

FEB 10 1971



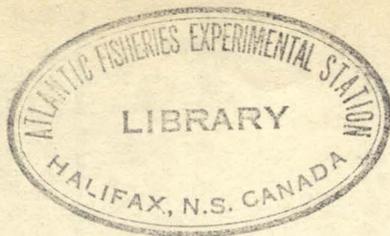
MANUSCRIPT REPORTS OF THE BIOLOGICAL STATIONS

No. 253

A Review of the American Literature upon the Success
of Stocking Salmonoid Fish.

by
M.W. Smith

58952



**FISHERIES RESEARCH BOARD
OF CANADA**

MANUSCRIPT REPORTS OF THE BIOLOGICAL STATIONS

No. 253

Title

A REVIEW OF THE AMERICAN LITERATURE UPON THE
SUCCESS OF STOCKING SALMONOID FISH.

Author

M. W. Smith

1941

A REVIEW OF THE AMERICAN LITERATURE UPON THE SUCCESS
OF STOCKING SALMONOID FISH.

Within the last decade an ever-increasing effort has been made to evaluate the results of planting the hatchery stock of various salmonoids in stream and lake. Previously the tacit assumption was made by most fish-culturists that the stocking of hatchery fish was largely a successful procedure and was the principal panacea by which stocks of fish in natural waters could be maintained near unexploited levels. Doubts concerning the truth of the above assumption were occasionally expressed, and as the demand became greater and the stock diminished, these doubts were entertained by more and more people, fish-culturists and anglers, until at the present time it is generally conceded that all is not well and that there are growing needs to revise our fish cultural procedures--to base them upon the determined survival of hatchery stock and upon the fundamental capacity of the waters to produce and support fish.

Facilities to follow the fate of hatchery-produced fish are limited, and the development of sound procedures for the management of our waters is slow, yet at the present time there are a number of research groups attacking the problems involved. No doubt hatchery-produced stock contributes much to the anglers' creels but plans for the proper utilization of the hatchery fish have still, to a large extent, to be established. Notable success has attended the stocking of certain waters. Rainbow trout have been established in a number of streams and lakes in eastern North America. The eastern brook trout contributes to the catch in certain western waters where it did not formerly occur. The fundamental problem, however, is the maintenance of a native species in its native habitat.

Much of the information secured in one locality may, in general aspects, apply far afield. However, it is probably true that the problems will be best attacked from a regional standpoint. In some States fish of legal size are planted with the anticipation that they will contribute only to the angling of the current season, without the establishment of breeding populations. Obviously this practice is unwarranted, at the present time at least, in many, if not most, other waters.

Possibly, until schemes for the management of waters have been evolved, the following statement expresses the situation: "Until such time as there is a clear-cut formulation of a precise program, it is necessary to view the hatcheries as an implement which has proved its effectiveness in a general way throughout a period of years." (Leach, James and Douglass, 1939).

BROOK TROUT - Survival of planted fish in streams

(a) Total survival.

Most records concerning the fate of planted trout have been made by means of a creel census, which method does not show the complete survival. The work of White (1924, 1927, 1930), however, gives a total assessment of the number of trout fingerlings remaining in one Prince Edward Island and two Ontario streams three months (summer) from the time of planting. In Gunstone and Buck creeks, Ontario, White (1924) found a survival of 4 and 30.5 per cent respectively for these streams from the stocking of 5000 fry in each creek. Some predators, as a few older trout, were present. In Forbes brook, P.E.I., White (1927, 1930) recovered from 15.0 to 50.4 per cent of introduced fry, depending upon the conditions existing in various sections of the stream and upon the number of fish stocked per unit

area. (These tests also ran during the summer and early fall for a period of approximately three months.) The greatest loss was encountered when the stocking was heaviest and considerable numbers of older native trout were present. Conversely, the greatest survival was secured when the stocking was moderate, all enemy fish removed, and the stream screened against birds.

(b) Survival according to creel censuses.

In many of the investigations the stock employed has consisted of moderately large trout, often over seven inches in length. From the results of the planting experiments it appears obvious that the survival of these fish, as measured by the angler's catch, depends upon the time of year that the fish are planted. Accordingly data upon the survival of fallstocking will be considered separately from those upon the planting of fish in the spring and during the fishing season.

