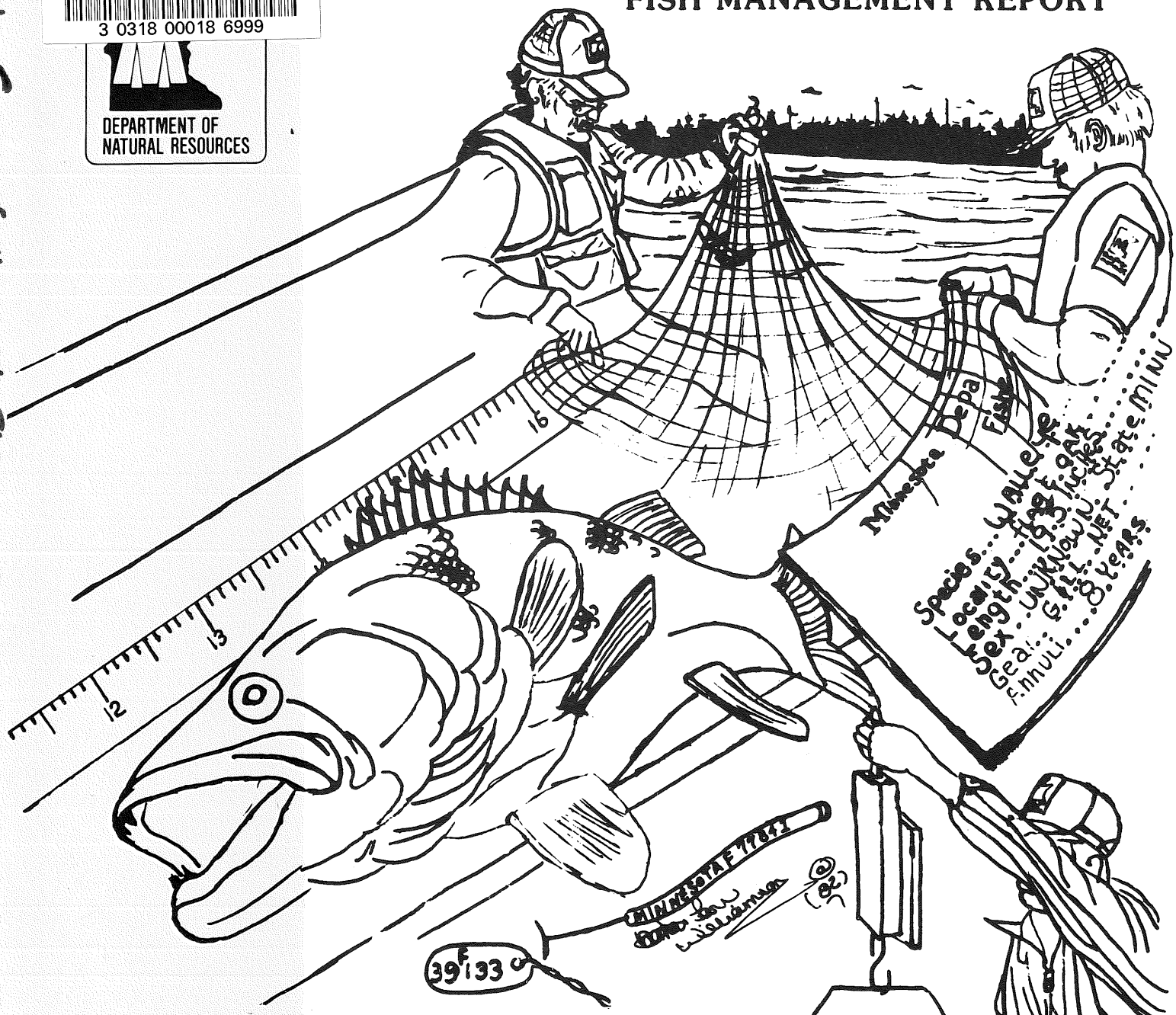
Angler Census of the North Shore

DEPARTMENT OF NATURAL RESOURCES

Section of Fisheries

FISH MANAGEMENT REPORT



No. 26

ANGLER CENSUS OF THE NORTH SHORE SPRING STREAM FISHERY, 1981-1982

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Division of Fish and Wildlife

ANGLER CENSUS OF THE NORTH SHORE SPRING STREAM FISHERY, 1981-1982[1]

by

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ABSTRACT

Angler creel census sampling programs were conducted in 1981 and 1982 to monitor the spring anadromous salmonid fishery of the North Shore streams tributary to Lake Superior in Minnesota. Fishing pressure on censused streams was 64,240 h during 24,277 trips in 1981 and 60,015 h during 26,043 trips in 1982. The Knife River attracted the highest angler use accounting for 30% and 32% of the fishing pressure in 1981 and 1982, respectively. Average angler harvest rate (CPUE) ranged from 0.02-1.67 fish/h. Rainbow trout (Salmo gairdneri) were the principal fish caught with an estimated harvest of 3,021 in 1981 and 2,561 in 1982. Rainbow averaged 2.2 kg in weight in 1981 and 1.8 kg in 1982. The average total length of rainbow trout creeled in 1982 was 588 mm. The 1976 age-class was the largest age-group in the 1981 and 1982 catches. Their respective life history categories (stream residency/lake residence years) were 2/3 and 3/3. Hatchery reared strains made up 1.1% of the catch in 1981 and 3.2% in 1982. The benefit-cost ratio was 309:1 in 1981 and 384:1 in 1982.

