmon and other fish species incidentally catch Thompson and Chilcotin River steelhead trout.

2.3 Population Projections, Allowable Harm and Objectives

Over the last three generations, there has been a decline in spawner abundance of 79% for the TR DU and 81% for the CR DU (DFO, 2018). The RPA suggests a recovery target for Thompson DU of 938 spawners with distribution maintained in each of the five sub-areas. The current estimate of mature spawners for this DU is 150. For the Chilcotin River DU, the recommended abundance recovery target is between 562 – 744 spawners distributed over the two sub-areas. The current estimate for the Chilcotin River DU spawners is 77. According to the RPA, these escapements are predicted to result in a high probability that 100 spawners or more will escape annually to each of five major sub-populations within the Thompson watershed, and to each of the two sub-populations in the Chilcotin watershed.

The population projection models consider only exploitation (mortality) from commercial salmon and recreational fisheries. The RPA states that mortality from direct steelhead FSC fisheries is unknown and this is not included in the recovery models (DFO, 2018). Further, there is a lack of reliable bycatch data in salmon fisheries which adds to uncertainty in the projections, according to the RPA.

Modeling using productivity of the most recent year (1 year model) does not project recovery or growth for either DU[22]. However, the RPA states that the "…current mean productivity is the most likely scenario…" (DFO, 2018: 10). Further, the 1 year mean productivity model suggests poor growth for both DUs (i.e. 1% for TR DU and 0% for CR DU, respectively).

The 5 year mean model is the most optimistic productivity scenario as it is the only model that allows for recovery of one of the DUs, for the CR DU, as recovery probability for TR DU is low under all models. Under the 5 year mean productivity model, the RPA projects that eliminating exploitation (i.e. 0% fishing mortality) would result in a high (97%) probability of achieving recovery for the Chilcotin River DU within 2 generations. Under a 10 year mean productivity model, there is only a 33% probability of recovery after 6 generations. For the Thompson River DU, simulations under either a 5 or 10 year mean productivity show low (up to 17%) probability of recovery within 6 generations under zero exploitation rates (see summary Table 1 and Table 2 below).

Table 1: Chilcotin River DU - Recovery Potential as a Result of Lower Fishing Mortality

		Exploitation Rate (fishing mortality)		
Years for Productivity Sample		**25%**	**15%**	**0%**
1 year (Most Likely Model)	**Probability of Recovering in 42 years**	0%	0%	0%
	Years to Recovery	NA	NA	NA
5 year	**Probability of Recovering**	39%	79%	97%
	Years to Recovery	NA	20	13
10 year	**Probability of Recovering**	0%	2%	33%
	Years to Recovery	NA	NA	NA

Source: DFO 2018, page 12.

Notes: The current exploitation rate is unknown and estimated to be at or less than 25%. Further, the projections were simulated over 42 years for the Chilcotin River DU. Also, see page 10 of the RPA for a statement that the most likely productivity projection is the 1 year mean projection (DFO, 2018: 10).

[22] The RPA also examines the probability of recovery if productivity increased (i.e. doubling of log) as a result of measures that are not proposed in the management scenarios. As the scope of the CBA is determined by the Management Scenarios, the projections examining "doubling" productivity through alternate measures are not considered in this CBA.

Table 2: Thompson River DU - Recovery Potential as a Result of Lower Fishing Mortality

		Exploitation Rate (fishing mortality)		
Years for Productivity Sample		**25%**	**15%**	**0%**
1 year (Most Likely Model)	**Probability of Recovering in 36 years**	0%	1%	1%
	Years to Recovery	NA	NA	NA
5 year	**Probability of Recovering**	0%	0%	2%
	Years to Recovery	NA	NA	NA
10 year	**Probability of Recovering**	0%	1%	17%
	Years to Recovery	NA	NA	NA

Source: DFO 2018, page 11
Note: The current exploitation rate is unknown and estimated to be at or less than 25%. Further, the projections were simulated over 36 years for Thompson River DU. Also, see page 10 of the RPA for a statement that the most likely productivity projection is the 1 year mean projection (DFO, 2018: 10).

3. Profile of Affected Activities

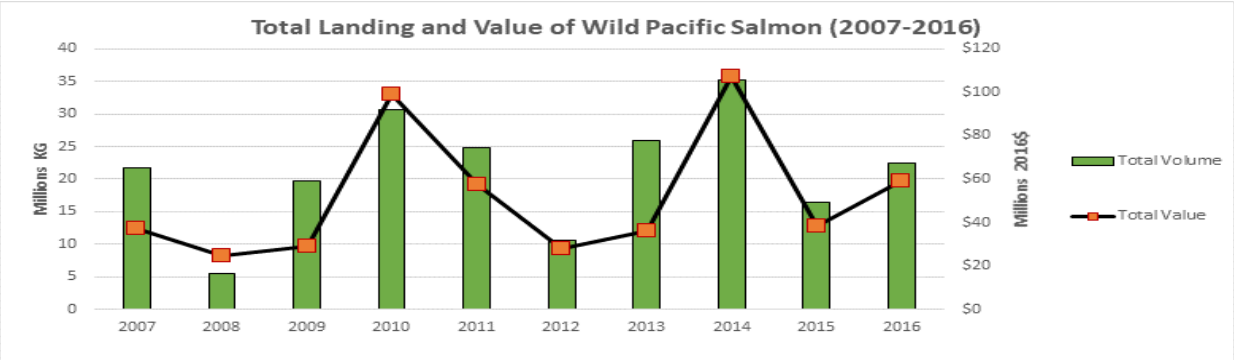
3.1 Commercial Fisheries

In BC, the commercial salmon fishery is a limited access fishery, mostly managed as a competitive fishery[23]; however, several parts of the fishery are operated under individual quotas. Commercially-harvested salmon support the seafood processing sector in BC, much of which is ultimately exported, and is a source of revenue for the province.

Over the past 10 years (between 2007 and 2016), the commercial salmon fishery contributed an average of 15% of the landed value and 13% of the total volume of BC wild caught seafood (BC, 2007-2016). The real value, in 2016 constant dollars (2016$), ranged from a high of $137.6m in 2014 to a low of $23.7m in 2008[24]. In recent years (between 2013 and 2016), the commercial marine salmon fishery generated an average of about $60.1m in revenues and about $135.4m in processed value (Figure 2 below).

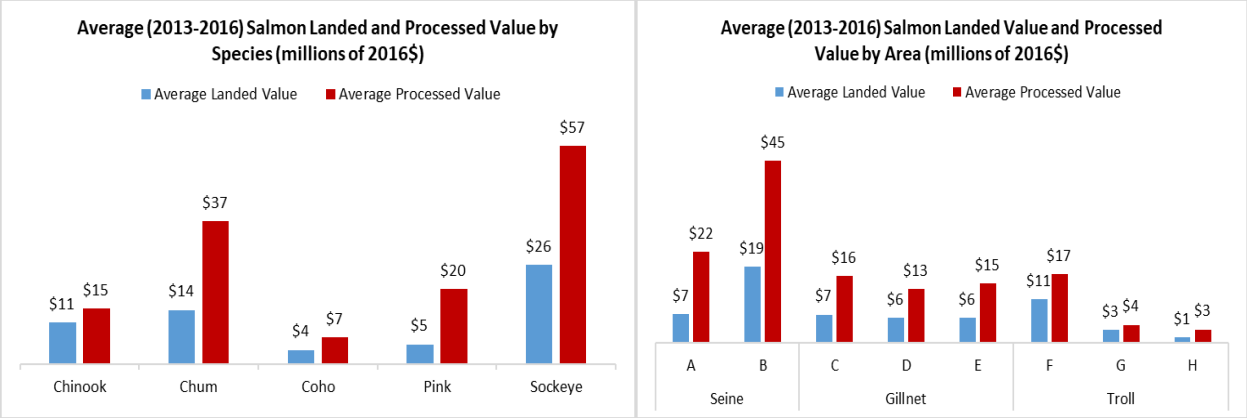
[23] Other names for this style of fishery include derby and Olympic style fishery
[24] These figures include inland fisheries (i.e. EO/Demo/ESSR).

Figure 2: Total Landing and Value of Wild Pacific Salmon (2007-2016)



Source: DFO logbooks matched to the best available price from sales slips, multiple years

Figure 3: Pacific Salmon Fisheries Landed and Processed Value (2013 to 2016)

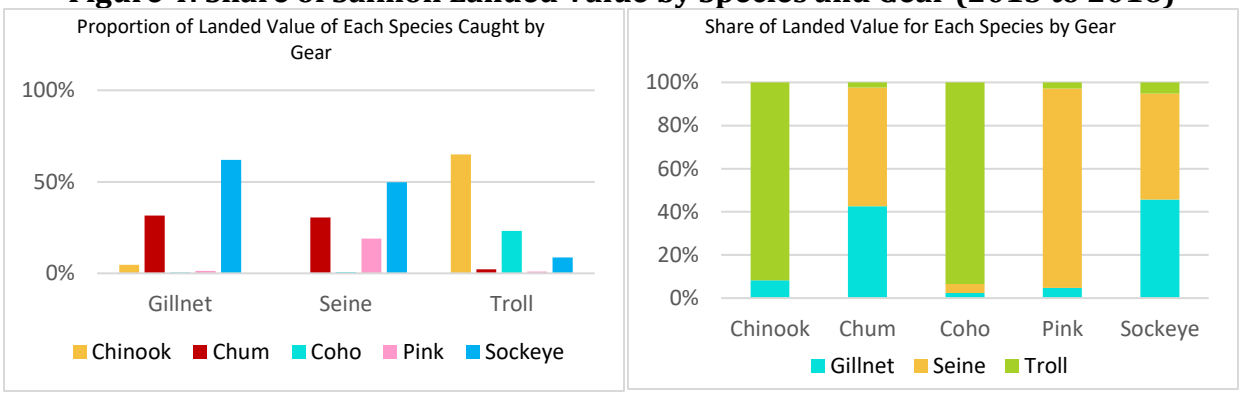


Source: DFO logbooks matched to the best available price from sales slips, multiple years

Three gear types, seine, gillnet and troll, are employed in the marine waters to harvest Pacific salmon. These are licenced as either First Nations party-based communal commercial (F Category Licence) or vessel based commercial licences. See section 3.1 and 3.2 for further discussion of these fisheries.

There are three main salmon marine fisheries on the west coast operating in various management areas: troll (Areas F, G, H); gillnet (Areas C, D, E); and, seine (Areas A, B). Sockeye and chum are mainly caught by gillnet and seine while chinook and coho are mainly caught in troll (see Figure 4). Figure 3 shows average annual landed value (2013 to 2016) by gear: seine $25.6m, gillnet $19.1m and troll $15.3m.

Figure 4: Share of Salmon Landed Value by Species and Gear (2013 to 2016)

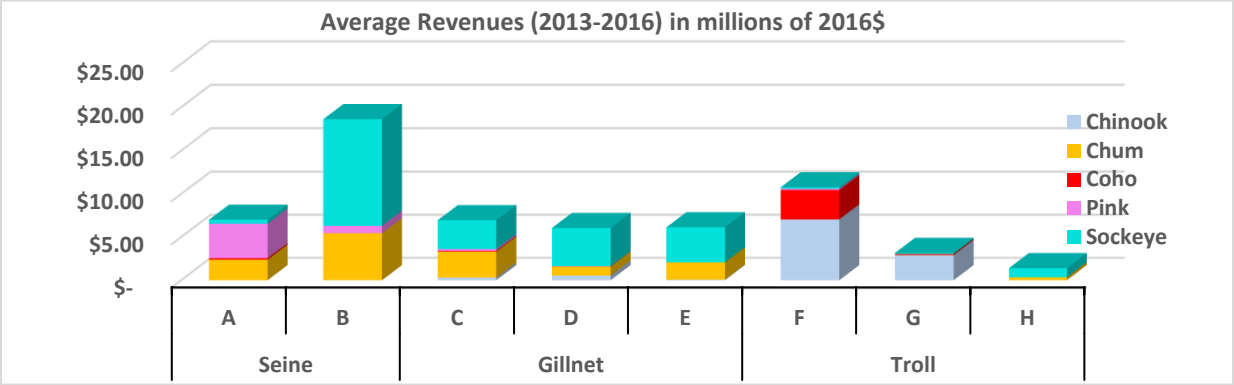


Source: DFO logbooks matched to the best available price from sales slips, multiple years

Across the fleet, chum harvest represents a significant proportion of revenues for the seine and gillnet fleets. On average, Area C gillnet relies on chum revenues more heavily than vessels that fish in other areas. Chum contributes 43% to Area C gillnet revenues whereas it represents about 29% of the revenues for the Area B seine fleet, and 32% for the Area E gillnet fleet (see Figure 5). The Area B seine fleet revenues depend on sockeye in big run years and chum in low sockeye return years. In terms of sockeye reliance, this species contributes to 50% of the entire seine fleet revenues, and specifically makes up 66% of the Area B revenues. Similarly, all three gillnet areas also rely on the big sockeye bump years for majority of their revenues and harvest chum in other years. Sockeye represents 62% of the entire gillnet fleet revenues, specifically making up 73% and 66% of the revenues in Area D and Area E, respectively. Area A seine relies most heavily on pink harvest. Majority of the pink salmon (93%) is caught in seine and it represents 57% of Area A revenues. However, pink salmon only represents about 19% of the entire seine fleet revenues, and 9% of the entire revenues across all areas (see Figure 5).

Troll Area F and G generate the majority of their revenues from chinook harvest. About 92% of the total chinook harvest is caught in the troll fleet, making up 65% of the entire troll fleet revenues. Area G relies most heavily on chinook, as it makes up 92% of this area's revenues. Area H troll is the lowest harvest area from all salmon fishing areas catching mainly sockeye in bump years and chum in other years (see Figure 5). Area A seine, Area C gillnet, and Area F troll are not expected to be impacted as they do not fall within the proposed closure areas under the management scenarios.

Figure 5: Salmon Revenues by Fleet and Species (2013 to 2016)



Source: DFO logbooks matched to the best available price from sales slips, multiple years.

Table 3 shows that the number of active vessels vary from year to year for all gear types. On average (based on 2013 to 2016 data), about 620 gillnet vessels are active, 222 troll vessels are active and 94 seine vessels are active.

Table 3: Average Unique Vessels Operating by Gear Type (2013 to 2016)

Years	Gear		
	Gillnet	Seine	Troll
2013	540	94	215
2014	742	99	238
2015	601	93	217
2016	596	91	218
Average # Vessels	**620**	**94**	**222**

Source: DFO logbook and sales slips

On average (2013 to 2016), the salmon seine, gillnet and troll fisheries contributed a total of $36.7m in GDP (direct, indirect and induced). In terms of direct employment, these fisheries support over 2000[25] crew and $17.4m in direct household income (see Table 4). The processing of salmon caught in these sectors further contributes a total of $121.2m to total provincial GDP. Salmon processing directly results in 421 jobs and $15.05m in direct household income (see Table 4).

[25] Direct Employment impacts are based on Pacific Fleet Financial Profiles, Nelson Bros Fisheries Ltd. 2011

Table 4: Regional Contribution of Commercial Marine Sector (Average 2013 to 2016)

(in million $, 2016)

Economic Indicators	Fishing		Processing	
	Direct	Total	Direct	Total
Output	$60.10	$94.35	$75.27	$121.19
GDP	$25.24	$36.66	$24.84	$44.41
Employment (FTE)*	2089	2217	421	632
Household income	$17.43	$24.64	$15.05	$27.10

Note: Direct Employment impacts in the fishing sector only are based on Pacific Fleet Financial Profiles, Nelson Bros Fisheries Ltd. 2011

Licences can be either party-based First Nations communal commercial licences or vessel-based full fee regular commercial licences. Party Based Licence categories (N and F categories) provide Indigenous communities with commercial fishing privileges. These are non-transferable and are intended to be held permanently for the benefit of the recipient First Nations communities. Both licence categories allow Indigenous communities to designate vessels and individual fish harvesters to carry out the fishing. The Northern Native Fishing Corporation holds 254 gillnet licences (Category N), of which 61 are in the South Coast.

As of January 2017, 159 communal commercial salmon licence eligibilities were issued to First Nations under the Aboriginal Fisheries Strategy (AFS) and Allocation Transfer Program (ATP), 46 were issued under the Pacific Integrated Commercial Fisheries Initiative (PICFI), 255 were used to offset First Nations demonstration fisheries projects and Economic Opportunity fishery arrangements with First Nations in the lower Fraser, Somass, Skeena and Nass Rivers, and 22 were used for treaties or other contingencies.

Party-Based and Vessel Based Licences

On average (2013 and 2016), about $60m of the marine commercial salmon was harvested under both communal and non-communal licences (i.e. all marine licences), annually. Of this total harvest, approximately $6.6m (11%) was harvested by party-based communal licences and the majority (89%) of all marine salmon harvest value occurred under vessel-based licences. The majority (56%) of the communal commercial harvest value occurs under gillnet (FAG/NAG) licences whereas the majority of the commercial value occurs under seine licences (44%). See Table 5.

Table 5: Average Value by Licence Types (2013 to 2016) *(in millions $, 2016)*

Gear Type	Licence Value	
	Party-based (Communal F and N licences)	Vessel-based Commercial
Troll	$0.80	$14.52
Gillnet	$3.69	$15.45
Seine	$2.10	$23.53

Source: Values are based on DFO sales slip data and quantities are based on logbook data, multiple years

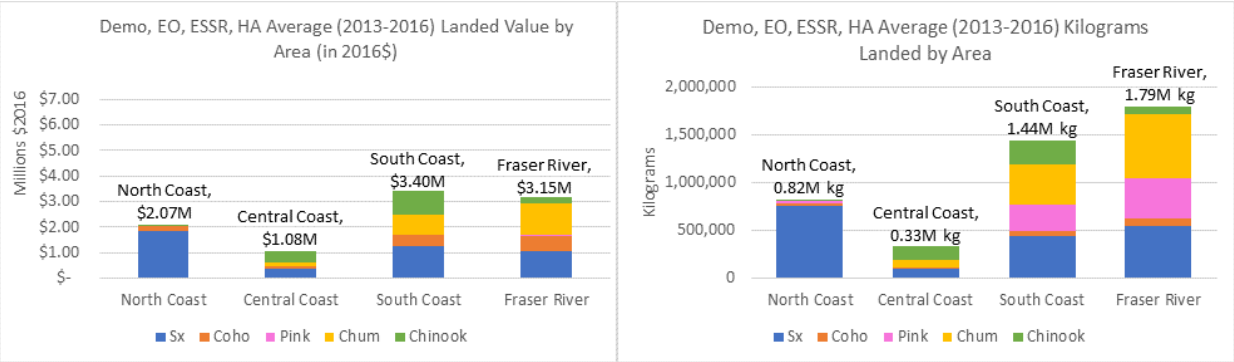
3.2 First Nations Commercial EO/Demo/ESSR Fisheries

Since 2005, First Nations have participated in demonstration commercial fisheries (Demo) with alternative implementations of individual quotas or pooling arrangements. In addition, there have been several commercial First Nations salmon economic opportunity (EO) fisheries which have been in place, in some form, since the 1990s. Some First Nations also have commercial access to salmon through Harvest Agreements (HA). Excess to salmon to spawning requirement (ESSR) fisheries also exist (see Appendix P for background details on EO/Demo/ESSR Fisheries).

In the EO, ESSR, HA and Demo fisheries, at least five fishing gears are employed. These include gillnets (or set and drift net), purse seines (in lakes and the lower Fraser), beach seines, weirs, and dip-nets. Over the timeframe of 2013 to 2016, the total average harvest under First Nations commercial EO/Demo/ESSR fisheries was 4.4 thousand tonnes with a value of $9.7m and $10.2m, to the harvesting and processing sectors, respectively. The majority of the harvest was in the South Coast, representing 35% of the total First Nations EO/Demo/ESSR fishery value, on average (between 2013 and 2016)[26]. See Figure 6 below. The Fraser River, with the second highest landed value, represents about 32% of the total revenues from First Nations sale fisheries. The North and Central coast together make up the remaining 32% of the harvest value.

[26] For the purposes of this analysis, South Coast Fisheries Management Area includes West Coast Vancouver Island (including Juan de Fuca Strait), Strait of Georgia and Johnstone Strait. Fraser River is separated out from other South Coast Areas.

Figure 6: First Nations EO/Demo/ESSR Fishery Harvest (KG's) and Value (2013 to 2016) *(in millions $, 2016)*



Source: Values are based on DFO sales slip data and quantities are based on logbook data, multiple years

First Nations EO/Demo/ESSR commercial harvesting and processing directly contribute around $4.1m and $3.4m to the provincial GDP, respectively.

Table 6: Average Contribution of First Nations EO/Demo/ESSR Salmon Harvesting Sector (2013 to 2016) *(in millions $, 2016)*

Economic Indicators	Average Contribution			
	Direct	Indirect	Induced	Total
GDP	$4.07	$1.36	$0.48	$5.91
Employment[1]	20.4	15.4	5.2	41.0
Household income	$2.81	$0.87	$0.29	$3.97

Source: BC Stats 2013. British Columbia's Fisheries and Aquaculture Sector, 2012 Edition. Page 60.
Note[1]: While direct employment in the commercial marine fisheries are based on Pacific Fleet Financial Profiles, Nelson Bros Fisheries Ltd. 2011, in absence of similar information on EO/Demo/ESSR fisheries, direct employment for these fisheries are based on regional multipliers (See Appendix C).

Table 7: Average Contribution of First Nations EO/Demo/ESSR Processing Sector (2013 to 2016) *(in millions $, 2016)*

Economic Indicators	Average Contribution			
	Direct	Indirect	Induced	Total
GDP	$3.38	$2.05	$0.61	$6.04
Employment	57.3	21.9	6.8	85.9
Household income	$2.05	$1.33	$0.31	$3.69

Source: BC Stats 2013. British Columbia's Fisheries and Aquaculture Sector, 2012 Edition. Page 60.

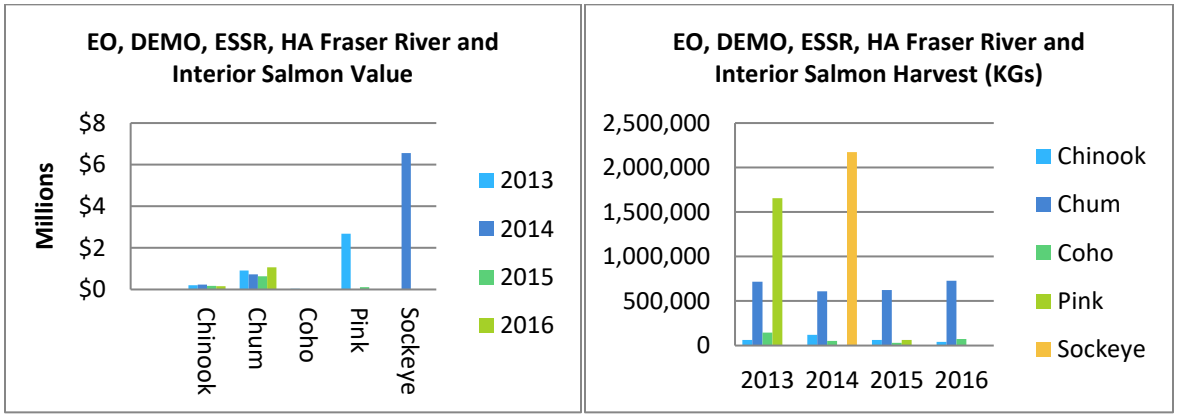
Fraser River EO, Demo, ESSR Fisheries

First Nations communities with EO/demo access vary from year-to-year as each nation determines their participation in fisheries agreements annually. On average, about 1.8m KG's of salmon are caught in the EO, Demo, ESSR fisheries in the Fraser River (upper, mid and lower Fraser) and in the Interior Area (see Figure 6).

Fish prices are lower inland than they are in the marine fishery (Counterpoint Consulting, 2014: 3). Higher ex-vessel fish prices are due to the superior quality of marine-caught fish. However, inland chum is an exception as roe yields are higher for the inland fishery. About 37% of landings in these fisheries are chum with lower levels of chinook and coho catch over recent years. Pink and sockeye salmon catch is over-represented in high return years for these species, specifically in 2013 and 2014, respectively. In 2013, pink represented 64% of the harvest volume in 2014, sockeye represented 74%. Similar to the marine salmon commercial fisheries, catch in these EO/Demo/ESSR fisheries varies widely. Based on Figure 7, annual landed value of salmon caught in Fraser River First Nations commercial EO/Demo/ESSR fisheries varied considerably between 2013 and 2016. The lowest Fraser River fishery harvest year was in 2015, with a value around $1.5m. The highest value year was in 2014; at about $6.2m. This is mainly attributable to the high sockeye return in 2014.

Figure 7: Fraser River and Interior Salmon Harvest (KG's) and Value

(in millions $, 2016)



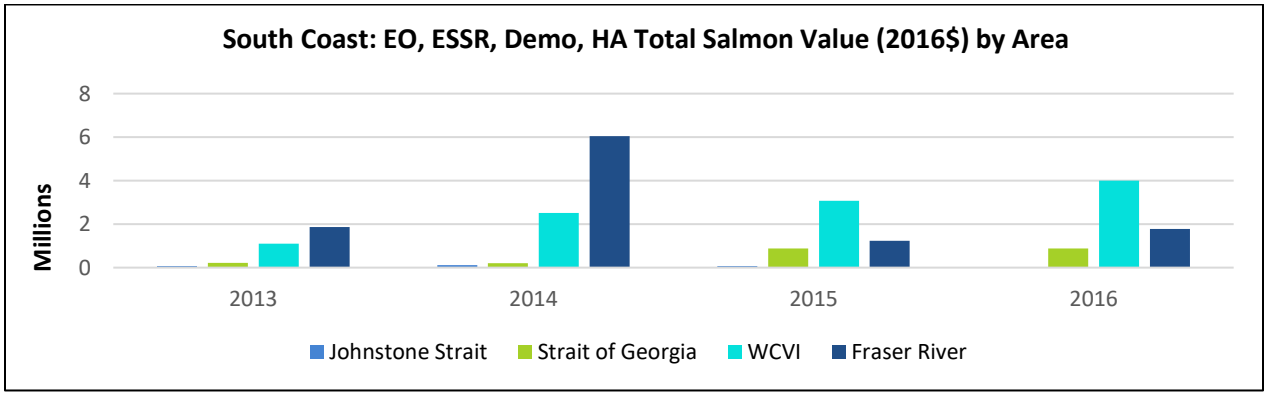
Source: Catch information from DFO Area logbook data. Inland EO/Demo/ESSR salmon value information based on Counterpoint Consulting, 2014.
Note: Only "for sale" Harvest Agreement catch is included in these charts.

South Coast (i.e. Johnstone Strait, Strait of Georgia, WCVI) EO, Demo, ESSR Fisheries

The South Coast Fisheries are separated into three key regions, Johnstone Strait, Strait of Georgia, West Coast Vancouver Island (WCVI)[27]. These regions further break down to include Pacific Fishery Management Areas 11-27, 121 to 127, and Subareas 29-1 to 29-5. The inland waters include Areas 11-20 and a portion of Area 29 (i.e. subareas 29-1 to 29-5). The marine waters include Area 21-27, 121-127 on the outside of Vancouver Island.

On average, South Coast EO, ESSR, Demonstration and Harvest Agreement fisheries landed harvests are valued around $3.4m per year. Each year, on average, about 46% of the landed value of these fisheries is attributable to the WCVI region, where 2015 had 66% of the landed value coming from this region. From 2013 to 2016, WCVI EO/Demo/ESSR fisheries consistently saw year-over-year increases in value, while annual landed value show a higher volatility in other areas. The variation seen in landed value across the South Coast inland fisheries is partly caused by the timing of certain salmon species. For example, pink salmon landings in 2013 comprise about 53% of the total harvest quantity across South Coast EO/Demo/ESSR fisheries. This is in contrast to the 4-year average contribution of pink salmon to the total harvest quantity of 34%.

Figure 8: South Coast and Fraser Region Salmon Harvest (KG's) and Value



Source: Harvest based on Post season review Reports. Inland salmon value information based on Counterpoint Consulting, 2014.
Note: Only "for sale" Harvest Agreement catch is included in this chart.

[27] For the purposes of this report, the Fraser River is considered separately from the other South Coast (i.e. WCVI, Johnstone Strait and Strait of Georgia) fishing regions.

3.3 Scientific Activities/Test Fisheries

There are science activities that target steelhead such as a mark-resight radio telemetry project to estimate the Thompson River steelhead trout population annually, but may result in capture mortality and sub-lethal effects. Studies that require the capture of juvenile steelhead fry and parr occur periodically and result in minimal capture mortality and sub lethal effects.

