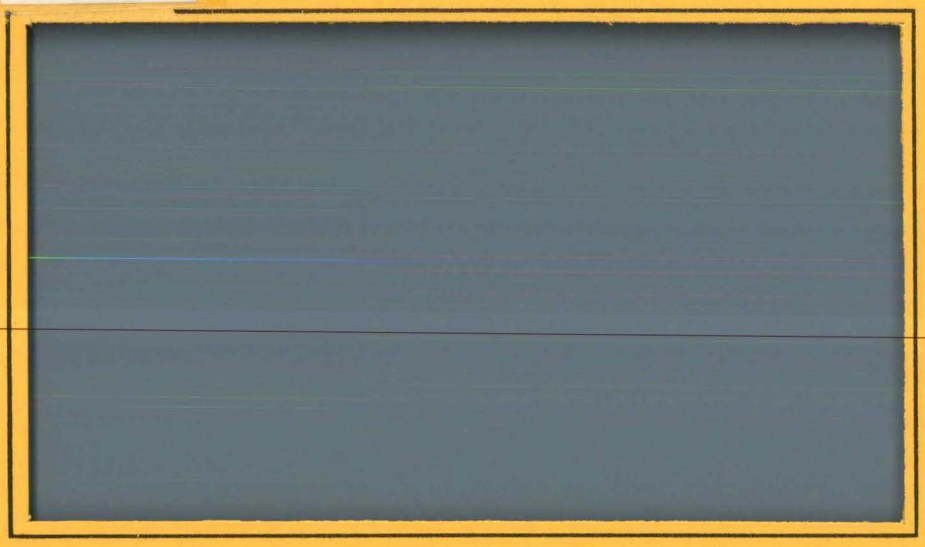

A REPORT FROM

The State Hygienic Laboratory

MEDICAL LABORATORIES BUILDING

THE UNIVERSITY OF IOWA

IOWA CITY, IOWA 52240

PESTICIDE RESIDUES IN THE EGGS OF SOME IOWA FISH

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by

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Report of a study conducted by the State Hygienic Laboratory in cooperation with the Iowa State Conservation Commission.

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PESTICIDE RESIDUES IN THE EGGS OF SOME IOWA FISH

Introduction

Routine monitoring of the pesticide concentrations in a number of Iowa rivers over a period of years indicated that chlorinated hydrocarbon insecticides used in row crop agriculture were being carried into the rivers by soil erosion.

The concentrations of dieldrin found were not uniform over the state. They were highest in areas where extensive row crop farming, with its accompanying erosion, was practiced.

A study was then made of the pesticide levels in the edible flesh of fish from most of the rivers in Iowa.

The levels of dieldrin found in channel catfish followed the same pattern as was found in river waters. The concentrations in the flesh were 2 to 5 times the U.S.F.D.A. actionable level of 0.3 parts per million for catfish from rivers in areas of extensive row crop farming, while the dieldrin concentrations in fish from rivers which did not drain areas with significant row crop farming were at or below the 0.3 ppm actionable level.

Because of the significant aggregation of dieldrin in the flesh of catfish in some rivers and the wide species to species variation in pesticide content a study of the pesticide levels in the eggs of some fish from five locations in Iowa was undertaken in the spring of 1971.

The roe of the fish selected were collected by the Iowa State Conservation Commission, wrapped in aluminum foil, frozen and sent to the State Hygienic Laboratory for analysis.

The areas were selected because of either high dieldrin levels in previous studies or commercial and sport fishing pressures.

Water from the Nishnabotna rivers has consistently had the highest pesticide content of the Iowa rivers monitored and fish from the Nishnabotna rivers had the highest dieldrin levels of any measured in 1970. The Coralville reservoir of the Iowa river was selected because of elevated dieldrin levels in fish and water and because of the large amount of sport fishing on it. Pools 11 and 19 were selected because of the extensive commercial fishing on the Mississippi river and because of the significant increase in pesticide levels in fish flesh progressing from Pool 11 near the northern border of Iowa to Pool 19 near the southern border.

Results

The pesticide concentrations and extractable fat contents found are listed in table I. The insecticides listed in table I are the same ones detected in fish flesh in these Iowa rivers. Aldrin, heptachlor and DDT have all been used for insect control in agriculture in Iowa in the past and it is not surprising to find their residues in the aquatic environment.

The presence of gamma and alpha chlordane is a little unexpected since chlordane has been used to a lesser extent in agriculture and has had some use in termite and lawn insect control. Several other compounds, in lower concentrations, which may be other components of technical chlordane were observed but their identities were not confirmed.

