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EFFECTS OF ANTIMYCIN ON PLANKTON POPULATIONS AND BENTHIC ORGANISMS

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ABSTRACT

One phase of an evaluation of antimycin as a piscicide in ten ponds and lakes in the Southeast involved a study of its effect on plankton and bottom organisms. Net zooplankton in the groups Cladocera, Copepoda, Rototaria and nauplii larvae were enumerated before and after the application of 5.0 ppb antimycin. All groups were severely reduced and some disappeared following the treatment. Bottom organisms in the groups Tendipedidae, Ceratopogonidae and Culicidae were enumerated. Bottom organisms in these groups did not disappear following antimycin applications. Probably reasons are discussed.

INTRODUCTION

The fungicide antimycin has been evaluated as a piscicide by a number of investigators (Walker, *et al.* 1964; Hogan, 1966; Callaham and Huish, 1967; and Burress, 1968). There exists a scarcity of information regarding the effects of the toxicant upon plankton populations and benthic organisms. Walker, *et al.* (1964) reported that plankton, aquatic plants, bottom fauna, salamanders, tadpoles and turtles were not harmed by piscicidal concentrations. This report contains the results of a study in three Georgia ponds where net zooplankton and bottom fauna were enumerated before and after application of selective and total kill concentrations.

METHODS

Zooplankton

Zooplankton samples were collected from the surface and other depths depending on the morphometry of the study area. All samples were collected within the same hour on successive days to minimize discrepancies caused by diel periodicity. A Wisconsin style plankton net and bucket with No. 20 mesh was used to concentrate the plankton. Surface samples of 38 liters were dipped with a plastic pail and poured through the net. Samples taken from various depths below the surface were pumped through the net into the 38 liter container (Holder 1967). The pumping technique for collecting plankton samples below the surface may be biased by the rheotaxis of some plankters (Langford 1953). However, this bias is assumed to be the same before as it is following the application of antimycin.

The concentrate was preserved in a 10 per cent formalin solution and taken to the laboratory for counting. A 1 ml aliquot of the concentrate was removed by a large bore apparatus. This subsampler designed to deliver 1 ml had an inside diameter sufficiently large that it was not occluded by the plankton. The aliquot was transferred to a Sedgewick-Rafter cell for counting. Counting procedure followed that outlined by Plankton Analysis (1964) and Standard Methods (1965) for net zooplankton. Net zooplankton per liter was determined as follows:

$$\frac{C}{\frac{S_n V_c}{V_s}}$$

Where C = Total number of organisms counted

S_n = Number of Sedgewick-Rafter cells counted

V_c = Volume of concentrate

V_s = Volume of sample collected

Every organism observed in the groups Cladocera, Copepoda, and Rotatoria was enumerated. References by Ward and Whipple (1918), Pennak (1953), Needham and Needham (1962) and Edmonson (1966) were used in the identification of zooplankton.

Benthos

A quantitative determination of bottom fauna was made in three of the study areas before and after the application of antimycin. An Ekman dredge was used to collect samples. All samples were collected at random within the same hour on successive days to eliminate the systematic distortion of diel migration. The littoral zone was not sampled.

All samples were discharged into a tub for screening. A U. S. series No. 30 sieve was used to concentrate the sediment. The residue was preserved in a 10 per cent formalin solution and transported to the laboratory for qualitative analysis.

A sucrose flotation technique for sorting bottom fauna samples was used (Anderson 1959). A solution with a specific gravity of 1.15 was prepared by dissolving approximately 3 pounds of sucrose in one gallon of water. The concentrate of each sample was placed in a pan and flooded with 1 to 2 gallons of solution. Most invertebrate organisms (excluding molluscs) float in this solution since they have a specific gravity less than 1.12. The animals were picked from the surface, separated into major taxonomic groups and enumerated.

RESULTS AND DISCUSSION

Zooplankton

The importance of zooplankton as a food supply for fish has been reported by many authors (Odum 1959, Kendeigh 1961, Raymont 1963). For many species of fish, the dependence upon zooplankton for food decreases with maturation. For these fish, the fry are dependent totally or substantially on zooplankton for their food. Fingerling rely more on bottom fauna. Rogers (1963) demonstrated that Cladocera and Copepoda comprised a major source of food for largemouth bass fry less than 30 mm in length. Young largemouth bass which exceed 30 mm fed mostly on bottom fauna. Some benthic organisms which are important fish food items, notably ***Chaoborus*** sp., are themselves dependent upon the plankton population for food (Ruttner 1963).

