UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

WATER QUALITY IN THE CONSERVATION AREAS OF THE CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT, 1970-72

By

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Open-file report

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ABSTRACT

Selected chemical indicators of water quality in and near the conservation areas in southern Florida in 1970-72 varied with location and season. Dissolved solids generally were highest in the north and northeast where averages ranged from 471 to 641 mg/l (milligrams per liter), and lowest in the south and west where averages ranged from 172 to 387 mg/l. Pesticides showed a similar distribution trend. The DDT family (the most commonly detected pesticide) averaged, 192 µg/kg (micrograms per kilograms) in bottom sediments in the north of the areas compared with 13.8 µg/kg in the south. DDT averaged 723 µg/kg in centrarchid fish (bass and sunfish) at the north end of Area 1, 264 µg/kg at the south end of Area 1, 230 µg/kg in Area 2, and 56 µg/kg in Area 3. Dieldrin (5.7 to 130 µg/kg) and toxaphene (2,200 to 5,000 µg/kg) were also in high concentrations in fish at the north end of Area 1 and in Area 2. Concentrations of polychlorinated biphenyls (PCB's) were highest (1,300 and 1,900 µg/kg) in bottom sediment at two stations in Area 2. Concentrations of nitrogen and phosphorus varied more with season or water level than with location. They were highest in June 1971, at the end of a drought; average values were 2.6 mg/l inorganic N (compared with 0.13 to 0.48 mg/l at other times), 4.0 mg/l organic N (compared with 0.8 to 2.5 mg/l at other times), and 0.05 mg/l as P (compared with 0.01 to 0.04 mg/l at other times).

INTRODUCTION

The water conservation areas of the Central and Southern Florida Flood Control Project cover about 1,345 square miles. Most of the areas are everglades marsh. They are bounded to the north and northeast by agricultural land, to the south and southwest by mostly undeveloped wetlands and to the east by partly drained land that is becoming increasingly agricultural and urban. As a result of agricultural and urban expansion water quality of the areas is subject to increasing deterioration.

This study was in cooperation with the Central and Southern Florida Flood Control District to provide background information on seasonal and spatial changes in water quality in the conservation areas.

Purpose and Scope

The purpose of the investigation was to make a qualitative assessment of existing chemical conditions of the water in the conservation areas during high-and low-water periods, and to document where water quality is affected by man's activities.

The scope of the investigation includes the collection and interpretation of chemical data at stations in and near the conservation areas. I collected data during wet and dry seasons in 1970-1972, and evaluated long-term data for several selected stations.

Sampling Stations

The locations of the sampling stations are shown in Figure 1. The kinds of data collected are given in Table 1.

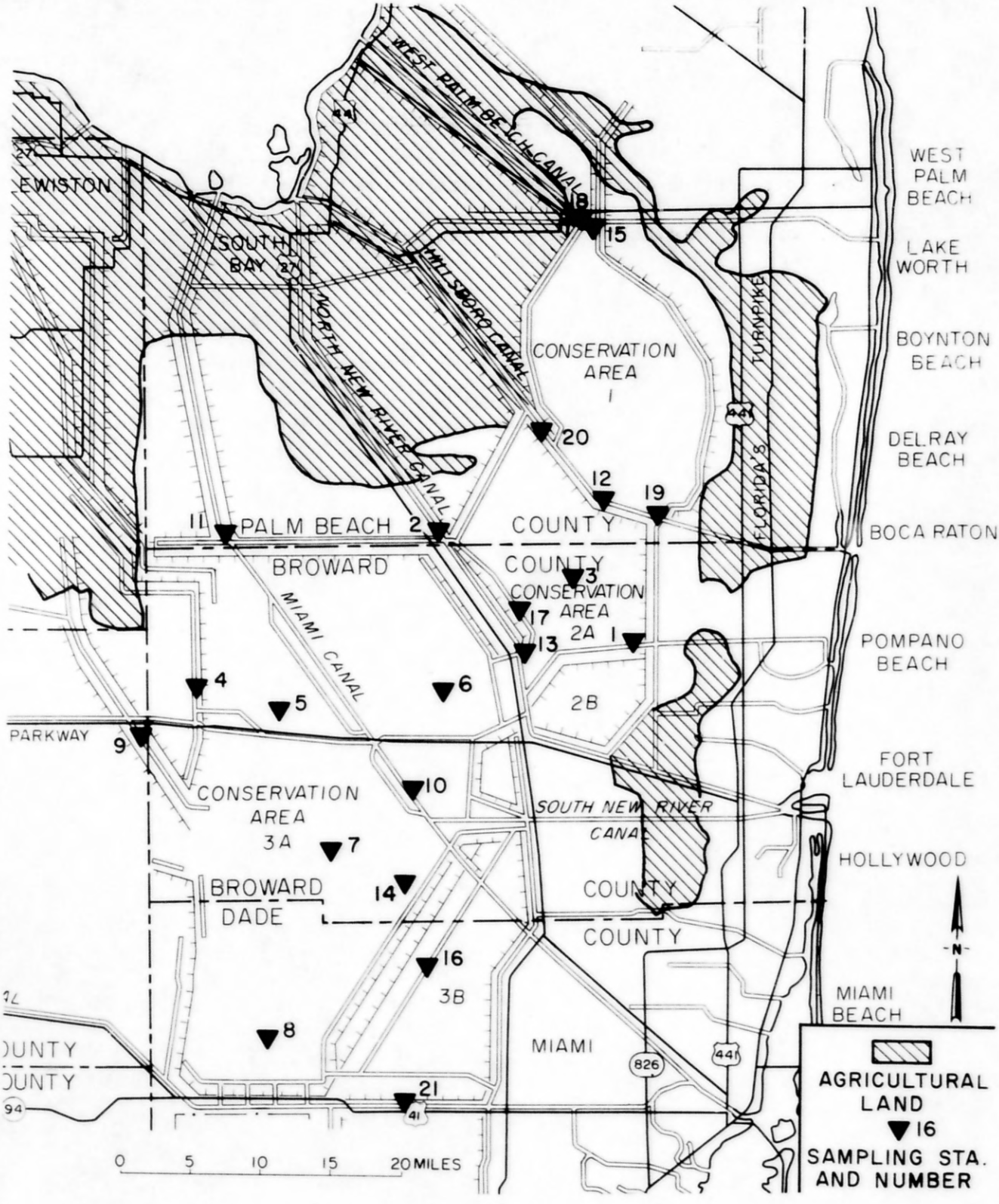

Figure 1.--Location of water-quality sampling stations in the conservation areas and delineation of principal agricultural areas in southeast Florida.

