TROUT PRODUCTION AND CATCH UNDER NORMAL AND SPECIAL ANGLING REGULATIONS IN THE NORTH BRANCH OF THE AU SABLE RIVER, MICHIGAN

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TROUT PRODUCTION AND CATCH UNDER NORMAL AND SPECIAL ANGLING REGULATIONS IN THE NORTH BRANCH OF THE AU SABLE RIVER, MICHIGAN [1]

By Gaylord R. Alexander and James R. Ryckman

ABSTRACT

The annual production of wild brook and brown trout from the normal regulation water (7.0-inch minimum size limit, 10 trout creel limit, any lure permitted) of the North Branch of the Au Sable River was 102 kg/ha compared to 83 kg/ha from the special regulation water (9.0-inch minimum size, 5 trout creel limit, artificial flies only). Brook trout made up about half the production in both waters. Overall production was similar to that found in other mid-western streams.

Over 80% of the trout production was accrued during the spring to fall period for both species. Most of the annual production was contributed by the younger fish in the population.

The turnover ratio was 1.88 for brook trout and 1.19 for brown trout in the normal waters and 1.87 and 1.43, respectively, for these species in the special waters.

Angler harvest of the annual production in the normal waters amounted to 35% of the brook trout and 39% of the brown trout. By contrast, a mere 4% of the brook trout and 15% of the brown trout production was cropped from the special waters.

If the management objective is to maximize the harvest of trout, normal regulations are far superior.

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[1] Contribution from Dingell-Johnson Project F-35-R, Michigan.

Introduction

There is comparatively little information available on production of wild trout in Michigan streams and elsewhere. Most studies of trout populations have not obtained the information needed to compute production. The opportunity to calculate trout production and that portion of the production cropped by anglers for the North Branch of the Au Sable River was possible because the needed information had been collected in a number of previous studies (Shetter and Alexander 1966, 1967; Shetter and Alexander 1970; and Alexander 1974). Management of trout streams relies heavily on our knowledge of the population dynamics of trout as they relate to angling regulations. Trout production may be the ultimate "index" of the whole array of factors that affect trout.

Study area

The North Branch of the Au Sable River (hereafter referred to as the North Branch) is located in Crawford and Otsego counties in Michigan's lower peninsula. The headwaters rise at an elevation of approximately 1,275 feet above sea level. In the 33 miles from the origin to the confluence with the main Au Sable River, the North Branch drops about 200 feet. The upper reaches of the river are marginal trout water because it receives the drainage from several warm-water lakes. Below Dam 2, an old lumber dam (Fig. 1), it receives considerable groundwater and is cool enough for trout from this point downstream. Water temperatures reach the high 70's at Dam 2 but become progressively cooler downstream. The study area was a 19.8-mile segment of the river between Dam 2 and Kellogg's Bridge (Fig. 1). Summer discharges are about 44 cfs at Dam 2, 85 cfs at Twin Bridges, 115 cfs at Eamon's and 156 cfs at Kellogg's Bridge. Stream flow is classified as stable. The stream bed is mostly sand and gravel, a good spawning substrate, throughout most of its length. The water is clear with a M.O. alkalinity of 150 ppm

and a neutral pH. The plant community within the stream channel is moderately abundant in summer but sparse at other seasons of the year.

The fish population of the river is predominantly brown trout (Salmo trutta) and brook trout (Salvelinus fontinalis). The relative biomass of trout to the other fish is about 4 to 1.

Methods

The study sections of the North Branch consisted of 12.9 miles of stream (average width 111.2 feet) fished under special regulations, and 6.9 miles (average width 106.0 feet) fished under normal (state-wide) regulations (Fig. 1). The special waters were comprised of two sections, one above (4.2 miles) and one below (8.7 miles) the normal-regulation water. Normal angling regulations were: 7.0-inch minimum size limit, 10 trout creel limit, and any lure permitted. Special regulations were: 9.0-inch minimum size, 5 trout creel limit, and artificial flies only.

