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**Sampling Methods Used on U.S. Ocean Salmon Research
Vessels, 1997-1998**

by

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Sampling Methods Used on U.S. Ocean Salmon Research Vessels, 1997-1998

Abstract

This document summarizes the sampling methods used on U.S. salmon research vessels operating between September 1997 and September 1998. During the fall, spring, and summer three research vessels, the *F/V Great Pacific*, and the NOAA ships *John N. Cobb* and *Miller Freeman*, conducted trawling operations to catch salmon in the inshore, nearshore, and oceanic areas of the Gulf of Alaska, North Pacific Ocean, and Bering Sea near the Alaska Peninsula. The objectives of these cruises were to collect data on salmon distribution, abundance, stock origins, migration, growth, and food habits, and to collect data on co-occurring fishes that may be competitors or predators of salmon. These research vessels used conductivity, temperature, and depth probes to gather information on the physical environment and towed Norpac, WP-2, and bongo nets to collect zooplankton samples in the vicinity of research trawling operations. To capture salmon, two trawl nets designed or modified to fish at the surface (a midwater and Nordic rope trawl) and one subsurface net (Aleutian wing trawl) were used by researchers aboard these ships. The methods used to process the salmon catch included sorting by species, counting, measuring lengths and weights, collecting scales and otoliths, determining sex and maturity, analyzing stomach contents, and when sample sizes were suitable, collecting tissues for genetic stock identification. Non-salmonid fish catches were identified, sorted, measured, and weighed, and some samples were analyzed for stomach contents.

Introduction

In 1997 the Methodology Standardization Working Group (MSWG) compiled information on ocean survey methods used by North Pacific Anadromous Fish Commission (NPAFC) member countries during their salmon research cruises (Mackas et al. 1997). One of the recommendations included in their report was that sampling gear and methodology used on salmon research cruises should be widely and regularly reported (Mackas et al. 1997). This report is a summary of the sampling methodologies used on U.S. salmon research vessels between September 1997 and September 1998.

Summary of Sampling Methods

Research vessels, survey areas, and cruise objectives

Three research vessels, the *F/V Great Pacific*, and the NOAA ships *John N. Cobb* and *Miller Freeman*, conducted trawling operations to catch salmon in the inshore, nearshore, and oceanic areas of the Gulf of Alaska, North Pacific Ocean, and Bering Sea near the Alaska Peninsula (Table 1). The objectives of these cruises were to collect data on salmon distribution, abundance, stock origins, migration, growth, and food habits, and to collect data on co-occurring fishes that may be competitors or predators of salmon. The *Great Pacific* was used for a one month cruise in spring 1998 to survey coastal areas around the eastern Aleutian Islands, Shelikof Strait, and Kodiak Island and offshore areas of the western and central Gulf of Alaska (145°W longitude). This vessel was used during another three week cruise in summer 1998, surveying nearshore, shelf, and slope transects along the coast of Alaska from Dixon Entrance to the eastern Aleutian Islands (Table 1). The *John N. Cobb* was used for five cruises of five to ten days' duration each in the fall, spring, and summer in the inshore waters and straits of the northern region of southeastern

Alaska and coastal waters to 40 nm offshore (Table 1). The *Miller Freeman* was used for a nine-day cruise in spring 1998 in the north central Gulf of Alaska near Kodiak Island and in the vicinity of 150°W (Table 1).

The contact persons for these cruises and their cruise reports are listed in Table 2.

Hydrographic sampling

To characterize the physical environment in the area where salmon fishing operations were conducted, CTD probes were used to collect temperature and salinity data at one meter increments to maximum depths of 200, 300, and 500 m (Table 3).

