

March 10, 1958

Report No. 1539

MORTALITY OF TROUT CAUSED BY HOOKING WITH ARTIFICIAL  
LURES IN MICHIGAN WATERS, 1956-1957

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Original: To printer  
cc: Fish Division ✓  
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In 1955 we published the results of hooking experiments which showed that worms kill many more sublegal trout than do artificial flies. This finding supported, in part, the order of the Conservation Commission which restricted the lure for fishing on several special sections of trout streams to "the commonly accepted artificial wet or dry fly." However, the status of various "hardware" lures (flatfish, spinners, plugs) in the mortality of sublegal trout remained questionable; therefore, hooking experiments were continued during the 1956 and 1957 fishing seasons to compare four hardware lures with the artificial fly. Certain sections of streams in Michigan have, or have had, a legal minimum length of 10 inches on trout; therefore, we are interested in the rate of hooking mortality of trout up to 10 inches in length.

Methods

Experimental fishing was carried on in seven streams and in one trout lake, namely: North Branch Au Sable River, South Branch Au Sable River, Main Au Sable River, Big Manistee River, Little Manistee River, Baldwin Creek, Hunt Creek, and East Fish Lake.

Five different lures (Fig. 1) were tested: artificial fly (sizes 10-14), Dardevle (fly-rod and spinning-rod sizes), Flatfish (mostly size F3), Colorado Spinner (3/0), and Mepps Spinner (No. 1, the smallest size). The four hardware lures were selected as being representative of hardware lures used by trout fishermen in Michigan.

During 1956 the experimental plan called for each angler to fish with each of the several lures. He was to fish with a given lure either for one-half hour or until five fish were captured, after which he changed lures. Most anglers during 1956 followed this experimental plan closely, but a few neglected to use all hardware lures regularly because of poor success on initial trials. During 1957 all anglers followed an experimental plan of fishing with all five lures, and fishing for one-half hour with each lure before changing to the next one. During the two years, thirteen Department employees, and six anglers recruited from the general public, participated in the experimental fishing.

Each angler was assigned a particular fin-clip, as was each lure. When a fish was captured, it was given the clip for the individual angler and a second clip for the lure on which it was caught. Each fisherman was equipped with a pair of manicure shears for fin-clipping, and a live sack in which to carry his fish. The live sack consisted of a wheat or gunny sack attached to a No. 2 can in which holes were punched to admit fresh water; it was tied to the waders and the can was kept submerged in the stream.

Each angler kept records on his fishing, including time, type of lure, and species of trout. After a number of fish were captured, they were transferred from the live sack to a screen live crate with locked cover, and were

Figure 1.--Artificial lures used in present hooking experiments. A--Artificial fly (No. 14 hook), B--Artificial fly (No. 10 hook), C--Mepps Spinner (No. 1), D--Colorado Spinner (No. 3/0), E--Dardevle (spinning rod size), and F--Flatfish (No. F3). Scale is in inches.