DFO uses a range of methods to determine in-season stock abundance and composition. Test fisheries play an essential role in providing information to support in-season abundance estimation, determining TAC and ensuring that conservation objectives are met in fisheries management. In tidal waters, salmon test fisheries are known to capture steelhead with associated capture mortality and sub-lethal effects.

There are several salmon science related projects that occur in B.C. marine and fresh waters. These include nine test fisheries for different salmon fisheries that may intercept TR and CR DUs. Sampling and counting activities (i.e. visual, acoustic and/or resistivity counting) also occur in freshwater for salmon and steelhead species such as those on the Bonaparte River fishway, Nicola River, Chilcotin River, Coldwater River, Spius Creek, Bonaparte and Deadman Rivers. In addition to the nine test fisheries, DFO also conducts annual sockeye and biennial pink juvenile stock assessments. Salmon research also takes place that the Nicola Research Collaborative on the Nicola River. Finally, there are two chinook mark-recapture programs in the Chilko and Nicola rivers.

Test fisheries operate on a cost recovery basis. About 260,000 pieces of salmon are harvested in test fisheries. About 95% of all the test fishing occurs in the South Coast. Pink salmon makes up about 40% of the harvest (see Table 8).

Table 8: Average Pieces Caught in Test Fisheries (2013 to 2016)

Fishing Areas	Sockeye	Coho	Pink	Chum	Chinook
South Coast (Areas 11-29)	88,300	600	100,500	58,200	3,600
North Coast (Areas 1-6)	4,300	200	1,900	100	300
All Test Fisheries	92,600	800	102,400	58,300	4,000

Source: Harvest is based on Post Season Review Reports, multiple years.

3.4 FSC Fisheries

Steelhead FSC fisheries

Steelhead are a species of significance to many First Nations. Steelhead are known to be targeted for FSC purposes and are incidentally intercepted in FSC fisheries targeting other species such as salmon. Information on steelhead used for FSC purposes was not provided in the COSEWIC assessment (COSEWIC, 2018) or the Recovery Potential Assessment (DFO, 2018). However, given the significance of the species based on available literature, it is clear that steelhead trout are an important species for several First Nations. Some First Nations engage in year round trout fishing, and some only at specified times. For example, the Upper Kutenai (Kootenai) fished year round, the Thompson (N'laka'pamux) fished for trout in spring and autumn, and the Chilcotin (Tsilhqot'in) fished in the winter (Kuhnlein & Humphries, 2017). Also, based on available literature, the southern Okanagan, Lower Lilooet, Upper Lilooet, Gitksan (Gitxsan), Tahltan, Bella Coola (Nuxalk), Central Coast Salish, Northern Coast Salish, Shuswap, Sto:lo, Nootka (Nuu-chah-nulth), and Thompson First Nations have all historically fished for steelhead.

The majority used a combination of traps, weirs, nets, and harpoons, with many of the techniques being similar/modified versions to those used during the salmon runs (M. W. L. after O. L. Ignace & Ignace, 2017; Kuhnlein & Humphries, 2017; Teit, 1900). Steelhead flesh was consumed in many different ways: fresh, dried, braised, boiled, smoked, roasted, and canned (Kuhnlein & Humphries, 2017); virtually all edible parts of the fish were consumed. By maximizing the utilization of each fish, less fish overall were harvested – and thus more were conserved – with the First Nations contributing to the sustainability of the resource While some of the larger salmon were often exclusively preserved for consumption during the winter, the steelhead (and other fish) were often eaten fresh around the time they were caught (Tk'emlups Te Secwepemc, n.d.). There is a lack of reference to steelhead in prominent First Nations salmon trade figures. However, as steelhead were often caught in the winter and eaten fresh, their use as a trade item may have been limited for this reason (Ignace, M & Ignace, 2018).

Each season, many First Nations practice a First Salmon Ceremony, in which community elders ceremonially offer ritualized prayers of respect. While most accounts of these ceremonies do not specifically reference steelhead, there is available literature on one First Nation south of the Canadian border (from what is now coastal Oregon), which held ceremony upon the arrival of the first steelhead (Kuhnlein & Humphries, 2017).

Salmon FSC Fisheries

The Pacific Salmon have been fundamental to sustenance and culture in all of BC's First Nations cultural areas with the use of salmon dating back to at least 10,000 years before present (Haggan et al., 2006). Today salmon remain as a keystone species for many First Nations (Garibaldi and Turner, 2004).

Historically, salmon was a major component in the economy of First Nations and the resource served as a valuable trade item (Harris, 2001; Miller, 2007) and those with control over major salmon fishing grounds such as the Fraser River became the elite among First Nations (Grier, 2003). Currently, while First Nations harvest salmon for ceremonial and subsistence purposes and participate in the commercial salmon fisheries, according to Chan et al (2011), 41% of First Nations in BC are food-insecure and 91% expressed they want to consume more traditional foods such as salmon.

The culture of First Nations of BC was and is influenced heavily by the salmon. The salmon myth is a widespread cultural aspect of various First Nations in British Columbia and the Pacific Coast of the USA where salmon have historically been utilized (Gunther, 1926). It tells that the salmon – or Salmon People – are proud, majestic beings with spirits of their own that ultimately sacrifice their rich, life-giving flesh each year (Gunther, 1926; Jones, 2002). The First Nations of BC thus revere and work in cooperation with the Salmon People to ensure their return each year. Each season, many First Nations practice the First Salmon Ceremony. While practices vary from Nation to Nation, in some communities, elders ritually replace the first salmon caught, or its bones, in the water offering prayers of respect. This is a symbolic transfer from the First Nations to the Salmon People of current produce – i.e. the first landed salmon – in return for continued future salmon stocks – i.e. the Salmon returning with their gift of life. Trosper (2003) and Haggan et al (2006) highlight that these traditions are a part of their culture, and whether their conscious intent was to preserve the salmon resource or not, their lifestyles were so reverent of the salmon that they were able to depend so heavily on its provisions.

There were social structures in place governing the use of the resource with examples of First Nations enhancing the physical environment to favour a plentiful return (e.g. clearing migratory spawning routes (Jones, 2002). Cannon and Moss (2011: 1) note that First Nations in BC "were not just fishers but fisheries resource managers, perfecting systems of ecosystem management tailored to their individual circumstances". Although First Nations harvested a variety of species, their management and control of salmon stands out from the rest. Atleo (2005) explains that First Nations view the salmon as brothers and sisters of creation and because of this relationship, protocols of resource management become necessary. As

salmon is so integral to First Nations, management practices that ensured sustainable use of the resource are deeply embedded into their culture.

Arguably the most significant resource utilized by First Nations in BC, especially to those near the coast, salmon remain a defining feature in BC's First Nation culture pivotal to Indigenous communities, societies, and cultures. Salmon tie in with many First Nations childhood experiences, sense of community, and ultimately ways of life. As a cultural keystone species (Garibaldi and Turner, 2004) salmon are "vital to the existence and identity of [First Nations] people and are a major conduit for the intergenerational transfer of traditional knowledge and values" (Haggan et al, 2006: 5). Because of its prominence, prevention of harvest of salmon for those dependent on the resource, either for sustenance, ceremony, or economic well-being, would have major implications.

Potentially Affected FSC Fisheries

There are approximately 200 First Nations in British Columbia. Many Indigenous communities are located near key fishing sites, oceans and aquatic resources, and consider the management of these resources important to their communities. Some Indigenous groups are seeking greater access to local traditional food; economic opportunities from aquatic resources as a potential driver for economic development in their communities; more stability in food, social and ceremonial (FSC) fisheries; a greater role in the aquatic resource and oceans management decisions that affect them; and a greater role in stewardship, including stock assessment, oceans and habitat management, conservation and protection, and recovery strategy development and implementation.

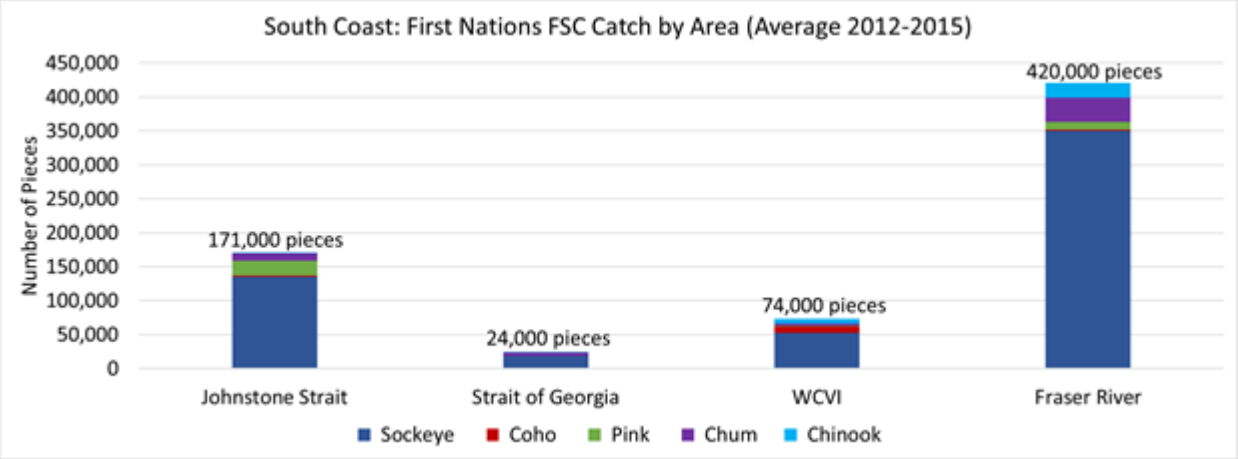
The majority of Indigenous peoples of BC have a current and/or historical interest in and/or use of one or more of the species that will be impacted by a SARA Listing decision of TR/CR steelhead, given the interception of these species in salmon fishing. Based on the 2016 Statistics Canada Census estimates of on and off reserve band populations, these communities represent more than 270,585[28] individuals in BC who may have a relationship with salmon and/or steelhead. Many of these individuals may have their identities and well-being linked to the harvest of species that will be impacted by the potential listing decision of TR/CR steelhead under SARA. This interest may be for harvest for food, social, and ceremonial purposes, and economic uses.

[28] See Statistics Canada website, last accessed November 2018 https://www12.statcan.gc.ca/census-recensement/2016/dppd/prof/details/page.cfm?Lang=E&Geo1=PR&Code1=59&Geo2=PR&Code2=01&Data=Count&SearchText=British%20Columbia&SearchType=Begins&SearchPR=01&B1=Aboriginal%20peoples&TABID=1

First Nations FSC Fisheries in the South Coast and Fraser River

Salmon harvest for FSC purposes varies considerably from year to year. Based on the DFO Post-Season Review public reports and data provided by DFO Aboriginal Programs staff[29], it is estimated that Indigenous groups harvested an annual average of 690,000 pieces of salmon for food, social and ceremonial purposes in the South Coast area between 2012 and 2015. Figure 9 provides a breakdown of harvest by area, showing that salmon harvested in the Fraser River made up about 61% of this harvest.

Figure 9: Average FSC Harvest by Area

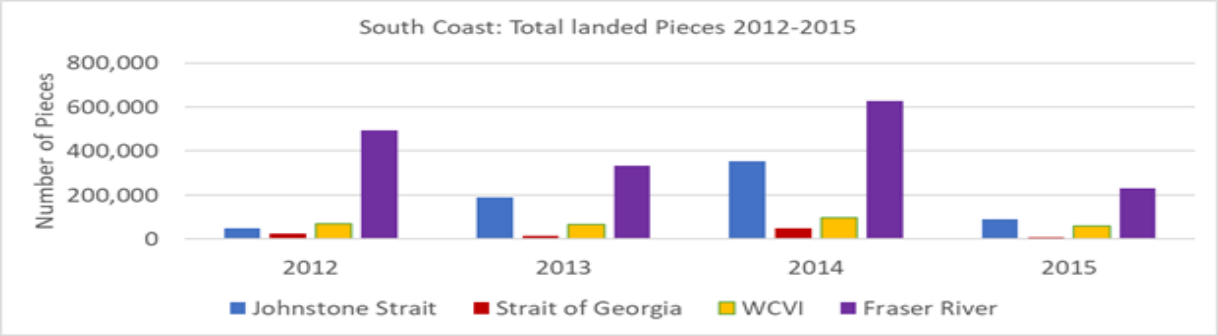


Source: Fraser River harvest estimates are based on Post Season Review and logbook data, multiple years. Estimates for other South Coast FSC harvest regions (Johnstone Strait, Strait of Georgia, WCVI) are provided by DFO South Coast Area experts (Kevin Conley, Aboriginal Programs Coordinator and Kent Spencer, A/ Aboriginal Affairs Advisor, Oct. 2018).

Around 23% of harvest can be attributed to FSC conducted in the Johnstone Strait, and about 12% and 3% to FSC in WCVI and Strait of Georgia, respectively. Johnstone Strait had a 270% increase in total harvest from 2012 to 2013, which can be attributed to a more than three-fold increase in sockeye and chum harvest. All other areas experienced decreasing harvests from 2012 to 2013. Over the four year period, First Nations in all of the South Coast and Fraser areas saw harvests peak in 2014, where the total salmon harvest was approximately 63% higher than the average harvest from 2012 to 2015. FSC harvest in all the South Coast and Fraser areas decreased between 2014 and 2015 (see Figure 10).

[29] While more updated harvest information is available through Post Season Review published reports, DFO South Coast Area staff (Kevin Conley, Aboriginal Programs Coordinator and Kent Spencer, A/ Aboriginal Affairs Advisor, Oct. 2018) advised that the available DFO estimates for 2016 South Coast harvest were incomplete. Hence, the best available data years for FSC harvest are 2012 to 2015.

Figure 10: FSC Harvest by Year, Multiple Years (2012 to 2015)



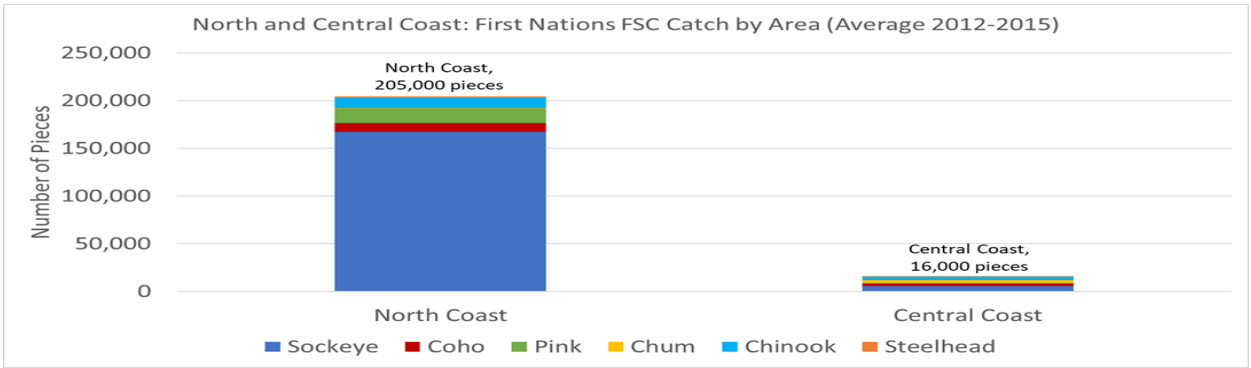
Source: Fraser River harvest estimates are based on Post Season Review, multiple years. Estimates for South Coast FSC harvest are provided by DFO South Coast Area staff (Kevin Conley, Aboriginal Programs Coordinator and Kent Spencer, A/ Aboriginal Affairs Advisor, Oct. 2018)

According to DFO harvest data, about 51 First Nations groups harvest for Food Social, Ceremonial purposes in the Johnstone Strait, Strait of Georgia and West Coast Vancouver Island Pacific Fisheries Management Areas (PFMAs). About 93 First Nations harvest in the area defined by DFO fisheries management as the Fraser River region.

First Nations FSC Fisheries in the North and Central Coast

Based on the DFO Post Season Review public reports, between 2012 and 2015, an annual average of over 205,000 pieces and 16,000 pieces of salmon were harvested by Indigenous groups for food, social and ceremonial purposes in the North coast and Central coast regions, respectively. See Figure 11 for harvest details by species. The management scenarios do not indicate any closures in these (North and Central Coast) areas.

Figure 11: FSC Harvest for North and Central Coast



Source: Post Season Review reports, Multiple Years.

3.5 Profile of Recreational Fisheries

Freshwater Recreational Fisheries

The BC freshwater recreational fishery has seen a notable decrease in the number of fishing licences sold between 1990 and 2010, from about 350,000 licences to around 285,000 licences, respectively. However, the number of freshwater angling licences sold has since increased but is still below pre-2010 levels. Between 2013 to 2016, on average, almost 339,000 freshwater fishing licences were sold in BC.

Table 9: Freshwater Recreational Fishing Licences by Category (2013 to 2016)

Recreational Licences Categories	2013	2014	2015	2016	4 year average
BC Resident	262,862	270,290	286,330	270,861	272,586
Other Canadian Province Residents	38,399	41,113	44,084	45,910	42,377
International Residents	22,495	23,038	24,264	24,398	23,549
TOTAL	**323,756**	**334,441**	**354,678**	**341,169**	**338,511**

Source: Province of British Columbia, FLNRO, internal data.

Based on licences sales, total expenditures for freshwater fishing (including purchases and investments) are estimated to be about $652m (2013-2016, 2016$). Of this, total direct spending is estimated at about $282m. DFO estimates that around 3.83m angling days are spent recreational fishing in freshwater (average, between 2013 and 2016). It is estimated that spending related to salmon fishing and steelhead fishing constitutes about 19.3% and 3.3% of the total BC freshwater recreation expenditures, respectively (See Appendix F).

In terms of contribution to the provincial economy, DFO estimates that the fresh water recreational fishery contributed about $248m (2016$) to B.C.'s GDP (direct and indirect) on average between 2013 and 2016. In terms of direct and indirect employment, freshwater fishing is responsible for about 7044 jobs and $182.6m in household income. These figures include the businesses that service the sector directly including tackle shops and retail sporting goods stores, boating rentals and dealerships, marina's and camp grounds, resorts, lodges, guides and charters. The spin-off impacts spread more broadly to support local tourism and businesses that indirectly service this sector such as transportation businesses, restaurants, motels, fuel stations etc. which are also included in this figure.

Steelhead is targeted in catch and release freshwater recreational fisheries. The 2010 Survey of Recreational Fishing in Canada found that approximately 50% of respondents regarded Rainbow trout as their favourite or preferred fish in freshwater fisheries. About 5.5% of respondents stated that steelhead trout was their favourite or preferred fish while 20.6% of respondents said that sockeye, other salmon and/or kokanee were their preferred fish (DFO, 2012).

In the Thompson River, steelhead is mainly targeted in the fall/early winter. There are nine provincial fisheries management regions in BC. Table 10 shows the general steelhead fishing seasons across the province and Table 11 and Table 12 show the number of angling days spent steelhead fishing and salmon fishing in areas the TR and CR DUs may be found.

Table 10: Key B.C. Steelhead Recreational Fisheries and Seasons

Region	River	Season
South-Western BC	Thompson River	Fall/early winter
Chilcotin-Caribou(Central BC)	Dean River	summer
Northern BC	Skeena River	summer/fall
Northern BC	Bulkley River	late summer/fall
Northern BC	Kisipiox River	late summer/fall
Northern BC	Copper River	summer/fall
South-Western BC	Vedder River	winter/spring
South-Western BC	Squamish River	winter/spring
Vancouver Island	Cowichan River	winter/spring
Vancouver Island	Gold River	winter/spring

Table 11: Average Steelhead Angling Days in Fraser River

Southern Regions	Average angling days targeting steelhead (2013 to 2016)
Fraser River	725
Thompson	2,432
Chilcotin	89
Chilko	22

Source: Province of British Columbia, FLNR internal data, provided September 2018.

Note: These estimates (between 2013 and 2016) include 2,432 (~2500 rounded) of steelhead angling days that were closed in the Thompson River under the August 2018 BC variation order.

Table 12: Average Salmon Angling Days in Areas/Times Steelhead are Intercepted (2013 to 2016)

Southern Regions	Average angling days targeting freshwater salmon (2013 to 2016) when steelhead are likely to be intercepted
Fraser River – Mouth of Fraser to Hope	26,700
Fraser River – Hope to Sawmill Creek	300
Fraser River – Sawmill Creek to Thompson River (above Bonaparte River)	526.5
Chilcotin River	N/A

Source: Angler days for freshwater salmon fishing in the proposed closure areas were provided by DFO Fraser and Interior Area Stock Assessment and based on expert opinion (Joe Tadey, Program Head, personal communications, September 2018)[30]. Note, these estimates (for 2013 to 2016) include 6,100 days of freshwater salmon angling that were closed through the DFO 2108 salmon IFMP.

Based on available information, over 60 lodges operate in the Thompson-Nicola and Cariboo regions that may service both the Chilcotin and Thompson Rivers and surrounding areas. Lodges in the Cariboo region specialize in a variety of species including: rainbow trout, char, lake trout, kokanee, bull trout, steelhead, chinook, coho, burbot, cutthroat trout and dolly varden. Lodges operating in the Thompson-Nicola region seem to focus on rainbow trout, speckled brook trout, lake trout and kokanee.

Tidal Water Recreational Fisheries

The BC tidal recreational fishery has seen a slight increase in the number of fishing licences over the past 15 years, from about 320,000 licences sold in 1999 to around 330,000 licences sold in 2016[31]. In 2016, based on licence sales, DFO estimates there were about 251,000 active tidal anglers in BC (see Appendix F for further details on methods).

British Columbia's tidal waters offer anglers over 27,000 kilometres of coastline, including the shoreline of the islands. The "expectation and opportunity" of recreational angling adds a dimension to recreational fishing where anglers are not just fishing to harvest a species for personal use but catching and keeping the fish offers a different dimension to the experience versus catching and releasing the fish (ARA Consulting Group Inc., 1996)[32]. The surrounding natural environment also adds an aesthetic dimension. This experience is also

[30] See Annex F for further information on how these estimates were compiled by DFO.

[31] Licences sold for tidal water fishing can be found on DFO website: http://www.pac.dfo-mpo.gc.ca/fm-gp/rec/licence-permis/Stats/99tocurrent-eng.html. Last accessed December 2, 2018 from

[32] Based on the National Survey of Recreational Fishers in British Columbia (2010), food value of their catch is the least important factor motivating BC recreational freshwater anglers (i.e. reasons cited to go fishing are related to relaxation, enjoying nature, the challenge of fishing, improving angling skills, getting away, and participating in an outdoor adventure/family get-together).

influenced by the type of angling trip, whether it is done through a lodge, charter or on an independent basis.

Lodges organize all-inclusive packages that include accommodation, meals, boat and fuel, fishing equipment, as well as a guide to accompany anglers (GS Gislason & Associates Ltd, 2009). Charters typically offer angling packages that provide only for the boat, fishing equipment and a guide. Independent anglers are responsible for their own gear, boat, accommodations, meals and transportation. The duration of fishing trips vary depending on the category is used. Lodge experiences typically lasting 3 to 5 days while charter and independent trips typically last a single day. Available estimates show there were about 125 fishing lodges and about 500 charter operations for salt water fishing in BC in 2005 (GS Gislason & Associates Ltd, 2009). Estimates for more recent years are unavailable.

Expenditures attributable to tidal fishing (including purchases and investments) are estimated to be about $1.03b (2013-2016, 2016$). [33] Of this, direct spending is estimated at about $705m. Tidal water recreational fishing results in almost 11,100 jobs and $287.7m in household income (direct and indirect). See Appendix F.

Based on DFO iREC data, steelhead may be incidentally caught in tidal water fisheries that target salmon and other finfish, although the rate of such an occurrence is likely low. Salmon recreational fishing occurs up and down the coast of BC throughout the year. The Majority (90%) of recreational salmon fishing occurs between May and September. Salmon are a significant draw for fishing lodges and other businesses offering fishing packages.

Based on results of the 2010 National Recreational Survey data, there was a 26.5% overlap in days spent tidal fishing for multiple types of species. Further, according to the 2010 National Recreational Survey data, spending related to salmon fishing accounts for about 57% of the total BC tidal recreation expenditures, more than double the spending related to fishing other finfish (e.g. halibut, lingcod, rockfish etc.) which constitute about 25% of expenditures. Shellfish spending made up the remainder (18%). See Appendix F for breakdown of tidal recreational expenditure proportions by species. About $311.8m and $142.5m (2013-2016, 2016$s) are estimated in direct expenditures in tidal water salmon and other finfish recreational fisheries, respectively.

[33] This figure is based on the expenditures per day in the 2010 National Survey, adjusted by estimated angling activity from 2013 to 2016.

3.6 Profile of Proponents of Activities in Freshwater

Juvenile steelhead trout typically spend 2-4 years in freshwater before undergoing a smoltification process which allows them to live in the ocean, where they live for 2-3 years before returning to freshwater to spawn. A unique characteristic of these fish is that a small percentage of steelhead, known as kelts, return to the ocean for 1 to 2 years to return to spawn again. Some of the potential threats to habitat identified by the Recovery Potential Assessment (DFO, 2018), include, physical habitat degradation (bank erosion, siltation, loss of riparian structure and function), decreased water quantity, increasing water temperature, decreased water quality and increased pollution in the mouth of the Fraser River estuary. These broad threat areas could include various activities such as, among other things, commercial and residential development, agriculture, sewage treatment plants, mills, forestry operations, gravel mining, and shipping and port activities. The lower reaches of the Fraser River is highly industrialized and urbanized.

Port infrastructure on the Lower Fraser River (LFR) estuary is an integral part of Port Metro Vancouver, the country's largest port and principal ocean gateway to the Pacific (RCC, 2014, pp. i). The foreshore of the LFR includes numerous business and residential developments. As well, there are a number of marinas and floating house docks. Extensive, ongoing dredging occurs on the LFR to ensure navigable depths and the removal of deposits from the river channels (RCC, 2014, pp. vi).

The valley and delta of the Fraser River also support a growing farming industry. A combination of quality soils, a long frost-free growing season and market access have supported a 22% increase in farm land between 1991 and 2006 in the Fraser Valley Regional District (Richmond Chamber of Commerce (RCC, 2014). The Fraser Valley and surrounding area accounted for the majority of the provinces gross farm receipts, generating about $1.6 billion from 5,000 farms in 2011 (RCC, 2014). Most crops in the area require some irrigation, while drainage is also used.

There is a substantial forest products industry on the LFR. Satellite photography (date not provided) showed 47 forest industry facilities along the Lower Fraser, including sawmills, shake and shingle mills, a veneer/plywood mill, a pulp mill, a combined pulp and paper mill, wood chip mills, wood chip/sawdust handling facilities, barge loading and unloading facilities, lumber storage, log sorting/log storage yards, and pole yards (Richmond Chamber of Commerce, 2014). Between the Strait of Georgia and Mission, part of the shoreline is taken up with moored log booms. In 2009 there were seven major sawmills with approximately 1,000 jobs, and the two pulp and paper facilities had approximately 350 jobs.

In 2015, BC extracted 27,523 kilotons of sand and gravel valued at $273m, making it the third most valuable mineral resource in BC after copper ($2.5b) and gold ($591m) (NRCAN, Annual Statistics[34]). Sand, gravel and rock used in construction, also termed aggregate, constitutes the largest mineral commodity used and mined in the province by volume. Between Hope and Mission the flow of the Fraser slows and sediments carried by the River are deposited. Since the 1950's this stretch of the Fraser has been the most heavily mined region in the river. In the gravel extraction industry this region of the Fraser is known as the Gravel Reach (Rosenau and Angelo, 2000). According to Rosenau and Angelo (2000), as development continues in the region, the demand for aggregates will remain high.

For communities of the Interior Fraser River region – which includes the Upper Fraser, Chilcotin and Thompson regions – the forest industry is an important economic element. These regions contribute to the aggregate revenue in the BC interior forestry industry, which was estimated to be about $9.73b in 2013 (MNP, 2015). Additionally, the BC forestry industry contributes around 6.1% of total regional employment in the BC Interior region (MNP, 2015). In recent years, however, industries such as agriculture and mining are playing an increasingly large role in the regional economies.

4. Analytical Framework

4.1 Scope

The scope of this analysis is defined by the management scenarios developed by DFO program staff in discussion with the Province of BC. The scenarios identify the existing management for specific threats and the 2018 measures that will remain in place if the DUs are not listed and the potential actions if the two DU's are listed on Schedule I of the SARA: scenario 1 (Do Not List) and scenario 2 (List with permits for science). Scenario 1 and scenario 2 are described in more detail in section 6.1 and section 6.2, respectively.

