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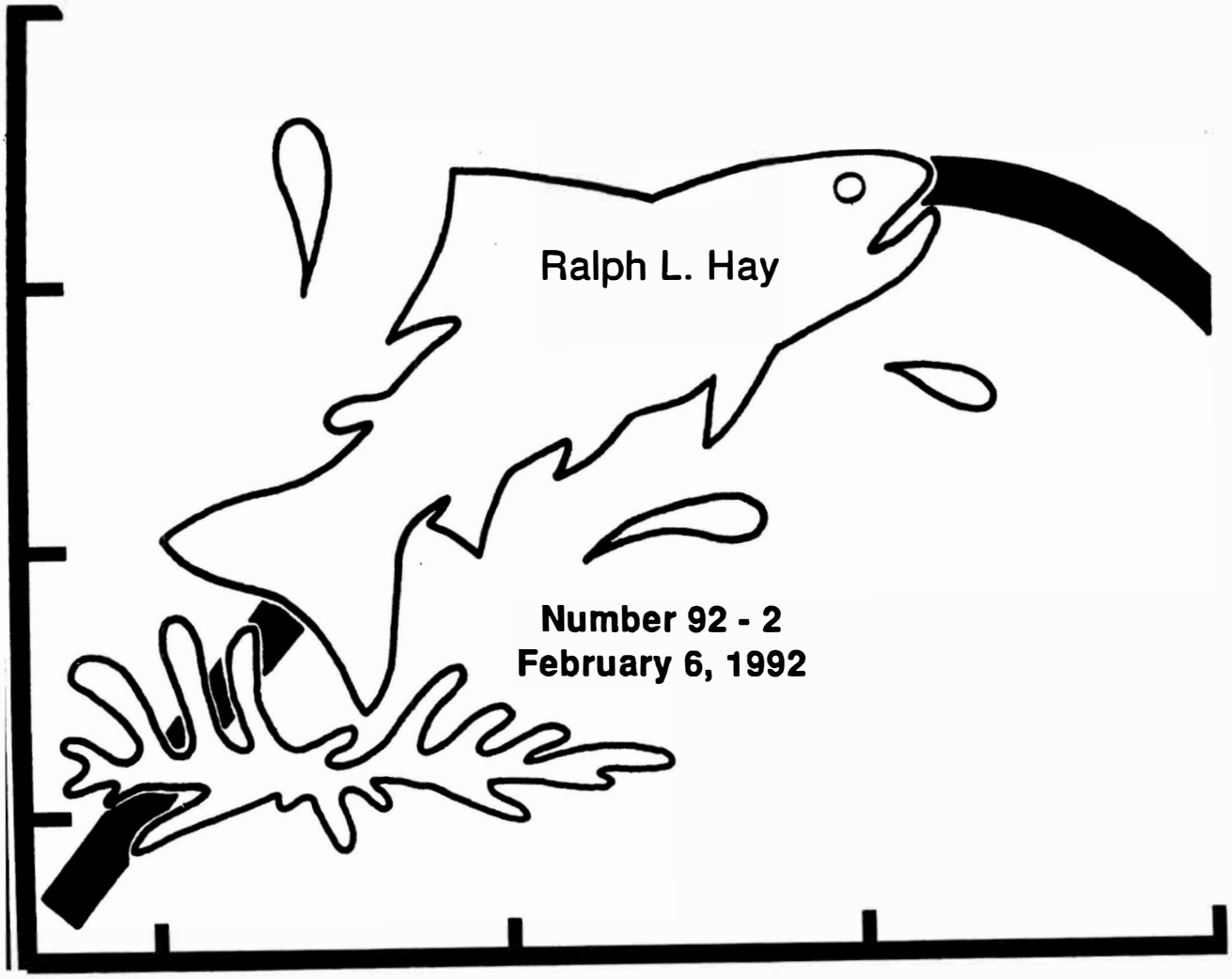
FISHERIES DIVISION

TECHNICAL REPORT

Boardman River Harvest Weir Report, 1990



Ralph L. Hay

Number 92 - 2
February 6, 1992

Michigan Department of
Natural Resources

MICHIGAN DEPARTMENT OF NATURAL RESOURCES
FISHERIES DIVISION

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Boardman River Harvest Weir Report, 1990

Ralph L. Hay

Michigan Department of Natural Resources
District Office #6
8015 Mackinaw Trail
Cadillac, Michigan 49601

Coho salmon *Oncorhynchus kisutch* and chinook salmon *O. tshawytscha* were stocked in Grand Traverse Bay early in the salmon program. However, because of the increased problems with large numbers of salmon returning to the Boardman River and nearby streams, it was decided to discontinue the salmon plants in the early 1980s.

In June 1984, the Traverse City Light and Power Department (TCLP), City of Traverse City, and the Michigan Department of Natural Resources (MDNR) signed an agreement forming a partnership in fisheries management of the Boardman River. By the following year, the MDNR began annual plantings of chinook salmon in the Boardman River to enhance the Grand Traverse Bay fishery and issued all permits necessary to produce hydroelectric power at the Boardman and Sabin dams. The TCLP Department constructed a fish ladder at Union Street dam and a fish trap-and-transfer/harvest facility between the Union Street dam and the mouth of the Boardman River (Figure 1).

The fish trap-and-transfer/harvest facility is located 0.8 mile upstream from Grand Traverse Bay and is within the City of Traverse City. This facility is named in honor of James P. Price, who was the first chairman of the Traverse City Light and Power Board and was instrumental in the agreement that was signed in 1984. Construction of the facility began early in 1987 and was completed by November. The fish ladder at the Union Street dam (1.2 miles upstream from Grand Traverse Bay) was completed about the same time as the harvest facility. Cost of both facilities including the land was about 1 million dollars.

Pacific salmon (*Oncorhynchus* sp.) are to be harvested at the weir each fall (September and October). The trout and Atlantic salmon *Salmo salar* are permitted to migrate upstream (through the fish ladder at Union Street dam) to Sabin dam. The fish ladder at Union Street dam is operational year-round. Each spring (April-July), metal plates with an overhanging lip are installed in the ladder to block the migration of adult sea lamprey *Petromyzon marinus*.

The 1984 agreement also created the Grand Traverse Area Fisheries Advisory Council. The council consists of 12 representatives from various interest groups and advises the MDNR on various fisheries issues in the area.

An average of 260,447 spring fingerling chinook have been planted annually in the Boardman River system since 1985 (Table 1). During this same time span, steelhead

O. mykiss plants have averaged 16,425 yearlings per year.

In aging anadromous fish, the number preceding the decimal denotes age at smolting (0 for most chinook, 1 for most coho) and the number following the decimal represents the number of annuli formed in the Great Lakes (mostly 0, 1, 2, 3, 4, or 5 for chinook and 0 or 1 for coho).

Chinook return to the weir at either age 0.0 (mini-jacks), age 0.1 (jacks), age 0.2, age 0.3, age 0.4, or age 0.5—but most commonly at age 0.3.

Harvest Weir Operations, 1990

On August 31, 1990, the weir grates were installed to block anadromous fish. On September 14, the ponds were filled and the fish ladder was activated. Harvest began on September 19. The weir remained operational until October 29, at which time the grates were removed and the building was winterized. The weir was in operation for 60 days. All harvested chinook and coho salmon were sold on contract to Tempotech Industries, Hart, Michigan. Steelhead and brown trout *Salmo trutta* were passed upstream of the weir.

