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Abstracts of Scientific Documents Submitted to the Commission for the 2012 Annual Meeting: Forecast of Pacific Salmon Production in the Ocean Ecosystems under Changing Climate

by

NPAFC Secretariat

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Abstracts of Scientific Documents Submitted to the Commission for the 2012 Annual Meeting: Forecast of Pacific Salmon Production in the Ocean Ecosystems under Changing Climate

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This document is a compilation of abstracts of new and revised scientific documents submitted to the Commission between adjournment of the 2011 Annual Meeting and September 17, 2012. The compilation is organized into sections. The first section lists the document number and title according to six topics (Section 1). The first five topics are the five research components of the 2011-2015 NPAFC Science Plan:

(1) migration and survival of juvenile salmon in ocean ecosystems;
(2) climate impacts on Pacific salmon production in the Bering Sea (BASIS) and adjacent waters;
(3) winter survival of Pacific salmon in North Pacific Ocean ecosystems;
(4) biological monitoring of key salmon populations;
(5) development and application of stock identification methods and models for management of Pacific salmon.

For convenience, one more topic was added:

(6) Other topics.

Individual documents may pertain to more than one topic and, therefore, may be listed more than once.

The second section lists the document number and title according to the country that submitted the document (Section 2). The third section lists abstracts of documents in order of document number (Section 3).

For consideration at the 2012 CSRS meeting, a total of 54 new documents and three revised documents (one from 2008, one from 2010, and one from 2011) were submitted. Of the new documents that were submitted, 17 documents related to research on juvenile salmon, 12 documents related to research on climate impacts on salmon in the Bering Sea and adjacent waters, four documents related to research on salmon winter survival, 33 documents related to research on biological monitoring of key populations, 23 documents related to research on development and applications of stock identification methods and models for management, and five documents related to other topics. The number of unique new documents included 15 from Canada, 10 from Japan, five from Korea, eight from Russia, and 13 from the United States. In addition, one document was submitted by the Working Group on Stock Assessment (Doc. 1422; added to each country's list in Section 2) and two documents were submitted by the Secretariat (Docs. 1388 and 1396).

Section 1. Documents (number, title) Listed by Topic

1. Migration and Survival Mechanisms of Juvenile Salmon in Ocean Ecosystems

Doc. 1367	Southeast Alaska Coastal Monitoring (SECM) Survey Plan for 2011
Doc. 1373	Canadian juvenile salmon surveys in 2012-2013
Doc. 1376	Trawl survey plans for Pacific salmon marine life period studies in the far eastern seas in summer and fall 2012 by Russia
Doc. 1379	Canadian research in 2012 relevant to the NPAFC Salmon Science Plan for 2011-2015
Doc. 1380	United States cruise plan for BASIS on the R/V *OSCAR DYSON*, August – October 2012
Doc. 1381	United States cruise plan for BASIS-northern Bering Sea and Chukchi Sea, August – October 2012
Doc. 1382	United States cruise plan for the Gulf of Alaska Project, July – August 2012
Doc. 1404	Concordant distribution, abundance and growth of juvenile pink, chum and sockeye salmon in eastern Pacific coastal waters.
Doc. 1411	Korean research plan for salmon in 2013
Doc. 1417	Japanese bibliography in 2011-2012 for NPAFC Science Plan
Doc. 1421	United States bibliography in 2011-2012 for NPAFC Science Plan
Doc. 1423	An early marine life history strategy for Fraser River sockeye salmon
Doc. 1424	Exceptionally poor survival of Chinook salmon entering the Strait of Georgia in 2007 is consistent with the synchronous poor survival of other Pacific salmon and Pacific herring
Doc. 1426	Estimating winter mortality in juvenile Marble River Chinook salmon
Doc. 1427	Relating spatial and temporal scales of climate and ocean variability to survival of Pacific Northwest Chinook salmon
Doc. 1428	Annual survey of juvenile salmon, ecologically-related species, and biophysical factors in the marine waters of southeastern Alaska
Doc. 1432	Canadian bibliography of 2010-2012 publication linked to the current NPAFC Science Plan

2. Climate Impacts on Pacific Salmon Production in the Bering Sea (BASIS) and Adjacent Waters

Doc. 1376	Trawl survey plans for Pacific salmon marine life period studies in the far eastern seas in summer and fall 2012 by Russia
Doc. 1379	Canadian research in 2012 relevant to the NPAFC Salmon Science Plan for 2011-2015
Doc. 1380	United States cruise plan for BASIS on the R/V *OSCAR DYSON*, August – October 2012
Doc. 1381	United States cruise plan for BASIS-northern Bering Sea and Chukchi Sea, August – October 2012
Doc. 1383	Results of 2011 salmon research by the *Oshoro maru*
Doc. 1385	Proposed cruise plans of Japanese research vessels for salmon in the North Pacific Ocean in 2012
Doc. 1398	Decreases in abundance of immature Pacific salmon in the western Bering Sea from 2002 to 2011: link to hydrological and forage conditions
Doc. 1417	Japanese bibliography in 2011-2012 for NPAFC Science Plan
Doc. 1419	The summer 2012 Japanese salmon research cruise of the R/V *Hokko maru*
Doc. 1421	United States bibliography in 2011-2012 for NPAFC Science Plan

Doc. 1427 Relating spatial and temporal scales of climate and ocean variability to survival of Pacific Northwest Chinook salmon

Doc. 1432 Canadian bibliography of 2010-2012 publication linked to the current NPAFC Science Plan

3. Winter Survival of Pacific Salmon in North Pacific Ocean Ecosystems

Doc. 1379 Canadian research in 2012 relevant to the NPAFC Salmon Science Plan for 2011-2015

Doc. 1421 United States bibliography in 2011-2012 for NPAFC Science Plan

Doc. 1426 Estimating winter mortality in juvenile Marble River Chinook salmon

Doc. 1432 Canadian bibliography of 2010-2012 publication linked to the current NPAFC Science Plan

4. Biological Monitoring of Key Salmon Populations

Doc. 1336 Rev. 1 Korean salmon catch statistics and hatchery releases in 2010-2011

Doc. 1367 Southeast Alaska Coastal Monitoring (SECM) Survey Plan for 2011

Doc. 1373 Canadian juvenile salmon surveys in 2012-2013

Doc. 1376 Trawl survey plans for Pacific salmon marine life period studies in the far eastern seas in summer and fall 2012 by Russia

Doc. 1379 Canadian research in 2012 relevant to the NPAFC Salmon Science Plan for 2011-2015

Doc. 1380 United States cruise plan for BASIS on the R/V *OSCAR DYSON*, August – October 2012

Doc. 1381 United States cruise plan for BASIS-northern Bering Sea and Chukchi Sea, August – October 2012

Doc. 1382 United States cruise plan for the Gulf of Alaska Project, July – August 2012

Doc. 1383 Results of 2011 salmon research by the *Oshoro maru*

Doc. 1385 Proposed cruise plans of Japanese research vessels for salmon in the North Pacific Ocean in 2012

Doc. 1397 Review of some results of Russian population studies of pacific salmon in 2010 and 2011

Doc. 1398 Decreases in abundance of immature Pacific salmon in the western Bering Sea from 2002 to 2011: link to hydrological and forage conditions

Doc. 1399 Was there a re-distribution of the pink salmon migratory flow between different areas of Sakhalin-Kuril region in 2011?

Doc. 1401 Japan salmon commercial fisheries catch statistics for 2011

Doc. 1402 Preliminary 2011 salmon enhanced production in Japan

Doc. 1405 Alaska salmon hatchery releases, commercial fishery catch statistics and sport fishery harvest statistics for 2011 season

Doc. 1408 Korean salmon catch statistics and hatchery releases in 2011-2012

Doc. 1409 Recoveries of coded wire tag from chum salmon in Korea in 2011

Doc. 1410 Monitoring of fish pathogenic viruses from chum salmon (*Oncorhynchus keta)* in Korea

Doc. 1413 Interannual variability in size and age structure of Russian chum salmon stocks

Doc. 1415 High seas salmonid coded-wire tag recovery data, 2012

Doc. 1417 Japanese bibliography in 2011-2012 for NPAFC Science Plan

Doc. 1419 The summer 2012 Japanese salmon research cruise of the R/V *Hokko maru*

Doc. 1420 Canadian enhanced salmonid production during 1978-2011 (1977– 2010 brood years)

Doc. 1421	United States bibliography in 2011-2012 for NPAFC Science Plan
Doc. 1422	Pacific salmon status and abundance trends - 2012 update
Doc. 1423	An early marine life history strategy for Fraser River sockeye salmon
Doc. 1424	Exceptionally poor survival of Chinook salmon entering the Strait of Georgia in 2007 is consistent with the synchronous poor survival of other Pacific salmon and Pacific herring
Doc. 1425	A proposal to establish an International Year of the Salmon
Doc. 1428	Annual survey of juvenile salmon, ecologically-related species, and biophysical factors in the marine waters of southeastern Alaska
Doc. 1429	Temporal growth patterns of Big Qualicum River chum salmon *(Oncorhynchus keta)* in the North Pacific Ocean
Doc. 1430	Biostatistical information on salmon catches, escapement and enhancement production in Russia in 2011
Doc. 1431	Salmon assessment and monitoring in British Columbia and Yukon
Doc. 1432	Canadian bibliography of 2010-2012 publication linked to the current NPAFC Science Plan

