BIOASSAYS OF LAKE APOPKA FARM DISCHARGES

ZELLWOOD DRAINAGE DISTRICT #2

AND

DUDA AND SON CLAY ISLAND OPERATION

ORANGE AND LAKE COUNTIES, FLORIDA

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OCTOBER 21, 1986

Biology Section
Division of Environmental Programs

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Biology Section
Bureau of Laboratories and
Special Programs
October 21, 1986

EXECUTIVE SUMMARY

Lake Apopka Farm Discharges, on 30 September to 2 October, 1986.

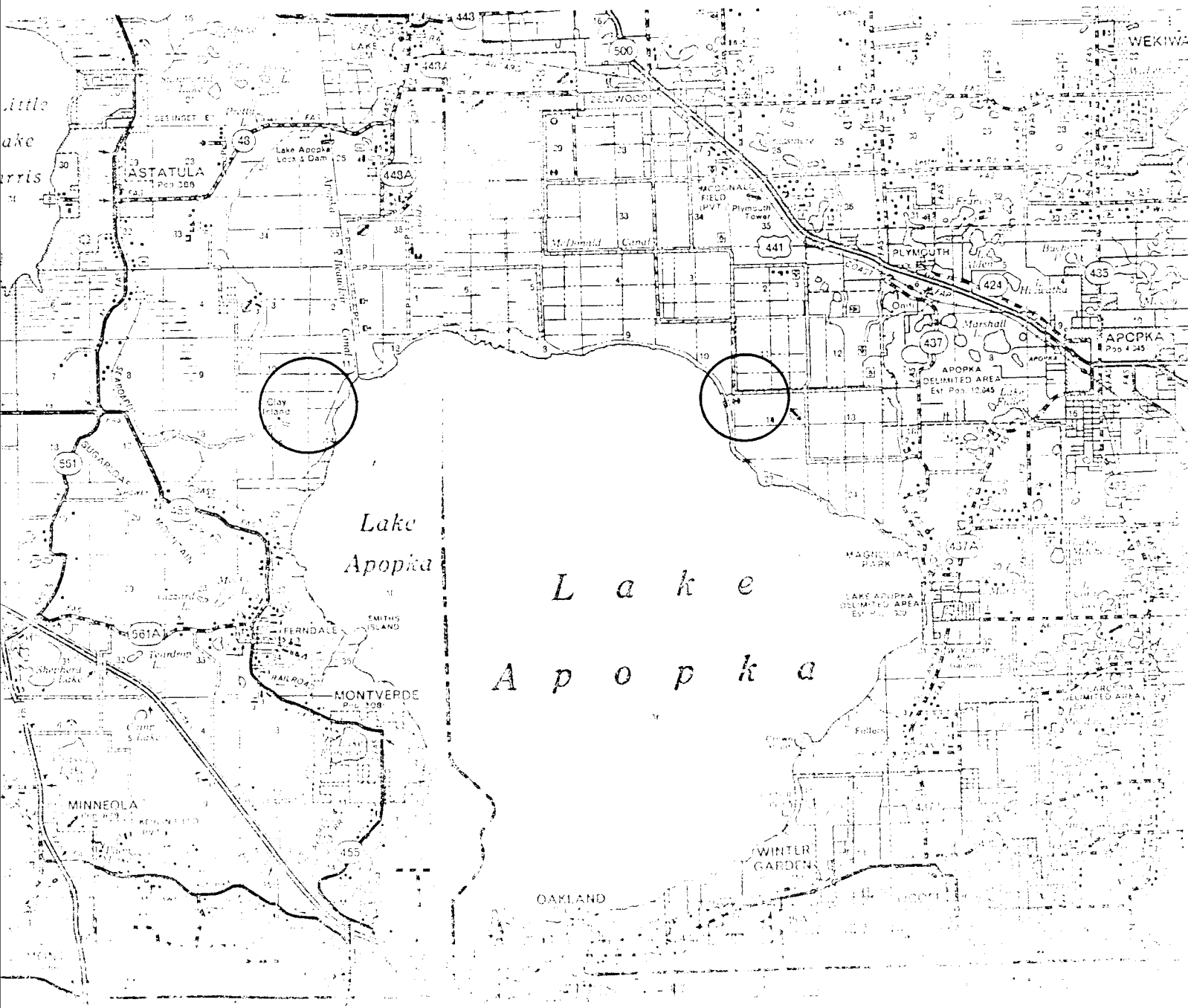
Two separate 48 hour screening bioassays (50% and 100% concentrations) were performed on each of two farm water discharges, Zellwood Drainage District #2 and Duda and Sons Clay Island Operation, that are eventually pumped to Lake Apopka. No mortality of either Daphnia pulex or of Notorpis leedsi was noted during the tests. The ammonia measured in these samples, up to 0.8 mg/l total and 0.04 mg/l unionized in the Zellwood water, was insufficient to have caused any toxicity. Since the samples were not acutely toxic, further chemical analyses were not requested.