Dieldrin is the major insecticide residue found in the eggs and the amounts found in the various locations are in the same order as the levels of dieldrin found in fish flesh and water samples from these locations.

Channel catfish eggs, the one species analyzed at each sampling site, have dieldrin levels highest in the Nishnabotna rivers and decreasing in order in the Iowa river, Pool 19 and Pool 11 of the Mississippi river.

Table I shows that in both Pool 11 and 19 of the Mississippi river the walleye have the highest lipid and dieldrin content in their eggs while the channel catfish eggs are lowest in both lipid and dieldrin content with the largemouth bass being intermediate in lipids and dieldrin.

In both Pool 11 and Pool 19 the catfish eggs have the lowest pesticide content. This is just the reverse of what was found in fish flesh where the dieldrin level was much higher in the catfish than in any pan or game fish.

Figure I shows the graphs of dieldrin concentration versus per cent lipids. It also shows the graphs of the regression equations determined by the least squares method and the correlation coefficients for the Iowa and Mississippi river samples. Even though only three points on the graph are available for each of these locations, the correlation between per cent lipids and dieldrin concentration appears to be good.

The lipid content and the amounts of pesticides aggregating in the eggs of the various species of fish exposed to the same level of pesticides is quite different.

No walleye eggs were collected from the Iowa river, but the concentrations of dieldrin in the eggs of walleye from there can be calculated using the regression equation for the Iowa river, $Y=-26.2+193X$, where Y is the dieldrin concentration in ppb and X is the lipids content in %. Assuming an average lipids level of 11.45% (average for the Mississippi river samples) the calculated dieldrin value is 2,200 ppb.

Very little information is available on the effect of dieldrin in fish eggs on reproduction.

However based on work by Burdick (Trans. Am. Fish. Soc., 93:127-136, 1964) which showed that concentrations of 4.75 ppm DDT in trout eggs produced at least 15% mortality in fry and on the greater toxicity dieldrin it is reasonable to assume that 2.2 ppm (2,200 ppb) dieldrin in fish eggs would have some adverse affect on reproduction.

Polychlorinated biphenyls (PCB's) were detected in those egg samples from the Mississippi river. Their gas chromatographic recordings matched those of the PCB arochlor 1254.

The concentrations of PCB's found are listed in table II.

Figure II is a graph of the PCB's concentration versus per cent lipids and the linear regression equations and correlation coefficients for Pools 11 and 19.

The levels of PCB's found in the same species in Pools 11 and 19 are roughly the same indicating the major source of these industrial chemicals is above Pool 11. No information is available now about the effect these levels in eggs would have on reproduction. However these compounds are less toxic than DDT and the levels recorded would not present the same hazard to reproduction as would similar concentrations of dieldrin.

The results in table I show that unlike pesticide residue levels in fish flesh, the highest dieldrin concentrations were found in walleye eggs with the concentrations in catfish eggs being significantly lower. Figure I shows a definite correlation between lipids or oil content and dieldrin levels. The graphs in figure I show that fish with high lipids content in the eggs, such as walleye, could accumulate dangerously high dieldrin concentrations if they live in rivers with relatively high dieldrin levels, such as the Iowa and Nishnabotna rivers.

Table 1. Chlorinated Insecticides and Lipids in Fish Eggs

River	Species	Date Collected	Length of Fish	Insecticides in Parts Per Billion								Per Cent Lipids
				Dieldrin	DDE	TDE	DDT	Heptachlor Epoxide	Aldrin	Chlordane Gama	Chlordane Alpha	
E. N.[a]	CCF[e]	6-24-71	12.8	930	240	150	84	57	175	210	140	2.5
E. N.	CCF	6-24-71	16.2	910	181	128	92	51	168	96	58	2.4
W. N.[b]	CCF	6-28-71	13.7	950	280	155	122	66	170	89	61	4.4
W. N.	CCF	6-28-71	14.9	910	360	180	175	76	162	102	59	4.2
M. 19[c]	CCF	4-16-71	24.0	145	64	36	16	28				2.3
M. 19	LMB[f]	4-15-71	17.5	455	190	107	46	69				6.3
M. 19	Wall.[g]	4-13-71	24.3	690	250	170	72	93				11.3
M. 11[d]	CCF	6-4-71	23.4	37	70	32	15	5				3.5
M. 11	LMB	5-20-71	16.4	79	110	76	48	10				4.9
M. 11	Wall.	4-16-71	27.5	142	190	98	69	13				11.6
Iowa	CCF	5-21-71	22.0	640	139	67	49	51		62	31	3.4
Iowa	CCF	5-23-71	19.4	420	110	56	28	37		43	29	2.4
Iowa	NP[h]	5-17-71	24.2	115	57	30	16	13		15	9	0.7

