

Original: Fish Division  
cc: Education - Game  
Institute for Fisheries  
Research  
J. T. Wilkinson  
Hilding Carlson, Muskegon  
Paul H. Escmeyer  
W. R. Crowe

*cef.*

March 10, 1950

Report No. 1247

SUMMARY OF INVESTIGATIONS PERTAINING TO THE  
WALLEYE FISHERY OF THE MUSKEGON RIVER SYSTEM

By  
Walter R. Crowe

ABSTRACT

The Muskegon River flows in a southwesterly direction for about 200 miles, from Houghton Lake to Lake Michigan. Five power dams have been erected on the main stream in the 45 mile stretch between Big Rapids and Newaygo.

These dams present a barrier to upstream migration by fish. Each spring thousands of game fish (predominantly walleyes) congregate below Newaygo Dam, which is the lowermost dam on the river. For a period of more than 20 years numerous (usually some thousands) game fish have been transferred to the various upstream impoundments. This operation has become generally known as the "Newaygo Transfer."

Since its inception, the transfer has been opposed by fishermen below Newaygo, and favored by those above.

Results of the walleye investigation on the Muskegon River System have indicated that:

1. The exploitation of the walleye run at Newaygo is not sufficient to deplete the downstream fishery.
2. The transfer is economically justifiable.

3. Transferred walleyes can and do move downstream through the various dams.

4. Present evidence, while circumstantial, indicates that walleyes native to the various impoundments also move downstream.

5. The walleyes migrating up the Muskegon originate in Lake Michigan.

It is concluded that the transfer should be continued as an annual operation of the Department of Conservation.

Original: Fish Division  
cc: Education - Game  
Institute for Fisheries  
Research  
J. T. Wilkinson  
Hilding Carlson, Muskegon  
Paul H. Eschmeyer  
W. R. Crowe

March 10, 1950

Report No. 1247

SUMMARY OF INVESTIGATIONS PERTAINING TO THE  
WALLEYE FISHERY OF THE MUSKEGON RIVER SYSTEM

By  
Walter R. Crowe

The following report, along with the conclusions reached, has been taken in its entirety from various reports prepared by Dr. Paul H. Eschmeyer, formerly of the Institute for Fisheries Research staff. The writer has endeavored only to combine the various reports. All ideas expressed, and conclusions reached, are those found in Dr. Eschmeyer's accounts of the investigation, and it should be understood that every effort has been made to preserve the original thought in every instance.

Introduction

This summary of a rather extensive investigation of the walleye in the Muskegon River system has been prepared so that interested parties may be brought up to date and acquainted with the results obtained and the conclusions reached in the three-year period which has elapsed since the investigation was initiated. Also, it was felt that it would be of much value if the salient features of the various reports covering the work were assembled; thus permitting a review of the entire investigation as a unit.

The Muskegon River originates in Houghton Lake, and flows in a south-westerly direction for about 200 miles to empty into southern Lake Michigan,

after having passed through Muskegon Lake near the city of Muskegon. The drainage basin of 2,663 square miles covers portions of nine counties. There is a drop in elevation of 620 feet from source to mouth. From the standpoint of both power development and recreational use, the Muskegon is among Michigan's most important waterways. Five power dams have been erected in the 46-mile stretch between Big Rapids and Newaygo. Modern power dams are nearly always very effective barriers to upstream migration of fish, while downstream movement may be sharply restricted. However, the sport fishery in the Muskegon ranks with the best Michigan has to offer. The proper management of game fish, whose movements are thus restricted, constitutes a very considerable problem, and it is with certain aspects of this problem that this paper deals.

Each spring large numbers of walleyes, and to a much smaller extent other game fish, ascend the Muskegon on their annual spawning migration. Thousands congregate in the stream below Newaygo Dam. For a period of over twenty years game fish have been transferred by mechanical means to various points in the stream above, and to certain connecting waters. This annual conveyance of fish around the dam has become generally known as the "Newaygo Transfer."

Since its inception, this transfer has caused bitter controversy between individuals and groups primarily concerned with the waters above Newaygo Dam, and those interested in the fishery below this point, particularly Muskegon Lake.

