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STRAYING AND REPRODUCTION OF COHO SALMON, ONCORHYNCHUS KISUTCH, PLANTED IN A LAKE SUPERIOR TRIBUTARY [1]

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Introduction

Adult coho salmon, Oncorhynchus kisutch, planted as smolts in a Lake Superior tributary, strayed into many other tributaries of the lake and reproduced successfully (Fig. 1 and Appendix A). Population estimates of young-of-the-year coho salmon in five of these streams showed that this reproduction was substantial.

Beal (1955) and West (1965) demonstrated that coho salmon which spent their entire life in fresh water can produce young if the sex products are removed and the eggs fertilized and incubated in a hatchery. However, to my knowledge there has been no documented evidence of reproduction in a natural environment by coho salmon which spend their entire life in fresh water. Straying and natural reproduction of coho salmon in Lake Superior tributaries of Michigan during 1967-68 and their management implications are described below.

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[1] Contribution from Dingell-Johnson F-31-R, Michigan.

Background

In the fall of 1964, Columbia River coho salmon eggs were shipped to the Oden State Fish Hatchery at Oden, Michigan, by the Oregon Fish Commission (Tody and Tanner, 1966).[2] The eggs hatched during December 1964 and January 1965 and the fish were reared at Oden for about 1 year. In December 1965, 200,000 fingerlings were transferred to the Marquette State Fish Hatchery on Cherry Creek (Fig. 1). Five months later, on 16-17 May, 192,400 were released in the Huron River (Fig. 1). Two hundred were also released in Cherry Creek at the hatchery but since this number was so small practically all straying and reproduction must have resulted from the salmon planted in the Huron River. The coho smolts were 100-150 mm long (total length) and their average weight was 18 g when released. The Huron River planting site was 13 km above the mouth of the stream. Most smolts left the river within a week[3] and essentially all had entered Lake Superior within a month after planting.

In the fall of 1966, a few male coho that had reached sexual maturity before attaining full growth returned to the Huron River. Several fish were examined, and all had mature gonads with motile sperm. As was expected, sexually mature coho returned to the Huron

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[2] Tody, Wayne H., and Howard A. Tanner. 1966. Coho salmon for the Great Lakes. Michigan Dept. Conserv., Fish Mgmt. Rept. No. 1, 38 p.

[3] Personal communication from Asa T. Wright, Region I Great Lakes Fish Biologist.

River in the fall of 1967. A pulsed d-c electrical weir (McLain, 1957) was used to collect adult salmon for enumeration, egg taking and introduction into the Falls, Silver, and Yellow Dog rivers (Fig. 1). The weir was below most of the area suitable for salmonid spawning and about 1,200 mature coho salmon were passed above the weir. In addition, an estimated 500 adult salmon entered the area above the weir prior to its operation. Visual surveys were made on the Huron River and its tributaries to determine if the coho were spawning.

Straying

Adult coho salmon strayed extensively in the fall of 1967 (Fig. 1). Evidence of this straying was obtained by electrofishing, visual surveys, and confirmed catches of coho by anglers. While these data were useful for verifying the presence of salmon, numbers of fish were not determined closely, nor could absence of salmon be proven. During September-November 1967, biologists with the Michigan Department of Natural Resources conducted visual and electrofishing surveys on six Lake Superior tributaries west of the Huron River. Adult coho were found in the three largest streams. Catches of coho by anglers were confirmed for 11 other tributaries in this area.[4] From the Huron River east to Munising, state

[4] Miller, Barry R., and John A. Scott. 1968. Assessment of salmon and steelhead migrations, Huron River, Baraga County, Michigan, fall, 1967. Mich. Dept. Nat. Res., Fish Div., Dist. I Rept., 24 p.

biologists conducted surveys on 19 of 21 permanent tributaries and found adult coho in 7.[5] Robert Braem, biologist with the U. S. Bureau of Commercial Fisheries, and anglers provided reliable reports of coho in 9 more of these 21 streams. No surveys were conducted east of Munising but anglers caught coho in at least three streams in that area (personal communication, L. R. Anderson, District IV Fish Biologist).

