Projects of Interest to the Board and its Work

Purpose

The purpose of this paper is to provide an update on projects of interest to the Board and its work, namely the Likely Suspects Framework, the ROAM Programme, SAMARCH and the SMOLTrack projects.

Decisions

- no decisions are required.

Background

At the 2020 Annual Meeting of the International Atlantic Salmon Research Board (the Board), ICR(20)16, it was agreed that an Agenda item would be retained in future years which focused on projects of interest to the Board and its work. This would include information on projects where NASCO has some ownership (such as EU-funded projects, the SALSEA-Track successor, when agreed, and the Likely Suspects Framework) and other relevant projects; those researchers could be invited to contribute information, CNL(20)12. The Board asked the Secretary to provide updates on projects where NASCO has some ownership and, through the Board and SAG members, to seek information on new and emerging projects that would be of interest to the Board and its work.

This paper contains the information provided in response to the Secretariat's request for information in relation to projects of interest to the Board.

LIKELY SUSPECTS FRAMEWORK PROGRAMME

Background

At its 16th Annual Meeting (2017) the Board agreed to part-fund a workshop on The Likely Suspects Framework (LSF) concept. An Atlantic Salmon Trust (AST) workshop in 2017 developed the concept and the proceedings were published in the AST Blue Book series.

The 35th Annual Meeting of NASCO (2018) endorsed the LSF concept and agreed to request the Secretary to explore with ICES how best to integrate Atlantic salmon marine survival and population data with relevant ICES marine databases, and to suggest that a number of joint workshops might be convened. The first of these workshops (WKSalmon) was held in June 2019 with the second completed in 2022.

The LSF project has been developed by the UK's Missing Salmon Alliance[1] since 2019, with an agreed 5-yr implementation plan to:

- provide and mobilise new knowledge on the drivers of salmon mortality from across the full life-cycle in sea and freshwater; and

[1] [The Missing Salmon Alliance brings together leading salmon conservation organisations across the UK -the Atlantic Salmon Trust, Game & Wildlife Conservation Trust, Fisheries Management Scotland, The Rivers Trust and the Angling Trust. It aims to reverse the devastating collapse in wild salmon populations around the UK. By combining expertise, coordinating activities and advocating effective management solutions MSA is focused on ensuring that wild Atlantic salmon populations survive and thrive in rivers, lochs and seas for the next generation.]

- generate new stock forecasting and scenario-testing capacities to support salmon managers' appraisal of options, and guide their activities.

Over the last three years, reports were delivered to the Board outlining project progress. The current report provides an update on LSF project progress over the past 12 months.

Progress in 2022

Supporting co-operative research and the ecosystems-based approach for Atlantic salmon was assisted in 2022 by the publication of primary scientific articles on the need for a life-cycle approach in salmon management and the Salmon and Ecosystem Data Hub (SalHub). The SalHub initiative has supported the collaborative development of an international database for sharing salmonid PIT tagging records. This now includes the capacity for users to register their PIT tags and to search PIT tag records collated from multiple pelagic fish processing plant each year. Within months of release, this collaborative venture has already provided new information on salmon marine migration with a smolt tagged in the River Scorff being recorded in July as a capture in a haul by an Icelandic mackerel-fishing vessel.

In September 2022 four members of the LSF team were active participants in the NASCO-ICES WKSalmon2 workshop .This group considered how to integrate new and emerging research knowledge into a marine mortality hypothesis testing framework identification and mechanisms to mobilise priority data sources. It produced a focused ICES data call for time series of commercial pelagic fish landings to assist in considering salmon bycatch risks. In October 2022 the LSF team also contributed three oral presentations to the International Year of the Salmon Symposium in Vancouver, Canada and have submitted two papers for the proceedings.

Development of an underlying salmon mortality framework has taken shape in 2022 as a new salmon stage-state life-cycle model, tuned using data from a focal population (River Bush, NI), and spanning a period (1980 to 2020) reflecting a range of population abundances. Sensitivity analysis and model tuning on the base-case model has been carried out and it now provides the foundation upon which we are building our Salmon Management Decision Support Tool.

