INVESTIGATION OF STRIPED BASS, Morone Saxatilis (WALBAUM), CULTURE IN OKLAHOMA [1]

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ABSTRACT

Various stocking rates were tested over a three year period for production of striped bass in culture ponds. Rates ranged from 10,000 to 160,000 fry per acre. Results indicate higher rates produced as high a percent yield as lower rates.

Four food types were also tested during this period to determine which produced the best yields. Commercially prepared supplemental feeds did increase production over natural foods.

Food habits data support earlier information that Copepoda, Cladocera and Insecta are important food organisms to juvenile striped bass.

INTRODUCTION

The establishment of a land-locked striped bass, *Morone saxatilis*, (Walbaum), population in the Santee-Cooper Reservoir system of South Carolina created great interest among fishery managers nationwide. They became interested in the suitability of this species for control and utilization of large shad populations in warmwater reservoirs. In addition, the sport fishing related industry generated in association with the population attracted national attention (Stevens, 1964).

Early attempts to establish this species in other inland waters were largely unsuccessful due to unhealthy stock, hauling failures (Surber 1957, Gray 1952) and general failure of fry stockings regardless of numbers. Sandoz and Johnston (1965) suggested rearing striped bass to fingerling size before stocking to reduce early mortality experienced with fry stockings.

Attempts were made to rear fingerling striped bass in Oklahoma in 1965 and 1966 but results varied. A research project (DJ-F-25-R) was

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initiated prior to the 1967 rearing season to determine causes of inconsistent production. Although many problems were encountered during the project, a large volume of information has been acquired which can be of value in striped bass culture.

PROCEDURES

CARE OF FRY

During the production years, 1967, 1968, 1969, striped bass fry obtained from South Carolina were stocked into culture ponds at the State Fish Hatchery in Durant, Oklahoma. Two-day old fry were procured from the Moncks Corner Hatchery, South Carolina. Approximately 100,000 fry and 2 gallons of water were placed in a plastic bag to which compressed O_2 was added. The bag was sealed and placed in a styrofoam box (14.7" X 14.7" X 7" inside measurements) with a cardbord outer liner. Fry were flown to Atlanta, Georgia, by charter aircraft then transferred by automobile to the State Fish Hatchery, Durant, Oklahoma. The bags were placed in 40 gallon aquaria, opened and an air stone placed in each bag. Water was added slowly for 2 hours until each bag contained 8 to 10 gallons. The bag was then inverted releasing fish and water into the aquarium. Each aquarium was supplied with compressed air through two air stones with water added at the rate of one to two gallons per minute.

During 1967 and 1968, fry were held in aquaria until development of the digestive tract and mouth parts were completed (5-7 days of age). Fry were then stocked into prepared culture ponds.

In 1969, freshly hatched and frozen brine shrimp were utilized as food for all fry held in the aquaria as suggested by Bayless and Bishop (personal communication). This enabled retention of the fry in the aquaria up to 14 days without significant loss by starvation.

CULTURE POND PREPARATION

Previous work (Harper et al, 1968) indicated the need for instar stages of Copepoda and Cladocera in culture ponds for post larval striped bass. Upon attaining a total length of 10mm to 15mm fry began feeding on adult Copepoda and Cladocera.

The following pond management techniques were used in an attempt to produce desired food organisms:

1. Ponds were filled with water as late as possible to limit numbers of predacious insects and produce an early zooplankton bloom.
2. After filling, dehydrated alfalfa meal pellets were added at the rate of 500 pounds per acre to produce a zooplankton bloom.
3. Inorganic fertilizers were added at the rate of 100 pounds 0-46-0 and 200 pounds 45-0-0 per acre to produce a phytoplankton bloom. An attempt was made to maintain a Secchi disc reading of 18 to 24 inches.