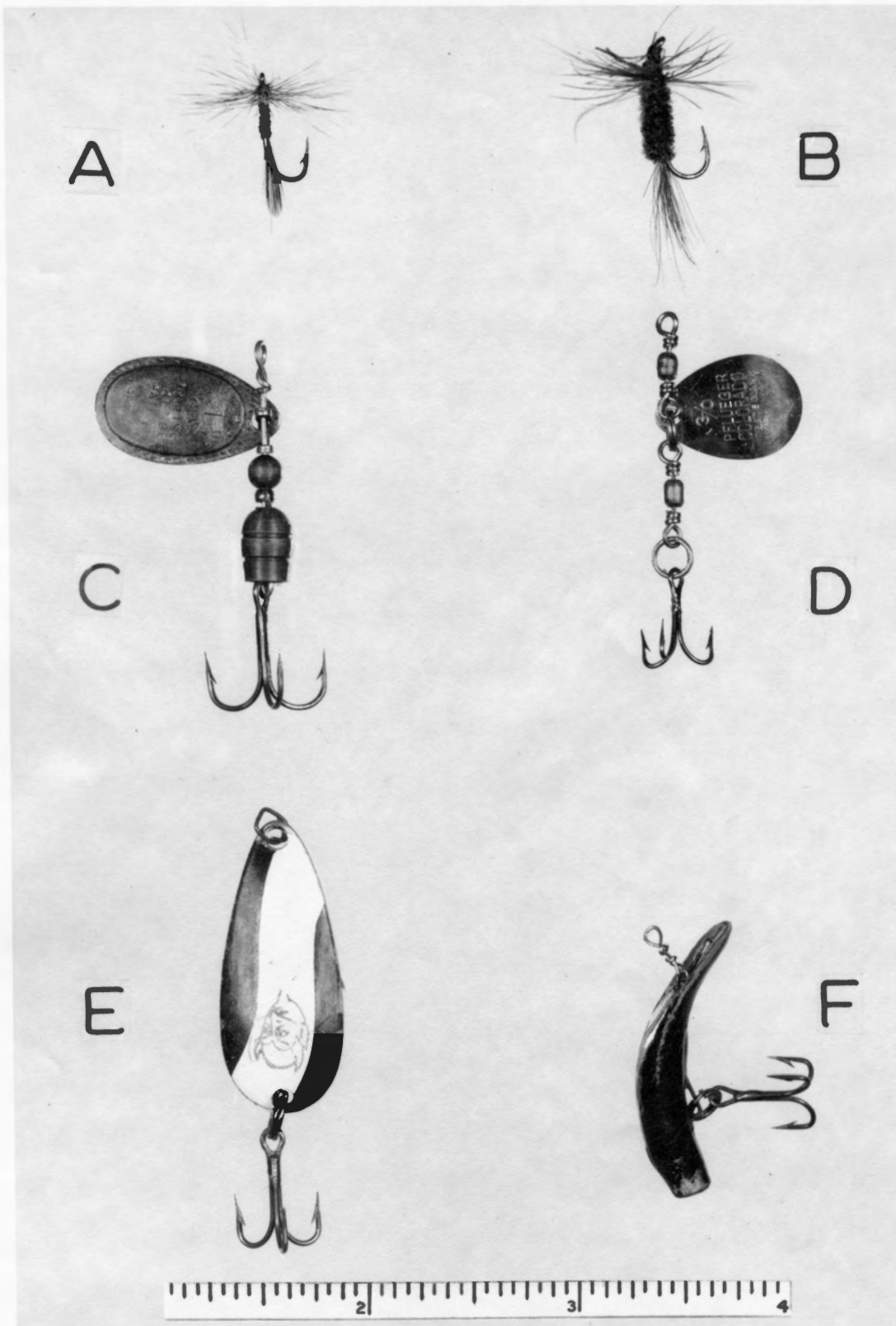


Figure 1

retained over night. On the following morning, the fish were examined, measured for length, and recorded according to angler and lure (from fin-clipping). Live fish were released. Dead fish were preserved in 10 percent formalin for autopsy.

#### General results

The 19 anglers fished for a total of 511 hours during 1956 and 1957 and caught 1,259 trout. These fish are listed by species, lure on which taken, and numbers later found dead, in Table 1 and Figure 2.

By species, 806 brook trout were caught, of which 21 later died; 107 brown trout were landed with one mortality; and 346 rainbow trout were taken, of which 18 died.

The four hardware lures killed more trout (4.6 percent) than did the artificial fly (1.3 percent) but the difference was small and in most comparisons between individual lures the differences were not statistically significant. The results are treated more fully below.

#### Size of fish taken

The average size of the fish taken on each lure is given in Table 2 and Figure 3; the size range is given in Table 2. Brown trout captured on the fly, Dardevle, and Flatfish were significantly larger than either brook trout or rainbow trout taken on the same lures. The Colorado Spinner caught fish of about the same average size among the three species. The Mepps Spinner took brook trout which were significantly larger than either brown or rainbow trout caught on that lure; however, the small sample of brown trout may not be typical in average length. The differences in average length noted for the three species taken on the same lure probably reflect differences in length frequency of fish in the stream, as well as some difference in size selectivity among lures.

Table 1.--Total hours of angling, total catch, and percentage hooking mortality among trout of all sizes, in test fishing with different lures on Michigan trout waters, 1956-1957

Species of trout	Lure	Hours fished <sup>1/</sup>	Number hooked	Deaths	Percentage mortality
Brook	Fly	128.3	424	6	1.4
	Dardevle	110.8	71	5	7.0
	Colorado spinner	105.3	127	6	4.7
	Mepps spinner	53.7	87	3	3.5
	Flatfish	113.1	97	1	1.0
	All lures	511.2	806	21	2.6
Brown	Fly	114.3	40	0	0.0
	Dardevle	96.8	17	1	5.9
	Colorado spinner	91.3	18	0	0.0
	Mepps spinner	40.2	10	0	0.0
	Flatfish	99.6	22	0	0.0
	All lures	442.2	107	1	0.9
Rainbow	Fly	95.1	75	1	1.3
	Dardevle	87.3	43	1	2.3
	Colorado spinner	74.3	70	6	8.6
	Mepps spinner	40.2	67	9	13.4
	Flatfish	85.6	91	1	1.1
	All lures	382.5	346	18	5.2
All species	Fly	...	539	7	1.3
	Dardevle	...	131	7	5.3
	Colorado spinner	...	215	12	5.6
	Mepps spinner	...	164	12	7.3
	Flatfish	...	210	2	1.0
	All lures	...	1,259	40	3.2

<sup>1/</sup>Total hours for each lure given for brook trout represent the total amount of fishing done on all waters. Hours spent fishing for browns and rainbows are less because these species were absent in certain waters. Since less time was spent fishing over browns and rainbows, hours fished for all species would be somewhat meaningless and are not given.

*2.500 ft. from shore with fly  
7.5 ... other lures ...  
Brook & rainbow ... other lures ...*

Figure 2.--Graph showing the percentage mortality among brook, brown, and rainbow trout hooked on the experimental lures. In the fraction above the bar for each lure are shown the number of deaths (numerator) and the number of fish hooked (denominator).



