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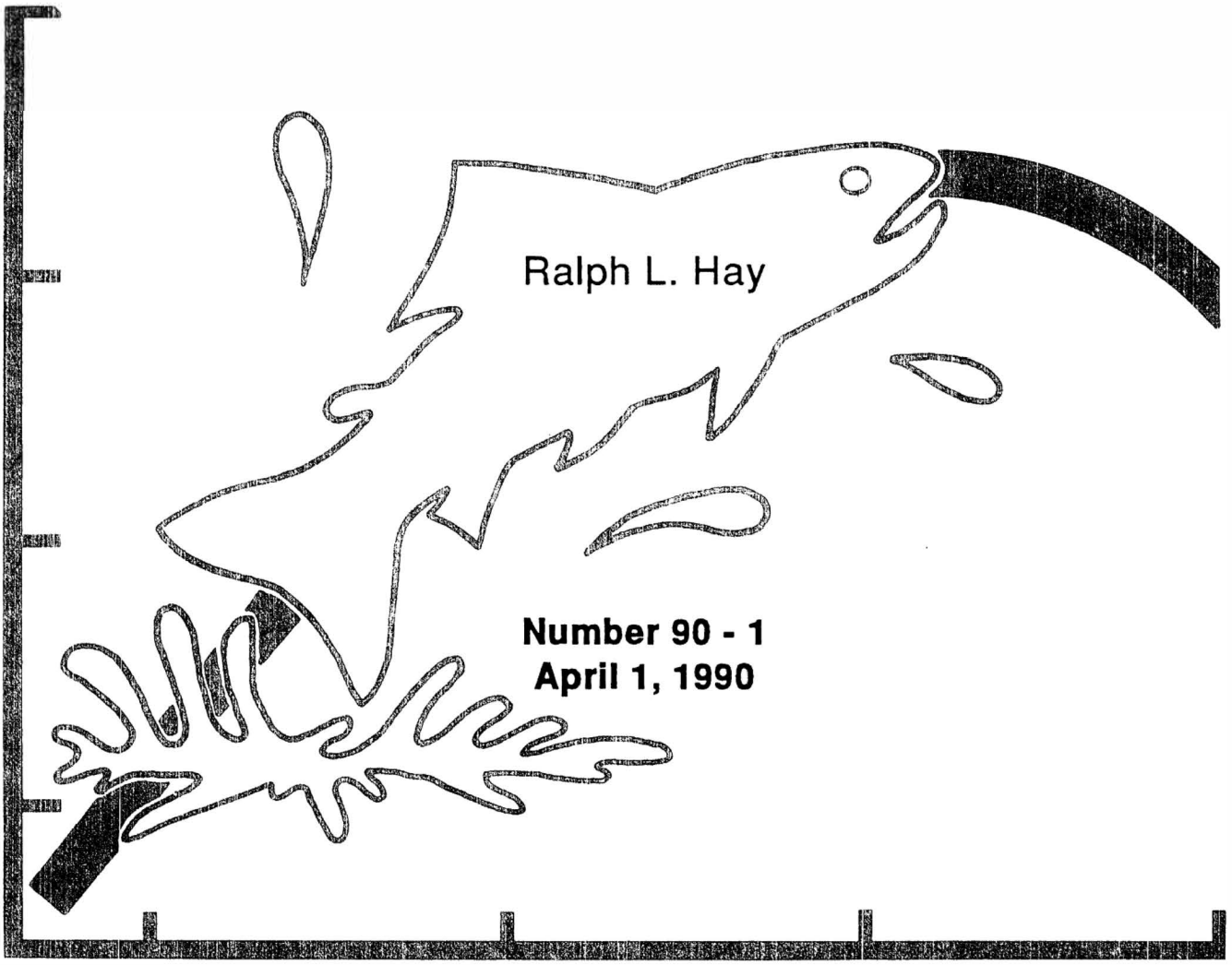
FISHERIES DIVISION

TECHNICAL REPORT

Boardman River Harvest Weir Report, 1988



Ralph L. Hay

Number 90 - 1
April 1, 1990

Michigan Department of
Natural Resources

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Fisheries Technical Report No. 90-1
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Coho and chinook salmon 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 miles 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 are to be harvested at the weir each fall (September and October). The trout and Atlantic salmon 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.

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 238,907 spring fingerling chinook have been planted annually in the Boardman River system since 1985 (Table 1). During this same time span, steelhead plants have averaged 16,637 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, 1988

On September 1, 1988, the weir grates were installed to block anadromous fish. On September 15, the ponds were filled and the fish ladder was activated. Harvest began on September 20. The weir remained operational until October 28, at which time the grates were removed and the building was winterized. The weir was in operation for 58 days. All harvested chinook and coho salmon were sold on contract to Tempotech Industries, Hart, Michigan. Steelhead and brown trout were passed upstream of the weir.

Chinook salmon

Harvest of chinook salmon began September 20 and ended October 28, a period of 39 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 6,129 chinook were harvested in 1988 (Table 3). The calculated total weight of all chinook, in the round, was 67,978 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 November 1988. 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 47 (0.8%) age-0.0 mini-jacks weighing 28 pounds; 1,195 (19.5%) age-0.1 jacks weighing 5,484 pounds; 1,247 (20.3%) age-0.2 adults weighing 10,315 pounds; 2,936 (47.9%) age-0.3 adults weighing 39,533 pounds; 694 (11.3%) age-0.4 adults weighing 12,394 pounds; and 10 (0.2%) age-0.5 adults weighing 224 pounds (Table 5). The 1988 run of jacks represented 0.5% of the fingerlings stocked in 1987, age-0.2 adults were 0.5% of the 1986 plant, and age-0.3 adults were 1.5% of the fingerlings stocked in 1985 (Table 6). Return rates for age-0.4 adults and older could not be determined since the Boardman River system did not receive plants prior to 1985. These fish were either strays from other nearby rivers or fish which were produced naturally in the Boardman River.

