

**Preliminary Cruise Plan of the Research Vessel *Professor Kaganovsky*  
to Study the Ocean Ecology of Pacific Salmon  
in the Northwestern Pacific Ocean in Winter 2019**

by

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## ABSTRACT

The document summarizes trawl survey plan for Pacific salmon marine winter life period studies in the western Subarctic front zone of North Pacific in 2019 by Russia (TINRO-Centre). The outline of materials, methods, surveys timing and theoretical background is provided.

According to NPAFC Doc. 1807, R/v “Professor Kaganovsky” is scheduled to conduct the first comprehensive survey of Pacific salmon in the Gulf of Alaska (GoA) in February-March 2019. To make winter monitoring program more comprehensive, it is decided to conduct epipelagic survey in the western Subarctic front zone of North Pacific out of Russia’s EEZ in January 2019.

The main objectives of the expedition are to identify the stock specific rearing areas for all species of salmon, their abundances, spatial distribution and their condition. Scientific group consists of 7 specialists from Russia. After the survey is finished, the vessel is heading to Vancouver, BC to take on board scientists from other NPAFC-member countries. Then the vessel is heading to the GoA.

**Key words:** Pacific salmon, Subarctic front zone, winter ecology, trawl survey

This is a preliminary cruise plan that will identify the major activities of the expedition to study the ocean ecology of Pacific salmon in western Subarctic front zone of North Pacific in the winter. Some activities may be added or abandoned but the general plan will remain essentially unchanged.

### Rationale

Pacific salmon are the second largest group of commercial fisheries target species in Russia’s Far East. Their catch level is currently very high. In 2018, there was a new historical catch maximum – 667 thousand tons, wherein more than 75% was pink salmon – 507 thousand tons. It was the third historical catch maximum since 2000. The Okhotsk Sea had the highest proportion of salmon catches in 2018 – 78%. One of the major components of successful fishing season was the constant scientific support during the almost all salmon life stages: seaward migration, early ocean cycle, wintering migrations, and spawning migrations. Each life stage is provided with abundance evaluations and spatial distribution data. The most valuable data for 2018 abundant fishing season was collected during trawl surveys on juvenile salmon in autumn 2017 in Okhotsk (2,7 bill. fish) and Bering (0,1 bill. fish) Seas and summer survey in northwestern Pacific in 2018 during spawning migration (1,1 bill. fish).

However, trawl estimations of juvenile salmon in autumn 2018 have decreased down to 1 bill. fish in the Bering Sea and 0,7 bill. fish in the Okhotsk Sea. How abundant will be the 2019 salmon run, this depends on salmon winter survival rate which is, according to many authors, considered as one of critical periods. At the same time, wintering period is the less studied. There is no reliable information on which factors have the greatest effect on salmon survival. To date, there are several controversial theories about severity of winter environment for salmon.

Proponents of “highly critical” winter period consider food deficit and, consequently, severe competition as the major factors, and size-dependent mortality. In addition, salmon production is affected by predation, parasites, and changing ocean environment. The experience of previous studies shows a wide mortality range during winter – from 36 to 64 %. The precise mortality rate evaluation is urgently needed for fishery management, especially during the years of low juvenile salmon abundance.

Pacific salmon overwinter in a broad water area within the boundaries of Subarctic front zone, the most of individuals stay within temperature range 4-8°C. Asian stocks mostly overwinter in the northwestern part, American stocks – in the Gulf of Alaska. Mixed stocks spend winter period in the south of Aleutian Arc.

Therefore, this expedition, as well as the following survey in the GoA will cover a wide water area of salmon wintering, including both western and eastern sides, help to broaden knowledge of their overwintering condition and determine mechanisms of their high/low mortality during the winter.

## **METHODOLOGY OF STUDIES**

This survey will be conducted using the standard methods and approaches. Trawl hauls are carried out by the standard midwater trawl, model RT 80/376 m fished with four 120 m bridles. Heavy orbicular midwater trawl doors, each one of 6 sq.m, are used. Depending on towing speed the vertical spread of the trawl is 32-42 m and horizontal spread is 30-34 m. At each station the net is towed for 1 hour. The net is towed at about 4.5-5.0 kts with the headrope located at the surface (fixed layer - 0 m), particularly at night. The length of warps is 250-310 m.

Each trawling is accompanied (before or after) by the collection of plankton samples. Samples for fish and squid diet studies are taken from the catch of every trawling and these samples undergo on-board processing. The processing of all samples is carried out by means of express methods of analysis that were developed by TINRO-Center. Intensification of research on caloric content of food items and their isotope composition will provide further insights into understanding of Pacific salmon biological environment. Pacific salmon tagging activities will be continued if workload permits.

Hydrological studies are conducted during the whole period of the survey by means of hydrological probe Neil-Brown or by ICTD. The data is recorded for the fixed layer 0-1000 meters and for the areas with the depth less than 1000 meters – down to the bottom.

## **SURVEY OBJECTIVES AND TASKS**

The major purpose of these studies is to determine the environment conditions and state of Pacific salmon during the less favorable period of their marine life cycle. In 2019, the studies on salmon distribution, salmon food selectivity, dependence of salmon feeding on biomass and composition of plankton and nekton communities, changes of biological condition of salmon during winter, salmon spatial differentiation, structure of stocks contributing to the mixture and the influence of abiotic environment on the salmon quantitative distribution and migrations are planned.

