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# Review of Allowable Harm Permits for inner Bay of Fundy Atlantic salmon.

# Revue des permis de dommage fortuit pour le saumon atlantique de l'arrière-baie de Fundy

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## ABSTRACT

This document provides an assessment of the potential for assignment of allowable harm permits for federally licensed activities possibly catching endangered inner Bay of Fundy Atlantic salmon. Potential captures require an Allowable Harm Permit under Section 73 of the Species at Risk Act. Assessments are conducted for fisheries or activities that may affect the survival or recovery of endangered species. The document follows a recommended framework to assess allowable harm permits. The document was drafted as a guide to Fisheries Management and completes the outlined framework regardless of intermediary conclusions. Application of the framework indicated that, since the population trajectory is below replacement, no increase in mortality was available to be allocated and therefore, no allowable harm can be permitted. The document examines 'what if' the trajectory was positive. A review of the sources of mortality revealed no high impact actions where further restrictions or elimination of the mortality sources could lead to recovery. This result was expected because the origin of the downturn in recruitment is not known but has been shown to be concurrent with the marine phase of the salmon life cycle.



## RESUME

Le présent document porte sur une analyse visant à établir la base sur laquelle des permis de dommage fortuit pourront être délivrés pour des activités autorisées par le fédéral pouvant mener à la capture, dans l'arrière-baie de Fundy, de saumons atlantiques en voie de disparition, permis requis en vertu de l'article 73 de la *Loi sur les espèces en péril*. Les pêches ou les activités qui peuvent nuire à la survie et au rétablissement d'espèces en péril sont évaluées en regard du cadre recommandé pour la délivrance de ces permis. Ce document a été préparé à titre de guide pour les gestionnaires des pêches et complémente le cadre, indépendamment des conclusions préliminaires. Selon le cadre, étant donné que la trajectoire de la population indique qu'elle se situe au-dessous du niveau de remplacement, on ne peut pas permettre que le taux de mortalité augmente; aucun dommage fortuit ne peut donc être autorisé. Le scénario d'une trajectoire positive est aussi évalué. Une analyse des sources de mortalité n'a révélé aucune activité ayant un impact important où d'autres restrictions ou l'élimination des sources de mortalité pourraient mener au rétablissement. Ce résultat était attendu car on ne connaît pas l'origine du fléchissement du recrutement, bien que l'on sache qu'il se produit en mer.

# INTRODUCTION

Inner Bay of Fundy (iBoF) Atlantic salmon was listed endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in May 2000 and placed on the Public Registry under the Species at Risk Act (SARA) of Canada. With respect to SARA, the Director of Fisheries Management, Maritimes Region, requested that Science Branch undertake a scientific evaluation of regional commercial fisheries (taking place in the Bay of Fundy) and permits or licenses issued by other jurisdictions that require clearance under other federal acts and regulations to determine if mortality incidental to the permit would jeopardize survival or recovery of iBoF salmon. To that purpose, this document follows a framework prescribed by DFO Science[11] that can assist Fisheries Management in the assessment and assignment of Allowable Harm Permits as prescribed by Section 73 of the SARA.

This framework responds to a series of questions concerning the population viability of the species and based on that assessment addresses specific questions concerning federally licensed activities that may impact recovery or survival of the species. This document provides a response to those questions and without prejudice to the acceptance or rejection of these responses completes the framework. No quantitative risk analysis is presented. However, a qualitative risk assessment table is presented to assist Fisheries Management in evaluating specific licenses with regard to impacts on survival or recovery of iBoF salmon.

# BACKGROUND

## *Species*

The population is a distinct genetic component of the anadromous species *Salmo salar* L. Based on current research[1], depending on the location and method used, only 15-50% of the population is absolutely identifiable through genetic typing. No external identifying features are known.

## *Distribution*

Freshwater: iBoF Atlantic salmon were known to spawn in at least 32 rivers northeast of the Saint John River in New Brunswick and the Annapolis River in Nova Scotia but not including either river.

