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Trawl Survey Plans for Pacific Salmon Marine Life Period Studies in the Far Eastern Seas in 2007 by Russia

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by

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INTRODUCTION

Previous year of Pacific salmon research 2002-2006 coincided with a relatively warm period (according to climate and hydrological indices). This was observed for surface, intermediate warm and intermediate cold layers. The surface and subsurface layers were characterized by increase in temperature during 2002-2005 period. During start of cold period in 2005-2006 period, the warm intermediate layer experience increase in temperature, which may be explained by increased subarctic circulation as well as increased inflow of Pacific waters into the Bering Sea (Basyuk et al. in press, Glebova in press).

Taking into account 8-10 year cyclicity in atmospheric processes, ice cover and SST dynamics, we can expect that 2007-2011 period will be relatively cold in the Bering Sea. Taking into account system organization of natural processes, it is highly important to continue with further research in order to achieve better understanding of Pacific salmon stocks and North Pacific ecosystem dynamics. The essential element of future research should be elucidation of influence of climate-oceanological factors upon foraging conditions, distribution and abundance of Pacific salmon stocks. This issue is of particular importance if we keep in mind the expected cooling down and possible decrease in stocks abundance of some North American and Asian stocks.

The macroplankton dominated primarily over deep-sea areas (75-85 % of total plankton biomass) while the highest biomass of small-sized group (mainly small copepods) were observed in the eastern Bering sea (10-45 % of total plankton biomass). Features of plankton communities structure in various parts of the Bering Sea have affected composition of Pacific salmon diets. Nekton species (which are of a higher energy content compared to macrozooplankton species) dominated the diet of all Pacific salmon species in the eastern Bering Sea (Volkov et al. 2005, Volkov et al. in press a, in press b, Shuntov, Temnykh 2005a).

Studies of carrying capacity of pelagic layer in relation to Pacific salmon should be continued during future research (abundance and relative share of individual species, foraging conditions dynamics, food competition and its influence upon growth and survival, etc.). According to some Russian research data (Temnykh et al. 2004, Shuntov, Temnykh 2005 a, b, Naydenko in press) food availability and food competition did not limit Pacific salmon abundance during previous years. This provides some insights upon

Pacific salmon carrying capacity. Another interesting observation is that increased Pacific salmon abundance, which was observed during previous years, did not result in lowered abundance of forage fish species. The decrease in forage fish species abundance may result in higher quantities of plankton being available to Pacific salmon.

Intensification of research on caloric content of food items and their isotope composition will provide further insights into understanding of Pacific salmon biological environment.

Further expansion of research on spatial and population differentiation of Pacific salmon stocks is envisaged to enhance the already gained results. Issue of interannual variability of these characteristics, as well as ration of different stocks, should be also addressed. The main methods of research (genetic, morphological, scale pattern analysis) in this direction should be strengthened through the thermal marking and tagging.

The high abundance estimates of Pacific salmon during last five years of research testifies for good survival of Pacific salmon. The next five years can be characterized by changed in survival/mortality of Pacific salmon. To correctly address this issue further total abundance estimates and biological characteristics analysis is required.

**I. CRUISE PLAN OF R/V TINRO FOR PACIFIC SALMON MARINE PERIOD OF
LIFE RESEARCH IN THE BERING SEA AND NORTH PACIFIC WATERS OFF KURIL
ISLANDS IN 2007 BY TINRO-CENTER**

SURVEYS OBJECTIVES AND TASKS

Trawl survey of R/V TINRO in summer-autumn period of 2007 on Pacific salmon abundance and ecology in the Bering Sea and North Pacific waters off Kuril islands is planned in accordance with comprehensive ecosystem research plans of Russia. The major purpose of these studies is the detection and interpretation of environmental variation and density-dependence mechanisms, which influence salmon carrying capacity in the North Pacific and Bering Sea and their relevance for conservation and rational exploitation of salmon stocks. In 2007 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 the anadromous migrations and foraging, salmon spatial differentiation, structure of stocks contributing to

the mixture and the influence of abiotic environment upon the salmon quantitative allocation and migrations are planned.

The major objectives of the survey are: 1) determination of the current state of Pacific salmon in the pelagic ecosystems of the Pacific waters of Kuril Islands and western Bering Sea; 2) elucidation of Pacific salmon position and role in the trophic structure of the epipelagic zone; 3) evaluation of pelagic ecosystems status, as well as oceanic and overall ecological conditions in the Pacific waters of Kuril Islands and western Bering sea in summer-autumn of 2007.

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

1) carrying out of trawl survey of epipelagic zone in the whole areas of the Pacific waters of Kuril Islands and western Bering Sea for estimation of Pacific salmon (one of the primary purposes – preliminary estimation of mature pink salmon abundance) 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.

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

3) carrying out of hydrological survey for evaluation of climate-oceanic conditions of the Pacific waters of Kuril Islands and western Bering Sea in 2007.

4) small-scale plankton, hydrological and trawl survey in Chukchi Sea to estimate the state of epipelagic community and its environment.

LOCATIONS AND PERIOD OF SURVEY

The cruise of research vessel "TINRO" is planned to begin in port of Vladivostok in June (provisional date - June 5, 2007). The research vessel returns to Vladivostok in November 13, 2007 (provisional). There are no plans for intermediate ports of call to change the scientific teams.

