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Bureau of Fish Management

Report No. 18

MANAGEMENT OF WALLEYE IN THE UPPER MIDWEST

by

John Klingbiel

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WISCONSIN DEPARTMENT OF NATURAL RESOURCES

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INTRODUCTION

Because the midwest has an abundance of walleyes and a number of active management programs, there has been considerable interest in the status of this species and their management. This paper is an attempt to summarize information on midwest walleye populations and management. This has been done by reviewing available literature and polling 11 states, Ontario and the U. S. Fish and Wildlife Service for current information. Information from Wisconsin was depended upon heavily.

Wherever the walleye is found in the midwest, it is highly prized. It is extremely widespread throughout the northern portion of the area and less so in the south. It is a species generally associated with large rivers and drainage lakes although excellent populations are also sometimes found in smaller landlocked waters as well. Many of the large impoundments also contain substantial populations even in drainages where they are not native.

In the Dakota's, Minnesota, Wisconsin and Michigan as well as in southwestern Ontario, the walleye is probably the most popular species of the larger warmwater game fish. In 1967, Wisconsin anglers alone were estimated to have taken about $4\frac{1}{2}$ million walleyes (Churchill 1968). It is estimated that this species contributes about \$4 million annually to South Dakota. (Hanten, personal correspondence) This is in contrast to Indiana and Illinois where the species is of rather minor importance because suitable habitat is very limited.

POPULATION AND HARVEST DATA

Even though the walleye is an extremely important sport fish, it is also harvested commercially in some of the larger waters which can support both commercial and sport fishing. Most states as well as Ontario allow commercial fishing in all or part of the Great Lakes within state boundaries. The Canadian provinces have inland commercial fisheries, some of which are dependent basically upon walleyes. In 1967, over 1,700,000 pounds valued at about \$550,000 were taken from Ontario's inland waters (Clark, personal correspondence). Minnesota has a commercial fishery in three large waters where production is about 900,000 pounds annually.

Natural walleye populations sometimes become quite abundant and comprise a significant portion of the standing crop. In Big Sand Lake, Wisconsin, population data suggests that they comprise more than half of the total poundage of fish (Niemuth and Klingbiel 1962). In 1951, Escanaba Lake, Wisconsin, contained 31 adults per acre (Patterson 1953). The population was probably even larger than that in the previous year when 20 per acre were taken by anglers (Churchill 1957). Adult populations from other parts of the midwest include 21 per acre in Storm Lake, Iowa, (Rose 1949) 8.5 per acre in Clear Lake, Iowa, (Whitney 1958) and 6.4 per acre in Maloney Reservoir, Nebraska, (Thomas, personal correspondence).

Natural mortality studies including those reported by Olson (1958), Mraz (1968) and others indicate annual adult mortalities of less than 10%, but annual angler exploitation of 20% to 30% is not uncommon even with only moderate fishing pressure. Substantial populations exist in many waters, however there are others where anglers are almost completely unsuccessful in catching them.

Wisconsin alone has over 1,200 lakes containing walleyes. These waters cover about 725,000 acres excluding the Great Lakes. Minnesota and Ontario have even more waters containing this species. Populations in many waters are quite stable, producing good natural year classes annually or every two or three years. Other waters, however, have tremendous population fluctuations. Causes of the fluctuations are not always known but at times are quite evident. High onshore winds, fluctuating water levels and high predator populations are sometimes limiting factors. Management measures are necessary in these unfortunate situations.

STOCKING PRACTICES

A great deal of stocking is done in the midwest. (Table 1) Most states stock fry annually and about half stock fingerlings. In many states more stocking would be done of both fry and fingerlings if they were available. Fingerlings range from slightly over one inch to about five inches with a few being somewhat larger. The most consistently successful stockings are in new impoundments or rehabilitated lakes. Fry are usually used for this purpose; however, at least one population has become established by stocking eyed eggs.

