POND WATER FOR REARING STRIPED BASS FRY, *Roccus Saxatilis* (WALBAUM), IN AQUARIA

EDWARD M. MCGILL, JR.
Arkansas Game and Fish Commission
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ABSTRACT

Fry striped bass, *Roccus saxatilis* (Walbaum)[1], were hatched at the Weldon, North Carolina State Fish Hatchery from eggs obtained from hormone-injected females collected from commercial pound nets in Albemarle Sound, North Carolina. The fry were packaged when two and three days old in conventional square (15" x 15" x 22") plastic bags with an oxygen atmosphere and shipped to Arkansas by airplane in insulated containers. Two hundred thousand (200,000) fry were held in each of two 58-gallon aquaria at the Joe Hogan State Fish Hatchery, Lonoke, Arkansas, for six days. Frequently changed, filtered pond water was used. At the end of six days when the fry were eight and nine days old and were swimming horizontally and feeding, they were released into a seven and one-fourth (7.25)-acre nursery pond. Total mortality during the entire operation from the time the fry were packaged in the plastic bags in North Carolina until they were released in the nursery pond in Arkansas was estimated to have been less than seven per cent. Upon draining the nursery pond sixty-three thousand six hundred seventeen (63,617) fingerlings were harvested (seventeen per cent of total estimated fry stocked). These fingerlings were planted in Dardanelle Reservoir on the Arkansas River.

INTRODUCTION

The construction of large reservoirs throughout the Southern United States has resulted in population explosions of shad (*Dorosoma cepedianum* (LeSeur) and *Dorosoma petenense* (Gunther). Since none of the native piscivorous fishes can adequately fill the pelagic niche and control the shad, a new predator is being sought by fishery biologists. The striped bass, *Roccus saxatilis* (Walbaum), is thought to be the most desirable fish to fill this vacant niche.

Some states attempted to establish the striped bass in reservoirs by stocking adult fish, but this has proved fruitless. Also, millions of fry striped bass have been stocked since the development of techniques to propagate and transport them, but this method of stocking is extravagant due to the low survival obtained.

North Carolina and South Carolina have held artificially propagated striped bass fry in aquaria until they were swimming horizontally, but other states have experienced high mortality when attempting this.

It is known by fish culturists and aquarists that the biological conditions which exist in old pond water have so "conditioned" this water that it provides a much better nursery medium for fry fish than does dechlorinated city water, well or spring water. Therefore, we decided to use filtered water taken from our earthen hatchery ponds in our attempt to hold fry striped bass until they could swim horizontally.

METHODS AND MATERIALS

Propagation of the Fry

Adult striped bass of both sexes were purchased from commercial fishermen at Albemarle Sound, North Carolina for the purpose of artificially propagating the fry. Techniques used in propagating this species have been reported by Stevens (1964), and Tatum, et al. (1965).

[1] Nomenclature recommended by the committee on common and scientific names of fishes, Spl. Publ. No. 2, American Fisheries Society, 1960.

After being fertilized the eggs were moved from Albemarle Sound to the Weldon Fish Hatchery, Weldon, North Carolina, where they finished hatching Sunday, 8 May, 1966.

Shipping the Fry

The four hundred thousand (400,000) two- and three-day-old fry were packed for shipment at 12:30 A.M., CST, on 10 May, 1966 in two and one-half gallons of water at 67°F. with one-fourth pound of crushed ice placed around the outside of the bag containing the fry. The bags of fry were then filled with an oxygen atmosphere and packed in insulated shipping containers.

Our Commission-owned airplane was used to transport the fry from Weldon, North Carolina to Lonoke, Arkansas. When received in Arkansas, six and one-half hours later, the fry were in excellent condition, and at that time the fry were capable of making only vertical swimming efforts every 10 to 20 seconds.

Receipt of Fry

Upon receipt, the eight bags of fry were placed in earthen pond Number 37 adjacent to the building which housed the aquaria. All bags were placed in the pond's edge with the tops rolled down for tempering. The pond water (62°F.) was splashed into the bags over a period of one to one and one-half hours even though the temperatures in the bags were within one degree of the pond water. Pond water was added until about four and one-half gallons were in each bag. (Two and one-half gallons when packed for shipping and two gallons of pond Number 37 water added.) By 8:30 A.M., all of the fry had been released into the aquaria.

