The Third NPAFC-IYS Virtual Workshop on

Linkages between Pacific Salmon Production and Environmental Changes

Date: **May 25–27, 2021** (Canada and USA)
May 26–28, 2021 (Japan, Korea, and Russia)

Venue: Virtual Workshop*
* The workshop format has been changed to a virtual online workshop with live sessions, pre-recorded, and E-poster presentations due to the ongoing COVID-19 pandemic and travel restrictions around the world. The virtual workshop will have a four-hour live session per day via video conferencing:

• Japan/Korea: 08:00–12:00, May 26 to 28, 2021
• Russia (Vladivostok): 09:00–13:00, May 26 to 28, 2021
• Canada/USA (Vancouver/Seattle): 16:00–20:00, May 25 to 27, 2021
• USA (Alaska): 15:00–19:00, May 25 to 27, 2021

Host: North Pacific Anadromous Fish Commission (NPAFC), https://npafc.org/
Partners:
- Fisheries Agency of Japan (FAJ), http://www.jfa.maff.go.jp/e/index.html
- Hokkaido Research Organization (HRO), http://www.hro.or.jp/en/index.html
- Hokkaido Salmon Propagation Association (HSPA), http://sake-masu.or.jp/
- Japan Fisheries Research and Education Agency (FRA), http://www.fra.affrc.go.jp/english/eindex.html
- Japan Salmon and Trout Resources Enhancement Association (JSTREA), http://www.honkei.jp/index.html
- North Pacific Marine Science Organization (PICES), https://meetings.pices.int/
- Tohoku Ecosystem-Associated Marine Sciences (TEAMS), http://www.i-teams.jp/e/index.html

Science Committee:
- Jun Aoyama (TEAMS, International Coastal Research Center, Atmosphere and Ocean Research Institute, Univ. Tokyo, Japan; IYS TCG-2)
- Ed Farley (Auke Bay Laboratory, NMFS, USA; SSC chair, IYS WG, TCG-1)
- Jim Irvine (Pacific Biological Station, DFO, Canada; IYS WG)
- Ju Kyoung Kim (Aquatic Living Resources Center, FIRA, Korea; SSC, IYS WG, TCG-1)
- Svetlana Naydenko (Pacific Branch of VNIRO (TINRO), Russia; SSC)
- Mark Saunders (IYS WG & NPSC chairs, Canada)
- Shigehiko Urawa, Chairperson (Fisheries Resources Institute, FRA, Japan; SSC, IYS WG, TCG-4)
- Jeongseok Park (NPAFC Secretariat, Canada)

Background:
Pacific salmon face many challenges and uncertainties associated with environmental variability, including climate change. It is more important than ever that we promote new international cooperative research that provides better scientific information on the ecological mechanisms regulating production of anadromous populations and climate impacts in North Pacific marine ecosystems.

The North Pacific Anadromous Fish Commission (NPAFC) and North Atlantic Salmon Conservation Organization (NASCO) are leading a major initiative entitled “International Year of the Salmon (IYS).” IYS provides an international framework for collaborative outreach and research. These efforts will raise

awareness of the challenges salmon face for improved stewardship during this period of increased environmental variability.

The IYS overarching theme is "Salmon and People in a Changing World" with six subthemes: (1) Status of Salmon; (2) Salmon in a Changing Salmosphere; (3) New Frontiers; (4) Human Dimension; (5) Information Systems; and (6) Outreach and Communication. IYS is stimulating investment in research expected to provide a legacy of knowledge, data/information systems and tools, and help train a new generation of scientists better equipped to provide timely advice to improve stewardship of salmon. In addition, the IYS program is connected to the 2016–2022 NPAFC Science Plan, whose research themes are (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; and (5) Integrated information systems. Annual progress for each research theme is reviewed at a series of NPAFC-IYS workshops including the present one.

