Summary of Mercury Levels in Lakes on the Churchill-Rat-Burntwood and Nelson River Systems from 1970 to 1979

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ABSTRACT

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The levels of mercury in commercially important fish appear to have increased along the Churchill-Rat-Burntwood River System from the early 1970's to 1978 and 1979. There is no clear indication if the mercury levels are still changing except for Rat Lake, in which they have decreased from 1978 to 1979, and for Southern Indian Lake where the mercury levels and changes in the fish vary according to area.

In Southern Indian Lake the highest mercury levels are found in Area 1, the South Bay area, for Northern pike, walleye, and lake whitefish and the next highest mercury levels in the fish are in Area 5 at the extreme north end of the lake. In 1979 compared to 1978 the mercury levels have decreased in the walleye from Area 1 and in the whitefish from Area 4, but appear to have remained the same for the other areas and species tested.

Key words: mercury compounds; mercury trends; mercury-weight relationships; freshwater fish; pike, Northern; walleye; whitefish, lake.

RESUME

McGregor, G.W.G. 1980. Summary of mercury levels in lakes on the Churchill-Rat-Burntwood and Nelson River Systems from 1970 to 1979. Can. Data Rep. Fish. Aquat. Sci. 195: iv + 16 p.

Chez le poisson d'importance commerciale des rivières Churchill, Rat et Burntwood, les concentrations de mercure semblent avoir augmenté depuis le début des années 70 jusqu'en 1978 et 1979. Rien ne montre clairement que ces concentrations varient toujours, sauf dans le Rat Lake, où elles ont diminué depuis 1978, et le Southern Indian Lake où elles varient selon le secteur et l'espèce de poisson.

Dans ce dernier lac, c'est dans le secteur 1 ou South Bay qu'on trouve le plus de mercure, chez le grand brochet, le doré et le grand corégone, puis chez le poisson du secteur 5, à l'extrême nord du lac. Comparativement à celles de 1978, les concentrations ont diminué en 1979 chez le doré du secteur 1 et chez le corégone du secteur 4, mais ne semblent pas avoir varié ailleurs ni chez les autres espèces.

Mots-clés: composés mercuriels; tendances du mercure; rapports avec le poids; poissons d'eau douce; grand brochet; doré; grand corégone.

INTRODUCTION

There has been a considerable quantity of mercury data for fish from the Churchill-Rat-Burntwood-Nelson River Systems accumulated since 1970, but interpretation of the data in regards to trends is still quite tenuous due to small sample sizes, no follow up sampling and poorly defined sampling areas. Nevertheless, after an accelerated mercury sampling program started in 1978 and continuing in 1979, some patterns are becoming apparent.

The Southern Indian Lake situation is of particular interest since it is the largest commercial fishery in Northern Manitoba, and it has been affected by a flooding program carried out by Manitoba Hydro where the level of Southern Indian Lake was raised 3 m in order to divert water from the Churchill River into the Nelson River through the Rat and Burntwood River Systems to generate hydro electric power. It has been noted (Bodaly and Hecky 1980) that there have been post-impoundment increases in the mercury levels in the fish from Southern Indian Lake which they have suggested are a result of shoreline erosion of the soil types in the area, which once in suspension can release mercury to the water where it may be readily bioaccumulated up the food chain.

The species studied were walleye or yellow pickerel *(Stizostedion vitreum)*, Northern pike *(Esox lucius)*, lake whitefish *(Coregonus clupeaformis)* and longnose sucker *(Catostomus catostomus)*.

This report presents all mercury data for the area, and attempts to establish the current trends of the mercury levels in the fish up until the end of 1979.

METHODS

Samples from commercial shipments are intended to estimate the mean mercury content of the fish in the shipment. One sample consists of a minimum of five fish and 15 pounds withdrawn at random from a lot. The fish were weighed and measured, and a homogeneous slurry was prepared by grinding together one fillet from each fish in the sample. The slurry was then sampled in triplicate, and the results of the three mercury analyses checked to ensure precision, and averaged to provide the reported mercury content.

Samples from lake surveys are designed to estimate the baseline mercury levels in a given species and area of a lake. Individual fish were selected from test nets set on a lake and ideally should have represented a reasonable distribution of age classes and size range. The samples were weighed and measured, and a portion of the edible muscle was removed from each fish. Each portion was sampled once and analysed for mercury, except for every sixth portion which was sampled in duplicate, and for which the two results were checked for precision and averaged as a quality control feature for the data.

All mercury determinations were conducted using flameless cold vapour atomic absorption (Hendzel and Jamieson 1976). Quality control of the data consisted of inclusion of known check samples in each batch of samples run, and participation in a 25 laboratory international check sample program co-ordinated by M. Hendzel, who also supervises the Industry Services Branch mercury analysis laboratory.

Regression analyses of ppm on weight were conducted on all the individual fish data. Since some of the data from Southern Indian Lake were for very small and immature fish, it was necessary to transform all weight and ppm data to log-log values to normalize the distribution about the regression line for the entire size range of fish in the survey samples. Regression analyses for all the lakes surveyed along the Churchill-Rat-Burntwood and Nelson River System other than Southern Indian Lake were conducted on untransformed weight and ppm data. In order to provide a comparison of mercury levels from area to area or year to year the estimated mercury levels at given weights were calculated.

Analysis of variance and covariance was conducted on groups of data to determine if there were differences in mean mercury levels between years, and between areas on Southern Indian Lake. Again the models on Southern Indian Lake were from log transformed data, and for all other areas were from untransformed weight and ppm data.

Maximum allowable sizes for commercially caught fish from Southern Indian Lake were determined using the log ppm on log weight regression line for samples of individual fish taken during commercial sampling. The 95% confidence limit of the line and that point at which an acceptable percentage of the samples would be within the lake classification tolerances established by the Industry Services Branch were calculated.

Individual fish from the commercial samples were used to estimate the maximum allowable sizes of the fish because they were a better size than the fish from the lake surveys, and should provide a better estimate of mercury levels at normal commercially caught fish size ranges.

The actual area of origin of the fish from the commercial samples is not known, but they should be representative of areas in the lake which are commercially fished.

Wherever necessary the weights of individual fish were transformed to round weight equivalents by multiplying the dressed weight of the fish by 1.2 and the dressed and headless weight by 1.4.

All estimates of ppm from a given size as given in Figs. 2, 3 and 4 were calculated from the overall mean weight of the samples being compared. The probability of a good estimate of ppm was best for values closest to the logarithmic mean weight of the samples, especially for instances where the ppm on size relationship was very weak, as was the case for some areas from Southern Indian Lake.

RESULTS AND DISCUSSION

The mercury levels in fish from the

Churchill-Rat-Burntwood River Systems appear to have increased in 1978 and 1979 when compared with previous years. Based on analysis of variance of data from pooled samples withdrawn from commercially produced shipments of fish from along the Churchill River System, walleye from the Churchill River, Northern pike and walleye from Barrington Lake, walleye from Opachuanau Lake, and N. pike and walleye from Southern Indian Lake have significantly different mean mercury levels between the years for which data is available (Tables 1 and 2). These differences appear due to increased mercury levels in the shipments monitored in the years from 1976 to 1979 (Table 1). In addition to the six instances listed above where levels have changed, there are nine instances along the system where sufficient data has been collected to test for differences between mean mercury levels by year, but where no significant differences have been found. There are no instances where the mercury levels from commercial sampling have decreased significantly.