Chinook Salmon

Harvest of chinook salmon began September 19 and ended October 29, a period of 40 days. A few chinook began entering the river shortly after the weir grates were installed. Migrations increased during September and peaked in early October (Table 2). A total of 6,236 chinook were harvested in 1990 (Table 3). The calculated total weight of all chinook, in the round, was 65,202 pounds.

For several weeks during the run, biological data were obtained from a randomly selected sample of 600 chinook to provide information on age composition and growth. To overcome the problem of aging river fish with reabsorbed scales, chinook salmon length frequencies were converted to age frequencies by means of a length-age frequency table (Table 4). Data for this table were obtained from scale samples and length measurements collected from Lake Michigan fish during a creel survey at several sites from August to October 1990. In applying the table to those length groups in which two or more age groups are represented, the lighter fish were assigned to the younger age group and the heavier fish to the older age group.

The estimated total harvest consisted of 1,915 (30.7%) age-0.1 jacks weighing 8,415 pounds; 1,140 (18.3%) age-0.2 adults weighing 10,787 pounds; 2,392 (38.4%) age-0.3 adults weighing 32,100 pounds; 768 (12.3%) age-0.4 adults weighing 13,418 pounds; and 21 (0.3%) age-0.5 adults weighing 482 pounds (Table 5). The absence of age-0.0 mini-jacks could be due to their ability to swim through the new, wider-spaced weir grates. The 1990 run of jacks represented 0.6% of the fingerlings stocked in 1989, age-0.2 adults were 0.4% of the 1988 plant, age-0.3 adults were 1.0% of the fingerlings stocked in 1987, age-0.4 adults were 0.3% of the fingerlings stocked in 1986, and age-0.5 adults were <0.1% of the fingerlings stocked in 1985 (Table 6).

Females constituted only about 21% of the total run—21.3% of age-0.2, 34.7% of age-0.3, and 33.7% of age-0.4 fish (Table 5). No age-0.1 or age-0.5 females were collected. The high percentage of males in the total run is in part due to returns of young fish (1988 and 1989 year classes) which are mostly males. Mean lengths and weights of males and females combined were: age 0.1 (males only), 22.4 inches and 4.4 pounds; age 0.2, 30.2 inches and 9.5 pounds; age 0.3, 33.8 inches and 13.4 pounds; age 0.4, 35.8 inches and 17.5 pounds; and age 0.5 (males only), 42.1 inches and 23.0 pounds (Tables 7 and 8). Growth was nearly linear on a weight basis (Figure 2). In general, females were slightly larger than males at each age.

Six hundred randomly selected chinook were examined for fin clips. Four (0.7%) had fin clips. The three clips observed were adipose (Ad, 1 fish), adipose-right pectoral (Ad-RP, 1 fish), and both ventrals (BV, 2 fish). Origin of the Ad fish could not be determined since it did not have a very small coded-wire tag in the snout. The Ad-RP fish

was planted in 1988 by the MDNR into Lake Huron at the Au Sable River (210,000 SF) and the BV fish were planted in 1988 by the MDNR into Lake Huron at Nunn's Creek (210,000 SF).

In addition to the random sample, five other clips were observed. The observed clips were adipose-right pectoral (Ad-RP, 1 fish), both ventrals (BV, 4 fish), left ventral-right pectoral (LV-RP, 3 fish), adipose-right ventral (Ad-RV, 2 fish), and adipose (Ad, 2 fish). Origin of the Ad-RP and BV fish have been mentioned previously. One LV-RP fish was planted in 1989 by the Indiana Department of Natural Resources (IDNR) into Lake Michigan at Trail Creek (100,000 SF), two LV-RP fish were planted in 1988 by the MDNR into Lake Huron at Swan Creek (284,000 SF), and both Ad-RV fish were planted in 1988 by the MDNR into Lake Huron at Harbor Beach (208,000 SF). Both Ad fish had a very small coded-wire tag in the snout. One was planted in 1987 by the MDNR into Lake Huron at Seymour Creek (130,000 SF), and the other was planted in 1987 by the MDNR into Lake Huron at Swan Creek (150,000 SF).

Only 2.5% of the chinook sampled had a lamprey wound (Table 9). This is considerably below the scarring rates in the 1960s and early 1970s (Hay 1989).

Chinook eggs were collected to supplement the egg-take operation at the Little Manistee River weir. On October 3, 730,000 eggs were collected for the Platte River Hatchery (Table 10). A total of 142 female chinook (ages 0.2, 0.3, and 0.4) were stripped, excluding those which yielded low-quality eggs or were otherwise unsatisfactory.

In an attempt to reduce the level of bacterial kidney disease (BKD) infection in chinook, each fish spawned was examined for gross clinical signs of BKD. Eggs and sperm from fish exhibiting any of the clinical signs (cloudy ovarian fluid; "cheesy" membranes on the spleen, liver or heart; bleeding from the vent; or swollen kidneys, sometimes with "pustules") were discarded and all utensils discarded or disinfected. The prevalence rate was 32.6% in males and 25.5% in females.

When the egg-take operation began, 90% of the females were ripe. The "dry" method of egg fertilization was employed. The "dry" method involved mixing eggs (from several females) with sperm in a 5-gallon plastic pail without water and letting the mixture stand for 10 minutes before water-hardening. The fertilized eggs were water-hardened in a 100 ppm iodophor solution for 30 minutes. The eggs were then placed in flowing river water for an additional 30 minutes prior to transportation. The 65.1% eye-up was better than last year, and more normal for chinook (Table 10).

A continuous recording thermometer was placed in the river at the weir on September 7 and removed October 28. River temperatures ranged from 67°F (September 7 and 11) to 44°F (October 28). Water temperature during egg-take ranged from 54°F to 55°F.

A random sample of 60 spawning chinook were inspected by the state pathologist for diseases and parasites. Analysis of the ovarian fluids for BKD showed that 100% of the chinook sampled were infected (J. Hnath, MDNR, personal communication).

In 1990 the estimated sport catch of chinook salmon from the West Arm of Grand Traverse Bay was 1,300 fish (G. Rakoczy, MDNR, personal communication). It would appear that about one-fifth of the returning chinook are taken by anglers and the remaining fish escape upstream to the weir.

Coho Salmon

In 1989, the coho harvest coincided with the chinook harvest (September 19 through October 29, a total of 40 days). The peak harvest occurred during the first week in October.

A total of 141 coho were harvested. The total weight calculated from biological samples was 820 pounds (Table 11).

The age composition of the harvested coho was 4 age-1.0 jacks weighing 9 pounds, and 137 age-1.1 adults weighing 811 pounds (Table 12). Because coho have not been planted in the Boardman River, this small

number represents fish that strayed from other planting locations or fish that were naturally reproduced in the river system. The total run consisted of 48.9% females. Mean lengths and weights were: age-1.0 males, 16.9 inches and 2.2 pounds; age-1.1 males, 26.0 inches and 6.1 pounds; age-1.1 females, 24.9 inches and 5.8 pounds; and age-1.1 sexes combined, 25.5 inches and 5.9 pounds (Tables 13 and 14). Adult males were slightly longer and heavier than females.

A total of 141 coho were checked for fin clips. Of these fish, only one (0.7%) had a fin clip. The adipose-right ventral fish was planted in 1988 by the Wisconsin Department of Natural Resources (WDNR) into Lake Michigan at the Kewaunee River (100,000 FF).

Only 0.7% of the coho had lamprey wounds (Table 9). This rate was significantly less than in the 1960s.