Workshop Objectives:

- Improve knowledge of the migration, growth and survival of salmon and their environments;
- Increase understanding of the causes of variations in salmon production in changing environments;
- Anticipate future changes in salmon ecosystems and resulting changes in the distribution, survival, and abundance of salmon;
- Discuss the application of new and developing technologies and analytical methods to research and manage salmon;
- Demonstrate integrated information/data management systems to support research, sustainable management, and understanding for the conservation of salmon; and
- Describe policies designed to ensure the resilience of salmon and people in changing environments.

Topic Sessions:

Topic 1. Salmon production in changing environments

Moderators: Ed Farley* (SC & TCG-1), Jim Irvine* (SC), Ju Kyoung Kim (SC & TCG-1), Svetlana Naydenko (SC), and Hiromichi Ueno (TCG-1) *session co-leader

The response of Pacific salmon to climate-driven environmental changes is variable and differs by species, populations, life stages, geographical locations, and/or seasonal timing. Variation in the early marine survival of salmon has been hypothesized to have a major role in determining brood year strength. However, there has been limited evidence to support this hypothesis. We need to understand the causes and mechanisms of mortalities at each stage of the salmon life cycle. This is necessary to understand and predict the responses of salmon to climate change and other factors, and to prepare for future scenarios. In the ocean, for example, climate change may result in significant variability and overall declines in the carrying capacity and usable habitat of Pacific salmon in the North Pacific Ocean, potentially leading to expanded use of the Arctic Ocean. An improved understanding of linkages between environmental changes and salmon production will help to enhance our predictions of changes to the distribution, abundance, and vulnerability of salmon populations to climate change for sustainable resource management.

1-1. Status and trends of key salmon populations and their environments

Time series of regional salmon production and biological and physical characteristics of key salmon populations and their ocean habitat provide broad scale perspectives necessary to examine the underpinnings of ocean salmon production and marine ecosystem conditions. The purpose of this sub-session is to understand the current status and trends of Pacific salmon production and their habitat. (**Keywords:** key salmon populations, trend, spawning escapement, catch, survival rate, body size, fecundity, smolt production, distribution, abundance, habitat conditions, and others)

1-2. Effects of freshwater habitat changes on salmon production

Physical changes to freshwater ecosystems resulting from human impacts and climate change will degrade and diminish available habitat, reduce reproductive success, and impact migration of salmon. Increasing water temperatures may cause direct and indirect impacts on salmon including physiological stress,

increased depletion of energy reserves, increased susceptibility and exposure to diseases, and disruptions to breeding efforts. The sub-session will: (1) review the impact of freshwater habitat changes on salmon production; and (2) evaluate effectiveness of habitat restoration programs to enhance resilience of salmon. (**Keywords:** freshwater salmon habitat, human impact, climate change, reproductive success, growth, migration, physiological stress, diseases, mortality, restoration, resilience, and others)

1-3. Survival mechanisms of juvenile salmon in changing ocean environments

There is growing recognition that size-dependent mortality of juveniles within the first ocean year regulates Pacific salmon production, which also suggests that environmental influences are greater in the first ocean year than later. The sub-session aims to increase our understanding of survival mechanisms of juvenile salmon and their responses to changing environments including SST, salinity, currents, prey abundance, inter- and intra-specific competition, and predators.
(**Keywords:** juvenile salmon, marine survival mechanism, ocean entry, feeding, growth, migration, SST, salinity, currents, prey, competition, predators, and others)

1-4. Winter ocean ecology and survival of Pacific salmon

One hypothesis is that winter is a critical period for Pacific salmon in the ocean, but winter surveys have been limited, and have yet to fully test this hypothesis. Key gaps in our understanding of winter ocean ecology and survival of salmon include: (1) winter ocean distribution and abundance by species and population, (2) ocean habitat environments including prey abundance, (3) key factors influencing winter distribution and abundance, (4) effects of changing winter environments on feeding, growth and metabolism, and (5) mechanisms determining winter survival. The international Gulf of Alaska expedition conducted in 2019 was the first comprehensive survey of Pacific salmon in winter/spring in the North Pacific Ocean in several decades. Results from this expedition will be presented to fill gaps in our knowledge of winter salmon in the ocean. Other presentations on winter salmon ecology and survival are welcome.
(**Keywords:** winter salmon, spatial and temporal dynamics of habitat conditions, stock-specific distribution and abundance, preys, food web, feeding, metabolism, growth, trophic and health conditions, survival mechanisms, and others)

