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Proceedings of the Regional Peer Review for the Assessment of Atlantic Salmon in Newfoundland and Labrador

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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

A Regional Peer Review Process on the status of Atlantic Salmon in Newfoundland and Labrador (NL) was held during March 5-7, 2019 in St. John's, NL. Its purpose was to provide the most recent scientific information concerning the status of Atlantic Salmon stocks for Salmon Fishing Areas (SFAs) 1-2 and 14B in Labrador and SFAs 3-14A in Newfoundland.

A Science Advisory Report (SAR) was drafted at the meeting that contains the conclusions of the science review. Research Documents will also be produced. This proceedings report includes abstracts, discussion summaries and research recommendations. The terms of reference, agenda and list of attendees for the meeting are appended. All publications produced from the meeting (SAR, Research Documents, Proceedings) will be available on the DFO Canadian Science Advisory Secretariat Website.

INTRODUCTION

The last full stock assessment of Atlantic Salmon for the NL Region took place from February 28 to March 1, 2018 (Fisheries and Oceans Canada [DFO] 2018). Based on the conclusions of the 2018 assessment, Resource Management requested that DFO Science conduct an in-season review of the status of Atlantic Salmon in the NL Region which took place during July, 2018 (DFO 2019). A preliminary data review was also completed during February, 2019 to inform a potential interim salmon management approach for the 2019 recreational fishery. The objective of the current Regional Peer Review Process, as outlined in the Terms of Reference (Appendix 1) is the assessment of Atlantic Salmon in NL (Salmon Fishing Areas 1–14B). Fisheries Management will use information from this Regional Peer Review Process to inform the 2019 salmon management plan.

PRESENTATIONS

OVERVIEW OF THE PHYSICAL OCEANOGRAPHIC CONDITIONS ON THE NL SHELF

Presenter: Frédéric Cyr, DFO Science

Abstract

Physical environmental conditions for 2018 (large-scale atmospheric forcing and hydrographic response) are presented. Although the North Atlantic Oscillation (NAO) index was high, annual average air temperature was normal for five sites around the Labrador Sea. This however masks a warmer than normal winter (especially March) and a colder than average spring (May and July) caused by abnormal patterns in sea-level pressure fields in the northern hemisphere. Driven by these air temperatures, sea ice volume near Newfoundland was below normal from early March to mid-April, and close to normal for the rest of the season. Annual sea surface temperatures (SST) were colder than normal in offshore regions around Newfoundland and Labrador, a pattern observed since 2015. In Comfort Cove (the only inshore region with available data at the time of the assessment), water temperature at 10 m depth was above normal in summer, likely resulting from warm air temperatures. At Station 27, integrated temperature over the water column (0-176 m) was normal in 2018, but the salinity exhibited its largest negative (fresh) anomaly since the beginning of the time series in 1948.

Discussion

Clarification was requested regarding the reported differences in regional and average SST estimates for the NL Region. It was explained that while some regions were warm (NE coast, southern Newfoundland), average SST over all regions was colder than normal in 2018. This was due to colder than normal water temperatures in offshore regions. In response to a request for predictions for 2019, the presenter stated that above average NAO in 2018 could result in below average spring SST.

OVERVIEW OF THE PHYSICAL CHEMICAL AND BIOLOGICAL OCEANOGRAPHIC CONDITIONS ON THE NL SHELF

Presenter: David Belanger, DFO Science

Abstract

In 2018, the biomass of chlorophyll a in the first 100 m of the water column was back to above normal levels across the NL region for the first time in 10 years. Positive chlorophyll a anomalies were associated with an increase in recent years of nitrate concentration in the deeper layers (50-150 m) of the ocean. However, low concentrations of deep nitrate observed across the shelf in 2018 may negatively affect chlorophyll biomass in the water column in 2019. Spring bloom indices derived from satellite data indicate that surface phytoplankton production was below the 1998-2015 climatology, with blooms occurring slightly later than normal. Zooplankton biomass was at historical low levels in 2018 for a fourth consecutive year, whereas abundance anomalies were among the highest in 20 years. Changes in the size-structure of the zooplankton community are driven by an overall decrease in the abundance of large, energy-rich copepods (*Calanus finmarchicus*) concurrent with an important increase in the abundance of small copepod taxa (*Pseudocalanus* spp. and *Oithona* spp.) in the fall.

Discussion

A participant asked what is known about the potential mechanisms driving the recent shift in the size-structure of the zooplankton community on the NL Shelf. The presenter explained that while the mechanisms are not fully understood, the trend is likely driven by bottom-up (i.e., environmental drivers) rather than top-down processes (i.e., competition, predation).

UPDATE ON ADVANCES IN THE GENETIC ANALYSIS OF MIXED STOCK SALMON FISHERIES IN THE NORTH ATLANTIC

Presenter: Ian Bradbury, DFO Science

Abstract

Stock composition of Atlantic Salmon harvested in three fisheries in the northwest Atlantic was examined using genetic mixture analysis and individual assignment with a single nucleotide polymorphism baseline (96 loci, 9,369 individuals, 31 groups), encompassing the species native range. One hundred and ninety-three individuals collected from the St. Pierre et Miquelon fishery (2017, 2018) were analyzed and estimates of stock composition showed consistent dominance of three regions: Gulf of St. Lawrence, Gaspe Peninsula, and Newfoundland, with Newfoundland contributions representing the largest component at 61%. One European individual from the British reporting group was detected in this fishery in 2018. In the West Greenland harvest (2017-18, n=1985), North American contributions were largely from Labrador, the Gulf of St. Lawrence, and the Gaspe Peninsula. European contributions (~20% of total) were almost entirely from the British reporting group. Finally, in the coastal Labrador fishery (2017-18, n=994) mixture estimates suggest the harvest is dominated by the three Labrador reporting groups, together accounting for >98% of the harvest. In all three fisheries, estimates of stock composition appear stable over the two years. Investigation of stock composition in all three fisheries will continue in 2019.