Females constituted only about 26% of the total run—13.4% of age-0.2, 40.8% of age-0.3, and 31.0% of age-0.4 fish (Table 5). No age-0.0, 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 (1986 and 1987 year classes) which are mostly males. Mean lengths and weights of males and females combined were: age 0.0 (males only), 10.9 inches and 0.6 pounds; age 0.1 (males only), 22.7 inches and 4.6 pounds; age 0.2, 28.8 inches and 8.3 pounds; age 0.3, 34.2 inches and 13.5 pounds; age 0.4, 36.8 inches and 17.9 pounds; and age 0.5 (males only), 40.0 inches and 22.4 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.

A total of 600 chinook were examined for fin clips. Five (0.8%) had fin clips. The two clips observed were adipose (Ad, 4 fish), and right ventral (RV, 1 fish). All four of the Ad fish had a very small coded-wire tag in the snout. Three of these fish were planted in 1987 by the MDNR into Lake Huron at Seymour Creek (130,000 SF) and one was planted in 1985 by the Wisconsin Department of Natural Resources (WDNR) into Lake Michigan at Strawberry Creek (50,000 SF). Origin of the RV fish could not be decided

because the fin clip, age (from scales), and planting records did not coincide.

Only 1.7% 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 (for the first time) to supplement the egg-take operation at the Little Manistee River weir. From October 12 through October 26 (14 days), 3.6 million eggs were collected for in-state rearing (Table 10). A total of 700 female chinook (ages 0.2, 0.3, and 0.4) were stripped, excluding those which yielded low-quality eggs or were otherwise unsatisfactory.

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 30 minutes before water-hardening: The fertilized eggs were water-hardened in flowing river water for 1 hour prior to transportation. The percent eye-up was slightly below normal for chinook, with a range of 62.6% to 65.2% (Table 10).

River water temperature at the conclusion of each day's egg-take ranged from 48°F to 52°F.

A random sample of 60 spawning chinook were inspected by the state pathologist for diseases and parasites. Nearly 80% of the fish examined had bacterial kidney disease (BKD) (J. Hnath, MDNR, personal communication).

In 1988 the estimated sport catch of chinook salmon from the West Arm of Grand Traverse Bay was 3,500 fish (G. Rakoczy, MDNR, personal communication). It would appear that about one-third of the returning chinook are taken by anglers and the remaining fish escape upstream to the weir.

Coho salmon

In 1988, the coho harvest coincided with the chinook harvest (September 20 through October 28, a total of 39 days). The peak harvest occurred during the first week in October.

A total of 477 coho were harvested. The total weight calculated from biological samples was 2,795 pounds (Table 11).

The age composition of the harvested coho was 29 age-1.0 jacks weighing 50 pounds and 448 age-1.1 adults weighing 2,745 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. All age-1.0 and 45.1% of the age-1.1 coho were males. The total run consisted of 51.6% females. Mean lengths and weights were: age-1.0 males, 15.4 inches and 1.7 pounds; age-1.1 males, 25.7 inches and 6.1 pounds; age-1.1 females, 25.0 inches and 6.1 pounds; and age-1.1 sexes combined, 25.3 inches and 6.1 pounds (Tables 13 and 14). Adult males were slightly longer than females but their weights were equal.

A total of 419 randomly selected coho were checked for fin clips. Of these fish, three (0.7%) had a fin clip. All three fish had an adipose (Ad) fin clip, but only one had a small coded-wire tag in the snout. This fish was planted in 1988 by the MDNR into Lake Michigan at the Platte River (155,000Y). Origin of the other two Ad fish could not be decided since no wire tags were found in the snout.

None 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 1988.

In 1988, no coho salmon were reported caught in the West Arm of Grand Traverse Bay (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 304 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). One possible explanation for the poor fall returns and excellent spring returns may be due to the fact that the planted fish are from spring spawners at the Little Manistee River. In an attempt to improve the fall runs, the summer strain of steelhead were planted beginning in 1986 with each plant receiving a different fin clip (Table 1).

Based upon the four weekly samples, nearly 83% of the returning steelhead were age 1.0 or age 1.2 (Table 16). Mean lengths and weights for the five different age groups are given in Table 17 and Figure 3. For all ages combined, the mean length and weight were 21.0 inches and 4.6 pounds (Table 15). Size of returning adults is more dependent upon years spent in Lake Michigan than on age at smolting.

A total of 43 randomly selected steelhead were examined for fin clips. Of these fish, 18 (42%) had a fin clip. All 18 fish had an adipose (Ad) clip. Because none of these fish was sacrificed in an attempt to recover the small coded-wire tag in the snout, the planting location could not be determined. However, aging (from scale samples) revealed two age groups, age 1.0 (2 fish) and age 1.2 (16 fish). The age-1.0 and age-1.2 fish were planted in 1988 and 1986, respectively, by the MDNR at several locations in Lake Michigan. Both stockings were the Skamania strain of summer steelhead.

No lamprey wounds were found on the 43 fish examined. Fifty-seven of the steelhead were passed upstream (Table 15).

In 1988, the estimated sport catch of steelhead (rainbow) trout in the West Arm of Grand Traverse Bay was 500 fish (G. Rakoczy, MDNR, personal communication).

Brown trout

Only eight 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 three weekly samples, 100% of the brown trout were age 1.1 (Table 19). Mean length (23.0 inches) and weight (5.6 pounds) of age-1.1 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 three fish examined. Seven of the brown trout were passed upstream (Table 18).

In 1988, the estimated sport catch of brown trout in the West Arm of Grand Traverse Bay was 600 fish (G. Rakoczy, MDNR, personal communication).

Pink salmon

No pink salmon were harvested at the weir in 1988. Also, none was reported caught by anglers in the West Arm of Grand Traverse Bay (G. Rakoczy, MDNR, personal communication).