5. Development and Application of Stock Identification Methods and Models for Management of Pacific Salmon

Doc. 1114 Rev. 1	Releases of otolith marked salmon from Japan in the fall of 2007 and spring of 2008
Doc. 1261 Rev. 1	Releases of otolith marked salmon from Japan in the fall of 2009 and spring of 2010
Doc. 1372 Rev. 1	Proposed thermal marks for brood year 2012 salmon in Alaska
Doc. 1374	Proposed thermal marks for salmon from Canada, brood year 2012
Doc. 1377	Proposed otolith marks for brood year 2012 salmon in Russia
Doc. 1379	Canadian research in 2012 relevant to the NPAFC Salmon Science Plan for 2011-2015
Doc. 1387 Rev. 1	Cruise plans of Japanese research vessels involving incidental takes of anadromous fish in the North Pacific Ocean in 2012
Doc. 1389	Microsatellite identification of sockeye salmon rearing in the Bering Sea 2011
Doc. 1396	Format and codes used in the INPFC/NPAFC high-seas salmonid tag-recovery database (1956-2010)
Doc. 1397	Review of some results of Russian population studies of pacific salmon in 2010 and 2011
Doc. 1399	Was there a re-distribution of the pink salmon migratory flow between different areas of Sakhalin-Kuril region in 2011?
Doc. 1400 Rev. 1	Marked salmon production by the hatcheries of Russia in 2012
Doc. 1403	Nonrandom distribution of Canadian sockeye salmon rearing in the Bering Sea and coastal Gulf of Alaska
Doc. 1406	Releases of otolith marked salmon from Alaska in 2011
Doc. 1409	Recoveries of coded wire tag from chum salmon in Korea in 2011
Doc. 1411	Korean research plan for salmon in 2013
Doc. 1412	Otolith thermal mark for brood year 2011 and proposed thermal marks for brood year 2012 chum salmon in Korea
Doc. 1413	Interannual variability in size and age structure of Russian chum salmon stocks
Doc. 1414 Rev. 1	Forecasting pink salmon harvest in Southeast Alaska from juvenile salmon abundance and associated biophysical parameters: 2011 returns and 2012 forecast

Doc. 1415	High seas salmonid coded-wire tag recovery data, 2012
Doc. 1416	Effects of aggregating coastwide genetic baseline for improved mixture resolution of high-seas caught salmon
Doc. 1417	Japanese bibliography in 2011-2012 for NPAFC Science Plan
Doc. 1418	Releases of otolith marked salmon from Japan in fall of 2011 and spring of 2012
Doc. 1421	United States bibliography in 2011-2012 for NPAFC Science Plan
Doc. 1432	Canadian bibliography of 2010-2012 publication linked to the current NPAFC Science Plan

6. Other Topics

Doc. 1384	Incidental catches of anadromous fish by Japanese research vessels in the North Pacific Ocean in 2011
Doc. 1386 Rev. 1	Cruise plans of Japanese research vessels involving incidental takes of anadromous fish in the North Pacific Ocean in 2012
Doc. 1388	Report of the Research Planning and Coordinating Meeting
Doc. 1407	Incidental catches of salmonids by U.S. groundfish fisheries in Bering Sea/Aleutian Islands and the Gulf of Alaska
Doc. 1425	A proposal to establish an International Year of the Salmon

Section 2. Documents (number, title) Listed by Country

Canada

Doc. 1373	Canadian juvenile salmon surveys in 2012-2013
Doc. 1374	Proposed thermal marks for salmon from Canada, brood year 2012
Doc. 1379	Canadian research in 2012 relevant to the NPAFC Salmon Science Plan for 2011-2015
Doc. 1389	Microsatellite identification of sockeye salmon rearing in the Bering Sea 2011
Doc. 1403	Nonrandom distribution of Canadian sockeye salmon rearing in the Bearing Sea and coastal Gulf of Alaska
Doc. 1404	Concordant distribution, abundance and growth of juvenile pink, chum and sockeye salmon in eastern Pacific coastal waters.
Doc. 1420	Canadian enhanced salmonid production during 1978-2011 (1977– 2010 brood years)
Doc. 1422	Pacific salmon status and abundance trends - 2012 Update
Doc. 1423	An early marine life history strategy for Fraser River sockeye salmon
Doc. 1424	Exceptionally poor survival of Chinook salmon entering the Strait of Georgia in 2007 is consistent with the synchronous poor survival of other Pacific salmon and Pacific herring
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Doc. 1426	Estimating winter mortality in juvenile Marble River Chinook salmon
Doc. 1427	Relating spatial and temporal scales of climate and ocean variability to survival of Pacific Northwest Chinook salmon
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Japan

Doc. 1114 Rev. 1	Releases of otolith marked salmon from Japan in the fall of 2007 and spring of 2008
Doc. 1261 Rev. 1	Releases of otolith marked salmon from Japan in the fall of 2009 and spring of 2010
Doc. 1383	Results of 2011 salmon research by the *Oshoro maru*
Doc. 1384	Incidental catches of anadromous fish by Japanese research vessels in the North Pacific Ocean in 2011
Doc. 1385	Proposed cruise plans of Japanese research vessels for salmon in the North Pacific Ocean in 2012
Doc. 1386 Rev. 1	Cruise plans of Japanese research vessels involving incidental takes of anadromous fish in the North Pacific Ocean in 2012
Doc. 1387 Rev. 1	Cruise plans of Japanese research vessels involving incidental takes of anadromous fish in the North Pacific Ocean in 2012
Doc. 1401	Japan salmon commercial fisheries catch statistics for 2011
Doc. 1402	Preliminary 2011 salmon enhanced production in Japan
Doc. 1417	Japanese bibliography in 2011-2012 for NPAFC Science Plan
Doc. 1418	Releases of otolith marked salmon from Japan in fall of 2011 and spring of 2012
Doc. 1419	The summer 2012 Japanese salmon research cruise of the R/V *Hokko maru*
Doc. 1422	Pacific salmon status and abundance trends - 2012 update

Republic of Korea

Doc. 1336 Rev. 1	Korean salmon catch statistics and hatchery releases in 2010-2011
Doc. 1408	Korean salmon catch statistics and hatchery releases in 2011-2012
Doc. 1409	Recoveries of coded wire tag from chum salmon in Korea in 2011
Doc. 1410	Monitoring of fish pathogenic viruses from chum salmon (*Oncorhynchus keta)* in Korea
Doc. 1411	Korean research plan for salmon in 2013
Doc. 1412	Otolith thermal mark for brood year 2011 and proposed thermal marks for brood year 2012 chum salmon in Korea
Doc. 1422	Pacific salmon status and abundance trends - 2012 update

Russia

Doc. 1376	Trawl survey plans for Pacific salmon marine life period studies in the far eastern seas in summer and fall 2012 by Russia
Doc. 1377	Proposed otolith marks for brood year 2012 salmon in Russia
Doc. 1397	Review of some results of Russian population studies of pacific salmon in 2010 and 2011
Doc. 1398	Decreases in abundance of immature Pacific salmon in the western Bering Sea from 2002 to 2011: link to hydrological and forage conditions
Doc. 1399	Was there a re-distribution of the pink salmon migratory flow between different areas of Sakhalin-Kuril region in 2011?
Doc. 1400 Rev. 1	Marked salmon production by the hatcheries of Russia in 2012
Doc. 1413	Interannual variability in size and age structure of Russian chum salmon stocks
Doc. 1422	Pacific salmon status and abundance trends - 2012 update
Doc. 1430	Biostatistical information on salmon catches, escapement and enhancement production in Russia in 2011

United States

Doc. 1367	Southeast Alaska Coastal Monitoring (SECM) Survey Plan for 2011
Doc. 1372 Rev. 1	Proposed thermal marks for brood year 2012 salmon in Alaska
Doc. 1380	United States cruise plan for BASIS on the R/V *OSCAR DYSON*, August – October 2012
Doc. 1381	United States cruise plan for BASIS-northern Bering Sea and Chukchi Sea, August – October 2012
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Doc. 1405	Alaska salmon hatchery releases, commercial fishery catch statistics and sport fishery harvest statistics for 2011 season
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Doc. 1414 Rev. 1	Forecasting pink salmon harvest in southeast Alaska from juvenile salmon abundance and associated biophysical parameters: 2011 returns and 2012 forecast
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Doc. 1421	United States bibliography in 2011-2012 for NPAFC Science Plan
Doc. 1422	Pacific salmon status and abundance trends - 2012 update
Doc. 1428	Annual survey of juvenile salmon, ecologically-related species, and biophysical factors in the marine waters of southeastern Alaska

Section 3. Document Abstracts (numerical order)

Doc. 1114 Rev. 1 Releases of otolith marked salmon from Japan in the fall of 2007 and spring of 2008

Masaya Takahashi, Masaya Iida, Keiichi Kusumo, Yasuhiro Okamura, Hideyoshi Iika, Yuuki Katayama, Ken-ichi Ohmoto, Mitsuharu Fukuhara, and Tooru Chiba

This document provided information of Japanese otolith mark releases, including release site, date, number, and mark patterns with images. In the spring of 2008, approximately 148.1 million chum, 34.2 million pink, 2.8 million masu, and 163 thousand sockeye salmon fry (2007 brood year) with thermal marks or ALC (alizarin complexone) patterns were released from 22 hatcheries in Japan. In addition, 477 thousand masu salmon smolts (2006 brood year) were released in the spring of 2008 after thermally marked. In the fall of 2007, 615 thousand juveniles of otolith-marked masu salmon (2006 brood year) were also released. Two thermal rings as base mark were adopted to distinguish Japanese salmon from other stocks. ALC marks were used for chum and pink salmon surveys by the Hokkaido Fish Hatchery. These data are uploaded to the database on the website of NPAFC Working Group on Salmon Marking (http://npafc.taglab.org).

