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by Patricia L. Johansen

Management Data Series Number 103
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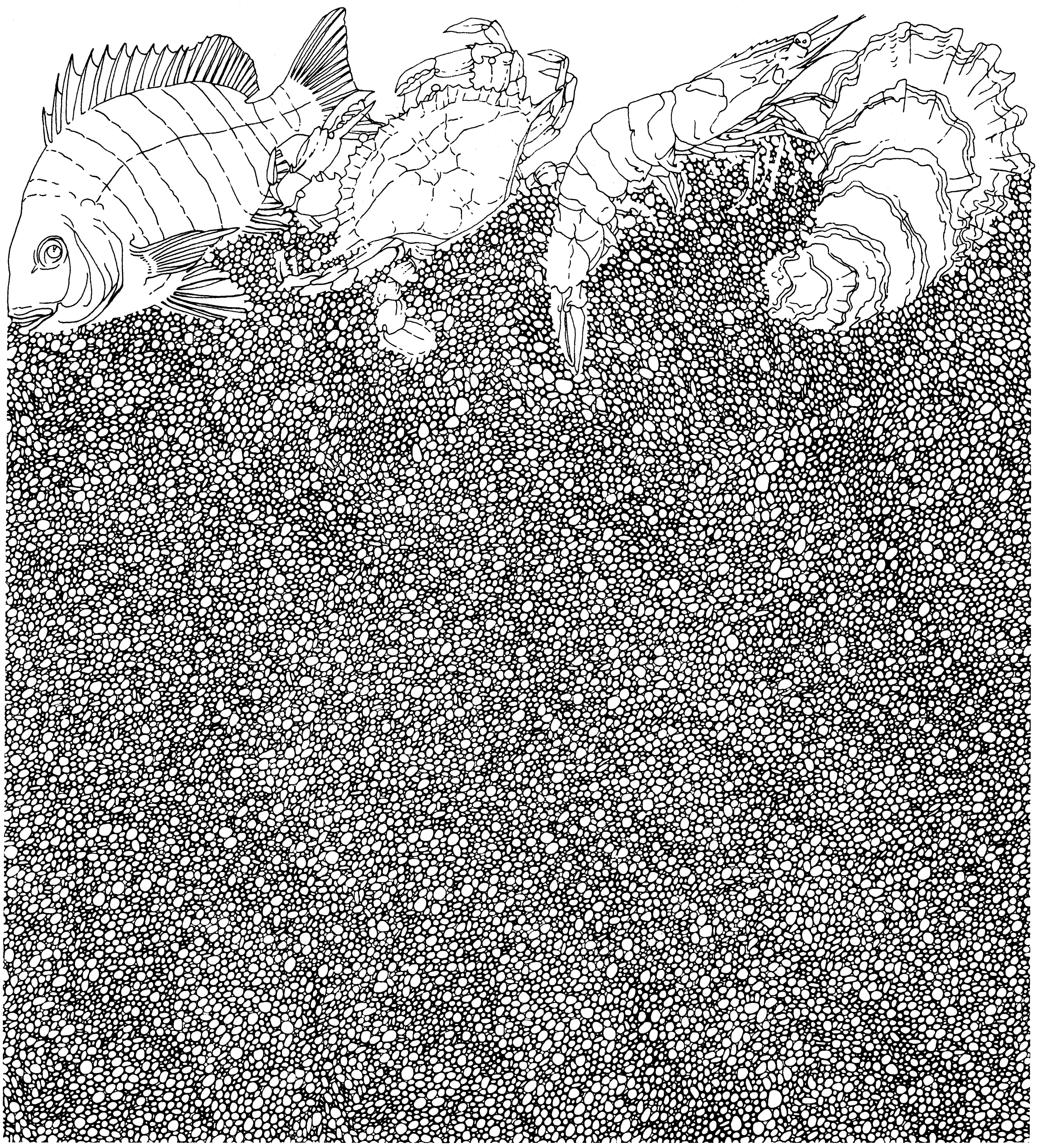