Provision of a Salmon Management Decision Support Tool has advanced considerably in 2022. It now provides an online scenario-testing platform that is stage-specific in its inputs, but provides population forecasts that reflect cumulative responses across the whole life-cycle. This tool will be developed further with stakeholder involvement in 2023 (to release online as Version 1.0) to expand and tailor the range of priority stage-specific and cumulative changes that it can consider. It will provide some previously unavailable support to salmon managers by helping explore and communicate the possible population responses to key life stage interventions, and possible environmental changes.

Researching the drivers of salmon mortality at sea has advanced in 2022 in the study of spatial and temporal variation in the prey energy available to southern European post smolts during early marine migration. This work (manuscript in prep) has revealed links between salmon marine return rates and zooplankton energy fluctuations through time and highlighted the importance of regional variation. This work will feed into the development of relevant indicators for forecasting marine conditions for Atlantic salmon and the Salmon Management Decision Support Tool. Developing this work further in 2023 will focus on testing hypotheses regarding marine predation and bycatch risks.

Developing science outputs that contribute to the evidence base has been achieved by the LSF programme in 2022 with significant contributions to the following outputs:

Bull, C.D., Gregory, S.D., Rivot, E., Sheehan, T.F., Ensing, D., Woodward, G. and Crozier, W., 2022. The likely suspects framework: the need for a life cycle approach for managing Atlantic salmon (*Salmo salar*) stocks across multiple scales. *ICES Journal of Marine Science*, *79*(5), pp.1445-1456. https ://doi.org/10.1093/icesjms/fsac099

Bull, C. & Luedke, W. (*in review*) Building salmon life cycle and risk assessment frameworks to address future management challenges. Salmon Data Mobilization, NPAFC

Diack, G., C. Bull, S.A. Akenhead, T. van der Stap, B.T. Johnson, E. Rivot, R. Patin, P.-Y. Hernvann, A. Schubert, T. Bird, M. Saunders and W. Crozier. 2022. Enhancing data mobilisation through a centralised data repository for Atlantic salmon (*Salmo salar* L.): Providing the resources to promote an ecosystem-based management framework. *Ecological Informatics* 101746. https://doi.org/10.1016/j.ecoinf.2022.101746

Diack, G., Bird, T., Knight, A., de Eyto, E., Bayer, J., Walker, A., Johnson, B.T., van der Stap, T., Nevoux, M., Bull, C., Hanson, N., Brophy, D., Jones, M., Akenhead, S.A. (*in review*) Salmon Data Mobilization, *NPAFC Bulletin*

ICES. 2023. The Second ICES/NASCO Workshop on Salmon Mortality at Sea (WKSalmon2; outputs from 2022 meeting). ICES Scientific Reports. 5:36. 69 pp. https://doi.org/10.17895/ices.pub.22560790

Tyldesley, Banas, Diack, Johns, Kennedy & Bull (*in prep*) Declining feeding conditions for forage fish larvae in the Northeast Atlantic: an indicator for Atlantic salmon marine survival.

Tyldesley et al., (*in prep*) Assessing the influence of spatial and temporal scales on using water temperature data as an indicator of ecosystem change for Atlantic salmon.

ROAM APPROACH TO MARINE TRACKING

RAFOS Ocean Acoustic Monitoring (ROAM) is an acoustic tracking system where low frequency long ranging sound wave 'pongs' are emitted from ocean moored sound sources and received by a tag equipped with a hydrophone attached to the study animal. A primary advantage of the ROAM approach is the long range of the 'pongs' which could result more accurate geolocation over a wider spatial and temporal range compared to traditional light-based methods. The development of the ROAM approach to marine tracking is being led by researchers at the Woods Hole Oceanographic Institute (WHOI), USA.

ROAM was first brought to the attention of the Board in 2017 (CNL(17)9) and annual updates have been provided to the Board since (ICR(18)06; CNL(19)09; ICR(20)16; CNL(21)12; CNL(22)10). In addition, a workshop involving researchers from the North Atlantic and Pacific oceans was held in 2018, which provided a detailed overview of the ROAM approach (https://repository.library.noaa.gov/view/noaa/22044). ROAM is a re-design and re-purposing of a common oceanographic monitoring technique. As such, efforts have been focused on evolving the monitoring approach to be suitable for tracking marine animals in the ocean and on conducting field trials to verify that the equipment performs since that time. Unfortunately, the project has experienced numerous delays associated and caused by the COVID-19 pandemic, equipment/supply shortages, equipment failure and a lack of dedicated funding. However, in spite of these setbacks all collaborators remained keen on the project and progress continues.

