FISH MANAGEMENT REPORT 112

CHARACTERISTICS OF THE SPORT FISHERY OF ROWAN CREEK AND THE IMPACT OF FISHING ON THE WILD BROWN TROUT POPULATION

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October 1982

Bureau of Fish Management • Wisconsin Department of Natural Resources, Madison, Wisconsin

ABSTRACT

Creel census data collected during the nine-month 1979 trout fishing season and data from five fall population estimates of brown trout (Salmo trutta) were analyzed to evaluate the impact of fishing on the Class I portion of Rowan Creek. This trout stream is considered to be one of the best in southern Wisconsin and is included in that eight-county zone of Wisconsin where the trout fishing season opens on 1 January rather than the first Saturday in May. Yet, anglers from counties where stream trout fishing is closed from January to April did not fish Rowan Creek at a higher intensity during the early season as compared to the usual May to September trout season.

Fishing pressure on Rowan Creek ranged from 215 to 1,560 hours/acre in the four study zones. The latter value is one of the highest calculated for a Wisconsin stream. Approximately 40% of the fishing pressure and 33% of the trout harvest occurred between January and April. Catch rate averaged 0.6 trout/hour during this period as compared to 1.2 trout/hour for the May-September period. Monthly length frequency distributions of the harvest were similar throughout the season. Few anglers kept trout less than 8 inches and 18% of the trout creeled exceeded 12 inches. Fishing pressure was three times greater and the harvest rate almost double on the study area containing artificial hiding cover versus values reported on the adjacent study area which lacked habitat improvement.

Variable recruitment (age 0 in fall) and high mortality of age 1+ stocks greatly influenced the standing stocks of brown trout from year to year. Recruitment ranged from 560 to 3,036 fall age 0 trout/mile during the 5 years of study. Annual mortality was as high as 90% for age 1+ trout in the creek area with habitat development. Only 24% of the annual mortality on age 11+ trout was attributable to fishing in this zone, but such harvest was deemed to be detrimental as the fishery dramatically declined during the 1979 season.

The theoretical effects of a more restrictive size limit, bag limit and season length change were calculated. A 10-inch minimum size limit is recommended if current trout population and angler use trends continue.

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INTRODUCTION

Rowan Creek is considered one of the best brown trout waters in southern Wisconsin. The stream receives heavy fishing pressure and portions of it have been subject to habitat improvement. This study was designed to document characteristics of the anglers, fishing pressure, and catch and harvest rates on selected areas of the stream, as well as to evaluate the impact of angling and the effect of possible changes in fishing regulations on this trout fishery.

Located in Columbia County, Rowan Creek flows 17 miles from its source to the Wisconsin River (Fig. 1). Abundant spring seepage along its upper 12 miles provides water temperatures capable of supporting trout. A steeper gradient (30 ft/mile) along the upper 4 miles exposes sufficient gravel to allow adequate natural reproduction (Class I water). The watershed is fairly large (60 miles^2) and its upper region consists primarily of agricultural lands. Therefore, heavy rains cause the stream to rise rapidly and become turbid. However it usually settles back to normal flow within 24 hours. Stream flow is typically stable with a base flow of 4.5 cfs on the lower region of the Class I water. Rowan Creek flows through Poynette (1,450 pop.) and lies 11 miles south of Portage (8,000 pop.). It is within 30 minutes driving time of 250,000 people, which includes the Madison area (Dane County).

A census of anglers was made along four stream sections containing 2.5 miles of the 4.0 miles of Class I water (Fig. 2). Station 1 (1,600 ft, 0.4 acre) is associated with a bridge crossing where most of the fishing occurred. Private lands border both sides of the bridge and the streambanks are pastured. Very little fishing occurs upstream from the bridge. Stations 2 and 3 lie within 8,000 ft of DNR-owned streamthread immediately downstream from Station 1. A habitat improvement project was initated on this area in 1976. Prior to the 1979 fishing season, Station 2 (2,000 ft, 0.6 acre) received bank tapering and 24 boom covers (ave. length = 30 ft). The banks were stabilized in Station 3 (6,000 ft, 1.8 acre), but no hiding covers were installed at this time. Boom covers were later placed within a 1,000-ft stretch of Station 3 during the summer of 1979. Station 4 (3,400 ft, 1.2 acres) lies downstream from Station 3, separated by one-quarter mile of privately owned streamthread which receives light fishing pressure. The stream frontage of Station 4 is owned by the DNR and bordered by Highway 51 on the downstream end. Riprapping and five boom covers were installed on the upper 1,800 ft of Station 4 in the early 1970's. Moderate fishing pressure occurs below Highway 51 in Poynette; however, heavy vegetation along the banks and many downstream access sites made it difficult to count fishermen without walking the stream during angler counts. Thus this section was not included in the study area.

The 1979 fishing regulations included a size limit of 6 inches and bag limit of 5 legal trout per day. The fishing season ran from 1 January through 30 September. The season had been changed in 1975 from an opening on the first Saturday in May to the present opening on 1 January.