The downstream interests contend that the numbers involved in the transfer are of sufficient magnitude to deplete the game fish population of the lower river, and to have a detrimental effect on the quality of the sport fishery in Muskegon Lake. They also contend that fish transferred

around the dams are unable to return downstream. Halting of the transfer has been repeatedly requested. The last formal request was made on February 13, 1947 when it was requested that the transfer be discontinued for a period of 5 years. It was further stated that this discontinuance of the transfer should be considered as a research and experimental measure to determine whether or not the transfer has any direct bearing on the fishing in Muskegon Lake.

Those primarily interested in the upstream (Newaygo Dam and above) fishery have always strongly favored the continuation of the transfer, and have opposed any limitations being placed on it. They contend that the barrier at Newaygo prevents the upstream areas from receiving the share of fish to which they are entitled, unless the fish are moved around the dams. They believe that fishing in the waters above the dam is materially improved by the transfer. Also, they state that only a very small percentage of the migrating fish are caught and transferred, and that therefore the number taken is insufficient to affect fishing in downstream areas. The opinion has been repeatedly expressed that movement downstream through the power dams can and does occur. The upstream interests are fully aware of the opposition of those downstream. Eschmeyer says, "To suppose that one might immediately and with ease effect a solution equally agreeable to all individuals on both sides of such a controversial issue is to borrow from the hallucinatory delusions of the demented." To effect a sound solution, answers to certain specific questions would be extremely desirable. Among the more important of these are the following:

1. Is the exploitation of the run by the transfer sufficient to cause a depletion of the downstream walleye fishery?

2. Is the transfer economically justifiable from a standpoint of providing fishing in the impoundments upstream, and is it necessary to maintain fishing in these areas?

3. Can the transferred fish move downstream through the dams, or are they permanently lost to the downstream areas once moved above the Newaygo Dam?

4. If the transferred fish are capable of moving downstream, do native fish, hatched and reared in upstream areas, also move through the dams and thus contribute to the downstream fisheries?

5. Do the walleyes migrating up the Muskegon River originate in Muskegon Lake, thus forming part and parcel of its fishery; or do they originate in Lake Michigan, thus providing an equal claim to both upstream and downstream residents?

#### Discussion

The transfer of game fish around Newaygo Dam was first undertaken in 1923. The transfer was conducted by various individuals and organizations until 1928 when the Conservation Department began to actively supervise the work and transport the fish caught. The operation has been continuous since that time.

Fish congregated below the Newaygo Dam are captured by means of dip nets. These dip nets are about 10 feet square, suspended from a spar projecting out from the bank of the river, and operated by a hand-powered winch. The number of fish caught in the dip nets and transferred has varied greatly from year to year but generally has been some thousands of individuals. Also, walleyes have always formed the bulk of the game fish transferred (96.4 percent). Complete records for the first five years

of the transfer are unavailable, but the catch of walleyes since 1928 is tabulated in Table I.

An examination of Table I immediately reveals that there has been a wide variation in the catch during the different years. This variation cannot be entirely attributed to the length of the netting season, or degree of success in hitting the peak of the walleye run. If the commercial catch records for southern Lake Michigan in general, and the part of Muskegon in particular, be compared with the dip net catch at Newaygo, a close correlation is immediately apparent, particularly for the period of years from 1929 to 1943. A marked deviation from this pattern is shown for the period from 1944 to 1946. Earlier trends would have justified the prediction of a substantially larger catch at Newaygo for these three years. There are no conclusive data at hand to indicate the reason for the pronounced change in the pattern of the catches (dip net and commercial) for the period, but a search for the cause would be incomplete without a consideration of the regulations governing the operation at Newaygo. In 1944, for the first time, rather stringent regulations were imposed, and almost certainly these regulations had a pronounced effect on the catch at Newaygo. It should also be pointed out that the pattern was restored for the period from 1947 to 1949. This parallel fluctuation in abundance in Lake Michigan, and at the Newaygo Dam, clearly indicates that the populations in the stream and in Lake Michigan are either part of the same population or are closely related populations showing characteristically similar trends in their cycle of abundance from year to year. In 1947 the mechanics of the transfer were observed rather closely. It was at once apparent that the method used to capture the fish was at best clumsy. The percentage of the run captured is not known. The tagging of