Lake trout

No lake trout were collected at the weir in 1988. However, a few lake trout were in the river by late October. Immediately after the weir was opened (October 28), anglers observed them upstream at the Union Street dam.

In 1988, the estimated sport catch of lake trout from the West Arm of Grand Traverse Bay was 8,800 fish (G. Rakoczy, MDNR, personal communication). This catch occurred during the period from May 1 through August 15.

Summary

In 1988, the Boardman River harvest weir was in operation from September 1 through October 28 (58 days). Harvest of chinook and coho salmon and passage of other anadromous

salmonids occurred from September 20 through October 28.

The entire salmon run of 6,129 chinook (67,978 pounds) and 477 coho (2,795 pounds) was harvested and sold to Tempotech Industries, Hart, Michigan.

The chinook run consisted of 47 age-0.0 mini-jacks (less than 0.1% of the 1988 fingerling plant); 1,195 age-0.1 jacks (0.5% of the 1987 fingerling plant); 1,247 age-0.2 adults (0.5% of the 1986 fingerling plant); 2,936 age-0.3 adults; (1.5% of the 1985 fingerling plant) 694 age-0.4 adults; and 10 age-0.5 adults. Percent returns for the age-0.4 and older adults could not be determined because the Boardman River system did not receive chinook plants prior to 1985. These older fish were strays from other planting locations or naturally produced fish from the Boardman River system. Mean sizes were: age 0.0, 10.9 inches (0.6 pounds); age 0.1, 22.7 inches (4.6 pounds); age 0.2, 28.8 inches (8.3 pounds); age 0.3, 34.2 inches (13.5 pounds); age 0.4, 36.8 inches (17.9 pounds); and age 0.5, 40.0 inches (22.4 pounds). Chinook eggs were taken at the weir for the first time in 1988. During the egg-take operations (October 12 through October 26), 700 females (ages 0.2, 0.3, and 0.4) were stripped to obtain 3.6 million eggs. The percent eye-up ranged from 62.6% (October 18) to 65.2% (October 12). River water temperatures during egg-take operations ranged from 48°F to 52°F.

The 1988 coho run was composed of 29 age-1.0 jacks and 448 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 1988.

The 1988 steelhead run of 66 fish included five different age groups. Nearly 83% of these fish were age 1.0 or 1.2.

The 1988 run of eight brown trout was comprised of only one age group (age 1.1).

No pink salmon and only a few lake trout were observed in the river below the weir. Neither species entered the holding ponds.

Recommendations for 1989

Biological samples should be collected on a weekly basis for all species. Several modifications to the weir complex need to be done before the start of the 1989 season.

These major changes are as follows:

1) Replace the existing weir panels. Spacing on the present panels is too narrow (15/16 inches clear space between bars) and is too long (8 feet). The new panels should have 1.75 inches of clear space between bars and only be 5.5 feet long. Several times during the season the structure almost failed due to excessive headwater buildup caused by leaves plugging the grates.

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

3) Install a better guardrail around the edge of the load dock.

4) Install electric-cord reels on the two fish crowders, which will allow elimination of the noisy gasoline engines.

5) Replace the four lower Plexiglas windows with safety glass. This will improve public viewing by eliminating the scratched Plexiglas, and make cleaning easier.

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

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

8) Install a continuously recording thermometer for river water temperatures.

9) Install a river staff gauge and correlate to mean sea level.

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, Donna Sivek, Robert Beagle, William Strom, Thomas Richards, 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.

