

Migration Behavior and Mortality of Late-run Fraser River Sockeye Salmon June 2001

Introduction

At the Pacific Salmon Commission's Annual Meeting in Portland, Oregon, on February 19-23, 2001, members of the bilateral Fraser River Panel and staff of the Pacific Salmon Commission reported that unusually high numbers of Late-run Fraser River sockeye salmon have died prior to spawning in the past five years. These stocks include the world-famous Adams River run and Weaver Creek sockeye, both of which contribute heavily to fisheries in both Canada and the United States. These fisheries may be impacted by action required for the conservation of these stocks. PSC staff has linked this mortality to earlier-than-normal entry of Late-run sockeye into the Fraser River. The Commission considered this problem sufficiently urgent that it sent letters to key Departments and Agencies in both Canada and the United States, requesting their support for comprehensive action to address this serious problem.

Problem Summary

In 1996, adult Late-run sockeye salmon were observed entering the Fraser River three weeks earlier than their normal date of entry. Since then, the phenomenon has occurred each year (Figures 1 and 2). In 2000, Late-run stocks entered the river six weeks early. Each year, the early migration timing has been associated with high levels of mortality prior to reaching the spawning grounds (Table 1) and, usually, to elevated levels of pre-spawning mortality at the natal streams. Fisheries and Oceans Canada has actively pursued the cause of the mortality and has traced it to a microscopic parasite that attacks the fishes' kidneys and gills (<http://www-comm.pac.dfo-mpo.gc.ca/english/release/bckgrnd/1999/BGparasite.107.htm>). Although the parasite (*Parvicapsula minibicornis*) is found in sockeye salmon populations throughout the Fraser watershed, it has caused large-scale pre-spawning mortality in recent years only in Late-run stocks (Adams River, Lower Shuswap River, Weaver Creek, Portage Creek, Cultus Lake, Harrison River, etc.).

At this time, the ultimate cause of mortality is strongly suspected to be the parasite. However, scientists believe that the early timing of river entry is the real problem. Early upstream migration may stress the adult salmon because they are not physiologically prepared to enter freshwater, and it exposes the fish to the parasite earlier than normal and increases the time they must survive in freshwater prior to spawning. The earlier the upstream migration has been, the higher the proportion of stock that has died before spawning. In 2000, the year with the earliest upstream migration, over 90% of sockeye salmon that returned to Weaver Creek died before spawning.

Biological and Fishery Impacts

The early upstream migration and subsequent mortality of Late-run Fraser River sockeye salmon has already impacted Canadian and United States fisheries that depend on this valuable resource. For example, in 2000, the Fraser River Panel and the Parties implemented a variety of management measures that included closures of commercial, Aboriginal and recreational fisheries in Canada and the United States in an attempt to increase the escapement of these stocks to compensate for expected mortality. Despite these measures, the number of viable spawners fell short of desired numbers for all Late-run stocks in 2000, due to extensive mortality prior to spawning. At least one stock is approaching a critically low escapement level on two cycles and these reduced spawning escapements have resulted in reduced juvenile production.

The causes of early upstream migration of Late-run sockeye are thus far unknown. The lack of information on these causative factors greatly hinders any efforts to either predict or prevent its future occurrence. In the near term (2001 and 2002 seasons), reduced production of Late-run sockeye will result in negative impacts for Aboriginal, commercial and recreational fisheries in the United States and Canada. Significant economic, cultural and societal impacts are expected. The negative impacts may result from: (1) reduced harvest of Late-run sockeye due to fisheries management actions that attempt to ensure that spawning escapement targets are met, and (2) reduced harvest of co-migrating sockeye (e.g., Summer-run stocks). In addition, these changes in sockeye behavior may reflect larger ecosystem problems.

In 2001, special management actions are expected to be required for conservation of Late-run sockeye stocks. Plans to deal with this problem are being considered for implementation in the 2001 season. Updates will be announced when available. Weekly information updates will be included in the Fraser River Panel news releases.

