

North Pacific Anadromous Fish Commission

Vancouver, B.C.
1999 March 24-26

REPORT OF THE RESEARCH PLANNING AND COORDINATING MEETING

1. OPENING REMARKS AND INTRODUCTIONS

The Research Planning and Coordinating Meeting (RPCM) was held from March 24 to 26, 1999 at the Empire Landmark Hotel and Conference Center in Vancouver, B.C. Dr. Irina Shestakova, Executive Director of NPAFC, opened the meeting and welcomed the participants to Vancouver, B.C.

List of participants is as follows (Appendix 1):

NPAFC Research Planning and Coordinating Group (RPCG)

Canada:	Richard Beamish Gerry Kristianson Skip M ^c Kinnell David Meerburg Donald Noakes David Welch	United States:	Richard Carlson Nancy Davis Douglas Eggers Hal Geiger Peter Hagen John Helle Bill Hines Steve Ignell Kenneth Johnson James Longwill Loh-Lee Low Kate Myers Eric Volk Robert Walker
Japan:	Masa-aki Fukuwaka Yukimasa Ishida Morihiko Kawana Shigehiko Urawa Norimasa Yoshida		
Russia:	Vladimir Fedorenko Oleg Gritsenko Vladimir Karpenko Igor Mikhno Vladimir Radchenko Alexander Rogatnykh		

PICES

Alexander S. Bychkov Patricia Livingston

Secretariat

Irina Shestakova	Hiroko Omori	Wakako Morris
Denise McGrann	Ikumi Graham (<i>Interpreter</i>)	Almira Safarova-Downey (<i>Interpreter</i>)

2. APPOINTMENT OF CHAIRPERSON

Dr. O. Gritsenko of the Russian Federation, Chairperson of CSRS, chaired the meeting.

3. AGENDA

The following agenda was adopted:

- (1) Opening remarks and introductions
- (2) Appointment of a Chairperson
- (3) Adoption of agenda
- (4) Meeting procedures
- (5) The 1999 CSRS Work Plan
 - (a) Review of Work Plan activities
 - (b) Coordination of research
- (6) Cruise activities
 - (a) Review of objectives and plans, including schedules
 - (b) Coordination of participation of scientists
- (7) Exchange of biological samples, data and personnel
- (8) Science Sub-Committee and Working Groups' discussions:
 - (a) Science plan
 - (b) Methodology standardization
 - (c) Stock assessment
 - (d) Salmon marking
 - (e) Archival tags
- (9) Preparation for the International Symposium on Recent Changes in Ocean Production of Pacific Salmon in November 1999
- (10) Cooperation with relevant international organizations
 - (a) Recent activities of PICES and cooperation with PICES on the Beyond El Niño conference in March 2000
 - (b) Consideration of future cooperation with NASCO
- (11) Other business and future meetings
- (12) Summary report

4. MEETING PROCEDURES

K. Myers was appointed Rapporteur. D. Meerburg of Canada, S. Urawa and M. Fukuwaka of Japan, V. Karpenko of Russia, and R. Walker of the United States were appointed to the editorial group.

5. THE 1999 CSRS WORK PLAN

The Work Plan approved at the 1998 Annual Meeting was reviewed. The Parties' 1999 research plans were updated and included in the NPAFC Science Plan 1999-2000 (Appendix 2).

6. CRUISE ACTIVITIES

(a) Review of Objectives and Plans, including Schedules

Each member country described its research cruises for 1999.

Canada

Canada is still in the process of planning 1999 cruise activities, which will be finalized in two weeks. Canada introduced the possible research cruise plans as follows:

- i) Ocean distribution and migration of juvenile salmonids from northern Vancouver Island to southeastern Alaska, using the *W.E. Ricker*.
- ii) Inshore salmon research (climate effect on salmonid resources)
Inshore cruises in southern British Columbia waters and off the west coasts of British Columbia and Washington State will be conducted several times in the 1999 fiscal year.

Japan

Japan submitted a revised Doc. 332 (Rev. 1) under this agenda item. Four Japanese salmon research vessels are scheduled to conduct the following scientific research in the western North Pacific, Bering Sea, and Gulf of Alaska in 1999/2000 fiscal year. In the case of gillnet operations, gillnets less than 2.5 km in length will be used.

- i) The *Hokusei maru* will conduct three cruises for oceanographic observations and research with gillnets to obtain data on the distribution and ecology of salmon and other pelagic fishes in the western North Pacific Ocean from June to August.
- ii) The *Oshoro maru* will conduct research with gillnets, longlines, and small trawl to obtain data on the distribution and ecology of salmon and other pelagic fishes in the North Pacific, Bering Sea, and Gulf of Alaska from early June to mid-August.
- iii) The *Wakatake maru* will conduct research with gillnets and longlines to obtain data on the distribution and stock abundance of salmon along 180° longitude in the North Pacific and Bering Sea from early June to late July.
- iv) The *Hokko maru* will conduct research with gillnets and to obtain information on the distribution and stock abundance of Asian salmon at the stations along 165° longitude in July.

Among the four cruises, the *Wakatake maru* and *Oshoro maru* cruises are Japan-U.S. cooperative research.

