HARVESTING AND PRODUCTION OF BAIT FISHES IN PONDS

Thesis for the Degree of M. S.
MICHIGAN STATE COLLEGE

Sheldon Bertram Hedges

1951

THESIS

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H R Hunt
Major professor

Date May 15, 1951.

O-169

HARVESTING AND PRODUCTION OF BAIT FISHES IN PONDS

By

SHELDON BERTRAM HEDGES

A THESIS

Submitted to the school of Graduate Studies of Michigan
State College of Agriculture and Applied Science
in partial fullfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Zoology

1951

THESIS

6/29/31
Gift

ACKNOWLEDGMENTS

The author wishes to extend his sincere appreciation to Dr. Robert C. Ball, Department of Zoology, Michigan State College, who directed this study and whose suggestions and guidance were always available. Special thanks are also due to the Institute for Fisheries Research, Michigan Department of Conservation, for the opportunity which made this study possible and for the use of data from their files.

Gratitude is extended to Dr. Don Hayne, Department of Zoology, Michigan State College, for his advice in the interpretation of the data and to the personnel of the Hastings State Fish Hatchery for assistance in parts of the field work.

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INTRODUCTION

In recent years the Conservation Department has received many complaints from minnow dealers (Carbine, 1940) pertaining to the apparent decline in numbers of minnows in Michigan lakes and streams. This decline of minnows is economically important to the bait dealer and has been looked upon with apprehension by the sportsman and biologist alike. To the sportsman it means a decrease in the availability of good bait minnows and the value of the minnows as food for the game species is recognized. In the future there will be a still greater demand for bait minnows to satisfy the increasing number of fisherman and a further diminishing of the natural supply. Recently Michigan altered its minnow regulations so that only certain designated streams may be seined by commercial minnow dealers and certain designated trout and non-trout streams were opened to removal of minnows by use of glass traps only.

At the time these regulations were put into effect the Institute for Fisheries Research undertook the problem of determining the feasibility of raising minnows in farm-type ponds. As a result of experiments it was found that many of our native minnows that are commonly used for bait can be successfully raised in farm-type ponds and as a result the bait dealer can reduce his transportation costs and have the

minnows available when the demand is highest. Thus by pond rearing of bait minnows, the demands of the fisherman for these would in part be met and some of the pressure would be removed from our natural waters.

One of the greatest problems that presents itself to the operator of minnow ponds is the harvest of these fish from the ponds. Experiments on methods of harvesting were conducted during the summers of 1949 and 1950. Several methods for removal of bait minnows from farm-type ponds were investigated and the data on these are presented here.

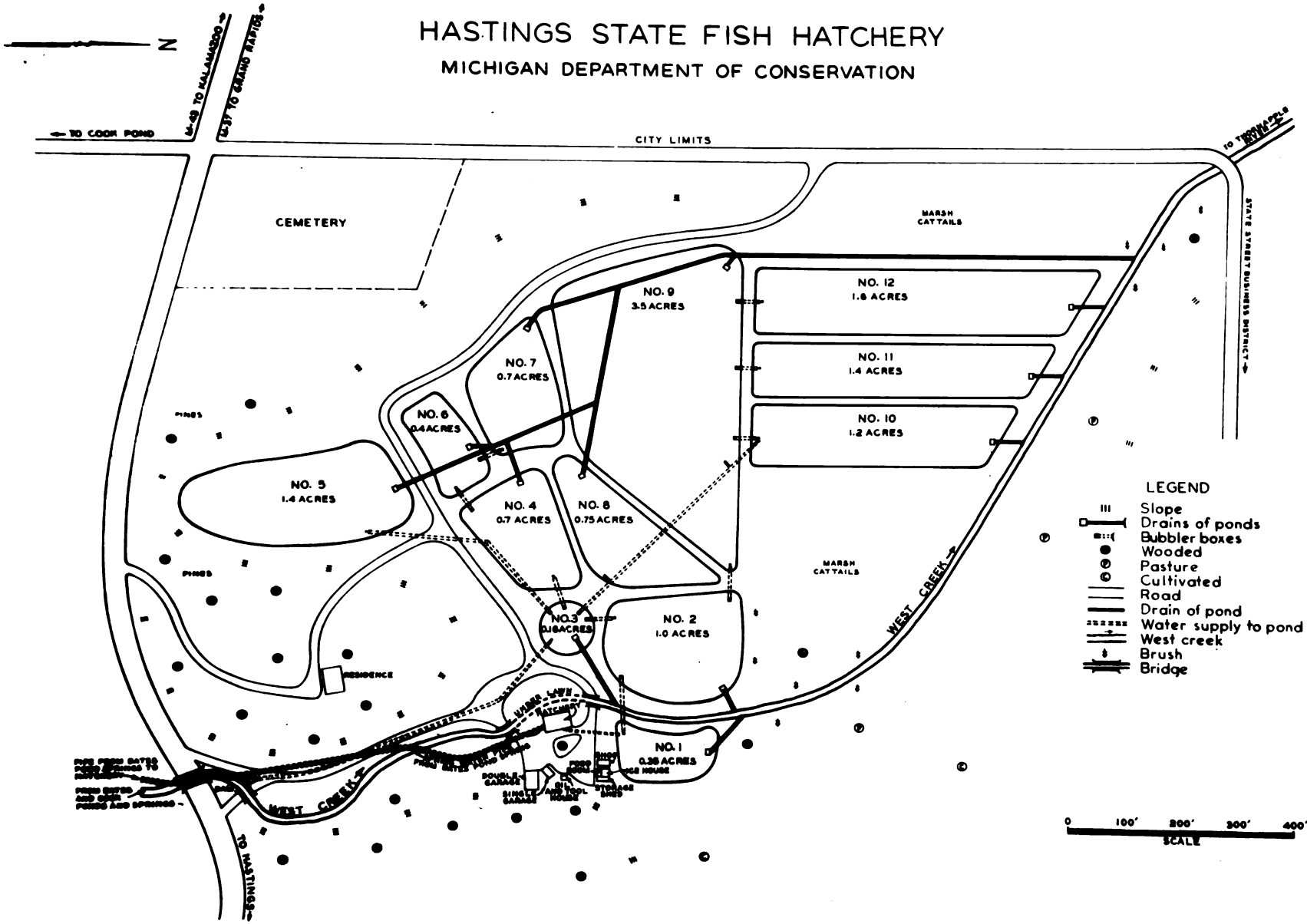
DESCRIPTION OF PONDS USED

The ponds used in this experiment are located at the Hastings State Fish Hatchery in southwestern Michigan. The ponds were formerly used for the production of bass and bluegills. Ponds 2,4,5, and 6 (Figure 1) were used in this experiment. All the ponds are artificial and can be drained. The water supply comes from several springs located about one-forth mile from the hatchery by a small creek. It is piped to a reservoir so that a constant supply is on hand. The inlet to the reservoir and the outlet to the ponds are screened to prohibit the entrance of unwanted fish. The water level in the ponds was maintained at the maximum level and very little water was lost by evaporation and seepage. The ponds are uniform in depth, each having a maximum depth of six to seven feet at the drain. The bottoms of all the ponds are soft due to sediment and softening of the bottom soil by seepage.

Figure 1. Hastings State Fish Hatchery showing location, water supply, and drainage system of the ponds used.

HASTINGS STATE FISH HATCHERY

MICHIGAN DEPARTMENT OF CONSERVATION



FERTILIZATION

The ponds were fertilized throughout the early part of the season to increase the available fish food organisms. According to Swingle and Smith (1942) an algae bloom is desired that will reduce the visibility to 1.5 feet. This cloudiness controlled the higher aquatic plants in the ponds of Smith and Swingle (1941) by eliminating the light. Elimination of the higher plants is important in the fall draining operations since many of the fish will become trapped in the plants. Commercial fertilizer having a 10-6-4 analysis was distributed over the pond by broadcasting and pouring from a boat into the shallow areas as the boat moved along.

Ponds 2 and 5 received early applications of 100 pounds each when the ponds were filled on May 17. On June 14 when daily observation were begun, the bottoms were visible in all the ponds. Pond 5 received another application of 100 pounds on June 16 and subsequent observations showed some increase in filamentous algae but no reduction in visibility.

Pond 2,4, and 6 each received 100 pounds of fertilizer on June 20. The bottom of pond 6 remained visible and a definite increase in filamentous algae was noted. The visibility decreased in ponds 2 and 4 following this application and both ponds remained cloudy, but the visibility did not drop below three feet. Consequently another application of 100 pounds

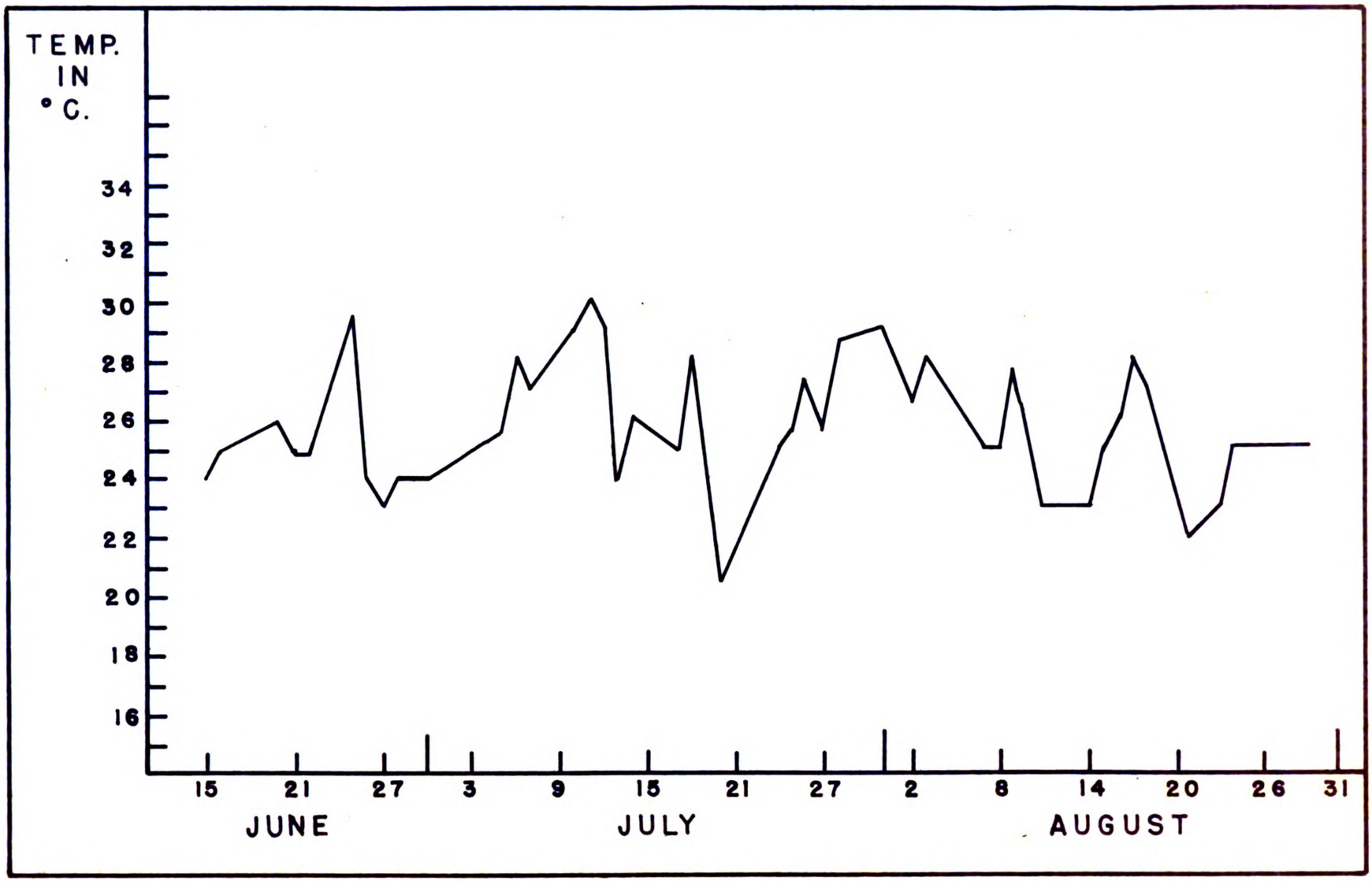
was made to all the ponds on July 7. No reaction was observed and the bottom remained visible in ponds 5 and 6. Ponds 2 and 4 remained cloudy but no bloom was attained.