Based on analyses of individual fish and analyses of covariance of the mercury levels and round weight data where enough data is available, six of nine lakes and species have significantly different mean mercury levels between years (Table 2). Mean mercury levels in N. pike from Granville Lake, in walleye from Opachuanau Lake, in walleye from Southern Indian Lake, and in N. pike from Split Lake have increased. Mercury levels in Split Lake walleye have been erratic, and although differences between mean mercury levels between years are significant, there is no apparent trend. Mercury levels in walleye from Rat Lake have decreased from 1978 to 1979. Although there is insufficient data to analyse statistically, mercury levels in Wuskwatim Lake appear to have increased according to the 1979 survey (Table 3) as compared to previous levels in commercial shipments (Table 1).

Southern Indian Lake is the largest lake on the Churchill River System and the lake where the most lake survey samples have been collected. The data have been arbitrarily grouped according to area (Fig. 1). According to analysis of covariance of the 1979 data, there are significant differences between the mean mercury levels by area for all species tested (Table 4). Area 1 has the highest mercury levels for whitefish, N. pike, and walleye; Area 5 has the second highest. Area 4 has consistently the lowest mercury levels, but Area 2 shows higher mean mercury levels than Area 3 for whitefish and N. pike, but for walleye that situation is reversed (Fig. 2) probably because the size to ppm mercury relationship for walleye from Area 3 was too weak to obtain a good estimate of the baseline mercury levels (Table 5).

In the longnose suckers sampled in 1979, the highest mean mercury levels were in Area 5, and the lowest mean mercury levels were in Area 7. Area 4 and 1 ranked second and third highest respectively.

There were significant differences for Southern Indian Lake whitefish and walleye between years for some areas (Fig. 3). According to analysis of covariance, the mean mercury levels in whitefish are significantly different between 1975, 1978 and 1979. When comparing mercury levels between 1978 and 1979 whitefish, however, only Area 4 showed a change and that was a significant decrease in 1979. Mean mercury levels in the walleye from Area 1 have also decreased significantly from 1978 to 1979, but there was no change in Area 4 (Fig. 4). There was no change apparent in the mercury levels for Area 1 or Area 4 for N. pike from 1978 to 1979 (Fig. 4), but the quality of the 1978 data for N. pike is limited, and was possibly inadequate to reflect any changes which may have occurred, particularly for Area 1 (Table 5).

The maximum allowable mercury contents for commercially produced fish are 1.0 ppm for shipments intended for export to the U.S.A., and 0.5 ppm for those shipments marketed in Canada. Based on survey regression analyses of log-log transformed ppm mercury on weight data, the maximum allowable sizes on Southern Indian Lake would be 3.15 kg round weight for the N. pike and 1.05 kg round weight for the walleye (Figs. 5 and 6).

From 1978 to 1979 the mean mercury levels in commercial shipments of walleye were 0.57 and 0.75 ppm, and the average sizes of all the fish sampled were 0.91 and 0.97 kg round weight equivalent respectively. In the same two years the mean mercury levels in the N. pike were 0.50 and 0.88 ppm with sizes of 2.03 and 2.98 kg round weight equivalent (Table 6). By analysis of variance the mercury levels in the walleye have not changed from 1978 to 1979, but the mercury levels in the N. pike have increased. This increase in the N. pike is possibly attributable to the increased size in the fish sampled. In 1979 there were five samples in which the mean weight of the N. pike was over 3.15 kg, and two of those six samples exceeded the maximum allowable mercury levels of 1.0 ppm. For N. pike in particular, if the size of the fish harvested continues to increase the rejection rate may affect the viability of fishing for that species even if the baseline mercury levels remain constant.

An important species utilized by the domestic fishery on Southern Indian Lake is longnose sucker. The recommended maximum mercury content for fish eaten on a continuous basis from domestic fisheries is 0.2 ppm as established by the Medical Services Branch of Health and Welfare Canada. The mercury levels in the longnose sucker appear to be acceptable for continuous domestic consumption (Table 5).

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Table 1. Mercury in commercially caught fish in lakes on the Churchill-Rat-Nelson River Systems.

Area	Species	Mean Mercury Levels in ppm by Year (no samples)									
		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Churchill River	Pickerel	0.24 (1)	0.22(12)	0.33 (3)	0.29 (4)	0.25 (1)	0.35 (1)	0.38 (2)			
	N. Pike		0.44 (7)		0.80 (1)		0.43 (1)				
Billard	Pickerel	0.33 (1)									
Barrington	N. Pike	0.36 (1)	0.41 (2)			0.33 (1)	0.41 (1)	0.51 (9)	0.63 (2)	0.75 (1)	
	Pickerel	0.25 (1)	0.13 (1)			0.26 (1)	0.40 (1)	0.43 (3)	0.42 (1)	0.46 (1)	
Burntwood	N. Pike		0.36 (4)	0.41 (5)				0.49 (2)	0.41 (1)		0.29 (1)
	Pickerel		0.26(10)	0.31 (4)	0.20 (1)	0.22 (1)		0.30 (2)	0.23 (1)		0.37 (1)
Gauer	N. Pike	0.31 (1)								0.19 (1)	
	Pickerel	0.25 (1)	0.20 (4)	0.07 (1)						0.21 (1)	
Granville	N. Pike		0.43 (4)		0.36 (1)	0.22 (1)		0.40 (3)	0.46 (1)	0.40 (1)	0.65 (1)
	Pickerel	0.39 (1)	0.22 (7)	0.10 (1)	0.22 (2)	0.30 (1)	0.28 (1)	0.28 (2)	0.29 (1)	0.23 (1)	
Northern Indian	N. Pike						0.31 (3)	0.28 (1)		0.28 (1)	
	Pickerel	0.28 (1)		0.28 (1)			0.26 (1)	0.30 (1)		0.34 (1)	
Notigi	N. Pike								1.59 (1)		
	Pickerel									1.32 (3)	
Mynarski	N. Pike								1.08 (4)		
	Pickerel								0.84 (4)		
Opachuanau	N. Pike		0.31 (6)		0.31 (1)			0.60 (1)	0.53 (1)	0.65 (3)	0.20 (1)
	Pickerel	0.20 (1)	0.18 (6)		0.21 (1)		0.24 (1)	0.38 (1)	0.30 (1)	0.35 (1)	0.72 (1)
Rat	Whitefish									0.37 (1)	
	N. Pike									2.14 (5)	
	Pickerel									2.54 (5)	
Southern Indian	N. Pike		0.26 (4)	0.32 (5)	0.30 (3)			0.47(10)	0.43 (2)	0.50 (7)	0.88 (9)
	Pickerel		0.19 (6)	0.21 (3)	0.28 (3)		0.30 (2)	0.24 (4)	0.26 (2)	0.57 (7)	0.75 (6)
Split	N. Pike	0.55 (5)								0.62 (1)	0.74 (1)
	Pickerel	0.76 (6)				0.57 (5)			0.62 (8)	0.59 (9)	0.28 (1)
Wuskwatim	Pickerel	0.34 (1)	0.25 (1)		0.40 (1)	0.44 (1)	0.35 (1)	0.26 (1)	0.38 (1)		

Table 2. Analysis of variance and covariance to determine differences of mean mercury levels between years for lakes on the Churchill-Rat-Burntwood-Nelson River Systems.