The costs and benefits of listing are assessed for each DU separately and for the two DUs combined. As well, the analysis considers the implications of listing under the following 3 different productivity models as described in the Recovery Potential Assessment (DFO, 2018) and in section 7 below:

- 5 Year Productivity Model (2a) based on 5 years of available estimates and with exploitation rate maintained at the current level (at or below 25%);

[34] Natural Resources Canada (NRCAN). 2015. *Annual Statistics of Mineral Production.* http://sead.nrcan.gc.ca/prod-prod/ann-ann-eng.aspx. Accessed July 2017

- 1 Year Productivity Model (2b); based on 1 year of available estimates and with exploitation rate maintained at the current level (at or below 25%) and
- 10 Year Productivity Model (2c) based on 10 years of available estimates and with exploitation rate maintained at the current level (at or below 25%)

This analysis does not evaluate the efficacy of the proposed management scenarios. Refer to section 2.3 of this report.

4.2 Cost-Benefit Analysis

A cost-benefit analysis approach was used to identify, quantify and monetize (where possible), the incremental costs and benefits of the proposed management scenarios. Impacts are described qualitatively where they cannot be quantified. In this analysis, incremental impacts are determined by comparing the anticipated outcomes of potential measures that have not yet been implemented described in the management scenarios with the outcomes from measures already in place or committed to under the baseline (see section 4.2.3). Impacts are assessed at the level of Canadian society as a whole and by stakeholder group, where feasible.

The cost-benefit analysis approach is based on a utilitarian (anthropocentric) approach, which focuses on individual preferences. Other non-utilitarian approaches exist based on ethical, religious and cultural points of view which may address ecological, sociocultural and intrinsic values (Alcamo and Bennett, 2003). The preamble to the SARA acknowledges both types of values, recognizing that "wildlife, in all its forms, has value in and of itself" (i.e. intrinsic value) in addition to more utilitarian values including, among others, recreational and economic values. Consequently, this cost-benefit analysis provides only one piece of the information that is made available to decision-makers. Information on non-utilitarian values (such as cultural and spiritual values) is being shared and reflected through alternate sources during the SARA listing process.

4.2.1 Benefits

The incremental changes in benefits as a result of the scenarios were evaluated qualitatively, with quantitative information presented where available.[35] A break-even analysis was undertaken to understand the level of willingness to pay required for the present value of

[35] The Treasury Board Secretariat uses a triage system to suggest scales of analysis proportion to potential impacts. Triage statement (http://www.tbs-sct.gc.ca/rtrap-parfa/temp-gabar/tsf-fet-eng.asp). Regulatory proposals expected to impose $1 million or more in average annual costs are considered significant-cost-impact proposals. Departments are to quantify and monetize both costs and benefits for such proposals. If it is not possible to quantify the benefits or costs, a rigorous qualitative analysis of costs or benefits of the proposed regulation is required, with the concurrence of TBS.

benefits to equal the present value of costs. These estimates were then compared to known non-market values for other species.

4.2.2 Costs

The incremental costs of the scenarios have been estimated in monetary terms (to the extent possible) and are expressed in millions of constant 2016 Canadian dollars, rounded to the nearest hundred thousand. Where monetization of costs was not possible, due to lack of appropriate data or difficulties in valuing certain components, costs were evaluated quantitatively or qualitatively.

Since all incremental benefits and costs could not be monetized, net benefits are not calculated in this report. Rather, a break-even analysis is presented to indicate the minimum level of benefits needed to equal the monetized costs in the commercial sector, recreational sector and First Nations EO/Demo/ESSR and food fisheries.

4.2.3 Baseline

The baseline includes measures that are already implemented and are described in section 5. This analysis assumes that, in the absence of the changes described in the management scenarios, the legislative and management regimes in place at the end of 2018 will continue in the absence of a decision to list. Therefore, these are not considered incremental to the listing decision. The baseline status for various sectors, are described in section 3. This information is used to make projections of impacts and as a point of comparison on the significance of impacts. Data and assumptions regarding economic variables for commercial fisheries, recreational fisheries, First Nations FSC and commercial EO/Demo fisheries and proponents operating in freshwater habitat are described below.

Commercial and EO/Demo fisheries[36]

The commercial fisheries analysis uses data on average landings, prices and costs from 2013-2016 to cover a representative 4-year salmon cycle. Generally, there is considerable annual variability in landings and prices of various salmon species. Based on discussions with DFO resource managers, using recent four year averages which include a high sockeye bump year (i.e. 2014) and low harvest year (i.e. 2015) reduces the impact of inter-annual variability of harvest.[37]

[36] For details on methodology see Appendix F to K.

[37] Complete data for 2017/18 was not available when this analysis was initiated in 2018. A review of the 2017 data suggests using 2013-2016 (instead of 2014-2017) would not materially change the results on impacts to the commercial fisheries.

First Nations food fisheries[38]

Evaluating the economic replacement cost of forgone food value does not capture the full values associated with First Nations food, social and ceremonial fishing. However, it can provide a lower bound dollar estimate as one indicator (among others) of importance.

The FSC fisheries analysis uses data on average landings, from 2012-2015 to cover a representative 4-year salmon cycle[39]. Post Season Review (PSR) reports for 2012 to 2015 (DFO, 2012 to 2015) were used for Fraser River harvest estimates. FSC harvest estimates for other affected regions (i.e. Strait of Georgia, Johnstone Strait, West Coast Vancouver Island) were provided by DFO South Coast Area experts.

Recreational fisheries[40]

At the time of this analysis, results from the 2015 National Survey of Recreational Fishing in Canada were not available. Data used to estimate recreational fishing impacts includes recreational licence sales (freshwater and tidal) between 2013 and 2016, and data from the 2010 Survey of Recreational Fishing in Canada (DFO, 2012) on number of anglers, angling days, expenditures per angling day. Expenditures by species for tidal fishing is also based on the 2010 National Survey while expenditures for freshwater salmon are based on the 2010 Survey of Recreational Fishing in Canada, Economic Impacts of Pacific Salmon Fisheries (GS Gislason, 2017) and the Angler Survey of BC, 2011 (Dabrowska, 2014; pg. 16). The economic values for 2013 to 2016 were estimated from the 2010 data adjusted for actual licence sales.

Proponents in Freshwater

Information on the number and type of projects that have and are expected to occur in waters where CR and TR DUs are found was not available for this analysis.

Ecological baseline

The exploitation rate for CR and TR DUs is unknown but, as the RPA explores a range from 0% up to 25%, it is assumed that the current exploitation is at or less than 25% (Paul Grant, DFO Science, personal communications, Dec 2018).

See section 2.1 for a discussion on rate of decline for these DUs. The reduction in exploitation as a result of the implementation of additional measures in 2018 is also not available. Therefore, the 25% exploitation rate and resulting growth and recovery

[38] For details on methodology see Appendix L.
[39] DFO South Coast area experts have suggested that data for more recent years (i.e. 2016) is incomplete; this precludes the use of more recent years. Using 2012-2015 would not materially change the results on impacts to the FSC fisheries as the range captures the cyclical high and low harvest years typical of salmon fisheries.
[40] For details on methodology see Appendix F.

probabilities under the three relevant productivity models are assumed to represent the baseline (DFO, 2018).[41]

4.2.4 Time Frame

The CBA measures the sum of impacts over a 20 year period, which is representative of approximately three generations for CR and TR DUs (three generations for Chilcotin and Thompson are 21 years and 18 years, respectively). Other factors that informed the choice of a 20 year time frame for the analysis include:

- COSEWIC assessment criteria that are based on the last three generations;
- COSEWIC reassessment a listed species every ten years; and
- Finally, the potential for recovery as outlined in the productivity models ranges from less than 20 years (13 years) under the best case productivity model or is not achievable in 6 generations.

The length of time for the analysis also took into consideration the costs that sectors would incur as these are assumed to differ based on the likely ability of some affected sectors to adjust activities and avoid profit losses. The cost analysis uses the following time frames:

- First Nation FSC harvester food replacement costs are assumed to extend through the 20 year period.
- Commercial harvester profit losses are also assumed to extend through the 20 year period[42]. The capital and skills in fishing are highly specialized and these groups may be least likely to adjust their capital and labour to other economic activities. For example, there could be an inability of fishers to obtain alternative employment due to lack of skill training and/or their location (i.e., a small coastal community where alternative work opportunities are limited).
- Processor costs are reduced linearly over 10 years as it is assumed it would take time to adjust business (i.e. capital investment affecting mobility, require time to secure more product for processing.); however, their adjustment period is likely less than harvesters.

[41] The scope of the CBA is to measure the impacts of the proposed Management Scenarios and actions outlined within. In addition to modelling productivity expected by reduction of threats, the RPA models doubled productivity. These are not relevant to the CBA as management actions that would be required to increase productivity are not included in the Management Scenarios. Therefore, doubling of productivity model projections are also not considered in the CBA.

[42] As the RPA indicates that recovery may be achieved within 13 years under the 5 year mean productivity assumption for CR DU, sensitivity analysis is undertake on potential cost savings of faster recovery where the cost stream of commercial harvester and First Nation's FSC fisheries goes to zero after the expected recovery, resulting in cost savings (See section 9.2.3).

- Lodges and charter profit losses are reduced linearly over 5 years as there will be some capital investment and some remotely located businesses with fewer alternatives needing extended time for adjustment.
- Recreational angler costs in terms of lost consumer surplus are reduced linearly over 3 years as alternate recreational activities are identified.

Therefore, for the above reasons, a 20 year timeframe for the analysis was considered sufficient to ensure both costs and benefits are considered in the analysis. This is also in keeping with the Treasury Board of Canada Secretariat (TBS) guidance that economic assessments cover at least ten years (Canada, 2012).

4.2.5 Discount Rate

The present value of the stream of monetized incremental costs is calculated; however, benefits are not monetized or discounted. Treasury Board guidelines requires the use of a discount rate of 7 percent to estimate the present value of incremental costs.[43]

4.2.6 Economic Framework

Within a cost-benefit framework, economic impacts are measured in terms of changes in consumer and producer surplus. Most of the costs identified in this analysis are the result of reductions in producer surplus or economic profits, which are approximated by changes in net revenues[44] to harvesters, processors, and lodges/charters. Reductions in consumer surplus also represent costs. Where monetary values of impacts are available, impacts were initially estimated in gross terms and then, where relevant and possible, changes in net revenues were estimated.

The detailed methodology for estimating these impacts are outlined in Appendix B.

4.3 Small Businesses

Treasury Board of Canada Secretariat defines a small business as any business, including its affiliates, with fewer than 100 employees **or** annual gross revenues of less than $5m and a micro business with fewer than 5 employees or less than $30,000 in annual gross revenues.[45] Based on this definition, the majority of fishing vessels and lodges and charters in BC are small businesses. Based on Statistics Canada data on enterprises by number of employees, approximately 90% of seafood processors are also small businesses.

[43] Treasury Board of Canada Secretariat. 2018. Policy on Limiting Regulatory Burden on Business. Available at: http://www.tbs-sct.gc.ca/rtrap-parfa/cabtrib-lfarie/cabtrib-lfariepr-eng.asp
[44] The term "net" measures gross revenue minus production costs (i.e. revenues net of costs).
[45] Treasury Board Secretariat (TBS) https://www.canada.ca/en/treasury-board-secretariat/services/federal-regulatory-management/guidelines-tools/policy-limiting-regulatory-burden-business.html#toc5

4.4 Regional Economic Impacts

Two levels of impacts (direct and indirect), are estimated using input-output multipliers[46] developed by BC Stats (2013: 60).[47] Within the input/output model, direct impacts are those associated with a change in output by the industry in question; for example, reduced harvest of salmon reduces the output (i.e. revenue) in the fishing industry. This has a direct impact on value added created in the region (i.e. GDP). Also, there are reduced crew payments (i.e. reduced household income) and some crew may exit the industry (i.e. reduced employment). The indirect impacts are cumulative, and include transactions related to the beginning of the supply chain, as the supply needs change for the industries directly affected. For example, the fishing industry may require less fuel or food for the crew, while the processing industry may require fewer cartons.

Changes in Gross Domestic Product (GDP), employment, and household income are indicators of interest.[48] To estimate the regional impacts on GDP, employment and wages and salaries multipliers for BC are utilized for the processing sector, as well as to estimate GDP for commercial fishing (BC Stats, 2013: 60). To estimate the number of potentially affected employees for the commercial fisheries, an estimate of the number of crews is based on the average crew levels and the number of potentially affected vessels as well as crew share estimates using Nelson (2011). As this provides an estimate of the number of jobs that may be affected to various degrees (i.e. reduction of hours to full job loss) by the change, it may be an overestimate the number of fishing related jobs lost. The direct and indirect impacts are presented in Section 8.4.

4.5 Assumptions and Uncertainties

The analysis in this report requires a large number of assumptions, many of which are implicitly incorporated information presented in section 4.2. For example, the choice of time period (2013-2016) assumes that these are representative years and that harvest and fishing effort in the future will be similar. Some other key assumptions (such as price,

[46] See Appendix D for multipliers used.
[47] Since these multipliers do not remove inter-sectoral purchases there is a potential for some double counting if results for commercial fishing and processing are added together. Previous work done with BC Stats showed that the multipliers differed little between the models with and without inter-sectoral purchases. However, in order to add the results together it is necessary to reduce the gross wholesale value by the landed value of seafood before using the multipliers.
[48] Gross domestic product (GDP) is a metric used for measuring the total amount of activity in an economy, and for comparing activity across industries. GDP measures the sum of *value added* of economic activities, which avoids double counting the value of goods which are the product of one industry and inputs of another (such as gasoline).

fishers ability to relocate effort/angling) may also impact the costs, but are unlikely to change the scale of impacts. This section discusses the uncertainties and how some of the potentially more consequential assumptions are tested in the sensitivity analysis.

4.5.1 Population Productivity Uncertainties

DFO (2018) identified several sources of uncertainty that may affect the estimates of productivity of each population including exploitation rate estimates, unaccounted for fixed rate terminal harvest, and variations in escapement. Three alternate productivity models were presented in the RPA (DFO, 2018) assuming that productivity would be similar to that observed over the most recent year, five years and ten years. While the RPA specified the most likely mean productivity is the 1 year mean productivity, impacts under all three models are presented in the analysis.

4.5.2 Species Recovery Probability Under Baseline

The RPA does not specify the current exploitation rate. Instead, it shows a range of fixed exploitation rates from 0% to 25% (DFO, 2018). Therefore, without additional information on what the current exploitation rate may be, this analysis assumes that it is 25% or less as information to assume a different exploitation rate for purposes of the CBA is not available.

4.5.3 Resuming Activities After Recovery

management scenarios are static and are assumed to be in place for the next 20 years i.e., the management scenarios do not consider the potential for relaxing prohibitions after recovery is reached. However, under certain conditions explored in the RPA (DFO, 2018) i.e., in the 5 year productivity model, it is possible that the CR DU could recover earlier than 20 years. Therefore, sensitivity analysis is undertaken to assess the effect on the results of the CBA if prohibitions are relaxed after recovery (see Sensitivity Analysis Section 9).

4.5.4 Food Replacement Costs[49]

DFO estimates that approximately 1,400 pieces of chinook, 2,900 pieces of coho, 3,000 pieces of pink, 30,000 pieces of chum and 6,200 pieces of sockeye are harvested in FSC fisheries during the closure times and in the areas identified under List (incremental to the closure areas identified under the baseline) based on past harvest information. However, the replacement costs could be higher than estimated for several reasons, such as higher market prices, higher harvest estimates, higher harvest reductions than estimated in the closure periods, or higher future harvest levels than the harvest in the recent past (i.e. between 2012 and 2015). In other words, current/past harvest may not be reflective of the

[49] See additional discussion in section 4.6 on limitations of assessing only the loss of food for nutritional purposes in the First Nations FSC fisheries as well as how information related to cultural significance values are being considered in the SARA Listing process.

expected future growth of Indigenous populations and increasing food needs (and potentially higher future harvest levels).

Therefore, these estimates should be used mainly as a way to understand the scale of food replacement impacts. That is, that the minimum economic value of salmon caught by First Nations for food during the closures under a Listing scenario exceeds $1m annually. Sensitivity analysis was undertaken to examine the impacts for a higher forgone harvest (10% and 20%)[50] and/or higher retail prices (25% and 50%)[51] to account for the possibility of underestimation of food replacement costs. Replacement costs for food are unlikely to be lower. Sensitivity analysis is presented in Section 9.

4.5.5 Permits for Science activities

Information on incremental measures necessary to meet the SARA s. 32 prohibition for science activities are not available, and DFO (2018) population projections do not include exploitation due to science activities (i.e. setting science mortality to zero would not result in changes to the model outcomes). In the absence of this information, the costs and benefits of scenario 3 (list with no permits for science) are uncertain and cannot be assessed, but costs are assumed to be higher than those estimated under scenario 2.

4.5.6 Consumer Prices

The analysis assumes that salmon prices do not change for consumers and harvesters. Canada is a price taker and represents a very small percentage of the global seafood market. It is assumed that any loss in market-based consumer surplus to Canadians due to changes in the commercial fisheries is negligible. Consumers incur costs if prices rise due to reduced supplies. In BC, the domestic market is highly competitive with numerous substitutes. Consequently, price increases resulting from management changes are not anticipated and domestic consumers are not anticipated to incur costs due to changes in the commercial salmon fisheries. Further, this analysis assumes that the reduction in salmon harvest is not anticipated to result in higher prices for harvesters. Processors are assumed to be constrained in the prices they can offer by the global seafood market.

[50] In BC, the Indigenous population will grow between 1.1% and 2.3% per year on average from 2011-2036. During this 25-year period, the BC Indigenous population would increase by between 31% and 78% (241,000 in 2011 to between 316,000 and 428,000 in 2036). Source: uses data from StatsCan National Household Survey 2011 https://www150.statcan.gc.ca/n1/pub/91-552-x/2015001/section08-eng.htm; https://www150.statcan.gc.ca/n1/pub/91-552-x/2015001/t/tbl09-eng.htm

[51] Over the past 20 years, the CPI for "Food" in British Columbia increased by 51% (from 1995 to 2015). Given this increase in the CPI, we included sensitivity analyses on the price of food at 25% and 50% so as to not underestimate the impacts of such price variation on consumers. See Statistics Canada. Table 18-10-0005-01 Consumer Price Index, annual average. Last Accessed July 5, 2016.

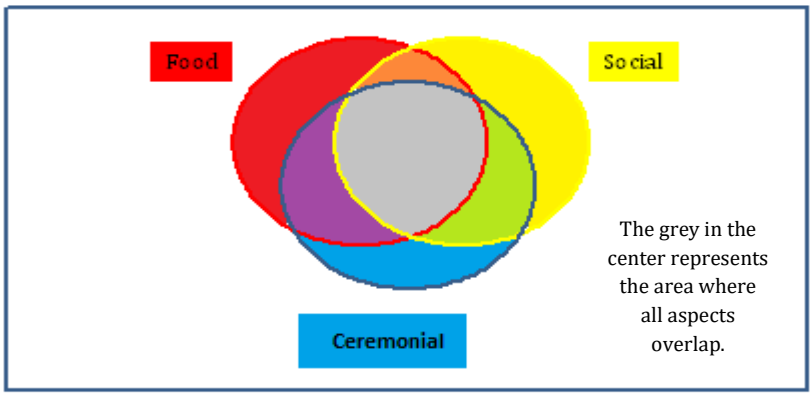
4.6 Limitations

Reflecting the interests of Indigenous peoples of Canada within a CBA poses unique challenges. The economic language of the CBA, using concepts such as marginal changes, willingness-to-pay and a current-period baseline, is not compatible with the holistic perspective that is reflected in Indigenous Traditional Knowledge and world views. The CBA framework is not well placed to provide information on the loss of food for social and ceremonial purposes and culture significance of FSC fisheries, other than losses of food for purely nutritional value.

Figure 12 attempts to illustrate this holistic concept for readers. If interlinking circles were to represent different components that make up the value of FSC fisheries, these values overlap and cannot be separated. Depending on the Nation and the degree of species' significance, the circles could be more tightly overlapped or more loosely associated with only a small overlap. This information is based on what DFO has heard through various discussions with First Nations. The purpose of this diagram is to explain that impacts on loss of harvest for FSC purposes cannot be fully assessed without a means to also assess the other components that make up the whole. Although the components are likely numerous[52], only three are noted here for illustrative purposes to show that food for nutritional purposes is only one component of many. Measuring loss of food for nutritional purposes captures only the non-overlapping (red shaded) portion of the interlinking diagram, and not the overlap with other components. Therefore, this CBA only captures the lower bound of potential impacts to First Nations.

[52] First Nations Fisheries Council indicate several other components that make up fisheries values such as culture, governance, economic values, social values, health and environmental values. See page 13 of the following link. Last accessed January 4, 2019. https://www.fnfisheriescouncil.ca/wp-content/uploads/2018/11/D-Machin-FN-Fisheries-Values-and-Ec-Analysis.pdf following link.

Figure 12:Illustrative Model of Overlapping First Nations FSC Values



For each Nation, (1) the degree of integration and overlap with other values and (2) the level of significance relative to other values or relative to other species of significance could differ within and across Nations. Hence, First Nations have indicated to DFO that reflecting cultural significance values requires special representation of the viewpoints of Indigenous peoples to provide additional insight into the significance of the species. For some species, greater or lesser emphasis may be placed on the food component, depending on the Nation. Further, species cultural significance values could differ from one nation to another. For some species, the emphasis could be greater on food consumption; whereas for other species of high significance that are not consumed, greater emphasis could be on cultural aspects. There are examples of species that are of great significance for some Nations that are not consumed, either due to reverence for the species or because of conservation concerns.

DFO recognizes that food, social, and ceremonial fisheries hold value beyond food replacement, such as social, ceremonial, cultural, spiritual, governance, historical and other values. Although available information allows for a quantitative assessment of food replacement values[53] in the CBA, in the absence of information on the impacts of loss of food for social and ceremonial purposes and culture significance of FSC fisheries, the impacts of a SARA Listing decision of TR/CR steelhead on First Nations will be understated.

It is important to note, while the CBA is just one input to inform the SARA listing process, more customized approaches to receive information on Indigenous social, cultural and economic importance of species are not precluded. The Species at Risk Program has initiated a separate process to consider information on the cultural and social significance of Thompson and Chilcotin Rivers steelhead trout and salmon FSC fisheries that may be

[53] A food replacement cost is assessed at current market prices (see Appendix L for calculations for retail value).

impacted under a listing decision[54]. Further, other implications for Indigenous groups that are not typically included in a CBA can also be reflected through the SARA Listing process.

5. Current Legislative Protections and Management Practices

Management of steelhead trout is shared by both federal and provincial governments. Management depends on whether it concerns commercial or sport fishing, whether actions are concerned with tidal or non-tidal waters and what actions are implemented or being varied. Three regulations under the *Fisheries Act* are relevant to TR and CR steelhead management. These include the *British Columbia Sport Fishing Regulations* ("BCSFR"), the *Pacific Fishery Regulations* ("PFR") and the *Fishery (General) Regulations* ("FGR").

Habitat Measures

- The *Fisheries Act* prohibits serious harm to fish. DFO reviews projects in freshwater , assesses activities likely to cause serious harm, and provides advice to avoid and mitigate effects of activities on fish and fish habitat resulting from habitat degradation or loss or alteration of fish passage and flow. DFO may issue authorizations for works, undertakings, or activities where there are residual impacts from serious harm. DFO manages habitat occurrences, supports fish habitat restoration and enhancement programs, and develops regulatory partnerships where appropriate.
- The Province of British Columbia develops Best Management Practices where appropriate (in collaboration with DFO), and regulates: changes in and about a stream, forest and range practices on BC Crown land, applications for new major mines and major expansion projects, agricultural waste management, water licences, and release of deleterious substances. BC, DFO, Indigenous groups, and industry are working to develop a new operating rule curve for Nicola Lake Dam, to enhance flow conditions to benefit Chinook, Coho and Steelhead.

[54] Information on the DFO Species at Risk (sara.xpac@dfo-mpo.gc.ca) process initiated for understanding cultural significance (as well as, other First Nations impacts of a Listing decision of TR and CR steelhead DUs that are outside the scope of a CBA) was provided on www.pac.dfo-mpo.gc.ca/consultation/index-eng.htm, last accessed October, 2018.

Fisheries Measures

A range of selective measures have been in place prior to the COSEWIC emergency assessment to reduce steelhead impacts in the recreational fisheries:

- The recreational fishery for wild Thompson and Chilcotin Rivers steelhead is exclusively catch and release; retention of hatchery steelhead is only permitted in Region 2, the Lower Mainland (see Appendix M). Size limits, fishing times (i.e. daylight), bait, and gear restrictions, and specific closures also exist depending on the location. In general, known holding or spawning areas are closed to all angling during periods typically inhabited by TR and CR DU steelhead.
- Other management measures for steelhead recreational fishery include: harvest restrictions, gear restrictions, time/area closures, and limited entry for non-residents and guided fishing tours.

A range of selective measures have been in place prior to the COSEWIC emergency assessment to reduce steelhead impacts in the commercial and EO/Demo salmon fisheries. These measures include:

- Non-retention of steelhead, delayed or reduced fishing times when steelhead are present in the area, and the use of selective fishing techniques to reduce or avoid steelhead encounters.
- Delay of the commercial chum fisheries until the majority of the steelhead run has passed through the Lower Fraser.
- Catch monitoring and enforcement measures are in place to ensure compliance with selective fishing methods. Selective fishing methods in the commercial fishery include using shorter gillnets, reduced daylight-only fishing times, and the mandatory use of revival tanks.
- Operation of the Albion Test Fishery, where data used to inform steelhead in-season abundance assessment is collected and shared with BC.
- Development of fisheries management objectives and management measures designed to reduce impacts of incidental/unintended interception in salmon fisheries managed by DFO.
- Collection and reporting of catch and encounter information data from fisheries managed by DFO

More recently, in response to the emergency assessment of TR/CR steelhead as well as declining trends in spawning abundance, DFO, First Nations and B.C. provincial partners implemented additional fisheries management measures designed to protect TR/CR

steelhead. The 2018 measures for indirect threats (i.e. bycatch) from commercial salmon fisheries and First Nations salmon EO/Demo fisheries, FSC fisheries and salmon freshwater and tidal water recreational fisheries were implemented through the 2018 South Coast Pacific Salmon Integrated Fisheries Management Plan (IFMP). These measures implemented rolling window closures within a 27 day period in specific areas designed to protect steelhead (See Appendix A). In terms of direct threats, a Province of BC variation order curtailed the targeted steelhead recreational fishery on Thompson River through a one month extension of existing closures to during times when TR DU steelhead are likely to be present.[55] Finally, the Tsilhqot'in National Government announced a closure of their steelhead directed FSC fishery on the Chilcotin River. Information on the total number of First Nations that harvest TR and CR steelhead for FSC purposes is not known. See Appendix A for details of the 2018 measures. The impacts of these more recent measures are also estimated and can be found in Appendix N.

Science and Conservation Activities

- DFO issues *Fisheries Act* licences for scientific, experimental, educational, public display, or aquatic invasive species control purposes. The Department's Resource Restoration Unit supports restoration, conservation and fish habitat enhancement programs, including education and federal contribution program initiatives. DFO also conducts research relating to stock assessment activities, for example: helicopter-based counts, fishway sampling, mark-recapture, resistivity counters, and numerous test fisheries.
- The Province of BC issues fish collection permits for scientific and other non-recreational purposes. BC also conducts research relating to stock assessment activities, including visual and helicopter-based counts.

6. Management Scenarios

Management scenarios outline the measures that would be implemented following a species listing decision. SARA prohibitions apply to species that are listed as threatened and endangered and the measures outlined in the List management scenario are assumed to meet the objectives of SARA and to fulfill the SARA s. 73/74[56] permit requirements. A decision may be made to not list the species (scenario 1 – Do Not List), or a decision can be

[56] Section 73 and 74 of the *Species at Risk Act* (SARA) addresses the powers of the Minister to enter into an agreement or issue a permit to authorize activities affecting a listed wildlife species, or its critical habitat, or its residences. *See:* https://laws-lois.justice.gc.ca/PDF/S-15.3.pdf

made to list the species (scenario 2 – List with science permits). See Appendix A and C for summary of the management measures.

6.1 Scenario 1: Do Not List

The *Fisheries and Oceans Canada* ***Species at Risk Act*** *Listing Policy and Directive for "Do Not List" requires* that prior to providing advice to the Minister of Fisheries and Oceans to not list a species, a work plan to address the needs of the species must be developed[57]. In response to the Emergency Assessment of TR/CR steelhead, DFO, First Nations and B.C. Provincial partners implemented additional measures in 2018 to address conservation concerns (See section 5 for description of the measures). See Appendix N for an analysis of the incremental impacts of these 2018 measures.

