

AN ESTIMATE OF TOTAL 1992 HATCHERY RELEASES OF
JUVENILE SALMON, BY COUNTRY, INTO WATERS OF
THE NORTH PACIFIC OCEAN
AND ADJACENT SEAS

by

William Heard

AUKE BAY LABORATORY
Alaska Fisheries Science Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
11305 Glacier Highway
Juneau, AK 99801-8626, U.S.A.

Submitted to the
NORTH PACIFIC ANADROMOUS FISH COMMISSION
by the
UNITED STATES OF AMERICA

OCTOBER 1995

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:

Heard, W. R. 1995. An estimate of total 1992 hatchery releases of juvenile salmon, by country, into waters of the North Pacific Ocean and adjacent seas. (NPAFC Doc.) Auke Bay Fisheries Laboratory, Alaska Fisheries Science Center, NMFS, NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626. 6 pp.

Abstract

This report provides an estimate, by country and species, of the total number of juvenile salmon released into the North Pacific basin from hatchery and other artificial propagation programs in 1992. The estimate of 5.5 billion juveniles in 1992 is a significant increase over estimates of 2.3 and 4.4 billion respectively in 1976 and 1985. Chum salmon represent 55 percent of the current total followed by pink salmon that accounted for 29 percent of the total. Much of the increase is from Alaska, where releases of hatchery salmon increased from 6 million in 1976 to 1.3 billion in 1992. Questions about carrying capacity of Pacific basin waters for salmonids and reductions in average sizes of some species, concomitant with record harvest levels of adults in many regions, have given increased emphasis to the need for current information on the magnitude of artificial propagation programs. New protocols established by NPAFC are needed to provide a workable mechanism for annually updating data presented in this report.

Introduction

Recent scientific discussions on how potential global climate changes may affect oceanic ecosystems have raised questions of possible effects on fish stocks and populations. Important among these issues are concerns about carrying capacity of the North Pacific Ocean for salmonid fishes. While the abundance of certain stocks in some regions have declined to the point of being endangered or threatened with extinction (Nehlson et al. 1991) , the abundance and well being of populations in many other regions are generally good. For example, salmon runs in both Japan and Alaska in recent years are at or near all time record high levels (Kaeriyama and Urawa 1992; Burger and Wertheimer 1995; Wertheimer in press). It has been suggested (Zorpette 1995) that "the total number of salmon in the Pacific is higher now than ever before".

Changes in biological characteristics of salmon population have been associated with shifts in environmental conditions including climatic influences, selective commercial fishing pressures, and changes in population abundance (Ricker 1981; Kaeriyama and Urawa 1992; Bigler and Helle 1994). When two or more of these factors occur concurrently, precise cause and effect changes in biological characteristics of populations are difficult to identify. Both Kaeriyama and Urawa (1992) and Bigler and Helle (1994) have noted recent decreases in average body

size and increases in age at maturity of certain salmon stocks and suggest these changes may be a reflection of density-dependant effects due to increased population abundance.

Procedure

Concomitant with recent increases in abundance of adult salmon in the Pacific basin have been increases in the numbers of juvenile salmon released from hatcheries and enhancement programs. While relatively good data are available on releases of juvenile salmon from some regions and countries, overall summary data for the entire basin are generally not available. This report was developed to provide an estimate of the total number of juvenile salmon released into the Pacific basin in 1992. The particular year was selected to represent recent conditions when all relevant data would be analyzed and available. Data from the Pacific Northwest of the United States was the most difficult region to assemble due to the large number of organizations and agencies that operate hatcheries and release juvenile salmon in that area.

Results and Discussion

The total number of juvenile salmon from hatcheries and other ocean ranching programs released into the North Pacific Ocean and adjacent seas in 1992 was 5.512 billion (Table 1). This number represents a substantial increase over estimates of 2.3 billion in 1976 (McNeil 1979) and 4.4 billion in 1985 (McNeil 1988). Much of this increase comes from Alaska, where in 1976 only 6 million hatchery salmon were released (McNeil 1979) compared with 1.346 billion in 1992 (Table 1). Chum salmon juveniles are produced in the largest numbers accounting for 55 percent of the 1992 estimate. Pink salmon were second accounting for 29 percent of the total. The greatest percentages of juveniles released by country was Japan 40%; United States 33%; and Russia 16%. Asian releases amounted to 56% of the total. In North America 42.2 million juveniles were released in 1992 with coded wire tags for management and research purposes (Johnson and Longwill 1993).