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[1] Completion report, Project AFS-6-1 Minnesota

INTRODUCTION

Current information from the anadromous stream fishery of the North Shore of Lake Superior is needed for long range planning. The first management plan of the Minnesota Department of Natural Resources for North Shore streams was prepared by Smith and Moyle (1944). Their recommendations were based on physico-chemical parameters with subjective references to fishing pressure and harvest. Hale (1950) quantified summer fishing pressure and harvest on the Cascade, Caribou, Two Island and Split Rock rivers as part of an assessment of stream improvement structures. Hassinger et al. (1974) quantified fishing pressure and harvest on selected streams from 1961-1967. Minnesota Department of Natural Resources files contain updated physico-chemical, fish species complex and general angler use data as part of individual stream surveys. Recent pressure and harvest data, however, is lacking.

A census was initiated in 1981 to collect and update fishing information for the entire North Shore. Information included instantaneous estimates of angler numbers, trip length, party size, harvest rate, fish size, age distribution and contribution of hatchery-reared strains to the catch. Estimates of total fishing pressure and harvest as well as distribution of the catch among anglers were made and a benefit-cost ratio was calculated.

STUDY AREA

Minnesota's portion of the Lake Superior watershed drains 621,619 hectares (Smith and Moyle 1944) extending 20-40 km inland from the lake shore between the Nemadji River on the south and the Pigeon River on the north. Its streams have relatively steep gradients, dropping up to 400 m from source to discharge (Hassinger et al. 1974). They descend

southeasterly in a series of plunge falls and cascades interspersed by sinuous runs and pools. Availability of spawning habitat to anadromous salmonids is usually limited by a barrier falls or cascade. Some barriers have been altered by blasting step pockets into the bedrock, facilitating fish passage. At present, approximately 145 km of spawning habitat is accessible to anadromous species in the censused streams (Table 1).

North Shore stream productivity is low and flows are variable. Total alkalinities range from 15-50 mg/l (Waters 1977). Army Corps of Engineers' records for Devil Track River indicate seasonal flow fluctuations from less than 0.06 m3/sec during the winter to 14.3 m3/sec during the spring (Hassinger et al. 1974).

Anadromous parr utilize the streams for nursery habitat prior to emigration to Lake Superior. Juvenile steelhead rainbow (Salmo gairdneri) residence may last from one to three years. Hassinger et al. (1974) found that steelhead spending two and three years as residents were dominant in the steelhead spawning population.

METHODS

The North Shore was divided into two roughly equal geographic sections (Fig. 1). A northern area between Little Manitou River and Farquhar Creek was censused by one clerk based at Grand Marais. A southern area between Talmadge River and Baptism River was censused by another clerk from Duluth.

The census was a randomized sampling type (Fleener 1971). Instantaneous counts of anglers were derived from counts of vehicles parked at access sites. The clerk's route was pre-determined and systematic. A census day began at the station following the last one censused the

Table 1. Streams censused in the 1981 and 1982 spring North Shore stream angler census (south to north) and length of stream (km) accessible to spring spawning anadromous salmonids.

Stream	Location of Mouth					Spawninga accessibility
	Trib. No.	Twp.	Rge.	Sec.	County	
Talmadge	S-7	51N	12W	19	St. Louis	1.77
Schmidt	S-12	51N	12W	17	St. Louis	0.16
Sucker	S-15	51N	12W	10	St. Louis	3.22
Knifeb	S-17	52N	11W	31	Lake	112.65
Stewartb	S-19	53N	10W	29	Lake	1.45
SilverB	S-21	53N	10W	21	Lake	0.32
Encampment	S-22	53N	10W	11	Lake	0.80
Crow	S-23	53N	10W	1	Lake	3.06
Castle	S-25	54N	9W	33	Lake	1.29
Gooseberry	S-26	54N	9W	22	Lake	1.29
Split Rockb	S-29	54N	8W	7	Lake	1.13
Mayer's	S-30	54N	8W	5	Lake	0.16
Beaver	S-35	55N	8W	12	Lake	0.32
Palisade	S-37	56N	7W	33	Lake	1.93
Baptismb	S-38	56N	7W	14	Lake	1.45
Little Manitou	S-46	57N	6W	2	Lake	0.80
Caribou	S-47	58N	6W	36	Lake	0.16
Crossb	S-52	58N	4W	6	Cook	0.48
Temperanceb	S-53	59N	4W	32	Cook	0.16
Onion	S-56	59N	4W	12	Cook	0.16
Poplar	S-58	60N	3W	33	Cook	0.16
Jonvick	S-61	60N	2W	19	Cook	0.16
Spruce	S-62	60N	2W	15	Cook	0.16
Indian Camp	S-63	60N	2W	11	Cook	1.13
Cascadeb	S-64	60N	2W	1	Cook	0.16
Cutface	S-65	61N	1W	34	Cook	0.64
Rosebush	S-66	61N	1W	25	Cook	0.16
Devil Trackb	S-67	61N	1E	13	Cook	2.09
Durfee	S-68	61N	2E	8	Cook	0.16
Cliff	S-69	61N	2E	10	Cook	0.16
Kimballb	S-70	61N	2E	10	Cook	2.57
Kadunceb	S-72	61N	2E	22	Cook	0.48
Bruleb	S-75	62N	3E	34	Cook	2.41
Myhr's	S-76	62N	3E	26	Cook	0.16
Flute Reed	S-77	62N	4E	20	Cook	0.48
Carlsonb	S-79	62N	4E	10	Cook	0.80
Farquhar	S-80	62N	4E	11	Cook	0.32
Total	--	---	--	--	--	144.96

a From Hassinger et al. 1974.
b Qualitative information collected.

