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Preliminary Cruise Plan for the Second Gulf of Alaska Expedition

by

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Abstract

The second Gulf of Alaska expedition is planned for March – April 2020. The ship will be the Canadian commercial trawler, the Pacific Legacy which is 37 m long, 10 m beam with a draft of 6.0 m and a gross tonnage of 600, with 2600 hp. It has modern accommodations for 15 researchers. It is planned to have participants from Canada, Japan, Korea, United States and Russia. The set locations will be similar to the first expedition, with more stations within the Canadian and United States EEZ. There also will be deeper sets. Sampling will be similar with limited oceanographic sampling. All data will be publically available through arrangements with the Tula Foundation. Funding for the expedition was available through government organizations, foundations, the commercial fishing industry and private donations. The Pacific Salmon Foundation is the supporting agency and will manage the financial aspects. The expedition will be a contribution to the International Year of the Salmon and coordinated with the North Pacific Anadromous Fish Commission. We are confident that the results of both expeditions will demonstrate the value of this research and the value of continuing these surveys to monitor ocean changes and impacts of rearing Pacific salmon.

Rationale:

In February and March 2019 an international crew (each NPAFC country represented) and a Russian researcher vessel successfully conducted the first winter ecology studies of Pacific salmon in decades. While some analyses remain to be completed, the vessel fished every day and caught Pacific salmon at 48 of the 58 sampling sites.

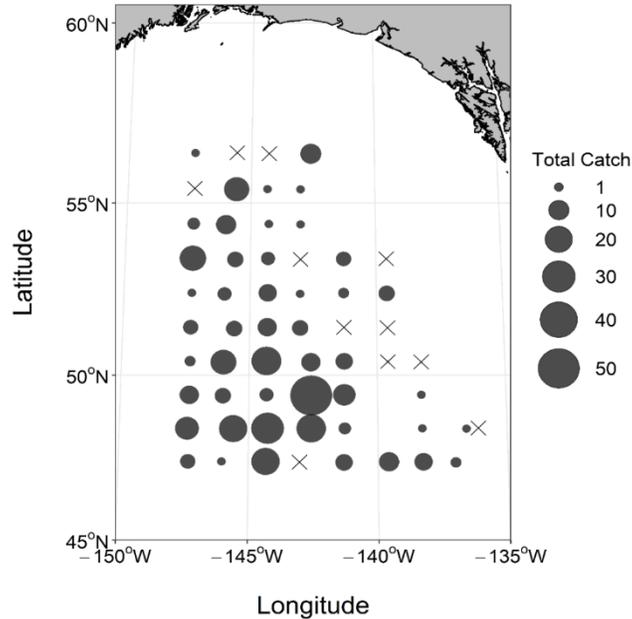
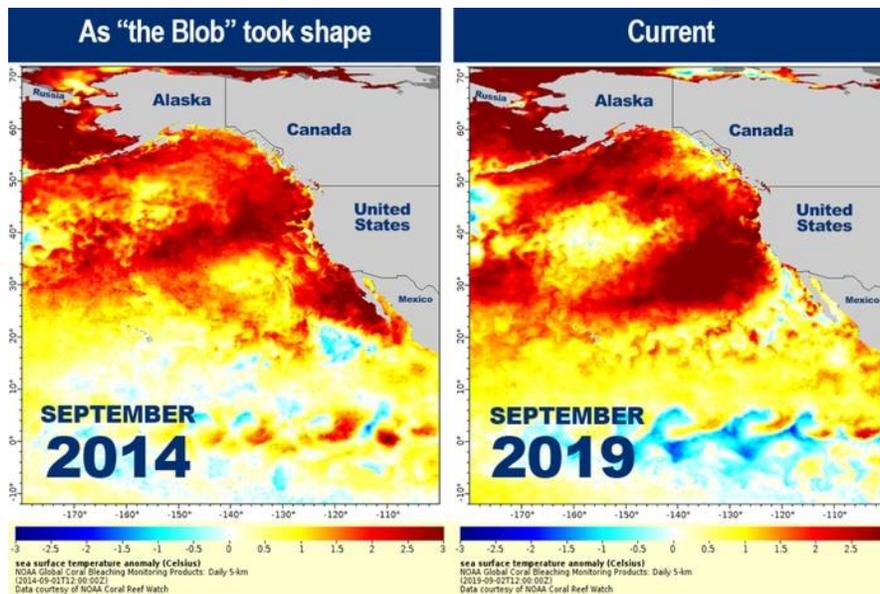


Figure: Distribution of Pacific salmon catches during the 2019 Gulf of Alaska research cruise.

