Microplankton in Red Drum Mariculture Ponds

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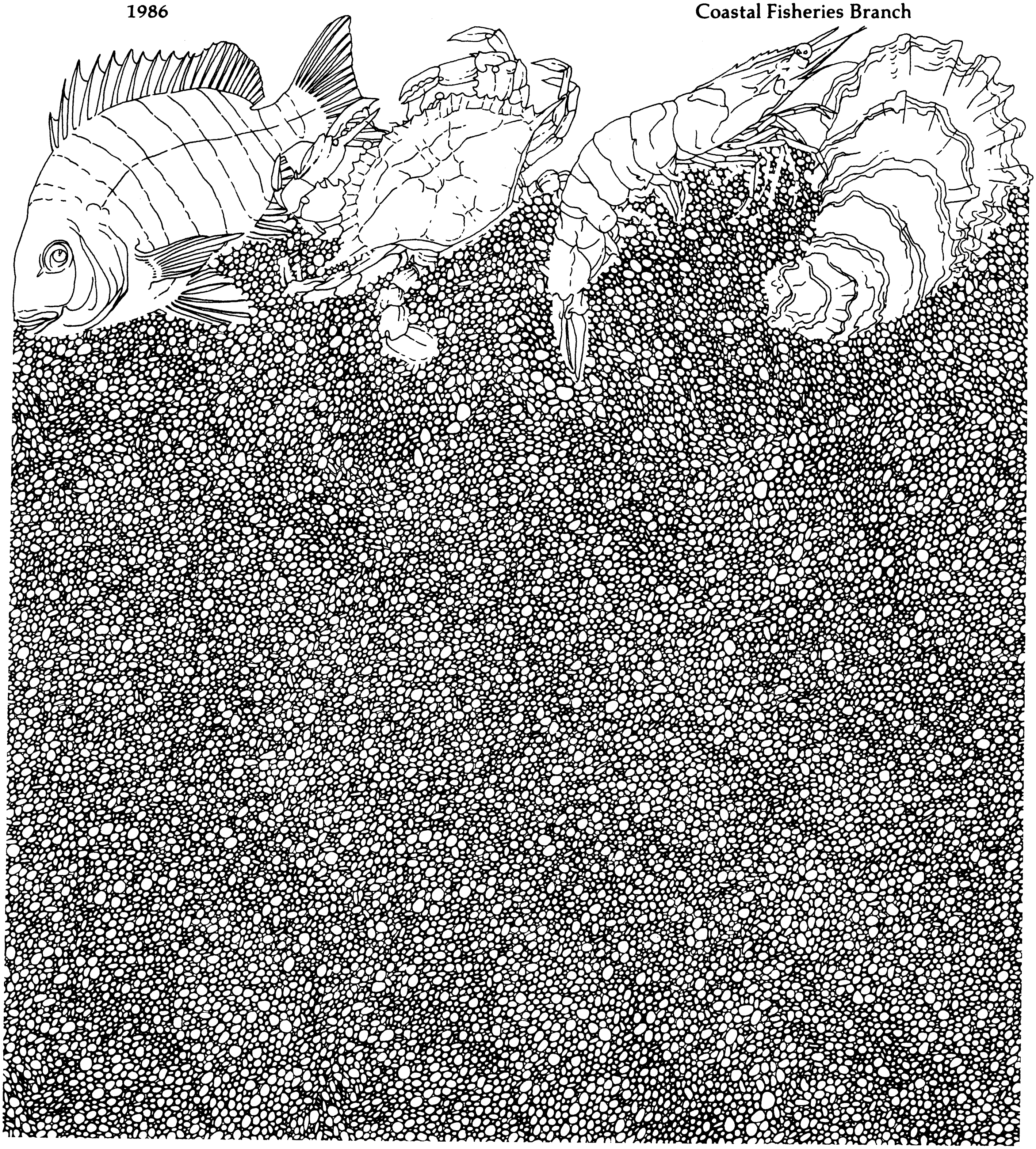

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ABSTRACT

Samples of microplankton were collected from the surface in saltwater culture ponds containing red drum using 10-μ mesh nets and 50-ml buckets in December 1978 and January 1979. Phytoplankters, protozoans and zooplankters were identified, counted and concentrations estimated. On each day the complement of species was about the same from pond to pond, but the number of organisms varied. In general, there were more species and more individuals (except dinoflagellates) in January than in December. The difference in species composition and number of individuals was probably a function of the kinds and numbers of "seed" organisms pumped into the ponds at a particular time.

The survival of larval red drum may depend upon the development of suitable kinds and numbers of microplankton at appropriate times. The microplankton may serve as food for larval fish or for the rotifers and copepods on which the fish feed.