Action to Date

The Fraser River Panel agreed on October 10, 2000, to bilaterally develop research proposals to address the causes of early upstream migration behavior of Late-run sockeye. As a first step, the Panel organized a workshop that was held on February 6-7, 2001, in Vancouver, B.C., and attended by Canadian and United States scientists. This meeting focused on identifying potential causes of the early river entry behavior of Late-run sockeye. The panel of 21 leading scientists represented five scientific disciplines: oceanography, water contaminants, diseases/parasites, predators and salmon physiology. The scientists proposed sixteen hypotheses that might explain the aberrant behavior and they recommended a number of studies be carried out, beginning this year in 2001 (Table 2). Several study proposals were subsequently funded by the PSC from its budget and from monies contributed by the United States Government. Fisheries and Ocean Canada is funding additional studies.

Next Steps

Initial research and data collection by Fisheries and Oceans Canada is expected to begin in 2001. Studies in four of the five disciplines (oceanography, water contaminants, diseases/parasites, and salmon physiology) will be conducted to look for potential causal mechanisms. In addition, a tagging program will be conducted in the Harrison River to determine the survival of early upstream migrants. A high level of effort to explain and deal with the early upstream migration behavior will be needed in 2002 when the dominant (largest abundance) cycle line of Late-run Adams River sockeye returns to the Fraser River.

Spokespersons:

Pacific Salmon Commission:

- Mr. Don Kowal, Executive Secretary, Pacific Salmon Commission at (604) 684-8081

Canada:

- Mr. Wayne Saito, Chair, Canadian Section Fraser River Panel, Fisheries and Oceans Canada, 604-666-3271

United States:

- Mr. Dave Cantillon, Chair, United States Section Fraser River Panel of the Pacific Salmon Commission, National Marine Fisheries Service, (206) 526-4140.

- Ms. Lorraine Loomis, United States Section Fraser River Panel of the Pacific Salmon Commission, Northwest Indian Fisheries Commission (360) 466-7240
- Mr. Rich Lincoln, United States Section Fraser River Panel of the Pacific Salmon Commission, Washington Department of Fish and Wildlife (360) 902-2750.

Figure 1. Migration timing of Lower Adams/Late Shuswap sockeye in recent years(solid lines) relative to the historical pattern(dashed lines).

