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EXPLOITATION, MOVEMENT, AND GROWTH OF TAGGED BROWN TROUT IN ROWAN CREEK, COLUMBIA COUNTY, WISCONSIN, 1983

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ABSTRACT

Impact of angling on harvestable size native brown trout (Salmo trutta) in Rowan Creek, one of the best brown trout streams in southern Wisconsin, was determined by voluntary angler tag returns. A conservative fishing mortality rate of 21% was estimated for the 1983 angling season. Total mortality was estimated at 57% for that period. Recaptured trout showed very little movement from March to October and an average growth increment of about 1 inch (SD = 0.6) for that period. Consequently, angling pressure prevented an increase in numbers of trout ≥12 inches, especially in stream segments with easy angler access. A 50% reduction in angling mortality would theoretically double the number of age V+ trout (≥12 inches).

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INTRODUCTION

Anglers have complained of low numbers of large trout in south central Wisconsin streams. The trout fishing season, formerly May through September, was expanded in 1975 from January through September for most of this region. While additional angling pressure likely occurred because of this extended season, a reduction in numbers of trout larger than 15 inches was also noted in areas of the region which retained the original season length (C. Brynildson, Wis. Dep. Nat. Resour., pers. comm. 1984).

Numbers of large trout are not increased by stocking hatchery trout, since these fish do not survive long. In a study of 13 north central Wisconsin streams, Johnson (1983) found that only 2% of yearling brook trout (Salvelinus fontinalis) and 11% of yearling brown trout (Salmo trutta) survived 60-120 days after stocking. In 3 south central Wisconsin streams, an annual mortality rate greater than 90% was found for age II+ native fish and age I hatchery brown trout planted as fall fingerlings (T. Larson, Wis. Dep. Nat. Resour., unpubl. data).

Although it is located in a heavily populated area, Rowan Creek is favored by many south central Wisconsin anglers for its brown trout fishery and aesthetic surroundings. Angler use and population dynamics of the upstream (Class I) portion of the stream were documented during 1979 (Larson 1982). Fishing pressure was high at that time, with values of 215, 433, 605, and 1,560 hours/acre for four study sections. On the section with only 215 hours/acre, total annual mortality of age I+ native brown trout was 89% (65% natural mortality and 24% angler exploitation). Some of the natural mortality may have been due to hooking mortality, as half the trout caught were released. The fishery in this section suffered a drastic decline during the 1979 season as a result of this mortality rate.

The present study evaluates exploitation, movement, and growth of brown trout 7 inches or larger tagged in February 1983 throughout the entire length of Rowan Creek. This information provides further insight into the present status of this trout resource and the potential for its improvement.

STUDY AREA

Rowan Creek is an alkaline (260 mg/L $CaCO_3$), spring-fed tributary to the Wisconsin River. Located in west central Columbia County, the stream flows through the Village of Poynette (population 1,500) (Fig. 1). Over a half-million people live within 50 miles of the stream, and angler demand for the trout resource is high. The upper 4 miles of its 17-mile length provide an excellent native brown trout fishery (Class I). Fall standing stock estimates have ranged from 75-300 lb/acre in the Class I portion of the stream over the past 7 years (T. Larson, Wis. Dep. Nat. Resour., unpubl. data). The watershed of the upper area is predominately agricultural.

Rowan Creek receives an annual quota of 7,000 fall fingerling hatchery brown trout (6-7 inches). The stocked trout help maintain a fishery in the 8 miles of stream below Poynette classified as Class II water. Land use and development along this lower stream section have been minimal due to unsuitable soil types, leaving an aesthetic setting for fishing.

During this study, the Wisconsin Department of Natural Resources (DNR) owned 3 miles of Rowan Creek and 300 acres of adjacent land in a public fishery area. During the past decade, the DNR has intensively improved habitat on 1.5 miles of the upper stream by fencing cattle away from the stream and constructing 60 bank covers.

