Observations on large and smallmouth bass nesting and early life history. No. 11 1964

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OBSERVATIONS ON

LARGE and SMALLMOUTH BASS NESTING

AND EARLY LIFE HISTORY

By
Donald Mraz

WISCONSIN CONSERVATION DEPARTMENT
Research and Planning Division
October, 1964

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INTRODUCTION

Both the largemouth bass Micropterus salmoides (Lacepede) and smallmouth bass Micropterus dolomieui (Lacepede) have been studied extensively and hundreds of papers on various aspects of their life history have been published. What generally is not available are the methods observers have used to gather their data, particularly during the early life stages. Once a person has worked with these species for a time he gradually accumulates a supply of techniques and knowledge of habits that become so routine and commonplace he himself forgets that he didn't always know them.

The purpose of this report is to assemble the various bits of knowledge accumulated over the past 10 years, which were outside the scope of the specific research project. The techniques presented here and the discussion of common and unusual situations encountered will perhaps cut down the time loss of others who are called upon to make detailed observations on these two species. The fisheries man working with bass generally has about 2 weeks, but often less than one week, to make observations during the spawning season. Time wasted and observations lost cannot be made up until the following year. Also given are ideas and suggestions that should be useful to the small pond owner who raises bass.

A more thorough description of the largemouth bass can be found in Wisconsin Conservation Department Publication 232, "The Largemouth Bass, Its Life History, Ecology and Management." The publication also contains a listing of over 50 papers concerning the largemouth.

LOCATING NESTS

It is well known that the male largemouth bass begins his nest building when water temperatures reach 60° F, and egg laying takes place at 62-65°F. Arrival of these temperatures should be anticipated and the program of observations initiated at once.

Shallow bays should be examined before the lake proper. Higher water temperatures will usually exist in these localities and it is there that the earliest spawnings will take place.

A good method to follow is to examine the west and north shorelines of a body of water first, because these areas will usually have more nests. Two reasons may account for this: (1) prevailing winds are from the west and north and nests built in shallow water on the east and south shores are more subject to destruction by heavy wave action during storms; (2) most of the nest building and spawning activity we have observed takes place early in the day. The west and north shores are favored by the early morning sunlight. At the Delafield ponds, a nest was rarely built on an east or south shore despite similar bottom types on all sides of the ponds.

It is generally assumed the male largemouth builds his nest on gravel in 1 to 3 feet of water. While this is an excellent area to make initial searches, no type of habitat should be overlooked as possible nesting sites. We have observed nests on about every substrate imaginable.

When searching gravel areas the nest can usually be recognized as a clean large circular depression. THe nest diameter varies as the size of the fish--usually the nest is one and a half times the length of the fish. Even in areas of excellent visibility it is often much easier to spot the adult fish rather than the nest itself. If a bass is seen to dart away from an area and the nest is not obviously noticeable, it frequently pays to sit quietly for a few minutes, await the return of the fish and then proceed to the nest.

In shallow muddy bays, the fish will fan out depressions as much as a foot deep to get down to sand, gravel, or even a firm layer of sticks. Nests of this type are fairly easy to notice as the depression is in great contrast to the surrounding bottom type.

Other nests in this kind of habitat are found on leaf or stick deposits and there is no indication they exist. In these areas it is best to have one man paddle the boat slowly while another keeps a sharp lookout for the fish lying quietly above the nest. Once the fish is seen, proceed to the exact area and make the necessary observations. This is the best procedure in any area where nests are not very obvious.

It is my impression that in many lakes bass are spawning in deeper water than formerly. Conversations with many lake shore property owners seem to bear this out. An apparent reason, though not necessarily the true one, is that more and more shoreline is developed each year and more and more boating traffic is occuring. In southeastern Wisconsin, it is difficult to find a hundred feet of shoreline without a pier. It seems reasonable that the male bass would seek deeper water where he can perform his paternal function without getting scared away from his nest several times a day.

The building of nests in deeper water presents additional problems for the observer. Unless the water is extremely clear, observations are useless except around concrete pier footings. Many nests have been found on footings that are

partially covered with algae or on large algae-covered stones. There is of course little resemblence to the typical largemouth nest. It appears as if an effort was made to fan the algae away but the eggs can be found among the algae still on the stone.