Doc. 1261 Rev. 1 Releases of otolith marked salmon from Japan in the fall of 2009 and spring of 2010

Masaya Takahashi, Masaya Iida, Keiichi Kusumo, Hideyoshi Ikka, Yuuki Katayama, Yukihiro Hirabayashi, Mitsuharu Fukuhara, Tooru Chiba, and Yasuyuki Miyauchi

This document provided information of Japanese otolith mark releases, including release site, date, number, and mark patterns with images. In the spring of 2010, approximately 152.9 million chum, 28.5 million pink, 1.9 million masu, and 131 thousand sockeye salmon fry (2009 brood year) with thermal marks or ALC (alizarin complexone) patterns were released from 21 hatcheries in Japan. In addition, 445 thousand masu salmon smolts and 52 thousad sockeye salmon smolts (2008 brood year) were released in the spring of 2010 after thermally marked. In the fall of 2009, 606 thousand juveniles of otolith-marked masu salmon (2008 brood year) were also released. Two thermal rings as base mark were adopted to distinguish Japanese salmon from other stocks. ALC marks were used for chum salmon surveys by the Hokkaido Fish Hatchery. These data are uploaded to the database on the website of NPAFC Working Group on Salmon Marking (http://npafc.taglab.org).

Doc. 1336 Rev. 1 Korean salmon catch statistics and hatchery releases in 2010-2011

Kwan Eui Hong and Ki Baik Seong

Total catch of chum salmon was 49,325 fish or 138.6 metric tons in 2010. The total fries of chum salmon released was 20,900 thousand fish in 2011 (2010 brood).

Doc. 1367 Southeast Alaska Coastal Monitoring (SECM) survey plan for 2012

Joseph A. Orsi, Molly V. Sturdevant, Emily A. Fergusson, William R. Heard, and Edward V. Farley

The Southeast Coastal Monitoring (SECM) project was initiated in 1997 by the Alaska Fisheries Science Center, Auke Bay Laboratories, to study the habitat use and early marine ecology of juvenile (age-0) Pacific salmon (*Oncorhynchus* spp.) and associated epipelagic ichthyofauna in Southeast Alaska. SECM surveys are conducted off government and chartered research vessels in the vicinities of Icy Strait and Icy Point (58° N, 135°W; 57° N, 134° W) to sample fish, zooplankton, nutrients/chlorophyll, and physical water properties using a surface trawl, plankton nets, and an oceanographic profiler. In 2012, SECM research surveys are scheduled to continue at 13 core stations during four monthly intervals from late May to late August. This 2012 SECM

survey plan reflects accomplishments since the inception of the project in 1997, and outlines how this additional survey year will extend the biophysical time series to 16 years.

Doc. 1372 Rev.1 Proposed thermal marks for brood year 2012 salmon in Alaska
Dion S. Oxman

In Alaska, mass-marking of salmon using otolith thermal marking is an effective research and management tool applicable to a variety of situations. For brood year 2012, approximately 60 million sockeye, 802 million pink salmon, 628 million chum, 9 million coho, and 7 million Chinook salmon will be marked at 23 different hatcheries using 82 thermal marks.

Doc. 1373 Canadian juvenile salmon surveys in 2012-2013
Marc Trudel, Chrys Neville, and Ruston Sweeting

Pacific salmon have a complex life cycle that involves a freshwater phase for spawning and rearing, as well as an ocean phase where they spend the greater part of their lives and gain the bulk of their mass and energy necessary for successfully completing their spawning migration. Pacific salmon experience heavy and highly variable losses in the ocean, with natural mortality rates generally exceeding 90-95% during their marine life. Most of this mortality is thought to occur during two critical periods: an early predation-based mortality that occurs within the first few weeks to months following ocean entry and a starvation-based mortality that occurs following their first winter at sea. Hence, Canada currently maintains two research programs on the marine biology of Pacific salmon to understand the processes regulating Pacific salmon production in the marine environment, the interactions between wild and hatchery-reared salmon, the impacts of ocean conditions and climate change on marine ecosystems and salmon resources, and to provide a sound scientific basis for optimizing hatchery production. Thus, an offshore program conducts research off the west coast of British Columbia and Southeast Alaska, and an inshore program works in the Strait of Georgia and Puget Sound. In this document, we present the juvenile salmon research surveys that have been planned in Offshore and Inshore areas by Canada for 2012-2013.

Doc. 1374 Proposed thermal marks for salmon from Canada, brood year 2012
Susan DiNovo and David O'Brien

Thermal marking continues to play an important role for both research and fisheries management in Canada. Canada plans to thermally mark approximately 60 million Pacific salmon for release in 2013/14. Thermal marking will include 46 thermal marks applied at 15 hatcheries with marked salmon released at 53 locations. The plan is similar to that of the 2011 brood year released in 2012/13.

Doc. 1376 Trawl survey plans for Pacific salmon marine life period studies in the far eastern seas in summer and fall 2012 by Russia
Olga S. Temnykh, Alexander V. Zavolokin, Alexander N. Starovoytov, and Alexander V. Bugaev

The document summarizes trawl survey plans for Pacific salmon marine life period studies in the Far Eastern Seas in summer and fall 2012 by Russia (TINRO-Center and KamchatNIRO). The outline of materials, methods, surveys timing and theoretical background are provided.

Doc. 1377 **Proposed otolith marks for brood year 2012 salmon in Russia**

Elena Akinicheva, Vladimir Volobuev, and Evegeny Fomin

Otolith marking of salmon of 2012 brood year will be conducted in four regions of the Far East: Kamchatka, Magadan, Sakhalin, and Kuril regions. Marking will be carried out using two methods: thermal and "dry". Their application will be determined by the possibilities and specificity of water supply of incubated embryos at hatcheries of the Far East. The dominating method of marking will be a "dry" one – it will be used on the 81% of salmon at hatcheries. Salmon will be marked at 27 hatcheries. Totally 39 otolith marks will be used.

Doc. 1379 **Canadian research in 2012 relevant to the NPAFC salmon science plan for 2011-2015**

J.R. Irvine, M. Trudel, A. Tompkins, T. Beacham, and M. Saunders

The primary research theme identified in the NPAFC Science Plan for 2010-2015 is the "Forecast of Pacific Salmon Production in the Ocean Ecosystems under Changing Climate". This document supplements an earlier overview by summarising relevant Canadian research activities planned for 2012. Activities are organised according to the five major research topics (*C-1 – C-5)* identified in the Science Plan. It should be noted that research activities often cross over several components of the science plan, due to the inherent overlap associated with the themes of these components.

Doc. 1380 **United States cruise plan for BASIS on the R/V *Oscar Dyson,* August – October 2012**

Auke Bay Laboratories, Ted Stevens Marine Research Institute

Scientists from the National Marine Fisheries Service (NMFS), Ecosystem Monitoring and Assessment Program, will conduct a survey during late summer and fall 2012 within the southeastern Bering Sea to provide key ecological data on the pelagic ecosystem. The survey is conducted as part of the Bering Aleutian Salmon International Survey (BASIS) phase 2 research plan. Primary objectives of the survey will be to: 1) collect biological information on ecologically important fish species and to 2) describe the physical and biological oceanographic conditions of the southeastern Bering Sea waters.

Doc. 1381 **United States cruise plan for BASIS-northern Bering Sea and Chukchi Sea, August – October 2012**

Auke Bay Laboratories, Ted Stevens Marine Research Institute

Scientists from the National Marine Fisheries Service (NMFS), Ecosystem Monitoring and Assessment Program, will conduct a survey during late summer and fall 2012 within the northern Bering Sea and Chukchi Sea to provide key ecological data on the pelagic ecosystem. The survey is conducted as part of the Bering Aleutian Salmon International Survey (BASIS) phase 2 research plan. Primary objectives of the survey will be to: 1) collect biological information on ecologically important fish species and to 2) describe the physical and biological oceanographic conditions of the southeastern Bering Sea waters.

Doc. 1382 **United States cruise plan for the Gulf of Alaska Project, July – August 2012**

Auke Bay Laboratories, Ted Stevens Marine Research Institute

Scientists from the National Marine Fisheries Service (NMFS), Pacific Marine Environmental Laboratory (PMEL), and the University of Alaska Fairbanks (UAF) will conduct a fisheries oceanographic survey during summer 2012 within the southeastern and central regions of the Gulf of Alaska (GOA) to provide key ecological data on the pelagic ecosystem, examine oceanographic transport mechanisms, lower trophic level production, and age-0 marine fish and juvenile salmon distribution and condition. Primary

objectives of the survey will be to: 1) collect biological information on ecologically important marine fish and salmon and 2) describe the physical, and biological conditions of the GOA.

Doc. 1383 **Results of 2011 salmon research by the *Oshoro maru***

Maki Ohwada, Keiichiro Sakaoka, Naoki Hoshi, Takuzo Abe, Keiri Imai, and Shogo Takagi

In order to accumulate oceanographic and biological data (including salmonids) and to clarify the oceanic structure and marine ecosystem, the T/V *Oshoro maru* conducted oceanographic observations and fishing surveys in the western North Pacific (along the 155°E longitude line). The survey was conducted during the Cruise #228 in May, and the Cruise #229-Leg5 from late July to early August, 2011.