Table I. Summary of the numbers of walleyes transferred at Newaygo from 1928 to 1949

Year	Number
1928	469
1929	3,680
1930	8,327
1931	1,547
1932	3,151
1933	43,088
1934	24,284
1935	24,241
1936	6,676
1937	6,931
1938	7,020
1939	6,345
1940	2,641
1941	12,460
1942	12,469
1943	13,186
1944	3,318
1945	789
1946	4,380
1947	5,540
1948	4,734
1949	1,483
Total	196,759



a large number of walleyes in Muskegon Lake in February or early March would provide good information on this point. The percentage of the total numbers of tagged fish recovered at Newaygo would then indicate directly the approximate percentage of spawners which are taken during the transfer. Two attempts have been made to catch these fish, once by a commercial fisherman in 1947, and by Institute personnel in 1948. Neither attempt was successful. In the absence of direct evidence, certain pertinent observations can be made as to the portion of the total run which is involved in the "transfer."

- a) In 1947 the dip nets would, if fished simultaneously, have covered only one-third of one percent of the total area of river bottom between the extremities being fished. Also, it is certainly true that for the past few years the dip nets have not been located in the areas of greatest concentration. Undoubtedly the fish mill about and cover considerable areas during their spawning activities but the probability of any given individual being captured must be slight.
- b) Observations made by Mr. R. B. Quigg during the run in 1936 indicate that there was a greater concentration of walleyes in mid-stream than along the edges. The dip nets do not reach far into the stream.
- c) When the fish are present in numbers of such magnitude that they can be "snagged," it is not just to assume that the dip nets catch more than a very small percentage. Information at hand at present strongly indicates that the numbers of walleyes transferred at Newaygo are very small in comparison with the total numbers migrating up the river, and the number taken in the dip nets could hardly have a significant effect on the fishing quality in downstream areas.

As for the economics involved, the cost per fish has been \$0.16 to the Department, and \$0.12 to the Consumers Power Company. This cost is certainly reasonable compared with the cost of raising walleyes to legal size, or obtaining them by any other method. Judging by the number of tag returns in 1947 and 1948 and by general field observations in 1947 and a creel census conducted on the various impoundments in 1948, it is rather apparent that the transferred fish make a significant contribution to the sport fishery in the waters above the Newaygo Dam. Approximately 34 percent of all fish caught were walleyes. Seventeen percent or half of the walleyes caught during the summer were originally transferred fish. The remaining 83 percent were fish native to the various impoundments. Data obtained to date indicate that the large transferred female walleyes make a very important contribution to the reproduction of the species in the Muskegon impoundments. Gill net and trap net catches in Hardy Reservoir have shown mature, native female walleyes to be almost entirely absent.

In the interest of obtaining information about the fate of transferred fish, the Institute first conducted a marking experiment in 1932 when 250 game fish were tagged and released in four upstream impoundments. The total included 172 walleyes. From this tagging experiment there was a return of only 2 percent. At that time one of the three walleyes captured had passed downstream through Rogers Dam. To meet a long-standing need for further evidence on the movements of walleyes transferred to upstream waters from the river below Newaygo Dam, more extensive tagging operations were undertaken. During 1947 and 1948, 1,375 jaw-tagged walleyes were distributed among the five major impoundments. Of those released in April, 1947, 216 (15.7 percent) were recovered by the end of the first year, 22 (1.6 percent) were taken the second year after tagging, and an

additional 5 fish (0.4 percent) were caught by the end of 1949. The same number of fish released in the same impoundments (but distributed among them in different proportions) in April, 1948 yielded a return of 18.3 percent during the first year after tagging, and an additional 0.4 percent by December 31, 1949. These data are summarized in Table II.