Marine: Regularly known in the Bay of Fundy for all months except December to February. Rarely observed as far south as Massachusetts, USA in the month of March and as far north as the Cabot Strait in the month of July.

## *Size*

Eggs to 16 cm juveniles in freshwater, 12 cm smolts to 85 cm adults in the marine environment, rarely over 70 cm.

## *Status*

Designated by COSEWIC as endangered in May 2000. Listed as a Schedule 1 species by GIC in June 2003.

## APPLICATION OF FRAMEWORK

The following respond to the various sections of the evaluation framework[11].

1) Population Trajectory

The population has been in decline since 1990 and has varied from a peak of 40,000 mature fish in the 1970's to less than 200 wild adult salmon in 2003 [1,3,5,8]. Two index rivers, Stewiacke River, Nova Scotia and Big Salmon River, New Brunswick and juvenile population monitoring in 43 rivers of the iBoF show a declining trend and widespread extirpations by 2002[4,5]. Eleven rivers that are used to store Living Gene Bank (LGB) animals have residual and increasing juvenile populations which are dependant on LGB deposits [2,6].

2) Population Status

The number of salmon returning to the Big Salmon River in 2003 was estimated to be 21 fish (mark-recapture estimate; 95% C.I.: 14.6 to 46.6)[6]. Based on the estimate for the Big Salmon River and its historical (1970-1990) proportional production of 20% of the total, the 2003 adult salmon population in the wild was likely less than 200 animals. The combined conservation requirement of the Stewiacke and Big Salmon rivers is about 2,500 mature salmon. Salmon from these rivers represented about 58% of the population in the 1980's. The freshwater environment can still support salmon, as evidenced by the survival of LGB progeny released into these rivers[6]. However, return rates from smolt to adult, an indicator of survival in the marine phase, has declined to less than 1% relative to the 1960's and 1970's[6] when the average was 6% in the Big Salmon River. Post-spawning adult survival has also decreased from 50% to almost zero since the 1970's. Under these conditions, freshwater production in the wild cannot offset the high marine mortality and remnant populations, already at extremely low levels, will continue to decline in the absence of supportive rearing. To illustrate this point, in the Big Salmon River, return rates of two groups of smolts from the 2002 smolt year class as one-sea-winter salmon in 2003 were 0.15% and 0.3%[6]. At these rates, adults would need to produce roughly 300 to 600 smolts per adult per lifetime for the population to be viable. These high rates have never been reported for wild salmon populations. Alternatively, based on freshwater survival of 0.25% egg to smolt marine survival of smolts would have to increase to about 4.8% if the population was entirely based on first recruit spawners or about 1.64% if based on recruits and repeat-spawning salmon.

Survival of the population is currently maintained through a LGB. The LGB program is a pedigree supported spawning and rearing regime designed to minimize the effects of domestication on fish populations. Almost all of the juvenile fish encountered in 16 rivers assessed in 2003 were in rivers where LGB progeny had been released[6]. Captive populations are maintained at three locations. Recruitment to the captive portions of the LGB is attained from collection of juvenile salmon stored as extant populations in eleven rivers. Deposits to the extant populations are made from fish surplus to the captive LGB. These fish are entered into the residual wild population to provide for natural selection and recovery of rare lineages, to provide research opportunities, and to maintain a recovery potential for the stock if major threats are identified and corrected or abate naturally.

3) Recovery Target

The iBoF Recovery Team set a first step recovery target as the population distribution and abundance observed prior to the collapse in 1990.The short term goal is "*to re-establish within ten years (i.e., two generations) wild self-sustaining populations representative of the two principal population groups (i.e. Chignecto and Minas) and of the Gaspereau River that collectively make-up the unique lineage of iBoF salmon"* [8]. This target would see populations at conservation levels for about 22 of the known 32 rivers. Assessment of advancement to the Recovery Target efficacy and feasibility recovery is scheduled for 2010.

