LITERATURE CITED

Clemens, Howard P. and Kermit E. Sneed
1962 Bioassay and use of pituitary materials to spawn warm-water fishes. Research Report 61, Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service.

Eisler, Ronald
1957 Some effects of artificial light on salmon eggs and larvae. Transactions of the American Fisheries Society, Vol. 87 (1957), pp. 151-162.

Pickford, Grace E. and James W. Atz
1957 The physiology of the pituitary gland of fishes. New York Zoological Society, New York, pp. 613.

Raney, E. C.
1952 The life history of the striped bass, *Roccus saxatilis* (Walbaum), Bulletin of the Bingham Oceanographic Collection, Vol. 14 (1): 5-97.

Sneed, Kermit E., and Howard P. Clemens
1959 The use of human chorionic gonadotrophin to spawn warm-water fishes. Progressive Fish-Culturist 21 (3): 117-120.

Sneed, Kermit E., and Harry K. Dupree
1961 The effect of thyroid-stimulating hormone combined with gonadotrophic hormones on the ovulation of goldfish and green sunfish. Progressive Fish-Culturist 23 (4): 179-182.

Stevens, Robert E.
1957 The striped bass of the Santee-Cooper Reservoir. Proceedings of the Eleventh Annual Conference, Southeastern Association of Game and Fish Commissioners, Mobile, Ala., October 20-23, 1957, pp. 253-264.

Stevens, Robert E., and Jefferson C. Fuller, Jr.
1962 A preliminary report on the use of hormones to ovulate striped bass, *Roccus saxatilis* (Walbaum), Proceedings of the Seventeenth Annual Conference, Southeastern Association of Game and Fish Commissioners, Charleston, S. C. October, 1962.

FLORIDA PHOSPHATE PITS FOR MANAGED PUBLIC FISHING AREAS[1]

EDWARD CRITTENDEN
Fisheries Experiment Station
Leesburg, Florida

Florida Game and Fresh Water Fish Commission
A Federal Aid Project

Presented At The 17th Annual Meeting
Southeastern Association of Game and Fish Commissioners
September 29 - October 2, 1963
Hot Springs, Arkansas

ABSTRACT

Several mined-out and flooded phosphate pits near a large population center in peninsular Florida have been acquired and put under management by the Florida Game and Fresh Water Fish Commission for public sport-fishing purposes. Costs of making these abandoned phosphate areas accessible to the public are discussed; fishing pressure and sportfishing success on renovated ponds are reported and compared; and the relationships of size and shape of the ponds to success in fishery management are noted.

[1] A contribution of Florida Federal Aid Project F-14-R.

INTRODUCTION

The State of Florida, like many other states, is faced with the ever-increasing demand for additional fishing, hunting, camping, and general outdoor recreational facilities. It is estimated that Florida's resident and tourist populations each will have increased by nearly 40 percent by the year 1970 (Governor's Committee, 1963). The need for increased outdoor recreational facilities will naturally fall in the vicinities of high concentrations of people: near the coastal areas of South Florida.

In an effort to help mitigate problems of insufficient fishing waters and recreational areas, the Florida Game and Fresh Water Fish Commission has undertaken a program of leasing mined-out phosphate lands to create managed public fishing waters. The first such land, known as the Pleasant Grove Fish Management Area, was leased in 1961. It is located approximately 20 miles from Tampa, a city of 274,970 people (Florida census records, 1960).

In order to evaluate this program, and to provide a means of planning for similar fish management areas in the future, a study was initiated to answer the following questions:

1. What is the maximum amount of sportfishing pressure to be expected on the ponds in the Pleasant Grove Area, and how will this pressure affect the fishery?
2. What is the best size and shape of the ponds for most efficient fish management practices?
3. How much will it cost to make an abandoned phosphate area accessible to the public?

In addition to the foregoing investigations, studies are also being conducted to determine the most desirable fishes to use, and the best ratio for stocking them to provide an optimum sport fishery. These studies are still in progress and will be reported on when sufficient information is obtained.

DESCRIPTION OF PLEASANT GROVE AREA

The Pleasant Grove Fish Management Area is a 505-acre tract of mined-out phosphate land, which contains 150 acres of ponds and 355 acres of land. The ponds are water-filled pits formed by the mining operations. The 30 ponds in the area range in size from one-half acre to slightly over 17 acres.

Water depths range from six to 30 feet. When first dug, the pits were deeper, but the washing of sand, clay, and silt from adjacent high spoil banks has partially filled the depressions.

