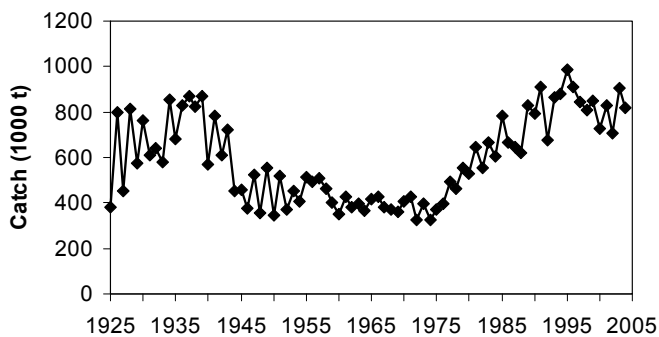


## Symposium Summary

Pacific salmon are the dominant group of fishes in the surface waters of the subarctic Pacific. Catches of Pacific salmon by all countries are also at historic levels. It is remarkable that one of the world's oldest and most important commercial fisheries is doing very well. The highest catches occurred in 1995, the second highest in 2005 (the year of the symposium) and the third highest catches were in 2003 (Fig. 1). Pacific salmon are also the indicator of the health of the ocean ecosystem that is most familiar to the general public. Ecosystem based management or the health of ecosystems has recently become a focus for most marine stewardship studies and many management agencies. Thus, it was natural that the North Pacific Marine Science Organization (PICES) with its focus on marine ecosystems and the North Pacific Anadromous Fish Commission (NPAFC) with its focus on Pacific salmon would combine efforts to assess the current status of Pacific salmon and explore the possibility that Pacific salmon provide measures of the health of large marine ecosystems.



**Fig. 1.** The total catch of all species of Pacific salmon. The largest catch in history was in 1995 with the second largest in 2003. The catches in 2005 were after the symposium.

The proceedings took a little longer than usual to be published but Bulletin No. 4 contains the most recent information and interpretations of scientists studying the marine ecology of Pacific salmon. All papers were peer-reviewed with the objective to publish new information and new interpretations. A reader will see in the papers that there is very good cooperation among the scientists.

There are three main topics in these proceedings: (1) status of Pacific salmon, trends in abundance and biological characteristics; (2) role of Pacific salmon in the function of North Pacific marine ecosystems; (3) Pacific salmon as indicators of climate variability in the North Pacific and this bulletin is organized according to these topics. The symposium was held October 30 to November 1, 2005, in the Lotte Hotel on beautiful Jeju Island, Republic of Korea. Vladimir Radchenko and Dick Beamish co-chaired the symposium.

The organization of the symposium and the setting for the meeting allowed for good discussion despite the ever-present language barriers. Vladimir Fedorenko, the NPAFC Secretariat, and Toshinori Uoya in particular, worked hard to provide a flawless organization. There is no question that this was a successful symposium, as the papers in this bulletin will confirm.

The conference opened with the message that the best time to establish international cooperative research programs to improve forecasts of Pacific salmon is now, when abundances are at historic high levels. High seas research on Pacific salmon is expensive and it makes economic sense to integrate the research conducted by the member countries of PICES and NPAFC. Most scientists agree that the current high and low abundances of Pacific salmon are associated with favourable and unfavourable ocean and climate conditions. Whole life cycle studies that combine research efforts in fresh water and the ocean can be merged with the new technologies and the existing spirit of international cooperation to identify how climate regulates recruitment. A new cooperative research approach and open and direct communication with clients and patrons should increase research funding that will result in discoveries that will provide managers with the models needed to navigate the management of Pacific salmon through the uncharted waters of a changing climate.

### Topic 1

There were 13 papers relating to the abundance and biology of Pacific salmon. It was evident that Pacific salmon in general are very healthy. Well-researched papers on the status of individual species were presented by Vladimir Radchenko, Alexander Kaev, Masa-aki Fukuwaka, Alexander Starovoytov, Doug Eggers, Bill Heard and Leon Shaul. There were examples of some stocks that were in low abundance off the coasts of British Columbia, Washington and Oregon, but the general trend was toward higher abundances. Several papers provided convincing evidence that the long-term trend of decreasing individual size had reversed and average sizes were typical of lengths at the beginning of the decline.

Diet studies are an essential contribution to the understanding of the linkage between ecosystems, ecosystem changes and Pacific salmon production. Detailed studies representing the results of extensive field research were presented by Vladimir Karpenko and Svetlana Naydenko. The importance of competition for food was assessed in a number of papers. Zavolokin and colleagues concluded that there was a low potential for feeding competition during their study in the western Bering Sea.