10 oceanographic observations and four drift gillnet surveys were conducted along the 155°E during the Cruise #228 in May. The Polar Front was observed in the vicinity of 44°N. The Subarctic Boundary observed in surface water (0-100 db) at nearby 42°-15'N and in deeper water at 40°-30'N. Pink salmon was the dominant species at 43°-22.1'N, 43°-57.3'N and 41°-45.0'N, and abundant at 43°-22.1'N. Chum salmon was collected at 43°-22.1'N and 41°-45.0'N. The fork lengths (F.L.) of chum salmon collected by C-gear gillnet ranged between 480-620 mm, and those of pink salmon ranged between 330-470 mm; 76.9% of chum salmon were adult fish.

Fourteen oceanographic observations and four drift gillnet surveys were conducted along the 155°E during the Cruise #229-Leg5 from late July to early August. Seasonal thermocline was observed in 25 m depth and, thereunder the Polar Front was observed in the vicinity of 43°N. The Subarctic Boundary was observed at 41°-15'N, clearly deeper than 140 m at 40°-15'N. Four pink salmon were collected by drift gillnet survey only at 43°-43.4'N. F.L. of pink salmon collected by C-gear gillnet ranged between 430-490 mm.

To collect salmon samples extensively and to collect fresh salmon blood and various tissues, three surface long-line and five hook-and-line gear samplings were conducted during the Cruise #228 and #229-Leg5. A total of 82 chum and 253 pink salmon was collected during the two cruises.

Doc. 1384 **Incidental catches of anadromous fish by Japanese research vessels in the North Pacific Ocean in 2011**

Shigehiko Urawa and Toru Nagasawa

Japanese research vessels conducted scientific fishing operations to assess Pacific saury, and other pelagic fishes using midwater trawls, drift gillnets, and saury dip net with possibilities of the incidental catch of anadromous fish in the western and central North Pacific Ocean in 2011. During these research surveys, a total of 674 salmonids including 141 chum salmon, 481 pink salmon, 32 coho salmon, 19 chinook salmon, and one steelhead trout was caught in the summer of 2011.

Doc. 1385 **Proposed cruise plans of Japanese research vessels for salmon in the North Pacific Ocean in 2012**

Shigehiko Urawa and Toru Nagasawa

According to the national research plan, two Japanese salmon research vessels are scheduled to conduct the following scientific research in the North Pacific Ocean and Bering Sea in 2012.

(1) The *Hokko maru* will carry out salmon research with a surface/midwater trawl and hook-and-line to obtain information on the distribution, abundance, and other biological characteristic of Pacific salmon in the Bering Sea from late July to early August.

(2) The *Oshoro maru* will carry out salmon research with gillnets, longline, and hook-and-line to obtain data on the distribution and ecology of salmon and other pelagic fishes in the western North Pacific in May and in the Gulf of Alaska from June to August

In the case of gillnet operations, gillnets less than 2.5 km in length at sea will be used.

Doc. 1386 Rev. 1 Cruise plans of Japanese research vessels involving incidental takes of anadromous fish in the North Pacific Ocean in 2012

Fisheries Research Agency

Eleven Japanese research vessels are scheduled to conduct high-seas researches for pelagic fishes and squids in the North Pacific Ocean in 2012. These surveys have a possibility of incidental salmon catch during the cruises. In the case of gillnet operations, lengths of gillnets will be less than 2.5 km at sea.

Doc. 1387 Rev. 1 Proposed otolith marks for brood year 2012 salmon in Japan

Tsutomu Ohnuki, Yasutaka Okamoto, Shunpei Sato, and Shigehiko Urawa

Japan plans to mark approximately 252 million salmon of 2012 brood year (225 million chum, 23.2 million pink, 3.3 million masu, and 150 thousand sockeye salmon) using 47 discrete thermal patterns and two ALC (alizarin complexone) patterns at 40 hatcheries. Two thermal rings in the first band are adopted as the base mark to distinguish Japanese chum and pink salmon from other stocks.

Doc. 1388 Report of the Research Planning and Coordinating Meeting

NPAFC Committee on Scientific Research and Statistics

The Research Planning and Coordinating Meeting (RPCM) was held over the time period April 10-18, 2012, by email communication among the RPCM participants. The group included nine participants and 32 advisors from the five member countries.

Research plans for 2012 and cruise activities were reviewed. Canada maintains an offshore salmon research program conducted off the west coast of British Columbia and Southeast Alaska and an inshore program in the Strait of Georgia and Puget Sound. Russia's survey plans include cruises in northwestern North Pacific, southern Okhotsk, and western Bering Sea. Japan anticipates cruises in the western North Pacific, central Bering Sea, and Gulf of Alaska. The US survey plans include cruises in northern Southeast Alaska, southeastern and central Gulf of Alaska, southeastern Bering Sea, and northern Bering Sea and Chukchi Sea. Research operations will be conducted in late winter-spring through fall, though most cruises will be conducted in the summer and fall. Exchanges of scientific personnel and biological samples were reviewed and updated.

The Science Sub-Committee suggested the Juvenile salmon Workshop III be held following the 2013 CSRS meeting. The RPCM members agreed and requested the CSRS to hold the 2-day workshop. The organizing committee and the Secretariat were asked to make arrangements, plan, and announce the workshop accordingly. The Working Group on Salmon Marking provided information on the status of the otolith mark database and proposed mark plans for brood year 2012. The practice of exchanging mark plans prior to the RPCM meeting has completely eliminated mark conflicts and no redundant mark patterns are planned for release during brood year 2012. The Working Group on Salmon Tagging reported on tagging plans in 2012, transfer of the tag release-recovery database to the Secretariat, and it was suggested that electronic tag data be permanently transferred to NPAFC from the High Seas Salmonid Research Program of the University of Washington.

The Secretariat provided an update for the online publication of Technical Report No. 8, which is planned for May 2012. A status report on the development of the Anniversary Salmon Book was given by the Lead

Editor (R. Beamish) who summarized plans to have chapters to the publisher by spring, 2013. Progress on the Statistical Yearbook and the CSRS List of Actions was reviewed.

Doc. 1389 **Microsatellite identification of sockeye salmon rearing in the Bering Sea 2011**
Terry D. Beacham, John R. Candy, Shunpei Sato, and Shigehiko Urawa

Stock composition of sockeye salmon (*Oncorhynchus nerka*) caught in the southern central Bering Sea during a Japanese research cruise in the summer of 2011 was estimated through an analysis of microsatellite variation. Variation at 14 microsatellites was analyzed for 177 immature sockeye salmon, and a 387-population baseline spanning Japan, Russia, Alaska, Canada, and Washington State was used to determine the stock composition of the fish sampled. Alaskan-origin sockeye salmon were the most abundant in the catch, comprising 86.1% of all sockeye salmon caught (United States total 86.7%), with the catch dominated by sockeye salmon of Bristol Bay origin. Russian-origin salmon accounted for 12.1% of the catch, while Canadian-origin sockeye salmon accounted for 1.2% of the catch.

Doc. 1396 **Formats and codes used in the INPFC/NPAFC high-seas salmonid tag-recovery database**
NPAFC Secretariat

In 2011, the NPAFC requested the Secretariat to assume responsibility for housing and maintaining the International North Pacific Fisheries Commission (INPFC) and NPAFC high-seas salmonid tag-recovery computer database (INPFC/NPAFC high-seas salmonid tag-recovery database) and progress toward making these data available on the web. As a first step in preparing the data for web-access, the Secretariat standardized and revised the format of the data, which is in a MS-Excel® file, and updated tag recovery information to 2010. This document lists the updated formats and codes used in the data file.

Doc. 1397 **Review of some results of Russian population studies of Pacific salmon in 2010 and 2011**
A.V. Bugaev, N. Yu. Shpigalskaya, O.A. Pilganchuk, R.A. Shaporev, V.A. Savin, A.I. Chistyakova, U.O. Muravskaya, and O.N. Saravansky

The document demonstrates general directions of Russian population studies of Pacific salmon in the system of fisheries institutes in Far East in 2010 and 2011. For today genetic and phenotypic methods are used to provide studying intraspecific structure of feeding and prespawning aggregations of salmon during the marine period of life history. Issues of development of the studying attract a great interest as promising for commercial fishery practical solutions in the Exclusive Economic Zone of Russian Federation. Some results of provided and demonstrated work on identification were already used in forecasting abundance of salmon returns in the rivers of Kamchatka.

Doc. 1398 **Decreases in abundance of immature Pacific salmon in the western Bering Sea from 2002 to 2011: link to hydrological and forage conditions**
Alexander V. Zavolokin and Gennady V. Khen

Changes in abundance and distribution of immature chum, sockeye, and Chinook salmon in the western Bering Sea in summer and fall of 2002-2011 were studied in relation to hydrological and forage conditions. From early 2000s to 2011, abundance of immature Pacific salmon in the surveyed area greatly decreased. The main causes of this decrease probably were (1) changes of current intensity resulted in weakening of water inflow from Pacific Ocean to the northwestern Bering Sea and (2) fluctuations of the total number of immature salmon in the North Pacific. Forage and temperature conditions were likely to have had relatively small impact on migration intensity of salmon.

Doc. 1399 **Was there a re-distribution of the pink salmon migratory flow between different areas of Sakhalin-Kuril region in 2011?**

Alexander M. Kaev, Alexander A. Koynov, and Larisa V. Romasenko

In 2011, pink salmon capture in the northern part of eastern Sakhalin was significantly higher and on Iturup Island, in contrast, lower than expected. This fact aroused discussion in favor of hypothesis of the fluctuating stock. To clarify the matter, we have studied a structure of fish scales. The statistically reliable differences in the number of circuli and consistent changes in width of the intercirculi distances in the first annual growth zone on the scales were found in fish sampled from different areas. These results were compared with the data obtained when studying pink salmon in the same areas in 1997. The new data obtained exclude the probability of mass relocation of fish in these years, particularly, fish of the south-Kuril origin, to the northern part of the eastern Sakhalin coast in 2011. At the same time, significant changes have been revealed in pink salmon returned in 2011 that occurred in their growth during the first year of life compared to fish returned in 1997–2000.