The waters of the pits are fertile and support dense blooms of phytoplankton. Secchi-disk readings range from 12 to 20 inches, indicating that the waters are comparable to those of fertilized ponds (Swingle, 1952). Another indication of such fertility is the high content of dissolved phosphorus. The mean of the phosphorus determinations for the waters of the ponds was 0.5 ppm (Hach colorimeter). The pH value of the water ranges from 6.0 to 6.4 and the total alkalinity from 10 to 24 ppm.

The major aquatic plants in the ponds are water lettuce, *Pistia stratiotes;* water hyacinth, *Eichhornia crassipes;* duckweed, *Lemna minor* and *Spirodela polyrhiza;* cattails, *Typha* sp.; coontail, *Ceratophyllum* sp.; and aquatic grasses, *Panicum* sp.

A hard-surface road separates the area into two parts or sections. These are called the Agrico and Thomas Sections. Mining operations began in Thomas Section in the early 1930's and continued on into the Agrico Section through the 1940's. It is quite obvious that the Thomas Section was the first mined, since it contains the greatest number and variety of the larger trees.

The more numerous trees in the Thomas Section are live oak, *Quercus virginiana;* laurel oak, *Q. laurifola;* water oak, *Q. nigra;* southern waxmyrtle, *Myrica cerifera;* guava, *Psidium guajava;* pines, *Pinus* sp., and groundsel-trees, *Baccharis halimifolia.* The predominate trees in the Agrico Section are southern waxmyrtle, pines, and groundsel-trees.

Generally, high spoil banks lie adjacent to the pits throughout the

area. These banks are piles of overburden materials stripped from over the phosphate ore by draglines during the mining operations. In places the spoil banks are up to 50 feet in height. These spoil banks made many of the pits inaccessible except by ardurous walking and climbing.

For maps and for administrative purposes, the individual pits in the management area were assigned a prefix and a number. The prefix was taken from either the Thomas or Agrico Section and the numbers ran consecutively from number one in each section. Examples would be T-1, T-2, T-3 . . . , or A-1, A-2, A-3. . . .

Access Preparation

The high spoil banks, the dense growth of vegetation along the edge of the pools, and lack of places to unload and load boats in the Pleasant Grove Area necessitated the undertaking of several projects. Ramps were constructed by the Commission's Public Boat Launching Ramp Project (F-13-D), a Federal Aid Project. The bulldozer was owned by the Game and Fresh Water Fish Commission. The Hillsborough County Commission furnished an operator and a road patrol machine to grade and maintain the roads in the Agrico Section.

Roads: One and one-half miles of graded dirt roads were prepared in the Agrico Section. A bulldozer and a road patrol machine were used for this work. The total time for the bulldozer on this particular job was five eight-hour days and one eight-hour day for the road patrol machine. Actual cost to the Commission for labor, traveling expenses, fuel, oil and grease was $210.00. If the bulldozer and road patrol machine had been hired from private industry the total cost for this equipment at $12.00 per hour would have been $576.00.

Three-quarters of a mile of road was prepared by the bulldozer in the Thomas Section. The right-of-way for this road followed an old road that had been destroyed by erosion from rains and non-maintenance. Actual time for the bulldozer to complete the job was two eight-hour days. The actual cost to the Game and Fresh Water Fish Commission was $85.00. A private bulldozer hired at $12.00 per hour would have cost the Commission a total of $192.00.

Ramp Construction: Three permanent boat ramps were constructed in the Pleasant Grove Fish Management Area by the Federal Aid Project, F-13-D. Cost of materials and supplies for these three ramps was $1,853.23. The cost of labor for this work would be approximately half the cost of materials and supplies making a total cost of about $2,750,-.00. The ramps were made of cement poured in place and of pre-fabricated cement slabs. Rip-rap of bagged cement was placed alongside of the entire ramp to prevent soil erosion by heavy rains.

Trail Making: Trails for bank fishermen have been cut around six ponds in the fish management area. It was found that cutting a narrow trail just wide enough for a bank fisherman to pass through would suffice since the heavy traffic by the fishermen would widen the trail considerably.

There were approximately 2.5 miles of trails cut around the six ponds. These were generally through a heavy growth of southern waxmyrtle trees. Equipment used to prepare the trails consisted of machetes, axes, and brush hooks. Twelve man-days were required to do this work. Total cost of labor and traveling expenses was $252.00.

Generally, the work needed in the phosphate areas to make the ponds accessible to fishermen include the building of ramps to unload and load boats, the building of roads to make the more distant ponds accessible by car, and the cutting of trails around the ponds for bank-fisherman use.