1-5. Linkages between salmon production and climate/ocean changes

The future of salmon is uncertain. Climate change may increase variability in the carrying capacity and usable habitat (distribution) of salmon in the ocean. Improved understanding of linkages between environmental changes and salmon production will help anticipate the economic consequences of these changes. The objectives of the sub-session are to: (1) understand and quantify the effects of environmental variability and anthropogenic factors affecting salmon distribution and abundance; (2) develop methods to predict future changes in salmon distribution and abundance with climate change, and (3) predict implications of climate/ocean environmental changes on salmon management.
(**Keywords:** climate impact, distribution, abundance, carrying capacity, linkage between salmon, climate and ocean changes, forecast models, energy budget models, biophysical models, and others)

1-6. Summary and discussion

Topic 2. New technologies/integrated information systems for salmon research and management

Moderators: Kazushi Miyashita (TCG-3), Dion Oxman (TCG-3), Shunpei Sato (TCG-3), and Mark Saunders* (SC) *session leader

With recent advancements in technology, data processing, and analytical methods, new tools are available to better study and manage salmon. The IYS aims to further advance the development of new and emerging technologies and analytical methods that are immediately available for salmon research and management. In addition, the IYS seeks to create open-access information systems for salmon research and management, and to develop management systems to aid the sustainable conservation of salmon in a changing climate.

2-1. New technologies
Novel stock and fish identification methods including molecular analyses, genomics, environmental DNA (eDNA), hatchery mass marking, intelligent tags, and remote sensing, continue to be developed, and these tools are integral to the formulation of effective models predicting the distribution and abundance of salmon populations. This sub-session will emphasize: (1) eDNA as an indicator of salmon distribution and abundance in aquatic ecosystems; (2) use of existing scale and otolith collections to determine ocean distribution of salmon (otolith microchemistry) and analyses of growth patterns to examine size-dependent mortality hypotheses; (3) potential for the application of real-time GSI and detection of pathogens at sea; and (4) intelligent data logger and tacking methods to determine migration behavior and survival.
(**Keywords:** genomics, environmental DNA, molecular identification, mass marking, intelligent tags, salmon observation systems, remote sensing, microchemistry, and others)

2-2. Integrated information and management systems
The IYS seeks to develop integrated information/data management systems using new and existing data sets to increase the resiliency of salmon and people in a changing world, to support research and management, and to increase public understanding of the role salmon have in ocean ecosystems. For the sustainable conservation of uncertain salmon populations, we need to develop integrated management systems including ecosystem-based management, improved management strategies for harvest and escapements, long-term sustainable conservation of genetic units and diversity, restoration and protection of marine and freshwater habitat, control of diseases and pollution, resilient salmon enhancement/hatchery technologies, and application of indigenous and local/traditional knowledge.
(**Keywords:** integrated information system, management strategy of harvest and escapements, genetic conservation, habitat restoration and protection, control of diseases and pollution, renovation of enhancement/hatchery technologies, indigenous and local/traditional knowledges and others)