Due to the current eutrophic condition of Lake Apopka, and to the restoration projects that are planned, we recommend that the ammonia measured in these samples, particularly from the Zellwood farm area, be view with considerable caution, especially if the volumes of flow from these operations are significant.

INTRODUCTION

The area along the northeast and norhwest shores of Lake Apopka support several agricultural muck farms that cultivate various vegetable and sugarcane crops. Two of these areas are the Zellwood Drainage District along the northeast shore in Orange County, and the Duda and Son Clay Island Operation along the northwest shore in Lake County. Both of these opeartions discharge agricultural water into Lake Apopka. The Zellwood area discharges directly into the lake from a pumping station while the Duda discharge passes through a marshy swamp before entering the lake (Fig. 1).

To evaluate the aquatic toxicity potential of these discharges, the St. Johns River District requested acute toxicity bioassays be performed. The Biology Section performed two static screening bioassays (50% and 100% concentrations) on samples collected from retention ponds from each of these operations just prior to discharge. The results of these tests are presented in this report. Those involved in performing the tests and in preparation of this report were: J. M. Faircloth, M. L. Roll, and P. G. Weiland.



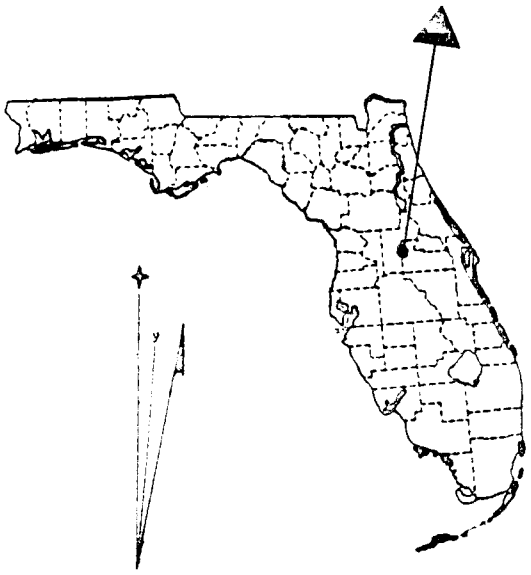


Figure 1. Portions of Orange and Lake Counties, Florida, including the locations of the Zellwood Drainage District #2 pump and the Duda Clay Island Operation.

METHODS AND MATERIALS

Test methods used to conduct these static bioassays are extensively described by Peltier and Weber (1985) and the FDER Biology Section (1985). The organisms selected for this study include a species recommended by Peltier and Weber (1985), the U.S. EPA (1978), and the FDER Biology Section (1985). Additionally, the Biology Section maintains cultures of several species of organisms indigenous to the State of Florida. One of these indigenous species was also selected for testing. Life histories of these test organisms and maintenance procedures used to culture them are detailed below.

