

NEWSLETTER OF THE NORTH PACIFIC ANADROMOUS FISH COMMISSION

NEW YEAR'S MESSAGE FROM THE PRESIDENT

I was honored very much to assume the presidency of the NPAFC at the 16th Annual Meeting last November in Seattle (USA), as the successor to Dr. D. Koo of Republic of Korea, and it is my great pleasure to say "A Happy New Year" to all in our NPAFC family.

The NPAFC has conducted its role beautifully in the NPAFC Convention Area for the last 16 years. Our philosophy of "mutual respect and trust of the researchers from the member nations" stated by Fran Ulmer has been nicely maintained, and our ambition to keep healthy salmon population in the North Pacific was successfully achieved. For example, member nations completed a 5-year joint research program (BASIS-I) successfully in 2006, and the total catch of Pacific salmon was the highest on record in 2007 – more than 1 million metric tonnes.

As we all know, the earth system has been changing rapidly since the latter part of the last century. Climate change induced by enhanced greenhouse gases influences on the natural ecosystems as well as human social structure including the fisheries economy. Therefore a proper and efficient fisheries management requires knowledge-based policy with precautionary concept. Our Commission for salmon management, in this regard, has had a great success, and has become one of the model fisheries organizations in the world. I am sure that the NPAFC is a well-balanced organization in science, enforcement, and international collaboration. Since I was elected as the President in November, however, I frequently asked myself what efforts the NPAFC can pursue more for better management of Pacific salmon in the future.

Especially, our efforts to eliminate illegal, unreported, and unregulated (IUU) fisheries would be the basis for ensuring sustainable fishery in the North Pacific. Furthermore, newly developing technologies such as satellite tracking buoys and the Integrated Information System (IIS) will improve ghost fishing characteristics and enforcement activities. Science has also made great progress. Internal collaboration within the NPAFC nations

conducted the BASIS-I research to clarify the mechanisms of ecological responses by salmon since 2002, and, based on results from the first phase, scientists are now planning the second phase of the BASIS. A grant award from the Moore Foundation was given to our Commission last year, enabling our scientists to set-up long-term research and monitoring plan for Pacific salmon, especially focusing on climate change effects. Also, in order to draw ordinary people's and policy makers' attention, some people in our Commission are considering the establishment of "The International Year of Salmon" in the near future. Out-reach and education will be one of the most important activities of the NPAFC.

Pacific salmon are very precious animal. However, the most important resource would be the young generations who have affection for salmon. Capacity building might be the critical issue determining the NPAFC's destiny. The CSRS Chair, Dr. Yukimasa Ishida, summarized the age distribution of presenters during the BASIS Symposium held in Seattle last November. It shows an increased number of young scientists and an even distribution of age groups in the 30s, 40s and 50s. This is a very good sign for Commission's future. Furthermore, the Secretariat plans to hire an NPAFC intern from this year, which will foster experienced young people for NPAFC. I hope our endeavor to train/support young salmon experts will continue and be expanded in every business of the NPAFC.

Finally, I would like to express my sincere thanks to other international organizations such as PICES, ICES, NASCO, NPCGF and WCPFC. They are our regional or thematic partners, and the purposes of our and their Commissions would be achieved more easily and efficiently through the international collaboration. Again, I wish all of you a Happy New Year, and look forward to meeting you and representatives from other international organizations at the coming Annual Meeting in Niigata, Japan, next November.



Suam Kim
NPAFC President

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An electronic edition is available at the NPAFC website: www.npafc.org



CSRS Summary from the 2008 Annual Meeting

The Committee on Scientific Research and Statistics (CSRS) met on November 17-20, 2008, in Seattle, U.S.A. The group, including 58 participants from the five member countries was welcomed to the Seattle Convention Center by the host country, U.S.A. A total of 51 scientific documents were submitted to the Commission. The documents are available from the NPAFC website (www.npafc.org).

The Science Sub-Committee (SSC) summarized the progress on the development of the Long-Term Research and Monitoring Program funded by the Moore Foundation. The final reports are due in August 2009. There has been excellent cooperation and strong support for the project among all countries. Regarding proposed 2011 symposium to be held jointly with NASCO, it was agreed that a detailed budget and location should be proposed by NASCO for the discussion at the next RPCM in April 2009.