Semi-annual estimates of the trout population were made by electrofishing, one in the spring prior to the angling season and one in the fall after the season closed, in nine sub-sections of river (six in special waters and three in normal waters) that ranged in length from 913 to 1,300 feet, from 1961 to 1967. Estimates were calculated by the Petersen mark-and-recapture method as described by Shetter (1957). Average estimates from these sub-sections were then transformed into numbers per hectare for the two regulation waters. The size of the population was derived by summing estimates of trout by inch classes. Age groups within each inch class were then determined by age assessment of scales from representative samples of trout. The average length of trout for a given age was calculated by multiplying the estimated number of trout of a specific age within each inch class times the class midpoint. Products similarly derived for this age group in all other inch classes were then summed and divided by the total number of trout of this particular age to arrive at the average length. Growth rates were determined from gains in weight made between one semi-annual estimate of average weight and to the next estimate.

A creel census was operated under two stratified random sampling plans which provided estimates of total fishing and total catch. A complete description of the census may be found in Shetter and Alexander (1966).

The calculation of trout production in terms of total weight of flesh elaborated per year followed the procedure outlined by Ricker (1958). Some of the pertinent trout population data used to compute production are given in Tables 1-4.

Production

Mean annual production, standing crop, average size, and population estimates of brook and brown trout at various ages over a 7-year period are given for the normal- and special-regulation waters of the North Branch in Tables 1-4. Annual production of all trout in the normal-regulation water amounted to 102.1 kg/ha (91.0 lb/acre). Brook trout accounted for 43.7% of the production (44.6 kg/ha or 39.8 lb/acre), brown trout the remaining 56.3% (57.5 kg/ha or 51.2 lb/acre). Total trout production in the special-regulation water was somewhat less at 82.7 kg/ha (73.7 lb/acre). Brook trout comprised 53.6% of the total production (44.3 kg/ha or 39.5 lb/acre) and brown trout made up 46.4% (38.4 kg/ha or 34.2 lb/acre).

Most trout production was accrued during the summer period (spring to fall) in contrast to winter (fall to spring). In the normal waters, 83% of the production of brook trout and 80% of the brown trout production occurred in the summer. In special waters, brook trout made 83% of their production during the summer period whereas the brown trout made 89%.

Most of the annual production was contributed by the younger fish in the population. In the normal water, only 6.5% of the brook trout and 38.4% of the brown trout production was made by age-II or older trout (Tables 1 and 2). The production pattern was similar in the special water with only 11.1% of the brook trout and 28.7% of the brown trout annual growth being accrued by age-II and older trout (Tables 3 and 4).

The relationship of annual production to average standing crop, the turnover ratio, was 1.88 for brook trout and 1.19 for brown trout in the normal waters. The annual turnover ratios were similar in the special waters, 1.87 and 1.43 for brook and brown trout, respectively.

Angler harvest

Angler utilization of trout production is an important management consideration. The creel census indicated that the mean annual harvest was 22.2 kg/ha (19.8 lb/acre) of brown trout and 15.5 kg/ha (13.8 lb/acre) of brook trout for a total trout harvest of 37.6 kg/ha (33.6 lb/acre) from the normal waters. Thus anglers harvested 36.8% of the total annual production under normal fishing rules. Angler harvest, by species, amounted to 34.8% of the brook trout and 38.6% of the brown trout production. By contrast, anglers on the special water only cropped 5.6 kg/ha (5.0 lb/acre) of brown trout and 1.6 kg/ha (1.4 lb/acre) of brook trout for a total harvest of 7.2 kg/ha (6.4 lb/acre)--a mere 8.7% of the total annual production. Harvest breakdown, by species, was 3.6% of the brook trout and 14.6% of the brown trout which is considerably below the proportions cropped from the normal waters.

Angling effort and catch by water were very different. Fishermen creeled, on the average during the study period, 35.6 trout per hectare (10.2 brook and 25.4 brown trout per hectare) each year from the special regulation water. By contrast, the anglers creeled 274.8 trout per hectare (178.8 brook and 96.0 brown trout per hectare) from the normal waters. Even the catch of trout over 9.0 inches long from the normal water was 2.5 times greater than that from the special water--92.2 trout per hectare (17.5 brook and 74.7 brown trout per hectare). In the special-regulation water anglers spent an average of 201 hours of fishing per hectare each year. Over three times as much fishing time was expended by fishermen on the normal regulation waters where angling effort amounted to 648 hours per hectare per year.