Lake	Species	Commercial: Analysis of variance to determine difference in mean mercury levels			Survey: Analysis of covariance to determine difference in mean mercury levels adjusted for size		
		F	df	F.95	F	df	F.95
Churchill River	N. Pike	0.67	2,6	5.14			
	Pickerel	2.95	6,17	2.70			
Barrington	N. Pike	4.77	6,10	3.22			
	Pickerel	10.55	6,2	19.30			
Burntwood	N. Pike	0.66	4,8	3.84			
	Pickerel	0.63	6,13	2.92			
Gauer	Pickerel	0.58	3,3	9.28			
Granville	N. Pike	0.46	6,5	4.95	42.77	2,7	4.74
	Pickerel	3.11	8,8	3.44	1.37	1,9	5.12
Northern Indian	N. Pike	0.02	2,2	19.00			
Opachuanau	N. Pike	2.15	2,7	4.74	3.84	1,15	4.54
	Pickerel	26.17	7,5	3.97	5.59	1,16	4.49
Rat Lake	Pickerel				12.85	1,48	4.00
Southern Indian	Whitefish				40.41	2,343	3.00
	N. Pike	7.12	6,33	2.42	2.01	1,443	3.84
	Pickerel	5.95	7,25		10.47	1,333	3.84
Split	Whitefish	0.12	1,1	161.00			
	N. Pike	0.16	2,4	6.94	3.21	4,202	2.37
	Pickerel	3.22	4,24	2.78	3.31	5,173	2.21

Table 3. Estimated mercury levels in fish from lakes along the Churchill-Rat-Nelson River Systems.

Lake	Species	Year	No. Fish	Range in ppm Mercury	Mean Wt (kg)	Where ppm = b(wt)+a			Estimated ppm at:			
						a	b	r^2	Mean Wt (kg)	0.5 kg	1.0 kg	3.0 kg
Barrington	N. Pike	1978	5	0.35 - 1.06	1.88	-0.03	0.39	0.50	0.70	0.17	0.36	1.14
	Pickerel	1978	5	0.29 - 0.55	1.06	0.14	0.28	0.66	0.44	0.28	0.42	
Burntwood	N. Pike	1979	6	0.15 - 0.32	1.30	0.03	0.17	0.78	0.25	0.12	0.20	0.54
	Pickerel	1979	7	0.28 - 0.57	0.81	-0.58	1.22	0.52	0.41	0.03	0.64	
Gauer	N. Pike	1978	5	0.15 - 0.24	1.54	0.27	0.00	0.16	0.27			
	Pickerel	1978	6	0.17 - 0.27	1.03	0.17	0.04	0.29	0.21	0.19	0.21	
Granville	N. Pike	1978	5	0.28 - 0.51	3.29	-0.00	0.11	0.99	0.36	0.06	0.11	0.33
	N. Pike	1979	5	0.54 - 0.70	3.63	0.48	0.05	0.72	0.66	0.51	0.53	0.63
	Pickerel	1976	6	0.14 - 0.54	0.74	0.21	0.16	0.19	0.33	0.29	0.37	
	Pickerel	1978	6	0.20 - 0.34	0.81	0.18	0.11	0.26	0.27	0.24	0.29	
Northern Indian	N. Pike	1978	5	0.14 - 0.57	2.61	-0.31	0.23	0.46	0.29			
	Pickerel	1978	5	0.27 - 0.47	1.13	-0.05	0.37	0.92	0.37	0.14	0.32	
Notigi	Pickerel	1978	19	0.19 - 2.91	0.95	-0.09	1.59	0.34	1.42	0.71	1.50	
Opachuanau	N. Pike	1978	11	0.30 - 0.91	2.12	0.17	0.15	0.68	0.49	0.25	0.32	0.62
	N. Pike	1979	7	0.12 - 0.31	1.06	0.07	0.11	0.45	0.19	0.13	0.18	0.40
	Pickerel	1978	12	0.22 - 1.44	1.74	0.27	0.22	0.71	0.65	0.38	0.49	
	Pickerel	1979	7	0.48 - 1.15	0.91	0.65	0.19	0.09	0.82	0.75	0.84	
Rat	N. Pike	1978	24	1.47 - 2.49	2.94	1.55	0.17	0.57	2.05	1.64	1.72	2.06
	Pickerel	1978	26	2.17 - 3.51	1.19	2.05	0.43	0.45	2.56	2.27	2.48	
	Pickerel	1979	25	1.68 - 3.29	1.36	1.82	0.37	0.53	2.32	2.01	2.19	
Rat River	N. Pike	1978	26	1.09 - 3.86	2.40	1.30	0.36	0.58	2.16	1.48	1.66	2.38
	Pickerel	1978	12	1.58 - 3.29	1.61	1.91	0.28	0.27	2.36	2.05	2.19	
Southern Indian	N. Pike	1978	60	0.13 - 1.72	1.98	0.48	0.04	0.17	0.56	0.50	0.52	0.60
	N. Pike	1979	386	0.10 - 2.48	1.36	0.40	0.12	0.45	0.56	0.46	0.52	0.76
	Pickerel	1978	74	0.25 - 1.55	0.93	0.31	0.37	0.27	0.65	0.50	0.68	
	Pickerel	1979	262	0.06 - 2.81	0.74	0.31	0.22	0.26	0.47	0.42	0.53	

Table 3. Continued.

Lake	Species	Year	No. Fish	Range in ppm Mercury	Mean Wt (kg)	Where ppm = b(wt)+a			Estimated ppm at:			
						a	b	r^2	Mean Wt (kg)	0.5 kg	1.0 kg	3.0 kg
Split	N. Pike	1972	64	0.12 - 0.88	1.62	0.39	0.01	0.08	0.41	0.40	0.40	0.42
	N. Pike	1973	33	0.19 - 1.32	4.51	0.28	0.07	0.51	0.60	0.32	0.35	0.49
	N. Pike	1976	101	0.16 - 1.14	3.41	0.42	0.05	0.37	0.59	0.45	0.47	0.57
	N. Pike	1978	5	0.20 - 0.94	3.04	-0.06	0.18	0.79	0.49	0.03	0.12	0.48
	N. Pike	1979	5	0.63 - 1.00	4.86	0.45	0.07	0.60	0.79	0.49	0.52	0.66
	Pickerel	1972	30	0.22 - 1.07	0.90	0.42	0.07	0.11	0.48	0.46	0.49	
	Pickerel	1973	7	0.35 - 1.01	0.97	0.66	0.10	0.09	0.76	0.71	0.76	
	Pickerel	1974	19	0.17 - 0.97	0.96	0.19	0.37	0.31	0.55	0.38	0.56	
	Pickerel	1976	52	0.28 - 1.28	1.31	0.46	0.17	0.27	0.68	0.55	0.63	
	Pickerel	1978	66	0.24 - 2.67	0.94	0.69	-0.06	0.04	0.63			
	Pickerel	1979	6	0.17 - 0.43	0.94	0.24	0.08	0.24	0.32	0.28	0.32	
Wuskwatim	N. Pike	1979	75	0.21 - 5.31	1.57	0.55	0.23	0.31	0.91	0.67	0.78	1.24
	Pickerel	1979	90	0.25 - 1.28	0.84	0.44	0.38	0.24	0.76	0.63	0.82	

Table 4. Covariance tests for Southern Indian Lake.