Doc. 1400 Rev. 1 **Marked salmon production by the hatcheries of Russia in 2012**

Elena Akinicheva, Vladimir Volobuev, and Evgeny Fomin

The process of salmon marking has been carrying out over 15 years in the hatcheries of Far East of Russia. First of all it is aimed at the estimation of hatchery effectiveness. The release amount of marked juvenile salmon increased considerably within the last years, due to the mass marking in Sakhalin-Kurile region, the place where a lot of hatcheries of Russia are located. The marking was conducted using two methods: "dry" and thermal.

Doc. 1401 **Japan salmon commercial fisheries catch statistics for 2011**

Kei Sasaki, Toshihiko Saito, and Toru Nagasawa

The commercial catches in coastal and offshore areas of Japan in 2011 totaled 46.1 million, including 39.7 million chum and 6.4 million pink salmon. The official specific statistics data may be available by the end of March 2013.

Doc. 1402 **Preliminary 2011 salmon enhanced production in Japan**

Kei Sasaki and Satoru Takahashi

Four species of anadromous Pacific salmon (chum, pink, masu, and sockeye salmon) are currently enhanced in Japan. This report does not include the number of anadromous salmon released from hatcheries along the Pacific Coast of Honshu, because the release data is not available due to the disaster caused by the East Japan Earthquake on March 11, 2011. A total of 1,359 million juveniles and smolts was released from Japanese hatcheries in 2011. Approximately 1,199 million chum salmon fry were released in the spring of 2011. Japanese hatcheries also released 148 million pink salmon fry, 11,866 thousand juveniles and smolts of masu salmon, and 378 thousand juveniles and smolts of sockeye salmon.

In 2011, the number of adult salmon captured in rivers along the Japanese coasts was 4,996 thousand fish, which corresponded to 14,964 metric tonnes in weight. The dominant and second dominant species were chum and pink salmon, contributing 87.8% and 11.9% in numbers of all salmon captured in rivers, respectively. Adult masu salmon occur in rivers of both Hokkaido and Honshu, but their number was not available in Honshu. The number of adult masu salmon returns in Hokkaido was approximately 17.6 thousand fish. Anadromous sockeye salmon were caught in several rivers in Hokkaido, where the number of catches was approximately 1.3 thousand fish.

Doc. 1403 **Nonrandom distribution of Canadian sockeye salmon rearing in the Bering Sea and coastal Gulf of Alaska**

Terry D. Beacham, John R. Candy, Strahan Tucker, Shunpei Sato, Shigehiko Urawa, Jamal H. Moss, and Marc Trudel

Individual identification of sockeye salmon (*Oncorhynchus nerka*) caught in coastal Gulf of Alaska and central Bering Sea sampling sites was estimated through an analysis of microsatellite variation. Variation at 14 microsatellites was analyzed for 2,255 juvenile sockeye salmon obtained from coastal surveys in the Gulf of Alaska, and 627 immature individuals from surveys in the Bering Sea. A 387-population baseline spanning Japan, Russia, Alaska, Canada, and Washington State was used to determine the individual identification of the fish sampled, with emphasis on Canadian-origin salmon. Not all Fraser River stocks displayed the same trends in relative abundance with respect to coastal Gulf of Alaska sampling groups, perhaps indicative of differential initial rearing environments. Immature sockeye salmon from some Canadian stocks rear in the Bering Sea at levels that are not commensurate with subsequent abundance as measured by escapement, indicative of a nonrandom distribution of rearing areas by stock. Immature Harrison River sockeye salmon from the lower Fraser River have only been identified in samples originating from waters in British Columbia. The marine rearing areas subsequent to the first year of marine residence are unknown for this population.

Doc. 1404 **Concordant distribution, abundance and growth of juvenile pink, chum and sockeye salmon in eastern Pacific coastal waters.**

Strahan Tucker, Mary Thiess, John Morris, Asit Mazumder, and Marc Trudel

Competition is thought to be an important factor affecting growth of Pacific salmon (*Oncorhynchus* spp.) in marine waters. Pink salmon (*O. gorbuscha*) are the most abundant species of the five Pacific salmon. As such, we hypothesized that high abundances of juvenile pink salmon might result in decreased abundances and/or growth of other planktivorous juvenile salmon species during the first growing season (summer-fall) at sea through direct competition for food. We evaluated spatial and temporal changes in growth rates and the seasonal catches between 1998 and 2011 of juvenile salmon and pelagic fishes, and the effects of oceanographic variables. Results suggest that, at least during the first marine growing season, interspecific competition is not manifested among salmon going to sea in the same year in northeastern Pacific stocks. Abundance of all salmon species was positively correlated and more likely driven by oceanographic features and processes at the base of the food chain.

Doc. 1405 **Alaska salmon hatchery releases, commercial fishery catch statistics and sport fishery harvest statistics for 2011 season**

Eric C. Volk and Ronald P. Josephson

In 2011 there were 27 private nonprofit, 2 federal, and 2 state hatcheries operating in Alaska. Most of these facilities (18) are located in Southeast Alaska. The Cook Inlet and Prince William Sound regions have 11 hatcheries and the Kodiak region has 2 hatcheries. Alaskan hatcheries released approximately 1.5 billion fish in 2011. Of the fish released, 57% were pink salmon and 37% were chum salmon. Hatcheries in Prince William Sound contributed 53% and hatcheries in Southeast Alaska contributed 35% of the fish released.

The Alaska salmon commercial harvest of all species combined for 2011 totaled 177.4 million fish, which was about 26 million less than the preseason forecast of 203.5 million, but still the ninth largest salmon harvest. In 2011, pink salmon catch was 116.2 million compared to the preseason projection of 133 million. Prince William Sound fisheries harvested 33.3 million, about 5 million below the projected harvest; the Southeast Alaska harvest of 59 million pink salmon was slightly above the 55 million forecast, and well above the recent 10-year average harvest of 40 million (2001–2010). The statewide chum salmon harvest of 17 million was effectively equal to the ten-year average harvest of 17.1 million. Coho salmon catches of 3.5 million were well below the ten-year average of 4.5 million and the lowest

since 1997. Sockeye salmon were expected to yield a harvest of 44.7 million fish and provided 40.3 million fish; in Bristol Bay, the harvest of 22 million sockeye salmon was 21% below projection, and also below the 10-year average harvest of 23.6 million. Cook Inlet's catch of 5.7 million sockeye salmon was the fourth-largest in the past 20 years. The Chinook salmon catch of 470,000 was below average; however, the Chinook salmon catch, outside of Southeast Alaska, was 126,000, the third lowest for that area since 1940 (the 2009 catch was the lowest at 98,000). The State of Alaska is very concerned about our Chinook salmon stocks and will be engaged in workshops and other venues to seek solutions to the current situation. The preliminary estimate for the total exvessel value of Alaska's 2011 harvest is $609 million.

Sport fishery harvests in Alaska for 2010 were slightly less than 1.4 million fish for all species.

Inseason harvest information, postseason statistics, and other information about salmon in Alaska can be found at http://www.adfg.alaska.gov

Doc. 1406 Releases of otolith marked salmon from Alaska in 2011

Dion Oxman

In Alaska, mass-marking of salmon using otolith thermal marking is an effective research and management tool for a variety of situations. This document reports the otolith mark patterns applied to hatchery-raised salmon stocks released in Alaska during 2011. It includes five species of salmon from brood years 2009 through 2011. Release numbers, mark patterns, and release locations are summarized.

Doc. 1407 Incidental catches of salmonids by U.S. groundfish fisheries in Bering Sea/Aleutian Islands and the Gulf of Alaska

Patricia A. Nelson and Renold E. Narita

This report presents the estimated incidental catches and average weights of Pacific salmonids in U.S. groundfish fisheries off Alaska from 1977 through August 30, 2012. Estimated annual incidental salmon catches (all species combined) through August 30, 2012, were 19,186 salmon in the Bering Sea/Aleutian Islands (BSAI) and 7,572 salmon in the Gulf of Alaska (GOA).

Annual estimated numbers of Chinook salmon (*Oncorhynchus tshawytscha*) incidentally caught in the U.S. groundfish fisheries in the BSAI, have ranged from 8,223 (year 2000) to 129,567 (year 2007) and the annual average weight has ranged from 2.60 kg in 2011 to 5.21 kg in 1995. Annual estimated numbers of non-Chinook salmon have ranged from 14,895 in 2010 to 709,387 in 2005. Chum salmon (*O. keta*) typically account for over 95% of the non-Chinook salmon catch. The annual average chum salmon weight has ranged from 2.07 kg in 1993 to 3.43 kg in 1995.

In the U.S. groundfish fisheries in the Gulf of Alaska, annual estimated numbers of Chinook salmon incidentally caught have ranged from 8,397 in 2009 to 54,559 in 2010 and the annual average weight has ranged from 2.11 kg in 2011 to 4.60 kg in 1991. Annual estimated numbers of non-Chinook salmon have ranged from 2,029 in 2010 to 64,792 in 1995. Chum salmon typically account for over 95% of the non-Chinook salmon catch. The annual average chum salmon weight has ranged from 2.16 kg in 1993 to 4.87 kg in 1999.

