International Council for the Exploration of the Sea

C.M. 1975/N:11
Marine Mammals Committee

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1. Cover page, Addresses section; "Department of Biomecidal Sciences" should read "Department of Biomedical Sciences".

2. Page 7, last line; "and the mandatory restrition" should read "and the mandatory restriction".

3. Table 2, last line; "*Frank et al., 1971" should read "*Frank et al., 1973".

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D. Jones,[1] K. Ronald,[2] D.M. Lavigne,[2]
R. Frank,[3] M. Holdrinet[3] and J.F.Uthe[4]

ADDRESSES:

1. Department of Biomecidal Sciences, University of Guelph.
2. Department of Zoology, University of Guelph.
3. Pesticide Residue Testing Laboratory, Ontario Ministry of Agriculture and Food, c/o University of Guelph.
4. Halifax Laboratory, Fisheries and Marine Service, Nova Scotia.

Introduction

Recently there has been an increased interest in persistent biocides and other chemical contaminants in the environment.

In 1968, 5000* tonnes (t) of polychlorinated biphenyls (PCB) were produced in North America alone. In 1970, production increased to 30,000 t (Anonymous, 1971). Voluntary reduction in the sale of these compounds reduced production of PCB in 1971 to roughly half that of 1970. The estimated cumulative production of PCB since 1930 is thought to exceed 400,000 t.

The cumulative production of DDT since 1940 has been estimated at 1,800,000 t. In the United States peak production of 72,000 t occurred in 1961. Since the use of DDT has been curtailed in North America the total global production has fallen to approximately 100,000 t most of which is released into the environment (Fishbein, 1973).

Widespread use of mercury in industry as well as its natural occurrence in the environment also presents a potential hazard to marine mammals. The world production of mercury in 1971 was 8,870 t (U.N. Statistical Yearbook, 1972). Various industries in the United States alone consumed over 11,134 t of mercury during the five year period from 1966 to 1970, most

*1000 kg

of which entered the environment (Vostal, 1972). Based on the average content of mercury in rain and snow, it has been estimated that the surface of the earth receives over 90,900 t of mercury through precipitation (Saha, 1972). Sea water has been reported to contain between 0.11 to 0.27 ppb of mercury (Hosohara, 1961).

A large percentage of industrial effluent consists of inorganic and organic mercury wastes which are converted into methyl mercury or dimethyl mercury by anaerobes (Jensen and Jernelöv, 1969). Accumulation of mercury in the food chain has been known to occur for some time (Rucher and Amend, 1969) and is usually present in the tissue as methyl mercury (Westöo, 1967).

Research has indicated that PCB and DDT residues accumulate in marine mammals such as whales (Holden and Marsden, 1967; Gaskin et al., 1971; Saschenbrecker, 1973) and seals (harbour, Phoca vitulina, Koeman and van Genderen, 1966; ringed, Pusa hispida, and grey, Halichoerus grypus, Jensen et al., Holden, 1970; fur, Callorhinus ursinus, Shaw, 1971; harp, Pagophilus groenlandicus, Holden and Marsden, 1967; Addison et al., 1973; Frank et al., 1973). Intraspecific differences in biocide residues seem to be common even from seals from the same geographical location (Holden and Marsden, 1967; Holden, 1970;

Addison et al., 1973; Frank et al., 1973).

Mercury residues have also been reported in a number of marine mammals such as cetaceans (Koeman et al., 1973; Gaskin et al., 1972; Gaskin et al., 1971; Holden and Marsden, 1967; Bligh, 1971), and seals P. vitulina, Koeman et al., 1972, 1973; Gaskin et al., 1973; C. ursinus, Kim et al., 1974; Annas and Wilson, 1970; and P. hispida, Helminen et al., 1968).

Materials and Methods

Ten males and six female pups born on the ice of the Gulf of St. Lawrence between February 27 and March 18, 1973 and ranging in age from 8 to 14/+* days and 3 to 14 days respectively were examined. Tissue samples were analyzed for organochlorine and total mercury residues. Residue levels were compared with those obtained in the 1971 hunt (Frank et al., 1973).

The method of analysis for organochlorine residues in tissue was that of Frank et al., 1973; total mercury that of Gaskin et al., 1972; methyl mercury that of Uthe et al., 1972. Residue levels are reported in parts per million based on their presence in tissue. The data were not corrected for per cent recovery.