Russia

- i) The R/V *TINRO* will conduct pelagic trawl surveys on Pacific salmon in the southern Okhotsk Sea and waters off the Kuriles in August-November 1999. During the first part of the cruise, anadromous salmon distribution, abundance, and biological characteristics, as well as the physical environment, will be studied. Offshore distribution and migration of salmon juveniles will be studied next, and abundance surveys will be conducted. Data and samples for stock identification, age composition, and salmon feeding will also be collected.
- ii) A middle-tonnage trawler will be chartered to conduct a trawl survey on Pacific salmon juveniles in the eastern Okhotsk Sea, including waters off western Kamchatka, in

September-October. The abundance of salmon juveniles will be estimated with specific attention to pink salmon.

- iii) The R/V *Kamchatsky Losos* will execute a stock assessment study on anadromous salmon in Pacific waters off Kamchatka and the Kuriles in May-July. Gillnets of 52-65 mm (104-130 mm stretched) mesh size will be used.
- iv) The R/V *Rubinovi*y will conduct studies of salmon migrations in offshore Pacific Ocean waters in April-May 1999 (Doc. 399, Rev. 1). The vessel will use four 2.5-km nets of 62 panels with 40-65 mm (80-130 mm stretched) mesh size. The main aim of the expedition is to study horizontal and vertical distribution of immature and maturing salmon in relation to oceanographic conditions.

With regard to the cruise plan of R/V *Rubinovi*y, the United States informed Russia that deployment of driftnets that exceed 2.5 km on the high seas is not consistent with US legislation.

Russia stated that it did not receive any objections from the Parties within the established 30-day notification period after receipt of the program from the Commission (Memo from I. Shestakova to NPAFC Points of Contact, February 23, 1999). As an act of goodwill, Russia shall extend the time for submittal of official responses to its request until April 2, 1999.

United States

Two cruises will be conducted in 1999:

- i) May, eastern North Pacific Ocean, F/V *Great Pacific* (Doc. 391): High seas salmon migrations will be studied, sampling near-surface waters with a large midwater trawl for immature and maturing salmon. Samples will provide information on stock identity, growth and condition, lipid content, and feeding habits of salmon on the high seas.
- ii) July, eastern Bering Sea, F/V *Great Pacific* (Doc. 392): The seaward migration route of juvenile sockeye salmon and other salmon species will be studied, sampling near surface waters with a large midwater trawl. Information on the environment and biology of juvenile salmon will be collected, including samples for studies on stock identity, growth, and food habits of salmon in their first ocean year.

(b) Coordination of Participation of Scientists

Participation of scientists on research cruises of other Parties is planned as follows:

Party	Vessel (Month)	Name of Scientist (Party)
Japan	<i>Oshoro maru</i> (June-July)	D. Moore (Canada)
USA	<i>Great Pacific</i> (May)	T. Nomura (Japan)
USA	<i>Great Pacific</i> (July)	one scientist (Russia)
Japan	<i>Oshoro maru</i> (June-July)	R. Walker, S. Hyun, J. Boldt (USA)
Japan	<i>Wakatake maru</i> (June-July)	N. Davis (USA)

Canada indicated that scientists from other Parties could be accommodated during its research cruises. Russia indicated that the cruise of the R/V *TINRO* would be able to accommodate one scientist from other Parties.

These arrangements will be completed by correspondence between the countries concerned.

7. EXCHANGE OF BIOLOGICAL SAMPLES, DATA, AND PERSONNEL

Exchanges of samples and data have been made informally between scientists and have worked well. The RPCG confirmed that this practice will be continued.

Russian contacts for sample and data exchanges are O. Gritsenko for statistics and V. Karpenko and V. Radchenko for scientific data.

8. SCIENCE SUB-COMMITTEE AND WORKING GROUPS' DISCUSSIONS

(a) Science Sub-Committee

The NPAFC Science Sub-Committee, consisting of R. Beamish, Y. Ishida (Chair), V. Karpenko, and K. Myers, met and discussed the following items:

- i) The NPAFC Science Plan 1999-2000 is completed (Appendix 2).
- ii) Before a substantial revision to the NPAFC Science Plan, the Steering Committee of the second NPAFC Symposium should summarize Symposium results with respect to important scientific questions for future NPAFC scientific activities. The summary should be provided to the Sub-Committee before the next RPCG meeting.
- iii) A workshop on factors affecting juvenile salmon production to be held in Japan in 2000 was discussed. Scheduling of the workshop will be examined with respect to the times and locations of the NPAFC and PICES annual meetings. An *ad hoc* organizing group for the workshop includes the members of the NPAFC Science Sub-Committee, the PICES Science Board Chairperson, and additional PICES representatives to be named later. Informal discussions about the structure of the workshop will continue via e-mail.

(b) Working Group on Methodology Standardization

The Methodology Standardization Working Group (MSWG), whose co-chairs are D. Meerburg (on behalf of D. Mackas), M. Fukuwaka, V. Karpenko, and N. Davis, discussed and exchanged information on measuring salmon biological characteristics and methods of zooplankton analysis. Preliminary discussions continued regarding methods of collecting salmon food habits and bioenergetics data, and discussions about a standardized format for a common NPAFC food habits database were initiated. Work in all areas will continue by correspondence. Each member will submit information on these topics to N. Davis by May 1999, and a report will be circulated among the members in September 1999.

