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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 meeting on the Regional Advisory Meeting on the assessment of Atlantic Salmon in Newfoundland and Labrador was held, March 2–5, 2021, virtually via Microsoft Teams. Its purpose was to collaborate with experts on environmental variables that may impact Atlantic Salmon and to assess the stocks in Salmon Fishing Areas (SFAs) 1–14B. Participants included staff from Fisheries and Oceans Canada (DFO) Science, Fisheries and Aquaculture Management, Parks Canada, Government of Newfoundland and Labrador, Memorial University of Newfoundland, Aboriginal Groups, and Non-Governmental Organizations and Associations.

A Science Advisory Report (SAR) was produced at this meeting and contains the summary and conclusions of this science review. This Proceedings report includes abstracts, discussion summaries, and recommendations for each presentation. The terms of reference for the meeting, agenda, list of participants and detailed summary sheets for the various Atlantic Salmon stocks assessed are appended.

PRESENTATIONS: ABSTRACTS AND DISCUSSION SUMMARIES

AN ECOSYSTEM APPROACH TO FISHERIES MANAGEMENT AT DFO

Presenter: Mark Simpson, DFO Science

Abstract

Fisheries and Oceans Canada (DFO) is committed to the implementation of ecosystem approaches for the management of aquatic living resources. This process aims at improving fisheries management decisions, and it is driven by Canada's international commitments and national legal obligations, (e.g., United Nations Convention on the Law of the Sea, United Nations Fish Stocks Agreement, Revised Fisheries Act, DFO Fisheries Sustainable Framework), but also by a global shift in fisheries management paradigms, and market forces that increasingly demand certifications of sustainability for fisheries products. As part of this progression, DFO has established a National Initiative aimed at implementing an Ecosystem Approach to Fisheries Management (EAFM) in Canada that will integrate environmental variables (i.e., climate, oceanographic, and ecological factors) into single-species stock assessments in order to improve fisheries management decisions. The current initiative, which will be completed by 2023, is intended to serve as steppingstone and learning ground for the more integrative Ecosystem-based Fisheries Management approaches that will be needed in the future. The National Initiative is organized through a National EAFM Working Group (WG) and a series of Regional EAFM WGs, and its main goal is to develop a national framework to operationalize EAFM. Within this framework, EAFM will retain primarily an individual stock and fishery focus, while incorporating ecosystem variables in science advice to better inform stock and individual fishery-focused decisions. DFO has already made progress towards EAFM in some stocks/fisheries; for example, those cases where oceanographic or prey considerations have been included in stock assessments and less often, science advice. With respect to fisheries management decision making process, it is unclear how these components are considered in stock/fisheries management actions. Roughly one quarter of DFO assessments provide advice that incorporates climate, oceanographic or ecological considerations in the recommendations. Under the EAFM framework, the management focus will remain on individual stocks, but ecosystem variables would be explicitly included in science advice and accounted for in recommendations for decision-making at the stock level. In this way, EAFM would provide more comprehensive and systematic advice to fishery decision makers on both the effects of environmental forcing (e.g., species interactions, climate change) on fish stocks, and the effects of fisheries on ecosystem components. Many international jurisdictions are already embracing ecosystem approaches in fisheries (e.g., Australia, New Zealand, and the USA). To move forward on the development of the National EAFM Framework, the Regional and National EAFM WGs have identified regional case studies to explore tangible ways of how to incorporate the principles of an ecosystem approach into fisheries stock assessments and science advice. In the NL region, the case studies focus on: Northern cod, Capelin, Northern shrimp, Snow crab, and Harp seal. The species included in these case studies not only support important and iconic fisheries in the NL bioregion; they also represent core components of its food web. Trophic interactions among these species and environmental signals are emerging as important drivers in the dynamics of the individual stocks as well as the overall ecosystem, making all of these case studies particularly relevant for the development and implementation of ecosystem approaches.

Each DFO region has identified their own case studies. These case studies were selected for their regional relevance, but also to cover a diversity of stock characteristics (e.g., biological traits and life histories, data quality and quantity, ecosystem context, management

considerations, etc.). Case studies are intended as learning tools, and depending on the case, they may cover all or part of the elements required for EAFM. As part of their development, and whenever appropriate, results and emerging ideas will be presented at already established science and/or management venues (e.g., Canadian Science Advisory Secretariat [CSAS] stock-assessments, Precautionary Frameworks, Rebuilding Plans or other Working Groups, advisory and/or consultation meetings) for discussion, consideration for application, and/or gathering feedback from participants (i.e., scientists, managers, and stakeholders). When taken together, these case studies and the experiences collected through their implementation, will inform the National EAFM WG conversation, contributing to create an approach that aims to be nationally consistent and regionally appropriate, and guiding the development of the National EAFM framework.

Discussion

There was discussion on national and regional scale approaches to build an integrated data collection program that would be long term and consistent. The response was that there has not been formal discussion on that sort of approach from a national perspective. From a regional perspective, there has been an emphasis on incorporating ecosystem variables into all of our stock assessments in recent years. The Environmental Sciences Division has provided long term data that are consistent, for all the different stock assessments. The presenter also indicated that the Gulf region has developed a spatially explicit data set that is updated with data that can be used. The majority of the variables that are available are specific to the Gulf, but they are expanding to include data from the Maritimes and hopefully the NL Region can contribute to that. A participant asked how and when the working groups would be getting feedback on the case studies. The response was that the committees have regional and national representation from science and management. Feedback will occur through already established science and/or management venues for discussion, consideration for application, and/or gathering feedback from participants (i.e., scientists, managers, and stakeholders).