Test	*F-value for difference of means adjusted for size F	df	F.95
1. Difference in areas for 1979 data			
a) Between mean ppm mercury in whitefish in areas 1,2,4	44.49	2,112	3.00
b) Between mean ppm mercury in N. pike in areas 1,2,4,5	18.35	3,178	2.60
c) Between mean ppm mercury in pickerel in areas 1,2,4,5	4.81	3,128	2.68
d) Between mean ppm mercury in longnose sucker in areas 1,4,5,7	7.83	3,51	2.80
2. Difference in years			
a) Between mean mercury levels in whitefish from area 2 in 1975, 1978 & 1979	44.29	2,64	3.13
b) Between mean mercury levels in whitefish from area 4 in 1975, 1978 & 1979	83.71	2,97	3.10
c) Between mean mercury levels in whitefish from area 1 in 1975, 1978 & 1979	44.45	2,68	3.12
d) Between mean mercury levels in N. pike from area 1 in 1978 & 1979	1.21	1,66	3.98
e) Between mean mercury levels in N. pike from area 4 in 1978 & 1979	1.53	1,64	3.98
f) Between mean mercury levels in pickerel from area 1 in 1978 & 1979	7.71	1,63	3.99
g) Between mean mercury levels in pickerel from area 4 in 1978 & 1979	0.23	1,25	4.25
h) Between mean mercury levels in whitefish from area 1 in 1978 & 1979	4.04	1,44	4.06
i) Between mean mercury levels in whitefish from area 2 in 1978 & 1979	0.01	1,40	4.08

* "F" is the calculated value to determine the difference between means after being adjusted for size.

"df" are the degrees of freedom. The first number is for the numerator, the second for the denominator.

"F.95" is the value for the appropriate degrees of freedom as taken from an F.95 distribution table.

Table 5. Estimated mercury levels in fish from Southern Indian Lake.

Area	Species	Year	No. Fish	Range in ppm Mercury	Mean Wt (kg)	Where ppm = a(wt)^b log a	b	t	Estimated ppm at: Mean Wt (kg)	0.5 kg	1.0 kg	3.0 kg
Area 1	Whitefish	1975	25	0.03 - 0.12	0.86	-1.1585	0.20	1.68	0.07	0.06	0.07	
		1978	17	0.06 - 0.60	1.44	-0.7235	0.88	2.40	0.26	0.10	0.19	
		1979	30	0.05 - 0.55	1.07	-0.5546	0.63	3.05	0.29	0.18	0.28	
	N. Pike	1978	9	0.28 - 1.72	2.63	-0.4690	0.65	1.61	0.63	0.22	0.34	0.69
		1979	60	0.42 - 1.21	1.21	-0.1757	0.05	0.72	0.67			
	Pickerel	1978	15	0.46 - 1.20	0.92	-0.0869	0.39	1.91	0.79	0.63	0.82	
		1979	51	0.06 - 1.14	0.72	-0.3183	0.61	2.99	0.39	0.32	0.48	
	Longnose Sucker	1979	10	0.05 - 0.19	1.16	-1.0473	0.51	2.41	0.10	0.06	0.09	
Area 2	Whitefish	1975	25	0.03 - 0.08	0.81	-1.3307	0.07	1.16	0.05	0.04	0.05	
		1978	17	0.06 - 0.60	1.44	-0.7235	0.88	2.40	0.26	0.10	0.19	
		1979	26	0.04 - 0.55	0.80	-0.6678	0.28	1.58	0.20	0.18	0.21	
	N. Pike	1979	35	0.29 - 0.89	0.92	-0.2285	0.38	4.10	0.57	0.46	0.59	0.89
	Pickerel	1979	30	0.25 - 2.19	0.48	-0.2883	0.24	1.93	0.43	0.44	0.51	
Area 3	Whitefish	1979	40	0.06 - 0.26	1.01	-0.9263	0.84	4.05	0.10	0.07	0.12	
	N. Pike	1979	35	0.36 - 1.10	1.37	-0.2661	0.22	2.49	0.58	0.47	0.54	0.69
	Pickerel	1979	11	0.32 - 1.80	0.88	-0.2831	0.09	0.16	0.52	0.41	0.52	
Area 4	Whitefish	1975	25	0.02 - 0.10	0.66	-1.2645	0.15	1.39	0.05	0.05	0.05	
		1978	14	0.09 - 0.38	0.92	-0.6825	-0.03	-0.14	0.21			
		1979	60	0.06 - 0.30	0.76	-1.0190	0.10	1.50	0.09	0.09	0.10	
	N. Pike	1978	13	0.28 - 0.62	1.36	-0.3609	0.21	1.38	0.47	0.38	0.44	0.55
		1979	54	0.30 - 1.20	1.28	-0.3259	0.25	4.76	0.50	0.40	0.47	0.62
	Pickerel	1978	6	0.41 - 0.70	1.26	-0.3711	0.91	1.15	0.53	0.23	0.43	
		1979	22	0.24 - 0.76	0.63	-0.3299	0.25	3.77	0.42	0.39	0.47	
	Longnose Sucker	1979	16	0.06 - 0.26	0.98	-0.9370	0.26	2.17	0.12	0.10	0.12	
Area 5	Whitefish	1975	25	0.04 - 0.12	0.95	-1.1762	0.21	2.25	0.07	0.06	0.07	
	N. Pike	1979	34	0.34 - 1.13	0.94	-0.2001	0.30	4.14	0.62	0.51	0.63	0.88
	Pickerel	1979	30	0.35 - 0.77	0.69	-0.2264	0.12	2.57	0.57	0.55	0.59	
	Longnose Sucker	1979	16	0.11 - 0.28	1.14	-0.8886	0.30	0.75	0.13	0.11	0.13	
Area 7	Longnose Sucker	1979	14	0.04 - 0.12	1.67	-1.2475	0.92	2.67	0.09	0.03	0.06	

Table 6. Mercury levels in commercial shipments from Southern Indian Lake in 1978 and 1979.