(c) Working Group on Stock Assessment

The Working Group on Stock Assessment, whose members are D. Noakes, S. Urawa, V. Radchenko (on behalf of S. Sinyakov), and H. Geiger, reviewed the proposed content of the stock assessment report as outlined in the Records of the Sixth Annual Meeting. The members agreed to provide the requested information to H. Geiger in September or early October 1999. The members recognized that some fisheries would still be taking place in the fall of 1999 and that any information on the 1999 season would be preliminary.

(d) *Ad Hoc* Working Group on Salmon Marking

The *ad hoc* Working Group on Salmon Marking and external experts considered four agenda items: a national thermal otolith mark; a proposal for a central data repository at a U.S. location; future coordination and cooperation among the Parties; and database formats and standards for data exchange. Experts advised that the number of unique patterns is very limited and that as the use of the technology grows, there will be increasing occurrence of conflicting marks. Generally, this is not a problem for local domestic management of terminal fisheries (the current major use of the marks) but can present problems for offshore mixed stocks.

At the 1998 NPAFC Annual Meeting, the United States was asked to nominate a repository for information about otolith marks released by the Parties. The United States proposed that the Pacific States Marine Fisheries Commission (PSMFC) would act as the repository. The PSMFC is a repository for US and Canadian coded-wire tag release and recovery data. The PSMFC proposes to develop and maintain a searchable otolith-mark database, accessible via internet. A budget request has been submitted by the PSMFC to the United States Government, but has yet to be approved.

The Working Group agreed on the need to continue international cooperation and coordination in the development, application and uses of all salmon marks. The Working Group **RECOMMENDS** that the *ad hoc* Working Group be changed to a permanent working group to better serve its role. Draft terms of reference for the Working Group will be developed by correspondence prior to the 1999 Annual Meeting. In the interim, informal contacts among the Parties will be used when necessary to reduce the probability of producing conflicting marks.

Because of their importance, agreements on database formats and standards for data exchange were deferred until the next meeting. Alaska Department of Fish and Game (P. Hagen) will coordinate the discussion and development of a document for the next annual meeting.

(e) **Ad Hoc Working Group on Archival Tags**

The Archival Tag Working Group summarized plans for applying archival tags to salmonids in the North Pacific Ocean and Bering Sea in 1999.

Canada has continued research on geolocation techniques for archival tags. One paper (in press) describes algorithms for estimating daily position of the tag based on the archived light record. Additional studies will soon be completed examining (1) growth and survival of salmon tagged externally (using pins) or internally (using surgery), and (2) effects of depth on changing the estimates of geolocation. Canada plans to submit documents reporting on the results of this work at the 1999 NPAFC Annual Meeting.

Japan intends to place 25 archival tags internally in maturing chum salmon in the Bering Sea. These tags will record water temperature, body temperature, depth, and geolocation determined by light levels. Chum salmon will be selected using criteria of maturity and likely Japanese origin (based on scale characteristics). Japan also plans to place archival tags that record temperature and depth on chum salmon in coastal waters of northern Hokkaido.

The United States intends to place 35 tags that record temperature data and up to 100 tags that record temperature and depth data externally on salmonids of several species in the Gulf of Alaska, central North Pacific, and Bering Sea. Fish to be tagged will be selected on criteria of maturity and likelihood of capture.

The objectives of all programs are to obtain environmental data for inferences of salmon behaviour and oceanographic features during migration and for bioenergetics applications.

9. PREPARATION FOR THE INTERNATIONAL SYMPOSIUM ON RECENT CHANGES IN OCEAN PRODUCTION OF PACIFIC SALMON IN NOVEMBER 1999 (STEERING COMMITTEE'S REPORT)

The Steering Committee met and discussed the program for the Symposium.

The Steering Committee selected oral presenters: 3 from Canada, 6 from Japan, 6 from Russia, and 6 from the United States. The Commission will nominate the presenters whose travel expenses will be subsidized by the Commission.

Names of the chairpersons for each topic are:

- 1) V. Radchenko (Russia): Physical and biological factors affecting ocean production of Pacific salmon
- 2) To be named (USA): Detection of trends, patterns, and changes in historical salmon and environmental data
- 3) Y. Ishida (Japan): Forecasts and models of Pacific salmon dynamics
- 4) D. Noakes (Canada): New research methods and techniques in ocean salmon research

Approximately 40 posters will be presented at the symposium. A written paper must accompany posters if authors intend to have the paper considered for publication in the proceedings.

Two keynote speakers are being considered. One would provide a global perspective on fisheries and climate changes and the second speaker would focus on historical perspectives for North Pacific salmon fisheries and climate.

The Steering Committee discussed the symposium publication. The Steering Committee members will choose two peer reviewers for each paper. The papers will be reviewed by peer reviewers, and then sent to the editor through the Secretariat for scientific editing. The authors will be contacted for final review directly by the editor.