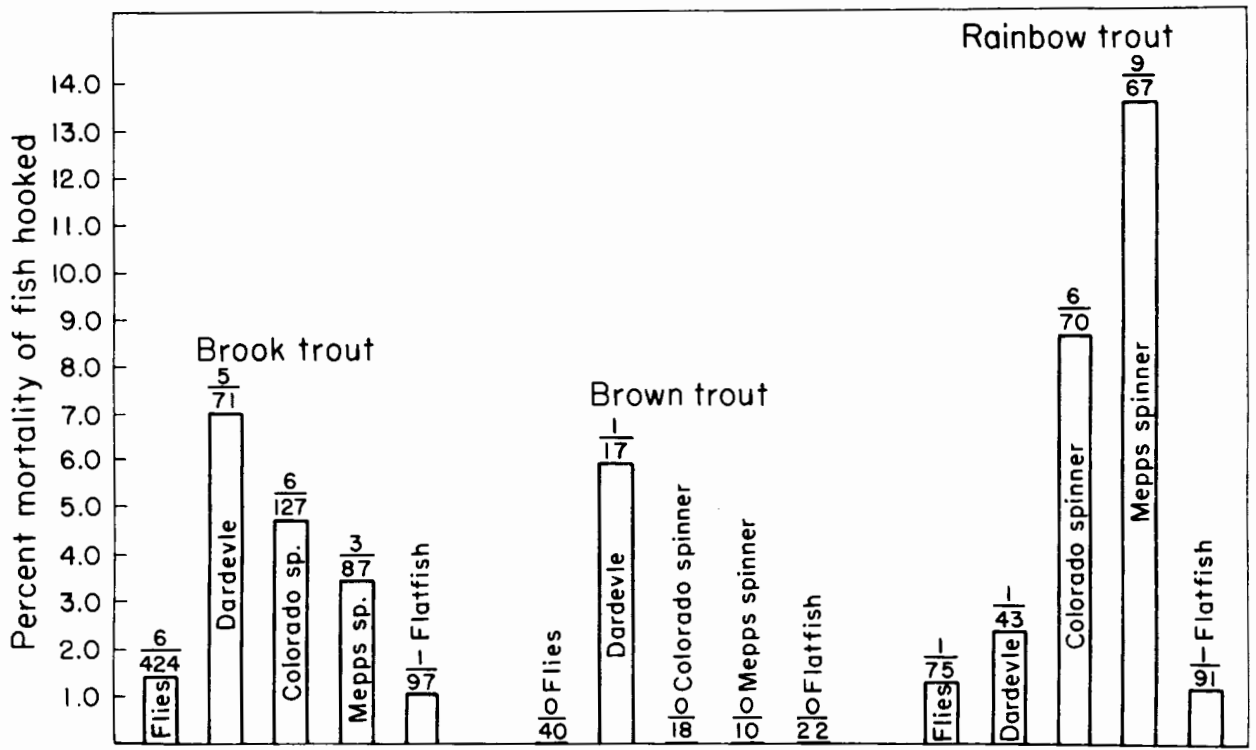


Figure 2

Table 2.--Average length (with range and standard error) of trout captured in "hardware" hooking experiments, 1956-1957

Species	Lure	Number of fish	Length in inches		
			Range	Average	Std. error
Brook trout	Fly	424	4.5 - 10.1	6.65	0.05
	Dardevle	71	5.5 - 10.9	7.88	0.15
	Colorado spinner	127	2.9 - 11.2	7.26	0.14
	Mepps spinner	87	4.6 - 11.8	7.41	0.13
	Flatfish	97	5.2 - 11.7	7.47	0.13
	All lures	806	2.9 - 11.8	7.03	0.05
Brown trout	Fly	40	4.2 - 15.4	7.58	0.40
	Dardevle	17	6.2 - 17.8	10.40	0.72
	Colorado spinner	18	3.6 - 11.8	7.42	0.53
	Mepps spinner	10	3.9 - 7.8	6.49	0.35
	Flatfish	22	5.5 - 13.3	9.02	0.52
	All lures	107	3.6 - 17.8	8.19	0.26
Rainbow trout	Fly	75	5.5 - 9.1	6.72	0.09
	Dardevle	43	5.2 - 10.3	7.11	0.20
	Colorado spinner	70	4.5 - 9.9	6.38	0.11
	Mepps spinner	67	5.2 - 10.7	7.01	0.15
	Flatfish	91	3.1 - 10.3	6.68	0.11
	All lures	346	3.1 - 10.7	6.75	0.06
All trout	Fly	539	4.2 - 15.4	6.73	0.05
	Dardevle	131	5.2 - 17.8	7.96	0.16
	Colorado spinner	215	2.9 - 11.8	6.99	0.11
	Mepps spinner	164	3.9 - 11.8	7.19	0.10
	Flatfish	210	3.1 - 13.3	7.29	0.04
	All lures	1,259	2.9 - 17.8	7.05	0.04

Figure 3.--Graph showing average total length (inches) of brook, brown, and rainbow trout taken on the experimental lures. The lure, and the number of specimens from which the average length was determined, are shown in each bar. (Data from Table 2.)