Discussion

There was a discussion around the finding of fewer large fish in the most recent samples from the St. Pierre-Miquelon (SP-M) fishery. A participant asked if this could be related to possible sampling bias. Specifically, it was asked if samples are representative of actual size composition of fish in the fishery, or what is sent to DFO (i.e., non-random sampling). It was suggested that if available, previous information on the size composition of salmon in the SP-M harvest reports could help address this question.

A participant asked whether the time series of scale samples from the Faroese fishery extended back to the 1960s, as this information would be of interest to assess changes over time in the origin of fish taken in this fishery. The same participant provided details of a tagging study of Greenland salmon that has recently collected pop-up information on locations from Northern NL, Labrador Sea and NE Atlantic, and inquired if the presenter could provide the genetic results of the tagged fish in the near future. The presenter responded that assignments of pop-up satellite archival tagged (PSAT) fish tagged in the Greenland study would be provided as they are needed. Another participant asked if the result showing 20% of the Greenland fishery samples being of Labrador origin could be further broken down by region. The presenter indicated that the samples showing Labrador origin consisted of three groups, with the largest group from southern Labrador and two smaller groups from Lake Melville and northern Labrador.

UPDATE ON GENETIC INTERACTIONS AMONG WILD AND FARM ESCAPED ATLANTIC SALMON IN SOUTHERN NEWFOUNDLAND

Presenter: Ian Bradbury, DFO Science

Abstract

Monitoring of escaped farmed salmon and hybridization between wild and farmed salmon continued in 2018. Examination of the relative survival of wild, hybrid, and feral juveniles in the wild suggests decreased survival of aquaculture salmon offspring. In addition, simulation modeling suggests possible impacts on the character and size of wild populations experiencing hybridization. Escapees were detected both at the Garnish River counting fence (n=5) and as part of a directed escapee survey following an escape event in late July 2018 (n=400). Regular monitoring for aquaculture escapees was conducted during the fall of 2018 using angling and tended gill nets in Fortune Bay and Bay d'Espoir with no detections of any escapees. Ongoing work will continue to monitor for levels of hybridization and developing baseline genetic data for Placentia Bay salmon populations.

Discussion

A participant asked whether the new snip process requires less genetic material, and if so, would it be possible to conduct non-lethal sampling of small fish. The presenter indicated that they are moving toward non-lethal sampling. Another participant requested information regarding the international modelling group meetings mentioned in the presentation, in particular how these groups are organized and whether any information/publications emerging from these meetings will be made available. The presenter responded that the modelling workshops are organized around an independent working group, that is supported by DFO, and that any publications coming out of the working groups can be made available upon request.

MODEL ESTIMATES OF CATCH AND RELEASE MORTALITY AT VARYING WATER TEMPERATURES

Presenter: Travis Van Leeuwen, DFO Science

Abstract

Catch and release angling has been widely accepted as a conservation tool among managers because of perceived minimal associated mortality. However, catch and release mortality is influenced by angler practices (e.g., air exposure, handling, hook type, bait type), experience and water temperature. As Atlantic Salmon are commonly caught by anglers during the warmest months of the year (July and August), angled fish can be exposed to physiologically stressful and potentially lethal water conditions. Therefore, the use of catch and release and the threshold temperature for river closure (e.g., temperatures are ≥18°C on two consecutive days in NL) remains controversial. A model was derived from a data synthesis of catch and release studies from North America and Europe to:

1. Predict the probability of mortality at a given water temperature for caught and released Atlantic Salmon; and
2. Combine catch and release estimates from NL angler survey data with river temperature data to provide estimates of total mortality of caught and released Atlantic Salmon.

Modelling results show that the probability of mortality increases significantly with water temperature and that the current catch and release mortality estimates used by DFO NL (10%) represent low to average predicted estimates.

Discussion

The discussion revolved around a number of key points:

1. The validity of the modelling approach, which involved a compilation of catch and release studies across North America and Europe (i.e., meta-analysis) and interpretation of the results; and
2. Whether the results showing predicted percent mortality at a given temperature are representative of catch and release mortality in the NL recreational salmon fishery and whether they should be used to inform management decisions on environmental closures in the NL recreational salmon fishery.

There was discussion around the inclusion of specific studies with low sample sizes; in particular it was highlighted that data points above 18°C had relatively small sample sizes (range: 10-23 fish). This was considered by some participants to be inadequate for robust quantitative outcomes. It was clarified by the presenter (and a co-author) that reported sample sizes do not necessarily represent the total number fish in a given study, but rather the number of fish angled at a given water temperature. The presenter emphasized the difficulty (perhaps impossibility) of obtaining large sample sizes across a range of temperatures and expressed the opinion that any further studies would likely generate mortality estimates that fall within the lower 95% confidence interval (CI) of the model results. The presenter also argued that the ‘ideal model’ would control for multiple explanatory factors (life-history, gear type, etc.) but in reality there is insufficient data to take this approach. By way of clarification, another participant (and a co-author) explained that the model accounts for sample size by giving more weight to data points with larger sample sizes. Accordingly, the recommendation was made to illustrate this in the model outcome figure by scaling the data points to sample size and removing the average regression line from the model. The interpretation of the model variance

(i.e., confidence intervals) as being representative of the probability of mortality at a given temperature using proper (i.e., lower CI) and improper (i.e., higher CI) fish handling practices was debated. An alternative interpretation was that the uncertainty around the predicted mortality estimates was the result of combining multiple experiments, each with their own level of variation. The presenter explained that his interpretation was intended to provide a non-statistical explanation for public consumption but acknowledged the inherent variability in the meta-analysis approach, and pointed out that this is addressed in working paper.