In 1947, 150 tagged walleyes were released in Newaygo Pond. From these there were 18 recoveries (12 percent) during the first year; 6 were caught in the impoundment, and 12 had moved downstream through the dam. Of the 12, 2 were recovered in Muskegon Lake, 4 were caught by commercial fishermen near Muskegon, 3 were taken in the lower Kalamazoo River, 1 was caught by dip netters, and 2 were taken by anglers near the Newaygo Dam during the 1948 spawning migration. These last 3 fish had presumably migrated downstream during the year and returned upstream to spawn. During the second year after tagging there were 6 additional returns, 2 from the river below Newaygo, immediately after the spawning season, and 4 from Lake Michigan. Two fish from the 1947 group were recovered in 1949. They were taken in the Muskegon River during the spawning run. In 1948, 300 tagged walleyes were released in Newaygo Pond. Thirteen percent of these have been recaptured; 7 from Newaygo Pond, 13 at various points in the river below the dam (8 during the 1949 spawning migration); 5 in Muskegon Lake, and 14 in Lake Michigan. Only 2 additional fish, both caught in May, were reported between mid-April and December 31, 1949. One was caught just below Croton Dam near the original point of release, and the other near the mouth of the Manistee River.

In 1947, 501 walleyes were released in Croton Pond. From these there was a return of 16 percent (80 fish) the first year; 66 from Croton Pond,

Table II. Summary of recoveries of tagged walleyes, Muskegon River, 1947 to 1949

Impoundment where released	Number released, April, 1947	Percentage recovered			Totals
		to April 15, 1948	April 15, 1948 to April 15, 1949	April 15 to December 31, 1949	
Newaygo	150	12.0	4.0	1.3	17.3
Croton	501	16.0	2.6	0.6	19.2
Hardy	200	26.5	1.0	...	27.5
Rogers	500	12.0	0.2	...	12.2
Big Rapids	24	20.8	...	...	20.8
<b>Totals</b>	<b>1,375</b>	<b>15.7</b>	<b>1.6</b>	<b>0.4</b>	<b>17.7</b>

Impoundment where released	Number released, April, 1948	Percentage recovered		
		to April 15, 1949	April 15 to December 31, 1949	Totals
Newaygo	300	13.0	0.7	13.7
Croton	300	22.3	...	22.3
Hardy	300	24.7	1.0	25.7
Rogers	275	13.8	...	13.8
Big Rapids	200	16.5	...	16.5
<b>Totals</b>	<b>1,375</b>	<b>18.3</b>	<b>0.4</b>	<b>18.7</b>

2 above Newaygo Dam, 4 by dip netters during the 1948 transfer, 1 in Muskegon Lake, and 7 in Lake Michigan. During the second year after tagging there were 13 additional returns; 1 from Croton Pond, 1 from Newaygo Pond, 4 in the river below the Newaygo Dam during the 1949 transfer, 1 in Muskegon Lake, and 6 in Lake Michigan. Three were taken the third year after tagging; 1 in the Muskegon River during the migration, 1 in Muskegon Lake, and 1 in Lake Michigan. In 1948, 300 tagged walleyes were stocked in Croton Pond. During the first year there was a return of 22.3 percent, 65 in Croton Pond, and 2 in Newaygo Pond.

In 1947, 200 tagged walleyes were planted in Hardy Pond. There were 53 returns the first year; 46 in Hardy Pond, 5 above Croton Dam, 1 from Muskegon Lake, and 1 from Lake Michigan. The second year there were 2 returns from Hardy Pond. In 1948, 300 tagged walleyes were released in Hardy Pond. From these there was a return of 24.7 percent the first year (74 fish); 69 from Hardy Pond, and 5 from Croton Pond. The second year 3 more were caught in Hardy Pond.

In 1947, 500 tagged walleyes were released in Rogers Pond. Sixty fish were recovered from this group the first year; 6 in Rogers Pond, 49 in Hardy Pond, and 5 in Croton Pond. The second year there was 1 return from Hardy Pond.

In 1947, 24 tagged walleyes were released in Big Rapids Pond; 4 were recaptured in Hardy Pond, and 1 above Croton. There have been no further recoveries from this group. In 1948, 200 tagged walleyes were stocked above Big Rapids; 25 were caught above Rogers Dam, and 8 above Hardy Dam, for a recovery of 16.5 percent.

The data collected to date show conclusively that walleyes transferred to the various impoundments can and do move downstream through the dams.

