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Canadian Research in 2012 relevant to the NPAFC Salmon Science Plan for 2011-2015

by

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Canadian Research in 2012 relevant to the NPAFC Salmon Science Plan for 2011-2015

The primary research theme identified in the NPAFC Science Plan for 2010-2015 is the "Forecast of Pacific Salmon Production in the Ocean Ecosystems under Changing Climate" (Anonymous 2010). This document supplements an earlier overview (Saunders 2010) by summarising relevant Canadian research activities planned for 2012. Activities are organised according to the five major research topics (*C-1 – C-5)* identified in the Science Plan. It should be noted that research activities often cross over several components of the science plan, due to the inherent overlap associated with the themes of these components.

C-1: Migration and Survival Mechanisms of Juvenile Salmon in the Ocean Ecosystems

Field research activities will primarily focus in coastal waters of British Columbia and the Gulf of Alaska and will include: (1) applying genetic stock-identification of juvenile, immature, and adult salmon to assess stock-specific distribution, migration, and habitat utilization of salmon over small (i.e. Strait of Georgia) and large spatial scales (i.e. continental shelf of the west coast of North America), (2) studying the movement of salmon with surgically implanted acoustic tags as part of the Pacific Ocean Shelf Tracking Project (POST), (3) collecting oceanographic data and zooplankton to determine the environmental conditions experienced by salmon, (4) using diet and stable isotope analyses to describe trophic interactions of juvenile salmon and their predators in marine ecosystems, (5) estimating growth of juvenile salmon and examining its relationship to habitat characteristics, ocean conditions, and climate, (6) determining how phenological changes in the migratory behaviour of salmon affect their survival, (7) assessing the extent of interactions among wild, hatchery, and farmed salmon, and (8) developing forecasting models of marine survival and salmon returns to British Columbia using a suite of biological and oceanographic indicators. These research activities are linked to two ongoing research and monitoring programs in the Strait of Georgia and coastal waters of British Columbia that were initiated in 1998; 2012 plans are described in detail by Trudel et al. (2012).

C-2: Climate Impacts on Pacific Salmon Production in the Bering Sea (BASIS) and Adjacent Waters

As well as the activities described in *C-1* that include a climate change impact assessment theme, research activities for this component will also include the development of ecosystem models to project future trends in abundance of salmon in relation to climate change and various management scenarios. The Canadian component of the long-term research and monitoring plan (Beamish et al. 2009) provides a unique opportunity to understand relationships among ocean conditions, climate, and the productivity of Pacific salmon due to the large natural variation in climate and environmental conditions that occurred since these programs were initiated.

In addition, Canada is in the process of reviewing proposals to carry out research designed to understand climate change impacts on Canada's oceans and inland waters, as well as to develop strategies and tools to respond to these changes. This new funding source that will support projects beginning in 2012 is expected to last four years. Some of the research will focus on downscaling climate data from Global Circulation Models to generate data that can be used to generate regionally specific forecasts relevant to Pacific salmon in freshwater, coastal areas, and the Gulf of Alaska.

C-3: Winter Survival of Pacific Salmon in the North Pacific Ocean Ecosystem

Research activities under this component include an ongoing winter survey in coastal waters of British Columbia that was initiated by Canada in 2001. This research is a collaborative effort between government and academic scientists aimed at understanding the processes affecting winter survival in juvenile salmon. More specifically, this survey will assess the extent and variability in overwinter size-selective mortality and energy depletion in juvenile salmon. 2012 plans for this survey are described in detail by Trudel et al. (2012)

C-4: Biological Monitoring of Key Salmon Populations

Understanding the linkages between climate and Pacific salmon production depends upon long-term monitoring of biological data. Research activities under this component include marine sampling activities identified in *C-1* where the stock composition of salmon caught is determined, and freshwater sampling activities described below. In addition, commercial,

recreational, and aboriginal fisheries are sampled and where possible, catches are assigned to major stock groupings wherever practicable; summaries are provided to NPAFC annually.

In 2012, Canada will continue to monitor key salmon populations as indicators of regional salmon production. Spawning escapements are estimated for many populations, and where population-specific catch estimates are possible, changes in productivity will be assessed (e.g. Tompkins et al. 2011).

In limited numbers of systems, smolt populations are also assessed, enabling the partitioning of mortality between freshwater and marine environments; these results are generally reported in annual State of Ocean Reports (e.g. Crawford and Irvine 2011). At some of these systems, detailed information including age and sex composition, body size of adults and juveniles, fecundity, egg size, genetic diversity, and disease will be monitored to help determine the biological status of key populations.

Canada will continue to mark and/or tag hatchery releases to monitor hatchery production, hatchery contributions to returns, interactions with wild stocks, and to enable mark selective fisheries. Hatchery release data are reported annually to the NPAFC (e.g. Wilkinson et al. 2011). Given the potential for food resources in the North Pacific Ocean to be limited as a consequence of climate change, it is important to understand the implications of increasing numbers of hatchery salmon in the North Pacific Ocean.

C-5: Development and Applications of Stock Identification Methods and Models for Management of Pacific Salmon

Stock identification research in Canada is centered on applying DNA-based genetic variation to discriminate among populations or stocks of Pacific salmon to aid in fisheries management and to determine ocean distributions of specific populations. Microsatellites are the main class of genetic variation employed, although SNPs are used in some management applications. Canadian activities in 2012 will involve identification of Pacific salmon in domestic waters and the North Pacific Ocean as required. Otoliths are thermally marked to aid in stock identification for some hatchery produced salmon and data reported annually to NPAFC (e.g. DiNovo and

O'Brien 2012). As well, coded-wire tags are applied at the time of smolt release from many hatcheries, and subsequent marine recoveries of tagged individuals in fisheries and other sampling (e.g. *C-1*) provide another method of stock identification. All techniques noted are used to evaluate ocean distribution of salmonids.

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