METHODS

The creel census was conducted throughout the 1979 fishing season. Instantaneous angler counts were made on a randomized schedule. On days chosen for instantaneous counts, five counts were made each day at 0500-0800 hours, 0800-1100 hours, 1100-1400 hours, 1400-1700 hours and 1700-2100 hours. Exact time of each count was randomized within the time period. In January through March, counts were excluded from the 0500-0800 and 1700-2100 periods. Angler interviews were conducted as time permitted during days of instantaneous counts as well as other days when time permitted (Table 1). Projected fishing pressure was based on a mean daily instantaneous angler count multiplied by the hours in the fishing day. Projected harvest was calculated by multiplying the projected fishing pressure with the rate of harvest.

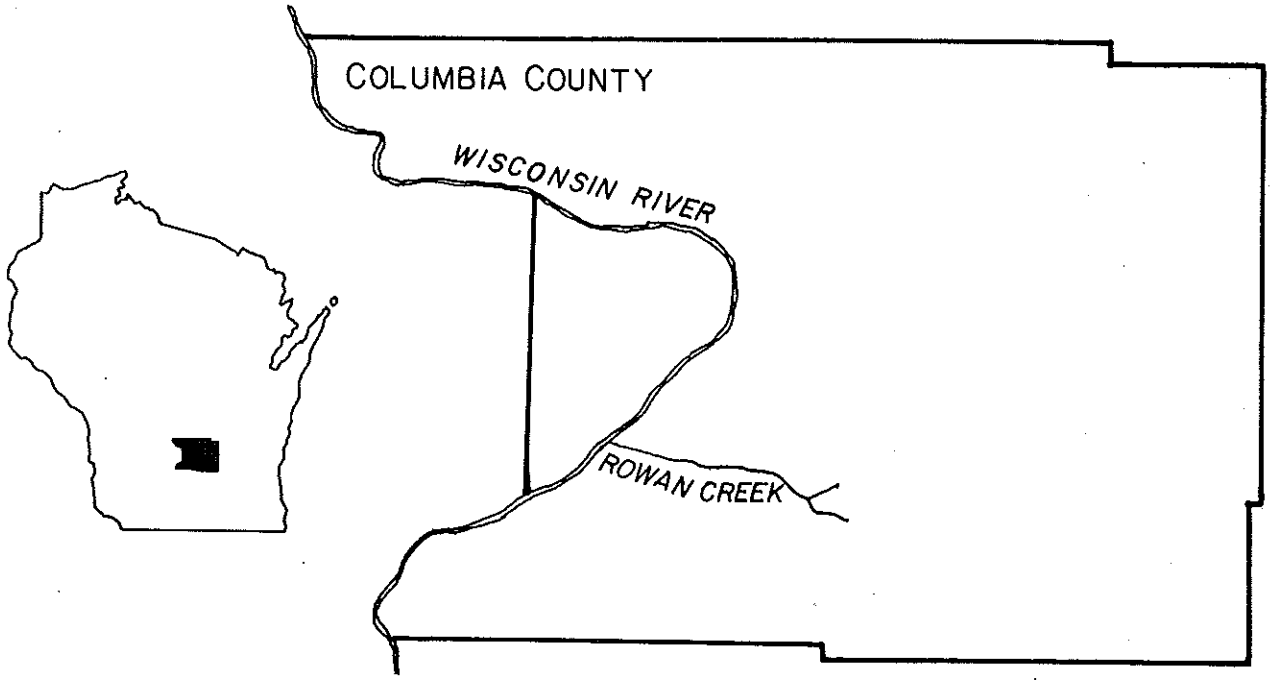

FIGURE 1. Location of Rowan Creek.