The Steering Committee discussed the necessity of hiring an editor to facilitate the scientific review process between reviewers and authors and to facilitate preparation of papers in English for publication. The Committee agreed that an editor would be essential to produce a high quality proceedings in a timely manner. The Committee strongly *RECOMMENDS* that an editor be contracted. The Committee will make some inquiries about cost of hiring an editor.

The Steering Committee addressed the issue of whether the printing should be done by a local printer or by a publishing company. The Secretariat will investigate the issues of copyright and cost by the end of July 1999.

10. COOPERATION WITH RELEVANT INTERNATIONAL ORGANIZATIONS

a) Recent Activities of PICES and Cooperation with PICES on the Beyond El Niño Conference in March 2000

Patricia Livingston, PICES representative, provided a summary of some activities of PICES that may be of interest to NPAFC. Items included an update on the *Beyond El Niño Conference*, progress on the PICES-GLOBEC Climate Change and Carrying Capacity Program, and activities of PICES Working Groups such as WG 11 on Consumption of Marine Resources by Marine Birds and Mammals and WG 14 on Micronekton. She stated that many of the PICES activities could assist NPAFC scientists in understanding ecosystem relations among salmon and their prey and predators, in both the regional and open ocean environments. PICES welcomes ideas for using data in collaborative efforts with NPAFC. NPAFC scientists were encouraged to submit abstracts to PICES by November 1, 1999 for the *Beyond El Niño Conference* in March 2000.

b) Consideration of Future Cooperation with NASCO

A Canadian representative, who participated in North Atlantic Salmon Conservation Organization (NASCO) activities, explained the intention of a proposed joint meeting between NASCO, International Baltic Sea Fishery Commission (IBSFC), and NPAFC. Japan suggested having a joint meeting in 2001. The RPCG agreed that the CSRS should consider the proposal at the 1999 NPAFC Annual Meeting.

11. OTHER BUSINESS AND FUTURE MEETINGS

a) Russian Proposal to the Committee on Enforcement

Russia suggested that the CSRS submit a proposal to the Committee on Enforcement for the collection of scientific information important for studies of salmon distribution and migration. For example, data on the location of ocean fronts and gyres, which can be determined visually from aircraft by a well-trained observer, could be collected during patrol flights. The NPAFC

Secretariat could distribute this oceanographic information among the Parties. If this proposal is approved by CSRS and the Committee on Enforcement, a recommendation should be made to use NPAFC funds to train observers. Important regions to monitor include those with significant annual changes in the locations of ocean fronts, for example, the Western Subarctic Gyre. Illegal fisheries by driftnet vessels of non-member countries are most active in this area. An increase in the frequency and duration of patrol flights in this region would benefit both science and enforcement.

The RPCG asked Russia to provide a written draft of the proposal to the CSRS at the 1999 Annual Meeting.

b) Location of the March 2000 RPCM

The RPCG discussed holding the next RPCM in La Jolla, California in conjunction with the *Beyond El Niño Conference* in March 2000, and **RECOMMENDS** to the CSRS that the time and place of the next RPCM be discussed further at the 1999 NPAFC Annual Meeting.

12. SUMMARY REPORT

A summary report was drafted by the Secretariat and the Rapporteur, reviewed by the editorial group, and approved by the RPCG.

13. ADJOURNMENT

The meeting adjourned at 12:00 p.m., March 26, 1999.

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The Science Plan

At the 1995 annual meeting of the Commission, the CSRS identified the following two critical issues for research by the Parties: (1) factors affecting current trends in ocean productivity in the North Pacific Ocean and their impacts on salmonid carrying capacity, and (2) factors affecting changes in biological characteristics (growth, size and age at maturity, oceanic distribution, survival, and abundance) of Pacific salmon. In 1998, the research planning and coordinating group reviewed each party's planned research activities that are related to these two issues and, based on these planned activities, developed a revised NPAFC Science Plan. Because of the short-term budget considerations of each Party, the Science Plan is revised annually.

The 1999-2000 NPAFC Science Plan consists of three components of research: (1) salmonid life history, (2) salmonid population dynamics, and (3) salmonid habitat and ecosystem. Each component has several items that identify questions relating to the two critical issues. The questions are to be clarified by coordinated research of the Parties. Each year, new questions may be raised, and the Science Plan will be revised accordingly.

A two-day NPAFC Symposium, *Recent Changes in Ocean Production of Pacific Salmon*, will be held on 1-2 November 1999, following the Annual Meeting in Juneau, Alaska, U.S.A. The Symposium topics are as follows: (1) Physical and biological factors affecting ocean production of Pacific salmon, (2) Detection of trends, patterns, and changes in historical salmon and environmental data, (3) Forecasts and models of Pacific salmon dynamics, and (4) New research methods and techniques in ocean salmon research. A substantial revision to the NPAFC Science Plan will be made after the 1999 Symposium based on NPAFC's total activities from 1992 to 1999.

It is the intent of the Parties to address the following types of questions:

1. Life History

1.1 Ocean Distribution and Migration

- How well do existing models describe the ocean distribution and migration routes of the major stocks of Asian and North American Salmon at different seasons and life-history stages? What new data are available to update and improve these models?
- What are the major biotic and abiotic factors that influence ocean distribution and migration patterns of salmon? Can they be used to predict year-to-year variation in ocean distribution and migration routes?
- What is the best application of new methods (e.g., archival tags; thermal marks on otoliths) to rapidly advance our knowledge of salmon movements and migration patterns?
- What are the mechanisms of migration of salmon in coastal and offshore waters?