OCEAN CLIMATE IN NEWFOUNDLAND AND LABRADOR WATERS

Presenter: Frédéric Cyr, DFO Science

Abstract

Mean annual air temperature in Newfoundland and southern Labrador was near the 1991–2020 long-term average in 2020, characterized by a cold winter/spring and a warm summer. Summer sea surface temperatures (SST) were above average and sea ice below average for the first time since 2014 and 2013, respectively. The amplitude and duration of the warmest SST conditions in the shallower areas around Newfoundland is increasing since the 1980s, in agreement with climate change projections.

Chlorophyll concentrations and zooplankton biomass were below normal in the early and mid-2010s, increasing to values above the long term (1999–2020) average since 2016–17. Changes in zooplankton community structure over the past decade resulted in fewer large and more small copepods although the abundance of large, energy-rich calanoid copepods has increased to above-normal levels in some areas since 2017. Additionally, changes in zooplankton seasonality (weaker spring and stronger summer and fall zooplankton signals) may change the quality and timing of food availability for upper trophic levels.

Discussion

The earth's surface temperature and sea surface temperatures setting record highs in recent years was discussed. A question was asked whether using the last five years in the data set

had an effect on the standard deviation and the ability to detect an anomaly. The response was that the climatological period was based over a span of 30 years. The data from 1981 to 2010 was used in stock assessments last week. This week the change was made for climatological period from 1991 to 2020 (previous 30 years). It depends on how you define your climatological period. If one compares the data with the 1981 to 2010 period and the 1991 to 2020 period, then the data shows the SD for the 1991 to 2020 period to be a bit less warm than it was. A warm year will still be a warm year. Overall, the global pattern is still the same when comparing one climatological period or the other and an anomaly would still be detected.

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

Presenter: D. Belanger

Abstract

Biogeochemical oceanographic conditions on the Newfoundland and Labrador Shelf are presented and interpreted against long-term (1999–2020) mean conditions in the region. Satellite ocean colour data indicated near-normal timing, duration and productivity of the spring phytoplankton blooms in past couple of years after a period of late, short and low-production blooms in the mid-2010s. In-situ data from the Atlantic Zone Monitoring Program (AZMP) seasonal surveys showed an increase in integrated inventories of nitrate (50–150 m) and chlorophyll (0–100 m) since the mid-2010s after several years of below-normal levels in the early 2010s. Zooplankton abundance has remained mostly above normal since ~2015. Zooplankton biomass has increased to above normal during the same period after several consecutive years of negative anomalies in the early 2010s. Changes in the zooplankton community structure since ~2010 resulted in fewer large, energy-rich calanoids (*Calanus* spp.), and more small copepods (*Pseudocalanus* spp., *T. longicornis*, *Oithona* spp.) and other non-copepod groups including appendicularians and pteropods. Additionally, there has been a change in zooplankton seasonality since 2016 characterized by a weaker spring and stronger summer and fall signals.

Discussion

There were no questions or comments.

STRUCTURE, TRENDS AND ECOLOGICAL INTERACTIONS IN THE MARINE COMMUNITY OF THE NEWFOUNDLAND-LABRADOR BIOREGION

Presenter: Mariano Koen-Alonso, DFO Science

Abstract

Marine ecosystem conditions in the Newfoundland-Labrador Bioregion remain indicative of overall limited productivity of the fish community. Total biomass level of the entire fish community remains much lower than prior to the collapse in the early-1990s. It showed some recovery up to the early to mid-2010s, when some declines were observed. Current total biomass of the fish community remains below the early-2010s level, but with some positive signals in 2020. Since the mid-2000s this fish community has shifted back to a finfish-dominated structure, but 2019–2020 have shown small increases in shellfish dominance.

Discussion

There was discussion on the decline in the capelin stock in the early 1990s. An area in Newfoundland was seeing cod fish in the river. There may have been a shift in prey items for cod when its normal prey items were not available. The importance of pelagic fish (capelin) in the diet of salmon was discussed and a participant referenced two studies from Labrador with Local Ecological Knowledge and Traditional Ecological Knowledge (LEK/TEK).

Participants asked whether the increase in shellfish was due to management measures, for example, the Total Allowable Catch (TAC). The presenter responded that the management measures did help but improvement in climate conditions were also a factor.

There was some discussion on diet and food consumption by seals. A participant asked if there were salmon smolt present in the stomach contents survey. The presenter stated that there were no salmon in stomachs, and it is looked for in the stomach survey. In the overall data, salmon smolt did not show up, there may be localized predation observations, however, it is clearly not a main prey item. Discussion continued on prey-predator relationships and a participant commented that both the prey and predator would need to be at the same location at the same time. For example, spawning migration of capelin and distribution of cod may not show that capelin is important part of the diet depending on the time of sampling. The presenter agreed that there is a seasonality and locality of diet, however, the presenter was confident in the data and that they are accurate as there are multiple years of data. Furthermore, stable isotopes data provide information on what is eaten over a longer period of time. When both are compared, they match well. For example, it was observed that there was a decline in shrimp and increase in capelin in the cod diet while it was occurring.