Given the issues raised during the discussion, a number of participants expressed the need for cautious interpretation of the model results and suggested additional review if the results were intended to inform fisheries management measures for the NL recreational salmon fishery. Specifically, the question was asked whether the results of the model would be used to provide advice on enforcement of environmental protocols for the NL recreational fishery in 2019. In response, some participants argued that the data used in the model were inadequate to provide robust scientific advice, and suggested that an ongoing study by the provincial government (with an expected sample size of >300 fish and high-resolution temperature data) would provide more tangible results. It was explained by the presenter that it will be equally challenging for fisheries managers to make management decisions based on one study on one river in NL that will also have to account for the effects of multiple variables (e.g., air exposure, fight duration).

The issue of downstream mortality events associated with catch and release angling was also raised as a point of discussion. Some participants suggested that this should be investigated in future studies as it can influence mortality estimates. A participant provided a specific example demonstrating down-stream effects on angled fish. During a tagging study, fish handled with cotton gloves that were recaptured months later (by anglers) were found to have ulcers and to be in very poor condition. There was a general consensus that the potential downstream effects of handling fish with cotton gloves should be studied by DFO. In addition, it was recommended that future research should explore the effects of handling techniques on catch and release mortality.

A participant made the comment that the public perception (including some NL angling groups) is that fish are less catchable at higher temperatures. The presenter debated that there is little scientific evidence to support this (i.e., two existing studies with opposing results) and furthermore, that the lack of scientific evidence reflects the difficulty of quantifying this question (e.g., requiring sample sizes of up 500 fish per water temperature strata). Despite this, the importance of quantifying changes in exploitation rate with water temperature was emphasized by a number of participants, since any future advice to fisheries management regarding probable changes in catch and release mortality with temperature would need to consider this potential bias.

RIVER TEMPERATURE AND CLOSURE TRENDS ACROSS NEWFOUNDLAND AND LABRADOR

Presenter: Travis Van Leeuwen, DFO Science

Abstract

Average global air temperature has increased dramatically in recent decades and since air temperature is correlated with river temperature, changes in river temperatures are also occurring. Poikilotherms, like Atlantic Salmon (*Salmo salar L.*), are vulnerable to temperature fluctuations and are commonly caught by anglers during the warmest months of the year (July and August) resulting in angled fish being exposed to physiologically stressful and potentially lethal water conditions. Threshold temperature for river closures (e.g., when river temperatures

are ≥18°C on two consecutive days in NL and ≥20°C on two consecutive days in New Brunswick) to catch and release angling remains controversial. An update and comparison of regional and temporal trends for river temperatures and environmental closures in the NL fishery was conducted. Average monthly river temperatures were highest in July and August, with Newfoundland rivers showing a significant increase in water temperature over time and an increase in percent of days closed to angling in more recent years. Monitored rivers on the East Coast (Salmon Fishing Area [SFA] 5) and Southeast Coast (SFA 9) of Newfoundland showed the greatest increase in river temperatures in both July and August after 2010, whereas rivers on the South Coast (SFA 11), West Coast (SFA 13) and North Coast (SFA 14A) showed either no significant trend (SFA 11) or a significant cooling trend (SFA 13 and 14A). Monitored rivers in Labrador showed a significant cooling trend with half of the rivers significantly cooler (SFA 2) in July and all rivers significantly cooler in August (SFA 1 and 2). Together, the results of the study indicate that increasing temperatures will increase the frequency of river closures and likely result in higher mortality in caught and released Atlantic salmon in rivers that remain open to catch and release angling at warm water temperatures.

Discussion

Fisheries management relies on environmental data collected by their own staff (using hand-held thermometers) to inform their decisions around environmental closures in the recreational fishery. This was considered by a number of participants to be inadequate, particularly given the high diurnal fluctuations in water temperatures reported in the presentation (that is based on archived thermograph data on monitored rivers). The protocol used to inform environmental closures in the New Brunswick recreational fishery, that uses real-time temperature data on index rivers with environmental stations, was put forward as an potential model for the NL fishery. There was a consensus that the option of using real-time water temperature data from water stations around the province (operated and posted online by the provincial Department of Municipal Affairs and Environment) could be explored to inform management decisions on environmental closures in the NL fishery.