In early summer 2021, two ROAM sound sources were deployed off the coast of the Northeast United States and a series of opportunistic glider missions were organized to conduct the trials. Unfortunately, the test were not optimally designed (e.g. gliders were programmed to stay relatively shallow) or equipment malfunctions (e.g. glider breakdowns) significantly decreased the efficacy of the field trials. However, results from one of the gliders were recovered and were encouraging. This was the first open-ocean test of a ROAM tag. The glider-attached tag

was deployed within a large warm-core ring and registered 14 (of 32 possible) pong detections. Most of the missed detections were when the glider was in the mixed layer or at the surface, where ambient noises from wind and waves are high. Distances between the glider and the sound source ranged from 42 to 84 km during the test. Geolocation estimates from the ROAM tag were within ~1 km of the gliders actual position.

Additional field trials were conducted in 2022. A dedicated glider mission was organized and the glider was programmed to behave like a migrating fish with frequent dives to depth. Additionally a dedicated tagging effort was conducted where large pelagic animals (e.g. sharks, swordfish) were fitted with both GPS and ROAM tags and released. Unfortunately the newly constructed ROAM tags had a fatal chip malfunction that has since been traced back to the manufacturing process. Some ship board data was collected, which measured the efficacy of the sound source 'pongs', but unfortunately not tag data was collected.

The chip issue has since been remedied and a batch of newly manufactured chips have been produced are being incorporated into the ROAM tags. Glider mission trials are scheduled for 2023 and barring any additional issues, field data assessing the performance of the ROAM tags in the marine environment will be available in late 2023.

In spite of the setbacks experienced over the past few years, interest remains high in ROAM and resources are being mobilised to support further field testing. In addition, numerous funding proposals are being developed, or have been developed and submitted, for consideration. These proposals are generally looking for funding to support ROAM monitoring projects across vast areas of the Northwest Atlantic and the Great Lakes of the United States. Collaborating researchers recognise the importance of having positive results from field trials to strengthen their proposals. However, given the results to date and the potential the technology holds for tracking animals over vast aquatic areas, they are pursing funding opportunities regardless, while eagerly awaiting the results from the planned field trials.

SAMARCH

The SAlmonid MAnagement Round the CHannel (SAMARCH) project, set out to deliver new information to improve the protection of our threatened wild salmon and sea trout in estuaries and coastal waters. It started in 2017 and held its closing conference on 14 and 15 March 2023 in Southampton, UK.

Part-funded (69 %) by the Interreg France England Channel Programme and with significant contributions from the Missing Salmon Alliance (MSA), SAMARCH has been a collaboration between scientists and those involved in the protection and management of our threatened wild salmon and sea trout with a particular focus on stocks in the rivers of the France England Channel area. Wild salmon in particular are under threat, having declined significantly over the last 40 years. Now, most populations in our rivers are classified as 'at risk' by the government.

The reasons for the declines are complex and are a combination of climate change effects and more direct man-made issues in freshwater, estuaries and at sea. SAMARCH focused on the more direct anthropogenic impacts. For example, the Channel's waters are some of the most intensively fished and developed waters in the whole of Europe which may cause a number of issues; from the by-catch of these fish in commercial fisheries to disturbance, displacement and loss of habitats by estuarine and coastal developments such as dredging and renewable energy schemes.

The effective protection of these fish has often been hampered by a lack of information, evidence and data. SAMARCH aimed to fill this gap. The project was led by key MSA member, the Game and Wildlife Conservation Trust (GWCT), and brought together a partnership between those involved in the management and research of wild salmon and sea trout on both sides of the Channel.

The project has undertaken a number of research projects to collect new information on the behaviour of juvenile and adult salmon and sea trout in the estuaries of four rivers and the Channel's coastal waters. SAMARCH collected new data and analysed historical data to provide new and updated information to inform the salmon stock assessment models used in England and France to more accurately manage stocks. It engaged with stakeholders at local, national and international levels, policy makers, and provided training for future managers.