Fertilization aided in reducing growth of rooted aquatic vegetation. Following initial applications, fertilizers were added as needed to maintain desired food organisms and color. Daily plankton samples were examined from each pond to determine which ponds contained the desired zooplankton. It was considered desirable to have numerous adult copepods and cladocerans carrying egg sacs in addition to numerous nauplii. This insures sufficient nauplii will be produced until the fry are large enough to ingest adult planktors.

Fry were stocked into the culture ponds with great care. Tempering required approximately 2 hours even when the temperature difference was only 1°C. Approximately 5 percent of the fry stocked in each pond were placed in saran screen boxes for observation. Fry survival in the box provided an indication of total pond survival.

Dissolved oxygen determinations were conducted weekly at dawn to monitor level changes and prevent fry loss due to oxygen depletion. When low readings were encountered, daily samples were taken.

Striped bass were periodically seined from the ponds and samples immediately preserved in 10 percent formalin. The stomachs were removed and the contents identified to genus when possible according to Pennak (1953) and Ward and Whipple (1959). Results were analyzed by percent frequency of occurrence, numerically and estimated percent of the total volume (Lagler, 1959).

In 1969, whole mounts were made of 40 fry, 5mm to 29mm total length, and sectioned for analysis. Identification of stomach contents was made by microscopic examination of the sections.

Periodic plankton samples were taken from each pond by filtering approximately 75.5 liters of water through No. 25 silk bolting cloth. These were preserved in 10 percent formalin for later analysis. Quantitative analysis was conducted by modified rotating counter (J. Ward, 1955).

Two benthos samples were taken from each pond with a 6-inch Ekman Dredge when plankton samples were collected. Samoles were preserved in 10 percent formalin and identified according to Pennak (1953) and Ward and Whipple (1959).

Routine chemical analysis was used as indices of pond water quality.

Supplemental Diets I and II were broadcast completely around the ponds three times daily. Diet III, a semi-liquid feed, was placed in floating boxes with a screen bottom allowing small strings of feed to constantly ooze through the screen. The food was replaced daily.

Due to the pond design, it was not possible to add fresh water to the ponds during harvest. When harvest was by pond drainage, the fish were stranded in muddy water and subjected to much stress. Harvest was conducted during June and July further complicating matters by high water temperatures. Therefore, an alternate harvest method was devised. Ponds were drained to one-fourth normal level. The fish were driven into an area where they were encircled by two 100′ X 8′ X ⅛″ mesh seines. Fish were bagged in seines and held in deeper water until they could be dipped from the seines into pre-weighed amounts of water. Representative samples from each pond were weighed and counted to obtain total production figures.

Due to high water temperature, harvesting operations began at dawn and ended at noon each day.

RESULTS

Yearly striped bass fingerling production is presented in Table 1. Highest percent return was experienced in 1967, but production per acre was greater in 1968 and 1969.

TABLE 1. Annual production of striped bass fingerlings in Oklahoma culture ponds.

Year	No. of Fry Stocked	Acres of Ponds	No. Harvested	Percent Recovery	Fingerlings Per Acre
1967	1,990,000	54	187,255	9.40	3,467.2
1968	5,400,000	72	290,940	5.39	4,040.8
1969	3,600,000	36	282,684	7.85	7,852.3

Table 2 indicates a higher percent return was accomplished when supplemental feed was utilized.

An overall comparison of fry stocking rates with various feed types used in this project are described in Table 3. Although there were several inconsistencies between stocking rates and food types, trends indicated heavier stocking rates produced results comparable with lower rates. These data indicate the number of fingerlings produced per acre was greater at the higher stocking rates. Closer examination of this

TABLE 2. Striped bass fingerling production in Oklahoma culture ponds in relation to feed types during 1967, 1968, 1969

Feed	Acres Stocked	Total Fry Stocked	Total No. Harvested	No. Harvested Per Acre	Percent Recovered
Diet I	47	3,380,000	276,137	5,875	8.17
Diet II	36	2,260,000	136,854	3,802	6.06
Diet III	12	1,200,000	163,405	13,617	13.62
Zooplankton	42.0	3,340,000	53,250	1,268	1.59
	137.0	10,180,000	627,646	4,596	6.19

parameter also strengthens the hypothysis that supplemental feeding was beneficial.