There was a discussion on the food value of capelin vs sand lance or shrimp. The response was that it varies, capelin is much more energy rich than shrimp, but this may change with the time of the year. The participant asked if timing would make a difference in the consumption models and the response was yes, we factor in seasonality and the energy content of the prey using weight as a good proxy. It was pointed out that work in Renew's River showed that smolts stayed in the harbour until July or until they were eaten. The predators in the harbour at the time were seals and cormorants. The presenter said you need to be open minded as to what can be a predator especially underwater. But yes, it is important to look at localised predators.

PRESENTATION: SUMMARY OF THE PRE-COSEWIC REVIEW FOR THE NEWFOUNDLAND AND LABRADOR REGION, FEBRUARY 1–4, 2021

Nicholas Kelly, DFO Science

Abstract

No abstract provided.

Discussion

There was discussion on the precautionary approach and the need to define or give reference to the lower and upper reference point.

Another participant asked if there was any catch effort over time of the Labrador harvest data and suggested that it would be good to see the catch effort over time. It was discussed that there is not enough data to create a time series.

There was discussion whether the counting fences that were doing really well were due to restrictive angling measures, as well as partners on those rivers that are favorable towards catch and release. The presenter explained that English river has had good returns and that the

amount of angling is very low (if any) due to its remote location. Terra Nova River, Northwest River (Port Blandford) and Middle Brook have higher returns but so did Western Arm Brook, Rocky River and Corner Brook Stream.

There was discussion on the lower and upper confidence interval on the graphs and how much of an adjustment was done, as they felt it to be important, to incorporate these data into the summary. The presenter agreed to give the upper and lower estimates for the remainder of the total returns.

A participant indicated that last year (2020) the public were saying the fish were running through the Exploits and no one was counting them. The presenter stated there were no fish missed in the count on the Exploits. The participant stated that the public needs to know this. The presenter agreed that better communication is required.

A participant asked to address the issue with the precautionary approach and to have specific definitions. The participant stated that the terminology, 100% conservation achieved, and 150% conservation achieved is not used for any other species and questioned whether using the terminology was in line with the current law and proposed regulations. Furthermore, the participant stated that with Salmon being up for Species At Risk Act (SARA) listing that it would be particularly important and based on their experience with CSAS stock assessments and the PA approach the participant suggested serious consideration should be given to revising the terminology that being the Limit Reference Point (LRP) and Upper Stock Reference (USR). The participant indicated that what is actually being referred to is recruitment and so was wondering why that is not being used since it is a lot clearer from a scientific perspective than using 100% Conservation Achieved. The responses were that this is the terminology that is used across Atlantic Canada for salmon. This is how colleagues in the Gulf and Maritimes package the information and it is the same across all DFO Regions. Using egg deposition and Conservation Achieved is consistent with other jurisdictions in Canada as well as being similar with other Countries that are a part of ICES. The Chair stated that the terminology will be clarified and ensured that the reference be included when this information is shown in the future.

Another participant commented on Corner Brook Stream stating that a local group started the count and one way to improve the data collected would be to collect some river specific data like percent fecundity, and length weight data to improve the conservation achieved calculation, instead of using data from other rivers in the area. The presenter stated that there is a lack of scale data from this river which is why the average of rivers in the area was used for this count. Also, the small number of returns to this river makes it hard to determine fecundity as we do not want to take any salmon from the river. The presenter stated that DFO would reach out to the Salmon Preservation Association for the Waters of Newfoundland (SPAWN) to see how they can improve the data from that river.

Another participant made a comment about Bay D'Espoir (including Conne River and Little River) as well as Garnish River. The participant wanted to see a comment in the report about a decline in sea survival as well as abundance. This area is different from adjacent areas. Therefore, the point needs to be made that stocks are behaving differently in southern Newfoundland than the adjacent areas. The presenter stated that the two rivers that we have data show extremely poor survivability at 3% or less when compared to the other 3 rivers in the province that we have these estimates. The presenter stated that we are limited in the data we have to fully understand what is happening in this area because it is a complex relationship. The Chair stated that one of the purposes of the CSAS meeting is to identify any issues so even though there is not a lot of data, this area shows something different is happening and it needs to be identified in this report. The participant agreed and said the only data that are available for the south coast, that would compare the adjacent areas, are the angling data which is variable.

The estimate of total returns to the Designatable Unit (DU) (SFA 12, and most of SFA 11 – including Bay D'Espoir) was calculated using estimates of the exploitation rate of small salmon and the proportion of large to small salmon observed on monitored rivers was taken and applied to rivers where only recreational angling estimates were present to determine the number of salmon that may have actually returned to the rivers for the whole DU. There was a sharp declining trend that is similar in magnitude to declines at Conne River and Little River. There are a lot of assumptions to the data and uncertainties surrounding the bump up, but it was interesting to see that not only was there a similar pattern but also a similar magnitude of decline. The participant asked that this discussion become a part of the report. The presenter and chair agreed that it would be an important point to add.

The participant also had a question about salmon abundance and asked if Garnish and Conne River were included in the abundance index. The presenter said yes. The participant asked what abundance would look like without these two rivers being added. It was stated that it would be a bit higher index of abundance, but these data were not analyzed in this way as the abundance is a relative index. Even though there may be a shift on the y axis the trend remains the same. There have been declines of salmon at Conne River for 25 years.