The first phase of the expedition (June 10-17, 2007) will be devoted to the small-scale epipelagic trawl, plankton and hydrological survey of the Pacific waters of Kuril Islands (Figure 1).

After fulfillment of the first part of the expedition the second part (June 22-July 13, 2007) will be devoted to the epipelagic survey of the south-western Bering Sea within the Russian economic zone (Figure 2). The major purpose of this (second) phase of RV TINRO survey will be monitoring of pink salmon anadromous migrations.

After fulfillment of the second phase of the expedition the third phase (July 19 – August 7, 2007) will be devoted to the walleye pollock studies in the north-western Bering Sea.

The fourth phase (August 12-31, 2007) of RV TINRO survey will be devoted to trawl and acoustic studies of pelagic community in the south-eastern Chukchi Sea (Figure 3).

The fifth phase (September 5-October 21, 2007) of RV TINRO survey will be devoted to will be devoted to the epipelagic survey of the entire western Bering Sea within the Russian economic zone (Figure 4).

METHODOLOGY OF STUDIES

Trawlings are carried out by the standard midwater trawl, model RT/TM 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.

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.

PARTICIPATING SCIENTISTS

Scientific field party will include 14 persons: 6 ichthyologists, 3 hydrobiologists, 3 hydrologists and 2 acousticians (preliminary). The participation in the survey of two scientists from NPAFC member country may be preliminarily arranged in accordance with the project of BASIS program.

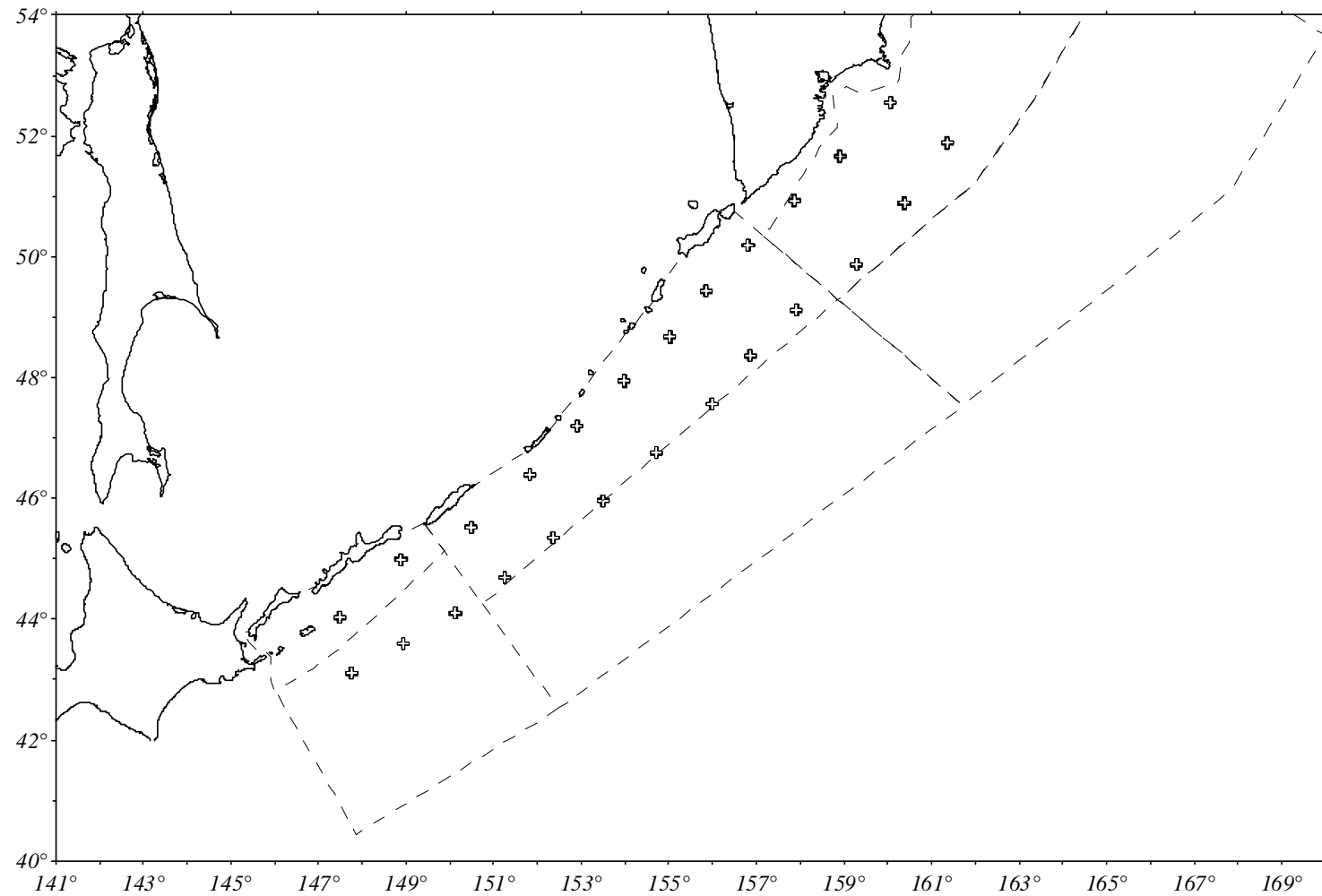


Figure 1. Station locations to be sampled during June 10-17, 2007 by the epipelagic trawl survey of the Pacific waters of Kuril Islands according to TINRO-Center plan.