Although the success of introductions in waters with established populations of other species is variable, some excellent populations have developed. In order to enhance survival in these situations as much as possible, Ontario now uses adults for introductions.

Support or maintenance stocking in waters with existing walleye populations is done mostly in cases where natural reproduction is limited or erratic or where populations of other species have been reduced. Results of stocking fingerlings smaller than 3 inches have been generally poor in waters where established populations exist.

Stocking has been attempted in order to strengthen predator populations in waters having slow-growing panfish. This was tested in 11 Wisconsin lakes by stocking fingerlings at rates of 49 to 258 per acre. In only one lake was significant survival found, and in that water there is some indication of increased panfish size.

An objective evaluation of stocking is not always easy. It can be measured in terms of survival rate, year class strength, contribution to the harvest or cost of stocked fish harvested. The estimation of success depends a great deal upon the basis of measurement. For example, Kempinger (in press) reports on a stocking of 166 fingerlings per acre made in 1954 in Escanaba Lake. Through 1966, 13.6% were caught by anglers. This may be considered by some to be a poor return; however, stocked fish comprised 77.4% of the 1954 year class and 35.2% of the angler catch in the next 5 years after stocking. Considering the cost of producing and stocking the fish, each one creel cost 66¢.

Many would consider this stocking as unsuccessful because of the low percent caught by anglers. This stocking contributed a great deal to the angler harvest however, and the cost compares very favorably with returns from trout stocking. This fingerling stocking, however, is one of the most successful reported.

There is a good deal of discussion regarding the merits of fry versus fingerling stocking. The discussion centers around survival and economics. Survival is extremely difficult to assess in waters already having walleyes. A number of investigators have stocked waters every second or third year in an attempt to correlate year class strength with stocking and in a few states this is a normal procedure. However, erratic natural reproduction may mask results entirely. There are a few instances, however, where large year classes consistently correspond to years of fry stocking. Clear Lake, Iowa, (Carlander et. al. 1960) Lake LaBelle, Wisconsin, (Kleinert 1967) and Big St. Germain Lake, Wisconsin, (Kempinger 1968) are good examples. There is little doubt that stocking at rates of 2,000 to 5,000 per acre have contributed significantly in these lakes. There are many other waters, however, including four reported by Kleinert (1967) and two by Kempinger (1968) where year class strength could not be correlated to fry stocking at these same rates.

Variability in results of fingerling stocking is widespread. Kempinger (1968) indicates that only one of four stockings in Escanaba Lake contributed significantly to the angler's catch. Mraz (1968) reported little contribution to the population for four stockings in Pike Lake while Williamson (1965) indicated some survival but no significant augmentation of the population in two lakes.

Little work has been done in comparing results of fry versus fingerling stocking in the same waters in any particular year. Considering Wisconsin's 1966 production costs of \$.3431 for 1,000 fry and \$12.30 for 1,000 fingerlings, survival of fingerlings must be at least 36 times greater than fry in order to justify their use.

Wisconsin and Ontario have stocked some yearlings. Three Wisconsin lakes stocked last spring have been sampled in the fall and survival has been found in each. The extent of survival is not yet known, but it appears to be substantial in at least one case.

Reasons for stocking failure have been considered at length. It is thought by some that the principal limiting factor in fry survival is zooplankton abundance for several weeks following stocking. Work done in four southeastern Wisconsin lakes does not support this hypothesis (Krone 1968). Undoubtedly, other factors as well as lack of plankton are important in fry mortalities.

There is some thought that the abundance of natural walleyes has an effect upon survival of stocked fish. Comparisons between natural fingerling abundance and stocking survival failed to establish a firm correlation in work done in South Dakota (Jurgens 1965) and Wisconsin (Kempinger, in press). Many investigators believe that large populations of yearlings reduce survival of stocked fish. A number of waters having strong year classes in alternate years have been reported and used as examples to support this premise. There are also other waters, however, which have a number of consecutive large year classes.