Natural reproduction

In October and November 1967, state biologists observed coho spawning activity in Chinks Creek, a tributary of the Huron River. Thirteen redds were located and eggs were collected on 31 January 1968, with a hydraulic sampler (McNeil, 1960). The eggs were cleared with glacial acetic acid (Leitritz, 1960) and were found to be developing normally (Miller and Scott, 1968).[4]

On 12 June 1968, I collected 50 naturally reproduced young-of-the-year coho by electrofishing in a 305-meter section on the Anna River near Munising, Michigan (Fig. 1). These fish averaged 42 mm in total length. Since no young-of-the-year coho were observed here during an identical survey on 7 May, the fry probably emerged later in the month.

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[5] Johnson, David C. 1967. District III report of straying of coho salmon in Lake Superior tributaries in 1967. Mich. Dept. Nat. Res., Fish Div., 6 p.

During June-November 1968, state biologists conducted electrofishing surveys on 13 streams east of the Huron River and found young-of-the-year coho in 5 of them. Federal biologists found young-of-the-year coho in three additional streams while operating electrical weirs to monitor sea lamprey spawning runs. West of the Huron River only the two streams which received adult coho (Falls and Silver rivers) were surveyed and both contained young-of-the-year salmon.

During August and September 1967 and August-October 1968, I collected physical data and [illegible] rainbow trout (Salmo gairdneri) population estimates on five Lake Superior tributaries (Table 1 and Fig. 1). These streams were selected because they contained many juvenile rainbows and were small enough to be sampled effectively. All five streams contained brook trout (Salvelinus fontinalis) and cottids (Cottus bairdi and/or C. cognatus). Brown trout (Salmo trutta) were present only in the Anna River. The estimates for each stream were conducted on a section 305 m long and all the sections were located within 3 km of their respective stream mouths. The field procedure was similar to that reported by Shetter (1957), and the population estimates were computed by the method of Bailey (1951).

Young-of-the-year coho salmon were present in all five streams in 1968; none were found in 1967. My estimates of their abundance appear in Table 2. Chinks Creek enters the Huron River 3.2 km upstream from where coho smolts were planted in 1966. The

other four streams flow directly into Lake Superior. The Little Huron River is closest (3.2 km) to the Huron River; Union River is farthest away, entering Lake Superior 240 km from the Huron River. Except for Chinks Creek, which contained the most salmon, there was no association between fingerling coho abundance and distance from the Huron River.

Discussion

My data do not permit quantitative estimates of adult coho salmon that entered streams other than the Huron River, but they prove that straying was widespread and strongly suggest that it was substantial. The straying occurred over 90% of the Michigan shoreline of Lake Superior and as far away as 300 km from the Huron River. Of the 120 Michigan streams tributary to Lake Superior (Moore and Braem, 1965), stray coho were found in 33. However, salmon may have migrated into many others. Coho surveys were conducted on only 25 streams but were too superficial to determine either the abundance of salmon when they were found or proof of their absence when none were seen. Anglers might have contributed many more records if angling had not been restricted to 45 streams in the fall. The return to the Huron of only an estimated 8,200 fish (4% of the planting) reinforces my belief that straying involved a sizeable proportion of the Lake Superior coho.[4] However, lack of information on the survival rate in Lake Superior obviates an assessment of straying based on the return to the "home" stream.

Perhaps the straying is best explained by the following influences in the early life history of these coho: (1) The fish were reared in water of two different streams and planted in a third; and (2) they spent less time in the stream where they were planted (1-4 weeks) than the two in which they were reared. Hasler (1966) concluded that stream odor is the stimulus which guides adult salmon to their birthplace. The juveniles become imprinted with the odor before and during migration to the sea (or lake). However, the stage of development at which imprinting occurs and the duration of exposure required are not known for coho salmon or any other anadromous salmonid of the Great Lakes region. Imprinting of the smolts planted in the Huron River may have begun or been completed in the Oden or Marquette hatchery rearing ponds.

In the Platte River, a Lake Michigan tributary, a 1966 planting of coho smolts resulted in a 19.5% return of mature salmon to the planting site. These fingerlings were reared for 12 months prior to planting in water supplied by a Platte tributary and therefore they likely received a good imprint. Imprinting of fish planted in the Huron River might have been improved had they been reared in that stream or one of its tributaries. However, the possibility that mortality rates in Lake Superior and Lake Michigan are significantly different precludes a definite comparison of imprinting.