Another participant suggested that DFO use data from fishing camps on the island of Newfoundland as they felt it would be as accurate as the angler log returns. The presenter agreed to look in to getting these data not only for Labrador but also Newfoundland. Another participant asked if it is valid to use the licence stub return data and DFO stated that it depends on the river as there is more information available for some rivers.

Another participant wanted to discuss the percent conservation number once again. What DFO does with this is useful but what DFO calls these numbers are not helpful. What these numbers really represent is how well the habitat in the watershed is being used. If the watershed is saturated, you are in the green and if it is not being fully utilized you are in the red and not hitting the potential of the watershed. But if you look at this in terms of Committee on the Status of Endangered Wildlife in Canada (COSEWIC) a watershed like Exploits with 20,000 adults is less likely to go extinct than Middle Brook. Even though the Exploits is underperforming when it comes to the amount of habitat it is actually a much larger population than Middle Brook and COSEWIC is looking for the probability of extinction not the efficiency of the watershed. Calling the numbers something else would make it less confusing. The Chair acknowledged that the participant made a good point.

A participant noted there are no monitoring facilities west of Conne River, but indicated there are a couple of remote rivers that have lodges (Grey River, White Bear and LaPoile River) that have excellent angling records and asked if it could be possible to use these records as a guide for relative abundance. The presenter acknowledged that DFO ought to reach out to these lodges the same as is done for lodged in Labrador. The data would need to be analyzed to see if it is comparable. The participant stated that these records are probably as accurate as the information we get from licence stub returns.

Another participant asked about the validity of the data from the licence stub return program. The presenter stated that it depends on the amount of effort on the river. A river with a lot of effort will give a better estimate of the number of salmon retained and released. The participant suggested that there may be some value in applying effort to increase the amount of licence stubs that are returned. The presenter said it isn't easy as DFO has been trying to increase the returns. DFO has been looking into using an angler app to help collect data, but its development has stalled. DFO is open to suggestions on how to do this. The Chair mentioned that it would be interesting to do a creel survey on a monitored river and one on an unmonitored river and compare to the general logbooks to see how they compare.

The previous participant then made another comment that when looked at in the past and in talks with the Provincial Government the cost would be too high to make log returns mandatory. The cost would have been seven million dollars, but maybe now is the time to have these discussions with the Government of Newfoundland and Labrador to see if we can make the return of the logbook mandatory for the next year. The participant said that it may be able to be done for a fraction of the cost as there may be a mechanized system to do this now. Another participant with the Provincial Government responded with the statement that they are looking at moving all licences to a digital format and once completed it will be easier to make logbook returns mandatory.

Another participant stated that he does not have much to add to what has been said over the past 25 years about the Conne River. The participant asked that something be put in this document to itemize what is happening in the Conne River and other south coast rivers. The decline has been dramatic to the point where there really isn't any salmon. The Chair agreed with the comments and stated that text would be written on this issue.

A participant made comment on trying to collect better angling data and the development of an angling application and indicated that it is actually a complicated endeavor. The hardest part is getting anglers to return their logs or record their catch. A whole new angler demographic may be captured by using an app. DFO is doing work in this area, and it is not as simple as just rolling it out. DFO would need to check the data and ensure that it can be compared to the data that we have been using for the past 25 years. Perhaps environmental data could be added to the app so fishers could check out what the rivers are doing from day to day. Maybe DFO can incorporate the counts from the monitored river on it as an incentive. First there needs to be the incentive to use the app and then the data that are being collected need to be validated.

Another participant wanted to look at the way DFO portrays the stocks for NL. Many of the monitored rivers are rivers where there have been enhancement programs. For example, the Terra Nova River was enhanced and presumably any increase that is seen is from the enhancement and not from increased sea survival. It may be useful to separate out the rivers with enhancement and those without to see if there is a difference in trends in salmon abundance. The presenter indicated this was a good point but also stated that DFO is limited with the data that it has. Every monitored river is resource intensive, so we are limited to the rivers we have counts on whether they have had enhancement or not. We could look at the data we have and separate out the enhanced from all monitored rivers but we do see some enhanced rivers with high returns and some with decreased returns so there may not be much of a difference. The participant stated that this may be looked at in other assessments.

MIGRATION AT SEA: OVERVIEW OF NEW AND ONGOING COLLABORATIVE TELEMETRY PROJECTS

Presenter: M. Robertson

Abstract

No abstract provided.

Discussion

A participant asked about the satellite track along the shelf break and whether fish traveling in this area do so on the shelf or on the break. The presenter stated that DFO does not have enough data yet, but these tracks are likely to be current or temperature driven. Another participant commented that the area in question was not the shelf but the middle of the Labrador Sea. The presenter commented that DFO does have some salmon diet surveys from 2009 that

looked at stomach contents in this area. A participant commented that the sea bird maps of satellite tracking look similar to the salmon and the presenter stated this may mean they are eating the same prey. The participant also commented on the need to look at how much time salmon spend in the area of the shelf and closer to the rivers and how it may help explain at-sea mortality. The presenter commented that more data are needed so more fish have to be tracked.