Our experience has been that most nest building takes place in early morning. The activity is apparently vigorous. We once found a nest full of eggs in a spot where a half hour earlier there wasn't even a nest present! An area was usually examined in late afternoon and no nests found. Observations by mid-morning of the following day, revealed several nests. However, continued observations throughout the day failed to show many new nests.

Water temperatures controlling smallmouth bass nesting are nearly identical to those for largemouth. Where the two species occur in the same waters, however, the largemouth probably spawn first. The reason for this is the wide variety of bottom types used by the largemouth. He will enter the shallow muddy bays where the water warms faster, while the smallmouth uses the gravel areas usually in the lake proper. Both species have been observed in the Delafield ponds and there the nesting and spawning function as related to water temperatures was identical.

A great variety of nesting conditions has been recorded for the largemouth bass but the same cannot be said for the smallmouth bass. In observations at Lake Geneva, Walworth County, a deep clear water lake, and the shallow ponds at Delafield we have never found a smallmouth nest that could be described as other than a "perfect" nest: a large, perfectly circular, clean gravel structure.

The male smallmouth seems to prefer to build alongside of stone cribs, logs, oil drums, large boulders, and the like--a fact helpful in locating smallmouth nests. This apparently gives him the feeling of security as he has a rear guard and only has to protect in three directions. Frequently two nests have been found by the same large block; one each on opposite sides. When water is fairly deep and such objects can be sighted, they should be examined closely for nests.

This facet of smallmouth behavior was utilized at Lake Geneva where concrete building blocks were placed on the lake bottom in an effort to concentrate nesting and facilitate spawning observations. Many of these blocks were utilized and the principle may have merit as a habitat improvement device or for concentrating spawning if it is desired.

Smallmouth nests were also found in open areas and in water 20 feet deep. Most, however, were found in 6 to 10 feet of water.

MARKING NESTS

Once a nest has been located and continued observations are desired, it is advisable to mark the nest either for easy relocation or positive identification of the same nest. In pond studies, or possibly shallow bays where relocation may be difficult, a wooden lath can be used. It is easy to write on with crayon and a nest history can be kept right on the lath. Willow or other sticks can also be used for site locations.

In deep water, the use of unsold deer or shooting preserve tags is very convenient for nest identification. They are numbered in series and can easily be placed alongside the nest. The tags can be retrieved by a small magnet on a string, the number checked, and the tag returned. A word of caution on this method when working with smallmouth is to deposit the tag about 3 feet from the nest. We once placed one right in the nest and the fish picked it up, swam out

of sight, dropped it, and returned to the nest.

Another useful procedure when working with a series of nests where exact location cannot be marked by using sticks is to carry a set of small cork or wooden floats tied to strings and small anchors. Often visibility, particularly in deep water, is limited to the period of complete calm water. It is advisable to use all this time locating nests and marking them with the float; then come back and do the more time-consuming detailed examination when further nest searching is no longer possible.

SAMPLING DEVICES AND METHODS

Once a nest has been located and is to be examined or sampled, the use of an underwater viewer is a near essential. The purpose is to shield out the reflected sun rays that prevent the observer from seeing into the water. The type shown in Figure 1 is an excellent piece of equipment for viewing underwater objects. Construction cost is about $12. Other types available commercially are cylinders about 18 inches long and 8 inches in diameter, with a narrow slot in the top and a glass-covered bottom. In an emergency a small slot can be cut in the bottom of a five gallon bucket, which then becomes the top. A coat or blanket over one's head and shielding out the sunlight can also be used.

The main advantage of the illustrated device is that the worker can use it in the comfortable position of standing in an almost upright position. It also offers a wide field of view. Even in water a foot or so deep advantages of examining a nest through a viewer as opposed to the naked eye are tremendous. At much greater depths the viewer is a basic essential.

If eggs or fry are found, the collection of samples is an easy matter with either of two very simple tools. In shallow water (depths to arm's length) an ordinary kitchen baster, available at most hardware stores for less than $1.00 can be used. It is about 10 inches long and a 1-inch diameter tube of plastic instead of glass is preferred to eliminate breakage. Cutting off the tip is sometimes useful to enlarge the open end. The rubber bulb is squeezed closed before the tube is put in the water and carefully lowered to a selected spot on the nest. Pressure on the bulb is slowly released and the eggs or fry sucked into the tube. The tube is then brought to the surface and contents removed by again depressing the rubber bulb. Carefully done, there is practically no disturbance to the nest.