The Working Group on Stock Assessment confirmed that preliminary 2007 commercial catch from the North Pacific were at the highest level on record, exceeding one million tonnes. Pink and chum salmon constituted the majority of the catch (51 and 31% by weight respectively), sockeye salmon were 16%, while coho and chinook salmon were 2% and 1% respectively. Largest catches were reported by Alaska (430 thousand tonnes), Russia (349 thousand tonnes), and Japan (221 thousand tonnes).

The Working Group on Salmon Marking reported that the number of otolith marked salmon released from Pacific Rim hatcheries was 1.61 billion in 2007 and 1.55 billion in 2008. The otolith mark release information is available from the Working Group website (<http://npafc.taglab.org/>). All countries have submitted their mark plans in 2008. There were no mark duplications among countries for all species. It was noted that 83 unique marks are applied to chum salmon in 2008. The Working Group reviewed use of the otolith marks assigned to countries for pink, chum, and sockeye salmon. There has been good compliance with the intended country codes, and this document will be used for selection of otolith marks.

The *ad hoc* Working Group on Stock Identification evaluated current status of genetic baselines of Pacific salmon. Russia has been conducting scale pattern analyses on sockeye, chum, and Chinook salmon and is also working on genetic databases for sockeye salmon. Canada reported on its extensive baselines for

microsatellites with between 40,000 and 70,000 individuals for the five main species. The major efforts for Japan are focused on conducting genetic stock identification projects for chum salmon in the Bering Sea and North Pacific Ocean. The United States is conducting multiple genetic stock identification projects on domestic fisheries for sockeye, chum, Chinook and coho salmon.

The BASIS Working Group discussed the review process of manuscripts for the proceedings of BASIS Symposium. The Working Group has decided to complete developing the final plan for BASIS Phase II at the 2009 RPCM.

The Salmon Tagging Working Group reviewed tagging activities in 2008. The new NPAFC tag and poster have been produced. A total of 1,598 salmonids were tagged and released in the North Pacific Ocean and Bering Sea in 2008. In 2007 and 2008, high seas tags were recovered from seven chum in Japan, seven sockeye in the US, and nine pink, one coho, and five chum salmon in Russia. A reward draw, future tagging activities, database management, and other items were discussed.

The North Pacific Marine Science Organization (PICES) invited NPAFC to: 1) participate in the development of the second PICES North Pacific Ecosystem Status Report; 2) contribute to the salmon research component of the new PICES integrative scientific program, called FUTURE (Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems); and 3) co-sponsor the international symposium on "Forecasting Climate Change Impacts on Fish and Shellfish" to be held in spring 2010. It was agreed the co-sponsorship of symposium, and the chair of SSC, R. Beamish, would represent our Commission on the steering committee.

The spring RPCM will be held in April 2009 in Yuzhno-Sakhalinsk, Russia.



Yukimasa Ishida
CSRS Chairperson

ENFO Summary from the 2008 Annual Meeting

The Committee on Enforcement (ENFO) convened on November 17, 2008, in Seattle, WA, U.S.A. For the first time one non-government observer was present.

Participants reviewed the 2008 enforcement activities and planned enforcement activities for 2009. In 2008 the Parties conducted a total of 118 ship patrol days and 371 aerial patrol hours in the Convention Area. Eleven high-seas drift net (HSDN) vessels were sighted of which, two were apprehended. One of the vessels arrested was fined approximately \$7,000US. The catch was also seized and sold, and the vessels were seized and auctioned off with the nets and other gear being destroyed.

The United States Coast Guard (USCG) conducted an international right of approach on another two vessels which were believed to be Indonesian registered. Parties continue to improve and increase combined operations involving aircraft, vessels and personnel from all member countries.

Canada employed Radarsat II (a recently launched earth surveillance satellite) on an experimental basis within the NPAFC Convention Area to assist with locating vessel concentrations and monitoring areas which were not being flown by the CP 140 aircraft.

Taiwanese observers reported that they conducted 168 patrol days in the Convention Area and observed two HSDN rigid vessels. This information was passed to NPAFC at the time of the sightings.

For 2009 ENFO members plan on similar effort as was expended in 2008. ENFO members will be coordinating 2009 patrols between surface and air assets in an attempt to maximize efforts and to ensure the capability of apprehending HSDN vessels sighted by the aircraft. This coordination will take place at the 2009 EECM.