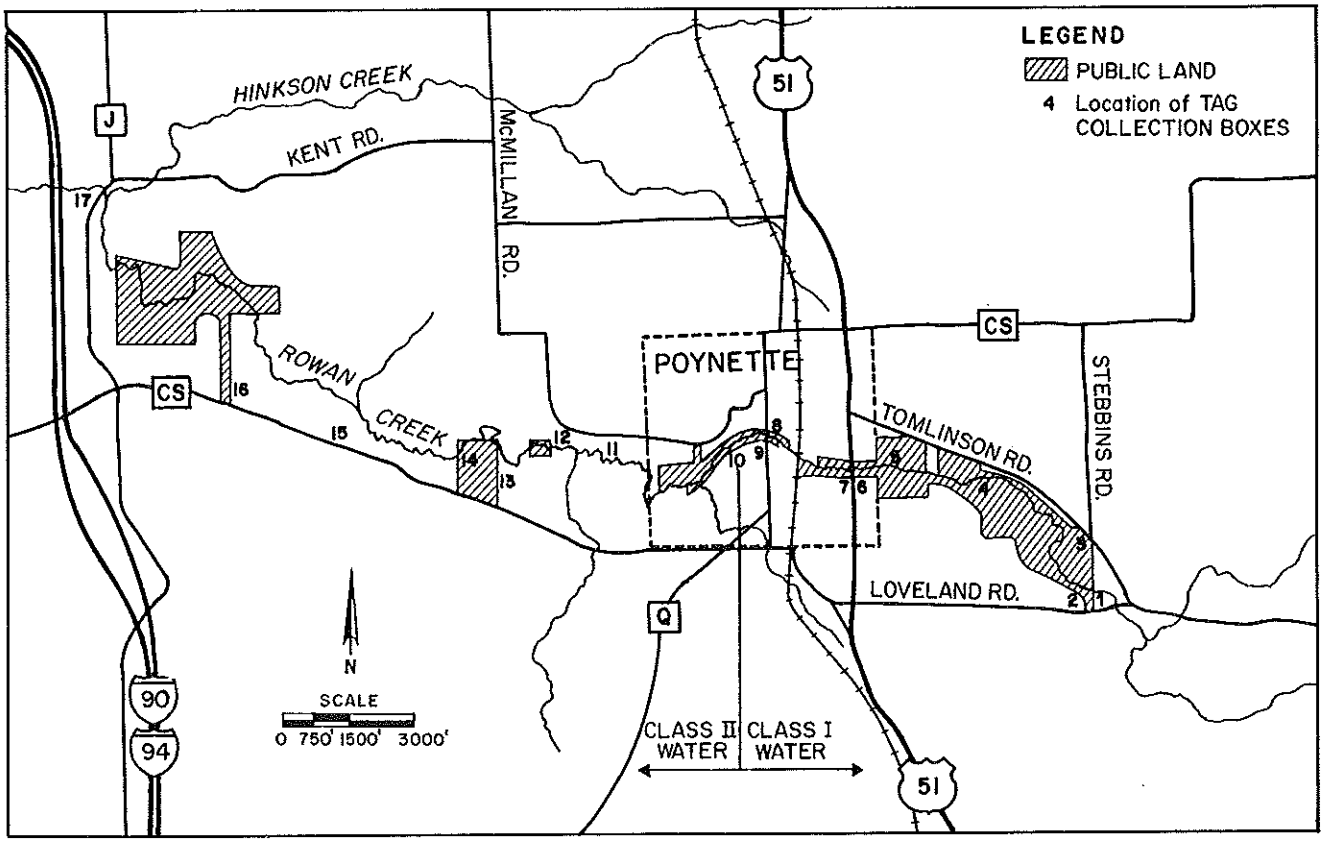

FIGURE 1. Rowan Creek study area.

METHODS

In February 1983, sections of the upper 12 miles of Rowan Creek were sampled with a standard electrofishing boat equipped with a 240-volt DC generator. The areas shocked were those throughout the stream that were most accessible for equipment transport and angler access.

Brown trout 7 inches or larger were measured and tagged with individually numbered Floy FD68B anchor tags inserted into the muscle between the anterior rays of the dorsal fin. Overall tag length was 35 mm with an exposed monofilament of 14 mm. An exposed monofilament portion of 10 mm injected into the muscle would have been adequate for the size of fish handled (7-21 inches). Seventeen tag return boxes with signs encouraging tag returns were located at angler access points. Boxes were checked weekly for returned tags. The sections of the upper 4 miles (Class I water) were reshocked in October to collect data on growth, movement, mortality, and tag loss.