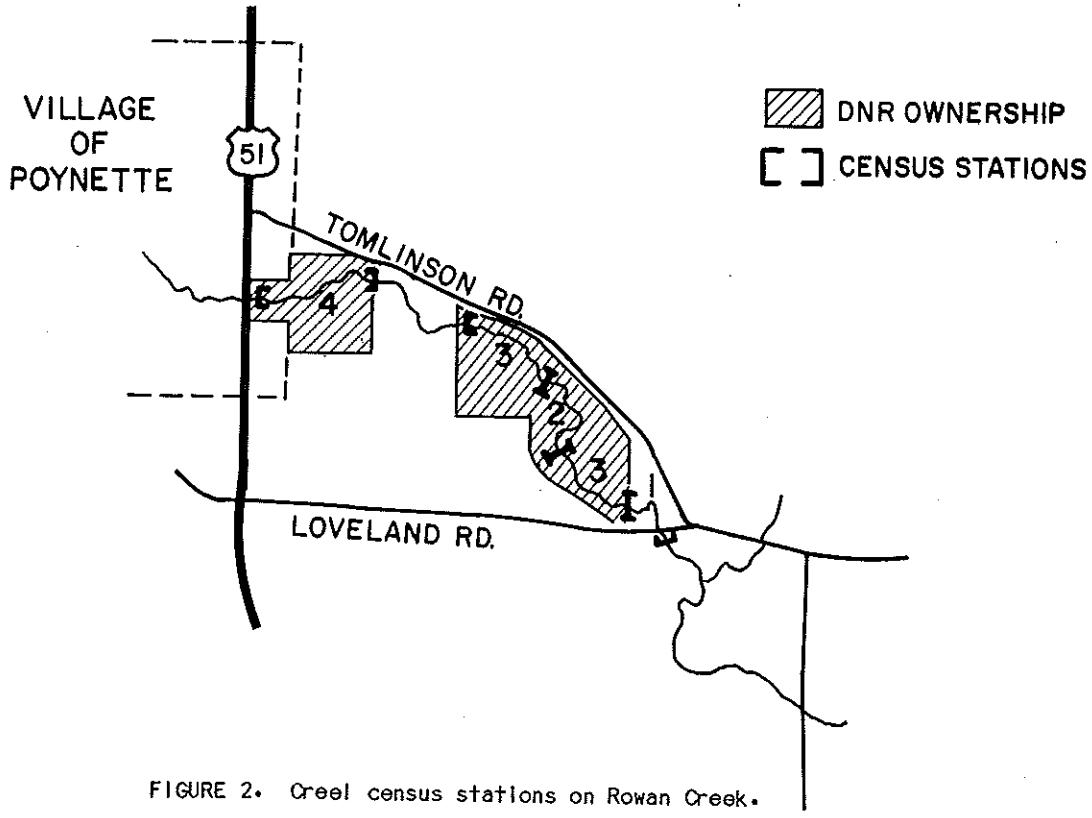

FIGURE 2. Creel census stations on Rowan Creek.

TABLE 1. Creel census conducted on Rowan Creek - 1979.

Month	Day of Week	Time Period Sampled (hours)	Instantaneous Counts	Angler Interviews	Hours Of Fishing Recorded
January	weekdays		30	4	7.5
	weekends		21	8	10.1
	Total	1000-1700 (7)	51	12	17.6
February	weekdays		30	7	5.8
	weekends		24	2	3.2
	Total	0900-1700 (8)	54	9	9.0
March	weekdays		51	29	43.0
	weekends		21	37	47.8
	Total	0900-1700 (8)	72	66	90.8
April	weekdays		54	37	77.9
	weekends		22	15	22.0
	Total	0600-1900 (13)	76	52	99.9
May	weekdays		48	18	24.2
	weekends		25	16	31.5
	Total	0600-2100 (15)	73	34	55.7
June	weekdays		50	15	32.5
	weekends		20	12	27.3
	Total	0500-2100 (16)	70	27	59.8
July	weekdays		25	5	21.0
	weekends		15	14	19.5
	Total	0530-2030 (15)	40	19	40.5
August	weekdays		50	24	40.0
	weekends		25	15	27.0
	Total	0600-2000 (14)	75	39	67.0
September	weekdays		20	6	10.8
	weekends		25	16	34.5
	Total	0630-1930 (13)	45	22	45.2
Entire census	weekdays		358	145	262.7
	weekends		198	135	222.9
	Total		556	280	485.6

Beginning in 1975, population estimates of brown trout were determined on selected 1,000-ft stream sections in Stations 2 and 3. A 240V-DC electro shocking unit was used to capture fish during late September or early October each year and population estimates calculated according to the Balleys modification of the Peterson formula:

$$N = \frac{(M)\ (C+1)}{R+1};$$

where N = estimated population; M = number of fish marked on first run; C = number marked fish plus unmarked fish on second run; and R = number of marked fish on second run (Ricker 1975). Shocker efficiency was noted to be 70% on fall fingerlings and 90% on age 1+ fish. Annual mortality rates were based on the number of surviving fish between age groups of the same year class. Projected harvest and standing crop data for Station 2 enabled the 1979 annual mortality rate to be divided into fishing mortality and natural mortality.

RESULTS AND DISCUSSION

Angler Characteristics

Of 260 anglers interviewed, 97% were male and 3% female.

The majority of anglers (80%) were between 16 and 64 years old, while 19% were less than 16 years old, and only 1% were 65 or older.

Most anglers traveled less than 25 miles (62%) to reach Rowan Creek and were from Columbia County (54%; Tables 2 and 3). Those traveling 26-50 miles accounted for 27% of the anglers and were primarily residents of Dane County (28%). Of the remaining anglers, 9% were from other Wisconsin counties, 6% from the Milwaukee area and 3% were nonresidents. Angler residences were similar during the early season (January-April) and the traditional season (May-September), indicating that anglers from distant counties were not zeroing in on Rowan Creek during the early season when surrounding counties were closed to trout fishing.

TABLE 2. Distance traveled by Rowan Creek anglers.

Distance Traveled (miles)	Angler Interviews
0-25	155 (62%)
26-50	66 (27%)
50+	27 (11%)
Total	248

TABLE 3. Residence of Rowan Creek anglers.

Angler Residence	Angler Interviews		
	January-April	May-September	January-September
Columbia County	62 (50%)	80 (58%)	142 (54%)
Dane County	37 (30%)	37 (27%)	74 (28%)
Other Wisconsin counties	16 (13%)	7 (5%)	23 (9%)
Milwaukee area	8 (6%)	9 (6%)	17 (6%)
Nonresident	2 (1%)	5 (4%)	7 (3%)

The average fishing trip (based on 127 completed trips) was 2.5 hours. Thirty percent of all trips were less than 2 hours, 66% were less than 3 hours, and 89% were less than 4 hours (Table 4).

Wading anglers were much more successful than shore fishermen. Those wading (139 anglers, 223 hours fishing time) caught 1.4 brown trout/hour and harvested 0.6 trout/hour. Bank fishermen (140 persons, 261 hours fishing time) caught 0.4 brown trout/hour and harvested 0.2 trout/hour.