INTRODUCTION

A major problem in rearing juvenile red drum (*Sciaenops ocellatus*) in saltwater ponds is the variation in survival among ponds. For example, Colura and Hysmith (1976) reported red drum survival in saltwater culture ponds ranged from 0 to 65%. If hatchery scale production of red drum fingerlings for estuarine stocking programs are to be successful, consistent survival from culture ponds is necessary. Although temperature, salinity and weather play a role in fish survival, these factors are presumably less important than the quantity and quality of plankton which serve as forage for larval fish.

Highest mortalities of red drum in culture ponds may occur within the first few days after stocking. Red drum fry are stocked shortly after yolk sac absorption when mouth parts have developed and exogenous feeding begins. Survival depends on the availability of the proper amounts and types (size) of food at this critical time of their lives, assuming suitable environment. Hunter (1972) reported larval anchovy (*Engraulis mordax*) were most vulnerable to starvation just after yolk absorption, and survival through the first 3 days of feeding was enhanced when phytoplankton were added to the rotifer diet.

Although 35-μ mesh nets are generally used to sample zooplankton towed in TPWD fish culture ponds, it is likely substantial numbers of microplankton pass through such nets undetected. Similarly, microplankton would not be readily identified in routine processing of larval fish stomachs. Accordingly, this study was undertaken to determine the composition and relative abundance of microplankters in red drum culture ponds.

MATERIALS AND METHODS

The study was conducted in six 0.2 and one 0.4-ha rectangular earthen ponds located at the Texas Parks and Wildlife Department, Marine Fisheries Research Station, Palacios, Texas. Ponds were fertilized with 398-909 kg/ha cottonseed meal or alfalfa meal by spreading 50% of the fertilizer on dry pond bottoms, filling ponds with filters (0.6-mm saran) Matagorda Bay water, and broadcasting remaining fertilizer from pond levees in 3 to 5 equal applications weekly to maintain plankton (Table 1). Ponds were subsequently stocked with varying numbers of red drum fry (Table 1) as described by Colura and Hysmith (1976).

Plankton populations in each pond were sampled on 6 December 1978. Five of the 0.2-ha ponds were resampled on 22 January 1979. Two sampling methods were used. A 50-ml unfiltered sample was collected from the surface in each pond by dipping a container into the water. The second sample type was obtained with a 0.3-m diameter net (10-μ mesh) pulled horizontally for 6.1 m at the surface. All samples were preserved with 5% basic Lugol's fixative. The unfiltered sample was placed in a settling chamber for 24 hours prior to decantation and counting. The tow sample was also settled and reduced to 50 ml. A 2-ml aliquot of settled samples was examined in a depression slide under an inverted microscope following Utermöhl (1931). Phytoplankton and protozoa in the unfiltered sample were identified and counted. For the tow sample only zooplankters (exclusive of protozoa) were counted. Estimated densities of identified taxa were expressed as number per liter. Surface water temperature and salinity were measured using a glass thermometer and refractometer, respectively.

RESULTS

The number of taxa and individuals of each species varied among ponds and sample dates (Tables 2 and 3). The total number of taxa varied among ponds from 8 to 23 in December and 12 to 23 in January. There were fewer individuals of each group of microplankton (except dinoflagellates) in December than in January (Table 4). The number of diatoms varied almost 100 times among ponds in December, primarily because of 119,160 *Navicula* sp. 1 in pond 11 and the relatively low densities (<1/liter) of *Amphora* sp. in ponds 7, 11, and 21 (Table 2). By January, the diatom composition in each pond (except pond 8) was dominated by *Rhizosolenia delicatula*, but the number of diatoms varied almost 10 times among ponds (Table 3). Dinoflagellates and protozoans were infrequently and inconsistently present among ponds in December with no species dominating (Table 2). By January *Prorocentrum* sp. was the only dinoflagellate represented, and it was present (<12/liter) in all five sampled ponds. The number of protozoans increased in each pond to over 4,000/liter in January; *Strombidium sulcatum* dominated in each pond (Table 3). There was an enormous difference in numbers of "other" phytoplankters between the 2 days. Nanoflagellates were almost completely absent in December, but exceeded 12 million per liter in every pond in January. Although the total number of zooplankters was about the same in January and December, nematodes and polychaete larvae were collected in more of the sampled ponds in January than in December.

Ponds 7 and 21 were sampled only in December. Pond 7, a 0.2-ha pond, and pond 21, a 0.4-ha pond, closely resembled ponds 8-12, 0.1-ha ponds, in species composition and numbers of individuals.