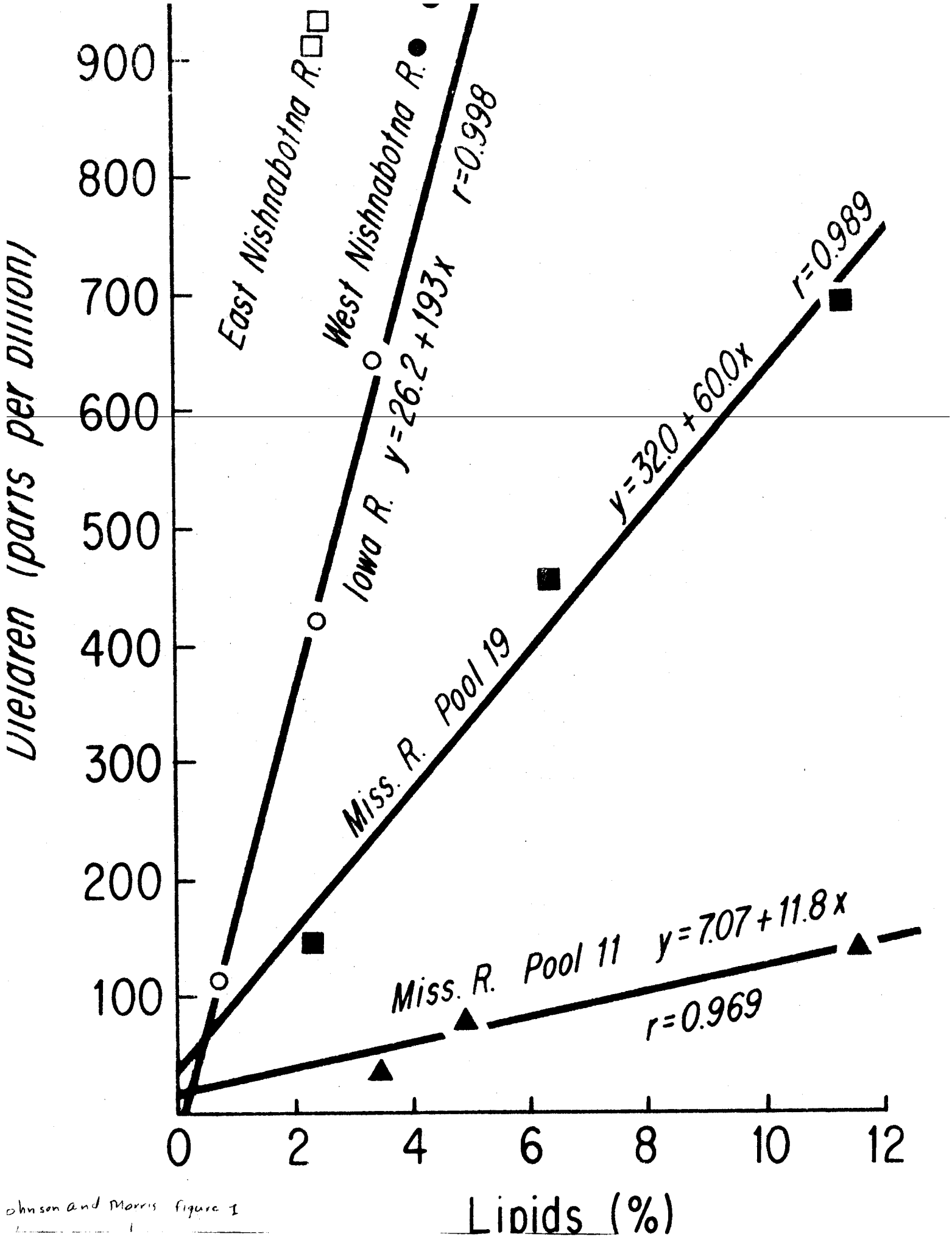
a East Nishnabotna; b West Nishnabotna; c Mississippi Pool 19; d Mississippi Pool 11; e Channel Catfish