The number and identity of organisms occurring in the culture ponds from April through November are presented in Tables 4 and 5.

The average number of plankton organisms per liter of pond water ranged from 75.19 in June to 846.23 in August. The number of organisms per square foot varied from 37.24 in April to 215.23 in November.

Although copepods were very important food items in the diet of 10mm to 50mm striped bass (Tables 6, 7, 8, and 9), they became less important to larger size fish. Cladocera were important to those fry between 20mm and 110mm but gradually became less important to larger fingerlings. However, Cladocera were ingested frequently by striped bass from 5mm to 120mm (Tables 6 and 9). Insects were utilized by all groups above 20mm and became increasingly important to fry which exceeded 80mm.

In this study, debris is defined as digested matter which could not be identified.

The only fish remains found in striped bass stomachs were scales. This observation poses two possibilities: (1) the scales were knocked from the fish during the seining operation and ingested or (2) stripers, when confined, are making unsuccessful cannibalistic attacks and ingesting only scales.

DISCUSSION

Data from this study indicates several guidelines for successful production of fingerling striped bass. Many complex variables are associated with the culture of any fish species and unless the limiting factors are controlled lower production will result.

Healthy striped bass fry must be carefully handled to avoid excessive mortality. Extended tempering is necessary for adjustment of fry to water temperature and chemical differences. A suitable fresh water supply is required for holding striped bass fry. The yolk sac is the primary food supply of prelarval fry. Following absorption of the yolk sac, fry must be stocked in fertile culture ponds or be fed in holding facilities. A preferred method of feeding post larval fish is the use of freshly hatched or frozen brine shrimp. This procedure enables the culturist to stock fry into culture ponds when optimum conditions occur. Brine shrimp can be produced throughout the year, frozen in small containers and fed to young striped bass with good success.

Food habits data indicated an early perference for copepods by striped bass fry. However, visual observation of early post larval striped bass showed the inability of these fish to ingest adult copepods due to undeveloped mouth parts. However, Nauplii of Copepoda and Cladocera were suitable in size and generally abundant in the early stages of a zooplankton bloom. Success in rearing striped bass fry past early post larval stages depended greatly on the presence of large numbers of nauplii in culture ponds.

TABLE 3. Production of striped bass fingerlings in Oklahoma culture ponds at various stocking rates and feed type 1967, 1968, 1969.

Stocking Rate	Feed Type	Number Acres	Total No. Stocked	Total No. Harvested	Percent Recovery	No. Harvested Per Acre	Avg. Harvest Per Acre	Avg. % Recovered
	Diet I	2	20,000	2,211	11.05	1,106	....	...
10,000/A	Diet II	2	20,000	0	0	0	375	3.73
	Zooplankton	2	20,000	39	0.195	20	....	...
	Diet I	12	240,000	11,516	4.80	960	....	...
20,000/A	Diet II	12	240,000	8,618	3.59	718	599	2.99
	Zooplankton	10	200,000	225	0.11	23	....	...
	Diet I	6	240,000	17,202	7.17	2,867	....	...
40,000/A	Diet II	6	240,000	44,330	18.47	7,388	3,819	9.55
	Zooplankton	6	240,000	7,208	3.00	1,201	....	...
	Diet I	15	1,200,000	79,243	6.60	5,283	....	...
	Diet II	10	800,000	22,481	2.81	2,248	....	...
80,000/A	Diet III	6	480,000	101,340	21.10	16,890	5,010	6.04
	Zooplankton	15	1,200,000	27,411	2.21	1,827	....	...
	Diet I	6	720,000	98,820	13.03	16,470	....	...
120,000/A	Diet III	6	720,000	62,065	8.62	10,344	8,950	7.23
	Zooplankton	6	720,000	207	0.03	35	....	...
	Diet I	6	960,000	67,145	6.99	11,191	....	...
160,000/A	Diet II	6	960,000	61,425	6.40	10,238	8,707	5.44
	Zooplankton	6	960,000	28,160	2.93	4,693	....	...