Another Participant asked what percent of tagged fish were not detected. The presenter did not know at the time of the meeting. The presenter then explained that the Strait of Bell Isle (SOBI) had two lines of receivers to look at the possibility of fish not being detected at the first line but being detected at the second line and that this was used to look at the detection probability. It was highlighted that there was a smolt not detected at the two SOBI lines but was detected off of the Port Hope line. It was explained that the two lines are being left in place and DFO Science is hoping to put another line off St. Anthony this year (2021). It was explained that it is possible for smolt to go through undetected but not kelt. The presenter further explained that currents are challenging for detecting fish in the SOBI, as the receivers can fluctuate from 20 feet below the sea surface to being on the seafloor.

Participants discussed the importance of increasing tagging of Newfoundland salmon. Most of the salmon are grilse and some of the earlier work done on marine tagging suggests that they may be overwintering on the Grand Banks, the edge of the shelf and on the southern Grand Banks. Furthermore, this is an area that may be the zone where oil exploration is taking place. Other areas around the island may also be used for overwintering. Only current data are shown and do not include past information. However, the presenter indicated that a lot of effort has been put in to collecting all the information available for salmon and putting together a document to show all we know about salmon movements which is expected to be complete in the next year. This publication will include everything we know now about salmon in Eastern Canada, and we will build on to this document as the ESRF study is carried forward. The participant then commented that they recalled from data on external tags there seemed to be a difference in the migration routes for post smolt and kelt and asked if the presenter was also seeing this pattern. The presenter said there is not enough data so far but the difference they are seeing is more so in timing than in direction. Kelts do not go far to condition so, depending on where they are going, they are going to have different migration routes. An alternate spawning kelt and a smolt would have more similar paths. The participant stated that the kelt and smolt would probably overwinter together. The participant then asked if the presenter planned on looking at more rivers of Newfoundland and looking at the overwintering of the grilse. The response was yes, the ESRF project is tagging smolt and kelt throughout Newfoundland and are focused on rivers of indigenous priority. Tagging is planned to take place in Conne River, Little River, Exploits River, Gander River, Humber River (possibly), Western Arm Brook, English River in northern Labrador, and several rivers in southern Labrador.

Another participant indicated Atlantic Salmon Federation (ASF), and partners have tagged a lot of kelt and from those tracks, show half the fish movements include hugging the Labrador Shelf to Baffin Island before they head to West Greenland, and they have had almost as many fish going out into the deep trench in the Labrador Sea similar to the fish track that was shown by the presenter. The collaborator also noted the importance of the oceanographers as the project moves forward.

Another participant asked about the detection line efficiency at Port Hope Simpson stating that the spacing of the line was 800 m and suggested that the spacing of the receivers be changed to 600 m instead, which may help with the detection efficiency of smolt. The participant also wanted to discuss the depth and temperature readings and whether they were instantaneous or an average. The presenter said it was instantaneous and the participant said that both the

values are not instantaneous. It tells you the depth when the tag hits and two minutes later it gives you the temperature when the tag pulses. So, one would need to be cognizant of this when looking at the data. The participant then asked if when tagging at Campbellton River using both a pit tag and an acoustic tag if anything was done to ensure that the 2 tags were separated as the acoustic may block out the pit tag. The suggestion was made to separate the tags with a suture.

There was a discussion of the tagging of smolt from Newfoundland. The concern is that seismic testing will have a negative impact on the smolt or their feeding. In terms of ESRF, the study is to determine when, where and how long the salmon are migrating. The second part will be looking at the area and time salmon are in areas or oil exploration and how to mitigate the impacts. In order to do that we need to follow the smolt and post smolt. A participant asked if the focus was on kelt. The presenter said that the focus is on both smolt and kelt.

A participant stated changing the name of the Port Hope Simpson line to the Spear Point line as the receiver line is set directly off of Spear Point. The presenter suggested changing it to the southern Labrador line. The participant didn't agree as more receiver lines may be installed in southern Labrador.

A participant commented on seismic impacts and stated that another researcher is looking into a broader spectrum of likely impacts of seismic on organisms. The researcher on seismic impacts invited those interested to make contact outside of this meeting and gave a short summary of the research.

UPDATE ON RECENT RESEARCH EXAMINING GENETIC INTERACTIONS BETWEEN WILD AND FARM ESCAPED ATLANTIC SALMON IN SOUTHERN NEWFOUNDLAND

Presenter: I. Bradbury

Abstract

Despite continued improvements in farmed salmon containment, escape events continue to occur and represent a significant threat to the persistence and stability of wild salmon populations. In Atlantic Canada, significant gains have been made over the last five years documenting the scale and extend of hybridization with escapees.

Genetic monitoring of hybridization between wild and domestic salmon. Juvenile surveys and genetic analysis indicate that the proportion of first-generation hybrids in southern Newfoundland in 2019 and 2020 were the lowest since monitoring began in 2014. Despite this, first-generation hybrids were detected in both years in Fortune Bay, and some smaller rivers continue to be dominated by hybrids. Both experimental evidence and increases in the detection of the offspring of first-generation hybrids and wild salmon support a role for precocial male hybrid maturation in ongoing introgression.

Genomic analysis of Atlantic salmon within the Conne River. Genomic analysis of Atlantic salmon across the Conne River watershed suggests that;

1. despite genomic evidence of declines in abundance since the mid-1980s, diversity within the watershed remains with significant differentiation between the mainstem and tributaries, and
2. that introgression with farmed escaped salmon has occurred in the lower parts of watershed.

