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

Meeting dates: February 28 to March 1, 2018
Location: St. John's, Newfoundland and Labrador

Chairperson: Fran Mowbray
Editor: Emma Cooke

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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 for the Assessment of Atlantic Salmon in Newfoundland and Labrador (NL) was held February 28 – March 1, 2018 in St. John's, NL. The purpose of this meeting was to provide the most recent 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.

In addition to these Proceedings, publications to be produced from the meeting include a Science Advisory Report and Research Document, all of which will be made available online through the Canadian Science Advisory Secretariat (CSAS).

PRESENTATIONS: ABSTRACTS AND DISCUSSIONS

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

Ian Bradbury, DFO Science

Abstract

Not provided.

Discussion

An overview was provided of the genetic analysis of stock composition in three mixed stock harvests in the Northwest Atlantic. It was noted that analysis of the 2017 data would be presented at the International Council for the Exploration of the Sea (ICES) Atlantic Salmon stock assessment in March 2018. A participant asked for clarification on the analysis of region specific exploitation and if these estimates could be converted to catches. The response was that the region specific amount of harvest could be retrieved from the annual ICES report. A participant asked if the baseline data used to identify reporting groups spoke to both "discreteness" and "significance" required under the guidelines for a COSEWIC designatable unit (DU). The response from DFO Science was that genomic data can be used to make linkages to function, and that the Single Nucleotide Polymorphism (SNP) panel used in the analysis provides information on both the discreteness and significance. A participant asked if the data was published and the response was that it hadn't been published yet. A participant asked how many SNPs of the 96 SNPs used in the range-wide analysis were gene associated and could be linked to functional traits. The presenter did not know offhand, but highlighted that 96 SNPs had been selected from a larger panel of which a large portion were gene associated. A participant asked if Lake Melville should be considered a DU under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The presenter suggested that with the current data, it certainly seemed consistent with the definition, but the identification of DUs falls to COSEWIC.

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

Ian Bradbury, DFO Science

Abstract

Not provided.

Discussion

An overview was provided of genetic analysis of hybridization between wild and farm escaped salmon in southern Newfoundland. A participant asked if the 2017 data had been analyzed and when it would be available. The response was that the data was currently being analyzed and results should be available by mid-March. A question was also asked regarding the availability of data on the survival and growth of second generation (F2) hybrids. The presenter responded that the data on F2 hybrids was currently limited as ongoing laboratory experiments had not produced F2s and F2s are rare in the wild.

European vs North American Salmon

In light of a proposed expansion of salmon aquaculture into Placentia Bay using European farmed salmon, a participant was curious about the survival of escapees from aquaculture cages, the origin of these salmon (i.e., North American or European), and how the origin of the farmed salmon might affect survival. The response was that to date only North American salmon had been used in aquaculture in Newfoundland. However, there was a proposal under review to develop European-origin salmon aquaculture in Newfoundland. The subsequent impacts resulting from escaped European-origin salmon would likely differ from that of North American escapees. There was discussion pertaining to ongoing experiments comparing European and North American-origin juvenile farmed salmon behavior. It was noted that the juvenile behaviors appear similar between Canadian farmed salmon and European farmed salmon. Another participant raised a question about the consequences of hybridization of European and North American salmon with respect to survival and fitness. The presenter explained that there was significant uncertainty regarding the impacts of hybridization between escaped farmed European salmon and wild North American salmon. This is complicated by the fact that there is genetic evidence of historical introgression between European and Newfoundland wild salmon in southeastern Newfoundland likely following the last glacial maxima. Ongoing lab work is conducting crosses with these various groups to explore the impacts of hybridization. A participant asked whether the source of the natural European post-glacial colonization event could be identified. The presenter responded that there are limited data at present that could be used to address this question. However based on the migratory routes of salmon in the North Atlantic it is likely they are from the United Kingdom.

Farmed and Wild Salmon

A participant asked if the sex of escaped individuals was known as it might influence the reproductive success of escapees in the wild as male escapees have been shown to have reduced spawning success. The presenter agreed, indicated that sex was not known, but added that other indirect genetic interactions could also still occur. Another participant asked if the parental genetics could be retrieved from mitochondrial DNA. The response was that it cannot, but there is a sex-linked nuclear marker than can be used to identify sex of escaped individuals. A participant asked how long the counting fences remain in rivers for monitoring, and when farm escapees could be seen at the fence. The response was that the fence in Garnish River remains in place from the end of May until September, and that aquaculture escapees are counted throughout the season.

