

BIOASSAYS OF THE CITY OF [redacted]

[redacted] PLANT, ALUM DISCHARGE

HILLSBOROUGH COUNTY, FLORIDA

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January 29, 1985

Biology Section
Division of Environmental Programs

BIOASSAYS OF THE CITY OF TAMPA

WATER TREATMENT PLANT, ALUM DISCHARGE

HILLSBOROUGH COUNTY, FLORIDA

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Biology Section
Bureau of Laboratories
January 29, 1985

EXECUTIVE SUMMARY

City of Tampa Water Treatment Plant Alum Discharge, on 27 to 30 November, 1984.

A sample of discharge collected from the City of Tampa Water Treatment Plant was not toxic at 72 hours to the test organisms Daphnia pulex and Notropis leedsi. No N. leedsi died during the 72 hour static test, while one mortality was observed in the D. pulex test. Analysis for aluminum indicated the presence of 1500 µg/l in this sample, which apparently was insufficient to cause any mortality.

INTRODUCTION

The City of Tampa Water Treatment Plant routinely discharges wastewater consisting of an alum supernatant to the Hillsborough River just below the salinity barrier.

In April, 1984, the Biology Section performed static acute toxicity bioassays on a sample of this discharge to determine its toxicity to aquatic organisms. Results indicated 48 hour LC_{50}'s of 79.6% and 314.2% for the test organisms Mysidopsis bahia (saltwater) and Daphnia pulex (freshwater), respectively (FDER 1984). No mortality occurred in the Notropis leedsi test. The DER Chemistry Section detected aluminum (1990 µg/l) and iron (551 µg/l) in the sample. The presence of these metals may have been responsible for the toxicity noted.

Since the discharge was close to being acutely toxic to freshwater D. pulex, the Southwest District requested additional bioassays be performed. The Biology Section, therefore, performed two additional 72 hour static bioassays on a sample of this discharge on 27 to 30 November, 1984. The results of these tests are presented in this report. Those involved in performing the tests and in the preparation of this report were: R. B. Frydenborg, M. L. Moultrie, and M. L. Roll.

METHODS AND MATERIALS

Test methods used to conduct these static bioassays are extensively described by Peltier (1978) and the FDER Biology Section (1983). The organisms selected for this study include a species recommended by Peltier (1978), the U.S. EPA (1978), and the FDER Biology Section (1983). 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° plus or minus 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° plus or minus 2°C under a 16:8 hour light 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 7 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

Two 72 hour static acute toxicity bioassays were performed on a sample collected from the City of Tampa's Water Treatment Plant discharge pipe. The tests were performed from 0930 hours on 27 November to 0955 on 30 November, 1984.

The sample was collected by Ms. Phyllis Giwer, of DER's Southwest District at 1400 hours on 26 November, 1984, using standard wastewater sampling procedures. Separate samples were obtained for chemical and biological testing. Samples for metal analyses were preserved with HNO_3. The samples were iced and transported to the DER laboratory in Tallahassee for analyses within 24 hours of collection.

Freshwater for dilution of the effluent sample was obtained from the same DER deep well that is used to culture the test organisms. The concentration series selected for this study (Table 1) is that recommended by APHA (1980).

Two replicates, of four concentrations and a control, were used to test with the water flea, Daphnia pulex. Flint glass jars of 250 ml capacity were used as test chambers, and 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 this test.

Two replicates, of four concentrations and a control, were used for the Notropis leedsi (bannerfin shiner) bioassay. 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 this test.

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, 48 hours, and 72 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. 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 ml	------	200 ml
10.0%	180 ml	20 ml	200 ml
32.0%	136 ml	64 ml	200 ml
56.0%	88 ml	112 ml	200 ml
100.0%	------	200 ml	200 ml

Notropsis leedsi (bannerfin shiner)

Concentration	Dilution Water	Effluent	Total Volume
Control	500 ml	------	500 ml
10.0%	450 ml	50 ml	500 ml
32.0%	340 ml	160 ml	500 ml
56.0%	220 ml	280 ml	500 ml
100.0%	------	500 ml	500 ml

Table 2. Data recorded during 72 hour, Daphnia pulex, static acute toxicity bioassay of The City of Tampa Water Treatment Plant, Hillsborough County, Florida, on 27 to 30 November, 1984.

