PRELIMINARY REPORT ON THE USE OF PARASITES AS BIOLOGICAL TAGS FOR THE STOCK IDENTIFICATION OF OCEAN-CAUGHT CHINOOK SALMON, ONCORHYNCHUS TSHAWYTSCHA

by

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Introduction

The chinook salmon (Oncorhynchus tshawytscha (Walbaum)) is widely distributed in the northern North Pacific Ocean and adjacent seas (Major et al., 1982). They have been heavily exploited by commercial and sport fisheries along the coasts of Canada and the United States, and also, to a lesser extent, utilized by Japanese offshore and Soviet coastal fisheries. In spite of their commercial importance, little information is available on their ocean life.

The continent of origin of each species of Pacific salmon (Oncorhynchus spp.) and steelhead trout (Salmo gairdneri Richardson) caught on the high seas has been a matter of concern to the International North Pacific Fisheries Commission (INPFC). Various approaches, such as tagging, scale-pattern, parasitological, morphological, and genetical studies, have been made for determining the freshwater areas of origin and the ranges of high-seas distribution of certain stocks of various anadromous salmonids by investigators of Canada, Japan, and the United States. Of these, Canadian parasitological studies have contributed highly to delineation of the ocean distribution of sockeye salmon (O. nerka (Walbaum)) of Kamchatkan and Bristol Bay origins (Marglois, 1963) and of steelhead trout of western North American origin (Margolis, 1984MS, 1985MS).

The present report gives information obtained from preliminary parasitological studies of ocean-caught chinook salmon and discusses a possibility of using naturally occurring parasites as biological tags for identifying the geographical origin of chinook.

Materials and methods

Forty-three chinook salmon caught by Japanese research vessels were examined (Table 1, Fig. 1): 30 fish, designated as "Bering samples", were collected in the central Bering Sea in July of 1986, and the remaining 13 fish, designated as "western North Pacific samples", taken in the North Pacific Ocean between 41° and 46° N from 166° to 174° E in May of 1982. On board the vessels, each fish was processed by recording fork length, body weight, sex, and gonad weight, and a scale sample for age determination was taken from the INPFC-preferred area of the body. The fish were then placed in bags with records of location and date of capture and immediately deep-frozen. They were brought to the laboratory and maintained in the frozen state until dissected for parasito-

logical studies.

After the fish were thawed, their following parts (the Bering samples only) were subjected to an examination for both protozoan and metazoan parasites: body surface, fins, buccal and branchial cavities, gills, eyes, medulla oblongata, heart, swimbladder, liver, kidney, spleen, gallbladder, stomach, pyloric caeca, intestine, and body musculature (half of dorsal portion excluded). Due to bad conditions of the fish samples, an examination for parasites in the urinary bladder could not be made. On the other hand, the western North Pacific samples were examined only for the presence of myxosporidians in their medulla oblongata.

Results and discussion

Parasite fauna

Ten species of parasites were recovered from the chinook salmon (Table 2): 1 Protozoa (Myxozoa: Myxosporea); 1 Trematoda (Digenea); 4 Cestoda; 2 Nematoda; 1 Acanthocephala; and 1 Copepoda. Of these, most species (8/10) were acquired at sea, but only two species, Myxobolus arcticus and Diphyllbothrium sp. in fresh water.

Since the taxonomy of M. arcticus and related species is confused, we identified the "pyriform" spores as M. arcticus based on the description of Pugachev and Khlokhlov (1979). This species may be often conspecific with "Myxobolus neurobius" that appears in the literature.

Potential of using parasites as biological tags

Of the parasites recovered, the myxosporean M. arcticus may be useful for stock identification of ocean-caught chinook salmon. There was a marked difference in prevalence of M. arcticus infection between the Bering samples and the western North Pacific samples: the latter were frequently (53.8%) infected with this parasite, whereas no infection was found in the former (Table 1). Because M. arcticus is a freshwater parasite, this difference may be caused by a difference in the geographical origin of respective samples.

In particular, the western North Pacific samples contained one "maturing" fish which was infected with M. arcticus, although they consisted mostly of immature fish. This finding indicates that the infected fish was returning to

its Asian natal river for spawning and that chinook salmon of Asian origin carry M. arcticus. Thus, there is a possibility that M. arcticus is useful as a biological indicator of the Asian origin of chinook salmon.

However, the use of M. arcticus as a biological tag for stock separation should be waited until more is known about the taxonomy of M. arcticus and related species and about their geographical distribution. Myxobolus arcticus is distributed in the Far Eastern Soviet Union, but Arthur et al. (1976) found "Myxobolus neurobius" (probably M. arcticus) in salmonids in the upper part of the Yukon River, which is one of the most productive rivers of chinook salmon in the western Alaska. In future, the following studies would be expected for the stock identification of ocean-caught chinook salmon by using M. arcticus:

1) Solution of the taxonomic confusion of M. arcticus and related species (M. neurobius, M. kisutchi, and others).

2) More extensive parasitological survey of chinook salmon caught on the high seas of the North Pacific Ocean and Bering Sea.

3) Parasitological survey of chinook salmon (both adult and young) from i) western Alaskan rivers, ii) central Alaskan rivers, iii) southeast Alaskan and British Columbia rivers, and iv) Washington, Oregon, and California rivers.

4) Parasitological survey of chinook salmon of Asian origin.

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Table 1. Localities and dates of capture of chinook salmon examined for parasites, and prevalence of *Myxobolus arcticus* infection.