Information determined by this study is representative for native brown trout. Very few fall-stocked brown trout (age I) were tagged, as few were larger than 7 inches by February and carryover of stocked trout to age III is minimal (Johnson 1983; T. Larson, Wis. Dep. Nat. Resour., unpubl. data).

Population statistics were calculated using terminology and definitions as described by Ricker (1975). Survival (S) was estimated from the resurveyed portion of the stream by comparing the number of tagged trout recaptured in the fall to the number of trout originally tagged in those areas. The number of fish which had lost their tags but were still present was added to the count of recaptured trout. To evaluate tag loss, the adipose fin was removed from trout which were tagged in the resurveyed areas.

The total mortality rate (A) was calculated as $1-S$. Total mortality was then divided into fishing mortality (u) and natural mortality (v). Fishing mortality was determined by the number of angler-returned tags for the 1983 season compared to the total number of fish tagged. To evaluate the impact of reduced fishing mortality on the population, instantaneous rates of fishing (F) and total mortality (Z) were adjusted, and theoretical numbers of surviving trout were calculated. The following relationships were used:

$$Z = \ln S,\ F = \frac{Z}{A}(u),\ \text{and}\ Z = F + M$$

where M = instantaneous natural mortality. These mortality statistics assume minimal movement of tagged trout out of the survey areas. The exploitation rate is minimal since it cannot be expected that anglers returned all tags from trout that were harvested. Trout 7 inches or larger in size were tagged to allow for recruitment of the smaller sizes into the harvestable size group.

RESULTS

A total of 994 brown trout were captured and tagged in February, 596 in the Class I water and 398 in the Class II section. The majority of fish captured were in the 8-, 9-, and 10-inch groups (Table 1). Trout 7.0-9.9 inches

TABLE 1. Length frequency of tagged brown trout and angler-recaptured trout from Rowan Creek, Wisconsin.

Total Length* (inches)	Tagged Trout Number	%	Angler-Recaptured Trout Number	%
7	54	5.4	16	7.8
8	202	20.4	35	17.0
9	298	30.1	56	27.1
10	182	18.3	43	20.8
11	96	9.6	19	9.1
12	70	7.0	17	8.3
13	36	3.6	6	2.9
14	16	1.6	2	1.0
15	13	1.3	1	0.5
16	10	1.0	4	2.0
17	6	0.6	3	1.5
18	3	0.3	1	0.5
19	3	0.3	1	0.5
20	3	0.3	2	1.0
21	2	0.2	0	0.0
Total	994	100.0	206	100.0

* Length recorded at time of tagging.

accounted for 56% of the number caught, while 74% were 7.0-10.9 inches. Size composition of angler-caught trout followed the same trend. Based on the length when tagged, trout 7.0-9.9 inches composed 52% of the angler harvest, and trout 7.0-10.9 inches accounted for 73% of fish taken. The percentage of larger fish ($\geq$13.0 inches) in the angler creel was 9.9% compared to 9.2% tagged. Anglers apparently were removing trout from Rowan Creek in direct proportion to the sizes present.

Exploitation

Of 525 trout tagged in the Class I portion of the stream resampled the following fall, 185 were recaptured and 100 had been harvested, based on tag returns. Forty-two trout were recovered which had lost their tags, resulting in a tag loss rate of 17.5%. Therefore, survival (S) of the tagged fish was 43.2%, and total mortality (A) was 56.8% from February to October. A conservative estimate of fishing mortality is 20.7%, as determined by 206 tags returned from 994 fish originally tagged throughout the stream. Thus the natural mortality rate (v) was 36.1%. The instantaneous rate of fishing (F) was .306.

The highest rates of exploitation were associated with locations most accessible to anglers (Table 2). Location 1, where the highest exploitation occurred (42%), is a bridge on the upper end of the stream which received 1,560 hours/acre of fishing pressure in 1979 (Larson, 1982). Other areas with considerably higher harvest than the stream average of 21% were location 10 (32%), a popular spot within the Village of Poynette, and location 16 (36%), a newly acquired public area. Location 14 (26%) is in a public park and location 8/9 (23%) is adjacent to a public park in Poynette.

