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Polychlorinated Biphenyls and p,p'-DDE in Loggerhead and Green Postyearling Atlantic Sea Turtles*

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The Green (Chelonia mydas) and Loggerhead (Caretta caretta) sea turtles are classified as endangered and threatened species respectively (CLARK & KRYNITSKY 1980). The Green sea turtle has a distribution in the Atlantic which ranges from New England to Mardel Plata and Necochea Argentina and from the English Channel to South Africa (HIRTH 1971; STERNBERG 1981; HUGHES 1974; and BLEAKNEY 1967).

The Green sea turtle feeds primarily on sea grasses and floating beds of algae (HIRTH 1971). The Loggerhead in comparison feeds on mollusks, crustaceans and coelenterates (BLEAKNEY 1967; BRONGERSMA 1968).

Chemical contamination in the embryonic stages of Atlantic sea turtles by polychlorinated biphenyls (PCB's) and pesticides has been studied by (CLARK & KRYNITSKY 1980; THOMPSON et al. 1974; HILLSTEAD et al. 1974). Research carried out in Merritt Island, Florida, by CLARK & KRYNITSKY (1980) compared residue levels of PCB's and DDE in the developing embryos of Green and Loggerhead turtles. The Loggerheads had higher concentrations of both DDE and PCB's (which were reported as Aroclor 1260) than the Greens which had low concentrations of DDE and no detectable PCB's. Data from this study correlated well with research done on Green turtle embryos collected during the nesting season on Ascencion Island in the South Atlantic (THOMPSON et al. 1974). These studies showed that the present level of organochlorides in the developing embryos of both the Green and Loggerhead turtles had no deleterious effects on the hatching success of either species.

To date there has been no research comparing PCB and DDE residues in post yearling sea turtles. The present study will examine PCB and DDE levels in the liver and muscle tissues of post yearling Green and Loggerhead turtles collected along the east coast of Florida.

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METHODS AND MATERIALS

Natural mortalities of Green and Loggerhead turtles were collected along the East coast of Florida. Only turtles which did not show extensive decay were retained for analysis. Nine Loggerhead and four Green turtles were used in this study. Turtle weights before dissection ranged from 22-61 kg for the Loggerheads and 4.0-12.0 kg for the Greens.

During dissection 100g aliquots of muscle (removed from the left scapula) and liver tissues were taken from each turtle. These samples were individually packaged, labeled and frozen (-20°C).

Sample Preparation

The 100g aliquots of liver and muscle were homogenized and 20.0g subsamples were taken for analysis. The homogenized samples were dried with anhydrous Na_2SO_4. The tissue/Na_2SO_4 mixture was layered on top of a 20g column of activated Florisil and was eluted with 100mL of hexane (MCB pesticide grade, redistilled in glass). The eluant was collected in a Kuderna-Danish apparatus and was concentrated to 10mL. Liver samples which required further cleanup were adsorbed on a column of Celite (20g), coated with concentrated sulfuric acid (10mL), and eluted with 100mL of hexane. A procedural blank was run with each set of samples.

A Hewlett-Packard 5710B gas chromatograph equipped with an EC detector, capillary inlet system and interfaced to a Hewlett-Packard 3354B laboratory automation system was operated under the following conditions:

Column:	60M x 0.25mm ID fused silica SE-54 (J & W Scientific)
Injections:	1.0 l splitless, Injector temp: 350°C, Detector Temp: 300°C
Temp Program:	80°C-280°C at 4°C/min. 2min. hold at 80°C, 16min. hold at 280°C
H_2 carrier:	Linear velocity = 36cm/sec at 80°C split vent flow - 80ml/min septum vent flow = 4ml/min
EC Detector:	N_2 makeup gas flow = 60ml/min

The chromatographic data were analyzed for PCB's using the COMSTAR peak pattern recognition program (WEININGER, et al. 1983).

Spiked recoveries of Aroclor 1254 averaged 111% (SD=12, N=4) at the 50 and 100ppb level using this procedure. The detection limit was 5ppb wet weight for PCB residues and 1ppb wet weight for DDE.

RESULTS AND DISCUSSION

Estimated turtle ages ranged from 12-34 years for Loggerheads and from 2-7 years for Greens (REBEL 1974).

The concentrations of DDE and PCB residues in Loggerhead and Green muscle and liver are presented in tables 1 & 2, respectively. In the muscle, DDE residues ranged from 1-45ppb in the Loggerhead and were less than 1ppb in the Green. Liver samples contained DDE concentrations which ranged from 2-100ppb in the Loggerhead and were less than 10ppb in the Greens. Total PCB levels ranged from 5-46ppb in Loggerhead muscle and from 8-182ppb in the liver. Concentrations in the Green turtles ranged from 5.4-9.4ppb in the muscle and from 43-80ppb in the liver.

Statistical comparisons were attempted. However due to the protected status of these turtles only recent natural mortalities could be taken for this study. This prevented the acquisition of large sample numbers and the subsequent use of significant statistical comparisons.