Table 1.--Station names, locations, and type of data collected.

Station Number	Station Name	U.S.G.S. Station No. or Coordinates	Water Quality 1970-72	Long-term Water Quality	Pesticides in water or Sediment	Pesticides in Fish 1/
1	L-35B Borrow Canal in Conservation Area 2	26°13'24" 80°21'18"	x		x	x
2	North New River Canal abv. S-7	26°20'00" 80°32'05"	x		x	
3	Everglades No. 2-17 in Conservation Area 2	2846.42 26°16'50" 80°25'10"	x		x	
4	L-28 Borrow Canal abv. S-140	26°12'40" 80°49'40"	x		x	
5	Corps of Engineers Gage 3-2, Conservation Area 3	26°10'23" 80°44'26"	x			
6	Corps of Engineers Gage 3-3, Conservation Area 3	26°11'02" 80°31'57"	x			
7	Corps of Engineers Gage 3-4, Conservation Area 3	25°59'51" 80°40'12"	x		x	
8	Corps of Engineers Gage 3-28, Conservation Area 3	2890.43 25°48'52" 80°43'12"	x			
9	Canal at Levee 28 Interceptor	26°13'00" 80°54'30"	x		x	
10	C-123 at Old Miami Canal	26°16'30" 80°43'58"	x		x	
11	Miami Canal north of S-8	26°21'34" 80°48'03"	x		x	
12	Hillsboro Canal 1 mile West of S-10	26°25'17" 80°24'20"	x			x
13	Structure 11C at Levee 38E	26°13'45" 80°27'45"	x		x	x
14	Conservation Area 3 about 1 mile west of Levee 67A.	25°56'28" 80°35'28"	x			x
15	Conservation Area 1 off L-40 south of S-5A.	26°41'00" 80°22'14"				x

Table 1.--Station names, locations, and type of data collected. (Continued.)

Station Number	Station Name	U.S.G.S. Station No. or Coordinates	Water Quality 1970-72	Long-term Water Quality	Pesticides in water or Sediment	Pesticides in Fish 1/
16	Conservation Area 3 off Levee 67C	25°56'37" 80°33'20"				x
17	Canal off Levee 38E about 4 miles north of S-11C	26°17'00" 80°28'30"				x
18	West Palm Beach canal above S-5A	2-2784.50 26°41'05" 80°22'15"		x	x	
19	Hillsboro Canal above S-39	2-2813.00 26°21'20" 80°17'58"		x		
20	Hillsboro Canal above S-6	2-2812.00 26°28'20" 80°26'45.1"		x		
21	Tamiami Canal at Bridge 45	2-2890.60 25°45'40" 80°37'40"		x		

1/ Location of fish sample stations is approximate. Fish were usually collected over several miles along a canal.

Methods

Water samples were collected several inches below the water surface. Samples for analyses of nitrogen and phosphorus, were preserved with $HgCl_2$ or were analyzed within a few hours of collection. Samples for dissolved trace metal analyses were filtered (0.45 micrometer filter) and treated with HNO_3; those for total recoverable metals were not filtered and were treated with HNO_3. Samples for herbicide analysis preserved with H_2SO_4.

Analyses for common ions (dissolved solids), trace metals, nitrogen, and phosphorus were made at the Geological Survey laboratory in Ocala, Florida in accordance with currently recommended procedures (Michael Beard, written commun., 1969). Samples collected in March and September 1971 were analyzed for ammonia, nitrite, nitrate, and total ortho plus acid hydrolyzable phosphorus using a four-channel auto analyzer in the field (Freiberger, 1972).

Analyses of pesticides were made at the Geological Survey laboratory in Washington, D.C. following the methods described by Lamar, Goerlitz, and Law (1965) and Goerlitz and Lamar (1967). Bottom sediments and fish were homogenized prior to analysis.

Acknowledgment

Biologists of the Central and Southern Florida Flood Control District collected the fish for pesticide analyses.

WATER STORAGE

The conservation areas are large, shallow reservoirs filled by rainfall and by water from canals. During periods of heavy rainfall excess surface water on adjacent land is pumped or flows by gravity into the areas. During dry periods water leaves the areas by seepage through the levees, evapotranspiration, and regulated releases through canals.

Water quality in the conservation areas is related to water storage fluctuations. During the wet season, as water storage increases, water quality is affected by drainage of agricultural land and by rainfall. Water drained off agricultural land is usually of poor quality because of high concentrations of nutrients, dissolved solids, pesticides, and other pollutants. Rainfall, however, tends to dilute pollutants and improve water quality. During the dry season, as water level drops, water quality is affected by ground water, which often has high concentrations of dissolved solids.

Water storage was generally above average in 1970, but decreased through the winter of 1971 to nearly record low conditions in the spring and early summer. The dates water was sampled are indicated on figure 2 to show the quality of water in storage at those times.