Additional measures incremental to those already implemented (i.e. incremental to the baseline), have not been identified under the Do Not List scenario (scenario 1).

6.2 Scenario 2: SARA List with Permits for Science Activities

The SARA List scenario (scenario 2) includes specific measures for all sectors. However, scenario 2 assumes permits will be considered for science activities, provided they meet the SARA section 73 preconditions. If TR and CR steelhead are listed as endangered under SARA, the following incremental measures have been identified under Listing. The CBA assesses the impact of each action:

- S.32 and s. 33 prohibitions would apply, making it illegal to kill, harm, harass, capture, take, possess, collect, buy, sell or trade a species listed as Endangered under SARA, and to damage or destroy their residence. Due to low levels of allowable harm (not to exceed current levels and to be reduced to the maximum extent possible; DFO, 2018) only science and conservation activities were considered by DFO for permits under s.73 of SARA. Prohibitions would therefore require rolling fishery window closures as described in Appendix A.

- A recovery strategy identifying critical habitat must be developed within one year of listing, followed by an action plan; progress of recovery strategy and action plan implementation must be reported on every five years.

[57] For further details, please see Species at Risk Act Listing Policy and Directive for "Do Not List" Advice. 2013. Deputy Minister's Policy Committee - Fisheries and Oceans Canada. Retrieved November 26, 2018 from http://waves-vagues.dfo-mpo.gc.ca/Library/365882.pdf.

- Critical habitat must be protected (often achieved through a Ministerial Order) 180 days following final publication of the recovery strategy in which it is identified.

- The management scenarios also indicated that there may be consideration of other habitat protection options (e.g. "Ecologically Significant Areas"); and, development of species-specific guidance, standards and/or regulations where appropriate. However, there is no further information provided on what these options, guidance or regulations could entail and what additional protections they would provide. Therefore, the impact (costs and benefits) of these habitat protection options cannot be considered further until detailed information on the specific measures is available.

7. Cost-Benefit Analysis

7.1 Scenario 1: Do Not List Under SARA

Additional or incremental measures are not anticipated under a Do Not List scenario (scenario 1). Consequently, there are no incremental costs or benefits associated with this scenario.

7.2 Scenario 2: List under SARA

7.2.1 Fishery Costs

Commercial Salmon Fishery (including First Nations sale and communal fisheries)
It is estimated that on an annual basis, revenues would be reduced by $13.8m (or $7.2m in profits) for the commercial salmon seine, troll and gillnet fleets (losses incremental to the baseline). If either DU is listed or both TR and CR DUs are listed, this translates to an estimated present value loss in profits of approximately $82.0m over 20 years (or $7.74m annualized).

In addition, revenues from First Nations' commercial sale fishery (i.e. EO, Demo and ESSR[58]) would be reduced by $0.78m each year (or a $0.34 reduction in profits each year), regardless of which DU is listed, or if both DU's are listed. The present value profit loss of approximately $3.9m over 20 years (or $0.4m annualized) is estimated.

[58] Reductions in ESSR fisheries are not anticipated under these measures.

Thus, the total impact on the commercial salmon fishery due to incidental catch prohibitions on harvesters, including First Nations, is estimated to be approximately $85.9m loss in profits over 20 years or an annualized value of $8.1m.

There are expected to be spin-off impacts on the larger economy and other sectors that provide services to the commercial sector. The regional impact section of this report discusses the direct and indirect impacts on GDP, employment and income in more detail (see Section 8.4).

First Nations Food, Social and Ceremonial (FSC) Fisheries

Pacific salmon are a species of incredibly high significance for Indigenous people of BC. The salmon remains as a defining feature in BC's First Nation culture pivotal to Indigenous communities, societies, and cultures. Because of its prominence, prevention of harvest of salmon for those dependent on the resource, either for sustenance, ceremony, or economic well-being, would have major implications. As described in more detail in section 4.6, listing the DU's under SARA could result in impacts on First Nations that cannot be addressed in the utilitarian framework used in this cost-benefit analysis. Therefore, this CBA only captures the lower bound of potential impacts to First Nations. However, as the CBA framework cannot clearly assess FSC impacts other than for assessing loss of food for consumption, DFO is undertaking a parallel process to understand information on Indigenous cultural significance of affected FSC fisheries. As well, other impacts on Indigenous groups that are outside the scope of a CBA can also be considered through SARA consultation processes.

Based on published DFO Post Season Review reports, logbook data and other DFO advice on harvest, the average (from 2012 to 2015) salmon harvest is estimated almost 690,000 pieces. DFO estimates that, of total coast-wide FSC catch, 5% of chinook, 9% of pink, 54% of chum, 22% of coho and 1% of sockeye is caught in the closure time/areas for FSC purposes.[59] Under certain circumstances some effort could be shifted outside the closure times. However, to ensure that impacts are not underestimated, we assume that forgone harvest cannot be made up elsewhere. Therefore, based on DFO harvest estimates in closure time/areas, the estimated present value of replacement costs range of the forgone harvest for consumption purposes under Listing is approximately $17.1m to $23.9m over 20 years (or $1.6m to $2.3m annualized). However, while the intent of this CBA is to provide a scale of impacts to decision-makers, it is important to note that there may be several reasons that the estimate of harvest in closures periods could under represent

[59] Estimates for Strait of Georgia, Johnstone Strait and West Coast Vancouver Island are approximated by DFO Area South Coast staff and may be different than those reported in the published Post Season Review reports.

actual FSC harvest, as noted in section 4.5.4 FSC Replacement Costs. [60] Therefore, these estimates should be used mainly as a way to understand the scale of food replacement impacts (i.e. low (<$1m annualized) and high (over $1m annualized)). Additionally, sensitivity analysis is also presented to show what the impacts would be if base case harvest levels were increased by 10% and 20% or if replacement costs were higher to account for underestimation of future food replacement costs (see sensitivity analysis in Section 9).

Salmon Test Fisheries

As activities for research and conservation would be permitted during the 60 day closures period for other fisheries under scenario 2, impacts are not anticipated. There may be some administrative burden. However, as s.73 permit requirements are minimal and could be coordinated with existing requirements for licences under the *Fisheries Act* or scientific permits provided under provincial authorities, the impact is anticipated to be negligible.

7.2.2 Industry Costs

Seafood Processing Sector

For the processing sector, the first year loss of $35.6m Gross Processed Value (GPV) is estimated (or first year net profit loss of $1.46m) which declines over 10 years. This translates into an estimated present value profit loss of approximately $4.8m over 20 years (or $0.5m annualized). These costs include an annual $1.9m gross processed value loss or a present value profit loss of $0.3m over 20 years (or $25,000 annualized) due to prohibitions on incidental catch in inland First Nations' EO and Demo fishery.

Recreational Service Industry

Economic impacts will also be incurred by businesses that directly service the tidal and freshwater recreational sector, including the lodges, charters and guides. The reduction in tidal and freshwater angling would reduce expenditures on packages and guides. This would result in estimated revenue losses of approximately $31.7m by lodges and $2.32m by charters operating in both the tidal water and the freshwater recreational sector. In terms of profits, these revenue reductions would mean a $16.0m in present value profit losses to the lodges, charters and guides operating in tidal water over 20 years (or $1.5m annualized). In terms of profits loss from freshwater fishing changes, reductions in angling

[60] While DFO South coast area experts already adjusted for some of these issues when providing their estimates of FSC harvest for Strait of Georgia, Johnstone Strait and West Coast Vancouver Island, they noted significant uncertainty around the estimates, which cannot be verified.

days would mean an additional $0.2m in present value profit loss over 20 years (or $15,800 annualized) to the lodges, charters and guides operating in freshwater. Therefore, the total loss in profits to these recreational services is estimated to be approximately $16.2m over 20 years (or $1.5m annualized).

There are expected to be spin-off impacts on the larger economy and other sectors that provide services to the recreational angling community. The regional impact section of this report discusses the direct and indirect impacts of reduced expenditures to other recreational sector businesses on GDP, employment and income in more detail (see Section 8.4).

Freshwater Project Proponents

Generally, when the incremental costs of a SARA listing on proponents that are engaged in works and undertakings are assessed, an examination is undertaken on whether additional mitigation measures beyond those necessary to avoid *serious harm to fish* under the *Fisheries Act* are necessary in order for proponents to meet the conditions for issuing a SARA permit, including the condition that the activity not jeopardize the survival or recovery of the species. As per the management scenario 2, s.73 permits are unlikely to be issued for this species for works or activities that will be undertaken in freshwater habitat. This would require proponents to avoid all harm to CR/TR steelhead. In such cases, incremental costs could be associated with redesign, relocation or cancellation of a project to avoid harm. For example, proponents of projects may need to delay the activity to avoid times when SARA Listed species are present, resulting in higher direct project costs or opportunity costs due to delays. Or the project may need to be relocated to an alternative location where it could be more costly to undertake the project or results in lower returns. Or, the project may need to undertake additional activities and measures which are more costly than other standard activities or measures. Finally, in some instances, projects may incur lost opportunity if they are not able to proceed because they are unable to avoid harm that could jeopardize the survival or recovery of the species. Given the extensive development along the Lower Fraser River, many works/undertakings have the potential to be affected, although, the number and types of potentially affected projects and degree of potential impact would be highly dependent the types of incremental actions required.

As data was not available on the number and type of projects that may require incremental mitigation as a result of a listing, it is not possible to estimate the potential impacts, which could range from low to significant.

7.2.3 Consumer Costs

Recreational Fishing

Due to the prohibition on incidental catch of steelhead in the tidal recreational fishery, approximately 17.18% (~226, 800) of the total salmon (1,320,000) angling days in tidal waters will be impacted during the closure time and in areas specified in scenario 2. Additionally roughly 14.56% of other finfish (e.g. halibut, lingcod, rockfish, tuna etc.) angling days occur in these time/areas which would also be impacted. This translates into reductions of about 226,799 angling days for salmon and almost 105,968 angling days for other finfish in tidal waters. The estimated consumer surplus per day for saltwater angling is $108.69 to $197.47, for a present value loss in benefits of between $65.4m to $118.7m over 20 years (or annualized value in the range of $6.2m to $11.2m).

In terms of freshwater salmon angling approximately 3.08% of total days (695,000) occur in the 60 day closure time/areas specified in scenario 2, of which about 0.6% of steelhead angling days remain directed at the Thompson/Chilcotin Rivers DUs following the extended closures of on the Thompson River. This translates into reductions of 21,427[61] angling days for salmon due to prohibitions on incidental catch of steelhead and about 836[62] angling days directed for steelhead. The estimated value of consumer surplus per day for freshwater angling (directed and incidental) is $23.73 to $116.85, which translates to a present value loss of consumer surplus for freshwater recreational anglers of approximately $0.9m to $4.5m over 20 years (or annualized value ranging from $87,000 to $430,000).

Therefore, the total loss in consumer surplus would range from $66.3m to $123.2m for both tidal and freshwater recreational fishing over 20 years (or annualized values of $6.3m to $11.6m).

7.2.4 Government Costs

The federal government would incur costs for the development of a Recovery Strategy and Action Plans . In addition, costs related to research actions would also be incurred. It can also be assumed that some cooperation and collaboration with partners will be required to draft and implement recovery documents. In addition to the collaborative process itself, there may be some costs related to research and monitoring work. These would be

[61] About 6,100 freshwater salmon days were reduced under the 2018 measures.
[62] Prior to the 2018 Measures, there were about 3,300 angling days targeting TR/CR steelhead. These days were reduced by 74% (reduced by almost 2,500 days) under the extended closures in the Thompson River. The remaining 836 days will be reduced under Listing Scenario 2.

primarily incurred by government from existing sources; however, First Nations and Provincial partners may also voluntarily incur direct and in-kind costs. Since the details of the plans are not yet known, the scale of the costs to undertake the research to support management for CR/TR steelhead is unknown. These activities would be funded through existing resources and no additional funding would be sought.

7.2.5 Other Costs

Damage/Destruction of Residence

Subsection 35(1) of the *Fisheries Act* prohibits serious harm to fish, which is defined in the Act as "the death of fish or any permanent alteration to, or destruction of, fish habitat". As the existing federal regulatory mechanisms are already in place, incremental costs of protecting the residence of steelhead under SARA s. 33 are not anticipated.

Critical Habitat Protection Order

The species' critical habitat needs are not currently known. If the species is listed, a Recovery Strategy identifying critical habitat would be developed. Protection of critical habitat from destruction is often accomplished through a SARA Critical Habitat Order made under subsections 58(4) and (5) of SARA, which would invoke the prohibition in subsection 58(1) against the destruction of the identified critical habitat. Considering the existing federal regulatory mechanisms in place, the incremental costs of implementing a Critical Habitat Protection Order are anticipated to be negligible. An Order is not anticipated to result in incremental costs to Canadian businesses and Canadians.

7.2.6 Summary of Costs

If only one DU is listed or both TR and CR DUs are listed, the present value of total monetized costs are estimated to range from $190.3m to $254.0m present value ($18.0m to $24.0m annualized) under all productivity models. As can be seen from Table 13 harvesters would incur bulk of the costs, ranging from 44% to 55%, followed by anglers bearing approximately 34% to 47% of the incremental costs. The loss in profits for the seafood processors accounts for about 8% to 11%.

Table 13: Present Value of Total Incremental Costs for Management Scenario 2 (over a 20 year period) *(in million $, 2016)*

Affected Parties	Present Value	Annualized Value
Fishery Costs		
- Commercial Salmon Fishery (including FN EO/Demo)	$85.9	$8.1
- First Nations FSC Fishery	$17.1 - $23.9	$1.6 - $2.3
Industry Costs		
- Seafood Processing Sector	$4.8	$0.5
- Recreational Service Industry	$16.2	$1.5
Consumer Costs		
- Recreational Fishing	$66.3 - $123.2	$6.3 - $11.6
TOTAL COSTS	**$190.3 - $254.0**	**$18.0 – 24.0**

Note: Totals may not add up due to rounding.

7.2.7 Incremental Benefits

Benefits can accrue from several sources. For example, there would be benefits if future harvest opportunities for directed fisheries exceed those anticipated under the baseline, or if other fisheries were able to harvest a greater share of their allowed catch as a result of higher bycatch allowances. Additionally, the economic welfare of Canadians (in the form of non-use values) could increase from knowledge that the species is recovering.

The benefits of protecting CR and TR steelhead flow from the use values for the species, as well as the values Canadians have for preservation of wildlife species and their associated provision of ecosystem goods and services (indirect and non-use values including existence and bequest values). Both sets of values contribute to consumer surplus. Some of these use values may be measured in the market, while others are non-market use values.

Protecting species at risk can provide benefits to Canadians beyond use benefits. Various studies show that Canadians place value on preserving species for future generations to enjoy and benefit from knowing the species exists, even if they will never personally see or otherwise enjoy them. Forbes et al. (2015) looked at management measures that resulted in changes in the listing status and probability of extinction for various species. Their analysis showed positive and significant impacts on welfare for Canadians if management actions resulted in an improvement in status of the species (e.g. from endangered to threatened); this change was illustrated by a positive willingness-to-pay for management actions.

Further, the development of a Recovery Strategy, Action Plan implementation and Critical Habitat protection would be expected to provide additional benefits. These measures raise the profile of the species, identify and protect critical habitat and describe and implement

measures to recover the species, all of which could result in reduced risk of extinction or recovery of the species. As such, a listing decision would result in incremental benefits beyond the baseline.

Incremental benefits would occur if listing recovery measures result in future harvest opportunities (for recreational fisheries, mixed stock salmon fisheries or First Nations FSC steelhead fisheries) that are higher than the baseline, if recovery measures result in a change of species status to a lower risk classification and/or if recovery is achieved at a faster pace than under the baseline.. The management scenarios are static and do not suggest future increases in direct use of the species, while additional fishing opportunities are unlikely in incidental mixed stock fisheries as they are constrained by other species.

Additional indirect incremental benefits for Canadians could result from changes to ecosystem goods and services supported by CR/TR steelhead, as well as option and non-use benefits such as bequest and existence values associated with either recovery or increased abundance if growth is expected. This is explored through analysis of differences in growth and recovery probabilities under three productivity models as outlined in the RPA (DFO, 2018).

Primary studies to provide monetary estimates of Canadians non-use values for TR and CR DUs of steelhead trout were not undertaken to inform this analysis. Further, there are no existing published studies that monetize Canadian's willingness-to-pay (WTP) to protect and conserve CR/TR steelhead. Benefits transfer methodology was used to identify a valuation study for steelhead protection and recovery in the US.

Numerous empirical socio-economic studies of steelhead that were developed elsewhere (especially in the US) were consulted and their results (in terms of willingness-to pay, and consumer surplus) were compared.[63] Previously published studies show a range of WTP values depending on factors such as the profile of the species, its likely future use, and its taxa (e.g. fish vs. mammals). The range of values is broad, and there is often a high degree of variability around the estimates. Differences in monetary values among the studies considered are attributed to alternative research approaches and varying methods used (including: travel cost method (TCM), and contingent valuation method (CVM)) to derive willingness to pay estimates. These studies also differed in the sample populations that were assessed (to estimate non-monetary benefits for steelhead) (e.g.: US households [non-users] versus steelhead anglers [users]). The questions considered in the studies also differed: (for example: What is the maximum stamp fee you would like to pay for improved steelhead fishery? What is your willingness to pay for caught fish? Which steelhead

[63] For details on consulted studies, please refer to references in Appendix O.

conservation option do you prefer and how much would you be willing to pay for it?). The studies also differed by the geographical study area, and the size and timeframe of data used in the analysis. The most suitable studies were identified considering the appropriateness of the geographical area and timelines to serve as proxies for BC steelhead. Transferring the values derived within a U.S. study to residents in Canada requires the assumption that U.S. residents have values similar to those of Canadians. The non-market benefits of steelhead that accrue to households (non-users) differ from the non-market benefits of steelhead perceived by steelhead anglers (users). It is expected that values perceived by Indigenous groups (users) would vary from these two groups.

This benefits analysis relies on household willingness-to-pay (WTP) estimates for steelhead conservation based on research undertaken by Wallmo, K. and D.K. Lew (2016). The Wallmo and Lew (2016) study was chosen to inform the benefits as it aligns with the regulatory scenario under consideration in this study. Wallmo and Lew (2016) conducted a comparison of regional and national values for recovering threatened and endangered marine species in the US. That research assessed whether there is variation among regional and national WTP estimates by employing a random utility discrete choice model which considered options to provide additional protection actions for eight threatened and endangered marine species (southern California steelhead, southern resident killer whale, humpack whale, Johnson's seagrass, Central California Coast coho salmon, elkhorn coral, black abalone, and the hawksbill sea turtle). In that study, the survey design framework asked respondents to choose their most and least preferred option to improve the *Endangered Species Act* (ESA) listing status of one or more species, from the status quo condition [with no associated costs], to options that would result in incremental costs to households. In that study, the ESA status of the Southern California steelhead was "Endangered". The species habitat spanned in tributary rivers and streams of central California to Northern Mexico (the population size of the species is unknown). The research surveyed a random sample of 5,000 US households, plus a stratified sample of 9 US census regions, and the study results are based on 5,061 completed survey responses. Among the nine regions considered, the estimated willingness-to-pay value for the Southern California steelhead ranged between ($60.17 - $101.23); and the national estimated mean willingness-to-pay was $71.06 (range $66.29 - $75.96). After adjusting the national mean WTP for the exchange rate and inflation[64], the value of steelhead recovery (in 2016 $'s) used in this study, ranged from CAD $69.44 to CAD$79.57 per household was used in this analysis.[65]

[64] See https://fred.stlouisfed.org/data/EXCAUS.txt for the average annual exchange rate of 1.029 in 2013 and adjusted to 2016 dollars using the Bank of Canada inflation rate at the following website https://www.bankofcanada.ca/rates/related/inflation-calculator/

[65] As per the 2016 Census, the total number of Canadian households is 14,072,080.

Benefits to Canadian under Three Productivity Models

The RPA provides the science basis for determining the recovery potential and associated recovery benefits of a listing decision and defining whether recovery is possible and under what circumstances. In this case, the RPA provides three separate mean productivity models (1 year, 5 year and 10 year) and various exploitation rates and suggests that the 1 year productivity model is the most likely (DFO, 2018: 10).

The RPA also projects the probability of recovery under different exploitation rates if productivity were to increase (i.e. doubling of log productivity) as a result of measures that are not considered in the management scenarios[66]. As the scope of the analysis is determined by the proposed management scenarios and measures that are likely to be implemented by DFO, the projections examining "doubling" productivity through alternate measures are not explored in this CBA.

The current exploitation rate is not known but expected to be at or lower than 25%. Under Listing, due to SARA prohibitions, a zero exploitation rate is expected from recreational, commercial and First Nations fisheries. Therefore, the benefits of recovery are assessed under a zero exploitation rate in this analysis for all three productivity models, without a doubling of the productivity log. The 5 year mean productivity is the most optimistic for recovery of CR DU. And, the 10 year productivity model is the most optimistic for probability of growth of TR DU. The TR DU is not expected to recover under any of the three productivity assumptions that relate to the management scenario 2. The incremental benefits due to recovery and growth potential based on the productivity models assessed in the RPA are as follows:

- **Productivity Model 2a (5 year):** This model shows a 97% probability of recovery for CR DU within 2 generations under a List scenario (i.e. under a zero exploitation rate). For the TR DU, however, the model shows a lower than 50% probability of growth (41%) for TR. Recovery of TR DU is not expected. Provided the results of the productivity model are accurate, the benefits of CR steelhead recovery can be significant. Based on values from Wallmo and Lew (2010), willingness to pay (WTP) value for steelhead recovery are estimated to range from about CAD $69.44 to CAD$79.57 per household per year for 10 years. While no specific study was conducted for this species in Canada, based on the incremental costs estimated for listing the species under SARA, the Canadian WTP would need to be $1.80 to $2.41

[66] According to the RPA Table A2.p.g 23, limiting factors for productivity include altered ocean and freshwater conditions, predation, competition and parasites or pathogens. These are not addressed through the measures outlined in the management scenarios which are focused on addressing threats. Hence, population projections that consider doubling of log productivity are not discussed in this CBA.

per household per year for 10 years for recovery under the SARA listing scenario. This value is well below the WTP range estimated in the Wallmo and Lew (2010) study and suggests that if the results of this productivity model holds, the benefits of listing the species under SARA would be significantly higher than the monetized costs.

- **Productivity Model 2b (1 year):** This model is the most likely and shows that, under a zero exploitation rate, there is a low probability of growth (4%) for TR DU and 1% probability of recovery. For CR DU, there is a 0% probability of growth and recovery. Thus under this "most likely" model, growth and recovery probabilities for both DUs are highly unlikely even in 6 generations. If the results of the productivity model are accurate, the RPA suggests a low recovery and growth potential for CR DU (0%) and low recovery and growth potential for TR DU (1% and 4%, respectively). Hence, the most likely model does not show a sustained growth for TR or CR DUs.

- **Productivity Model 2c (10 year):** This is the most optimistic model for TR DU and shows increased probability of growth from 8% to 81% under a 25% and 0% exploitation rate, respectively. The probability of growth for the CR DU increases from 6% to 88% (under a 25% exploitation rate to a zero exploitation rate, respectively). Therefore, while both DUs show increased growth, neither CR nor TR DUs recover under this model. Assuming that the results of the productivity are accurate, the RPA suggests a low recovery potential of both DUs. However, under this model, there is an increase in probability of growth compared to the baseline (from 6% to 88% for Chilcotin and from 8% to 81% for Thompson) for both DUs which may result in some unknown positive benefits associated with the reversal in population declines and higher abundance and distribution for both TR and CR DUs.

Further, surveys conducted to elicit values of individuals' willingness-to-pay for conservation of other species indicate that Canadians value not only a wildlife species itself, but also the ecosystem to which it contributes. While the specific role and importance of CR/TR steelhead in maintaining ecosystem health is not known, this does not mean that the species has no value. However, it is currently not possible to quantify and monetize the incremental ecological benefits associated with conserving CR/TR steelhead.

8. Distributional Analysis

8.1 Commercial Sector

The distribution of impacts across the commercial fishing sector and the seafood processing sector in terms of profit losses are shown in Table 14. The commercial

harvesting sector will be impacted more than 17 times those in the processing sector under the List scenarios. Under the List scenarios the present value profit loss for the commercial harvesting sector is over 21 times that for the EO, Demo harvesting sector. The present value profit loss to the EO, Demo fisheries makes up about 4.3% of the total across all commercial sectors.

Table 14: Distributional Impacts: Commercial Sector's Profit Loss : Management Scenario 2 List Under SARA (over a 20 year period)*(in million $, 2016)*

Commercial Sectors	Loss in Profit (Present Value)
Harvesting	
EO/Demo	$3.9
Commercial	$82.0
Processing	$4.8
TOTAL	**$90.7**

Based on input provided by the commercial sector (i.e**.** commercial sector workbooks), fishers expect between 10% and 100% of their total revenues to be affected by the proposed closures. The range is wide and depends on their level of diversification into other fisheries. Whereas some harvesters may be disproportionately affected due to locations and timing of harvests, the analysis shows that the incremental impacts to commercial salmon harvesters across all gears will amount to approximately 23% of total revenues on average. (See Appendix Q for summary of input received). Processors were requested for their input on impacts of the proposed measures. Based external consultations (i.e. seafood processor workbooks), some impacted processors that provided input would be considered small businesses as they reported that they employed between 40 and 120 employees[67]. Some respondents noted that the proposed listing would be crippling to their business, and would "eventually lead to closing the doors". Of the respondents, the proportion of their business activity spent on salmon ranged from 15% to 80%. Therefore, some plants may be disproportionately impacted (See Appendix Q for summary of input received).

In terms of impacts by gear, under the list scenario, commercial salmon areas B, D, E, G and H will be impacted, while areas A, C and F will remain unaffected as they do not fall within the closure areas. Under the list scenario, majority of impacts (around 68% of landed value) will be in commercial salmon area B. From all reductions, sockeye and chum account for roughly 50% and 46% of the total impacted landed value under a list scenario, respectively.

[67] Treasury Board Secretariat of Canada which defines a small business as any business, including its affiliates, with fewer than 100 employees

Table 15: Distributional Impact on Landed Value by Fishing Gear and Area Fished: Management Scenario 2 List Under SARA (2013-16 Average Value) *(in million $, 2016)*

Gear Type	Fishing Area	Landed Value Chinook	Landed Value Chum	Landed Value Coho	Landed Value Pink	Landed Value Sockeye	Total Landed Value
Seine	A	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
	B	$0.0	$4.3	$0.0	$0.3	$4.8	$9.4
Gillnet	C	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
	D	$0.0	$0.5	$0.0	$0.0	$0.7	$1.1
	E	$0.0	$1.2	$0.0	$0.0	$0.9	$2.1
Troll	F	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
	G	$0.3	$0.0	$0.1	$0.0	$0.0	$0.4
	H	$0.0	$0.3	$0.0	$0.0	$0.4	$0.8
Total		$0.3	$6.3	$0.1	$0.3	$6.9	$13.8

In terms of impacts by licence type, under the List scenario, about 10.5% of the landed value impacted is under communal commercial licences (see Table 16). The remaining 89.5% of landed value impacted is expected under vessel based commercial licences. Further, approximately 68% of the estimated impacts will fall to commercial seine harvesters, with the remaining 23% and 8% going to commercial gill net and commercial troll harvesters, respectively.

Table 16: Distributional Impact on Landed Value by Licence Type: Management Scenario 2 List Under SARA (2013-16 Average Value) *(in million $, 2016)*

Licence Type	Average Landed Value
FAT	$0.06
FAG/NAG	$0.45
FAS	$0.95
F Licences	$1.45
AT	$1.10
AG	$2.75
AS	$8.50
Non-F licences	**$12.35**
Total All Licences	**13.8**

8.2 Recreational Sector

The costs to lodges and charters under the List scenarios are estimated to be approximately $16.2m. Under the SARA List scenario the tidal water angler surplus loss could be up to 73 times higher than that of freshwater anglers. The reduction in freshwater

angler surplus would range from $0.9m to $4.5m while the reduction in tidal angler surplus would range from $65.4m to $118.7m (see Table 17 for details).

Table 17: Consumer Surplus and Recreational Business Profit Loss: Management Scenario 2 List Under SARA (over 20 years) *(in million $, 2016)*

Recreational Sectors	Consumer Surplus and Profit Losses (Present Value)
Recreational Anglers	
Freshwater angler surplus	0.9m to 4.5m
Tidal water angler surplus	65.4m to 118.7m
Lodges and Charters	16.2m
TOTAL	**82.5m to 139.4m**

Recreational Tidal water anglers that provided input through consultations (i.e. recreational fishing workbooks) stated that they expect between 10% and 100% of their angling days to be affected by the proposed closures/times. Freshwater anglers that responded expect between 75% and 100% of their angling days to fall within the proposed closures/times. While some anglers may be impacted more than others, depending on the location they fish, overall the analysis estimates a much lower impact to freshwater angling days than tidal anglers (See Appendix Q for summary of input received).