Zooplankton sampling

Bongo nets were used for zooplankton sampling (Table 4). The bongo net used aboard the two NOAA ships is configured with 333- and 505- μm meshes, and aboard the *Great Pacific* a bongo net equipped with a 253- μm and 505- μm mesh was used. The bongo nets were towed obliquely from the surface to a depth of 200 m, or near the bottom in shallow areas. During the *John N. Cobb* survey, two conical nets including the (original) Norpac net (243- μm mesh; Norpac Committee 1960) and a WP-2 net equipped with a 202- μm mesh (UNESCO 1968) were also used for vertical plankton tows (Fig. 1). The WP-2 net and the SCOR net used by Canadian researchers are the same net design (pers. comm., D. Mackas, Institute of Ocean Sciences, Sidney; Fig. 1). On board the *John N. Cobb*, the Norpac net was used for shallow tows (0-20 m) and the WP-2 net was used for tows from the surface to 200 m, or near the bottom in shallow areas (Table 4).

Salmon sampling

Three types of trawl nets were used for catching salmon by U. S. salmon research vessels (Table 5). The *Great Pacific* and the *Miller Freeman* towed the same 400/580 midwater rope trawl produced by Cantrawl. The 400/580 midwater rope trawl is designed to catch juvenile, immature, and maturing salmon, and is towed at the surface. In addition, the *Miller Freeman* towed a second trawl called an Aleutian wing trawl (AWT), which is designed to fish below the surface. This trawl was towed at various depths to a maximum of 300 m. The *John N. Cobb* towed a Nordic rope trawl (model 264), which was towed at the surface and was capable of catching juvenile, immature, and maturing salmon (Table 5). The surface trawls were usually towed at predetermined intervals of 20, 30, or 60 minutes, and the AWT was towed for a variable tow duration.

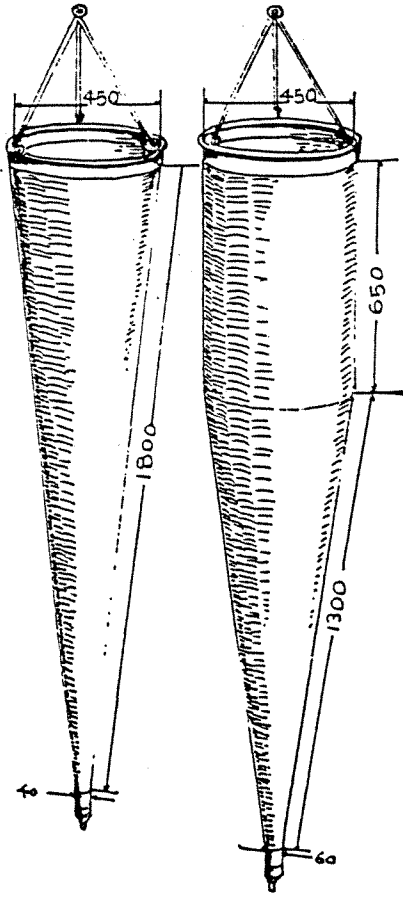
Processing of salmon in the catches included sorting by species and counting, measuring salmon fork length and body weight, and inspecting fish for the presence of hatchery marks and tags. On board the ship or later in the laboratory, scales and otoliths were collected, the sex and maturity were determined, salmon stomach contents analyzed, and occasionally other tissues were collected. Non-salmonid fishes were identified, measured, and weighed, and often the stomach contents of potential salmon predators were examined (Table 5).

