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## Workshop Review

The Bering-Aleutian Salmon International Survey (BASIS) was “born” in 2000, when then Lieutenant Governor of Alaska Fran Ulmer was President of the North Pacific Anadromous Fish Commission (NPAFC). In fact, it was President Ulmer who proposed that the NPAFC Parties initiate a large-scale collaborative research effort in the Bering Sea to learn the causes of declining abundance of salmon returns to Japan, Russia, and western Alaska. As the “mother” of BASIS, the Organizing Committee’s decision to invite her to present a keynote address at the 2004 BASIS Workshop in Sapporo was very appropriate. Her presentation focused on the reasons why BASIS “is greater than just the sum of its parts”. She stated that with recent publications by the U.S. Commission on Ocean Policy and the Pew Oceans Commission on the status of the world’s oceans, that “the remarkable level of collaboration and cooperation” exhibited by BASIS “is now more than ever” highly pertinent. Understanding changes in the Bering Sea, as well as understanding changes in the rest of the world’s oceans, will require international scientific collaboration. In her concluding remarks, she encouraged workshop participants to educate “policy makers, regulators, fishermen, community leaders, university faculty, foundation and grant giving organizations and media representatives” about BASIS.

The second keynote address by Vyacheslav Shuntov and Olga Temnykh, TINRO-Centre, and presented by Dr. Temnykh discussed the status of Pacific salmon in North Pacific pelagic communities. Dr. Shuntov and his colleagues from the Laboratory of Applied Biocenology at TINRO-Centre have been involved in North Pacific marine ecosystem research for more than 20 years. Drs. Shuntov and Temnykh reviewed scientific data in support of their hypothesis that salmon abundance is currently “below the North Pacific carrying capacity, and that salmon do not overpopulate epipelagic ecosystems”. In spite of changes in various components of the zooplankton community, their research indicates that salmon in the western Bering Sea, especially pink and chum salmon, have fared well over the long term due to their high plasticity of food habits.

Following the keynote addresses, national overviews of BASIS research were presented by Japan, Russia, and the United States. As part of the BASIS Science Plan, synoptic research vessel surveys of the entire Bering Sea were implemented by the national Parties of NPAFC in 2002 by using a Russian vessel to survey the western Bering Sea, a Japanese vessel to survey the central Bering Sea, and U.S. vessels to survey the eastern Bering Sea in summer-fall seasons. Surveys by all three countries are ecosystem studies that include salmon and forage fish, plankton, and oceanographic observations.

Japan has a long history of salmon research on the high seas that started in 1952. Toru Nagasawa, Hokkaido National Fisheries Research Institute, analyzed Japanese salmon research vessel data from 1972-2000 and compared these observations with the results of recent BASIS surveys. An important conclusion from his presentation is that winter and spring surveys need to be added to the BASIS program.

Olga Temnykh reviewed the history of marine salmon investigations by Russia in the western Bering Sea. In the 1970s KamchatNIRO started intensive studies on salmon in estuaries and on the western Bering Sea shelf. In the early 1980s they introduced surface trawling in their research, and in 1986 these studies were expanded into larger ecosystem studies by TINRO-Centre in Vladivostok. Comparative assessments of epipelagic nekton and plankton biomass in relation to abundance of salmon from these earlier studies were contrasted with the results of BASIS surveys.

Jack Helle, Auke Bay Laboratory, provided an overview of U.S. BASIS research. The United States initiated small scale studies on juvenile sockeye salmon in the eastern Bering Sea in 1966–1972. More comprehensive research was begun in 1999 on sockeye salmon in Bristol Bay, and this research was expanded into the BASIS program in 2002 to include all species of Pacific salmon in the eastern Bering Sea. Dr. Helle also provided an update on recent climate change in the Bering Sea ecosystem, and concluded that “the success of BASIS at a time of major ecological change suggests that BASIS should be extended beyond 2006”.