Figure 1. North Shore Lake Superior watershed.

previous work day. Qualitative trip information was collected by interviews of anglers at five represenative southern streams and eight representative northern streams in 1981 and at the same five southern streams in 1982 (Table 1). Anglers were interviewed on all northern streams censused in 1982. All weekend days and holidays were censused along with six randomly selected weekdays per two-week period. Clerks worked an 8 h day starting at a randomly selected time of 0600 h or 1100 h. A minimum stay of 1 h and maximum of 3 h was required at stations where anglers were interviewed. As part of the interview, fish were measured to the nearest 0.1 inch (2.5 mm) and weighed to the nearest 0.1 pound (45.4 g). A scale sample was collected for aging purposes.

Angling use and catch parameters were derived by arithmetic calculations with empirical data. Estimated fishing pressure at each station was the product of the mean number of vehicles, the mean number anglers per vehicle and the approximate number of daylight hours in the stratum (either total weekday or weekend hours). Other parameters were derived using the estimates of station pressure and catch data collected in the interviews. Confidence intervals (95%) were determined using procedures outlined by Johnson and Wroblewski (1962). Differences were tested for significance using Student's t-test.

Benefit value was calculated by multiplying the fishing pressure estimate (trips) by the average expenditure per fresh water trip ($26) as presented in the 1980 National Survey of Fishing, Hunting and Wildlife-Associated Recreation for Minnesota (U.S. Dept. Int. 1982). Cost value was the production cost of steelhead fry at French River Hatchery stocked in North Shore streams that year. Transportation,

distribution, egg collection and amortized facility costs were not included.

RESULTS

Fishing Pressure and Trip Length

Fishing pressure was roughly equal both years. Anglers expended 64,240 ± 9,645 h during 24,277 fishing trips in 1981. Weekdays accounted for 59.9% of the estimated fishing hours. Approximately 72% of the angling effort was directed at southern streams. Fishing pressure totaled 60,015 ± 4,378 h during 26,043 trips in 1982. Weekdays accounted for 54% of the fishing hours. Eighty-one percent of the fishing effort was directed at southern streams. The Knife River supported 30% and 32% of total fishing hours in 1981 and 1982 respectively. Fishing pressure on individual streams varied from 0 h to 19,511 h, and averaged 1,782 ± 1,128 h in 1981 and 1,620 ± 1,125 h in 1982 (Table 2). Average trip length varied from 1.5 to 3.2 h (Table 3). An average trip was shorter in 1981 than in 1982.

Harvest Rate and Total Harvest

Harvest rates (CPUE) ranged from 0.02 fish/h to 1.66 fish/h (Table 4). Successful angler CPUE rate (creeled at least one fish) was significantly higher than the CPUE of an average angler ($p < 0.05$). CPUE at individual streams varied from < 0.01 - 0.12 fish/h (pooled data, Table 5). Comparison of unweighted averages indicated that the 1981 CPUE (0.04 fish/h) was not significantly different than the 1982 CPUE (0.08 fish/h) at the 0.05 level.

Rainbow trout comprised virtually the entire catch with an occasional lake trout (Salvelinus namaycush), brook trout (Salvelinus fontinalis) and brown trout (Salmo trutta) caught. The estimated

Table 2. Average fishing pressure 1961-67, estimated fishing pressure 1981-82 and 95% confidence interval and change (%) 1961-67 to 1981-82 at individual streams, North Shore spring fishery.

Stream	Av. fishing pressure(h) 1961-1967a	1981 fishing pressure(h)	Changeb (%)	1982 fishing pressure(h)	Changeb (%)
Talmadge	-	1,195±679	-	1,031±722	-
Schmidt	-	0	-	0	-
Sucker	802	8,205±3,066	1,023	8,100±2,829	1,010
Knife	-	19,511±7,694	-	18,926±7,560	-
Stewart	1,637	4,515±2,168	276	5,366±1,534	328
Silver	287	1,682±800	586	1,543±858	538
Encampment	209	1,511±939	723	568±392	271
Crow	-	108±154	-	0	-
Castle	-	0	-	0	-
Gooseberry	343	1,432±484	417	957±493	279
Split Rock	1,278	3,241±1,604	254	4,861±1,455	380
Meyer's	-	0	-	271±300	-
Beaver	375	1,323±662	353	2,176±704	580
Palisade	260	532±643	205	610±415	235
Baptism	1,282	2,906±1,126	227	4,245±1,659	332
L. Manitou	-	204±189	-	108±218	-
Caribou	-	737±276	-	124±154	-
Cross	-	917±355	-	93±107	-
Temperance	-	1,352±305	-	758±349	
Onion	-	225±108	-	181±156	-
Poplar	-	1,394±303	-	716±311	-
Jonvick	-	179±174	-	0	-
Spruce	-	134±138	-	69±98	-
Indian Camp	-	45±61	-	69±98	-
Cascade	361	2,150±919	596	1,504±525	417
Cutface	-	693±324	-	72±113	-
Rosebush	150	512±176	341	265±161	177
Devil Track	1,085	3,542±955	326	1,411±433	130
Durfee	50	50±43	0	79±96	158
Cliff	-	0	-	35±62	-
Kimball	427	1,011±488	237	890±395	208
Kadunce	470	1,495±475	318	1,448±565	308
Brule	486	3,974±930	818	2,381±748	490
Myhr's	-	0	-	0	-
Flute Reed	92	471±228	358	170±123	184
Carlson	-	674±357	-	674±365	-
Farquhar		0	-	234±269	-
Unweighted Average	564±231	1,782±1,128	415±124	1,620±1,125	345±104

a From Hassinger et al. 1974.
b Percent increase from Hassinger et al. 1974.