Preparation of Equipment

All of the equipment used in this project was cleaned thoroughly by washing with either borax or table salt (NaCl) and rinsing, then allowing it to soak in a strong solution of potassium permanganate for about 30 minutes. All equipment was then rinsed thoroughly with well water. The aquaria were cleaned as described except the potassium permanganate was flushed by allowing well water to flow through the aquaria until only clear water remained.

Aquaria Set-Up

The two aquaria used in this project have a 58-gallon capacity each with a drain in one end. The drain is composed of a cylinder inside a cylinder with several one-fourth inch holes in the outside cylinder. The holes are in the lower six inches of the cylinder.

It was decided that four gallons of water would be drained and replenished each hour, and to prevent the fry from being sucked into the drain, the cylinders with holes were wrapped three times with 50 x 50 nylon mesh held in place by rubber bands. Later, when the fry could swim strongly, only one wrap was used to facilitate the draining process. When wrapped three times with the nylon mesh, draining of the four gallons required 20 to 25 minutes and when changed to one wrap, it required about four to five minutes.

Oxygen Supply

The oxygen supply for the aquaria was by means of compressed (bottled) oxygen with a regulator and gauges indicating pounds of pressure and pounds per square inch (Table 1). This was connected

TABLE 1. COMPRESSED OXYGEN USED.

	Aquarium Number 1	Aquarium Number 2*
Consumption:	1st Day — 300 pounds	—
	2nd Day — 300 pounds	—
	3rd Day — 150 pounds	—
	4th Day — 150 pounds	—
	5th Day — 150 pounds	—
	6th Day — 150 pounds	—
Total Consumption:	1200 pounds	—

* No accurate reading due to gauge malfunction.

by rubber air hoses to a system of valves which would allow individual adjustment of oxygen flow through each of the two airstones in each aquaria. This same system is used on our fish hauling trucks. The pounds per square inch gauge was maintained between zero and four to obtain the desired oxygen flow into the aquarium water through two airstones (Figures 1 and 2).