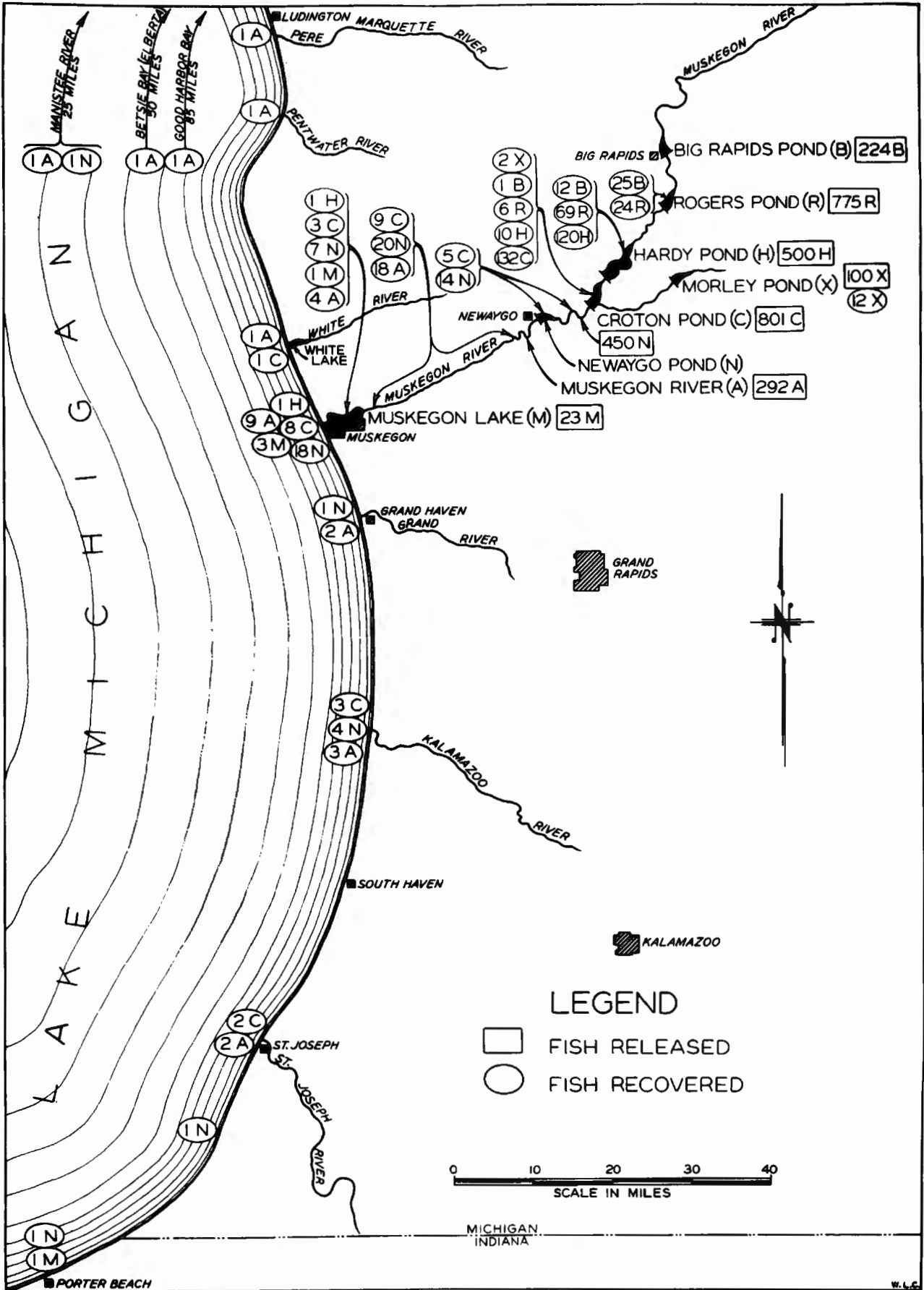
In fact, the tendency for these fish to move downstream is most impressive. Of the 508 returns to date only 28 were captured at a distance of more than a mile above the point of release. Anglers fishing the various impoundments habitually devote most of their fishing time to the areas immediately surrounding the dam gates. Apparently they are quite familiar with the tendency of the walleyes to be concentrated in the vicinity of the dams. A summary of the walleyes recovered after having passed various dams is presented in Table III. The table does not, however, show whether certain fish negotiated more than one dam. Walleyes which by-passed more than one dam are as follows: Big Rapids and Rogers, 12; Big Rapids, Rogers and Hardy, 1; Rogers and Hardy, 6; Hardy, Croton and Newaygo, 2; Croton and Newaygo, 26. Of fish tagged in 1947, 43 percent of the recoveries during the first year had moved through one or more dams. For fish tagged in 1948 this percentage was 40. That the Muskegon River walleyes have a great inclination to move downstream is further supported by recoveries from 292 tagged walleyes released in the river below Newaygo Dam in 1948. There were 39 recoveries the first year; 17 in various downstream portions of the river, 4 in Muskegon Lake, 9 by commercial fishermen near Muskegon, and 9 in other parts of Lake Michigan. The second year there were 5 additional returns; 1 from the river near the point of release, 1 from Pentwater Lake, 1 at the mouth of the Pere Marquette River, 1 near the mouth of the Manistee River, and 1 in Good Harbor Bay, 175 miles away. This last had covered the greatest recorded distance during the time of the study. Most of the information on tagging recoveries and migration of the walleyes is graphically portrayed in the map (Figure 1). A few walleyes tagged in Muskegon Lake and mature walleyes tagged in Hardy Pond are not shown, but the map gives a good summary of the tagging study to date.