The kitchen baster has also been used to sample eggs from nests in deep water. In this situation a diver may go down to do the sampling but the following method is much more practical.

A piece of rubber hose about 0.5 inch in diameter is fastened to a long bamboo fishing pole (Fig. 1). The user places his finger over the open top end of the hose and the pole is then placed in the water and the bottom end guided over the nest. Once in position, the finger is removed and water rises in the hose. The finger is then again placed over the top and the trapped water will be retained as the pole is raised to the surface. In deep water it is necessary to swing the pole up in an arc. Sampling should therefore be done from either the very front or stern of the boat. The second man holding the container for sample deposit must go to the opposite end to receive the sample.

Eggs and fry have been removed by this method from nests found in 18 feet of water. If visibility is very good and the sampler operator can see the nest he can position the open end by himself. Otherwise the second man looks at the

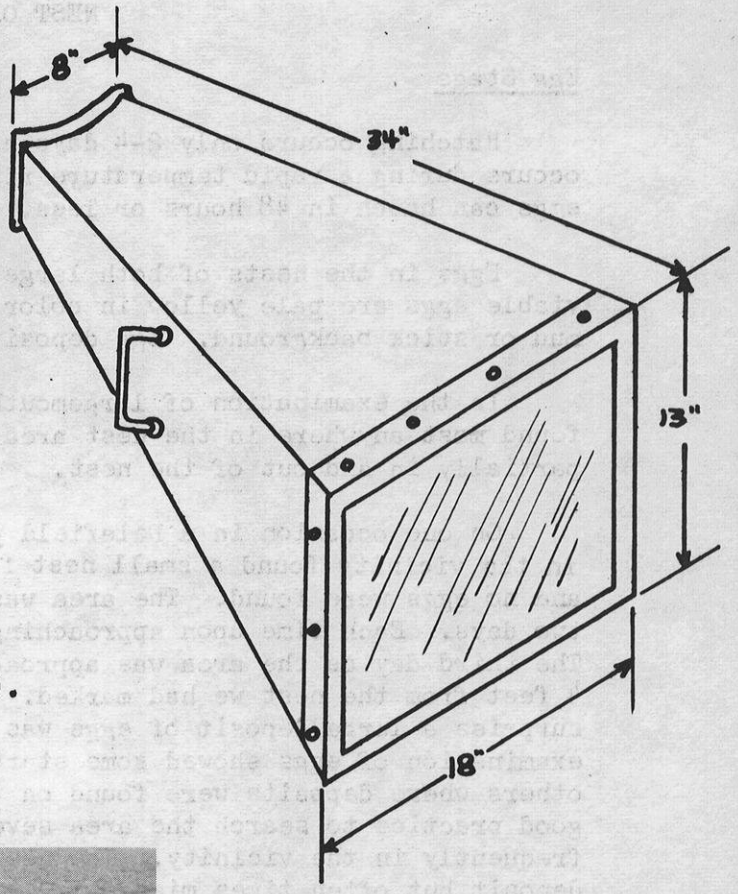
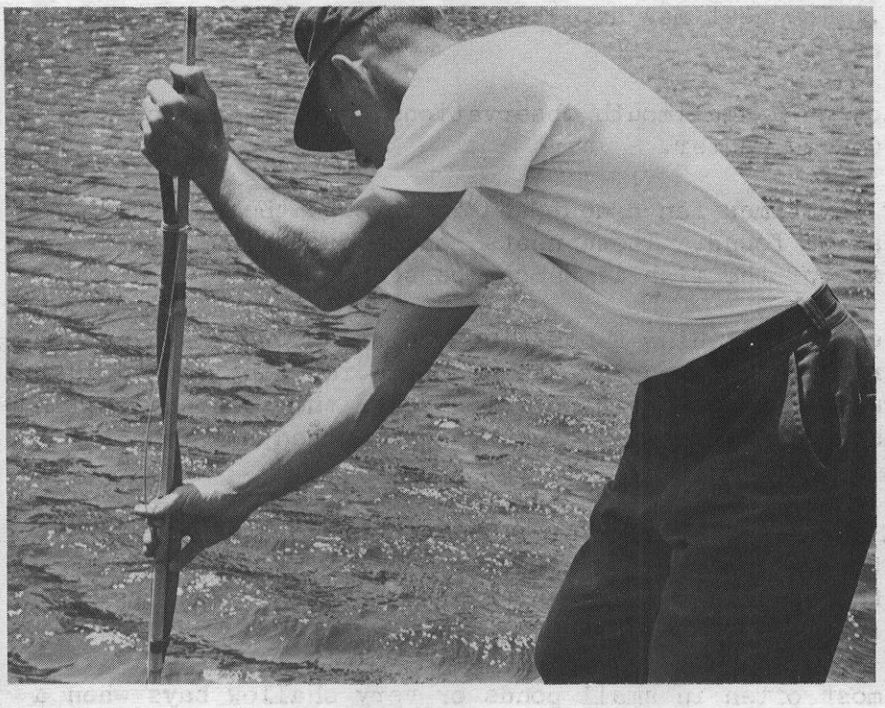