The major objectives of the survey are: 1) to determine the current state of Pacific salmon in the pelagic ecosystems of the Pacific waters; 2) to elucidate the Pacific salmon position and role in the trophic structure of the epipelagic zone; 3) to evaluate the pelagic ecosystems status, as well as oceanic and overall ecological conditions in the Pacific waters in winter-spring of 2019, 4) to estimate the salmon mortality during winter period.

Achievement of these objectives will be accomplished through the fulfillment of the following tasks:

1) carrying out of trawl survey in epipelagic zone in the western and central areas of the Subarctic for estimation of Pacific salmon and other nekton species abundance and biomass.

Assessment of their abundance, biological condition and spatial distribution patterns, size and age composition of stocks and their mixtures. Sampling for feeding studies.

2) carrying out of plankton survey in epipelagic zone for collection of data on plankton community composition and structure, salmon and mass nekton species feeding environment; description and development of nektonic community trophic structure models.

3) carrying out of hydrological survey for evaluation of climate-oceanic conditions.

4) carrying out of acoustic survey for estimation of Pacific salmon abundance and biomass.

### LOCATIONS AND PERIOD OF SURVEY

The cruise of research vessel R/V “Professor Kaganovsky” is planned to conduct its survey in the Pacific waters out off Russia EEZ for estimation of mature and immature Pacific salmon and other nekton species abundance and biomass in January 16 – 31, 2019 (Fig. 1). After the survey is done the vessel is heading to Vancouver.

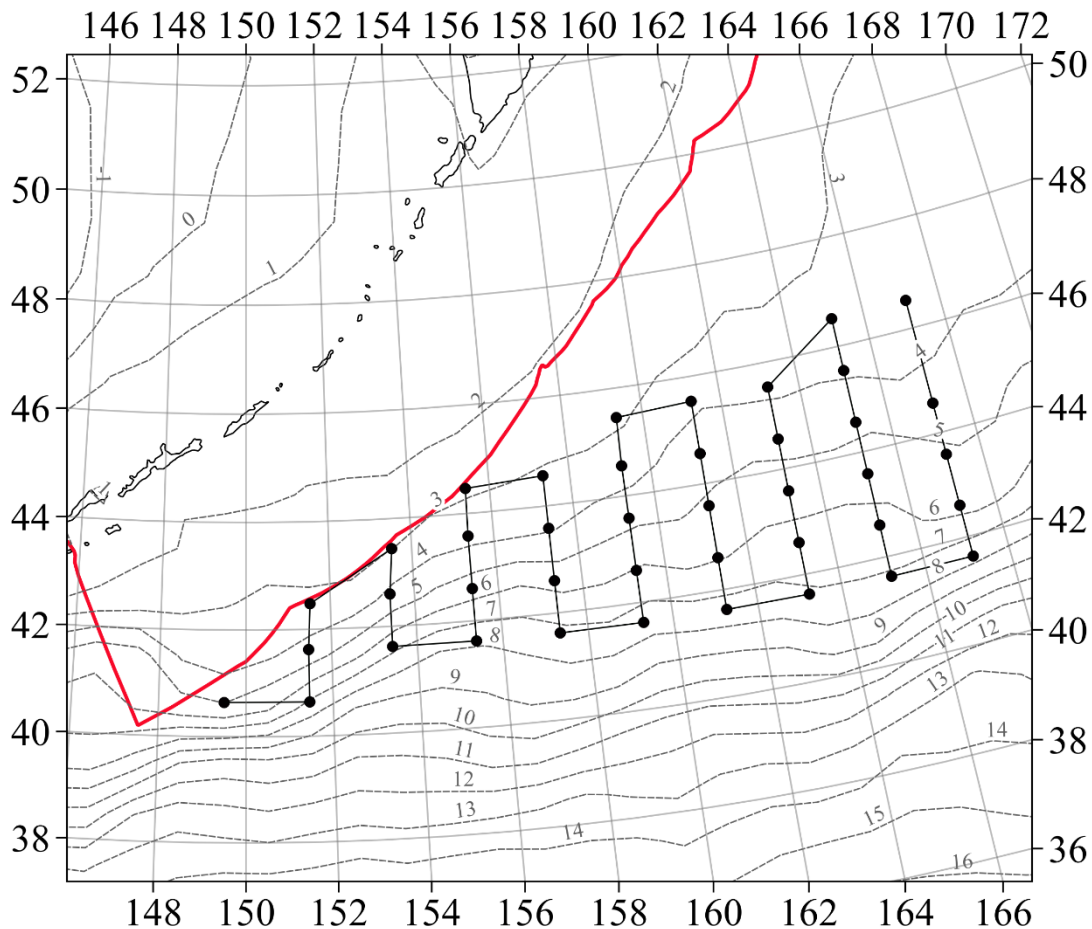


Fig. 1. The survey grid in the northwestern Pacific Ocean.

### PARTICIPATING SCIENTISTS

Scientific group includes 7 persons: 3 ichthyologists, 2 hydrobiologists, 2 hydrologists (preliminary).