In an attempt to get a bloom started, 300 pounds of fertilizer was added to each pond on July 10. Ponds 5 and 6 remained clear and ponds 2 and 4 continued to clear up. By July 18 the water was clear enough in all of the ponds so that the bottoms were clearly visible. No more fertilizer was added and no further reduction in visibility was attained in ponds 4,5, or 6 for the remainder of the season.

After clearing so that the bottom was visible, pond 2 clouded up and the visibility decreased to 2.5 feet on July 27 and then the pond gradually cleared up as the season progressed. The greatest reduction in visibility occurred during the warmest weather and the water cleared up for a short time during a cold period (Figure II) on July 20.

Although the ponds did not attain the desired bloom condition at any time throughout the season, the writer feels that the fertilization did have the desired effect of increasing the production in the ponds. The production compares very well with the figures published by Dobie, et al (1948) for this region. Also the higher plants were reduced to some extent in ponds 2 and 5 and there was no interference from plants in draining. In comparison, pond 6, in which the bottom was visible all season, had a heavy growth of plants and there may have been some loss of fish on draining due to this condition.

Figure II. Average daily water temperatures.


TEMP.
IN
°C.
34
32
30
28
26
24
22
20
18
16
15
21
27
3
9
15
21
27
2
8
14
20
26
31
JUNE
JULY
AUGUST

Chemical analysis of the water for dissolved oxygen, carbon dioxide, and alkalinity determinations were made at two week intervals in all of the ponds. A Kemmerer water sampler was used to obtain water samples and water analysis was carried out by the methods outlined in "Standard Methods for the Examination of Water and Sewage". Dobie (1947a) points out that there is a danger of oxygen depletion upon fertilization but these determinations did not reveal any condition that would be detrimental to fish life.

AQUATIC VEGETATION

Although the dominant plants in the ponds were various species of Potamogeton and Chara, there were many minor species that were specific to certain ponds. The bottom of pond 2 was nearly covered with Chara sp. and a heavy growth of Vallisnaria spiralis developed in the north end toward the latter part of the season. The edge of the pond was clear, the primary plants being grasses and sedges. The bottom of pond 4 was also covered with Chara which necessitated some channeling and stacking during harvesting to allow the fish (suckers) to free themselves. Some filamentous algae was present on the bottom of the pond. Pond 5 had some Potamogeton pectinatus scattered throughout and a heavy growth of filamentous algae developed on the plants. The east and west sides of the pond were bordered by trees and cattails were encroaching on the south end. The cattails were completely removed by cutting below the waterline early in the summer. Pond 6 had the heaviest growth of vegetation of any of the ponds under consideration. Several species of Potamogeton were present as well as Heteranthera dubia. A heavy growth of filamentous algae developed and persisted throughout the latter part of the season.

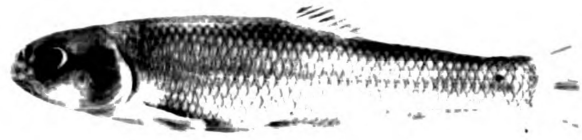
LIFE HISTORY AND SPAWNING OBSERVATIONS

Spawning observations on the fathead minnow (Pimephales p. promelas) in pond 2 and the golden shiner (Notemigonus crysoleucas auratus) in pond 5 were maintained throughout the season. A more complete record was possible on the fathead due to the fact that their activities were more easily observed. The observations were made to verify information already available and to establish spawning seasons, egg counts, etc. for this region. The four fish used in these experiments are shown in Figure III.

Fathead Minnow
Pimephales p. promelas (Rafinesque)

The fathead minnow is used as a bait minnow in Minnesota, Wisconsin, and to a lesser extent in Michigan. It is a small minnow and never exceeds 3.5 inches in length, the males being somewhat larger than the females. It meets many of the qualifications of a bait species for propagation by being extremely tolerant to handling and holding, having an extended spawning season, and having a rapid growth rate. The fathead minnow is especially adapted for pond culture and thrives under cultivation. It feeds mainly on phytoplankton, but also takes zooplankton and insect larvae. The eggs are attached to the underside of objects in the water and guarded by the male. Several females may use the same nesting site.

Figure III. The four types of bait fishes used in the harvesting and production experiments.

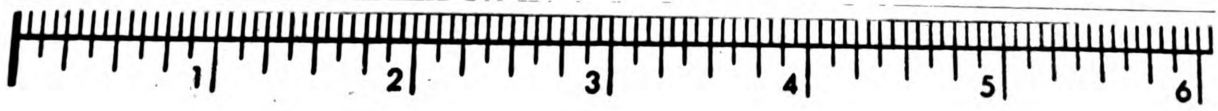


FATHEAD MINNOW

WHITE SUCKER

GOLDEN SHINER

NORTHERN CREEK CHUB



Pond 2 was stocked on May 17 at the rate of 1000 breeders per acre. To facilitate spawning and to insure a maximum production in the pond (Dobie, et al, 1948), a series of spawning boards were placed in the water around the edge of the pond on May 20. The boards were approximately two by three feet in size and were anchored in depths of water ranging from one to three feet. On June 14 all of the boards had one or more nests of eggs on them (Figure IV) and fry ranging from one-half to one inch were observed on the surface. Some of the nesting sites used were the vertical sides of drain boxes, in crevices under a cement walkway, on the bottom of a boat, and under branches on the bottom. The males could be seen patrolling the nest and it appeared as if the rugose area actually touched the eggs, but this could not be definitely determined. Those boards that were anchored in deep water away from shore usually had more nests than those closer to shore. Consequently, on June 21 ten boards were reanchored in water one to two feet deep. On June 22 these boards were rechecked and all of them had eggs on the undersides. As a rule the eggs are laid in a single layer, but in some cases the eggs were piled two and even three deep.

Egg counts were made to determine the average number of eggs per nest. Seven nests were measured and the results obtained are shown in Table I.

Figure IV. Fathead minnow eggs on spawning board.

TABLE I

EGG COUNTS OF FATHEAD NESTS

Nest No.	Size	Square Inches	No. of Eggs
1	4 X 6	24	12,124
2	4 X 4	16	8,096
3	3 X 3	9	4,527
4	5 X 3	15	7,590
5	4 X 5	20	10,120
6	3 X 3	9	4,527
7	3 X 3	9	4,527

Average number per nest 7,387

Average number per square inch 506

It will be noticed that there was wide variation in the size of the nests. This is due to the continual addition of eggs to the nests. When first observed the nests were approximately three inches square and the nests would then become larger due to the addition of eggs. A nest would thus contain eggs in different stages of developement.

Incubation time of the eggs was determined. Eggs spawned on June 22 had reached the eyed stage by June 26 and hatching had commenced. The water temperature averaged 25° C. during this period. Thus the incubation period for fathead eggs was five days for this area.

The fatheads continued to use the spawning boards until July 18. At that time a notable decrease in spawning activities

was noticed and many boards were void of eggs. For several days no eggs appeared on the boards. During this same period the air temperature remained below normal (Figure II). Perhaps this cool weather was the cause of the early cessation of spawning activities. With rising water temperatures some spawning resumed and on July 25 one board of 15 had eggs on it. Fathead eggs were present until August 14 and from then on no eggs were found.

Golden Shiner
Notemigonus chrysoleucas auratus (Rafinesque)

The golden shiner has a thin and flat body from side to side and is deep from top to bottom. The adults are golden in color and the scales are loose and easily visible. It can be recognized most easily by its deeply forked tail and greatly curving lateral line. It is larger than the fathead minnow and reaches a maximum size of 10 inches. It is a desirable bait species due to its brilliant color, but the young fish are not very hardy during the warmer months. If great care is not taken in handling, many scales will be removed. Consequently, difficulty is encountered in holding unless the fish are adequately treated to prevent fungus infection.

The golden shiner will thrive in small ponds and is a preferred bait fish in spite of its weakness in warm weather. It is readily taken by game fish and reaches a sufficient

size for bass and pike. The growth rate is fairly rapid and the young will reach three inches in the fall of the first year (Cooper, 1935). The eggs are adhesive and are scattered over filamentous algae and higher plants.

The brood stock was introduced into the pond on May 17 and consisted of 450 fish (321 per acre). On June 14 when daily observation were begun there were many fry around the edges and on the surface of the pond. The sizes of the fry observed ranged from one-forth to three-forths of an inch with the majority being less than one-half an inch. On June 22 there were fry visible over the entire surface of the pond. A check was made on the various types of plants in the pond for eggs and a few eggs were found on some filamentous algae in water about two feet deep but these were widely scattered.

An attempt was made to induce the fish to spawn on an artificially made spawning mat constructed of willow branches woven together to form a mat so that egg counts and incubation periods could be determined. The fish did not use the mat and after several weeks the attempt was abandoned. Recently hatched fry were continually visible in the pond and on July 6 some fry had reached the size of 1.5 inches. On August 29 very small fry were on the surface and larger young of the year were feeding actively on them.

Northern Creek Chub
Semotilus a. atromoculatus (Mitchell)

The northern creek chub is one of the most desirable bait species in use in Michigan. It is a preferred bait for bass and pike fishing and is highly sought after by both fisherman and bait dealers. The creek chub is one of the largest native Michigan minnows, the males often reaching a total length of 10 inches. The fish is stocky and only slightly compressed laterally. The scales number 55-70 along the lateral line and are relatively small, especially anteriorly. The creek chub is an olive color above the lateral line and silvery or grey below. The breeding males develop horny tubercles and become colored with brilliant hues of blue, purple, orange, and gold on the body and fins (Dobie, et al 1948). The mouth is terminal and large and the maxillary has very small barbels on each side. A characteristic often used in field identification is the pronounced black spot on the anterior edge of the dorsal fin.

The creek chub occurs throughout the central and eastern parts of the United States. In Michigan the creek chub occurs abundantly in small, clear brooks. Its habitat is similar to that of trout but it is not found in the very cold streams and seldom occurs in lakes.

The creek chub spawns from the latter part of April to July when the water temperature reaches approximately 60° F.

(Langlois, 1937). The male builds a nest in gravel bottomed streams, usually at the head of rapids. The completed nest is a ridge of gravel about one foot wide and two or three inches deep and extends from one to eighteen feet in length. The nest is constructed in line with the current. Several females may visit the nest at different intervals. Each is met by the male and the spawning act is carried out. The male wraps himself around the female and thrusts her into a vertical upright position, holding her in place with the aid of the nuptial tubercles on the head, tail, and fins. When the fish are in this position the eggs and milt are released. The spent female then drifts downstream but soon swims away while the male covers the eggs and guards the nest. The fry hatch in the gravel and work their way free. They feed on microscopic crustaceans and other small aquatic organisms.

The Fish Division of the Michigan Department of Conservation has distributed chub fry to bait dealers during the past few years for propagation in farm-type ponds. In order to encourage artificial propagation of this bait species, the Department of Conservation has undertaken the gathering and hatching of the creek chub eggs since this process demands certain facilities and equipment that the average bait dealer can not provide. The fry are then sold to bait dealers for stocking in private ponds. The creek chubs that were propagated at the Hastings Hatchery were obtained from this source. Pond 6

(0.4 acre) was stocked with 30,000 fry on May 28.

White Sucker
Catostomus c. commersonnii (Lacepede)

Although the suckers are not a member of the minnow family (Cyprinidae) they are commonly used for bait and decoys and are closely related to the true minnows. The suckers are fishes with cycloid scales and a ventral, protrusible mouth with fleshy, sucking lips. The scales are coarse near the tail and become smaller near the head.