No coho eggs were taken at the Boardman River weir in 1990.

In 1990, the estimated sport catch of coho salmon from the West Arm of Grand Traverse Bay was only 100 fish (G. Rakoczy, MDNR, personal communication). This is due to the fact that no coho are planted in Grand Traverse Bay and that the few fish taken at the weir are strays from other planting locations or naturally produced fish from the Boardman River system.

Steelhead Trout

Only 66 steelhead (weighing 596 pounds) were collected during the weir operation (Table 15). This return is less than expected considering that the river has been stocked annually (Table 1). Skamania (summer strain) were planted in the Boardman River beginning in 1986. One possible explanation for the poor fall return is that the Skamania tend to migrate up the rivers prior to the installation of the weir in September and that the fall operation captures only the late migrants.

Based upon the five weekly samples, nearly 83% of the returning steelhead were age 1.3 (Table 16). Mean lengths and weights for the six different age groups are given in Table 17 and Figure 3. For all ages combined, the mean length and weight were 30.1 inches and 9.0 pounds (Table 15). Size of returning adults is more dependent upon years spent in Lake Michigan than on age at smolting.

A total of 60 randomly selected steelhead were examined for fin clips. Of these fish, 56 (93%) had a fin clip. The four fin clips observed were dorsal-adipose (Do-Ad, 43 fish), adipose (Ad, 9 fish), right-pectoral (RP, 3 fish), and left ventral (LV, 1 fish). The Do-Ad fish were planted in 1987 by the MDNR at several locations in Lake Michigan, including the Boardman River. They were the Skamania strain of summer steelhead. The Ad fish were not sacrificed in an attempt to recover the small coded-wire tag in the snout. However, aging (from scale samples) revealed that seven were age 1.4, and were planted in 1986 by the MDNR at several locations in Lake Michigan, including the Boardman River. Origin of two Ad fish could not be determined since fin clip, aging (from scale samples), and planting records did not coincide. The RP and LV fish were planted in 1987 by the WDNR into Lake Michigan at the Oconto River. The RP fish were Skamania.

None of the 60 fish examined had a lamprey wound. All steelhead were passed upstream (Table 15).

In 1990, the estimated sport catch of steelhead (rainbow) trout in the West Arm of Grand Traverse Bay was 1,000 fish (G. Rakoczy, MDNR, personal communication).

Brown Trout

Only 10 brown trout (weighing 45 pounds) were collected during the weir operation (Table 18). Despite large plants of brown trout into Grand Traverse Bay, the numbers returning to the river are very low. However, this is similar to data collected at the Little Manistee River weir (Hay 1989).

Based upon the four weekly samples, 90% of the brown trout were age 1.1 (Table 19). Mean length and weight of age-1.1, and

age-2.1 fish are found in Table 20. Size of returning adults is more dependent upon years spent in Lake Michigan than on age at smolting.

No fin clips or lamprey wounds were found on the eight fish examined. All of the brown trout were passed upstream (Table 18).

In 1990, the estimated sport catch of brown trout in the West Arm of Grand Traverse Bay was 700 fish (G. Rakoczy, MDNR, personal communication).

Pink Salmon

No pink salmon *O. gorbuscha* were harvested at the weir in 1990. Also, none were reported caught by anglers in the West Arm of Grand Traverse Bay (G. Rakoczy, MDNR, personal communication).

Lake Trout

No lake trout *Salvelinus namaycush* were collected at the weir in 1990. However, a few lake trout were in the river by late October. Immediately after the weir was opened (October 29), anglers observed them upstream at the Union Street dam.

In 1990, the estimated sport catch of lake trout from the West Arm of Grand Traverse Bay was 6,200 fish (G. Rakoczy, MDNR, personal communication). This catch occurred during the period from May 1 through August 15.

Summary

In 1990, the Boardman River harvest weir was in operation from August 31 through October 29 (60 days). Harvest of chinook and coho salmon and passage of other anadromous salmonids occurred from September 19 through October 29.

The entire salmon run of 6,236 chinook (65,202 pounds) and 141 coho (820 pounds) was harvested and sold to Tempotech Industries, Hart, Michigan.

The chinook run consisted of 1,915 age-0.1 jacks (0.6% of the 1989 fingerling plant); 1,140 age-0.2 adults (0.4% of the 1988 fingerling plant); 2,392 age-0.3 adults (1.0% of the 1987 fingerling plant); 768 age-0.4 adults (0.3% of the 1986 fingerling plant) and 21 age-0.5 adults (<0.1% of the 1985 fingerling plant). Mean sizes were: age 0.1 (males only), 22.4 inches (4.4 pounds); age 0.2, 30.2 inches (9.5 pounds); age 0.3, 33.8 inches (13.4 pounds); age 0.4, 35.8 inches (17.5 pounds); and age 0.5 (males only), 42.1 inches (23.0 pounds). Chinook eggs were taken again in 1990. On October 3, 142 females (ages 0.2, 0.3, and 0.4) were stripped to obtain 730,000 eggs. The 65.1% eye-up was better than the previous year.

The 1990 coho run was composed of 4 age-1.0 jacks and 137 age-1.1 adults. Percent returns could not be determined because coho have not been planted in the Boardman River. These were strays from other planting locations or naturally reproduced fish from the river system. No coho eggs were collected at the weir in 1990.

The 1990 steelhead run of 66 fish included six different age groups. Nearly 83% of these fish were age 1.3.

The 1990 run of 10 brown trout was comprised of age 1.1 (90.0%), and age 2.1 (10.0%) fish.

No pink salmon were observed in the river below the weir. However, a few lake trout appeared at the weir just prior to removal of the grates (October 29).

Recommendations for 1991

For chinook salmon, a percentage of the daily harvest should be sampled. For the remaining species biological data should be collected from all individuals. In addition to the random sampling biological data should be collected from any marked fish. Several modifications to the weir complex need to be done before the start of the 1991 season.

These major changes are as follows:

1) Install additional supports to the overhead beam that the lift baskets travel along.

2) Modify the loading dock area to permit the fork-lift to drive off the dock into the parking lot.

3) Eliminate the rough concrete from the walls of the holding panels. Scales are missing from fish that are held for several days.

4) Use an electronic weight scale. It is more precise and easier to read.

5) Apply a non-skid paint to the cement floors inside the building.

6) Reinforce the metal walkway grates around the ponds.

Acknowledgments

Data collection, tabulation, and scale reading for age analyses were done by Alfred Allen, Steve Lazar, Janice Sapak, Dann Manz, Peter Makoweski, and Tom Rozich. Various employees of Tempotech also assisted in the data collection. Technical advice was given by Charles Pecor and Kelley Smith. A computer program for age and data analyses was developed by Kelley Smith.

This partnership in fisheries management of the Boardman River would not have been possible if it were not for the cooperation of Traverse City Light and Power Department employees Thomas Miner, Robert Beagle, Rod Simsa, and Charles Fricke (Executive Director). Employees in various other departments of the city of Traverse City have contributed to this successful program. Finally, special thanks to William Strom, who has been involved with the project from the beginning. His knowledge and willingness to help from the planning process through construction and operation were greatly appreciated.

