A History of U.S. High Seas Salmon and Steelhead Stock Identification Research

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Keywords: High seas, salmon, steelhead, U.S. history, stock identification

This abstract provides a brief history of U.S. high seas salmon and steelhead stock identification research. Jackson and Royce (1986) and Harris (1989) reviewed the history of the Japanese high seas salmon driftnet fisheries and the international treaties that regulated them. After World War II, interceptions of Alaska salmon by Japan's rapidly expanding high seas salmon driftnet fisheries were a major concern to the U.S. salmon fishing industry. A Japanese mothership fleet operated in the Bering Sea and in the North Pacific Ocean (north of 46°N), and a landbased fleet operated south of 46°N in the North Pacific Ocean. In 1953 the International Convention for the High Seas Fisheries of the North Pacific Ocean established the International North Pacific Fisheries Commission (INPFC, 1953–1992), and set a provisional abstention line that restricted the Japanese fisheries to areas west of 175°W. The major goal of INPFC research was to determine the areas of intermingling of Asian and North American salmon in the North Pacific Ocean and adjacent seas.

Burgner (1992) reviewed the history of INPFC research by the United States, which involved a coordinated effort among federal, university, and state scientists, as well as cooperation with Canadian, Japanese, and Soviet scientists. A U.S. tagging study conducted in the first three years of the program (1956–1958) showed that Asian and North American salmon intermingle in the vicinity of 175°W, and established the necessity for a major international high seas salmon research program (Thompson 1954, 1962; Hartt 1962). The INPFC research plan included four major elements: (1) sampling to determine salmon distribution, (2) tagging to study salmon movements, (3) oceanographic studies to relate environmental factors to salmon migration, distribution, and growth, and (4) racial studies to identify Asian and North American salmon. The U.S. racial studies involved the development and application of new methods to identify Asian and North American salmon, including: (1) meristics and morphometrics, (2) scales, (3) serology, and (4) parasites. These methods met with varying degrees of success. The most frequent problem encountered was the lack or insufficiency of baseline data for Russian salmon. The major results of this pioneering research are summarized in INPFC joint comprehensive reports for coho (Godfrey et al. 1975), sockeye (French et al. 1976), chum (Neave et al. 1976), chinook (Major et al. 1978), and pink (Takagi et al. 1981) salmon.

The INPFC Convention was changed in 1978 and again in 1986 to reduce Japanese interceptions of North American salmon, and INPFC research focused on determination of the continent of origin of salmon and steelhead migrating in the Japanese landbased driftnet fishery area. Myers et al. (1993) summarized the methods and results of this research. The primary stock identification tools used were: (1) scale patterns, (2) tags, and (3) parasites. The U.S. scale pattern research provided the first quantitative estimates of the relative proportions of Asian and North American sockeye, coho, and chinook salmon in the region south of 46°N, as well as estimates of interceptions of Russian and North American salmon by the Japanese landbased fishery. The final results indicated intermingling of Asian and western Alaska stocks in this region, however, the majority of sockeye and chinook salmon intercepted by the landbased fishery were of Russian (Kamchatka Peninsula) origin. Bias was suspected in the results of coho salmon scale pattern analyses because of insufficient baseline data. High seas tagging results significantly increased the known limits of ocean distribution of many Asian and North American salmon and steelhead stocks, and provided indisputable evidence of the presence of western Alaska sockeye, coho, chum, pink, U.S. West Coast stocks of steelhead, and Russian sockeye, chum, and coho salmon in the area closed to high seas salmon driftnet fishing in 1978. Coded-wire tag recoveries showed that U.S. Pacific Northwest coho and steelhead stocks migrated far offshore into the landbased fishery area, as well as into the area of a rapidly expanding Asian driftnet fishery for flying squid (*Ommastrephes bartramii*). Parasite studies showed that U.S. steelhead ranged across the area south of 46°N to as far west as about 162°E.

In 1993 the Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean established the North Pacific Anadromous Fish Commission (NPAFC, 1993-present). The Convention prohibits salmon fishing in international waters of the North Pacific Ocean and Bering Sea, and emphasizes the importance of scientific research for the conservation of anadromous salmon stocks. The development of the NPAFC science plan was coordinated with the North Pacific Marine Sciences Organization (PICES). The overarching goal of this plan is to

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investigate the effects of change in the productivity of the North Pacific Ocean on Pacific salmon, including: (1) current trends in ocean productivity and effects on carrying capacity, and (2) changes in biological characteristics of salmon (growth, size and age at maturity, oceanic distribution, survival, and abundance). Myers et al. (2000) reviewed the results of U.S. research in the 1990s under this plan, including the development and application of new stock identification tools, comprehensive genetic baselines, and statistical techniques in cooperation with Canadian, Japanese, and Russian scientists. The primary stock identification tools used by U.S. scientists included genetics (allozyme and DNA), thermal otolith marks, tags, and parasites. The results provided new information on the distribution, migration patterns, and relative proportions of regional stocks of Asian and North American salmon in coastal and offshore waters, as well as information on the origins of salmon seized from vessels fishing illegally in NPAFC Convention waters.

In 2000 the NPAFC adopted a new five-year science plan (2001–2005) that emphasizes cooperative science activities in three areas: (1) Bering Sea salmon research, (2) juvenile salmon research in eastern and western North Pacific waters, and (3) winter salmon research. An important aspect of U.S. research in all three areas is to investigate stock-specific growth and other biological characteristics of Asian and North American salmon. Some of the new stock identification methods being developed and the preliminary results of this research were presented in other papers at this workshop.

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