The white sucker is widely distributed in the United States, occurring in the eastern states from Canada to Georgia. This fish is primarily a bottom feeder and thrives under a variety of conditions, but prefers clear water in lakes and streams.

Like the creek chub, the white sucker spawns in streams early in the spring. The white sucker will spawn in lakes where there are no inlets or outlets, but a swift stream with a gravel bottom is preferred. The eggs are scattered freely in the current. The incubation period is from five to seven days depending on the water temperature. The white sucker will feed on practically anything that appears in the water and is thought to be selective in its feeding habits (Dobie, et. al. 1948) during different stages.

The white sucker is widely used in Michigan as a bait fish and is a common decoy for pike during the winter months.

Under the present regulations on the taking of bait fishes in Michigan it is difficult for the bait dealers to obtain suckers during the fishing season. As white suckers do not spawn successfully in small ponds the Fish Division of the Michigan Department of Conservation nets suckers in the spring and removes the eggs. The eggs are then hatched and distributed as fry to bait dealers at a nominal cost. The white suckers used in this work on propagation were obtained from this source. Pond 4 was stocked with 70,000 fry on May 28.

TABLE 2

DATA CONCERNING PRODUCTION OF BAIT FISHES AT THE HASTINGS HATCHERY IN 1950

Pond	Acreage	Species	Stocking Rate Per Acre	Fertilizer in Pounds Per Acre	Production Per Acre		Value Per Acre	
					Pounds	Numbers	Wholesale	Retail
2	1.0	Fathead Minnow	1000 (Breeders)	600	212.2	251,375	279.8	559.9
4	0.7	Common Sucker	100,000 (Fry)	714	255.4	64,504	322.5	645.0
5	1.4	Golden Shiner	321 (Breeders)	429	33.4*	12,860	64.3	128.6
6	0.4	Creek Chub	75,000 (Fry)	1250	313.3	43,655	873.1	1746.2

*Complete data not available due to loss in fall draining.

GROWTH AND PRODUCTION

The growth rate of bait minnows in a pond is dependent on the amount of food that is available and the number of fish that are utilizing this food. Since the bait dealer is interested in a maximum growth and production of salable fish, the pond must not be overcrowded and at the same time the pond must be made to produce as many salable fish as possible. Bait dealers commonly divide bait fishes into three catagories depending on the size and use of the fish as bait. The fish are commonly classified as perch, bass, and pike size minnows. The minimum size bait fish that is offered for sale is 1.5 inches and for the purpose of this study a salable fish is considered to be 1.5 inches or more in size.

In order to produce a maximum number of salable fish the minnow pond operator is interested in controlling the number of fish that are in the pond. In stocking a pond with brood stock, the number must be determined from previous trials. When fry are used to stock a pond the number can be more positively controlled, but a loss of 35 to 50 per cent of the fry can be expected so this must be taken into consideration before introducing the fry into the pond. The actual number of fish that a pond can successfully support is dependent on the type of fish used, the natural fertility of the pond, the geographical

location and many other factors. Consequently no figures on stocking are universally applicable and can only act as a guide for the beginning operator. Experience will be gained that will enable the operator to successfully estimate the stocking rates and production that can be expected from the ponds that he is operating.

Samples of fish from each pond were collected weekly for growth studies. The growth curves shown in Figures V, VI, VII, and VIII are based on the mean lengths of the weekly samples and all measurements were total lengths and were rounded off to the nearest tenth of an inch. An attempt was made to measure fish of the same age but some error was induced in the golden shiner and fathead curves due to the dilution of the samples by younger fish. As this error would tend to reduce the growth rate, it will not interfere with the use of the charts. These charts are useful in estimating the length of time necessary for the fish to reach a salable size and to predict when harvesting operations can begin.

FIGURE V. GROWTH RATE OF FATHEAD MINNOWS
(100 DAYS)

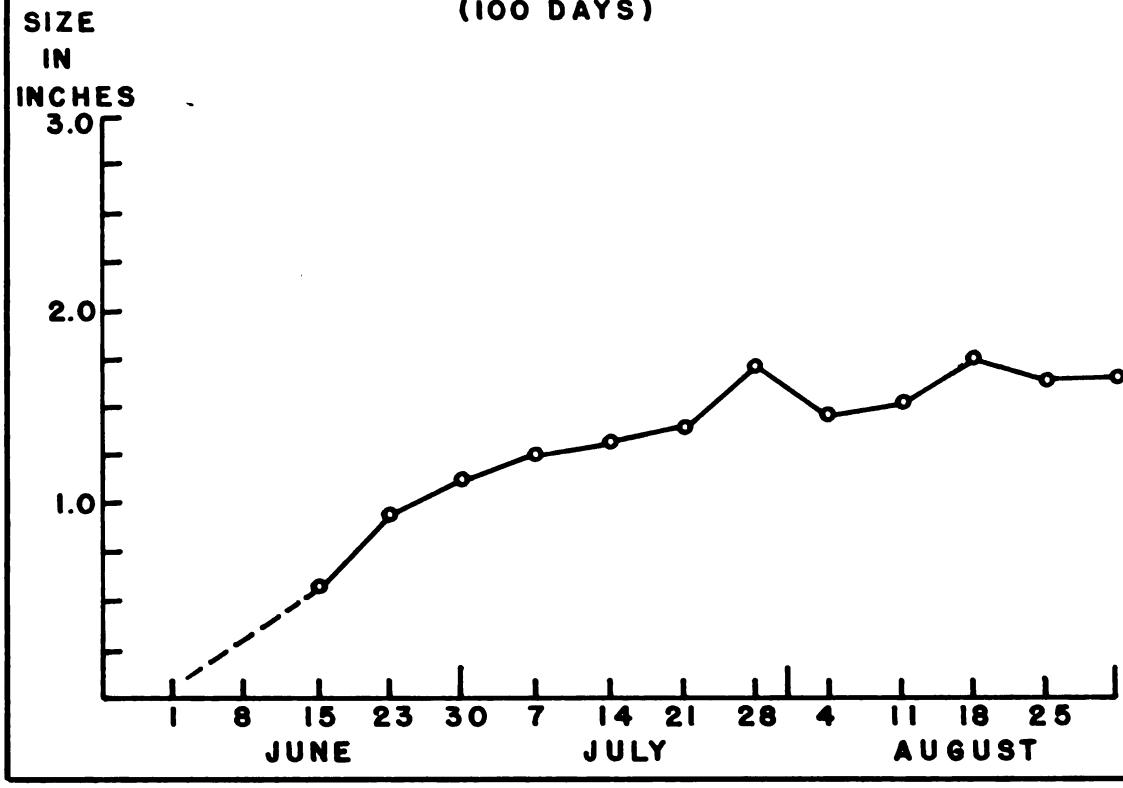
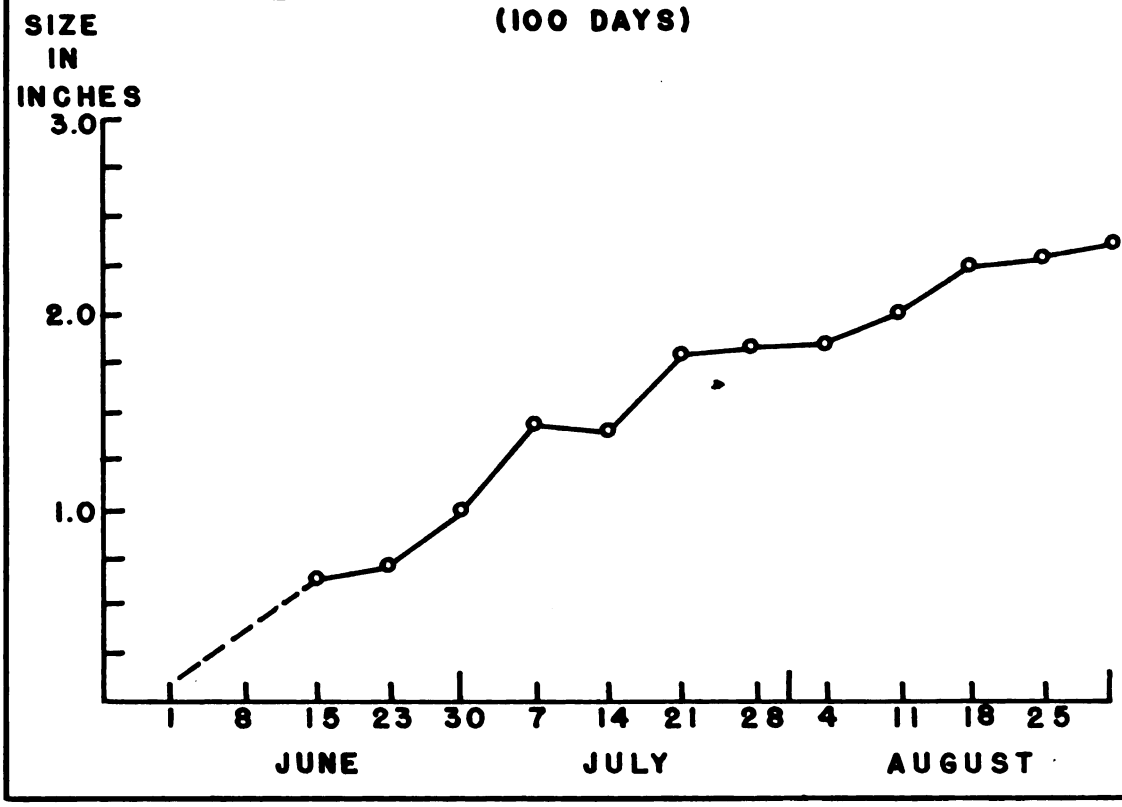


FIGURE VI. GROWTH RATE OF GOLDEN SHINERS
(100 DAYS)



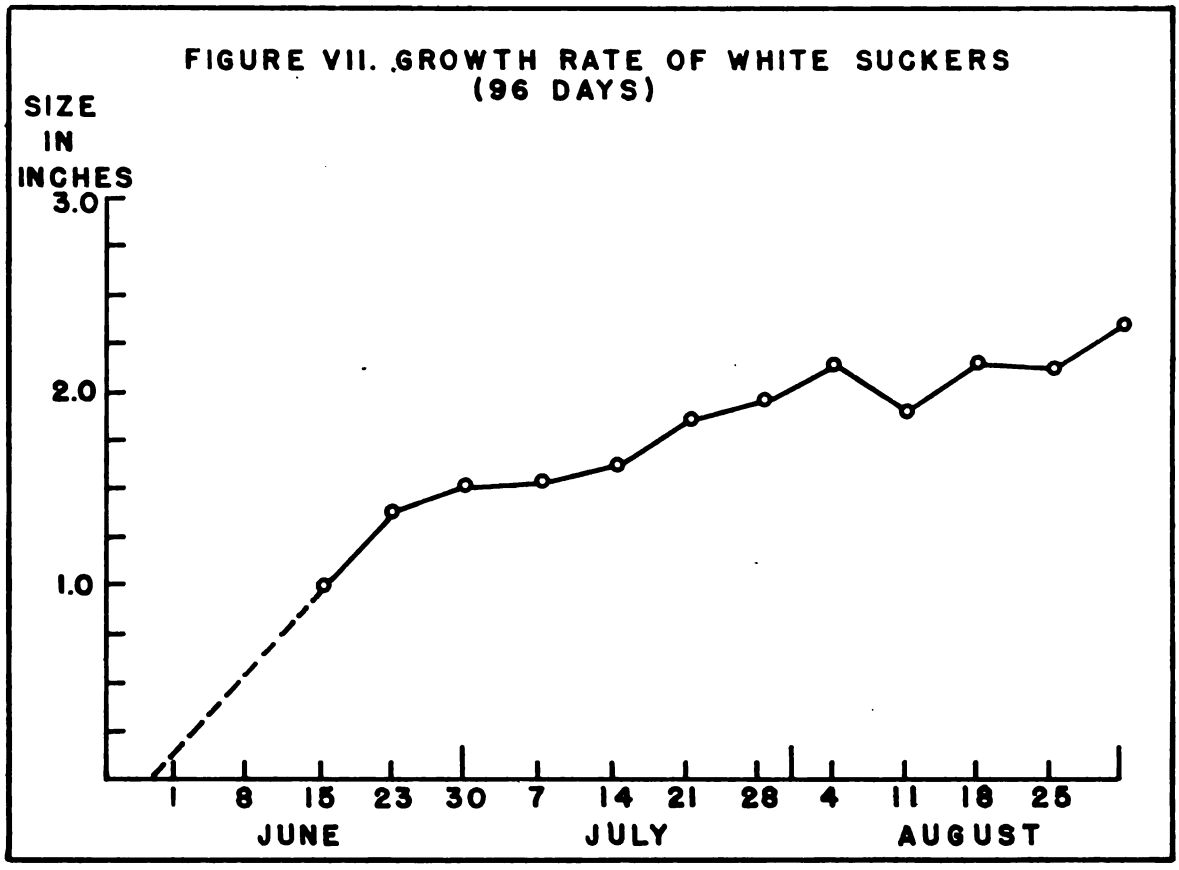


FIGURE VII. GROWTH RATE OF WHITE SUCKERS
(96 DAYS)
SIZE
IN
INCHES
3.0
2.0
1.0
1 8 15 23 30 7 14 21 28 4 11 18 25
JUNE
JULY
AUGUST