TABLE 4. Average monthly number of organisms per liter in plankton samples from Oklahoma culture ponds.

Organisms	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.
Cladocera								
Diaphanosoma	2.43	2.90	10.40	1.65	1.70	8.80	3.51	.28
Moina	1.22	3.00	9.64	9.82	6.37	.91	2.20	....
Ceriodaphnia	1.61	15.05	13.50	.18	13.30	12.57	3.01	.41
Simocephalus	....	....	....	....	.37	.09	.13	.87
Daphnia	1.17	4.34	2.18	.18	.13	....	8.21	11.86
Scapholeberis	....	T	....	....	....	11.10	2.11	.18
Bosmina	.21	.36	2.27	.28	.28	36.33	37.18	31.93
Kurzia	....	....	....	....	....	....	....	.05
Macrothrix	....	.01	1.06	....	.50	....	.51	.50
Pleuroxus	....	....	....	....	....	....	.05	.69
Alona	....	....	....	....	....	....	....	3.72
Unid. Clad.	....	1.14	....	....	.50	....	....	....
TOTAL Clad.	6.64	26.80	39.05	12.11	23.15	69.80	56.91	50.49
Copepoda								
Diaptomus	10.63	19.25	9.17	5.32	11.83	8.80	10.50	1.33
Cyclops	21.08	13.05	4.15	2.48	9.30	5.69	8.49	11.26
Nauplii	42.34	63.75	12.25	64.59	37.93	55.88	62.16	34.31
Unid. Cop.	....	....	....	....	.27	....	....	....
TOTAL Cop.	74.05	96.05	25.57	72.39	59.33	70.37	81.15	46.90
Other								
Rotifera	37.34	112.16	10.50	42.20	106.53	125.15	100.79	26.26
Ostracoda	.01	.01	.07	1.29	7.85	6.70	11.61	14.38
Nematoda	....	....	....	.18	.19	....	.32	.23
Arachnida	....	....	....	....	.41	....	....	....
Algae	....	....	....	98.36	612.43	71.72	188.58	74.25
Porifera	....	....	....	1.29	3.49	1.38	1.06	2.82
Astramoeba	....	....	....	.37	.23	.28	.14	.67
Ciliophora	....	....	....	2.20	30.37	16.61	33.19	10.95
Centropyxis	....	....	....	.18	....	....	.09	2.23
Rhizopoda	....	....	....	....	.83	.37	....	....
Insecta	1.00	.07	....	0.28	1.42	.17	.14	.14
Ostiacoda	.02	.01	....	....	....	....	....	....
Anostraca	....	....	T	....	....	....	....	....
TOTAL other	38.37	112.25	10.57	146.35	763.75	222.38	335.92	131.93
GRAND TOTAL	119.06	235.10	75.19	230.85	846.23	362.55	473.98	229.32
No. of Samples	69	104	39	16	32	16	32	16

TABLE 5. Average monthly number of organisms per square foot in bottom samples from Oklahoma culture ponds.