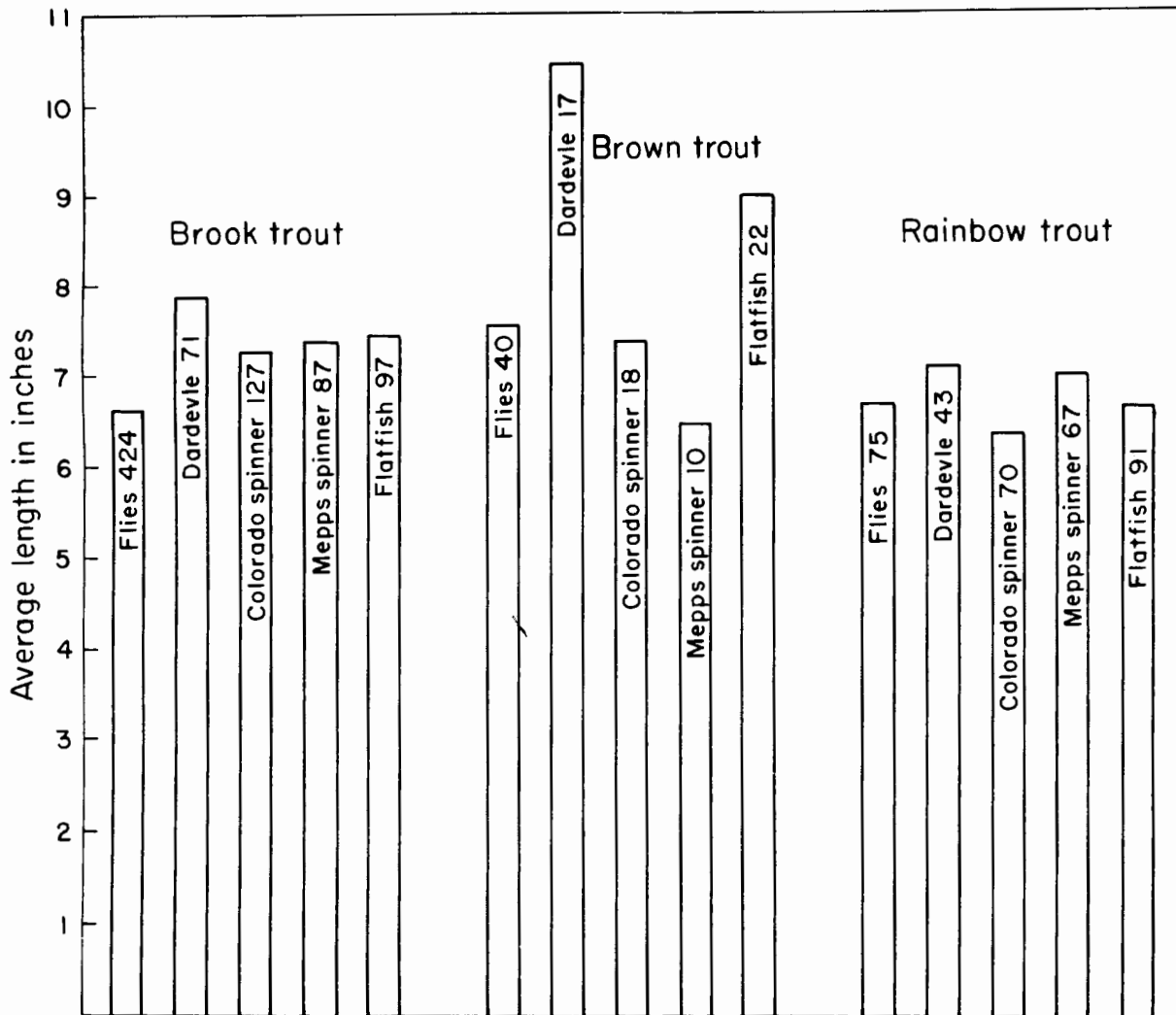


Figure 3

For brook trout, each of the hardware lures caught fish whose average size was significantly larger than that of fly-caught fish ( $t$  tests all yielded probability values below 1 percent). For brown trout, Dardevle-caught and Flatfish-caught fish were significantly larger than fly-caught or spinner-caught fish ( $t$  tests yielded probability values ranging from 5 to less than 1 percent). Brown trout caught on the Colorado Spinner were not significantly different in size from those taken on the fly. Rainbow trout caught on the Colorado Spinner were significantly smaller than those caught on the fly ( $t = 2.39$ ,  $p = 3$  percent). Comparison of the average length of fly-caught rainbow trout with those taken on the Dardevle, Mepps Spinner, and Flatfish indicated no significant differences.

The differences in average size of trout caught on the various lures result in different proportions of sublegal to legal-size trout taken by these lures. The numbers of trout hooked which were less than 7 inches in total length, by lure, are given in Table 4, as well as the number of fish which were between 7.0 and 8.9 inches, between 9.0 and 9.9 inches, and larger than 10.0 inches. The percentages of the total fish caught, in the above categories, can be calculated from the table. Among fly-caught trout 45.0 percent (brown trout) to 70.7 percent (rainbow trout) were smaller than 7.0 inches. For Dardevle-caught fish 11.8 (brown trout) to 55.8 percent (rainbow trout) were less than 7 inches long. The trout less than 7 inches in length caught on the Colorado Spinner ranged from 40.2 (brook trout) to 78.6 percent (rainbow trout). The catch of fish under 7 inches by the Mepps Spinner varied from 44.8 (brook trout) to 70.0 percent (brown trout); and by the Flatfish, from 22.7 (brown trout) to 68.1 percent (rainbow trout).