4) Recovery Time Frame

With potential juvenile production rates, which are at the mid to high end of juvenile salmon production rates in North America, and at recent observed marine survival rates for both maturing (smolts) and mature (repeat-spawning) salmon, which are among the lowest recorded in North America, there is no time horizon for recovery of iBoF salmon. Maintaining genetic diversity and research into the cause of the collapse are priority actions for this stock.

5) Allowable Incidental Mortality

At present, iBoF salmon populations are not recovering and are not viable without LGB support. If marine survival were to increase to a viable level there would be no human-induced mortality available for wild iBoF salmon in the marine environment that would not jeopardise recovery. At higher spawning escapements, there may be room for allowable mortality within the freshwater environment if density dependent mortality compensates for the loss. Present spawning escapements are low and therefore any loss of smolt production could potentially affect recovery if marine survival were to increase.

6) Potential Sources of Mortality[7] Controlled or Exerted by DFO Permits
(!) indicates a commentary is provided in section 7.

1. There are no directed salmon fisheries in New Brunswick, Nova Scotia, and Newfoundland, areas where catches of iBoF Atlantic salmon have been recorded.

2. There are no directed salmon fisheries in the eastern United States.

3. By-catch in non-salmon gear was prohibited in Canada and in the United States in 1983.

4. By-catches of salmon are known to occur in high head-weirs of the Bay of Fundy.**!**

5. The potential exists for mortality of Atlantic salmon in the by-catch of gill nets set for shad, mackerel and gaspereau. **!**

6. Commercial fishing activities for gaspereau in freshwater could be a source of indirect fishing mortality on juvenile salmon. **!**

7. There are no known commercial fishing activities licensed in the marine habitat area utilized by iBoF salmon that would harm the marine habitat of maturing or mature salmon at sea.

8. Direct mortality of seaward migrating Atlantic salmon, particularly maturing smolts, is known to occur at hydro powered electrical generating stations in the Gaspereau River, Nova Scotia. **!**

9. Water management permits issued under provincial legislation but cleared through DFO as referrals to the Fisheries Act are in place in many iBoF rivers. These activities include water management for power generation, irrigation, flood control, commercial and domestic water supply. The principal listed salmon rivers affected are: Cornwallis, Halfway, Avon, Gaspereau, St. Croix, Chiganois, Great Village, Parrsboro, Shepody, Petitcodiac and tributaries of Petitcodiac River. **!**

10. The by-catch in marine recreational fisheries directed to other species in the Bay of Fundy is unlicensed. There is no known by-catch of salmon in these fisheries.

11. There is the possibility for by-catch of salmon in freshwater recreational fisheries. **!**

12. There is the possibility for mortality on maturing and mature salmon associated with noise created by construction and quarry blasting along the coast of Nova Scotia. **!**

13. At present, there are no licensed seismic activities in the Bay of Fundy.

14. There are licensed seismic activities on the Scotia shelf of Nova Scotia that could incur fin fish mortalities. **!**

15. There are licensed drilling activities on the Scotia shelf of Nova Scotia that could result in fin fish mortalities. **!**

16. There are no known mortalities of salmon associated with marine transportation.

17. There are commercial fisheries for known prey of Atlantic salmon. **!**

18. There are extensive salmon farming activities in the western Bay of Fundy that could increase the mortality of wild salmon. **!**

19. The status of iBoF salmon is known to the Nova Scotia and New Brunswick Introductions and Transfers Committees.

20. There is the possibility for mortality of Atlantic salmon associated with scientific research in the Bay of Fundy. **!**

21. There are no known military activities that could negatively impact Atlantic salmon in the Bay of Fundy.

22. The status of inner Bay of Fundy Atlantic salmon is a known consideration for CEAA applications within the Bay of Fundy.

7) Comments associated with (**!**) potential sources of mortality controlled or exerted by DFO permits from Section 6.