NOAA satellite buoy used for tracking marine debris such as ghost drift nets



2008 NPAFC Annual Meeting, 1st Plenary

The ENFO Chairman briefly described the discussions at the EECM and North Pacific IUU Tripartite Meeting held in Vancouver, Canada, February 27-29, 2008.

Russia presented an updated detailed report on the Integrated Information System (IIS) website and identified a need for more frequent input from administrators to keep IIS moving forward.

The United States briefed ENFO on NOAA funded satellite tracking buoys which are intended to be deployed on any significant debris for tracking purposes (see picture on the left). This is part of the US ghost fishing initiative to clean up the North Pacific Ocean. A sample of the satellite tracking buoy was presented to the committee. During the 2008 enforcement season, the USCG cutter *MUNRO* had taken multiple buoys on board but was unable to locate any unattended nets in the Convention Area, and therefore, did not have an opportunity to deploy any of the buoys. NOAA currently has five buoys available for use and the US requested Parties to deploy them using their patrol vessels or even their research vessels. The Chairman encouraged the Parties to participate as ghost nets continue to entangle fish and sea birds in the ocean.

The next EECM will be held in Fukuoka, Japan on February 23-25, 2009 with an enforcement workshop. The main objectives of the EECM will be to finalize the detailed patrol schedule for 2009, to explore cooperative patrol opportunities, to discuss the threat assessment for illegal fishing for salmon by HSDN and to share and learn from previous years' experiences.

For the enforcement workshop, each Party was invited to bring hands-on officers to give presentations on how the patrols are conducted, problems encountered and lessons learned in an attempt to improve our abilities to detect, deter and detain vessels participating in IUU fishing.

In 2008, the Secretariat attended the North Pacific Coast Guard meeting in Seattle, U.S.A. on behalf of NPAFC, and although not a formal representative of NPAFC, the ENFO chair attended both the North Pacific Coast Guard Forum (NPCGF) and the Western Central Pacific Fish Commission (WCPFC) on behalf of the Government of Canada and kept the interests of NPAFC in mind.

The ENFO chair noted that the WCPFC had expressed an interest in NPAFC activities; WCPFC has approved boarding and inspection guidelines and is currently reviewing a conservation management measure which supports NPAFC activities in the North Pacific. The combination of WCPFC boarding and inspection guidelines and the conservation and management measure may provide another tool to detect and deter IUU fishing. NPAFC approved participation of a representative of NPAFC ENFO or the Secretariat at the WCPFC and NPCGF meetings on a regular basis upon formal invitations received from these organizations.



Robert Martinolich
ENFO Chairperson

NPAFC International Symposium on Bering-Aleutian Salmon International Survey (BASIS):

Climate Change, Production Trends and Carrying Capacity of Pacific Salmon in the Bering Sea and Adjacent Waters

November 23-25, 2008

Sheraton Seattle Hotel, Seattle, WA, U.S.A.

Dramatic fluctuations in the ocean growth and survival of many Asian and North American salmon populations over the past decade have been attributed to changes in the Bering Sea and other marine ecosystems. The absence of scientific observations for salmon, ecologically related species, and environmental conditions in the North Pacific Ocean has limited our understanding of these changes and how they affect salmon populations and economies around the Pacific Rim. International research efforts to address these issues were developed by the NPAFC, as part of its Science Plan. The research plan called BASIS (the Bering-Aleutian Salmon International Survey), began in 2002 as a coordinated program of cooperative research on Pacific salmon in the Bering Sea. The goal of BASIS research was to clarify the mechanisms of biological response by salmon to the conditions caused by climate change in the Bering Sea.

The symposium was held November 23 – 25, 2008, in the Sheraton Hotel in downtown Seattle, Washington. E. Farley chaired a steering committee consisting of: T. Azumaya, R. Beamish, K.B. Seong, V. Sviridov, and S. Urawa. During the symposium, NPAFC commemorated the efforts from research and contract vessels: *Kaiyo maru* and *Wakatake maru* (Japan), *TINRO* (Russia), and *Sea Storm* and *Northwest Explorer* (USA) for their expertise and support in conducting BASIS research surveys.

There were three main topics: 1) Overviews of climate change, Bering Sea ecosystems, and salmon production; 2) biological responses by salmon to climate and ecosystem dynamics; and 3) discussion and summary on BASIS 2002 – 2006: where do we go from here? There were 42 oral and 30 poster presentations. All presentations were in English. It was evident that the Arctic is warming and that sea ice extent is declining (Fig. 1).