1.2 Growth, Age, and Maturity

- How are body size and growth rates related to ocean distribution, migration, abundance, survival, ocean age, and maturation of salmon?
- What biotic and abiotic factors affect ocean growth and maturity of salmon?
- What is the range of variation in ocean growth and age at maturity for specific stocks of salmon at different spatial, temporal, and biological scales?
- What are the physiological mechanisms underlying ocean growth rates and size and age at maturation?

1.3 Feeding Ecology (Diet) and Bioenergetics

- What are the consistent inter- and intra-specific differences and similarities in feeding ecology and salmon bioenergetics by life-history stage, habitat, and season?
- Does predation by salmon regulate populations of prey organisms (top-down control), or is prey abundance regulated by production at lower trophic levels and abiotic factors (bottom-up control)?
- What is the range of variation in salmon diets at different spatial and temporal scales and different densities or distributions (e.g., patchiness) of salmon and their prey?
- What are the best methods for estimating the abundance and composition of salmon prey populations?
- What are the mechanisms of variation in feeding ecology and nutritional condition of salmon?

2. Population Dynamics

2.1 Stock Assessment, Forecasting, and Carrying Capacity

- How is ocean salmon research vessel catch data or other ocean survey data being used to forecast adult salmon returns? How can these data be used to improve other forecasts of adult salmon returns?
- Can salmon carrying capacity in the ocean be determined? If so, what are the best methods and variables for estimating and modeling salmon carrying capacity?
- Can the salmon catch data from different research trawl gears and vessels be compared? What are the best methods for estimating salmon abundance from ocean research trawl surveys?

2.2 Mortality

- What life-history stages, habitats, and seasons are most critical to ocean survival of salmon? Is there a critical size/critical period in the natural regulation of salmon populations?
- What are the major biotic and abiotic factors involved in ocean mortality of salmon?
- Can we identify the major predators of salmon at each salmon life-history stage? What are the best estimates of predation rates on salmon by these major predators?

2.3 Stock Identification

- How can salmon stock identification techniques (genetics, scales, otolith thermal marks, parasites, tags), standardization of methods, and exchange of information among the parties be improved?
- Which genetic stock identification techniques are best for distinguishing salmon in mixed-stock ocean research vessel samples? What baseline data are available? What additional stocks need to be included in the databases?

3. Habitat and Ecosystem

3.1 Physical-Biological Interactions and Productivity

- How do the dominant weather and climate patterns (e.g., Aleutian Low, El Niño) affect ocean production of salmon?
- How do ocean circulation, nutrient levels, and other physical factors affect salmon production in different regions of the North Pacific Ocean and Bering Sea?

3.2 Climate Change

- How does sea ice affect salmon production?
- What are the predicted effects of climate change on distribution limits, migration patterns, survival, and carrying capacity of salmon and their predators and prey?

3.3 Regime Shifts (Changes in Oceanographic or Climate State)

- What are the best methods of describing or predicting regime shifts?
- What are the relationships between global climate indices and measures of salmon abundance and growth at different spatial, temporal, and biological scales?
- How have changes in fisheries and fisheries management (e.g., harvest, hatchery production) affected long-term trends in North Pacific salmon production?

Science Sub-Committee

Members of the Science Sub-Committee:

Canada	-Richard Beamish
Japan	-Yukimasa Ishida (Chairperson)
Russia	-Vladimir Karpenko
U.S.A.	-Katherine Myers

Research by the Parties

The Parties of the Commission are also coordinating their respective research activities to address the issues identified in the Commission's Science Plan. Specific research activities for 1999-2000 are described below.

NPAFC Science Plan for 1999-2000								
Research Activities of the Parties								
Research Components	NPAFC Issue #1				NPAFC Issue #2			
	Productivity, Carrying capacity				Biology, Abundance, Distribution			
	Cdn	Jpn	Rus	US	Cdn	Jpn	Rus	US
1. Life History								
- Ocean Distribution and Migration	C-2	J-1		U-1 U-5	C-1	J-2 J-3	R-1	U-1 U-2 U-5
- Growth, Age, and Maturity	C-1 C-2	J-1		U-3 U-5	C-1 C-2	J-1 J-2	R-1 R-2	U-1 U-2 U-3 U-5
- Feeding Ecology (Diet) and Bioenergetics	C-2	J-2		U-1 U-5	C-1 C-2	J-2	R-1 R-4	U-1 U-2 U-5
2. Population Dynamics								
- Stock Assessment, Forecasting, and Carrying Capacity		J-4	R-3	U-3 U-5		J-1	R-1 R-3	U-1 U-3 U-5
- Mortality	C-3		R-3			J-1	R-1 R-3	
- Stock Identification	C-2 C-4	J-3	R-2	U-4	C-2 C-4	J-3	R-2	U-1 U-2 U-4 U-5
3. Habitat and Ecosystem								
- Physical-Biological Interactions and Productivity	C-1	J-1	R-3 R-4	U-1 U-2 U-5	C-1	J-2		U-1 U-5
- Climate Change	C-3	J-4	R-3 R-4	U-1 U-3 U-5	C-3 C-3			U-1 U-3 U-5
- Regime Effects	C-3	J-4		U-5				U-5

Canadian Research Plan

C-1 *Distribution, Growth and Bioenergetics of Salmon in the Eastern North Pacific Ocean.*

High seas salmon research in 1999 will focus on the region from northern Vancouver Island to southeast Alaska. The research will involve juvenile salmon distribution relative to oceanographic and biological features and relative nutritional status and growth.