Papers from several Russian scientists provided perhaps

some of the best information available on the types of predators and their impact. It was suggested that an atlas of salmon injuries, symptoms of disease and prevalence of parasites be produced. This suggestion was enthusiastically supported by the audience; but the limitation is money. Included in this topic was the first report of the parasites of chum salmon in Korea.

## Topic 2

There were 8 papers that described Pacific salmon distribution and the methods used to identify stocks and stock aggregates. Amazing progress has been made. Through cooperation and integration of research it has become possible to identify where stocks rear in the ocean seasonally throughout the entire period of their ocean residence. We are in the early stages of this research, but it is only a matter of money before we are able to use climate information and stock identification to model how climate is affecting marine survival in the open ocean as well as migration timing.

The research by Japanese scientists that has worked out the movements of chum salmon from juveniles to adults impressed the audience as chum salmon were shown to migrate south from the Bering Sea into the Gulf of Alaska in the winter and back to the Bering Sea in the summer. Elena Zavolokina summarized TINRO-Centre studies of chum salmon in the western Bering Sea. Go-Eun Kim and colleagues using SNPs proposed that chum salmon exist as three genetic population units. This was particularly interesting because of the large percentage of chum salmon that originate in hatcheries. New information on archival tags was reported by Trey Walker. These vertical migration graphs held the attention of the audience as participants theorized in their own minds why salmon undergo these sometimes extensive vertical migrations.

Kate Myers reviewed the distributions, migration routes, migration timing and feeding areas of Asian and North American Pacific salmon. She proposed that species, populations, age and maturity groups occupy different habitats in the open ocean and these niches can change in response to climate changes. Mitsuhiro Nagata reported that hatcheries in Japan would get the best production when fry were released into ocean waters ranging from 7 to 12°C. Eventually, such models may provide a method of forecasting the impacts of changes in coastal plankton composition, such as reported by Hiroki Asami and colleagues, and marine survival of Pacific salmon.

## Topic 3

This was a challenging topic for participants. A major threat to the future management of Pacific salmon is climate variability. Natural variability has several modes, but it is the regime scale that appears most influential for Pacific salmon.

A number of papers addressed the issue of the impact of climate variability but it was apparent that global warming impacts are not well understood. Masahide Kaeriyama looked specifically at the impacts of global warming on Pacific salmon of Asian origin. There was a better relationship between early marine survival and the coastal environment than the open ocean areas. Survival was related to growth in the coastal areas; and thus global warming impacts that affect the early rearing environment of chum salmon in the Sea of Okhotsk will have important impacts in Japanese chum salmon production. Dave Beauchamp showed how bioenergetic models can be used to identify the separate effects of temperature, food availability and food quality.

Ed Farley linked Pacific salmon early marine growth and recruitment through the critical size, critical period hypothesis. Results of studies of juvenile Bristol Bay sockeye, Prince William Sound pink salmon and coho salmon from British Columbia showed that sufficient growth in the first marine summer was necessary for subsequent marine survival. The size of Pacific salmon that return to the fisheries has intrigued researchers since Bill Ricker reported the trend in declining sizes. Jack Helle and Ole Mathisen assembled a team of international researchers to look at this issue with some surprising interpretations. Ole Mathisen died before this bulletin was published and I suspect that he would be as pleased to have his paper in these proceedings as we were to have him participate in the conference. The challenge of using Pacific salmon as indicators of ecosystem health was tackled head on by Peter Rand and Jim Irvine. Alexander Kaev looked at the factors affecting a pink salmon population at the southern limit of its distribution in the western Pacific. The study caught the attention of Canadian researchers because the major production of pink salmon in Canada occurs in the Fraser River which is also at the southern limit of its distribution. Day and night diet studies are rare; thus the results reported by Anatoly Volkov applied to the results of papers in all three topics.

In the time since the symposium, researchers continued to share data and interpretations. Scientists, managers of science and agencies funding research recognized the importance this international effort to share data and discuss cruise results annually. PICES and NPAFC need to find ways to complement each other's scientific strengths at a time that is exciting for researchers and potentially dangerous for salmon. A major result of the conference was an agreement to synthesize the existing knowledge about climate impacts on Pacific salmon in the ocean and to produce an international plan to focus on research and monitoring needs.

Richard Beamish  
Co-chair, Symposium Steering Committee