It is strongly suspected that in some cases the fish that are stocked are in poor condition. This may be caused by poor physical or chemical conditions in rearing or handling. A condition sometimes called whitetail has been noted among fingerlings. The caudal fin becomes white and the fish listless and weak. The cause of this condition is unknown, but because it appears very rapidly when harvesting or handling a group of fish, there is strong suspicion that it may be caused by shock. When it appears, usually a large percentage of the fish are affected and serious mortalities can be expected in a very short time.

There is little doubt that the size of the fish at the time of stocking is important. There is strong opinion and some scattered evidence that the larger the fish stocked the better the survival that can be expected. It is reasonable to believe, however, that the size of the fish should be correlated with the phenology of the water. In most cases, stocked fingerlings are considerably smaller than natives. A small fingerling stocked early in the summer when it is the same size as the native fingerling may have a better opportunity of survival than a somewhat larger fish stocked in fall when it may be considerably smaller than the native fingerling and probably too small to eat most of the available forage fish.

The question of stocking rates can also be discussed at length. If, as has been reported earlier, the abundance of native fingerlings has no effect upon the survival of stocked fish, it is probable that the survival rates will not vary with the stocking rates. There is little experimental evidence favoring a particular rate.

The abundance of natural fingerlings may shed some light upon desirable stocking rates. A population of 775 per acre in Little John Lake, Wisconsin, was considered by Williamson to be excessive (1965). Kempinger (in press) indicates that in Escanaba Lake, fall fingerling levels ranged up to 108 per acre and overwinter survival averaged about 50%. Survival of the fall fingerling population to age III was 10 to 15%. If we assume a 15% survival from fall fingerlings to age III and relate it to population levels, a minimum basis for stocking is suggested. Assuming that mortality rates for stocked fish are equal to that of natives, the annual stocking of 50 per acre will provide a cumulative population of fish of age III and older of 20 per acre. This figure assumes an annual angling mortality of 25% and an annual natural mortality of 10% for fish of age III and older (Fig. 1). Twenty per acre is an abundance level which has been reported from several sources previously.

It is apparent from sampling that in most cases large reductions in numbers take place within a few weeks after stocking. Therefore, if a substantial year class is to be produced by stocking, the rate should probably be higher than 50 per acre, perhaps closer to 100 per acre.

Stocking rates vary drastically from state to state and are probably more regulated by production and economics than by biological factors. Wisconsin uses as a guideline a sliding scale for different size lakes. The larger the lake, the smaller the per acre stocking rate. A 100-acre lake would receive 20 fingerlings per acre whereas a 1,000-acre lake would receive 7.8 per acre. Deviations are made, however, whenever conditions warrant.

PROPAGATION PRACTICES

Spawning operations are generally similar throughout the midwest. Eggs are taken from wild brood stock and hatched in jars. Normally, either bentonite or clay is used to keep the eggs from lumping. During incubation a daily flush treatment with malachite green tends to alleviate fungus problems. About 55% to 70% of the eggs hatch.

Fry are placed in rearing ponds preferably the day they appear in the fry tank. Wisconsin stocks their rearing ponds at a rate of 75,000 per acre. Drainable ponds are preferred, but natural ponds and small lakes are also used. Minnesota has more drainable ponds in use than any other state. They also have the highest fingerling production.

Natural ponds are not normally managed intensively. Fertile ponds are chosen and the natural plankton and bottom fauna are depended upon as a basis for production. Drainable ponds are usually managed quite intensively, however. Aquatic vegetation is controlled and oil is used to kill predatory aquatic insects. Many types of fertilization programs are used. Probably the most detailed work on walleye ponds and particularly fertilization in the midwest has been done by John Dobie in Minnesota. He recommends fertilization based upon pond soil type rather than water quality (Dobie 1958). Barnyard manure and yeast are used along with green fallowing. He indicates that food shortages can be expected early in the season unless the soil contains at least 4% organic matter. Harvesting is generally begun at the end of June in drainable ponds. If cropping is delayed substantially, numbers decline rapidly. Early cropping is done mostly by establishing a current of fresh water and trapping as the fish move into the area. The pond is gradually drained as the harvest continues and it is normally completed by August. Ponds are then treated with fish toxicants. In North Dakota ponds are left fallow every third year to help build fertility.