Table III. Numbers of tagged walleyes recovered after negotiating dams in the Muskegon River, 1947 to 1949

Dam passed	Height of dam in feet	Returns from fish tagged April, 1947			Returns from fish tagged April, 1948		Total returns
		First year	Second year	Third year	First year	Second year	
Newaygo	17.5	26	17	5	32	1	81
Croton	40	16	12	3	2	..	33
Hardy	100	13	...	...	5	...	18
Rogers	40	59	1	...	28	...	88
Big Rapids	16	5	...	...	33	...	38
Morley	12	...	...	...	1	1	2
Totals	...	119	30	8	101	2	260

Figure 1. Migration of Muskegon River walleyes.





To properly understand and manage the walleye fishery of the Muskegon, it would be very desirable to know whether the native walleyes, hatched and reared in the impoundments, also move downstream, thereby contributing to the upstream run in future years, and to the downstream fishery in transit. The downstream movement through power dams of walleyes native to the impoundments has not been demonstrated conclusively. In June and August of 1948, 296 native walleyes (12.8" average length) were tagged and released in Hardy Pond. During the first year there were 9 returns, all from Hardy Pond. The second year there were 8 additional returns, also from Hardy Pond. While netting these fish for tagging, it was noted that few of the native fish were of legal length, 75 percent of those caught being sublegal. All walleyes over 18 inches were transfers. One would immediately suspect that the natives were making poor growth, but an examination of the scales showed the native fish to be young fish which were making better than average growth. Also, all of the natives examined appeared to be healthy and in good condition. Many of the males were mature fish (though of less than legal length), but mature, native females were lacking. Netting results and examination of the gonads show that nearly all native females are lost to Hardy Pond before reaching sexual maturity. Where do they go? The moderate exploitation, the numerous sublegal (but fast growing) walleyes in Hardy Pond, and the known tendency of the transfers to move downstream, all give strong inferential evidence that the natives also move down. The evidence is strengthened by the recovery of a native walleye in the river in November, 1949, which had been tagged and released above Newaygo Dam in 1948. Further study is required to definitely establish the cause or causes of the disappearance of walleyes from Hardy Pond (and other impoundments?) before reaching sizes and ages

which would be expected in the population. Further effort was made in this direction when 99 native walleyes were tagged and released in Hardy Pond in the spring of 1949, and 152 in the fall of 1949. This tagging was done by Mr. H. Olsen, of Lansing, under permit issued by the Conservation Department.