The lures which were used (see Fig. 1) ranged in size, in order, from the fly (the smallest) to Colorado Spinner, Mepps Spinner, Flatfish, and Dardevle (the largest). If one arranges the average lengths of the fish taken on these lures (data in Table 2) in the above sequence for size of lure, the brook trout show a regular, step-by-step increase in size. For brown trout the relationship was not so precise, but the two larger lures caught the largest fish on the average. This relationship--the larger the lure, the larger the fish taken--did not hold for rainbows; but this may have been due, in part, to the fact that few rainbow trout larger than 12 inches were present in the Little Manistee River where our rainbows were caught.

#### Catch per hour per angler for the various lures

From our records on fishing with the fly and hardware lures, the catch per hour per angler was computed for each lure, separately for each species. The time spent fishing on a stream which did not contain a given species was not included in computing the catch per hour for that species. For example, no rainbow trout were caught in the North Branch of the Au Sable; therefore fishing time on this stream was not included in computing the catch per hour for this species. The basic statistic which was used for catch per hour per angler was obtained from the total hours of fishing done by an individual during one season (1956 or 1957) on waters containing a given species of trout. For example, if Angler A fished 20 hours during 1956 with the artificial fly on streams containing brook trout, and caught 20 brook trout, his fishing provided a single statistic of 1.0 brook trout per hour by fly; if Angler A fished with the fly on brook trout waters

also during 1957, this fishing provided a second statistic for catch per hour of brook trout on the fly. For the 19 anglers who took part in the hooking tests during the two years, there were 24 catch statistics for brook trout taken on fly, 24 for brook trout on Dardevle, etc., as shown in Table 3; this table gives the number of anglers and the average of their catches per hour, for each species and lure (see also Fig. 4).

Among brook trout, the artificial fly took significantly more fish per hour (3.35) than did the Flatfish (0.84) or the Dardevle (0.59) (the  $t$  test yielded  $p$  values of less than 5 percent). The catch rates for Mepps Spinner (1.87) and Colorado Spinner (0.97) also were lower than for the fly, but not significantly so by the  $t$  test. Among brown trout, no lure was significantly different from the others (at the 5 percent significance level), although a higher rate for the fly than for the Colorado Spinner approached statistical significance. Among rainbow trout, the Mepps Spinner (1.58) exceeded the fly, Dardevle, and Colorado Spinner (0.85, 0.44, 0.88); other differences were not statistically significant.

#### Mortality related to catch

In comparing mortality rates for different lures, it is important to consider both the amount of mortality as a percentage of the number of sublegal and legal-size fish caught, and the rate of mortality per hour of fishing. One must also define the objective of trout management. We take the point of view that the final objective is to catch legal-size trout, with a minimum amount of hooking mortality on trout of sublegal size. Thus, if two lures catch legal-size trout at the same rate per hour, the lure which kills the fewest sublegal trout is the better lure. Furthermore, if two lures kill sublegal trout at the same rate per hour, the lure

Table 3.--The average catch per hour per angler for the various experimental lures, 1956-1957

Species	Lure	Number of anglers <sup>1/2</sup>	Average catch per hour per angler	Standard error
Brook trout	Fly	24	3.35	1.23
	Dardevle	24	0.59	0.16
	Colorado spinner	25	0.97	0.27
	Mepps spinner	10	1.87	0.70
	Flatfish	24	0.84	0.26
Brown trout	Fly	22	0.33	0.11
	Dardevle	22	0.17	0.08
	Colorado spinner	23	0.09	0.04
	Mepps spinner	8	0.21	0.05
	Flatfish	22	0.19	0.08
Rainbow trout	Fly	19	0.85	0.20
	Dardevle	20	0.44	0.12
	Colorado spinner	19	0.88	0.26
	Mepps spinner	8	1.58	0.26
	Flatfish	19	1.17	0.35

<sup>1/2</sup>The fishing done by one person during one year (1956 or 1957) is here regarded as one "angler" record. Nineteen persons were involved in the fishing. An angler who fished with a particular lure and for a particular species in both years is counted as two anglers; thus the "number of anglers" in many instances exceeds 19. Furthermore, since some anglers did not fish with all lures on waters containing all three species, the "number of anglers" in some instances is less than 19.



Figure 4.--Graph showing the average catch per hour per angler for brook, brown, and rainbow trout on the various experimental lures (data from Table 3).

