

NPAFC Science Plan 2001-2005

Salmon are important to the economies, cultural activities, and heritage of the people of the North Pacific Rim. As we enter the 21st Century, the total North Pacific Rim catch of salmon is almost 1 million metric tons at a gross value of more than \$1 billion annually. Approximately 5 billion hatchery salmon per year are released into Convention waters and adjacent seas to augment natural salmon runs. The NPAFC Convention area forms a common feeding ground for salmon from all NPAFC member Parties. To achieve our common goal of conservation and sustainable management of anadromous fish resources, we need the best available scientific information on the condition of fish migrating in the Convention area. Questions about ocean migration, distribution, intermixing of stocks, associated effects on growth rates, and the need for international baselines to identify stock origins of salmon are major research issues faced by all NPAFC member Parties. A growing body of scientific evidence supports hypotheses about the direct and indirect effects of environmental change on salmon production. For example, there is a strong correspondence between salmon catch and climate indices, indicating a shift to a more productive regime in the late 1970s. To address the broader questions of salmon carrying capacity in the North Pacific Ocean and how the environment influences salmon biology and population dynamics, we need stock-specific information on ocean distribution, migration, and behavior patterns of salmon. Knowledge of underlying processes gained from research in specific areas should be applicable to stocks in other regions. Changes in the production of salmon are often the consequence of complex changes in marine and freshwater ecosystems. To assess and manage salmon populations methods must be developed to incorporate all relevant information affecting their production including the effects of climate change, stock-recruitment relationships, and fishing. The NPAFC provides a forum for international coordination of regional salmon research programs, essential to resolution of these important issues.

Focus of Cooperative NPAFC Science Activities

For sustainable conservation of salmon stocks in their ocean ecosystems, we plan to focus our cooperative research activities on the following three areas:

1. Bering Sea Salmon Research

Asian and North American salmon stocks are distributed in high density in the Bering Sea during summer. Intra- and inter-specific interactions have been observed in some species and stocks. Physical and biological conditions in the Bering Sea changed drastically in the 1990s, and there were extreme fluctuations in the abundance and growth of some stocks. These changes in carrying capacity and salmon growth and production are not coincidental, but show a clear linkage between the marine environment and salmon production. Specific mechanisms underlying these linkages, however, are unknown principally due to absent or outdated information on the life history of many salmon populations in the Bering Sea. A coordinated program of cooperative research in the Bering Sea will clarify the mechanisms of biological response by salmon to the conditions caused by climate changes. Scientific issues that will provide necessary direction to the research include:

- Seasonal-specific migration patterns of salmon and their relation to the Bering Sea ecosystem
- Key biological, climatic, and oceanographic factors affecting long-term changes in Bering Sea food production and salmon growth rates
- Similarities in production trends between salmon populations in the Bering Sea and common factors associated with their trends in survival
- Overall limit or carrying capacity of the Bering Sea ecosystem to produce salmon

2. Juvenile Salmon Research in Eastern and Western North Pacific Waters

Ocean production of salmon in terms of numbers of fish is closely linked with their early ocean survival. Recent reviews of national research on juvenile salmon show wide diversity of survival rates, predation, interannual variation, etc. The decrease of many stocks and intermixing of stocks in the eastern and western North Pacific coastal waters has increased concern and interest in this critical period. Variations in early marine growth and survival are often related to climate-induced changes in distribution and abundance of predator and prey populations. In order to increase our understanding of determination of population sizes and our ability to forecast stock sizes, we must address the following research issues:

- Seasonal distribution and migration of juvenile salmon
- Population size and survival estimates of juvenile salmon
- Trophic linkages and growth changes of juvenile salmon
- Primary production and salmon food resources

3. Winter Salmon Research

Compression of salmon distribution in winter intermixes many stocks at a time of reduced food resources, and extremely low salmon lipid content suggests some stocks face starvation in this critical period. Salmon size at the end of the winter also determines size of their potential prey and growth in the coming summer. In spite of difficult research conditions, the impacts of winter conditions on salmon need to be addressed by the following research issues:

- Winter distribution of salmon
- Population size and survival estimates of overwintering salmon
- Survival strategies of salmon in winter
- Feeding, growth, and condition of salmon in winter
- 24-hour sampling to elucidate possible day-night differences

The Parties of the Commission are coordinating their respective research activities to address the issues identified in the Commission's Science Plan.