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REPORT FROM FALSTERBO BIRD STATION No. 43

Effect of PCB on Nocturnal Activity in Caged Robins, *Erithacus rubecula* L.

CHLORINATED hydrocarbons are a recognized threat to populations of wild birds, but their precise mode of ecological action is largely unknown. They are, however, known to have a thinning effect on the egg shell[1,2], and they react with some hormones[3,4], thus affecting the endocrine balance of the body. Such findings suggest that these substances may exert a profound influence on the activity and behaviour of contaminated animals, but little attention has been devoted to this aspect.

The migratory activity of birds is governed chiefly by the interplay of hormonal systems[5,6], and the orientation of the migrants is a highly refined instinct pattern. This suggests that the nocturnal activity of affected migratory birds might be a suitable indicator of the possible ecological effects of organochlorines.

The robin, *Erithacus rubecula* L., in Sweden is almost completely migratory, moving exclusively by night. Its main flight direction during the autumn migration is SW–SSW. Robins were trapped at Falsterbo Bird Station (55° 23′ N, 12° 50′ E) in the last week of September 1970. They were kept singly in opaque plastic containers under a natural light–dark rhythm and were fed mealworms and berries *ad lib.* Beginning on October 2, twenty-eight robins were given one extra mealworm each day, injected with 5 μg of 'Clophen A50', a polychlorinated biphenyl (PCB). These worms were marked with a small dot of red dye to enable us to determine whether the worm had been eaten; in a few cases it was not taken. Eighteen robins were kept in identical conditions but were not given worms containing PCB.

The experiments were performed between 1900 and 2100 on October 21 and 22 (within the normal migratory period of Swedish robins) on birds which had eaten eleven to thirteen PCB-loaded worms. The experimentally contaminated and control birds were placed singly in Emlen funnels under the open sky at a site 20 km east of Lund, where no artificial light sources interfered. During the first night the sky was overcast, and the experiment was discontinued after 35 min because of rain. During the second night, cloud-cover was approximately 1/8, and the experiment was continued for 75 min as planned. The evaluation of the activity sums and of the mean vectors of the birds followed the procedures described by Raböl[7,8]. On the first occasion, twenty PCB-loaded and twelve control birds were tested, and on the second, nineteen and eleven birds, respectively. With a few exceptions, the same individuals were used in both experiments.

The average activity sums were compared separately for each night using a Mann–Whitney U test (two-tailed). The average activity on the first night was much higher in the PCB-loaded birds than in the controls, but the difference was not quite significant. On the second night, when the experiment ran for a longer period, the average activity of the PCB-loaded birds was significantly higher than that of the controls ($P < 0.05$). The dispersion of the mean vectors was greater on the overcast night of October 21 than on the following night which was cloudless. No significant differences between PCB-loaded and control birds with respect to direction or dispersion were detected on either night. The direction was the same as the supposed standard migratory direction of Swedish robins.

The age[9] and body weight of control and PCB-loaded birds were compared, and no significant differences were found. Both groups had gained weight equally by comparison with birds weighed immediately after trapping at Falsterbo[10].

The breast muscles of six PCB-loaded birds and four control birds were analysed by gas chromatography for organochlorine content (Table 1). The apparatus consisted of a Varian Aerograph 204 gas chromatograph equipped with electron capture detectors, and three different columns using SF 96 (4%), QF I (8%) and SF 96/QF I (3:1) as the stationary phases on GasChrom P (100/120 mesh) were utilized. The identity of the more important compounds detected was also confirmed by chemical techniques. The PCB level in the experimentally contaminated birds was four times that found in the controls, the difference being statistically highly significant, but it was in unexpectedly low concentration, indicating that much of it had been excreted or stored elsewhere than in the breast muscles. Both groups of birds were also analysed for *p,p'*-DDE and *p,p'*-DDT, but no significant differences were detected.

These results demonstrate an effect of organochlorine residues on the activity patterns of the bird. Gwinner[11] demonstrated a correlation between the degree of migratory

Table 1 Organochlorine Residues (ng/g Fresh Weight) in Breast Muscles of Robins

	μg of PCB ingested	*p,p'*-DDE	*p,p'*-DDT	PCB
Birds fed with PCB	60	95	7	375
	55	96	25	467
	65	75	25	341
	55	64	24	164
	60	91	22	365
	55	56	2	287
Control birds	—	72	23	120
	—	69	27	70
	—	70	30	90
	—	66	26	51

activity (restlessness) and the distance between the breeding and wintering quarters in different warbler species of the genus *Phylloscopus*. A quantitative change in such activity therefore assumes great ecological significance. The rapid mobilization of fat during migration is also an important aspect of this problem[12,13].

PCB compounds occur widely in the global ecosystem and, like other chlorinated hydrocarbons, they accumulate in food chains[14,15]. Their effects, even at the relatively low levels used in these experiments, indicate that they are important environmental contaminants.

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