TRACKING THE MARINE MIGRATIONS OF ATLANTIC SALMON

Presenters: David Meerberg, ASF (Part 1), Nicholas Kelly, DFO Science (Part 2)

Abstract (Part 1)

Atlantic Salmon populations have precipitously declined since the 1980s, and poor marine survival is thought to be the primary driver. Complex broad-scale climatic oceanographic changes are likely influencing salmon distribution, but the causal mechanisms are poorly understood. To understand and identify reasons for mortality, we need an in-depth investigation of Atlantic Salmon from the time they enter the sea as smolts to their return to freshwater as mature adults. Telemetry is a tool that can be used to address these knowledge gaps. Since 2003 we have tracked more than 4,000 smolts (acoustic) and 580 kelts (acoustic and satellite) from several Gulf of St. Lawrence rivers through estuaries, bays, the gulf and into Labrador Sea. In 2018, we tagged 14 pre-adults in coastal waters at west Greenland (2 acoustic and 12 satellite) to begin mapping their routes back towards home rivers. Our goal is to gain insight into each phase of the salmon's life at sea to map their spatial and temporal distribution and determine annual variation. Also, we aim to address knowledge gaps on mortality and predation rates, and migration dynamic linkages with oceanographic conditions. This is the largest telemetry program for Atlantic Salmon on an international scale and it involves many partnerships both in North America and Europe.

Discussion (Part 1)

There was a general discussion regarding the types and capability of tags used in tracking studies of Atlantic Salmon. It was also pointed out that staff at NL monitoring facilities should be made aware that if salmon with a satellite tag are encountered, the tag should be removed and returned to DFO since they can be re-used and may contain additional data.

Abstract (Part 2)

A collaborative Atlantic Salmon telemetry project was initiated in Lake Melville, Labrador, in 2017. The partners on this project included DFO, Nunatsiavut Government, the Atlantic Salmon Federation and the Atlantic Salmon Conservation Foundation. Sixty adult Atlantic Salmon were captured and tagged entering Lake Melville near the town of Rigolet, Labrador in 2017. Salmon were tagged with both radio (LOTEK MCFT2-3LM) and acoustic (VEMCO V13) tags to monitor their movement, habitat use and survival throughout the spawning and overwintering seasons. Salmon were tagged between July 19-27 and August 6-10. A total of 55 small salmon (<63 cm FL) and five large salmon (≥63 cm FL) were tagged (Mean Fork Length = 57 cm, Mean Whole Weight = 2.15 kg). Salmon movements were tracked using 33 acoustic receivers placed throughout Lake Melville and eight radio stations placed on various rivers (Mulligan River, Sebaskatchu River, Naskapi River, Susan River, Goose River, Kenamu River, Kenemich River, and Traverspine River). A radio receiver was also used to determine the location of tagged salmon during the spawning season (October/November). Of the 60 tagged salmon, four were recaptured in the subsistence fisheries and 44 (44 of 56 = 79%) were tracked to rivers in Lake Melville (Kenamu River - 32, Traverspine River - seven, Cape Caribou River - two, Naskapi River - two, Kenemich River - two). Twenty-five (55%) of the 44 tagged fish in Lake Melville rivers left the river in the spring/summer of 2018 (i.e., 55% overwinter survival rate). Three kelt were detected on the Port Hope Simpson receiver line in the summer of 2018. One of these fish was detected leaving Lake Melville shortly after tagging. This fish likely spawned in a river outside the Lake Melville area. The final data for these tagged fish will be downloaded in the summer of 2019. The project will continue in 2019 and data downloaded at that time will provide the final data from these fish tagged in 2017.

Discussion (Part 2)

It was noted that preliminary tracking data from the Lake Melville salmon tagging study showed a high proportion of tagged fish moving into Kenamu River, and that this aligns with the local perception that Kenamu River is an important salmon river. A comment was made that it would be of interest to know the genetic origin of tracked salmon that did not go into Lake Melville. In response to a question regarding the availability of results from a tagging study on the Hunt and Lewis rivers (2016, 2017), a participant involved in that study commented that the results are expected to be available next year.

ASSESSMENT OF ATLANTIC SALMON STOCKS IN MIDDLE BARACHOIS BROOK AND ROBINSONS RIVER, 2018

Presenter: Rex Porter, DFO Science (Retired)

Abstract

The Atlantic Salmon (*Salmo salar*) stocks in Middle Barachois Brook and Robinsons River were assessed from visual counts by snorkelers, August 13-17, 2018. A raising factor, ranging from 1.0 to 1.2, was applied to the counts of salmon in each River Section to account for fish not counted (observer efficiency). The adjusted count for each river is an estimate of the total

number of salmon spawners. Egg depositions were calculated using mean weights, percent females and fecundity for small (<63 cm) and large (≥63 cm) salmon that differed from previous assessments. These revised biological characteristics were also applied to previous estimates of spawning escapements (1996-2008) to obtain revised estimates of egg deposition. The estimated numbers of spawners in Middle Barachois Brook in 2018 are 362 small salmon and 94 large salmon. Of these, 86% were located in seven pools. The total spawners (456) is the lowest number recorded in the 11 years that assessments were conducted (1996-2008), 15% lower than in 2008, and 44% below average. The estimated egg deposition for Middle Barachois Brook was 39% of the lower Limit Reference Point (LRP) in 2018, the same as estimated for 2008, indicating a serious conservation issue. The estimated numbers of spawners for Robinsons River are 1,099 small salmon and 201 large salmon. Of these, 96% were found in 18 pools. The total number (1,300) of spawners is 37% lower than estimated in 2008, and 11% below the average (1996-2008). The egg deposition in 2018 is 70% LRP, and is 24% below the estimated % LPR in 2008. Applying the revised biological characteristics resulted in a 2-11% increase in the estimated egg deposition and % LRP for Middle Barachois Brook (1996-2008); but on Robinsons River the revised estimates of egg deposition resulted in 18-43% decrease in egg deposition and % LRP. The magnitude of these changes in % LRP highlights the importance of using river-specific biological characteristics.