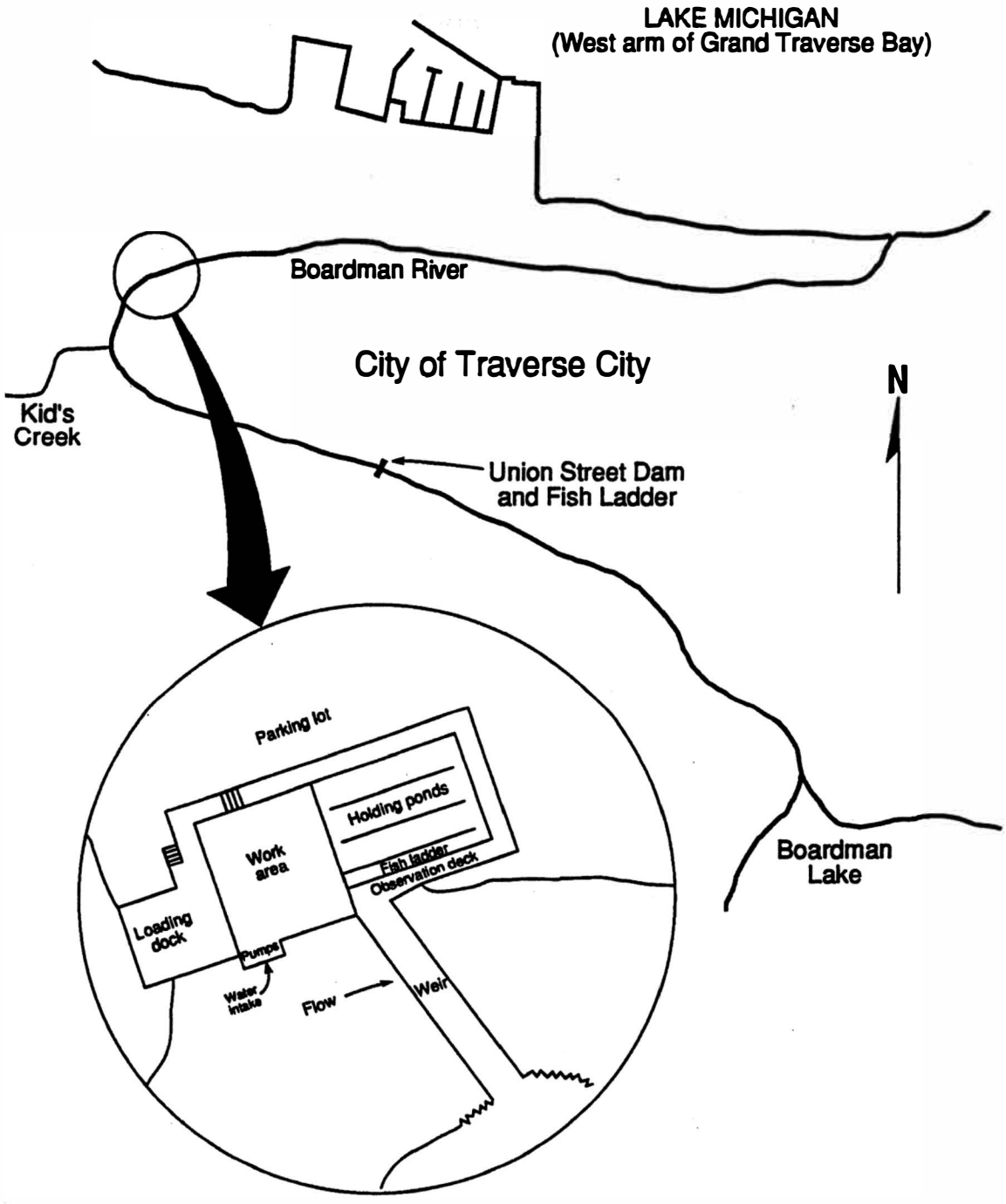

Figure 1.—Location and schematic diagram of the Boardman River weir complex in Traverse City.

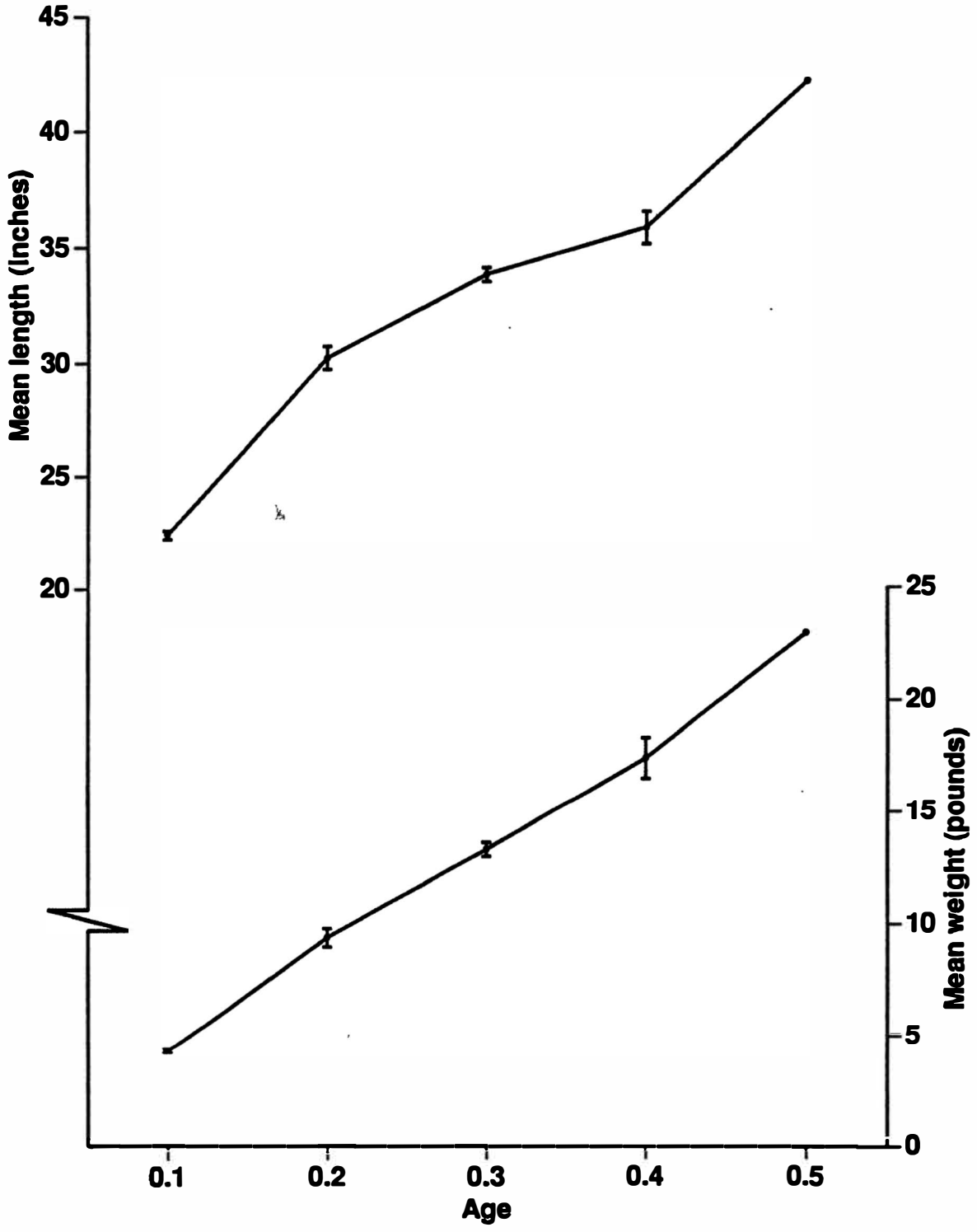

Figure 2.—Mean total length (inches) and round weight (pounds), by age, of chinook salmon harvested at the Boardman River weir, fall 1990. Vertical bars represent two standard errors.