SAMARCH achieved the following:

- collected information on the timings, movements and survival of 900 juvenile salmon and sea trout through the lower river and estuary of 4 rivers;
- tagged 314 adult sea trout in 3 rivers and collected data from 84 of them on their marine movements, swimming depths, survival and reasons for mortality at sea;
- individually tagged nearly 100,000 juvenile salmon and trout on two rivers to assess marine survival rates;
- collected data from 24,000 juvenile salmon and trout (called 'smolts') as they migrated out to sea in Spring;
- used molecular genetics to sex 9,500 juvenile salmon and trout;
- read 10,000 sets of salmon scales for changes in the ages and growth of fish at sea since 1971;
- developed genetic data bases for salmon and trout from all rivers flowing into the Channel's waters;
- assigned sea trout caught at sea back to their rivers of origin;
- published 17 Scientific papers thus far;
- two PhD projects;
- 12 MSc projects; and
- over 200 students have received experience over the project's 6 years.

A few points to highlight from the project are as follows:

- Mortality of salmon smolts in the lower river Frome: 20%. Mortality in the estuary can be high, up to 50%.
- Mortality of salmon smolts in the lower river Tamar: 9%. Mortality in the Tamar estuary: 9%.

This shows the importance of different estuary types, and raises questions of pressures, human modification, barriers, pollution etc perhaps predation upon survival and highlights the need to know each river system and where management of ecosystems can be improved. Interestingly at present, similar numbers of adult fish are found in both rivers; they both just meet egg deposition limits.

- The other significant finding from SAMARCH, from looking at the scale records of salmon, is that a significant decline in growth for salmon can be seen in the key first six month period at sea; the first summer at sea shows that marine growth is at a low since 2005.

Systemwide changes in the Norwegian sea

In early stages of migration, salmon post smolts do best when preying on juvenile fish species, such as sandeel, blue whiting and herring. A lack of this prey means that post smolts have to

make do with other less nutritious food to survive and do not grow as well. If the salmon do not reach a critical size, they will stay out at sea feeding for longer. So explaining lack of returning grilse and a slight increase in MSW that has been seen in last decade, but trend on some rivers of smaller salmon. Fish size importance for egg deposition.

SMOLTRACK PROJECTS

The EU has provided funding to NASCO to support the following SMOLTrack projects:

- Understanding and comparing early mortality of European salmon populations at sea (SMOLTrack I – completed);
- Comparing mortality of European salmon populations at sea using multiple-method telemetry studies (SMOLTrack II – completed);
- Quantifying smolt survival from source to sea: informing management to optimise returns (SMOLTrack III – completed in December 2022); and
- Quantifying salmon survival from river exit to return as adult: Collecting thermal and behavioural data to refine smolt to adult survival indices (SMOLTrack IV – ongoing. Update below).

The SMOLTrack V project is under discussion with the EU at the time of writing.

The website for the projects is: SMOLTRACK. There is also information on the Board website.

SMOLTrack III: Quantifying smolt survival from source to sea: informing management to optimise returns

Despite conservation efforts, wild Atlantic salmon stocks have experienced declines throughout the global range of distribution. Maximising the number of wild smolts in good condition that leave the river to the ocean can help minimise the impacts of changing ecosystems and low marine survival. Based on the platform developed in SMOLTrack I and II, this project (SMOLTrack III) investigated several key factors potentially contributing to smolt mortality during their transition from freshwater to the marine environment. The following section summarises this project's objectives and its main findings.

Objective 1: Eval-smolts – Evaluate wild smolt survival during migration

A tracking study was undertaken in 2021-22 to investigate whether the release point for tagged smolts impacted subsequent migratory success and survival. The underlying hypothesis was that smolts released at or upstream of the putative bottleneck would suffer higher losses (e.g. due to predator habituation downstream of a smolt-trap) than smolts released downstream of the bottleneck zone. To test this hypothesis, equal sized groups of smolts were captured at the smolt trap, tagged with 7 mm diameter acoustic tags, and subsequently released at either the trap ('Trapped') or below the bottleneck zone ('Trucked'). This study was performed in the River Black, a tributary of the River Erriff (Ireland), and in the River Bush (Northern Ireland). Both are important salmon index systems. The downstream migrations of tagged smolts were monitored by acoustic arrays in the river, fjord, and coastal mouth. In the River Bush, smolts released below the bottleneck ('Trucked') had better survival compared to smolts released at the trap ('Trap'), with survival rates of 88 % (2021) and 90 % (2022) in the trucked groups and 55 % (2021) and 69 % (2022) in the trapped groups. In the River Black, trapped and trucked groups had low survival in 2021, with survival rates of 6 and 18 %, respectively. Therefore, in 2022 the groups (Trap / Trucked) were subdivided as two types of tags were used to see if tag size had an impact on survival. Preliminary results from 2022 indicate greater survival in the smolt group transported past the bottleneck ('trucked') for the bigger sized-tag (7.3 mm), however, no difference was observed between trucked and trapped groups for the smaller tags (6.3 mm). There was no difference in survival between groups tagged with smaller (6.3 mm)

versus bigger (7.3 mm) tags. The results from Eval-smolt will be analysed and published during 2023.