TABLE 2. Angler harvest of brown trout by area from Rowan Creek, Wisconsin.

Area	No.Trout Originally Tagged	No. Tags Returned by Anglers		% Harvest
1	33	14		42
2	63	12		19
3	104	10		10
4	97	20		21
5	95	14		15
6/7	84	16		19
8/9	120	28		23
10	93	30		32
11/12/13	78	14		18
14	47	12		26
15	63	4		6
16	76	27		36
17	41	5		12
Total	994	206	Average	21

Movement

The vast majority of brown trout remained within the same area of the stream during the spring-summer period. Of 144 tagged trout recaptured in the 1,000-ft stream segments inventoried in October, 71% were recaptured within the segment where they were originally tagged, 19% were recovered within an adjacent segment, and 10% were found more than 2 segments from the tagging site. Although no attempt was made to determine the exact location of angler-caught trout, 94% of the tags were returned to a deposit box within one mile of the tagging site. A small percentage of the fish roamed, with the extreme example of a tagged 10-inch trout that swam 10 miles downstream from Rowan Creek to Lake Wisconsin, navigated 12 miles down the lake, found its way over the Prairie du Sac Dam on the Wisconsin River, and was caught in May by a surprised angler on the lower Wisconsin River.

Growth

Growth information on individually marked trout in Wisconsin is scarce (L. Claggett, Wis. Dep. Nat. Resour., pers. comm. 1983). Fish measured and tagged in February were remeasured the following October. The mean growth increment was 1.2 inches for trout 8-15 inches, with fairly large individual differences (SD = 0.6) (Table 3). Two 8-inch trout grew 3.1 inches, while one 9-inch fish didn't grow at all.

Growth data from the tagged fish compare favorably with information obtained previously from fin-clipped 1978 year class fish (T. Larson, Wis. Dep. Nat. Resour., unpubl. data). Annual increments between average lengths of the age classes show growth of slightly over 1 inch/year for trout over 10 inches (Table 4).

TABLE 3. Growth of tagged brown trout from February to October 1983, Rowan Creek, Wisconsin.

Inch Group	Average Growth Increment (inches)	Standard Deviation	Sample Size
7	2.2	.07	2
8	1.2	.67	45
9	1.1	.53	64
10	1.0	.60	29
11	1.0	.42	25
12	1.2	.60	17
13	1.1	.60	11
14	1.3	.08	4
15	1.4	.14	2

TABLE 4. Growth rate of the 1978 year class of native brown trout from Rowan Creek, Wisconsin, as determined from recaptured fin-clipped fish.

Age	Average Total Length (inches)	Annual Growth Increment (inches)	Range (inches)	Sample Size
I	4.7		2.8-6.2	349
		3.0		
II	7.7		5.5-9.9	515
		2.3		
III	10.0		8.2-12.7	79
		1.6		
IV	11.6*		--	--
		1.1		
V	12.7		10.7-15.2	14

* No sample, mean length estimated by using Von Bertalanffy growth prediction (Ricker 1975).

DISCUSSION

The exploitation rate of brown trout in Rowan Creek was 21%, determined by angler tag returns. This value should be considered minimal, as it is unlikely that all tags from angler-caught trout were returned. Also, the regional trout fishing season runs from 1 January through 30 September, and harvest may occur prior to February tagging. Cold weather usually inhibits trout fishing until March, but 1983 was an exception. Many warm days occurred during January, and I observed considerable fishing pressure then. This exploitation rate is comparable to that observed in 1979 (24%) on a 1/2-mile section of upper Rowan Creek, in a study which compared angler harvest as determined by creel survey to the standing stock of trout (Larson 1982). Avery and Hunt (1981), in a study of 4 central Wisconsin trout streams, noted substantially reduced densities of fish greater than 10 inches (age III+) where angler exploitation rates of 16-20% occurred. If current angling mortality were reduced by 50%, the number of trout 12 inches or larger (age V+) would double (Table 5), assuming a constant rate of growth and natural mortality. In reality, if fishing mortality is reduced it is likely that natural mortality would increase slightly. Hooking mortality, reflected as natural mortality, might also increase if angling pressure is reduced by a size- or bag-limit reduction.