N. Bond showed that climate warming will increase water column stability on the eastern Bering Sea shelf, limiting the flux of nutrients into the photic zone and perhaps negatively impacting primary and secondary productivity. O. Temnykh suggested that climate warming will not impact carrying capacity for salmon in the western Bering Sea and that current models indicate that the carrying capacity for salmon in the Bering Sea is much higher than present abundance levels. G. Ruggerone presented a different view on carrying capacity, suggesting that the large increase in the abundance of hatchery salmon impacted wild salmon stocks by limiting growth via density-dependent processes in the ocean, increasing their mortality rates. K. Myers reviewed BASIS data and revealed new migrations models for salmon, some which indicate varying migration pathways depending on whether sea surface temperatures are warm or cold.

M. Kaeriyama showed prediction models for the impact of global warming on the ecosystems of the North Pacific Ocean and concluded that: 1) global warming will decrease salmon carrying capacity by reducing their preferred ocean habitat; 2) increase density-dependent effects on growth of salmon thus potentially reducing their marine survival; and 3) Hokkaido chum salmon will no longer migrate to the Sea of Okhotsk, an important rearing region for



Dr. J. Helle, the former BASIS Working Group Chairperson, introduced the BASIS program.



Mr. J. Downing (right), the owner of F/V *Northwest Explorer*, got a commemorative plaque from the NPAFC Executive Director V. Fedorenko. Five research vessels were commended for their expertise and support in conducting BASIS researches.



Approximately 130 people attended the 3-day symposium at the Sheraton Seattle Hotel.



In addition to 42 oral presentations, 30 significant posters were presented during the symposium.



Fig. 1. Annual September sea ice extent in the Arctic. Courtesy of NASA http://www.nasa.gov/vision/earth/environment/arctic_minimum.html.

juvenile chum salmon. H. Seo revealed that climate change would likely impact survival of Asian chum salmon during their first year at sea.

Well-researched papers on the migration and distribution of Pacific salmon were presented by A. Bugaev, T. Nagasawa, J. Seeb, J. Murphy, C. Habicht, S. Urawa, T. Beacham, M.H. Kang, R. Walker, and J. Irvine. Most of these presenters provided stock-specific information on salmon distribution using genetic stock identification techniques. T. Nagasawa (for T. Azumaya) presented a fish bioenergetic model that suggested carrying capacity for salmon distributed in the Bering Sea is not limited during summer, but is limited for salmon distributed in the North Pacific Ocean during winter and spring.

Climate cycles are embedded in the climate trends. For instance, our Russian colleagues have shown that shifts in the position the Far Eastern Low and Aleutian Low pressure systems determine whether or not the Bering Sea experiences warming or cooling and also affect velocity of ocean currents. The position of these atmospheric low pressure systems (NE and W respectively) during 2002 to 2005 brought warmer air to the Bering Sea during winter and was related to decreased storm activity during summer. The position of these low pressure systems shifted again (SW and E respectively) during 2006; as a result, colder arctic air covered much of the Bering Sea during winter and summer storm activity increased.

The impacts of these climate cycles (cool versus warm) on physical and biological parameters in the eastern Bering Sea were presented S. Danielson, L. Eisner, A. Andrews, J. Murphy, K. Coyle, K. Ciciel, and E. Farley. These papers suggested pelagic productivity was highest during years with warm SSTs, as abundance levels of juvenile salmon and age 0 pollock are much higher than during years with cool SSTs. However, the zooplankton community shifted from large to small taxa during warm SSTs years, altering energy transfer to pelagic fish and negatively impacting fish energy density prior to winter. This finding may explain why recruitment of commercial fish species in the eastern Bering Sea was low during warm SST years, as fish with low energy reserves prior to winter would be expected to have higher mortality during winter.

Within the western Bering Sea, climate cycles of warm and cool also resulted in shifting food webs and abundance of pelagic consumers. S. Naydenko showed that juvenile walleye pollock consumed a large portion of the forage resource during 2002 and

2003 and Pacific salmon, squids, Atka mackerel, herring, and capelin were the dominate consumers of the available forage during 2004 to 2006. S. Naydenko (for A. Volkov) noted that copepods dominated the zooplankton biomass in the western Bering Sea during 2006, whereas euphausiids and hyperiids dominated the zooplankton biomass during 2003 and 2005. M. Koval connected 11 year cyclic solar activity to shifts in biomass of dominant pelagic fish species in the western Bering Sea (between salmon and Atka mackerel to walleye Pollock).