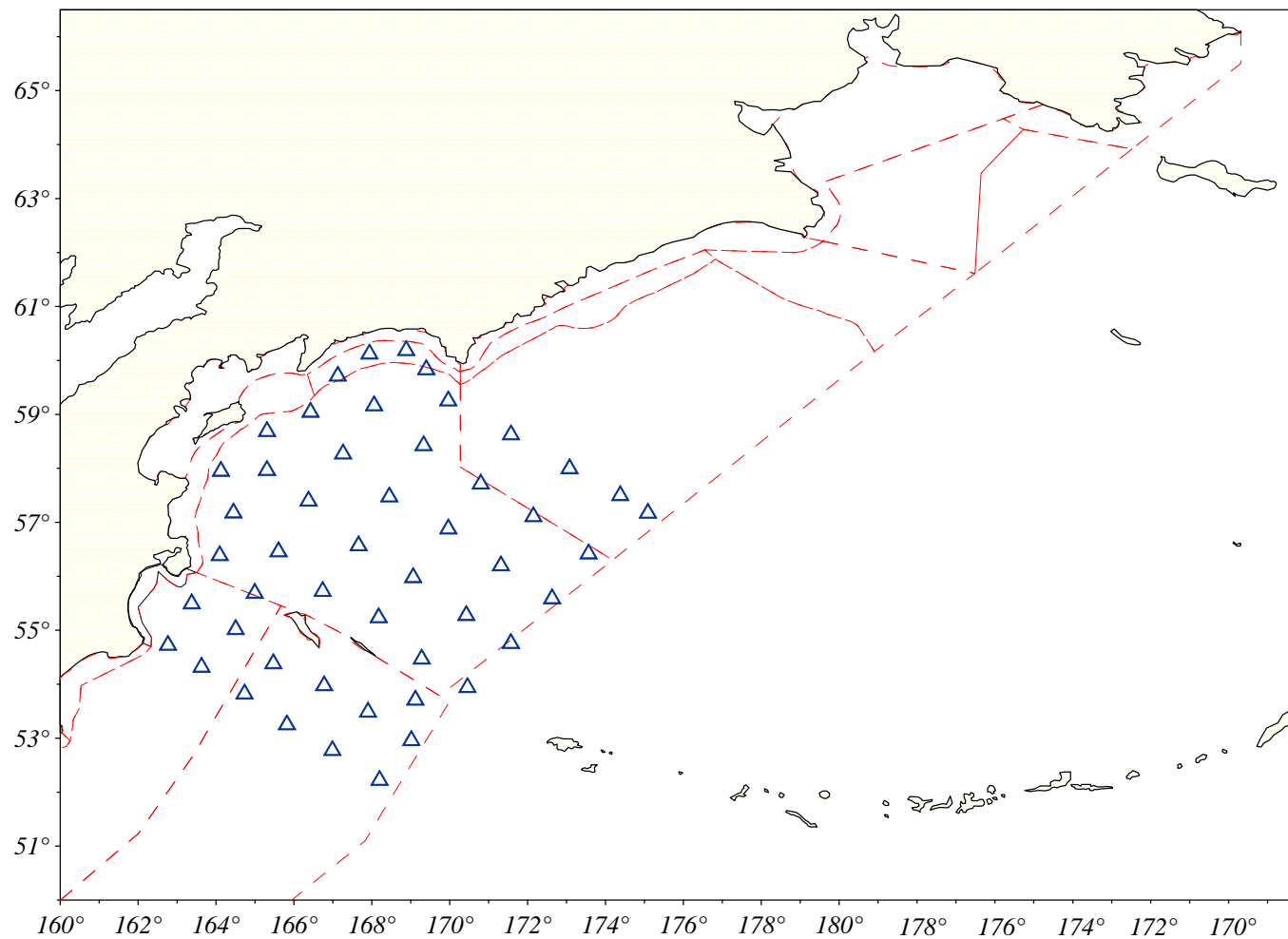


Figure 2. Station locations to be sampled during June 22-July 13, 2007 by the standard comprehensive survey of the upper epipelagic layer of the south-western Bering Sea and adjacent Pacific waters according to TINRO-Center plan.