A participant then asked if one can link the detection rates of hybrids in the rivers to the number of escapees. It was stated that aside from the 2013 escape event, it is difficult as so few escapees are encountered. A participant shared the concern that natural population declines may be due to proximity to finfish farms, and asked if these data could link hybridization to population trends. The presenter responded saying that the data does not exist to evaluate this linkage at this time. A participant asked whether fish health testing and culling has been completed for escapees in Garnish River. The response was that there is culling of escapees detected, but that no fish health testing has been conducted to date. A participant asked whether there are differences in fecundity between wild and farmed fish. The presenter stated that they have not looked at fecundity; however large fish usually have high fecundity, and farmed fish are generally larger, but the link has not been tested. A participant noted that if farmed fish are growing faster than wild fish, they may smoltify earlier as well.

Garnish River

A participant asked if the presenter was going to use data from the Garnish River to examine population level effects, since data are limited at other sites. The presenter responded that there are only three years of counts from Garnish River and as such data are limited at this time. However there have been discussions about conducting a release experiment there to look at growth and survival of hybrids in the wild. There was then discussion around the detection rate of escapees at Garnish River. The participants discussed that the detection rate depends on when the fish escape as well as the size of the fish. Farmed salmon approaching market size are easily identified based on physical appearance, however individuals that escape earlier may not be detected.

POTENTIAL CHANGE IN ANGLING HARVEST UNDER VARIOUS CATCH OPTIONS FOR 2018

Geoff Veinott, DFO Science

Abstract

Published data suggest that harvest is a strong motivating factor for recreational Atlantic Salmon anglers in NL and that effort will shift to take advantage of harvest opportunities (Veinott et al. 2013). As well, research shows that effort will increase significantly when harvest is permitted for only the latter part of the angling season (Veinott et al. 2013). Data was presented that estimated the change in harvest that could be expected under three different catch options for the 2018 angling season:

1. Catch-and-release angling only for the entire season;
2. A season retention limit of one salmon; and
3. A season retention limit of two salmon.

The results suggested that under a catch-and-release only scenario, total mortality in the fishery would be reduced, at a minimum, by 82%. Under scenario two (retention of one salmon) the estimated reduction in harvest on the island ranged from 40% to 78%, and from 32% to 72% in Labrador. Under scenario three (retention limit of two salmon) the estimated reduction in harvest on the island ranged from 5% to 61%, and from 0% to 53% in Labrador. However, all results assume that angler success and retention rates are constant across all levels of licence sales and percent null effort, and are independent of river classification.

Discussion

A participant asked whether the analysis comparing time of year and percent catch per unit effort was for both Newfoundland and Labrador combined. The presenter clarified that the analysis was not split for Newfoundland and Labrador.

Catch and Release Mortality

There was a discussion on the value used for catch and release mortality. It was explained that catch and release mortality has been standardized at 10% for many years as a result of extensive literature reviews. A participant noted that catch and release mortality varies with water temperature (i.e. fish mortality increases with increasing water temperature). For example, fish mortality was once reported as 8.2%, however at higher water temperatures the mortality rate was above 10%, therefore 10% mortality is used as an average and precautionary value. Another participant agreed that 10% was a reasonable value as mortality can range from

anywhere between 2-23% in the literature. One study conducted a meta-analysis using 274 studies on catch and release, 38% of which involved salmonids. The results showed that the mean value for salmonids was skewed at 17% mortality but the median was under 10%. Participants agreed that 10% should remain as the standardized mortality rate; however water temperature measurements and river closure protocols should also be standardized. Furthermore, instead of modifying the mortality rate, there was a suggestion that more effort should be put in to obtaining more accurate catch estimates.

Fishery closure temperature

A participant suggested that DFO Science should examine water temperature and the threshold for environmental fishery closures. For example, how many days would the fishery be closed if the threshold was set at 21^{o}C or 19^{o}C, and how would this affect mortality rates, effort, and counts. Another participant noted that this type of study has been done in New Brunswick, where the time it takes to close a fishery is much longer than in Newfoundland; therefore, this type of study is feasible and should be conducted in Newfoundland. One participant noted that there should be a drop in catch per unit effort when the fishery is closed, however the data does not support this. Another participant suggested that effects may vary with river size and therefore may not be detected on all rivers. For example, when small rivers close, anglers would likely shift their effort to larger rivers. A participant noted it would be worth researching the distribution of anglers to see if there's an effect from fishery closures.

Angler Handling Practices

It was suggested that mortality could be reduced if anglers were better educated on proper fish handling techniques. There have been many studies showing that mortality decreases when fish are handled correctly. The presenter did note that proper handling techniques (e.g., fish being kept in the water at all times, landed quickly, and the line cut if the fish is hooked deeply) are promoted in the DFO NL Angler's Guide.