Results and Discussion

Comparison of 10 day old male and female pups

The amount of extractable fat found in the blubber,

*14 or more days

liver, brain and kidney of male and female pups did not vary notably.

Residues of PCB were slightly higher in the blubber and kidney of male pups as compared to females (1.40 ± 0.41 ppm vs. 0.81 ± 0.60 ppm and 0.49 ± 0.47 ppm vs. 0.15 ± 0.07 ppm). Similar levels of PCB were found in liver and brain samples taken from male and female pups.

Slightly higher levels of ΣDDT were found in the blubber, liver and kidney of male pups as compared to females. ΣDDT residues found in brain tissue did not differ markedly between the sexes (Table 1). The metabolite DDE was found to be higher in males than females in all tissues analyzed. In the liver approximately five times as much DDE was found in male pups as compared to females (0.22 ± 0.18 ppm vs. 0.05 ± 0.03 ppm). Kidney tissue taken from males was also higher in DDE than were female pups (0.87 ± 0.11 ppm vs. 0.11 ± 0.04 ppm).

Mercury residues were not detected in samples of blubber from either sex. Mercury levels in the liver, brain and kidney of male and female pups did not differ markedly (0.20 ± 0.18 ppm vs. 0.18 ± 0.07 ppm, 0.06 ± 0.13 ppm vs. 0.05 ± 0.18 ppm, 0.10 ± 0.05 ppm vs. 0.10 ± 0.01 ppm). The amount of methyl mercury found in the blood of female pups was slightly higher than that observed in the male pups (0.06 ± 0.01 ppm vs.

0.03 ± 0.03 ppm).

In summary no significant sex differences were found between male and female pups aged 10 days in the amount of mercury or organochlorine residues present in the liver, blubber, brain or kidney. This may be due to a similarity in steroid hormone levels which exist in prepubescent animals.

Fasted harp seal pups

Transplacental transfers of organochlorine and mercury residues are known to occur in a large number of mammals including man. Two female pups were captured shortly after birth. One was fasted for 2 days and the other for 3 days prior to sampling. The level of biocides reported for these two fasted pups should closely approximate the amount of biocide which has crossed the placental barrier and has been deposited in the foetal tissues while in utero. From the data which follows it would appear that detectable amounts of biocide are capable of crossing the placental barrier in the harp seal.

DDT was not detected in the brain of either fasted or nonfasted pups. Similarly the metabolite TDE was not detected in the brain tissue of the fasted pups but a trace amount was detected in a nonfasted 3 day old female pup. Small smounts of DDE were found in both the 2 day old and 3 day old pups (0.02 ppm and 0.01 ppm). Similar amounts of PCB were found in both pups (0.02 ppm).

Total brain mercury levels were found to be 0.088 ppm and 0.094 ppm respectively for the female pups aged 2 and 3 days.

Liver tissue obtained from these two fasted animals were observed to have extractable fat levels slightly lower than nonfasted pups. DDT was not detected in these animals although small amounts of DDE, TDE, PCB and mercury were observed.

Blood samples were obtained from these two fasted female pups. Methyl mercury residues were detected at a concentration of 0.04 ppm and 0.06 ppm for the 2 day and 3 day fasted pups respectively. The methyl mercury residue level of the 3 day old fasted pup was twice as high as that observed in a 3 day old fed female pup. By way of comparison, 2 lactating females taken at the same time were found to have blood methyl mercury levels of only 0.09 ppm and 0.05 ppm. PCB and DDT residues were not ascertained.

Comparison of white coats and ragged jackets taken in 1973 versus those taken in 1971.

Voluntary reduction in the sale of PCB by the Monsanto Co. (Anonymous, 1971) and the mandatory restrition on

the use of DDT in North America have reduced the amounts of chlorinated hydrocarbons entering the environment. At the same time there has been a matching decrease in the PCB concentrations in the surface waters of the North Atlantic (Harvey et al., 1974). Liver samples obtained from pups taken in 1973 showed no significant decrease in biocide residue levels when compared to animals of similar age taken during 1971 (Table 2). Residue levels of ΣDDT, DDE, and dieldrin obtained from brain samples taken in 1973 did not vary significantly from those obtained in 1971. A significant ($p = 0.05$) decrease in the residue levels of PCB was noted however in brain samples obtained in 1973 as compared to those taken in 1971. It is also of interest to note that all the brain samples taken in 1971 were found to contain DDT residues ranging from 0.01 ppm to 0.61 ppm while none of the 1973 brain samples were found to contain detectable DDT residues.