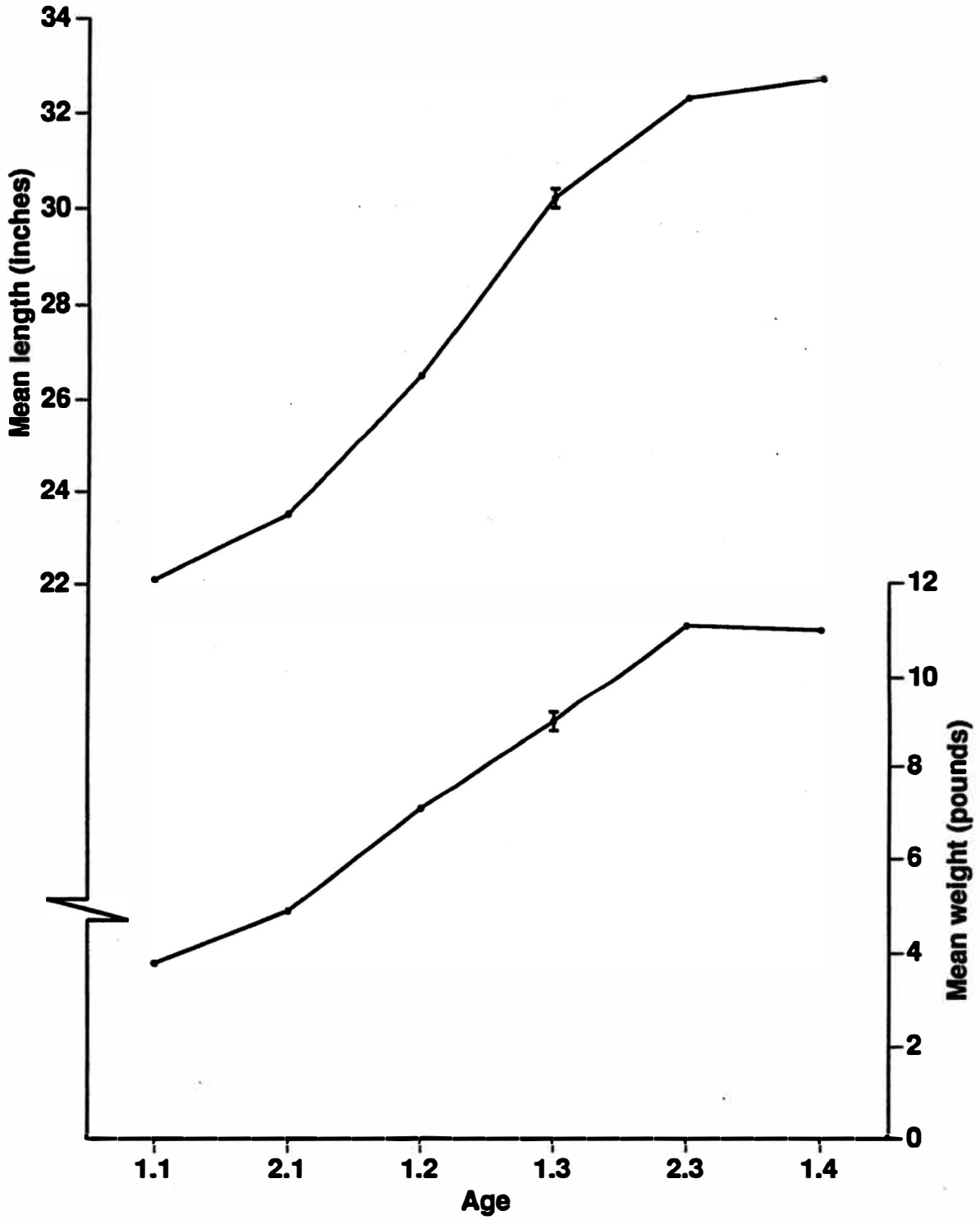

Figure 3.—Mean total length (inches) and round weight (pounds), by age, of steelhead passed upstream at the Boardman River weir, fall 1990. Vertical bars represent two standard errors.

Table 1.—Planting history of chinook salmon (spring fingerlings) and steelhead trout (spring yearlings) in the Boardman River, Grand Traverse County, since 1985. The chinook plants beginning in 1987 were moved to Kid's Creek, a major tributary to the Boardman River. Fin clips in parentheses (Ad = adipose, Do-Ad = dorsal-adipose, Mt-Ad = microtag-adipose, Ox-RV = oxytetracycline-right ventral).

Planting year	Chinook salmon	Steelhead
1985	190,022	14,000
1986	250,105	20,000 (Ad)
1987	238,500	17,547 (Do-Ad)
1988	277,000	15,000 (Mt-Ad)
1989	300,093	15,000 (Mt-Ad)
1990	306,964 (Ox-RV)	17,000
Total	1,562,684	98,547
Average	260,447	16,425

Table 2.—Number, by week, of salmon harvested and trout collected at the Boardman River weir, fall 1990.

Week beginning	Salmon		Trout	
	Chinook	Coho	Steelhead	Brown
09/16	544	27	30	2
09/30	1,635	22	14	6
10/07	2,426	33	12	1
10/14	643	22	6	0
10/21	597	19	0	1
10/28	391	18	4	0
Total	6,236	141	66	10

Table 3.—Number, by age, of chinook salmon harvested at the Boardman River weir, fall 1987-90. Weight (pounds) is in parentheses and was estimated using seasonal means.

Year	Age 0.0	0.1	0.2	0.3	0.4	0.5	Total
1987	1	1,210	677	1,588	1,335	91	4,902
	(<1.0)	(5,363)	(4,528)	(18,400)	(19,951)	(1,754)	(49,996)
1988	47	1,195	1,247	2,936	694	10	6,129
	(28)	(5,484)	(10,315)	(39,533)	(12,394)	(224)	(67,978)
1989	0	1,810	886	1,878	1,202	33	5,809
	(0)	(8,192)	(6,061)	(24,991)	(21,532)	(709)	(61,485)
1990	0	1,915	1,140	2,392	768	21	6,236
	(0)	(8,415)	(10,787)	(32,100)	(13,418)	(482)	(65,202)

Table 4.—Length-age distribution (in percent of inch group) for chinook salmon scale-sampled during creel survey at Ludington, Manistee, Frankfort, and Grand Traverse Bay, August-October 1990.[1]

Length (inches)	Age					
	0.0	0.1	0.2	0.3	0.4	0.5
<13	100	—	—	—	—	—
14	—	—	—	—	—	—
15	—	—	—	—	—	—
16	—	—	—	—	—	—
17	—	—	—	—	—	—
18	—	100	—	—	—	—
19	—	100	—	—	—	—
20	—	100	—	—	—	—
21	—	100	—	—	—	—
22	—	100	—	—	—	—
23	—	100	—	—	—	—
24	—	67	33	—	—	—
25	—	17	83	—	—	—
26	—	—	100	—	—	—
27	—	—	100	—	—	—
28	—	—	70	30	—	—
29	—	—	75	25	—	—
30	—	—	59	35	6	—
31	—	—	54	38	8	—
32	—	—	40	40	20	—
33	—	—	5	80	15	—
34	—	—	—	92	8	—
35	—	—	—	67	33	—
36	—	—	—	62	38	—
37	—	—	—	50	50	—
38	—	—	—	25	75	—
39	—	—	—	—	100	—
40+	—	—	—	—	75	25

[1]Table developed by District 6 personnel at the Harrietta warehouse.

