NPAFC
Doc. 1791
Rev.

Canadian Research Planned for 2018/19 Relevant to the 2016–2020 NPAFC Science Plan

by

J.R. Irvine[1], T. Beacham[1], J. King[1], C. Neville[1], K. Dunmall[2], S.C.H. Grant[3], and B.V.P. Hunt[4,5,6]

[1]Fisheries and Oceans Canada
3190 Hammond Bay Road, Nanaimo, B.C., Canada V9T 6N7

[2]Fisheries and Oceans Canada, Freshwater Institute
501 University Crescent, Winnipeg, Manitoba, Canada R3T 2N6

[3]Fisheries and Oceans Canada
100 Annacis Parkway, Unit 3, Delta, B.C., Canada V3M 6A2

[4] Institute for the Oceans and Fisheries, University of British Columbia
Vancouver, B.C., Canada V6T 1Z4

[5]Hakai Institute, P.O. Box 309, Heriot Bay, B.C., Canada V0P 1H0

[6]Department of Earth, Ocean and Atmospheric Sciences, University of British Columbia
Vancouver, B.C., Canada V6T 1Z4

Submitted to the

NORTH PACIFIC ANADROMOUS FISH COMMISSION

by

Canada

April 2018

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:
Irvine, J.R., T. Beacham, J. King, C. Neville, K. Dunmall, S.C.H. Grant, and B.P.V. Hunt. 2018. Canadian research planned for 2018/19 relevant to the 2016–2020 NPAFC Science Plan. NPAFC Doc. 1791. 3 pp. Fisheries and Oceans Canada, Institute for the Oceans and Fisheries and Department of Earth, Ocean and Atmospheric Sciences, University of British Columbia, and Hakai Institute (Available at http://www.npafc.org).

Keywords: Salmon, salmon research, Canada, Hakai Institute, NPAFC Science Plan

ABSTRACT
This document summarises Canada's scientific research activities in relation to the 2016–2020 NPAFC Science Plan. The focus is on research activities planned by Canada during 2018/19 that are relevant to the Science Plan.

The Science Sub-Committee of the North Pacific Anadromous Fish Commission (NPAFC) developed a five-year Science Plan (2016–2020) (http://www.npafc.org/new/publications/Science%20Plan/SciPlan%202016-20/NPAFC_science_plan2016-2020.pdf) with five research themes intended to help understand variations in Pacific salmon productivity in a changing climate:

1. Status of Pacific Salmon and Steelhead Trout
2. Pacific Salmon and Steelhead Trout in a Changing North Pacific Ocean
3. New Technologies
4. Management Systems
5. Integrated Information Systems

This document summarises Canada's scientific research activities in relation to the 2016–2020 Science Plan. The focus is on research activities planned by Canada during 2018/19 that are relevant to the Science Plan. The list is not complete but provides an overview of major activities planned for the upcoming year. Activities are organised according to the five major themes topics (1–5*)* listed above. It should be noted that research activities often cross over several components of the science plan, due to the inherent overlap associated with these themes.

1. Status of Pacific Salmon and Steelhead (including Biological Monitoring of Key Salmon Populations; Seasonal Migration and Distribution; Variation in Growth and Survival; Modeling the Future for Salmon)

Canada continues to monitor the status and important biological characteristics (e.g., salmon size, age composition, survival) for various key (important) salmonid populations. Time series information on catches, spawner escapements, and regional salmon production trends for hatchery and wild stocks are also obtained.

Starting in 2019, Fisheries & Oceans Canada's (DFO's) new State of the Salmon Program plans to track and compare Canadian Pacific salmon population trends. Conservation and sustainable use of these salmon populations relies on an understanding of their changes in abundance, productivity, size-at-age, fecundity, and status. An analytical framework is being developed to process data and examine covariation among populations of Pacific salmon. Comparisons of trends within and across species, adult & juvenile migration periods, and freshwater and marine salmon rearing locations will be made interactively within this framework to enable the exploration of causal factors. A synoptic overview of salmon status for Pacific salmon populations will also be produced. Canadian Pacific salmon population trends and status will be compared with salmon populations throughout the north Pacific and the Atlantic and salmonid populations in the Arctic. A key feature of the State of the Salmon Program is the engagement of local, regional, and international experts on salmon populations and their ecosystems. Other deliverables of this program include facilitating an annual State of Salmon forum to foster collaboration among DFO experts on salmon and their ecosystem research and monitoring. Pre-season,

in-season, and post-season reporting on salmon returns, escapements, and survival will also be a component of this emerging program.

The Hakai Institute is studying juvenile salmon in the northern Strait of Georgia, Discovery Islands and Johnstone Strait to: evaluate the controls of prey phenology, quantity and quality for migrating juvenile salmon in the northern Strait of Georgia, Discovery Islands and Johnstone Strait; determine stock-specific migration behavior of juvenile sockeye salmon, and co-migrating salmon species, through the Discovery Islands and Johnstone Strait; determine juvenile salmon feeding biology and measure growth and condition across a spatial-temporal gradient of prey quantity and quality; determine juvenile salmon parasite and pathogen infection dynamics across the Discovery Island / Johnstone Strait region and; estimate mortality rates of juvenile salmon during their Strait of Georgia to Queen Charlotte Strait migration.