2-3. Summary and discussion

Topic 3 (Special Session). Resilience for salmon and people: lessons from the Great East Japan Earthquake in 2011
Moderators: Jun Aoyama* (SC & TCG-2), Masahide Kaeriyama (TCG-1), and Shigehiko Urawa (SC & TCG-4) *session leader
The IYS is seeking to ensure that salmon and people are resilient to changing environments. The Great East Japan Earthquake (GEJE) on March 11, 2011 was devastating for salmon and people. It created a massive tsunami that killed more than 18,000 people and gravely damaged the coastal zone systems, including salmon habitats, hatcheries and fishery facilities along the Pacific coast of northern Honshu. Tohoku Ecosystem-Associated Marine Sciences (TEAMS) was launched in January 2012 as a decade-long project to clarify the impacts of the GEJE and the restoration process of marine ecosystems for the reconstruction of local subsistence and fishery industries. In conjunction with TEAMS, this special session is planned to review the impact of the GEJE on salmon, people and coastal ecosystems, and the recovery processes for human security and risk management. Lessons learned from this project should contribute to enhancing the resilience of salmon and people in the face of future challenges elsewhere.

3-1. Restoration of ecosystems and human society in the coastal zone systems
Salmon have a long historical association with local people in northern Honshu, being a vital resource for various aspects such as food, economy, recreation, culture and education. The GEJE damaged coastal ecosystems as well as human society connecting with salmon and other marine resources. Long-term monitoring surveys have been initiated by TEAMS to assess changes in the marine ecosystems and human society affected by the GEJE. This sub-session introduces the outcomes of TEAMS to understand the process and mechanism of restoration in coastal ecosystems and the recovery of human society.
(**Keywords:** coastal ecosystem, human society, impact of earthquake/tsunami, restoration, and others)

3-2. Research for retrieval and sustainable management of salmon populations

Chum salmon are an important fish resource in northern Japan, and most populations have been maintained by hatchery releases. This sub-session introduces research results of TEAMS in order to: (1) assess the impact of the GEJE and other factors on the behavior, survival and returns of chum salmon; and (2) review the procedure of recovery and sustainable management for chum salmon populations. (**Keywords:** chum salmon, survival, impact of earthquake/tsunami, recovery procedure, sustainable management, and others)

3-3. Risk management and sustainability for the coastal zone systems and salmon production

As a result of the huge tsunami, millions of tonnes of marine debris including live organisms were widely dispersed into the Pacific Ocean. Radioactive materials were also released into freshwater and marine environments from the damaged Fukushima Daiichi nuclear power plant. In addition, non-native coho salmon escaped from broken net-pens in coastal waters. The sub-session intends to recommend: (1) risk management approaches including the adaptive management, precautionary principle and feedback control between monitoring and modeling; and (2) sustainable processes for the coastal zone systems and salmon production from catastrophic disaster, such as the GEJE and global warming effects. (**Keywords:** risk management, adaptive management, monitoring, modeling, sustainable process, coastal zone system, salmon production, and others)

3-4. Summary and discussion: overview of lessons learned for future challenges

Oral and Poster Presentations:

The **virtual online workshop** will be conducted by live and pre-recorded presentations in English. Sessions will be comprised of contributed presentations, which will be selected for live oral, pre-recorded oral or electronic (E) poster.

- ✓ **Live Oral**: Keynote (max 25 min including 5 min discussion) and other oral (max 15 min including 3 min discussion) presentations in live sessions.
- ✓ **Pre-Recorded Oral***: Video (MP4, max 15 min) converted from PPT or other formats with narration
- ✓ **E-Poster***: Electronic (E) poster (PDF) converted from one slide or multiple slides in PPT or other formats

** Note that live sessions will be mostly allocated to invited keynote speakers' live oral presentations, summary, and discussion. Only a few live oral presentations under each sub-topic will be allowed due to time constraints at the live sessions. Pre-Recorded Oral and E-Poster Presentations will be posted on the NPAFC workshop website for previews by registered participants at least one week prior to live sessions. These pre-recorded presentations will be considered for the summary and discussion of each live topic session.*

Abstracts:

- ✓ Presenters whose abstracts have been already accepted do not need to resubmit their same abstracts unless there are any updates to make. However, they will be asked to select their preference of presentation format.
- ✓ The Call for Papers is reopened. Updated or new abstracts for live oral, pre-recorded oral, and E-poster presentations must be received by the NPAFC Secretariat by e-mail (secretariat@npafc.org) **no later than January 15, 2021**.
- ✓ Abstracts must be prepared according to guidelines and sample format (refer to the appendix on the last page).
- ✓ The Science Committee will select updated and new abstracts, and these authors will be notified of the result by the NPAFC Secretariat in the middle of February 2021.
- ✓ Presenters who had their abstracts selected will receive guidelines for their presentations and a formatting guide for extended abstracts from the NPAFC Secretariat.