By comparing the "sample" trace to the "PCB" trace in each of the PLOTSTAR graphic reports, Figures 1 and 2, it is possible to resolve peaks present in a complex mixture which are not a contribution from technical PCB mixtures. These figures seem to indicate the presence of EC sensitive compounds which are not polychlorinated biphenyls. Mass spectral analysis performed on the turtle samples showed no chlorinated compounds present above instrumental detection limits.

This study has shown that organochlorine residues in both species of postyearling turtles exist at unusually low concentrations, in the muscle and liver tissues. One explanation for both the presence of the chemicals and their low concentrations involves the dietary habits of the turtles. The herbaceous Green turtle, which feeds primarily on marine sea grasses and algae as an adult, may spend up to the first year of its life as a carnivore, feeding on small mollusks and crustacea. The Loggerhead in comparison is primarily carnivorous feeding on crustacea, conchs, tunicates and mollusks (REBEL 1974).

TABLE (1)
DDE & PCB Residue Concentrations in Loggerhead & Green Turtle Muscle

LOGGERHEAD

Turtle	Weight	DDE* (ppb)	Aroclor/mixtures (ppb)** 1242	1248	1254	1260	Total
C	22kg	10	ND	7.8	ND	6.8	15
D	18kg	1	ND	2.0	1.7	2.0	5.7
E	31kg	2	ND	5.9	1.7	3.0	11
F	25kg	1	ND	2.4	2.1	2.3	6.8
G	22kg	1	ND	2.8	2.2	2.1	7.1
H	23kg	10	ND	5.6	0.9	7.8	14
I	24kg	1	ND	1.9	1.5	1.8	5.2
J	40kg	45	ND	13	ND	33	46
K	61kg	1	ND	1.9	1.6	1.4	5.0

mean DDE = 8.0 ppb
mean total PCB = 13 ppb
blank = 5.0 ppb

GREEN

Turtle	Weight	DDE	1242	1248	1254	1260	Total
A	7.0kg	1	ND	ND	3.5	5.3	9.4
B	6.8kg	ND	ND	2.0	1.9	2.1	6.0
C	12kg	ND	ND	1.8	2.3	1.4	5.4
D	4.0kg	1	ND	2.0	1.7	2.7	6.4

mean DDE = 1.0 ppb
mean total PCB = 6.8 ppb
blank = 5.0 ppb

TABLE (2)
DDE & PCB Residue Concentrations in Loggerhead & Green Turtle Liver
Loggerhead - Group (1)

Turtle	Weight	DDE* (ppb)	Aroclor/mixtures (ppb)** 1242	1248	1254	1260	Total
C	22kg	25	ND	10	ND	22	33
D	18kg	20	ND	ND	9.9	45	55
I	24kg	2	ND	ND	4.4	3.6	8.0

mean DDE = 16 ppb
mean total PCB = 32 ppb
blank = 10 ppb

Table (2) continued

Loggerhead - Group (2)

Turtle	Weight	DDE	1242	1248	1254	1260	Total
G	22kg	7	ND	32	15	88	135
H	23kg	4	ND	ND	8.1	13	21
J	40kg	100	ND	ND	54	128	182

mean DDE = 37 ppb
mean total PCB = 113 ppb
blank - 49 ppb

Loggerhead - Group (3)+

Turtle	Weight	DDE	1242	1248	1254	1260	Total
E	31kg	10	ND	ND	20	22	42
K	61kg	4	ND	ND	23	16	39

mean DDE = 7.0 ppb
mean total PCB = 40 ppb
blank = 5.0 ppb

Green - Group (1)

		DDE*	Aroclor/mixtures (ppb)**				
Turtle	Weight	(ppb)	1242	1248	1254	1260	Total
C	12kg	ND	ND	12	16	16	43
D	4.0kg	10	ND	13	14	43	70

mean DDE = 10 ppb
mean total PCB = 57 ppb
blank = 49 ppb

Green - Group (2)

Turtle	Weight	DDE	1242	1248	1254	1260	Total
A	7.0kg	2	ND	ND	23	57	80

mean DDE = 2.0
mean total PCB = 80
blank = 10 ppb

Green - Group (3)+

Turtle	Weight	DDE	1242	1248	1254	1260	Total
B	6.8kg	1	ND	8.9	28	31	68

mean DDE = 1.0 ppb
mean total PCB = 68 ppb
blank = 5.0 ppb

\+ required additional sulfuric acid cleanup
* detection limit 1 ppb wet weight
** detection limit 5 ppb wet weight
ND below instrumental detection limits