8.3 First Nations Food Fisheries

Of the approximately 200 First Nations recognized in BC, DFO data includes information that 144 Nations have harvested for FSC purposes in the closure times and areas in the listing scenario (scenario 2).[68] Of these the majority (65%) fished in the Fraser River or Inland region, 9% in Johnstone Strait, 11% in West Coast of Vancouver Island and the remaining 15% in the Strait of Georgia.

Table 18 shows the distribution of harvest reductions across fishing regions. It is estimated that an incremental 6% of the total coast-wide FSC salmon harvest occurs in the areas and times coinciding with the proposed List closures. Around two thirds of this can be attributed to FSC harvests of salmon occurring in the Fraser River. The remaining third comes from FSC harvest in South Coast areas. It is estimated that the present value cost of food replacement for such FSC salmon harvests by area would be $10.6m-$14.7m, $0.5m-$0.7m, $2.4m-$3.6m and $3.6m-$4.8m for the Fraser River, the West Coast of Vancouver

[68] It is important to note that while all First Nations may not directly harvest in affected areas, some Nations may trade with other Nations that directly harvest in affected areas or they may be gifted harvest from the affected closure areas. Therefore, figures using direct harvest information should not be used to estimate the number of affected Nations. Rather, these figures are intended to provide a scale of impacts by region.

Island, the Strait of Georgia and Johnstone Strait, respectively. That is to say the estimated impact on FSC salmon harvests in the Fraser River is as least 15% higher than the estimated combined FSC salmon harvest impacts in the Strait of Georgia, West Coast of Vancouver Island and Johnstone Strait.

Table 18: Distribution of FSC Harvest Impacts and Food Replacement Costs by Geographical Region: Management Scenario 2 List Under SARA (over 20 years)

(in million $, 2016)

Geographic Area	Impacts (Present Value)
Quantitative Impacts: First Nations Food Replacement Costs	
Salmon	
Lower Fraser	$10.6 to $14.7
West Coast Vancouver Island	$0.5 to $0.7
Strait of Georgia	$2.4 to $3.6
Johnstone Strait	$3.6 to $4.8
Steelhead	
Marine and Inland waters	Unknown
Total	$17.1 to $23.9
Qualitative Impacts	
Salmon and Steelhead	Salmon is a species of great significance to First Nations of BC. Based on input received through the SARA consultation processes, any amount of FSC harvest reduction could have significant impacts of Indigenous Peoples that have their identities and well-being linked to harvest of species such as salmon and steelhead. This interest may be for harvest for food, social, and ceremonial purposes, and economic uses. Based on DFO data, about 6% of salmon FSC harvest is caught in the areas that will be closed for 60 days under the list scenario. Therefore, the impacts of a Listing decision on TR/CR steelhead are expected to be high. Steelhead is an important food source for First Nations in the winter. The level of current harvest for steelhead is unknown.
Fraser	6% of FSC salmon harvest in the Fraser Region may be impacted. Majority of this is chum and sockeye (3,700 pieces of sockeye and 18,000 pieces of chum). This represents 4% of total salmon FSC in all of BC. The level of current harvest for steelhead is unknown.
South Coast	6% of harvest in salmon FSC fisheries may be impacted in the West Coast Vancouver Island, Strait of Georgia, Johnstone Strait. This represents 2% of total salmon FSC harvest in all of BC. The level of current harvest for steelhead is unknown.

Source: FSC Harvest is based on DFO logbook data and published post-season review reports
Note: Totals may not add up due to rounding

8.4 Regional Economic Impacts

In terms of economic contribution to the provincial economy, Table 19 and Table 20 show that revenue reductions in the commercial sector ($14.6m for harvesting and $21.1m[69] for processing) will reduce total provincial GDP by $21.3m under the list scenario. In terms of direct employment impacts, about 1150 crew fishing with seine, gillnet and troll vessels will be affected (seine-356; gillnet 515; troll 276). It is unclear how many First Nations participate in EO/Demo fisheries for income purposes and/or for capacity building. Estimates of crew based on vessel type are not possible as these fisheries employ a variety of harvest gear and use of available input/output models could under represent the number of affected harvesters. Additional direct job and income losses would be incurred in the processing sector, estimated at ~120 jobs and $4.2m, respectively.

Table 19: Regional Impacts of Listing to the Commercial Harvesting Sector
(in million, $ 2016)

Economic Indicators	Harvesting Sector (Commercial Marine and First Nations Inland)			
	Direct	Indirect	Induced	Total
GDP	$6.1	$2.0	$0.7	$8.9
Employment*	~1150	22.75	7.73	60.52
Household income	$4.2	$1.3	$0.4	$6.0

Note*: Employment estimates for the commercial sector are based on average number of crew per vessel type

Table 20: Regional Impacts of Listing to the Commercial Processing Sector
(in million, $ 2016)

Economic Indicators	Processing Sector (Marine and Inland)			
	Direct	Indirect	Induced	Total
GDP	$7.0	$4.2	$1.3	$12.4
Employment	117.7	45.06	13.9	176.7
Household income	$4.2	$2.7	$0.63	$7.6

Finally, under the List Scenario, a total of $61m in provincial GDP reduction is expected from impacts to the recreational sector based on a reduction of expenditures of $3.79m in freshwater fisheries and $138.1m in tidal water fisheries. Almost 1,200 workers will be directly impacted with a $25.5m reduction in direct household income (See Table 21).

Table 21: Regional Impacts of Listing to the Recreational Sector *(in million, $ 2016)*

Economic Indicators	Sport Fishing Sector (Tidal and Freshwater)			
	Direct	Indirect	Induced	Total
GDP	$32.64	$21.29	$7.10	$61.02
Employment	1,171	362	79	1,612
Household income	$25.54	$14.19	$4.26	$43.99

[69] When calculating the economic contribution of the processing sectors, multipliers are applied to the gross processed value net of the landed value.

The freshwater sport fishing sector represents just under 2% of the impacts seen in the total sport fishing sector. Impacts to proponents with projects in freshwater may also be expected. However, information was not made available for this analysis on types of projects that are occurring where steelhead can be found.

8.5 Distribution of Benefits

Benefits under the 3 productivity models for SARA Listing vary depending on the productivity assumptions. For all incremental increases in non-market benefits associated with the existence of the species in Canada as a result of lower risk of extinction, higher abundance or faster rate of recovery, Canadians in general will experience these benefits.

9. Sensitivity Analysis

While the management scenarios are static (i.e. they do not suggest a change in management with the recovery of the species), recovery use benefits could accrue to the recreational sector should steelhead fishing be reinstated at higher levels than under the baseline. Further, given that steelhead is a species harvested in FSC fisheries, recovery and/or faster recovery of CR DU under scenario 2a will lead to both consumptive and non-consumptive benefits for First Nations that fish for steelhead. Due to the uncertainties around some of the key variables used in the analysis a sensitivity analysis was undertaken to test the impact of changes in these variables on the incremental cost impacts. The variables that were tested for sensitivity included harvest levels and retail price variations on FSC fishery impacts; and recovery and growth of steelhead on consumer surplus and commercial fishery revenues and FSC harvest. The results of the sensitivity analysis are discussed in the following subsections.

9.1 First Nation FSC Impacts

9.1.1 Foregone FSC Catch

To test the assumptions on food replacement costs on First Nations, a 10% and 20% higher forgone quantity of Food Social and Ceremonial (FSC) catch was assumed. The results support the intuitive assessment that the incremental cost of food replacement would increase roughly by between $213,000 and $292,000 per year. With an increase of 20%

higher catch, the increase in incremental costs would be between roughly $426,000 and $584,000 per year (see Table 22).

Table 22: Sensitivity Analysis on Impacts of 10% and 20% Higher Forgone FSC Harvest *(2016 $)*

Range of Values	Management Scenario 2 (Replacement Value)	Replacement Value (10% Higher Harvest)	Replacement Value (20% Higher Harvest)
Low Value	$1,509,000	$213,000	$426,000
High Value	$ 2,104,000	$292,000	$584,000

The present value of this increase in loss is between $2.4m to $3.3m and between $4.8m and $6.6m, respectively under the 10% and 20% harvest adjustments. Overall the scale of impacts remains high.

9.1.2 Replacement Price

In addition to higher FSC catch levels, the sensitivity of incremental costs were also tested for changes in the replacement price. With a replacement price of catch assumed to be 25% higher than the replacement price used for estimating the impacts of management scenario 2 (see Appendix L), the incremental cost of food replacement would increase to roughly $377,000 to $526,000 per year. If we assume the replacement price to be 50% higher than used for management scenario 2, the increase in incremental impacts would be between roughly $754,000 and $1,052,000 higher each year (see Table 23).

Table 23: Sensitivity Analysis of Impacts of 25% and 50% Higher Retail Price *(2016 $)*

Range of Values	Management Scenario 2 (Replacement Value)	Value of Food Replacement Cost (25% Higher Replacement Price)	Value of Food Replacement Cost (50% Higher Replacement Price)
Low Value	$1,509,000	$377,000	$754,000
High Value	$ 2,104,000	$526,000	$1,052,000

The present value of this loss is between $6.0m to $8.3m and between $12.1m and $16.6m, respectively under the 25% and 50% replacement price adjustments. Overall the scale of impacts remains significant.

Table 24: Summary of Impacts under Alternate Food Replacement Cost Assumptions
(in million, $ 2016)

Costs	Management Scenario 2 (PV)	Sensitivity Analysis (PV)
Commercial Fishery	$82.0	No Change
First Nations EO/Demo	$3.9	No Change
Seafood Processing	$4.8	No Change
Lodges/Charters	$16.2	No Change
Tidal Recreational Fishery	$65.4 to $118.7	No Change
FW Recreational Fishery	$0.9 to $4.5	No Change
First Nations (low value and high value)	$17.1 to $23.9	$25.4 to $42.4*
Total	**$190.3 to $254.0**	**$198.6 to $272.5**

Note*: This examines a 50% retail price adjustment and a 20% adjustment to forgone harvest.

9.2 Recovery and Growth of Steelhead

As discussed in section 7.2.7, incremental benefits of listing could occur if future harvest opportunities exceed those suggested by the baseline due to species recovery. While the management scenarios do not indicate whether directed steelhead fisheries could re-open after recovery and to what level relative to historic levels, if steelhead recovers, there could be incremental increases in direct use values (post-recovery) if prohibitions no longer apply (due to listing at a lower risk level of Special Concern, or removal from Schedule 1 of SARA entirely) or abundance is sufficient to allow for SARA exemptions or permits for fisheries.

9.2.1 Consumer Surplus

Under productivity model 2c, if only CR DU is listed, this sensitivity analysis assumes that after 13 years when recovery is reached, permits may be possible for recreational angling within the Chilcotin and Fraser Rivers. This sensitivity analysis examines the effect on angler surplus (benefits) of assuming different levels in angling days in the restored fishery, using historical recreational fishing angling days in the Chilcotin River and Fraser mainstream. Table 25 shows how angler surplus estimates change based on alternative assumptions on the number of angler days in the Chilcotin and Fraser Rivers. The benefits of these post-recovery consumer surpluses depend on which historical year is used as a reference for the level of angling activity. If the level of angling activity 30 years ago would be representative of angling activity after the CR DU recovery, the angler surplus could be as high as $7.6m in 7 remaining years (over the 20 year analysis period) after recovery[70]

[70] This is based on the productivity model 2c which shows that CR DU recovers after 13 years.

(present value). If the level of angling activity 20 years ago is representative of the level after the CR DU recovery, the angler surplus could be anywhere from $0.5m to $2.4m over 7 years (present value). If angling activity 10 years ago is representative of the level of activity that could resume after CR DU recovery, then incremental benefits are not expected from recovery as angling activity would be lower than 2016.

Table 25: Present Value of Consumer Surplus of CR DU Recovery (in Fraser River and Chilcotin River) Based on Historical CR DU Steelhead Angling Activity (over 7 years)

(in 2016 $)

Historical Year	Total Angling Days in Chilcotin	Total Angling Days in Fraser	Incremental angling days over Baseline due to recovery	Incremental Present Value over 7 years (Discount Rate 7%)	Incremental Annualized Value
1986	315	11730	11,230	$1.5m to $7.6m	$0.28m to $1.4m
1996	204	4137	3527	$0.5m to $2.4m	$0.09m to $0.44m
2006	76	596	-142	N/A	N/A
Baseline	89	725	0	N/A	N/A

Source: Information on steelhead angling days by river and watershed for multiple years was provided by the Province of BC and is based on unpublished annual survey results on steelhead angling in the province.

If Chilcotin River and Thompson River DUs were both listed, the market benefits would be lower as angling in the mainstream of the Fraser would likely remain prohibited to protect migrating Thompson River steelhead, even if the Chilcotin River DU was to recover in 13 years (Table 26). In this case, in the 7 years after recovery (remainder of the 20 year time frame of the analysis), the angler benefits of recovery range depending on the choice of historical year to represent future angling activity following CR DU recovery. If angling activity 30 years ago is representative, the angler surplus could be anywhere between the range of $30,000 to $150,000 over 7 years (present value). If angling activity 20 years ago is representative of the level of activity that could resume after CR DU recovery, then the market benefits would be lower, between $20,000 and $80,000.

Table 26: Market Benefits of CR DU Recovery (in Chilcotin River only)

Historical Year (Values in millions of 2016$s)	Total Angling Days in Chilcotin	Incremental angling days over Baseline due to recovery	Incremental Present Value over 7 years (Discount Rate 7%)	Incremental Annualized Value
1986	315	226	$0.03m to $0.15m	$0.006m to $0.028m
1996	204	115	$0.02m to $0.08	$0.003m to $0.014m
2006	76	-13	N/A	N/A
Baseline	89	0	N/A	N/A

Source: Information on steelhead angling days by river and watershed for multiple years was provided by the Province of BC and is based on unpublished annual survey results on steelhead angling in the province.

9.2.2. First Nations Directed FSC Fisheries

Thompson and Chilcotin River steelhead are species of cultural significance for Indigenous people and are harvested for food, social and ceremonial purposes (refer to section 3.4 of this report). If the CR DU steelhead recovered, direct use values as a result of FSC harvest (i.e. consumptive) and non-consumptive cultural activities involving steelhead would also accrue to First Nations harvesting in the Fraser and Chilcotin regions.

9.2.3 Commercial and First Nation Fisheries

Further, similar to the sensitivity analysis undertaken for recovery benefits, should recovery of CR DU occur within 13 years under the most optimistic productivity model (2a), an assumption is tested in the sensitivity analysis where the prohibitions (and associated costs) cease after the recovery target is reached.

Under scenario 2a, it is possible that Commercial harvesters and First Nations harvesters (EO/Demo fisheries and FSC) would not incur incremental costs after the 13th year if:

- recovery resulted in reclassification of the relevant DU as special concern rather than endangered; or,
- permits and exemptions are considered in response to improved stock status.

If constraints on activities were relaxed compared to the list scenario, costs would be reduced (i.e. costs savings). While if constraints on activities were relaxed compared to the baseline additional benefits may be obtained, as illustrated by the recreational fishery benefits above.

If it is assumed that after recovery activities which currently harm steelhead (such as fishing) could resume, there would be cost savings for the commercial sector and First

Nations. Therefore, under the 5 year mean productivity model for Chilcotin River DU which assumes recovery of this DU in 2 generations (13 years), the stream of costs for commercial salmon and FSC harvesters become zero after the 13th year. Cost savings are not anticipated for other sectors since costs for these sectors reduce to zero in less than 13 years (i.e. when the recovery threshold).

While one DU may recover within the timeframe of the analysis under certain productivity assumptions, fishing activities that are occurring affect both DUs (i.e. cannot distinguish which DU will be harmed by fishing in areas where both DUs co-migrate). Therefore, if both DU's are Listed, it is unlikely that recovery of only CR DU would allow for these activities in tidal water to resume (i.e. activities would still be prohibited for the TR DU) after the recovery of CR DU. Therefore, if both DUs are listed, the costs to the commercial harvesters and First Nations FSC and EO/Demo fisheries can be expected to continue despite recovery of CR DU.

Incidental Catch in Commercial Salmon Gillnet, Seine and Troll Fisheries

If only the CR DU is listed, annual revenue reductions would be the same as those assessed in the CBA ($13.8m) under the static management assumption. However, the relaxation of prohibitions after year 13 would result in a lower present value of profits losses of $64.7m (or $6.1m annualized; 13 years at 7%) as harvesting at levels similar to the baseline would resume.

Incidental Catch in Inland FN's Fisheries – EO, Demo

If only CR DU was listed, while revenues reductions would be the same as those assessed in the CBA ($0.77m), the present value of this revenue loss would be lower at $3.1m (or $0.3m annualized; 13 years at 7%).

First Nations FSC Fisheries – Replacement Cost Savings

If only the CR DU was listed, while the replacement value of forgone harvest would be the same, the present value of this value would be lower at $14.12m to $19.69m (or $0.70 to $2.36m annualized; 13 years at 7%).

In summary, under alternate assumption of adaptive management scenarios which allow permits in response to improved stock status (i.e. recovery and growth of steelhead), costs would be lower at $171.12m to $223.9m present value (or, between $24.7m and $35.6m lower than under a no cost-savings assumption).

Table 27: Summary of Impacts Under Adaptive Management Measures After Recovery *(in million, $ 2016)*

Costs by Affected Party	Management Scenario 2 (PV)	Sensitivity Analysis (PV)
Commercial Fishery	$82.0	$64.7
First Nations EO/Demo	$3.9	$3.1
Seafood Processing	$4.8	$4.8
Lodges/Charters	$16.2	$16.2
Tidal Recreational Fishery	$65.4 to $118.7	$65.4 to $118.7
FW Recreational Fishery	$0.9 to $4.5	-$1.5 to -$7.6
First Nations	$17.1 to $23.9	$14.12 to $19.7
Total	**$190.3 to $254.0**	**$166.8 to $219.6**

Overall, the impact of alternative assumptions resulting in higher food replacement costs and/or lower costs (i.e. costs savings) and benefits of recovery do not have a significant impact on the scale of impacts. Costs are expected to remain high (over $100m present value).

10. Summary

Methodology

A cost-benefit analysis approach was used to identify, quantify and monetize where possible, the incremental economic costs and benefits of the proposed management scenarios. Impacts are described qualitatively where they cannot be quantified. Impacts of Listing CR DU Only, Listing TR DU only and Listing both CR and TR DUs were examined under three different productivity model assumptions, as per the RPA. The exploitation rate is not known but was assumed to be less than 25%. Under Listing, exploitation from fisheries (recreational, commercial and First Nations fisheries) is expected to be zero. The scenario examined (list scenario 2), proposed full SARA prohibitions with permits for science activities only.

Probability of Recovery

If the 5 year mean productivity model is assumed, under the list scenario at zero exploitation, there is a 97% probability of achieving recovery for the Chilcotin River DU within 2 generations. Under the 10 year productivity model, the probability of recovering CR DU is low (33% probability of recovery after 6 generations under the list scenario). Under all mean productivity models, there is a very low probability that TR DU will recover within the 20 year time frame of this analysis and even within 6 generations (less than 17%) under a zero exploitation rate assumption. However, under the 10 year mean

productivity, TR DU showed a higher probability of growth (from 8% to 81%) under Listing.

Costs

Costs under all the list scenarios (i.e. list CR, list TR or list both DUs) and the 3 productivity models are the same. The present value (over 20 years at 7%, 2016$) of monetized costs range between $190.3m to $254.0m present value ($17.9m to $24.0m annualized; 20 years at 7%) if only one DU or both DUs are listed. Further, non-monetized costs (i.e. First Nations non-consumptive values) may be significant[71] as a reduction in FSC harvest will have unquantifiable but high negative impacts for First Nations in BC.

Benefits

The benefits of a Listing decision are sensitive to the information provided in the RPA on the potential recovery of the species under differing levels of productivity under the list scenario. In this case, clarity around these parameters is important to more precisely understand the potential scale of impacts.

If abundance and distribution of steelhead increase incrementally in the 20-year period following a listing decision, or if recovery were achieved, there could be incremental increases in direct use, indirect use, option and non-use values. Direct use values, as a result of FSC harvest (i.e. consumptive) and non-consumptive cultural activities involving steelhead would accrue to First Nations in the Fraser, Thompson and Chilcotin regions if harvest is allowed to resume. Direct use values would also accrue to recreational anglers in angling is allowed to resume. Incremental benefits for Canadians more broadly could result from of changes to ecosystem goods and services supported by steelhead (i.e. indirect use), as well as option and non-use benefits such as bequest and existence values.

The benefits of Listing CR and TR DU vary based on the productivity model used. While the RPA identifies the productivity model is most likely, it does not specify which model is the definitive one associated with the list scenario. As a result, in this analysis the benefits of the listing scenario are presented for all 3 productivity models and are summarized below.

Productivity Model 2a – 5 year

This model suggests, at zero exploitation, a recovery probability for CR DU of 97% after 2 generations. Further, the probability of growth in the TR DU increases under a Listing, but

[71] Refer to Figure 12 of this report which shows that only a small segment of impacts of reduced FSC harvest is monetized in this CBA to provide a lower bound of impacts to broadly assess the scale of potential listing impacts (i.e. over $1m present value (low), over $10m present value (high)). Non-monetized impacts could be significant.

remains low (41%) while the incremental increase in probability of higher abundance of CR under the list scenario is positive, although minimal (increasing from 93% to 100%). However, the benefits of recovery could also be significant if recovery was possible.

There would also be some unknown benefits associated with greater abundance and ecosystem services benefits associated with higher abundance and recovery. Incremental benefits related to recovery actions (i.e. increased research, monitoring and prohibitions on projects that result in harm in freshwater and raising species profile) may also occur; but are unknown. For the benefits to equal the monetized costs, Canadians would need to be willing to pay $1.80 to $2.41 for recovery of CR DU if listing both TR and CR DUs or listing CR DU only. Based on values from Wallmo and Lew (2010), benefits of CR steelhead recovery far exceed this value (estimated to range from about CAD $69.44 to CAD$79.57 per household).

Productivity Model 2b – 1 year

Under this model, the most likely productivity model of 1 year, growth for both TR and CR DUs (4% and 0%, respectively) is low and the probability of recovery in unlikely (1% and 0%, respectively) for either DU. There may be some minimal positive benefits associated with monitoring, research measures and identification of critical habitat that are typically included in recovery documents, should these measures aid in reducing mortality. Given the high monetized costs and non-monetized costs (i.e. First Nations non-consumptive values) could be significant, net benefits from Listing are unlikely under the most likely productivity model as recovery and growth are not anticipated under a Listing decision over the 6 generations that were modelled in the RPA.

Productivity Model 2c – 10 year

Under this model there are incremental increases in probability of growth for both DUs (from 6% to 88% for Chilcotin and from 8% to 81% for Thompson). There may be some unknown benefits associated with higher abundance and distribution of TR and CR DUs. While there may be some positive benefits associated with higher probability of growth under this scenario and recovery actions, the monetized costs are high, the non-monetized costs could be significant; but, the recovery potential for both DUs under this model are low.

Conclusion - Overall, the costs under the list scenarios (i.e. List CR only, List TR only or List Both DUs) and each productivity models all fall in the high range (above $100m present value over 20 years). Monetized costs range between $190.3m to $254.0m present value ($17.9m to $24.0m annualized; 20 years at 7%) if one or both DUs (TR and CR) were listed.

However, the benefits, while positive under all three models, can vary due to uncertainty around the productivity parameters and differ under each listing options (i.e. List CR DU, List TR DU or List Both DUs).

Under the most likely productivity model (2b), economic benefits, while likely positive, are the lowest of all productivity assumptions. In 6 generations, this productivity model shows that if all fishing activity affecting these two steelhead DUs ceased, the probability of recovering CR and TR DUs would be 0% and 1%, respectively. Further, the probability of growth of these DUs also remains very low (4% for TR DU and 0% for CR DU) under the most likely productivity assumptions. Under the most likely productivity model of 1 year mean productivity (2b), Listing CR and TR DUs is expected to result in negligible non-market benefits with significant monetized and non-monetized costs. This CBA examines impacts over 20 years, or roughly 3 generations[72]. If impacts were assessed over a longer timeframe, for example over 40 years, the resulting costs would be higher under the most likely productivity model while the benefits would remain the same, i.e. negligible[73]. Overall, given the 0% probability of species' recovery and low probability of growth and high monetized and non-monetized costs, it is unlikely that net economic benefits would result under 2b (the most likely productivity). Net economic benefits under 2a and 2c are unknown.

[72] One generation for TR and CR DU is 6 year and 7 years, respectively.

[73] The Recovery Potential Assessment for Chilcotin and Thompson River Steelhead only provide information on species future potential for recovery up to 6 generations (or 36 and 42 years for TR and CR, respectively). Therefore, potential for recovery benefits beyond this timeframe under the most likely productivity model cannot be assessed.

Bibliography

Atleo, R. E. 2005. "Preface." In Keeping It Living: Traditions of Plant Use and Cultivation on the Northwest Coast of North America , D. Deur and N. J. Turner, eds., pp. vii– xi. University of Washington Press, Seattle.

Alcamo, J., Bennett, E. M., & Millennium Ecosystem Assessment (Program). (2003). *Ecosystems and human well-being: A framework for assessment*. Washington, DC: Island Press.

ARA Consulting Group Inc. 1996. Economic Value of Salmon, Chinook and Coho in British Columbia, Prepared for Department of Fisheries and Oceans Canada. Retrieved December, 1, 2018 from http://www.dfo-mpo.gc.ca/Library/193109.pdf

Bailey, M., and Sumaila, U.R. (2012). Freshwater Angling and the B.C. Economy. Report prepared for the Freshwater Fisheries Society of B.C. 54 pp.

BC Ministry of Agriculture. Annual. British Columbia Seafood Industry Year in Review. Retrieved November 20, 2018, from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/statistics/industry-and-sector-profiles/year-in-review/bcseafood_yearinreview_2016.pdf

BC Ministry of Environment, Lands, and Parks, Fisheries and Oceans Canada. (1998). Review of Fraser River steelhead (Oncorhynchus mykiss). Retrieved November 26, 2018 from http://a100.gov.bc.ca/appsdata/acat/documents/r281/Anonymous1998_1062018598770_bd5e32610c5c44b4927ed0fbcf804c77.pdf.

BC Ministry of Environment and Climate Change Strategy. (n.d.). *Rainbow trout: Oncorhynchus mykiss*. *BC Fish Facts*. Retrieved from Retrieved from https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/fish/fish-and-fish-habitat-data-information/fish-fact-sheets

BC Stats 2013. British Columbia's Fisheries and Aquaculture Sector, 2012 Edition. Page 60. http://www.bcstats.gov.bc.ca/Publications/AnalyticalReports.aspx

2016 British Columbia Fish Processing Employment 31 August 2018. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/statistics/industry-and-sector profiles/employment/2016_british_columbia_seafood_processing_employment.pdf

Canada. Species at Risk Act, Statutes of Canada 2002, c.29, ss 38, 49(1), 55, http://laws-lois.justice.gc.ca/eng/acts/S-15.3/index.html).

Cannon, A. and Moss, L. M. 2011. The Archaeology of North Pacific Fisheries. University of Alaska Press, 2011. ProQuest Ebook Central.

Chan, L., Receveur, O., Sharp, D., Schwartz, H., Ing, A. and Tikhonov, C. 2011. *First Nations Food, Nutrition and Environment Study (FNFNES): Results from British Columbia (2008/2009)*. University of Northern British Columbia, Prince George, BC, Canada

Counterpoint Consulting. (2014). Economic Dimensions of British Columbia's Pacific Salmon Resource, Prepared for Pacific Salmon Foundation, June, pp. 26.

Dabrowska, K., Haider, W., Hunt, L., & Clarke, A. (2014). *Survey of the Freshwater Anglers of British Columbia 2011*. Summary Report.

DFO. 2012. The 2010 Survey of Recreational Fishing in Canada. Prepared by Fisheries and Oceans Canada.

DFO. 2014. Pacific Region Integrated Fisheries Management Plan, Salmon Southern BC. 2017/2018.

DFO. 2018. Recovery Potential Assessment for Chilcotin River and Thompson River steelhead trout (*Oncorhynchus mykiss*) designatable units. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/050

DFO. Tidal Recreational Licence Statistics: *Annual Comparison of Recreational Licence Sales.* Retrieved December 2, 2018 from http://www.pac.dfo-mpo.gc.ca/fm-gp/rec/licence-permis/Stats/99tocurrent-eng.html.