4. High head weirs in the iBoF caught and live released seven salmon in 2003, five were sampled before live release. To date, none have been positively identified by genetic analysis as iBoF salmon.[a]

5. No documented catches are known for the gill net fisheries in the Bay of Fundy. According to Fishery Officer Reports, incidents are rare. Legislation already exists for mandatory release of captured fish.

6. Square net traps in the Gaspereau River require in-stream work. There is a possibility to disrupt a nest (redd) or to crush juvenile salmon. However, in this case it is unlikely that this impact would jeopardise the production of smolts and therefore the recovery of iBoF salmon.

8. The mortality is likely in the order of 1.2% of the migrating population of smolts and if completely eliminated would not place the production rate above replacement at recent marine survival values. Impact relative to marine mortality is therefore low.

9. Since recruit salmon cannot replace spawning salmon in non-impacted rivers and maximum juvenile productivity cannot balance the low marine survival, hydrologic impacts in these rivers are not presently jeopardising or increasing the jeopardy of iBoF salmon.

[a] Dr. Patrick O'Reilly, Diadromous Fish Division, Bedford Institute of Oceanography, PO Box 1006, Dartmouth, Nova Scotia, B2Y 4A2

11. Seasons are regulated to minimise the interaction with downstream and upstream migrating salmon and retention is prohibited under the General Fishing Regulations of Nova Scotia. Catch and therefore mortality is likely minimal and not likely to affect the survival or recovery of iBoF salmon.

12. Mandatory review of applications to alter fish habitat during construction in inter-tidal areas habituated by iBoF salmon can result in alterations to the permit to minimize impacts. Construction times and methods can and have been varied to reduce or eliminate mortality on iBoF salmon.

14. The density of iBoF Atlantic salmon over the Scotian Shelf and the practice of ramping up sound propagation is unlikely to result in mortality.

15. The low incidence of lethal spills and the low density of Atlantic salmon in any impact area suggest a low probability of such an incident jeopardising survival or recovery of iBoF salmon.

17. Small mesh seines are pursed inside a few remaining high head weirs to capture juvenile herring in the Bay of Fundy. Live release of salmon is possible and did occur regularly. Juvenile herring are a known prey of salmon. No data exist that indicate that food availability i.e. starvation, is a significant source of mortality for iBoF salmon at sea.

18. There are many possible biological mechanisms for salmon farming to negatively impact iBoF salmon. However, there is no direct evidence to indicate an impact other than occupation of known marine habitat for wild iBoF Atlantic salmon. Indirect impacts are associated with escaped farmed salmon entering wild salmon rivers and through interference or cross breeding leading to reduced production or fitness of wild salmon; increased incidence of parasites and transmission to adjunct wild salmon at sea; higher incidence and varieties of salmon diseases and increased presence of predators of salmon associated with farm operations. These issues have been reviewed and measures have been taken to reduce their possible effects[10]. Administration of therapeutics such as pesticides, fungicides and anti-biotic treatment is a regulated activity.

20. All scientific research activities that could harm an iBoF Atlantic salmon are licensed and all data contribute to the information base of iBoF Atlantic salmon. To date, none of the salmon mortalities associated with the capture of adult salmon at sea have been definitely identified as iBoF salmon i.e carry the iBoF haplotype. Non-lethal sampling is used wherever possible.

8) Aggregate Mortality

*Freshwater:* Aggregate known losses of juvenile salmon in freshwater from licensed activities are minimal and do not significantly affect the collection of juvenile broodstock for the LGB. Known losses do not significantly affect recovery at current low marine survival. Known losses of juvenile salmon will not significantly alter the possibility of scientific research to uncover the cause of the decline in marine survival.

*Marine*: Aggregate known losses of maturing and mature iBoF salmon in licensed fishing gear are minimal and at current high marine mortality are unlikely to significantly affect the potential for recovery of the salmon. Analysis indicates that this would not be the case if marine survival increased to 1.64%. In that case any loss of mature and cumulative losses of maturing salmon to a point equalling one potential mature return salmon could affect survival or recovery.