DISCUSSION

There are major changes in species composition and number of microplankton during a relatively short period of time (about 1.5 months). The kinds of plankters and their abundance in individual ponds may well be a result of the kinds and numbers of organisms pumped into the individual ponds at filling. Water from Matagorda Bay is coarsely-filtered (500-m mesh). The increase in protozoa and nanoflagellates in the ponds in January is consistent with the occurrence of blooms of these organisms during January-March 1977 in the Port Aransas Ship Channel, Texas (Johansen 1979). The numbers of copepods are consistent with those reported in the ponds in early December (8.3/1) by Colura and Hysmith (1976) and consistent with the low biomass of copepods in the near shore Gulf of Mexico off Port Aransas during winter (Park 1979).

Microplankton in pond ecosystems are extremely important. These small organisms serve as food for the rotifers, nauplii, copepodites, copepods and other invertebrate larvae on which young red drum ultimately feed

(Nival and Nival 1976). During this study, only two ponds yielded any red drum at harvest, and survival rates were less than 1% in those ponds. The availability of microplankton at stocking may have been a factor in these low survival rates.

The currently used 3 to 4-day period between pond filling and stocking may be too short for an adequate red drum diet to develop. The relative abundance of specific microplanktonic taxon may go from a minor community constituent to the dominant organism and decline back to minor status within 4 days (Takahoashi et al. 1975, Beers et al. 1977, Johansen, unpublished data). Such rapid cycles emphasize the need for precise timing in filling and stocking ponds. Additional research is needed to determine the types and amounts of microplankton.

Microplankton abundance is related to temperature, salinity and food supply (Johansen 1978) blooms and declines of individual microplankters in enclosed ecosystems occur with alarming rapidity (Takahashi et al. 1975, Beers et al. 1977, Johansen, unpublished data). For example, the abundance of a phytoplankter, protozoan, rotifer or copepod nauplii may go from undetectable to being the dominant organism in the system and back to undetectable within a 4-day period. Such rapid cycles emphasize the need for precise timing in filling and stocking the ponds. Additional research is needed to determine the types and amounts of microplankton necessary to maximize available food for larval red drum. Ponds should be sampled intensively during the time between filling the ponds and 5 days after stocking to compare the abundance of the plankton during this time with ultimate fish survival. Ponds should be sampled once a day at the same time. Both surface net tows and unconcentrated unfiltered samples should be collected. Nets should be towed across the pond to avoid the problem of patchiness. Unfiltered samples should be collected at least near the pond side and near the pond center (i.e., shallow and deep water).

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Table 1. Number of red drum stocked into and harvested from ponds at the Texas Parks and Wildlife Department's Marine Fisheries Research Station during October 1978-January 1979. Surface water temperature and salinity were measured at the drain boxes. Blanks indicate no data were collected.

Pond	Pond area	Date			Fertilization[a]	Salmon feed (#2 crumble)	Number	Number	6 Dec 1978[b]		22 Jan 1979[c]	
(No.)	(ha)	Filled	Stocked	Drained	(kg/ha)	fed (kg/ha)	stocked	harvested	Temp (C)	Salinity (o/oo)	Temp (C)	Salinity (o/oo)
7	0.2	21 Oct 78	24 Oct 78	15 Jan 79	455 AM	318	46000	400	7	23		
8	0.2	8 Nov 78	12 Nov 78	30 Jan 79	398 AM	386	100000	0	7	19	11	19
9	0.2	8 Nov 78	12 Nov 78	30 Jan 79	398 CM	386	100000	0	7	18	11	16
10	0.2	8 Nov 78	12 Nov 78	30 Jan 79	398 CM	386	100000	0	7	18	11	16
11	0.2	8 Nov 78	12 Nov 78	29 Jan 79	398 CM	386	100000	0	7	17	11	15
12	0.2	8 Nov 78	12 Nov 78	29 Jan 79	398 AM	386	100000	0	7	18	11	16
21	0.4	11 Oct 78	31 Oct 78	17 Jan 79	909 CM	148	125000	2900	8	16		

[a] AM = alfalfa meal; CM = cottonseed meal.
[b] 6 Dec 1978: Rained most of the day.
[c] 22 Jan 1979: Sunny most of the day, cloudy in late afternoon.

Table 2. Concentrations of microplankton (number/liter in each of six 0.2-ha (7-12) and one 0.4-ha (21) ponds on 6 Dec 1978. Blanks indicate none collected, and 0 indicate <1/liter collected.