Licenses and bag limits

A participant asked if there was a correlation between population size and the number of licenses sold. The presenter responded that the data are available; however the group concluded that this analysis was not necessary as there has been a steady increase in license sales since 2007. There was also a suggestion to look at the impact of catch limits on different classes of rivers.

Angler reporting

One participant expressed concern that some anglers may poach salmon when rivers are closed. As a result, DFO Science should account for "potential" mortality as well as bycatch mortality. Another participant added that angling violations have not increased. A participant asked if anglers only send in fishing activity reports when they catch a salmon. The presenter clarified that the non-respondent phone survey indicates that 30% of anglers with zero catch report effort. In addition, it was highlighted that the phone survey is conducted to obtain catch and effort information from anglers who do not return their log.

Scenarios

A participant stated that given how many anglers in Newfoundland are retention anglers, it would be interesting to explore other scenarios, such as season changes before concluding that catch and release angling only is the best scenario. It was suggested that catch data should be presented by river class to assess where most of the harvest is taken. A participant stated that

to further understand consequences of all scenarios, additional factors such as temperature need to be assessed.

SPAWNING MIGRATION AND SURVIVAL OF ATLANTIC SALMON IN LAKE MELVILLE, LABRADOR

Martha Robertson, DFO Science

Abstract

A collaborative Atlantic salmon telemetry project was initiated in Lake Melville, Labrador, in 2017. The partners on this project included Fisheries and Oceans Canada, Nunatsiavut Government, 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. Travel time from tagging to first detection in the upper Lake Melville area, approximately 140 km, ranged from 4 to 23 days (Mean = 9 days). Salmon were detected entering rivers from August 8 to September 7. There was little movement of salmon between the October and November tracking dates. Tracking will continue until February 2019 (battery life of tags).

Discussion

A participant asked if the number of fish observed in different rivers is proportional to the fish caught in the Rigolet fishery, and if the sampling method is the same. The presenter stated that the sampling method is the same and the number of fish is proportional; however, they did not sample throughout the entire season so this number may not be representative of the entire population. Furthermore, the fish numbers provide important information about overwinter survival, mortality rates, and how long the fish are staying and feeding in Lake Melville. A participant also added that DFO now has genetic data on Atlantic Salmon stocks within Lake Melville that is allowing the assignment of fish harvested to river of origin. A participant stated that there are salmon in Rigolet in May and June, and asked whether they had thought about tagging salmon earlier in the season to see what salmon are entering Lake Melville. The presenter responded that environmental conditions change annually and in 2017, for example, there was too much ice to begin sampling early. Another participant discussed that they had thought about tagging salmon earlier, however based on discussions with the local community there are not many salmon returning before July. A participant asked if parr are found at these sites. The presenter responded that anywhere receivers are placed parr can be found. A participant asked if salmon are detected in the lower part of the river later in the season. The presenter responded that they had never looked; however, salmon were found in the same location from October to November further upriver, and more fish were detected on the later trip as a result of a different flight path. A participant asked where the nets were placed, and

whether or not the salmon may have been intercepted in the net fishery (e.g. between Rigolet and Mulligan). Another participant in the project responded that a great area for salmon fishing is in upper Lake Melville, and although it is possible that some fish were captured and not reported, that number would be minimal. A participant asked if the area with no salmon detections was due to lack of accessible habitat, and the presenter responded that salmon can reach these areas but there were no detections. The presenter indicated that DFO Science will be completing another flight during late-March to check these receivers.

USING TELEMETRY TO EXPLORE ATLANTIC SALMON MORTALITY

Jonathan Carr, Atlantic Salmon Federation

Abstract

Not provided.

Discussion

A participant asked for clarification on RAFOS. The response was that RAFOS is an acoustic based receiver. Several participants expressed concerns about the environmental implications of covering these large areas, and whether the frequency being emitted could be having an impact on marine life. The participants discussed that these receivers have been in the ocean for decades and the frequency is likely below the threshold for most animals, so therefore will not affect marine mammals. However, the presenter stated that implications would be reviewed at an upcoming workshop. A participant asked if they know whether salmon entered the ocean before the freezing conditions occurred, and the presenter responded that they are unsure but it would be interesting to tag fish in the Labrador Sea to gain a better understanding regarding migration routes. A participant asked if the Striped Bass on the North coast of the Gulf of St. Lawrence are from populations going into the St. Lawrence River, or if those populations are crossing the Gulf from the Southwest or Northwest Miramichi River. The presenter responded that they do not have the data from the tags so they cannot answer that question, and indicated that they have seen evidence of long migrations during 2017. Another participant suggested that there was a temperature effect in 2017 that allowed a window for Striped Bass to undertake long migrations. A participant asked about the positional accuracy of tags on kelts. The response was that the positional accuracy is about 200 km, unless the tag is returned in which case the accuracy is much higher.