E. Martinson, J. Helle, and G. Ruggerone showed how salmon scale pattern analyses, where long time series of scale collections are available for salmon populations, can be used to reveal possible impacts of climate change to salmon marine growth. B. Beckman and T. Kaga described methods to measure salmon fitness in connection with recruitment success and monitoring the impact of climate variation on salmon health.

There was a lively discussion at the end of the meeting regarding future research for BASIS and a resounding commitment to continue this vital research by Parties within NPAFC. C. Pautzke, the Executive Director of the North Pacific Research Board (NPRB), suggested NPAFC researches keep NPRB in mind for funding research during the 2nd phase of the “Bering Sea Integrated Ecosystem Research Program” that would likely occur several years from now. There was a general sense of satisfaction knowing that BASIS research captured the response of the Bering Sea pelagic ecosystem to cyclic patterns in climate. There was no question that the North Pacific Anadromous Fish Commission, BASIS research strengthened our knowledge of the effects of climate variation on pelagic ecosystems of the Bering Sea. This research also fostered unprecedented cooperation among NPAFC Parties and is a model for future collaborative research efforts in the North Pacific Ocean.



Ed Farley
BASIS Symposium
Steering Committee Chairperson

Report from the Ad Hoc Working Group on Stock Identification



The total biomass of Pacific salmon has shown significant fluctuations over the last decades, and the pattern of these fluctuations differs among species as well as local stocks. Recent attention has focused on climate change and how the ocean environment and variable marine ecosystems affect these fluctuations and the abundance and distribution of salmon stocks. Information on the oceanic migration pattern and marine survival of individual stocks is essential for understanding the population dynamics of these species.

Stock-specific biological information has been provided by various stock identification techniques including tags, parasites, scale patterns, and genetic marks. In 2000, the North Pacific Anadromous Fish Commission established an *ad hoc* Working Group on Stock Identification with the intent to: 1) develop, standardize, and disseminate genetic and other databases among the Parties; 2) encourage the development of new genetic technologies; and 3) facilitate the dissemination of statistical techniques. The focus of the working group has been on the various types of genetic markers as genetic stock identification studies have become a central part of NPAFC research activities supporting BASIS and other programs across the Pacific Rim.

Genetic analyses of salmon in international waters require large, comprehensive datasets of genetic information developed cooperatively by multiple parties across international boundaries. Multi-party, multi-national datasets require robust methods that are both transparent and transportable because all NPAFC Parties are contributing to a common set of data that can be accessed

and used by each for analyses. Initially, protein or allozyme marker were used, but they are now rapidly being replaced by DNA markers such as microsatellites, and, more recently, single nucleotide polymorphisms (SNPs).

However, the large data set of allozyme allele frequencies from chum salmon originating from the Pacific Rim has been widely used by multiple research laboratories. Most recently, the database has been used by NPAFC scientists to track the stock-specific migration of chum salmon in the North Pacific Ocean and Bering Sea (Fig. 1).

Concurrently with the application of the allozyme databases, genetic markers based on DNA fragment variation (e.g. microsatellites) were shared among the NPAFC Parties. Although more difficult to transfer between laboratories than many other genetic markers, large databases exist for microsatellites across the Pacific Rim. Canadian researchers at the Department of Fisheries and Oceans have developed extensive microsatellites baselines with greater than 40,000 individuals for the five main species. They have shared these databases with other NPAFC Parties for collaborative stock identification research projects.