Discussion

There was a discussion around whether the interpretation of a declining trend in total spawners on Middle Barachois Brook was valid given the large gap between survey years (last surveyed in 2008). The presenter agreed that additional years are needed to assess trends and that there are plans to conduct addition snorkel surveys in 2019. The presenter highlighted the finding of large differences in egg deposition and % LRP on Robinsons River (18-43%) using revised biological characteristics data and emphasized the importance of applying river-specific biological characteristics.

ATLANTIC SALMON MONITORING, GROS MORNE NATIONAL PARK

Presenter: Shawn Gerrow, Parks Canada

Abstract

In Gros Morne National Park, Atlantic Salmon populations are monitored as part of a larger park-wide monitoring program, whereby salmon population data are used with other aquatic measures to assess the status and trend of the ecological integrity of aquatic ecosystems. Three populations of salmon are monitored in Gros Morne using counting fences: Western Brook, Deer Arm Brook and Trout River. Over a five-year period, counting fences are established at least once on each of the three rivers. The salmon population in Western Brook was last assessed in 2016, at which time it exceeded the conservation requirement (366 small salmon), with 654 small and 139 large salmon being counted. Deer Arm Brook was assessed in 2018 and exceeded the conservation requirement (179 small salmon), with 228 small and 62 large salmon being counted. The Deer Arm counting fence washed out on August 15 and was not re-installed since only three salmon were counted in the five days prior to the washout. In addition, data from previous years indicate that 92% to 98% of salmon enter the river by August 15. Trout River was last assessed in 2017, at which time it did not meet its conservation requirement (252 small salmon) as only 13 salmon were counted. Given the low returns of adult salmon to Trout River since 2001, Gros Morne National Park will be undertaking a salmon restoration initiative for the river with the goal of enhancing the salmon population to a point where it is no longer in danger of being extirpated. To achieve this, methods used in Fundy

National Park are being considered whereby smolt captured from the river are raised in salt water and then released back into the river as adults. Planning and preparation will start this year with the goal of smolt being captured in the spring of 2020.

Discussion

A participant commented that during a prioritization process for Lomond River (by the World Wildlife Fund), locals expressed concern that the collapsed fishway could be obstructing salmon migration. The presenter's opinion was that this does not pose an obstruction, however there is some concern that salmon pooling downstream of fishway during low water may be vulnerable to poaching.

There was discussion about the methods for salmon restoration on Trout River. In response to a question about the use of Scotty Boxes, the presenter explained that since salmon numbers are so low (13 fish in 2018), the risks associated with holding fish are too high. Consequently, the "Fundy Model", which involves captive rearing of wild smolt and adult release is being considered with plans to implement this in 2020. There was clarification that the collected smolt would not be reared in sea cages but rather at the nearby Bonne Bay Marine Station lab. Another participant asked whether the proposed restoration project for Trout River would also involve habitat enhancement. It was clarified that the current objectives do not involve plans for significant habitat enhancement since there appears to be limited habitat degradation; rather the focus will be to enhance the adult salmon population. There was a final question about the known availability of salmon spawning habitat in Trout River. The presenter stated that no assessments had been done, but that in the near future Parks may be seeking advice from some of the participants at the meeting that have the relevant expertise.

There was a discussion around the potential evolutionary significance of the Trout River salmon population given the unique geology of the region and whether there are plans to collect genetic samples. Ian Bradbury (DFO) indicated that if genetic samples (a minimum of 50 fin clips from smolts) were collected they could be run in his lab under an existing project.

ATLANTIC SALMON MONITORING, TERRA NOVA NATIONAL PARK

Presenter: Kirby Tulk, Parks Canada

Abstract

The lower 1.9 km of the Northwest (NW) River was gazetted into Terra Nova National Park in 1989. At that time the recreational fishery was regulated by Parks Canada under the *National Park's Act*. In 1996, the recreational salmon fishery was closed as salmon returns were well below the predicted conservation target. Subsequently, a salmon fence was installed to monitor salmon returns. In 2002, Parks Canada and DFO, working with local residents and stakeholders, helped establish the NW River Working Group to promote stewardship and assist with salmon restoration and conservation. In 2003, the recreational salmon fishery re-opened at NW River. In the beginning, a three-year interim conservation target of 500 salmon (escape to spawn) and a long-term target of 700 salmon (escape to spawn) were established. If these targets were met then a recreational retention salmon fishery could occur. Threshold-based conservation was discontinued in 2012 with the removal of the counting fence. Conservation measures applied from 2012-16 included a maximum retention limit/quota of 150 salmon per year. In 2017 and 2018, the salmon counting fence was re-established to assess salmon returns. As a result, long-term management targets were implemented which included no retention fishery until salmon return models indicated a minimum return of 770 salmon. Both in 2017 and 2018 modelling indicated returns greater than 700 salmon which resulted in a

retention fishery. Actual returns in 2017 was 1,418 salmon with a partial count in 2018 due to a significant rain event resulting in long-term breaches of the fence. Nevertheless, the incomplete fence still managed to capture 740 salmon in 2018. The Newfoundland East Field Unit is planning to re-establish the salmon counting fence on NW River in 2019.

Discussion

The presenter noted that Parks Canada monitors several large brooks and rivers in Terra Nova Park for temperature (via thermographs) and river flow, and that these data can be made available to DFO. A participant asked if there was catch and release angling on NW River, as this could be used in combination with the thermograph data to investigate the relationship between temperature and catch and release mortality. It was stated that there is no catch and release angling since it is not supported by Indigenous partners and the likelihood of very high catch rates given some features of the river.