Live grasshoppers were the most successful bait used with a catch rate of 7.8 trout/angler (Table 5). However, this average was based on only four anglers. Fly fishermen caught trout at a rate of 3.8 fish/angler. Fishermen using minnows caught 2.4 trout/angler. Those casting spinners caught 2.2 trout/angler, and worm fishermen caught 1.5 trout/angler. But worms were still the most popular bait, used by 47% of the anglers. Spinners were chosen by 24% of the fishermen and flies by 23%. The higher catch rate by fishermen using flies over other types of baits (excluding grasshoppers) may reflect a segment of fishermen who are more knowledgeable of trout habits as well as the effectiveness of flies as bait.

TABLE 4. Length of fishing trips.

Trip Length (hours)	Completed Trips
0-1	4 (3%)
1-2	34 (27%)
2-3	46 (36%)
3-4	29 (23%)
4-5	8 (6%)
5-6	1 (1%)
6-7	4 (3%)
7-8	1 (1%)
	127

TABLE 5. The effectiveness of trout bait used.

Type of Bait	No. of Anglers	No. Of Trout Caught	Catch/Angler
Grasshopper	4	31	7.8
Fly	64	246	3.8
Minnow	10	24	2.4
Spinner	68	150	2.2
Worm	130	194	1.5
Other	3	3	1.0
Total	279	648	

Fishing Pressure

Very limited fishing pressure occurred at the study stations during January and February (4%) because of the severe winter in 1979 (Table 6). Temperatures were seldom suitable for fishing and snow depth was 2 ft throughout the period. Ice would rapidly build up on fishing lines and deep drifts surrounded the creek. By March, conditions began to moderate and fishing pressure increased to 13% of the total. The highest fishing pressure occurred during April (23%). Forty percent of all fishing took place during January-April, the extended portion of the season. Fishing in May (19%) was undoubtedly influenced by high winds during the first three weeks. Fishing pressure dropped off in June (10%) despite ideal weather conditions. The rate picked up slightly during July and August with 13% and 12% of the year's fishing pressure occurring, respectively. Beginning in July, instream aquatic vegetation reached densities that restricted fishing throughout much of the census area. Despite ideal weather conditions in September, angling declined to 7% of the total fishing pressure. Fishing pressure was heavier on weekends and holidays than during the week. Approximately 50% of the fishing occurred on weekends and the other half on weekdays (Table 7).

TABLE 6. Projected fishing pressure by month on all Rowan Creek stations.

Month	Total Hours Fished
January	40 (2%)
February	36 (2%)
March	249 (13%)
April	426 (23%)
Early Season	751 (40%)
May	355 (19%)
June	181 (10%)
July	251 (13%)
August	230 (12%)
September	129 (7%)
Traditional Season	1,146 (60%)
Total	1,897

TABLE 7. Projected fishing pressure on weekdays and weekends on all Rowan Creek stations.

Day	Total Hours Fished
Weekday	965 (51%)
Weekend	932 (49%)
Total	1,897

Fishing pressure also differed by census site (Table 8). Most of the pressure (61%) occurred at Station 1 (1,560 hours/acre) and Station 4 (433 hours/acre). These areas are the most accessible. Road bridges cross the stream at these stations, and heavy fishing pressure occurs in the immediate vicinity of the bridges. It should also be pointed out that the high amount of fishing pressure at Station 1 is also due to the small area in which fishing occurred.

Although Station 2 and Station 3 are similar in accessibility, though less accessible than the other sites, a much greater amount of fishing was spent at Station 2. The 2,000-ft stretch of Station 2 received 605 hours of fishing/acre while the 6,000-ft streamthread of Station 3 received only 215 hours/acre. Fishermen knew hiding covers were present throughout Station 2 making it an easy area to fish, with trout always present.

TABLE 8. Projected fishing pressure by station.

Station	Total Hours Fished	Hours/Mile	Hours/Acre
1	625 (33%)	2,059	1,560
2	363 (19%)	955	605
3	388 (20%)	340	215
4	520 (28%)	807	433
Total	1,897		

Catch and Harvest

The length distribution of fish harvested and catch rate in Rowan Creek differed between census sites. Station 1 and Station 2 exhibited a much higher percentage of 7-inch and 8-inch trout in the creel (Table 9). Fish less than 9 inches in length accounted for 34% of the harvest at Station 1, 25% at Station 2, 18% at Station 3 and 11% at Station 4. Fishing at Station 1 was almost entirely still fishing around the bridge and Station 2 contained the boom covers. Assuming a similar size distribution of trout at each site, the size of fish creeled may reflect the attitudes and skills of the anglers fishing each section.

Catch rates were similar at Stations 1, 3 and 4, varying from 0.7 to 0.9 trout/hour. Station 2 provided a catch rate of 1.5 trout/hour (Table 10). The boom covers most likely increased this catch rate.

TABLE 9. Length distribution of trout harvested at each station.