# PLANKTON TOXICITY AS A POSSIBLE CAUSE OF A RED DRUM KILL IN GROW-OUT PONDS

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# ABSTRACT

On 10 October 1980 fish kills occurred in the red drum (*Sciaenops ocellatus*) grow-out ponds at the Texas Parks and Wildlife Department Marine Fisheries Research Station near Palacios, Texas. Unconcentrated water samples were collected from these ponds on 10 and 14 October. The samples were examined for the presences of "red tide" organisms using the Ùutermohl method. No toxic phytoplankters were observed and phytoplankter cell densities did not appear to be high enough to cause toxic effects or oxygen depletion in the ponds.

## INTRODUCTION

The culture of red drum (*Sciaenops ocellatus*) in ponds is being examined by the Texas Parks and Wildlife Department (TPWD) as a means of enhancing bay populations. On the evening of 9 October 1980 water from Matagorda Bay was pumped into ponds 1, 2, 3, 4, 5, 14 and 16 of the TPWD Marine Fisheries Research Station (MFRS) near Palacios, Texas. Occasional pumping is necessary to restore water lost by evaporation from the ponds. Ponds 1-5 were 0.1 ha, pond 14 was 0.4 ha and pond 16 was 1.62 ha.

Pond 1 contained red drum, (~270 mm total length) which were part of a magnetic nose tag retention study. Ponds 2-5 contained fish (~50 mm total length) which were being used in a feeding study. Pond 14 had been stocked with 3-day old fry about 1 week earlier. Pond 16 was in the process of being filled; it contained no fish.

On the morning of 10 October 1980 all fish in the ponds were dead and floating on the surface. Because several minor fish kills had been reported in Carancahua Bay during 6-10 October, it was thought that perhaps the kills were caused by a "red tide" organism. Plankton samples were collected from the ponds and examined for such an organism. This report is a result of the plankton examinations.

## MATERIALS AND METHODS

On 6 October 1980 an unconcentrated water sample was collected at Port Alto, Texas, in Carancahua Bay. The sample was collected following the report of a fish kill in that area. This sample was returned to the MFRS and refrigerated until it was preserved with 5% acid Lugol's solution on 14 October.

On 10 October unconcentrated water samples were collected from ponds 1-5 and 16 and preserved with 5% acid Lugol's solution. Bioassay studies indicated a sustained toxic effect; unconcentrated water samples were collected on 14 October from ponds 1, 3, 5, 14 and 16 and preserved with acid Lugol's.

Using the Ütermohl method, 30 ml of water were settled onto a counting chamber and the contents examined using a Wilde M-40 inverted microscope at 20X. Microplankters were identified to species and counted; the presence of macroplankters was noted. Cell densities (No./l) were obtained using the following formula:

$$\text{no. organisms present} = \frac{\text{area of base (mm}^2)}{\text{area counted (mm}^2)} \times \frac{1000 \text{ ml/l}}{\text{sample size (ml)}} \times \text{no. organisms counted}$$

## RESULTS

Cell counts from the ponds are presented in Table 1. Cell counts from the Carancahua Bay sample are presented in Table 2. Because the Carancahua Bay sample had set so long before being preserved, it is probable that cell counts and species on 14 October bore no relationship to those present on 6 October. However, except for the absence of protozoa and lower numbers of nanoflagellates in the Carancahua Bay sample, there appeared to be no substantial differences in numbers or types of organisms between it and the pond samples.

The pond samples were dominated by nanoflagellates (nondescript cells <10u) and dinoflagellates (Table 1 and Fig. 1). The numbers of dinoflagellates generally decreased from 10 October to 14 October; the number of nanoflagellates generally increased as did the number of diatoms (Table 1 and Fig. 2). The number of protozoa varied erratically (Table 1, Fig. 3).

Ponds 14 and 16 generally contained higher total cell concentrations than the other five smaller ponds. Elements of the macroplankton were observed in every pond except 14.