Table 5.—Number and weight, by age and sex, of chinook salmon harvested at the Boardman River weir, fall 1990.

Week beginning	Male		Female		Total	
	Number	Pounds	Number	Pounds	Number	Pounds
Age 0.0						
09/16	—	—	—	—	—	—
09/30	—	—	—	—	—	—
10/07	—	—	—	—	—	—
10/14	—	—	—	—	—	—
10/21	—	—	—	—	—	—
10/28	—	—	—	—	—	—
Total	—	—	—	—	—	
(Percent)	—	—	—	—	—	—
Age 0.1						
09/16	92	403	—	—	92	403
09/30	360	1,497	—	—	360	1,497
10/07	922	4,033	—	—	922	4,033
10/14	283	1,284	—	—	283	1,284
10/21	137	621	—	—	137	621
10/28	121	577	—	—	121	577
Total	1,915	8,415	—	—	1,915	8,415
(Percent)	(30.7)	(12.9)	—	—	(30.7)	(12.9)
Age 0.2						
09/16	87	825	22	222	109	1,047
09/30	327	3,057	33	384	360	3,441
10/07	267	2,405	121	1,304	388	3,709
10/14	90	735	45	458	135	1,193
10/21	60	615	18	196	78	811
10/28	66	539	4	47	70	586
Total	897	8,176	243	2,611	1,140	10,787
(Percent)	(14.4)	(12.5)	(3.9)	(4.0)	(18.3)	(16.5)
Age 0.3						
09/16	158	2,098	71	1,062	229	3,160
09/30	474	5,966	196	2,808	670	8,774
10/07	558	7,373	315	4,471	873	11,844
10/14	90	1,097	77	1,135	167	2,232
10/21	191	2,432	113	1,586	304	4,018
10/28	90	1,173	59	899	149	2,072
Total	1,561	20,139	831	11,961	2,392	32,100
(Percent)	(25.0)	(30.9)	(13.3)	(18.3)	(38.4)	(49.2)

Table 5.—Continued:

Week beginning	Male		Female		Total	
	Number	Pounds	Number	Pounds	Number	Pounds
Age 0.4						
09/16	60	935	49	923	109	1,858
09/30	180	3,147	49	879	229	4,026
10/07	194	3,235	49	919	243	4,154
10/14	26	406	32	637	58	1,043
10/21	18	330	60	1,164	78	1,494
10/28	31	480	20	363	51	843
Total	509	8,533	259	4,885	768	13,418
(Percent)	(8.2)	(13.1)	(4.2)	(7.5)	(12.3)	(20.6)
Age 0.5						
09/16	5	119	—	—	5	119
09/30	16	363	—	—	16	363
10/07	—	—	—	—	—	—
10/14	—	—	—	—	—	—
10/21	—	—	—	—	—	—
10/28	—	—	—	—	—	—
Total	21	482	—	—	21	482
(Percent)	(0.3)	(0.7)	—	—	(0.3)	(0.7)

Table 6.—Numbers, and in parentheses percent, by age, of chinook salmon in various year classes returning to the Boardman River weir 0 to 5 years after stocking.

Year class	Number stocked	Age 0.0	0.1	0.2	0.3	0.4	0.5	Total
1985	190,022	—	—	677	2,936	1,202	21	4,836
		—	—	(0.4)	(1.5)	(0.6)	(<0.1)	(2.5)
1986	250,105	—	1,210	1,247	1,878	768	—	5,103
		—	(0.5)	(0.5)	(0.8)	(0.3)	—	(2.0)
1987	238,500	1	1,195	886	2,392	—	—	4,474
		(<0.1)	(0.5)	(0.4)	(1.0)	—	—	(1.9)
1988	277,000	47	1,810	1,140	—	—	—	2,997
		(<0.1)	(0.7)	(0.4)	—	—	—	(1.1)
1989	300,093	—	1,915	—	—	—	—	1,915
		—	(0.6)	—	—	—	—	(0.6)
1990	306,964	—	—	—	—	—	—	0
		—	—	—	—	—	—	(0.0)

Table 7.—Mean total length (inches) and weight (pounds), by age and sex, of chinook salmon harvested at the Boardman River weir, fall 1990. Two standard errors in parentheses.

Week beginning	Measurement	Age 0.0		Age 0.1		Age 0.2	
		Male	Female	Male	Female	Male	Female
09/16	Length	—	—	22.5	—	30.7	29.9
		—	—	(0.647)	—	(0.936)	(1.372)
	Weight	—	—	4.4	—	9.5	10.1
		—	—	(0.504)	—	(0.630)	(1.666)
09/30	Length	—	—	22.2	—	30.4	32.2
		—	—	(0.566)	—	(0.836)	(0.400)
	Weight	—	—	4.2	—	9.4	11.6
		—	—	(0.358)	—	(0.555)	(0.700)
10/07	Length	—	—	22.4	—	29.6	30.9
		—	—	(0.358)	—	(1.685)	(1.309)
	Weight	—	—	4.4	—	9.0	10.8
		—	—	(0.224)	—	(1.107)	(1.401)
10/14	Length	—	—	22.5	—	28.8	30.9
		—	—	(0.386)	—	(1.649)	(0.568)
	Weight	—	—	4.5	—	8.2	10.2
		—	—	(0.220)	—	(0.944)	(0.913)
10/21	Length	—	—	22.5	—	31.6	31.4
		—	—	(0.474)	—	(0.481)	(0.593)
	Weight	—	—	4.5	—	10.3	10.9
		—	—	(0.254)	—	(0.476)	(0.521)
10/28	Length	—	—	22.8	—	28.8	31.6
		—	—	(0.456)	—	(1.291)	—
	Weight	—	—	4.8	—	8.2	11.7
		—	—	(0.277)	—	(0.713)	—
Weighted seasonal mean	Length	—	—	22.4	—	30.0	31.1
		—	—	(0.210)	—	(0.605)	(0.670)
	Weight	—	—	4.4	—	9.1	10.7
		—	—	(0.131)	—	(0.395)	(0.732)
Sexes combined	Length	—		22.4		30.2	
		—		(0.210)		(0.507)	
	Weight	—		4.4		9.5	
		—		(0.131)		(0.381)	

Table 7.—Continued:

Week beginning	Measure-ment	Age 0.3 Male	Age 0.3 Female	Age 0.4 Male	Age 0.4 Female	Age 0.5 Male	Age 0.5 Female
09/16	Length	33.9	34.7	34.6	35.7	40.0	—
		(0.801)	(0.980)	(1.657)	(1.451)	—	—
	Weight	13.3	15.0	15.6	18.8	23.8	—
		(0.777)	(0.840)	(1.851)	(2.290)	—	—
09/30	Length	33.3	35.0	36.2	34.9	42.8	—
		(0.559)	(0.620)	(2.057)	(3.196)	—	—
	Weight	12.6	14.3	17.5	17.9	22.7	—
		(0.530)	(1.041)	(2.257)	(4.852)	—	—
10/07	Length	33.9	33.8	35.7	36.3	—	—
		(0.776)	(1.495)	(1.928)	(1.000)	—	—
	Weight	13.2	14.2	16.7	18.8	—	—
		(0.699)	(1.409)	(2.474)	(0.300)	—	—
10/14	Length	33.1	34.3	34.7	37.1	—	—
		(0.991)	(0.712)	(1.773)	(1.942)	—	—
	Weight	12.2	14.7	15.6	19.9	—	—
		(0.875)	(0.885)	(2.351)	(2.241)	—	—
10/21	Length	33.4	33.0	36.9	36.2	—	—
		(0.627)	(1.145)	(3.690)	(1.142)	—	—
	Weight	12.7	14.0	18.3	19.4	—	—
		(0.545)	(1.140)	(3.987)	(1.697)	—	—
10/28	Length	33.5	34.4	34.9	35.6	—	—
		(0.761)	(1.105)	(1.833)	(3.442)	—	—
	Weight	13.0	15.2	15.5	18.2	—	—
		(0.762)	(1.175)	(1.810)	(3.801)	—	—
Weighted seasonal mean	Length	33.6	34.1	35.7	36.0	42.1	—
		(0.339)	(0.602)	(1.037)	(0.774)	—	—
	Weight	12.9	14.4	16.8	18.9	23.0	—
		(0.311)	(0.604)	(1.236)	(1.098)	—	—
Sexes combined	Length	33.8		35.8		42.1	
		(0.307)		(0.726)		—	
	Weight	13.4		17.5		23.0	
		(0.304)		(0.902)		—	

Table 8.—Mean total length (L, in inches) and weight (W, in pounds), by age, of chinook salmon harvested at the Boardman River weir, fall 1987-90.

	Age											
	0.0		0.1		0.2		0.3		0.4		0.5	
Year	L	W	L	W	L	W	L	W	L	W	L	W
1987	10.9	0.5	22.8	4.4	26.6	6.7	33.0	11.6	35.4	14.9	38.1	19.3
1988	10.9	0.6	22.7	4.6	28.8	8.3	34.2	13.5	36.8	17.9	40.0	22.4
1989	—	—	23.0	4.5	26.2	6.8	33.6	13.3	36.1	17.9	41.0	21.5
1990	—	—	22.4	4.4	30.2	9.5	33.8	13.4	35.8	17.5	42.1	23.0

Table 9.—Percent lamprey scarring of anadromous salmonids captured at the Boardman River weir, fall 1987-90.

	Salmon		Trout	
Year	Chinook	Coho	Steelhead	Brown
1987	1.8	0.7	0.0	0.0
1988	1.7	0.0	0.0	0.0
1989	1.2	0.3	4.8	0.0
1990	2.5	0.7	0.0	0.0

Table 10.—Summary of the chinook egg-take operation at the Boardman River weir, fall 1990.

Date	Number of females stripped	Number of eggs collected	Percent eye-up	Destination
10/03	142	729,036	65.1	Platte River
Total	142	729,036	—	
In-state	142	729,036	—	
Out-of-state	—	—	—	

Table 11.—Number, by age, of coho salmon harvested at the Boardman River weir, fall 1987-90. Weight (pounds) is in parentheses and was estimated using seasonal means.

Year	Age 1.0	Age 1.1	Total
1987	45	261	306
	(62)	(1,651)	(1,713)
1988	29	448	477
	(50)	(2,745)	(2,795)
1989	0	288	288
	(0)	(1,785)	(1,785)
1990	4	137	141
	(9)	(811)	(820)

Table 12.—Summary of the number and weight, by age and sex, of coho salmon harvested at the Boardman River weir, fall 1990.

Week beginning	Male		Female		Total	
	Number	Pounds	Number	Pounds	Number	Pounds
Age 1.0						
09/16	1	1	—	—	1	1
09/30	1	2	—	—	1	2
10/07	1	3	—	—	1	3
10/14	1	3	—	—	1	3
10/21	—	—	—	—	—	—
10/28	—	—	—	—	—	—
Total	4	9	—	—	4	9
(Percent)	(2.8)	(1.1)	—	—	(2.8)	(1.1)
Age 1.1						
09/16	11	63	15	82	26	145
09/30	9	50	12	66	21	116
10/07	16	102	16	98	32	200
10/14	15	93	6	38	21	131
10/21	8	51	11	64	19	115
10/28	9	54	9	50	18	104
Total	68	413	69	398	137	811
(Percent)	(48.2)	(50.4)	(48.9)	(48.5)	(97.2)	(98.9)

Table 13.—Mean total length (inches) and weight (pounds), by age and sex, of coho salmon harvested at the Boardman River weir, fall 1990. Two standard errors in parentheses.

Week beginning	Measurement	Age 1.0		Age 1.1	
		Male	Female	Male	Female
09/16	Length	14.5	—	25.5	24.2
		—	—	(1.191)	(1.213)
	Weight	1.3	—	5.7	5.4
		—	—	(0.824)	(0.817)
09/30	Length	17.5	—	25.1	24.4
		—	—	(2.047)	(1.665)
	Weight	2.3	—	5.5	5.5
		—	—	(1.025)	(0.988)
10/07	Length	18.0	—	26.3	25.6
		—	—	(1.035)	(1.000)
	Weight	2.5	—	6.4	6.1
		—	—	(0.818)	(0.725)
10/14	Length	17.6	—	25.8	25.9
		—	—	(1.105)	(1.426)
	Weight	2.5	—	6.2	6.3
		—	—	(0.841)	(1.007)
10/21	Length	—	—	26.8	25.1
		—	—	(1.530)	(1.387)
	Weight	—	—	6.4	5.9
		—	—	(1.286)	(0.830)
10/28	Length	—	—	26.9	24.8
		—	—	(0.985)	(1.385)
	Weight	—	—	6.0	5.6
		—	—	(0.709)	(0.774)
Weighted seasonal mean	Length	16.9	—	26.0	24.9
		—	—	—	—
	Weight	2.2	—	6.1	5.8
		—	—	—	—
Sexes combined	Length	16.9		25.5	
		—		—	
	Weight	2.2		5.9	
		—		—	

Table 14.—Mean total length (L, in inches) and weight (W, in pounds), by age, of coho salmon harvested at the Boardman River weir, fall 1987-90.

Year	Age 1.0		Age 1.1	
	L	W	L	W
1987	15.4	1.4	26.0	6.3
1988	15.4	1.7	25.3	6.1
1989	—	—	26.0	6.2
1990	16.9	2.2	25.5	5.9

Table 15.—Number and mean total length (L, in inches) and weight (W, in pounds) of steelhead (ages combined) collected at the Boardman River weir, fall 1987-90.

Year	Number			Mean	
	Passed	Mortalities	Total	L	W
1987	15	2	17	18.4	3.1
1988	57	9	66	21.0	4.6
1989	35	1	36	29.3	9.0
1990	66	0	66	30.1	9.0

Table 16.—Summary of the number and weight, by age and sex, of steelhead passed upstream at the Boardman River weir, fall 1990.