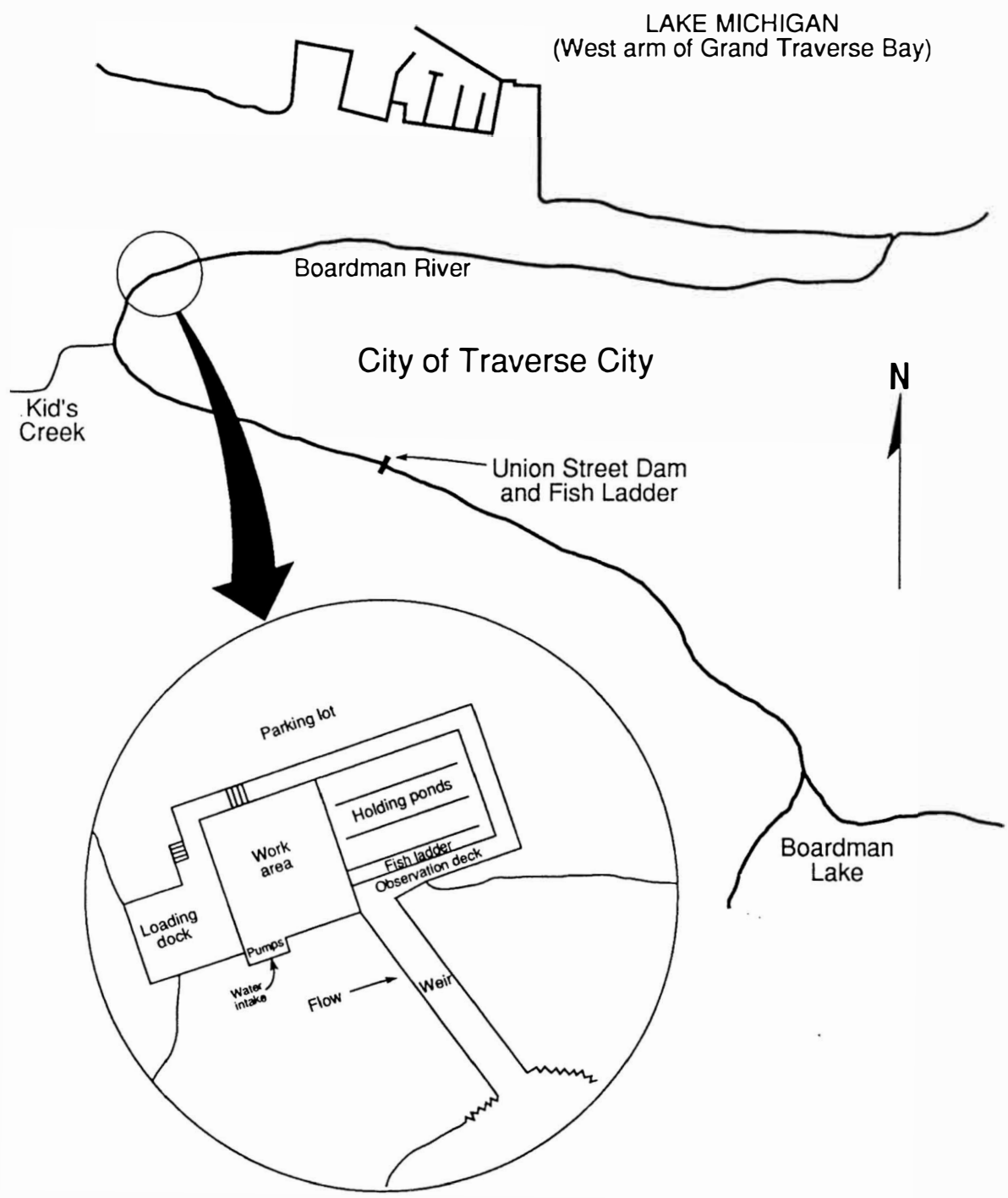

Figure 1.—Location and schematic diagram of the Boardman River weir complex in Traverse City.

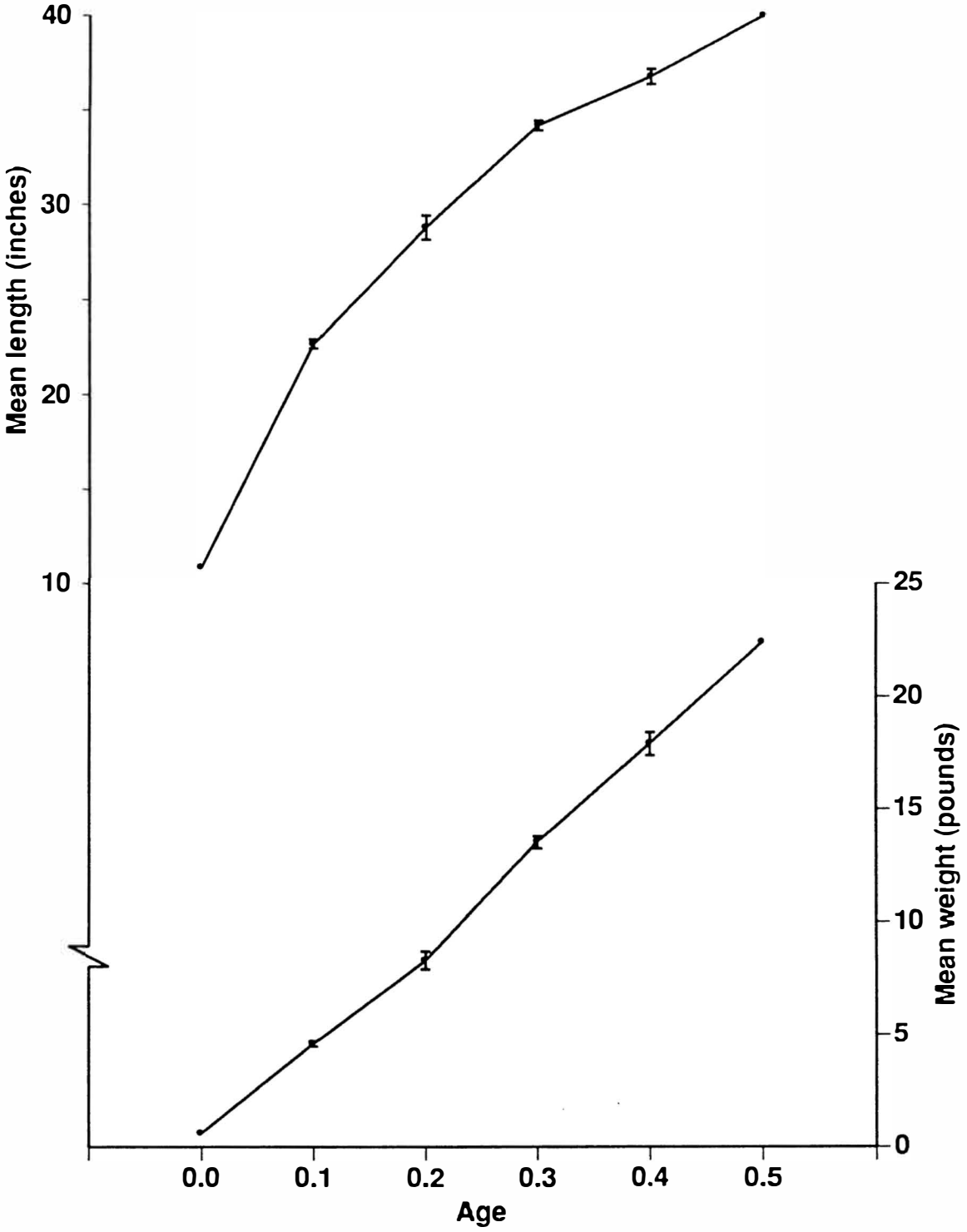

Figure 2.—Mean total length (inches) and round weight (pounds), by age, of chinook salmon harvested at the Boardman River weir, fall 1988. Vertical bars represent two standard errors.