Table 3. Average (weighted) trip length (h) and its 95% confidence interval of anglers of the North Shore stream fishery, 1981-1982

Streams	1981			1982		
	Weekends	Weekdays	Both	Weekends	Weekdays	Both
Northern	2.3 ± 0.4	2.1 ± 0.4	2.2 ± 0.2	1.9 ± 0.3	1.5 ± 0.2	1.6 ± 0.2
Southern	3.2 ± 0.3	2.8 ± 0.2	3.0 ± 0.2	2.7 ± 0.3	2.4 ± 0.3	2.5 ± 0.2
All	2.9 ± 0.2	2.5 ± 0.2	2.7 ± 0.2	2.4 ± 0.2	2.1 ± 0.2	2.2 ± 0.2

Table 4. Harvest rates (fish/h) of average and successful (SA) anglers and their 95 percent confidence intervals at northern and southern census streams of the spring North Shore fishery, 1981-82.

	NORTHERN STREAMS		SOUTHERN STREAMS	
	1981	1982	1981	1982
CI				
Weekends PDa	0.04 ±0.03	0.02 ±0.02	0.03 ±0.01	0.03 ±0.02
Weekends Sa	0.66 ±0.46	0.40 ±0.15	0.19 ±0.05	0.36 ±0.13
Weekdays PD	0.10 ±0.11	0.03 ±0.02	0.05 ±0.02	0.06 ±0.06
Weekdays Sa	1.67 ±1.55	0.51 ±0.12	0.31 ±0.08	0.67 ±0.59
Combineda PDb	0.06 ±0.06	0.02 ±0.01	0.04 ±0.01	0.05 ±0.03
Combined Sa	1.16 ±0.82	0.47 ±0.09	0.26 ±0.05	0.53 ±0.33

a Pooled data.
b Weekends combined with weekdays.

Table 5. Mean angler harvest rates (CPUE, fish/h) and estimated total harvest and their 95% confidence intervals of individual streams, spring North Shore fishery, 1981-82.

	CPUE			Harvest[a]		
	1961-67 Avg.	1981	1982	1961-67 Avg.	1981	1982
Talmadge	-[b]	-	-	-	48 ± 31	48 ± 47
Schmidt	-	-	-	-	0 -	0 -
Sucker	0.04	0.05 ±0.04	0.01 ±0.01	35	377 ±395	81 ± 117
Knife	-	0.05 ±0.02	0.06 ±0.07	-	917 ±546	1,154 ± 1,385
Stewart	0.10	0.04 ±0.03	0.03 ±0.03	188	167 ±150	140 ± 187
Silver	0.09	0.01 ±0.02	0.30 ±0.26	27	22 ± 34	464 ± 482
Encampment	0.28	- -	- -	59	60 ± 42	27 ± 26
Crow	-	- -	- -	-	4 ± 6	0 - -
Castle	-	- -	- -	-	0 -	0 -
Gooseberry	0.10	0.03 ±0.03	- -	34	46 ± 43	45 ± 38
Split Rock	0.06	0.02 ±0.03	0.03 ±0.03	73	81 ± 93	156 ± 144
Meyers	-	- -	- -	-	0 -	13 ± 17
Beaver	0.11	- -	- -	45	53 ± 32	102 ± 77
Palisade	0.19	- -	- -	48	21 ± 27	29 ± 28
Baptism	0.09	0.04 ±0.04	0.02 ±0.04	114	102 ±115	89 ± 173
L. Manitou	-	- -	- -	-	13 ± 17	3 ± 5
Caribou	-	- -	0.15 ±0.29	-	50 ± 45	18 ± 43
Cross	-	- -	- -	-	60 ± 56	2 ± 3
Temperance	-	- -	- -	-	88 ± 78	18 ± 13
Onion	-	- -	- -	-	15 ± 14	4 ± 4
Poplar	-	- -	- -	-	91 ± 81	17 ± 12
Jonvick	-	- -	- -	-	12 ± 15	0 -
Spruce	-	- -	- -	-	9 ± 12	2 ± 3
Indian Camp	-	- -	- -	-	3 ± 5	2 ± 3
Cascade	0.03	C ±0.01	0.02 ±0.04	12	11 ± 22	27 ± 56
Cutface	-	- -	- -	-	45 ± 44	2 ± 3
Rosebush	0.01	- -	- -	18	33 ± 31	6 ± 5
Devil Track	0.07	0.03 ±0.03	0.04 ±0.04	71	92 ±106	51 ± 64
Durfee	0.03	- -	- -	16	3 ± 4	2 ± 3
Cliff	-	- -	- -	-	0 -	1 ± 2
Kimball	-	- -	0.06 ±0.08	-	66 ± 65	49 ± 73
Kadunce	-	0.03 ±0.05	0.02 ±0.03	-	49 ± 72	29 ± 42
Brule	0.07	0.12 ±0.12	0.02 ±0.02	33	473 ±509	36 ± 42
Myhr's	-	- -	- -	-	0 -	0 0
Flute Reed	0.08	- -	- -	7	31 ± 30	4 ± 4
Carlson	-	- -	- -	-	44 ± 44	16 ± 12
Farquhar	-	- -	- -	-	0 -	6 ± 7
Unweighted Avg.	0.09	0.04	0.08	52	83	71

[a] Overall harvest rate used when data was insufficient.
[b] Dash indicates insufficient data.
[c] Less than 0.01.

rainbow trout harvest in 1981 was 3,021 ± 1,243 while in 1982 it was 2,561 ± 1,618. Estimated harvest from individual streams varied between years ranging from 0 to 1,154 rainbow. Average catch per stream was 83 fish in 1981 and 71 in 1982 (Table 5).