In Wisconsin, cropping does not begin in natural ponds until the middle of July and it continues until October. Harvesting is done by seine. The objectives of July cropping are to remove cannibalistic fish which are much larger than the others and to reduce the population in order to obtain additional growth and maximum pounds of production. Both survival and harvest are extremely variable in natural ponds. In 1968, two of Wisconsin's natural ponds produced about 200 pounds of fingerlings per acre, but the average for all ponds was 42 pounds per acre (Fig. 2). Although the greatest survival rate was 40.5% the average was 7.8% (Fig. 3). This data is from 34 ponds, 4 of which had no production. Generally, 50 pounds per acres is considered good production.

Wisconsin has a 23-acre drainable pond which has been used for walleye fingerling production for many years. In the last 5 years, annual production has averaged 94 pounds per acre and survival averaged 67%. Excluding 1 year in which production was very low, the harvest averaged 116 pounds per acre and 83% survival was obtained.

Because of the very erratic and questionable benefits from stocking very small fingerlings, Wisconsin has recently changed its emphasis on walleye propagation. Attempts are now being made to raise larger fish of high quality even at a sacrifice of numbers. It is thought also that survival can be enhanced by stocking in the spring when forage fish supplies would be at their highest level.

In 1968, the first year of the trial yearling production program, 35,500 were produced. Although large numbers were not obtained, important information was gained. No significant growth in length or weight can be expected from the middle of November until the middle of March even if proper sized forage minnows are present. In one pond where small minnows were not available, fish lost weight during the winter. In the two ponds utilized, survival was 62% and 41%.

It appears that in Wisconsin fingerlings will not grow to be larger than about five inches by fall unless fish are part of their diet. In order to obtain maximum growth, it appears that proper sized forage fish should be fed as early as possible. Late perch or sucker fry followed by fathead minnows will be used. Faster growth encouraged by feeding minnows appears to encourage uneven growth and cannibalism. Operationally, this will be controlled by early harvesting from one pond and restocking of small even-sized fingerlings in other ponds where small forage fish are abundant. These ponds will then be harvested in the fall and even-sized fish stocked in other ponds for additional growth and holding overwinter.

There has been some experimental work on feeding walleyes artificial food. There has been some success; however, this has not been on a production basis and much work is yet to be done.

HABITAT CONTROL

The control of the environment is of paramount importance to walleye management. Pollution control is now in the national forefront and much effort is being placed in this direction. The manipulation of water levels, particularly during spawning season, is also important. Most states attempt to execute agreements to maintain fairly stable or slightly rising levels during spawning and incubation periods. Stable levels have not proved to be necessary at other times of the year, however. Some of Wisconsin's best populations exist in water storage reservoirs which are lowered as much as 18 feet each winter, reducing their surface acreage to 25% of normal. Levels remain low throughout the winter and increase in the spring. Fortunately in most of these impoundments, levels are not raised rapidly enough to be detrimental. In some cases, major spawning occurs in inflowing streams.

Because of the greatly increased emphasis upon human development around lakes and streams in the midwest, a few states are purchasing or obtaining easements on spawning areas. Most of the emphasis has been placed on controlling stream sites which are smaller than those on lakes and could be damaged more easily.

Artificial spawning beds are being constructed in a number of states. Generally, these consist of coarse gravel and rubble deposits in shallow waters. Some have proved unsuccessful, apparently because they were placed too deep. Johnson (1961) reported on spawning taking place on a sandy area which was later changed to a gravel rubble bottom. With this change egg deposits increased 10 times and estimated fry production more than 100 times. Although the total effect upon an adult population is unknown, at least six midwestern states have constructed artificial spawning beds and much interest exists.

