DDT and PCB Levels and Reproduction in Ringed Seal from the Bothnian Bay

Report

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The serious DDT and PCB contamination of the Baltic area might explain the rapid decrease of the Baltic seal populations. In the Bothnian Bay only 27 percent of the Ringed Seal females of reproductive age are pregnant, compared to a normal of 80–90 percent in areas with low levels of pollution. Significantly higher levels of both DDT and PCB have been found in the non-pregnant females compared to the pregnant ones.

In November, about four months before normal pupping, half of the non-pregnant females showed enlarged uteri and scars in the uterine wall. This indicates that implantation occurred, followed by resorption or abortion.

Comparing analytical data on Californian Sea Lions, where similar reproductive disturbances have been reported, it seems probable that PCB and not DDT substances are responsible for the perturbation of reproduction in seals.

During the last decades the seal populations in the Baltic area have been reported to decrease (1–4). The Baltic area is seriously polluted by DDT and PCB substances (5, 6), and the effect of these substances on the seal reproduction in the Baltic area has previously been discussed (7, 8).

Among Californian Sea Lions an increased number of aborted seal pups have been correlated to the levels of DDT and PCB (9). The PCB levels reported in this population are in fact of the same order as those of the Baltic seals. It is well known that DDT and PCB affect the steroid reproductive hormones (10–12), that they prolong the oestrus cycle and decrease the frequency of implanted ova (13–15).

In order to study the reproductive success of Ringed Seals in relation to the levels of DDT and PCB, 40 female Ringed Seals (*Pusa hispida* Schreb) of reproductive age were collected in Finland (from Simo–the northern Bothnian Bay) in October–November 1973 and 1974 by seal nets. See Figure 1.

Pregnancy lasts about 11 months, including around three months delayed implantation, and the breeding period is in March (16). In October–November the females can easily be separated into pregnant and non-pregnant specimens since the length of the foetus at that time is about 30–45 cm. Blubber of the females has been analyzed for DDT and PCB. The analytical method has previously been published (6).

The reproductive success of the Simo population of Ringed Seal has recently been studied. Only 27 percent of mature females were found to be pregnant (7), whereas the corresponding figures for the same species in the Choska inlet and the Ochotskan Sea were 62.5 percent and 85–90 percent respectively (17–18).

Since no simple correlation for age against DDT and PCB levels was found, the material has been assumed to be normally distributed. The equality test has been performed according to Student's t-test.

RESULTS AND DISCUSSION

The mean levels of DDT and PCB substances in blubber of seal from this northernmost part of the Bothnian Bay are lower than those in the Baltic proper and the Gulf of Bothnia. See Table 1. This means that the seal population with the lowest levels of organochlorines in the Baltic area is nevertheless relatively unsuccessful at reproduction. If organochlorines were responsible for the low reproductive rate in this material, a difference in levels of organochlorines between pregnant and non-pregnant females would be expected. Thus these two groups were separated. See Table 2. The mean levels found in the group of non-pregnant females are higher than the corresponding levels for the pregnant ones. The differences are significant: see Table 2. It ought to be added that within the group of non-pregnant females, some specimens might be sterile for other reasons than the presence of organochlorines. This might decrease the mean values and increase the variance in this group. Furthermore, the females found pregnant would not necessarily produce offspring, since both resorption and abortion might occur during the rest of the pregnancy.

In this material all specimens in both groups had a corpus luteum in one ovary. This means that all females had ovulated. In the 1974 material, about half of the non-pregnant females showed enlarged uteri and scars in the uterine wall, which implied that implantation had occurred but abortion, resorption or maceration had followed.

The effects of organochlorines on the reproduction of Californian Sea Lions and Baltic seals have been discussed (7–9). In both populations the levels of PCB and DDT substances are high. It is difficult to separate the effect of one single group of these substances to see if one or both groups are interfering with reproduction. However, looking for the levels found in Sea Lions breeding normally, it is obvious that these DDT levels are as high as those in the Baltic seals that fail to breed (9). The PCB levels, on the contrary, are much lower in the normally breeding Californian group than in the Baltic seals. Thus the danger may lie in PCB or other substances co-varying with PCB, which are for the present unknown.