Figure 1.

Making nest observations through the nest viewer (above). Construction model of a nest viewer (right). Egg sampling using rubber hose attached to bamboo pole (below).



nest through the viewer and gives directions to the sampler operator until the hose is guided into proper position for the sample.

The collected samples can be placed in a variety of utensils for closer field examination but the white plastic wash pans or dish pans are very useful. Here again the plastic eliminates the chipping problem common with enamaled pans.

NEST OBSERVATIONS

Egg Stage

Hatching occurs only 2-4 days after the eggs are deposited. If spawning occurs during a rapid temperature rise which continues into the mid-70's, the eggs can hatch in 48 hours or less.

Eggs in the nests of both large and smallmouth bass are easy to see. The viable eggs are pale yellow in color and quite visible against the gravel, sand, mud or stick background. Egg deposits are usually quite heavy.

In the examination of largemouth nests we have noted that the eggs can be found most anywhere in the nest area; along the edges, in the center, or sometimes partially in and out of the nest.

On one occasion in a Delafield pond we saw a bass dart away from an area and in the vicinity found a small nest fanned out in blue clay. The nest was examined and no eggs were found. The area was marked and examined several times the next two days. Each time upon approaching the area a bass was seen to dart away. The third day as the area was approached the bass was seen lying still about 4 feet from the nest we had marked. This different spot was examined and to our surprise a large deposit of eggs was found on top of some Chara. Sampling and examination of eggs showed some starting to hatch. After this experience and others where deposits were found on the fringe of the nest, we concluded it is a good practice to search the area several feet from the nest if a fish is seen frequently in the vicinity. The nest may have been built for the purpose of egg deposit but often times missed.

This has never been noted in smallmouth observations. Nests that have been examined had eggs deposited dead center.

The immature male may sometimes fan a nest and go through the process of guarding it, but no eggs can be found. These nests can be recognized by their small size and the small size of the fish if he can be seen.

A 10-inch fish was observed building a nest in a Delafield pond and establishing occupancy. Females were seen approaching the nest and inviting courtship but to no avail. The male merely maintained his position above the nest and continued to do so for over two weeks. He was finally caught and examined and found to be immature.

Smallmouth males will apparently build "practice" nests, for fanned areas where fish never reappear to use the sites are very common. These nests can usually be discarded from the sampling program after two or three days of examination.

Deserted nests occur most often in small ponds or very shallow bays when a severe drop in water temperature takes place. In a Delafield pond, for example, after eggs had been deposited, the water temperature dropped from 65° F to 45° F

in a 24-hour period. None of the five smallmouth males were seen on or near the nests. Closer examination revealed that all of the nests had silt deposits on the gravel and eggs, and many of the eggs were dead, with fungus starting. In all cases there were marks in the dirt close to the nest which appeared as if the male had intentionally attempted to partially conceal the nest by fanning silt over it. A few days later the water temperature again rose to 65° F and the males reappeared, cleared the nests off and fresh egg deposits were found. None of these nestings were successful, however, as not all of the fungused eggs were removed and the new eggs were quickly infected and lost.

The irony of the whole matter was that a sixth nest had been screened to keep the male away from the eggs during the incubation period to see if they would hatch and the fry develop without his assistance. The eggs in this nest survived the temperature drop, hatched, developed, and produced the only fingerlings in the pond that year.