Researchers collected extensive physical and chemical oceanographic data, biological oceanographic including and extensive array of pelagic squids, and used trawl gear to collect salmon and other fishes. And, for the first time ever, the crew conducted on-board DNA analyses to identify origins of the coho salmon samples (DNA on all salmon was conducted upon return to port). The numbers of salmon collected seemed low but there was no other surveys to compare the catches against. Our catches totalled only 417 salmon (Figure 1) composed of 222 chum, 94 Coho, 68 sockeye, 30 pink, and 3 Chinook. However, in hindsight, the catches by species were quite consistent with the subsequent adult returns to Pacific salmon in 2019 to areas of southwestern Alaska and southward through Canada (poor returns of pink and chum salmon, and historic low runs of Fraser River sockeye).

The 2019 research cruise demonstrated the capacity of trawl sampling and winter surveys to study Pacific salmon in the Gulf of Alaska where an estimated one third of all Pacific salmon spend their winter. The similarity of catch rates by species (and ages for chum salmon) with subsequent rates of adult return argues strongly for a second research effort to further our understanding and interpretation of the 2019 sampling results. In March 2020, we propose to use a Canadian commercial trawler with a comparable trawl net to repeat the 2019 survey through funding by private and industry donors, the Pacific Salmon Foundation, NPAFC (trawl net), and the governments of Canada and the Province of B.C. (<http://www.dfo-mpo.gc.ca/fisheries-peches/initiatives/fish-fund-bc-fonds-peche-cb/index-eng.html>). An international crew has again been invited to participate.

These first two expeditions directly address understanding determinants of sustainable salmon production, provides an enhanced understanding of changes in the ocean ecosystem, and may ultimately provide a basis for new forecasting tools providing greater sustainability of fisheries and salmon production. Further, sampling during March 2020 may directly sample an extraordinary environmental event with extremely warm water returning to the Gulf of Alaska.



<https://www.fisheries.noaa.gov/feature-story/marine-heatwave-pacific-shrinks-blob-size-retreats-farther-offshore>

However, the current size of the “blob” has decreased from the September extent but the NOAA website still cautions:

“It has declined to about half the size and intensity it displayed in August. However scientists caution that the heatwave designated MHW NEP19a remains two to three times the size of Alaska and still retains enormous amounts of heat in the upper layers of ocean. It remains one of the top four or five largest heatwaves on record in the North Pacific in the last 40 years.”

2020 Research Project purpose

There is a general understanding that ocean and climate conditions are major factors regulating salmon abundances. However, the mechanisms regulating salmon abundances in the ocean are not known. The expedition in the Gulf of Alaska this February – March was the first ever comprehensive study of the factors affecting the production of salmon in the winter in the Gulf of Alaska where it has been estimated that about 1/3 of all Pacific salmon spend their winter.

The hypothesis being addressed is that fish that grow faster in the early months in the ocean (nearshore) are the ones that best survive through the first ocean winter, and largely determine the subsequent year-class strength. Our preliminary results support this hypothesis. In general, our catches were smaller than expected but this result may reflect low abundances of salmon or use of trawl gear in the open ocean. On the basis of one survey, the interpretation is uncertain and emphasizes the need for subsequent surveys to build of our knowledge of salmon research in the open ocean ecosystem. A study in the winter of 2020 also will provide an understanding of the impact of anomalous warming event on the marine ecosystem, and the effects on feeding, growth and survival of Pacific salmon. In March 2020, the survey generally will overlap the areas fished in 2019 but will respond to observed abundances of sockeye and pink salmon (differs from the 2019 activities).