History and Maintenance of Bioassay Organisms

Daphnia pulex (water flea) - A breeding culture of Daphnia pulex was obtained from the EPA laboratory in Athens, Georgia, in March, 1979. This culture has been maintained since its arrival in 2 1/2 gallon all-glass aquaria, filled with unchlorinated DER well water, under a 16:8 hour light-dark cycle. Organisms are fed a liquified blend of Purina Trout Chow® and Cerophyl® twice daily, once daily on weekends, and are kept at a constant temperature of 22° ± 2°C. The aquaria are cleaned weekly by siphoning off half the water along with the detritus and excess organisms, and then refilling with fresh aerated well water. Additional measures are taken and/or new cultures started in the event of abnormal circumstances such as: declining populations, ephippia formation, or excessive fungal or bacterial growth.

Notropis leedsi (bannerfin shiner) - Approximately 40 adult bannerfin shiners were obtained from an indigenous population in the upper Suwannee River during October, 1981. The breeding stock is maintained in 30 and 125 gallon all-glass aquaria equipped with a flow-through water exchange system. Water for this system is unchlorinated and is pumped from the DER deep well. The bannerfin shiners are reared at 22° ± 2°C under a 16:8 hour light-dark cycle and are fed Tetra-Min® and frozen Artemia (brine shrimp) twice daily, and once daily on weekends. Breeding and egg hatching are encouraged at 25°C. The eggs are laid between stacked red ceramic tiles separated by a 3mm bead of silicone. Most of the eggs adhere to the tiles and are easily removed to heated, aerated hatching tanks. The narrow space between the tiles eliminates egg predation by adult fish. New hatching tanks are started regularly to segregate fry into even age groups. Newly hatched fry are fed a liquefied blend of Purina Trout Chow® and Cerophyl® twice daily. After one week, feeding is augmented with newly hatched Artemia nauplii and finely crushed Tetra Min®. The fish used in this test were approximately 40 days old at the time of the test.

To ensure the uniform sensitivity of these test organisms to toxic substances, the Biology Section conducts monthly standard reference toxicant bioassays using sodium lauryl sulfate as the reference toxicant.

Test Methods

Methods used to perform acute toxicity bioassays are described by Peltier and Weber (1985) and the FDER Biology Section (1985). Some of the methods described below are more specific than those of Peltier and Weber. These will be noted in more detail.

Sampling Methods and Test Dates

Two separate 48 hour static screening bioassays were performed on each sample of agricultural water collected from the retention ponds of the Zellwood Drainage District #2 and the Duda and Son Clay Island Operation. The tests were performed from 1100 hours on 30 September to 1100 hours on 2 October, 1986.

The samples were collected by Mr. David Chasteen of DER's St. Johns River District at 1230 hours on 29 September, 1986, using standard wastewater sampling procedures. Separate samples were obtained for chemical and biological testing. Samples for metal analyses were preserved with HNO_3. Samples for organic chemical analyses and for the bioassays were unpreserved. The samples were iced and transported to the DER laboratory in Tallahassee for analyses within 24 hours of collection.

Test Temperature

Upon arrival of the iced (4°C) bioassay samples in the Tallahassee laboratory, the containers were placed in warm water and the temperature of the samples allowed to rise to 20° $\pm$ 2°C. Although this temperature may be different than the temperature of the sample during collection, it is the temperature range to which the test organisms are acclimatized and is the range recommended in the above referenced bioassay protocols. This avoids stressful effects caused by exposure to unusually cold or warm samples.

Freshwater Tests

Freshwater for dilution of the samples was obtained from the same DER deep well that is used to culture the test organisms. The concentration series selected for this study is presented in (Table 1).