(I) Results of fall planting. Shetter (1939) reports that in November, 1936, 9778 brook trout fingerlings with an average length of 3.5 inches were marked by fin-clipping and planted in the North Branch of the AuSable river, Michigan. Anglers took only three of these marked trout in 1937 and none in 1938. In four other Michigan streams the anglers captured in 1937 and 1938 only three out of 2135 marked trout, 4 to 6 inches in length, which had originally been planted in 1936 and 1937. From further work upon Michigan waters Shetter and Hazzard (1941) report a recovery of 4.4 per cent from a fall release of 2798 marked trout, of seven or more inches in length, in four streams. Smith (1941) likewise secured poor results from planting 7- to 9-inch fish in Salmon Trout river, Northern Michigan. Of 1233 tagged brook trout released on November 12, 1938, only 3 or 0.02 per cent were recovered in 1939. Similarly only 1

per cent of 600 fish planted on October 17, 1938, was recaptured.

In Vermont the stocking of Furnace brook with legal-size fish in the fall was found to be wasteful. "Of 5000 trout planted in the fall of 1936 less than 12 per cent were taken the following year, and of the same number planted in the fall of 1937 only 2 per cent were taken by anglers the following season." (Davis, 1940, p.3). These results obtained although Furnace brook is an excellent trout stream. In 1935 the anglers' catch consisted of 5647 brook and 2942 rainbow trout, the majority of which were native fish. (Lord, 1935) Davis (1941, p.172) gives further evidence that fall-planted trout do not survive well: "Another striking example of the failure of hatchery fish to influence the fishery is provided by the Davidson river in the Pisgah National Forest, North Carolina. During 1937, 1938 and 1939 most of the stocking was done in the fall, a total of 18,135 trout over 6 inches long having been planted during that time. Of this number, 795 or 4.4 per cent have been recovered." In nearby Virginia, Surber (1940) found that of two groups of brook trout, comprising 3626 individuals and averaging 3.75 and 5 inches in length, planted in the St. Mary river in September, 1935 and November, 1936, only 29 were ever recaptured and recorded. From another group of 1106 fish (5.6 inches in length) stocked in October, 1938, only 96 recoveries were made during the season of 1939. Surber remarks that these fish were slim and colourless.

The results, therefore, of planting trout in the fall appear consistent in showing very poor yields to the anglers. There is an apparent inability of the hatchery stock to survive the winter. This statement might be countered by one to the effect that the survival is good but that migration from the census areas accounts for the poor returns. An explanation of this nature cannot be

entirely ruled out, but it is largely contrary to the findings of investigators. Davis (1940,p.4) states: "Our studies have shown that brook trout tend to remain where planted even though there is very little food to be had and there are no obstacles to their descent to more favourable sections." Shetter advances evidence that in the Au Sable river, Michigan, there is a downstream movement of the bulk of the trout population during the winter months; yet he presents equal evidence that the population returns to the same general areas occupied the preceding season. Obviously, unless there was a return upstream, the upper reaches of trout streams would quickly be depleted. Cobb (1933) also found that a large percentage of trout remained in the sections of streams where they had been planted.

(II) Results from spring and summer planting. A plant of 3809 large trout in the Davidson river, North Carolina during the spring of 1940 gave a yield of 31.4 per cent to the anglers (Davis, 1941). In Michigan streams, Hazzard and Shetter (1939) obtained returns of 4.9, 6.0, 8.1 and 40.2 per cent from groups of 7-inch fish planted during the spring and summer. In a later report, these same investigators present additional returns from four Michigan streams (Shetter and Hazzard,1941). From spring releases of 3300 legal fish, 983 or 29.8 per cent were recaptured , and from an open-season release of 9501 trout there was a recovery of 24.7 percent. From the Salmon Trout river in northern Michigan, anglers were successful in capturing 15.5, 19.6 and 16.01 percent of 7- to 9-inch trout planted during the springs of 1938 (252), 1939 (1100), and 1940 (699) (Smith, 1941).

Cobb (1933) secured a return of 5403 marked brown and brook trout from a total of 15,875 planted inConnecticut

streams. In specific reference to brook trout, the anglers' catch showed a recovery of 11,34 and 38 percent of the planted fish in the Salmon, Natchaug and Pomperaug rivers. In Bear brook, New Hampshire, Hoover and Johnson (1938) planted 2000 legal fish during the first week of June, of which 500 were tagged. By the end of three weeks anglers had removed 70 percent of these marked fish from the stream. After one week 45 percent had been taken, and at the end of the second week, 60 percent.