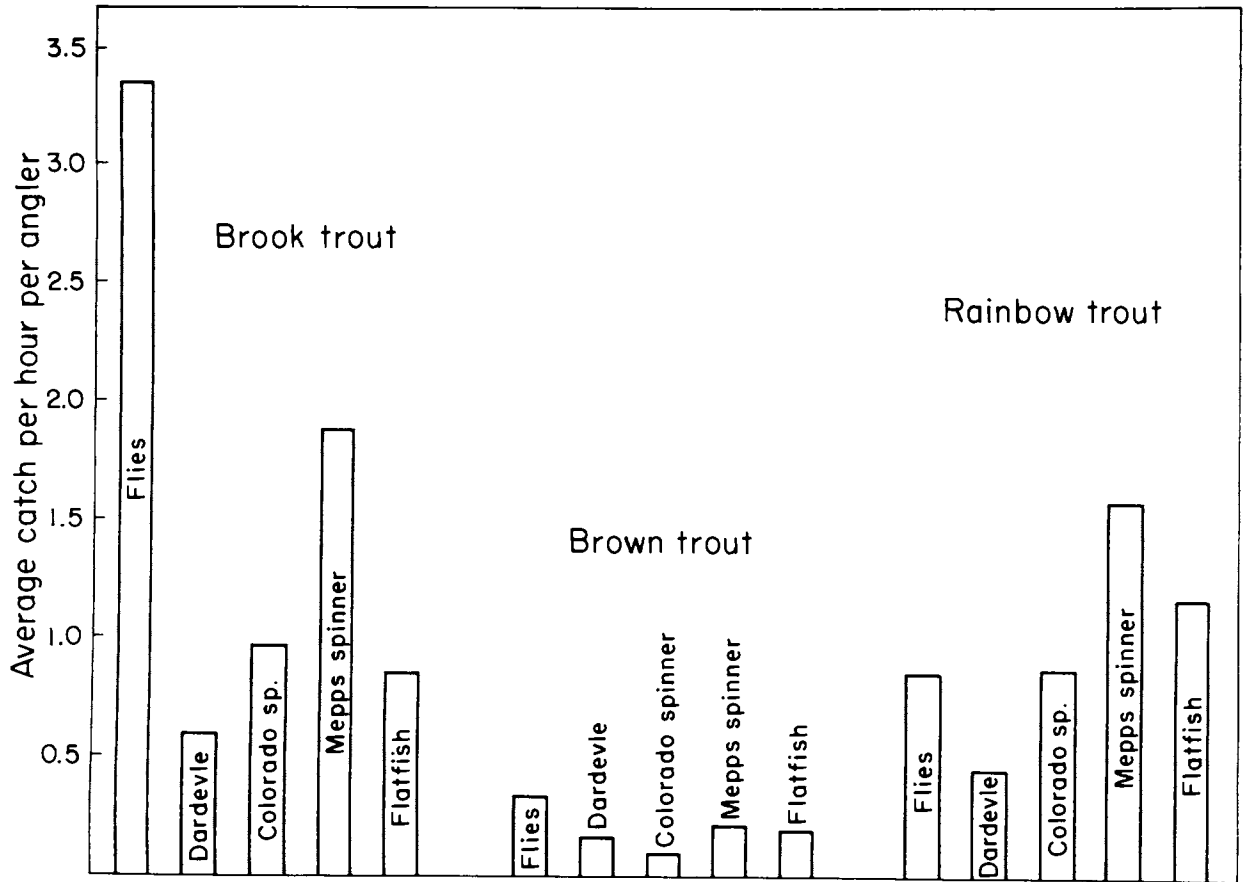


Figure 4

which catches the greater number of legal-size fish is the better lure. In this section, we first consider mortality as a percentage of the total number of sublegal and legal-size trout caught.

Numbers of fish hooked, and resulting mortalities, are summarized by species, size of fish, and lure in Table 4. The records are adequate for comparisons of mortality, by lure and size group, for the brook and rainbow trout, but not for the brown trout.

Chi-square was used to test the difference between fly mortality and mortality caused by each of the hardware lures, within each size group and species. Among brook trout under 7 inches, the only lure which caused significantly more deaths than the fly was the Dardevle (Chi-square = 10.55). Among 7.0- to 8.9-inch brook trout, no statistically significant differences were found among any of the lures. When brook trout of all sizes were combined (Table 1), again only the Dardevle yielded a significantly higher hooking mortality than that noted for the fly. Among rainbow trout under 7 inches, fish were killed at a significantly higher rate by the Mepps Spinner than by the fly; other differences between lures were non-significant for rainbow trout under 7 inches. As with brook trout, there were no statistically significant differences between lures, in mortality among 7.0- to 8.9-inch rainbows. For all sizes of rainbow trout combined (Table 1), the Mepps Spinner killed significantly more fish than did the fly. For brown trout, where only one mortality resulted from hooking 107 fish, hardware lures obviously were not significantly more lethal than the fly.