Garnish River Experimental Release Study. In the Garnish River an experimental release of wild, farmed, and hybrid parr was used to examine their survival and growth over several years.

Observations suggest changes in the relative survival of wild and farmed individuals over the study period and that hybrid male precocial maturation is a common occurrence. This observation suggests that hybrid parr maturation could play large role in introgression in the region.

European introgression into wild and domestic Atlantic salmon. Population genomic analysis exploring European introgression into North American farmed salmon indicates that some farmed Atlantic salmon have been significantly interbred with European salmon, and that some of these individuals have escaped and hybridized in the wild in southern Newfoundland.

Discussion

The Chair of the meeting stated that some of the information presented was in the last SAR. Several points that were brought up included that it is interesting that the diversity is still persisting in Conne River as it allows some opportunity for mitigation measures if we have them. The idea of the rapid integration needs to be understood. Was there any advice given in the last stock assessment meeting? Has anything been done or acted upon? How are we going to provide advice on this going forward? Based on the 2006 information from the Bay of Fundy what were the outcomes based on what happened there and will that provide insight as to what might happen here (NL) given we have an expanding aquaculture industry? There is a whole range of many complicated things that could drive our discussion. The Chair then opened the floor to some questions.

A participant asked for clarification on the Garnish release experiment. The presenter stated there was a loss of wild individuals in the third recapture of the experiment. One possibility is that the wild have migrated downstream, whereas the aquaculture offspring did not. Continuing with questions on the Garnish release experiment, another participant asked if the pure aquaculture/hybrid fish were growing faster than the wild fish? The presenter noted that there were strong differences in growth between the sites. Another participant involved in the Garnish release experiment commented on some of the results on survivorship and growth and stated that data analysis of the 2019 and 2020 recaptures was incomplete. The participant then asked if they would be following the smolt to adult survival for the Garnish experiment. The presenter indicated that this was a small release into three tributaries of the system, therefore, the power to detect them may be low. A participant involved in the Garnish release experiment commented that the fish were lethally sampled and taken out of the system.

A participant asked if there was evidence to show that the aquaculture industry is still using pure European brood stock. The presenter summarized the findings of hybrid index values from 20–40%. The presenter then suggested that the European hybrids may be maintained through selective breeding, and they may just be doing better due to longer periods of domestication or there are European brood stock still being added to the system. However, with the data that they have collected they are unable to rule out either possibility. The participant then asked about the 500 Single Nucleotide Polymorphisms (SNPs) looking at the European verses in the North American samples, specifically for the St. John River escapees. With that SNP would you be able to determine which fish came from the St. John River? The presenter said this would require a separate panel development process and more SNPs would be needed. The participant then had a last comment on the SAR bullet for this section. It was suggested that the bullet state that due to continued persistent introgression or aquaculture escapes in to the wild this may impact recovery efforts such as enhancement or restocking programs, for example, in Conne River. The presenter commented that Conne River is interesting in that there are hardly any escapees at the fence. However, there is evidence of older introgression. So maybe this has happened a while ago and we are seeing the legacy of it in the samples we are analyzing now. This will be important if any mitigation was to take place on Conne. These individuals

could be selected out so we wouldn't be perpetuating signatures of introgression further into the population. Another participant asked about the genomic adaptations, specifically the differences between the European and the Atlantic versions of salmon. The presenter stated that there are differences on a coarse level of North American vs European and there are adaptive differences between the two. This is not new as there were calls to determine subspecies status for both sides of the North Atlantic recognizing that there was a lot of evidence suggesting that these groups are really discrete. But within North America the genomic tools are allowing us to zoom in and understand what makes these groups adaptively different and it is tied to population performance and persistence and stability, how they respond to their environment. We can now use this information to make predictions in terms of climate change impacts and survivorship.

Another participant asked how long is the counting fence kept at Conne each year? The response was that the fence is operating from May to August. Participant commented maybe escapees are showing up after the fence is removed. Salmonid staff commented that from 1986–1999 the fence wasn't removed until late August, September 31, October 26. However, during the last 10 years removal takes place the first week of August to mid-August. This is due to knowing that most of the run has gone through in July.

Another participant suggested that the hybridization introgression could cause a population decline or lower productivity. Is there any evidence what the rate of decline would be at NF Rivers if the introgression is recurring? The presenter said based on experiments and modeling work looking at population decline with different levels of escapees, if more than 10% of individuals in a river are escapees then we start to see decline and the decline increases as the proportion of escapees increases. Many parameters are involved in this modeling, the 10% is a best guess and it seems to be reasonable based on the experimental work that has been done.

Another participant asked a question regarding the introgression work and whether or not samples were collected from Long Harbour. It was indicated there were none collected since 2018.

Another participant stated that recent work done by Dr. Ian Bradbury created positive feedback and hope that something may be done in relation to the upper portion of the river. The participant suggested a bullet that shows support from DFO with intervention now otherwise it (Salmon of Conne River) will become extinct.

The Chair then stated that there would be discussion on this point and also on what the advice was in the last SAR and what was done in respect to the advice given.

