PRELIMINARY RESULTS IN THE USE OF A NURSERY POND AS A TOOL IN FISHERY MANAGEMENT

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ABSTRACT

The history of the "nursery' area concept in fisheries management dates back several years and includes varying techniques including fencing of a shallow bay of a reservoir to protect fish on their spawning grounds, utilizing sloughs adjacent to reservoirs for spawning grounds and making use of sloughs, old river lakes and small ponds as nursery areas for young fishes which during high water migrate into the river.

One of the most recent modifications which has been put into effect on five of the major reservoirs in Arkansas includes a separate structure nursery pond which is built adjacent to the receiving reservoir and connected only by a manually operated gate and drainage canal system. This type nursery pond has a sizeable watershed to permit annual refilling but one that is not too extensive to cause frequent flushing of fertility from the pond. Complete control of the species of fish reared in the pond and the best known techniques of fish culture can be carried out on a highly controlled structure such as this.

The primary uses of the nursery pond include the introduction of "exotic" or non-native species of fish into the reservoir, supplementing the natural reproduction of desirable fishes which are unable to maintain their numbers and producing instant fishing by stocking catchable size fishes such as channel catfish.

Success of nursery pond stockings are evident as shown by before and after population samples and routine checks of fishermen's creel. Several years of stocking of millions of walleye fry in some of the deep, clear reservoirs in Arkansas have failed to established a fishable population of walleye, however, by rearing walleye fry in a nursery pond for 30 to 45 days and two to three inches in length, a substantial walleye fishery has developed in both Bull Shoals and Norfolk Lakes. Other successful nursery pond releases have been four to six inch striped bass, six to ten inch northern pike and catchable channel catfish.

The results of the first year's crop from the Lake Greeson Nursery Pond have been easily evaluated since the first crop was a combination of striped bass, an exotic to this reservoir, and albino channel catfish, which could be readily identified as a product of the nursery pond.

The nursery pond technique is not without its problem, some of which are: (1) Cost of construction, (2) fluctuating water level of receiving reservoir, (3) reaction of different species of fish upon draining, (4) initial predation on released fish and (5) estimating size of crop. Most of the problems encountered, however, do have solutions and it is believed that the nursery pond approach to establishing desirable species of fish in a reservoir in order to fully utilize all available niches is a major step in the fishery management of large reservoirs.

INTRODUCTION

Management of the large multi-purpose reservoirs has presented a problem to the fish manager since the initial conception of this type of impoundment. We have branded these reservoirs with almost every name from "biological deserts" to "two-story lakes" to "multi-niche habitats". Perhaps the most significant achievements made in association with the large multi-purpose reservoirs is in the research field. However, with only a few exceptions, intensive fishery management within these massive and varied impoundments has been very limited.

One of the newest approaches in the fishery management field has been the introduction of "exotic" or non-native fishes into a reservoir in order to fully utilize all ecological niches. These introductions may be in the form of predator fishes which aid in controlling an overabundance of unwanted species of fish and also add another fish to the fishermen's creel or they may be forage fishes which create a more desirable forage base and thereby enhance the well-being of the desired sport fishes. Attempts to establish a population of certain exotic fishes in an environment with a previously established native fish population have met with many failures, particularly when only eggs or fry are available for stocking. The use of a separate structure nursery pond to raise fry fishes to fingerling size or larger then draining them directly into the reservoir has been highly successful in establishing measurable populations of desirable fishes in a reservoir.

HISTORY OF NURSERY POND CONCEPT

The idea of a nursery or rearing area to produce larger numbers of young fishes in a reservoir is not new. Some of the earlier ideas were to fence off a shallow bay of the reservoir and protect the adult fishes from angling during the spawning season; also improvement of spawning sites within the bay were attempted.

Some of the most productive natural nursery areas are the shallow, marshy sloughs connected to larger lakes during the spring of the year. These areas are said to be the key to northern pike, *Esox lucius*, production.

Smith and Swingle (1944) described the use of ponds located adjacent to small streams in improving stream fishing. The ponds serve as nursery areas and continuously add fish to the stream during pond overflow.

The use of old river or oxbow lakes which have had the native fish population completely eradicated and subsequently overstocked with desirable game fishes has been considered successful in improving the stream fishing in the Saline River in Arkansas (Mathis, 1964). Fishes stocked in the renovated old river lakes emigrate into the river as catchable or near catchable size fishes during periods of high water following a rearing or growing period in the lake.