The planting of legal-size trout in the spring and summer yields more to the anglers than when these fish are stocked in the fall. It is noteworthy, however, that, although 6- to 9-inch trout may be planted just prior and during the fishing season, yet less than 50 percent of these are recaptured in the majority of cases. A plan to produce hatchery trout of sufficient size for the angler with the anticipation that when planted these fish will be taken during the current season has to provide a production of at least two trout for every one entering the fishermen's creels.

The results of the various investigators were obtained by the creel census method. Thus the recoveries do not represent the total survival. Nevertheless, Hazzard and Shetter (1939) discovered that very few legal trout planted during one season (spring and summer) survived to enter the catch of the subsequent year. It would appear that the factors, which operate to make the fall planting of trout in streams a poor venture, also deal similarly with the residual stock from spring and summer releases.

A rather surprising result of the planting of legal-size trout in a Michigan stream was the definite correlated increase in the take of wild fish (Hazzard and Shetter, 1939). These investigators postulate that the consistent stocking of a stream with hatchery fish

of legal size during the fishing season would eventually lower the number of adult trout of breeding size to the point where spawning would be seriously impaired. The suggested reason for the greater catch of native fish following the plant of hatchery fish was that the added population reduced the available food supply so that wild trout more eagerly take the angler's bait.

(c) Survival according to seining records.

Shetter (1937) planted 3098 tagged trout in the north branch of the AuSable river, Michigan, between July 25, 1934 and February 15, 1936. Between the same dates, 776 or 25 percent of these trout were accounted for by seining.

Later, Shetter (1939) obtained the following results from seining operations after planting 9778 marked fish (3.5 in. in average length) in the same Michigan stream. The date of planting was October 13, 1936.

<u>Date of seining operations.</u>	<u>Wild trout captured.</u>	<u>Marked trout captured.</u>
Nov. 1936	599	166
Feb. 1937	229	51
July 1937	290	20
Sept. 1937	477	5
Nov. 1937	825	27
Oct. 1938	Approx. 1000	none

BROOK TROUT - Survival of planted fish in lakes.

A notable example of the establishment of a non-indigenous fish population is that with brook trout in the Maligne river system, Jasper park. In 1928, 1929 and 1931, some 577,000 speckled trout fry were introduced (Rodd, 1929, 1931, 1932; Rawson, 1941). From Maligne lake proper 8920 trout were taken by anglers during the years from 1933 to 1940. Between 1935 and 1940, the combined catch from Medicine and Beaver lakes, and Maligne river, was 33,457 fish. The actual number of planted fry that survived is not known, but obviously sufficient

reached maturity to establish a good breeding stock.

The stocking of a small Michigan lake (11.7 acres) with speckled trout gave a contrasting result. Of 6,500 trout, including some adults, stocked in Ford lake, 15 fish were taken in gill nets and 27 were found when the fish population was poisoned. (Eschmeyer, 1938). The fish were planted in 1933 and 1934 and caught in 1934 and 1936. The lake also supported a large number of yellow perch, upon which, through predator and competitor action, the poor survival is blamed.

The results obtained in three other Michigan lakes is summarised as follows (Eschmeyer, 1938):

Lake and area in acres.	Fingerlings planted, 1933-35	Number caught 1935, and per cent of plant	Yield in pounds per acre 1935 and 1936.	
Lost - 4.6	16,500	627 -- 3.8%	30.2	11.8
West Lost - 4.0	16,000	453 -- 2.8	23.5	22.5
Hemlock - 6.0	20,000	267 -- 1.3	8.0	4.3

The above data show a low survival among the stocked fish, but that the yield per acre to the angler was quite good. Eschmeyer assumed from the character of the lakes that there was little, if any, natural reproduction.

For Fish lake, Umpqua National Forest, the information given by Needham and Cliff (1938) shows a poor survival from an attempt to introduce the eastern brook trout. In each of two years, 1935 and 1936, 20,000 small fingerlings were planted. The catch record for 1937 revealed only 68 brook trout, or a percentage yield to the angler of 0.34 if we consider the 68 fish as survivals of the 1935 planting only, or a percentage of 0.17 if referred to the stocking for both years. This lake supported a population of native rainbow trout, and the angling record for these in 1937 was 5878 fish.