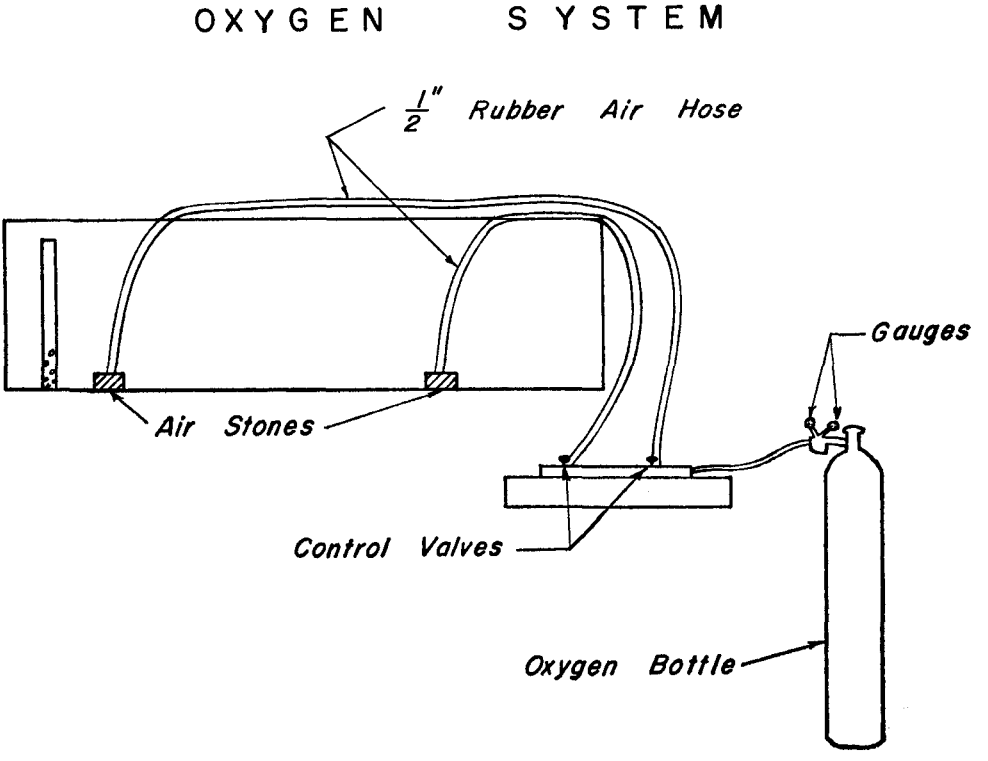

Fig. 1

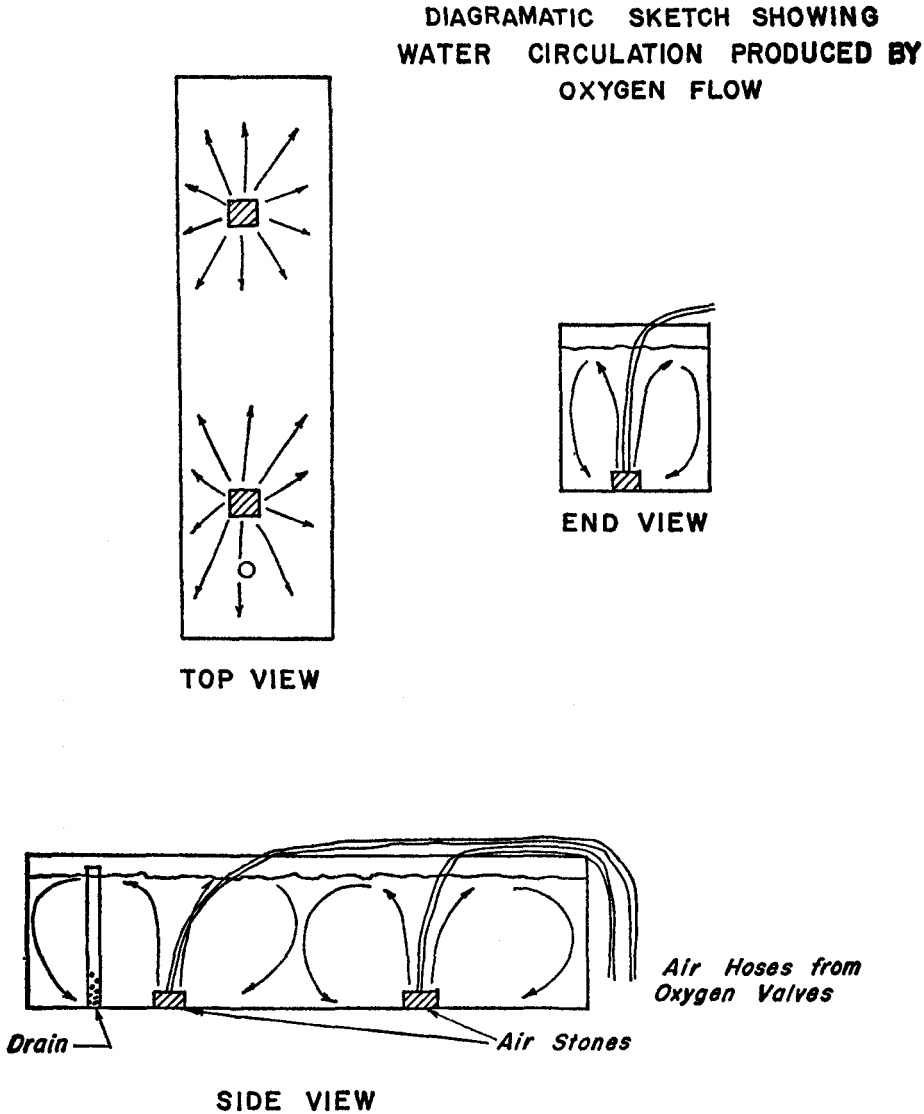

Fig. 2

The force with which oxygen was released and the amount was regulated by a screw valve on the pounds per square inch gauge. This was very important in obtaining the circulation of the aquaria water to keep the fry from settling to the aquaria bottom and suffocating. The cooling effect of releasing compressed oxygen was important in maintaining desirable water temperatures in the aquaria.