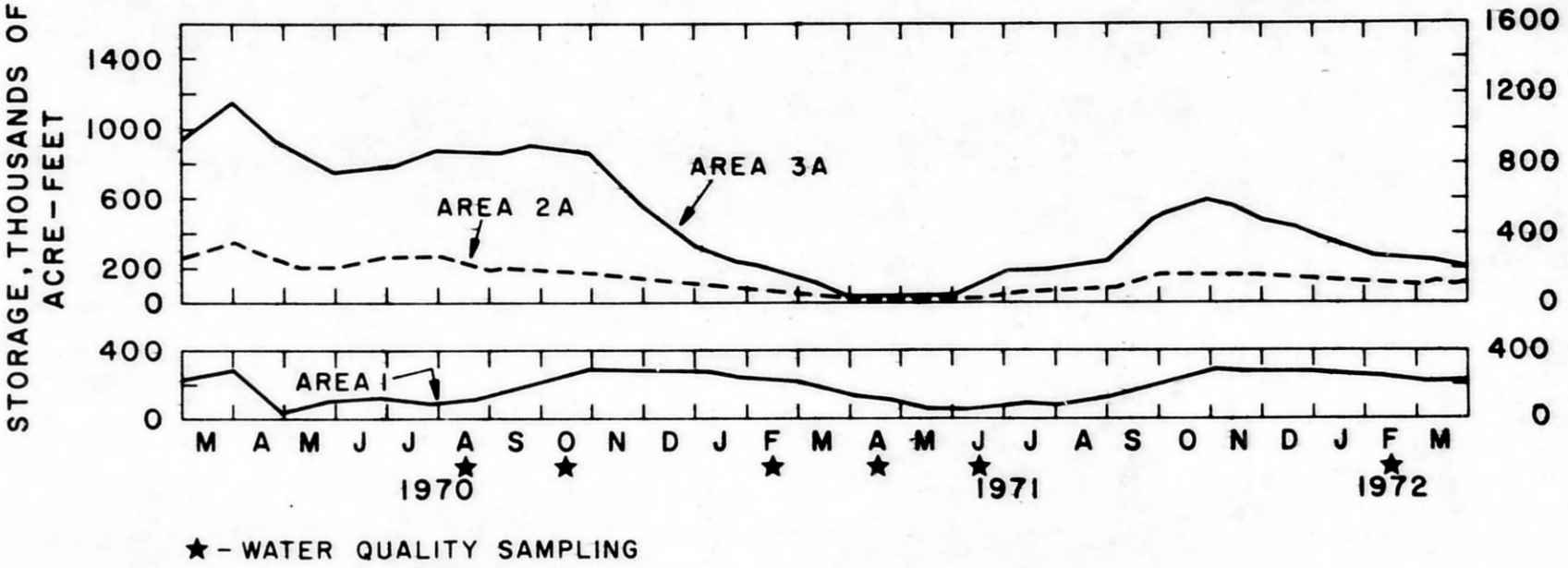

Figure 2.--Water storage in the conservation areas and water-quality sampling periods, 1970-72.

SELECTED CHEMICAL CHARACTERISTICS

Dissolved Solids

Average concentrations of dissolved solids were higher in the northern part of the conservation areas than in the southern part (fig. 3). Samples of water from long-term stations (1950-71) 18, 19, and 20 in the northern part had average concentrations that exceeded 470 mgl (milligram per liter), while those from station 21 in the south averaged 205 mg/l (table 2). In 1970-72, average dissolved solids content in water samples from six stations north of Conservation Area 3A exceeded 500 mg/l. At all stations to the south, except station 10 on the Miami Canal, dissolved solids averaged less than 300 mg/l. Average concentrations at 4 marsh stations (5, 7, 8, and 14) in Area 3A ranged from 172 to 289 mg/l compared with 641 mg/l at a marsh station (3) in Area 2A (see table 7A).

The southward decrease in concentrations of dissolved solids in surface water is coincidental with the southward decrease in concentrations of dissolved solids in ground water and the increasing remoteness from agriculture. During low water periods a relatively large part of canal water comes from the ground-water contributions. Ground water is more saline in the northern Everglades than in the southern part (Parker and others, 1955). During high-water periods agricultural land is drained by pumps which discharge water with high dissolved solids into canals in the northern Everglades.

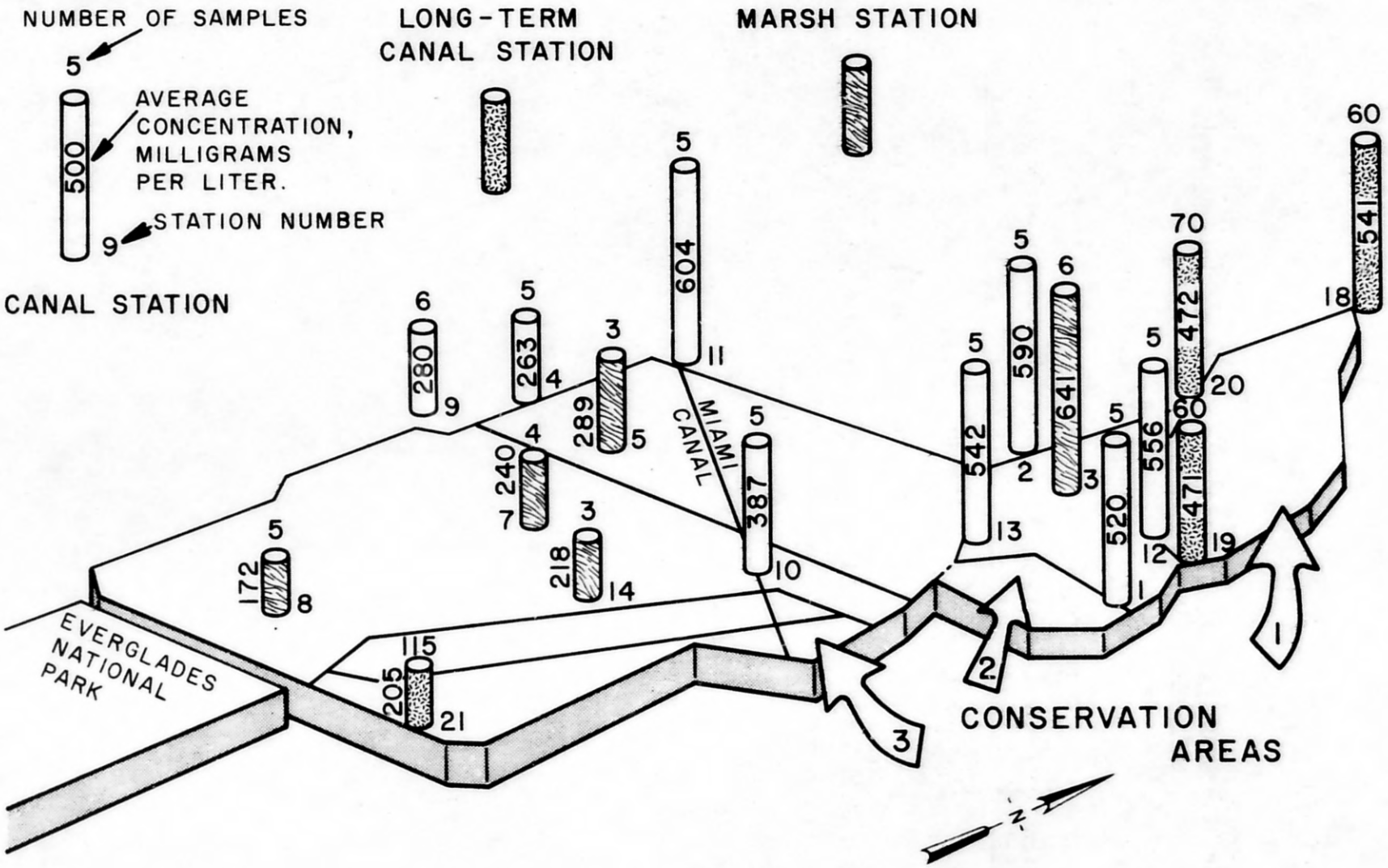

Figure 3.--Average concentrations of dissolved solids at 13 stations in 1970-72 and at 4 long-term stations.

