Bull. Environm. Contam. Toxicol. 30, 186–190 (1983)

Polychlorinated Biphenyl, Mercury, and Cadmium Concentrations in Minnesota Snapping Turtles

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The snapping turtle Chelydra serpentina may become an alternative choice to fish for monitoring pollutants in aquatic systems. They are common in many lakes and rivers throughout the eastern United States (CARR 1952; ERNST & BARBOUR 1972). They appear to remain abundant despite cadmium pollution (ROBINSON & WELLS 1975; STONE 1980) and PCB pollution (STONE 1980). Since they are long-lived and remain relatively sedentary (HAMMER 1969), they make good indicators of local environments. Trends in local pollution may be obtained by comparing concentrations of the pollutant to the age of the turtle. Snapping turtles accumulate toxic compounds through their diet or by direct absorption by pharyngeal and cloacal respiration (HAMMER 1969). Fat bodies on the ventral side of the turtles (POND 1978) are good sites for lipophilic compounds to accumulate.

Snapping turtles are commercially harvested for human food in Minnesota. There are 35 turtle trappers licensed for 1982 (JOHANS 1982). Approximately 70,000 lb of turtle meat are harvested annually on inland Minnesota waters (HENNAGIR 1982). Annual harvest by Mississippi River trappers is not known, but it is estimated at between 10,000 and 20,000 lb (HENNAGIR 1982).

The primary objective of the study was to determine the concentrations of selected toxicants in the meat and fat bodies of the Minnesota snapping turtle.

METHODS

Seventeen turtles were collected from six locations in Minnesota (Table 1). Three locations were on the Mississippi River (St. Paul, Prairie Island, Lake City), one on the Pomme de Terre River (Hoffman), one at Silver Lake in Wright County, and one at Reeds Lake in Waseca County.

Turtles were collected by field staff of the Minnesota Department of Natural Resources and Northern States Power Company. Snapping turtles were taken from nets which were set in conjunction with fisheries management work or were taken by hand collection. The turtles were sexed, and the carapace lengths were recorded prior to dissection for the fat bodies and red meat. Fat bodies were dissected from near the front and rear legs. Red meat was obtained

0007-4861/83/0030-0186 $01.00

Table 1. Minnesota Snapping Turtle Collection Program for 1981

Collection Location	Length (in.)	Weight (lb)	Sex	Estimated Age (yrs.)	Collector
Miss. R.-St. Paul*	7.5	3.6	F	5	MDNR
	5.5	1.8	F	3	MDNR
Miss. R.-St. Paul	9.5	6.9	M	6	MDNR
Miss. R.-St. Paul	11	10.0	M	7	MDNR
Miss. R.-St. Paul	12	12.6	F	10	MDNR
Miss. R-Prairie Island	10	7.0	M	6	NSP
Miss. R-Prairie Island	10	7.8	M	6	NSP
Miss. R-Prairie Island	11.5	11.6	M	8	NSP
Miss. R-Prairie Island	13	16.5	F	16	NSP
Miss. R-Lake City	9	4.5	M	6	MDNR
Miss. R-Lake City	12	11.5	M	10	MDNR
Miss. R-Lake City	15	21.8	M	>20	MDNR
Reeds Lake-Waseca Co.	9	6.0	M	6	MDNR
Reeds Lake-Waseca Co.	11.5	11.0	M	8	MDNR
Pomme de Terre R.-Hoffman	7.2	2.3	-	5	MDNR
Pomme de Terre R.-Hoffman	12	12.3	-	10	MDNR
Silver Lake-Wright Co.	10.5	8.3	F	7	MDNR

* Two turtles composited

from the legs. Both the fat and red meat were thoroughly ground prior to analysis. All polychlorinated biphenyl, lipid, mercury, and cadmium, analyses were conducted by the Minnesota Department of Health laboratory. The turtles were aged by comparing the carapace length to the number of annuli as found in the South Dakota turtle studies (HAMMER 1969).

All less-than values used in the calculations were treated as the actual number.

RESULTS AND DISCUSSION

PCB concentrations ranged from < 0.2 to 60.5 mg/kg in the turtle fat and < 0.025 to 0.086 mg/kg in the turtle meat. Mean PCB concentrations were 21.7 mg/kg in the turtle fat and 0.036 mg/kg in the turtle meat (Table 2). Mercury concentrations ranged from < 0.02 to 0.04 mg/kg in the turtle fat and 0.05 to 0.30 mg/kg in the turtle meat. The means were 0.024 and 0.145 mg/kg of mercury for the fat and meat, respectively. Cadmium analyses were performed on only the meat samples and ranged from 0.002 to 0.025 mg/kg with a mean of 0.010 mg/kg. Lipid concentrations in the turtle fat ranged from 14.9 to 88% with a mean value of 71.3%. Lipid concentrations in the turtle meat ranged from < 0.05 to 0.68% with a mean of 0.29%.