The occurrence of a fungus condition in bass nests is very common. Once the infection starts, it spreads rapidly and the entire egg deposit is lost. The male bass will continue to guard the nest for several days after it is obvious to the observer that no young will ever be produced. Eventually the male leaves the nesting area.

Fry Stage

As with egg incubation, fry development varies with water temperatures. The first fry stage may again take 2-4 days. If hatching occurs in less than 4 days because of high water temperature, and the temperature persists, fry development will also be hastened.

The period when the eggs hatch and fry emerge is one when considerable error in nesting observations can be made. The newly-hatched fry are nearly transparent and a hasty or haphazard examination of the nest will yield the conclusion that nothing is there. The same is true if visibility is poor. If a nest has been examined previously and eggs were observed and it now appears as if nothing is present, the eggs have probably hatched and the nest is full of fry. It is important to sample the nests by the methods previously described to determine if the fry do exist. Visual observation is a poor method of obtaining positive results during this period.

At a later stage visual observation of the nest is possible. By this period the fry have taken on dark pigmentation and are readily visible to the observer. Smallmouth nests look as if tar has been poured into them, hence the term "black fry". The young bass remain in this stage 2-4 days and then the dark pigmentation disappears, the yolk sac is being absorbed, and the school is ready to move away from the nest.

Fry Dispersal

As the school is ready to disperse, it rises as a cloud from the nest. The school may then move a couple of feet away from the nest, return and hover over it. Finally there is a slow movement away by the group. The largemouth bass continue to remain in compact schools but as feeding begins and the fish start to grow the school broadens out until it covers several square feet. During this period the male remains with the group and again becomes a valuable observation aid. Once the small fish have entered growths of vegetation they are difficult to see. We have found that by slowly cruising these areas and watching for a large bass we could most easily locate schools of young bass. On many occasions an adult would see us and orient himself in a defensive position,

sometimes swimming slowly in the direction of the boat as if to drive it off. This type behavior never has failed to disclose a school of young bass in the immediate area.

The male bass valiantly and successfully defending his brood of young against all comers has become a popular image. People also commonly accept the male on the nest during egg incubation and fry development as a necessary action.

That the latter is not true has been shown many times. On numerous occasions we have removed or excluded by screen exclosures males from both largemouth and smallmouth bass nests immediately after spawning had taken place and traced many of these nests to successful hatches and dispersal of fry. In some cases the nests were total losses due to unobserved predation. On the other hand, we observed the total loss of many nests where the male was present. Fungus was a common cause, as was predation by minnows, bluegills, pumpkinseed sunfish, and green sunfish.

The male bass can be successful against a single invader but is utterly helpless if a group of fish are determined to prey on the nest or school of small fish. Their method of operation is very simple. One lead fish approaches the nest or school and the male leaves to chase the fish away. At once, the remainder dart in and feed, then dart away at the male's return. This is repeated until the nest or school is cleaned up or the group of predators decide to leave.

It has been interesting to note, however, that the very young fish are aware of this impending danger and a widely spread school will regroup into a very small compact one during the period of attack.

Apparently male smallmouth can distinguish between degrees of danger. While attempting to catch them on nests by using artificial lures, we have seen the males' attention diverted by a rock bass. Even placing the bait right into the nest caused him little concern as long as the live fish was nearby. Once the fish had left, the male would then return to the problem of removing the artificial bait from the nest.

The joining of two or more schools of young largemouth bass is not uncommon. In these cases the respective males will accompany the group. The most we have ever seen together is five in one of the Delafield ponds.

The fish remain as a single group for a couple of weeks and as they increase in size the male eventually leaves them, the original group breaks up into many smaller ones and the fish are on their own.

The smallmouth bass apparently has much less inclination to school than the largemouth. The young smallmouth have been observed dispersing from the nest with apparently individual intent so that in 24 hours fish could be seen 30 feet in any direction. Once this occurred the male departed from the area and the fish were on their own.

CAPTURE OF YOUNG BASS

In lake work, samples of fingerling largemouth and smallmouth bass can be taken by small mesh minnow seines. The fish, if present, can usually be found along the shoreline in water 1 to 2 feet deep. Light stands of aquatic plants are good seining areas for the largemouth while rocky bottoms are excellent for the smallmouth.