SEPARATE STRUCTURE NURSERY POND

One of the latest nursery pond concepts includes the use of a highly controlled, separate structure located adjacent to the receiving reservoir and connected only by a pipe and manually operated gate system and canal (Figure 1). This type structure is constructed to utilize natural runoff water for filling. A specific size watershed is necessary as dictated by the size of the pond. A sufficient size watershed to fill the pond at least annually is needed; however, an excessive watershed must be avoided to prevent the flushing of fertility from the pond and often the introduction of unwanted species of fish during high flows through the uncontrolled spillway. Control of the entire watershed of the pond is desired to prevent pollution and fish introductions from other sources.

Site Location Criteria

The topography of the area around the reservoir is a major controlling factor in nursery pond site location; however, the following guidelines for site selection are useful:

1. Located so as to facilitate draining directly into the adjacent reservoir. This may necessitate the location of the pond at least partially within the flood pool of the reservoir.
2. Suitable drainage area to pond area ratio. This approximates a 10:1 ratio under typical Arkansas hydrology.
3. Economical construction site. A maximum pond surface acreage at the least cost per acre is desired.

4. Adequate access to site.

5. Containing no private ponds in watershed. If farm ponds are located within the watershed full control over the ponds should be obtained.

6. Preferable locations are on state or federal lands which would not have to be purchased outright. The U. S. Corps of Engineers and the National Forest Service have been particularly cooperative in these endeavors in Arkansas.

Construction of nursery ponds should be oriented to facilitate complete drainage and without leaving potholes where fish may be stranded. This normally requires considerable extra effort in properly shaping the pond bottom.

Figure 1. Aerial View Of The Lake Greeson Nursery Pond With Connecting Channel To Lake Greeson.

Uses of Nursery Ponds

One of the primary uses of the nursery pond is for introductions of certain desirable species of fish which are not already present in the reservoir. These fishes are selected to serve a particular function in the reservoir to aid in its fishery management. Often fishes such as this are obtained in large numbers only as eggs or fry. The nursery pond is used to rear these fry to a large enough size to escape extensive predation and a size capable of feeding on the natural food in the reservoir.

When available, broodstock of some species may be placed in the nursery pond to spawn in a protected and non-hostile environment, and the fry can be reared to a desirable size before being released.

Maintenance stocking of certain species is also carried out in a similar manner. For example, walleye, *Stizostedion vitreum*, and channel catfish, *Ictalurus punctatus*, which were native to some reservoirs but are not maintaining a fishable population through natural reproduction, have been successfully reared and released from nursery ponds and have re-established a substantial fishery.

Species such as channel catfish and rainbow trout, *Salmo gairdneri*, may be raised to a catchable size in a nursery pond on a diet of commercial feed, and upon release, instant fishing is produced and high survival is obtained.

Also, in the case of a national emergency, a particular reservoir may be converted into a food fish producer. Fingerling buffalo, *Ictiobus sp.*, or carp, *Cyprinum carpio*, can be produced in a nursery pond for introduction into the reservoir where high survival and growth to an edible size could be expected.

ARKANSAS' NURSERY POND SYSTEM

The Arkansas Game and Fish Commission visualizes the use of nursery ponds in the long-range plans for intensive fishery management on large reservoirs. At present, the Commission has nursery ponds in operation on five major reservoirs. A summary of the annual production from these nursery ponds is as follows:

1964—Norfork Nursery Pond (8 acres), 40,000 Walleye fingerlings (2-3 inches).

1965—Norfork Nursery Pond, 75,000 Walleye fingerlings (2-3 inches).

1966—Norfork Nursery Pond, 40,000 Channel Catfish (9 inches); Bull Shoals Nursery Pond (10 Acres), 120,000 Walleye fingerlings (2-3 inches.

1967—Norfork Nursery Pond, 4,000 Northern Pike (10 inches); 5,000 Striped Bass (4-5 inches); Bull Shoals Nursery Pond, 300,000 Walleye fingerlings (2-3 inches), 18,000 Channel Catfish (1/3 pound), 5,000 Largemouth Bass (3-4 inches).

1968—Norfork Nursery Pond, Crop failure; Bull Shoals Nursery Pond, 9,000 Walleye (6-8 inches); Beaver Nursery Pond (27 Acres), 500,000 Walleye fingerlings (2-3 inches); Greeson Nursery Pond (20 Acres), 23,000 Albino Channel Catfish (1/2 pound), 17,000 Striped Bass (4-6 inches).