Incidental catches of Pacific salmonids in foreign and joint venture groundfish fisheries off Alaska are presented for 1977-1990. The last joint venture operation took place in 1990 in the BSAI, with an incidental catch of 152 salmon.

Doc. 1408 **Korean salmon catch statistics and hatchery releases in 2011-2012**

Kwan Eui Hong, Ju Kyoung Kim, and Doo Ho Kim

Total catch of chum salmon was 27,891 fish or 72.8 metric tons in 2011. The total fries of chum salmon released was 7,630 thousand fish in 2012 (2011 brood).

Doc. 1409 **Recoveries of coded wire tag from chum salmon in Korea in 2011**

Kwan Eui Hong, Ju Kyoung Kim, and Sun Jong Lee

Korea has released CWT tagged juvenile chum salmon since 2003 and 15 CWT chum salmon were recovered at Namdae-cheon and harbor of coastal area (set net) during the spawning seasons in 2011. Among 21 chum salmon, 11 salmon were female and 10 were male. Most salmon sampled were age 2 (4.8 %) and age 3 (81%) and age 5 (14.2%), which were released in 2010 and 2009 and 2007.

Doc. 1410 **Monitoring of fish pathogenic viruses from chum salmon (*Oncorhynchus keta)* in Korea**

Chan-Hyeok Jeon, Rungkarn Suebsing, Kwan-Eui Hong, Myun-Joo Oh, and Jeong-Ho Kim

A field survey was carried out to study the occurrence and distribution of salmonid pathogenic viruses. IHNV, IPNV and VHSV were tested from migrating chum salmon (*Oncorhynchus keta*) spawners and their offsprings from the Namdae River, the east coast of Korea, during 2006-2012. Detection rate of those viruses was compared by RT-PCR and RT-LAMP, and several samples were sequenced for the phylogenetic analysis. Of 901 samples tested, 218 samples (24.2%) were IHNV-positive by RT-LAMP, whereas 164 samples (18.2%) were IHNV-positive by nested RT-PCR. 296 out of 901 (32.9%) samples were IPNV-positive by RT-LAMP, whereas 195 samples (21.6%) were IPNV-positive by nested RT-PCR. All samples were VHSV-negative (0/901). Thus, the detection rates were increased when using RT-LAMP assay, compared with RT-PCR. The prevalence of those viruses was dramatically decreased since 2008, particularly in fry samples, maybe due to the use of disinfectants for eliminating active virus from fertilized eggs. In phylogenetic analysis, the IHNV isolates were clustered into the JRt genogroup including Japanese and other Korean isolates. The IPNV isolates were clustered into the genogroup or including Asian isolates. In addition, all of the isolates were clustered with the rainbow trout isolates. Further studies are needed to clarify their origins and the potential pathogenicity.

Doc. 1411 **Korean research plan for salmon in 2013**

Kwan Eui Hong, Ju Kyoung Kim, and Ki Yeol Park

Salmon are political resources due to the characteristics of transboundary distribution and economic importance. The interest in chum salmon biology in Korea was much increased since the establishment of the Yangyang Salmon Station (formerly Cold-water Fish Research Center) of Korea Fisheries Resources Agency. The enhancement program of chum salmon has been expanded thereafter, so that chum salmon were transplanted 18 streams in the coast of the Korean Peninsula. On the other hand, however, the ecological research on salmon species was very limited until recently due to the lack of a research program. Though the involvement in NPAFC requires scientific investigation on salmon research of each member nation, the conspicuous increase in research funding was not achieved. Oceanic environments have been rapidly altered by climate change during the last few decades and ocean ecosystems including salmon populations will be modified under the global warming situation. Especially, special intention is needed for stocks in southern boundary of distribution such as Korean chum salmon.

Adult salmon will be disc tagged to investigate the coastal migration route and timing of Korean chum salmon. Salmon will be caught in set net fisheries at eastern coastal areas of Korea.

To reveal the mechanisms of mass mortality of chum salmon during their early life in rivers and coastal areas, in conjunction with the fluctuation of return rates, will be investigated.

Climate change effects on salmon distribution, migration route, and abundance will be investigated.

Otolith thermal marking on Korea chum salmon will be carried out to provide information about growth, survival during the early ocean life stage, and hatchery origins on 2012 releases (2011 brood).

For the stock identification, we will develope new microsatellite loci of chum salmon to investigate genetic variation and population structure of Korean populations.

We plan to expand the cherry salmon releasing program, and as the first step of cherry salmon research, we will examine stomach contents to know the prey items of cherry salmon and the competition for prey with other fish species in the coastal area and ocean.

Doc. 1412 Otolith thermal mark for brood year 2011 and proposed thermal marks for brood year 2012 chum salmon in Korea

Kwan Eui Hong, Ju Kyoung Kim, Kyoung Sik Kim, and Tae Young Kim

Korea released 8.1 million and 2.5 million thermal marked chum salmon in March 2011 and 2012, respectively. The marks were 3,2,1H for 2011 (2010BY) and 3,3nH for 2012 (2011BY). We will mark approximately 6.0 million chum salmon in BY 2012, which covers about 50% ~60% of release of BY 2012 chum salmon at Namdae-cheon (river). Chum salmon will be marked at Yangyang Salmon Station using only 1 thermal mark (3,1,2H).

Doc. 1413 Interannual variability in size and age structure of Russian chum salmon stocks

O.S. Temnykh, A.V. Zavolokin, L.O. Zavarina, V.V. Volobuev, S.L. Marchenko, S.F. Zolotuhin, N.F. Kaplanova, E.V. Podorozhnyuk, A.A. Goryainov, A.V. Lysenko, A.M. Kaev, Yu.I. Ignat'ev, E.V. Denisenko, Yu. N. Khokhlov, and O.A. Rassadnikov

Data on trends in abundance, size and age composition of chum salmon stocks from all major Russian stocks are considered for the last 40-50 years. Increase in the total abundance of chum salmon was accompanied by decrease in average size in most major reproduction areas from the 1970s to 2010s. Changes in size were accompanied by changes in age structure of chum salmon populations. The tendency of growth in average age of spawners due to an increase in the proportion of older chum salmon spawners was observed in most of examined areas (except Primorye chum salmon stocks). Statistically significant correlation coefficients between average sizes and total catches of chum salmon indicate that there is a close relation between chum salmon abundance and its production features. The reasons of the changes in the size-age structure of chum salmon stocks are discussed. Certain deficiency in food supply during marine life can negatively impact chum growth rate, but ocean food resources are not the limiting factor in the abundance of salmon.

Doc. 1414 Rev. 1 Forecasting pink salmon harvest in southeast Alaska from juvenile salmon abundance and associated biophysical parameters: 2011 returns and 2012 forecast

Alex C. Wertheimer, Joseph A. Orsi, Emily A. Fergusson, and Molly Sturdevant

The Southeast Alaska Coastal Monitoring (SECM) project has been sampling juvenile salmon (*Oncorhynchus* spp.) and associated biophysical parameters in northern Southeast Alaska (SEAK) annually since 1997 to better understand the effects of environmental change on salmon production. A pragmatic application of the annual sampling effort is to forecast the abundance of adult salmon returns in subsequent years. Since 2004, juvenile peak salmon catch per unit effort (CPUE) from SECM, adjusted

for highly-correlated biophysical parameters, has been used to forecast harvest of adult pink salmon (*O. gorbuscha*) in SEAK. The 2011 forecast of 56.2 M fish was 5% lower than the actual harvest of 59.0 M fish. Seven of eight forecasts produced over the period 2004-2011 have been within 0-17% of the actual harvest, with an average forecast deviation of 7%. The forecast for 2006 was the exception; while the simple CPUE model indicated a downturn in harvest, the prediction still overestimated the harvest by 209%. These results show that the CPUE information has great utility for forecasting year-class strength of SEAK pink salmon, but additional information may be needed to avoid "misses" such as the forecast for the 2006 return. For the 2012 forecast, model selection included a review of ecosystem indicator variables and considered additional biophysical parameters to improve the simple single-parameter CPUE forecast model. A two-parameter model, including May temperature data as well as juvenile CPUE, was selected as the "best" forecast model for 2012. The 2012 forecast from this model, using juvenile salmon data collected in 2011, was for 18.8 M fish, with an 80% bootstrap confidence interval of 13-25 M fish.

Doc. 1415 **High seas salmonid coded-wire tag recovery data, 2012**

Adrian G. Celewycz, Emily A. Fergusson, Jamal H. Moss, and Vanessa J. Tuttle

Information on high seas recoveries of salmonids (*Oncorhynchus* spp.) tagged with coded-wire tags (CWTs) has been reported annually to the International North Pacific Fisheries Commission (1981-1992) and to the NPAFC (1993-present). Data from these CWT recoveries are also reported to the Regional Mark Processing Center (RMPC, http://www.rmpc.org) of the Pacific States Marine Fisheries Commission (PSMFC) for inclusion into their Regional Mark Information System Database. This document lists recovery data for 279 CWT salmonids that will be reported to PSMFC/RMPC for the first time. These 279 CWTs were recovered from the 2011 and 2012 U.S. groundfish trawl fishery in the Gulf of Alaska (13 Chinook salmon, *O. tshawytscha)*, the 2011 and 2012 U.S. groundfish trawl fishery in the eastern Bering Sea-Aleutian Islands (4 Chinook salmon), the 2010 and 2011 at-sea Pacific hake (*Merluccius productus*) trawl fishery in the northern Pacific Ocean off Washington/Oregon (WA/OR, 220 Chinook salmon and 2 coho salmon, *O. kisutch)*, the 2011 West Coast trawl fishery off WA/OR/CA (15 Chinook salmon), and from 2011 U.S. trawl research in the Gulf of Alaska (3 Chinook salmon, 21 coho salmon, and 1 sockeye salmon, *O. nerka*). Recovery information is also presented for 5 new recoveries (4 Chinook salmon and 1 sockeye salmon) of salmon tagged with agency-only wire tags (not CWTs).