The results of BASIS oceanographic and primary production research were presented by Lisa Eisner (Auke Bay Laboratory), Akira Kusaka (Hokkaido National Fisheries Research Institute), and Gennady Khen (TINRO-Centre). Comprehensive studies include observations on ocean temperature, salinity, currents, stratification, frontal boundaries, nutrients, and phytoplankton and zooplankton biomass and taxonomy. These oceanographic variables

are being monitored for yearly and long-term changes and compared to salmon distribution and abundance. Dr. Kusaka noted there have been few surveys such as BASIS that provide comprehensive hydrographical observations over large areas of the Western Aleutian Basin, and these data can be used “to estimate the thermohaline and flow structures that influence salmon migrations and distributions”. Dr. Khen reported that “BASIS investigations (2002–2003) have coincided with warming and intensification of water exchange between the Pacific and the Bering Sea”—a fact that has important implications for salmon production. Dr. Eisner concluded that in the eastern Bering Sea “the higher temperatures and lack of extensive coccolithophores blooms may have contributed to higher juvenile sockeye salmon survival during 2002 and 2003”.

Food habits of salmon in the Bering Sea have been studied by Japan, Russia, and the United States for many years; and the coordinated research on food habits within BASIS has resulted in a wealth of additional data. Nancy Davis, University of Washington, reviewed the scientific literature (1960–present) on Bering Sea salmon food habits studies, which provide substantial information on salmon prey, diet overlap, ration, and bioenergetics that is useful to BASIS investigators. An important conclusion by Anatoly Volkov, TINRO-Centre, who analysed 2003 BASIS samples collected aboard Russian, Japanese, and U.S. vessels, is that daytime plankton and food habits data are not sufficient to estimate the quantity of many prey species (e.g., euphausiids, mysids and some species of copepod) in the diets of salmon and other nekton. Clearly, more research needs to be done on diel feeding habits, as salmon frequently make deep dives during the day and stay near the surface at night. Are salmon feeding during these deep dives or conserving energy in the colder deep water? Masahide Kaeriyama, Hokkaido Tokai University, recommended “seasonal basin-scale process studies to investigate the effects of climate-induced changes in feeding conditions (especially prey composition and availability) and density-dependent interactions among species, size, age, and maturity groups, and stocks of salmon that migrate between the Bering Sea and Gulf of Alaska”. BASIS is also providing valuable new information on trophic interactions between salmon and other pelagic species. Naoki Tanimata suggested that “more research is needed to better understand the role of northern lampfish (*Stenobranchius leucopsarus*), which is one of the most abundant species in the Bering Sea pelagic ecosystem, especially regarding its role as a potential competitor with salmon”.

One important objective of BASIS research is to gain a better understanding of the distribution and migration patterns of Asian and North American salmon stocks in the Bering Sea, and their relation to the Bering Sea ecosystem. Robert Walker, University of Washington, reviewed new information from archival tagging studies of the depth and temperature distribution of salmon in the Bering Sea. Each salmon species appears to have characteristic patterns of diurnal vertical migration, and as individual fish migrate through different water masses they appear to be “choosing maximum depths and not temperature ranges”. New advances in genetic stock identification techniques are rapidly improving our ability to accurately identify the geographic region or river of origin of salmon caught at sea. Chris Habicht, Alaska Department of Fish and Game, provided significant new information on the migration patterns of sockeye salmon stocks in the Bering Sea, as determined by analysis of 2002-2003 BASIS samples with a DNA (microsatellite and single nucleotide polymorphism) baseline. The results show intermingling of immature Russian and Alaskan sockeye salmon in the western and central Bering Sea in August-October. In addition, Hiroshi Ueda, Hokkaido University, summarized his groundbreaking research results and future projects on mechanisms of homing migration in Japanese chum salmon at sea.

BASIS research on growth and energetics of salmon is improving our ability to detect changes in the Bering Sea ecosystem and to predict the effects of these changes on marine survival and density-dependent growth of salmon. Ed Farley, Auke Bay Laboratory, is using BASIS data to test relationships between early marine growth of juvenile Bristol Bay sockeye salmon, ocean conditions, and subsequent marine survival. He speculated that large body sizes of juvenile sockeye salmon in the southeastern Bering Sea, since the start of BASIS research in 2002, indicate high growth rates and improved or changing ocean conditions, and that “growth of juvenile Pacific salmon may be an excellent indicator of ecosystem change”. Yukimasa Ishida, National Research Institute of Fisheries Science, concluded from a retrospective analysis of Japanese salmon research vessel data (1974–1995) that density is one of the factors influencing growth variations of juvenile and maturing pink salmon in the Bering Sea.