Length (inches)	Station 1		Station 2		Station 3		Station 4		Combined Stations	
	No. Of Trout	%	No. Of Trout	%	No. Of Trout	%	No. Of Trout	%	No. Of Trout	%
7	8	16	2	3	2	6	-	0	12	6
8	9	18	14	22	4	12	7	11	34	16
9	13	26	15	23	3	9	17	27	48	23
10	10	20	18	28	4	12	14	23	46	22
11	5	10	7	11	6	19	13	21	31	15
12	2	4	4	6	4	12	5	8	15	7
13	2	4	3	5	2	6	5	8	12	6
14	1	2			5	16	1	2	7	3
15			1	2	1	3			2	1
16					1	3			1	1
Total	50		64		32		62		208	

TABLE 10. Catch and harvest rates of brown trout at each station.

Station	Recorded Catch	Catch Rate (trout/hour)	Recorded Harvest	Harvest Rate (trout/hour)	Projected Harvest	Harvest (trout/mile)	Harvest (trout/acre)
1	99	0.7	50	0.4	263	868	657
2	160	1.5	59	0.5	216	570	360
3	98	0.9	32	0.3	113	99	63
4	100	0.8	61	0.5	221	343	184

The length distribution of fish harvested at all census sites was similar throughout the fishing season, both the early season and the traditional season (Table 11). During the 1979 season only 6% of the trout harvested were less than 8 inches, while 39% harvested were between 8 and 9 inches, and 37% were between 10 and 11 inches. Trout larger than 12 inches accounted for 18% of the harvest on Rowan Creek.

Although the length distribution of fish harvested was similar throughout the fishing season, catch and harvest rates varied considerably between the early and traditional seasons (Table 12). Twice as many fish were caught per hour during the summer (1.2 trout/hour) as opposed to the winter and spring (0.6 trout/hour). Corresponding harvest rates were 0.5 fish/hour in May through September and 0.3 fish/hour during January through April. This disparity may be explained in part by less skilled anglers fishing during the early months. Generally, those who fished the early season were one-time fishermen, whereas summer anglers were more typically repeat fishermen. The logic being that the angler who fishes more is generally more skilled.

TABLE 11. Comparitive length frequencies for trout harvested during the early season and the traditional trout season.

Length (Inches)	January-April No. of Trout	%	May-September No. of Trout	%	Combined Seasons No. of Trout	%
7	4	55	8	6	12	6
8	9	11	25	19	34	16
9	22	28	26	20	48	23
10	16	20	30	23	46	22
11	12	15	19	15	31	15
12	9	11	6	5	15	7
13	3	4	9	7	12	6
14	3	4	4	3	7	3
15	1	1	1	1	2	1
16			1	1	1	1
Total	79		129		208	

TABLE 12. Catch and harvest rates for brown trout during the early season and traditional trout season.

Month	Recorded Catch	Catch Rate (trout/hour)	Recorded Harvest	Harvest Rate (trout/hour)	Projected Harvest
January	3	0.2	3	0.2	7 (1%)
Febuary	10	1.1	6	0.7	24 (3%)
March	75	0.8	31	0.3	85 (11%)
April	43	0.4	34	0.3	145 (18%)
Early Season	131	0.6	74	0.3	261 (33%)
May	39	0.7	25	0.4	159 (20%)
June	77	1.3	26	0.4	79 (10%)
July	32	0.8	18	0.4	111 (14%)
August	12	1.9	38	0.6	130 (16%)
September	50	1.1	21	0.5	60 (7%)
Traditional Season	326	1.2	128	0.5	539 (67%)

Projected harvest, based on harvest rates and projected pressure, was totaled by month (Table 12) and by census site (Table 10). Of the total harvest, 33% occurred from January to April and 67% from May to September. This compares with 40% of the total fishing pressure occurring in January through April and 60% between May and September. Projected harvest was highest at Station 1 (868 trout/ mile), followed by Station 2 (570 trout/mile), Station 4 (343 trout/mile) and Station 3 (99 trout/mile). Station 1 was the bridge crossing that received high fishing pressure and Station 2 was the boom cover area that had a high catch rate.

Population Dynamics

Trout populations are influenced by the rates of recruitment and mortality as the year classes of fish grow. Fall population estimates were made at Station 2 and selected portions of Station 3 (Append. Table 23). Year class strength for 1975, 1977, 1978, 1979 and 1980 varied considerably (Table 13). Fall fingerling populations for Stations 2 and 3 varied from 560 to 3,036 trout/mile, averaging 1,793 trout/mile over the 5 years of study. The smallest year classes occurred in 1975, prior to any stream improvement work, and in 1980, following four summers of habitat work. Obviously, many factors are involved in determining natural reproductive success.

TABLE 13. Population estimates of fall brown trout fingerlings on Station 2 and Station 3.