1969—Norfork Nursery Pond, 1,200 Muskellunge (9 inches); Bull Shoals Nursery Pond, 100,000 Walleye fingerlings (3-5 inches); Beaver Nursery Pond, 250,000 Northern Pike fingerlings (4-5 in.); Greeson Nursery Pond, 300,000 Walleye fingerlings (2-3 inches); Conway Nursery Pond (80 acres), No release as yet.

Examples of typical nursery pond crops are seen in Figure 2.

The Norfork Nursery Pond has been in operation for six years and the results of its operation are most apparent. Of particular significance has been the development of a walleye fishery through the use of the nursery pond technique.

The native population of walleye in the North Fork River disappeared from Lake Norfork shortly after impoundment, but as early as 1949 an effort to re-establish the walleye population was attempted. Over three and one-third million walleye eggs and fry were stocked at various times by both the states of Arkansas and Missouri. However, by 1963, the fisherman's catch of a walleye from Lake Norfork remained a rare occurrence, and thirteen years of population samples yielded only ten walleye. In 1964 and 1965, a total of 115,000 two to three inch walleye were released from the Norfork Nursery Pond. The rotenone fish population sample of 1965 produced seven yearling and fifty-nine young-of-the-year walleye, and fisherman catches to date have shown a very obvious increase, even to the extent that many fishermen fish Lake Norfork exclusively for walleye. The following excerpts from a memorandum from W. F. Hailey, Conservation Agent Supervisor, Missouri Department of Conservation to Charles A. Purkett, Chief of Fisheries, Missouri Department of Conservation, is particularly signficant in realizing the success of walleye stocking from the Arkansas Game and Fish Commission's Norfork Nursery Pond.

"Information secured indicates that the past "season" (1968) was the best of the past four years as walleye fishing success increased at a continuous rate during this period in Norfork Lake. During the past season, many walleye in the eight to nine pound class were taken from Norfork Lake in Ozark County, Missouri, and these were the predominant classes taken. A few walleye in the ten to twelve pound class were reported taken".

The Lake Norfork Recreational Association in its weekly newsletter has listed the top fish catches of the week for a period of over fifteen years. In comparing these listings on an annual basis the average number of walleye listed for the years of 1960 through 1967 was forty-six. In contrast, one hundred and eight were listed in 1968 and the rate so far in 1969 continues to show an increase. These figures probably represent a minor percentage of the total catch, however, it is believed that the trend shown toward increased walleye catches is valid.

Since 1963, the only walleye stocked in Lake Norfork was from the nursery pond and it is, therefore, apparent that this technique was effective in establishing a fishable walleye population in Lake Norfork when fry stocking was a failure.

OPERATION AND PRELIMINARY RESULTS OF LAKE GREESON NURSERY POND

The Lake Greeson Nursery Pond has been used as a model to further demonstrate the effectiveness of the nursery pond technique.

After several years on the "drawing boards" or in the "insufficient funds" file, the Greeson Nursery Pond became a reality in January, 1968, with completion of its construction. Its location is at the upper end of Cowhide Cove on Lake Greeson, Pike County, Arkansas (Figure 3). The full pond contains approximately 20 acres and its watershed covers 220 acres. The drainage system is composed of a sliding wedge type gate on the upstream side of a 16 inch pipe through the levee, and discharges are made into a 150 foot long by 30 foot wide channel which extends to the low water elevation of the reservoir.

First Crop

The pond began filling for the first time in January, 1968, and was full by May, 1968, at which time 28,000 albino channel catfish, three to six inches long, were stocked in it. These catfish were fed daily on commercial fish pellets at the rate approximating three per cent body weight. In the latter part of June, 30,000, one to two inch striped bass, *Roccus saxatilis*, were added to the pond. In addition to the daily cat-