ATLANTIC SALMON MONITORING, GROS MORNE NATIONAL PARK

Tom Knight, Parks Canada

Abstract

Anadromous Atlantic Salmon in Gros Morne National Park are found in all of the park's major watersheds and in some small streams. Trout River, Western Brook, Deer Arm Brook and Lomond River all have, or have had, historically sizable populations and are scheduled salmon rivers. Salmon management decisions in Gros Morne National Park are based on grilse returns to Western Brook, Deer Arm Brook and Trout River; and over the past five years, a counting fence has been established on at least one of these river systems every year. Grilse returns are assessed against river-specific conservation targets. Western Brook, which has been closed since 1985 exceeded its conservation target in 2016, while Deer Arm Brook exceeded conservation requirements in 2015, which is the last years those rivers had counting fences.

Trout River remains critically below conservation requirements. Trout River has been closed to fishing since 2013 and in 2017, only 13 adult salmon (eight grilse and five large) returned to the river. Electrofishing surveys to assess juvenile salmon densities in Trout River; revealed a mean fry and parr density (#/100m^2) of 12.8 and 3.6, respectively. Gros Morne National Park is looking to establish a salmon recovery program in Trout River. This would involve capturing smolts, raising them in salt water and releasing them directly back into the river to spawn as adults.

Discussion

There was a request for clarification on conservation targets. It was stated that the 100% conservation target is considered good, while the 50% conservation target is considered poor, but not critical. A participant asked whether there has been any indication of poaching. The presenter indicated that poaching is an issue for Trout River. Further, there is significant at-sea mortality from bycatch in commercial nets due to the characteristics of the estuary. A participant asked if Parks Canada were planning on using the same lower and upper reference limits as DFO. The presenter stated that consistent thresholds would enhance long-term reporting and should be considered. Another participant noted that rainbow trout have been observed feeding around the fish plant during the 1980s; however there have not been any sightings since the fish plant has ceased operation. A participant suggested that the observed decline in rainbow trout may be due to angling pressure at the mouth of the river. A participant asked if any rainbow trout had been sampled during electrofishing surveys. It was clarified that rainbow trout were not detected this past year; however, they have been in previous electrofishing surveys.

OCEAN CLIMATE VARIABILITY IN THE NORTHWEST ATLANTIC DURING 2017

Eugene Colbourne, DFO Science

Abstract

The North Atlantic Oscillation (NAO) Index, a key indicator of the direction and intensity of the winter wind field patterns over the Northwest Atlantic, was weakly positive during 2017. The associated atmospheric pressure fields resulted in a reduced arctic air outflow in the northwest Atlantic during the winter months causing near-normal winter air temperatures in many areas. Sea ice extent across the Newfoundland and Labrador Shelf between 45-55°N, although above normal during late spring, was below the long-term mean in 2017. In the inshore regions along the east and northeast coast of Newfoundland, sea ice duration was up to 15-60 days longer than normal. Sea ice in these regions disappeared by mid-June, which ranged from 15-45 days later than normal depending on the area. Annual sea-surface temperature (SST) trends on the Newfoundland and Labrador Shelf, while showing an increase of about 1°C since the early 1980s, were mostly below normal during 2017, driven largely by very cold spring conditions. Summer temperatures at 10 m depth in the inshore waters of Notre Dame Bay at Comfort Cove were 2°C below normal in 2017. The spring warming to 3°C was also delayed by up to 50 days in Notre Dame Bay, due mainly to the late sea ice departure.