Concentration or %	Number of Live Organisms				Dissolved Oxygen (mg/l)				pH				Temperature (°C)				Conductivity (umhos)	
	0	24	48	72	0	24	48	72	0	24	48	72	0	24	48	72	0	72
Control	10	10	10	10	8.1	8.4	8.8	9.1	7.5	7.1	8.2	8.3	20.7	19.8	20.6	17.8		
Control	10	10	10	10	8.1	8.4	8.8	9.1	7.5	7.2	8.2	8.3					220	213
10.0%	10	10	10	10	8.1	8.4	8.7	9.0	7.5	7.7	8.2	8.3	20.9	19.4	20.3	17.4		
10.0%	10	10	10	10	8.1	8.4	8.6	9.0	7.5	7.7	8.2	8.3					240	221
32.0%	10	10	10	10	8.0	8.4	8.6	8.8	7.5	7.7	8.2	8.3	21.3	19.3	20.4	17.3		
32.0%	10	10	9	9	8.0	8.3	8.6	8.8	7.5	7.7	8.2	8.3					285	272
56.0%	10	10	10	10	7.9	8.3	8.6	8.7	7.4	7.7	8.2	8.3	21.9	19.2	20.2	17.3		
56.0%	10	10	10	10	7.9	8.2	8.6	8.7	7.4	7.8	8.2	8.3					335	315
100.0%	10	10	10	10	7.6	8.1	8.3	8.9	7.3	7.8	8.2	8.3	22.9	19.3	20.5	17.5		
100.0%	10	10	10	10	7.6	8.1	8.3	8.9	7.3	7.8	8.2	8.3					428	399

Control Water

NH_3(as NH_3)(mg/l) _____

Total ammonia (as N)(mg/l) _____

Total Alkalinity 92 (mg/l $CaOO_3$)

Total Hardness 113 (mg/l $CaOO_3$)

100% Effluent

NH_3(as NH_3)(mg/l) _____

Total ammonia (as N)(mg/l) _____

Total Alkalinity 96 (mg/l $CaOO_3$)

Total Hardness 189 (mg/l $CaOO_3$)

Remarks: Total residual chlorine 0.05 mg/l (HACH).

Table 3. Data recorded during 72 hour, Notropis leedsi, static acute toxicity bioassay of The City of Tampa Water Treatment Plant, Hillsborough County, Florida, on 27 to 30, 1984.

Concentration or %	Number of Live Organisms				Dissolved Oxygen (mg/l)				pH				Temperature (°C)				Conductivity (umhos)	
	0	24	48	72	0	24	48	72	0	24	48	72	0	24	48	72	0	72
Control	6 [a]	6	6	6	8.1	8.2	8.4	9.1	7.6	7.9	8.2	8.4					220	212
Control	5	5	5	5	8.0	8.2	8.4	9.1	7.6	7.9	8.2	8.4	20.9	19.1	20.3	17.2		
10.0%	5	5	5	5	8.1	8.2	8.6	9.0	7.6	7.9	8.2	8.3					240	229
10.0%	5	5	5	5	8.0	8.2	8.7	9.0	7.6	7.9	8.2	8.3	21.2	18.9	20.4	16.9		
32.0%	5	5	5	5	7.8	8.2	8.7	9.0	7.5	7.9	8.2	8.3					388	270
32.0%	5	5	5	5	7.9	8.2	8.7	9.0	7.5	7.9	8.2	8.3	21.5	18.7	19.8	16.9		
56.0%	5	5	5	5	7.8	8.2	8.5	8.9	7.4	7.8	8.1	8.3					389	312
56.0%	5	5	5	5	7.8	8.1	8.5	8.9	7.4	7.8	8.1	8.3	22.2	18.8	19.8	17.0		
100.0%	5	5	5	5	7.6	7.9	7.9	8.6	7.3	7.8	8.0	8.3					425	392
100.0%	5	5	5	5	7.6	7.9	7.9	8.6	7.3	7.8	8.0	8.3	22.9	18.9	20.0	17.2		

Control Water

NH_3(as NH_3)(mg/l) _____

Total ammonia (as N)(mg/l) _____

Total Alkalinity 92 (mg/l $CaOO_3$)

Total Hardness 113 (mg/l $CaOO_3$)

100% Effluent

NH_3(as NH_3)(mg/l) _____

Total ammonia (as N)(mg/l) _____

Total Alkalinity 96 (mg/l $CaOO_3$)

Total Hardness 189 (mg/l $CaOO_3$)

Remarks: Total residual chlorine 0.05 mg/l (HACH)

[a] Extra organism loaded by mistake, allowed to remain.

RESULTS AND DISCUSSION

A sample of discharge from the City of Tampa Water Treatment Plant was not toxic to the test organisms Daphnia pulex and Notropis leedsi during the 72 hour static tests. No N. leedsi died (Table 3), while only one mortality was observed in the D. pulex test (Table 2). A slight total chlorine residual (0.05 mg/l HACH DPD Method) was detected in this sample, which was insufficient to cause any mortality. Analyses for aluminum indicated a concentration of 1500 µg/l in this sample (Dr. Yuh Hsu Pan, personal communication), which apparently was also insufficient to cause any mortality.

LITERATURE CITED

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