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Japanese Salmon Research under the NPAFC Science Plan 2011-2015

Fisheries Agency of Japan

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Introduction

The North Pacific Ocean continues to produce large quantities of Pacific salmon, but catch patterns vary among species and areas (Irvine and Fukuwaka 2011). The abundance of Japanese chum salmon is highly variable (140-258 thousand tonnes/year) in the last decade. Accurate forecast of salmon returns is indispensable for stock management, while it is confronted with difficulties because of uncertain factors caused by climate change. The 2011-2015 NPAFC Science Plan has defined its research theme "Forecast of Pacific salmon production in the ocean ecosystems under changing climate" with five research components (NPAFC 2010). It is a high priority for Japanese salmon research to explain and forecast the annual variation of salmon production, corresponding to this new Science Plan theme.

Japanese salmon research under the previous NPAFC Science Plan for 2006-2010 was reviewed by Nagasawa et al. (2010). Brood-year strengths of several chum salmon populations in northern Japan were determined by survival of juveniles, which were influenced by body size at release and/or coastal SSTs (Saito and Nagasawa 2009). However, survival mechanisms of juvenile salmon in coastal waters have not been well understood yet. Genetic stock identification and otolith mark techniques could indicate stock-specific ocean distribution of chum salmon (Sato et al. 2009, Urawa et al. 2009) and their biomass in the Bering Sea (Fukuwaka et al. 2010). Those techniques as well as long-term monitoring information of salmon and their habitats in the ocean should be applied for accurate forecast of returning salmon abundance.

It was believed that the majority of Japanese anadromous salmon were enhanced by hatcheries. However, recent assessments have suggested that abundance of wild pink and masu salmon may exceed that of hatchery origins (Morita et al. 2006; Nagata et al. in review). Otolith mark surveys also suggest that Japanese chum salmon include considerable number of wild origins. New synthetic management strategy is necessary to conserve salmon populations including wild stocks in Japan.

The primary goal of our research is to accomplish sustainable salmon fisheries with the conservation of wild and hatchery stocks in the North Pacific ecosystems. The Japanese research consists of four components: (1) juvenile salmon studies, (2) high-seas salmon studies, (3) monitoring of major salmon populations, and (4) development and application of stock identification techniques and forecast model.

Japanese Research Plan in 2011-2015

J-1 Juvenile Salmon Studies in Coastal Waters

The early life history studies are important to understand the survival mechanisms of salmon. To clarify mechanisms controlling population dynamics of juvenile salmon, we focus on the following research items:

- Feeding, growth, and survival of juvenile salmon
- Stock-specific distribution and migration of juvenile salmon
- Monitoring of coastal environments such as SST, salinity, primary production, and prey organisms

J-2 High-seas Salmon Studies in the Bering Sea and Adjacent Waters

The Bering Sea is an important feeding habitat for various salmon populations including Japanese chum salmon. The current BASIS is designed to understand how climate change will affect Pacific salmon production and ecosystems in the Bering Sea (NPAFC 2009). Japan continues a long-term monitoring survey in the Bering Sea and adjacent waters to examine the following items:

- Stock-specific distribution and abundance
- Climate change and primary production
- Production of prey organisms
- Feeding competition, trophic status and growth change of salmon

J-3 Biological Monitoring of Major Salmon Populations

This long-term monitoring program aims to assess the status of major populations of chum and pink salmon for their proper stock management including forecast of salmon survivals. The program includes the flowing items:

- Annual changes in the timing and number of adult returns
- Annual changes in body size and age at maturity, and fecundity
- Otolith mark surveys to assess status of wild and hatchery stocks
- Genetic monitoring for stock diversity conservation
- Epidemiological survey of pathogenic organisms

J-4 Development and Application of Stock Identification Techniques and Forecast Model

The development of North Pacific rim genetic baseline for Pacific salmon is necessary to monitor stock-specific ocean distribution and abundance for accurate estimates of intra-specific interactions and adult returns. The genetic baseline of chum salmon will be improved to estimate fine-scale stock origins of adult salmon caught in coastal waters as well as in offshore waters. In addition, we will examine genetic structure of even-year and

odd-year pink salmon to develop a baseline for their stock identification and conservation. Mass otolith mark releases will be continued to assess biological status of hatchery and wild stocks. For accurate forecast, we will develop a population dynamics model, which may be exploited from long-term monitoring information for salmon and their habitat in the coastal and offshore waters.

- Improvement of genetic baseline for chum salmon
- Development of genetic baselines for pink salmon
- Mass otolith mark releases for assessment of wild and hatchery stocks
- Development of synthetic model for accurate forecast

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