Week beginning	Male		Female		Total	
	Number	Pounds	Number	Pounds	Number	Pounds
Age 1.1						
09/16	1	4	—	—	1	4
09/30	—	—	—	—	—	—
10/07	—	—	—	—	—	—
10/14	—	—	—	—	—	—
10/28	—	—	—	—	—	—
Total	1	4	—	—	1	4
(Percent)	(1.5)	(0.7)	—	—	(1.5)	(0.7)
Age 2.1						
09/16	—	—	—	—	—	—
09/30	—	—	—	—	—	—
10/07	—	—	—	—	—	—
10/14	2	10	—	—	2	10
10/28	—	—	—	—	—	—
Total	2	10	—	—	2	10
(Percent)	(3.0)	(1.7)	—	—	(3.0)	(1.7)
Age 1.2						
09/16	—	—	1	7	1	7
09/30	—	—	—	—	—	—
10/07	—	—	—	—	—	—
10/14	—	—	—	—	—	—
10/28	—	—	—	—	—	—
Total	—	—	1	7	1	7
(Percent)	—	—	(1.5)	(1.2)	(1.5)	(1.2)
Age 1.3						
09/16	8	78	13	110	21	188
09/30	3	26	11	102	14	128
10/07	5	44	7	63	12	107
10/14	2	20	2	19	4	39
10/28	1	8	3	28	4	36
Total	19	176	36	322	55	498
(Percent)	(28.8)	(29.5)	(54.5)	(54.0)	(83.3)	(83.6)

Table 16.—Continued:

Week beginning	Male		Female		Total	
	Number	Pounds	Number	Pounds	Number	Pounds
Age 2.3						
09/16	1	11	—	—	1	11
09/30	—	—	—	—	—	—
10/07	—	—	—	—	—	—
10/14	—	—	—	—	—	—
10/28	—	—	—	—	—	—
Total	1	11	—	—	1	11
(Percent)	(1.5)	(1.8)	—	—	(1.5)	(1.8)
Age 1.4						
09/16	3	36	3	30	6	66
09/30	—	—	—	—	—	—
10/07	—	—	—	—	—	—
10/14	—	—	—	—	—	—
10/28	—	—	—	—	—	—
Total	3	36	3	30	6	66
(Percent)	(4.5)	(6.0)	(4.5)	(5.0)	(9.1)	(11.1)

Table 17.—Mean total length (inches) and weight (pounds), by age and sex, of steelhead passed upstream at the Boardman River weir, fall 1990. Two standard errors in parentheses.

Week beginning	Measure-ment	Age 1.1		Age 2.1		Age 1.2	
		Male	Female	Male	Female	Male	Female
09/16	Length	22.1	—	—	—	—	26.5
		—	—	—	—	—	—
	Weight	3.8	—	—	—	—	7.1
		—	—	—	—	—	—
09/30	Length	—	—	—	—	—	—
		—	—	—	—	—	—
	Weight	—	—	—	—	—	—
		—	—	—	—	—	—
10/07	Length	—	—	—	—	—	—
		—	—	—	—	—	—
	Weight	—	—	—	—	—	—
		—	—	—	—	—	—
10/14	Length	—	—	23.5	—	—	—
		—	—	(2.500)	—	—	—
	Weight	—	—	4.9	—	—	—
		—	—	(0.600)	—	—	—
10/28	Length	—	—	—	—	—	—
		—	—	—	—	—	—
	Weight	—	—	—	—	—	—
		—	—	—	—	—	—
Weighted seasonal mean	Length	22.1	—	23.5	—	—	26.5
		—	—	—	—	—	—
	Weight	3.8	—	4.9	—	—	7.1
		—	—	—	—	—	—

Sexes combined				
	Length	22.1	23.5	26.5
		—	—	—
	Weight	3.8	4.9	7.1
		—	—	—

Table 17.—Continued:

Week beginning	Measure-ment	Age 1.3		Age 2.3		Age 1.4	
		Male	Female	Male	Female	Male	Female
09/16	Length	31.6	29.6	32.3	—	33.9	31.4
		(1.403)	(0.507)	—	—	(1.856)	(2.367)
	Weight	9.8	8.5	11.1	—	12.1	9.9
		(1.409)	(0.478)	—	—	(2.083)	(3.740)
09/30	Length	30.0	29.8	—	—	—	—
		(5.900)	(1.356)	—	—	—	—
	Weight	8.5	9.3	—	—	—	—
		(3.800)	(1.702)	—	—	—	—
10/07	Length	30.4	30.0	—	—	—	—
		(0.966)	(0.973)	—	—	—	—
	Weight	8.8	8.9	—	—	—	—
		(0.900)	(0.801)	—	—	—	—
10/14	Length	31.2	30.7	—	—	—	—
		(0.400)	(0.800)	—	—	—	—
	Weight	10.1	9.6	—	—	—	—
		(0.300)	(0.400)	—	—	—	—
10/28	Length	30.5	30.1	—	—	—	—
		—	(1.222)	—	—	—	—
	Weight	8.3	9.2	—	—	—	—
		—	(1.800)	—	—	—	—
Weighted seasonal mean	Length	31.0	29.8	32.3	—	33.9	31.4
		(0.568)	(0.260)	—	—	—	—
	Weight	9.3	8.9	11.1	—	12.1	9.9
		(0.366)	(0.319)	—	—	—	—
Sexes combined	Length	30.2		32.3		32.7	
		(0.222)		—		—	
	Weight	9.0		11.1		11.0	
		(0.226)		—		—	

Table 18.—Number and mean total length (L, in inches) and weight (W, in pounds) of brown trout (ages combined) collected at the Boardman River weir, fall 1987-90.

Year	Number			Mean	
	Passed	Mortalities	Total	L	W
1987	12	0	12	20.4	4.4
1988	7	1	8	23.0	5.6
1989	19	2	21	24.7	7.2
1990	10	0	10	20.5	4.4

Table 19.—Summary of the number and weight, by age and sex, of brown trout passed upstream at the Boardman River weir, fall 1990.

Week beginning	Male		Female		Total	
	Number	Pounds	Number	Pounds	Number	Pounds
Age 1.1						
09/16	—	—	1	5	1	5
09/30	3	15	3	12	6	27
10/07	—	—	1	4	1	4
10/21	—	—	1	6	1	6
Total	3	15	6	27	9	42
(Percent)	(30.0)	(33.3)	(60.0)	(60.0)	(90.0)	(93.3)
Age 2.1						
09/16	—	—	1	3	1	3
09/30	—	—	—	—	—	—
10/07	—	—	—	—	—	—
10/21	—	—	—	—	—	—
Total	—	—	1	3	1	3
(Percent)	—	—	(10.0)	(6.7)	(10.0)	(6.7)

Table 20.—Mean total length (inches) and weight (pounds), by age and sex, of brown trout passed upstream at the Boardman River weir, fall 1990. Two standard errors in parentheses.

Week beginning	Measurement	Age 1.1 Male	Age 1.1 Female	Age 2.1 Male	Age 2.1 Female
09/16	Length	—	21.5	—	19.2
		—	—	—	—
	Weight	—	4.5	—	2.9
		—	—	—	—
09/30	Length	21.8	19.0	—	—
		(2.500)	(2.100)	—	—
	Weight	5.1	4.1	—	—
		(1.400)	(2.100)	—	—
10/07	Length	—	20.2	—	—
		—	—	—	—
	Weight	—	3.6	—	—
		—	—	—	—
10/21	Length	—	22.2	—	—
		—	—	—	—
	Weight	—	5.8	—	—
		—	—	—	—
Weighted seasonal mean	Length	21.8	20.2	—	19.2
		(1.443)	(1.212)	—	—
	Weight	5.1	4.3	—	2.9
		(0.808)	(1.212)	—	—
Sexes combined	Length	20.7		19.2	
		(1.184)		—	
	Weight	4.6		2.9	
		(0.690)		—	

References

Hay, R. L. 1989. Little Manistee River harvest weir and chinook salmon egg-take report, 1987. Michigan Department of Natural Resources, Fisheries Technical Report 89-5, Ann Arbor.

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Richard D. Clark, Jr., Editor
Kelley D. Smith, Editorial Board Reviewer
Alan D. Sutton, Graphics
Grace M. Zurek, Work Processor