Oceanographic data from the fall multi-species surveys in NAFO Divisions 3LNO indicate bottom temperatures were about 1.2 standard deviations (SD) below normal. In Divisions 2J and 3K, fall bottom temperatures continued to decrease from a record high in 2011 to about normal conditions in 2017. Observations from spring and summer AZMP oceanographic surveys indicated that the area of cold-intermediate-layer (CIL <0°C) water overlying the continental shelf off eastern Newfoundland increased over 2016 to about 1 SD above normal, implying more extensive cold winter chilled water throughout the region. A standardized composite climate index for the Northwest Atlantic derived from 28 time series of

meteorological, ice and ocean temperature and salinity since 1950 reached a record low (cold) value in 1991. Since then it shows a warming trend that reached a peak in 2010 and thereafter decreased to mostly below normal conditions during the past four years. The 2015 value was the seventh lowest in 68 years of observations and the lowest value since 1993. Analyses have shown strong associations between environmental conditions and adult salmon run timing and abundance of both large and small salmon. For example, Dempson et al. 2015 showed earlier adult salmon run-times clearly associated with warmer ocean climate conditions. The abundances of both small and particularly large salmon for all insular waters of Newfoundland are also highly correlated ($r=0.75$, $p<0.01$) with sea surface temperatures and climate conditions in general.

Discussion

A question was raised regarding the time lag between the correlation with water temperature at Station 27 and the abundance of large salmon. It was noted that all correlations presented were at zero time lag, with the most significant correlation between winter surface temperatures and abundance indices.

A participant asked whether DFO Science had examined correlations between water temperature and decrease in water levels in Newfoundland Rivers, however, no freshwater data were examined in this study. It was suggested that any such correlation may be most significant during the summer when water level fluctuations are influenced by temperature and precipitation levels.

During a discussion on whether winter ocean temperatures affect the current year's returns, it was stated that warm ocean temperatures positively affect abundance estimates, run timing and at-sea survival. It was also stated that the exact timing of salmon mortality is unknown and it is often the case that poor or delayed salmon returns are related to sea ice conditions. The unusually late sea ice departure from many inshore areas during the spring of 2017, in combination with below normal ocean temperatures in the inshore, may have negatively impacted salmon returns.

It was noted that not only temperature affects returns; for example, the ability for smolts to osmoregulate could also be a factor. There was a suggestion that perhaps two cold winters in a row could have detrimental effects on the NL salmon population. It was also suggested that although there are many challenges with making predictions using oceanographic data, they need to be investigated and it was suggested that DFO Science research the effects of temperature on the abundance of small salmon with a lag effect of one year to investigate how each life stage might be affected.

A study on the extent of sea ice and its correlation with salmon run time was described by meeting participants and the results show that sea ice extent influences the return year more than the smolt year. They also looked at the lag between the date of the peak spring bloom for Hamilton Bank and date of the 25% of the smolt migration in Western Arm Brook (1971+), and related this value to marine survival the following year. Preliminary results showed for every day that the 25% smolt migration lags behind the spring bloom, there is a decline of survival by 0.1%.

There was a question on predictions for water temperatures for the spring of 2018. The response was that the winter NAO index can often indicate the following spring conditions in NL waters. During the winter of 2018 the NAO was still positive but decreased compared to the high values during previous years. High positive values of the NAO historically corresponded to cold

conditions; however, spring sea ice and inshore temperatures are highly influenced by local winds and air temperatures during the spring.

Another meeting participant expressed concerns about the conclusions regarding the correlations between cold water temperatures and low salmon abundance. Abundance was high from 1970-85 when there were cold periods, which contradicts many arguments regarding warm water increasing survival. It is possible that the past few years have been “noise” and that DFO Science should include additional information such as the abundance of small salmon from the previous year, survival, and productivity rate.

OCEAN PRODUCTIVITY TRENDS IN THE NORTHWEST ATLANTIC

Gary Maillet, DFO Science

Abstract

Long-term trends in nitrate inventories indicate substantial reduction over the past decade across the Newfoundland and Labrador Shelf resulting in reduced standing stocks of phytoplankton. Large-scale ocean colour, which provide near-surface data on phytoplankton biomass, were consistent with ship-based surveys showing declining trends in production indices since 2011. A zooplankton community shift has been observed in recent years across the NW Atlantic, characterized by lower abundance of the large energy-rich copepod *Calanus finmarchicus*, higher abundances of small and warm water copepods, and higher abundance of non-copepods. The change in community composition is consistent with the general reduction in zooplankton biomass observed across the northwest Atlantic. Evaluation of a number of physical indices including sea ice extent, ocean climate indicators, and water temperature indicate an association with primary and secondary production indices and may represent important drivers in the ecosystem. The key physical drivers indicate reduced primary and secondary production that may impact transfer of energy to higher trophic levels in recent years.