## DISCUSSION

Although there are approximately 20 species of toxic dinoflagellates found in the Gulf of Mexico, none of the plankters observed in the ponds is reported to be toxic. This conclusion is supported by Ms. Beverly Roberts (Florida Department of Natural Resources) and Dr. Alfred Loeblich (University of Houston) both of whom examined water samples from the MFRS.

Even if one or more of the plankters found in the ponds contained toxins, cell densities were hardly high enough to produce toxic effects. Generally, "bloom" conditions are reached when phytoplankton densities approach $10^6$/l. However, "red tide" organisms such as Gonyaulax monilatus can be toxic to fish at 775,000/l; Gymnodinium brevis can be toxic at 250,000/l (Roberts, personal communication). In Florida, shellfish beds are closed when G. brevis densities reach 10,000/l because the shellfish concentrate the toxin. The only way the fish in the ponds could have been killed by any of the phytoplankters in the pond would probably have been for the fish to have consumed some filter feeder which in turn had fed on the phytoplankters and had concentrated the toxin. Phytoplankton densities did not appear to be high enough to cause oxygen depletion in the ponds. However, dissolved oxygen was not measured.

There appeared to be nothing unusual about the plankters in the ponds. The dominance of dinoflagellates and nanoflagellates in near shore waters is common during late summer when low nutrient levels occur in the water. The increase in diatom numbers from 10 October to 14 October may have reflected the first signs of the autumn nutrient regeneration which favors the development of diatom blooms. In short, the ponds (particularly 14 and 16 which had been recently filled and fertilized) probably reflected the availability of plankton in nearby Matagorda Bay at the time.

There is a vague possibility that the fish kills in Carancahua Bay and at the MFRS were caused by a red tide at an earlier time with no trace of the organism remaining but with the toxin still in the water. Gymnodinium brevis toxin has remained active in seawater at least 2 mo after the cells had lysed or had been filtered out of the water. This is, however, unlikely since a prolonged kill would have occurred during the presence of the organism as well as during its subsequent absence.

Examination of the plankton present in samples from the MFRS ponds indicated that a red tide organism was not responsible for the fish kill which occurred. This study did not consider any other possible causes of the kill (e.g. salinity, dissolved oxygen, etc.). Therefore, the only conclusion that can be drawn is that red tide was not the cause.

Table 1. Number of microplankters per liter and presence of macroplankters (indicated by X) in ponds in which a fish kill occurred at Texas Parks and Wildlife Department Marine Fisheries Research Station on 10 October 1980 (ND = no data collected). Blanks indicate zero.

| | | Ponds | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Species | Date | 1 | 2 | 3 | 4 | 5 | 14 | 16 |
| NANOFLAGELLATES | 10 Oct | 441,280 | 124,110 | 190,302 | 115,836 | 184,786 | NS | 273,035 |
| | 14 Oct | 1,421,321 | NS | 408,174 | NS | 66,190 | 1,613,086 | 5,294,232 |
| DIATOMS | | | | | | | | |
| *Amphiphora paludosa* | 10 Oct | | | 172 | | | | |
| | 14 Oct | | | | | | | |
| *Coscinodiscus* sp. | 10 Oct | 344 | | | | | | 1,032 |
| | 14 Oct | | | 172 | | | | |
| *Navicula* sp. | 10 Oct | | | | | | | |
| | 14 Oct | | | 4,644 | | | | 46,440 |
| *Nitzschia closterium* | 10 Oct | 1,204 | 1,032 | 688 | | | | 6,192 |
| | 14 Oct | 172 | | 2,752 | | 344 | 7,740 | 186,160 |
| *Pleurosigma normanii* | 10 Oct | | | | | | | |
| | 14 Oct | | | 172 | | | | |
| *Scoliopleura turmida* | 10 Oct | 2,236 | 2,406 | 4,128 | 516 | 172 | | 516 |
| | 14 Oct | 860 | | 1,376 | | | | |
| *Skeletonema costatum* | 10 Oct | | | | | | | |
| | 14 Oct | | | | | | | 46,440 |
| *Thalassionema nitzschoides* | 10 Oct | | | 344 | | | | |
| | 14 Oct | | | | | | | |
| Total Diatoms | 10 Oct | 3,784 | 3,438 | 5,332 | 516 | 172 | ND | 7,740 |
| | 14 Oct | 1,032 | ND | 9,116 | ND | 344 | 7,740 | 279,040 |