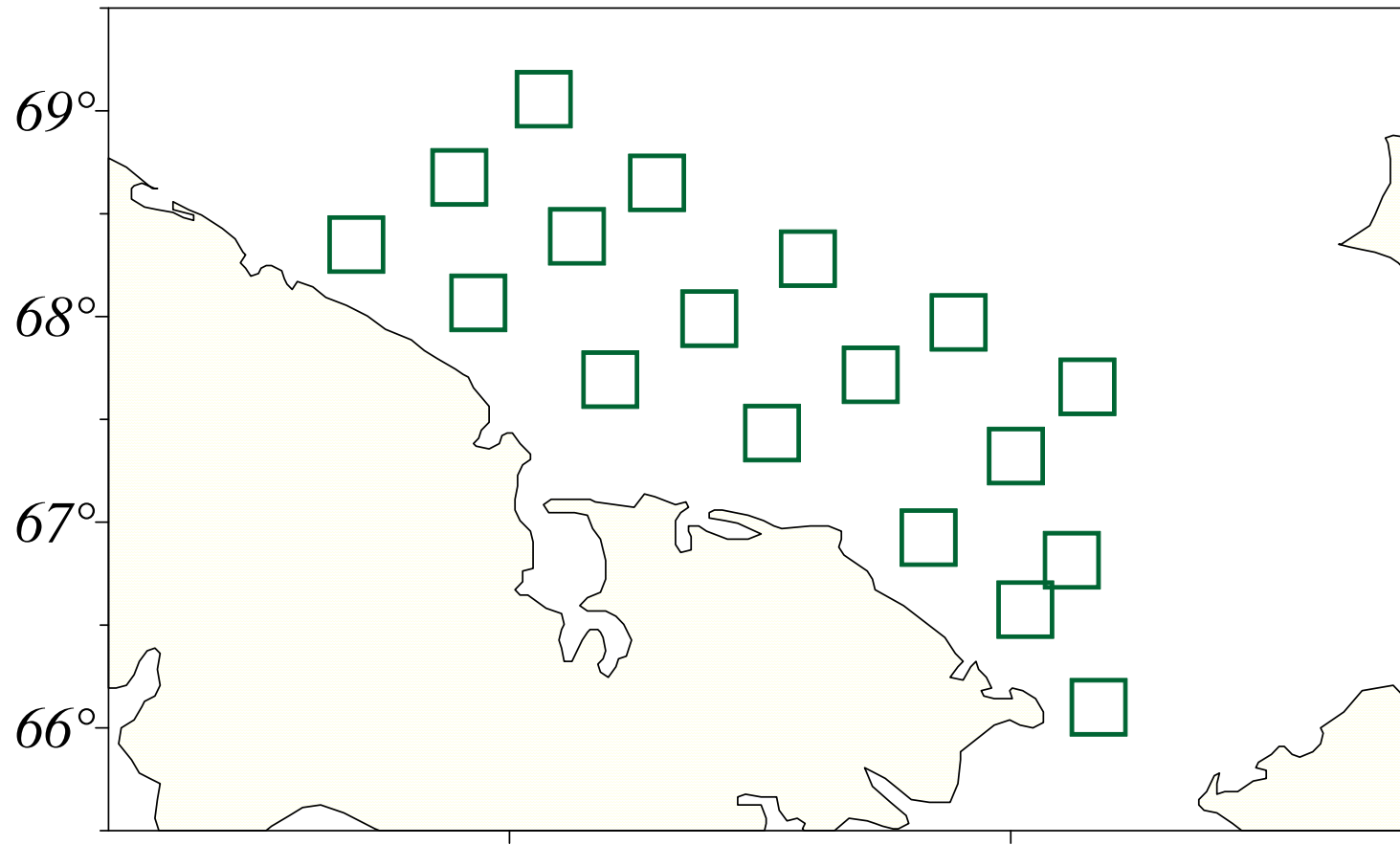


Figure 3. Station locations to be sampled by the trawl-acoustic survey of pelagic community in the south-eastern Chukchi Sea during August 12-31, 2007 according to TINRO-Center plan.