Acknowledgements

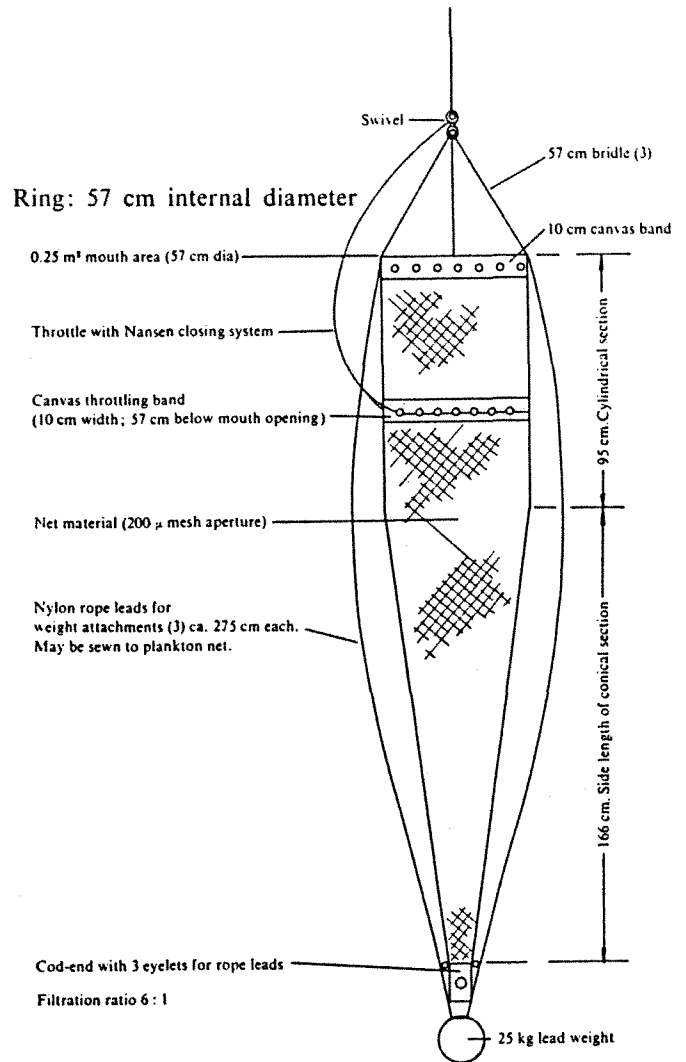
I thank Richard Carlson, Joseph Orsi, and Richard Haight for providing detailed information regarding their research cruises for the compilation of this summary. Funding for this report was provided by the Auke Bay Laboratory, Alaska Fisheries Science Center, U.S. National Marine Fisheries Service (NOAA Contract No. 50ABNF700003).

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Original
Norpac netRemodeled
Norpac net

WP-2 (or SCOR) net



Bongo net

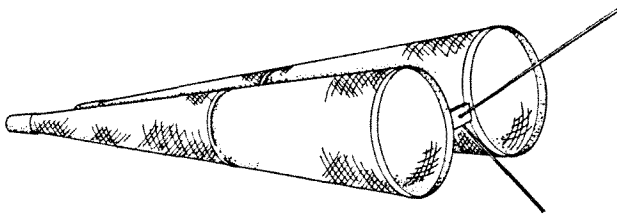


Figure 1. Zooplankton nets used in salmon research. The WP-2 (Working Party No. 2) net was designed for collection of small mesozooplankton and described in UNESCO (1968). U.S. and Canadian research vessels use the WP-2 (or SCOR) net. This WP-2 net drawing was taken from UNESCO (1968). The original Norpac was specified by the Norpac Committee (1960) and later remodeled by Motoda (1994). The original Norpac net is used in U.S. salmon research and the remodeled design is used in Japanese salmon research. This drawing of both Norpac nets is taken from Motoda (1994). The drawing of the bongo net is taken from Snyder (1983).

Table 1. Description of U. S. salmon research vessels, cruise objectives, research time period, and geographical area for cruises conducted between September 1997 and September 1998.