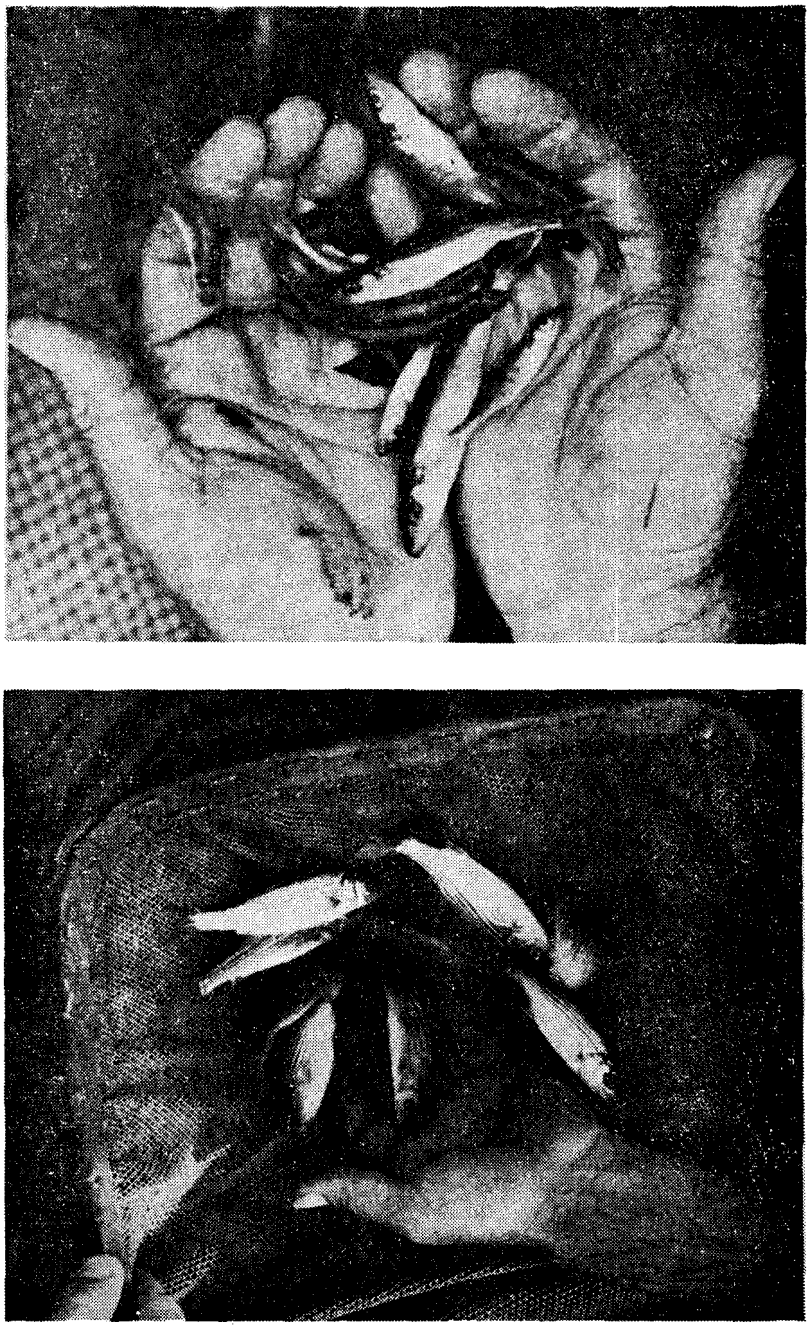

Figure 2. Separate Crops of Walleye and Striped Bass Reared in Nursery Ponds.