Species	Pond number						
	7	8	9	10	11	12	21
DIATOMS							
Amphora sp.	0	206	309	206	7	412	3
Chaetoceros sp.							
Coscinodiscus sp.		0	1				1
Fragilaria sp.							
Licmorpha sp.							
Navicula sp. 1		722	27		119160	570	101
Navicula sp. 2	412	103	412		2163	2163	206
Navicula sp. 3	515	1648	1442	1339	618	206	1957
Nitzschia closterium	618	4635	4429	1030	8961	9270	1030
Nitzschiella lorenziana				0		0	
Pleurosigma sp.		0			0	103	0
Rhizosolenia delicatula							
Rhizosolenia setigera	1						
Scoliopleura tumida			2		1	2	3
Total	1546	7315	6622	2575	130910	12726	3301
DINOFLAGELLATES							
Ceratium furco		2			0	2	1
Gymnodinium sp.				103			
Gyrodinium sp.		103	2			103	
Peredinium sp.			103				
Peredinium depressum						0	
Phalocroma sp.				103			
Prorocentrum sp.							2
Total		104	105	206		105	3
OTHER PHYTOPLANKTERS							
Blue-greens							360
Chilomanas sp. (cryptomonad)							140
Dictyocha fibula			0		103		
Ebria tripartita							
Nanoflagellates							
Total					103		500

Table 2. (Cont'd.).

Species	Pond number						
	7	8	9	10	11	12	21
PROTOZOA							
Amoeba							
Amphisia pernix							103
Eutintinnus apertus							
Lohmaniella oviformis	0				103	103	
Mesodinium rubrum							824
Nassula microstoma						1545	
Strombidium calkinsi	103					206	
Strombidium ovale							
Strombidium sulcatum							1725
Vorticella oceanica							103
Total	103				103	1854	2755
ZOOPLANKTON							
Copepod eggs						1	13
Copepod nauplii	4	5		0	1	10	17
Copepodites	6	2				1	0
Copepods		9	2	5	13	3	1
Polychaete larvae	6						29
Sagitta sp. (arrow worm)	0						4
Total	16	16	2	5	14	15	63

Table 3. Concentrations of microplankton (number/liter in each of five 0.2-ha ponds on 22 Jan 1979. Blanks indicate none collected, and 0 indicate <1/liter collected.

Species	Pond number 8	9	10	11	12
DIATOMS					
Amphora sp.	309		38	2	1
Chaetoceros sp.			206		
Coscinodiscus sp.	0		2	0	103
Fragilaria sp.	2				
Licmorpha sp.	1				
Navicula sp. 1	6	10			
Navicula sp. 2	309			103	1
Navicula sp. 3	618		309	309	309
Nitzschia closterium	8549	412	15169	309	2987
Nitzschiella lorenziana					
Pleurosigma sp.			103	103	0
Rhizosolenia delicatula	4017	36956	79428	110885	13790
Rhizosolenia setigera					
Scoliopleura tumida	2	103	103	0	206
Total	13812	37481	95358	111712	17397
DINOFLAGELLATES					
Ceratium furco					
Gymnodinium sp.					
Gyrodinium sp.					
Peredinium sp.					
Peredinium depressum					
Phalocroma sp.					
Prorocentrum sp.	12	4	4	0	1
Total	12	4	4		1
OTHER PHYTOPLANKTERS					
Blue-greens					
Chilomanas sp. (cryptomonad)					
Dictyocha fibula					
Ebria tripartita					
Nanoflagellates	14355198	12839338	47318986	32963788	62737532
Total	14355198	12839338	47318986	32963788	62737532

Table 3. (Cont'd.).

Species	Pond number 8	9	10	11	12
PROTOZOA					
Amoeba		10	82	397	115
Amphisia pernix					
Eutintinnus apertus	1442	412	206	1687	24
Lohmaniella oviformis	0				
Mesodinium rubrum	309			309	
Nassula microstoma	0		2		103
Strombidium calkinsi					
Strombidium ovale	103				
Strombidium sulcatum	4326	4017	4635	1957	26890
Vorticella oceanica					
Total	6181	4439	4925	4350	27132
ZOOPLANKTON					
Copepod eggs	3	2	7	5	2
Copepod nauplii	3	1	1	9	4
Copepodites	1		1	1	3
Copepods	0	47	7	4	
Nematodes			1	0	0
Polychaete larvae	1		4	0	1
Sagitta sp. (arrow worm)					
Total	8	49	20	20	9

Table 4. Mean microplankton abundances (no/l ± 1SD) in ponds 8-12 on 6 Dec. 1978 and 22 Jan. 1979.

Taxa	6 Dec	22 Jan
Diatoms	32030 ± 55394	55152 ± 45448
Dinoflagellates	104 ± 73	4 ± 5
Other phytoplankters	21 ± 46	34042968 ± 214359
Protozoa	391 ± 819	8365 ± 10409
Zooplankters	10 ± 6	21 ± 17