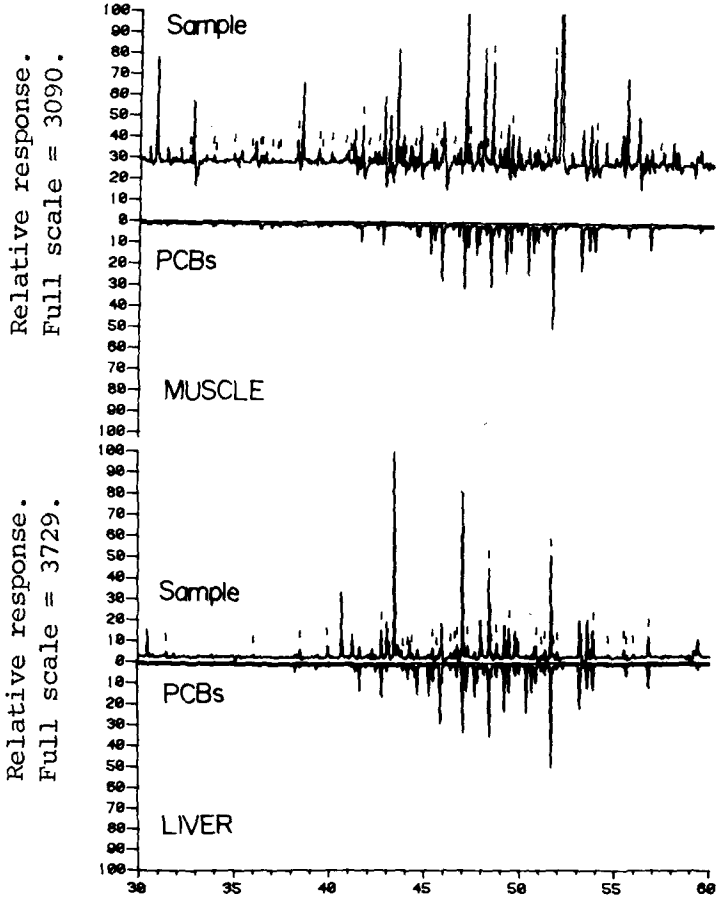

Fig. 1. Plotstar Output Green A

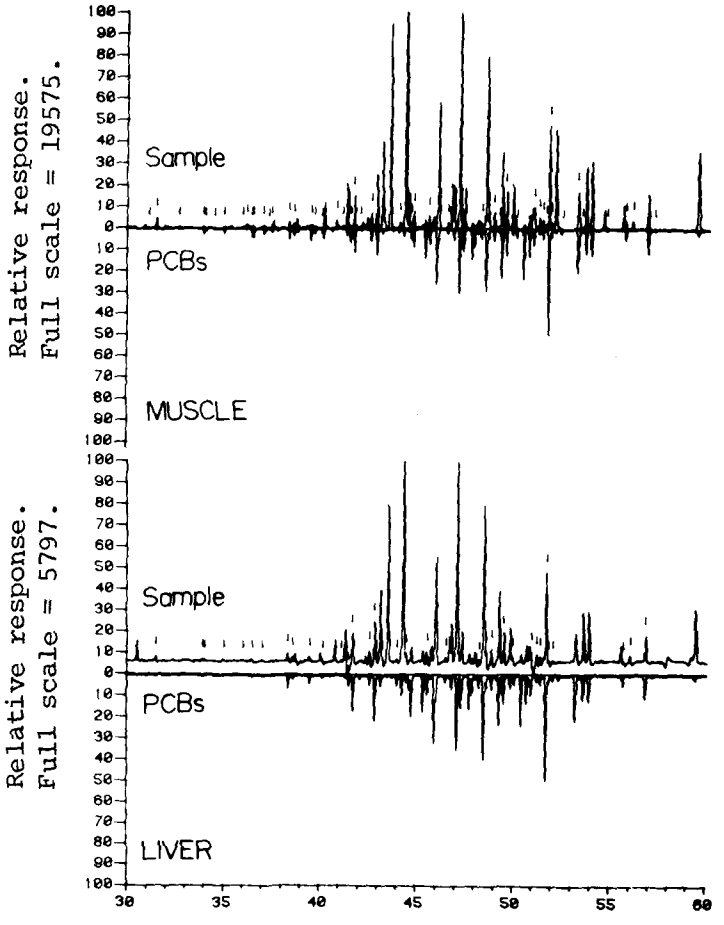

Fig. 2. Plotstar Output Loggerhead J

To our knowledge no information is avaiable on levels of organochlorines in marine grasses. However, since the grasses make up part of the turtles' diet and since the concentrations in the turtles are low it may be an indication that the concentrations in the seagrasses are also extremely low.

During a 1965 to 1972 pesticide monitoring program, (BUTLER et al. 1978), it was shown that mollusks collected from Florida to Maine had DDT levels which ranged from 14-308ppb with PCB concentrations below instrumental detection limits at many of the stations. In 1977 mollusks collected from the same stations showed no DDT residues in 85 of 87 samples, with PCB's being completely absent. A similar study, carried out in Liverpool Bay in the British Isles, concluded that marine invertebrates, which included mollusks and crustaceans, contained PCB concentrations ranging from 5-177ppb and total DDT from .5-3ppb, (RILEY & WAHLBY 1977).

The presence of low level organochlorine concentrations in the food source of the turtles may be one explanation for the unusually low concentrations shown in tables 1 and 2.

The present study has provided a preliminary screening of PCB and DDE residues in two species of postyearling Atlantic sea turtles. Although polychlorinated chemical residues in these turtles are presently low, the levels of these chemicals should continue to be monitored to insure the protection of these currently endangered species.

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