Blubber samples taken in 1971 were found to contain significantly ($p = 0.05$) higher residue levels of DDE, TDE, ΣDDT and PCB than those obtained during 1973. Thus it would appear that blubber biocide levels may reflect the decreased amounts of contaminants entering the environment.

Abstract

Samples of blubber, liver, kidney and brain, obtained from 10 male and 6 female neonatal harp seals (Pagophilus groen-

landicus), were analyzed for DDT, dieldrin, PCB, and total mercury. Methyl mercury levels in blood were also determined. Biocide deposition was not significantly different in female and male ten day old pups.

Wide intraspecific variation was noted in organochlorine and mercury residue levels. Pups taken in 1973 were found to have lower organochlorine residues than pups taken in the same area in 1971.

Preliminary investigation indicates that detectable amounts of organochlorine and mercury residues are capable of crossing the placenta in the harp seal.

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Table 1. Mean organochlorine residue levels found in tissues of male and female pups aged 10 days

Tissue	Animals (#)	Sex	Extractable fat (%)	DDE	TDE	DDT	Σ DDT	PCB
Blubber	4	M	74.9 ± 21.8*	1.18 ± 0.44	0.17 ± 0.11	0.24 ± 0.07	1.58 ± 0.38	1.40± 0.41
	4	F	80.5 ± 4.3	1.06 ± 0.52	0.20 ± 0.16	0.25 ± 0.19	1.52 ± 0.79	0.81± 0.60
Liver	4	M	6.2 ± 3.3	0.22 ± 0.18	0.03 ±0.01	0.01 ± 0.01	0.26 ± 0.20	0.21 ± 0.14
	4	F	3.3 ± 0.5	0.05 ± 0.03	0.00 ±0.00	-	0.05 ± 0.03	0.22 ± 0.22
Brain	4	M	6.1 ± 0.1	0.01 ± 0.00	0.01 ±0.01	-	0.04 ± 0.03	0.02 ± 0.01
	4	F	6.3 ± 0.3	0.03 ± 0.02	0.00 ±0.00	-	0.01 ± 0.00	0.03 ± 0.01
Kidney	4	M	15.6 ± 12.6	0.87 ± 1.11	0.08 ±0.10	0.02 ±0.01	0.97 ± 1.20	0.49 ± 0.47
	4	F	10.7 ± 5.1	0.11 ± 0.04	0.01 ±0.01	0.025±0.02	0.14 ± 0.06	0.15 ± 0.07

*Mean ppm ± standard deviation

Table 2. Mean organochlorine residue levels in tissues of young harp seals caught in the Gulf of St. Lawrence in 1973 and 1971.*

Tissue	Year	No. of Samples	% fat	DDE	TDE	DDT	Σ DDT	Dieldrin	PCB
Liver	1973	16	4.4 ± 2.6	0.11 ± 0.14	0.01 ± 0.01	0.01 ± 0.01	0.16 ± 0.21	0.002 ± 0.002	0.16 ± 0.18
	1971	11	7.0 ± 3.2	0.15 ± 0.19	0.03 ± 0.13	0.07 ± 0.05	0.28 ± 0.17	Tr	0.14 ± 0.10
Blubber	1973	15	83.0 ±13.1	1.10 ± .43	0.13 ± 0.12	0.19 ± 0.14	1.34 ± 0.59	0.050 ± 0.046	1.08 ± 0.53
	1971	10	97.8 ± 4.3	2.44 ± 1.45	0.50 ± 0.32	0.50 ± 0.32	1.41 ± 0.66	0.064 ± 0.483	2.46 ± 1.38
Brain	1973	14	6.6 ± 0.8	0.01 ± 0.01	0.01 ± 0.01	-	0.02 ± 0.02	Tr	0.03 ± 0.04
	1971	10	7.5 ± 1.3	0.02 ± 0.01	Tr	0.06 ± 0.19	0.09 ± 0.17	Tr	0.05 ± 0.13
Kidney	1973	13	14 4 ± 9.2	0.43 ± 0.75	0.04 ± 0.06	0.03 ± 0.03	0.49 ± 0.82	0.012 ± 0.019	0.43 ± 0.44
	1971	ND							

- = non detectable

ND = no data

Tr = trace

*Frank et al., 1971.