ANGLING REGULATION

Generally, the states where walleyes are most important have the most restrictive regulations. (Table 2) This does not mean that they have become important because of restricting regulations, however. The general attitude seems to indicate a trend toward more restrictions. Even Ohio, the pioneer in liberalization, went from no limit to a bag of 10 in 1968. In 1969, Michigan's season will be one month shorter than previously.

All states now have a bag limit; this ranges from 4 to 10 per day. About half have closed seasons, all of which include the spawning season. Only 4 states close their season in midwinter. Only Michigan has a size limit. Almost all states have variable regulations in certain sections. Although Wisconsin has rather stringent general regulations it also has certain waters with relaxed regulations as well. This seems to be the case in many states.

Fishery workers in many states are not completely satisfied with their regulations. However, in other places, satisfaction is shown by referring to good angler catches and population abundance. Olson (1968) indicates that in Many Point Lake, Minnesota, a higher sustained yield in pounds could be obtained if fishing intensity were lowered. This is assuming that natural mortality and growth rates were stable. Some work has been done regarding the effect of regulations upon the angler catch. Priegel (1967) found that in Lake Winnebago and its tributaries, from 33% to 64% of the annual angler harvest was made during the month of normal spawning when the season is closed in most Wisconsin waters. In ten years of creel census on Escanaba Lake, a closed season of January 16

through May 14 would have reduced the catch 16%, a bag of 5, 13%, and a 13-inch size limit, 39% (Churchill 1957). Catch reductions caused by regulations depend upon the habits of the angler as well as population structures. Although the angler harvest is reduced by regulation, the effect upon the population itself is rarely known.

OUTLOOK

There is increasing interest on the part of sportsmen, the recreation industry and fishery administrators to intensively manage waters for walleye. Increasing abundance in many waters such as the main stem reservoirs on the Missouri River has helped to bring about this increased emphasis. The more widespread use of toxicants followed by successful walleye introductions and good angling has also contributed to additional interest.

Historically, walleye management has been synonymous with stocking in the eyes of much of the public. Because of this attitude, fisheries administrators are under pressure to initiate or increase stocking programs. Some resist because of the lack of consistent results while others are eager to increase their program because of those waters which have responded. All agree that under certain conditions stocking is successful. These desirable conditions have not been fully identified and, until they can be, results will continue to be erratic. Since the factors involved include the quality of the stocked fish as well as the ecological conditions of the waters to be stocked, the fish culturist and administrator must make sure that the highest possible quality fish are available for stocking. In many cases in the past, emphasis has been placed only upon the waters to be stocked.

A recognition of other management practices is becoming increasingly essential. The regulation of impoundment water levels to favor walleyes is in many cases becoming easier because of legislation and public opinion. Protection of natural spawning areas by land control and legislation is increasing. The management of waters with only limited spawning potential appears to be more practical than in the past through the use of artificial spawning beds.

Probably the most effective method of walleye management continues to be stocking following lake rehabilitation. The development of better toxicants and more widespread public acceptance of chemical rehabilitation will increase effective management markedly.

It behooves the manager to utilize the tools which are most effective and tailor them to fit his own situation. A good walleye management program will gain a great deal of support and confidence on the part of the public, and the entire fisheries program will, therefore, be furthered.

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TABLE 1. Approximate number of fry and fingerling stocked annually* in state or province.

	Millions of Fry	Thousands of Fingerlings
Illinois	0	0
Indiana	0	0
Iowa	100	up to 50
Kansas	10 to 12	0
Michigan	5	0
Minnesota	175 to 200	6,000 to 7,000
Missouri	3 to 5	0
Nebraska	0	800
North Dakota	5 to 6	600
Ohio	30	0
Ontario	up to 27	157
South Dakota	8 to 10	500 to 600
Wisconsin	55	3,200

* In some cases figures are only for 1967 or 1968 because of variable programs.