Table 1. (Cont'd).

| Species | Date | Ponds 1 | 2 | 3 | 4 | 5 | 14 | 16 |
|---|---|---|---|---|---|---|---|---|
| DINOFLAGELLATES | | | | | | | | |
| *Ceratium fusus* | 10 Oct | | | | | | | 2,580 |
| | 14 Oct | | | | | | | |
| *Ceratium hircus* | 10 Oct | | | 172 | | | | |
| | 14 Oct | | | | | | | |
| *Cyrodinium herbaceum* | 10 Oct | 7,052 | 5,676 | 3,096 | 2,408 | 1,376 | | 10,320 |
| | 14 Oct | 1,032 | | | | 344 | 154,800 | 154,800 |
| *Oxytoxum scolopax* | 10 Oct | | | 172 | 344 | | | |
| | 14 Oct | | | 172 | | 172 | 38,700 | 43,860 |
| *Peredinium nanum* | 10 Oct | 33,095 | 15,444 | 9,976 | 15,796 | 13,396 | | 30,959 |
| | 14 Oct | 16,942 | | 11,032 | | 11,951 | 147,060 | 1,075,593 |
| *Prorocentrum micans* | 10 Oct | 688 | 344 | | 344 | 344 | | 4,148 |
| | 14 Oct | 172 | | 172 | | 688 | 10,320 | 2,580 |
| Total Dinoflagellates | 10 Oct | 47,035 | 21,464 | 13,416 | 18,892 | 15,116 | ND | 45,427 |
| | 14 Oct | 18,146 | ND | 11,376 | ND | 13,155 | 350,880 | 1,279,413 |
| BLUE-GREEN ALGAE | | | | | | | | |
| *Trichodesmium thiebaulti* | 10 Oct | | | | | | | |
| | 14 Oct | | | | | | | 2,580 |

Table 1. (Cont'd).

| Species | Date | Ponds 1 | 2 | 3 | 4 | 5 | 14 | 16 |
|---|---|---|---|---|---|---|---|---|
| PROTOZOANS | | | | | | | | |
| *Didinium balbioni* | 10 Oct | | 860 | 1,032 | | 344 | | |
| | 14 Oct | | | | | | | |
| *Euplotes sexcostatus* | 10 Oct | 172 | | | | | | |
| | 14 Oct | | | 860 | | | | |
| *Lohmaniella oviformis* | 10 Oct | | | | | | | |
| | 14 Oct | 516 | | | | 172 | | 20,640 |
| *Nassula microstoma* | 10 Oct | | 22,064 | | 234,430 | 146,174 | | |
| | 14 Oct | | | | | | | |
| *Strombidium conicum* | 10 Oct | 344 | | | | | | |
| | 14 Oct | | | | | | | |
| *Strombidium sulcatum* | 10 Oct | 344 | | | | | | 6,192 |
| | 14 Oct | 1,892 | | 1,032 | | 16,088 | | |
| *Tintinnopsis minuta* | 10 Oct | | | | | | | |
| | 14 Oct | | | | | | 7,740 | |
| *Vorticella oceanica* | 10 Oct | | | 516 | | | | |
| | 14 Oct | | | | | | | |
| Total Protozoa | 10 Oct | 860 | 22,924 | 1,548 | 234,430 | 146,518 | ND | 26,832 |
| | 14 Oct | 2,408 | ND | 1,892 | ND | 16,260 | 7,740 | 0 |

Table 1. (Cont'd).