Standardization of BASIS data, sampling gear, and analytical methods is a critical aspect of BASIS research. Terry Beacham, Pacific Biological Station, reviewed progress on the development and testing of a Pacific Rim microsatellite DNA baseline for sockeye salmon, which has “the potential to provide accurate estimates of stock composition to quite local areas”. Jim Murphy, Auke Bay Laboratory, compared two different approaches used to estimate juvenile salmon abundance. His future work “will include selection of an optimal estimator of abundance, refining abundance estimates by freshwater age and stock structure, and comparisons with adult returns”. Vladimir Karpenko, KamchatNIRO, summarized information (1981–present) on the use of trawl methods, which “fulfill

many theoretical and practical tasks associated with management of salmon stocks, including the collection of data on abundance and biological characteristics, annual assessment of distribution, migration, and foraging conditions, forecast information for commercial runs of certain stocks, and assessment of the role of juvenile salmon in coastal ecosystems”.

In addition to the 20 oral presentations reviewed above, there were 27 poster presentations pertaining to various aspects of BASIS or related research on salmon that are included as extended abstracts in this volume.

The workshop concluded with a panel discussion. Questions posed and discussed by panel members included:

1. Are the mission and objectives of BASIS clear? How well do they fit the objectives of the national programs that are currently funding BASIS?
2. What can we do to increase funding for BASIS research from the national Parties of NPAFC or from outside sources?
3. What can we do to improve BASIS research vessel cruise planning and coordination? In particular, NPAFC provides a good forum for these activities, but at present BASIS depends on a small number of people to accomplish a large amount of work.
4. What are the major problems limiting exchanges of BASIS samples and data? Would additional funding help to resolve this matter?
5. Are BASIS researchers publishing their results in the peer-reviewed scientific literature?
6. Who and what is being reported to people who make the decisions to fund research?

These questions resulted in a lively discussion among workshop participants. Policy makers in attendance described their needs for a BASIS report, written by scientists in layman’s terms, which could be used to justify and obtain more funding. In addition, BASIS scientists were encouraged to give the NPAFC’s External Funding Working Group specific proposals that identify needs and set priorities. Fund-raising methods used successfully by other organizations were discussed. It was noted that some organizations hire public relations experts to write science plans and research results in layman’s terms, as well as to print and distribute reports and brochures to potential donors. Collaboration with non-governmental salmon conservation organizations, which have large amounts of funding to synthesize, publish, and distribute data, was suggested as another possible approach.

At the time of this workshop, BASIS scientists were just completing their third season of fieldwork in the Bering Sea. The major objective of holding this BASIS workshop was to provide scientists with an opportunity to meet among themselves to discuss and evaluate their preliminary scientific results, as well as to plan future research collaboration and cooperation. Goals and objectives for future BASIS research proposed during the panel session included:

1. Evaluate interactions of hatchery and wild chum salmon in the eastern and western Bering Sea, including development of a Pacific Rim DNA baseline for chum salmon;
2. Increase oceanographic data collection, especially investigations of diurnal and vertical distribution of zooplankton and the availability and caloric content of salmon prey;
3. Continue collection of BASIS data time series;
4. Increase seasonal sampling (winter and spring);
5. Expand archival and data storage tagging efforts and improve methods of live capture;
6. Continue calibration of BASIS plankton and trawl gear;
7. Develop schemes and models reflecting the place and role of salmon in the trophic structure of the Bering Sea pelagic community and ecosystem;
8. Emphasize ecosystem research on how climate change in the Bering Sea will affect NPAFC nations and their salmon returns.

At the close of the workshop, all participants expressed their gratitude to the local organizing committee and the NPAFC Secretariat staff for their efforts that contributed greatly to the success of this workshop.

John H. (Jack) Helle – *Chair of the BASIS Working Group*  
Loh-Lee Low – *Chair of the Committee on Scientific Research and Statistics*  
Katherine W. Myers – *Member of the Workshop Organizing Committee*