Electro-fishing with 220 volt A. C. current is also very effective for fingerling smallmouth. The rocky areas that are unseinable are excellent shocker locations. We have found that it pays to go back and forth across the same area several times for best results, for the young bass appear to hide between the larger stones and are not always turned over on the first run. It seems necessary to get the fish to relocate themselves to unfamiliar areas before good results are obtained. A large portion of these fingerlings do not come to the surface when stunned but remain on the bottom making recovery somewhat difficult.

In pond work, the most effective method to obtain fingerling bass is by trapping while utilizing a water current. A wooden trap with solid sides and bottom 4 feet long by 2 feet wide and high with the conventional "V" type screen in front works well (Fig. 2). The water source is pumped into the trap and the outflowing current passing through the screen will attract the fish. Either an electric or gasoline pump can be used--the higher the flow the better the results.

Largemouth bass are especially easy to capture by this means but we have had only moderate success with the smallmouth. Where a newly constructed pond can be so designed to include a permanent concrete structure with the water supply for the pond passing through it, an excellent trap can be had which will insure an efficient and simple largemouth harvesting method.

We have noted in pond studies at Delafield that the adult female largemouth can easily be trapped by attraction to a strong current during the period immediately after spawning. We have no theory why this should be so but it is an easy method of removing some of the adult fish from a rearing pond if so desired.

Draining of ponds, where possible, is another method of harvesting fingerling bass. Here of course it is assumed that there will be complete recovery of fish or at least that the major portion of the crop is to be removed. The ideal condition is to have concrete seining kettles at the outlet. The Delafield kettles have 24-inch-high walls and three openings. "V" type screens are placed in the openings once the water level is below the top of the wall. Fish entering can't get out and are caught.

Largemouth bass respond readily to this practice. As the water is slowly lowered the fish are content to come along with it to the drainable end and become entrapped in the seining kettle. Very nearly complete recovery of fish has been the rule.

Smallmouth bass, however, are not nearly as cooperative. While we have on occasion obtained nearly complete recovery, we generally found that the smallmouth did not come down but hung in small pockets until stranded, continued to fight their way up current into very small trickles of water, and stayed away from the kettle until nearly no water remained. Adult smallmouth were particularly difficult to trap during draining operations and could be placed on a par with carp as regards difficulty in removing.

These responses to current, while being of great assistance in harvesting, can also prove to be quite a source of loss of fish to a pond owner. The proper screening of artificial ponds is a necessity to prevent large numbers of fingerlings from leaving via the outlet. If a substantial current exists at an outlet the fingerlings will be attracted to the area. They will orient themselves in an up-current position and play in the current for hours. If the outlet is not screened, periodically a large portion or an entire group will for no apparent reason turn and let themselves be carried down current and out of the pond.