Discussion

Total annual production of brook and brown trout in the North Branch was 102 kg/ha in the normal water and 83 kg/ha in the special water. These values fall within the range of production reported by other investigators. Some values for midwestern streams are: 67 kg/ha under fishing and 107 kg/ha under no fishing for brown trout in Gamble Creek, Michigan (Gowing 1975), 94 to 109 kg/ha for brook trout in Lawrence Creek, Wisconsin (Hunt 1966), 62 kg/ha for brook trout in Valley Creek, Minnesota (Elwood and Waters 1969) and an extremely high value of 395 kg/ha in Black Earth Creek, a highly polluted creek in Wisconsin (Brynildson and Mason 1975). From Pennsylvania, Cooper and Scherer (1967) reported production of brook trout to be 58 kg/ha in Larry's Creek and 300 kg/ha in Big Spring Creek. LeCren (1967) found production of brown trout to range from 20 to 120 kg/ha for small streams in England. An extraordinary production value of 540 kg/ha was reported by Allen (1951) for the Horokiwi, a New Zealand stream.

Greater production might be achieved by one species of trout in the absence of the other, but to our knowledge, no one has tested brook and brown trout production in the same stream. The production level of the mixed population of brook and brown trout in the North Branch is quite similar to the levels of production found for either pure brook or pure brown trout populations in other midwestern streams, which suggests that production might be similar, regardless of which species is present. Further, in the North Branch where the two species compete, brown trout production was about equal to brook trout production. In the normal water, 56% of the production was attributed to brown trout compared to 41% in the special water. However, this does not necessarily mean that brook and brown trout production will be equal in all streams where they coexist.

It is not surprising that most of the trout production in the North Branch (84%) occurred during the summer season. Cooper (1953) has reported on the seasonal growth of stream trout. In the North Branch, as in other streams, much higher growth rates occur during the summer.

Survival of trout, however, does not vary as widely with the season, therefore variability in production is due mainly to variation in growth.

Most of the production is made by younger fish in the population. In the North Branch about 91% of the brook trout and 66% of the brown trout annual production is made by age 0 and age I trout. Cooper and Scherer (1967) found a similar situation in Larry's Creek and Big Spring Creek, Pennsylvania, where brook trout of the same ages made 70% and 61% of the annual production.

The turnover ratios for North Branch populations are somewhat higher than those reported for other streams. For brook trout, it was about 1.88 in both sections of the North Branch as compared to 1.34 and 1.30, respectively, in Larry's Creek and Big Spring Creek (Cooper and Scherer 1967) and 1.80 in Lawrence Creek (Hunt 1966). Gowing (1975) computed a rate of 0.87 for brown trout in Gamble Creek whereas brown trout rates in the North Branch were 1.19 and 1.43.

The fact that special regulations did not result in greater overall trout production is evident. Further the cropping of trout by anglers under the two regulations was drastically different. If the management objective is to maximize the harvest of trout, normal regulations are far superior to the special regulations. Anglers cropped 37.6 kg/ha from the normal waters and 7.2 kg/ha from the special waters or 37% of the trout production under the normal fishing rules but only 9% under the special regulations.

Acknowledgments

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Table 1.--Average numbers, standing crops (g), and production (g) per hectare by season for brook trout in the normal-regulation waters of the North Branch of the Au Sable River (1961-1967). Mean lengths (mm), weights (g) and percentage of total production by age group are included.

Age group	Number of trout	Average total length	Average weight	Standing crop	Production	Percentage of total production
Fry[a]	21,269	23	0.1	2,340	20,465[c]	45.9
0[b]	1,335	89	6.8	9,061	4,750[d]	10.6
I[a]	688	107	11.8	8,078	13,940[c]	31.2
I[b]	244	170	48.7	11,889	2,606[d]	5.8
II[a]	197	183	60.6	11,961	2,271[c]	5.1
II[b]	24	209	90.0	2,186	208[d]	0.5
III[a]	16	216	100.3	1,645	365[c]	0.8
III[b]	1	262	179.7	151	-15[d]	0.0
IV[a]	1	254	164.3	193	36[c]	0.1
IV[b]	tr	318	323.4	6	0[d]	0.0
V[a]	tr	318	323.4	12	2[c]	0.0
V[b]	tr	343	408.5	7		
Spring/ summer	22,171	---	---	24,229	37,079	83.1
Fall/ winter	1,604	---	---	23,300	7,549	16.9
Totals					44,628	100.0

[a] Spring estimates.

[b] Fall estimates.

[c] Summer production.

[d] Winter production.

tr = less than 1 fish.