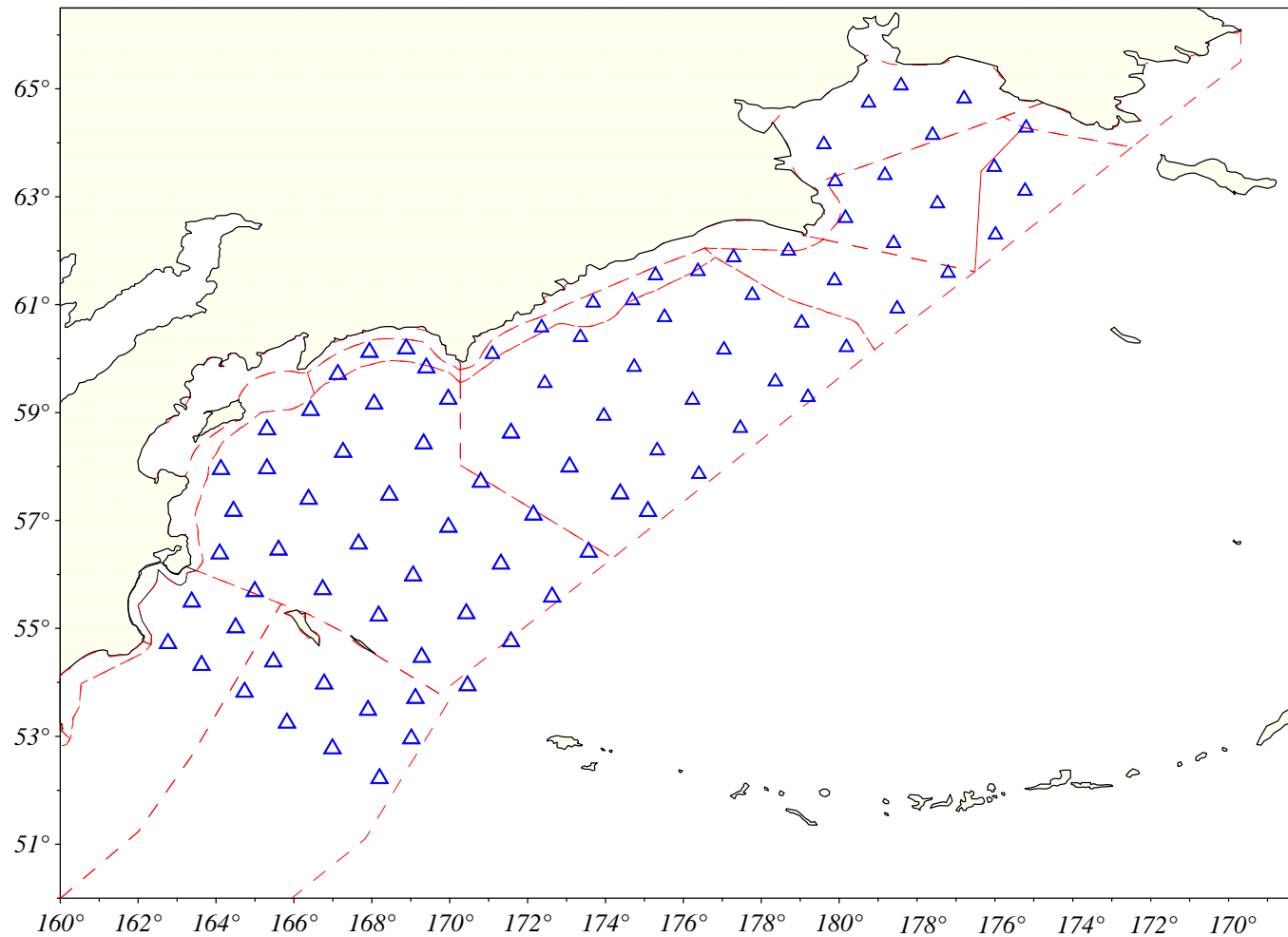


Figure 4. Station locations to be sampled by the standard comprehensive survey of the upper epipelagic layer of the western Bering Sea according to TINRO-Center plan during September 5-October 21, 2007.

II. CRUISE PLAN OF R/V PROFESSOR KAGANOVSKY FOR PACIFIC SALMON
MARINE PERIOD OF LIFE RESEARCH IN THE OKHOTSK SEA IN 2007 BY TINRO-CENTER

SURVEYS OBJECTIVES AND TASKS

The conduction of summer-autumn of 2007 trawl by RV “Professor Kaganovsky” on salmon abundance and ecology in the southern Okhotsk Sea and Pacific waters off Kuril Islands is planned in the baseline of the comprehensive ecosystem research of the Far Eastern Seas and North Pacific ecosystems status monitoring. The major purpose is to conduct standard ecosystem upper epipelagic trawl survey in order to study mature, immature and juvenile Pacific salmon abundance, distribution, food selectivity, composition of plankton and nekton communities, changes of biological condition of salmon during the anadromous and catadromous migrations, salmon spatial differentiation, structure of stocks contributing to the mixture and the influence of abiotic environment upon the salmon quantitative allocation and migrations. 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 the anadromous and catadromous migrations and foraging, salmon spatial differentiation, structure of stocks contributing to the mixture and the influence of abiotic environment upon the salmon quantitative allocation and migrations are planned.

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

1) carrying out of trawl survey of epipelagic zone in the whole areas of the southern Okhotsk Sea and Pacific waters off Kuril Islands for estimation of mature, immature and juvenile Pacific salmon and other nekton species abundance and biomass (one of the primary purposes – preliminary estimation of mature pink salmon abundance). 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 of epipelagic zone for collection of data on plankton communities composition and structure, salmon and mass nekton species feeding environment; description and development of nektonic communities trophic structure models.

3) carrying out of hydrological survey for evaluation of climate-oceanic conditions of the southern Okhotsk Sea and Pacific waters off Kuril Islands in 2007.

LOCATIONS AND PERIOD OF SURVEY

The cruise of research vessel "Kaganovsky" is planned to conduct its survey in the southern Okhotsk Sea in June and October-November of 2007 (Figure 5).

METHODOLOGY OF STUDIES

Trawlings are carried out by the standard midwater trawl, model RT/TM 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.

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.

PARTICIPATING SCIENTISTS

Scientific field party will include 15 persons: 7 ichthyologists, 3 hydrobiologists, 3 hydrologists (preliminary).