Year	Trout/Mile
1975	743
1976	
1977	3,036
1978	2,739
1979	1,889
1980	560
Average	1,793

Populations of older-age fish are initially determined by year class strength and thereafter affected by the rate of mortality. The annual mortality rate observed for trout in Station 2 and Station 3 was about 71% from 1978 through 1980 (Table 14). Mortality data was broken down for each year class on 1,000-ft sections within Stations 2 and 3 (Table 15). Very high rates of mortality were observed for the 1979 fishing season within the boom cover area (Station 2 -- Sections 12 and 13). Mortality rates ranged from 85% to 90% on older-age fish. Mortality rates were about 15% less on Sections 10, 11, and 15 of Station 3 than the rates for Station 2 during the 1979 angling season. Section 14 of Station 3 had a mortality rate of 83% to 96% in 1979, probably due to boom cover construction during that year. The higher mortality rates in Station 2 versus Station 3 coincide with 1979 creel census data indicating three times greater fishing pressure and two times greater harvest rate at Station 2. This combines to give a harvest within the boom cover area that is 5.7 times greater than the area that lacked boom covers. A slight decline in total mortality on age I+ fish was noted for the 1980 fishing season (Table 14). Exceptions are Sections 10 and 11 of Station 3 (Table 15) where boom cover work was done during 1980.

TABLE 14. Annual trout mortality rates on Stations 2 and 3.

Age Group	1978	1979	1980
0-I	72%	76%	74%
I-II	27%	84%	76%
(II+III^{+})-III+	68%	83%	78%

TABLE 15. Annual trout mortality rates for sections of Rowan Creek (percent mortality).

	Section 10**			Section 11**			Section 12*			Section 13*		
Age Group	1978	1979	1980	1978	1979	1980	1978	1979	1980	1978	1979	1980
0-I	72	78	83	82	80	79	64	67	-41[1]	68	68	55
I-II	42	70	79	52	84	91	-20[1]	90	72	18	89	68
(II+III+)-III+	80	76	92	80	79	76	65	85	68	61	87	66

	Section 14**		Section 15**	
Age Group	1979	1980	1979	1980
0-I	79	77	80	80
I-II	83	66	78	66
(II+I II+)-III+	96	75	65	87

*Creel Census Station 2 = Sections 12, 13.
**Creel Census Station 3 = Sections 10, 11, 14, 15.
[1](-) Indicated trout movement into study area.

As observed on the boom cover versus non-boom cover areas, increased angling increases the annual mortality rate on age I+ trout. However, a certain percentage of fish die annually regardless of angling. Both standing crop and projected harvest data were available for Station 2, which had the highest mortality rates in 1979 (Table 16). Thus, it was determined on age II+ trout that 65% of mortality was due to natural causes and only 24% to fishing. Angling mortality on age I trout, that grew from an average size of 4.5 inches to 9.5 inches during 1979, was 12%.

TABLE 16. Brown trout mortality rates on Station 2.

Standing Crop Fall 1978		Standing Crop Fall 1979					
Age Group	No. of Trout	Age Group	No. of Trout	Projected Harvest	Annual Mortality (%)	Fishing Mortality (%)	Natural Mortality (%)
0	716	I	230	84	68	12	56
I	397	II	40	105	90	27	63
II+III+	129	III+	17	27	87	21	66

Natural mortality appears somewhat high compared to angling mortality given the high level of fishing pressure (605 hours/acre) and a harvest rate of 0.5 trout/hour. However, the creel census that was used to estimate harvest is felt to be valid, as instantaneous angler counts occurred on 45% of all weekdays and 59% of weekends and holidays during the fishing season and fishermen were interviewed during 26% of the projected angling hours. The estimate of natural mortality could be affected though by migration out of the study area, resulting in an increase in natural mortality . However, there is no reason to believe exit from the area would be any greater than movement into the area, thereby balancing this source of error. An unknown amount of hooking mortality could also have occurred as approximately half the trout caught were released. This could inflate the natural mortality rate. Also, natural mortality exhibits annual fluctuations and 1979 could have been one of those years of high natural mortality.

The high natural mortality rate on Rowan Creek is comparable to data reported by Avery and Hunt (1981) on Emmons Creek, located in central Wisconsin. During 1977, Emmons Creek had a natural mortality rate of 50% for age II+ brown trout and an angling mortality rate of 26%. Therefore, the mortality values observed on Rowan Creek appear acceptable.

While an additional 5% or even 10% increase in annual mortality as a result of angling would seem nonsignificant, when added to a natural mortality rate of 65%, the trout population would be drastically reduced. Given a trout population density of 1,800 fall fingerlings/mile (5-year average for Rowan Creek), a 10% angler harvest (75% annual mortality rate) would reduce the number of surviving age II trout by 50% and age III trout by 64% (Table 17). With a 20% angler harvest rate (85% annual mortality rate), age II trout are reduced by 82% and age III trout by 92% when compared to the 65% total mortality rate. It has been demonstrated by Hunt et. al. (1962) and Avery and Hunt (1981) that increased harvest more effectively reduces the percentage of larger trout in the population than the smaller, yet legal size, portion of the fishery.

TABLE 17. Theoretical trout population under varying rates of mortality.

	Annual Mortality Rate					
	90%	85%	80%	75%	70%	65%
Age Group	Surviving Fall Population - No. of Trout					
0 (6 inches)	1,800	1,800	1,800	1,800	1,800	1,800
I (6 inches-9.5 inches)	180	270	360	450	540	630
II (9.5 inches-12 inches)	18	40	72	112	162	220
III (12 inches)	2	6	14	28	49	77

TABLE 18. Trout population estimates for Station 2.