Economic Repercussions of a Chinook Catch Reduction" by GS Gislason & Associates Ltd., January 2009 found at http://www.dfo-mpo.gc.ca/Library/336645.pdf.

Fisheries and Oceans Canada. (Multiple Years: 2012-2016) Post Season Review – Salmon North Coast Areas 1-6 & Central Coast Areas 7-10.

Fisheries and Oceans Canada. 2011. Demonstrations Fisheries at a Glance. Retrieved November 30, 2018, from http://publications.gc.ca/collections/collection_2018/mpo-dfo/Fs144-48-2011-eng.pdf

Fisheries and Oceans Canada, Communications Branch. (2012, September 13). Strengthening Our Relationship - The Aboriginal Fisheries Strategy and Beyond. Retrieved November 30, 2018, from http://www.dfo-mpo.gc.ca/fm-gp/aboriginal-autochtones/afs/afsoct03-eng.htm.

Fisheries and Oceans Canada, Communications Branch. (2012, September 24). AAROM – Statement of Interest - Collaborative Management. Retrieved November 30, 2018, from http://www.dfo-mpo.gc.ca/fm-gp/aboriginal-autochtones/aarom-pagrao/cmsoi-gcsoi-eng.htm#iii.

Fisheries & Oceans Canada. (2018). Pacific Region Integrated Fishery Management Plan. South Coast Salmon 2018. June 1, 2018–May 31, 2019. Retrieved November 26, 2018 from http://waves-vagues.dfo-mpo.gc.ca/Library/40694306.pdf.

Freshwater Fisheries Society of BC (2013). *2013 BC Freshwater Sport Fishing Economic Impact Report.* Last accessed November 8, 2018 from https://www.gofishbc.com/PDFs/Footer/2013_bc_freshwater_sport_fishing_economic_impact_r.aspx.

Forbes, K., Boxall, P. C., Adamowicz, W. L., & Sukic, A. D. (2015). Recovering Pacific Rockfish at Risk: The Economic Valuation of Management Actions. *Frontiers in Marine Science, 2*. doi:10.3389/fmars.2015.00071

Fraser Basin Council (FBC). 2009. *State of the Fraser Basin Report – Sustainability Snapshot 4: The Many Faces of Sustainability.* Last retrieved December 12, 2018 from https://www.fraserbasin.bc.ca/_Library/Comm_Indicators/report_ss4_2009.pdf.

Fraser River Sediment Management Program (FRSMP). *Table of Annual Sediment Removals 2000 – 2013.* http://www2.gov.bc.ca/assets/gov/public-safety-and-emergency services/emergency-preparedness-response-recovery/embc/fraser-river-sediment program/quantities.pdf. Accessed July 8th 2017.

Garibaldi, A. and Turner, N.J. 2004. Cultural Keystone Species: Implications for Ecological Conservation and Restoration. Ecology and Society, 9(3): 1.

Grier, C. 2003. Dimensions of Regional Interaction in the Prehistoric Gulf of Georgia. In Emerging from the Mist. Studies in Northwest Coast Culture History, edited by Richard G. Matson, G. Coupland, and Quentin Mackie, pp. 170-187. University of British Columbia Press, Vancouver, British Columbia

Government of Canada. 2012. *Cabinet Directive on Regulatory Management*, 2012, Catalogue No. BT22-110/2007. ISBN 978-0-662-49149-1.

GSGislason, 2004, British Columbia Seafood Sector and Tidal Water Recreational Fishing: A SWOT Assessment, Prepared for BC Ministry of Agriculture, Food and Fisheries, Victoria, BC

GS Gislason & Associates Ltd. 2017. Economic Impacts of Pacific Salmon Fisheries. Prepared for Pacific Salmon Commission. Vancouver, BC.

Gunther, E. 1926. An Analysis of the First Salmon Ceremony. *American Anthropologist.* 28(4):605–617.

Haggan, N., Turner, N., Carpenter, J., Jones, J.T., Mackie, Q. and Menzies, C. 2006. *12,000+ Years of Change: Linking Traditional and Modern Ecosystem Science in the Pacific Northwest*. Fisheries Centre, University of British Columbia, Vancouver, BC, Canada

Harris, D.C. 2001. Fish, Law, and Colonialism: The Legal Capture of Salmon in British Columbia. University of Toronto Press, Toronto

Ignace, M., & Ignace, R. E. (2018). Fishing. In *Secwépemc People, Land, and Laws* (pp. 154–167).

Ignace, M. W. L. after O. L., & Ignace, R. E. (2017). The Traditional Seasonal Round. In *Secwépemc People, Land, and Laws* (pp. 195–203). McGill-Queen's University Press

Jones, J. T. 2002. *"We looked after all the salmon streams": Traditional Heiltsuk cultural stewardship of salmon and salmon streams: a preliminary assessment.* Thesis, University of Victoria, British Columbia, Canada.

Kuhnlein, H. V, & Humphries, M. M. (2017). Trout \ Traditional Animal Foods of Indigenous Peoples of Northern North America - Animals - Fish - Freshwater Fish. Retrieved January 1, 2018, from http://traditionalanimalfoods.org/fish/freshwater/page.aspx?id=6151#rain-e

Loomis, J.B. & White, D.S. (1996). Economic Benefits of Rare and Endangered Species: Summary and Meta-analysis. Ecological Economics, 18: 197-206.

Miller, B.M. 2007. *Be of good mind: Essays on the Coast Salish*. Vancouver: UBC Press

Ministry of Forests, Lands and Natural Resource Operations (FLNRO) (2016). *Provincial Framework for steelhead Management in British Columbia*. Victoria, BC. Retrieved from http://www.env.gov.bc.ca/fw/fish/docs/Provincial-Framework-for-steelhead-Management-in-BC-April-2016.pdf

MNP. 2015. *BC Forest Industry: Economic Impact Study*. Last retrieved December 12, 2018 from https://www.cofi.org/wp-content/uploads/bc_industry_impact_01-2015-1.pdf.

Natural Resources Canada (NRCAN). 2015. *Annual Statistics of Mineral Production.* http://sead.nrcan.gc.ca/prod-prod/ann-ann-eng.aspx. Accessed July 8th 2017.

Nelson, S. (2011a). Pacific Commercial Fishing Fleet: Financial Profiles for 2007. Prepared for Fisheries and Oceans Canada, Pacific Region. June. 2011-4. 160 pp.

Nelson, Stuart. (2011). Pacific Commercial Fishing Fleet: Financial Profiles for 2009. Prepared for Fisheries and Oceans Canada, Pacific Region. June. Pacific Commercial Fishing Fleets Financial Profiles Series, 2011-4, pp. 160.

Nelson Bros Fisheries Ltd. 2016. West Coast Fishing Fleet: Analysis of Commercial Fishing Licence, Quota, and Vessel Values. Prepared for Fisheries and Oceans Canada, Pacific Region. Retrieved November 30, 2018 from http://waves-vagues.dfo-mpo.gc.ca/Library/364124.pdf.

Nisga'a First Nation, Province of British Columbia, Government of Canada. (2000). Nisga'a Nation Harvest Agreement. Retrieved November 26, 2018 from https://www.nisgaanation.ca/sites/default/files/Nisga%27a%20Nation%20Harvest%20Agreement.pdf.

Pacific Salmon Commission. (Multiple Years: 2012 to 2016). PSC Annual Report. (Multiple Years: 2012-2016) Post-season Report for the Canadian Treaty Limit Fisheries. Retrieved November 26, 2018 from https://www.psc.org/publications/annual-reports/commission/

Privy Council Office. 2011. Policy and Practice Report: Overview of Habitat Enhancement and Restoration. Retrieved Nov 30, 2018 from http://publications.gc.ca/collections/collection_2017/bcp-pco/CP22-139-2011-eng.pdf

Richmond Chamber of Commerce (RCC), D.E. Park & Associates Ltd. 2014. *The Economic Importance of the Lower Fraser River*. July. Retrieved Nov 26, 2018 from http://www.richmondchamber.ca/external/wcpages/wcwebcontent/webcontentpage.aspx?contentid=10641.

Rosenau, Marvin., Angelo, Mark. 2000. *Sand and Gravel Management and Fish-Habitat in British Columbia Salmon and steelhead Streams.* Prepared for Pacific Fisheries Resource Conservation Council.

Rosenau, Marvin., Angelo, Mark. 2007. *Saving the Heart of the Fraser. Addressing Human Impacts to Aquatic Ecosystem of the Fraser River, Hope to Mission, British Columbia.* Prepared for Pacific Fisheries Resource Conservation Council.

Rosenberger, Randall S. 2016. Recreation Use Values Database. Corvallis, OR: Oregon State University, College of Forestry. Retrieved November 6, 2018, from http://recvaluation.forestry.oregonstate.edu/.

Rudd, M. A., Andres, S., Kilfoil, M., & Andres, S. (2016). Non-use Economic Values for Little Known Aquatic Species at Risk : Comparing Choice Experiment Results from Surveys Focused on Species , Guilds , and Ecosystems. *Environmental Management*, *58*(3), 476–490. https://doi.org/10.1007/s00267-016-0716-0

Species at Risk Act Listing Policy and Directive for "Do Not List" Advice. (2013). Deputy Minister's Policy Committee - Fisheries and Oceans Canada. Retrieved November 26, 2018 from http://waves-vagues.dfo-mpo.gc.ca/Library/365882.pdf.

Teit, J. (1900). The Thompson Indians of British Columbia. In Memoirs of the American Museum of Natural History Vol II. Anthropology I. The Jesup North Pacific Expedition.

Tk'emlups Te Secwepemc. (n.d.). *Early Secwepemc Fishing Techniques*. Kamloops. Retrieved from http://www.llss.sd73.bc.ca/clark/flyfishing/secwepemc_fishing.pdf

Trosper, R. L. 2002. Northwest Coast indigenous institutions that supported resilience and sustainability. *Ecological Economics* 41:329–344.

Tsawwassen First Nation, Province of British Columbia, Government of Canada. (2010). Tsawwassen First Nation Harvest Agreement. Retrieved November 26, 2018 from http://www.tsawwassenfirstnation.com/pdfs/TFNAbout/Treaty/TFN_Harvest_Agreement.PDF.

Wallmo, K., & Lew, D. K. (2016). A comparison of regional and national values for recovering threatened and endangered marine species in the United States. Journal of Environmental Management,179(1), 38-46. doi:10.1016/j.jenvman.2016.04.

Appendix A: Measures Implemented in 2018

Tidal Salmon Recreational Fisheries			
Location Affected	**Location Details**	**Start**	**End**
Fraser River and Thompson and Chilcotin River tributaries	Fraser River – Mouth to Mission (Sub Areas: 29-11 to 29-17)	28-Sep	24-Oct
Strait of Georgia	Area 29 (Sub Areas 6, 7, 9, 10)	28-Sep	24-Oct
Freshwater steelhead FSC Fisheries			
Location Affected	**Details**	**Start**	**End**
Chilcotin River tributaries	Tsilhqot'in National Government announced a closure of their FSC fishery targeting steelhead on the Chilcotin. River	All year	
Targeted Freshwater steelhead Recreational Fisheries			
Location Affected	**Details**	**Start**	**End**
Fraser River, Thompson and Chilcotin River tributaries	The existing closure on the Thompson River has been extended by one month to avoid times that steelhead are present. Please note: there were recent existing closures in the Chilcotin and Chilko Rivers	Existing closures in the Thompson River now extended to include an additional month (Oct1 to Oct 30th).	
Freshwater Salmon Recreational Fisheries			
Location Affected	**Location Details**	**Start**	**End**
Fraser River, Thompson and Chilcotin River tributaries	Fraser River – Mission to Hope	29-Sep	25-Oct
	Fraser River – Hope to Sawmill Creek	3-Oct	29-Oct
	Fraser River – Sawmill Creek to Lytton (Thompson Confluence)	5-Oct	31-Oct
	Fraser River - Lytton (Thompson Confluence) to Texas Creek	8-Oct	3-Nov
	Fraser River - Texas Creek to Kelly Creek	10-Oct	5-Nov
	Fraser River - Kelly Creek to Deadman Creek	13-Oct	8-Nov
	Fraser River - Deadman Creek to Chilcotin River	16-Oct	11-Nov
	Chilcotin River	19-Oct	14-Nov
First Nations Salmon EO, Demo Fisheries			
Location Affected	**Location Details**	**Start**	**End**
Fraser River, Thompson and Chilcotin River tributaries	Fraser River – Mouth to Mission (Sub Areas: 29-11 to 29-17)	28-Sep	24-Oct
	Fraser River – Mission to Hope	29-Sep	25-Oct
	Fraser River – Hope to Sawmill Creek	3-Oct	29-Oct
Strait of Georgia	Area 29 (Sub Areas 6, 7, 9, 10)	28-Sep	24-Oct
Commercial Salmon Fisheries			
Location Affected	**Location Details**	**Start**	**End**
Strait of Georgia	Area 29 (Sub Areas 6, 7, 9, 10)	28-Sep	24-Oct
Johnstone Strait	Area 13 (Sub Areas 1 to 19, 23 to 41) (Gillnet only)	17-Sep	13-Oct
	Area 12 (Sub Areas 1 to 22, 24, 26) (Gillnet only)	12-Sep	8-Oct
First Nations Salmon FSC Fisheries			
Location Affected	**Location Details**	**Start**	**End**
Fraser River, Thompson and Chilcotin River tributaries	Fraser River – Mouth to Mission (Sub Areas: 29-11 to 29-17)	Reduction of 50% of chum as a proportion of total chum harvest in these 3 locations.	
	Fraser River – Mission to Hope		
Strait of Georgia	Area 29 (Sub Areas 6, 7, 9, 10)		

Appendix B: Measuring Change in Surplus

a. Gross and Net Revenue

Gross and Net Revenues: Marine Commercial Fisheries

For the commercial salmon fisheries, the change in marine commercial profits was estimated as earnings before taxes, depreciation and amortization (EBITDA) based on Nelson (2011). Estimates of economic profits from fishing are typically derived by adjusting the EBITDA by adding licence costs. Further, a market value for the active vessels in each salmon fleet is netted from this adjusted EBITDA bottom line accounting for factors such as asset depreciation, opportunity cost of capital and normal profits given the risk involved in fishing. However, as these adjustments will not alter the scale of impacts, EBITDA is considered an appropriate proxy to economic profits.

Vessel level information on licences, landings, revenues and effort derives from logbooks, dockside monitoring data (DMP), sales slips and licencing data. To calculate EBITA, average revenues for 2013 to 2016 were reduced by costs for the highest variable cost year in the timeframe (i.e. 2014)[74]. Using this high year ensures costs that are not underestimated.

Vessel level costs for 2014 were estimated based on values and assumptions in Nelson (2011) which uses data from 2009 and models costs based on fleet tiers (top 1/3, middle 1/3 and bottom 1/3). The unit costs were adjusted for inflation and modified using vessel level data to provide estimates of catch, days fished and trips, while vessels were designated to tiers based on 2014 revenues. Vessel-level values were aggregated into fleet totals. Specific modifications to Nelson (2011) included:

- Fuel cost per day fished or per trip was adjusted for inflation using the BC specific CPI for fuel.
- Monitoring costs were calculated on per tonne of harvest or day fished was adjusted for inflation using the Canadian GDP deflator.
- All other unit costs (e.g. ice per trip, grub per person per day) were adjusted using the Canadian GDP deflator.
- Quota and licence lease fees for 2014 were taken from the annual licence and quota value report (Nelson, 2016, with assumptions on share of harvest leased or number of licences lease from Nelson 2011.

[74] While using average variable cost estimates over four years would be a preferred method, fleet cost information is only available for 2009 and 2014. Using a high revenue and high costs year instead of an average cost year is unlikely to change the scale of impacts.

- Licence fees were not adjusted as fees have not changed. Where public information was available on changes in co-management fees (e.g. in IFMP) these values were changed, but otherwise were not adjusted.
- Crew payments were calculated using the crew numbers and share calculation from Nelson 2011, applied to the year specific revenues.

Gross and Net Revenues: Inland Commercial First Nation Economic Fisheries

The changes in the commercial profits for First Nations EO/Demo fisheries are estimated as earnings before taxes, depreciation and amortization (EBITDA) based on Counterpoint (2014). Landings information on EO/Demo harvest for 2013 to 2016 are based on published Post Season Review reports. Inland commercial prices are based on inland prices detailed in CounterPoint Consulting 2014. Prices were adjusted for current years (2013 to 2016) based on a conversion factor of commercial marine prices to inland commercial prices in 2009 to 2012, and scaled forward (See Table 28). Commercial prices are based on sales slip data. While a portion of Area 29 EO/Demo fisheries operate in marine waters, it is assumed that the prices for catch in these are similar to inland prices (See Map in Appendix E).

Table 28: Price per KG for Estimating Landed Value - South Inland Fisheries

South Inland (in 2016 $s)	2013	2014	2015	2016
Sockeye	3.25634	1.97785	2.62677	4.05339
Coho	7.82366	6.37881	7.16179	8.25523
Pink	0.04529	0.04332	0.03653	0.05214
Chum	1.53472	1.98763	1.65064	2.12655
Chinook	3.31533	3.01018	3.24130	4.80939

Gross and Net Revenues: Commercial Processing Sector (Marine and Inland)

Estimates of gross processed value for commercial species were obtained by applying a conversion factor to the landed value of marine commercial salmon and inland salmon. Data from GS Gislason (2017: 12) are used to calculate the ratio of gross processed value to landed value by species to provide an estimate of gross processed mark up for each year 2012 to 2015 (see Table 29 for conversions). The conversion factor for 2016 was derived based on the average of the processed and ex-vessel values for the previous 4 years (2012 to 2015).

Following the calculation of gross processed mark up, changes in profits were calculated using a ratio of net revenues to gross revenues for fish processing in BC (Statistics Canada

2013). Due to confidentiality, this ratio has not been available for NAICS 3117 (fish processing) in BC from 2009 to 2011. The average of the ratio for five years with available data (2005-2008 and 2012) was 4.10%. This is the most recent information available.

Table 29: Conversion Factors for Estimating Gross Processed Value (2012 to 2016)

Gross Processed Value	Sockeye	Coho	Pink	Chum	Chinook
2012	2.21	1.86	4.46	2.92	1.35
2013	1.93	1.66	3.38	3.17	1.51
2014	2.27	2.32	4.19	2.22	1.36
2015	1.59	2.07	5.37	2.40	1.16
2016*	2.17	1.87	3.70	2.67	1.34
Average (2013-2016) Gross Wholesale Markup Ratio	**1.99**	**1.98**	**4.16**	**2.61**	**1.34**

Source: Based on GS Gislason (2017)

Note*: To provide an estimate for 2016 where data was unavailable, the ratio of the average (2012-2015) processed value to the average (2012-2015) ex-vessel value by species was used.

Gross and Net Revenues: Lodges and Charter/Guides

The gross revenues for lodges and charters were set to equal estimated expenditures for these categories. For both freshwater and tidal fishing, the 2010 expenditures on lodges and charters (DFO, 2012) were adjusted to 2013 to 2016 values as per methodology described in Appendix F.

Net revenues for the lodges and charters are based on the ratio of net revenues to gross revenues in GS Gislason (2004) of 20% for lodges and 25% for charters. In the absence of values for lodges and charters operating in freshwater, ratios specific for tidal water operations were used. Input received from a freshwater recreational business through consultations (i.e. through **recreational charter** fishing workbooks – Appendix Q); supported this estimate of profit margin for freshwater recreational charter fishing operations.

b. *Angler Surplus*

Consumer surplus is a measure of welfare benefits that is grounded in economic theory. The term relates to the amount that consumers are willing-to-pay above what they actually

pay for a good or service. When anglers use commercial enterprises such as lodges and charters the price they pay is determined in the market by the costs of lodge packages and daily charter costs. When anglers fish on their own the cost of a day of angling is measured by their expenditures to undertake that activity including travel, gear, bait and equipment. In the case of recreational angling, consumer surplus may relate to attributes of the fishing activity beyond the value of the fish caught, such as participating in the adventure, and enjoying the outdoor nature experience. The realization of consumer surplus benefits in relation to recreational angling is supported by unpublished survey results from the 2010 National Survey of Recreational Fishing in Canada. In that survey, anglers who visited some of the 800 freshwater lakes and 780,000 km's of rivers and streams in BC expressed the view that the decision to fish was based on many factors. According to the survey, Canadians from outside BC rank the food value of their catch as the least important factor motivating recreational freshwater fishing, versus other factors including: relaxation, enjoying nature, the challenge of fishing, improving angling skills, getting away, and participating in an outdoor adventure that gets the family together. The survey results support that the decision to go fishing in BC is mostly related to the enjoyment and relaxation aspects of angling in BC freshwater lakes rivers and streams.[75] When calculating consumer surplus, it is assumed that recreational fishers do not participate in any other leisure activity over the timeframe that the loss is calculated. If they do participate in other activities, then the loss is overestimated.

This report estimates the change in consumer surplus to recreational anglers that is associated with the incremental recreational fishing closures identified in the management scenarios[76]. This is achieved by applying benefits transfer techniques to estimate the average consumer surplus value per angling day. Benefits transfer refers to applying the results of studies that exist within the published literature base as a proxy to assign value to similar goods, services or outcomes. Using benefits transfer is supported within Treasury Board Cost/Benefit Analysis Guidelines.[77]

[75] This information is based on unpublished results from DFO. 2012. The 2010 Survey of Recreational Fishing in Canada. Prepared by Fisheries and Oceans Canada

[76] Closures that occurred in 2018 are not considered incremental to the Listing decision.

[77] See: Canadian Cost-Benefit Analysis Guide Regulatory Proposals (Interim), Treasury Board of Canada, (p. 20). *https://www.tbs-sct.gc.ca/rtrap-parfa/analys/analys-eng.pdf*

Tidal Recreational Surplus

DFO iREC provides estimates of angler activity (catch and release by species) by Pacific Fisheries Management Areas (PFMAs)[78]. The proportion of total affected fishing activity was calculated for the list closures time/areas (average of 18.19% for salmon and 14.46% for Finfish between 2013 and 2016) using iREC data.

Data from the national recreational survey (DFO, 2012) was used to estimate (as described in Appendix F) an annual total number of angling days by species group (salmon, groundfish) which was averaged over the most recent 4 years (2013-2016). To estimate the number of angling days affected by the time/area closures, the proportion of affected activity calculated from iREC was applied to the total number of angling days. This methodology assumes that the catch success (e.g. number of fish per angling day) was similar in 2010 as during 2013-16).

Benefits transfer was used to provide an estimate of average consumer surplus per tidal water angling day of $108.69 to $197.40. Rosenberger (2016) created the Recreation Use Values Database (RUVD) examining economic valuation studies with use values for recreational activities in Canada and the US from 1958 to 2015. Around 130 documents provide a range of estimates for saltwater fishing. These estimates provide consumer surplus value estimates (net willingness-to-pay) value estimates for recreational access to specific sites or activities. The use values (advanced in the research by Rosenberger 2016) for salt-water fishing are based on 135 documents.[79]

Freshwater Recreational Surplus

DFO does not conduct a survey of freshwater salmon angling. However, estimates of angler days for freshwater salmon fishing (See Table 12 in section 3.5) in the proposed closure areas were provided by DFO Fraser and Interior Area Stock Assessment (Joe Tadey, Program Head, personal communications, September 2018). Estimates for changes in angler days for freshwater steelhead fishing are based on unpublished Province of BC steelhead Questionnaire Data (see Table 11 in section 3.5).

[78] iREC estimates are based on self-reported responses to an internet survey of tidal water licence holders without any direct verification thus response data and resulting estimates may be subject to a variety of biases.

[79] The Recreation Use Values Database (RUVD) created by Dr. Randall Rosenberger (Oregon State University) contains over 420 economic studies that estimate the use values of recreational activities in Canada and the US (from 1958 - 2015).

Benefits transfer was used to provide an estimate of average consumer surplus per angling day (net willingness-to-pay) for freshwater fishing is estimated at $23.73 to $116.85. These estimates derive from the Recreation Use Values Database (RUVD). The use values are based on 957 documents relevant to freshwater fisheries.

c. Displacement of Harvest

The South Coast Salmon IFMP states that a fixed harvest rate approach was initiated for chum in 2002 where exploitation in Johnston Strait was limited to 20%. DFO resource managers suggest that if the Johnstone Strait chum fishery is closed under the list scenario, roughly 20% more chum would return to the terminus areas (excluding the Fraser terminal areas) and increase catch by 20% in those areas. DFO data shows that 99% of chum harvest in Johnston Strait occurs during the List closures time/areas meaning the fisheries would be eliminated/fully closed for all practical purposes. To account for this displacement of harvest, chum harvest is adjusted higher by 20% in areas within the Strait of Georgia that will remain unaffected by a Listing.

d. Food Replacement Costs

A retail value for salmon is used to estimate food replacement values for fish caught under the FSC designation. The retail value is calculated based on the value chain for commercially landed harvest (see Table 30 for the economic value chain).

Salmon
The retail values per salmon species are based on a 40% retail margin on top of a 20% wholesale trade margin (which is the markup over the processed value), as per GS Gislason (2017). Estimates of the change in gross processed value for commercial salmon species is obtained by applying a conversion factor to changes in the landed value of marine commercial salmon. See Table 31 for replacement value per piece which is based on retail values.

Steelhead
From 2006 to 2009, there are 72 records of steelhead sales for fish caught in Area 4 and Area 20 (see map in Appendix E). The average landed price per piece of steelhead adjusted for inflation is estimated at $4.65 (in 2016$'s). Using this landed price and the value chain multipliers described above for salmon, the retail value is estimated at $22.95 per piece of steelhead.

Table 30: Economic Salmon Value Chain - Commercial Sector

Indicator	Formula
Catch Weight	no. of pieces x average weight
Landed Value	catch weight x ex-vessel price
Processed Value*	catch weight x processed price
Wholesale Value	processed value x (1+%wholesale margin)
Retail Value	wholesale value/ (1-%retail margin)

Source: Economic Impacts of Pacific Salmon Fisheries (2017) – GS Gislason & Associates Ltd. pg. 48.
Note*: Estimates of gross processed value for commercial species were obtained by applying a conversion factor to the landed value of marine commercial salmon and inland salmon as per GS Gislason (2017: 12). See Section 4.2.6(a) on Gross and Net Revenues: Commercial Processing Sector (Marine and Inland).

Table 31: Estimated High and Low Retail Price Range by Species Type (2012 to 2015)

The highest and lowest estimated retail prices per piece between 2012 and 2015					
Replacement price per piece	**Sockeye**	**Coho**	**Pink**	**Chum**	**Chinook**
low value	$29.39[1]	$40.02	$6.86	$34.83	$105.38
high value	$56.27	$49.72	$10.39	$45.77	$150.22

Appendix C: List Scenario Rolling Window Closure Details

All commercial, recreational[1] and food, social ceremonial fisheries for salmon closed in locations and times listed below.

Location Affected	Location Details		Start	End
Fraser River and Thompson and Chilcotin River Tributaries	Fraser River – Mouth to Mission	Sub Areas: 29-11 to 29-17	11-Sep	10-Nov
	Fraser River – Mission to Hope		12-Sep	11-Nov
	Fraser River – Hope to Sawmill Creek		16-Sep	15-Nov
	Fraser River – Sawmill Creek to Lytton (Thompson Confluence)		18-Sep	17-Nov
	Fraser River - Lytton (Thompson Confluence) to Texas Creek		21-Sep	20-Nov
	Fraser River - Texas Creek to Kelly Creek		23-Sep	22-Nov
	Fraser River - Kelly Creek to Deadman Creek		26-Sep	25-Nov
	Fraser River - Deadman Creek to Chilcotin River		29-Sep	28-Nov
	Chilcotin River		2-Oct	1-Dec[1]
	Thompson River - Thompson Confluence to Bonaparte River		21-Sep	20-Nov[1]
	Thompson River - Bonaparte River to Kamloops Lake		25-Sep	24-Nov[1]
Strait of Georgia	Area 29	Sub Areas 1 to 5	6-Sep	5-Nov
	Area 29	Sub Areas 6 to 10	11-Sep	10-Nov
	Area 28	Sub Areas 6 to 10	6-Sep	5-Nov
	Area 18	Sub Areas 1 to 6, 9 to 11	7-Sep	6-Nov
	Area 17	Sub Areas 1 to 11, 17, 19 to 21	6-Sep	5-Nov
	Area 16	Sub Areas 1 to 4, 16 to 22	5-Sep	4-Nov
	Area 15	Sub Areas 1 to 3, 5	4-Sep	3-Nov
	Area 14	Sub Areas 6, 12, 13	4-Sep	3-Nov
Johnstone Strait	Area 13	Sub Areas 1 to 19, 23 to 41	1-Sep	31-Oct
	Area 12	Sub Areas 1 to 22, 24, 26	27-Aug	26-Oct
	Area 11	Sub Areas 1 and 2	26-Aug	25-Oct
	Area 111	All Sub Areas	26-Aug	25-Oct
Strait of Juan de Fuca	Area 19	Sub Areas 1 to 6	5-Sep	4-Nov
	Area 20	Sub Areas 1, 3 to 5	2-Sep	1-Nov
West Coast of Vancouver Island	Area 21	All Sub Areas	1-Sep	31-Oct
	Area 121	All Sub Areas	1-Sep	31-Oct
	Area 123	All Sub Areas	30-Aug	29-Oct
	Area 124	All Sub Areas	27-Aug	26-Oct
	Area 125	All Sub Areas	25-Aug	24-Oct
	Area 26	Sub Areas 1, 7, 10, 11	22-Aug	21-Oct
	Area 126	All Sub Areas	22-Aug	21-Oct
	Area 27	Sub Areas 1, 2 , 4 to 6	24-Aug	23-Oct
	Area 127	All Sub Areas	24-Aug	23-Oct

[1]Recreational closure is a finfish closure in tidal waters. In freshwater, fishing is closed with the exception of fishing for White Sturgeon.
[2]As per baseline, spawning and holding areas would remain closed longer than 60 days, mirroring provincial angling closures to protect steelhead.