A participant commented that a lot of small salmon were reported moving through the fence in 2018 and raised the possibility of these being post-smolts. A participant from DFO Science indicated that scale samples collected from NW River (from angled fish) over the past two years indicate a high proportion of post-smolts (30-40% in 2017-18) with fork lengths between 30-35 cm. It was noted that estimates of spawning escapement could be inflated if post-smolts in the fence counts are incorrectly classified as grilse. The presenter explained that the NW River Working Group have also raised this issue and suggested the possibly of leaving the fence in longer to determine if post-smolt are entering the river later in the season. Another participant commented that this would be of little value since very few salmon come into rivers in late August, and furthermore if the late runs include post-smolts they should not be included in the assessment since there is no information on fecundity of post-smolts. There was a discussion around the fluctuating trends over time in the count data. A participant suggested that this may be correlated to river closures whereby recovery follows years of closures. Another participant suggested that the reasons driving these trends were related to community engagement in the early-2000s that significantly reduced poaching and reversed the previous declining trend observed from 1995-2000.

ASSESSMENT OF ATLANTIC SALMON ON MONITORED RIVERS IN NEWFOUNDLAND AND LABRADOR

Presenter: Nicholas Kelly, DFO Science

Abstract

There are 15 Atlantic Salmon (*Salmo salar*) management areas, known as SFAs 1-14B, in NL. Twenty-two populations of Atlantic Salmon were monitored in 2018, 20 using counting fences and fishways and two by snorkel surveys. Of the 22 rivers monitored, 21 were included in the stock assessment: four in Labrador and 17 in Newfoundland. Northwest River-Port Blandford was not assessed in 2018 since the count was incomplete due to a washout. Four of the 21 assessed rivers in Newfoundland also counted juvenile salmon (smolt) migrating to sea. In 2018, five assessed rivers showed declines in total returns, and three of these had declines of greater than 30% compared to their previous generation mean (2012-17 and 2013-17 for Labrador and Newfoundland, respectively). Seven rivers had declines in total returns compared to the generation mean prior to 2016 (2010-15 for Labrador and 2011-15 for Newfoundland), four of which were greater than 30%. Data were unavailable during the previous generation and the generation prior to 2016 for six rivers (Table 3). Of the 15 assessed rivers for which there is information on returns over the previous three generations (2000-17 and 2003-17 for Labrador and Newfoundland, respectively), total returns in 2018 were lower on one of four rivers in

Labrador and on five of eleven rivers in Newfoundland. Of these, four Newfoundland rivers had declines greater than 30% (Table 3). Estimated spawning escapements (eggs) were below the river-specific LRP (critical zone) on two of the four assessed rivers in Labrador. Estimated spawning escapement exceeded the river-specific Upper Stock Reference Point (USR) (healthy zone) on English River and fell between the LRP and USR (cautious zone) on Muddy Bay Brook. In Newfoundland, estimated spawning escapements (eggs) were below the LRP (critical zone) for eight of the 17 assessed rivers in 2018. Of the remaining nine Newfoundland rivers, seven rivers exceeded the USR (healthy zone) and two fell between the LRP and USR (cautious zone).

Discussion

A participant raised the issue that the perception among some angling groups is that counts on some of DFO's monitoring rivers are unreliable. As an example, the 2018 counts of adult salmon on the Exploits River were inaccurate, with a higher number of fish counted at the Grand Falls fishway than the Bishops Falls fishway. This was known to be the result of fallback at the Grand Falls section of the hydro dam that resulted in some fish being counted twice. The presenter commented that, moving forward, DFO will be speaking with operational staff at the dam to facilitate movement of adults, as well as possibly conducting a tagging study in collaboration with Nalcor.

There was a discussion around the need to revisit estimates of habitat area utilization in some monitoring rivers (i.e., physical versus biological habitat availability). On specific rivers, it is known that the percent available habitat being colonized by salmon is overestimated, which results in lower estimates of percent conservation achieved. It was suggested that if management is expected to act directly based on conservation limit estimates, refinements should be made. The Exploits River was identified as an example of a river that has been in the critical zone (<100% CI) but that includes large areas of un-colonized habitat (Red Indian Lake) in its conservation achieved estimates. Therefore, a recommendation was made to conduct studies to investigate colonization of habitat by salmon within some of DFO's monitored rivers where the area utilized by salmon is thought to be over-estimated (e.g., Exploits River, NW River- Port Blandford, Terra Nova River, Rocky River, Rattling Brook, Torrent River and Western Arm Brook).

A participant raised concerns over the need to revisit the scientific process used to define the upper stock reference point (150%), and noted that the current reference point was introduced as interim management tool in 2018 (during the Regional Advisory Process assessing the status of 2017 Atlantic Salmon stocks). Accordingly, a recommendation was made to scientifically evaluate the USR at the next science assessment meeting.

A possible discrepancy between the number of licences sold by the province and the number of stubs received by DFO was raised as a potential problem with our angling data (i.e., catch rate estimates). For example, in 2017 ~21,000 stubs were received by DFO versus ~27,000 licences reported sold by the province. Moving forward, it was recommended that the most accurate estimate of the number of licences sold should be used in angling data. It was suggested by a participant that vendor apathy is a major issue, since there is no incentive for vendors to return completed stubs. To address this issue, the province is initiating a new incentive for the 2019 season, whereby no new licences will be issued to vendors until all stubs are returned.