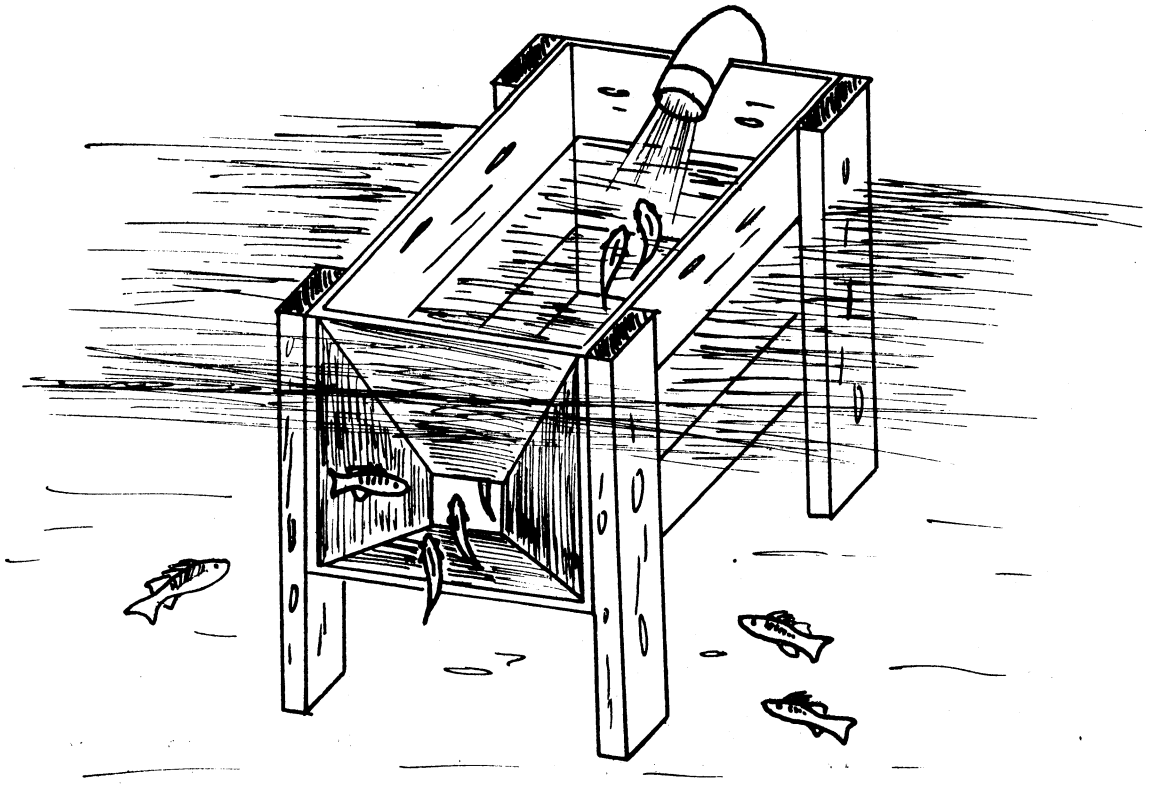


Figure 2.

Bass fingerling trap utilizing pumped water.

Thousands of bass have been seen leaving Lake Nagawicka in this manner. The outlet dam site provides the necessary current and the fish go down the Bark River.

Where an artificial pond has an uncontrollable water supply such as springs or surface runoff and keeping screens cleared to prevent too much of a water rise is a problem, the following practice is a good one.

Prior to spawning, and this can be determined by observing water temperatures, lower the water level a foot or so. This provides a reservoir area to absorb influxes of water so when the small fingerlings are initially moving about the pond they will not be attracted to the outlet vicinity. Obviously once nesting has taken place, the level should not be lowered unless it can be determined that all nests are located in water deep enough to prevent exposure.

TRANSPORT OF FINGERLINGS

We have never experienced any difficulty in the transport of either largemouth or smallmouth fingerlings or adults. Survival during transport has nearly always been 100 percent and the fish remained in excellent condition despite long hauls by tank truck. The Delafield trucking facilities utilize the circulation of pure oxygen in the hauled water. There is no indication that it is better or poorer than compressed air or circulated water.

Fingerling bass truck especially well. On one occasion a load was taken from Delafield to the Woodruff area (about 300 miles). The fish were in transit about 7 hours and when released in a small lake immediately began to feed on aquatic insects.

Fingerlings to 1-inch long have been transported distances of up to 50 miles in plastic bags with excellent results. The usual method of 3 to 5 gallons of water and up to 500 1-inch fish plus the pure oxygen in the plastic bag produced good results even in June and July.

If the trip is a short one and the nearest parking place is a considerable distance from the release point a handy method is to place the plastic bags in a bushel basket instead of the usual corrugated boxes. Two men utilizing the handles on the basket can carry the load much easier than wrestling the boxes.

EFFECT OF SHOCKER ON BROOD STOCK

Adult largemouth bass have been collected just prior to spawning by 200-volt A. C. electro-fishing gear to see if there is any effect on reproductive success. In no instance could any ill-effect be determined. An example of productivity of shocker-caught bass was 30,799 fingerlings from 8 nests (average of 3,849 per nest) obtained in a Delafield pond in 1959.

Adult smallmouth were collected by 230-volt D. C. current and no negative effect could be noted. An instance of 4 nests producing 18,944 fingerlings (average 4,736 per nest) occurred in 1962. These figures are not in variance with pond yields in other years when fish were obtained by fyke nets.

Our experience indicates no reason for concern regarding the reproductive functions of bass collected just prior to the spawning period by electro-fishing gear.