Table 2.--Long-term data on dissolved solids at stations near and remote from agricultural land.

Near Agricultural Land

Northern Part of Conservation Areas

Station Number	Average mg/l	Standard error	No. of samples	Range mg/l	Time period
18	541	39	60	1,220-114	1959-71
19	471	27	60	953-106	1957-70
20	472	19	70	740-262	1950-68

Remote from Agricultural Land

Southern Part of Conservation Areas

21	205	7.6	115	402- 77	1950-65, 69

Nitrogen

Long-term data (1950-71) indicate that there were no significant differences between concentrations of nitrate at stations 18, 19, and 20 in the northern conservation areas and station 21 in the south (table 3). Average concentrations during this period ranged from 0.2 to 0.4 mg/l as N.

Nitrate, nitrite, ammonia and organic nitrogen, were measured in 1970-72 (table 4). Most nitrogen was organic; average concentrations ranged from 0.8 mg/l in October 1970 to 4.0 mg/l in June 1971. Most inorganic nitrogen was ammonia. It was the most abundant form in 68 percent of the samples. Average concentrations ranged from 0.05 to 0.45 mg/l-N; the averages were highest at marsh stations 2 and 7 in June 1971. Nitrate was the most abundant form of inorganic nitrogen in 32 percent of the samples. Average concentrations ranged from 0.00 to 2.1 mg/l-N, but all were below 0.5 mg/l except in June 1971.

Concentrations of all forms of nitrogen were maximal in June 1971, at the end of the spring drought. Presumably the high values occurred at least partly as a result of the first summer rains flushing nutrients into the water. Concentrations of both organic and inorganic nitrogen remained higher after the 1971 drought (June 1971 - February 1972) than prior to the drought (August 1970 - April 1971).

Table 3.--Long term data on nitrate as N at four stations near the conservation areas.

Northern Stations

Station	Average mg/l	Standard error	No. of samples	Time of Record
18	0.4	0.07	60	1959-71
19	.2	.05	63	1957-70
20	.4	.05	72	1950-68

Southern Station

21	.3	.05	111	1950-65, 69

Table 4.--Average concentrations of organic and inorganic nitrogen as N (mg/l) in the conservation areas, 1970-72.

	Aug 70	Oct 70	Feb 71	Mar 71 /1	Apr 71	Jun 71	Sept 71 /1	Feb 72
Organic N	0.9	0.8	0.9	--	--	4.0	--	2.5
NO_3	.00	.16	.00	0.16	0.23	2.08	0.42	.10
NO_2	.02	.01	.01	.005	.02	.07	.01	.01
NH_4	.07	.08	.12	.14	.34	.45	.05	.14
Inorganic-N (total)	.09	.25	.13	.31	.59	2.60	.48	.25
No. of samples:								
Dominant forms of inorganic-N (NO_3)	0	2	0	5	1	7	5	5
(NO_2)	0	0	1	0	0	0	0	0
(NH_4)	10	3	11	6	2	6	9	8
Total No. of samples	10	5	12	11	3	13	14	13

/1 Auto analyzer

Phosphorus

Average concentrations of total phosphorus as P ranged from 0.01 to 0.05 mg/l (table 5). Concentrations were highest in June 1971 and ranged from 0.02 to 0.22 mg/l. Values exceeded 0.07 mg/l only at stations 2 and 13 (North New River Canal).

The average concentrations of total ortho plus acid hydrolyzable phosphorus was 0.01 mg/l in March and September 1971 (table 5). For comparison, the average concentration east of the conservation areas but inland from the urban coastal areas was 0.07 mg/l (0.22 mg/l as $P-PO_4$) in March 1971 (Freiberger, 1972).

Table 5.--Concentrations (mg/l) of total phosphorus as P and ortho plus acid hydrolyzable phosphorus as P (*) in the conservation areas, 1970-72.

Stations	Aug 1970	Oct 1970	* Mar 1971	Apr 1971	Jun 1971	* Sept 1971	Feb 1972
1	0.01	--	0.01	0.03	0.05	0.00	0.01
2	--	0.02	.01	--	.17	.04	.02
3	--	.02	.00	--	.02	.02	.01
4	.02	.07	.01	--	.02	.03	.02
5	--	--	--	--	.02	.00	.02
6	--	--	--	--	--	.01	--
7	--	--	--	--	.02	.00	.01
8	--	--	.01	--	.02	.00	.02
9	.02	.03	.01	--	.02	.03	.02
10	--	--	.00	--	.03	.00	.02
11	--	--	.00	--	.04	.03	.02
12	--	--	.003	.08	.03	.03	.02
13	--	--	.00	--	.22	.01	.01
14	--	.01	.01	.02	.02	.00	.01
Average	.02	.03	.01	.04	.05	.01	.02

Trace Metals

On the 9 dissolved trace metals analyzed in water at 13 stations in and near the conservation areas, concentrations exceeded the standards established in 1969 by the FDAWPC (Florida Department of Air and Water Pollution Control) as criteria for pollution in 3 percent of the samples. Average concentrations of all metals were below the standards (tables 6 and 7). Copper, zinc, and lead exceeded the standards at either stations 10 or 12, in August 1970. Iron exceeded the standard at stations 4 and 5 in August 1970, station 8 in February 1971, and station 7 in June 1971. Average concentrations of aluminum, chromium, copper, iron, lead and zinc were higher in August 1970 than in October 1970, February 1971, June 1971, and February 1972.

Concentrations of total recoverable metals sampled in February 1972 were below the FDAWPC standards. Average concentrations of total recoverable copper and lead slightly exceeded dissolved values (table 7). The average for total recoverable zinc was slightly less than dissolved zinc, presumably as a result of contamination in the filtering process.

Table 6.--Average, minimum, and maximum concentrations (mg/l) of dissolved trace metals in and near the conservations areas, 1970-72.

	Number of samples	Overall Average	Average for August 1970	Minimum	Maximum	FDAWPC Standards	Site and month with highest concentration	
							Site	Month
Aluminum	18	0.07	0.14	0.00	0.37	--	12	August
Arsenic	54	.01	.01	.00	.03	0.05	3, 13	February
Chromium^{+6}	55	.00	.01	.00	.02	.05	4, 11	August
Copper	54	.05	.21	.00	2.00	.50	12	August
Iron	53	.13	.18	.01	.54	.30	5	August
Lead	53	.008	.03	.00	.15	.05	10	August
Manganese	53	.02	.02	.00	.12	--	3	February
Zinc	53	.13	.48	.01	2.2	1.0	10	August

Table 7.--Total recoverable trace metals (mg/l), TRM, sampled in June 1971 for mercury and in February 1972 for the other metals.