Another participant agreed with the statement made by the previous participant. And hoped that the group would be receptive to forming a bullet on Conne River. The participant stated they know how frustrating it is to study a population that is in decline. The participant then referenced the World Wildlife Fund Canada's living planet report that is showcasing alarming declines in freshwater and anadromous fishes.

Another participant asked when escape events happen. Escapes can happen at any time, but timing matters and impacts of escape events on wild salmon differs among months. So, an escape event in the fall would differ from one in the spring in terms of the possibility of introgression in rivers. The participant wanted to discuss ways to determine the impacts of an escape event as it relates to introgression. Another participant stated that there is some literature and anecdotal information from New Brunswick that spans over 20 years that they would pass along. Furthermore, the participant acknowledged that it is correct to say that escapes can happen anytime, and escapees can enter rivers anytime. A river in New Brunswick is monitored from May to December and the largest proportion of escapees enter in the fall when they are closer to maturation. The escapees have no home rivers so presumably when

they enter the river it is when they are getting closer to maturation. Therefore, the participant thought the highest risk would be introgression. The participant indicated there is some evidence that these fish enter the rivers sometimes later than the wild fish. When fish enter earlier (there is not much data on this yet) there is the risk of these fish carrying diseases. The participant indicated they found there is a lot of immature fish entering the rivers, they were market size large fish but there was no size to the gonads. Some of these fish may be entering earlier but they may be maturing later. There needs to be much more data to look at in terms of the timing of year that escapes occur.

Another participant added that there is also literature from Norway on the timing of escapes and the likelihood of entering rivers. The presenter stated the literature from Norway looks at an escapee not entering into a river the year of the escape but the year(s) after the escape, therefore, this is something else to keep in mind. When we capture escapees at the Garnish fence annually, often in the absence of an escape event, we wonder is that a loss in this year or in a previous year. We gather all of the parentage from all of the juveniles we capture, and we do see some half siblings. This is presented in Wringe et. al. (2018).

Another participant added that there was a paper out of Europe that suggests that the trickle escape events may be more detrimental than the large escape events.

DRAFTING OF SCIENCE ADVISORY REPORT

Summary SAR bullets

SAR bullets were reviewed. There was a discussion on the bullet which discussed disruptions and delays to the 2020 monitoring activities. A participant asked if it was a result of province wide public health measures or DFO policy that caused the delay.

A participant suggested that the geographic area of the counting fences that were showing declines over the previous generation average be included. There was discussion on the geographic location and that five of the declines were on the south coast.

A participant asked to clarify the wording for the upper stock reference point. Another participant suggested not using LRP and USR but instead using critical zone and healthy zone. Another participant suggested including (between the LRP and USR) so the zone is being described in the parenthesis.

There was discussion on the logbook returns and whether it was needed in the bullet and the correct wording to use.

There was discussion on the recreational fishing bullet. There was some uncertainty in the numbers, but participants agreed that a bullet should still be included for consistency and as a reference.

There was extensive discussion on the wording for the bullet for SFA 11. In the end participants agreed to quantify the numbers showing the decline and that strong, factual language be used.

There was discussion on the wording of the marine survival bullet to ensure it is factual.

There was discussion on the genetics bullets to ensure statements were factual, wording was clear and whether words being used needed to be defined in the bullet. There was discussion on the European brood stock and why European genetics were still showing up when stocking of European origin salmon was supposed to be eliminated in the 80s. It was suggested that the trickle events of escapees may be having a big impact on the genetics of the stock. There has been introgression with farmed European hybrids in the wild and there is not enough information to determine the magnitude of the impact on the wild populations.

RESEARCH RECOMMENDATIONS

1. Expand and improve monitoring (e.g., counting, assessment) in all SFAs and prioritize SFAs with little to no coverage (e.g., 3, 6, 7, 8, 12 and 14b).
2. Further investigation into declines in SFA 11 and exploration of impacts of aquaculture on wild Atlantic Salmon (e.g., sea lice, disease, hybridization and genetic impacts, and increased predation in the vicinity of aquaculture cages).
3. Investigate improvements for collecting and incorporating all angling data for future stock assessments in collaboration with Department of Fisheries, Forestry, and Agriculture.
4. Conduct further study to determine various levels of marine survival across the NL Region (increase smolt monitoring/tagging program).
5. Examine environmental factors impacting both freshwater and marine survival of post smolts.
6. Further study potential impacts of European introgression into farmed salmon on wild salmon, and mitigation measures.
7. Collect biological characteristics data on monitored rivers that are limited to improve conservation egg requirement achieved (e.g., Corner Brook Stream).

REFERENCES CITED

- DFO. 2020a. [Stock Assessment of Newfoundland and Labrador Atlantic Salmon in 2018](#). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2020/038.
- DFO. 2020b. 2019 [Stock Status Update for Atlantic Salmon in Newfoundland and Labrador](#). DFO Can. Sci. Advis. Sec. Sci. Resp. 2020/045.
- Wringe, B.F., Jeffery, N.W., Stanley, R.R.E., Hamilton, L.C., Anderson, E.C., Fleming, I.A., Grant, C., Dempson, J.B., Veinott, G., Duffy, S.J., and Bradbury I.R. 2018. [Extensive hybridization following a large escape of domesticated Atlantic salmon in the Northwest Atlantic](#). Commun. Biol. 1: 108.