Age Group	1975	1976	1977	1978	1979	1980
0	190		1,164	716	271	189
I	119		97	397	230	194
II	37		45	91	40	68
III+	30		25	30	17	19
II+	67		70	121	57	87

The impact of mortality on the actual trout population is illustrated by Station 2 (Table 18). Despite the presence of 24 boom covers constructed during 1976-77 and an exceptional 1977 year class, the population of age II+ trout at Station 2 was 50% less in 1979 (due to high fishing mortality) than in 1978. In 1980, the annual mortality rate declined by approximately 20% from the previous year, and the fall 1980 age II+ population rebounded to levels considerably higher than previous years, excluding 1978. The reduction in mortality was probably due to a lower natural mortality rate, as the stream continued to be heavily fished. The above-average year class of 1978 also played a significant role in the greater number of age II+ trout present after the 1980 fishing season.

Rowan Creek can not continue to support a high quality fishery under the angling pressure observed on Station 2 during 1979. The resource is limited and extremely vulnerable to angling. Boom covers were installed to provide additional hiding space, thereby increasing the trout population. They work extremely well on Rowan Creek, as up to one age I+ trout/lineal ft of cover has been observed. However, increased fishing pressure and success in boom cover areas offsets the effectiveness of such habitat improvement.

The fragility of a stream's trout population is also illustrated by the impact one expert angler can impose. During the 1979 season, one fisherman kept a diary of his fishing trips. He made 27 angler trips on Station 4, fished 56 hours and caught 146 trout. Of these, 91 fish (8 inches-15 inches) were harvested. This angler alone accounted for 34% of the total harvest at this station.

Thus, recruitment and mortality determine the number of trout present in any stream. And if high natural mortality is coupled with additional angler harvest, it can significantly reduce the trout resource.

Regulations

While recruitment and natural mortality fluctuate and little can be done to change this, three methods are traditionally used to restrict angler harvest -- length of season, bag limit and size limit.

The trout fishing season was extended on Rowan Creek in 1975. The season now begins on 1 January rather than the first Saturday in May. Data on the Rowan Creek fishery were not available prior to 1975, thus it was not determined whether fishing pressure and harvest increased or simply spread over the longer season.

A daily bag limit of 5 fish has been in effect on Rowan Creek since 1975. However, a change in general fishing regulations in 1980 reduced the daily bag limit to 2 fish from 1 January to the first Saturday in May, with 5 fish per day thereafter until 30 September when the season closes. From the 1979 creel census data, a bag limit of 2 fish would not affect the average angler even for the entire season (Table 19). Average harvest per trip during the early season was 0.8, increasing to 1.2 in the traditional season.

TABLE 19. Average catch and harvest per trip.

Period	Average Length Of Trip (hours)	Catch Rate (trout/hour)	Average Catch/Trip (trout/hour)	Harvest Rate (trout/hour)	Average Harvest/Trip (trout/trip)
January-April	2.3	0.6	1.4	0.3	0.8
May-September	2.5	1.2	3.0	0.5	1.2

TABLE 20. Size of anglers' catch on Rowan Creek.

Trout Caught	January-April Angler Interviews	%	May-September Angler Interviews	%	January-September Angler Interviews	%
0	88	62	65	46	153	54
1-2	39	28	35	25	74	26
3+	14	10	41	29	55	20
Total	141		141		282	

However, bag limits are meant to restrict the harvest of extremely successful anglers. Ten percent of the early season fishermen caught 3 or more fish/day, while 29% of the fishermen caught 3 or more trout during the traditional season (Table 20). Thus, a significant number of fishermen are catching more than 2 fish, especially during the summer months. With a bag limit of 2 trout/day during the entire season, the 1979 Rowan Creek harvest would have been reduced by 29%, whereas the regulations of 1980 requiring a bag limit of 2 trout/day only during the early season would have reduced harvest by only 7% in 1979 (Table 21).

A size limit protects all fish under the designated size. A statewide 6-inch size limit for trout has been in effect for years. Length frequency of the 1979 Rowan Creek harvest shows that only 6% of the trout were less than 8 inches. A 10-inch limit would have reduced the harvest by 46% and a 12-inch limit would have reduced it by 82% (Table 22).

TABLE 21. Harvest reduction with a daily bag limit of 2 fish.

Period	Recorded Harvest	Recorded Harvest After 2 In Creel	Harvest Reduction (%)
January-April	77	15	19
May-September	129	44	34
January-September	206	59	29
January-September (2 fish bag limit during January-April)	206	15	7

TABLE 22. Harvest reduction under 8-inch, 10-inch and 12-inch size limits.

Period	Size Limit (Inches)	Trout Harvested	Harvest Reduction (%)
January-April	< 8	4	6
May-September	< 8	8	6
January-September	< 8	12	6
January-April	< 10	35	44
May-September	< 10	59	46
January-September	< 10	94	45
January-April	< 12	63	80
May-September	< 12	108	84
January-September	< 12	171	82

While harvest is reduced by stricter size limits, the chance of catching trout would be increased as fish are released and recaught. For example, Kerr (in press) reports that during the 1979 fishing season on Castle Rock Creek each trout was caught an average of four times. This stream is subject to no harvest and artificial lures only. The catch rate on Castle Rock was 1.6 trout/hour, twice as much as the 0.8 rate noted on areas of Rowan Creek which lacked hiding covers.