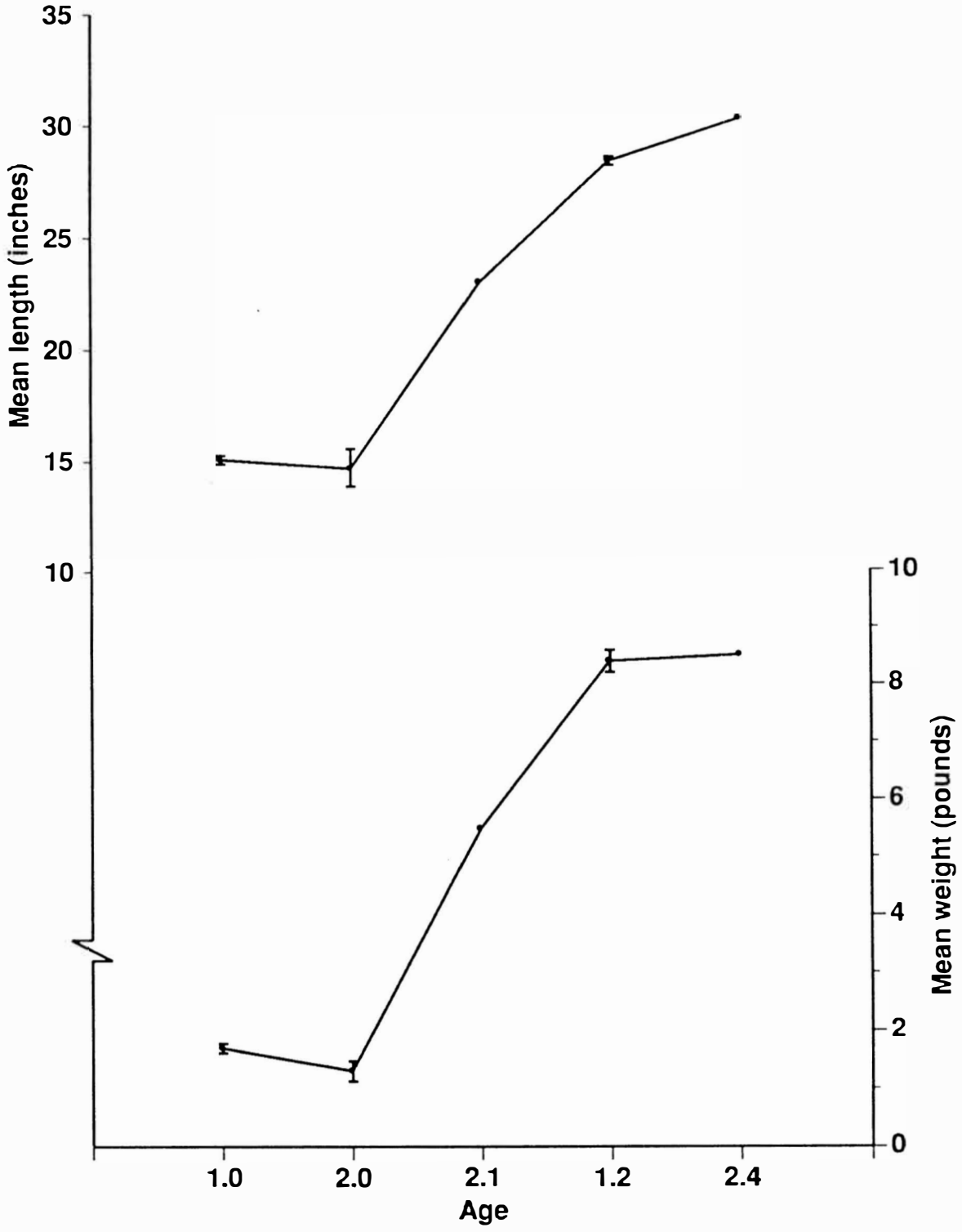

Figure 3.—Mean total length (inches) and round weight (pounds), by age, of steelhead passed upstream at the Boardman River weir, fall 1988. Vertical bars indicate two standard errors.

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).

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)
Total	955,627	66,547
Average	238,907	16,637

Table 2.—Number, by week, of salmon harvested and trout collected at the Boardman River weir, fall 1988.

Week beginning	Salmon		Trout	
	Chinook	Coho	Steelhead	Brown
09/18	725	86	28	2
09/25	462	76	12	2
10/02	2,258	132	12	2
10/09	1,078	28	3	1
10/16	1,023	54	4	1
10/23	583	100	7	0
Total	6,129	476	66	8

Table 3.—Number, by age, of chinook salmon harvested at the Boardman River weir, fall 1987-88. 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 (<1.0)	1,210 (5,363)	677 (4,528)	1,588 (18,400)	1,335 (19,951)	91 (1,754)	4,902 (49,996)
1988	47 (28)	1,195 (5,484)	1,247 (10,315)	2,936 (39,533)	694 (12,394)	10 (224)	6,129 (67,978)

Table 4.—Length-age distribution (in percent of inch group) for chinook salmon scale-sampled during creel survey at Pentwater, Ludington, Manistee, Frankfort, Onekema, Leland, Grand Traverse Bay, Betsie River, Platte Bay, and Platte River, August-November 1988.[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	---	29	71	---	---	---
25	---	20	80	---	---	---
26	---	---	100	---	---	---
27	---	---	100	---	---	---
28	---	---	100	---	---	---
29	---	---	80	20	---	---
30	---	---	62	38	---	---
31	---	---	54	46	---	---
32	---	---	23	77	---	---
33	---	---	---	96	4	---
34	---	---	---	83	17	---
35	---	---	---	68	32	---
36	---	---	---	75	25	---
37	---	---	---	53	47	---
38	---	---	---	46	54	---
39	---	---	---	67	33	---
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 1988.