Item	Inshore/Offshore Cruises (OCC) (<i>Great Pacific</i>)	Southeast Alaska Monitoring Cruises (<i>John N. Cobb</i>)	Central Gulf of Alaska (<i>Miller Freeman</i>)
Ship name	<i>F/V Great Pacific</i>	NOAA ship <i>John N. Cobb</i>	NOAA ship <i>Miller Freeman</i>
Gross tonnage	199	185	1,515
Ship type	38-m Bering Sea stern trawler	29-m multi-gear research vessel	66-m stern trawler
Owner or sponsoring institution	Chartered by National Marine Fisheries Service, Auke Bay Laboratory	National Oceanic and Atmospheric Administration (NOAA)	National Oceanic and Atmospheric Administration (NOAA)
Research objectives	(1) determine distribution of juvenile, immature, and maturing salmon during the spring and summer in coastal and oceanic waters; (2) obtain information on salmon stock identity, growth and body condition, migration routes, maturation, incidence of hatchery marked fish, food habits, and time of annulus formation; (3) collect data on co-occurring fish species including potential salmon predators and competitors; (4) collect oceanographic and zooplankton data to characterize the physical and biological environment; (5) perform comparative gear trials with Canada Dept. of Fish. and Oceans R/V <i>W.E. Ricker</i> (July cruise only)	(1) sample juvenile salmon and ecologically related species along a primary seaward corridor May-October; (2) recover coded-wire tagged and otolith-marked salmon to examine stock-specific distribution, migration, growth, survival, and hatchery-wild interactions; (3) analyze stomach contents of potential salmon predators; (4) collect oceanographic and zooplankton data to characterize the physical and biotic environment	(1) conduct oceanography and trawling on a nearshore monitoring transect; (2) assess the distribution of immature and maturing salmon; (3) observe diel movements of salmon, obtain data on stock identity, growth and body condition, maturation levels, incidence of hatchery marks, and food habits; (4) collect data on the physical and biological environment of salmon and co-occurring species
Research time period	departed Dutch Harbor, Alaska, 27 April 1998 and arrived Seattle, Washington, 26 May 1998 departed Seattle 21 July 1998 and arrived Dutch Harbor 12 August 1998	all departures and arrivals were Juneau, Alaska; 2-11 October 1997 14-18 May 1998 24 June-1 July 1998 20-28 July 1998 24-30 August 1998	departed Kodiak, Alaska, 27 March 1998 and returned to Kodiak 4 April 1998

Table 1. Continued.

Item	Inshore/Offshore Cruises (OCC) (<i>Great Pacific</i>)	Southeast Alaska Monitoring Cruises (<i>John N. Cobb</i>)	Central Gulf of Alaska (<i>Miller Freeman</i>)
Geographical area of research	<p>April-May cruise: sampled the North Pacific and Bering Sea sides of the Alaska Peninsula; in the Gulf of Alaska seaward of Unimak Pass to 50°N and eastward to 155°W, then northwestward to Shelikof Strait; Cape Chiniak inshore monitoring transect (Kodiak Is.); southwards along 145°W to 38°N, and northeast to Cape Flattery (Washington)</p> <p>July-August cruise: transects perpendicular to shore that covered nearshore, shelf, slope, and oceanic habitats off Dixon Entrance, southeastern Alaska, Prince William Sound, Cook Inlet, Kodiak, Alaska Peninsula, and the North Pacific side of the eastern Aleutian Islands</p>	<p>northern region of southeastern Alaska including the following:</p> <p>Inshore waters: Auke Bay, Taku Inlet, False Point Retreat, Lower Favorite Channel;</p> <p>Straits: Upper Chatham Strait, Icy Strait, Cross Sound;</p> <p>Coastal waters (to 40 nm offshore): Icy Point and Cape Edward (June cruise only)</p>	<p>salmon survey southeast of Kodiak Island into the Gulf of Alaska:</p> <p>Cape Chiniak inshore monitoring transect: sampling 2.5 nm off of Cape Chiniak to 60 nm offshore;</p> <p>ocean survey: in the vicinity of 150°W, south from Kodiak to approximately 52°N</p>
Number of trawl stations	<p>April-May cruise: 65 July-August cruise: 63</p>	<p>October 1997 cruise: 14 May 1998 cruise: 11 June 1998 cruise: 23 July 1998 cruise: 31 August 1998 cruise: 25</p>	16

Table 2. List of contact persons and cruise reports for the salmon research cruises of the *F/V Great Pacific*, and the NOAA ships *John N. Cobb* and *Miller Freeman*.