Water Sources

The water used in the aquaria was taken from four earthen rearing ponds on the Joe Hogan State Fish Hatchery (Table 2). It was pumped

TABLE 2 WATER SOURCES FOR THE AQUARIA*

Rearing Pond Number	Surface Acres	Date of Water Use in Aquaria	Pond Filled & Water Source	Water Description	pH	Fertilizer and/or Chemical Used		
						Type	Lbs.	Date Applied
58	5.9	Initial filling until 6:00 P.M. 10 May 1966	Filled early March 1966 with well water	Heavy zooplankton bloom. Many *Daphnia* & rotifers	8.5	16-20-0 16-20-0 $CuSO_4$ 10-20-10	480 240 25 320	3/25/66 4/16/66 5/ 2/66 5/ 6/66
56	15.9	6:00 P.M. 10 May 1966 until 7:00 P.M. 11 May 1966	Contained water from several ponds which were drained into it Feb. - March 1966	Same as above	8.5	16-20-0	2400	4/ 4/66
54	12.03	7:00 P.M. 11 May until 7:00 P.M. 13 May 1966	Filled early March 1966 from well water	Same as above	8.5	16-20-0	960	3/25/66
1	1.0	7:00 P.M. 13 May to project completion	Full over winter (contained channel catfish brood stock)	Heavy phytoplankton bloom with a few zooplankton present. Mesh size on siphon hose changed to allow larger zooplankton into aquaria	8.5			

* Some well water (62°F.) was used to cool the water in the outside tank when it rose into the low 70°F. range.

into a 250-gallon livestock watering trough on a truck. This was then transported to the aquaria building where it was bucketed into a 150-gallon livestock watering trough situated on a six-foot-high scaffold outside the aquaria building. Two garden hoses with plankton net filters over the tank ends were used to siphon into the aquaria. The filter was later changed to a 50 x 50 nylon mesh to allow larger zooplankton to enter the aquaria when the fry began feeding. The filters required frequent cleaning during refilling operations to remove the larger zooplankton and to keep the water flowing freely.

The tank on the scaffold was refilled an average of three times each 24 hours. It is felt that this method of securing the pond water is advantageous over a system of pipes since the dissolved oxygen level in pond water can drop quickly in a closed watering system.

Placing Fry in Aquaria

After tempering the fry in pond Number 37, adjacent to the aquaria building, the bags of fry were carried to an aquarium and emptied directly into it. Both aquaria had been filled one-half full with filtered water from pond Number 58, and the water temperature in aquarium number one was 60°F. and 59°F. in aquarium number two (Table 3).

TABLE 3. AQUARIA TEMPERATURE CHARTS

Date	Time	Aquarium Number 1 Temp. °F.	Aquarium Number 2 Temp. °F.	Date	Time	Aquarium Number 1 Temp. °F.	Aquarium Number 2 Temp. °F.
10 May	9:00 AM	60	59	12 May	1:00 AM	68	68
Tues.	10:00	60	59	Thurs.	2:00	69	69
	11:00	60	59		3:00	69	69
	12:00 PM	60	59		4:00	69	69
	1:00	60	59		5:00	69	69
	2:00	60	59		6:00	69	69
	3:00	60	59		7:00	69	69
	4:00	60	61		8:00	68	68
	5:00	61	62		9:00	68	68
	6:00	61	61		10:00	68	68
	7:00	62	61		11:00	69	68
	8:00	62	62		12:00 PM	68	68
	9:00	63	63		1:00	69	68
	10:00	62	62		2:00	69	68
	11:00	62	62		3:00	69	68
11 May	12:00 AM	62	63		4:00	68	68
Wed.	1:00	62	62		5:00	69	69
	2:00	62	63		6:00	70	69
	3:00	63	63		7:00	70	70
	4:00	63	63		8:00	71	71
	5:00	63	63		9:00	71	71
	6:00	63	63		10:00	71	71
	7:00	63	63		11:00	71	71
	8:00	63	63	13 May	12:00 AM	71	71
	9:00	63	63	Fri.	1:00	71	71
	10:00	64	64		2:00	71	71
	11:00	64	64		3:00	70	71
	12:00 PM	65	65		4:00	70	71
	1:00	65	65		5:00	70	71
	2:00	66	66		6:00	70	70
	3:00	66	67		7:00	70	70
	4:00	67	67		8:00	69	70
	5:00	67	67		9:00	69	69
	6:00	68	68		10:00	68	69
	7:00	68	68		11:00	68	68
	8:00	68	68		12:00 PM	68	68
	9:00	68	68		1:00	—	—
	10:00	68	68		2:00	—	—
	11:00	68	68		3:00	70	70
	12:00	68	68		4:00	69	69

TABLE 3. AQUARIA TEMPERATURE CHARTS—(CONTINUED)