Year	Species	Specimen No.	Mean ppm Mercury	Mean Round Wt. Equivalent (kg)
1978	N. Pike	W 839	0.83	2.32
		W 815	0.48	0.94
		W 853	0.49	2.53
		W 938	0.44	2.53
		W 956	0.37	2.03
		W 972	0.25	2.17
		W 992	0.66	1.67
	Pickerel	W 838	0.66	0.90
		W 850	0.52	0.95
		W 907	1.12	1.08
		W 937	0.33	0.77
		W 957	0.44	0.95
		W 971	0.35	0.88
		W 992	0.54	0.85
1979	N. Pike	W 379	0.67	1.36
		W 427	0.83	1.33
		W 453	1.21	3.89
		W 470	0.74	3.23
		W 490	0.53	2.40
		W 497	0.65	2.98
		W 515	1.00	4.63
		W 522	1.51	3.46
		W 537	0.77	3.50
	Pickerel	W 387	0.91	1.13
		W 428	0.82	0.81
		W 454	1.21	1.09
		W 496	0.51	0.94
		W 514	0.47	0.87
		W 521	0.56	0.94

Analysis of Variance (on log transformed values)

1. Difference in mean ppm mercury in N. pike between 1978 and 1979.

   F = 10.20 d.f. 1,14

2. Difference in mean ppm mercury in pickerel between 1978 and 1979.

   F = 1.82 d.f. 1,11

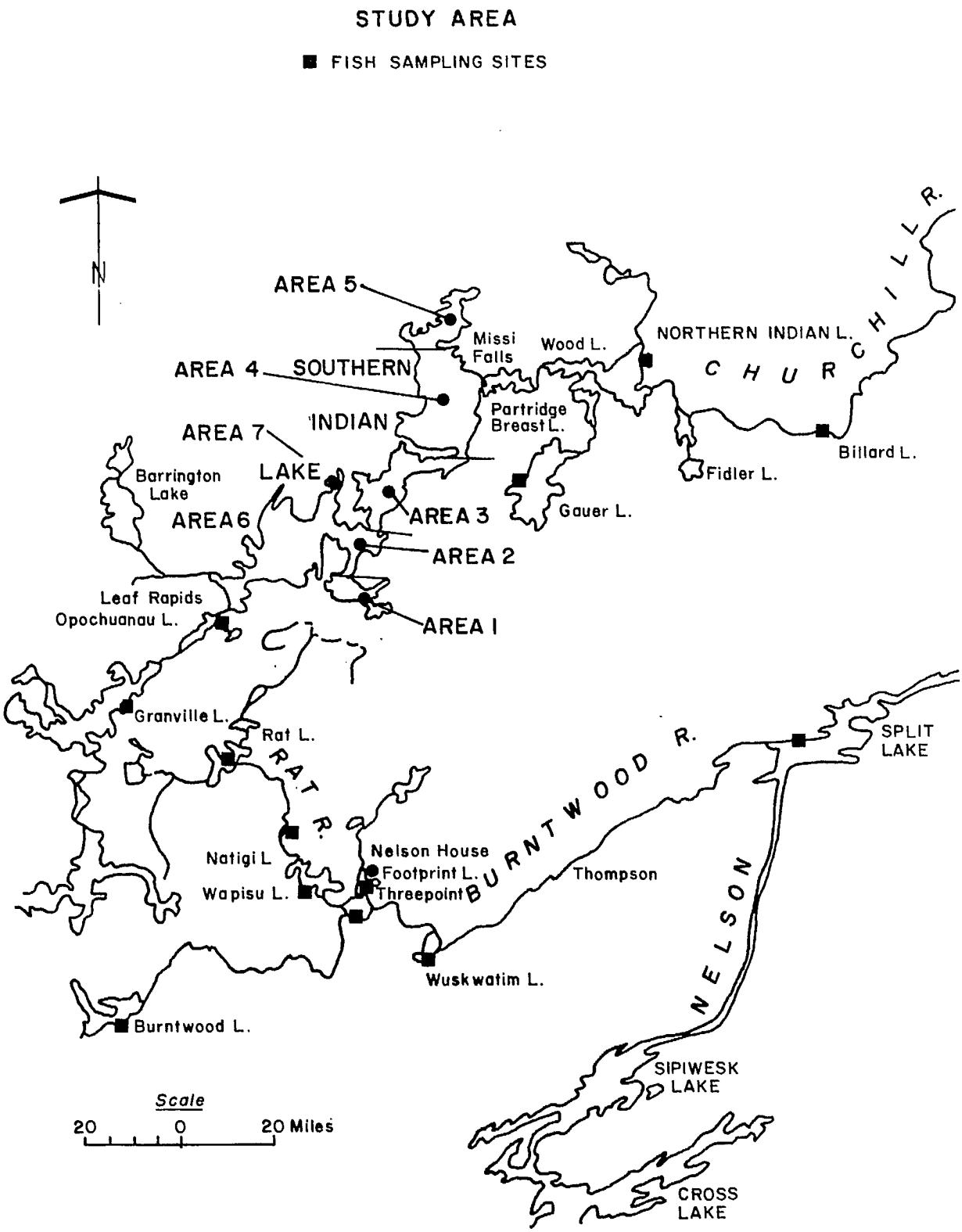


Fig. 1. Map of study area.