C-2 *Stock and Species Interactions in the Eastern North Pacific Ocean.*

The relationship between the size of Fraser River sockeye spawners in 1997 and the size of sockeye in other rivers and the Gulf of Alaska will be studied to determine the spatial correlation scale in sockeye body size.

The Canadian-GLOBEC study of Gulf of Alaska zooplankton will begin its third year in 1999. The major objective is to recalibrate the Station Papa time series (1956-1981) of zooplankton data and to examine the relationship between salmon stomach contents and zooplankton community structure. Deep-water samples of overwintering stages of copepods will be studied.

The Canadian-GLOBEC study on the ocean growth of Pacific salmon is continuing. This study is using archival collections of sockeye salmon scales to provide records of annual growth by year at sea since 1952 for five major river systems in British Columbia.

C-3 *Climate Change vs. Survival, St. of Georgia, Coho and Chinook Salmon.*

A four-year study of the impacts of climate on the carrying capacity of coho and chinook in the Strait of Georgia was completed in March 1999. A follow up study is planned which will test one of the major hypotheses developed in the study.

The preliminary conclusion from the study is that a changing climate beginning about 1989 affected the oceanography of the Strait of Georgia and shifted the species abundance of key fish species as the strength of the Aleutian low weakened in the 1990s. There were more days in the winter when the direction of winds was zonal (direct westerly winds). These westerly winds reverse the estuarine circulation in Juan de Fuca Strait, bringing surface water into the Strait and backing up fresh water flowing from the Fraser River. This reduces surface salinity and wind mixing. The same winds also melt the snow pack earlier causing earlier spring freshets and an earlier "spring" in the Strait of Georgia. Associated with this earlier spring has been a change in the timing of copepod movement into the surface. The earlier migration better matches the fixed mean maximum spawning period of herring and hake. Both of these species increased their abundance. Hake is the dominant species in the Strait and feeds mainly on euphausiids which are a main food item of coho and chinook when they enter salt water in May and June. The increased competition for euphausiids reduces growth of coho and chinook over the

summer, which results in higher mortality during the winter when food is scarce.

C-4 *Stock Identification (genetics, scales, etc.)*

Recent advances in genetic stock identification for coho, chinook, and sockeye salmon will be summarized. Implications for stock assessment and management will be summarized as well as opportunities for international cooperation.

Japanese Research Plan

J-1 *Salmon Population Dynamics*

J1-1 Coastal Environment

Northern Japan is located in the southern limit of anadromous salmonid distribution, and the coastal environments have a significant impact on the survival of juvenile salmon. Salmon habitat environments will be monitored at 14 stations along the coast of Hokkaido, where juvenile salmon migrate in spring. This monitoring program includes the collection of data on surface water temperature, salinity, and zooplankton biomass.

J1-2 Offshore Environment

In relation to climate changes such as global warming, oceanographic conditions for salmon habitat including physical and chemical conditions, and phytoplankton and zooplankton biomass will be monitored in the western and central North Pacific, the Bering Sea, and the Gulf of Alaska in summer.

J1-3 Biological Monitoring of Salmon in the North Pacific Ocean

Independently of coastal catch and escapement data, salmon abundance and fish size will be monitored on board salmon research vessels in the western and central North Pacific, the Bering Sea, and the Gulf of Alaska in summer.

J1-4 Biological Monitoring of Adult Salmon

This long-term monitoring research will focus on evaluating salmon stock conditions affected by various factors. Body size, fecundity, and egg size will be examined in adult chum salmon returning to major spawning rivers in Japan. The age structure will be determined in each local salmon population. Genetic variations will be monitored in five hatchery populations of chum salmon and a pink salmon population. Health status will be evaluated for wild and hatchery salmon.

J1-5 Survival and Growth of Salmon

To clarify the survival process and growth history of salmon, the survival and growth rate at each life stage are estimated using mark-recapture experiments,

calcified-tissue analyses, and population monitoring of high-seas salmon and returning adults.

J-2 *Salmon Life History*

J2-1 Coastal Life History of Juvenile Salmon

Major mortality of chum and pink salmon may occur during the initial coastal life. Thus, coastal life history studies are important to understand the survival mechanism of salmon. Feeding, growth and survival of juvenile chum and pink salmon will be surveyed in the Nemuro Strait, eastern Hokkaido. The migration route of thermally marked chum salmon juveniles will be determined by geographically continuous surveys along the coast of Hokkaido.

J2-2 Offshore Migration and Distribution of Salmon

To visualize offshore migration and distribution of salmon, abundance and biological data (species, age compositions, and maturity) collected by salmon research vessels will be analyzed retrospectively. Tagging experiments using archival and disc tags will be conducted in the Bering Sea to investigate Japanese chum salmon migration routes and the relationship between salmon migration and ocean conditions.