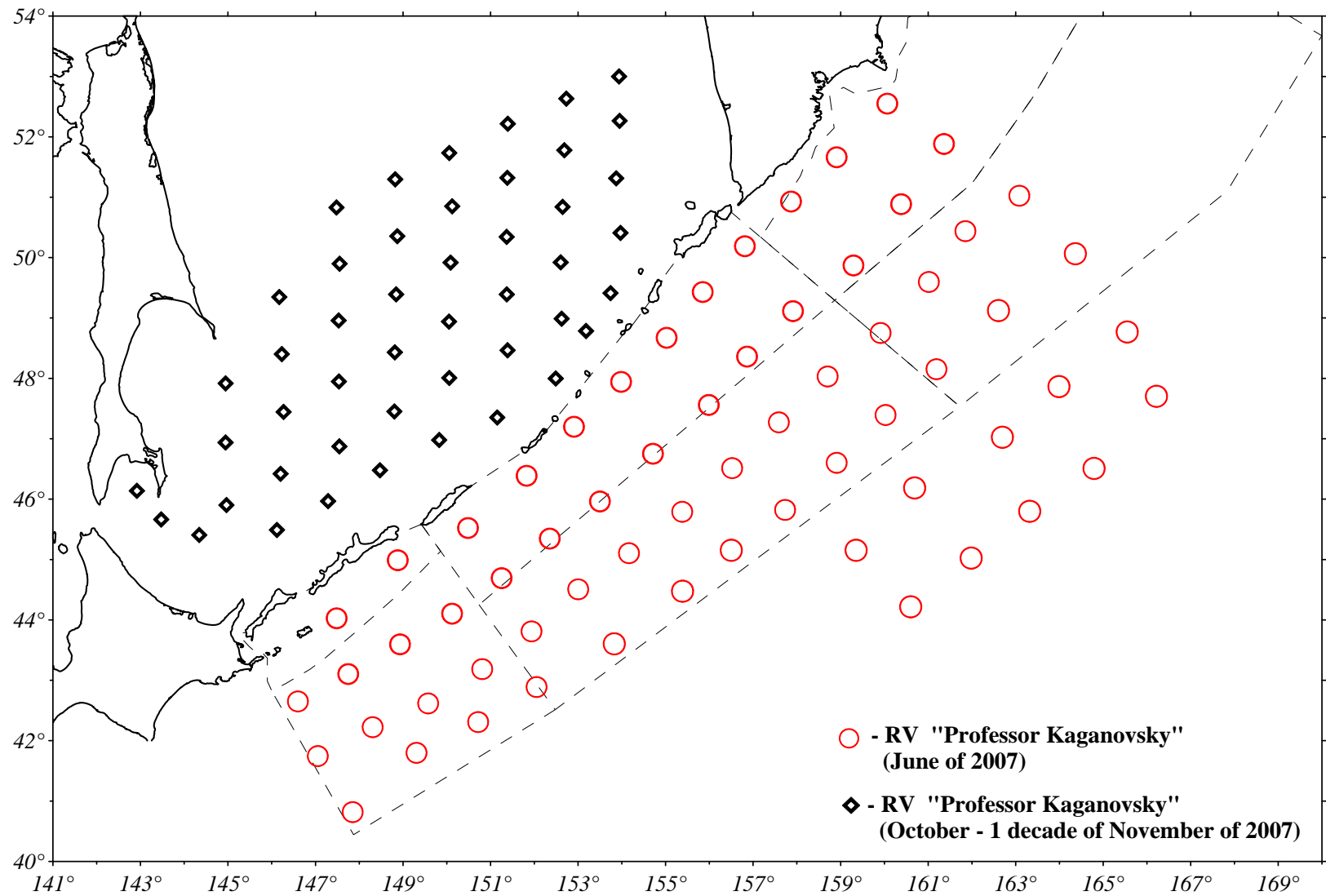


Figure 5. Station locations to be sampled by the standard comprehensive survey of the upper epipelagic layer of the southern Okhotsk Sea of Kuril Islands according to TINRO-Center plan for June and October-November of 2007.

**III. CRUISE PLAN OF R/V "DMITRY PESKOV" FOR PACIFIC SALMON EARLY
MARINE LIFE RESEARCH IN THE OKHOTSK SEA IN 2007 BY SAKHNIRO**

SURVEYS OBJECTIVES AND TASKS

In the Sakhalin-Kuril region, the pink salmon and chum salmon constitute a basis of the Pacific salmon stocks. In the productive years the total numbers of juveniles of these species (reared from natural reproduction and released from the hatcheries) reach 0.8-1.0 billions fish. However, the spawners return (catch and escapement) usually comprises not more than 3-4% from the juvenile salmon abundance. Entire remaining numbers of fishes perish during the sea life cycle, which indicates significance of this phase in the formation of the number of year classes. It was revealed in 1970s-1990s that pink salmon and chum salmon juveniles do not stay during any long time not only in the river estuaries and lagoons, but also in the inshore shelf adjacent to them. Juveniles move away from the coast to the outer shelf water area already during the first days and weeks after entry into the marine environment, where they dwell under the conditions of the open sea. However, its further fate remains unclear before occurrence in the autumnal aggregations in the southern Sea of Okhotsk.

During June-July of 2002-2006, SakhNIRO conducted the trawl surveys of Pacific salmon juveniles in the shelf and continental slope zones off the eastern Sakhalin and southern Kurile Islands on the r/v "Dmitry Peskov". Pelagic rope trawl 54.4/192 m was used. In spite of the expectations, aggregations of juvenile salmon were not found in 2002-2003. Catches per unit effort (CPUE) were insignificant and did not correspond to abundance of juveniles migrated from the rivers of this region. For the first time, notable aggregations of pink salmon and chum salmon fry occurred in the Aniva Bay, and so in the shelf and continental slope zones of southeastern Sakhalin during July of 2004. It was revealed that Pacific salmon juveniles demonstrated prolonged residence in the inshore shelf zone along the southern Sakhalin coast before the migration to the offshore waters. Pink salmon could not be revealed beyond this inshore zone before the end of June. During July of 2005, trawl survey was repeated in the Aniva Bay and the results of 2004 were confirmed. Besides, in July 2006 similar marine researches indicated pronounced effect of short scale oceanologic conditions on the both time limits of juveniles migration from inshore waters and their

further distribution. In 2007, SakhNIRO intends to proceed the study on Pacific salmon juveniles distribution, biology, environmental conditions influencing the year-class abundance formation during the stage of offshore migrations from the Sakhalin Island coast. The study objectives are as following:

1. Definition of migration timetable of young salmon from the coast.
2. Estimation of distribution and numbers of juvenile Pacific salmon.
3. Estimation of the biological parameters of the captured juvenile Pacific salmon by the regions and periods of observation.