Item	Inshore/Offshore Cruises (<i>Great Pacific</i>)	Southeast Alaska Monitoring Cruises (<i>John N. Cobb</i>)	Central Gulf of Alaska (<i>Miller Freeman</i>)
Contact Person	<p>Richard Carlson National Marine Fisheries Service Auke Bay Laboratory 11305 Glacier Hwy Juneau, AK 99801-8626 tel (907)789-6050, fax (907)789-6094 email: dick.carlson@noaa.gov</p>	<p>Joseph Orsi National Marine Fisheries Service Auke Bay Laboratory 11305 Glacier Hwy Juneau, AK 99801-8626 tel (907)789-6034, fax (907)789-6094 email: joe.orsi@noaa.gov</p>	<p>Richard Haight National Marine Fisheries Service Auke Bay Laboratory 11305 Glacier Hwy Juneau, AK 99801-8626 tel (907)789-6052, fax (907)789-6094 email: dick.haight@noaa.gov</p>
Cruise Reports	<p>Carlson, H.R., E.V. Farley, K.W. Myers, E.C. Martinson, J.E. Pohl, and N.M. Weemes. 1998. Survey of salmon in the southeastern Bering Sea, Gulf of Alaska and northeastern Pacific Ocean April-May, 1998. NPAFC Doc. 344. NMFS, Auke Bay Lab., Juneau. 33 pp.</p> <p>Carlson, H.R., E.V. Farley, E. C. Martinson, and C.M. Kondzela. 1998. Survey of salmon in the North Pacific Ocean and Gulf of Alaska—Dixon Entrance to Unimak Pass July-August, 1998. NPAFC Doc. 345. NMFS, Auke Bay Lab., Juneau. 25 pp.</p>	<p>Orsi, J.A., J. M. Murphy, and D.G. Mortensen. 1998. Survey of juvenile salmon in the marine waters of southeastern Alaska, May-August 1998. NPAFC Doc. 346. NMFS, Auke Bay Lab., Juneau. 26 p.</p> <p>Murphy, J.M. 1998. JC-98-05 Cruise Report. Auke Bay Lab., Juneau. 7 p.</p> <p>Orsi, J.A., J.M. Murphy, M.V. Sturdevant, and J. Boldt. 1998. JC-98-08 Cruise Report. Auke Bay Lab., Juneau. 9 p.</p> <p>Orsi, J.A., J.M. Murphy, D.G. Mortensen, and A.C. Werthheimer. 1998. JC-98-11 Cruise Report. Auke Bay Lab., Juneau. 9 p.</p> <p>Orsi, J.A., D.G. Mortensen, J.M. Murphy, and W.R. Heard. 1998. JC-98-15 Cruise Report. Auke Bay Lab., Juneau. 10 p.</p>	<p>Haight, R.E., N.M. Weemes, E.C. Martinson. 1998. Biological characteristics of sockeye and chum salmon in late winter (March-April) in the Gulf of Alaska. Auke Bay Lab., Juneau. (manuscript.)</p>

Table 3. Methods used for hydrographic sampling on board U. S. salmon research vessels operating between September 1997 and September 1998.

Item	Inshore/Offshore Cruises (<i>Great Pacific</i>)	Southeast Alaska Monitoring Cruises (<i>John N. Cobb</i>)	Central Gulf of Alaska (<i>Miller Freeman</i>)
Gear, model name, and manufacturer	CTD meter: SEACAT SBE 19-01: Sea-Bird Electronics Inc., Seattle, with DO sensor and fluorometer; surface (bucket) sampling used a YSI 30/50 salinity-temperature probe	CTD meter: SEACAT 19; Seabird SBE 23 thermosalinograph records temperature and salinity at 2-m depth every minute	CTD meter: Sea-Bird model 911 equipped with dual temperature and salinity sensors.
Vertical range of observations	0-300 m, or near bottom at shallower depths	0-200 m, or near bottom at shallower depths	0-500 m, or near bottom at shallower depths

Table 4. Methods used for zooplankton sampling on board U. S. salmon research vessels operating between September 1997 and September 1998.