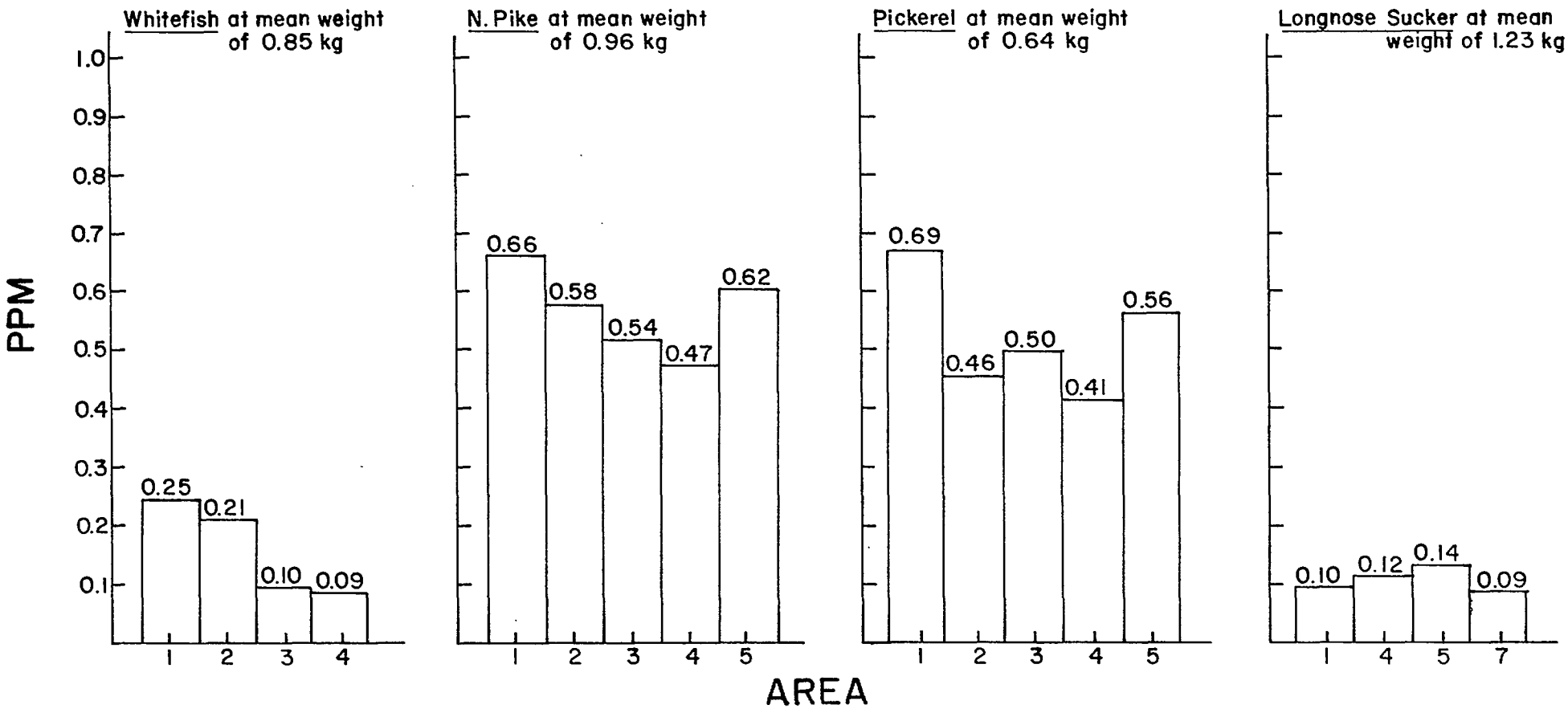
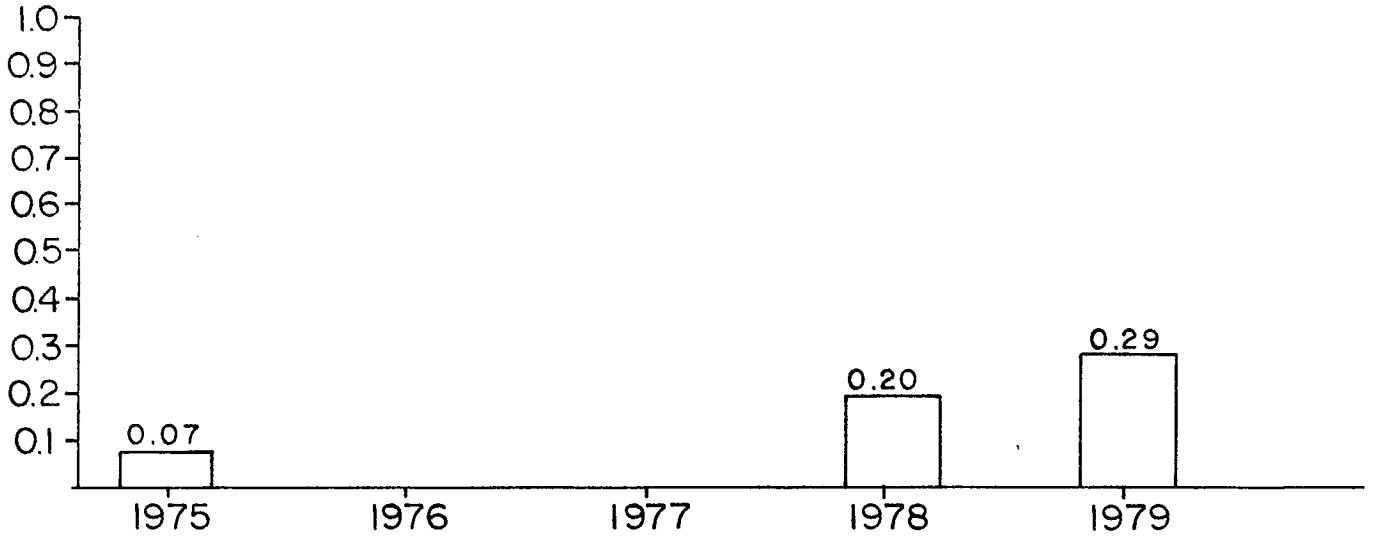
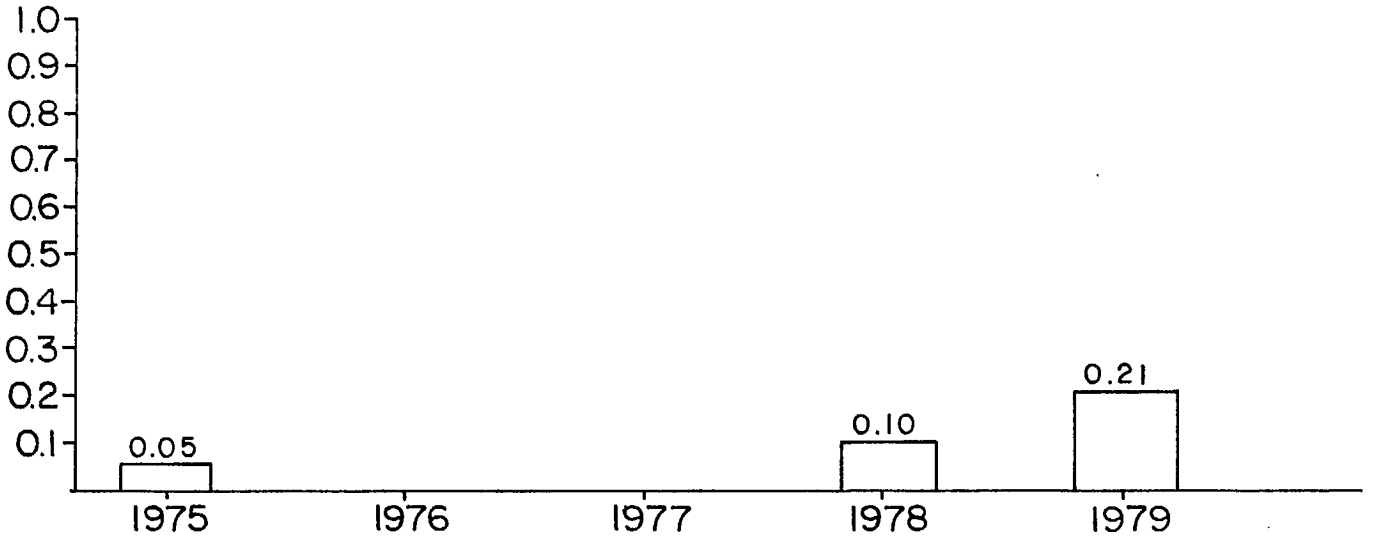