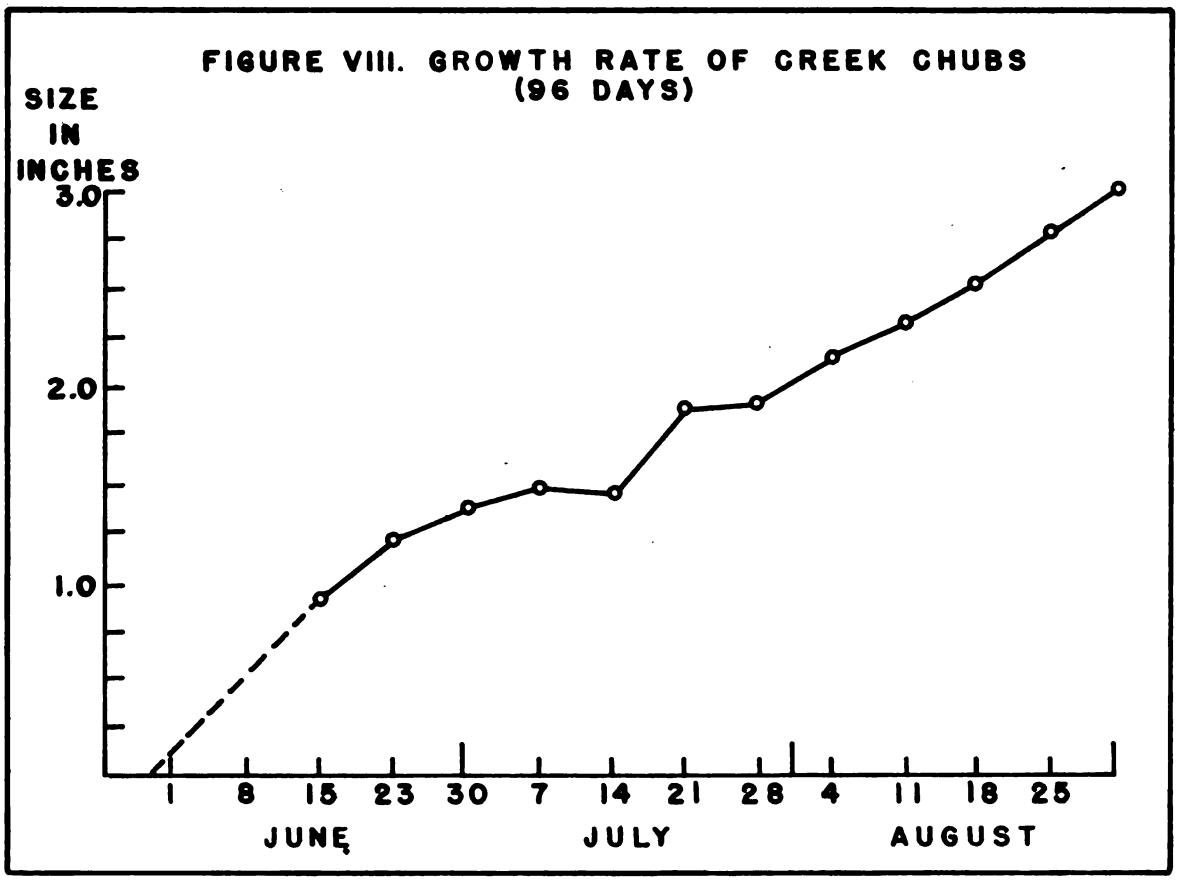


FIGURE VIII. GROWTH RATE OF CREEK CHUBS
(96 DAYS)
SIZE
IN
INCHES
3.0
2.0
1.0
1 8 15 23 30 7 14 21 28 4 11 18 25
JUNE
JULY
AUGUST

Pond 2 - Fathead Minnow

The brood stock of fathead minnows in pond 2 was introduced into the pond on May 17, 1950. These fish were obtained from a stock of fatheads that were over-wintered in the ponds at the Hastings Hatchery. The males could be readily distinguished from the females by their black head and the nuptial tuburcles. A total of 1000 fish were used for brood stock, consisting of about one-third males and two-thirds females. All of these fish were mature and in good condition. Spawning evidently began in May as fry were visible during the latter part of the month and when daily observations were begun on June 14 many fry were visible over the entire surface of the pond, ranging in size from one-half to one inch. By the latter part of July there were salable size fish in the pond (Figure V) and harvesting operations were started. Between July 20 and August 30 a total of 53 pounds (26,790) of salable fish were removed from the pond.

The pond was completely drained on September 5 and 159.2 pounds (224,585) of fish were removed and of these 13 per cent or 29, 202 were salable fish. There was some loss in draining in the smaller sizes of fish, but the losses were neglegible in the larger sizes. Thus a total of 251,375 fish were produced in the pond and of these 22.2 per cent or 55,992 fish were of a salable size (Table II). Figure IX shows a frequency

distribution of the fathead minnow population at the time the pond was drained.

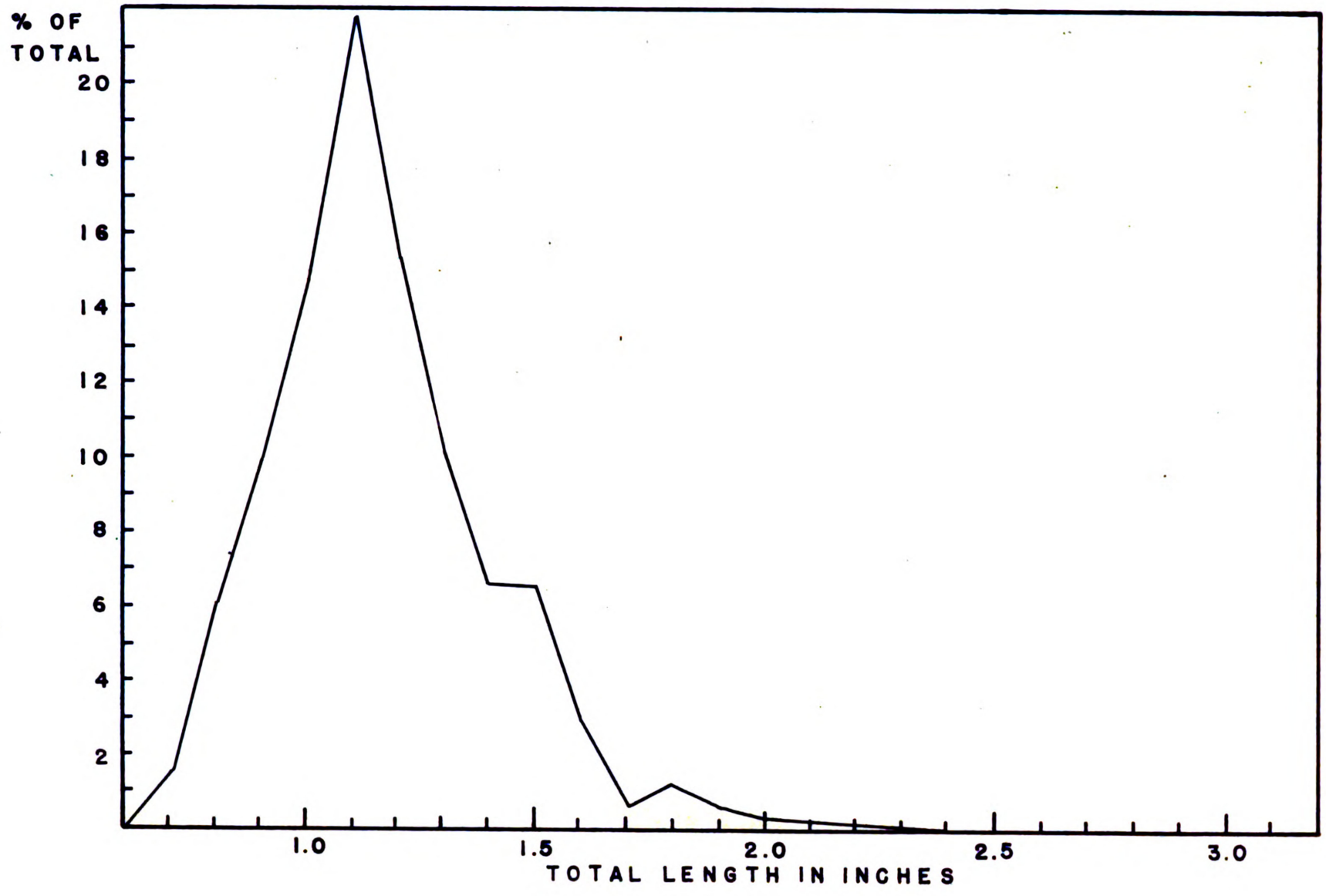
The growth rate shown in Figure V and the production shown in Table II that were obtained compare favorably with those published by Dobie, et al (1948) which included a summary of the available information on fathead minnow production in Michigan, Minnesota, and Wisconsin.

Pond 4 - White Sucker

Adult suckers were collected and the eggs stripped and hatched in hatching jars at Wolf Lake Hatchery. The fry were about one week old when they were stocked in the pond at the rate of 100,000 per acre on May 28, 1950. On June 14 the fry were visible in the shallow areas in large schools. As the fry increased in size they were not as readily visible and became more difficult to observe as the season progressed. Weekly samples were being taken during this time and it was exceedingly difficult to take enough suckers for a sample. Although the fish were difficult to see it appeared as though the pond was overstocked as the shallow areas appeared pock marked each morning and the growth of the fish taken in the weekly samples was not as good as could be expected.

Harvesting operations were begun on July 26 when the fish averaged two inches in length (Figure VII). At this time the fish were variable in size ranging from 1.7 to 2.8 inches and

Figure IX. Length frequency distribution of fathead minnows.