Distribution of the Catch

Between 3% and 15% of the anglers were successful (Table 6). Anglers fishing south of Little Manitou River were generally more successful than those fishing farther north. Weekday trips were about as successful as weekend trips.

Size and Age of the Catch

An average rainbow trout in the creel weighed 2.2 ± 0.3 kg in 1981 with the largest weighing 4.0 kg (Fig. 2). An average rainbow trout weighed 1.8 ± 0.2 kg in 1982, with the largest weighing 3.9 kg. Length data was insufficient in 1981 to calculate a reliable average but the average total length in 1982 was 588 ± 18 mm (Fig. 3).

The 1976 year-class was the most abundant age group both years and comprised 25% and 33% of the harvest for 1981 and 1982, respectively. This year class returned as group 2/3 in 1981 (two growing seasons in the stream/three growing seasons in the lake) and 3/3 in 1982 (Fig. 4).

Hatchery-Reared Strains

Hatchery-reared rainbow contributed a small number of fish to the catch. One of 90 rainbow observed in 1981 was a finclipped Donaldson strain. Three of 94 fish examined in 1982 were finclipped, including two Kamloops strain and one Madison strain.

Benefit-Cost Ratio

Estimated monetary benefit of the spring North Shore stream fishery to the state economy was $631,202 in 1981 and $677,118 in 1982.

Table 6. Distribution of the daily rainbow trout harvest (number and %) among weekday and weekend anglers contacted in the 1981-1982 spring North Shore stream fishery.

No. trout creeled	NORTHERN STREAMS		SOUTHERN STREAMS	
	Weekday anglers	Weekend anglers	Weekday anglers	Weekend anglers
1981				
0	93-97%	122-92%	189-85%	187-89%
1	1- 1%	8- 6%	21-13%	21-10%
2	0- 0%	2- 1%	2- 1%	3- 1%
3	2- 2%	1- 1%	3- 1%	0- 0%
Total Contacted	96	133	215	211
1982				
0	75-96%	47-92%	135-88%	154-92%
1	3- 4%	4- 8%	14- 9%	12- 7%
2	0- 0%	0- 0%	3- 2%	0- 0%
3	0- 0%	0- 0%	1- 1%	1- 1%
Total Contacted	78	51	153	167