Rodd (1941) gives the number of recaptures reputedly obtained by anglers from plantings of marked brook trout, yearlings or older, in lakes of the Antigonish district, Nova Scotia. The percentage of marked fish recovered varied from 2.2 to 86.1 for thirteen lakes--the average percentage was 28.6. These results were not obtained from an organized creel census but apparently from volunteer reports, provided by the anglers of the region.

In September, 1933, 5028 marked eastern brook trout, averaging two inches in length, were planted in Upper Angora lake, California (Storer, 1938; Needham and Sumner, 1941). In June, 1935, an additional plant of 2080 marked 5.5-inch trout was made. (Angora lake has an area of 5 acres. The lake outlet was screened to prevent outward migration of the planted fish.) A creel census was maintained in 1934, 1935 and 1936. "Over the three year period covered, only 4.3 percent of the 5028 two-inch eastern brook trout and 25.6 percent of the five and a half inch fish, were reported caught. From the results of work presented in this paper and the results of the work of other investigators cited, losses of trout planted are extremely heavy regardless of the size of fish planted." (Needham and Sumner, 1941).

RAINBOW TROUT

Non-indigenous populations of rainbow trout have been established in several eastern streams (Davis, 1941). For some years rainbow trout have been planted in a number of streams and lakes, principally lakes, in the Maritime provinces. A certain measure of success has been reported from the stocking of Crooked creek, New Brunswick, and Glenfinnan and Pisquid lakes, Prince Edward Island, but in the majority of cases it is yet to be established that there were worthwhile returns from the planted fish or that natural spawning has been established. One factor which materially affects the results of stocking rainbow trout in new habitats is their tendency to migrate. Results indicate, however, that this tendency is manifest more in certain strains than in others. Davis (1941, p.43) writes: "It appears that the two most important factors that determine whether rainbow trout will become established in a stream are (1) the character of the stream and (2) the strain of the trout with which the stream is stocked. I am convinced that in many instances the failure of rainbow trout to remain long in the stream after stocking is due to the fact that conditions are unsuitable for this species.---- It also appears that rainbow trout prefer neutral or alkaline waters and it is probable that this may explain the failure of this species to become established in many instances." Probably pertinent to the planting of rainbow trout in the Maritime provinces is the fact that lakes in Nova Scotia that have been stocked with little success are acid, some quite highly so, while the Prince Edward Island lakes are neutral or alkaline. Yet, the waters in Crooked creek are reported to be soft.

Records (creel census) for the recapture of marked rainbow

trout show on the whole comparable results to those secured from planting brook trout. Plants of legal-size stock in the fall have given poor returns to the anglers. More successful in this regard have been the stocking of legal fish during the spring or summer. In a number of instances where breeding populations of rainbow trout have become established, the progeny from the natural spawning contribute well to the fishermen's creels, apparently better than introduced stock (Lord, 1935; Hazzard, 1935; Needham, 1939; Surber, 1940

(a) Survival of planted rainbow trout in streams.

Nesbit and Kitson (1937) found that the anglers recaptured from Miller's river, Massachusetts, only 1.5 percent of a plant of rainbow trout made in the fall. The percentage recaptured was much higher, at 14.9, when legal fish were released in the same river during the spring. In Big Spring creek, West Virginia, Surber (1937) planted rainbow trout in July and August (No. 4 fingerlings.) The numbers planted in 1932, 1933, 1934, and 1935 were respectively 950, 1253, 1080 and 2160. In the seasons following each of these plants the anglers caught the following percentages of the numbers released: 8.3 (1933), 7.5 (1934), 6.0 (1935) and 1.5 (1936). Poorer results were obtained by Shetter (1939) in Michigan streams from fall planting. No survivors were accounted for from a small stocking of 197 six-inch fish in Perry creek. Of 468 rainbow trout, 4.8 inches in average, planted in November in Clancey creek, only five were recaptured by anglers the following year.