Organisms	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.
Tubifex	35.40	50.50	49.52	66.40	150.13	150.50	183.13	151.75
Chironomus	1.25	76.17	61.10	2.40	3.50	5.00	14.63	30.50
Chaoborus	....	....	....	8.53	2.00	2.50	5.50	17.50
Neuroptera	....	....	....	....	....	....	88	1.50
Hirudinia	.16	1.47	1.69	....	....	....	....	....
Ephemeroptera	....	....	.15	14.67	.63	....	....	....
Odonata	....	.29	.78	10.40	1.25	2.25	5.13	12.00
Coleoptera	.25	.67	.78	6.67	1.63	.25	1.38	2.00
Diptera	....	.04	....	....	....	....	....	....
Plecoptera	....	....	.05	....	....	....	....	....
Orthoptera	....	....	.05	....	....	....	....	....
Cladocera	....	....	.10	....	....	....	....	....
Anostraca	.09	....	.05	....	....	....	....	....
Decapoda	....	.04	....	....	....	....	....	....
Anura (immature)	.09	.13	.06	....	....	....	....	....
Tabanus	....	....	....	....	.13	....	....	....
Trichoptera	....	....	....	1.60	.13	....	....	....
TOTAL	37.24	129.31	114.33	110.67	159.40	160.50	210.65	215.25
No. of Samples	24	48	38	15	32	16	32	16

TABLE 6. Percent frequency of occurrence of food organisms consumed by striped bass ranging from 10mm-169mm T. L. in Oklahoma culture ponds—1968 & 1969.

Item Eaten	10-19mm	20-29mm	30-39mm	40-49mm	50-59mm	60-69mm	70-79mm	80-89mm	90-99mm	100-109mm	110-119mm	120-129mm	130-139mm	140-149mm	150-159mm	160-169mm
Cladocera																
Diaphanosoma	....	....	50.00	....	....	....	7.1	57.1	53.1	45.5	53.9	16.7	20.0	....	....	....
Miona	....	....	....	....	....	....	....	....	....	....	4.5	....	....	....	....	....
Ceriodaphnia	....	....	....	22.22	26.66	16.66	28.6	37.1	24.5	27.3	30.8	8.3	....	....	....	....
Simocephalus	....	....	....	....	....	....	....	....	4.1	....	....	....	....	....	....	....
Daphnia	....	....	....	22.22	26.66	....	35.7	40.0	38.8	59.1	23.1	41.7	....	20.0	....	....
Bosminia	....	....	....	....	....	....	7.1	5.9	4.1	18.2	7.2	....	....	....	....	....
Unid. Cladocera	....	....	....	....	....	....	....	....	2.0	....	15.4	....	....	....	....	....
TOTAL CLADOCERA	....	....	50.00	33.33	33.33	16.66	35.7	74.3	67.3	81.8	69.2	50.0	20.0	20.0	....	....
Copepoda																
Diaptomus	100.00	....	....	11.11	....	....	35.7	54.3	73.5	59.1	69.2	33.3	20.0	20.0	....	....
Cyclops	....	....	....	11.11	13.33	....	7.1	14.3	18.4	27.3	7.2	16.7	....	....	....	....
Unid. Copepoda	....	....	....	....	6.66	....	....	....	2.0	4.5	....	8.3	....	....	....	....
TOTAL COPEPODA	100.00	....	....	33.33	46.67	....	35.7	54.3	73.5	63.6	69.2	50.0	20.0	20.0	....	....
Insecta																
Hemiptera	....	....	....	....	....	....	....	....	2.0	....	....	....	....	....	....	....
Ephemeroptera	....	....	....	11.11	33.33	16.66	7.1	2.9	4.1	4.5	7.2	8.3	....	60.0	....	....
Trichoptera	....	....	....	22.22	20.00	....	....	5.9	2.0	....	15.4	8.3	20.0	20.0	50.0	....
Odonata	....	....	....	11.11	....	....	....	5.9	4.1	....	7.2	....	....	40.0	50.0	....
Diptera	....	....	50.00	....	13.33	....	7.1	5.8	14.2	4.5	15.4	....	....	....	....	....
Unid. Insecta	....	....	....	22.22	6.66	16.66	21.4	17.1	16.3	27.3	15.4	33.3	20.0	40.0	50.0	50.0
TOTAL INSECTA	....	....	50.00	55.55	66.66	33.33	42.9	34.3	38.8	36.4	61.5	50.0	40.0	80.0	100.0	100.0
Fish Scales	....	....	....	33.33	13.33	66.66	21.4	22.9	36.7	31.8	23.1	33.3	20.0	....	....	....
Debris	....	....	....	55.55	53.33	33.33	92.9	85.7	83.7	90.0	92.3	83.3	80.0	80.0	100.0	50.0
Miscellaneous	....	....	....	....	....	....	7.1	5.9	10.2	4.5	23.1	....	....	....	....	....
Stomachs containing food	1	0	4	9	15	6	14	35	49	22	13	12	5	5	2	2
No. empty stomachs	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL STOMACHS	2	4	4	9	15	6	14	35	49	22	13	12	5	5	2	2