In the Pleasant Grove Fish Management Area the 10-foot wide cement ramps cost nearly $1,000.00 apiece to build. The graded dirt roads for two-way traffic cost $140.00 per mile with county-aid and use of Florida Game and Fresh Water Fish Commission personnel and equipment. If the equipment had been hired the cost would have been $384.00 per mile. The primitive, one-way traffic dirt roads made by the bulldozer cost $113.00 per mile. Hired equipment would have run the cost to approximately $250.00 per mile. The cost of trail-cutting would

depend on the density of the vegetation. In the Pleasant Grove Area the cost was about $100.00 per mile for a very narrow trail. Hired labor would probably have been cheaper since some of the men used were on traveling expenses.

Management Activities and Results

Fish population samples, taken with rotenone, showed that all but two of the ponds in the Pleasant Grove Fish Management Area contained fish. Complete renovation work, which included the use of fish toxicants and restocking, was necessary in many cases because of the crowded conditions caused by too-numerous forage fishes; bluegill, gizzard shad, threadfin shad, or golden shiner. Several ponds were selectively treated with rotenone to reduce the numbers of threadfin and/or gizzard shad.

To date, six of the renovated ponds have been opened to public fishing. Fishes stocked in these ponds include largemouth bass, bluegill, redear sunfish, channel catfish, white catfish and the nile tilapia *(Tilapia nilotica)*.

A statewide fish tagging program was in effect during the periods these ponds were opened to public fishing (Copeland, 1963). The tags returned by the anglers had rewards ranging from $25.00 to $10,000. All of the above ponds received varying numbers of the reward-carrying tagged fish.

The opening day for fishing in the ponds was advertised by all available news media for several days prior to the opening. The public was aware that these ponds were under management, had been restocked, and that reward carrying tagged fish were present in them.

Fishery personnel from the Game and Fresh Water Fish Commission were stationed at each pond on the first and second day it was opened for fishing. As many fishermen as possible were interviewed at the completion of their fishing trips. Each interview furnished information including the number in the party, the time spent fishing, and the number and weight by species of the fish caught. Actual counts of fishermen were made by boat every two hours in each of the ponds, with the time of the counts being staggered from day to day. On the succeeding days, following the first two days, the interview team was limited to a two-man crew, which allowed only spot checks of the interviews and fishermen counts. Spot checks continued for approximately one year following the opening of the T-1 pond.

The following formula was used to estimate the number of fishing trips made on each pond:

$$\frac{\text{Length of Day } \textit{(daybreak to sundown)}}{\text{Average Hours Fished}} = \text{Number of Trips Possible in a Day}$$

$$\text{Number of Trips Possible in a Day} \times \text{Average Count of Anglers} = \text{Number of Fisherman Trips Per Day}$$

The first renovated pool (T-1) was opened to public fishing on February 17, 1962. This 17.4-acre pond had been stocked with 340 largemouth bass fingerlings and 50 adult bluegills per acre.

From February 17, 1962 through March 31, 1963, a period of 408 days, there were an estimated 16,689 fishing trips made on the T-1 pond. This amounted to almost 1,000 trips per acre for this period or about 850 trips for the year. It was estimated that this pond received 110 fishing trips per acre the first three days after opening and furnished 106 pounds of fish per acre to the anglers. An estimated 1,191 largemouth bass weighing 946 pounds and 4,569 bluegill weighing 896 pounds were taken by fishermen during the three-day period.

On April 13, 1963, five additional ponds were opened to public fishing. These ponds had a total of 37.5 acres of area ranging from 1.5 acres to 23.4 acres (two were connected). Various combinations of fresh water fishes, including nile tilapia, were stocked in the ponds. Stocking rates per acre were from 100 to 150 largemouth bass fingerlings; 1,000 to 1,500 bream (mixed bluegill and readear sunfish)

fingerlings; 110 white catfish fingerlings; 50 channel catfish fingerlings; and 35 adult to 900 fingerling nile tilapia.

The first seven days these five ponds were open, it was estimated that 3,546 fishing trips were made, averaging 95 trips per acre. An estimated 2,816 pounds of fish, or 75 pounds per acre, were taken by anglers during this period.

A comparison of the catch rates in two large and two small ponds in the Thomas and Agrico Sections on the day of opening and on the following day shows a dramatic decrease in number of fish caught per hour on the second day in the small ponds (Table 1). The larger ponds were much more capable of sustaining a high rate of catch under conditions of heavy fishing pressure. In future mining operations, where the phosphate companies plan to leave bodies of water in which public fishing will be allowed, it is recommended that the excavated holes or pits cover as large an area as possible.

Table 1. Fishing Pressure and Success in Two Large and Two Small Ponds in the Thomas and Agrico Sections of Pleasant Grove Fish Management Area.