Discussion

One participant asked for clarification of the term “ biomass fraction”. It was explained that there are two biomass size fractions: mesozooplankton (<1 mm), which consist primarily of small copepods and young stages of the larger calanoid copepods and macrozooplankton (>1 mm), which consist of the adult stages of calanoid copepods, amphipods, euphausiids, etc. There was interest amongst participants regarding the cause of the changes observed in zooplankton biomass size fractions. The presenter indicated that the observed shift in community structure from large to smaller taxa along with higher abundance of gelatinuous zooplankton in recent years, has resulted in a decline in overall biomass for both size fractions by 75%. Possible explanations for some of the reciprocal shifts in the different biomass size fractions include predator-prey interactions and/or interactions with pelagic species. The presenter indicated the observed decline in zooplankton biomass on the Newfoundland and Labrador Shelves has also been observed within the Gulf of St. Lawrence and the Scotian Shelf, which may be part of a large-scale change in community structure across the northwest Atlantic.

One participant asked how copepods relate to salmon. It was explained that marine copepods are not commonly observed as prey in diet studies of post-smolt and young adult stages within the northwest Atlantic. These early life stages appear to commonly feed on pelagic fish such as herring and capelin. Other diet studies in the northeast Atlantic indicate the importance of both fish and crustacean prey such as amphipods, euphausiids, and decapod larvae. There was a

brief discussion on diet studies of salmon that have been conducted to support this general pattern of feeding in post-smolts and adult stages published by Sinnatamby et al. 2009.

NEWFOUNDLAND AND LABRADOR ASSESSMENT OF ATLANTIC SALMON ON MONITORED RIVERS

Nicholas Kelly and Rebecca Poole

Abstract

In 2017, DFO Science monitored the abundance of adult Atlantic Salmon on fifteen rivers in Newfoundland and four rivers in Labrador. Fifteen monitored rivers showed declines in total returns, and twelve of these showed declines of greater than 30% compared to the previous generation average (five years in Newfoundland, six years in Labrador). Spawning escapements were below the river-specific Limit Reference Point (LRP) on three of the four assessed rivers in Labrador, however, the fourth river exceeded its Upper Stock Reference point (USR). In Newfoundland, spawning escapements were below the LRP for nine of the fifteen (60%) assessed rivers. Of the remaining Newfoundland rivers assessed in 2017, five out of fifteen (33%) exceeded the USR, and one assessed river fell between the LRP and USR. In 2017, juvenile salmon (smolt) migrating to sea were counted on five assessed rivers in Newfoundland. A complete smolt count was obtained for the first time on Garnish River. Smolt production decreased on three of four rivers and increased on one compared to the previous five-year means (2012-16). Marine survival estimates, based on 2016 smolt counts and adult returns in 2017, averaged 5.7% (range of 3.7-7.7%) across the monitored rivers which had complete smolt counts in 2016. FSC and subsistence fisheries harvests in Labrador were inferred from logbook returns, and estimated 13,600 salmon in 2017 (7,200 small, 6,400 large), which is 4% lower than the previous six-year mean (14,100 salmon in 2011-16).

Discussion

During the presentation, a participant asked for clarification on the “previous six-year mean.” The response was that the previous six-year mean includes 2016 when salmon returns were anomalously low (i.e. 2011-16). There was also a question regarding how fish are sized. The response was that they are categorized as small (<63 cm) or large (≥63 cm). There was a discussion on possible explanations for the dramatic increase in angling effort in Labrador during 2017. It was suggested that camps on Sand Hill and Eagle River could explain this, or there a possible displacement of anglers following fisheries closures in Newfoundland. A participant suggested that the data obtained from the Rocky River fishway should be removed for 2015 and 2016 as there were technical issues with the operation of the fishway that may have affected the number of salmon returning to the river.

Following presentation if adult sex ratio data, a participant asked if there was any change in the percentage of adult females in response to the reported reduction in the proportion of age 3 smolt. The response was that there are not enough years of data to see a change. It is possible to use collected scales to sex salmon over the time series; however, this has not been completed. Participants inquired as to how many rivers met the conservation egg requirement (CER). In Labrador, three out of four rivers did not achieve CER, and 9 out of 15 rivers in Newfoundland did not achieve CER. The rivers that were did acheive CER were English River, Campbellton River, Middle Brook, Western Arm Brook, Torrent River, and Northeast River (Placentia). A participant asked if the CER was reflected in the returning or spawning salmon. The response was that CER is based on returns and the number of spawners. There was discussion around the importance of presenting the status of the salmon in rivers before and

after exploitation to better understand the health of the rivers. One participant noted that since rivers are given a classification, it would be useful to see how rivers are performing within their assigned classification. There was a discussion around the validity of using the monitored rivers as index rivers. A participant was hesitant to consider these rivers as index rivers and there was a suggestion to monitor rivers using a stratified random design in order to assess their value as index rivers. Participants reached consensus that given the extensive time series on these rivers, they should be used as index rivers.