	Number of samples	Average TRM	Average for dissolved metals on same date	Range TRM
Chromium	13	0.00	0.00	0.00
Cadmium	13	.00	--	.00 - .01
Copper	13	.01	.00	.00 - .02
Lead	13	.004	.003	.000 - .008
Manganese	13	.02	.02	.00 - .09
Mercury	6	.00	--	.00
Zinc	12	.01	.03	.00 - .02

Pesticides and Related Compounds

Fourteen of 29 water samples contained detectable pesticides (table 8). Concentrations ranged from 0.00 to 2.3 µg/l (micrograms per liter). The herbicides 2,4D; 2,4,5-T; and silvex were the most commonly detected; they were recorded at 6 of 11 stations. Herbicides were found in most of the samples at stations 10, 11, and 13. Insecticides were detected in only three of 29 water samples.

The DDT family was the most commonly detected pesticide in bottom sediments. Concentrations ranged from 0.00 to 1,618 µg/kg (micrograms per kilogram) (table 9). Concentrations tended to be higher in the north, near agricultural land, than in the south (fig. 4). Stations 4, 5, 7, 8, 9 and 10, which are relatively remote from agricultural areas, had an average of 13.8 µg/kg for 20 samples. Stations 1, 2, 3, 11, 13, 18, and 20, which are closer to agricultural land, had an average of 192 µg/kg for 17 samples.

On February 16, 1972, a sample of bottom sediment at station 11 contained 78 µg/kg of silvex. A water sample collected at the same time at station 11 had 2.3 µg/l of silvex.

In addition to pesticides, polychlorinated biphenyls (PCB's) were detected in bottom sediments at stations 1 and 13 in concentrations of up to 1,300 and 1,900 µg/kg, respectively.

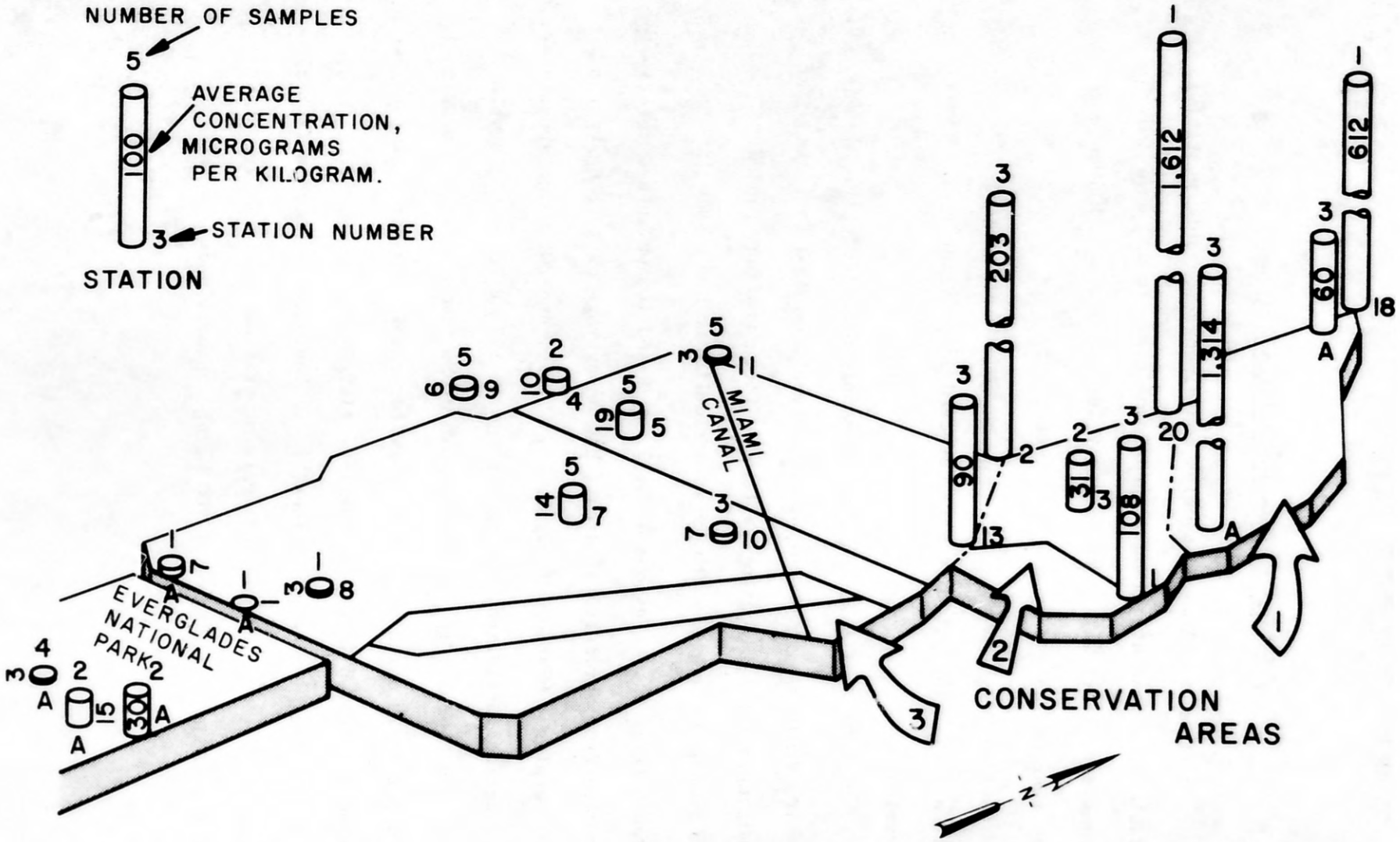

Figure 4.--Concentrations of the DDT family in bottom sediments in the conservation areas and Everglades National Park. Stations marked "A" are from data collected for other studies.

The DDT family was the most commonly detected pesticide in fish; it ranged in concentration from 5.7 to 805+ µg/kg (tables 10-12). Fish from the northern part of the areas contained higher concentrations than fish from the southern part (fig. 5). The DDT family averaged 723 µg/kg in centrarchid fish (bass and sunfish) at the north end of Area 1, 264 µg/kg at the south end of Area 1, 230 µg/kg in Area 2, and 56 µg/kg in Area 3. Average values for this group of fish at several stations in Everglades National Park (1969-70) ranged from 10 to 89 µg/kg (fig. 5).