The highest PCB concentrations occurred in the turtles from the Mississippi River in general and from the Prairie Island station in particular. At the St. Paul collection location, the mean PCB

Table 2. Minnesota Snapping Turtle Analysis Results for 1981

Collection Location	Weight (lb)	Meat PCB (mg/kg)	Meat Hg (mg/kg)	Meat Lipid (%)	Meat Cd (mg/kg)	Fat PCB (mg/kg)	Fat Hg (mg/kg)	Fat Lipid (%)
Miss. R.-St. Paul*	3.6-1.8	0.058	0.11	0.68	0.012	11.6	0.02	72.4
Miss. R.-St. Paul	6.9	0.038	0.15	0.67	0.008	13.2	< 0.02	77.7
Miss. R.-St. Paul	10.0	< 0.025	0.23	0.43	0.002	23.3	0.02	82.7
Miss. R.-St.Paul	12.6	0.086	0.26	0.61	0.016	47.7	0.02	88.0
Miss. R.-Prairie Island	7.0	0.035	0.12	0.14	0.015	30.9	< 0.02	82.5
Miss. R.-Prairie Island	7.8	0.073	0.08	0.10	0.016	28.8	0.02	73.6
Miss. R.-Prairie Island	11.6	0.033	0.15	< 0.05	0.006	40.7	0.02	76.7
Miss. R.-Prairie Island	16.5	< 0.025	0.29	0.15	0.007	60.5	0.03	84.8
Miss. R.-Lake City	4.5	< 0.025	0.10	0.17	0.025	1.4	0.04	25.1
Miss. R.-Lake City	11.5	< 0.025	0.10	0.08	0.005	16.8	0.02	83.6
Miss R.-Lake City	21.8	< 0.025	0.08	< 0.05	0.004	22.8	0.02	82.8
Reeds Lake-Waseca Co.	6.0	< 0.025	0.11	0.38	-	0.8	< 0.02	78.5
Reeds Lake-Waseca Co.	11.0	< 0.025	0.05	0.41	-	-	-	-
Pomme de Terre R.-Glenwood	2.3	< 0.025	0.06	0.19	-	< 0.2	0.03	14.9
Pomme de Terre R.-Glenwood	12.3	< 0.025	0.14	0.50	-	-	-	-
Silver Lake-Wright Co.	8.3	< 0.025	0.30	0.07	-	5.0	0.04	75.2

*Two turtles composited

-No sample available

concentrations in the turtle fat and the meat were 28.1 and 0.05 mg/kg, respectively. At the Prairie Island site, the mean PCB concentration in the turtle fat was 40.2 mg/kg and 0.04 mg/kg in the turtle meat. The Lake City site had a mean PCB concentration of 13.7 mg/kg in the turtle fat and < 0.025 mg/kg PCB in the turtle meat. Turtles from Silver Lake, Reeds Lake, and the Pomme de Terre River all had mean PCB fat concentrations less than or equal to 5.0 mg/kg and meat concentrations less than 0.025 mg/kg.

Since high PCB concentrations were found in fish of the Mississippi River (PCB TASK FORCE 1976), it was not surprising to find high PCB concentrations in the turtles. What was interesting was the extremely low level of PCBs in the turtle meat and the presence of PCBs as Aroclor 1260. All PCBs found were measured as Aroclor 1260 although it is recognized that some of the Aroclor 1254 may have been masked by Aroclor 1260 during the analysis. Aroclor 1260 is a highly chlorinated PCB mixture. The more the chlorination, the more persistent the PCB mixture. Aroclor 1260 will be retained within an organism for a longer time period than lesser chlorinated mixtures because the highly chlorinated biphenyls are very hard to metabolize or eliminate. Since 16 of the 17 turtles were greater than five years old and 5 of the 17 were ten years old or older, the most persistent PCB to which they were exposed would be the dominant PCB form retained, Aroclor 1260.

PCBs are very lipophilic compounds. Table 2 shows the high PCB levels and the corresponding high lipid content of the turtle fat. The bioaccumulation of PCBs is directly related to the weight and lipid content of the organism exposed (PCB TASK FORCE 1976; ROBERTS 1978). The low lipid content of the turtle meat greatly reduces the potential bioaccumulation of PCBs in the meat.

Conclusions

1. Low levels of PCBs, less than .086 mg/kg, were found in the meat of all turtles collected from the Mississippi River and other Minnesota locations.

2. High levels of PCBs, up to 60.5 mg/kg, were found in the fat of turtles collected from the Mississippi River below the Twin Cities.

3. PCB concentrations at or below 5 mg/kg were found in the fat of turtles collected at other locations.

4. Low levels of mercury, less than 0.03 mg/kg, and cadmium, less than 0.025 mg/kg, were found in all of the turtles sampled.

Acknowledgements. Study was funded by the Minnesota Pollution Control Agency.

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Accepted December 11, 1982