A participant suggested there should be an outline on how the mid-season predictions compares with the end-of-season predictions. However, the angling data from 2017 was not analyzed at the time of the meeting, and it was noted that the end-of-season report is preliminary. One participant asked if variation in smolt age is associated with marine environmental conditions, or a response to growth potential in the freshwater environment. The presenter stated that the literature does not support increased survival with body size; rather smolt survival depends on conditions in the marine environment. Furthermore, survival at age is inconsistent and our knowledge of size-dependent salmon survival is limited.

A participant asked about how counts are adjusted when counting fences are washed out. It was clarified that the data can in some cases be adjusted based on comparison with returns from previous years. Another participant stated that large gaps in data are rare as washouts typically occur over a limited number of days.

RETURNS IN RIVER CLASSES

Geoff Veinott, DFO Science

Discussion

There was a request to show correlations between angling catch and total returns for select rivers in each river class. A participant noted that the rivers appeared to act as a good index. In addition, the analysis was noted to be beneficial as it outlined the percentage of catch occurring within each river class. It should be noted that not all rivers were used in the analysis. However, the rivers used make up a substantial amount of the catch. A participant expressed concern that rivers are considered an index of the local area even if the catches between rivers are highly correlated. However, it was concluded that even before the river classification system was implemented, angling catches as well as commercial catches were correlated, and that over broad areas rivers are correlated. Participants suggested examining combined rivers instead of individual rivers to allow a better understanding of large scale processes for this stock. It was also highlighted that the effects of anomalous years with respect to temperature and other environmental factors may not be detected if only individual rivers are examined.

CAPELIN

Fran Mowbray, DFO Science

Discussion

There was a short presentation on the status of the capelin stock in NL and how the data could be incorporated into the stock assessment of Atlantic Salmon. One participant proposed that if salmon feed on capelin and move towards Greenland, then the salmon population could thrive when capelin are distributed further north. A participant suggested that an analysis between abundance and distribution of capelin, and abundance of returns and smolts may be beneficial with regards to predictions of salmon abundance. Another participant suggested that the

inclusion of capelin in salmon assessments is important from an ecosystem perspective. Also, the drop in the capelin index correlates well with the drop in the salmon index. However, it was also noted that there was a low presence of capelin found in the stomach contents of salmon located near Greenland.

DRAFTING OF SCIENCE ADVISORY REPORT

Discussion

In-season review

A participant suggested that the mid-season assessment in 2017 was successful and was a good indicator of 2017 returns. There was discussion around the timing of the assessment meetings for Atlantic Salmon. Currently, full assessments for Atlantic Salmon in NL are scheduled to occur biannually and can occur annually if triggered (see DFO 2018 for triggers).

Five-year mean

It was suggested again by several participants that the mean abundance in the future should be compared to counts in 2011-15 rather than the past five-year mean, as 2016 and 2017 years were extremely poor. Instead of comparing counts to the previous five year mean it should be rephrased to compare mean counts to abundance in 2011-15 to account for the present low stock levels.

Summary SAR bullets

There was debate on whether abundance indices for NL should be included as a bullet to show the overall change in population abundance. It was noted that an index cannot be completed for Labrador; however, an index for Newfoundland as well as Sand Hill and Southwest Brook could be included. It was suggested that in addition to indices, a heat map to visualize returns in each area should be tabled at the next stock assessment meeting.

There was discussion on index rivers, and several participants suggested that new rivers should be sampled in the future, or that sections of rivers should be excluded (e.g. the upper portion of Exploits River) for future assessments. A participant requested clarification on why only 16 out of 19 rivers were reported and it was stated that long-term data were only available for 16 rivers.

RESEARCH RECOMMENDATIONS

1. Analyze existing temperature records to determine the impact of temperature levels and closure days at varying thresholds.
2. Standardize closure protocols based on scientifically recommended thresholds.
3. Improve our knowledge and understanding of marine mortality of Atlantic Salmon by continuing to explore spatial and temporal distributions.
4. Evaluate whether spring temperature has a larger effect on smolts or adults.
5. Research potential for detecting escapees using eDNA.
6. Research possible correlations between capelin and salmon abundance.
7. Include abundance index and estimates of abundance used in ICES.

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).

Sinnatamby, R.N., Dempson, J.B., Chaput, G., Caron, F., Niemela, E., Erkinaro, J., and M. Power. 2009. Spatial and temporal variability in the trophic ecology of Atlantic Salmon in the North Atlantic inferred from analyses of stable isotope signatures. American Fisheries Society Symposium. 69: 447-463.