These data represent numbers released at hatchery and enhancement sites and not necessarily the numbers actually entering ocean waters. In the Columbia River drainage of the United States for example, a high percentage of hatchery juveniles

released may not reach the ocean due to mortalities associated with downstream passage over several dams (K. Johnson, personal communication, Pacific States Marine Fisheries Commission).

New protocols established by NPAFC are needed to provide workable mechanisms for annually updating data presented in Table 1.

Literature Cited

- Bigler, B. S. and J. H. Helle. 1994. Decreasing size of North Pacific salmon (*Onchyrhynchus sp.*): possible causes and consequences. (Document submitted to the Annual Meeting of NPAFC, Vladivostok, Russia, October, 1994) Ward Cove Packing Company, P. O. Box C-5030, Seattle, WA. 98105.
- Burger, C.V. and A.C. Wertheimer. 1995. Pacific salmon in Alaska. pp. 343-347 *In*: LaRoe, E.T., G.S. Farris, C.E. Puckett, P.D. Doran, and M. J. Mac [eds.]. Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. U.S. Dept. of Interior, NBS, Washington, D.C.
- Johnson, J. K. and J. R. Longwill. 1993. Pacific salmonid coded wire tag releases 1986-1992. Pacific States Mar. Fish. Comm., Gladstone. OR..
- Kaeriyama, M. and S. Urawa. 1992. Future research by the Hokkaido Salmon Hatchery for the proper maintenance of Japanese salmon stocks. pp. 57-62. *In*: Y. Ishida, K. Nagasawa, D. Welch, K. Meyers, and A. Shershnev [eds.]. Proceedings of the international workshop on future salmon research in the North Pacific Ocean. Spec. Pub. Nat. Res. Inst. Far Seas Fish. 20. Shimizu, Japan
- McNeil, W. J. 1979. Review of transplantation and artificial recruitment of anadromous species. pp. 547-554. *In*: T.V.R. Pillay and W. A. Dill, [eds.]. Advances in Aquaculture. FAO, Fishing News Books Ltd., L. Farnham, England.

- McNeil, W. J. 1988. Afterward. p. 187-188. *In*: W. J. McNeil, [ed.]. Salmon production, management, and allocation-biological, economic, and policy issues. Oregon State Univ. Press, Corvallis, OR.
- Nehlsen, W., J. Williams, and J. Lichatowich. 1991. Pacific salmon at the crossroads: stocks at risk from California, Oregon, Idaho, and Washington. *Fisheries* 16 (2): 4-21.
- Ricker, W. E. 1981. Changes in the average size and average age of Pacific salmon. *Can. J. Fish. Aquat. Sci.* 38: 1636-1656.
- Wertheimer, A. C. in press. Status of Alaska salmon. *In*: D. J. Stouder, P. A. Bisson, and R. J. Naiman, [eds.]. Pacific salmon and their ecosystems: status and future options. Proceedings of a Symposium , Seattle, Wa., Jan. 10-12, 1994. Chapman Hall, Inc. New York.
- Zorpette, G. 1995. So many salmon, but so little. *Sci. American*, May, 1995. p 21-22.

Table 1. Estimates for numbers of juvenile salmon released into the North Pacific Ocean and adjacent seas in 1992 by hatcheries, enhancement and ocean ranching programs, in millions of fish.

Country/Region	Species						Totals
	Pink	Chum	Sockeye	Coho	Chinook	Masu	
Canada ¹	64.7	200.4	286.3	23.5	58.8	---	633.7
China ²	---	1.0	---	---	---	---	1.0
Japan ³							
Hokkaido	140.8	1,053.9	2.9	---	---	13.5	1,211.1
Honshu	---	987.7	---	---	---	3.4	991.1
Korea ²	---	10.0	---	---	---	---	10.0
Russia ⁴							
Sakhalin/Kuriles	584.5	206.8	---	---	---	---	791.3
Other	11.7	67.7	0.2	0.1	0.1	---	79.8
United States							
Alaska ⁵	802.8	436.4	75.3	20.7	10.9	---	1,346.1
Other ⁶	2.4	66.1	0.2	112.2	267.0	---	447.9
Totals	1,606.9	3,030.0	364.9	156.5	336.8	16.9	5,512.0

¹ Data from E. A. Perry, SEP, Canada DFO.

² Data from China and Korea provided by H. Kawamura, Hokkaido Fish Hatchery.

³ NPAFC Doc. 40.

⁴ Data from F. Rukhlov, Sakhalin Branch, TINRO.

⁵ Data from NPAFC, Doc. 33; W. R. Heard, NMFS; S. Leask, Metlakatla Indian Community.

⁶ Data from K. Johnson, PSMFC; L. Blankenship, WDF&W; C. Corrarino, ODF&W; and F. Fisher, CDFG.