AN INVESTIGATION INTO POTENTIAL VARIABLES DRIVING MARINE MORTALITY OF ATLANTIC SALMON POST-SMOLTS FROM TWO NEWFOUNDLAND RIVERS (WESTERN ARM BROOK AND CAMPBELLTON RIVER)

Presenter: Nicholas Kelly, DFO Science

Abstract

Survival of post-smolts in the marine environment is critical to producing healthy returns of adults to Newfoundland and Labrador rivers each year, however, the direct mechanisms that influence marine survival of salmon are poorly understood. Several factors have been proposed as drivers in marine survival trends for North American and European salmon populations, including the size or condition of smolt as they first enter the ocean, the thermal environment experienced during the first months at sea (critical growth period) or the winter prior to the return migration, and prey abundance and phenology (zooplankton biomass, timing and magnitude of plankton blooms) and predation. We investigated how marine survival trends on two rivers in Newfoundland (Western Arm Brook [SFA 14A] and Campbellton River [SFA 4]) were influenced by smolt size/condition, average monthly and seasonal sea surface temperature (SST), zooplankton biomass and phytoplankton bloom phenology and magnitude. Correlation analyses were used to determine candidate covariates that had an effect on marine survival for each population. The effect of each candidate covariate on marine survival was modelled using Beta Binomial Regression. There were significant positive relationships between marine survival and average Summer SST in the Labrador Sea and Winter SST on the Northeast Newfoundland Shelf for both populations. Western Arm Brook marine survival was significantly affected by zooplankton abundance in NAFO Area 2J, while Campbellton River marine survival was significantly affected by zooplankton abundance in NAFO Area 3K. There was little evidence that marine survival of these two populations was affected by the timing and magnitude of plankton blooms or the average size of smolts sampled at the counting fences annually on their migration to sea. Overall, relationships that were significant were mostly weak, explained only 20-45% of the deviance resulting in poor predictive ability.

Discussion

There was a consensus on the importance of continuing to study the factors that may be influencing the marine survival of Atlantic Salmon. Some suggestions to move forward included:

1. The addition of commercial fishing mortality (pre-moratorium) as a covariate in the survival model;
2. Future collaboration within DFO Science to explore possible links between marine survival of salmon and recent changes in the NL Shelf ecosystem, including changes in capelin biomass and biology. A participant made the observation that the overlap in the timing of the commercial salmon fishery moratorium and the dramatic crash in capelin biomass (early-1990s) suggests a reduction in food availability as a possible mechanism driving poor marine survival of salmon; and
3. Influence of water temperature on mortality of Atlantic salmon after catch and release angling

WORKING PAPERS

It was agreed that the following two working papers will be published in the CSAS Research Document series:

1. Modelling the influence of water temperature on mortality of Atlantic Salmon (*Salmo salar* L.) after catch and release angling
2. Status of Atlantic Salmon Populations in Middle Barachois Brook and Robinsons River, Newfoundland in 2018

RESEARCH RECOMMENDATIONS

- Explore the effects of handling techniques on catch and release mortality.
- Evaluate the application of using real-time water temperature data (as collected by the Province) on rivers for management decisions around environmental closures.
- Apply updated biological characteristics data (Veinott and Cochrane 2011) to conservation status estimates in Bay St. George rivers, except where appropriate river-specific data are available.
- Biological characteristics data should be collected on assessed rivers where this information is not presently available.
- Collaboration between DFO (I. Bradbury) and Parks Canada to collect genetic samples of salmon in Trout River given the unique physical features of the region and the possibility of a genetically distinct population. 50+ samples requested.
- Conduct a tagging study to reconcile observations around fall back of salmon at Grand Falls. This may help address some of the local perceptions of inaccurate counts on the Exploits river in 2018.
- Conduct studies to investigate colonization of habitat by salmon within some of DFO's monitored rivers (e.g., Exploits River, NW River – Port Blandford, Terra Nova River, Rocky River, Rattling Brook, Torrent River and Western Arm Brook) as this influences estimates of river-specific conservation status. The recommendation was made to move towards quantification of the availability of biological versus physical habitat.
- Scientifically evaluate the Upper Reference Points.
- Continue to investigate factors that influence the marine survival of Atlantic Salmon.
- Continue to investigate consequences of interactions between farmed and wild Atlantic Salmon.
- Increase the number of monitoring facilities to include more SFAs.
- Enhanced investigations to examine potential factors driving the ongoing declines in the Conne River population.

REFERENCES CITED

DFO. 2018. Stock Assessment of Newfoundland and Labrador Atlantic Salmon – 2017. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/034. (Erratum: September 2018)

DFO. 2019. 2018 Atlantic Salmon In-Season Review for the Newfoundland and Labrador Region. DFO Can. Sci. Advis. Sec. Sci. Resp. 2019/004.

Veinott, G and Cochrane, N. 2011. New Estimates of Whole Weight, Percent Females and Fecundity for Use in the Determination of Conservation Status of Atlantic Salmon (*Salmo salar*) in Assessed Rivers in the Bay St. George Area (SFA 13). DFO Can. Sci. Advis. Sec. Res. Doc. 2011/006. iv + 9 p

APPENDIX I: TERMS OF REFERENCE

Assessment of Atlantic Salmon in Newfoundland and Labrador

Regional Peer Review Process - Newfoundland and Labrador Region

March 5-7, 2019
St. John's, NL

Chairperson: Dale Richards, DFO Science

Context

There are 15 Atlantic Salmon (*Salmo salar*) management areas, known as Salmon Fishing Areas (SFAs) 1-14B, in Newfoundland and Labrador (NL) (Fisheries and Oceans Canada [DFO] 2018). Within these areas there are more than 370 rivers with reported Atlantic Salmon populations characterized by differences in life history traits including freshwater residence time, age at first spawning, and the extent of ocean migrations.