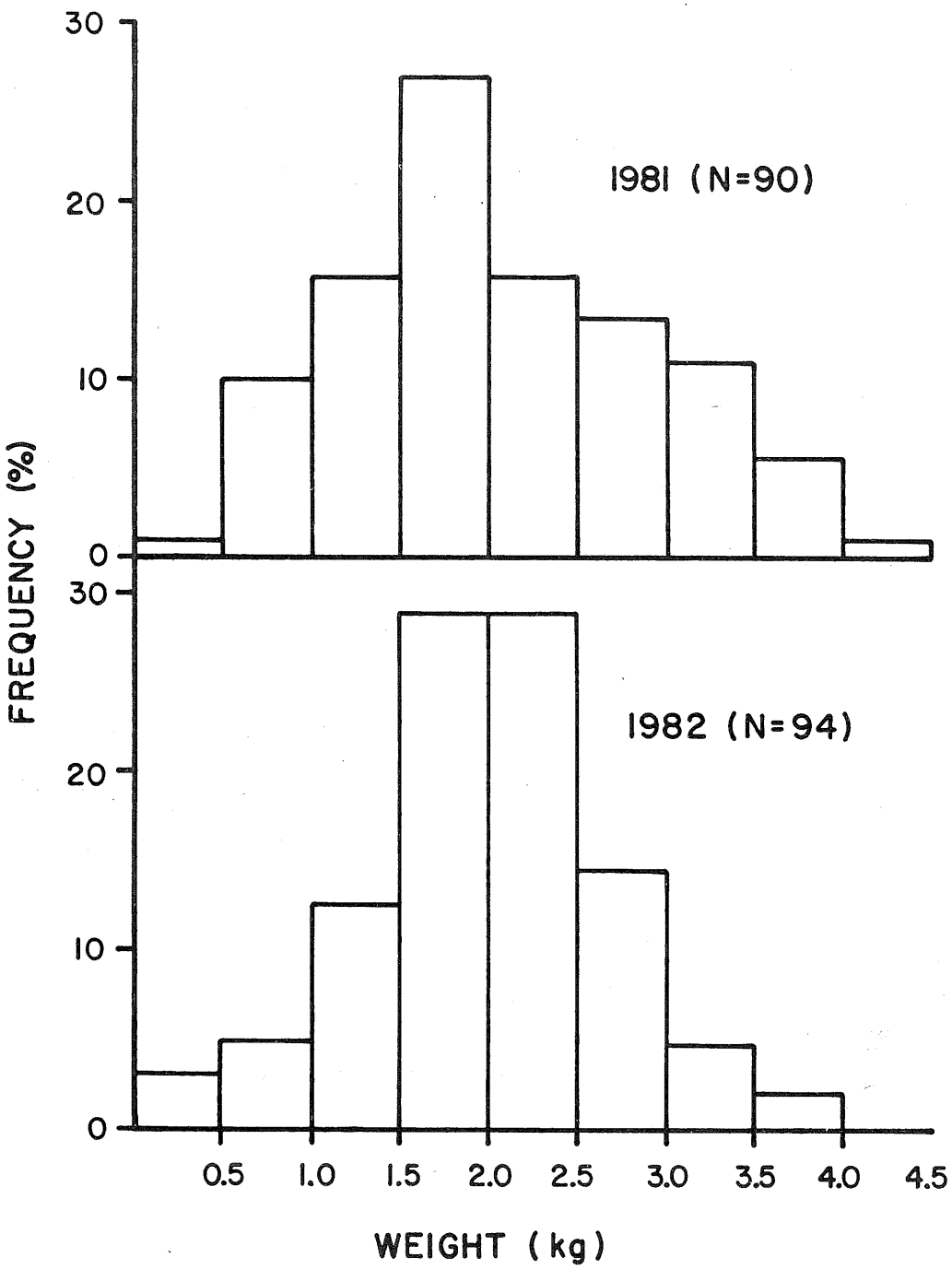

Figure 2. Weight frequency distribution (%) of rainbow trout harvested in spring from North Shore streams, 1981-82.

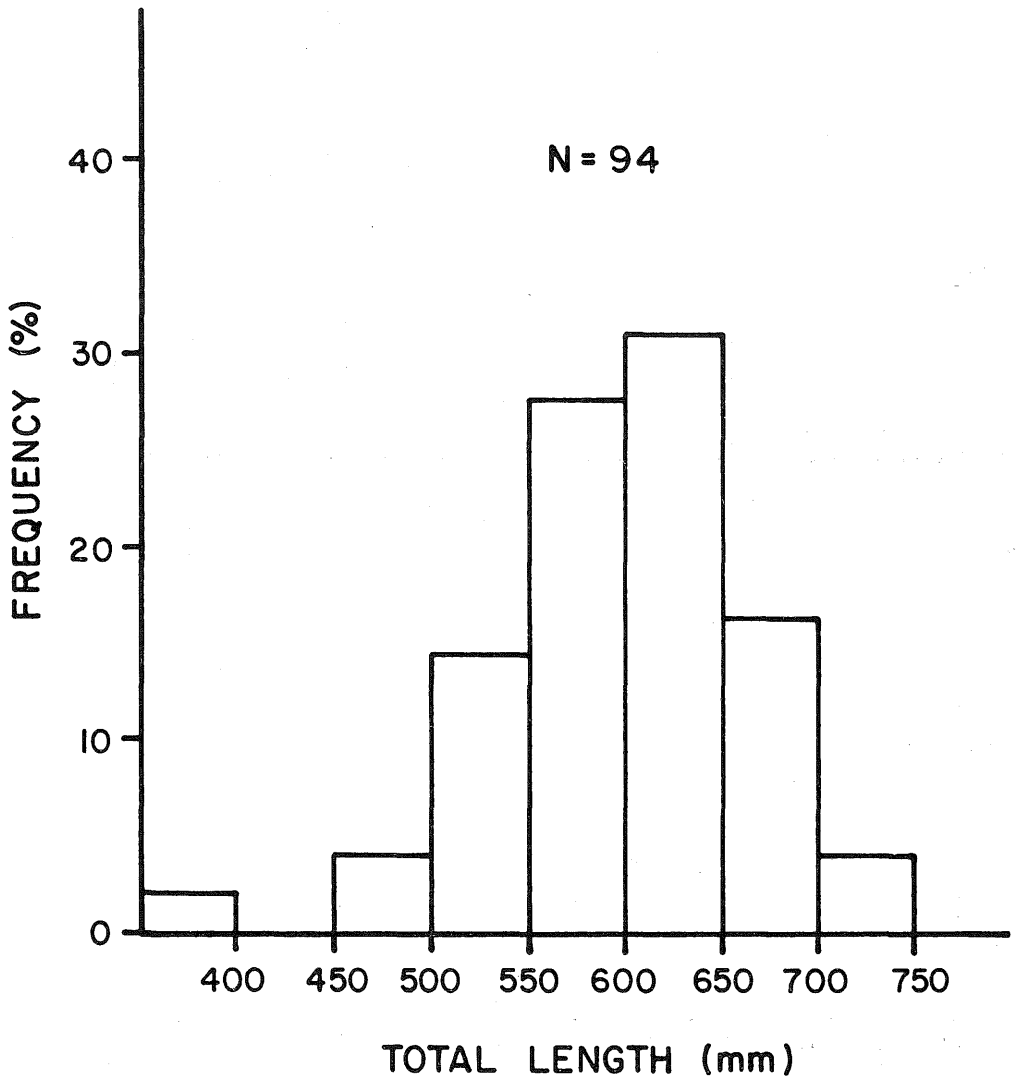

Figure 3. Length frequency distribution (%) of rainbow trout harvested from North Shore streams, spring 1982.