Doc. 1416 **Effects of aggregating coastwide genetic baseline for improved mixture resolution of high-seas caught salmon**

Jeffrey R. Guyon

Genetic analysis is used to identify individual stocks in mixed stock fisheries for management purposes. In instances where the number of potential contributing stocks is large and there is limited genetic divergence between populations within areas, baseline populations are often grouped into regional aggregations for analysis. Commonly used stock composition software maximizes the probability that the mixture allele frequencies are derived from specific baseline populations and those probabilities are added to determine the overall contribution from each regional grouping. An assumption with current stock composition methodologies is that the sampled baseline population allele frequency distribution represents the actual population allele frequency distribution, a condition which may be unrealistic especially with multi-allelic markers assayed in a small subset of a baseline stock. Differences between individual baseline and population allele frequency distributions can adversely affect stock composition analyses through misallocation. As a result, we investigated whether there may be instances where it may be advantageous to combine baseline allele counts within a region prior to stock composition rather than sum individual population allocations within regions after allocation. Results show that aggregating allele counts within regional baseline populations prior to mixture stock analysis can be an effective method in certain instances resulting in increased stock accuracy.

Doc. 1417 **Japanese bibliography in 2011-2012 for NPAFC Science Plan**

Shunpei Sato, Toru Nagasawa, and Shigehiko Urawa

This bibliography listed original papers and documents published in 2011-2012 by Japanese scientists and their collaborators in order to review Japanese national researches for the 2011-2015 NPAFC Science Plan. The bibliography includes 34 articles with abstracts, corresponding to five research components of the NPAFC Science Plan.

Doc. 1418 **Releases of otolith marked salmon from Japan in fall of 2011 and spring of 2012**

Yasutaka Okamoto, Tsutomu Ohnuki, Shunpei Sato, Nobuaki Watanabe, Yasuyuki Miyauchi, Tsutomu Arauchi, Masaya Iida, and Shigehiko Urawa

This document provided information of Japanese otolith mark releases, including release site, date, number, and mark patterns with images. In the spring of 2012, approximately 263.2 million chum, 24.0 million pink, 1.6 million masu, and 88 thousand sockeye salmon fry (2011 brood year) with thermal marks or ALC (alizarin complexone) patterns were released from 45 hatcheries in Japan. In addition, 373 thousand masu salmon smolts and 138 thousand sockeye salmon smolts (2010 brood year) were released in the spring of 2012 after thermally marked. In the fall of 2011, 286 thousand juveniles of otolith-marked masu salmon and 67 thousand juveniles of otolith-marked sockeye salmon (2010 brood year) were also released. Two thermal rings as base mark were adopted to distinguish Japanese salmon from other stocks. ALC marks were used for chum and pink salmon surveys by the Hokkaido Salmon and Freshwater Fisheries Research Institute, Hokkaido Research Organization. The data are uploaded to the database on the website of NPAFC Working Group on Salmon Marking (http://npafc.taglab.org).

Doc. 1419 **The summer 2012 Japanese salmon research cruise of the R/V *Hokko maru***

Shunpei Sato, Tomoki Sato, Ken-ichi Ohmoto, and Fumihisa Takahashi

A summer high-seas research cruise to investigate the biology of Pacific salmon was conducted from July 20 to August 9 in the Bering Sea aboard the Japanese research vessel *Hokko maru*. Research cruise activities included the collection of data on oceanography, zooplankton, micronekton, salmonid fishes, and other organisms. A total of 3,694 salmonids were caught by trawls and angling. Chum salmon was the most abundant species (91.4%), followed by sockeye salmon (5.4%), Chinook salmon (3.1%), pink salmon (0.1%), and coho salmon (0.05%). Salmonids were measured with respect to fork length and body and gonad weights, they were sexed, and the scales were removed for age determination. Isotope, genetic, otolith, and radioactive monitoring samples were obtained for future study. There were 70 chum salmon tagged with disk tags and released in the Bering Sea. From among fish released with disk-tags, 28 small and 12 large chum salmon were released carrying DST milli-F and DST magnetic tags, respectively. Age-specific catch per surface trawl (CPUE) and scale mass index of chum salmon from 17 fixed fishing stations from 2007 to 2012 are documented.

Doc. 1420 **Canadian enhanced salmonid production during 1978-2011 (1977–2010 brood years)**

J. Sandher, C. Lynch, D. Willis, R. Cook, and J.R. Irvine

The Salmonid Enhancement Program (SEP) in British Columbia, Canada was initiated in 1977 to rebuild stocks and increase catch through the expanded use of enhancement technology. The program currently comprises approximately 150 projects which produce chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), chum (*O. keta*), pink (*O. gorbuscha*), and sockeye (*O. nerka*) salmon, as well as small numbers of steelhead (*O. mykiss*) and cutthroat trout (*O. clarki*). Projects include hatcheries, fishways, spawning and rearing channels, and small classroom incubators, and range in size from spawning channels releasing nearly 100 million juveniles annually, to schools with classroom incubators that release fewer than one hundred. Data from facilities that operate outside the direction of SEP are not included in this report. Steelhead and cutthroat are a provincial government responsibility, but some enhancement takes place at

SEP facilities under a cooperative arrangement. Steelhead and cutthroat numbers in this report do not include releases from facilities operated by the Freshwater Fisheries Society of British Columbia.

Doc. 1421 United States bibliography in 2011-2012 for NPAFC Science Plan

Auke Bay Laboratories, Ted Stevens Marine Research Institute

This bibliography listed original papers and documents published in 2011-2012 by United States scientists and their collaborators that address research priorities in the 2011-2015 NPAFC Science Plan.

Doc. 1422 Pacific salmon status and abundance trends– 2012 update

James R. Irvine, Arlene Tompkins, Toshihiko Saito, Ki Baik Seong, Ju Kyoung Kim, Natalya Klovach, Heather Bartlett, and Eric Volk

This report updates a major review published in 2009 of commercial catch and hatchery release data for Pacific salmon. Pacific salmon abundance in the North Pacific, as indexed by aggregate commercial catches, is at all time high levels, with no indication of decline. The highest catches on record occurred during 2009 and 2011 when more than 1 million tonnes (>600 million fish) were caught. There are more adult salmon caught in odd numbered years than even years because the most frequent species in the catch, pink salmon, are most abundant in odd years. The ranking of species in the aggregate catch varied little since the time series began in 1925. Pink salmon have generally been the most numerous, usually followed by chum, sockeye, coho, Chinook, and masu salmon. Although the northern North Pacific Ocean continues to produce large quantities of Pacific salmon, temporal abundance patterns vary among species. Currently, pink and chum salmon are very abundant, coho and Chinook salmon are less abundant than they were previously, while sockeye salmon abundance varies among areas.

Pink and chum salmon dominate Asian catches; numbers increased following the 1977 but especially the 1989 regime shift, and remain at all time highs. Russia currently catches the largest proportion of the Asian catch although in earlier years, Japan often caught a greater proportion; catches by the Republic of Korea are relatively minor. Asian hatchery production continues to increase, primarily because of increased numbers of salmon released from Russian hatcheries. Improved survivals reported for some groups of hatchery-origin salmon are a consequence of both improved hatchery practices and environmental changes. Favourable marine conditions for pink and chum salmon, expanding hatchery operations, and improved hatchery technologies have all played a role in increasing the abundance of chum and pink salmon in Asia.

North American salmon abundance increased following the 1977 regime shift. The relative abundance of salmon species in North America varies from north to south. Pink and sockeye salmon are the primary species in Alaska while in Canada, pink, sockeye, and chum salmon have historically been the most important, and in Washington, Oregon, and California, Chinook and coho salmon are the most abundant species. Interannual variability in the importance of various species in North America has been more pronounced during the last decade than previously.

Doc. 1423 An early marine life history strategy for Fraser River sockeye salmon

R. Beamish, C. Neville, and R. Sweeting

The Fraser River is one of the major producers of sockeye salmon. Most of the populations have fry that spend one year in a lake before migrating to the ocean. A small percentage spends two years in a lake, and a small percentage are sea type and migrate directly into the ocean in the year that they emerge from the gravel. Most smolts from the lake-type populations migrate into the Strait of Georgia in early May and by the end of June they are spread out from the Gulf Islands area in the Strait of Georgia to at least Hecate Strait, a linear distance of about 1,000 km. Most sea-type juveniles enter the Strait of Georgia in July and remain until about November. Although the sea-type population was only about 1.2 % of the production in

the since 1952, it has been 5.0% in the last six years. We propose that sockeye salmon smolts from the Fraser River migrate and disperse over a vast area of the ocean in the critical early marine period, as well as using the Strait of Georgia over an extended period, to ensure that some juveniles always find favourable ocean conditions and abundant prey. This means that juvenile sockeye salmon from the Fraser River are spread out in time and space in the early marine period. It is important to recognize that there is an early marine life history strategy for Fraser River sockeye salmon and that the strategy is an adaptation to optimize the survival of the aggregate of populations over a period of hundreds to thousands of years of changing climate and ocean conditions.