The last full stock assessment of Atlantic Salmon in NL was completed for 2017 returns in March 2018 (DFO 2018). During July 2018, an in-season review was completed for Atlantic Salmon in NL (DFO 2019). In February 2019, a preliminary data review was conducted to inform a potential interim 2019 Atlantic Salmon Management Approach in NL.

Fisheries Management will use information from this Regional Peer Review Process to inform the current salmon management plan.

Objective

- Assessment of Atlantic Salmon in NL (Salmon Fishing Areas 1-14B)

Expected Publications

- Science Advisory Report
- Proceedings
- Research Documents

Expected Participation

- DFO (e.g., Ecosystems and Oceans Science, Ecosystems Management, and Fisheries Management sectors)
- Government of Newfoundland and Labrador – Department of Fisheries and Land Resources
- Indigenous groups
- Academia
- Other invited experts

References

DFO. 2018. Stock Assessment of Newfoundland and Labrador Atlantic Salmon – 2017. DFO Can. Sci. Advis. Rep. 2018/034. (Erratum: September 2018).

DFO. 2019. 2018 Assessment Salmon In-Season Review for the Newfoundland and Labrador Region. DFO Can. Sci. Advis. Sec. Sci. Resp. 2019/004.

APPENDIX II: AGENDA

Regional Peer Review Process Assessment of Atlantic Salmon in NL Region

March 5-7, 2019, St. John's, NL

Chairperson: Dale Richards, DFO Science

Tuesday, March 5

Time	Topic	Presenter
09:00	Opening remarks, Terms of Reference and agenda review	Dale Richards
-	Presentation: Overview of the physical oceanographic conditions on the NL Shelf	Frédéric Cyr
-	Presentation: Overview of the chemical and biological oceanographic conditions on the NL Shelf	David Belanger
-	Presentation: Update on advances in the genetic analysis of mixed stock Atlantic Salmon fisheries in the North Atlantic	Ian Bradbury
-	Presentation: Update on genetic interactions among wild and farm escaped Atlantic Salmon in southern Newfoundland	Ian Bradbury
-	Presentation: Model estimates of catch and release mortality at varying water temperatures	Travis Van Leeuwen
-	Presentation: River temperature and closure trends across NL	Travis Van Leeuwen
-	Presentation: The Marine Migrations of Atlantic Salmon	Jonathan Carr and Nick Kelly
-	Presentation: Assessment of Salmon Stocks in Middle Barachois Brook and Robinson's River, 2018	Rex Porter
-	Presentation: Atlantic Salmon monitoring, Gros Morne National Park	Shawn Gerrow
-	Presentation: Atlantic Salmon monitoring, Terra Nova National Park	Kirby Tulk
-	Presentation: Assessment of Atlantic Salmon on monitored rivers in Newfoundland and Labrador	Nicholas Kelly
-	Presentation: Investigating potential factors affecting marine survival of post-smolts from Western Arm Brook, NL	Nicholas Kelly

Wednesday, March 6

Time	Topic	Presenter
09:00	Drafting of Science Advisory Report bullets	All
-	Discussion of Research Recommendations	All
-	Upgrading of Working Paper(s) to Research Document	All
-	Closing remarks and *ADJOURN*	Dale Richards

Thursday, March 7

This day is allotted in case of building closure due to poor weather conditions.

Notes:

- Health breaks will occur at 10:30 a.m. and 2:30 p.m. Coffee and tea can be purchased from the cafeteria.
- Lunch (not provided) will normally occur 12:00-1:00 p.m.
- Agenda remains fluid – breaks to be determined as meeting progresses.

APPENDIX III: LIST OF PARTICIPANTS

Name	Affiliation
Amber Messmer	DFO Science
Blair Adams	NL Department of Fisheries and Land Resources
Brian Dempson	DFO Science Emeritus
Carole Grant	DFO Science
Chantelle Burke	DFO Science
Chris Hendry	DFO Aquaculture
Colin Webb	Nunatsiavut Government
Connie Korchoski	DFO NL Center for Science Advice
Craig Purchase	MUN
Curtis Pennell	DFO Science
Dale Richards	DFO NL Center for Science Advice
Darrell Green	NL Aquaculture Industry Association
Dave Meerburg	Atlantic Salmon Federation
David Belanger	DFO Science
Don Hutchens	Salmonid Council of NL
Erika Parrill	DFO NL Center for Science Advice
Frédéric Cyr	DFO Science
Geoff Veinott	DFO Science Retired
George Russell	NunatuKavut Community Council
Hannah Murphy	DFO Science
Heather Penney	DFO Science
Ian Bradbury	DFO
Ian Flemming	MUN
Jackie Kean	DFO RM
Jenn Duff	DFO Communications
Kirby Tulk	Parks Canada
Kristin Loughlin	DFO Science
Nick Kelly	DFO Science
Rebecca Poole	DFO Science Goose Bay
Rex Porter	DFO Science (Retired)
Roanne Collins	DFO Science
Robert Perry	NL Department of Fisheries and Land Resources
Robin Morris	DFO Resource Management
Scott Whitehouse	DFO Science
Shawn Gerrow	Parks Canada
Stephanie Synard	NL Department of Fisheries and Land Resources
Travis Van Leeuwen	DFO Science
Victoria Neville	WWF Canada
Wayne King	DFO Resource Management