Rainbow trout, 7 inches or more in length, were marked and released by Hazzard and Shetter (1939) in the Pine river, Michigan, in 1937. On June 15, they planted 2007 fish, of which the anglers captured 448, or 22.3 percent of the number liberated, during the

1937 fishing season. Later, from plantings, 1000 fish in each, made on July 13 and August 10, the anglers were successful in recapturing 10.2 and 13.6 percent of the marked trout respectively.

During the period from 1932 to 1936 rainbow trout to the number of 120,000 were liberated in Squaw creek, Shasta National Forest (Needham, 1939). Over the 1937 season, 2497 rainbow trout were secured by the anglers, Needham (1939,p.329) remarks: "The ratio caught to planted here was approximately 1:48 and the gross survival to the anglers' creels roughly 2 percent if all the fish caught were of hatchery origin. However, undoubtedly a high proportion were naturally propagated----."

In the autumns of 1935 and 1936 Surber (1940) planted a total of 6373 rainbow trout, that ranged in length from 5 to 6 inches in length, in St. Mary river, Virginia. During the three fishing seasons, 1936, 1938 and 1939, only 143 were accounted for by the anglers or a percentage survival to the creel of 2.2. In contrast, Gee (1941) reports that of 799 rainbow trout, averaging 8 inches in length, which were tagged and placed in the Upper Pecos river, New Mexico, 458 or 58.8 percent were recorded in a creel census upon that stream. During the first 10 days of the fishing season 30 percent of these 458 fish were taken, and by July 3, 77 percent had been secured.

The investigations of Shetter and Hazzard (1941) well illustrate the difference in yield from fall and spring stocking. In two Michigan streams 1000 marked rainbow trout (8 inches or more in length) were planted in the fall. These gave a return of 0.9 percent to the anglers the following season. From spring releases of the same number of fish in the same streams there was a return of 24.2 percent. Also, 7391 fish were planted during the open season and 25.7 percent of these were recaptured.

(b) Survival of planted rainbow trout in lakes.

Very similar to the success attained by stocking barren Maligne lake with speckled trout was that realized with rainbow (Kamloops) trout in Paul lake, British Columbia. (Rodd, 1936; Mottley, 1940) Paul lake contained no fish until 5000 free-swimming rainbow fry were planted in 1909 (Mottley, 1940). There were sufficient survivors from this stocking to establish a breeding population. By 1932, about 3000 trout were angled from the lake, and this number increased to 12,000 in 1935. In recent years the fish have been trapped as they run to spawn and the eggs taken. Thus the catch of 12,000 in 1935 and other catches of late years have been obtained from an annual plant of about 200,000 fry. Mottley estimates that approximately 5 percent of this annual plant reaches the fishermen's creels. He considers that the principal loss is in the first year, when fry and fingerlings are eaten by older fish.

Chittenden reservoir in Vermont is an example of an eastern body of water that has been stocked with rainbow trout with quite good results. (Progressive Fish-Culturist, No. 53, 1941). For some time yearling rainbows have been put into the reservoir annually. In 1940, a creel census showed that 3.7 percent of the catch had been planted in 1937, 13.8 percent in 1938, and 20.2 percent in 1939. "These fish, planted in the fall at the end of the open season, gave better results than any fall plants of legal-sized fish in streams."

Shetter (1939) planted 5000 marked rainbow trout (3.9 inches in average length) in lake Charlevoix, Michigan. No creel census was maintained on the lake, and only one of these fish was reported by anglers. The stocking of 5 other small Michigan lakes (5-40 acres) gave a higher percentage of recovery (Shetter and Hazzard, 1941). Returns ranging from 13.8 to 66.0 percent of the planted fish were experienced.

Smith and Van Oosten (1940) report that of 147 large tagged rainbow trout (17.1 inches in average length) released in lake Michigan from 1927 to 1931, approximately 6 percent were recovered, mostly in the vicinity where they were liberated. Also Harkness (1941) presents statistics to show that of 2400 rainbow trout, from 5 to 10 inches in length, which were liberated in the Glen Major ponds (8 acres), Ontario, there was a total catch of 257, or a return of 10.7 percent.