Objective 2: Thermo-smolt – Quantifying the influence of climate change on salmon production

Thermo-smolt investigated the effect of thermal stress and the adaptability of smolts under various temperature / climate scenarios. Nineteen temperature loggers were procured for work package 2 and deployed in the river, estuary and sea areas of study rivers in order to collect baseline data on water temperatures. This includes loggers for Denmark (one logger (River Storaa)), three for Ireland (River Erriff), six for Northern Ireland (River Bush), five for Portugal (Minho and Lima river basins) and four for Spain (River Ulla and River Minho). The loggers remain deployed and continue to collect water temperature data. Corresponding data on salmon smolt runs was collected using smolt traps in Ireland (River Erriff), Northern Ireland (River Bush), Spain (Ulla and the Tea tributary of the Minho), and Portugal (Mouro, tributary of the Minho). Hydraulic data has proved difficult to compile as there is variable monitoring infrastructure available between study rivers. Smolt and temperature data are currently being compiled by project partners with corresponding assessments on duration of peak of run timing, and the age and growth of smolts being undertaken. In addition, relevant historical datasets have been identified to support this work. A study to monitor the behaviour of a group of hatchery-reared smolts held at an elevated temperature prior to their migration into coastal waters, and compared to that of an untreated group was considered in detail by the project group, but it was decided not to undertake this work due to the impracticalities of conducting such a study and the limitations of using hatchery fish to represent wild conspecifics.

Objective 3: Evaluate telemetry-based assessments to provide accurate information on smolt migration and survival

This study investigated the effects of trapping, handling, and tagging on the migration success of Atlantic salmon smolts using acoustic telemetry. Two groups of smolts were tagged with acoustic transmitters: One group was captured and tagged before smolt migration (‘Up’) and the other group was trapped in a rotary screw trap and tagged during seaward migration (‘Down’). We hypothesized that interrupting smolts in traps during their seaward migration could impact both their survival and speed of migration, thus introducing a bias into the results from telemetry survival studies. Migration of tagged smolts was monitored using acoustic arrays in the river and at sea outlet. Data were collected from the River Skjern (Denmark) in 2020 and 2022 and in the River Ballycastle (Northern Ireland) in 2022. Preliminary results from the River Skjern indicate similar survival between ‘Up’ (42 %) and ‘Down’ groups, with survival rates of 42 % and 50 %, respectively. Results from the River Ballycastle are expected soon, as we await the download of the offshore receivers. The results from these three field studies will be analysed and published during 2023/24.

Conclusions

The findings from SMOLTrack III have advanced our understanding of how bottlenecks can influence the size of smolt runs and highlight the benefits of moving smolts past identified bottlenecks. These results are highly relevant for policy makers and managers seeking to reduce smolt mortalities during their riverine migration. The recent increase in awareness about negative effects of barriers and other bottlenecks is in part an outcome of the studies performed in SMOLTrack I – III. Identifying and removing / mitigating bottlenecks may represent one of the fastest and potentially easiest ways of increasing adult return of salmon populations. SMOLTrack III also provided the foundation for a temperature logger infrastructure with an extensive latitudinal distribution, which will be used to track the ongoing effects of climate change on wild salmon stocks. Finally, the findings from objective 3 indicate that trapping smolts during their seaward migration does not influence their survival, further validating the standard operating procedure (SOP) and the method of using trapped smolts for investigating

behaviour and survival. These findings are highly relevant to improve methods used by the academic community and fisheries managers monitoring smolt runs, using fish traps.