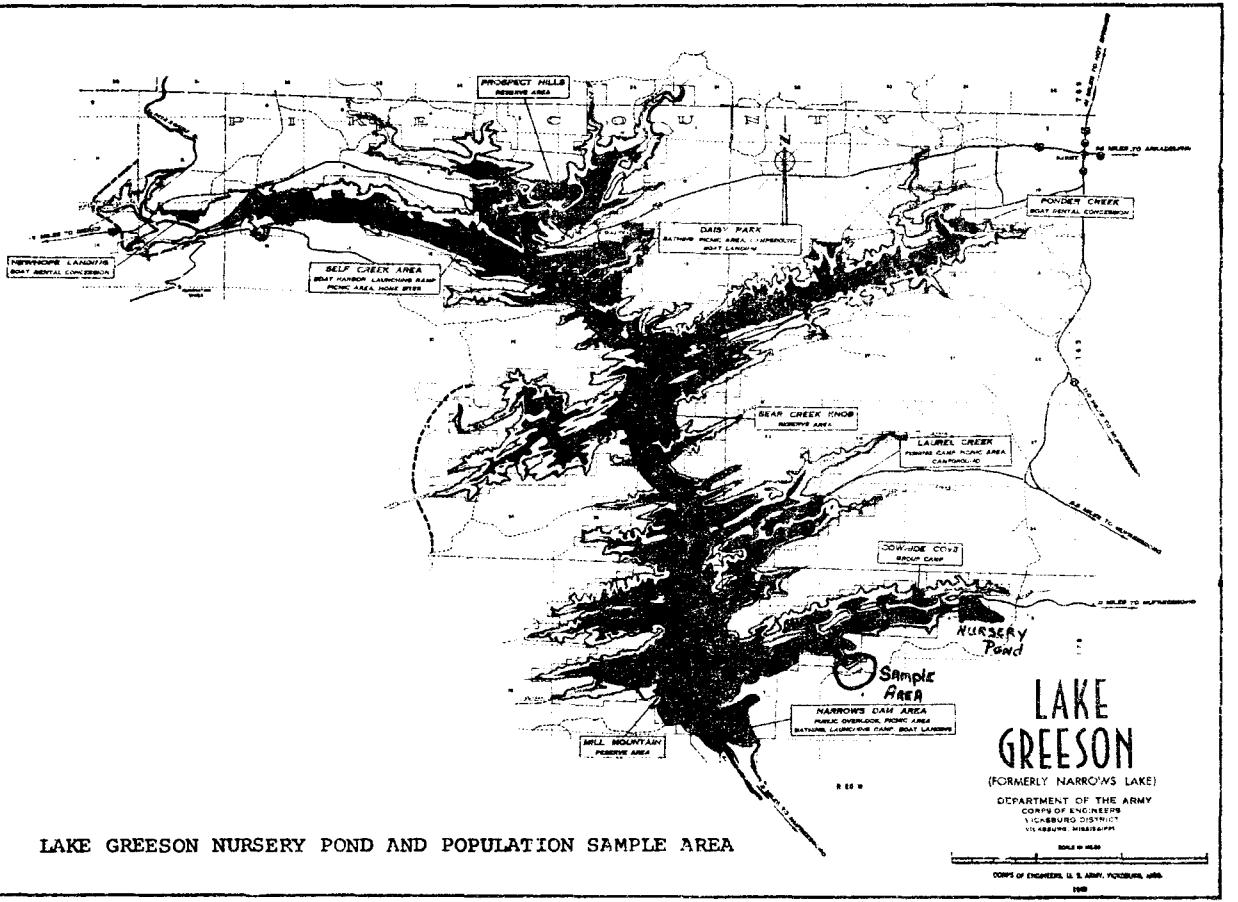

Figure 3 LAKE GREESON NURSERY POND AND POPULATION SAMPLE AREA

fish feeding, a total of 570 pounds of minnows and approximately 50,000 threadfin shad were stocked into the pond at various intervals to provide forage for the striped bass.

Due to the rapidly falling water level in Lake Greeson and the subsequent reduction of water in the channel below the nursery pond, draining of the pond was begun on August 12, 1968, three days later the pond was empty.

Throughout the period when fish were in the nursery pond, frequent seine checks were made to determine survival, growth, and to estimate the size of the crop released. It was estimated that 23,000 albino channel catfish, ten to twelve inches long, two per pound, and 17,000 striped bass, four to six inches long, twenty-six per pound, were released as the first crop from the Lake Greeson Nursery Pond. The catfish were in the pond for three months, and the striped bass were held for about six weeks.

Since the striped bass was an exotic to Lake Greeson and the albino channel catfish can be easily identified as a product of the nursery pond, it was a relatively simple task to keep up with the progress of the nursery pond reared fish. The catfish began showing up in the fishermen's creel immediately, in fact, even before the pond had drained completely. Three weeks after the pond was drained albino channel catfish were being caught near the upper end of the lake—almost 10 miles upstream; however, the greatest harvest was within a three to five mile radius of the pond.

The following is a summary of routine collections made on Lake Greeson showing the striped bass and albino channel catfish collected:

Date	Collection Method	Number-Size Albino Channel Catfish	Number-Size Striped Bass
Nov. 25, 1968	Electric Shocker	1 (12 inches)	5 (8-10 inches)
Nov. 26, 1968	Gill Nets		5 (8-9 inches)
March 27, 1969	Gill Nets	11 (12-15 inches)	3 (10-11 inches)
June 10, 1969	Electric Shocker	18 (12-14 inches)	1 (12 inch)*
June 26-27, 1969	Four acre Rotenone Sample	71 (10-16 inches)	

* Caught on hook and line.