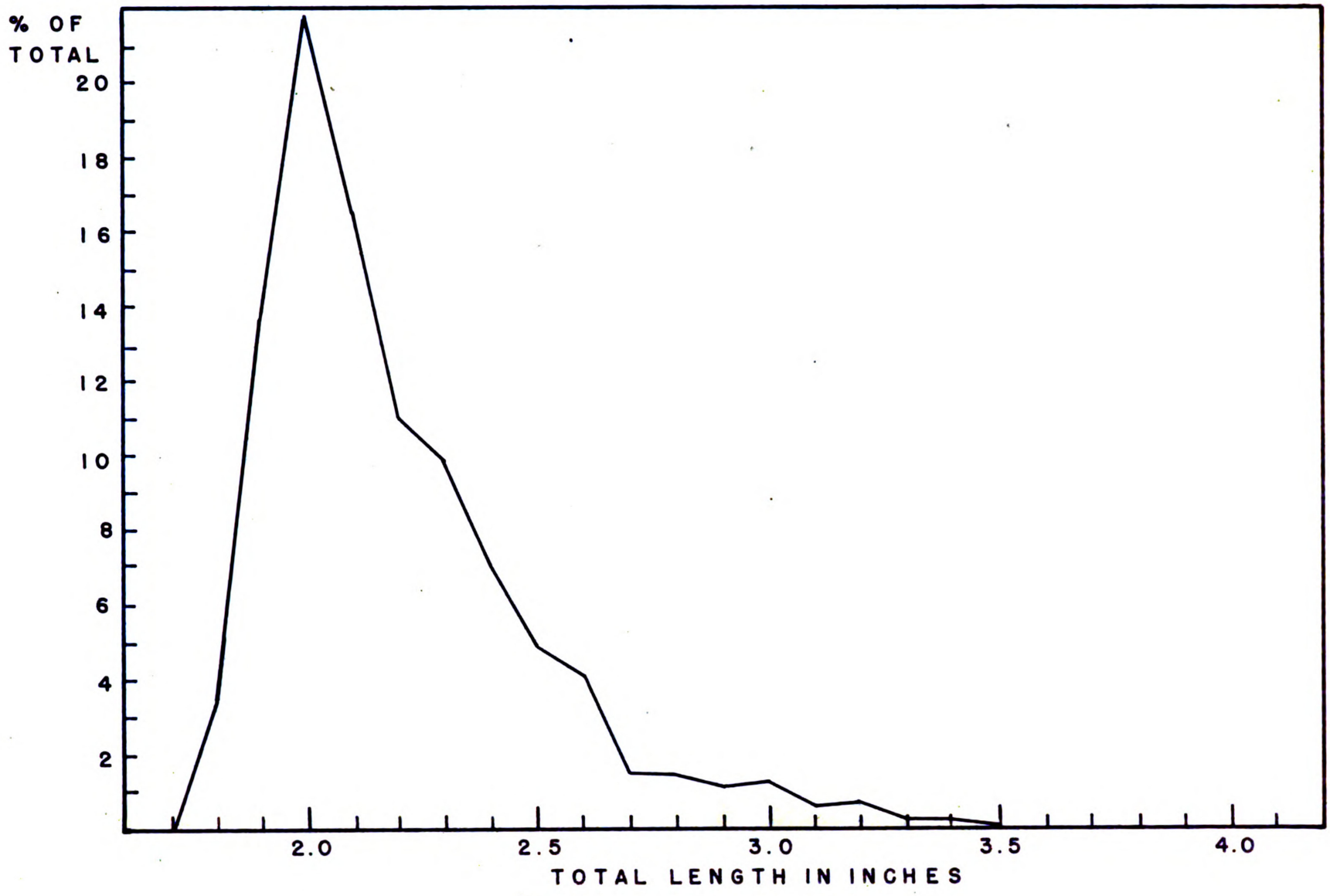

% OF TOTAL
20
18
16
14
12
10
8
6
4
2
1.0
1.5
2.0
2.5
3.0
TOTAL LENGTH IN INCHES

it was apparent the growth rate was not uniform throughout the population in the pond. The fish had oversize heads and small bodies which also was interpreted as an indication that the pond had more fish in it then it could properly support. A total of 13.8 pounds (4,842) of salable fish were removed between July 26 and September 1.

The pond was completely drained on September 4 and 164.9 pounds or 40,311 fish were removed. All of these fish were considered salable as perch minnows, but very few were of sufficient size to sell as bass minnows. Since suckers are not commonly used as perch minnows it would probably be best in cases where they are not of salable size in time for the late summer market to leave the fish in the pond until the following spring when a higher percentage could be sold as bass size minnows and a higher price could be obtained. The fish would have to be removed early enough in the spring, however, so that the pond could be used again that year. The increase in value of the fish after a second season in the pond would be offset by the additional loss in numbers over the second season and the loss of a second crop that the pond could have produced.

A return of 64.5 per cent of the original stocking of 70,000 was obtained. Figure X shows a length frequency distribution of the population of suckers that was present at the time the ponds were drained.

Figure X. Length frequency distribution of white suckers.


% OF TOTAL
20
18
16
14
12
10
8
6
4
2
2.0
2.5
3.0
3.5
4.0
TOTAL LENGTH IN INCHES

Pond 5 - Golden Shiner

The pond was stocked on May 17, 1950 with 450 golden shiners that were obtained from a stock of fish that had been overwintered in the ponds at the Hastings Hatchery. The brood stock ranged in size from three to six inches and they were in good condition. Before the pond was stocked several of the fish were checked and were found to be mature. The females were gravid and no spawning had begun. Spawning evidently began shortly after the pond was stocked as fry were observed within two weeks. By June 14 there were many fry on the surface of the pond ranging in size from one-quarter to three-quarters of an inch.

The first harvesting operations started on July 24 and by August 30 a total of 46.4 pounds (18,007) of salable golden shiners were removed from the pond.

The data for the final fall harvest of golden shiners are not available due to a complete loss in draining. This loss was due to structural failure in the drain box. There were, however, many salable golden shiners in the pond and it is believed that the production would have approached that which was obtained in pond 2.

Pond 6 - Creek Chub

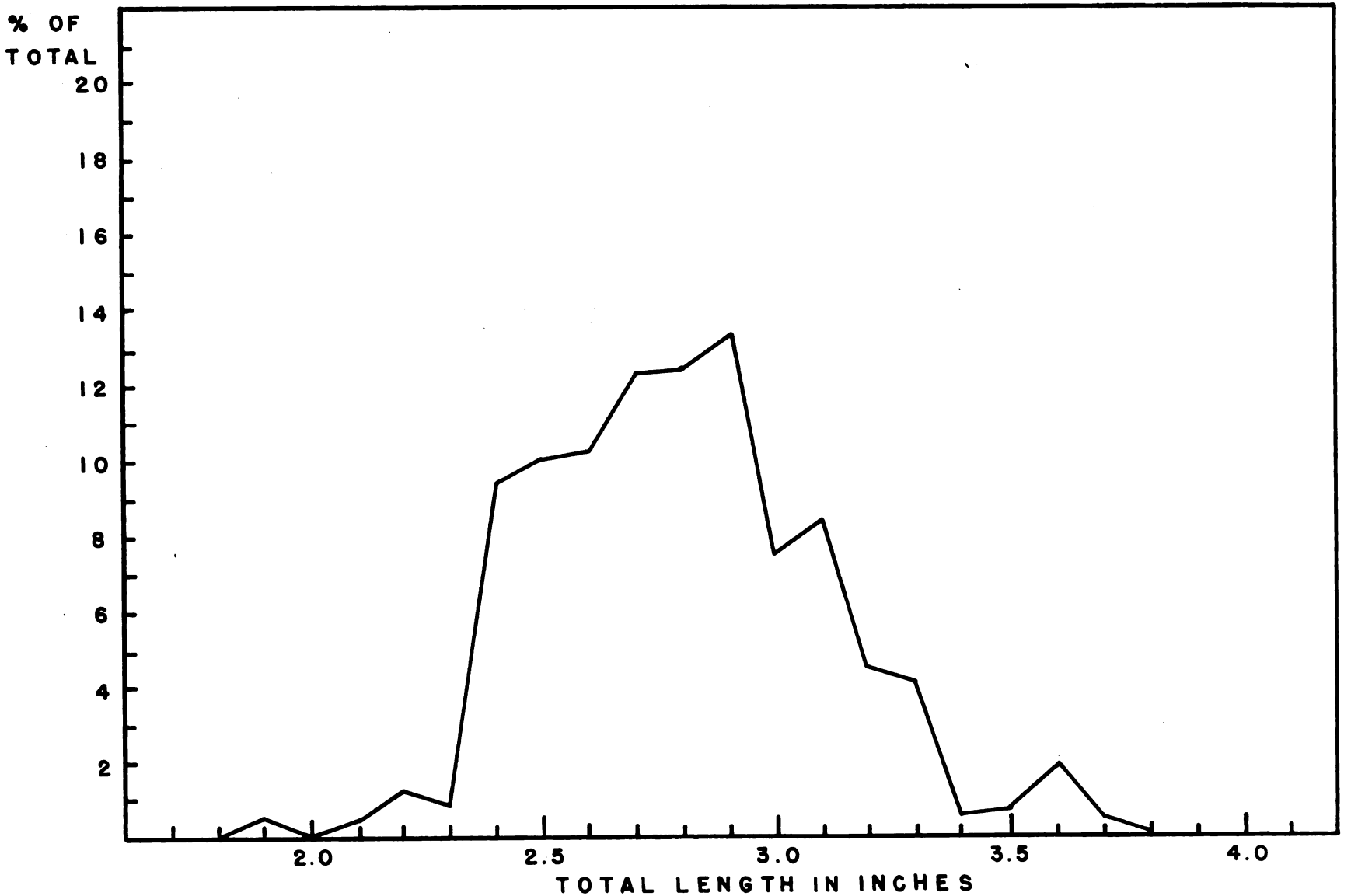
Adult creek chubs were injected with pituitary extract (Bacon, 1951) and the eggs stripped and hatched in hatching

jars. The fry were approximately one week old when they were introduced into the pond. On May 28, 1950, 30,000 fry (75,000 per acre) were stocked in the pond. By June 14 the chubs were easily observed in the pond as they were concentrated around the water inlet.

Growth of the chubs was fairly rapid (Figure VIII) and harvesting operations were begun on August 10 when the fish averaged over two inches in length. By August 16 a total of 10.3 pounds (1822) salable fish were removed.

The pond was completely drained on September 5 and a total of 115 pounds (15,640) of fish were removed. A total production of 17,462 fish were harvested which is a 58.2 per cent return of the original stocking of 30,000 fry. A length frequency distribution of the chub population that was present at the time of draining is shown in Figure XI.

Figure AI. Length frequency distribution of creek chubs.


% OF TOTAL
20
18
16
14
12
10
8
6
4
2
2.0
2.5
3.0
3.5
4.0
TOTAL LENGTH IN INCHES

VALUE OF FISH PRODUCED

The value of the fish shown in Table 2 was computed from the market price of bait minnows in southwestern Michigan at the time the fish were being harvested. The prices remained fairly stable in the area as a whole, but they were subject to change depending on the demand and availability. The average prices are shown in Table 3, along with the use and size ranges of the various fish. The retail value of the fish was approximately twice the wholesale price.

TABLE 3

SIZE RANGE AND VALUE OF BAIT FISHES

Type Fish	Use	Size In Inches	Value	
			Wholesale	Retail
Fathead Minnow	Perch	1.5	@ 1¢ ea.	@ 2¢ ea.
Golden Shiner	Perch	1.5 - 2.5	@ 1¢ ea.	@ 2¢ ea.
	Bass	2.5 - 4.0	@ 2¢ ea.	@ 4¢ ea.
	Pike	4	@ 5¢ ea.	@10¢ ea.
Creek Chub	Perch	1 - 2	@ 1¢ ea.	@ 2¢ ea.
	Bass	2 - 4	@ 2¢ ea.	@ 4¢ ea.
	Pike	4	@ 5¢ ea.	@10¢ ea.
Sucker	Perch	1 - 2.5	@ 1¢ ea.	@ 2¢ ea.
	Bass	2.5 - 4	@ 2¢ ea.	@ 4¢ ea.
	Pike	4 - 6	@ 5¢ ea.	@10¢ ea.
	Decoy	6	@ 5¢-30¢	@10¢-60¢

The retail price of perch minnows was two dozen for 25 cents and was considered to be below a fair trade price by most of the bait dealers surveyed. The price of good perch minnows was kept down by the lake emerald shiners Notropis atherinoides (Rafinesque) that were made available to the retail dealers by wholesale truckers from the Great Lakes area near Muskegon. Most dealers do not like to sell emerald shiners during the warm summer months as they do not live well in minnow buckets nor remain alive long on the hook in the warm water of the inland lakes. The bait minnows that were native to the warm lakes and streams were very difficult to obtain and consequently it was felt that they should bring a higher price.