Week beginning	Male		Female		Total	
	Number	Pounds	Number	Pounds	Number	Pounds
Age 0.0						
09/18	4	2	---	---	4	2
09/25	5	3	---	---	5	3
10/02	6	4	---	---	6	4
10/09	5	4	---	---	5	4
10/16	9	6	---	---	9	6
10/23	18	9	---	---	18	9
Total	47	28	---	---	47	28
(Percent)	(0.8)	(<0.1)	---	---	(0.8)	(<0.1)
Age 0.1						
09/18	94	443	---	---	94	443
09/25	59	273	---	---	59	273
10/02	495	2,239	---	---	495	2,239
10/09	161	701	---	---	161	701
10/16	284	1,366	---	---	284	1,366
10/23	102	462	---	---	102	462
Total	1,195	5,484	---	---	1,195	5,484
(Percent)	(19.5)	(8.1)	---	---	(19.5)	(8.1)
Age 0.2						
09/18	122	919	22	199	144	1,118
09/25	55	461	5	47	60	508
10/02	495	4,093	45	511	540	4,604
10/09	204	1,540	64	611	268	2,151
10/16	142	1,067	20	227	162	1,294
10/23	62	520	11	120	73	640
Total	1,080	8,600	167	1,715	1,247	10,315
(Percent)	(17.6)	(12.7)	(2.7)	(2.5)	(20.3)	(15.2)

Table 5.—Continued:

Week beginning	Male		Female		Total	
	Number	Pounds	Number	Pounds	Number	Pounds
Age 0.3						
09/18	274	3,561	130	1,837	404	5,398
09/25	96	1,295	182	2,609	278	3,904
10/02	631	8,239	338	4,633	969	12,872
10/09	376	4,936	236	3,291	612	8,227
10/16	213	2,685	183	2,621	396	5,306
10/23	147	1,986	130	1,840	277	3,826
Total	1,737	22,702	1,199	16,831	2,936	39,533
(Percent)	(28.3)	(33.4)	(19.6)	(24.8)	(47.9)	(58.2)
Age 0.4						
09/18	72	1,329	7	119	79	1,448
09/25	46	774	14	249	60	1,023
10/02	225	4,113	23	389	248	4,502
10/09	21	368	11	190	32	558
10/16	81	1,380	81	1,471	162	2,851
10/23	34	541	79	1,471	113	2,012
Total	479	8,505	215	3,889	694	12,394
(Percent)	(7.8)	(12.5)	(3.5)	(5.7)	(11.3)	(18.2)
Age 0.5						
09/18	---	---	---	---	---	---
09/25	---	---	---	---	---	---
10/02	---	---	---	---	---	---
10/09	---	---	---	---	---	---
10/16	10	224	---	---	10	224
10/23	---	---	---	---	---	---
Total	10	224	---	---	10	224
(Percent)	(0.2)	(0.3)	---	---	(0.2)	(0.3)

Table 7.—Mean total length (inches) and weight (pounds), by age and sex, of chinook salmon harvested at the Boardman River weir, fall 1988. Two standard errors in parentheses.

Week beginning	Measurement	Age 0.0		Age 0.1		Age 0.2	
		Male	Female	Male	Female	Male	Female
09/18	Length	10.4	---	22.7	---	27.7	29.9
		(0.327)	---	(0.750)	---	(1.598)	(3.142)
	Weight	0.5	---	4.7	---	7.5	9.1
		(0.096)	---	(0.394)	---	(0.899)	(2.034)
09/25	Length	11.1	---	22.8	---	29.9	29.6
		(0.707)	---	(0.479)	---	(1.177)	---
	Weight	0.6	---	4.6	---	8.4	9.4
		(0.117)	---	(0.282)	---	(0.862)	---
10/02	Length	10.8	---	22.6	---	28.9	32.5
		(0.423)	---	(0.484)	---	(1.224)	(0.600)
	Weight	0.6	---	4.5	---	8.3	11.4
		(0.120)	---	(0.238)	---	(0.713)	(0.500)
10/09	Length	10.9	---	22.7	---	27.7	30.6
		(0.665)	---	(0.417)	---	(1.438)	(0.775)
	Weight	0.7	---	4.4	---	7.5	9.6
		(0.080)	---	(0.278)	---	(0.939)	(0.690)
10/16	Length	11.2	---	23.1	---	27.3	31.6
		(0.408)	---	(0.512)	---	(1.635)	(1.900)
	Weight	0.7	---	4.8	---	7.5	11.0
		(0.047)	---	(0.257)	---	(0.957)	(1.500)
10/23	Length	---	---	22.5	---	28.7	31.5
		---	---	(0.573)	---	(2.114)	(1.100)
	Weight	---	---	4.5	---	8.4	11.4
		---	---	(0.301)	---	(1.255)	(1.300)
Weighted seasonal mean	Length	10.9	---	22.7	---	28.4	31.2
		---	---	(0.245)	---	(0.672)	(0.568)
	Weight	0.6	---	4.6	---	8.0	10.3
		---	---	(0.124)	---	(0.399)	(0.435)
Sexes combined	Length	10.9		22.7		28.8	
		---		(0.245)		(0.626)	
	Weight	0.6		4.6		8.3	
		---		(0.124)		(0.396)	

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	---	---	3,613
		---	---	(0.4)	(1.5)	---	---	(1.9)
1986	250,105	---	1,210	1,247	---	---	---	2,457
		---	(0.5)	(0.5)	---	---	---	(1.0)
1987	238,500	1	1,195	---	---	---	---	1,196
		(0.0)	(0.5)	---	---	---	---	(0.5)
1988	277,000	47	---	---	---	---	---	47
		(0.0)	---	---	---	---	---	(0.0)

Table 7.—Continued:

Week beginning	Measure-ment	Age 0.3		Age 0.4		Age 0.5	
		Male	Female	Male	Female	Male	Female
09/18	Length	33.7	33.8	37.4	35.6	---	---
		(0.738)	(0.758)	(0.952)	---	---	---
	Weight	13.0	14.1	18.5	17.0	---	---
		(0.704)	(0.952)	(1.168)	---	---	---
09/25	Length	34.6	34.8	36.7	35.8	---	---
		(0.892)	(0.455)	(1.073)	(1.525)	---	---
	Weight	13.5	14.3	16.8	17.8	---	---
		(0.718)	(0.673)	(1.453)	(3.126)	---	---
10/02	Length	34.0	34.2	38.0	35.6	---	---
		(0.851)	(0.489)	(0.933)	---	---	---
	Weight	13.1	13.7	18.3	16.9	---	---
		(0.905)	(0.679)	(1.254)	---	---	---
10/09	Length	34.5	34.5	37.7	35.7	---	---
		(0.866)	(0.643)	(0.600)	---	---	---
	Weight	13.1	13.9	17.5	17.3	---	---
		(0.849)	(1.021)	(0.200)	---	---	---
10/16	Length	33.6	33.7	36.5	35.5	40.0	---
		(0.879)	(0.745)	(1.008)	(0.657)	---	---
	Weight	12.6	14.3	17.0	18.2	22.4	---
		(0.766)	(0.727)	(1.319)	(1.346)	---	---
10/23	Length	35.2	33.3	36.1	35.5	---	---
		(0.945)	(0.683)	(1.297)	(0.908)	---	---
	Weight	13.5	14.2	15.9	18.6	---	---
		(1.163)	(0.625)	(1.174)	(1.560)	---	---
Weighted seasonal mean	Length	34.2	34.1	37.4	35.5	40.0	---
		(0.391)	(0.242)	(0.493)	(0.486)	---	---
	Weight	13.1	14.0	17.8	18.1	22.4	---
		(0.402)	(0.322)	(0.651)	(0.904)	---	---
Sexes combined	Length	34.2		36.8		40.0	
		(0.250)		(0.401)		---	
	Weight	13.5		17.9		22.4	
		(0.275)		(0.517)		---	

Table 8.—Mean total length (L, in inches) and weight (W, in pounds), by age, of chinook salmon harvested at the Boardman weir, fall 1987-88.

	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

Table 9.—Percent lamprey scarring of anadromous salmonids captured at the Boardman River weir, fall 1987-88.

	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

Table 10.—Summary of the chinook egg-take operation at the Boardman River weir, fall 1988.

Date	Number of females stripped	Number of eggs collected	Percent eye-up	Destination
10/12	332	1,757,424	65.2	Platte River
10/18	235	1,238,204	62.6	Platte River
10/26	103	469,000	---	Wolf Lake
10/26	30	133,000	---	Wolf Lake (MSU)*
Total	700	3,597,628	---	
In-state	700	3,597,628	---	
Out-of-state	---	---	---	

*MSU = Michigan State University.

Table 11.—Number, by age, of coho salmon harvested at the Boardman River weir, fall 1987-88. Weight (pounds) is in parentheses and was estimated using seasonal means.

Year	Age 1.0	Age 1.1	Total
1987	45 (62)	261 (1,651)	306 (1,713)
1988	29 (50)	448 (2,745)	477 (2,795)

Table 12.—Summary of the number and weight, by age and sex, of coho salmon harvested at the Boardman River weir, fall 1988.

Week beginning	Male		Female		Total	
	Number	Pounds	Number	Pounds	Number	Pounds
Age 1.0						
09/18	13	22	---	---	13	22
09/25	9	13	---	---	9	13
10/02	3	7	---	---	3	7
10/09	---	---	---	---	---	---
10/16	2	4	---	---	2	4
10/23	2	4	---	---	2	4
Total	29	50	---	---	29	50
(Percent)	(6.1)	(1.8)	---	---	(6.1)	(1.8)
Age 1.1						
09/18	39	232	34	202	73	434
09/25	36	211	31	192	67	403
10/02	53	345	77	481	130	826
10/09	11	63	17	103	28	166
10/16	17	113	35	214	52	327
10/23	46	270	52	319	98	589
Total	202	1,234	246	1,511	448	2,745
(Percent)	(42.4)	(44.2)	(51.7)	(54.1)	(94.1)	(98.2)

Table 13.—Mean total length (inches) and weight (pounds), by age and sex, of coho salmon harvested at the Boardman River weir, fall 1988. Two standard errors in parentheses.

Week beginning	Measure-ment	Age 1.0		Age 1.1	
		Male	Female	Male	Female
09/18	Length	15.2	---	24.9	24.6
		(0.556)	---	(0.658)	(0.439)
	Weight	1.7	---	6.0	5.9
		(0.153)	---	(0.453)	(0.309)
09/25	Length	15.0	---	25.4	25.2
		(0.420)	---	(0.674)	(0.544)
	Weight	1.4	---	5.9	6.2
		(0.124)	---	(0.404)	(0.391)
10/02	Length	16.9	---	26.0	25.1
		(0.700)	---	(0.592)	(0.374)
	Weight	2.2	---	6.5	6.3
		---	---	(0.436)	(0.259)
10/09	Length	---	---	25.3	25.2
		---	---	(1.839)	(0.613)
	Weight	---	---	5.7	6.0
		---	---	(0.863)	(0.513)
10/16	Length	15.1	---	26.7	24.8
		(0.100)	---	(0.865)	(0.347)
	Weight	1.8	---	6.7	6.1
		(0.600)	---	(0.691)	(0.275)
10/23	Length	17.5	---	25.9	25.2
		(0.099)	---	(0.533)	(0.398)
	Weight	2.1	---	5.9	6.1
		(0.100)	---	(0.369)	(0.339)
Weighted seasonal mean	Length	15.4	---	25.7	25.0
		(0.060)	---	(0.100)	(0.071)
	Weight	1.7	---	6.1	6.1
		(0.013)	---	(0.071)	(0.053)
Sexes combined	Length	15.4		25.3	
		(0.060)		(0.061)	
	Weight	1.7		6.1	
		(0.013)		(0.043)	

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 1987-88.