Dieldrin and toxaphene were also detected in numerous fish samples (tables 13-15). Concentrations of dieldrin were as much as 130 µg/kg. Average concentration was highest at northernmost station 15. Toxaphene concentrations were as much as 5,000 µg/kg and were also highest, on the average, at station 15. Average concentrations of toxaphene exceeded 700 µg/kg at stations 13, 15, and 17.

Concentrations of PCB's in fish ranged from 0 to 260 µg/kg; less than the maximum quantity found in sediment.

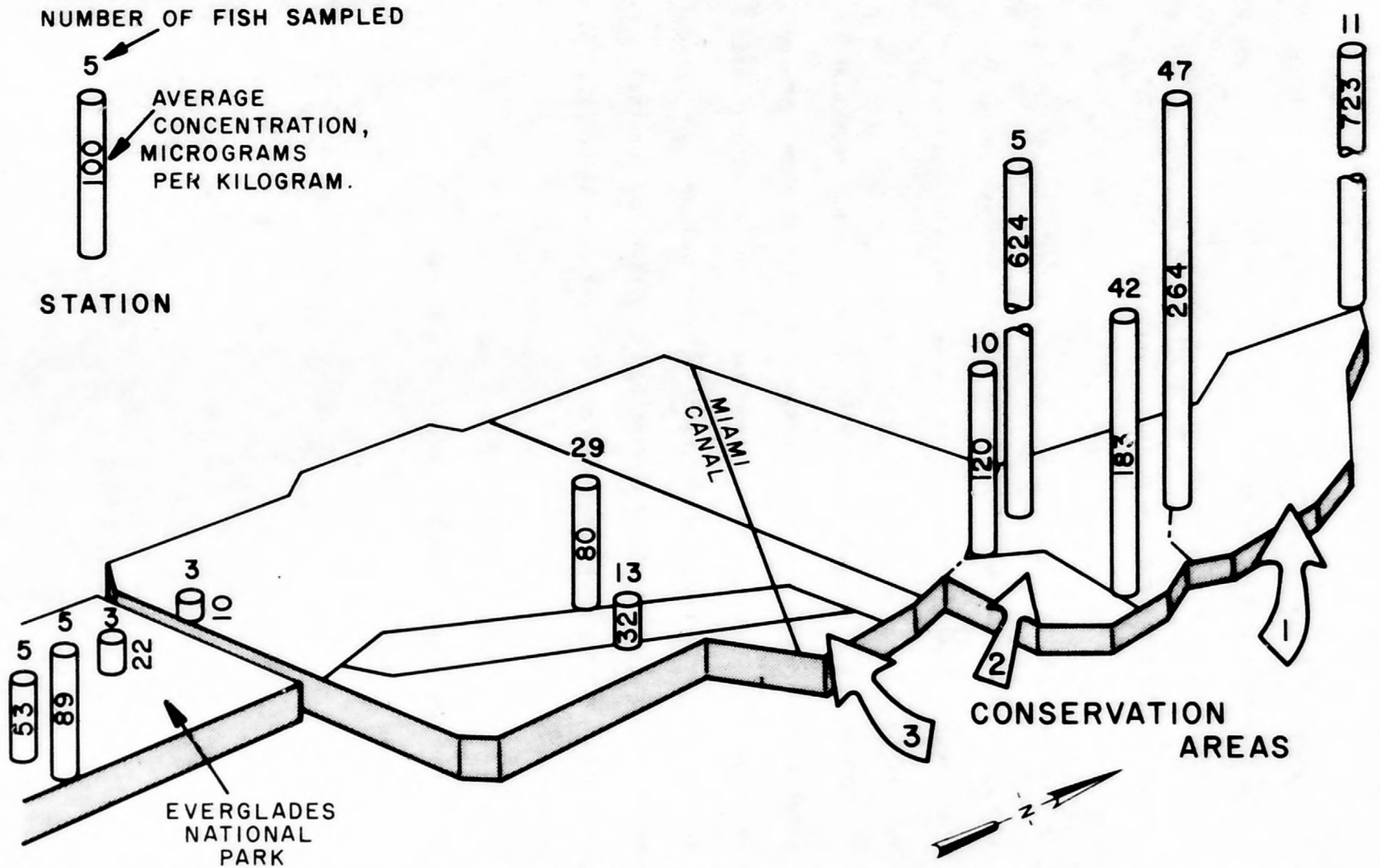

Figure 5.--Average concentrations of the DDT family in centrarchid fish (bass and sunfish) in the conservation areas (1971-1972) and Everglades National Park (1969-70).

Table 7A.--Concentrations of dissolved solids (residue) in mg/l in the conservation areas,

Stations	Aug '70	Oct '70	Feb '71	June '71	Feb '72	Oct '72	Average
1	441	--	660	553	432	--	522
2	--	515	520	460	844	610	590
3*	635	587	694	928	512	490	641
4	282	178	290	338	--	230	263
5*	127	--	--	411	--	330	289
7*	108	--	300	241	310	--	240
8*	143	--	220	183	204	110	172
9	271	280	330	240	386	170	280
10	317	--	360	511	498	240	387
11	730	--	370	586	706	630	604
12	437	--	508	594	780	460	556
13	388	--	580	556	738	450	542
14*	--	210	250	194	--	--	218

* indicates stations in the marsh.

Table 8.--Concentrations of pesticides in water, Conservation Area 3, 1970-72, (ug/l).

Station		Aldrin	DDD	DDE	DDT	total DDT's	Dieldrin	Endrin	Heptachlor	Lindane	2,4D	2,4,5-T	Silvex
11													
	Aug 70	.00	.00	.00	.00	.00	.00	.00	.00	.00	.10	.00	.00
	Feb 71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.03	.01	.01
	Jun 71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	Feb 72	.00	.00	.00	.00	.00	.00	.00	.00	.00	.02	.00	2.30
13													
	Aug 70	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.02
	Feb 71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01
	Jun 71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.09	.13	.00
	Feb 72	.00	.00	.00	.00	.00	.00	.00	.00	.00	.06	.00	.01
12													
	Aug 70	.00	.01	.00	.01	.00	.00	.00	.00	.00	.25	.00	.00
8	Aug 70	.00	.00	.00	.01		.00	.00	.00	.00	.00	.00	.00
4	Aug 70	.00	.00	.00	.01		.00	.00	.00	.00	.00	.00	.00
3													
	Aug 70	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1	Aug 70	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	Feb 71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	Feb 72	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
5													
	Aug 70	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	Feb 71	Dry											
	Jun 71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	Feb 72	.00	.00	.00	.00	.00	.00	.00	.00	.00	.02	.00	.00

Table 8.--(Continued) Concentrations of pesticides in water, Conservation Area 3, 1970-72, (µg/l).