Date	Time	Aquarium Number 1 Temp. °F.	Aquarium Number 2 Temp. °F.	Date	Time	Aquarium Number 1 Temp. °F.	Aquarium Number 2 Temp. °F.
13 May	5:00	68	68	15 May	1:00	68	68
Fri.	6:00	68	68	Sun.	2:00	68	68
	7:00	68	67		3:00	70	70
	8:00	67	67		4:00	70	70
	9:00	67	67		5:00	72	72
	10:00	67	67		6:00	72	72
	11:00	—	—		7:00	73	73
	12:00 AM	66	66		8:00	73	73
14 May	1:00	66	66		9:00	73	73
Sat.	2:00	66	66		10:00	73	73
	3:00	65	65		11:00	73	73
	4:00	64	64		12:00 AM	73	73
	5:00	64	64	16 May	1:00	73	73
	6:00	64	64	Mon.	2:00	73	73
	7:00	63	63		3:00	73	73
	8:00	63	63		4:00	73	73
	9:00	64	63		5:00	73	73
	10:00	65	64		6:00	72	72
	11:00	65	65		7:00	71	71
	12:00 PM	66	66		8:00	fry removed	fry removed
	1:00	66	66				
	2:00	67	67				
	3:00	68	68				
	4:00	68	70				
	5:00	69	70				
	6:00	69	70				
	7:00	69	70				
	8:00	69	69				
	9:00	69	69				
	10:00	69	69				
	11:00	68	68				
	12:00 AM	68	68				
15 May	1:00	67	67				
Sun.	2:00	66	66				
	3:00	66	66				
	4:00	65	65				
	5:00	64	64				
	6:00	63	63				
	7:00	64	64				
	8:00	64	64				
	9:00	65	64				
	10:00	65	65				
	11:00	66	65				
	12:00 PM	67	66				

The airstones which had been bubbling oxygen through the aquaria for 30 minutes prior to releasing the fry, circulated the two hundred thousand (200,000) fry (four bags) released in each aquarium.

A small wooden paddle was used to gently stir the aquaria water to keep the fry that did settle, off the aquaria bottoms. This was done about every five minutes during the first 12 hours.

The temperature in each aquarium was taken and recorded every hour just prior to draining out four gallons and refilling with water siphoned from the elevated outside tank containing pond water (Table 3). The siphoned water was allowed to strike the surface of the aquaria water when refilling, causing a bubbling action. Later during the project, this prevented stirring up detritus on the aquaria bottoms.

Controlling Aquaria Temperatures

On a few occasions during the six days the fry were held, the pond

water reached temperatures into the low 70°F. range, at which time addition of some well water (64°F.) and/or ice in plastic bags were used to lower the temperature in the small, frequently replenished outside siphon tank.

RESULTS

During the period the fry were held in the aquaria, no appreciable loss was noticed. Including ten thousand (10,000) fry which were removed for experimental purposes, total mortality was estimated to be twenty-five thousand (25,000). Therefore, we had a survival of 375,000 or 93.8 per cent after holding the four hundred thousand (400,000) fry for six days in the two aquaria.

During the last week of July, 1966, a total of fifty-one thousand five hundred (51,500) fingerlings were removed from the rearing pond. Dardanelle Reservoir was stocked with forty-one thousand five hundred

(41,500) of these and an acute oxygen depletion accounted for another ten thousand (10,000) fingerlings. The pond was only partially lowered during this harvesting and after removing the fifty one thousand five hundred (51,500) fingerlings, the pond was refilled. Then, during the second week of October, 1966 the pond was completely taken out and a total of twelve thousand one hundred seventeen (12,117) yearlings were harvested and stocked in Dardanelle Reservoir. This gives a yield of 17 per cent (63,617) from stocking (375,000) to harvesting (Figure 3).

DISCUSSION

Visibility in the two aquaria varied from 14 inches (total depth of water) on the first, second and third days to about four inches for the remainder of the project. The heavy phytoplankton bloom in the water from earthen pond Number 1 caused this reduction in visibility (Table 2).

The only source of light in the aquarium room, besides indirect sunlight through a few windows, was a one-hundred-watt light bulb on a drop cord. This light bulb was left on 24 hours a day throughout the project.

The compressed (bottled) oxygen and airstone system used to circulate the fry during the sac-fry stage is also believed to have been important in maintaining high oxygen content and in keeping aquaria temperatures in a desirable range. A total of one thousand two hundred (1,200) pounds of compressed oxygen was used in aquarium number one. Due to a malfunction in the gauge, a correct reading was not obtained for aquarium number two (Table 1).