9) Qualitative Risk Assessment – Table 1

Table 1. Summary of information associated with permits affecting mortality of iBoF salmon and qualitative assessment of actions directed to reduce or eliminate the activity. Associated with these actions are expected decreases in catchability "q" or mortality "M", collateral effects that would result e.g. closed fishery, likely benefits and costs that may arise. Uncertain numbers are followed by (?).

| **Activity with potential for impact** | **Number licenses units e.g. (nets)** | **Effort (days per season)** | **Relative probability of capture ("q")** | **Probability of live release** | **Possible alternative management actions** | **Probable reduction in "q" or change in "M"** | **Collateral Impact** | **Benefit/Cost** |
|---|---|---|---|---|---|---|---|---|
| High head weirs | Unknown | 60d | Low | High | -Do not licence general non-directed catch weirs,<br>-Reduce to low head | High<br><br>High | Nil<br><br>Nil | Low/-10k/weir<br><br>Low/-8k/weir |
| Gaspereau and herring gill nets | 255 / 25,507 | unknown | Low | Low | -Restrict to fished tight<br>-Restrict to smaller mesh<br>-Delay opening of season in rivers to >14C | Moderate<br>Moderate<br>High | Nil<br>Nil<br>Nil | Low/Low<br>Low/Low<br>Low/Low |
| Gaspereau trap nets | 32 / 164 | 30d/trap | Low | High | None required | | | |
| Power plants | 1 / 1 | 360d | 0.15 | 0.8 | -Increase bypass efficiency<br>-Reduce turbine mortality<br>-Cease operation during kelt and smolt migration | Moderate<br>Moderate<br>High | Nil<br>Nil<br>Moderate + | 100K per %??<br>Not possible<br>20k/d*30d |
| Dams | 11(?) / 11 | 360d | Not applicable | Not applicable | -By-passes<br>-Flow control | Not applicable<br>Not applicable | Moderate<br>Moderate | Low/High<br>Low/Moderate |

| Activity with potential for impact | Number licenses units e.g. (nets) | Effort (days per season) | Relative probability of capture ("q") | Probability of live release | Possible alternative management actions | Probable reduction in "q" or change in "M" | Collateral Impact | Benefit/Cost |
|---|---|---|---|---|---|---|---|---|
| Recreational fisheries | Unknown | 180d | Low | High | Further restrict angling in rivers during the presence of migrating smolts and returning adults | Low | Nil | Low/High estimate 30$$/rod day lost??? |
| Scotia Shelf Seismic | 1-6 surveys annually | Unknown | Low | Low | -Ramp up sound generation (Already done in some areas)<br>-No activity during thermal preference temperature (4-10C) | Nil<br>Nil | Nil<br>Nil | Low/Low<br>Low/High |
| Lethal spills Scotian Shelf drilling | Unknown | N/A | Low | Unknown | Do not permit drilling | Nil | Nil | Low/High |
| Herring fisheries (Juveniles) | Unknown | Unknown | Low | High | Do not permit high head weirs | Low | Low + | Low/High |
| Salmon farming | Unknown | 360d | Nil | Not Applicable | -Close farms<br>-Move to land based<br>-Enforce no escapement rules<br>-Enforce therapeutics laws | Unknown<br>Unknown<br>Unknown<br>Unknown | Unknown<br>Unknown<br>Moderate +<br>Moderate + | Unknown/High<br>Unknown/High<br>Moderate/Moderate<br>Moderate/Unknown |
| Scientific research | 3 - 5 projects | 30d per device | Unknown to 0.10 | High (0..997 BSR) To Low for at-sea trawling | Do not issue permits that have a high probability of catch and low probability of live releae. | High | High (No research) | Not applicable |

10) Inventory of Management Measures

Added to column “Alternatives” above in 9.

11) No alternatives were identified that have a high probability of decreasing human induced mortality and a low cost. Furthermore, no alternatives were identified that are known to have the potential to double the marine survival of iBoF salmon and thereby give rise to a positive recovery trajectory. This is because the cause of the decline in marine survival is unknown.

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