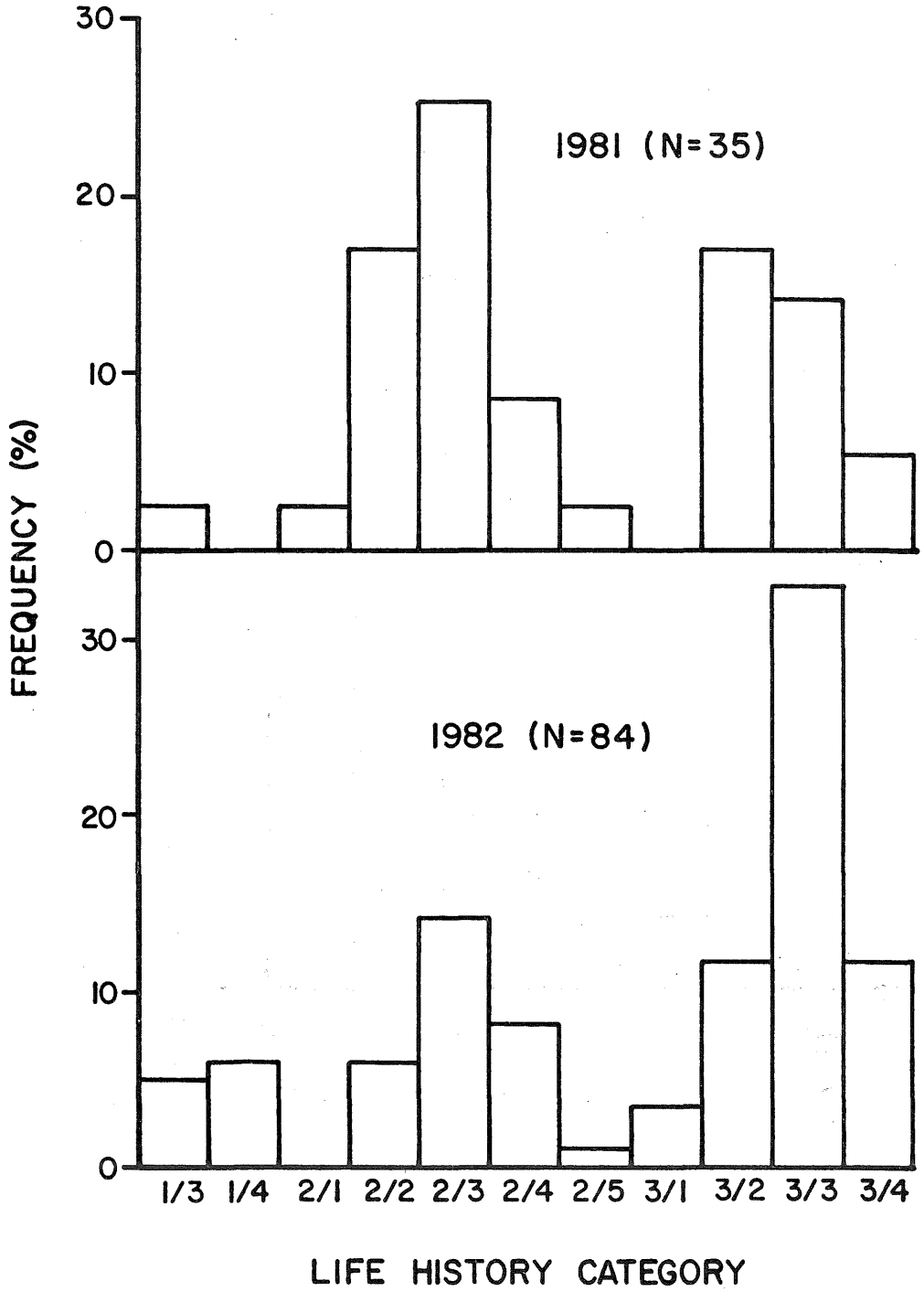

Figure 4. The frequency (%) of the life history categories (growing seasons in streams/growing seasons in lakes) of rainbow trout harvested in the spring North Shore stream fishery, 1981-1982.

Benefit-cost ratios of 309:1 and 384:1 resulted for 1981 and 1982 estimates, respectively.

Origin of Anglers

The clerk working in the northern section recorded angler home-towns incidental to other information. The majority of northern anglers lived in the local Grand Marais area (Fig. 5). Almost 60% of weekday anglers were local people but only about 35% of weekend anglers lived in the immediate area.

DISCUSSION

Fishing pressure on North Shore streams is increasing. Comparisons with data collected by Hassinger el al. (1974) indicate increases on individual streams ranging from 177% to 1,023% (Table 2). Fishing pressure increased most dramatically (1,023%) on the Sucker River where the barrier falls had been altered to facilitate fish passage. This observation provides evidence that such procedures can result in significant increases in fishing recreation and benefits of such work should be evaluated in terms of expanded fishing opportunity as well as increased smolt production. Continued increases in fishing pressure will require intensive studies to develop other cost effective approaches to maintain and increase the output of anadromous smolts to meet sport fishing demand.

Fishing pressure per km of fishable water was lower shorewide than that found in 1979 from the Brule River in Wisconsin. Pressure on the Brule during the same months totaled 75,177 h or 1,914 h/km (Scholl et al. In Press). Shorewide fishing pressure on censused streams in Minnesota totaled 431 h/km in 1981 and 402 h/km in 1982 which compares to 22% and 21% of the pressure on the Brule River, respectively.