Table 2.--Average numbers, standing crops (g), and production (g) per hectare by season for brown trout in the normal-regulation waters of the North Branch of the Au Sable River (1961-1967). Mean lengths (mm), weights (g) and percentage of total production by age group are included.

Age group	Number of trout	Average total length	Average weight	Standing crop	Production	Percentage of total production
Fry[a]	24,714	23	0.1	2,647	13,330[c]	23.2
0[b]	421	97	8.4	3,514	2,063[d]	3.6
I[a]	244	117	14.9	3,628	12,863[c]	22.4
I[b]	177	224	79.3	14,019	7,172[d]	12.5
II[a]	141	236	125.0	17,622	11,852[c]	20.6
II[b]	73	295	243.8	17,850	1,121[d]	1.9
III[a]	44	302	263.4	11,632	3,026[c]	5.2
III[b]	16	341	377.2	5,875	987[d]	1.7
IV[a]	12	361	449.4	5,394	2,221[c]	3.9
IV[b]	6	419	707.6	4,422	326[d]	0.6
V[a]	4	432	774.5	2,895	1,801[c]	3.1
V[b]	3	518	1,344.1	3,670	352[d]	0.6
VI[a]	1	544	1,553.4	1,509	266[c]	0.5
VI[b]	1	579	1,881.4	1,276	89[d]	0.2
VII[a]	tr	597	2,061.6	718	24[c]	0.0
VII[b]	tr	605	2,142.2	550		
Spring/ summer	25,160	---	---	46,045	45,383	78.9
Fall/ winter	697	---	---	51,176	12,110	21.1
Totals					57,493	100.0

[a] Spring estimates.

[b] Fall estimates.

[c] Summer production.

[d] Winter production.

tr = less than 1 fish.

Table 3.--Average numbers, standing crops (g), and production (g) per hectare by season for brook trout in the special-regulation waters of the North Branch of the Au Sable River (1961-1967). Mean lengths (mm), weights (g) and percentage of total production by age group are included.

Age group	Number of trout	Average total weight	Average weight	Standing crop	Production	Percentage of total production
Fry[a]	24,636	23	0.1	2,710	20,342[c]	45.9
0[b]	1,357	87	6.2	8,436	3,553[d]	8.0
I[a]	599	102	10.2	6,095	12,417[c]	28.1
I[b]	282	163	42.4	11,969	3,015[d]	6.8
II[a]	184	178	55.6	10,248	3,428[c]	7.7
II[b]	43	211	93.3	3,984	1,145[d]	2.6
III[a]	26	219	127.6	3,362	370[c]	0.8
III[b]	1	259	174.5	238	-42[d]	0.0
IV[a]	2	244	145.1	220	47[c]	0.1
IV[b]	tr	305	285.7	11		
Spring/ summer	25,447	---	---	22,635	36,604	82.6
Fall/ winter	1,683	---	---	24,638	7,671	17.4
Totals					44,275	100.0

[a] Spring estimates.

[b] Fall estimates.

[c] Summer production.

[d] Winter production.

tr = less than 1 fish.

Table 4.--Average numbers, standing crops (g), and production (g) per hectare by season for brown trout in the special-regulation waters of the North Branch of the Au Sable River (1961-1967). Mean lengths (mm), weights (g) and percentage of total production by age group are included.

Age group	Number of trout	Average total weight	Average weight	Standing crop	Production	Percentage of total production
Fry [a]	12,468	23	0.1	1,335	12,422 [c]	32.4
0 [b]	626	97	8.4	5,227	1,485 [d]	3.9
I [a]	242	109	12.1	2,938	11,829 [c]	30.8
I [b]	157	201	76.3	11,974	1,447 [d]	3.8
II [a]	87	211	88.6	7,709	6,605 [c]	17.2
II [b]	50	272	191.0	9,557	808 [d]	2.1
III [a]	25	282	213.4	5,395	1,824 [c]	4.8
III [b]	10	325	328.4	3,251	321 [d]	0.8
IV [a]	4	341	377.2	1,588	854 [c]	2.2
IV [b]	3	405	632.6	1,715	81 [d]	0.2
V [a]	1	414	682.0	616	433 [c]	1.1
V [b]	1	496	1,172.7	1,105	112 [d]	0.3
VI [a]	tr	521	1,364.1	472	67 [c]	0.2
VI [b]	tr	559	1,688.8	195	33 [d]	0.1
VII [a]	tr	584	1,931.8	297	43 [c]	0.1
VII [b]	tr	610	2,197.1	380		
Spring/ summer	12,827	---	---	20,350	34,077	88.8
Fall/ winter	847	---	---	33,404	4,287	11.2
Totals					38,364	100.0

[a] Spring estimates.