2. Pacific Salmon and Steelhead Trout in a Changing North Pacific Ocean (including Retrospective Salmon Studies; Linking Salmon Production, Climate and Ocean Changes)

DFO continues to examine salmon ocean ecology on the continental shelf of Vancouver Island: historic field-based research coupled with integrated pelagic ecosystem studies are investigating linkages between climate forcing and juvenile salmon growth and survival through association with oceanographic condition and prey communities.

Canadian scientists are working collaboratively on a major International Year of the Salmon signature project scheduled for Feb/March 2019 in the Gulf of Alaska. The overall objective of the survey is to identify the abundance, distribution, biological status and habitat conditions of Pacific salmon in the Gulf of Alaska. The intent is to improve understanding of salmon winter mortality in this area. There is also the plan to tag Pacific salmon with both archival and disk tags. Hopefully this will be the first of other major ocean sampling projects carried out under IYS.

Continuing empirical analysis of regional mechanisms linking extreme climate events to Fraser River sockeye salmon productivity includes: field-based research investigating the growth and marine survival of juvenile Pacific salmon as they migrate out of the Strait of Georgia, through Johnstone Strait. Estimates of salmon condition in relation to prey availability, predator consumption, utilizing diet, stable isotopes, and energy density analyses will be used to empirically test of the proposed “Trophic Gauntlet Hypothesis” for the marine survival of migrating juvenile sockeye salmon from the Fraser River.

Ongoing salmon ocean ecology research in the Salish Sea, an inland sea shared by Canada and Washington State, includes investigating the relationship between early marine growth and total marine survival of Pacific salmon. The investigation includes examination of variability in ocean climate conditions and how changes in these conditions impact the prey field, juvenile fish growth and feeding and condition of the juveniles at the end of their first marine winter.

In collaboration with American researchers studying both top-down and bottom-up processes in the Salish Sea, DFO is working to identify factors regulating the early marine survival of Chinook salmon

Further north, Canadian scientists continue to monitor distribution and abundance shifts of salmon northward into the Canadian Arctic using a community-based monitoring approach called Arctic Salmon, assess the northern extent of the current, natural chum salmon distribution in North America, and assess marine environmental factors influencing distributional shifts of salmon northward.

3. New Technologies

Canada will continue to apply extensive baselines for microsatellites with between 45,000 and 75,000 individuals for sockeye and pink salmon. Canada will continue to apply a next generation sequencing platform to genotype Chinook salmon and coho salmon through direct sequencing of amplicons. For Chinook salmon, a panel of primers has been developed where approximately 390 amplicons are amplified via a highly-multiplexed single polymerase chain reaction, with a minimum of one single nucleotide polymorphism (SNP) analyzed for each amplicon. For coho salmon, a panel has been developed to amplify approximately 490 amplicons. Both panels are being used in an evaluation of whether parental-based tagging is a practical alternative to the present coded-wire tag program for Chinook and coho salmon. Samples will be collected annually from 100% of the Chinook salmon broodstock (approximately 13,000 individuals) at hatcheries in British Columbia where coded-wire tags are currently applied. Samples will also be collected from coho salmon broodstock (approximately 5,500 individuals) at hatcheries where individuals are adipose fin clipped upon release. Canada intends to genotype these individuals using the SNP amplicon panels. Returning adults from the hatchery releases will be genotyped to identify returning Chinook and coho salmon to specific hatchery parents sampled in 2013-2017, thereby providing a method to evaluate the accuracy parental-based identification (PBT). Standard genetic stock identification techniques (GSI) will also be used to identify the origin of individuals not assigned via parental-based identification. Accurate identification of returning individuals to specific hatchery parents will provide the year and location of hatchery release, thereby providing a possible alternative to the current method of coded wire tagging (CWT). Canada also intends to develop a 500-SNP amplicon panel for chum salmon, with emphasis on screening populations from southern British Columbia in anticipation of applying the genetic differentiation among populations in mixed-stock fishery applications.

4. Management Systems (Cultural and Social Studies)

5. Integrated Information Systems

Canada is examining the feasibility of applying a New Information Sharing Technology to improve communication and collaboration between various government sectors involved in the management, assessment and harvesting of salmon. The project would include assembling a listing of salmon activities or projects (all sectors) (i.e., an Activities Catalogue). Activities will be associated with who is leading it, who is collaborating, objectives, budget etc. Information will be brought into an existing software system that will connect activities and people etc. The activities catalogue is expected to be particularly useful to middle and senior managers as well as new employees including young scientists. Identifying connections among activities and people should result in new and improved partnerships that will improve our ability to manage salmon in an uncertain future.