TABLE 7. **Estimated percent of total number of each food organism consumed by 10mm-169mm T. L. striped bass in Oklahoma culture ponds—1968 & 1969.**

Item Eaten	10-19mm	20-29mm	30-39mm	40-49mm	50-59mm	60-69mm	70-79mm	80-89mm	90-99mm	100-109mm	110-119mm	120-129mm	130-139mm	140-149mm	150-159mm	160-169mm
Cladocera																
Diaphanosoma	....	....	33.3	....	....	....	0.9	17.7	54.9	33.9	66.4	63.1	72.7	....	....	....
Miona	....	....	....	....	....	....	....	....	....	1.1	....	....	....	....	....	....
Ceriodaphnia	....	....	....	34.3	56.4	90.9	24.9	35.1	16.1	11.5	18.2	0.7	....	....	....	....
Simocephalus	....	....	....	....	....	....	....	....	0.4	....	....	....	....	....	....	....
Daphnia	....	....	....	42.8	30.6	....	30.3	30.7	13.0	28.2	8.9	28.7	....	43.8	....	....
Bosmina	....	....	....	....	....	....	0.2	0.4	T	2.5	1.0	....	....	....	....	....
Unid. Cladocera	....	....	....	....	....	....	....	....	T	....	0.7	....	....	....	....	....
TOTAL CLADOCERA	....	....	33.3	77.2	87.0	90.9	56.4	84.0	84.4	77.2	95.2	92.5	72.7	43.8	....	....
Copepoda																
Diaptomus	100.0	....	....	0.5	....	....	32.9	10.0	9.6	6.4	3.5	3.1	9.1	16.7	....	....
Cyclops	....	....	....	7.4	3.1	....	3.8	1.9	3.4	10.4	....	0.3	....	....	....	....
Unid. Copepoda	....	....	....	....	1.9	....	....	....	....	....	....	3.1	....	....	....	....
TOTAL COPEPODA	100.0	....	....	7.9	5.0	....	36.7	11.9	12.9	16.8	3.5	6.5	9.1	16.7	....	....
Insecta																
Hemiptera	....	....	....	1.5	....	....	....	....	T	....	....	....	....	....	....	....
Ephemeroptera	....	....	....	....	3.9	1.5	0.1	T	T	....	0.1	0.1	....	6.3	....	....
Trichoptera	....	....	....	2.6	2.5	....	....	T	T	....	0.2	0.2	....	22.9	60.0	....
Odonata	....	....	....	1.0	....	....	....	T	T	....	....	....	2.3	6.3	20.0	....
Diptera	....	....	66.6	....	0.4	....	0.2	0.1	0.4	....	0.3	0.1	....	....	....	....
Unid. Insecta	....	....	....	4.2	0.5	1.5	0.3	0.1	0.1	0.2	....	....	11.4	4.2	20.0	100.0
TOTAL INSECTA	....	....	66.6	9.5	7.4	8.0	0.6	0.2	0.5	0.2	0.7	0.4	13.7	39A	100.0	100.0
Fish Scales	....	....	....	5.2	0.4	6.0	0.5	0.3	1.7	3.9	0.2	0.7	4.6	....	....	....
Debris	....	....	....	....	....	....	5.8	3.6	3	1.8	0.4	....	....	....	....	....
Stomachs containing food	1	0	4	9	15	6	14	35	49	22	13	12	5	5	2	2
No. empty stomachs	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL STOMACHS	2	4	4	9	15	6	14	35	49	22	13	12	5	5	2	2

TABLE 8. Estimated percent volume of food organisms consumed by striped bass ranging from 10mm-169mm T. L. in Oklahoma culture ponds—1968 & 1969.