The Pacific Salmon Foundation is the supporting agency and will manage the financial aspects. The expedition will be a contribution to the International Year of the Salmon and coordinated with the North Pacific Anadromous Fish Commission. We are confident that the results of both expeditions will demonstrate the value of this research and the need for a continuation of these surveys to monitor ocean changes.

2020 Research Project Objectives

The second expedition is a continuation of the international, scientific effort to identify the mechanisms and environmental factors that determine the annual abundance and condition of Pacific salmonids in the Gulf of Alaska. The proposed research will identify the factors limiting production of Pacific salmonid species, estimate stock-specific biomasses, and could ultimately improve forecasts of adult returns.

The specific objectives for this research are:

- a) Demonstration of the utility of a winter trawl survey to study the condition of Pacific salmonids and determine abundances of Pacific salmon by stocks of origin and age-classes.
- b) Through a series of surveys examine the utility of abundance forecasts for major salmon stocks for management by various international.
- c) Assess this unknown portion of the life cycle of Pacific salmon and the factors determining the level of and variability of production of Pacific salmonids in the North Pacific.
- d) Assess the potential conflict between hatchery-produced and wild salmonids in ocean conditions.
- e) Establish a greater research capacity and network of international scientists to study future environmental conditions and effects on Pacific salmon in the North Pacific Ocean.

There is considerable uncertainty about the causes of variation in salmon returns and declining abundance among most populations along the west coast of North America. But, there is correlative evidence of relationships among salmon abundance trends with indices of large scale ocean conditions. This controversy even extends to debates about the relative abundance of hatchery-produced salmon and wild salmon at sea and the competition between them (includes consideration of inter-species completion and within species from different nations).

But, there is a growing recognition that size-dependent mortality within the first ocean year regulates Pacific salmon production which also implies that environmental influences are greatest in the first ocean year. The mechanism suggested involves an initial high mortality during the first months at sea, and variation in the growth/body size during this period. Fish that grow faster survive better. However, survival to maturity is a cumulative effect that also involves survival and growth at sea, particularly during a critical period during their first winter at sea. The fish sampled in this expedition, according to the hypothesis, will be the individuals that grew faster in the first months in the ocean and this will show on the scales or in the growth of daily zones in the otoliths. There could be additional pressure on these early ocean survivors, if there was increased competition with abundant hatchery-produced fishes. All estimates of abundance during the survey will be differentiated into hatchery and wild individuals.

The primary objective is to study juvenile salmon in their first winter at sea. The research is associated with the extensive research in the coastal environment during the Salish Sea Marine Survival Project (www.marinesurvivalproject.com). Researchers need to examine the stress of winter conditions in the North Pacific as a critical phase in the life cycle of Pacific salmon. Understanding these issues prepares

for appropriate management responses to sustain fisheries and wild Pacific salmon in a future of ecosystem change.

The outcome of the above hypotheses is that major factors affecting brood year strength have mostly occurred by the end of the first ocean winter. A test of the hypothesis is in the reliability of forecasts of the abundance of adult returns. The utility of trawl-based forecasts has been demonstrated in Russia where this method is used to forecast pink salmon returns; but it remains to be tested for species and populations rearing in the Gulf of Alaska. We note that this is the first time these winter observations have been made in the Gulf of Alaska and the testing of the hypothesis will help with the understanding of the mechanisms regulation production.

Importantly, all of the information collected during these international surveys will be openly available to the science community. The science team will have first access to publication of information but it will be open to all users via a website to be maintained at UBC. Beginning in 2020, and in collaboration with the Tula Foundation (Victoria, BC), data collected in both expeditions will be integrated into the Canadian Integrated Ocean Observing System, a component of the Global Ocean Observing System (GOOS) framework. This develop enables us to provide the data openly to all users. .