OTHER SALMONOIDS

Brown trout, like rainbow, have been successfully introduced into a number of eastern waters. As with other species of trout, however, the stocking of hatchery fish has met with varied results. Cobb (1933) obtained a return of 36 and 39 percent of tagged brown trout that had been planted in the Pomperaug and Salmon rivers, Connecticut. Nesbit and Kitson (1937) secured only a moderate survival in Massachusetts waters from stocking fairly large brown trout, although they indicate that the method of tagging (internal rubber tags) probably caused considerable mortality. They record the following results:

	Percentage return	
	Spring plant	Fall plant
Westfield river	11.7	2.3
Farmington river	9.1	3.1
Big Spectacle pond	2.2	1.1

Needham and Cliff (1938) record that 20,000 fingerling cutthroat trout were planted in 1934 in Fish lake, Umpqua National Forest. A creel census was established on this lake in 1937, but no survivors of the cutthroat fingerlings were reported caught during that season. In an experimental section of Convict creek, California, experiments showed that predacious fish severely depleted the numbers of planted cutthroat fry (Davis, 1940). With light

predation, 21.7 percent of planted fry survived after 50 days, while under heavy predation, only 1.4 percent survived when under otherwise similar conditions.

From extensive work at Cultus lake, British Columbia, Foerster (1936a, 1936b) showed that regardless whether sockeye salmon were allowed to spawn naturally, whether the eggs were taken and artificially deposited, or whether the eggs were taken, laid down in a hatchery and then the progeny liberated as fry, there was a very high mortality which approximated 99.75 percent for the entire life cycle of the fish in fresh water and in the sea. In 1926, 1929 and 1932, hatchery-reared fry were liberated in Cultus lake. Counts made at the time of their migration from the lake revealed the low percentage survivals of 5.83, 3.86 and 2.81, for the above years respectively, to that stage in the life history of the sockeye salmon. "From the marking of 104,061 seaward-migrating sockeye at Cultus lake, B. C., in 1930 and 365,265 in 1931, recoveries of 3,821 and 12,803 adults, respectively, were obtained, or 3.67 percent and 3.5 percent." From all tests, Foerster indicated a probable value of 9.9 percent as a normal survival in the ocean. The general conclusion reached was that artificial propagation methods were not economically justified when compared to nature's results.

SUMMARY OF DATA UPON THE RECOVERY OF MARKED BROOK TROUT FROM CREEL CENSUS OR VOLUNTARY REPORT,
AND UPON THE TOTAL RECOVERY OF PLANTED FISH.

Authority	Place	Size of fish	Number	Percentage recovery	Remarks
I. Total recovery.					
White (1924)	Gunstone creek, Ont.	fry	5000	4	3 months in summer
	Buck creek, Ont.	"	5000	30.5	" " " "
White (1927)	Forbes brook, P. E. I. 1925	fry	4020	27.5	Older trout present
	Forbes brook, P. E. I. 1926				3 months in each case
	Section I	fry	1000	28.8	Older trout & sticklebacks
	Section II	"	1000	50.4	Sticklebacks only
	Section III	"	1000	36.1	Older trout only
	Section IV	"	1000	43.5	Not screened against birds
White (1930)	Forbes brook, P. E. I.				3 months in each case
	Section I	fry	1000	45.6	Only sticklebacks
	Section II	"	1000	21.4	Large trout
	Section III	"	1000	15.0	" " & sticklebacks
	Experiment B - - - - -	"	1000	15.0	Older trout present
	"	333	21	Not screened	
	"	111	44.2	" "	
II. Recovery from creel census.					
Shetter (1939)	Au Sable river, Mich.	3.5 in.	9778	0.03	Fall plant
	Canada creek, "	5.5 "	500	1.60	Spring plant
	" " "	4.0 "	1000	0.0	Fall plant
	Pine river "	5.5 "	496	0.6	" "
	" " "	4.6 "	98	0.0	" "
	Clancey creek "	6.0 "	541	0.0	" "
Shetter & Hazzard (1941)	Four streams, Mich.	7 in. or more	2798	4.4	Fall plant
	" " "	7 " " "	3300	29.8	Spring "
	" " "	7 " " "	9501	24.7	Open-season plant
Smith (1941)	Salmon Trout river, Mich.	7 to 9 in.	252	15.5	Spring plant
	" " " "	7 " 9 "	1100	19.6	" "
	" " " "	7 " 9 "	699	16.01	" "
	" " " "	7 " 9 "	1233	0.02	Fall "
	" " " "	7 " 9 "	600	1.0	" "