Appendix D: Input/Output Multipliers for Fisheries

2008 British Columbia Input Output Model
Multipliers for the fishing and fish processing sector

Capture Fishing

	Direct	Indirect	Induced	Total
Output	1.000	0.490	0.080	1.570
GDP	0.420	0.140	0.050	0.610
Employment	2.100	1.590	0.540	4.230
Household income	0.290	0.090	0.030	0.410
Government revenue	0.110	0.020	0.010	0.140

Processing

	Direct	Indirect	Induced	Total
Output	1.000	0.520	0.090	1.610
GDP	0.330	0.200	0.060	0.590
Employment	5.590	2.140	0.660	8.390
Household income	0.200	0.130	0.030	0.360
Government revenue	0.030	0.040	0.010	0.080

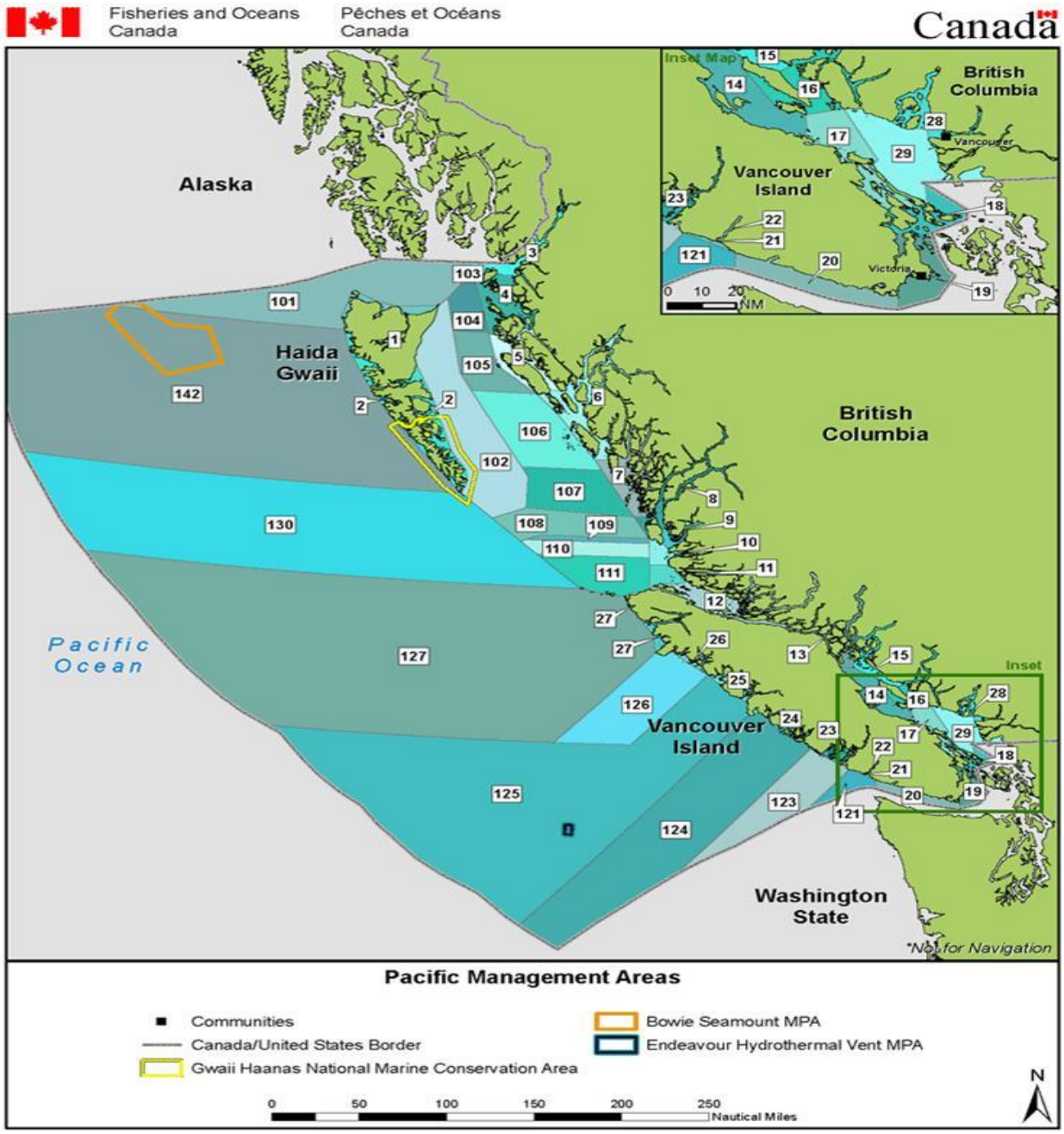
Sport Fishing

	Direct	Indirect	Induced	Total
Output	1.000	0.320	0.080	1.400
GDP	0.230	0.150	0.050	0.430
Employment	8.250	2.550	0.560	11.360
Household income	0.180	0.100	0.030	0.310
Government revenue	0.020	0.020	0.010	0.050

Source: BC Stats 2013. British Columbia's Fisheries and Aquaculture Sector, 2012 Edition. Page 60. http://www.bcstats.gov.bc.ca/Publications/AnalyticalReports.aspx

NOTE: These values included intra-sectoral purchases. *Induced effects assume a social safety net is in place, and include spending by workers directly employed in the industry*

Appendix E: Commercial Salmon Fishing Management Areas



Source: http://www.pac.dfo-mpo.gc.ca/fm-gp/maps-cartes/areas-secteurs/index-eng.html

Appendix F: Development of the Baseline for Recreational Fisheries

Saltwater Fisheries:

The baseline for saltwater salmon and other finfish recreational fisheries was developed using data from 2010 National Recreational Fishing in Canada.

- The number of active anglers in recent years (average 2013 to 2016) is estimated based on the proportion of licences sold to active anglers in 2010.
- The average number of angling days per active angler is based on the 2010 National Survey.
- Expenditures per day and average expenditures per active angler as outlined in the 2010 National Survey were adjusted for inflation using the Canadian GDP deflator.
- Ratios of expenditures per cost category (i.e. proportion of total spending on lodge packages and charters/guides) are based on the 2010 National Survey of Recreational Fishing in Canada, 2010).
- The estimate of angling days by species was based on the results of the 2010 National Recreational Fishing in Canada. The Survey shows that there were slightly over 2.05 million angling days in tidal waters. Further, respondents were asked how many were spent fishing by species and by location. Given that some people do not fish a single species on an angling day, the number of angling days reported by species is much higher than the number of total angling days. There was about a 26.5% overlap in days fished for multiple species (See Table 32). Therefore, the number of days reported fishing for each species type were reduced by 26.5% to estimate the proportion of angling days by species. Based on this methodology, the following proportion of angling days were estimated by species: Salmon 48.75%, Halibut and Other finfish 27.06%, Shellfish 24.19%. This methodology estimates that there were ~1,320,000 saltwater salmon fishing days on average between 2013 and 2016.

Table 32: Angling Days and Expenditures by Species

Angling days reported in millions (rounded to the nearest ten thousand)	Total	Salmon	Halibut	Other Finfish	Shellfish
2010 Survey Responses	2.05m	1.36m	0.32m	0.44m	0.68m
Estimated proportion of angling days after accounting for the 26.5% overlap	100%	48.75%	11.47%	15.59%	24.19%
Estimated angling days by species 2016	2.71m	1.32m	0.31m	0.42m	0.66m
2016 Estimated expenditures by species (based on 2010 Survey results)	1,027m	57%	14%	11%	18%

- However, expenditures per day by species can vary widely as the targeted species may define the characteristics of the trip (e.g. distance travelled, the location of the fishing experience, bag limit, the length of the trip, specific gear requirements etc.).

- Based on results of the National Survey, DFO estimates that salmon represents about 57% of tidal water expenditures (or, about $585.8m). This estimate is in-line with saltwater salmon expenditure estimates (between 2012 and 2015) reported in *Economic Impacts of Pacific Salmon Fisheries prepared by GS Gislason & Associates Ltd. 2017, (page 58*). Other finfish angling represents about 25% of tidal water expenditures.

Based on this methodology, the following proportions of angling days were estimated by species: Salmon 48.75%, Halibut and Other Finfish 27.06%, Shellfish 24.19%.

Table 33: Baseline Tidal Recreational Fishing Expenditures (2013 to 2016)

2013 to 2016 RECREATIONAL FISHING Cost Category Breakdown	Salmon Tidal Water Expenditures	Other Finfish Tidal Water Expenditures
EXPENDITURES		
Accommodation	4.54%	4.61%
Camp Site Fees	1.20%	0.90%
Food	5.28%	5.93%
Travel	8.01%	8.86%
Household Owned Boat Costs	10.39%	10.41%
Shared Boat Costs	1.25%	1.24%
Boat Rentals	0.39%	0.50%
Fishing Supplies	2.18%	2.09%
Guide Costs	1.05%	1.25%
Licence Fees	0.83%	0.80%
Access Fees	0.09%	0.10%
Other Expenses	0.17%	0.12%
Package Allocation	17.84%	18.19%
Total Direct Spending	53.22%	55.00%
Investments Attributable to Fishing	46.78%	45.00%
Total Spending for Fishing (in $2016s)	585.8m	259.2
Total Angling Days (2016)	~1,320,000	~733,000

Source: Estimates for Tidal water angling (salmon and other finfish) are based on unpublished results of the Survey of Recreational Fishing in Canada, 2010.
Note: This baseline includes ~13,350 salmon angling days that were reduced under the 2018 measures which are not considered incremental to a listing decision.

Table 34: Affected (average 2013 to 2016) Proportion of Coast-wide Tidal Angling

Affected Areas under the List Scenario (Incremental to 2018 Measures)	Closed From	Closed To	Number of Days Closed	Salmon	Other Finfish
Area 11	26-Aug	25-Oct	61	0.412%	0.444%
Area 12	27-Aug	26-Oct	61	2.230%	1.175%
Area 13	01-Sep	31-Oct	61	2.020%	1.230%
Area 14 (all sub areas)	04-Sep	03-Nov	61	1.067%	0.887%
Area 15 (all sub areas)	04-Sep	03-Nov	61	0.186%	0.313%
Area 16 (all sub areas)	05-Sep	04-Nov	61	0.158%	0.470%
Area 17 (all sub areas)	06-Sep	05-Nov	61	0.296%	0.591%
Area 18 (all sub areas)	07-Sep	06-Nov	61	0.151%	0.438%
Area 19 (all sub areas)	05-Sep	04-Nov	61	0.703%	0.761%
Area 20 (all sub areas)	02-Sep	01-Nov	61	2.393%	0.452%
Area 21 (all sub areas)	01-Sep	31-Oct	61	0.248%	0.086%
Area 121 (all sub areas)	01-Sep	31-Oct	61	0.047%	0.041%
Area 111	26-Aug	25-Oct	61	0.011%	0.026%
Area 123 (all sub areas)	30-Aug	29-Oct	61	1.686%	1.017%
Area 124 (all sub areas)	27-Aug	26-Oct	61	0.440%	0.397%
Area 125 (all sub areas)	25-Aug	24-Oct	61	0.786%	1.005%
Area 26/126 (all sub areas)	22-Aug	21-Oct	61	0.617%	0.729%
Area 27/127 (all sub areas)	24-Aug	23-Oct	61	1.154%	1.931%
Area 28 (all sub areas)	06-Sep	05-Nov	61	0.386%	0.482%
Areas 29 (Marine only Subarea 29-1 to 29-10)	06-Sep	05-Nov	61	0.748%	0.777%
Areas 29 (Inland Subarea 29-11 to 29-17)	11-Sep	10-Nov	61	0.548%	1.196%
Closures implemented in 2018				**1.01%**	**-**
All Incrementally affected proportion of catch under List				**17.18%**	**14.46%**

Source: DFO iREC data, multiple years

Freshwater Fisheries:

The estimates of salmon angling days in Freshwater Region 2 are based on expert judgement. Please see notes below on how these estimates were informed:

- These estimates are for anglers targeting salmon only; effort directed to other species, such as sturgeon, is not included.
- Region 2 has been closed to fishing for salmon from January 1 to July 16 from 2010-2018. An estimate of zero angler-days was assumed for this period of the baseline
- The Coquihalla (Hope) to Sawmill Creek area has not been assessed for the period between 2008 and 2018. The Coquihalla (Hope) to Sawmill Creek area was last assessed from August 21 to August 30, 2007. This data was used as an indication of the magnitude of the angler effort in this area.
- Expert judgement was used to estimate that the Coquihalla-Sawmill area would be (on average) in the range of 0.5% to 1.0% of the effort seen in the Mission to Coquihalla section during September-November
- An estimate of 1.0% of the Mission to Coquihalla (Hope) was assumed in the calculations to estimate (on average) the number of angler-days in the Coquihalla to Sawmill area for time periods indicated in each scenario
- All estimates are rounded to the nearest 100
- Programs data from 4 years (2017, 2016, 2012 and 2014) was used to generate the estimates. The average angler trip length (i.e. average angler-day length in hours) was calculated from the data, and then the number of angler trip/date (angler-days/date) was approximated using effort estimates. Program data for the 4 years generated an average angler-day length of 4.1 hours (range 2.3 to 5.4) for the Mission to Coquihalla (Hope) area.
- Note: 2012 and 2017 were the only years where the fishery was assessed through to the end of October; 2012 was the only year that assessed the fishery through the end of November.

The baseline for all freshwater salmon and all steelhead recreational fisheries (and TR/CR DUs) was developed using data from 2010 National Recreational Fishing in Canada.

- The number of active anglers in recent years (average from 2013 to 2016) is estimated based on the proportion of licences sold to active anglers in 2010.
- For freshwater fishing, the angling days were adjusted based on the average angling day per active angler from the 2010 survey. The average number of angling days per active angler is based on the 2010 National Survey.
- Ratios of expenditures per cost category (i.e. proportion of total spending on lodge packages and charters/guides) are based on the 2013 BC Freshwater Sport Fishing Economic Impact Report.
- This analysis estimates that approximately 16.8% of total angling days were spent angling for freshwater salmon based on a 2017 report, *Economic Impacts of Pacific*

Salmon Fisheries prepared by GS Gislason & Associates Ltd. 2017, (page 58), which estimated 695,000 freshwater salmon angling days annually from 2012 to 2015 .

- Another source, the Angler Survey of British Columbia, 2011 also estimates that a similar proportion (about 16.4%) of angling days were spent fishing for freshwater salmon average angler days by species (Dabrowska, 2014; pg. 16).
- About 137,000 average angling days for steelhead (2013 to 2016) were based directly on B.C.'s annual steelhead survey (B.C. FLNRO, unpublished internal data).
- Total expenditures for freshwater salmon ($125m) are based on GGislason and Associates, 2017. These freshwater salmon expenditures represent about 19.3% of all freshwater expenditures. As information on expenditures for steelhead were unavailable, this analysis assumes that expenditures are proportionate to the proportion of days spent angling for steelhead (i.e. 3.32%)

Table 35: Baseline Freshwater Recreational Fishing Expenditures (2013 to 2016)

Expenditure Category	Expenditures in Freshwater	All Freshwater Salmon	*All Freshwater Steelhead	TR and CR Steelhead DUs Only
Package Deals				
Other Packages	*0.18%*	*229,000*	*39,000*	237
Full Charter boat	*0.58%*	*724,000*	*124,000*	764
Fly-in Packages	*0.58%*	*730,000*	*125,000*	764
Guided Charter boat	*0.87%*	*1,101,000*	*189,000*	1,147
Lodge Package Allocation	2.59%	3,260,000	559,000	3,414
Food and Lodging	13.96%	17,570,000	3,014,000	18,400
Transportation Costs	16.58%	20,876,000	3,582,000	21,854
Fishing Services & Supplies	7.70%	9,693,000	1,663,000	10,149
Other Costs	0.16%	205,000	35,000	211
DIRECT EXPENDITURES	**43.20%**	**54.4m**	**9.3m**	**56,941**
FISHING INVESTMENTS	**56.80%**	**71.5m**	**12.3m**	**74,866**
TOTAL FISHING SPENDING	**$652.2**	**$125.9**	**$21.6**	**$0.13**
% of angling days by species	100%	16.88%	3.32%	0.02%
Total Angling days	~4,119,000	~695,000	~137,000	~836
% of total expenditures by species	100%	19.30%	3.30%	0.02%

Source: Estimates for freshwater expenditures for charters, guides and lodges are based on the report, BC Freshwater Sport Fishing Economic Impact Report, 2013, pg. 8. The proportions of expenditures for each cost category are based on the Survey of Recreational Fishing in Canada, 2010.
Note*: This column includes expenditures for all steelhead recreational fishing in British Columbia, including Thompson and Chilcotin River Steelhead DUs.

Appendix G: Development of the Baseline for Commercial Marine Fisheries

The baseline for commercial marine salmon was developed using data from vessel logbooks and sales slips. A financial model was also created to estimate earnings before interest, taxes, depreciation and amortization (EBITDA) at the vessel level, using parameters from the "Pacific Commercial Fishing Fleet: Financial Profiles for 2009" report, prepared by Stuart Nelson (See Appendix E, F, G). The financial model is based on the following:

The values and assumptions in Nelson 2009 were adjusted for inflation and using vessel level data to provide estimates of catch, days fished, trips and revenues. Vessel-level values were aggregated into fleet thirds, and into fleet totals.

- Revenue (landed value) is calculated at the vessel level, by year and by salmon species, using average landings from logbook data and prices from sales slips from 2013 to 2016.
- Fuel cost per day fished or per trip was adjusted for inflation using the BC specific CPI for fuel.
- Monitoring costs were calculated on per tonne of harvest or day fished was adjusted for inflation using the Canadian GDP deflator.
- All other unit costs (e.g. ice per trip, grub per person per day) were adjusted using the Canadian GDP deflator.
- Quota and licence lease fees were from the annual licence and quota value report (Nelson various), with assumptions on share of harvest leased or number of licences lease from Nelson 2009.
- Licence fees were not adjusted (i.e. fees have not changed). Where public information was available on changes in co-management fees (e.g. in IFMP) these values were changed, but otherwise were not adjusted.
- Crew payments were calculated using the crew numbers and share calculation from Nelson 2009, applied to the year specific revenues.
- See Table 36 for financial profiles following the above methodology

Table 36: Salmon Fleet Financial Profiles (in millions of 2016 $s)

Seine			
Inflation Adjusted (2016$)	**Average 2013 to 2016**	**2018 Measures**	**List (incremental)**
# of vessels affected	94	3.0	89.0
Gross Revenue (Gross Stock)	25.63	25.6	16.2
Total Fishery Specific Expenses	0.84	0.8	0.5
Net Revenue (Net Stock)	24.79	24.8	15.7
Fishery Contribution (Boat Share)	10.06	10.1	6.4
Total Vessel Expenses	2.51	2.9	2.9
Earnings (EBITDA)	**7.19**	**7.2**	**3.5**
Earnings (EBITDA) Reduction		0.0	-3.7
Gillnet			
Inflation Adjusted (2016$)	**Average 2013 to 2016**	**2018 Measures**	**List (incremental)**
# of vessels affected	620	169.0	387.0
Gross Revenue (Gross Stock)	19.14	18.7	15.5
Total Fishery Specific Expenses	2.27	2.2	1.8
Net Revenue (Net Stock)	16.87	16.5	13.6
Fishery Contribution (Boat Share)	16.45	16.1	13.3
Total Vessel Expenses	4.48	4.5	4.5
Earnings (EBITDA)	**11.97**	**11.6**	**8.8**
Earnings (EBITDA) Reduction		-0.4	-2.8
Troll			
Inflation Adjusted (2016$)	**Average 2013 to 2016**	**2018 Measures**	**List (incremental)**
# of vessels affected	222	0	69
Gross Revenue (Gross Stock)	15.32	15.3	14.2
Total Fishery Specific Expenses	2.89	2.9	2.7
Net Revenue (Net Stock)	12.43	12.4	11.5
Fishery Contribution (Boat Share)	10.23	10.2	9.5
Total Vessel Expenses	2.89	2.9	2.9
Earnings (EBITDA)	**7.34**	**7.3**	**6.6**
Earnings (EBITDA) Reduction		- 0.0	- 0.8
South - Inland Fishery			
Inflation Adjusted (2016$)	**Average 2013 to 2016**	**2018 Measures**	**List (incremental)**
Gross Revenue (Gross Stock)	9.69	9.28	8.51
Total Fishery Specific Expenses	2.75	2.63	2.41
Net Revenue (Net Stock)	6.94	6.65	6.09
Fishery Contribution (boat share)	4.88	4.67	4.28
Total Harvesting expenses	6.88	6.58	6.03
Earnings (EBITDA)	**2.19**	**2.07**	**1.84**
Earnings (EBITDA) Reduction		-0.12	-0.34

Source: Table is based on methodology outlined above.

Appendix H: 2009 Commercial Seine Fisheries: Income Statements

Number of Vessels	**47**	**58**	**105**
Salmon Seine Fleet Aggregate Vessel Profiles	Single	Double	Fleet Total
Landings (kg)	2,993,217	10,371,594	13,364,811
Vessel Price (per kg)	$0.79	$0.64	$0.67
Gross Revenue (Gross Stock)	**$ 2,350,119**	**$ 6,590,991**	**$ 8,941,110**
Less: Fishery Specific Expenses			
Fuel	382,500	862,200	1,244,700
At sea monitoring	-	-	-
Offload Monitor	-	-	-
Licence / Co-management Fees	183,300	440,800	624,100
Licence/Quota lease	-	-	-
Ice	48,100	70,000	118,100
Bait	-	-	-
Gear Maintenance/replace	-	-	-
Total Fishery Specific Expenses	613,900	1,373,000	1,986,900
Net Revenue (Net Stock)	**1,736,219**	**5,217,991**	**6,954,210**
Less:			
Captain's Bonus	105,662	259,050	364,711
Deckhand Shares	1,056,616	3,108,595	4,165,210
Fishery Contribution (Boat Share)	**573,942**	**1,850,346**	**2,424,288**
Vessel Fixed Expenses			
Insurance	423,000	522,000	945,000
Repairs & Maintenance	705,000	870,000	1,575,000
Moorage	94,000	116,000	210,000
Miscellaneous	70,500	87,000	157,500
Total Vessel Expenses	**1,292,500**	**1,595,000**	**2,887,500**
Earnings (EBITDA)	**-$718,558**	**$255,346**	**-$463,212**

Source: Nelson Bros Fisheries Ltd. 2011, page 18

Appendix I: 2009 Commercial Gillnet Fisheries: Income Statements

Number of Vessels	**303**	**135**	**12**	**450**
Salmon Gillnet Fleet Aggregate Vessel Profiles	Single	Double	Triple	Fleet Total
Landings (kg)	820,654	688,900	78,035	1,587,589
Vessel Price (per kg)	$2.19	$1.89	$1.98	$2.05
Gross Revenue (Gross Stock)	**$ 1,799,756**	**$ 1,304,473**	**$ 154,158**	**$ 3,258,387**
Less: Fishery Specific Expenses				
Fuel	681,750	418,500	42,600	1,142,850
At sea monitoring	-	-	-	-
Offload Monitor	-	-	-	-
Licence / Co-management Fees	293,910	234,900	30,120	558,930
Licence/Quota lease	-	-	-	-
Ice	99,325	58,750	22,000	180,075
Bait	-	-	-	-
Gear Maintenance/replace	-	-	-	-
Total Fishery Specific Expenses	1,074,985	712,150	94,720	1,881,855
Net Revenue (Net Stock)	**724,771**	**592,323**	**59,438**	**1,376,532**
Less:				
Captain's Bonus	-	-	-	-
Deckhand Shares	-	77,922	10,699	88,621
Fishery Contribution (Boat Share)	**724,771**	**514,400**	**48,739**	**1,287,911**
Vessel Fixed Expenses				
Insurance	454,500	202,500	21,000	678,000
Repairs & Maintenance	1,060,500	472,500	42,000	1,575,000
Moorage	303,000	135,000	12,000	450,000
Miscellaneous	151,500	67,500	6,000	225,000
Total Vessel Expenses	**1,969,500**	**877,500**	**81,000**	**2,928,000**
Earnings (EBITDA)	**-$1,244,729**	**-$363,100**	**-$32,261**	**-$1,640,089**

Source: Nelson Bros Fisheries Ltd. 2011, page 34

Appendix J: 2009 Commercial Troll Fisheries: Income Statements

Number of Vessels	**205**	**40**	**1**	**246**
Salmon Troll Fleet Aggregate Vessel Profiles	Single	Double	Triple (not calculated)	Fleet Total (exclude triples)
Landings (kg)	1,217,710	420,279	-	1,637,989
Vessel Price (per kg)	$5.17	$5.05	-	$5.14
Gross Revenue (Gross Stock)	**$ 6,296,452**	**$ 2,121,714**	**$ -**	**$ 8,418,165**
Less: Fishery Specific Expenses	0	0		
Fuel	889,200	237,600	-	1,126,800
At sea monitoring	-	-	-	-
Offload Monitor	-	-	-	-
Licence / Co-management Fees	198,850	69,600	-	268,450
Licence/Quota lease	187,358	50,211	-	237,569
Ice	118,500	53,200	-	171,700
Bait	-	-	-	-
Gear Maintenance/replace	-	-	-	-
Total Fishery Specific Expenses	1,393,908	410,611	-	1,804,519
Net Revenue (Net Stock)	**4,902,543**	**1,711,103**	**-**	**6,613,646**
Less:	-	-		
Captain's Bonus	-	-	-	-
Deckhand Shares	959,660	385,782	-	1,345,441
Fishery Contribution (Boat Share)	**3,942,884**	**1,325,321**	**-**	**5,268,205**
Vessel Fixed Expenses	-	-		
Insurance	410,000	70,000	-	480,000
Repairs & Maintenance	1,537,500	300,000	-	1,837,500
Moorage	307,500	60,000	-	367,500
Miscellaneous	153,750	30,000	-	183,750
Total Vessel Expenses	**2,408,750**	**460,000**	**-**	**2,868,750**
Earnings (EBITDA)	**$1,534,134**	**$865,321**	**$0**	**$2,399,455**

Source: Nelson Bros Fisheries Ltd. 2011, page 45

Appendix K: Development of the Baseline for EO/Demo fisheries

Revenue (landed value) is calculated at the fleet level, by year and by salmon species, using average landings from logbook data. The 2013 to 2016 prices were adjusted using a conversion factor of marine to inland prices from 2009 to 2012 as reported in the "Financial Analysis of Commercial Salmon Fisheries: Marine & Inland Fisheries, 2014" report, prepared by Counterpoint Consulting. Earnings before interest, taxes, depreciation and amortization (EBITDA) was estimated using the four year average (2009 to 2012) EBITDA for South Inland fishing operations as per Counterpoint Consulting 2014 (See table below).