Station	Aldrin	DDD	DDE	DDT	Total DDT's	Dieldrin	Endrin	Heptachlor	Lindane	2,4D	2,4,5T	Silvex
7												
Aug 70	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Feb 71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Jun 71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Feb 72	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00	.00
9												
Aug 70	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Feb 71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00	.05
Jun 71	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Feb 72	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
10												
Aug 70	.00	.00	.00	.00	.00	.00	.00	.00	.00	.04	.00	.00
Jun 71	.00	.00	.00	.00	.00	.00	.00	.00	.00	TR	.01	TR
Feb 72	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01

TR = trace

Chlordane and polychlorinated biphenels (PCB's) were analyzed for in February 1972 at stations 1, 5, 7, 9, 11, and 13. None were detected.

Table 9.--Pesticides in bottom sediments in the conservation areas, 1970-1972 (ug/kg).

Station No.	Aldrin	DDD	DDE	DDT	Dieldrin	Endrin	Hepta-chlor	Lindane	2,4D	2,4,5-T	Silvex	Chlor-dane	PCB
1 Aug 70	*	*	*	0.0	*	*	*	*	*	*	*	*	76
Feb 71	.0	120	57	.0	.0	.0	.0	.0	--	--	--	--	--
Jun 71	.0	99	49	.0	.0	.0	.0	.0	--	--	--	--	--
Feb 72	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	1300
2 Feb 71	.0	200	57	.0	.0	.0	.0	.0	--	--	--	--	--
Oct 72	.0	94	55	.4	.0	.0	.0	.0	--	--	--	50	40
3 Aug 70	.0	16	17	.0	.0	.0	.0	.0	--	--	--	--	--
Oct 72	.0	17	13	0	TR	.0	.0	.0	--	--	--	0	0
4 Aug 70	.0	.0	.0	.0	.0	.0	.0	.0	--	--	--	--	--
Oct 72	.0	.6	20	0	.0	.0	.0	.0	--	--	--	0	TR
5 Aug 70	.0	1.9	1.2	.0	.0	.0	.0	.0	--	--	--	--	--
Feb 71	.0	53	19	.0	.0	.0	.0	.0	--	--	--	--	--
Jun 71	.0	3.4	2.9	.5	.0	.0	.0	.0	.0	.0	.0	--	--
Feb 72	.0	7.4	5.5	.0	.0	.0	.0	.0	.0	.0	.0	0	0
Oct 72	.0	.4	.6	0	.0	.0	.0	.0	--	--	--	0	0
7 Aug 70	.0	.0	.0	.0	.0	.0	.0	.0	--	--	--	--	--
Feb 71	.0	28	20	.0	.0	.0	.0	.0	--	--	--	--	--
Jun 71	.0	.7	1.1	1.2	.0	.0	.0	.0	.0	.0	.0	--	--
Feb 72	.0	8.4	7.5	.0	.4	.0	.0	.0	.0	.0	.0	0	0

* PCB interference
TR = trace

Table 9.--Continued-Pesticides in bottom sediments in the conservation areas, 1970-1972 in micrograms per kilogr

Station No.	Aldrin	DDD	DDE	DDT	Dieldrin	Endrin	Hepta-chlor	Lindane	2,4D	2,4,5-T	Silvex	Chlor-dane	PCB
8 Oct 72	.0	1.5	1.3	0	.1	.0	.0	.0	--	--	--	0	0
9 Aug 70	.0	6.2	1.2	.0	.0	.0	.0	.0	--	--	--	--	--
Feb 71	.0	.4	.1	.0	.0	.0	.0	.0	--	--	--	--	--
Jun 71	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	--	--
Feb 72	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	0
Oct 72	.0	0.6	.20	.0	.0	.0	.0	.0	--	--	--	0	TR
10 Jun 71	.0	25	11	1.4	.0	.0	.0	.0	--	--	--	--	--
Feb 72	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	0
Oct 72	.0	23	2.6	.0	.8	.0	.0	.0	--	--	--	0	0
11 Aug 70	.0	5.9	1.8	.0	.0	.0	.0	.0	--	--	--	--	--
Feb 71	.0	.9	.4	.0	.0	.0	.0	.0	--	--	--	--	--
Jun 71	.0	.3	.0	.0	.1	.0	.0	.0	.0	.0	.0	--	--
Feb 72	.0	2.4	3.1	.0	.0	.0	.0	.0	.0	.0	78	0	0
Oct 72	.0	.0	2.0	.0	.0	.0	.0	.0	--	--	--	--	400
13 Aug 70	*	*	*	*	.0	*	*	*	.0	.0	TR	--	1100
Feb 71	*	*	*	*	.0	*	*	*	--	--	--	--	400
Jun 71	.0	35	15	.0	.0	.0	.0	.0	.0	.0	.0	--	75
Feb 72	.0	29	23	3.3	.0	.0	.0	.0	.2	.0	.2	0	1900
Oct 72	.0	49	52	1.7	.1	.0	.0	.0	--	--	--	0	TR
18 Oct 72	.0	500	100	12	1.0	.0	.0	.0	--	--	--	0	0
20 Oct 72	.0	870	740	8.1	17	.0	.0	.0	--	--	--	0	100

* PCB interference
TR = trace

Table 10.--Concentrations of the DDT family in fish from Conservation Area 1 in 1971-72.

Station	Species	Number	Date	Concentration ug/kg	Average for sp.
15	largemouth bass	5	28 June 71	800	803
	largemouth bass	1	12-18 Jan 72	805+	
	redear sunfish	5	28 June 71	630	
	gizzard shad		12-18 Jan 72	390	
	Average DDT family at Station 15 = 656 + µg/kg.				
12	largemouth bass	1	16 Feb 71	244	227
	"	5	"	100	
	"	1	"	117	
	"	1	"	199	
	"	1	"	300	
	"	1	"	141	
	"	5	28 Jun 71	510	
	"	5	18 Jan 72	208+	
	blue gill	6	16 Feb 71	750	445
	"	5	18 Jan 72	140	
	redear sunfish	5	16 Feb 71	64	143
	"	5	18 Jan 72	222	
	spotted sunfish	6	16 Feb 71	112	
	lake chubsucker	5	16 Feb 71	10.2	200
	"	5	28 Jun 71	390	
	Average DDT family at Station 12 = 234 + µg/kg.				