APPENDIX 1: TERMS OF REFERENCE

ASSESSMENT OF ATLANTIC SALMON IN NEWFOUNDLAND AND LABRADOR

Regional Advisory Meeting - Newfoundland and Labrador Region

March 2–4, 2021

Virtual Meeting

Chairpersons: Corey Morris and Roanne Collins, 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 2018 returns in March 2019 (DFO 2020a). During March 2020, a stock status update was completed for Atlantic Salmon in NL (DFO 2020b).

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

Objectives

- Assessment of Atlantic Salmon in NL (Salmon Fishing Areas 1–14B).
- Consider ecosystem status where the assessed Atlantic Salmon stocks occur based on an overview including relevant summaries of oceanographic conditions, biological community structure and trends, and pertinent knowledge of ecological interactions (e.g., predator, prey) and stressors (e.g., anthropogenic impacts).

Expected Publications

- Science Advisory Report
- Proceedings
- Research Document

Participation

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

References

DFO. 2020a. [Stock Assessment of Newfoundland and Labrador Atlantic Salmon in 2018](#). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2020/038.

DFO. 2020b. [2019 Stock Status Update for Atlantic Salmon in Newfoundland and Labrador](#).
DFO Can. Sci. Advis. Sec. Sci. Resp. 2020/045.

APPENDIX 2: AGENDA

CSAS Regional Peer Review Process: Assessment of Atlantic Salmon in Newfoundland and Labrador

Chairs: Corey Morris and Roanne Collins

March 2–5, 2021

Day 1: Tuesday, March 2

Time	Topic	Presenter
9:00 am	Opening remarks, Terms of Reference and agenda	Chairs
-	Presentation: An Ecosystem Approach to Fisheries Management at DFO	M. Simpson
-	Presentation: Ocean climate in Newfoundland and Labrador waters	F. Cyr
-	Presentation: Overview of the chemical and biological oceanographic conditions on the NL Shelf	D. Belanger

Day 2: Wednesday, March 3

Time	Topic	Presenter
9:00 am	Presentation: Structure, trends and ecological interactions in the marine community of the Newfoundland-Labrador Bioregion	H. Munro/ M. Koen-Alonso
-	Presentation: Summary of the Pre-COSEWIC Review for the Newfoundland and Labrador Region, February 1–4, 2021	N. Kelly
-	Presentation: Migration at Sea: Overview of new and ongoing collaborative telemetry projects	M. Robertson

Day 3: Thursday, March 4

Time	Topic	Presenter
9:00 am	Presentation: The abundance and stock status of monitored Atlantic Salmon populations in Newfoundland and Labrador in 2020	N. Kelly
-	Presentation: Update on recent research examining genetic interactions between wild and farm escaped Atlantic Salmon in southern Newfoundland	I. Bradbury
-	Conclusions and Drafting of Summary Bullets	All

Day 4: Friday, March 5

Time	Topic	Presenter
9:00 am	Drafting of Summary Bullets - Continued	All
-	Research Recommendations	All
-	Upgrading of Working Paper to Research Document and Next Steps	E. Parrill
-	Adjourn	

Notes:

- The agenda remains fluid and exact timing of breaks to be determined as meeting progresses.
- The meeting will start at 09:00 am and adjourn each day at 12:30 pm (Newfoundland Standard Time).
- Long distance charges may apply for the teleconference line. DFO is unable to reimburse long distance charges.

APPENDIX 3: LIST OF PARTICIPANTS

Name	Affiliation
Carr, Jon	Atlantic Salmon Federation
Collins, Roanne	Co-Chair (DFO – Science)
Morris, Corey	Co-Chair (DFO – Science)
Adams, Blair	Department of Fisheries and Land Resources
Penton, Norman	Department of Fisheries and Land Resources
Synard-McInnis, Stephanie	Department of Fisheries and Land Resources
Dobbin-Vincent, Connie	DFO – Resource Management
Kean, Jackie	DFO – Resource Management
Belanger, David	DFO – Science
Bradbury, Ian R	DFO – Science
Burke, Chantelle	DFO – Science
Frédéric Cyr	DFO – Science
Duffy, Steven	DFO – Science
Healey, Brian	DFO – Science
Hendry, Christopher	DFO – Science
Kelly, Nicholas	DFO – Science
Koen-Alonso, Mariano	DFO – Science
Lancaster, Darienne	DFO – Science
Loughlin, Kristin G.	DFO – Science
Munro, Hannah	DFO – Science
Newton, Brianna	DFO – Science
Parrill, Erika	DFO – Science
Pennell, Curtis	DFO – Science
Robertson, Martha	DFO – Science
Simpson, Mark	DFO – Science
Van Leeuwan, Travis	DFO – Science
Porter, Rex	DFO – Science (Retired)
Veinott, Geoff	DFO – Science (Retired)
Dempson, Brain	DFO Scientist Emeritus
Eddy, Tyler	Marine Institute
Fleming, Ian	Memorial University
Purchase, Craig	Memorial University
Solberg, Abe	Memorial University
Hinks, Ross	Miawpukek First Nation
Russell, George Jr.	NunatuKavut Community Council
Karbowski, Chelsey	Oceans North
Langdon, Mervin	Parks Canada
Poole, Rebecca	DFO – Science (Rapporteur)
Hutchens, Don	Salmonid Council of Newfoundland and Labrador
Neville, Victoria	World Wildlife Fund Canada