Figure 1. Sampling areas of seals from the Baltic.

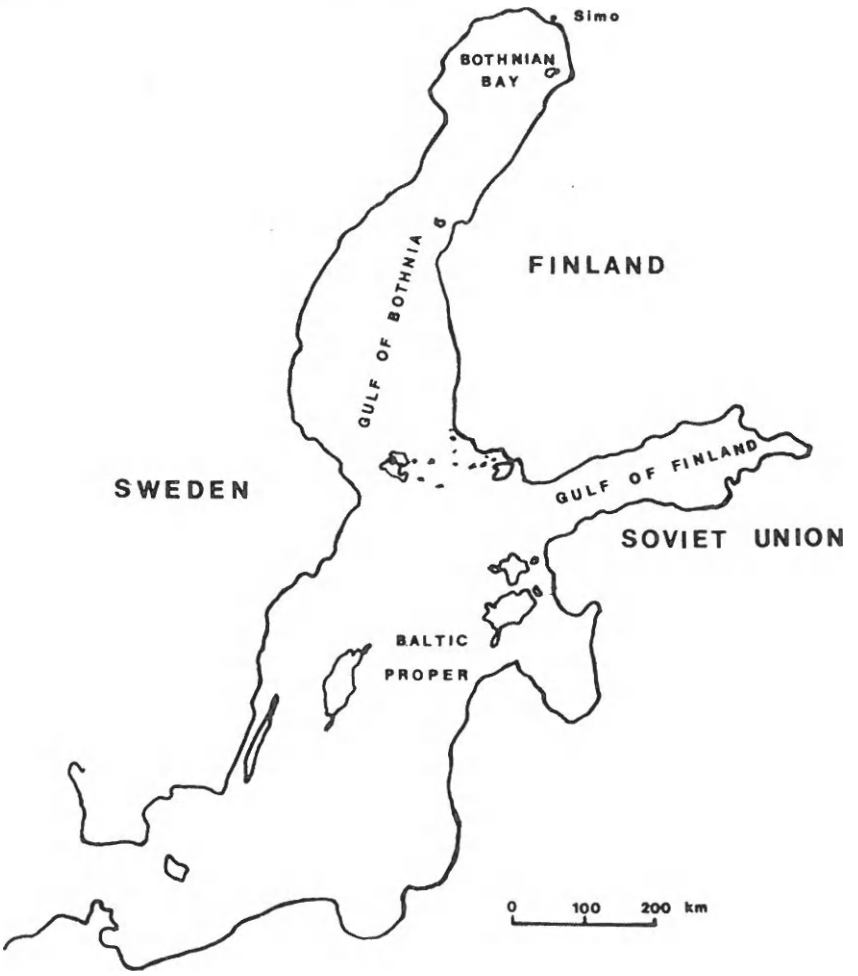

Table 1. Levels of DDT and PCB substances in extractable fat of blubber from Ringed Seal and Grey Seal from the Baltic area.

	Ringed Seal n	sDDT*	PCB*	Grey Seal n	sDDT*	PCB*
Northernmost part of the Bothnian Bay	40	110 ± 10**	69 ± 4.4**			
Gulf of Bothnia***	33	200 ± 28	110 ± 15	15	210 ± 28	100 ± 18
Baltic proper***				18	420 ± 53	140 ± 17

* Mean (mg/kg) ± S E ($\frac{S}{\sqrt{n}}$)
** Values from the Bothnian Bay significantly lower than those from the Gulf of Bothnia ($p < 0.05$).
*** Previously published data (8) for Grey Seals from the Baltic proper and the Gulf of Bothnia and Ringed Seals from the Gulf of Bothnia included for comparison.

Table 2. Levels of DDT and PCB substances in extractable fat of blubber found in non-pregnant and pregnant Ringed Seal of reproductive age.

	n	sDDT*	PCB*
Non-pregnant	26	130 ± 13**	77 ± 5.2**
Pregnant	15	76 ± 11	66 ± 6

* Mean (mg/kg) ± S E ($\frac{S}{\sqrt{n}}$)
** Values of non-pregnant females significantly higher than those of pregnant DDT $p < 0.01$, PCB $p < 0.05$.

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