Coho released in the Huron River reproduced in at least 16 Lake Superior tributaries including the Huron River. A check on 17

of the 36 streams in which adults were found revealed young-of-the-year coho in 13. In addition, reproduction was discovered in three streams where the presence of adults had not been reported. Streams not surveyed for the presence of young coho included 19 where adults were found, 73 that were not checked for the presence of adults, and 8 that were checked but no adults found. Hence the number of streams where coho reproduced must be considerably more than 16.

Coho salmon natural reproduction has also been recorded for Platte River and Bear Creek, Lake Michigan tributaries which received coho smolt plantings in 1966.

Reproduction was substantial in some Lake Superior tributaries as shown by the population estimates in the five test streams (Table 2). The density of 4- to 5-month-old coho ranged from 2 to 95 fish per 100 m^2 of stream area. In comparison, density in a "good" western coho stream (Deer Creek, Oregon), was 150 4- to 5-month-old fish per 100 m^2 (Chapman, 1965). Growth of juvenile coho was faster in Michigan streams than in Oregon. The Michigan coho were 63-100 mm long (Table 2) as compared to 55-60 mm for the same age fish of the 1959-62 year classes in Deer Creek.

Young coho salmon and rainbow trout collected during the August 1968 population estimate in the Union River are shown in Figure 2. Their average total lengths were 54 mm (age 0 rainbow trout), 112 mm (age I rainbow trout) and 70 mm (age 0 coho salmon).

Planted coho salmon reproduced successfully in many streams and may result in self-perpetuating populations in Lake Superior and its tributaries. The effect of planted salmon, their progeny, and/or possible self-perpetuating salmon populations on "native" species cannot now be predicted. Will there be severe competition between salmon and native species or will salmon fill an unoccupied niche? Monitoring of coho abundance, growth, food habits and possible competition with other species is essential to answer this question.

The continued introduction of non-imprinted salmon will most surely result in widespread straying and reproduction. Imprinting could significantly reduce straying and concentrate the mature fish for optimum angling and commercial harvest, but knowledge regarding the physiology of imprinting is scant. There is a need for good practical methods of imprinting for future plantings of coho salmon in the Great Lakes.

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INSTITUTE FOR FISHERIES RESEARCH

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Table 1.--Physical characteristics in 305-meter sampling sections of five Lake Superior tributaries, 1968

Stream	Month measured	Average width (m)	Average depth (cm)	Volume of flow (m^3/sec)	Water temperature (° C)	Conductivity (μmho/cm^3 at 18° C)	Type of substrate[a] (estimated percentage)					Estimated salmonid spawning area (m^2)
							B	G	S	SS	DB	
Little Garlic River	Aug.	5.9	20	0.2	19	137	59	35	4	-	2	446
Union River	Aug.	4.1	15	0.1	17	215	25	61	13	-	1	701
Chinks Creek	Aug.	4.5	18	0.1	11	145	25	53	2	15	1	615
Anna River	Sep.	6.2	55	1.0	8	208	9	24	51	3	13	314
Little Huron River	Oct.	4.8	18	0.2	9	148	49	42	9	-	-	380

[a] B = boulders, G = gravel, S = sand, SS = silt-sand, DB = debris.

Table 2. --Estimated populations of naturally reproduced young-of-the-year coho salmon in 305-meter sections of five Michigan streams tributary to Lake Superior, 1968

Stream	Dates of sampling	Population estimate	95% confidence limits	Coho per 100 m^2	Average total length (mm)
Little Garlic River	5-7 Aug.	473	278-1,480	27	70
Union River	12-14 Aug.	743	612- 924	59	70
Chinks Creek	26-27 Aug.	1,292	1,020-1,624	95	63
Anna River	25-26 Sep.	91	74- 129	5	100
Little Huron River	8-9 Oct.	29	19- 107	2	75