SMOLTrack IV: Quantifying salmon survival from river exit to return as adult: Collecting thermal and behavioural data to refine smolt to adult survival indices

WP 1: OceanTemp-smolt – Describing temperature experience of coastal and ocean migrating smolts

Introduction

This WP proposed to record the range of temperatures that migrating salmon from smolt stage to adult river return experience over their full oceanic migration. It is recognised that marine temperatures are likely to influence survival and behaviours of smolts at sea. Yet data on the thermal environment experienced by migrants, initially in freshwater, and subsequently in transitional and marine waters, are limited. Few data are available due to the small size of salmon smolt which cannot accommodate internal implantation of temperature logger tags which typically exceed the tag burden smolts can tolerate. Recent advances in logger technology has resulted in increased miniaturisation and this presented a unique opportunity for SMOLTRACK IV to collect a key dataset (thermal data for migrating salmon smolt).

Methods

A total of 400 wild salmon smolts were surgically implanted with Star Oddi DST nano-T tags* during the smolt migration window in Ireland between 2021 and 2022 (Table 1). Rivers Erriff (run by Inland Fisheries Ireland, Ireland) and Bush (run by AFBI, Northern Ireland) were selected based on accessibility to smolt through already existing trapping as well as full covering traps catching adult fish upon return. Migrating smolts were trapped in a screw trap temporarily deployed in the middle reaches of the River Erriff, and in a permanent trap operating the River Bush (at Bushmills Salmon Station). Smolts were also implanted with a PIT tag to trigger a DST implanted adult fish removal at each of the permanently monitored fixed upstream trap sites on these rivers, if any tagged adults returned.

Table 1. Summary of salmon smolts jointly implanted with Star-Oddi DST nano-T tags and PIT tags in 2021 & 2022

System	Date	Method	No. implanted	No. PIT tagged
Erriff	April/May 2021	Screw trap	100	100
Erriff	April/May 2022	Screw trap	100	100
Bush	April 2021	Fixed trap	100	100
Bush	April 2022	Fixed trap	100	100
TOTAL			**400**	**400**

* https://www.star-oddi.com/products/data-loggers/small-thermo-logger

For the 2021 study the nano tags were programmed to log temperature (ºC) every 30 min for 1 year from mid-April 2021 to mid-April 2022 and subsequently hourly to mid-Sept 2022. The same programming regime was operated for smolts implanted in Spring 2022. Maximum battery life is typically 14 months when logging at 10 min intervals (Star-Oddi data).

The Erriff and Bush upstream salmon monitoring traps were monitored daily in 2022 to check for any nano-T tagged returning adults.

Results

One tagged adult 1 SW salmon has returned and been recovered from the 2021 tagging study. This fish, weighing 1.46 kg, was recorded at the River Bush trap on 3/10/22. The nano-T tag was recovered from the fish and the data has been downloaded. The body of the fish has been retained to allow for additional study.

The nano-tag data showed that the tagged salmon inhabited marine temperatures ranging from 2.6^{o}C (25/8/21) to 12.84^{o}C (01/06/22). Whilst at sea the thermal conditions experienced sometimes varied by over 3^{o}C on the same day, perhaps indicative of diving behaviour or active movement between areas of divergent water temperature.

The adult traps will be monitored at both sites in 2023 and 2024 for potential returnees from the 2022 smolt tagging.

Conclusions

The recovery of one tag has provided high quality data of the thermal experience of one salmon from the smolt to returning adult stage. This is the first known record of the thermal experience of wild salmon from smolt to adult return, a period of approximately 17 months. This study has demonstrated that such a study is feasible using new technology, allied to the availability of high-quality trapping infrastructure in the systems chosen.

It is hoped that further tag recoveries will occur in summer / autumn 2023 when some adult survivors of smolts tagged in 2022 are anticipated to return to either or both sites. Potentially 2 SW fish could also be recovered in 2024. Data from additional recoveries will allow for a more comprehensive analysis of the thermal regime preferences in the marine phase of Atlantic salmon.

WP2: FFPT-adult – Fit for purpose tagging of adult salmon to describe / information / understand feeding behaviour and backtrack return migration in the north Atlantic.