Two replicates, of each concentration and a control, were used to test with the water flea, Daphnia pulex. Flint glass jars of either 60 ml or 250 ml capacity were used as test chambers, and either 50 ml or 200 ml of the appropriate test concentration was placed in each chamber. Daphnia were siphoned into a large culture dish to isolate the proper size and age organisms (neonates). To accomplish this, the water fleas were siphoned through a stainless steel screen. The trapped adults were then discarded. These neonates were then transferred by glass pipette, examined for injury, and were loaded 10 per chamber, resulting in 20 per test concentration. Water fleas were not fed during these tests.

Two replicates, of each concentration and a control, were used for the Notropis leedsi (bannerfin shiner) bioassays. The fish were transferred individually or by twos, into wide mouth quart jars containing 500 ml each of the appropriate test concentration, and were loaded 5 per chamber, resulting in 10 per concentration. Fish were not fed during these tests.

Test Parameters

Dissolved oxygen (YSI Model 57 oxygen meter), pH (Corning Model 7 pH meter with Orion Ross® combination electrode), temperature (NBS calibrated glass thermometer), and the number of live organisms were recorded for each test concentration at 0 hours, 24 hours, and 48 hours. Total alkalinity and total hardness (measured as $CaCO_3$ using HACH Chemical Company reagents) were recorded at the beginning of the test for the controls and the 100% effluent concentration. The specific conductance (YSI Model 33 S-C-T meter) of each test concentration was recorded at the beginning and end of the test. All instruments were calibrated daily according to manufacturer's recommendations. Ammonia concentrations, including the total and unionized fraction (expressed in mg/l as N and as NH_3, respectively), were recorded in the controls and the 100% test concentrations at the beginning of the test. Total ammonia concentrations were determined using a HACH ammonia test kit. The unionized fraction was then calculated based on the total ammonia concentration, and the pH, temperature, and salinity of the sample. These values were recorded on the bioassay data forms and are presented in Tables 2 and 3.

Table 1. Concentration Series and Volumes Used for These Static Bioassays.

Daphnia pulex (water flea)

Concentration	Dilution Water	Effluent	Total Volume
Control	200.0 ml	--------	200 ml
50.0%	100.0 ml	100.0 ml	200 ml
100.0%	--------	200.0 ml	200 ml

Notropis leedsi (bannerfin shiner)

Concentration	Dilution Water	Effluent	Total Volume
Control	500 ml	--------	500 ml
50.0%	250 ml	250 ml	500 ml
100.0%	------	500 ml	500 ml

Table 2. Data recorded during 48 hours, Daphnia pulex and Notropis leedsi, static acute toxicity bioassays of Lake Apopka Farm Discharge (Zellwood Drainage District #2), on 30 September to 2 October, 1986.

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH			Temperature (°C)			Conductivity (umhos)	
	0	24	48	0	24	48	0	24	48	0	24	48	0	48
Daphnia pulex														
Control	10	10	10	8.8	8.7	8.3	8.1	8.0	7.9	20.6	20.5	19.9		
Control	10	10	10	8.8	8.7	8.3	8.1	8.0	7.9				191	202
50.0%	10	10	10	8.9	8.7	8.2	8.0	8.1	8.1	20.8	20.2	19.9		
50.0%	10	10	10	8.8	8.7	8.2	8.0	8.1	8.1				352	362
100.0%	10	10	10	8.8	8.7	8.1	8.0	8.2	8.2	21.3	20.1	19.9		
100.0%	10	10	10	8.8	8.7	8.1	8.0	8.2	8.2				600	590
Notorpis leedsi														
Control	5	5	5	8.5	7.0	6.7	7.7	7.7	7.7	22.5	20.2	19.7		
Control	5	5	5	8.5	7.0	6.7	7.7	7.7	7.7				202	205
50.0%	5	5	5	8.7	6.6	6.2	8.0	8.0	8.0	21.5	20.4	19.9		
50.0%	5	5	5	8.7	6.6	6.2	8.0	7.9	8.0				368	377
100.0%	5	5	5	8.8	6.9	5.7	8.0	8.0	8.0	21.7	20.0	19.8		
100.0%	5	5	5	8.8	6.9	5.7	8.0	8.0	8.0				600	600