Position Lat.	Position Long.	Research vessel	Date of capture	No. examined	No. infected by *M. arcticus* (%)
55° 30'N,	177° 30'W	Wakatake maru	05-VII-86	10	0(0)
55° 30'N,	175° 30'W	Wakatake maru	06-VII-86	20	0(0)
Total (Bering samples)				30	0(0)
44° 35'N,	173° 35'E	Hoyo maru No. 53	07-V-82	4	2(50.0)
45° 32'N,	171° 31'E	Hoyo maru No. 53	09-V-82	2	0(0)
43° 30'N,	166° 30'E	Hoyo maru No. 53	18-V-82	1	1(100.0)
42° 29'N,	163° 30'E	Hoyo maru No. 53	24-V-82	2	2(100.0)
41° 47'N,	167° 30'E	Hokushin maru	10-V-82	4	2(50.0)
Total (western North Pacific samples)				13	7(53.8)

Table 2. Parasites recovered from chinook salmon caught on the high seas of the North Pacific Ocean and Bering Sea.

Parasite species	Site of infection	Origin
Protozoa (Myxozoa: Myxosporea)		
Myxobolus arcticus	medulla oblongata	FW*
Trematoda (Digenea) - adults		
Hemiurus levinseni	stomach and intestine	M*
Cestoda - adults		
Eubothrium crassum	pyloric caeca and intestine	M
Cestoda - metacestode stages		
Diphyllobothrium sp. plerocercoid	liver	FW
Nybelinia surmenicola plerocercoid	body cavity	M
Phyllobothrium caudatum plerocercoid	intestine	M
Nematoda		
Anisakis simplex larvae	somatic musculature	M
?*Contracaecum osculatum* larvae	intestine	M
Acanthocephala		
Bolbosoma caenoforme juvenile	intestine	M
Copepoda		
Lepeophtheirus salmonis adult	external body surface	M

*FW = acquired in fresh water
M = acquired in the marine environment

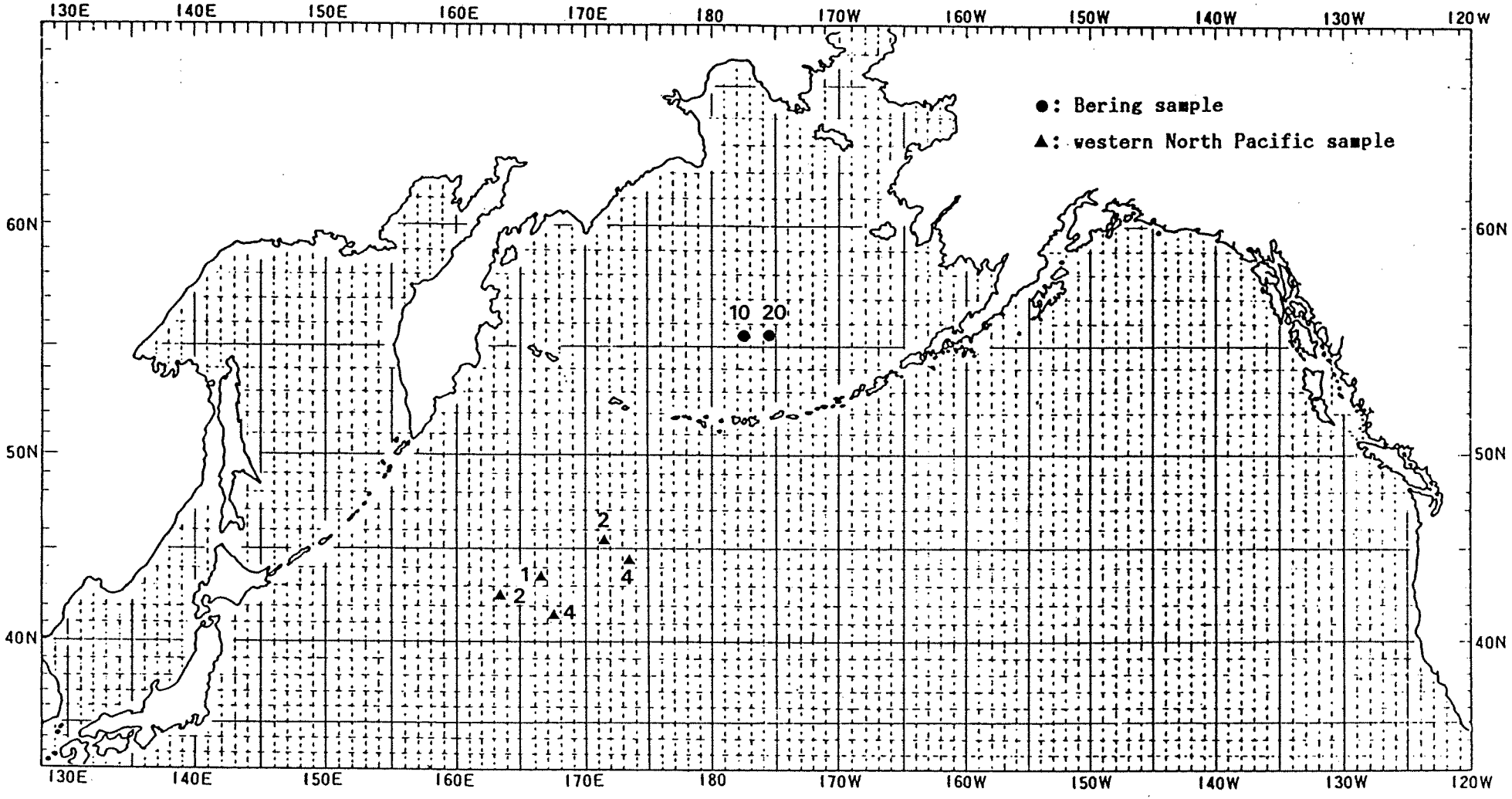

Fig. 1. Map of the North Pacific region showing the collection localities of chinook salmon. Numerals refer to the numbers of fish examined.