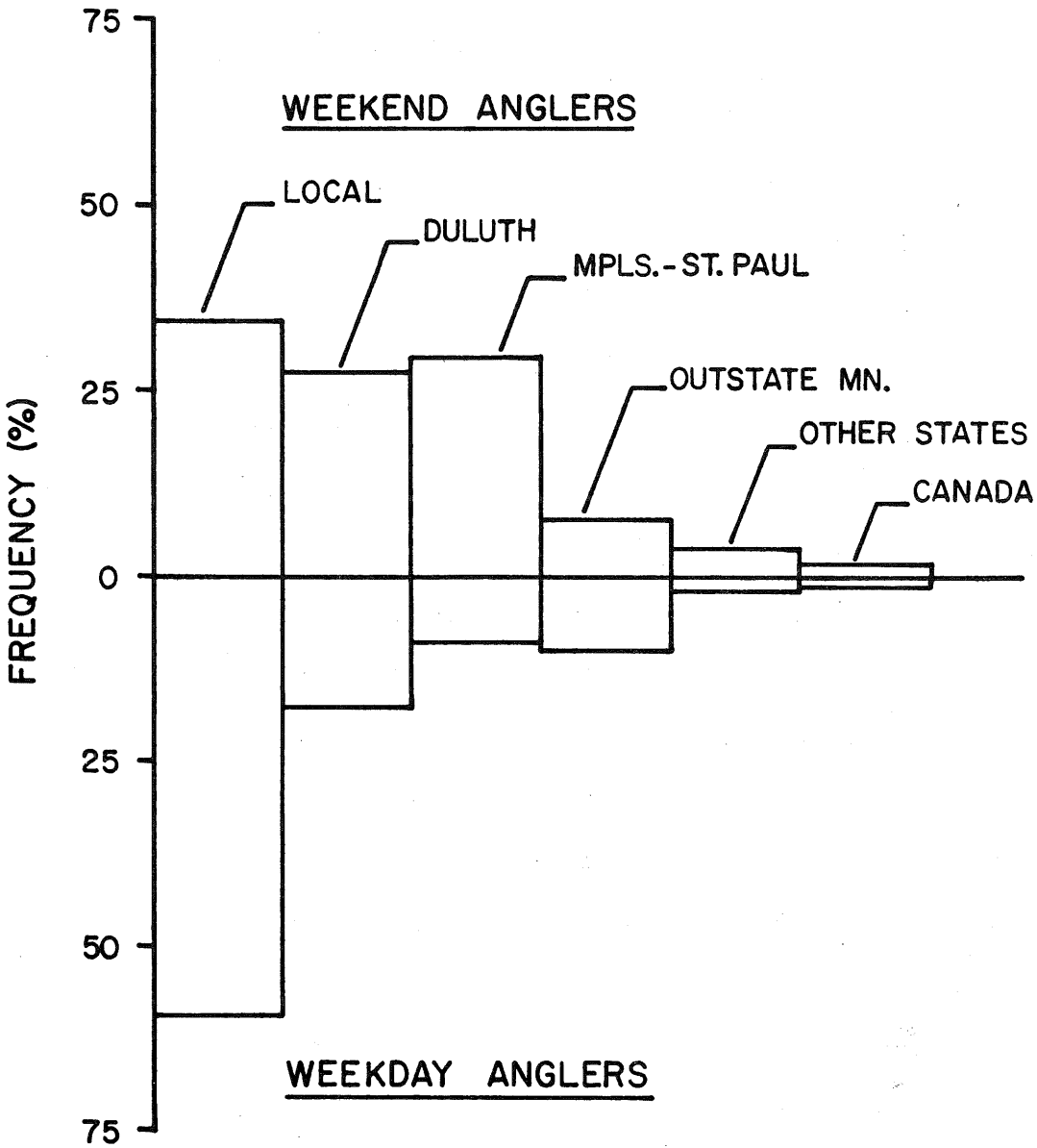

Figure 5. Distribution (%) of hometowns of anglers fishing the northern streams of the spring North Shore fishery, 1981-82.

Data indicate that anglers fishing North Shore streams have experienced declines in catch rate as fishing pressure increased. Average catch rates on comparable streams was higher in the 1960's than during either 1981 or 1982 (Table 5). Only the 1981 catch rate, however, was significantly lower ($p \leq 0.05$).

Comparison of CPUE between years and studies should be limited to unweighted average values rather than individual stream harvest rates. A test of homogeneity of variance ($p < 0.05$) of CPUE from individual streams resulted in rejection of the null hypothesis. This indicates that individual harvest rates may be inaccurate with an equal probability of being too high or too low. Census effort on individual streams must be increased if an accurate CPUE is desired for each.

CPUE and total harvest were higher from the Brule River in Wisconsin in 1979 than from Minnesota streams during this study. CPUE in the Brule River was 0.07 rainbow trout/h as compared to 0.06 trout (1981) and 0.02 rainbow trout/h (1982) in northern streams and 0.04 (1981) and 0.05 rainbow trout/h (1982) found in southern streams (Table 4). Total harvest of rainbow trout in the Brule River from March through May was an estimated 5,238 while an estimated 3,021 and 2,561 rainbow were taken during the same months from North Shore streams in 1981 and 1982, respectively. The Brule River has abundant high-quality nursery habitat, and over-winter survival of parr is probably substantially better than in the harsher environments of Minnesota streams. Increases in total catch and catch rates from Minnesota streams may be realized if the quality and quantity of nursery habitat can be increased.

As in most fisheries, the majority of fish are caught by a

minority of skilled and persistent anglers. Significant increases in catch rate would probably occur if fewer fish were killed by the skilled anglers. Efforts to recognize skilled anglers and promote catch and release fishing may distribute the catch to more anglers and improve the quality of the fishery.

The contribution of hatchery-reared fish to the catch was small but the program has not been adequately evaluated. Most of the fish observed by the clerks were observed at the Knife River which was not stocked with hatchery-reared fish. Closer observation of the smaller streams that have been stocked is necessary before judgments about the stocking program are made.

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