SUMMARY (CONTINUED)

Davis (1940)	Furnace Brook, Vermont	7 in. or over	5000	12	Fall (1936) plant
	" " "	7 " " "	5000	2	" (1937) "
Davis (1941)	Davidson river, North Carolina	6 in. & up	18135	4.4	Fall plants over number of years
	" " " "	6 " " "	3809	31.4	Spring plant
Surber (1940)	St. Mary river, Virginia	3.75 in.	2841	0.7	Fall plant
	" " "	5.0 "	787	1.3	" "
	" " "	5.6 "	1106	8.7	" "
Hazzard & Shetter (1939)	Pine river, Mich.	7 in. & over	3000	40.2	Spring (May) plant
	" " "	7 " "	959	6.0	Summer (June) "
	" " "	7 " "	2004	4.9	Summer (July) "
	" " "	7 " "	1550	8.1	Summer (Aug.) "
Cobb (1933)	Pomperaug river, Conn.	legal size		38	Spring plant
	Salmon " "	" "		11	" "
	Natchaug " "	" "	1200	33.7	" "
Hoover & Johnson (1938)	Bear brook, N. H.	legal size	500	70	Summer (June) plant
Eschmeyer (1938)	Lost lake, Mich.	fingerlings	16,500	3.8	
	West Lost lake, Mich.	"	16,000	2.8	
	Hemlock " "	"	20,000	1.3	
Needham and Cliff (1938)	Fish lake, Umpqua Forest	fingerlings	40,000	0.17	Rainbow principally caught
Needham and Sumner (1941)	Angora lake, Cal.	2 in.	5028	4.3	
	" " "	5.5 in.	2080	25.6	

 III. No creel census--voluntary reports from anglers.

Rodd (1941)	Campbell lake, Nova Scotia	Yearlings &	900	2.7	
	Coose Coffre lake " "	older	1300	35.7	
	Copper lake " "	"	1200	30.4	
	Cutter lake " "	"	813	86.1	
	Barney river, " "	"	250	24.8	
	Dobson lake, " "	"	468	35.3	

SUMMARY (CONTINUED)

Rodd (1941)	Donahue lake, Nova Scotia	Yearlings &	2000	35.1
Grant	" " "	older	200	18.0
McLean	" " "	"	1200	46.6
Long	" " "	"	3504	2.2
East river	" "	"	200	15.0
Sherbrook lake	" "	"	2015	24.3
Simon	" " "	"	690	30.8
South river	" " "	"	1816	3.8
Tributary to Little river, N. S.	" "	"	2075	53.6
Trout lake, Nova Scotia	" "	"	200	20.0
West river	" " "	"	3100	0.7

- Ibid. 1929, pp. 1-78, 1931.
- Ibid. 1031, pp. 1-67, 1932.
- Rodd, J. A. Proc. Wildlife Conf. 1936, pp. 324-326, 1936.
- Can. Dep. Fish. Annual report of fish culture 1939, pp. 1-61, 1941.
- Shetter, David S. Trans. Amer. Fish. Soc., 66(1936), pp. 203-210, 1937.
- Shetter, David S. Trans. Fourth N. A. Wildlife Conf. 1939, pp. 318-325, 1939.
- , and Albert S. Hazzard. Trans. Amer. Fish. Soc., 70(1940),
pp. 446-468, 1941.
- Smith, Lloyd L. Jr. Ibid., 70(1940), pp. 249-259, 1941.
- Smith, Oliver H. and John Van Oosten. Ibid., 69(1939), pp. 63-84, 1940.
- Storer, Tracy I. Progressive fish-Culturist, U. S. Bur. Fish., Mem. I-131,
no. 35, pp. 9-19, 1938.
- Surber, Eugene W. Trans. Amer. Fish. Soc., 66(1936), pp. 193-202, 1937.
- Progressive Fish-Culturist, U. S. Bur. Fish., Mem. I-131,
no. 49, pp. 1-13, 1940.
- White, H. C. Contr. Can. Biol. Fish. N. S., 2(9), pp. 137-149, 1924.
- Ibid., 3(15), pp. 367-375, 1927.
- Ibid., 5(8), pp. 205-211, 1930.

M. W. Smith
October 10, 1941.