Item	Inshore/Offshore Cruises (<i>Great Pacific</i>)	Southeast Alaska Monitoring Cruises (<i>John N. Cobb</i>)	Central Gulf of Alaska (<i>Miller Freeman</i>)
Net type and specifications	Bongo net: 0.60-m diameter, 253- and 505- μ m mesh:	Norpac: 0.50-m diameter, 243- μ m mesh; original Norpac design (see Fig. 1); WP-2: 0.57-m diameter, 202- μ m mesh; Bongo net: 0.60-m diameter, 333- and 505- μ m mesh	Bongo net: 0.60-m diameter, 333- and 505- μ m mesh
Vertical range of observations	0-200 m oblique tow, or near the bottom in shallow areas	Norpac: 0-20 m WP-2: 0-200 m vertical tow, or near the bottom in shallow areas Bongo: 0-200 m oblique tow, or near the bottom in shallow areas	0-200 m oblique tow (some to 100 m)
Comments	Bongo nets equipped with a flow meter in each opening; zooplankton preserved in 5% formalin	Bendix time-depth recorder was used on the bongo net to record maximum sampling depth; for deep tows (0-200 m) the WP-2 was equipped with General Oceanics or Roshiga flow meters; zooplankton settling volumes (ml) were estimated by letting a sample settle out over 24 hrs in a 1000-l Imhof cone.	Bongo net equipped with a General Oceanics flow meter; Sea-Cat CTD was attached to the wire above the bongo net to monitor depth, temperature, and salinity while towing; samples preserved in 5% formalin

Table 5. Methods used for salmon sampling on board U. S. salmon research vessels operating between September 1997 and September 1998.

Item	Inshore/Offshore Cruises (<i>Great Pacific</i>)	Southeast Alaska Monitoring Cruises (<i>John N. Cobb</i>)	Central Gulf of Alaska (<i>Miller Freeman</i>)
Gear type	400/580 midwater rope trawl (Cantrawl)	Nordic rope trawl model 264 (NorEastern Trawl Systems) modified to fish at the surface	400/580 midwater rope trawl (Cantrawl); same net as used on the <i>Great Pacific</i> used for surface tows; Aleutian wing trawl 20/26 (AWT) used for deeper tows
Targeted salmon life history stage	juveniles, immature, and maturing	juveniles , immature, and maturing	immature and maturing
Gear size, specifications	198 m long; typical mouth opening 52- m horizontal and 18-m vertical spread; codend has a 1.2-cm mesh liner; 5-m trawl doors, each weighs 463 kg; net monitored by a Simrad 300 netsounder; hexagonal mesh in the wings and body of the trawl	184 m long; typical mouth opening 30- m horizontal and 24-m vertical spread; codend is 6.1-m long with 0.8-cm mesh knotless liner 3-m trawl doors, each weighs 544 kg; to minimize escape of fish behind the headrope a small mesh panel (10.2 cm) was incorporated onto the top panel of the trawl.	Cantrawl: typical mouth opening 44-m horizontal and 16-m vertical spread; AWT: at depths below 20 m, typical mouth opening 36-m horizontal and 16- m vertical spread; Westmar net scanner provided data on depth of the head rope and spread of the net opening
Usual setting or towing time	30 or 60 min tow duration; generally trawl towed during the daytime	20 min tow duration; trawl towed during the daytime	tows of various duration; trawl towed all times of the day
Towing speed	5 kts	3 kts	3-4 kts
Usual towing or setting depth	0-13 m	0-18 m	Cantrawl: 0-16 m; AWT: minimum depth 15 m and test fishing as deep as 300 m
Comments	salmon and other fishes sorted and counted; length and weight recorded, scales collected; genetic samples collected (eye, heart, liver, muscle), otoliths, blood serum, samples for stomach content analysis; some lengths measured with a Limnotera FMB-IV electronic measuring board and weights measured with a Marel M2000 electronic platform scale	many juveniles caught and a few immature chinook and adult salmon caught; catch sorted, anaesthetized, identified, counted, measured, inspected for the presence of a coded-wire tag, salmon bagged, and frozen; fork length (mm) measured with a Limnotera FMB IV electronic measuring board	salmon caught in both trawls; salmon length and weight measured, scale sample collected, salmon frozen whole; later (in the laboratory) sex, maturity, stomach contents, otoliths, and other tissues were collected