At noon on 11 May, the four-day-old fry began to swim horizontally (very weakly) in both aquaria. By noon on the next day, 12 May, the fry were swimming very strongly horizontally and their mouth parts appeared to be functioning to some degree. On 13 May, at six days of age, their mouth parts were functioning properly. The following day, at 7:30 P.M., several fry were examined and all contained plankton and were defecating. Peristaltic movement of the alimentary canal was observed at this time. It was also noted that when the fry began to swim horizontally, they schooled in an area of the aquarium where a source of light was most prevalent. During this schooling, they came to the water's surface and appeared to feed on plankton adhering to the aquaria sides.

On the morning of 16 May, the fry were removed from the aquaria to pond Number 38. It was planned that we move the fry early in the morning (about 6:00 A.M.) since it was noted that the water temperature and pH were about the same in both the aquaria and the pond during the early morning. This pond had been treated six days previously with 0.25 p.p.m. ethyl parathion for predator control.

Removal of the fry from the aquaria was accomplished as follows:

Each aquarium volume was reduced to one-half by using the drain. Large aluminum pots used for moving fish on the hatchery, and which had been cleaned as previously described for the aquaria, were filled about three inches with water directly from the aquaria by means of a 2,000 milliliter plastic beaker. Very few fry were taken by dipping the water with the beaker. The fry were then siphoned from the aquaria by using a section of garden hose. It required three pots to remove all the fry—estimated three hundred seventy-five thousand (375,000). A small number of fry were left in both aquaria to prevent mixing the detritus on the aquaria bottoms with the fry in the aluminum pots.

In tempering the fry into the nursery pond, one hour was taken to slowly splash the pond water into the large pots. During this process the fry were observed feeding actively on zooplankton (water mites) which were splashed into the pots along with the pond water.

Immediately following the stocking of the fry, the pond was also oiled with 35 gallons of kerosene for the control of predaceous insects.

CONCLUSION

1. Receiving the fry in excellent condition was significant in little or no mortality resulting from handling.

2. Acclimating the fry to the pond water by slowly tempering them was a factor of importance.
3. Compressed (bottled) oxygen was an essential part of the success in this project.
4. It is believed that the filtered pond water containing planktonic food for the fry was the most significant factor in maintaining the fry for six days in the aquaria.
5. The receiving pond, having been treated with ethyl parathion, was in excellent condition when the fry were introduced. The zooplankton bloom was moderate to heavy at the time.
6. To us, the 17 per cent survival to fingerlings and yearlings was surprisingly high. Considering the high survival, the rearing pond was probably overstocked with fry.

SUMMARY

1. Striped bass eggs were taken from hormone injected females purchased from commercial fishermen in the Albemarle Sound, North Carolina. Sperm from males, purchased also from commercial fishermen, was used to fertilize the eggs.
2. At two and three days of age, 400,000 fry were packed in eight plastic bags (50,000 per bag) and flown to Arkansas by Commission-owned airplane where they were received in excellent condition.
3. They were held for six days in two 58-gallon aquaria. Filtered, earthen pond water containing high plankton blooms and compressed (bottled) oxygen were used in holding the fry. Four gallons of water were drained and refilled each hour in both aquaria.
4. Light source was from indirect sunlight and one 100-watt light bulb on a drop cord which was left on 24 hours a day.
5. Temperatures averaged 67°F. in aquarium number one and 66°F. in aquarium number two. A minimum temperature of 60°F. in aquarium number one and 59°F. in aquarium number two were established the first day. Maximum temperature was 73°F. in both aquaria on the final day.
6. The fry were observed feeding on plankton in the aquaria when six and seven days old.
7. Mortality was estimated to be less than seven per cent during the six-day holding period.
8. The fry were removed for stocking the rearing pond by draining the aquaria volume to one-half, then siphoning into a partially filled pot.
9. An estimated 375,000 fry were stocked in a 7.25-acre rearing pond which had been previously treated for control of predators with 0.25 p.p.m. ethyl parathion.
10. Stocking was completed during the early morning when temperatures and pH readings were almost the same in both the aquaria and the pond. One hour was used for tempering the fry at which time they were observed feeding on water mites. Following their introduction into the rearing pond, the pond was oiled with 35 gallons of kerosene, applied from the windward side.

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