The trout population of Rowan Creek will fluctuate according to variable recruitment and mortality rates. A very weak 1980 year class coupled with continued high levels of mortality will result in fewer fish available to the angler in the immediate future. Given a high level of natural mortality, reduction in fishing mortality must occur in order to preserve an adequate fishery in such Class I trout waters as Rowan Creek.

To reduce annual mortality on Rowan Creek by 10%, given a 25% fishing mortality rate, angler harvest must be reduced by more than 40% (0.1/0.25). Decreasing harvest rates more than the desired level of reduction is necessary because as fishing mortality is decreased, natural mortality will increase slightly, since a certain portion of those fish dying from angling would die from natural causes had they not been caught. Also, an increased size limit or decreased bag limit will cause an unknown amount of hooking mortality, especially from bait fishing. Thus to achieve a 10% reduction in annual mortality would require a daily bag limit stricter than 2 trout/day for the entire season or a 10-inch size limit.

MANAGEMENT RECOMMENDATIONS

Habitat improvement on Rowan Creek has been geared at reducing bank erosion through tapering and bank stabilization with sod cover, and increasing the amount of hiding cover available for age 1+ trout. Saturation of the additional cover with trout will increase the stream's carrying capacity. Therefore, bank covers should continue to be built. Trends in recruitment, natural mortality and angling mortality should continue to be monitored. And, if annual mortality continues at the present level, a reduction in angler harvest is recommended. A 10-inch size limit would best achieve a reasonable, yet effective, level of harvest reduction.

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ACKNOWLEDGMENTS

The author is grateful to Charles Wolfe and Paul Kanehl for helping collect creel census data. Cheryl Goodman provided computer processing of the data. The paper was reviewed by James Congdon, Gordon Priegel, Robert Hunt and C. W. Threinen. Connie Nelson and Lois Rehse typed the manuscript.

Editor: Lori L. Goodspeed
Graphic Artist: Richard G. Burton
Word Processor: Susan J. Hoffman

TABLE 23. Fall brown trout population in Rowan Creek[1].

	Section 10**					Section 11**					Section 12*				
	1975	1977	1978	1979	1980	1975	1977	1978	1979	1980	1975	1977	1978	1979	1980
Age 0															
Number	184	428	493	520	76	189	708	866	640	159	56	614	367	75	66
Pounds	6.8	13.0	15.4	17.1	2.2	7.0	24.8	25.4	18.9	4.6	2.1	21.0	11.8	3.5	1.7
Age I															
Number	20	64	118	110	89	68	44	125	171	132	78	30	219	120	106
Pounds	4.2	13.5	22.1	21.0	13.5	12.7	9.0	22.0	28.1	19.2	14.4	5.8	36.7	20.7	19.1
Age II															
Number	12	34	37	36	23	14	8	21	20	16	19	11	36	21	33
Pounds	5.3	14.3	15.3	14.8	9.7	5.7	3.2	8.5	7.7	6.5	8.5	4.4	16.8	8.4	13.6
Age III+															
Number	6	11	9	11	4	4	7	3	5	6	12	8	10	7	9
Pounds	6.8	10.0	9.4	10.9	3.4	3.2	5.6	2.9	4.0	6.3	10.8	7.3	8.7	6.7	7.8
Total															
Number	222	537	657	677	192	275	767	1,672	836	313	165	663	632	223	214
Pounds	23.2	50.8	62.2	63.8	28.8	28.7	42.6	58.8	58.7	36.6	35.8	38.5	74.0	38.3	42.2
Pounds/acre	79.8	175.6	214.5	219.9	99.1	89.4	132.8	183.3	183.2	113.8	108.6	116.6	223.9	116.0	127.9

	Section 13*					Section 14**					Section 15**				
	1975	1977	1978	1979	1980	1975	1977	1978	1979	1980	1975	1977	1978	1979	1980
Age 0															
Number	134	550	349	196	123	91		335	336	204	104		271	322	154
Pounds	5.0	18.2	11.8	6.0	3.4	3.4		10.7	11.3	5.8	3.9		8.1	9.4	4.4
Age I															
Number	41	67	178	110	88	32		86	71	76	10		41	55	63
Pounds	8.4	13.2	30.9	17.9	16.4	6.9		15.5	12.0	14.0	2.2		7.8	10.4	12.5
Age II															
Number	18	34	55	19	35	11		18	15	24	5		10	9	19
Pounds	8.0	14.8	22.6	7.7	14.2	6.4		8.1	6.2	9.6	1.9		4.6	3.6	8.2
Age III+															
Number	18	17	20	10	10	10		6	1	4	7		7	6	2
Pounds	17.8	17.8	20.2	10.4	11.0	9.1		4.2	0.7	3.2	6.0		5.8	4.7	1.4
Total															
Number	211	668	602	335	256	144		445	423	308	126		329	392	238
Pounds	39.2	64.0	84.9	42.0	45.0	25.8		38.5	30.2	32.5	14.0		26.3	28.1	26.4
Pounds/acre	126.4	206.8	274.2	135.5	145.4	85.8		128.2	101.0	108.2	35.9		67.1	71.7	67.6

*Creel Census Station 2 = Sections 12, 13.
**Creel Census Station 3 = Sections 10, 11, 14, 15.
[1]No data available for 1976.

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