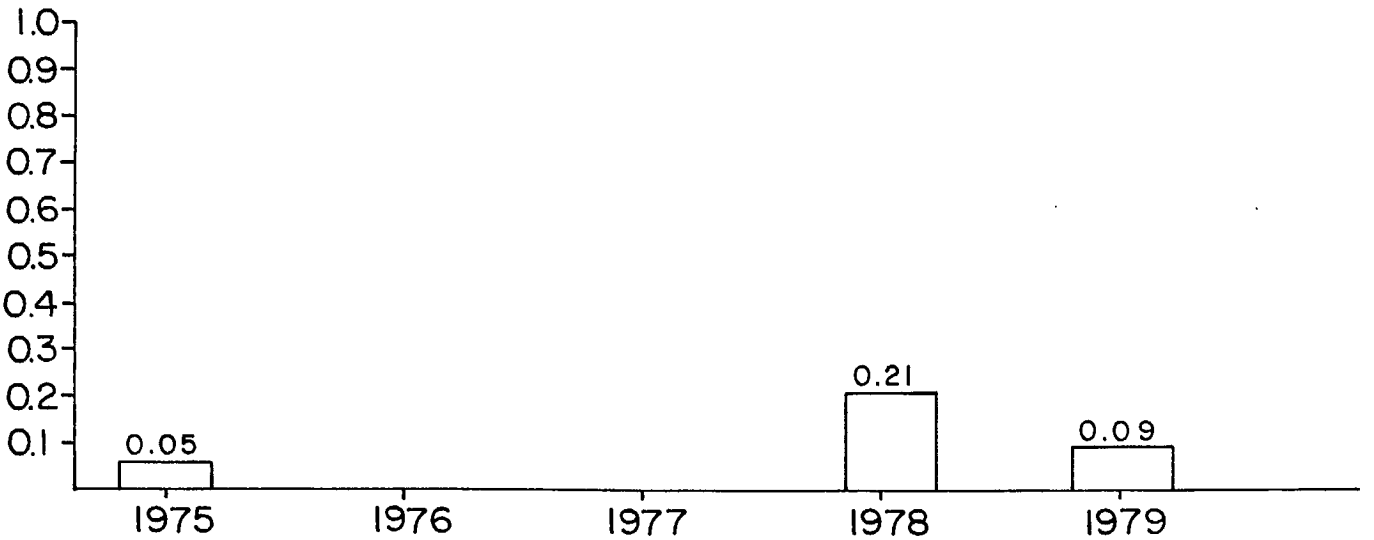
Fig. 2. Estimated 1979 mercury levels in fish from areas of Southern Indian Lake.



Estimated Mercury Levels in AREA I at a Mean Weight of 1.08 kg

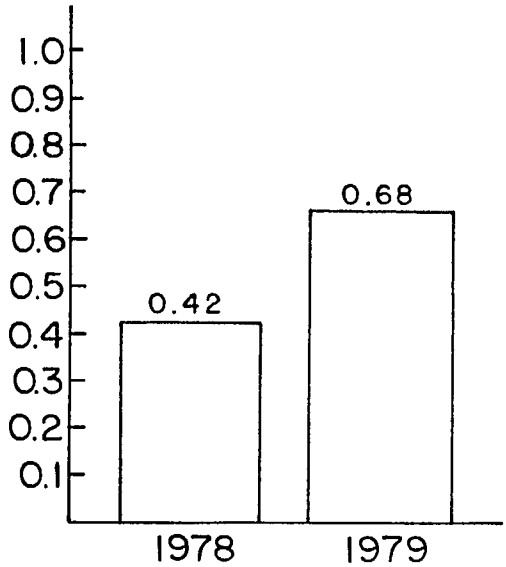


Estimated Mercury Levels in AREA 2 at a Mean Weight of 0.96 kg

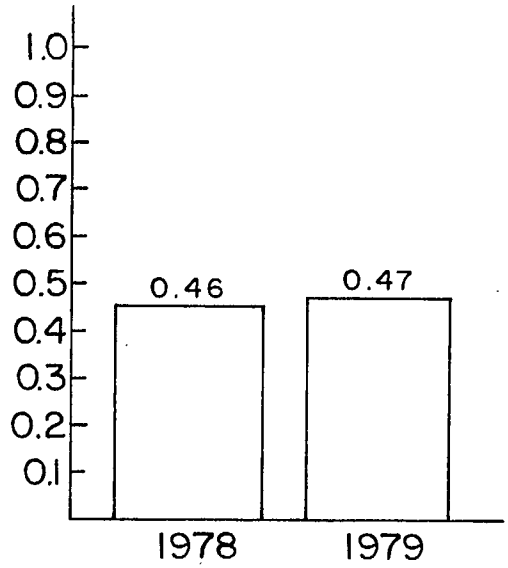


Estimated Mercury Levels in AREA 4 at a Mean Weight of 0.74 kg

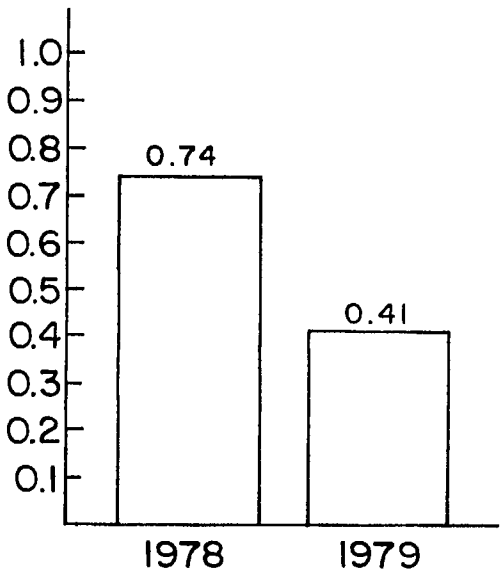
Fig. 3. Mercury levels in Southern Indian Lake whitefish by year.



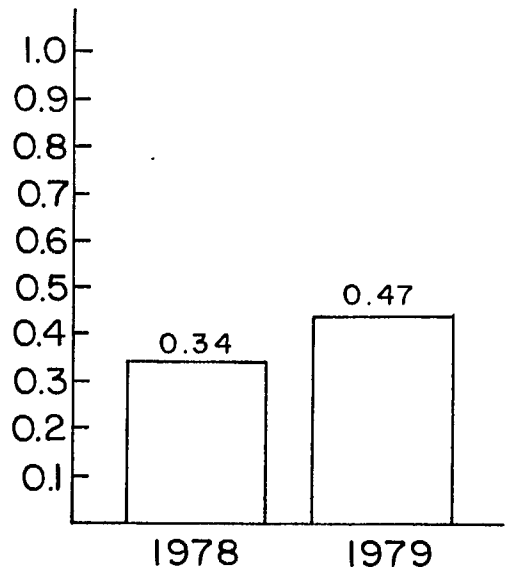
Estimated Mercury Levels in N. PIKE in AREA I at 1.4 kg.



Estimated Mercury Levels in N. PIKE in AREA 4 at 1.30 kg.



Estimated Mercury Levels in PICKEREL in AREA I at 0.77 kg.



Estimated Mercury Levels in PICKEREL in AREA 4 at 0.77 kg.

Fig. 4. Mercury levels in Southern Indian Lake N. pike and pickerel by year.