So far in 1969, the fishermen's creel regularly contains albino channel catfish, particularly on the stringer of trotline and night bank fishermen. However, the greatest excitement among the anglers is being caused by the striped bass. Even though the majority of these fish are under three pounds in size, many anglers are fishing exclusively for the striper and catching them in good numbers (Figure 4).

Second Crop

Preparation for the second crop from the Lake Greeson Nursery Pond began by closing the gate in November, 1968. By the first of April, the pond was full with more spring rains anticipated, therefore, approximately four feet of water was released from the pond to furnish additional storage. A few weeks before stocking, the pond and the immediate area around it was limed with 30 tons of lime; 200 bales of hay, and 2,000 pounds of 10-20-10 fertilizer were placed in the pond and zooplankters from a hatchery pond were innoculated into the water. On April 28, 1969, 500,000 two and three day old walleye fry were tempered into the Lake Greeson Nursery Pond. During the next 38 days, routine seine checks and plankton samples were made to aid in determining the percent survival and the date to release the fish. Seine checks were also made in Lake Greeson to determine the availability of adequate forage on which the walleye could feed after release. The release

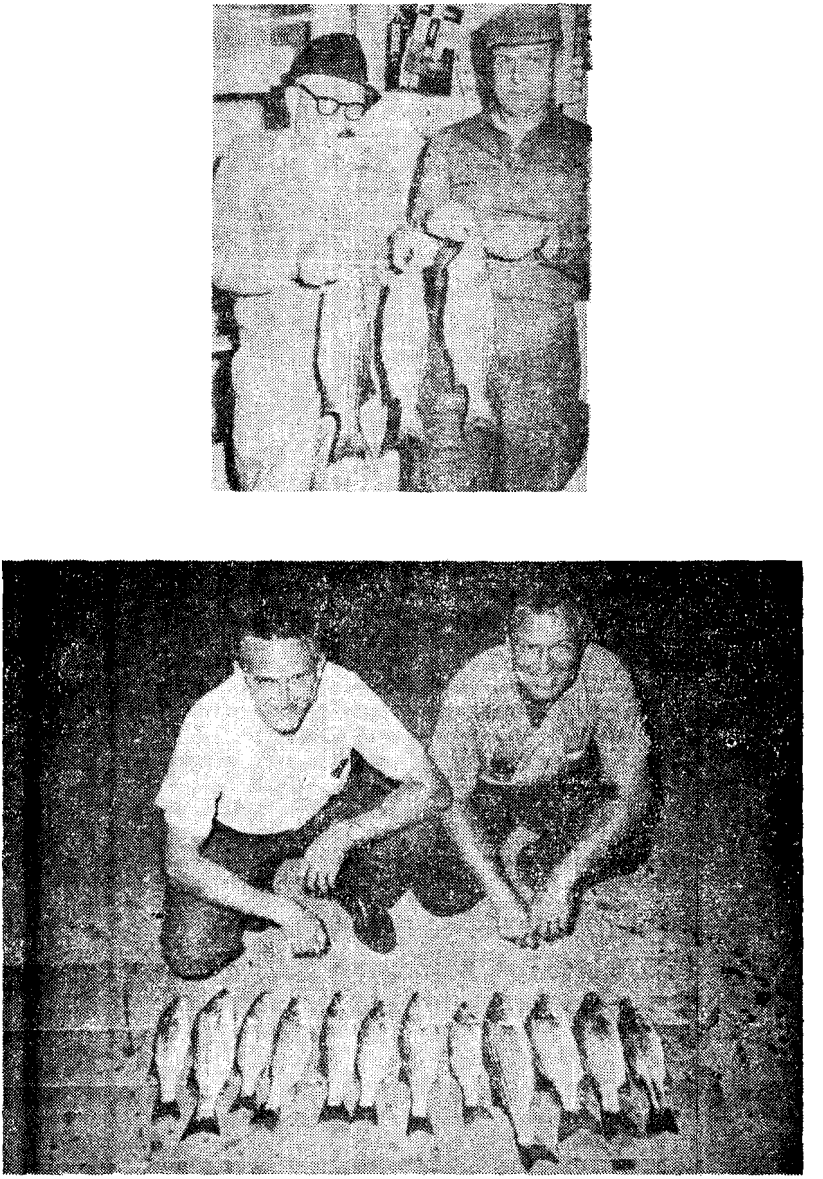

Figure 4. Catches Of Striped Bass From Lake Greeson Within The First Year After Being Released From The Nursery Pond.

of the second crop began on June 3, 1969, and it was estimated that between two hundred and fifty and three hundred thousand, two to three inch, walleye were drained from the pond.