Table 37: Inland Commercial Salmon Fisheries: Income Statements

Inland South Income Statement Estimation by region – Harvest level	**2009**	**2010**	**2011**	**2012**
Landings (kg)	**1,410,291**	**3,487,728**	**2,826,069**	**1,093,104**
Vessel Price (per kg)	**0.50**	**1.79**	**0.95**	**1.50**
Gross Revenue (Gross Stock)	**$702,683**	**$6,243,782**	**$2,687,474**	**$1,638,299**
Fishing Expenses				
Fuel	$67,496	$571,404	$252,413	$148,281
Offload Monitor	$62,304	$527,450	$232,997	$136,875
Ice	$77,880	$659,313	$291,246	$171,093
Total Fishery Specific Expenses	$207,681	$1,758,167	$776,656	$456,249
Net Revenue (Net Stock) (Rev - Costs)	$495,002	$4,485,615	$1,910,818	$1,182,050
Harvesting wages	$155,761	$1,318,625	$582,492	$342,187
Fishery Contribution (boat share)	$339,241	$3,166,990	$1,328,326	$839,863
Vessel Expenses				
Insurance	$31,152	$263,725	$116,498	$68,437
Vessel R&M	$57,112	$483,496	$213,580	$125,468
Fishing Gear R&M	$31,152	$263,725	$116,498	$68,437
Phone/Communications	$10,384	$87,908	$38,833	$22,812
Miscellaneous	$25,960	$219,771	$97,082	$57,031
Total Vessel Expenses	$155,761	$1,318,625	$582,492	$342,187
Total Harvesting expenses	$519,203	$4,395,417	$1,941,640	$1,140,622
CFE or Other Business Overhead expenses				
Salaries and wages	12,381	180,966	98,340	37,853
Office expense	4,127	60,322	32,780	12,618
Professional fees	8,254	120,644	65,560	25,236
Miscellaneous	2,751	40,215	21,853	8,412
Total overhead expenses	$27,513	$402,148	$218,532	$84,118
Total Harvesting and CFE exp	$546,716	$4,797,565	$2,160,172	$1,224,740
Income (EBITDA)	**$155,967**	**$1,446,218**	**$527,302**	**$413,558**

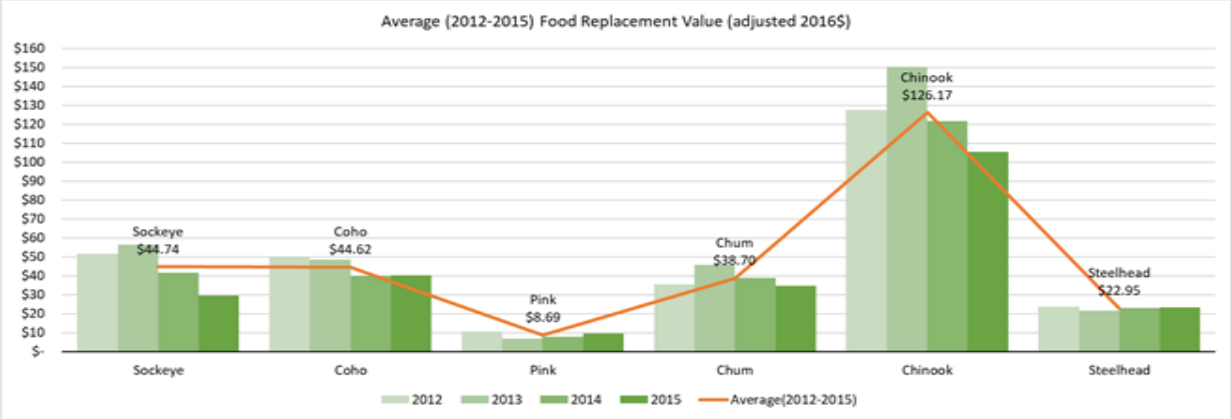
Source: Counterpoint Consulting 2014

Appendix L: Food Replacement Value of Salmon

The Highest and Lowest Values Between 2012 and 2015					
Retail price/piece	**Sockeye**	**Coho**	**Pink**	**Chum**	**Chinook**
Lowest value	$ 29.39	$ 40.02	$ 6.86	$ 34.83	$ 105.38
Highest value	$ 56.27	$ 49.72	$ 10.39	$ 45.77	$ 150.22
FSC Harvest (Average 2012-2015)					
Harvest Area	**Sockeye**	**Coho**	**Pink**	**Chum**	**Chinook**
Fraser River	349,900	2,300	10,700	35,700	21,700
Strait of Georgia	18,700	100	200	5,100	300
Johnstone Strait	135,500	1,300	21,600	11,700	700
WCVI	52,400	9,800	800	3,400	7,200

Proportion of Harvest Affected Under List					
Harvest Area	**Sockeye**	**Coho**	**Pink**	**Chum**	**Chinook**
Fraser River	1.05%	96.89%	25.11%	49.29%	4.58%
Strait of Georgia	11.72%	25.61%	3.79%	79.04%	16.13%
Johnstone Strait	0.22%	20.00%	1.35%	71.30%	7.01%
WCVI	0.00%	3.99%	0.58%	0.18%	4.24%

Range of Replacement Value of Potential Forgone Harvest						
Retail Value	**Sockeye**	**Coho**	**Pink**	**Chum**	**Chinook**	**Total**
Lowest value	$ 181,200	$ 116,300	$20,500	$1,043,900	$ 147,200	$1,509,100
Highest value	$346,900	$144,400	$31,100	$ 1,372,100	$ 209,800	$ 2,104,300



Appendix M: Freshwater Fisheries Management Regions

Appendix N: Impacts of 2018 Measures

The CBA only examines incremental costs of a Listing decision. While recent efforts were made towards conservation of TR and CR DUs, these are not considered incremental. Therefore, separate analysis was undertaken to explore the impacts of these measures. Table 40 shows that, overall, in terms of monetized costs, the present value loss of the 2018 measures is expected to be between $19.56m to $27.95m (2016$ at 7% discount rate over 20 years, $3.44m to $5.99m annualized). The harvest of TR/CR steelhead for FSC purposes is unknown. However, it has been indicated through consultations with First Nations groups (in the context of a SARA Listing) that any level of forgone steelhead FSC harvest will have significant impacts on First Nations.

Costs of 2018 Measures

Commercial Harvesters

Under the 2018 measures, it is expected that on an annual basis, revenues would reduce by $0.44m for the commercial seine, troll and gillnet fleets compared to the pre-2018 measure levels.[80] This translates into a present value profit loss of $4.2m over 20 years (or $0.40m annualized). Further, it is expected that on an annual basis, revenues would reduce by $0.41m for the Indigenous commercial EO, Demo fisheries under the 2018 measures. This translates into a present value profit loss of $1.37m over 20 years (or $0.13m annualized). Further, these harvesting sector impacts would also affect the processing sector, resulting in an annual $1.45m gross processing margin loss. This translates into a present value profit loss of $0.31m (or $29,000 annualized).

[80] DFO fisheries management indicates that reallocation of reduced effort is not expected i.e. forgone catch is not expected to be harvested in other areas or during other times (Marla Maxwell, DFO Resource Management, personal communications, October 2018).

Table 38: Commercial Fishing Reductions under 2018 IFMP Measures

Average (2013 to 2016) and Rounded to the nearest thousand	Gear	Fleet Reductions in the First Year
Kilograms	Seine	6,200
	Gillnet	256,000
	Troll	0
Landed Value (2016 $s)	Seine	8,200
	Gillnet	431,400
	Troll	100
Processed Value	Seine	25,900
	Gillnet	1,162,900
	Troll	100

Source: Quantity is based on DFO logbook data and value is based on sales slip data, multiple years. Processed value is based on conversion factors (see Table 29 of this report).

Table 39: First Nations Commercial Fishing Reductions under 2018 IFMP Measures

First Nations Sale (i.e. EO, Demo Fisheries) Affected	
Average (2013 to 2016) and Rounded to the nearest thousand	**2018 Measures**
Kilograms	200,000
Landed Value	$400,000
Processed Value	$1,100,000

Source: Quantity is based on DFO logbook data and value is based on Counterpoint 2014, and adjusted for more recent years. Processed value is based on conversion factors (see Table 29 of this report).

First Nations Food Social Ceremonial Fishing

Under the 2018 measures, it is expected that on an annual basis, 50% of the chum harvest in First Nations fisheries in select areas (Area 29-6 to 29-17 and mouth of the Fraser River to Hope) would be impacted. This translates into a present value replacement cost of forgone harvest of $7.05M to $9.27M over 20 years (or $0.66m to $0.87 annualized). Salmon is a species of great significance to First Nations of British Columbia. Based on input received through the SARA consultation processes, any amount of FSC harvest reduction could have significant impacts of Indigenous Peoples that may have their identities and well-being linked to harvest of species such as salmon and steelhead.

Recreational Fishing

Recreational angling days are expected to be reduced by about ~2,500 days for freshwater steelhead and salmon and ~11,000 days for tidal water salmon under the 2018 measures. This translates into a tidal angler surplus loss of between $5.31m to $10.46m over 20 years (or $2.02m to 3.97m annualized) and freshwater surplus loss of between $0.27m and $1.29m over 20 years. See section 4.2.6 (Economic Framework) and Appendix B for further information on methodology used to calculate loss of surplus. In terms of impacts to the lodges and charters, there would be an annual $445,000 gross revenue loss. This translates into a present value profit loss of $1.05m (or $0.1m annualized).

Table 40: Costs of 2018 Measures

A. Quantified or Monetized Costs

In millions of 2016 $s (rounded to nearest ten thousand)	Commercial Harvesters	First Nations EO/Demo Fisheries	Processors	Tidal Anglers	Fresh water Anglers	Lodges and Charters	First Nations Food Replacement	Total
Annualized Surplus loss	$0.40	$0.13	$0.029	$2.02 to $3.97	$0.1 to 0.49	0.10	$0.66 to $0.87	$3.44 to $5.99
Present Value Surplus Loss	$4.2	$1.37	$0.31	$5.31 to $10.46	0.27 to 1.29	$1.05	$7.05 to $9.27	$19.56 to $27.95

B. Qualitative Costs

First Nations FSC harvest	The harvest of TR/CR steelhead for FSC purposes prior to the voluntary moratorium is unknown. However, it has been indicated through input received from First Nations through consultations that any level of forgone steelhead FSC harvest will have significant impacts on First Nations.

C. Regional Impacts

In millions of 2016 $s (rounded to nearest ten thousand)	Commercial Harvesters	EO/Demo Fisheries	Processors	Tidal Anglers	Fresh water Anglers	Lodges and Charters	First Nations Food Replacement	Total
Reductions in Direct Household Income	$0.13	$0.12	$0.29	$2.02	$0.26	unknown	n/a	Over $2.82
Reductions in Direct Employment	237	unknown	8	92	12	unknown	n/a	Over 349

Summary of Costs - 2018 Measures

Table 40 shows that, overall, in terms of monetized costs, the present value loss of the 2018 measures is expected to be between $19.56m to $27.95m (2016$ at 7% discount rate over 20 years, $3.44m to $5.99m annualized). First Nations (First Nations commercial EO/Demo and salmon FSC harvest) have incurred significant costs at $8.42m to $10.64m present value ($0.78m to $1m annualized). These costs are associated with profit loss to First Nations commercial EO/Demo harvesters and include the replacement value of forgone food replacement value of forgone salmon. Additional impacts beyond food replacement costs are also anticipated given the significance of salmon to Indigenous groups. The commercial harvesting sector (vessel based and party based First Nations communal commercial licences) incurred about a $4.2m reduction in present value of profits. These harvesting reductions also impact the processing sector for a total present value loss of 310,000 (for both commercial and First Nations EO/Demo fisheries). Finally, angling days will also be reduced, with loss of angler surplus ranging between $5.31m to $10.46m and $0.27m to $1.29m present value for tidal and freshwater, respectively (see Table 40).

Benefits of 2018 Measures

The intention of the 2018 measures was to reduce incidental mortality to CR/TR steelhead below that which would occur in the absence of these measures. However, benefits of the 2018 measures cannot be assessed without some indication of the level steelhead mortality reduction associated with these. The RPA explores an exploitation rate only up to 25% (DFO, 2018). The exploitation rate prior to the 2018 measures is unknown but assumed to be at or less than 25%. According to DFO Resource Management and Science, the reduction in exploitation under measures implemented in 2018 is also unknown. Therefore, benefits of these measures cannot be assessed but assumed to be positive given that they intend to reduce incidental steelhead mortality.

Appendix O: Studies Consulted for Benefit Transfer

Household Benefit References

Forbes, K., Boxall, P. C., Adamowicz, W. L., & Sukic, A. D. (2015). Recovering Pacific rockfish at risk: The economic valuation of management actions. *Frontiers in Marine Science, 2*. doi:10.3389/fmars.2015.00071

Helvoigt, T., D. Charlton. (2009). The Economic Value of Rogue River Salmon. ECONorthwest, pp. 29.

John B. Loomis (1996) How large is the extent of the market for public goods: evidence from a nationwide contingent valuation survey, Applied Economics, 28:7, 779-782, DOI: 10.1080/000368496328209

Meyer Resources, Inc. (1985). *The Economic Value of Striped Bass, Chinook Salmon, and Steelhead Trout of the Sacramento and San Joaquin River Systems*. California Department of Fish and Game, Administrative Report No. 85-03. Sacramento, CA: Department of Fish and Game.

Meyer Resources, Inc. (1987). *An Economic Methodology for Valuing Salmon and steelhead in California*. Report no. 129-J. For the California Advisory Committee on Salmon and Steelhead Trout.

Olsen, Darryll, Jack Richards, R. Douglas Scott. (1991). A Study of Existence and Sport Values for Doubling the Size of the Columbia River Basin Salmon and steelhead Runs. Rivers. 2. 1. 44-56.

Wallmo, K., Lew, D. K. (2016). A comparison of regional and national values for recovering threatened and endangered marine species in the United States. *Journal of Environmental Management,179*(1), 38-46. doi:10.1016/j.jenvman.2016.04.053

Recreational Value References

Alexander, S.J. (1995). Applying Random Utility Modeling to Recreational Fishing in Oregon: Effects of Forest Management Alternatives on steelhead Production in the Elk River Watershed. Doctoral thesis. Oregon State University

Brown, W., C. Surhus and K. Gibbs. (1981). Estimated Expenditures by Sport Anglers and Net Economic Values of Salmon and steelhead for Specified Fisheries in the Pacific Northwest. Pacific Northwest Regional Commission, pp. 88.

Donnelly, Dennis M., John B. Loomis, and Cindy F. Sorg. (1984). Net Economic Value of Recreational steelhead Fishing in Idaho. USDA Forest Service Resource Bulletin RM-9, pp. 23. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

Douglas, A.J. and A. Sleeper. (2005). Estimating Recreation Trip Related Benefits for the Klamath River Basin with TCM and Contingent Use Data. Midcontinent Ecological Science Center, U.S. Geological Survey and Successful Statistics, Fort Collins, Colorado

Johnson, N. S., R. M. Adams. (1989). On the Marginal Value of a Fish: Some Evidence from a steelhead Fishery. *Marine Resource Economics,6*(1), 43-55. doi:10.1086/mre.6.1.42629002

Johnston, R. J., M. H. Ranson, E. Y. Besedin, & E. C. Helm. (2006). What Determines Willingness to Pay per Fish? A Meta-Analysis of Recreational Fishing Values. *Marine Resource Economics,21*(1), 1-32. doi:10.1086/mre.21.1.42629492

Layman, R., J. Boyce, K. Criddle. (1996). Economic Valuation of the Chinook Salmon Sport Fishery of the Gulkana River, Alaska, under Current and Alternate Management Plans. *Land Economics, 72*(1), 113-128. doi:10.2307/3147161

McKean, J. R., D. Johnson, and R. G. Taylor (2010), Willingness-to-pay for steelhead trout fishing: Implications of two-step consumer decisions with short-run endowments, *Water Resources Research*, *46(9),* doi: 10.1029/2009WR008664.

Meyer, P.A., W.G. Brown, and C.K. Hsiao. (1983). *An Updating Analysis of Differential Sport Fish Values for Columbia River Salmon and steelhead*. Prepared for The National Marine Fisheries Service.

Meyer-Zangri Associates, Inc. (1982). *Net Economic Values for Salmon and steelhead from the Columbia River System.* NOAA Technical Memorandum NMFS F/NWR-3. Prepared for The National Oceanic and Atmospheric Administration.

O'Laughlin, J. (2005). Economic Impact of Salmon and steelhead Fishing in Idaho: Review of the Idaho Rivers United Report. College of Natural Resources Policy Analysis Group University of Idaho. Moscow, Idaho. pp. 20.

Rosenberger, Randall S. 2016. Recreation Use Values Database. Corvallis, OR: Oregon State University, College of Forestry. Retrieved November 6, 2018, from http://recvaluation.forestry.oregonstate.edu/.

Schuhmann, P. W., & Schwabe, K. A. (2004). An Analysis of Congestion Measures and Heterogeneous Angler Preferences in a Random Utility Model of Recreational Fishing. *Environmental and Resource Economics, 27*(4), 429-450. doi:10.1023/b:eare.0000018517.33432.0b

Sorg, C. F., & Loomis, J. B. (1986). Economic Value of Idaho Sport Fisheries with an Update on Valuation Techniques. *North American Journal of Fisheries Management,6*(4), 494-503. doi:10.1577/1548-8659(1986)62.0.co;2

Toivonen, A. , E. Roth, S. Navrud, et al. (2004), The economic value of recreational fisheries in Nordic countries. Fisheries Management and Ecology, 11: 1-14. doi:10.1046/j.1365-2400.2003.00376.x

Appendix P: First Nations Commercial EO/Demo/ESSR/HA Fisheries[81]

When DFO identifies a weak salmon stock, it may opt to transfer some of the commercial allocations to up-river environments, protecting the weaker stocks by reducing the catch of these fish in the mixed-stock fisheries that occur in marine waters closer to the Pacific. In-river **demonstration commercial fisheries** provide an opportunity for First Nations to participate in the commercial salmon fishery, establishing clearly defined shares in the salmon fishery and building capacity within First Nations communities under the Pacific Integrated Commercial Fisheries Initiative (PICFI). The pre-season allocations of salmon to demonstration fisheries are determined as a percentage share of allowable catch. Licences are made available for up-river fisheries through voluntary licence relinquishment from commercial licence holders in traditional marine waters fisheries (DFO, 2011).

Excess salmon to spawning requirement **(ESSR)** fisheries are identified by DFO based on the surplus stock size to the requirements for conserving present stocks after all FSC, commercial, EO/Demo, and rec fisheries. The licences under such agreements are non-transferrable and non-leasable. ESSR fisheries are relatively infrequent as "excess" stocks are minimized through allocating more to FSC and recreational fisheries, but the department constantly monitors fisheries in order to capitalize on as much of the harvestable portion of the salmon stock as possible while sustaining conservation and FSC goals (DFO, 2018, pp. 115; PCO, 2011, pp. 13).

Added as an amendment to the Aboriginal Fishing Strategy (AFS), **Economic Opportunity** (EO) fisheries began under the Pilot Sales Program which provides Indigenous groups an opportunity to sell their communal FSC harvests. Similar to the regular commercial fisheries, the First Nations' EO fisheries come with the regulatory framework that is provided by DFO (i.e. particular stock restrictions, area closures, etc.) These fisheries are conducted separately from FSC fisheries, and fish harvested are off-set with licences voluntarily relinquished from the commercial fishery (DFO, 2012).

For the purposes of this report, catch for commercial sale under **Harvest Agreements (HA)** are included under the First Nations commercial sale fisheries baseline discussions. A harvest agreement is an agreement entered into between a First Nations community and the appropriate governing bodies (provincial, federal, etc.) with regards to harvesting and/or gathering rights. Some of these agreements come in the form of a treaty and/or lands claim agreement, pursuant of sections 25 and 35 of the 1982 Constitution Act, while others do not. Some existing agreements include conditions with regards to the harvesting,

[81] Reductions to sale fisheries under ESSR and Harvest Agreements are not anticipated under the management scenarios.

gathering, sale and/or trading of certain resources[82]. However, not all harvest agreements designate harvest for commercial sale purposes. In British Columbia, there are a number of Harvest Agreements in place, including with the following Treaty Nations: Maa-nulth Nation, Nisgaa'a Nation, Tla'amin Nation and Tsawwassen Nation.

[82] As seen in various existing First Nations Harvest Agreements, including Tsawwassen First Nation Harvest Agreement (http://www.tsawwassenfirstnation.com/pdfs/TFN-About/Treaty/TFN_Harvest_Agreement.PDF) and Nisga'a Nation Harvest Agreement (https://www.nisgaanation.ca/sites/default/files/Nisga%27a%20Nation%20Harvest%20Agreement.pdf), among others.

Appendix Q: External Input Received on Impacts

Stakeholders (commercial harvesters and processors, recreational anglers, guides and charters) and First Nations harvesters participating in EO, Demonstration, ESSR and FSC fisheries were asked to provide input into the CBA in the form of workbooks in order to identify and qualify potential impacts they would expect from a TR/CR steelhead Listing decision based on the closures identified under the list scenario.

Several respondents commented on issues and concerns that are outside the scope of the CBA i.e. SARA consultation process, efficacy of the proposed measures, predominant factors influencing declines, lack of information on encounter rates in impacted fisheries, evidence that proposed measures will help achieve recovery, compensation to offset losses, predation effects, to name a few. These comments were forwarded to the SARA program for consideration in other processes.

Commercial harvesters were asked to identify the ways the proposed closures would affect them/their businesses, and how their business decisions would adjust in response to these effects. Some adverse impacts noted by stakeholders in the workbooks follow.

- Commercial harvesters that are diversified into other fisheries reportedly expect between 10% and 80% of their total revenues to be affected, while those harvesters that solely target salmon reportedly expect 40% to 100% of their total revenues to be affected.
- Harvesters across the financial spectrum reported that the proposed regulation would be “economically devastating”, resulting in “financial ruin” and “decimating the industry”, forcing many out of the fishery. One respondent noted that, as a result of the proposed closures, he or she “would retire in poverty”.
- Many respondents echoed the sentiment that their businesses would be “terminally crippled”, forcing employees “to find new employment or face financial ruin”.
- A few respondents noted that businesses would respond to the proposed closures by seeking “compensation for lost revenue” and/or objecting to the decision.
- One respondent raised concerns that the “south coast fleets, processors and many businesses that depend on the fisheries would probably not survive the financial impact from this closure,” demonstrating that enterprises like unloading facilities, fuel and equipment suppliers could also be affected.
- A respondent noted that the proposed closures would “drive out the last skilled fishers from the industry” making their “licences and gear worthless along with [the] vessel”. Another respondent indicated that it would not only be the commercial fishers that are “put into survival mode”, but that the closures would

"have serious consequences on all coastal communities in BC" that are indirectly related to the industry.

- Some concerns were brought up about the existing difficulty to maintain viability due to other factors such as, "limited access due to diminishing stocks" and "existing lack of opportunities". However, these factors are not addressed by the CBA.

In the workbook responses, **seafood processors** that focus more on other species in addition to salmon note that in most years they see certain periods of salmon processing intensity (usually chum, unless it is a predominant year for another salmon species) that will probably be reduced or lost due to the proposed closures. The proportion of total processing dedicated to salmon in such facilities is variable (around 15%), but the proposed closures could result in large financial impacts in years of large salmon runs. For example, one response noted that during "big sockeye years, [the proposed closures] would greatly reduce processing days". In most other years the proposed closures would "curtail chum fisheries" during a time of year when "[processors] have very little else going on in the plant". According to the workbook responses, processing enterprises that specialize mainly in salmon would see these impacts magnified. A respondent from one enterprise (which focusses around 80% of its effort on salmon) noted the proposed regulation would be crippling to businesses, and would "eventually lead to [processors] closing the doors". In terms of spin-off impacts to suppliers, all packaging and equipment supplies used by these respondents are sourced from the Lower Mainland, with some other supplies coming from Vancouver Island. In response to questions on the steps that might be taken by businesses in response to the listing of TR/CR steelhead, respondents noted that it would be difficult to prescribe a business response without a full picture of the potential impacts. One seafood processor was certain that the proposed management strategies would lead to them being put "out of business" and forcing their "employees out of work".

Recreational anglers fishing in tidal water and freshwater that provided input via the workbooks reportedly fish in the Lower Mainland and the Strait of Georgia areas. All respondents reportedly fished more than the average number of angling days per angler as found in the DFO 2010 Survey of Recreational Fishing for tidal water and freshwater angling, respectively. In their workbooks, recreational anglers fishing in tidal waters revealed that they expect to have between 10%-100% of their fishing days affected, while anglers fishing in freshwater areas reportedly expect to see 75% to 100% of their fishing days affected.

The main concerns raised by recreational anglers focused on issues that are not covered by the CBA. Specifically, respondents raised the relatively insignificant "adverse effect [of recreational fishing] on the protection [of TR/CR steelhead stocks] compared to other activities".

As stated in a response from **recreational fishing charters**, the respondent expects around 25% of their charter activity to take place within the closure periods and areas. The main area fished by this charter operation is the Strait of Georgia, and the main target species are chinook, coho, and sockeye salmon. This respondent mentioned that their operating profit margin as a charter was 25%. When asked how the proposed closures would affect their business operations, the respondent said that such an impact would force the business to close down "as it would not be economical to continue" operating.

A response from **commercial indigenous EO/Demo/ESSR harvester** noted that the proposed closures would affect over 10% of their chinook harvest and over 90% of their Demo/EO/ESSR coho harvests. When asked to describe the impacts of the proposed management measures on business, the respondent noted that under the current regulations, the proposed closures would "mean that there will be no access to a directed coho fishery or a chinook fishery with retention of coho after September 15th". Furthermore, it was advanced that "time will be further limited and more pressure put on the already limited fishery for fishermen to catch chinook at an earlier date when chinook are smaller and worth less money".

A response from **FSC harvesters** noted that the proposed closures would 'significantly affect' the Nations' ability to harvest for FSC in their area and noted that harvesters would flock to the limited areas that would remain open after August 27th depleting the salmon resources in these areas. In other consultations with First Nations, participants noted that the cultural significance of the species should be considered in the impact assessment of the proposals.

Input received on behalf of a group of First Nations noted the proposed measures "would have a devastating effect on [the Nations' ability] to exercise [the Nations'] constitutionally protected treaty fishing rights". This would reduce the opportunity for harvesting Chum, Coho and Chinook, and would "cause significant cultural harm, as the domestic harvest of these species is critically important to who [the Nations are as] First Nations." The proposed Listing of Steelhead "would cause irreparable harm to not only [the Nations'] commercial fisheries […] but also the many First Nations-owned businesses and citizens that rely on recreational salmon fishing opportunities." Many of the proposed closures to the recreational fishing sector fall within "some of the busiest months of the tourist season". This has the potential to limit "an important income stream for [the Nations'] citizens who offer sports fishing charters, and would decrease revenues at First Nations-owned businesses offering accommodations, food, cultural tours and other tourism

services." The proposed closures could also, therefore, limit the "ability of businesses to remain open to serve local residents."

Based on the Nations own analysis, 9.5% of their Chinook, 10.3% of their Chum and 19.0% of their Coho catch designated as FSC will be impacted under the proposed closure areas during the closure times. The CBA, however, reports FSC harvest impacts by region and not on a per nation basis. On a coast-wide basis, the CBA estimates the proposed closure areas/times will impact 5% of Chinook, 54% of Chum and 22% of Coho FSC harvest. This demonstrates that FSC harvest impacts will vary by First Nation based on a number of factors including but not limited to the locations, timing and target species of First Nations' FSC harvest preferences.

Appendix R: Commercial Fishery Reductions

Table 41: Total Revenue Loss from Areas Affected by Closures - 2016$

Values Reported in 2016$ (Rounded to the nearest 100,000)	Gear	Average Harvest in Years 2013 to 2016	Harvest Reductions Under 2018 Measures	List - Reductions Under List (incremental to 2018 Measures)
Kilograms	Seine	15,500,000	10,000	4,480,000
	Gillnet	7,100,000	260,000	1,400,000
	Troll	2,400,000	0	310,000
Landed Value	Seine	25,600,000	10,000	9,390,000
	Gillnet	19,100,000	430,000	3,220,000
	Troll	15,300,000	0	1,160,000
Processed Value	Seine	66,800,000	30,000	23,250,000
	Gillnet	44,100,000	1,160,000	7,900,000
	Troll	24,500,000	0	2,520,000

Source: Quantity is based on DFO logbook data and value is based on sales slip data, multiple years. Processed value is based on conversion factors (see Table 29 of this report).

Table 42: First Nations EO, Demo Fisheries Affected

Values Reported in 2016$ (Rounded to the nearest 100,000)	Average Harvest in years 2013 to 2016	Harvest Reductions Under 2018 Measures	List - Reductions Under List (incremental to 2018 Measures)
Kilograms	4,300,000	200,000	800,000
Landed Value	9,700,000	400,000	800,000
Processed Value	19,900,000	1,100,000	1,900,000

Source: Quantity is based on DFO logbook data and value is based on Counterpoint 2014, and adjusted for more recent years. Processed value is based on conversion factors (see Table 29 of this report).