An analysis of diversity within each of the major groups enumerated conformed to the conclusion of Ruttner (1963). There was one dominant species for each group. Nauplii were counted separately from adult copepods (Tables 1, 2 and 3) because larval stages and metamorphosis represent critical physiological phases in the life history of most organisms (Prosser and Brown 1950).

Each of the groups reported in Tables 1 and 2 varied in abundance from day to day and at differing depths. Zooplankton distribution has been shown to be influenced by food supply. The principal food sources included bacteria, phytoplankton and organic detritus (Raymont 1963). Slobodkin (1954) showed zooplankton abundance to be related to food supply when he established a linear relationship between food supply and population size of *Daphnia.* Phytoplankton blooms have inhibited zooplankton growth and reproduction.(Ryther 1954). This situation apparently existed in Rock Eagle II where the high density of *Aphanizomenon* sp. resulted in low zooplankton counts.

The number of organisms per liter for each taxonomic group decreased or disappeared in post-treatment samples. Notable among the groups which disappeared were the Cladocera, Copepoda and nauplii of Tanglewood pond. Copepoda and Cladocera also disappeared from post-treatment Dekle pond counts. Samples collected at Dekle pond 6 days after antimycin application revealed the presence of all groups although at a number lower than the pretreatment level. Samples from

TABLE 1
Dekle pond - zooplankton per liter, April 8-20, 1967

	Depth (meters)	8	12	12	13	13	14	14	15	15	16	16	18	20	22	20
Rototaria	Sur	54.7	231.0	428.6	46.3	4.2	5.8	1.5	1.8	--	.5	.8	--	1.9	4.5	2.3
	1m	43.2	109.5	308.4	51.1	17.5	21.0	2.9	2.3	2.8	--	1.1	.8	20.6	10.2	1.1
Copedpoda	Sur	1.3	9.3	8.4	2.3	--	--	--	1.0		--	--	--	--	--	4.5
	1m	10.1	2.0	7.3	6.3	3.0	3.1	3.5	--	5.3	--	--	--	--	--	9.5
Cladocera	Sur	--	5.1	23.8	3.8	--	--	--	1.5	--	--	--	--	--	--	2.3
(Daphnia)	1m	2.7	4.1	42.5	3.3	3.8	3.1	2.9	3.3	--	--	.8	--		--	6.8
Nauplii	Sur	54.9	59.3	90.1	28.1	2.4	11.4	--	3.0		--	2.0	4.3	.3	--	14.0
	1m	16.7	19.6	39.7	45.3	15.6	16.8	11.4	8.1	2.0	.5	8.1	.5	--	1.1	3.4
TOTAL		183.6	439.9	948.8	186.5	46.5	61.2	22.2	21.0	10.1	1.0	10.8	5.6	22.8	15.8	43.9

TABLE 2
Tanglewood pond - zooplankton per liter, May 12-27, 1967

	Depth (meters)	*Date*											
		12	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*21*	*23*	*25*	*27*
Rototaria	Sur	831.8	394.6	68.4	74.6	11.5	10.3	1.3	--	2.3	2.3	--	--
	1m	184.7	200.8	99.3	30.8	5.7	4.5	--	--	2.3	--	--	25.0
	2m	97.0	175.7	263.5	41.1	15.9	9.1	1.1	1.1	3.4	--	--	--
Cladocera	Sur	2.3	--	1.1	1.1	1.1	--	--	1.1	17.4	--	--	--
	lm	1.1	2.3	11.4	--	1.1	--	--	2.3	--	--	--	--
	2m	10.3	10.3	8.0	4.6	1.1	1.1	1.1	--	--	--	--	--
Copepoda	Sur	2.3	5.7	2.3	1.1	1.1	--	--	--	--	--	--	1.1
	1m	31.9	12.5	17.1	1.1	1.1	--	--	--	--	--	--	--
	2m	3.4	8.0	8.0	5.7	1.1	4.6	2.4	--	--	--	--	--
Nauplii	Sur	170.5	47.9	9.1	2.3	2.3	1.1	--	--	2.3	--	--	--
	1m	36.5	34.2	33.1	12.5	4.6	1.1	1.1	--	--	--	--	--
	2m	28.5	35.4	19.4	9.1	9.1	11.4	---	--	--	--	1.1	--
TOTAL		1400.3	927.4	540.7	184.0	55.7	43.2	9.0	4.5	27.7	2.3	1.1	26.1