There was a ready market for the fish produced at the prices indicated in Table 3 and the bait dealers indicated that there were shortages in all size classes. Bass and pike sizes are most difficult to obtain in the early part of the fishing season when the demand is at its peak.

HARVESTING METHODS

The harvest of the bait minnows from the pond may begin as soon as a sufficient number of the fish reach a salable size. All of the types of fish under consideration could be used for perch minnows if the operator desired. However, the golden shiner and fathead minnow are commonly used as perch minnows since the chubs and suckers bring a better price if allowed to reach a bass or pike size before being sold. Harvesting operations can begin about the first of August as a sufficient number of the fish will be of a salable size. It is believed that a greater production will be attained if some of the minnows are removed as soon as they reach a salable size, thus making more food available for those fish remaining in the pond. As the larger fish are removed the smaller fish should grow more rapidly due to the increase in food supply formerly utilized by the larger fish (Beckman, 1940).

The method of harvesting the fish that the operator uses will depend on many factors. The size and depth of the pond, the type of bottom material, the amount of vegetation, and the slope of the bottom are all important factors that must be taken into consideration. The number of fish desired, the equipment that is available, and the labor force at hand are also important in the selection of the method to be used.

There are four methods that are commonly used by fish culturists in removing fish from ponds. The use of seines, lift nets, and drainable ponds are old and well established methods in hatchery operations, but little use of glass traps has been made for this purpose. Consequently the use of glass traps in ponds has been treated more extensively since preliminary investigations have indicated that they may be an efficient, low cost method of harvesting bait minnows from ponds.

Seines

In many localities the bait dealer will have to use natural ponds for the production of minnows. The expense in the construction of ponds is high and the location and water supply for artificial ponds are not always available. Under these conditions a complete harvest is difficult, but seines can be used to get as complete a recovery as possible. Seines are also useful in drainable ponds when removal of the water from the ponds is not desired.

When large numbers of minnows are desired at the same time and adequate manpower is available, long hauls with a large seine are quite effective. The entire pond can thus be covered and a large percentage of the salable fish removed. Many ponds, however, are too deep to seine or have too soft a bottom for proper footing. Other obstacles such as tree stumps or aquatic plants may confront the operator and another method must be used. There are also certain disadvantages to this method that

cannot be overcome. A seine may injure the salable fish thus making them susceptible to fungus and other diseases, and at the same time many of the younger fish are destroyed. Damage to the fish may be reduced if the seine is landed on a firm shore and then bagged to keep the fish in the water. Under no circumstances should the fish be lifted from the water while in the seine as the weight of the fish on one another will injure or kill many fish. After bagging the net in the water it can be moved to deeper water where the fish can be removed by a dip net into a floating live box or sorter. The size of the net must be adapted for the size of the area to be seined and the mesh size is dependent on the size and type of fish that are being removed. A 200 foot seine would be best suited for a 1-2 acre pond but a shorter seine may be used if the pond is partially drained or the dimensions of the pond are such that a shorter seine is more effective. A one-forth inch mesh seine should be used if only salable fish are desired as many of the young fish will be allowed to escape unharmed.

The universal effectiveness of a seine should not be overestimated, however, as often filamentous algae or higher vegetation will restrict or even prevent seining in a pond that is otherwise well suited to its use. The filamentous algae are picked up by the seine making it very difficult to haul through the water and those fish that are taken become hopelessly entangled in the algae and when recovered they are greatly weakened or even dead. When thick beds of Chara or other higher plants are

present the seine will tend to roll or be stopped completely by the plants, thus making it ineffective. Although there are many disadvantages to the use of a seine, it is a very effective method of removing fish when in the hands of a competent crew under suitable conditions.

Drainable Ponds

A pond should have a drain to allow the operator to remove all of the water and fish if so desired. Edminster (1947) indicates that a drain is highly desirable in a pond for harvesting, removal of silt, or removing unwanted fish populations. Schaeperclaus (1933) points out that non-drainable ponds are less productive and less profitable than drainable ponds. Certain states have laws requiring that all ponds constructed be equipped with a drain pipe (Lawrence, 1949). If a pond is to be constructed for the purpose of raising bait minnows on a commercial scale a drainage system should be included. Complete removal of all the fish could then be accomplished in the spring or fall if so desired. In conjunction with a drain a concrete catch basin should be constructed that will allow concentration of the fish where they can be readily removed. The catch basin is either constructed in the pond at the base of the drain or outside of the pond. The catch basin outside of the pond is preferable since a certain amount of sediment will be stirred up in the catch basin in the pond that will interfere with the removal of the fish. Many ponds, although

they are drainable, do not have a catch basin and the fish must be removed when the water level is reduced. Under these circumstances a seine would be effective since the fish are concentrated, but this procedure entails more labor than is necessary in ponds having a catch basin.

Lift Or Drop Nets

Lift or drop nets as they are sometimes called are frequently used in removing minnows from lakes and streams. They are usually square in design and form a pocket in which the fish are trapped when the net is lifted directly upwards (Figure XII). The nets which range in size from three square feet upwards are spread by four supporting arms. The nets are used by fisherman for obtaining bait and they are often used by commercial fish dealers operating farm-type ponds in which large numbers of fish are being raised by artificial feeding. Under these conditions when a large number of fish are concentrated in the pond the lift seines are very effective. Feeding is generally accomplished by scattering the food around the shoreline. The fish become accustomed to this and gather in great numbers when the food is scattered over the water. Consequently, the lift nets can be set near the shore and when the fish have become accustomed to its presence food is scattered over the net. When a large number of fish concentrate over the net it can be raised suddenly with the use of a tripod and lever.

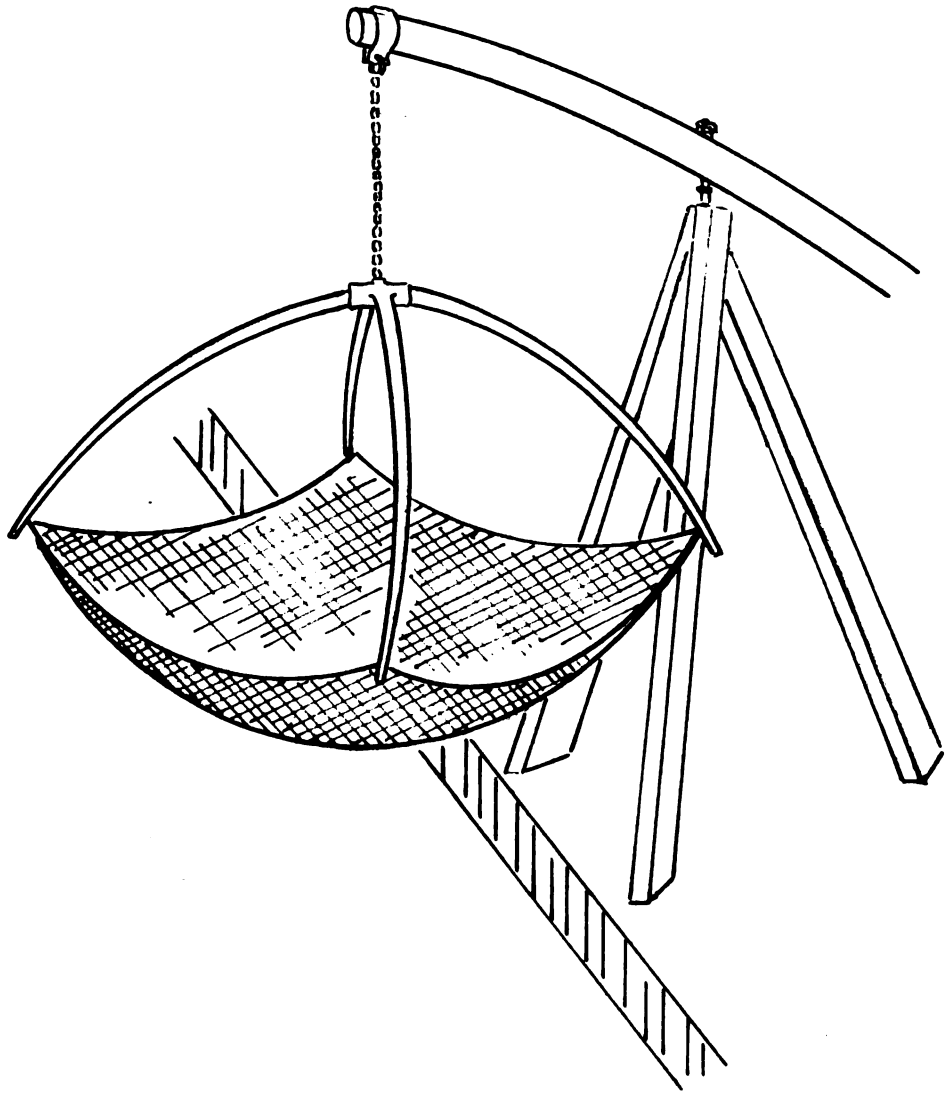
The lift net did not prove too successful in ponds in which natural food is being utilized by the fish. A limited number of fish can be maintained by natural food and consequently the fish are not as numerous and they are not further concentrated as they would be by artificial food. If lift nets are to be used some artificial feeding or baiting of the nets is necessary and this must be done often enough to accustom the fish to the food so that they can be concentrated when desired. Baiting of the nets can be accomplished by placing bread or crackers in the net to lure the fish over the net.

The effectiveness of this type of net was determined without feeding and the results were very poor. The golden shiners would gather in the water when any commotion was made, but when the net was lifted they would scatter and would not be taken. There is a time lag between the time the net starts to move upward and the time the line is pulled due to the spring in the spreading arms and many of the fish that do come over the trap move quickly away in time to avoid the net. A lift net would be more efficient in very shallow water such as in lakes where the minnows are kept close in to shore by the activities of other fish preying on them but in ponds they tend to range in deeper water.

Glass Traps

Glass traps have been used for years by fishermen and minnow dealers as a means of removing minnows from streams.

Figure XII. Sketch of lift net to show construction and position when in use.



It is generally agreed among commercial minnow dealers that many more minnows of desirable size can be caught by glass traps than by seining (Yoder, 1948). Observations on the use of glass traps in trout streams were made by Carbine (1944) when he had the opportunity to observe the use of glass traps by an established minnow dealer. At this time the removal of minnows from trout waters was prohibited. Further experiments were carried out by Washburn (1945) to determine if the use of these traps by bait dealers on trout waters would have any effect on the trout. As very few trout were taken in the glass traps he recommended that certain trout streams be opened for the taking of minnows by glass traps only for personal use and commercial purposes. Consequently certain trout streams were opened to the use of glass traps in 1948.

During this time the State was conducting experiments on the artificial propagation of bait minnows in farm-type ponds. Since one of the major problems of operating a pond is the harvest of the fish, the use of glass traps was suggested for this purpose. Consequently, glass trapping experiments were conducted during the summers of 1949 and 1950 to determine the usefulness of glass traps in farm-type ponds. Although it is generally thought that a current of water moving through the traps is essential in their use it was found that minnows could be successfully trapped in ponds.