In the above comparisons of mortality according to lure, species, and size, only the Dardevle on brook trout and the Mepps Spinner on rainbow trout resulted in significantly greater mortality than did the fly. Even though these tests indicate differences which are statistically significant, the numbers of fish in the mortality categories were relatively

Table 4.--Number of trout caught, and number of hooking mortalities, by species, size group, and lure, from test fishing in 1956-1957

Species	Length group (inches)	Fly		Dardevle		Colorado spinner		Mepps spinner		Flatfish	
		Caught	Died	Caught	Died	Caught	Died	Caught	Died	Caught	Died
Brook	0.0-6.9	266	4	18	3	51	3	39	1	38	1
	7.0-8.9	148	2	37	2	56	3	37	1	49	0
	9.0-9.9	9	0	11	0	17	0	8	1	4	0
	10.0+	1	0	5	0	3	0	3	0	6	0
Brown	0.0-6.9	18	0	2	0	10	0	7	0	5	0
	7.0-8.9	15	0	3	0	3	0	3	0	6	0
	9.0-9.9	1	0	2	0	3	0	..	..	4	0
	10.0+	6	0	10	1	2	0	..	..	7	0
Rainbow	0.0-6.9	53	0	24	1	55	5	38	7	62	1
	7.0-8.9	21	1	13	0	13	1	23	2	27	0
	9.0-9.9	1	0	5	0	2	0	4	0	1	0
	10.0+	..	..	1	0	..	..	2	0	1	0

small (e.g., 4 for fly versus 3 for Dardevle) and we are inclined not to attach too much importance to these differences. Since the four hardware lures were selected as representative of similar lures used generally in Michigan, it seems appropriate to combine hooking records for the four hardware lures for a comparison with the fly. For brook trout the fly killed 6 of 424 fish; the four hardware lures killed 15 of 367 fish. The difference (tested by Chi-square) is significant ( $p = 0.04$ ), with hardware lures about three times as lethal as the fly on brook trout. For rainbow trout, the fly killed 1 of 75 fish; the four hardware lures killed 17 of 254 fish. The difference (tested by Chi-square) is not significant ( $p = 0.16$ ), although the observed mortality for all hardware lures was about four times that for the fly. For brook, brown, and rainbow trout combined, the fly killed 7 of 539 fish; the four hardware lures killed 33 of 720 fish. This difference (tested by Chi-square) is statistically significant ( $p$  less than 0.01); apparently the hardware lures are about three times as lethal as flies on the three species of trout combined (4.6 percent versus 1.3 percent).

Although the above analysis on proportional mortality shows hardware lures to be more lethal, the question is investigated further below by two other approaches.

#### Mortality rates under different size limits

The present section deals with two questions: (1) How many sublegal trout were killed per hour of fishing by different lures? and (2) What is the relationship between number of sublegal trout killed and the number of legal-size fish caught (which could have been kept in the creel)? Furthermore, these two questions are considered in connection with three hypothetical

size limits--7 inches, 9 inches, and 10 inches--since, in experimental trout streams in Michigan, restrictions on lures are being tried in conjunction with higher size limits.

Table 5 contains figures on number of sublegal trout killed per hour of fishing by different lures; the number given for each lure is an average based on the fishing done by 8 to 25 anglers (Table 3). The mortality rate was highly variable among trout caught by the different anglers; hence the standard errors (Table 5) are large in relation to the number of sublegal trout killed per hour of fishing.

In the kill of sublegal trout per hour, the only significant differences (measured by the  $t$  test) among lures and within a given species of trout involved the Mepps Spinner; this lure killed significantly more sublegal rainbow trout than did the fly, Dardevle, and Flatfish, at all three size limits. If the four hardware lures are combined and compared with the fly, the observed rate of kill of brook trout by fly was higher than by hardware lures, and conversely for rainbow trout, but none of the differences are statistically significant. The general conclusion from the analysis of kill of sublegal trout per hour is that the four hardware lures were not significantly more lethal than the fly, and this would apply to sublegal trout under size limits of 7 inches, 9 inches, and 10 inches.

Table 5 contains the actual number of sublegal trout killed and the number of legal-size fish caught by each lure and for each species, for the three hypothetical size limits. The data<sup>are</sup> also summed for the four hardware lures, and for the three species of trout. In instances where

Table 5.--Rate of hooking mortality per hour, actual number of sublegal fish killed, and number of legal-size fish caught with different lures, related to hypothetical size limits. Data from hooking experiments, 1956-1957

Species, and minimum size limit	Lure	Sublegal trout killed per hour of fishing (X 1,000)		Number of sublegal trout killed	Number of legal-size trout caught
		Number	Standard error		
<b>Brook trout</b>					
7 inches	Fly	32	20	4	158
	Dardevle	25	16	3	53
	Colorado	23	14	3	76
	Mepps	22	23	1	48
	Flatfish	9	9	1	59
	All hardware	19	7	8	236
9 inches	Fly	47	26	6	10
	Dardevle	42	21	5	16
	Colorado	46	22	6	20
	Mepps	43	34	2	11
	Flatfish	9	9	1	10
	All hardware	34	11	14	57
10 inches	Fly	47	26	6	1
	Dardevle	42	21	5	5
	Colorado	46	22	6	3
	Mepps	64	44	3	3
	Flatfish	9	9	1	6
	All hardware	37	11	15	17
<b>Rainbow trout</b>					
7 inches	Fly	0	..	0	22
	Dardevle	10	10	1	19
	Colorado	63	33	5	15
	Mepps	165	65	7	29
	Flatfish	13	13	1	29
	All hardware	47	14	14	92
9 inches	Fly	11	12	1	1
	Dardevle	10	10	1	6
	Colorado	75	37	6	2
	Mepps	212	74	9	6
	Flatfish	13	13	1	2
	All hardware	57	16	17	16
10 inches	Fly	11	12	1	0
	Dardevle	10	10	1	1
	Colorado	75	37	6	0
	Mepps	212	74	9	2
	Flatfish	13	13	1	1
	All hardware	57	16	17	4
<b>Brown trout</b>					
7 inches	Fly	0	..	0	22
	All hardware	0	..	0	43
9 inches	Fly	0	..	0	7
	All hardware	0	..	0	28
10 inches	Fly	0	..	0	6
	All hardware	0	..	0	19
<b>Brook, rainbow, and brown trout</b>					
7 inches	Fly	..	..	4	202
	All hardware	..	..	22	371
9 inches	Fly	..	..	7	18
	All hardware	..	..	31	101
10 inches	Fly	..	..	7	7
	All hardware	..	..	32	40