LOCATIONS AND PERIOD OF SURVEY

Surveys will be conducted in the south-western Sea of Okhotsk in the limits of Aniva Bay, coastal waters of south-eastern Sakhalin, and Terpenia Bay. They will be conducted from the beginning of July, 1 to August, 31 of 2007, that must cover a period from juvenile salmon migration into marine environment until their migration into the offshore southern Sea of Okhotsk (Figure 6). There will be two consecutive legs (first – July, 2007, second – August 2007) with similar station grid (every leg- total of 250 stations arranged in 31 rows).

METHODOLOGY OF STUDIES

Trawl survey will be carried out from the SakhNIRO r/v "Dmitry Peskov" (STR-420) along the previously developed pattern of trawling stations from the 30-meters depth far to the continental slope limits. Trawling stations will cover inner, middle, and outer part of the sea shelf. Trawl hauls will be carried out by the standard midwater trawl, model RT/TM 54.4/192 m with the small mesh (4.5 mm) insert in the trawl codend. Upper epipelagic layer from 0 to 30 m will be swept during the trawl hauls. It is planned to conduct up to 150 trawl hauls during the research cruise.

Trawl catches of fishes will be investigated by species, CPUE will be calculated (in weight and quantitative units), and size and weight parameters of fish will be measured. Trawl survey will be accompanied by hydrological survey using the CTD-probe. Oceanographic research will be carried out using the Juday plankton net in the places of juvenile Pacific salmon aggregations. Juvenile salmon and associated fish species will be fixed with 4% formalin for feeding studies.

PARTICIPATING SCIENTISTS

Scientific field party will include 7 persons: 4 ichthyologists, 1 biological oceanographer, and 2 physical oceanographers.

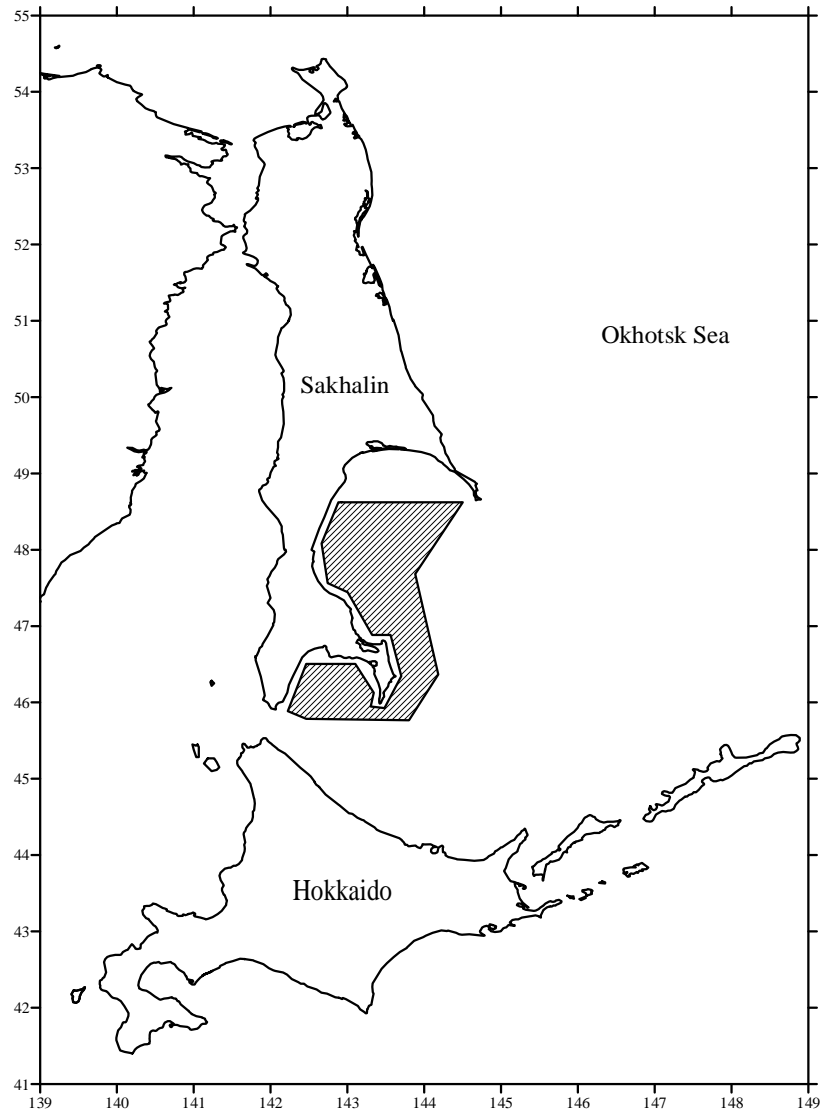


Figure 6. Station locations to be sampled by the standard trawl survey of the upper epipelagic layer of the south-western Okhotsk Sea according to SakhNIRO plan for July 1-August 31, 2007.