	Name of Pond	Size in Acres	No. Fishing Trips Per Acre	Fish Caught Per Hour Opening Day	Second Day
Large Ponds	T-1	17.4	83	.95	.61
	A-1 & A-2 (connected)	23.4	33	1.09	2.00
Small Ponds	T-2	9.0	62	1.00	.13
	A-6	1.5	103	.92	.17

The desire to fish in a "new" body of water, plus the prospect of catching a tagged fish worth from $25.00 to $10,000.00 contributed greatly to the amount of fishing pressure in the area on the opening and succeeding days.

This study has shown the great recreational value of an area such as this near a high concentration of people. However, in order to maintain a sustained fishery on small bodies of water, the study suggests that the ponds contain no reward-carrying tagged fish and that publicity concerning the fishery be limited. If excessive advertising cannot be controlled, the number of fishermen allowed to fish at any one time will have to be restricted. The limits on predatory game fish, *i.e.*, largemouth bass (10) should also be reduced under these circumstances.

Both the size and the shape of ponds appear to play an important part in control of certain unwanted aquatic vegetation. Most of the ponds in the area were filled with water lettuce or with water hyacinth. However, when the hyacinth or water lettuce were eradicated from the small ponds they became badly infested with duckweed.

In addition to being a nuisance to sportfishermen, duckweed appears to have an adverse effect on the fish populations of a pond. Fish population estimates were made in a number of ponds that were covered with duckweed for at least one year. The estimates showed that the total number and pounds of fish became considerably reduced following heavy infestation with duckweed. Fish reproduction was found to be practically absent from these ponds.

The greatest single factor in the control of duckweed appears to be that of waves caused by wind action. Combinations of high banks with extensive tree growth, size and shape of the ponds may effectively shield the water from the wind. It was found that the ponds in the Pleasant Grove Area with the greatest duckweed infestation had little or no wave action.

It is difficult to state any minimum length and width dimensions a pond should have in order that heavy growths of duckweed may be prevented or inhibited. However, observations in Pleasant Grove and other mined-out phosphate areas indicate that the pits should be at least 150 feet wide and 1,000 feet long to permit adequate wind and wave movement for the control of duckweed.

LITERATURE CITED

Copeland, J. B. and Melvin T. Huish. 1963. A description and some results of a statewide fish tagging program. Proc. Ann. Conf. S. E. Game and Fish Comm., 16 (1962): In Press.

Governor Ferris Bryant's Committee on Recreational Development. 1963. Florida's Outdoor Recreation at the Crossroads. State of Florida, 36 pp.

Swingle, H. S. 1952. Farm pond investigations in Alabama. Journ. Wildl. Mgt. 16(3):243-249.

RESULTS OF A TAGGING STUDY ON THE SPOTTED BASS, *Micropterous punctulatus*

BY

LEON KIRKLAND

Georgia Game and Fish Commission

Atlanta, Georgia

Presented at the 17th Annual Meeting,
Southeastern Association of Game and Fish Commissioners
September 29-October 2, 1963

"Federal Aid to Fish Restoration Funds Under Dingell-Johnson Project F-14-R-2, 'Reservoir Management Investigations'"

ABSTRACT

One thousand seven hundred and forty-nine Spotted Bass were tagged in Allatoona Reservoir, Georgia, in the winter of 1961-62 and rewards were paid for return of the tags by sport fishermen. The nature of the Spotted Bass fishery and population density is described on the basis of these tag returns and creel census. Two hundred and sixty-two Largemouth Bass were tagged simultaneously and comparative data on the two species is given.

INTRODUCTION

The dominance of the Spotted Bass over the Largemouth Bass in the fishery at Lake Allatoona has resulted in an increased interest in this species as a potential predator in other situations.

Although the Largemouth was more abundant in the first few years after impoundment, the Spotted Bass has gradually become more and more prominent in the fishery until it makes up over 90% of the bass catch at present. Even though Allatoona is a relatively old reservoir at 14 years, the Spotted Bass still maintains a relatively high population and good fishery under conditions of heavy fishing pressure.

The present study was initiated to obtain further information on this species, with particular reference to its density, catchability, and harvest rate. If the Spotted Bass could be determined to be a desirable fish from the sportsman's standpoint, exhibit a good harvest rate and maintain itself well in an old reservoir, then it will probably be introduced in some of the other impoundments where it does not occur.

METHODS AND MATERIALS

The capturing and tagging of the fish for this study was carried out from Nov. 15, 1961 to March 15, 1962. All fish used in the experiment were captured with the electric seine and tagged with the Petersen tag (Kirkland, 1962). Studies on the mortality from tagging and the electric shocking using the same equipment and procedure has previously been found to be negligible (*ibid.*).

Effort was made to exert an equal amount of capturing effort in all areas so that tagged fish would occur in all areas in proportion to the population density. However, the difference in catch rate due to weather