Recent efforts in United States and Japan have centered on developing DNA databases using single nucleotide polymorphism (SNPs). SNPs are assayed through high-throughput technologies and are particularly appropriate for NPAFC applications (Fig. 2). Unlike marker types based on fragment size, SNPs are based on the actual DNA sequence and require relatively little inter-laboratory standardization. SNP data can be easily transferred

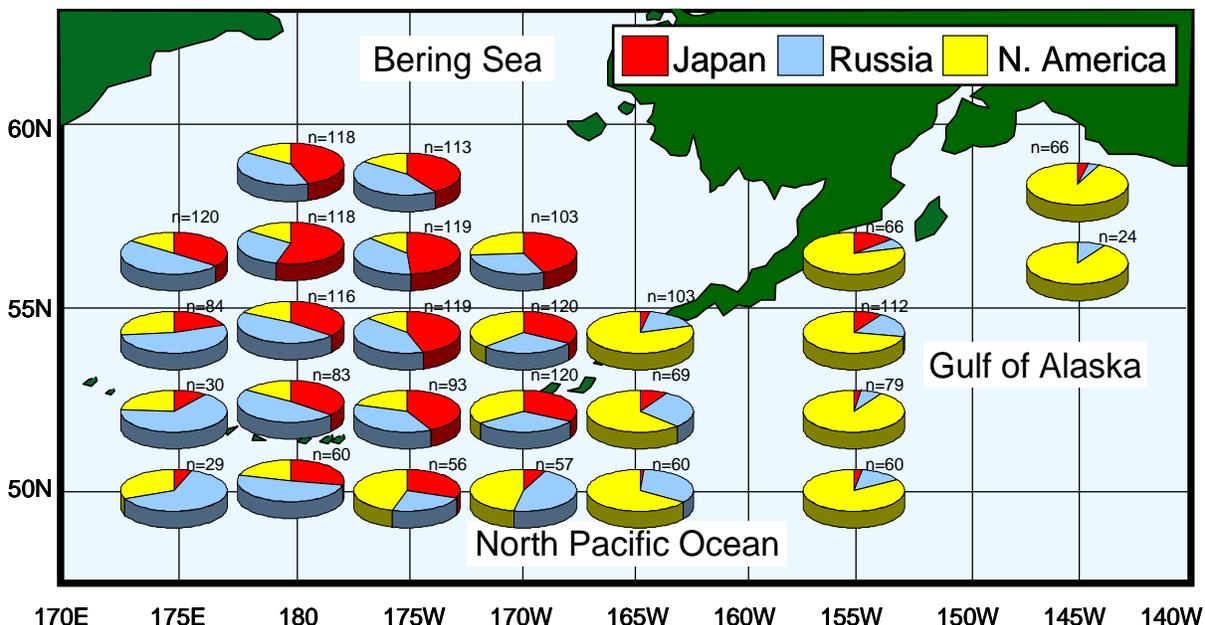


Fig. 1. The stock composition of immature chum salmon in the Bering Sea and North Pacific Ocean, estimated by 20 allozyme loci (Urawa et al. 2005. NPAFC Doc. 896).

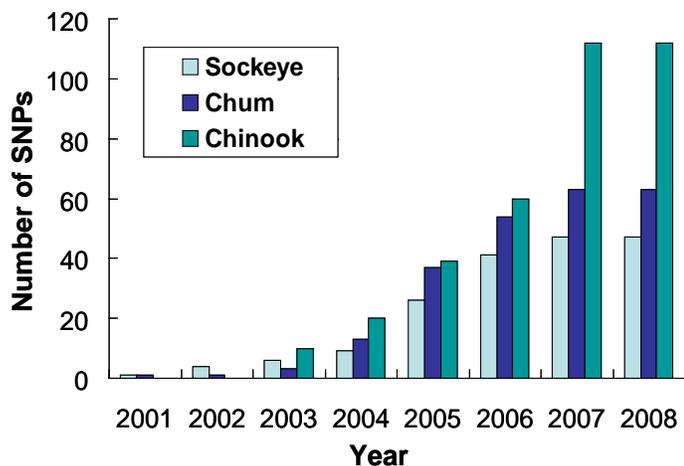


Fig. 2. Annual changes in number of SNPs found in sockeye, chum and Chinook salmon.