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

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 1987-88.

Year	Number			Mean	
	Passed	Mortalities	Total	L	W
1987	15	2	17	18.4	3.1
1988	57	9	66	21.0	4.6

Table 16.—Summary of the number and weight, by age and sex, of steelhead passed upstream at the Boardman River weir, fall 1988.

Week beginning	Male		Female		Total	
	Number	Pounds	Number	Pounds	Number	Pounds
Age 1.0						
09/18	9	14	---	---	9	14
09/25	10	18	---	---	10	18
10/02	4	6	---	---	4	6
10/23	2	4	---	---	2	4
Total	25	42	---	---	25	42
(Percent)	(42.4)	(15.2)	---	---	(42.4)	(15.2)
Age 2.0						
09/18	---	---	---	---	---	---
09/25	---	---	---	---	---	---
10/02	8	10	---	---	8	10
10/23	---	---	---	---	---	---
Total	8	10	---	---	8	10
(Percent)	(13.6)	(3.6)	---	---	(13.6)	(3.6)
Age 2.1						
09/18	1	6	---	---	1	6
09/25	---	---	---	---	---	---
10/02	---	---	---	---	---	---
10/23	---	---	---	---	---	---
Total	1	6	---	---	1	6
(Percent)	(1.7)	(2.2)	---	---	(1.7)	(2.2)
Age 1.2						
09/18	5	44	13	105	18	149
09/25	1	10	---	---	1	10
10/02	---	---	---	---	---	---
10/23	2	17	4	34	6	51
Total	8	71	17	139	25	210
(Percent)	(13.6)	(25.6)	(28.8)	(50.2)	(42.4)	(75.8)
Age 2.4						
09/18	---	---	---	---	---	---
09/25	1	9	---	---	1	9
10/02	---	---	---	---	---	---
10/23	---	---	---	---	---	---
Total	1	9	---	---	1	9
(Percent)	(1.7)	(3.2)	---	---	(1.7)	(3.2)

Table 17.—Mean total length (inches) and weight (pounds), by age and sex, of steelhead passed upstream at the Boardman River weir, fall 1988. Two standard errors in parentheses.

Week beginning	Measure-ment	Age 1.0		Age 2.0		Age 2.1	
		Male	Female	Male	Female	Male	Female
09/18	Length	15.0	---	---	---	23.0	---
		(0.690)	---	---	---	---	---
	Weight	1.5	---	---	---	5.5	---
		(0.231)	---	---	---	---	---
09/25	Length	15.2	---	---	---	---	---
		(0.626)	---	---	---	---	---
	Weight	1.8	---	---	---	---	---
		(0.312)	---	---	---	---	---
10/02	Length	14.8	---	14.7	---	---	---
		---	---	(1.000)	---	---	---
	Weight	1.4	---	1.3	---	---	---
		---	---	(0.200)	---	---	---
10/23	Length	15.9	---	---	---	---	---
		---	---	---	---	---	---
	Weight	2.0	---	---	---	---	---
		---	---	---	---	---	---
Weighted seasonal mean	Length	15.1	---	14.7	---	23.0	---
		(0.183)	---	(0.866)	---	---	---
	Weight	1.7	---	1.3	---	5.5	---
		(0.082)	---	(0.173)	---	---	---
Sexes combined	Length	15.1		14.7		23.0	
		(0.183)		(0.866)		---	
	Weight	1.7		1.3		5.5	
		(0.082)		(0.173)		---	

Table 17.—Continued:

Week beginning	Measure-ment	Age 1.2		Age 2.4	
		Male	Female	Male	Female
09/18	Length	29.8	28.1	---	---
		(1.391)	(0.553)	---	---
	Weight	8.9	8.1	---	---
		(1.234)	(0.427)	---	---
09/25	Length	28.3	---	30.3	---
		---	---	---	---
	Weight	9.9	---	8.5	---
		---	---	---	---
10/02	Length	---	---	---	---
		---	---	---	---
	Weight	---	---	---	---
		---	---	---	---
10/23	Length	28.4	27.7	---	---
		---	(1.200)	---	---
	Weight	8.5	8.4	---	---
		---	(1.700)	---	---
Weighted seasonal mean	Length	29.3	28.0	30.3	---
		---	(0.232)	---	---
	Weight	8.9	8.2	8.5	---
		---	(0.297)	---	---
Sexes combined	Length	28.4		30.3	
		(0.188)		---	
	Weight	8.4		8.5	
		(0.194)		---	

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 1987-88.

Year	Number			Mean	
	Passed	Mortalities	Total	L	W
1987	12	0	12	20.4	4.4
1988	7	1	8	23.0	5.6

Table 19.—Summary of the number and weight, by age and sex, of brown trout passed upstream at the Boardman River weir, fall 1988.

Week beginning	Male		Female		Total	
	Number	Pounds	Number	Pounds	Number	Pounds
Age 1.1						
09/18	---	---	2	11	2	11
09/25	2	14	---	---	2	14
10/02	---	---	2	9	2	9
Total	2	14	4	20	6	34
(Percent)	(33.3)	(41.2)	(66.7)	(58.8)	(100.0)	(100.0)

Table 20.—Mean total length (inches) and weight (pounds), by age and sex, of brown trout passed upstream at the Boardman River weir, fall 1988. Two standard errors in parentheses.

Week beginning	Measure-ment	Age 1.1	
		Male	Female
09/18	Length	---	23.8
		---	---
	Weight	---	5.5
		---	---
09/25	Length	23.8	---
		---	---
	Weight	6.8	---
		---	---
10/02	Length	---	21.5
		---	---
	Weight	---	4.5
		---	---
Weighted seasonal mean	Length	23.8	22.6
		---	---
	Weight	6.8	5.0
		---	---
Sexes combined	Length	23.0	

	Weight	5.6	

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.

Report approved by W. C. Latta
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