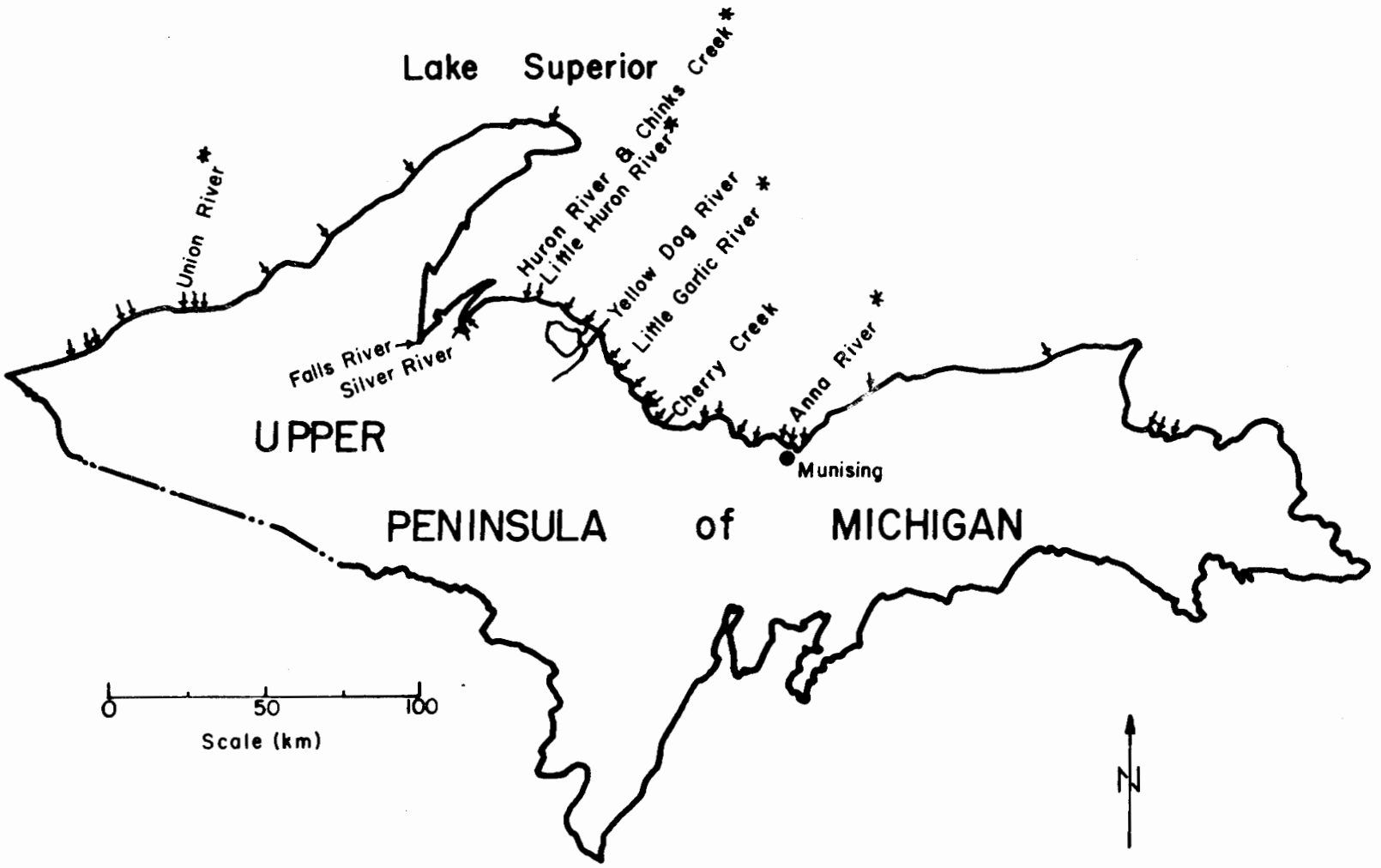

Figure 1.--Dispersion of coho salmon in Michigan tributaries of Lake Superior in 1967 and 1968, as indicated by arrows along shoreline. Population estimates were made in streams marked with an asterisk.