Introduction

Detailed information about the marine behaviour and whereabouts of Atlantic salmon in marine areas is limited and difficult to obtain, especially on a population level. However, using biotelemetry in combination with genetic assignment may be a viable way forward, if salmon can be caught, tagged and released in good condition. This requires access to salmon of a certain size and in good condition, a non-trivial task. However, based on historic records and efforts made in western Greenland by North American colleagues, we hypothesized that it would be possible to access good condition salmon in eastern Greenland. The plan was to test methods of capturing Atlantic salmon in a way that the fish suffered minimal injury and could be held for some days, tagged and released again. Methods could be traditional, such as long lining and netting, but also trolling by boat. The results from the trip was presented at an IYS-conference in Denmark in October 2021 and at ICES WGNAS meetings in 2022.

Methods

A two-week pilot trip to the Tasiilaq area in East-Greenland was organised and took place from 7 – 22 September 2021. Kim Aarestrup and Niels Jepsen (DTU) travelled via Reykavik to Kulusuk airport.

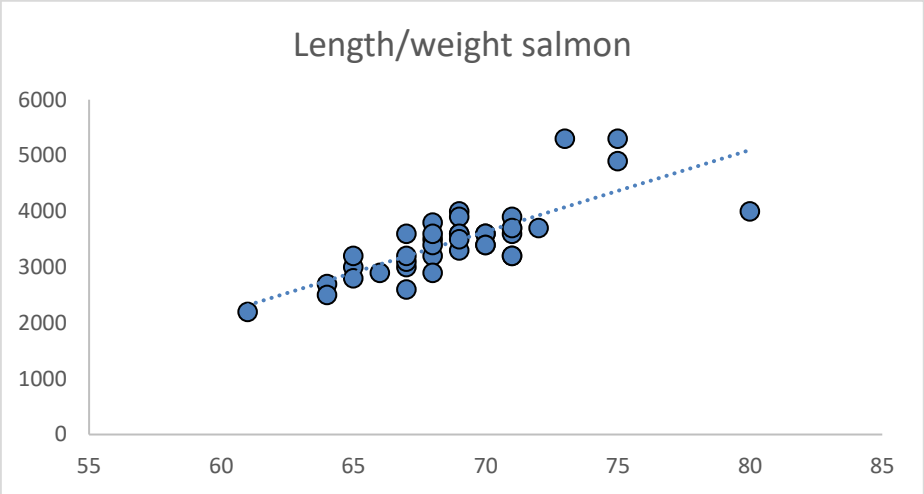
A local (Icelandic) outfitter was chartered for the whole trip to provide a research vessel (Vega, 32 feet, motor vessel) and a small open boat for trolling, guiding, field assistance as well as accommodation throughout the period. The team consisted of NJ + Kaa from DTU, Sigurdur and Miki (Siggi Tours). We brought professional long-line equipment (as used for salmon fishing in the Baltic) as well as suited trolling gear for trolling with up to 4 rods, and were going to test both methods. Additionally we used local gill-nets to 1. Assert possibilities for

this capture type to be used for catching live good condition salmon for tagging; 2. Verifying presence of Atlantic salmon and their size, investigating stomach content and collect samples for genetic origin. Each of the salmon caught in gill-nets were assessed to evaluate if it was fit to be tagged, subsequently killed (if not dead already) and measured, weighed, stomach content studied, scale and tissue sampled. The nets also gave captures of Pink salmon, which we sampled for NINA, Norway.

Results

The use of long-lines was were tested in many locations, depths, bait and under various weather conditions, but failed to catch even one salmon. Primary challenges was other boats sailing across the lines and no salmon taking squid, angmasalik or shrimps. Potentially long lines baited with sandeel and set where they are no boats could be a possibility, but it still appears difficult and time-consuming. Setting of short gill-nets perpendicular from the coast and out, consistently produced catches of salmon, so fish appeared abundant in the area at this time of year. However, the condition of most Atlantic salmon when retrieved was not in a condition warranting tagging. Potentially a 'sit and wait' strategy by the nets may be more successful for this, but also very time consuming. Unfortunately, the trolling gear (that was sent up in advance) was lost in the airport and was only retrieved after more than a week. Hence, trolling could only be tested during the last 6 days (which gave 4 days of fishing 2-6 h due to weather local conditions). It took some adjusting of technique to get it right, but we managed to get two salmon in the boat the last two days, with just a few hours fishing. The fish were in great condition and were anaesthetized and tagged with floating DST-tags and released on site.

We caught 38 Atlantic salmon in nets and two by trolling. The salmon were between 61 and 80 cm and 2.2 – 5.3 kg. The sex-ratio was 80 % females, 20 % males.