Proposed activities and Work plan

- a. October 2019 to January 2020, planning for the 2020 survey and improvements to sampling processes, communication capabilities, and preparation of the expedition sampling plans.
- b. January – March, 2020; preparation and acquisition of equipment and supplies;
- c. March 2020, conduct of survey including communications materials
- d. April to September 2020, processing and reporting of 2020 samples.
- e. September 2020, international workshop amongst international science team plus other experts to review our state of understanding from the 2019 and 2020 expeditions and recommendations for future work (possibly in Russia due to the travel limitations for working scientists and inclusion of other Russian researchers such as Dr. V.P. Shuntov, Pacific Research Fisheries Centre, Vladivostok, Russia).
- f. April/May 2020, initiate efforts to finance a third winter expedition (required in advance of the workshop due to timing of funding requests from various sources). This task will be confirmed following the 2020 research.

Specific sampling activities

The sampling planned for the second expedition is listed as follows. Methods are described in Pakhomov et al. 2019. All salmon will be given a Floy tag number attached to the caudal peduncle. This number will be used for all samples and all fish will be frozen after sampling. Each fish will be examined for CWTs, PIT tags, measured for length and weight and a scale sample collected. Both otoliths will be collected. Samples will be collected for DNA analysis, diet analysis, energy density, fish health and parasites. All salmon will be examined for scars and wounds. Plankton, basic oceanographic information and water samples for e-DNA will be collected at each station. Following from last year, there will be an emphasis on identifying and measuring squid in the catch and in stomachs. All fishes in the catch will be identified and measure with an emphasis on myctophids. When possible, myctophids will be sampled for scales and otoliths. Jellyfish in the catches will be identified and numbers and biomass estimated. Observations will be made of marine mammals, birds and plastics. Equipment will be available to sample

and photograph large predators. A camera will be attached to the net opening when possible.

In terms of fisheries research, the ability to conduct trawl sampling during the winter months with demonstrated ability to acquire samples of salmon adequate to determine their health, abundance, use of the marine habitats, and stocks of origin is a significant accomplishment. Given this, it becomes feasible to design an annual survey that could provide an advance indication (forecast) of Pacific salmon after just their first winter at sea. Research in the first winter at sea is crucial to understanding the limits to marine production of Pacific salmonids. For example, this research is a natural seaward progression from the extensive in-shore research conducted within the Salish Sea (www.marinesurvivalproject.com) in order to understand the full life cycle limitations to salmon production. Marine growth and survival during the first few months at sea, followed by the over-winter survival of juvenile salmon, makes up the current hypothesis as the primary determinant of salmon abundance/productivity.

Communications: In 2019, the science team was very successful in providing near-daily communications material to profile this research efforts and the collaboration between nations. Communications materials were extensively used by national and international media and are presently being used to produce producing videos for future communications. In 2020, we will improve our communication capacity through between satellite capacities. All communication materials are archived at an FTP site at UBC. Communications included a detailed cruise summary to be ready immediately upon return to Vancouver. All communications recognize the financial supporters that enabled the research.

Scientific team

All participants have not been confirmed, but there is modern accommodation for 15 scientists on board the Pacific Legacy. We are planning for three participants from Russia, two from Japan, one from Korea, two from the United States and six from Canada. There will be a chief scientist from Russia, United States and Canada. There is a coordinating team of Drs. Richard Beamish, Brian Riddell and Vladimir Radchenko. Mark Saunders will coordinate all activities with the International Year of the Salmon.



Photo: The 2019 science team include 21 scientists representing all of the NPAFC countries. (Photo credit: Egor Glyzin, 3rd Mate, Professor Kaganovskiy)

Canada: Christoph Deeg, Svetlana Esenkulova, Brian Hunt, Chrys Neville, Evgeny Pakhomov (Chief Scientist), Vishnu Perumthuruthil (student, UVic)

Korea: Hae Kun Jung **Japan:** Hiko Urawa

Russia: Arkadii Ivanov, Gennady Kantakov, Albina Kanzeparova, Anton Khleborodov, Igor Shurpa, Aleksnadr Slabinskii, Aleksei Somov, Anna Vazhova, Mikhail Zuev

U.S.: Gerard Foley, Charlie Waters, Laurie Weitkamp

NPAFC: Vladimir Radchenko (Cruise Director)

2020 Research Cruise Plan

The ship will leave Vancouver early in March and return to Vancouver after 25 days. It is possible that one port call may be needed in SE Alaska. Fishing will occur over 24 hours with the spacing between sets about the same as in the first expedition. At each station, sampling will be similar to the first expedition and a sampling plan will be developed prior to leaving Vancouver. At some locations, there will be deeper sets that will be used to assess the effectiveness of surface sets. The area of research in 2019 is presented below, but some variation is anticipated in 2020.