[b] Fall estimates.

[c] Summer production.

[d] Winter production.

tr = less than 1 fish.

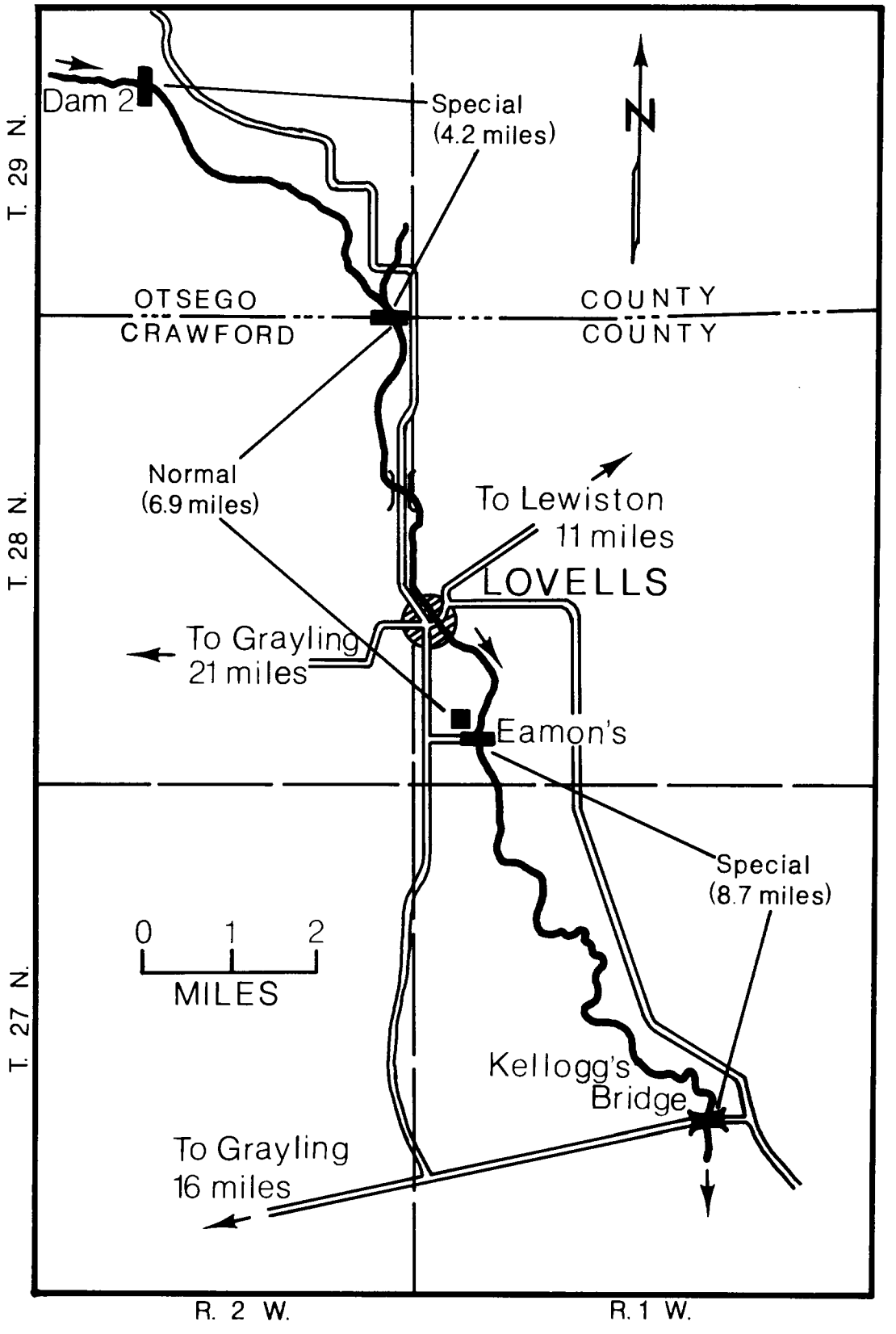

Figure 1.--North Branch Au Sable River, Otsego and Crawford counties, Michigan, showing normal and special regulation waters.

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