A fish population sample on June 26-27, 1969, in a bay approximately two miles from the nursery pond (Figure 3), yielded 59 young walleye. During the past fifteen years of rotenone population sampling, no other walleye have been collected from Lake Greeson. Walleye were, however, native to the stream before impoundment, and a total of over three million fry have been placed in Lake Greeson throughout the past ten years. Fishermen occasionally catch walleye from this reservoir, but these catches are considered a rarity and occur normally in the early spring while fishing for white bass, *Roccus chrysops.* It is anticipated that during the next two to three years a walleye fishery will develop in Lake Greeson.

PROBLEMS ENCOUNTERED

With each new technique comes new problems; this has been true with the nursery ponds. However, with the construction of each new nursery pond and the experience gained from rearing and releasing various species of fish from a nursery pond, most of these initial problems are being alleviated.

Cost of Construction

Cost of Construction will perhaps always be a major problem to contend with in the use of nursery ponds, but obviously the best solution to this problem would be the success achieved by using this technique. Construction cost will be highly variable and are probably most influenced by the topography of the construction site. Most nursery ponds in Arkansas have been built in steep, mountainous terrain and have required very high and often long levees, at considerable expense. However, it seems feasible that in a flatter terrain a low levee on three or four sides could be utilized at a cheaper construction cost. This type of structure would require pumping lake water into the pond of filling.

Fluctuating Water Level of Reservoir

Since the majority of the multi-purpose reservoirs are subject to moderate to drastic water level fluctuations during the year, the elevation of the lowest point in the nursery pond is very critical. Depending on the species of fish in the pond, releases may have to be made at full pool elevation of the reservoir or near minimum pool elevation. The nursery ponds in operation in Arkansas are normally located partially within the flood pool of the reservoir with the lowest elevation in the pond approximately the maximum power pool elevation of the reservoir. Thus the pond can be completely drained when the reservoir is at top of power pool elevation. For draining the pond when the reservoir is below this elevation, a canal has been dug connecting the drain pipe to the lake at lower elevations.

Draining of Different Species of Fish

Certain species of fish are resistant toward draining from the pond. For example, the majority of channel catfish remain in the pond until the last water is drained out. Therefore, it is important that all of the water completely drain from the pond. Although, not as bad as channel catfish, striped bass remain in the pond in large numbers until near the end of draining operations. In contrast, fingerling walleye drain from the pond rapidly and there is rarely any loss of walleye from the draining operation.

Initial Predation Upon Release

Upon release of a large volume of water from the nursery pond into the reservoir, a concentration of fish is attracted to the inflow. The filter feeders, such as shad, are normally the first to appear, followed

by the predator fishes. It has been apparent that some loss of fingerling size fishes being released from the nursery pond has occurred through predation. However, water being released from the pond is fairly turbid, thus limiting predation to some extent; also, only the sub-adult and adult fishes are capable of ingesting the fingerling size fishes, whereas fry fishes are consumed by almost all fishes within the reservoir.

Estimating Size of Crop

Determining the number of fish which are being released from a nursery pond is extremely difficult, particularly when little previous experience has been obtained in rearing a certain species. Estimations of the size of the crop are made from frequent test seining samples during both the rearing and draining period. Considerations for making an estimate are given to the number of fish stocked per acre, the number caught per test seine haul, growth rate, available food supply, uniformity of size and previous knowledge of rearing the species in a hatchery situation. It is felt that knowing the exact number of fish released is valuable but not critical and the actual measure of success of a nursery pond release is found on the fishermen's stringer.

SUMMARY

The separate structure nursery pond technique is being used on some of the major impoundments in Arkansas as a means of introducing non-native species of fish into a reservoir in an attempt to initiate a form of intensive fishery management. The re-establishment of a walleye fishery in both Norfork and Bull Shoals Reservoir has been a direct result of nursery pond releases following the failure of fry stocking.

The Lake Greeson Nursery Pond has been used as a model to demonstrate the effectiveness of the nursery pond technique by raising and releasing a concurrent crop of an exotic fish to the reservoir and a genetically tagged fish that could be easily identified as a product of the nursery pond.

Some of the problems encountered in the use of nursery ponds are discussed and the approaches toward solving these problems are given.

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