The origin of the fish migrating up the Muskegon River in the spring is a matter of considerable concern. If they originate in Muskegon Lake they should be considered as part and parcel of its fishery, but if they come mainly from Lake Michigan they presumably belong to the whole river (while present in it). The parallel fluctuations in abundance of the spawning run, and Lake Michigan production has already been indicated (page 5). To obtain a direct answer as to the origin of the Muskegon walleyes, it would be necessary to tag substantial numbers of walleyes in Lake Michigan and in Muskegon Lake during mid-summer (to assure marking of native populations in each water). A record of all recoveries below Newaygo Dam the following spring would clearly show the origin of the fish. However, the Institute is not equipped to operate in Great Lakes waters. Judging by netting results by Institute personnel in 1936 and 1948, and by a commercial fisherman in 1947, the collection from Muskegon Lake of adequate numbers of walleyes for marking would require a long period of time, and much effort, and might not be possible at all. General creel census records from 1937-1947 also indicate a dearth of walleyes in Muskegon Lake. A more intensive census (I.F.R. Report No. 1246) taken in 1948 shows the same picture. In the absence of direct evidence, the following may be cited as indications of the origin of the Muskegon walleyes:

- a) Of the 130 recoveries of tagged fish from below the dams, 57 were recovered from Lake Michigan; 47 were recovered from the river between Newaygo Dam and Muskegon Lake (virtually all of these during the spawning migration), and only 16 from Muskegon Lake. In 1948, 23 walleyes were tagged and released in Muskegon Lake, near where the river enters. There were 5 recoveries during the first year; 4 from Lake Michigan, and 1 from Muskegon Lake.
- b) The growth rate of the transferred walleyes is typical of the species in Great Lakes waters, and much greater than that exhibited by the species in inland lakes.
- c) Creel census records for the Muskegon River below Newaygo show no tendency towards an inverse relationship between quality of fishing in these areas and the numbers of fish transferred at Newaygo. By and large, the available creel census data show a direct rather than an inverse relationship between fishing in Muskegon Lake (and in the stream below Newaygo Dam) and numbers of fish transferred at Newaygo. That is, in years of large transfers, fishing was better in the river below Newaygo Dam and in Muskegon Lake than it was when few fish were transferred over the dams. In other words, the number transferred was generally a reflection of the number of walleyes actually present in the river system but the number caught and lifted over the dams was too small a part of the number available to have had any effect on fishing quality below.
- d) During the course of a public hearing held at Fremont, Michigan, on December 5, 1947 it was stated by several fishermen that the best walleye fishing at Muskegon Lake occurred while the ice cover was present, and the fish were moving through this body of water en route to the river above. By and large it seemed to be generally agreed that the bulk of the fish

transferred at Newaygo came from Lake Michigan. In view of these observations by representatives of Muskegon Lake sportsmen, the source of the fish does not seem to be a matter of serious contention. These data taken together point strongly toward Lake Michigan as the origin of the fish, and further research bearing on this point does not seem to be required at the present time.

### Conclusions

1. The exploitation of the run at Newaygo is not sufficient to deplete the downstream fishery. Methods used are clumsy, and areas of concentration are not covered. Many walleyes are known to spawn in the river itself and some may never reach the dam. Eggs deposited in the gravel were found abundantly for about 5 miles below the dam, and in fewer numbers to a point 16 miles below the dam. From here down, the stream bottom is sandy, with only scattered amounts of gravel, and is presumably less suitable for walleye spawning than upstream areas. As has been pointed out in the discussion, it is most unlikely that more than a very small percentage of the migrating walleyes are caught for transfer, and the possibility that the transfer has a significant effect on the downstream fishery is remote.

Table IV. Returns to anglers of transferred and non-transferred walleyes

Year	Released in impoundments	Percent recovery to Dec. 31, 1949	Released below Newaygo	Percent recovery to Dec. 31, 1949
1947	1375	17.7 (243)		
1948	1375	18.7 (257)	292	15.0 (44)

Number of fish given in parentheses.

Of the 44 recoveries from the fish released below Newaygo, 21 were recovered by commercial fishermen. Thus the recovery to anglers from the planting below Newaygo was only 7.9 percent. While the number of fish tagged and released below Newaygo is too small to permit an adequate comparison, it nevertheless appears that the transferred fish furnish more sport than do those which remain below the dam. It is anticipated that this will be further checked by additional tagging.