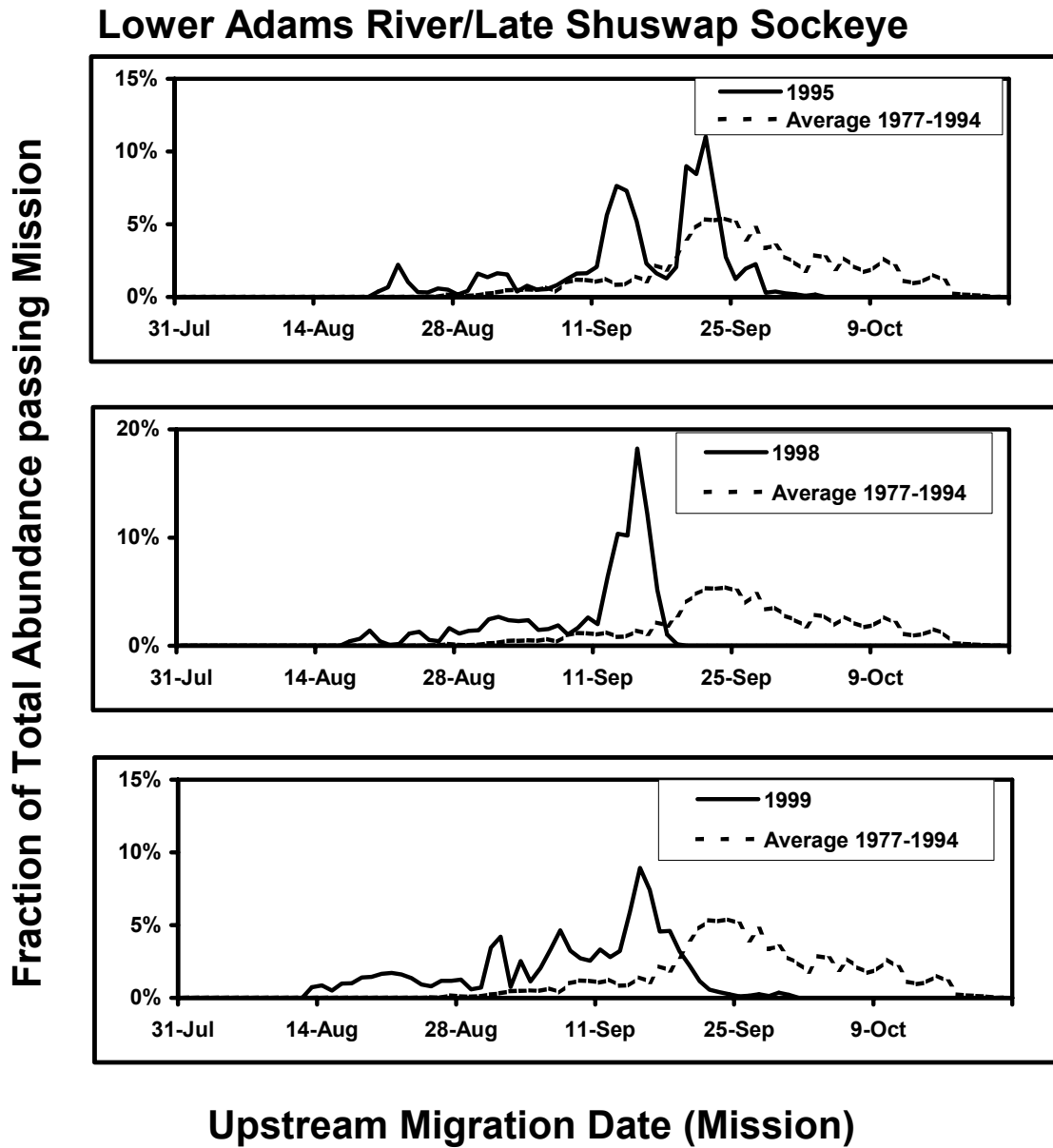


Figure 2. Migration timing of Weaver sockeye in recent years (solid lines) relative to the historical pattern (dashed lines).