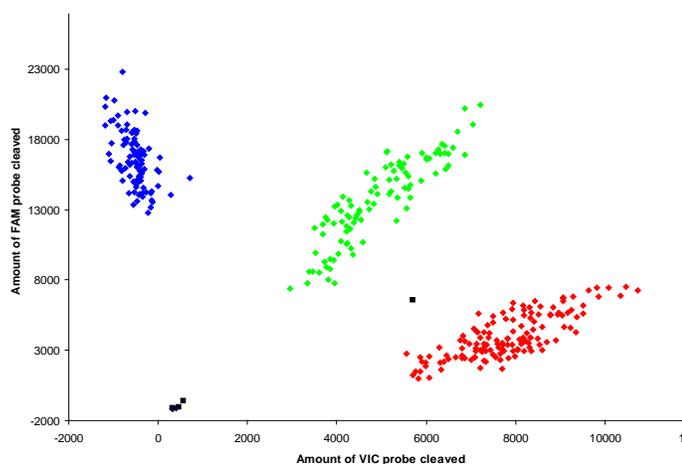


Fig. 3. Scatter plot of 380 individuals assayed for an A/T SNP. Units on the Y axis are fluorescence probes designed to detect the A allele; units on the X axis are fluorescence of the probes designed to detect the T allele. Four no-template controls cluster near the origin on the bottom left. AA homozygotes cluster on the Y axis and TT homozygotes cluster on the X axis. Heterozygotes (green) are intermediate.

between laboratories and instrument platforms (Fig. 3). United States and Japanese researchers met at the National Salmon Resources Center in Sapporo, Japan, for a 2-day meeting, October 15-16, 2008, hosted by the University of Washington with a grant from the Moore Foundation (Fig. 4). The goal of the meeting was to discuss progress and development of a shared database for chum salmon. The participants informally adopted the name



Fig. 4. Eleven scientists and students from Japan, Korea, and United States participated in the PacSNP meeting in Sapporo, Japan. (from left to right: (front row) K. Warheit, J.-N. Yu, J. Stevens, and N. Azuma; (back row) S. Abe, Y. Kogura, B. Templin, J. Seeb, L. Seeb, S. Sato, and S. Urawa)

PacSNP for the initiative. Following the meeting in Sapporo, graduate students and researchers from Russia, Korea, and Japan visited the University of Washington in Seattle for one to two weeks of hands-on training in SNP discovery and genotyping. Work on other SNP databases are progressing on both sockeye and Chinook salmon lead by efforts at Alaska Department of Fish and Game.

Within the next year, the *ad hoc* Stock Identification Working Group anticipates continuing research and development of DNA-level databases and markers in all species. Easily accessible on-line databases to archive and disseminate the data are also a high priority for future efforts to support these highly valuable multi-party, multi-national datasets.



Lisa Seeb
Ad Hoc Working Group on
Stock Identification
Chairperson

SUAM KIM — REPRESENTATIVE OF KOREA



Dr. Suam Kim received his B.Sc. (1976) and M.Sc. (1979) in Oceanography from Seoul National University and Ph.D. in Fisheries Oceanography from the University of Washington in 1987. Currently, he is a Professor of Pukyong National University, Busan, Korea. His areas of interest include fisheries ecology, especially recruitment variability focusing on early life histories of fish in relation to oceanic/climate changes. Suam represented Korea on several international organizations/programs such as: PICES, GLOBEC, CCAMLR, IGBP and SCAR. Currently, he serves in a new PICES/ICES Working Group on Forecasting Climate Change Impacts on Fish and Shellfish (WG-FCCIFS) as a Co-chair, and Korea-SCOR Committee as a Chair.

UPCOMING EVENTS

Enforcement Evaluation and Coordination Meeting (EECM) and ENFO Workshop

Fukuoka Convention Center
Fukuoka, Kyushu, Japan: February 23-25, 2009

Research Planning and Coordinating Meeting (RPCM)

Sakhalin Convention Center
Yuzhno-Sakhalinsk, Russia: April 21-23, 2009

NPAFC 17th Annual Meeting

Toki Messe Niigata Convention Center
Niigata, Japan: November 2-6, 2009



Fukuoka



Yuzhno-Sakhalinsk



Toki Messe, Niigata

PUBLICATION

NPAFC Annual Report 2008 including results of the Commission's major activities such as Annual Meeting, symposium, workshop and other NPAFC events, will be available on CD and online in the early summer of 2009.

RECIPE FROM OUR PEOPLE

Russian Salmon Recipe



A whole salmon is filleted and baked with sour cream, fresh tomatoes, onion, salt, black pepper and bay leaves. Sockeye and masu salmon are most suitable for the recipe.



Two recipes in one. The right side is called "Smetana" prepared with sour cream, and the other side is with tomatoes and onions. Visit www.npafc.org/new/recipes for details.

Victor Nazarov
TINRO-Center

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Visit the NPAFC website: <http://www.npafc.org> for more information on events, publications, scientific documents, and salmon catch statistics.

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