Genetic assignment test of DNA from 38 of the salmon from the Kummiut area was successful and these were initially assigned:

17: Scotland, 8: Ireland, 4: Norway, 3: Northern Ireland, 3: Denmark, 2: England, 1:Wales.

However, the results of this assignment test are preliminary, because there are some challenges with the assignment probabilities for a number of samples, likely related to the baseline used. This leads to especially the number of Scottish fish may be being overestimated. We are currently investigating additional genetic tests on the samples with an updated baseline, to enable more reliable assignment.

The catch of *pink salmon* in the gill nets was disturbing. A hike into a remote lake and river, showed active pink salmon spawning going on in the river. This is the first documentation of this phenomenon in Greenland

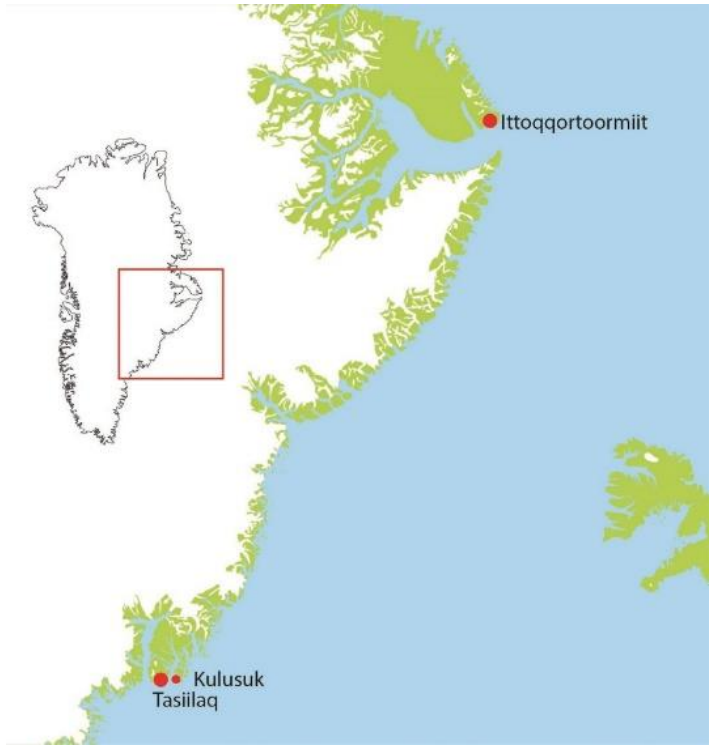
Conclusions

Summary results:

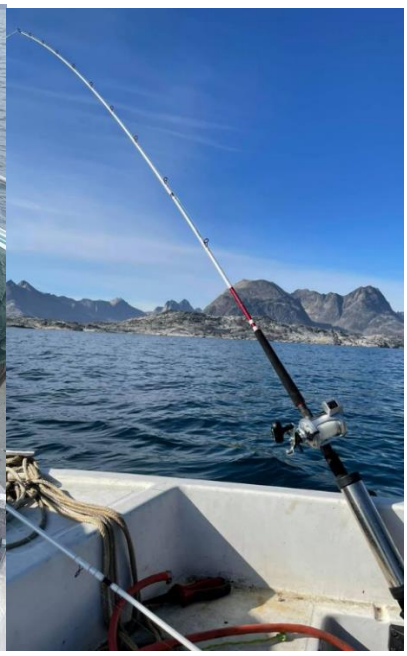
- Salmon are present in good numbers in the East Greenland waters in September;
- Pink salmon are also present;
- We obtained samples (tissue, scales) from 40 Atlantic salmon and a handful of *pink salmon* (sampled for NINA, Norway);
- Longline does not appear to be a feasible option to catch salmon in East Greenland. Monofilament net fishing is efficient and easy to catch Atlantic salmon. But the present method is not suited if salmon are to be kept alive and tagged; and
- Trolling is a slow, but well suited method. Fish can be kept and tagged later, so the concept of fit-for-purpose tagging is clearly feasible.

A second SMOLTRACK expedition to Greenland is currently planned to take place in September 2023, with a two week period of salmon trolling with two boats and hopefully tagging of many more salmon.

A male pink salmon caught in a small river, where many individuals were observed engaged in spawning.



The Kuummiut village and surrounding fjords, where the survey was done.



Secretariat
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