TABLE II. General Angling Regulations by State or Province

	Closed Season	Bag Limit	Min. Size
Illinois	none	10	0
Iowa	Feb. 16 thru April 26	5	0
Kansas	none	5	0
Michigan	March 1 thru May 14	5	13"
Minnesota	Feb. 16 thru May 14	6	0
Missouri	none	4	0
Nebraska	none	8	0
North Dakota	6 weeks variable-spring season	5	0
Ohio	none	10	0
Ontario (southwest)	April 14 thru May 14	6	0
South Dakota	none	8	0
Wisconsin	Feb. 15 thru May 9	5	0

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Fig. 1 Theoretical population and natural and angling mortalities in relation to fall fingerling population assuming 15% survival to age III, 10% annual natural mortality and 25% annual angling mortality.

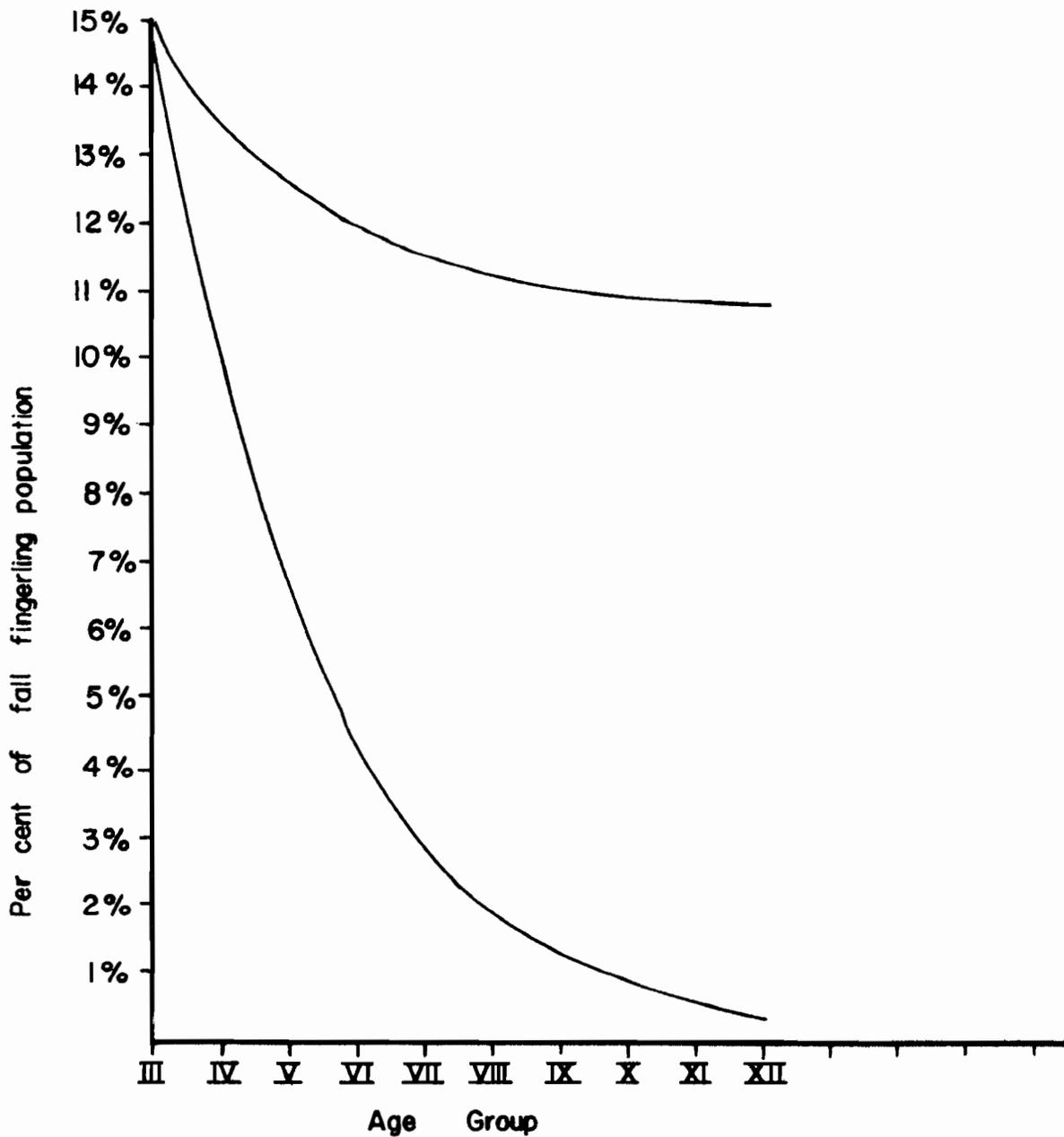


Fig. 2 Harvest of fingerling in pounds per acre in natural rearing ponds in Wisconsin in 1968.

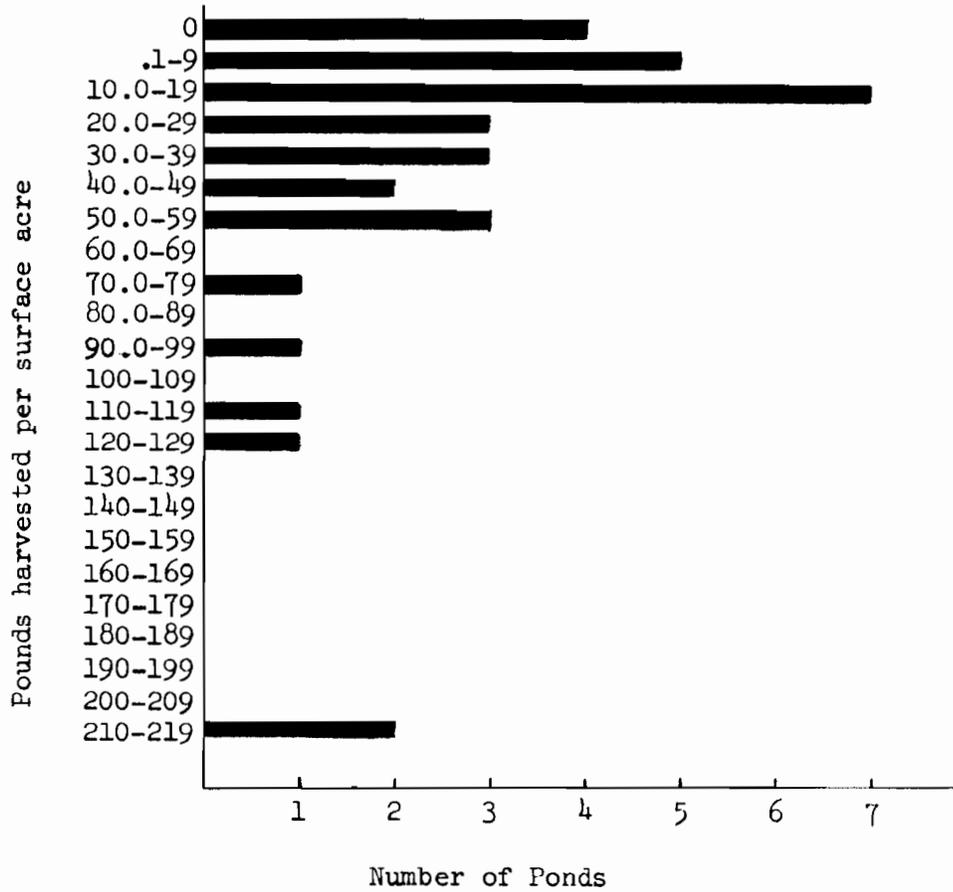


Fig. 3 Percent of survival from fry to fingerlings harvested in natural rearing ponds in Wisconsin in 1968