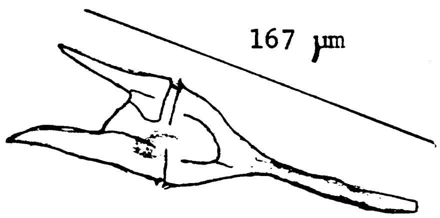
| Species | Date | Ponds 1 | 2 | 3 | 4 | 5 | 14 | 16 |
|---|---|---|---|---|---|---|---|---|
| MACROPLANKTERS | | | | | | | | |
| Copepod eggs | 10 Oct | X | X | X | X | X | | X |
| | 14 Oct | | | X | | | | |
| Copepod nauplii | 10 Oct | | | | | | | |
| | 14 Oct | X | | X | | X | | |
| Copepods | 10 Oct | | | X | | | | |
| | 14 Oct | | | | | | | |
| Nematodes | 10 Oct | X | | | | | | |
| | 14 Oct | | | | | | | |
| Polychaete larvae | 10 Oct | | | | X | | | |
| | 14 Oct | | | | | | | |

Table 2. Number of microplankton per liter and presence of macroplankters (indicated by X) in a sample collected at Port Alto in Carancahua Bay, Texas following a fish kill on 6 October 1980.

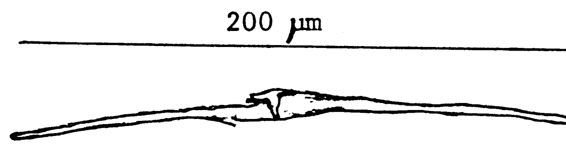
| Species | Number/l |
|---|---|
| NANOFLAGELLATES | 85,496 |
| DIATOMS | |
| Coscinodiscus sp. | 1,032 |
| Diploneis splendida | 172 |
| Melosira moniliformis | 680 |
| Navicula sp. | 860 |
| Nitzschia closterium | 172 |
| Scoliopleura tumida | 1,548 |
| Thalassionema nitzschoides | 1,548 |
| Total Diatoms | 5,012 |
| DINOFLAGELLATES | |
| Peredinium nanum | 46,885 |
| Prorocentrum micans | 344 |
| Total Dinoflagellates | 47,229 |
| MACROPLANKTERS | |
| Copepods | X |

Figure 1. Dinoflagellates and blue-green algae observed in water samples collected from red rum grow-out ponds on 10 and 14 October 1980.

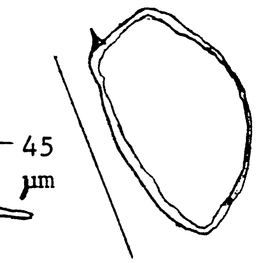
DINOFLAGELLATES



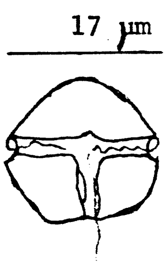

Ceratium hircus



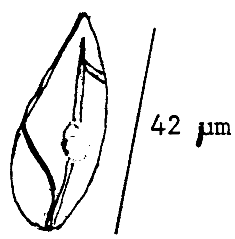

Ciratium fusus



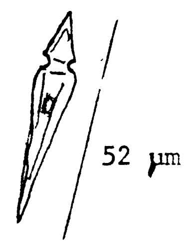

Prorocentrum micans




Peredinium nanum

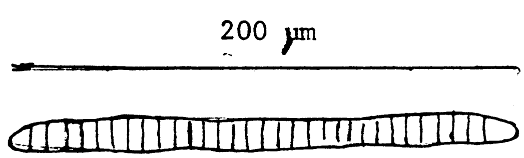



Gyrodinium herbaceum




Oxytoxum scolopax

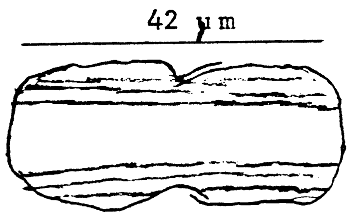
BLUE-GREEN ALGAE



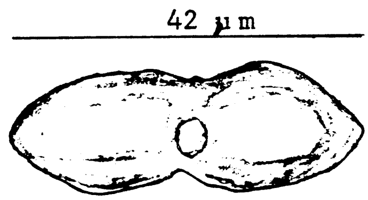

Trichodesmium thiebaulti

Figure 2. Diatoms observed in water samples collected from red drum grow-out ponds on 10 and 14 October 1980.