Control Water	
NH_3(as NH_3)(mg/l) 0	Total Alkalinity 120 (mg/l $CaCO_3$)
Total ammonia (as N)(mg/l) 0	Total Hardness 121 (mg/l $CaCO_3$)

100% Effluent	
NH_3(as NH_3)(mg/l) 0.04	Total Alkalinity 211 (mg/l $CaCO_3$)
Total ammonia (as N)(mg/l) 0.8	Total Hardness 260 (mg/l $CaCO_3$)

Table 3. Data recorded during 48 hour, Daphnia pulex and Notropis leedsi, static acute toxicity bioassays of Lake Apopka Farm Discharge (Duda and Sons Clay Island Operation), on 30 September to 2 October, 1986.

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/1)			pH			Temperature (°C)			Conductivity (umhos)	
	0	24	48	0	24	48	0	24	48	0	24	48	0	48
Daphnia pulex														
Control	10	10	10	9.0	8.8	8.3	8.1	8.0	8.1	20.8	20.2	19.9		
Control	10	10	10	9.0	8.8	8.3	8.1	8.0	8.1				194	208
50.0%	10	10	10	9.0	8.8	8.3	7.8	7.9	8.0	20.7	20.0	19.9		
50.0%	10	10	10	9.0	8.8	8.3	7.8	7.9	8.0				194	202
100.0%	10	10	10	8.7	8.6	8.3	7.2	7.9	8.0	20.8	20.0	20.0		
100.0%	10	10	10	8.7	8.6	8.3	7.2	7.9	8.0				191	199
Notropis leedsi														
Control	5	5	5	8.5	7.0	6.7	7.7	7.7	7.7	22.5	20.2	19.7		
Control	5	5	5	8.5	7.0	6.7	7.7	7.7	7.7				202	205
50.0%	5	5	5	8.7	6.3	6.2	7.3	7.6	7.7	21.0	20.0	19.9		
50.0%	5	5	5	8.7	6.3	6.2	7.3	7.6	7.7				195	201
100.0%	5	5	5	8.6	6.4	6.3	7.2	7.6	7.7	21.1	20.0	19.9		
100.0%	5	5	5	8.6	6.4	6.3	7.2	7.6	7.7				193	199

Control Water	
NH_3(as NH_3)(mg/1) 0	Total Alkalinity (mg/l $CaCO_3$) 120
Total ammonia (as N)(mg/1) 0	Total Hardness (mg/l $CaCO_3$) 121

100% Effluent	
NH_3(as NH_3)(mg/1) 0.002	Total Alkalinity (mg/l $CaCO_3$) 80
Total ammonia (as N)(mg/1) 0.2	Total Hardness (mg/l $CaCO_3$) 90

RESULTS AND DISCUSSION

The samples of agricultural water collected from the retention ponds of the Zellwood and Duda muck farm operations were not acutely toxic to the test organisms, Daphnia pulex and Notropis leedsi, during 48 hour screening bioassays. No mortality was noted in the tests. The ammonia measured in the samples, up to 0.8 mg/l total and 0.04 mg/l unionized in the Zellwood sample, was insufficient to have caused any toxicity. Since the samples were not acutely toxic, further chemical analyses were not performed.

Recommendation

Due to the current eutrophic condition of Lake Apopka, and to the planned restoration activities, we recommend that the ammonia detected in these samples, particularly in the Zellwood sample, be viewed with considerable caution, especially if the volumes of flow from these operations are significant.

LITERATURE CITED

Florida Department of Environmental Regulation, Biology Section. 1985. Quality Assurance Manual for Performing Acute Toxicity Tests (Second Edition). FDER.

Peltier, W. and C. I. Weber. 1985. Methods for measuring the acute toxicity of effluents to aquatic organisms (Third Edition). Environmental Research Laboratory. Athens, Georgia. EPA-600/4-85-012. 217 p.