Doc. 1424 **Exceptionally poor survival of Chinook salmon entering the Strait of Georgia in 2007 is consistent with the synchronous poor survival of other Pacific salmon and Pacific herring**

R.J. Beamish and R.M. Sweeting

Indices of marine survival of eight populations of Chinook salmon entering the Strait of Georgia identified the ocean entry year 2007 as a year of generally poor survival. Marine survival was exceptionally low for the Harrison River population which is the largest Chinook salmon population in British Columbia. The low survival is consistent with the poor survival and poor growth of the other species of Pacific salmon and juvenile Pacific herring that reared in the Strait of Georgia in the spring of 2007.

Doc. 1425 **A proposal to establish an International Year of the Salmon**

R.J. Beamish

The Long-term Research and Monitoring Plan developed by the NPAFC concluded that a proposal should be developed for an International Year of the Salmon. An International Year of the Salmon will allow experts from all Pacific salmon producing countries to focus on identifying the mechanisms that regulate Pacific salmon abundance and to use this understanding to maximize economic opportunities in the future while ensuring responsible stewardship. This proposal identifies some of the major climate and ocean influences on Pacific salmon production to show that there will be major changes in abundance trends in the future. It is of benefit to everyone that these changes are anticipated and not come as surprises. I suggest that the NPAFC form a group that will look at the feasibility of funding an International Year of the Salmon.

Doc. 1426 **Estimating winter mortality in juvenile Marble River Chinook salmon**

Marc Trudel, Katherine R. Middleton, Strahan Tucker, Mary E. Thiess, John F.T. Morris, John R. Candy, Asit Mazumder, and Terry D. Beacham

Winter is generally considered a critical period for juvenile salmon due to low temperatures and food availability. However, mortality rates have not been quantified for juvenile salmon during the winter months. Here, we use changes in the catch-per-unit effort (CPUE) for five brood years (2004-2008) of juvenile Marble River Chinook salmon between fall and winter to estimate stock-specific overwinter mortality rates in juvenile salmon. This stock is ideal for estimating overwinter mortality, as the catch distribution suggest that they remain in Quatsino Sound, British Columbia, for a year before migrating to the open ocean. CPUE of juvenile Marble River Chinook salmon in the Quatsino Sound system were 7- to 169-fold lower in the winter relative to the fall. CPUE varied significantly among brood years and seasons, but the interaction term between brood years and seasons was not significant. Overall, 80% of these fish died over winter, and mortality rates averaged 0.014-0.017 d^{-1}. The variance in fish size did not decrease during winter. Taken together, these results indicate that overwinter mortality can be substantial and variable in juvenile salmon, but that it is size-independent, at least, for this population.

Doc. 1427 **Relating spatial and temporal scales of climate and ocean variability to survival of Pacific Northwest Chinook salmon**

Luis A. Vélez-Espino, Rishi Sharma, Alex C. Wertheimer, Nathan Manuta, and Robert C. Francis

Pacific Northwest Chinook, *Oncorhynchus tshawytscha*, have exhibited a high degree of variability in smolt-to-adult survival over the past three decades. This variability is summarized for twenty two Pacific Northwest stocks and analyzed using Generalized Linear Modeling techniques. Results indicate that survival can be grouped into eight distinct regional clusters: (1) Alaska, Northern BC and North Georgia Strait; (2) Georgia Strait; (3) Lower Fraser River and West Coast Vancouver Island; (4) Puget Sound and Hood Canal; (5) Lower Columbia Tules; (6) Columbia Upriver Brights, Willamette and Cowlitz; (7) Oregon and Washington Coastal; and (8) Klamath River and Columbia River Summers. Further analysis for stocks within each of the eight regions indicates that local ocean conditions (particularly sea surface temperature) following the outmigration of smolts from freshwater to marine areas had a significant effect on survival for the majority of the stock groups analyzed. Our analyses of the data indicate that Pacific Northwest Chinook survival covaries on a spatial scale of 350-450 km.

Doc. 1428 **Annual survey of juvenile salmon, ecologically-related species, and biophysical factors in the marine waters of southeastern Alaska**

Joseph A. Orsi, Emily A. Fergusson, Molly V. Sturdevant, William R. Heard, and Edward V. Farley, Jr.

Juvenile Pacific salmon (*Oncorhynchus* spp.), ecologically-related species, and associated biophysical data were collected from the marine waters of the northern region of southeastern Alaska (SEAK) in 2011. This annual survey, conducted by the Southeast Coastal Monitoring (SECM) project, marks 15 consecutive years of systematically monitoring how juvenile salmon utilize marine ecosystems during a period of climate change. The survey was implemented to identify the relationships between year-class strength of juvenile salmon and biophysical parameters that influence their habitat use, marine growth, prey fields, predation, and stock interactions. This report also contrasts the 2011 findings with selected biophysical factors from the prior 14 sampling years. Thirteen stations were sampled monthly in epipelagic waters from May to August (total of 21 sampling days). Fish, zooplankton, surface water samples, and physical profile data were typically collected during daylight at each station using a surface rope trawl, Norpac and bongo nets, a water sampler, and a conductivity-temperature-depth profiler. Surface (3-m) temperatures and salinities ranged from approximately 6 to 14 ºC and 15 to 32 PSU from May to August across inshore, strait, and coastal habitats. A total of 6,640 fish and squid, representing 27 taxa, was captured in 96 rope trawl hauls fished from June to August. Juvenile salmon comprised approximately 78% of the total fish catch. Juvenile pink (*O. gorbuscha*), chum (*O. keta*), sockeye (*O. nerka*), and coho (*O. kisutch*) salmon occurred in 42-80% of the hauls by month and habitat, while juvenile Chinook salmon (*O. tshawytscha*) occurred in ≤ 17% of the hauls. Abundance of juvenile salmon was relatively low in 2011; peak CPUE in strait habitat occurred in August for all species except chum salmon (June). Coded-wire tags were recovered from 10 coho salmon and 6 Chinook salmon from hatchery and wild stocks originating in SEAK and Washington. Alaska enhanced stocks were also identified by thermal otolith marks from 60%, 21%, and 5% of chum, sockeye, and coho salmon examined, respectively. Predation on juvenile salmon was observed in three of nine species examined. Biophysical measures from 2011 differed from prior years, in many respects. Compared to the 15-yr long term mean values, temperature anomalies were negative, salinity anomalies were positive, zooplankton density was low, and condition residuals were negative for juvenile pink, chum, and sockeye salmon. The SECM juvenile salmon stock assessment and biophysical data are used in conjunction with basin-scale biophysical data to forecast pink salmon harvest in SEAK. Long term seasonal monitoring of key stocks of juvenile salmon and associated ecologically-related species, including fish predators and prey, permits researchers to understand how growth, abundance, and interactions affect year-class strength of salmon during climate change in marine ecosystems.

Doc. 1429 **Temporal growth patterns of Big Qualicum River chum salmon *(Oncorhynchus keta)* in the North Pacific Ocean**

G. Oka, J.R. Irvine, C. Holt, M. Trudel, S. Tucker, D. Gillespie, and L. Fitzpatrick

Increases in salmon abundance in the Pacific Ocean over the past three to four decades have been attributed to favourable environmental conditions and enhanced hatchery production. However, the effects of inter- and intra- species competition for food resources in the ocean remains inconclusive. Chum salmon (*Oncorhynchus keta)* are of particular interest because of the large numbers of hatchery releases and some evidence of density dependence. Scales from Big Qualicum River chum salmon gathered during 1971-2010 were examined to evaluate marine growth during this period. A consistent temporal trend was observed for all growth years for the dominant age classes of chum salmon; growth was most rapid in the early 1980s and 2000s and slowest in years centered around 1990. Future work to continue statistical analysis of these data and examine temporal patterns in growth of other populations and species is recommended.

Doc. 1430 **Biostatistical information on salmon catches, escapement and enhancement production in Russia in 2011**

Pacific Research Fisheries Centre (TINRO-centre) and Russian Federal Research Institute of Fisheries and Oceanography (VNIRO)

Commercial, subsistence, and sport catch statistics, escapement of adult salmon, and fry releases from hatcheries in 2011 are summarized by species, and region. In total, 502,992.25 tonnes of salmon was caught in commercial fisheries in Russia in 2011. Most of the catch comprised pink (77%) chum (16%), sockeye (6%), and coho (1%) salmon by weight. Hatchery releases of salmon fry numbered 935,230.60 thousand fish. Most of the hatchery releases were chum (62%), pink (36%), and sockeye (2%) salmon.

Doc. 1431 **Salmon assessment and monitoring in British Columbia and Yukon**

A. Tompkins, N. Komick, and M. Thiess

The purpose of salmon stock assessment is to provide the information on stock status, trends and productivity needed to inform and guide management of salmon fisheries. Understanding the status of salmon stocks and the factors (e.g. climate) influencing Pacific salmon production requires long-term monitoring of biological data. Stock assessment data are required to address issues related to conservation, fisheries management, biodiversity, fish habitat, and the effects of climate change. Stock assessment research conducted by Canadian Department of Fisheries and Oceans Pacific Region includes freshwater sampling activities to determine abundance of returning adults and juvenile production and marine sampling activities to determine stock composition of catch.

Doc. 1432 **Canadian bibliography of 2010-2012 publication linked to the current NPAFC Science Plan**

J.R. Irvine, T. Beacham, M. Trudel, A. Tompkins, and M. Saunders

The current bibliography lists publications in primary scientific journals and other documents published during 2010-2012 by Fisheries and Oceans Canada scientists and their collaborators relevant to the 2011-2015 NPAFC Science Plan. The bibliography lists 79 papers with abstracts, corresponding to the five key research components of the NPAFC Science Plan.