f Largemouth Bass; g Walleye; h Northern Pike

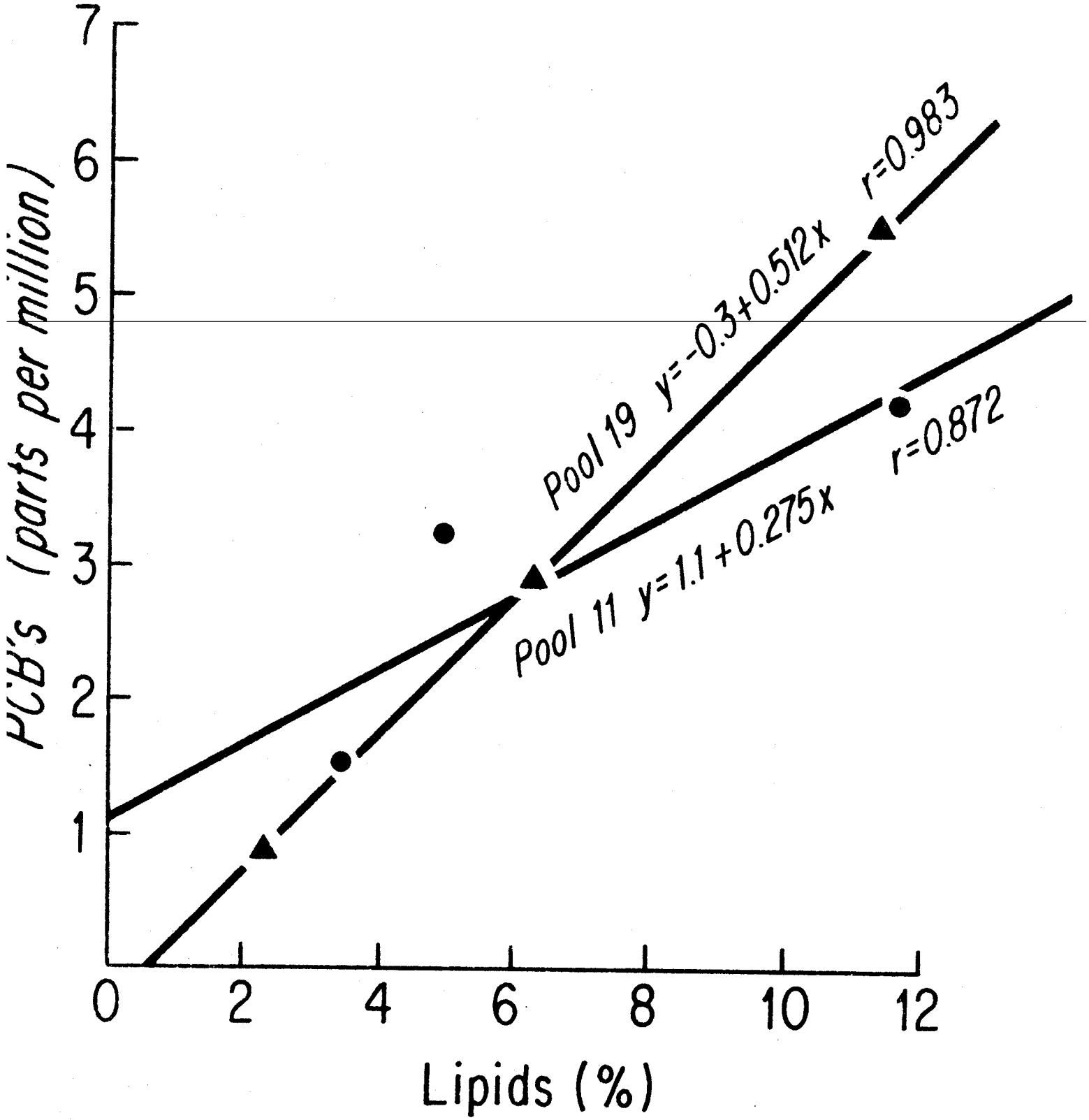
Table II. Polychlorinated Biphenyls in Fish Eggs from the Mississippi River

River	Species	Date Collected	Length of Fish	Polychlorinated Biphenyls[a] Parts Per Million
Mississippi Pool 19	CCF[b]	4-16-71	24.0	0.9
Mississippi Pool 19	LMB[c]	4-15-71	17.5	2.9
Mississippi Pool 19	Wall.[d]	4-13-71	24.3	5.5
Mississippi Pool 11	CCF	6-4-71	23.4	1.5
Mississippi Pool 11	LMB	5-20-71	16.4	3.2
Mississippi Pool 11	Wall.	4-16-71	27.5	4.2

a Calculated as Arochlor 1254; b Channel Catfish; c Largemouth Bass; d Walleye



Johnson and Morris figure 1


PCB's (parts per million)
7
6
5
4
3
2
1
0
2
4
6
8
10
12
Lipids (%)
Pool 19 y=-0.3+0.512x
r=0.983
Pool 11 y=1.1+0.275x
r=0.872