Item Eaten	10-19mm	20-29mm	30-39mm	40-49mm	50-59mm	60-69mm	70-79mm	80-89mm	90-99mm	100-109mm	110-119mm	120-129mm	130-139mm	140-149mm	150-159mm	160-169mm
Cladocera																
Diaphanosoma	....	....	25.00	....	....	....	0.25	19.44	26.67	15.59	31.00	10.83	7.00	....	....	....
Moina	....	....	....	....	....	....	....	....	....	2.72	....	....	....	....	....	....
Ceriodaphnia	....	....	....	7.78	10.47	13.33	15.21	16.14	7.06	6.88	13.46	2.50	....	....	....	....
Simocephalus	....	....	....	....	....	....	....	....	0.70	....	....	....	....	....	....	....
Daphnia	....	....	....	9.11	22.33	....	5.21	9.54	7.06	21.45	3.54	14.92	....	1.20	....	....
Bosminia	....	....	....	....	....	....	0.07	0.31	0.06	1.59	0.77	....	....	....	....	....
Unid. Clad.	....	....	....	....	....	....	....	....	0.20	....	1.54	....	....	....	....	....
TOTAL CLADOCERA	....	....	25.00	16.89	33.07	13.33	20.74	45.43	41.25	48.03	50.31	28.25	7.00	1.20	....	....
Copepoda																
Diaptomus	100.0	....	....	0.11	....	....	16.50	12.56	15.41	6.90	3.62	3.42	1.00	0.60	....	....
Cyclops	....	....	....	0.11	0.17	....	0.36	1.71	3.27	4.36	....	0.42	....	....	....	....
Unid. Copepoda	....	....	....	....	2.01	....	....	....	0.04	0.22	....	0.42	....	....	....	....
TOTAL COPEPODA	100.00	....	....	0.22	2.18	....	16.86	14.27	18.72	11.48	3.62	4.26	1.00	0.60	....	....
Insecta																
Hemiptera	....	....	....	....	....	....	....	....	1.02	....	....	....	....	....	....	....
Ephemeroptera	....	....	50.00	8.79	26.65	1.67	0.79	0.57	1.22	4.31	6.92	6.67	....	23.20	....	....
Trichoptera	....	....	....	12.00	15.20	....	....	0.17	0.02	....	3.82	0.83	....	10.00	25.00	....
Odonata	....	....	....	7.78	....	....	....	0.63	0.71	....	.28	....	14.00	29.80	10.0	....
Diptera	....	....	....	....	1.32	....	5.00	0.09	0.52	0.40	.96	....	....	....	....	....
Unid. Insecta	....	....	....	3.33	2.01	15.00	20.00	9.80	11.43	17.36	15.15	29.58	20.00	9.00	45.00	50.00
TOTAL INSECTA	....	....	50.00	31.89	45.17	16.67	25.79	11.26	14.92	21.71	26.79	37.08	34.00	72.00	80.00	50.00
Fish Scales	....	....	....	11.11	4.10	31.67	13.64	2.63	4.59	2.00	0.92	0.83	16.00	....	....	....
Debris	....	....	25.00	39.89	15.47	38.33	22.71	24.31	19.82	16.59	17.92	29.33	42.00	26.20	20.00	50.00
Miscellaneous	....	....	....	....	....	....	0.29	0.09	0.24	0.13	0.77	....	....	....	....	....
Stomachs containing food	1	0	4	9	15	6	14	35	49	22	13	12	5	5	2	2
No. empty stomachs	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL STOMACHS	2	4	4	9	15	6	14	35	49	22	13	12	5	5	2	2

TABLE 9. Percent frequency of occurrence of each food organism by total length-class of fry as determined by sectioning of whole mounts.