Veinott, G., Cochrane, N. and J.B. Dempson. 2013. Evaluation of a river classification system as a conservation measure in the management of Atlantic salmon in insular Newfoundland. Fisheries Management and Ecology. 20: 345-459.

Veinott, G., Variyath, A.M. and L. Pike. 2018. Response of anglers to less restrictive harvest controls in a recreational Atlantic Salmon fishery. North American Journal of Fisheries Management. 38(1): 210-222.

APPENDIX I – TERMS OF REFERENCE

Assessment of Atlantic Salmon in Newfoundland and Labrador

Regional Peer Review Process - Newfoundland and Labrador Region

February 27-28, 2018
St. John's, NL

Chairperson: Fran Mowbray, 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, DFO 2017). 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 the Newfoundland and Labrador Region was completed for 2016 returns (Fisheries and Oceans Canada [DFO] 2017). Fisheries Management will use information from this Regional Peer Review Process as the basis for revising the current salmon management plan.

Objectives

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

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 and Land Resources
- Indigenous groups
- Academia
- Other invited experts

References

DFO. 2017. Stock Assessment of Newfoundland and Labrador Atlantic Salmon – 2016. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2017/035.

APPENDIX II – AGENDA

Assessment of Atlantic Salmon in Newfoundland and Labrador

Chair: Fran Mowbray

February 28-March 1, 2018

Memorial Room - Northwest Atlantic Fisheries Centre
80 East White Hills Road, St. John's

Wednesday, February 28

Time	Topic	Presenter
09:00	Opening remarks and overview of Regional Peer Review Process	*Fran Mowbray*
-	Advances in the genetic analysis of mixed stock Atlantic Salmon fisheries in the North Atlantic	*Ian Bradbury*
-	Genetic interactions among wild and farm escaped Atlantic Salmon in southern Newfoundland	*Ian Bradbury*
-	Potential change in angling harvest under various catch options for 2018	*Geoff Veinott*
-	Spawning migration and survival of Atlantic Salmon in Lake Melville, Labrador	*Martha Robertson*
-	Using telemetry to explore Atlantic Salmon marine mortality	*Jonathan Carr*
-	Atlantic salmon monitoring, Gros Morne National Park	*Tom Knight*
-	Biological and Physical Oceanography Overview	*Eugene Colbourne and Gary Maillet*
-	Newfoundland and Labrador assessment of Atlantic Salmon on monitored rivers	*Nicholas Kelly and Rebecca Poole*
-	Review of draft Science Advisory Report	*All*

Thursday, March 1

Time	Topic	Presenter
09:00	Review of draft Science Advisory Report – continued	*All*
-	Discussion of Research Recommendations	*All*
-	Upgrading of Working Paper to Research Document	*All*
-	Closing remarks and *ADJOURN*	*Fran Mowbray*

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.
- This agenda may change.

APPENDIX III – LIST OF PARTICIPANTS

Name	Affiliation
Jonathan Carr	Atlantic Salmon Federation
Fran Mowbray	Chair
Blair Adams	Department of Fisheries and Land Resources
Norman Penton	Department of Fisheries and Land Resources
Erika Parrill	DFO – Centre for Science Advice
James Meade	DFO – Centre for Science Advice
Jackie Kean	DFO – Resource Management
Kim Penney	DFO – Resource Management
Jason Simms	DFO – Resource Management
Ian Bradbury	DFO – Science
Travis Van Leeuwen	DFO – Science
Rebecca Poole	DFO – Science
Martha Robertson	DFO – Science
Nick Kelly	DFO – Science
Carole Grant	DFO – Science
Trevor Fradsham	DFO – Science
Geoff Veinott	DFO – Science
Gary Maillet	DFO – Science
Eugene Colbourne	DFO – Science
Curtis Pennell	DFO – Science
Kate Dalley	DFO – Science
Gerald Chaput	DFO – Science (Gulf Region)
Dave Reddin	DFO – Science (Retired)
Rex Porter	DFO – Science (Retired)
Brian Dempson	DFO Emeritus
Bob Rogers	DFO Science
Ian Fleming	Memorial University
Craig Purchase	Memorial University
Todd Broomfield	Nunatsiavut Government
George Russell	NunatuKavut Community Council
Tom Knight	Parks Canada
Jonathan Strickland	Qalipu Mi'kmaq First Nation Band
Emma Cooke	Rapporteur
Don Hutchens	Salmonid Council of Newfoundland and Labrador
Jim McCarthy	Wood plc
Christoph Konrad	Wood plc