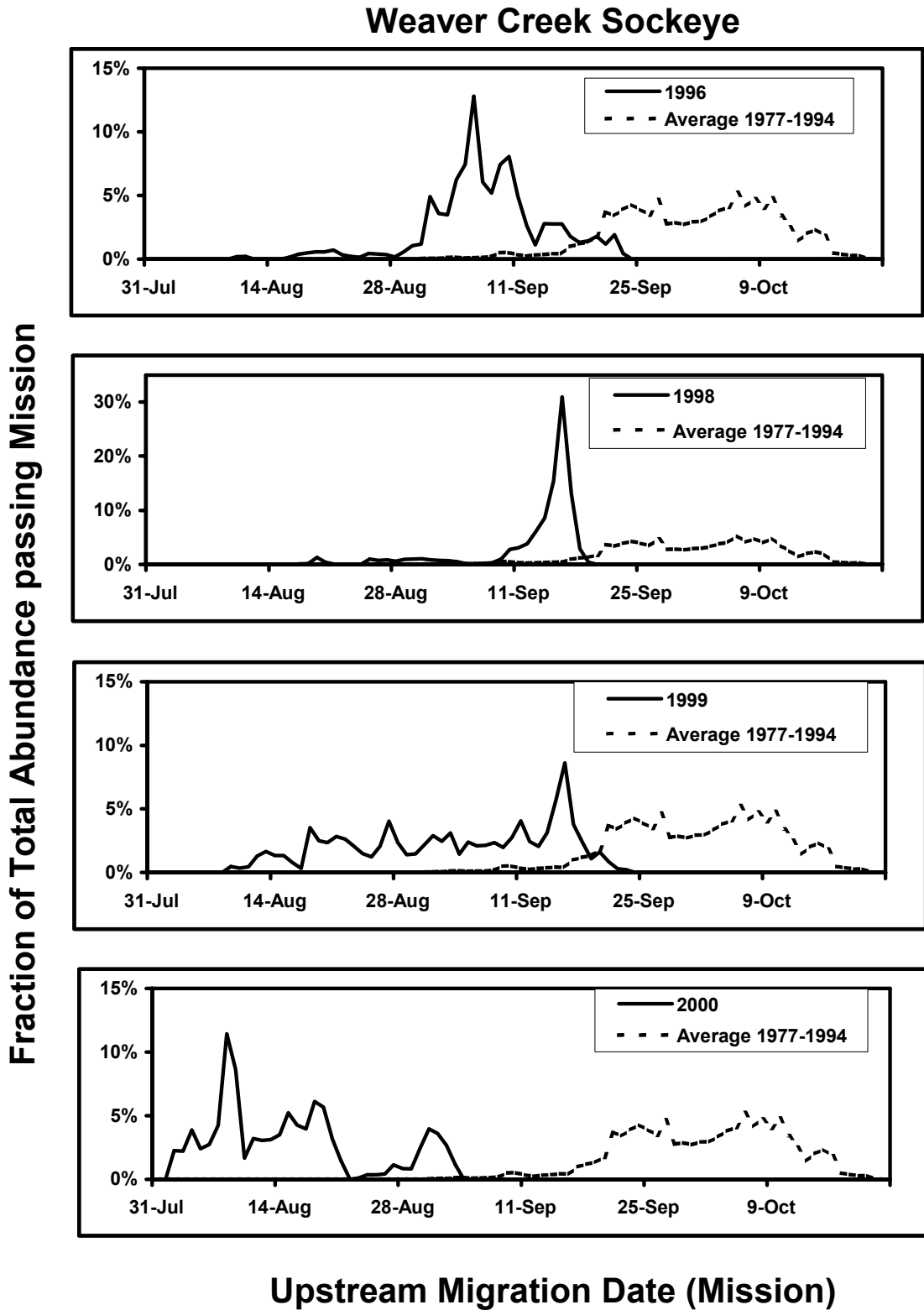


Table 1. Estimate en route losses of Late-run ¹ Fraser River sockeye salmon.

Year	Past Mission	Mission ²	Spawning Grounds	Estimates ³
1996	468,000	88,000	106,000	274,000
1997	81,000	2,000	38,000	41,000
1998	2,984,000	142,000	1,480,000	1,362,000
1999	1,023,000	8,000	371,000	644,000
2000	356,000	22,000	14,000	320,000
Total	4,912,000	262,000	2,009,000	2,641,000

1 Stocks include Adams River, Lower Shuswap River, Portage Creek, Weaver Creek, Cultus Lake, Harrison River and minor stocks.

2 Includes catches taken in First Nations, ESSR and recreational fisheries.

3 Estimate of loss; includes all sources of mortality and errors in estimates.

Table 2. Hypotheses that may explain the early migration timing of Late-run ¹ Fraser River sockeye salmon.

Hypotheses

Contaminants

Adults approaching the Fraser River are exposed to chemicals that trigger early entry into the Fraser River.
Outmigrant juveniles are exposed to chemicals that reduce their ability to hold as adults.

Migration/Physiology

Diet may be responsible for changes to Late-run sockeye behaviour.
One or more Biological Clocks has/have been advanced leading to early upstream migration.

Oceanography/Fisheries Oceanography

Exchange processes in Georgia Strait have altered delay behavior in Late-runs.
Interaction of diversion rate with physical ocean conditions affects Late-run upriver timing.
The fish behaviour has changed (EMG tagging)
Changes in vertical distribution of Late-run sockeye causes them to experience different physical conditions, which alters delay behavior.
Choice of river entry timing is related to conditions in year of ocean entry (smolt effect).
Early upriver migration triggered by low stored energy reserve.
Exploratory data analysis of ocean parameters related to Late-run upstream timing.

Parasites/Diseases

Smolts are infected near mouth of the Fraser River.
Sockeye salmon acquire infection prior to Fraser River entry leading to a behavioral change.
There is a relationship between parasite infection and host mortality.

Predators

Predation by harbour seals and killer whales has increased ?
Sockeye are fleeing into the Fraser River to avoid predators.