Organism	5-9mm	10-14mm	15-19mm
Cladocera	69.23	43.47	25.00
Copepoda	15.38	73.91	50.00
Diptera	....	13.04	25.00
Amarphous	7.69	8.69	....
Number of Samples	13	23	4
Number of stomachs containg food	11	20	4

When striped bass attained a total length of approximately 20mm they began feeding on small Cladocera. These organisms were utilized extensively as food until fry reached approximately 110mm. Larger food items became more important in the striped bass diet as mouth parts and feeding behavior changed.

Data from an earlier study indicated forage fish were seldom utilized by striped bass until they reached 100mm (Harper et al 1968). The frequent occurrence of unexplained fish scales identified in striped bass stomachs pointed to a need for further food preference studies of fish in the size range in which this item was significant. Striped bass fingerlings of this size have been successfully stocked into Oklahoma reservoirs. This success and the additional cost involved has reduced the desire to rear this species to a larger size.

The wide ranges of stocking rates tested and lack of stunting or decrease in percent return in higher rates indicated maximum stocking rates may not have been attained. There were indications blooms were rapidly depleted in ponds with populations of striped bass stocked at 160,000 fry per acre. Extensive observation is needed to prevent food depletion and subsequent fingerling mortality.

Mortality rates were high when culture ponds were completely drained during harvest. Partial draining of culture ponds followed by seining of striped bass greatly reduced this mortality. High cost and use of labor are negative factors in this type of operation.

High hauling mortality has been encountered by most workers transporting striped bass. If fingerlings are to be hauled for more than 9 hours, they should be held in tanks for at least 24 hours prior to transit. This allows time for waste products to pass from the intestine and prevent fouling of transport water. The use of agitator tanks filled with dechlorinated municipal water containing 1 percent NaCl and 0.25 ppm. Quinaldine is a proven method. Oklahoma personnel have utilized this technique in successfully transporting this species 24 hours without measurable mortality.

CONCLUSIONS

Data from this study indicate a successful striped bass rearing program can be conducted where suitable hatchery facilities are available. A primary requirement is a water supply which is acceptable to striped bass in terms of physical and chemical characteristics. This is essential to produce healthy fry necessary for successful fingerling production.

A major breakthrough in the culture of this species occurred with the use of brine shrimp to feed post larval fish. This enables the culturist to select the correct pond conditions before stocking the fragile fry. Data from Bowker, et al 1969, show young striped bass are very selective in their food habits and to be successful in rearing this species, the proper food must be provided.

Another factor which aides in utilization of pond space is the use of saran boxes to retain a portion of the fry for daily observations. When problems occurred and a loss of stocked fry was indicated, the pond could be restocked, thereby utilizing the time and expense of preparing this pond for striper production. If this method had not been used, many ponds would have been prepared and stocked with no harvest success.

Proper culture pond management is required to produce the needed food organism at the proper time. If poor pond conditions prevail, frequent physical and chemical analyses should be conducted so needed management can be applied prior to the stocking of fry.

Supplemental feeding of striped bass fry and fingerlings aided in production, although identification of this material in the food habits study is lacking. The large amount of debris and its consistant occurrence in the stomachs of sampled fish supports the belief that a portion of this material is commercial food. Past studies (Stevens 1957, Heubach, et al, 1963) indicate striped bass is not a bottom feeding species and large amounts of debris in the stomach would not be expected. Water-soaked and partially digested fish food would greatly resemble debris found in other species.

The harvest methods described in this report enabled large numbers of healthy striped bass fingerlings to be transported to warmwater reservoirs in excellent condition. This method would only be applicable to antiquated hatchery ponds without modern harvest facilities.

The rearing of striped bass is a complex refined operation, requiring a great deal of care during the rearing procedure. This task requires an observant meticulous fish culturist, provided with well trained labor, suitable equipment and adequate supplies.

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