Workshop Proceedings:

Oral and E-poster presenters are asked to submit an extended abstract. The extended abstracts will be compiled into the workshop proceedings and issued as a NPAFC Technical Report after the workshop. The Technical Report will be available online at the NPAFC website.

Important Dates for Workshop (Vancouver time):

January 15, 2021:	Deadline to submit updated or new abstracts
Mid-February 2021:	Announcement of selection to authors who submitted updated or new abstracts
Late-February 2021:	Second announcement of workshop
Early-April 2021:	Workshop registration opens
Early-May 2021:	Workshop registration due and deadline to upload pre-recorded oral and E-poster presentations
Mid-May 2021:	Start of viewing pre-recorded oral/E-poster presentations on the workshop website
May 25–27, 2021*:	Workshop Live Sessions *May 26–28, 2021 in Japan, Korea, and Russia
June 30, 2021:	Extended abstracts due (late submission of extended abstracts may not be included in a Technical Report.)

Registration:

Registration for the workshop is **FREE**. However, you have to register in advance to attend the virtual workshop. You will be notified of the links to the live sessions and pre-recorded presentations after completing your registration.

For More Information Contact:

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Appendix: Abstract Guidelines

- Limit the abstract to 400 words and submit using Microsoft Word according to the sample format shown below.
- Tables and figures are not included in the abstract.
- Indicate the intended topic session (and sub-session).
- Specify the presenter with an asterisk (*). Please use full first and last names for each author (not just first initial).
- State the preference of presentation format: (1) live oral, (2) pre-recorded oral, (3) live oral but pre-recorded oral is acceptable, or (4) electronic (E)-poster. The Science Committee reserves the right to change the presentation from a live oral to a pre-recorded oral depending on time constraints.
- The abstract should begin with a clear statement of the problem or objectives, give a brief summary of methods and the major results, and end with a substantial conclusion. Do not use vague statements, such as "results will be discussed."
- Accepted abstracts will be included in the program and abstract booklet for circulation at the workshop.
- Accepted abstracts for oral and poster presentations may not be edited before printing the abstract booklet. Authors are responsible for the clarity and accuracy of the information presented in the abstract.

Sample Format for Submitting Abstracts

Topic Session: Topic 1. Salmon production in changing environments (1-1. Status and trends of key salmon populations and their environments).
Preferred Presentation Format: (2) pre-recorded oral
Title: Late ocean entry timing provides resilience to populations of Chinook and sockeye salmon in the Fraser River
Authors: Richard J. Beamish*, Ruston Sweeting, and Chrys Neville
Pacific Biological Station, Fisheries and Oceans Canada, 3190 Hammond Bay Rd., Nanaimo, B.C., V9T 6N7, Canada (*Email: richard.beamish@xxxx.ca; Tel: 1-250-756-xxxx; Fax: 1-250-756-xxxx)

Abstract: Most sockeye salmon from the Fraser River enter the Strait of Georgia by early May and most Chinook salmon by mid May. There are populations of Chinook salmon from the South Thompson River area and one population of sockeye salmon from the Harrison River that enter the Strait of Georgia almost two months later. The productivity of these species with a late ocean entry life history strategy has been exceptional in recent years. The reasons for the recent improved productivity of the late ocean-entry life history type are not known, but the success identifies the importance of a temporal spread in ocean entry timing of the aggregate of populations. The recent success also reminds us that ocean entry timing of the aggregate of populations has evolved to be able to adapt to long-term changes in the timing of prey populations in the early marine period.