The glass traps used in these experiments are of standard design (Figure XIII) and are commonly used by fisherman and

bait dealers. They have a cylindrical shape with an overall length of 13 inches and a circumference of 23 inches. There is a funnel type opening of 1 1/8 inches centrally located in one end of the trap and a swivel type door perforated with holes on the other end. This type of door allows easy and rapid removal of the trapped fish. There are wire traps on the market that are similar in design to the glass traps at a lower price, but the cost of the glass trap is more than compensated for by its advantages. The glass trap can be lifted from the water without the water draining completely from the trap (Figure XIV) and there are no sharp edges on the inside of the trap that will injure the fish. If the minnows are to be held for any length of time it is important that they be uninjured. The wire traps, however, drain completely when lifted from the water and the fish are injured by the weight of the other fish.

Use of Glass Traps in Ponds

Preliminary experiments were begun in 1949 on the use of glass traps in ponds. In order to determine the number of traps that could be used in a trap line the optimum length of each set had to be determined. A total of 11 traps were used to establish the optimum trap inspection time. The experiment was set up to compare the catch of many short sets with one long set over the same period of time. The pond in which the traps were set contained golden shiners. Under the conditions

Figure XIII. Type of glass minnow trap used in harvesting experiments.

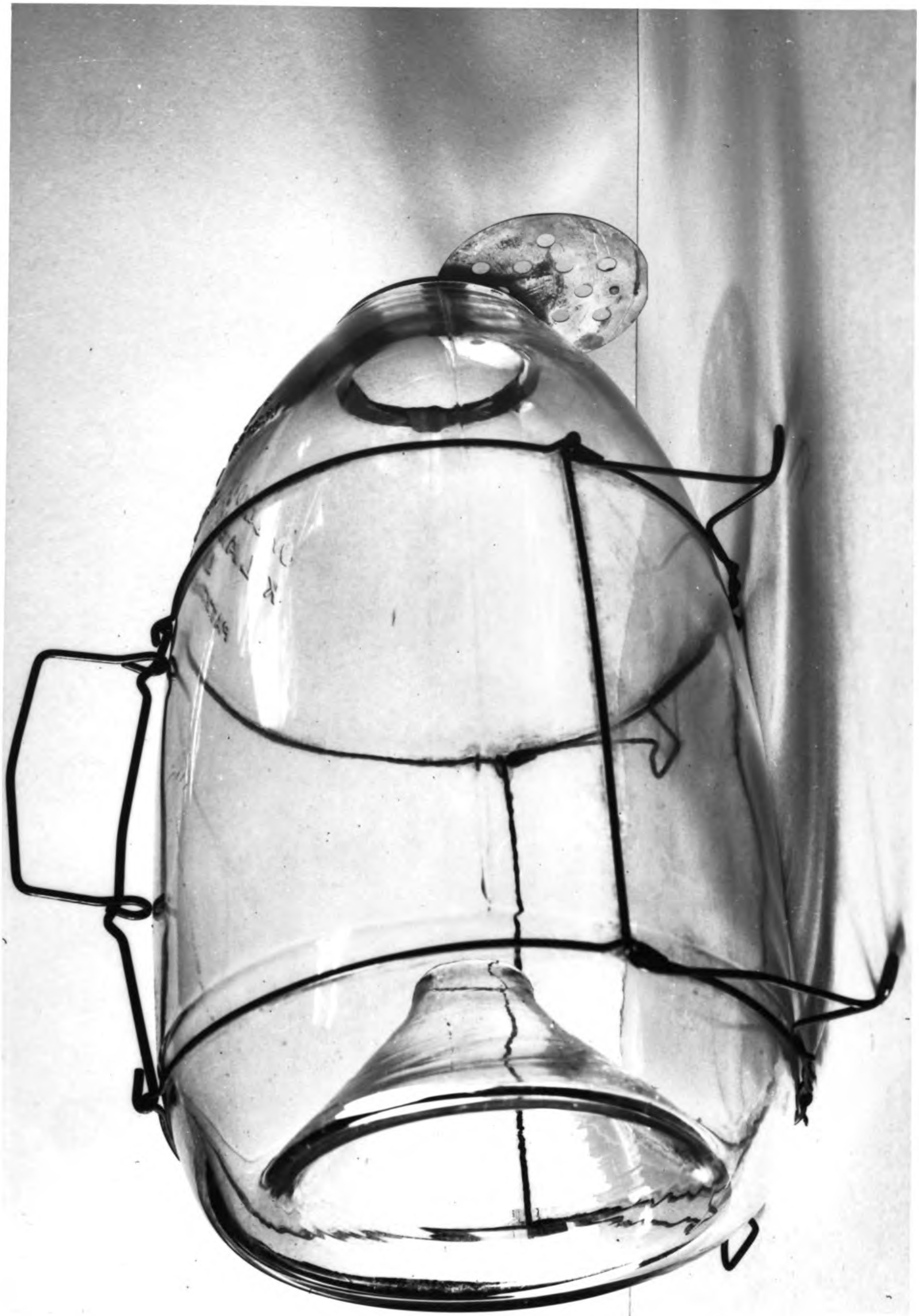


Figure XIV. Photograph showing minnows (Creek Chubs) in trap.

of this experiment where counting the fish was necessary a maximum of 11 traps could be adequately handled in a trap line. The traps were all baited with Rowena dog food and the fish were removed every 15 minutes for a period of one hour. The traps were then rebaited and reset and inspected at the end of one hour. The data obtained are shown in Table 4.

TABLE 4

COMPARISON OF CATCH OF GLASS TRAPS SET FOR SHORT AND LONG INTERVALS

Trap	Traps Lifted At 15 Min. Intervals				Catch Per Trap Hour	
	I	II	III	IV	Four Lifts Per Hour	One Lift Per Hour
1	0	121	118	62	301	67
2	150	111	60	37	358	84
3	0	92	71	108	271	0
4	176	64	64	91	395	121
5	0	17	21	138	176	116
6	121	0	132	113	366	22
7	97	3	29	100	229	130
8	0	116	18	0	134	147
9	0	135	127	16	278	114
10	0	0	113	0	113	31
11	21	67	68	3	159	76
Ave.	54	57	75	70	253	82

This experiment indicated that several lifts of the trap produced more minnows than one lift over the same period of time.

In 1950 the experiments were expanded to include methods of trapping other species of fish under varying pond conditions. Short sets proved effective in trapping fathead minnows and creek chubs, but longer sets were found to be essential in trapping suckers. Twelve glass traps were used in the ponds in the latter part of the summer when the early young had reached a salable size. The number of traps that could be used in a short lift schedule would vary with the size of the pond and proximity of the sets but from 10 to 15 traps is all that could be adequately handled. In trapping suckers a set of from 60 to 90 minutes was found to be necessary and consequently more traps would have to be used in trapping suckers to remove large numbers. Special consideration was given to trapping suckers as the first attempts were unsuccessful. A method of pushing the trap down into the sand so that the opening of the trap would be level with the bottom of the pond was devised. This method of setting the trap along with a long set was necessary to trap the suckers. As the suckers moved along the bottom of the pond in search of food they would enter the trap quite readily when the opening of the funnel was on a level with the bottom of the pond. The suckers were much more cautious than any of the other fish and thus the longer set was necessary as they took longer to approach the traps after they were set.

The 12 glass traps were all baited and set in the water around the edge of the pond at intervals of about ten feet and care was taken to insure that the opening in the funnel of the

trap was clear. The traps were then lifted at regular intervals and those traps that produced were reset in the same place and those that did not produce were moved closer to those traps that were taking minnows. Usually at the end of these trapping periods the traps would be grouped in one or two productive areas. As the fish were removed from the traps they were placed in a bucket and moved to a floating sorting box. This sorting box was constructed of a wooden frame with quarter inch hardware cloth on the sides and bottom. The quarter inch mesh retained the salable fish and allowed the smaller fish to escape unharmed. The fish were left in the sorter for ten minutes and the remaining salable fish were placed in a screened holding box that was placed in the pond. At the end of the trapping period the number of salable fish per pound was determined and the remaining fish were weighed to determine the total number of fish trapped. The results of the trapping are shown in Table 5.

TABLE 5

RESULTS OF GLASS TRAPPING

Pond	Type Fish	Total Trap Hours	Total Salable Fish	Wholesale Value	Salable Fish Per Trap Hour	
					Number	Value
2	Fathead	415.5	26,790	133.85	63.2	31.6
4	Sucker	368.0	4,842	24.20	13.2	6.5
5	Golden Shiner	392.5	18,007	90.02	45.8	22.9
6	Creek Chub	204.0	3,955	79.10	19.4	38.8

The return per unit of effort (catch per trap hour) varies with the type of fish being trapped. The average value per trap hour for the four types of fish under consideration is 25 cents per trap and on the basis of 12 traps in the trap line would be three dollars per hour. These figures are based on wholesale prices and would be doubled if the fish were sold at retail prices. The variability shown in the catch per trap hour indicates that there is a difference in the susceptibility of the fish to the traps.

Factors Affecting Glass Traps

Time of day. Attempts were made to trap the fish at all hours of the day to determine the most productive time. It was found that the fish trapped best during the sunlight hours. Results were greatest when the sun was high and the trap was well illuminated. As the sun started to go down and shadows were cast across the pond the traps would produce fewer fish. As complete darkness approached fewer and fewer fish were taken until no fish were being trapped.

Trapping was conducted on the four species of fish under consideration after darkness fell and the results were negligible. The fish were observed by artificial light and little activity was seen. Many fish were sighted, but they were all quiet and did not move about.

The results of early morning and evening trapping were fairly good, but the catch did not compare with the mid-day results when the sun was high in the sky. Evidently the

sunlight was the controlling factor since the catch was not as good on overcast days as it was on clear days.

Baiting of traps. The use of some kind of bait was found to be essential for high production of minnows from the glass traps. Several types of baits were tried in the traps including dog food (Rowena), bread, soda crackers, graham crackers, and cereals. All of these baits were effective in luring minnows into the traps, but of the baits soda crackers were found to be most effective. It appeared as if this was due to the brilliant whiteness of the cracker in the sunlight and to the flavor of the cracker. Other shiny objects such as metal were tried, but these did not attract the fish as well as an edible bait. There was some indication that the salt on the cracker or some other soluble ingredient was important as the bait had to be renewed each time the trap was set for best results although there was often crackers remaining in the trap.

Fish can be attracted to the trapping area by scattering food on the water over the traps. This method works particularly well with creek chubs because they feed readily on the surface of the water and tend to swim in a school in the pond.

Use of decoys. It was found in comparing decoyed and non-decoyed traps that decoys were not necessary in the pond trapping. Due to the large numbers of fish present in the ponds some fish would enter the traps almost immediately and consequently decoys were not necessary. It appeared as if the

activity of the fish around the trap was more important than the presence of fish in the trap. The fish converged in large numbers on one or two traps even when there were many traps in the same area. When some fish found their way into the trap the others would follow without hesitating at the opening.

Turbidity of the water. There was some indication that the turbidity of the water influenced the trapping results. When the ponds were cloudy due to fertilization or when the water was roiled on windy days the catch was not as high as it was on days when the water was clear. On dull days the reduction in visibility in the water was more apparent and the catch was low. If glass traps are to be used for harvesting a pond, care should be taken in fertilizing so that the visibility in the water is not reduced to a point where trapping results are affected. If, however, another method of harvesting the fish is available the bloom should be encouraged as the plankton algae is an important link in the food chain of fishes (Swingle and Smith, 1938).

Deep and shallow sets. In comparing the catch between deep and shallow water it was noted that slightly larger fish were taken from the deeper sets. This was offset, however, by the many disadvantages of the deeper sets. The funnel opening of the trap was difficult to keep clear in the deeper water as the trap often settled into the weeds. On some occasions, depending on the visibility in the pond, the traps would

disappear from view before reaching the bottom. The traps had to be set from a boat which was subject to wind action and thus the set was difficult to make by one man. In view of these difficulties the production of the traps was impaired and deep sets produced fewer fish. Shallow water sets, however, could be set by wading in the water and the funnel could be cleared by careful setting of the trap. Even in clear areas in deep water the traps usually produced fewer fish. The brood stock was small compared to the young-of-the-year fish present and the young fish were concentrated around the shore areas. In circumstances where the traps are being used in natural ponds where there are many adult fish deep sets may be warranted, but in drainable ponds where the production is on a yearly basis they are not necessary.