**IV. CRUISE PLANS FOR PACIFIC SALMON EARLY MARINE LIFE PERIOD RESEARCH
IN THE OKHOTSK SEA IN 2007 BY KAMCHATNIRO**

SURVEYS OBJECTIVES AND TASKS

The purpose KamchatNIRO research described below is the analysis of distribution, abundance and biological characteristics of juvenile Pacific salmon in the Okhotsk Sea (Figure 7). Environmental, feeding, and food competition data will be collected September-October of 2007. Seasonal distribution, abundance, migration, population characteristics, and survival of juvenile salmon will be surveyed by means of various approaches. Stocks abundance, habitat conditions, feeding and trophic interactions of salmon juveniles and others species will be studied. Primary production and salmon food resources in different salmon habitats will be estimated. A comparison between salmon and other pelagic fishes of the consumption rates of plankton and micronekton animals will help to estimate the place of salmon in the trophic structure of pelagic ecosystems.

LOCATIONS AND PERIOD OF SURVEY

The chartered STR-type or ST-type vessel will be used during September-October of 2007. Assessment of juvenile salmon abundance during their migration to Okhotsk sea will be carried out by means of STR-503 – type vessels during September 1-October 31, 2007. Station locations are shown in Figure 7.

METHODOLOGY OF STUDIES

During the September 1-October 31, 2007 assessment of juvenile salmon abundance during their migration to Okhotsk Sea will be carried out by standard midwater trawl, model 54.4/192 m. with the small mesh (12 mm) insert in the trawl codend. Upper epipelagic layer from 0 to 30 m will be swept during the trawl hauls with a headrope located at 0 m. Speed during trawl tows should be 4-4.8 knots. Three 1-hour hauls during daytime period are planned per day. Length of warps – 150-200 m. The set of standard plankton, trophic, bioenergetics and oceanographic observations accompanies every trawl tow. The catch of every trawl tow is sorted, measured and analysed. Otolith, scale, genetic, tissue, parasite, morphological samples are collected to identify origin of Pacific salmon juveniles.

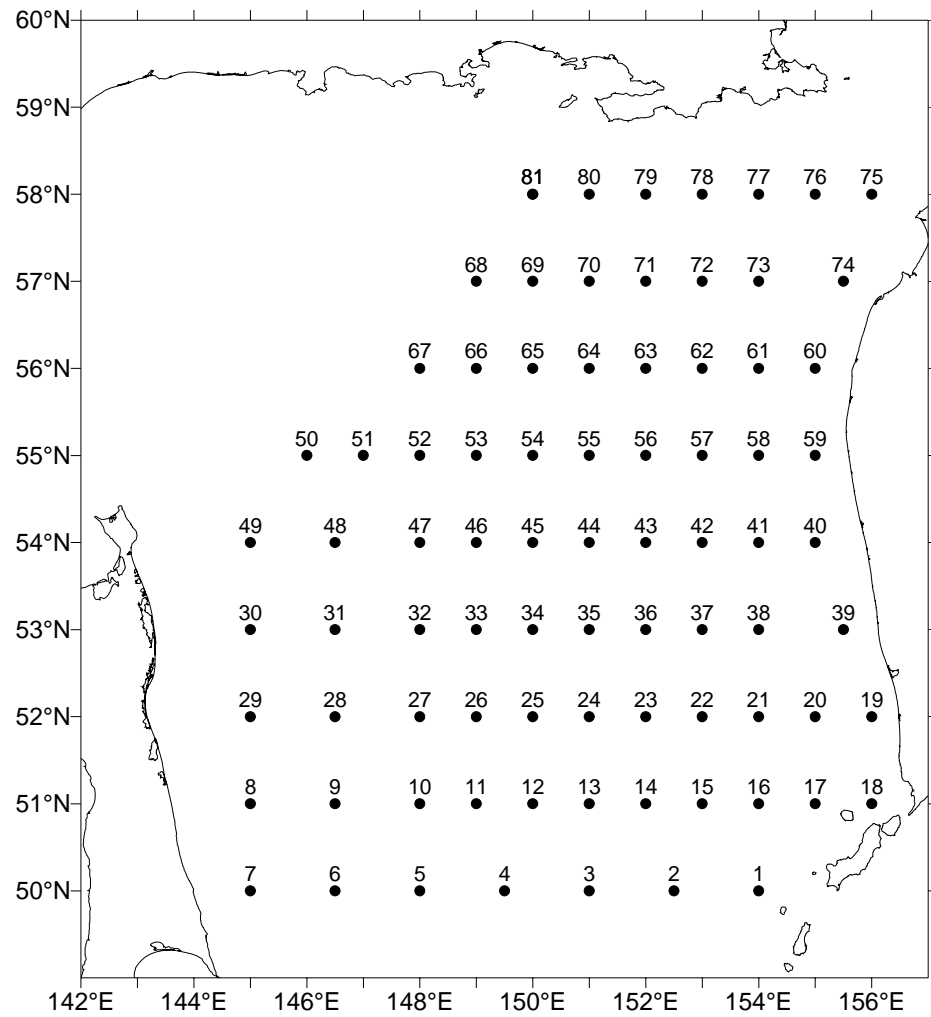


Figure 7. Station locations to be sampled by trawl survey of the upper epipelagic layer for the assessment of juvenile Pacific salmon abundance during their migration in Okhotsk Sea in 2007.

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