TABLE 5. Theoretical number of surviving trout at the beginning of the fishing season with the present annual survival rate (43.2%) vs. the annual survival resulting from a 50% reduction in angling mortality (50.3%).*

Age	Average Total Length (inches)	43.2% (S) No./Mile	50.3% (S) No./Mile
I	4.7	750	750**
II	7.7	324	377
III	10.0	140	190
IV	11.6	60	95
V	12.7	26	48
VI	13.9	11	24
VII	15.1	5	12
VIII	16.3	2	6
IX	17.5	0	3

* Calculation Z = Instantaneous total mortality
F = Instantaneous fishing mortality
M = Instantaneous natural mortality

$S = 43.2\%$	$S = 50.3\%$
$Z = F + M$ $.83845 = .30580 + .53265$	$.68555 = .15290 + .53265$
$-\ln S = Z$	
$S = e^{-Z}$ $S = e^{-.83845} = .432$	$S = e^{-.68555} = .503$

** Based on an 8-year average in Class I water of 1,500 fall fingerlings/mile (T. Larson, Wis. Dep. of Nat. Resour., unpubl. data) and assuming a 50% rate of overwinter mortality.

Recaptured tagged trout >8 inches grew at an average rate of slightly over 1 inch/year. This annual growth increment remained constant for all size groups from 8 to 15 inches. Few trout over 15 inches were captured. This constant increment indicates that growth is likely not food-limited and that the population is not stunted. Rather, it takes many years for a trout to grow to the larger size that the angler hopes to catch.

Ninety percent of the native brown trout in Rowan Creek remained within a 1/4-mile area from February to October. Thus the most accessible stream segments were subject to higher rates of exploitation. Trout populations within streams which offer easy angler access are especially vulnerable to depletion.

Fish tagging with voluntary tag returns to deposit boxes located near access points on Rowan Creek was a viable method for obtaining useful information on the stream trout fishery. When conducted in conjunction with other survey work and with the aid of volunteer labor for checking the tag deposit boxes, this method provides extremely low-cost data.

MANAGEMENT RECOMMENDATIONS

Rowan Creek is recognized as one of the best brown trout streams in southern Wisconsin. This study documented slow growth and limited movement of native trout in the stream. These factors, along with the observed total mortality rate of 57% (21% fishing, 36% natural), make it difficult to provide a population of trout $\geq$12 inches. Stream segments which were more accessible to anglers showed higher exploitation rates. A reduction in fishing mortality of 50% is predicted to double the number of trout larger than 12 inches. This increase would be a significant improvement in the native trout resource of Rowan Creek, as survival of stocked trout to the 12-inch size is reportedly minimal under the 6-inch minimum size limit and 5-fish daily bag limit.

I recommend a reduction in angler harvest to improve the quality of the trout fishery of Rowan Creek. More restrictive regulations such as a shorter season, higher size limit, and/or a lower daily bag limit are possible changes. Effective with the 1986 fishing season, an increase in the minimum legal size limit from 6 to 9 inches and a reduction in the bag limit from 5 to 3 trout per day was enforced in the southern zone. This regulation change should protect hatchery trout well into their first summer in the stream and hopefully increase survival of native trout. To realize the full benefit of the regulation change, proper catch and release measures for nonharvestable fish need to be practiced. Fish should not be played until exhausted, and the line should be cut on deeply hooked trout. The concept of catch and release should be practiced on all sizes of trout to allow trout streams to reach their biological potential and to improve the quality of trout fishing opportunities.

LITERATURE CITED

Avery, E. L. and R. L. Hunt
1981. Population dynamics of wild brown trout and associated sport fisheries in four central Wisconsin streams. Wis. Dep. Nat. Resour. Tech. Bull. No. 121. 26 pp.

Johnson, M.
1983. An evaluation of stream trout stocking in Langlade, Lincoln and Marathon Counties. Wis. Dep. Nat. Resour. Fish Manage. Rep. No. 114. 7 pp.

Larson T.
1982. Characteristics of the sport fishery of Rowan Creek and the impact of fishing on the wild brown trout population. Wis. Dep. Nat. Resour. Fish Manage. Rep. No. 112. 15 pp.

Ricker, W. E.
1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. No. 191. 382 pp.

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