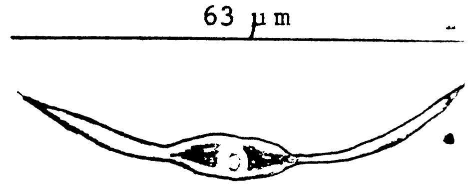
DIATOMS



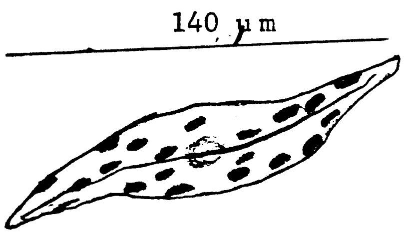

Amphiphora paludosa



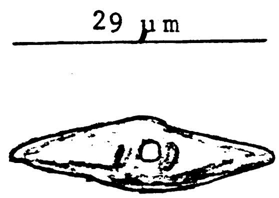

Diploneis spiendida



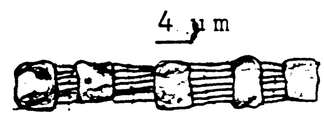

Nitzschia closterium



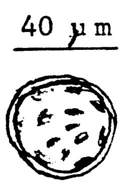

Pleurosigma normanii



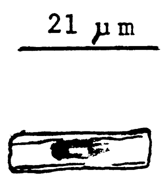

Scoliopleura turmida



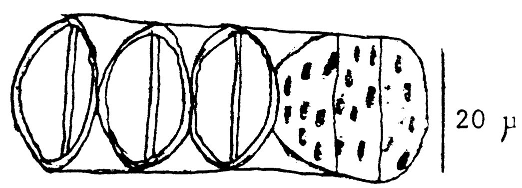

Skeletonema costatum



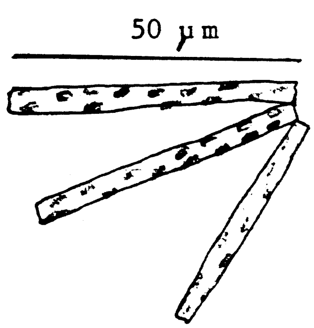

Coscinodiscus sp.




Navicula sp.



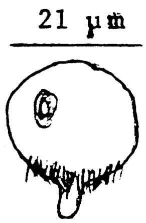

Melosira monilformis



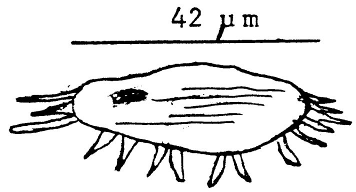

Thalassionema nitzschoides

Figure 3. Protozoa observed in water samples collected from red drum grow-out ponds on 10 and 14 October 1980.

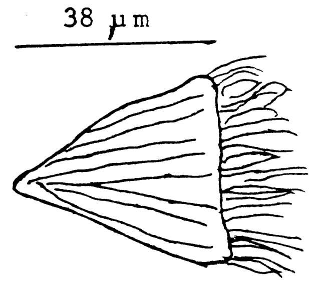
## PROTOZOA



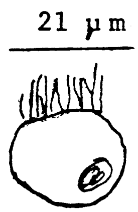

Didinium balbiana



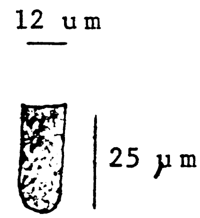

Euplotes sexcostatus



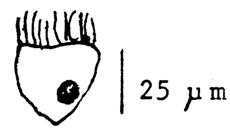

Strombidium conicum



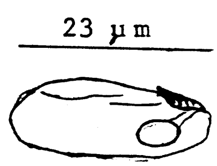

Lohmaniella oviformis



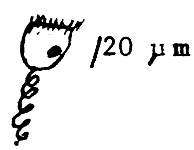

Tintinnopsis minuta




Strombidium sulcatum




Nassula microstoma




Vorticella oceanica