+DDT not detected but possibly obscured by toxaphene.

Table 11.--Concentrations of the DDT family in fish from Conservation Area 2 in 1971-72.

Stations	Species	Number	Date	Concentration--ug/kg	Average for sp.
1	largemouth bass	6	16 Feb 71	250	
	"	5	"	148	
	"	1	"	34.5	
	"	5	30 Jun 71	64	107
	"	5	12 Jan 72	39.6	
	redear sunfish	5	16 Feb 71	169	
	lake chubsucker	5	16 Feb 71	22.4	
	"	5	30 Jun 71	27.2	18.5
	"	5	12 Jan 72	6.0	
	redear sunfish	5	30 Jun 71	450	
	American eel	5	30 Jun 71	10.3	
	Average DDT family at Station 1 = 111 ug/kg.				
13	largemouth bass	5	30 Jun 71	178	
	redear sunfish	5	30 Jun 71	61	
	Average DDT family at Station 13 = 120 ug/kg.				
17	largemouth bass	5	12 Jan 72	624	712
	white catfish	5	"	800+	
	Average DDT family at Station 17 = 702+				

+DDT obscured.

Table 12--Concentrations of the DDT family in fish from Conservation Area 3 in 1971-72

Station	Species	Number	Date	Concentrations ug/kg	Average for sp. ug/kg
14	largemouth bass	2	19 Feb 71	10.2	83
	"	5	28 Jun 71	20	
	"	5	10 Jan 72	218	
	lake chubsucker	2	19 Feb 71	8.3	7.1
	"	5	28 Jun 71	6.0	
	golden shinner	2	19 Feb 71	5.7	10.1
	"	9	10 Jan 72	14.6	
	redeared sunfish	2	19 Feb 71	43	
	bluegill	5	28 Jun 71	35	43
	"	5	10 Jan 72	50	
	gizzard shad	5	28 Jun 71	5.9	-
	black crappie	5	10 Jan 72	40.5	-
	Average for station 14 = 38 µg/kg.				
16	largemouth bass	5	10 Jan 72	28	
	bluegill	4	"	31	
	Warmouth	4	"	37	
	Average for station 16 = 32 µg/kg.				

Table 13.--Concentrations of pesticides and related compounds other than the DDT family in fish from Conservation Area 1, 1971-72 (No aldrin, endrin, heptachlor, lindane or chlordane detected.)

Station	Species	Number	Date	Concentration ug/kg Dieldrin	Toxaphene	PCB
15	largemouth bass	5	28 Jun 71	130	5,000	50
	"	1	12-18 Jan 72	29	2,200	15
	redear sunfish	5	28 Jun 71	5.7	5,000	40
	gizzard shad		12-18 Jan 72	9.9	2,700	20
12	largemouth bass	1	16 Feb 71	0	--	--
	"	5	"	0	--	--
	"	1	"	0	--	--
	"	1	"	0	--	--
	"	1	"	0	--	--
	"	1	"	0	--	--
	"	5	28 Jun 71	4.6	500	40
	"	5	18 Jan 72	2.6	150	50
	bluegill	6	16 Feb 71	0	--	--
	"	5	18 Jan 72	1.1	40	30
	redear sunfish	5	16 Feb 71	0	--	--
	"	5	18 Jan 72	2.5	150	35
	spotted sunfish	6	16 Feb 71	0	--	--
	lake chubsucker	5	16 Feb 71	0	--	--
	"	5	28 Jun 71	6.0	.0	40

Table 14.--Concentrations of pesticides and related compounds (other than the DDT family) in Conservation Area 2, 1971-72.

Station	Species	Number	Date	Concentration ug/kg Dieldrin	Toxaphene	PCB
1	largemouth bass	6	16 Feb 71	.0	--	--
	"	5	"	.0	--	--
	"	1	"	.0	--	--
	"	5	30 Jun 71	.6	300	40
	"	5	12 Jan 72	1.4	30	15
	redear sunfish	7	16 Feb 71	.0	--	--
	lake chubsucker	5	16 Feb 71	.0	--	--
	"	5	30 Jun 71	.0	.0	.0
	"	5	12 Jan 72	.3	5	10
	redear sunfish	5	30 Jun 71	2.3	50	.0
	American eel	5	30 Jun 71	1.3	150	25
13	largemouth bass	5	30 Jun 71	3.4	5,000	40
	redear sunfish	5	30 Jun 71	2.1	1,300	50
17	largemouth bass	5	12 Jan 72	6.3	450	70
	white catfish	5	12 Jan 72	16	1,100	260

Table 15.--Concentrations of pesticides and related compounds (other than the DDT family) in Conservation Area 3, 1971-72.

Station	Species	Number	Date	Concentration ug/kg Dieldrin	Toxaphene	PCB
14	largemouth bass	2	19 Feb 71	0	--	--
	"	5	28 Jun 71	(1)	20	100
	"	5	10 Jan 72	2.1	80	50
	lake chubsucker	2	19 Feb 71	0	--	--
	"	5	28 Jun 71	(1)	70	30
	golden shiner		19 Feb 71	0	--	--
	"	9	10 Jan 72	.2	10	4
	redear sunfish		19 Feb 71	0	--	--
	bluegill	5	28 Jun 71	2.0	25	30
	"	5	10 Jan 72	3.3	30	12
	gizzard shad	5	28 Jun 71	1.0	20	35
	black crappie	5	10 Jan 72	1.0	10	15
16	largemouth bass	5	10 Jan 72	1.1	30	10
	bluegill	4	"	1.0	30	10
	warmouth	4	"	1.8	10	7

(1) unable to determine dieldrin due to interferences

Table 16 .--Scientific names of fish collected for pesticide analysis.

Gizzard shad	*Dorosoma cepedianum*
Goldenshiner	*Notemigonus crysoleucas*
Lake chubsucker	*Erimyzon sucetta*
White catfish	*Ictalurus catus*
American eel	*Anguilla rostrata*
Warmouth	*Chaenobryttus gulosus*
Bluegill	*Lepomis macrocherus*
Redear sunfish	*L. microlophus*
Spotted sunfish	*L. punctatus*
Black croppie	*Pomoxis nigromaculatus*
Largemouth bass	*Micropterus salmonides*

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