TABLE 3

Rock Eagle - zooplankton per liter, May 2-20, 1967

	Depth (Meters)	Date 2	3	4	5	6	9	11	13	20
Rototaria	Sur	14.2	--	--	1.1	--	.6	.6	5.3	31.9
Cladocera	Sur	--	1.1	--	.6	--	--	--	5.3	33.1
Copepoda	Sur	--	--	--	--	--	--	--	--	2.3
Nauplii	Sur	2.3	--	.6	1.7	--	.6	1.7	10.6	14.8
Ceratium*	Sur	666	348	755	540	264	607	339	210	515

*a phytoflagellate

Tanglewood pond 9 days after treatment failed to show Cladocera nauplii. Copepods reappeared but in small numbers (1.1 per liter).

Benthos

Bottom fauna constitute an important source of food for small fish. Welch (1967) in a study of a Georgia piedmont pond stated that chironomids constituted 90 per cent of the food of bluegills. Ball (1952) estimated that bottom fauna provided 85 per cent of the fish food in a lake where bluegill was the dominant fish. Therefore, a knowledge of the effect of piscicides on fish food organisms is essential especially when reclaimed ponds are to be restocked soon after treatment.

The many factors which effect biomass and species diversity of bottom fauna include nature of the bottom, amount of vegetation, fertility of the water and depth (Kendeigh 1961). Uniform bottom conditions existed in the study areas sampled for benthos excepting the extensive littoral zone of Dekle pond which was excluded from sampling. Species diversity is inversely related to the nutrient level of the water (Ruttner 1963, Patrick 1949).

The organisms present in greatest abundance are listed in Tables 4 through 6. The flotation technique for separating these specific organisms is 98.4 to 99.6 per cent efficient as reported by Whitehouse and Lewis (1966). In Rock Eagle study area, a 1.2 p.p.b. concentration of antimycin was added May 2, 1967 and a 5.0 p.p.b. concentration was applied May 5, 1967. In Dekle pond, the selective and total kill concentrations were added April 12 and April 15, 1967 respectively. Tanglewood pond was treated with a selective kill concentration May 14, 1967. A total kill concentration was applied here May 18, 1967.

Considerable variation in number of organisms per square foot was observed for all taxonomic groups. Similar variations in density per square meter was observed for *Chaoborus* by Carr and Hiltunen (1965). Grzenda *et al.* (1964) found no uniform trend in the numerical abundance of bottom fauna among stations included in a study of pesticide pollution in an Alabama agricultural basin. The tables clearly show no regular change in abundance of bottom organisms. The significance of these data is that none of the organisms observed in samples prior to antimycin application failed to appear in abundance in post-treatment samples. The survival of benthic organisms at concentrations which severly reduce zooplankton may be due to differential resistance or lack of contact with the toxicant.

CONCLUSIONS

1. Plankton populations are severely reduced by antimycin concentrations of 5.0 ppb.
2. Bottom organisms do not disappear following applications of 5.0 ppb antimycin.

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TABLE 4

Dekle pond - Abundance of bottom fauna, April 1967

Organism	*Average Number per square foot*						
	4-11	*4-12*	*4-15*	*4-18*	*4-20*	*4-22*	*5-20*
Tendipedidae *(Chironomus)*	134	103	244	47	68	283	12
Ceratopogonidae	16	88	187	113	111	167	31
Culicidae *(Chaoborus)*	523	27	11	14	6	22	7

TABLE 5

Rock Eagle - Abundance of bottom fauna, May 1967

Organism	*Average Number per square foot*						
	5-2	*5-3*	*5-5*	*5-6*	*5-9*	*5-11*	*5-20*
Tendipedidae *(Chironomus)*	383	401	72	417	141	251	99
Ceratopogonidae	18	9	55	76	26	18	4
Culicidae *(Chaoborus)*	12	7	21	47	11	4	19

TABLE 6

Tanglewood pond - Abundance of bottom fauna, April 16-24, 1967

Organism	Average Number per square foot					
	5-16	*5-17*	*5-18*	*5-19*	*5-23*	*5-24*
Tendipedidae *(Chironomus)*	119	71	95	157	28	71
Ceratopogonidae	36	19	36	26	77	11
Culicidae *(Chaoborus)*	36	30	41	24	15	14

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