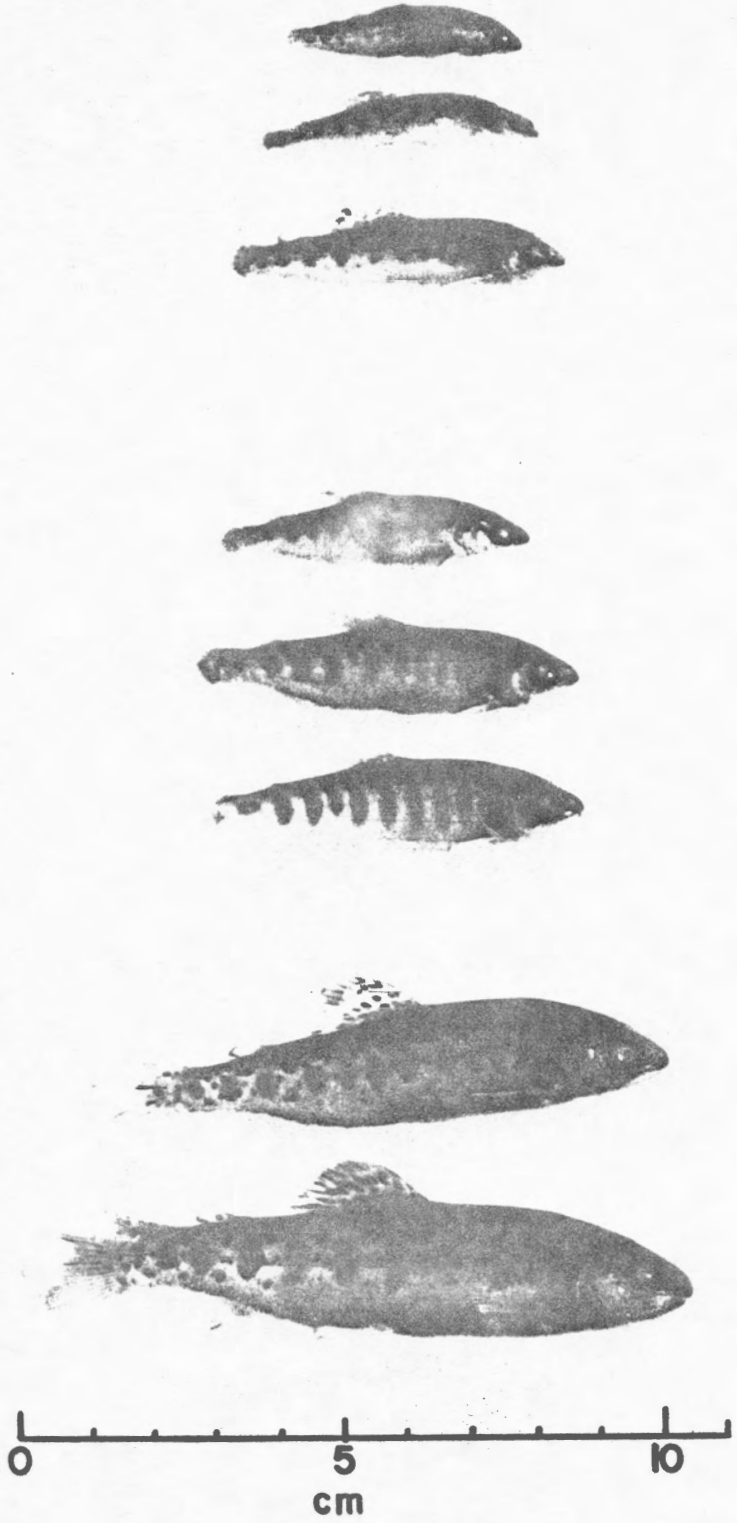

Figure 2.--Age 0 rainbow trout (top 3), age 0 coho (middle 3) and age I rainbow trout (bottom 2) collected in the Union River in August 1968.

Appendix A. --Michigan tributaries of Lake Superior known to contain either stray adult coho salmon in the fall 1967, or progeny during 1968

Stream	County	Stream	County
Maple Creek	Gogebic	Dead River	Marquette
Black River	Gogebic	Carp River	Marquette
Presque Isle River	Gogebic	Chocolay River	Marquette
Little Carp River	Gogebic	Sand River	Alger
Carp River	Ontonagon	Laughing Whitefish River	Alger
Union River	Ontonagon	Rock River	Alger
Little Iron River	Ontonagon	Au Train River	Alger
Iron River	Ontonagon	Furnace Creek	Alger
Firesteel River	Ontonagon	Anna River	Alger
Elm River	Houghton	Tannery Creek	Alger
McGunns Creek	Houghton	Seven Mile Creek	Alger
Fanny Hoe Creek	Keweenaw	Two Hearted River	Luce
Silver River	Baraga	Halfaday Creek	Chippewa
Slate River	Baraga	Grants Creek	Chippewa
Ravine River	Baraga	Pendills Creek	Chippewa
Little Huron River	Marquette		
Salmon Trout River	Marquette		
Iron River	Marquette		
Garlic River	Marquette		
Little Garlic River	Marquette		
Harlow Creek	Marquette		