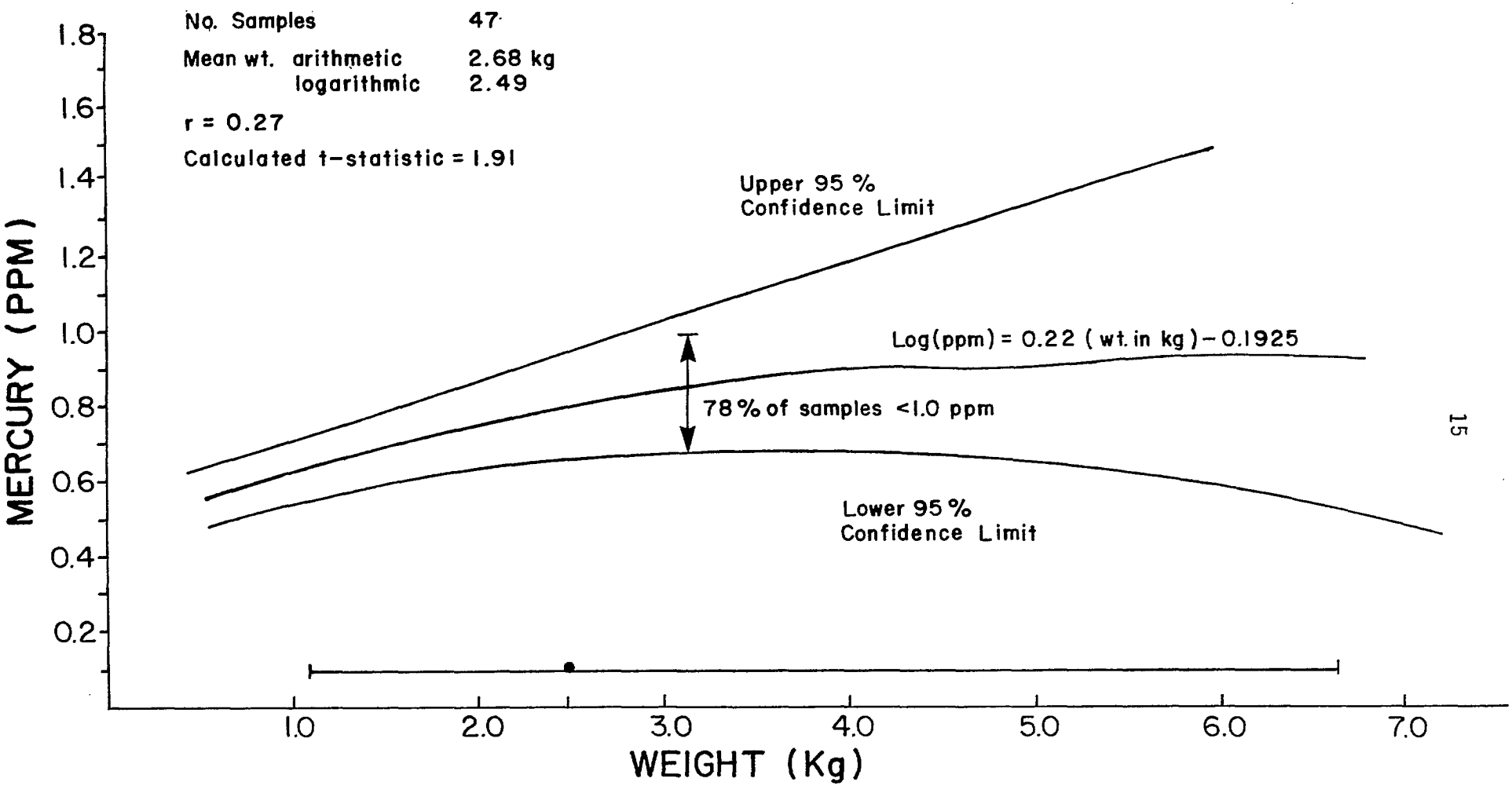


Fig. 5. Regression analysis for Southern Indian Lake N. pike.

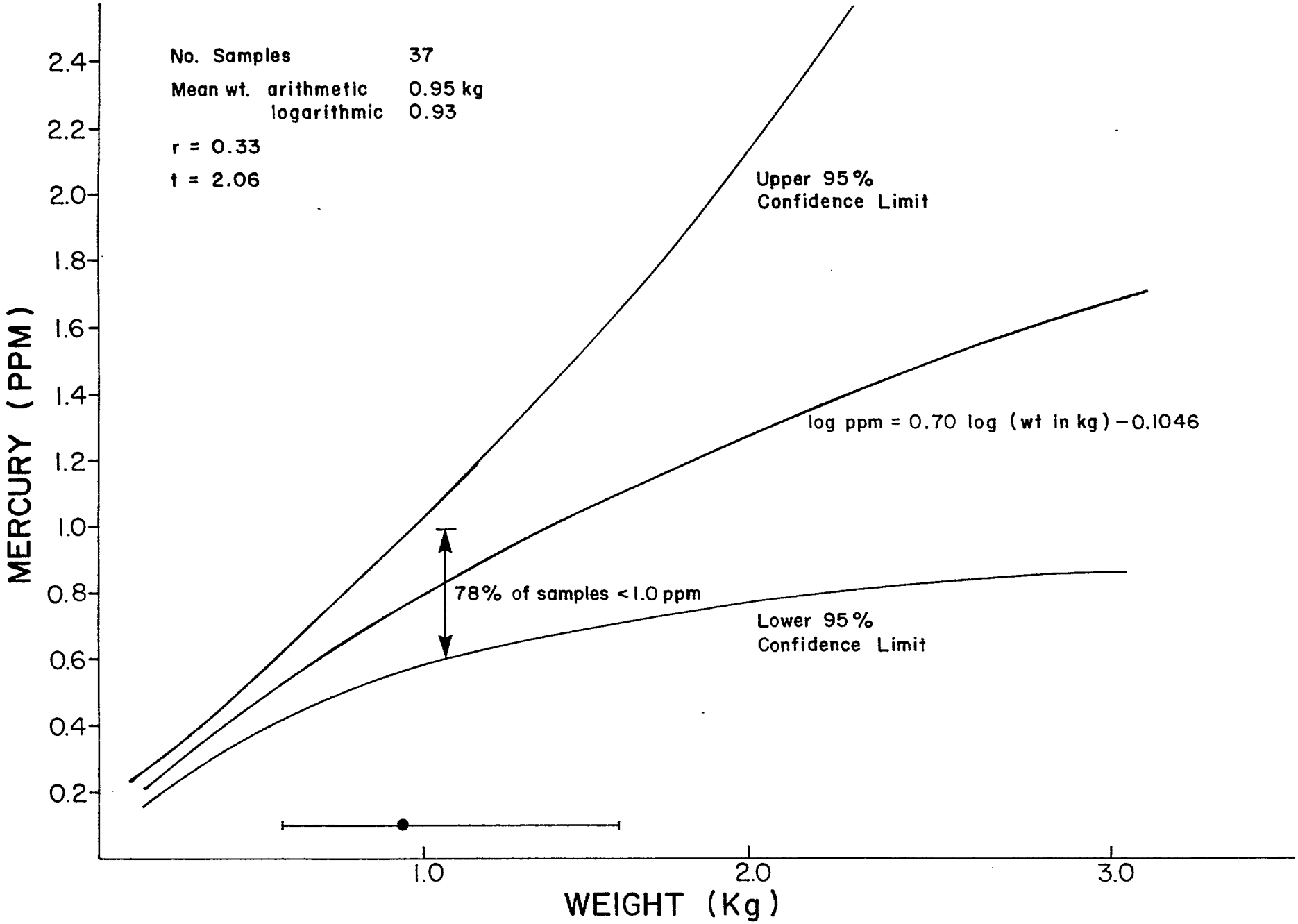


Fig. 6. Regression analysis for Southern Indian Lake pickerel.

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