POND MANAGEMENT OF LARGEMOUTH BASS

Waukesha County leads the state in numbers of licensed private fish hatcheries and other southeastern counties contain many more. A substantial portion of these hatcheries raise largemouth bass and the owners have asked for advice on how many adult bass to stock to establish a population by natural reproduction. While no detailed follow-up of results was possible enough people have reported their experiences to establish a reliable pattern.

I have recommended that 2 or 3 pairs of adult bass be stocked in ponds of less than an acre and 3 to 5 pairs in ponds of one to two acres. Few private ponds exceed this size but if they do, no more than 2 pairs per acre need be used.

The inexperienced pond owner wonders about needing only 2 pairs of adult fish to establish a population in an acre pond, as he had a preconceived notion that he'd need probably 20 or 25 pairs. Here one need only point out that 2,000 to 5,000 fingerlings can be expected from a single nest; if only 10 percent of a single nest survive to become one pound fish, a standing crop of 200 to 500 pounds per acre will be achieved. If the pond is 150 x 150 feet, or about one half acre, this would result in a standing crop of 400 to 1,000 pounds of bass per acre; levels considerably above any ever reported in this latitude.

In general, most new owners accepted these stocking rates, plus a couple of extra pairs just in case the fish couldn't find each other. Results regarding sufficient reproduction have been excellent to the point most return the following year and request advice on how to thin their population of young bass down to a level that will encourage better growth.

As with lakes, the individual ponds vary greatly in their ability to support a given standing crop. Data available from a one-acre pond located near Oconomowoc showed the owner stocked 15 adult bass in the spring of 1957. A large hatch resulted and in October 1959 he asked if the Department could use any of the fish. A single seine haul produced 688 bass 5 to 9 inches long, with a total weight of about 100 pounds, for stocking in a rehabilitated lake. The pond was heavily fished by hook and line prior to this time and also the following summer. However, the following fall 707 fish weighing 108 pounds were removed. These fish averaged 7 inches, showing practically no linear growth during the year. A minimum of 100 pounds per acre was removed from this pond each of the two years and a substantial population of small fish still was present.

Similar situations of heavy overpopulation and resulting slow growth are not uncommonly reported. Once growth stops, continuous thinning is recommended to lessen the population to the level where growth is again encouraged.

"Should adults be removed after spawning has taken place"? is also frequently asked. There is no reason to do so. Predation by the adults is more beneficial than harmful. Also, the second year's spawning is a ready supply of forage for the now yearling bass. Few if any of these fingerlings will survive for long in a dense population of the larger yearlings.

The pond owner who wishes to raise largemouth bass for sale and who is interested in maximum production of numbers may encounter the problem of split hatches. This occurs when a portion of the brood stock spawn at an earlier date than the remainder. In this situation 2 or 3 nests may produce bass fingerlings that will be 10 or 12 days older than the second group and predation by the first group will be extensive. In these cases a pond owner will have to decide which

group of fish is of most value to him. An example would be 2 early nests with 5,000 to 10,000 fish already hatched and feeding and then the hatch from 6 later nests of 15,000 to 30,000 fish about 10 days later. It would be advantageous to net or trap and remove the lesser number of older fish to preserve the larger number of young fish. If this is not done, almost assuredly the only slightly larger fish will clean out the majority of the late hatch, and very quickly. We experienced an instance of this type where an estimated 20,000 fish disappeared over a weekend. While the loss of this many fish very quickly may sound impossible, we need only postulate that if 5,000 fish eat only one a day each, 50,000 fish can go in a ten-day period. Also, the characteristics of the tightly knit schools of the young bass make this a good probability.

In instances where trapping operations are conducted and two sizes of fish are trapped together, predation within the trap is also very great. Fish trapped should be quickly removed and sorted to prevent substantial losses.

A semi-inventory of brood stock can sometimes be made during the spawning season. If a differential mortality has occurred favoring survival of the females it is common to see the females out searching for a nest and a place to breed. This occurs when there are no males or only one or two have built nests. The females will form a school and proceed in single file to circle the pond. They will stay out about 4 or 5 feet from the shoreline and slowly swim around the pond. This will continue all day long and sometimes for several days. The fish are easily recognized as females because of the bulging sides and the fullness of the abdomen. When this occurs, it is easy to count the number of females present, and then obtain and add only male fish to the population to bring about as many additional nests as one wishes.