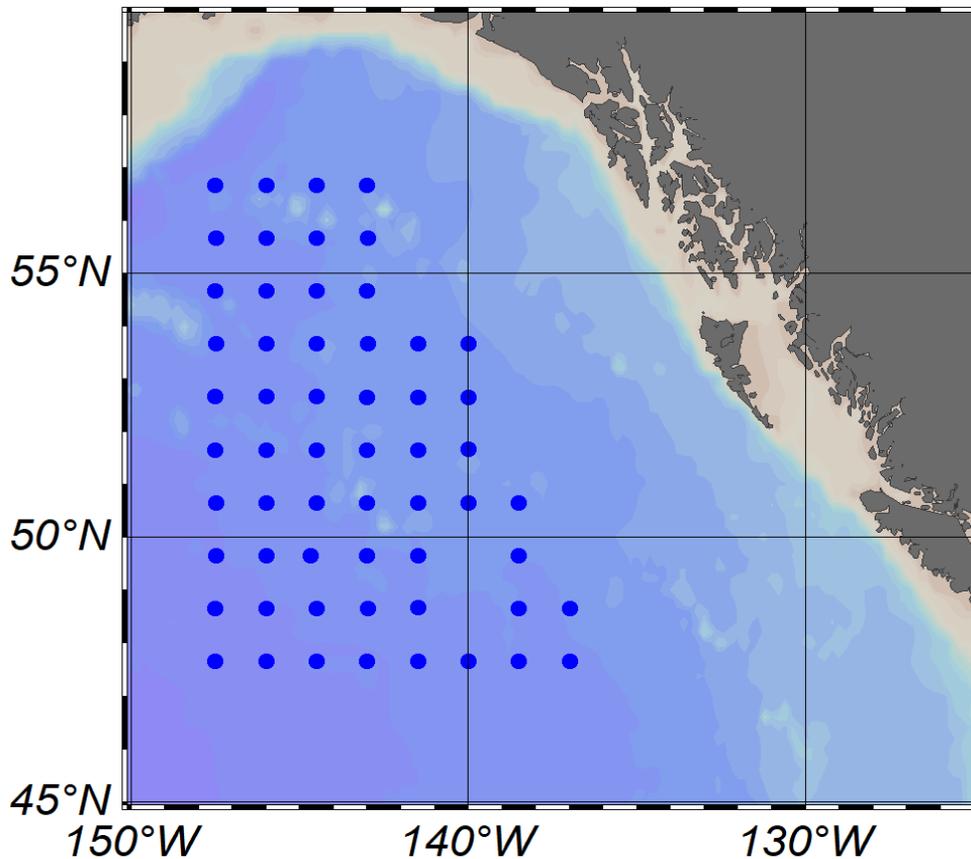


Figure: Proposed study area for 2020. There will be additional stations within the EEZ of United States and Canada and one port call will be made in SE Alaska. The additional stations and the port will be determined during the expedition.

Citation:

Pakhomov, E.A, C. Deeg, S. Esenkulova, G. Foley, B.P.V. Hunt, A. Ivanov, H.K. Jung, G. Kantakov, A. Kanzevarova, A. Khleborodov, C. Neville, V. Radchenko, I. Shurpa, A. Slabinsky, A. Somov, S. Urawa, A. Vazhova, P.S. Vishnu, C. Waters, L. Weitkamp, M. Zuev, and R. Beamish. 2019. Summary of preliminary findings of the International Gulf of Alaska expedition onboard the R/V Professor Kaganovskiy during February 16–March 18, 2019. NPAFC Doc. 1858. 25 pp. Canada, Japan, Korea, Russia, and USA (Available at <https://npafc.org>).



Photo: Canadian freezer trawler, Pacific Legacy. Pacific Legacy is 37m long, 10m beam, a draft of 6m, a gross tonnage of 600 t and 2600 horsepower.