Selectivity of the traps. The ponds in which the glass trapping experiments were carried out had either young-of-the-year fish only or young-of-the-year fish plus the brood stock. Since the number of brood stock was relatively few the majority of the fish being trapped were young fish and only occasionally would any of the brood stock show up in the traps. Although the fathead minnows and golden shiners have a prolonged spawning season and small fish were present it was noted that the majority of the fish trapped were of the larger size classes. It is suggested that this size selectivity of the traps was due to differences in feeding habits or behavior of the fish at various ages. About 75 percent of the fish that were taken in

the traps were retained by a sorting box constructed of one-quarter inch hardware cloth and were of a salable size. Only 13 percent of the fathead minnows were salable upon final draining of the pond and removal of all the fish. Thus it is shown that the glass traps take the larger minnows in a proportion far greater than their abundance in the pond.

Interference of other aquatic organisms was negligible throughout the early part of the trapping season. By August 21, however, the tadpoles had increased in size and numbers to a point where they were definitely a nuisance. Up to this time the tadpoles that had been entering the traps could be easily picked by hand from the sorting box. By the latter part of August there were so many tadpoles entering the traps that they had to be removed by the use of a one-half inch sorting box. This abundance of tadpoles in the pond suggested the use of a fish in the pond that would utilize the tadpoles without interfering with the minnow production. Perhaps the bullhead would serve this purpose and at the same time be a source of food for human comsumption. Adult bullheads were used during the summer of 1949 in ponds with minnows and the tadpoles were not abundant and minnow production was high. Much difficulty was encountered, however, in harvesting due to the interference of the young bullheads in the traps and the sorting that was necessary when the fish were mixed together. If there was a legal market for young bullheads as bait they could be sold, but the present laws prohibit their use.

Barometric pressure. Barometric pressure has long been thought to influence fishing results (Hazzard, 1950). A recording barometer was in operation at the Hastings Hatchery during the time the trapping operations were conducted. These records were used to determine if there was any correlation between trapping results and barometric pressure trends. Upon comparison of the catch per trap per hour with the barometer trend it was found that all daytime trapping was done on a steady or falling barometer. This could be used in comparison of the catch on a steady and unsteady barometer. On the basis of the inconclusive evidence presented in Table 6 it appears as if the fish trapped more readily on a steady barometer. The total average of the catch per trap hour of all trapping supports this conclusion and the average catch of fathead minnows shows a greater correlation than the other species. The interaction between the various types of fish and the trend of the barometer is not taken into consideration, although it is recognized that there is a difference in susceptibility of the fish to the traps. The data, although inconclusive, are presented since it appears that barometric pressure affects the results of trapping for minnows.

TABLE 6

CORRELATION OF BAROMETER AND CATCH OF MINNOWS IN TRAPS.

FIGURES REPRESENT CATCH PER TRAP HOUR.

Type Of Fish	Barometer Trend	
	Falling	Steady
Fathead		57.1
Fathead		95.6
Fathead	44.5	
Fathead	25.9	
Ave.	35.2	76.3
Sucker	7.3	
Sucker	7.3	
Sucker	12.3	
Ave.	9.0	
Shiner		29.0
Shiner	40.5	
Shiner	37.2	
Shiner		52.8
Ave.	38.8	40.9
Chubs	11.6	
Chubs		14.9
Ave.	11.6	14.9
Total Ave.	23.7	44.0

DISCUSSION

The artificial propagation of bait fishes can be a profitable and successful way of meeting the increasing demands of fisherman for good bait minnows. The four species of fish raised at the Hastings hatchery during the summer of 1950 give additional evidence that a large crop of bait minnows can be produced quite successfully in small ponds. Certain fishes such as the golden shiner and fathead minnow are well adapted to small ponds. They will spawn quite successfully and large numbers of marketable bait fishes will be produced the first season. The rate of growth is rapid enough to insure a reasonable number of salable fish by August of the first summer. Other fish, such as the creek chub and white sucker, will not spawn successfully in small ponds since they normally spawn in small swift streams. If fry can be obtained from another source they can be successfully raised in small ponds with a minimum of effort. In Michigan, fry are made available to bait dealers by the Fish Division of the Department of Conservation at a nominal cost. This initial cost is more than compensated for by the value of the fish upon final harvest. After 96 days the chubs averaged three inches in size and would have brought a good price on the market as bass size minnows.

Harvesting operations can begin whenever a sufficient number of the fish reach a salable size. There is no reason to believe that removal of the salable fish from the ponds early

in the season will be detrimental to the total production at the end of the season. On the contrary, their removal should increase the overall production of salable fish since the limiting factor in most cases is the amount of food that is available to the fish. The available food organisms can be controlled to a certain extent by proper management of the ponds. The use of fertilizer in pond management for increasing the food organisms is well established (Ball, 1949). Artificial feeding can also be used to increase the total production of fish from the ponds.

Throughout most of Michigan there is a constant demand for bait fishes and at the present time all indications suggest a ready market at profitable prices for all of the fish produced. The production of bait fishes in ponds would be advantageous to bait dealers since it would insure them of a constant supply that is readily available. At the present time minnow dealers often travel hundreds of miles to obtain fish and extensive holding and transporting facilities must be available. Large losses are sustained by the minnow dealers that sometimes reach 80 per cent of the fish they handle (Dobie, 1947b). Thus a waste in fish and effort on the part of the bait dealer arise.

In pond operation, however, the fish can be harvested as they are needed and a faster turnover between dealer and fisherman would result. Thus the fish would be in better condition when sold and a much higher return on the number of fish handled would be experienced. Sales would probably be increased

considerably since fisherman often travel many miles to obtain bait and a dealer who could be depended on for good bait would get a high proportion of the business.

The method used in the removal of the fish from the ponds will depend on many factors such as the type of bottom, depth of the pond, the aquatic vegetation and other obstacles, and the labor force available. In early harvest of the fish seines, lift nets, and glass traps are available. Of these methods the glass traps are the most flexible and have proven an effective way to remove fish from ponds. The glass traps can be used in any kind of pond and can be operated effectively and inexpensively by one man. Both natural and artificial ponds can be used for bait fish production. Artificial ponds are usually constructed with a drain which enables the operator to completely harvest the fish in the pond in the fall of the year. If natural ponds are used all of the fish in the pond should be eliminated before stocking the pond with bait minnows. The presence of even a few carnivorous fish in the pond would reduce the number of marketable fish that the pond can produce. A large seine would have to be used to harvest the fish in the fall of the year and repeated hauls with the seine would be necessary to remove as many fish as possible. A complete harvest would be impractical because the cost for the effort involved would exceed the return.

SUMMARY

1. Fathead minnows, golden shiners, northern creek chubs, and white suckers were propagated at the Hastings State Fish Hatchery in southwestern Michigan during the summer of 1950.

2. All of the ponds used were fertilized during the early part of the season to increase the fish food organisms. A high production of bait fishes was obtained from the ponds and the growth rate of the fishes was good.

3. The market prices of the fish that were produced were determined by interviewing several bait dealers in the Hastings area. The demand for bait minnows was fairly steady and the prices were stable in the area as a whole, but they are subject to change depending on the demand and availability.

4. The value of the fish as bait minnows was high enough to insure an adequate return for the cost and effort involved.

5. Several methods for harvesting the fish from the ponds were investigated. These methods included the use of seines, drainable ponds, lift nets, and glass traps. The first three methods are old and well established in hatchery operations, but little use of glass traps has been made for this purpose.

6. Long hauls with a seine that is large enough to cover much of the area of the pond are effective in removing fish from a pond. Many factors such as vegetation, depth, and type of bottom restrict the use of a seine, however, and the universal effectiveness of a seine should not be overestimated.

7. If a pond is to be constructed the addition of a drain is highly recommended. Drainable ponds are more productive and thus more profitable than non-drainable ponds. Natural ponds can be used for the production of bait minnows, but the lack of a means to remove the water interferes with the proper management of the pond.

8. Lift nets are used by many commercial fish hatcheries where large numbers of fish are being raised by artificial feeding in limited areas. Under these conditions lift nets are very effective as the fish can be highly concentrated in the ponds. In ponds where the fish are utilizing natural food the lift net did not prove too successful.

9. The glass traps proved effective in trapping fish in ponds. They can be used successfully in many types of ponds, are economical to operate, and can be operated by one man. It was possible to remove an average of 5,056 salable fathead minnows in an eight hour day throughout the latter part of the season.

10. Many factors influence the catch of minnows in the traps. The traps should be fished during the mid-day hours and baited with a cereal bait for maximum results. Many short sets are more productive than one long set over the same period of time. A maximum of 15 traps in a trap line can be successfully operated by one man on a short lift schedule.

LITERATURE CITED

American Public Health Association
1946 Standard methods for the examination of water and sewage. Am. Pub. Health Assoc., New York 9th. ed., 286 pp.

Bacon, Edward H.
1951 Experimental use of carp pituitary in the production of fish. Unpublished M. A. thesis. Michigan State College, 80 numb. leaves.

Ball, Robert C.
1949 Experimental use of fertilizer in the production of fish-food organisms and fish. Mich. State Coll., Agr. Exp. Sta., Tech. Bull. 210, 28 pp.

Beckman, William C.
1940 Increased growth rate of rock bass, Ambloplites rupestris (Rafinesque), following reduction in the density of the population. Trans. Am. Fish. Soc., 1940, 70, 143-148.

Carbine, W.F.
1940 Michigan Minnow dealers. Michigan Department Conservation, I.F.R. (Unpublished) Report No. 627.

- - - - - - -
1944 Observations on the use of glass minnow traps in marginal trout streams in Oakland and Macomb counties. Mich. Dept. Cons., I.F.R. (Unpublished) Report No. 916.

Cooper, Gerald P.
1935 Some results of forage fish investigations in Michigan. Trans. Am. Fish. Soc., Vol. 65, pp. 132-142.

Dobie, John
1947a Artificial vs. natural minnow ponds. Cons. Vol., July-Aug.

- - - - - - -
1947b Handling and holding of minnows. Cons. Vol., Nov.-Dec., pp. 34-36.

Dobie, J.R., O.L. Meehean, G.N. Washburn
1948 Propogation of minnows and other bait species U.S. Dept. Int., F. and W.S., Cir. 12.

Edminster, Frank C.
1947 Fish ponds for the farm. Charles Scribner's Sons, New York.

Hazzard, Albert S.
1950 Theories can't catch trout. Outdoor Life, Vol. 106: No. 4, Oct. 1950, pp. 30-31.

Langlois, T.H.
1937 Bait Culturists Guide. Ohio Dept. of Agr. Bull. No. 137, Div. of Cons.

Lawrence, J.M.
1949 Construction of farm fish ponds. Circ. No. 95, Agr. Exp. Stat., Ala. Poly. Inst., Auburn, Ala.

Schaeperclaus, Wilhelm Translated By F. Hund.
1933 Textbook of pond culture. U.S. Dept. Int., F. and W.S., Fishery leaflet 311.

Smith, E.V. and H.S. Swingle
1941 The use of fertilizer for controlling several submerged aquatic plants in ponds. Trans. Am. Fish. Soc. 71: 94-101.

Swingle, H.S. and E.V. Smith
1938 Fertilizers for increasing the natural food for fish ponds. Trans. Am. Fish. Soc., 68: 126-135.

- - - - - - - and - - - - - -
1942 Management of farm fish ponds. Ala. Agr. Exp. Sta., Bull. 254, 23 pp.

Washburn, George N.
1945 Experimental use of glass minnow traps in certain Michigan trout streams. Mich. Dept. Cons., I.F.R. (Unpublished) Report No. 984.

Yoder, C. Troy
1948 The use of glass minnow traps in trout streams. Mich. Dept. Cons., I.F.R. (Unpublished) Report No. 1173.

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