Also, present information indicates that it is biologically sound because the mature females transferred to the impoundments are apparently making the major contribution to the reproduction of the species in the impoundments and possibly to the spawning runs of later years. It has been pointed out in the discussion that mature native females appear to be lacking in the impoundments (at least in Hardy Pond). However, there is a large native population of young fish. The obvious conclusion is that the transferred fish spawn among themselves, or that the native males fertilize the eggs of the transferred females, or, most likely, native and transferred males spawn with the transferred females.

3. Transferred fish can, and do, move downstream through the dams.

It is theoretically possible for an individual walleye to migrate from Houghton Lake to Lake Michigan, although no individual has been recorded as having done so. However, we have records of individual walleyes having completed part or parts of the whole journey. Croton and Hardy Dams offer the major barriers to downstream migration, but both have been passed by numerous individuals. It is true that second- and third-year returns from fish stocked in the impoundments were not only few but that their number was inversely proportional to the distance of the impoundment from Lake Michigan. In view of the tendency for Muskegon River walleyes to pass

downstream, one may suspect that the hazards to survival multiply with the number of dams which must be passed to reach the original habitat.

4. There is much circumstantial evidence indicating that native walleyes also tend to move downstream, thereby making a contribution to the downstream fishery (or to Lake Michigan). Most notable is the dearth of mature native females in the impoundments, and of large native fish of either sex.

Netting in Hardy Reservoir in 1948 showed all of the walleyes longer than 18 inches to be transferred fish. The same condition prevailed among those fish taken by anglers. However, all of the impoundments, and particularly Hardy and Croton, contain large populations of young (up to 3 years old) fast-growing walleyes. These fish are quite healthy and in good condition. It seems quite obvious that the older fish have moved down through the dams, although as yet there is little direct evidence to support the theory. Returns from immature walleyes tagged in the reservoir in the past few years should provide more definite evidence on this point in the future.

5. The Muskegon River walleyes originate in Lake Michigan. The overwhelming weight of more or less indirect evidence permits no other conclusion. It is of great interest to note that none of the Muskegon River walleyes have been taken in other known spawning streams during the spawning season. During the summer they spread along 250 miles of the eastern Lake Michigan shore. Concentrations occur near the mouths of larger rivers entering the lake, such as the Muskegon, the St. Joseph, the Kalamazoo, and the Grand. However, with the arrival of spawning season, they apparently return to their "home" stream (the Muskegon) to be stopped by the barrier at Newaygo.

In conclusion, the facts at hand to date indicate that the transfer has had no harmful effect on the sport fishery either above or below Newaygo, and that it is of considerable benefit to the upstream waters. It is recommended that the transfer of walleyes at Newaygo be continued as a regular annual operation of the Department of Conservation.

Two matters of considerable biological interest need further investigation in connection with the management of the fishery. Additional direct evidence for downstream movement by native walleyes is desirable. A sufficient number have now been tagged that such information should be forthcoming. The size of the upstream migration should be determined, by tagging of an adequate number of walleyes before they reach Newaygo. Two unsuccessful attempts have been made to do this, one by a commercial fisherman in 1947, and the other by Institute personnel in 1948. The difficulty is in catching sufficient numbers of walleyes in either Muskegon Lake, or in the lower river before they reach Newaygo.



References Cited

Eschmeyer, Paul H.

- 1947 Observations on Certain Waters of the Muskegon River Drainage, with Particular Reference to the Annual Transfer of Adult Yellow Pikeperch to These Waters from the River Below Newaygo Dam. I. F. R. Report No. 1142. December 2, 1947.
- 1949 Reproduction and Migration of the Yellow Pikeperch, Stizostedion vitreum vitreum, in Michigan. I.F.R. Report No. 1210 (Thesis) January 31, 1949.
- 1949 A Review of Pikeperch Tagging Experiments in Michigan, with Particular Reference to Studies on the Muskegon River. I.F.R. Report No. 1222. April 27, 1949.
- 1950 The Life History of the Walleye in Michigan. I.F.R. Bulletin No. 3 (in press).

Fukano, K. G.

- 1950 Muskegon Lake Creel Census for the Spring and Summer of 1948. I.F.R. Report No. 1246.

INSTITUTE FOR FISHERIES RESEARCH

Walter R. Crowe

Approved by A. S. Hazzard

Typed by B. J. Bair