J2-3 Feeding and Growth of High Seas Salmon

To clarify ocean life history of Pacific salmon, variation of growth, maturity, and feeding ecology of salmon in the ocean will be analyzed using data collected by salmon research vessels.

J2-4 High Seas Interaction

To clarify species interaction, such as between chum and pink salmon, and to investigate stock interactions, such as between Japanese and other chum salmon stocks, salmon abundance, distribution, prey organisms, and somatic growth obtained from high-seas surveys will be analyzed retrospectively.

J2-5 Homing Migration and Maturing Mechanism

To determine the maturing mechanism, endocrinological surveys will be conducted for chum salmon during their feeding and homing migrations. Archival tags will be used for adult chum salmon migrating in the coastal waters to elucidate how they locate their natal river.

J-3 *Salmon Stock Identification*

J3-1 Genetic Stock Identification

The genetic population structure and distribution of chum salmon will be determined by genetic stock identification (GSI). GSI samples will be

collected in the eastern, central, and western waters of the North Pacific Ocean, and the central Bering Sea by Japanese research vessels.

J3-2 Thermal Otolith Marking

About 4.5 million chum salmon fry will be released in the Chitose River after thermal otolith marking. Thermal marking techniques and facilities will be developed for further mass marking at Japanese national hatcheries. Thermally marked chum and pink salmon will be monitored in the North Pacific Ocean and Bering Sea.

J3-3 Stock Identification by Scale Pattern

To clarify stock composition in the North Pacific Ocean, chum salmon stock identification will be conducted using scale patterns. Cooperative sockeye salmon stock identification using scale pattern will be conducted with scientists of member countries, if possible.

J3-4 Stock Identification by High Seas Tagging

To confirm stock distribution in limited survey areas such as in the central Bering Sea and the Gulf of Alaska, tagging experiments will be conducted on board salmon research vessels.

J-4 *Salmon Stock Assessment*

J4-1 Modeling of Salmon Population and Ecosystem Dynamics

Using numerical models, dynamics of salmon populations will be simulated and the effects of density dependence, environmental factors, carrying capacity, interaction with other populations, and harvest strategy will be examined and possible future surveys will be proposed.

J4-2 Salmon Stock Assessment and Forecasting

To manage salmon stocks, abundance and conditions of stocks will be assessed and forecasted using monitoring of conditions of released juveniles, survival, growth, environmental factors during freshwater, coastal, and oceanic lives, and population structure of returning adults.

Russian Research Plan

R-1 *Salmon Life History*

R1-1 Coastal Life History of Juvenile Salmon

High mortality of pink, chum, and other species of salmon juveniles (age .0) may occur in estuaries and coastal waters of far-eastern regions. The main

factors are temperature regime, food supply, and predators. The coastal life history is important for the survival mechanism and forming productivity of salmon stocks. Some areas are the main polygon of study of these phenomena.

R1-2 Offshore Distribution, Migration, and Abundance of Salmon Juveniles

Offshore distribution, migration, abundance, and biological data of salmon juveniles are collected by research vessels annually, and will be analyzed retrospectively. Major investigation areas are the western Bering sea, southern and eastern part Sea of Okhotsk, and northwestern Pacific of the Kurile Islands. Meteorological and oceanographic data also will be collected during surveys.

R1-3 Anadromous Migration and Abundance of Adult Salmon

During spring-summertime data will be collected on the salmon research vessels concerning distribution, migration, abundance and biological characteristics of adult and immature salmon in different areas of far-eastern seas and Pacific. In April-May, salmon migrations will be studied in the offshore ocean beyond Russian EEZ limits.

R-2 *Salmon Stock Identification*

R2-1 Population Genetics and Conservation of Endangered Species

Genetic characterization of the main local stocks of Pacific salmon will be continued. The genetic aspects of interaction between natural and hatchery-reared populations will be studied. Special attention will be paid to population dynamics and genetics of endangered populations of *Parasalmo* [*Oncorhynchus*] *mykiss*. An electrophoretic study of Asian chinook salmon will be continued. Research on distribution of Pacific salmon in the ocean will focus on genetic stock identification of pink, chum, sockeye, and chinook salmon in mixed collections from the Bering Sea and Pacific.

R2-2 Stock Identification by Scale Pattern

To clarify stock composition in the North Pacific Ocean, pink, chum, and sockeye salmon identification will be conducted using scale patterns. For this aim, Russian and other countries' databases will be used, if possible.

R2-3 Stock Identification Using Other Materials (Otoliths, Data on Parasites, etc.)

Thermal and "dry" marking programs will be continued at hatcheries and in the nature in the northern Okhotsk Sea region. Most of the chum salmon released will be marked. Return of marked maturing fish will be monitored. In the Yana River the portion of hatchery salmon in the mixed population will be determined. For correct stock identification, we plan to collect new information on otoliths, parasites, and morphometric characteristics of some stocks, and also to participate in international tagging experiments.