the numbers of fish in individual categories are less than five, tests of differences between different lures were made by the Fisher Exact Probability Test (Siegel, 1956, p. 96); other comparisons were tested by Chi-square.

To take an example from Table 5, the fly killed 4 brook trout under 7 inches in length while capturing 158 brook trout 7 inches or more in length--a ratio of 1:39. For comparison, the Dardevle killed 3 sublegal brook trout (under 7 inches) while taking 53 legal-size brook trout--a ratio of 1:18. The Fisher Exact test (on the actual numbers of fish caught) tells the probability of this difference in the two ratios occurring merely by chance. In this instance  $p$  is about 0.25, which means that this difference could happen by chance about once in four trials. Thus it is concluded that the observed greater kill of sublegals per legal-size trout was not statistically significant.

The more extreme differences between lures, in mortality of sublegal trout per legal-size fish caught, were tested. Most differences in individual comparisons were not significant. Exceptions were that the Mepps and Colorado spinners were more lethal than the fly on rainbow trout under 7 inches; and, conversely, that the fly was more lethal than the Flatfish on brook trout under 10 inches. Another significant difference results when data for the three species of trout are combined; the four hardware lures combined were more lethal than the fly on trout under 7 inches, but not under hypothetical size limits of 9 inches and 10 inches.

The general conclusion on mortality of sublegal trout per legal-size fish caught is that the four hardware lures were not significantly more lethal than the fly under size limits of 9 inches and 10 inches; but the hardware lures were more lethal (or the fly less so) under a size limit of 7 inches.



In interpreting the present mortality figures for different lures in relation to different size limits as postulated, there is one additional and important fact to be considered. Most of the test fishing was done on sections of streams where a 7-inch legal size limit prevails, and it is safe to say that these streams now have fewer large trout (8 to 10 inches long and larger) than they would have under a higher size limit--at least of brook and brown trout. With more larger fish present, presumably fewer sublegals would be killed for each legal-size fish caught, but the relative differences in hooking loss between the lures involved in the present tests should not be affected.

#### Discussion

The tests described here show that the Dardevle, Colorado Spinner, Mepps Spinner, and Flatfish are not generally more destructive of 7-inch to 10-inch trout than is the artificial fly. This fact suggests that all hardware lures could be legalized, along with the artificial fly, on streams with a 9-inch or 10-inch size limit and on which lures are restricted. Hardware lures which might be allowed on these streams should be no smaller in size than those used in the present tests (Fig. 1), and it is recommended that the Mepps and Colorado spinners should be at least one size larger. (The 3/0 Colorado and No. 1 Mepps used in the present tests were somewhat more lethal than the Dardevle and Flatfish.) We believe that it would also be best to limit hardware lures to those with one treble hook, as a means of keeping hooking mortality at a minimum.

The use of hardware lures, in addition to the artificial fly, would be advantageous to fishermen because there are many days when weather and stream conditions are not good for fly fishing, but are more favorable for

using hardware lures. Field checks with an electric shocker in some streams (the Au Sable River system for example) reveal many large brown trout which are being underharvested as compared to brook and rainbow trout. Undoubtedly more of these brown trout would be caught if hardware lures were legalized.

On the several trout streams in Michigan where the lure is now restricted to the artificial fly, the principal concern has been the high mortality of sublegal trout when caught on worms (Shetter and Allison, 1955). The low rates of mortality caused by hardware lures and by flies are closely comparable, and are in sharp contrast to the much higher mortality of sublegal fish which results from the use of worms. Even though the mortality rates for the fly and hardware lures, in relation to the number of legal-size trout creeded, are quite high under size limits of 9 inches and 10 inches, the mortality rate for worms (not investigated in our earlier study) probably would be much higher.

#### Acknowledgments

The authors acknowledge assistance of the following individuals in the experimental fishing: Departmental employees G. R. Alexander, Arnold Hubbell, Lois Bradley, Donald Peterson, Stanley Lievense, C. Troy Yoder, E. H. Andersen, R. Wright, C. Roberts, Paul Schoepploman and Jack Hammond, and public anglers Messrs. Harris, Hartman, Wolf, Snider, Sindlinger, and Penrod. Drs. D. W. Hayne and G. P. Cooper assisted in the analysis and interpretation of the data.

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