R-3 *Salmon Population Dynamics*

R3-1 Coastal and Offshore Environment

The main environmental characteristics of salmon habitat will be monitored in the seven principal coastal areas off Sakhalin, Kamchatka, and in the northern Sea of Okhotsk, where salmon juveniles migrate in the spring-summer season. Data will be collected in shelf and offshore regions during the fall season on research vessels. The monitoring program includes water temperature measurement in the 500-m layer, salinity, zooplankton, and micronekton biomass estimations, and studies of community structure.

R3-2 Biological Monitoring of Adult Salmon in REEZ

This monitoring study will concern the estimation of salmon stock abundance and population structure during the anadromous migration. Biological characteristics of adult Pacific salmon and environmental conditions before returning to major spawning areas in Russia will be examined. In this period different biological and environmental data will be collected.

R-4 *Assessment of Salmon Stocks*

R4-1 Salmon Stock Assessment and Forecasting

For management aims, salmon stocks will be assessed using monitoring of reproduction conditions and abundance in freshwater period. Data on abundance of juveniles in rivers and coastal waters, their survival, growth, and population structure of returning adults will be used for forecasting of Pacific salmon returns in different regions of the Far East.

R4-2 Ecosystem of the North Pacific and Salmon Population Dynamics

Feeding of Pacific salmon will be studied during summer and fall expeditions in the far-eastern seas and North Pacific Ocean. Also data will be collected in these surveys on other fishes of the pelagic community. A comparison between salmon and other pelagic fishes of the consumption rates of planktonic/micronektonic organisms will help to estimate the place of salmon in the trophic structure of northwest Pacific pelagic ecosystems. The role of salmon as prey for large predatory fish species and marine mammals will be studied using data from marine surveys.

United States Research Plan

U-1 *Coastal Juvenile Salmon Studies*

Research activities take place primarily in the coastal waters of southeastern and western Alaska. Activities include: (1) repeated measurements of the habitat, and stock specific life history characteristics of salmon from their early marine residence period to their later migration through coastal waters; (2)

modeling salmon production based on interannual variability in early marine salmon survival and growth; and (3) describing the trophic dynamics of juvenile salmon and their predators in coastal waters. The southeastern Alaska program was initiated in 1997. Particular focus of the southeastern Alaska research is placed on examining the extent of seasonal (May – October) interactions between hatchery and wild stocks of salmon, and their potential impact on marine carrying capacity. The western Alaska program will begin in 1999. Particular focus of the western Alaska research is placed on monitoring effects of climate on growth, migration, and distribution of juvenile Bristol Bay sockeye salmon as they migrate in the coastal waters of the eastern Bering Sea.

U-2 *Gulf of Alaska Salmon Ecology*

Ocean research activities take place on the high seas of the Gulf of Alaska and northeastern Pacific Ocean and in Alaska Coastal Current waters. Activities include: (1) broad-scale field studies of the distribution and migration of juvenile and immature salmonids; (2) fine-scale field studies that focus on aggregations of salmonids to look for specific processes or factors that influence their distribution, behavior, and growth; (3) studies on diet overlap and prey selectivity among salmon and other fishes; (4) genetic stock-identification studies of juvenile, immature, and maturing salmon; (5) monitoring of thermally marked salmon; and (6) studies of growth and size of juvenile and immature salmon.

U-3 *Retrospective Analyses*

Retrospective studies characterize past variability in climate and salmonid population parameters over various time and space scales, and are a key component to understanding effects of climate change on the abundance and life-history of U.S. salmon populations. Current retrospective studies include: (1) analyses of scale growth patterns of Karluk Lake and Bristol Bay, Alaska sockeye salmon, Yukon River chum salmon, and six pink and chum populations from the northern and eastern Gulf of Alaska; (2) a summary of historical salmon research in the Karluk Lake area; (3) reconstructing long-term changes in salmon abundance using high-resolution paleoenvironmental analysis of sediment cores from sockeye salmon lake systems in North America and anoxic marine basins in southeastern Alaska; and (4) time-series analyses of North American salmon population and climate data.

U-4 *Stock Identification*

This research program is designed to find biological markers capable of identifying stocks of salmon in the North Pacific Ocean. These biological markers include genetic characters displayed in protein electrophoresis and in various forms of DNA. Non-genetic characters being evaluated are derived from scale pattern analysis and thermal marks on otoliths. The first task is to develop standardized methods of genetic analysis among parties, and to identify important stocks of salmon that should be included in the database. The United States is also continuing international cooperative high-seas tagging studies and recovery of coded-wire tagged salmonids in ocean fisheries and research vessel operations. These data will assist in identifying the origins

of stocks harvested in mixed-stock fisheries and in determining the oceanic distribution of stocks.

U-5 *High-seas Salmon Studies*

An integrated program of field and laboratory studies, and computer modeling in cooperation with the other Parties is designed to address NPAFC-related scientific research issues in the international waters of the North Pacific Ocean and Bering Sea. The current cooperative program includes: (1) field research aboard salmon research vessels, (2) analyses of high-seas salmonid food habits data and development of ocean salmon bioenergetic models, (3) various studies of ocean growth of salmon using historical and recent high-seas salmonid scale collections and corresponding biological and oceanographic data, and (4) ocean salmon life history and carrying-capacity modeling.