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Occurrence of Mercury in Feathers from Scottish Peregrines (*Falco peregrinus*)

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The use of mercury and especially organic mercury compounds in industry and agriculture has led to contamination of the natural environment. Alkyl mercury compounds have been used as a seed-dressing agent and show great chemical stability and accumulate readily in the food web.

In Sweden, many raptorial and seed-eating birds declined severely during the 1950s and 1960s due to the use of alkyl mercury compounds. Other mercury compounds such as phenylmercury and alkoxy-alkyl mercury are easily degraded and are much less hazardous to birds (BORG et al. 1969, WESTERMARK et al. 1975). The use of alkyl mercury in agriculture was banned in Sweden in 1966, after which the levels of mercury in certain terrestrial birds declined (WESTERMARK et al. 1975).

The aquatic environment was locally contaminated with mercury used in different industrial processes within the paper and pulp industry, the chlor-alkali industry and others (JENSEN et al. 1972, FIMREITE 1974). Inorganic mercury that reaches the aquatic environment can be methylated to the stable methyl-mercury (WOOD et al. 1968). This process can also occur in the terrestrial environment (BECKERT et al. 1974). In Britain alkyl mercury compounds have not been used on any great scale. Industrial contamination of the aquatic environment with mercury compounds is relatively minor and localized.

Mercury may, however, have entered the food web with birds migrating through, and wintering in,Britain. Mercury levels can be measured in feathers and have been associated with levels present in the environment (JOHNELS et al. 1968). The mercury level found in the feather is related to the methylmercury content of the blood at the time of feather formation (WESTERMARK et al. 1975). The mercury levels varies between different parts of the same feather, probably dependant on differentiation of mercury in the bloodstream when the feather was formed (BERG et al. 1966). The mercury level can thus vary both within individual feathers

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and between different feathers from the same individual.

This paper deals with the occurrence of mercury in moulted feathers and feather samples from Scottish Peregrines.

MATERIALS AND METHODS

Moulted feathers (11 primaries, 7 secondaries, 3 tailfeathers) were collected from 8 different breeding sites in southern Scotland (55°50´N 4°00´W) during April-July 1975-77.

In addition feather samples were taken from (a) a female Peregrine found injured in Speyside, Inverness (57°00´N 4°30´W) 1976; (b) 2 Peregrines (originating from Speyside in 1977) kept in captivity in Sweden; (c) 2 young Peregrines from different nests in Killwheny, N.E. Scotland (57°00´N 5°30´W), 1976.

The total mercury content in the feathers was analysed using the neutron activation method (SJÖSTRAND 1964, CHRISTELL et al. 1965). The analyses on moulted feathers were all done on the proximal part of the shaft; the other samples were taken from the distal part of the feather and included some vane. Levels are expressed in µg/g (dry-weight).

RESULTS

In tables 1 and 2 the mercury levels for the different samples are given. As the levels vary for different feathers from the same bird we could not compare all the feathers from different birds. Comparing the same feathers from different birds also shows a large variation. The sample sizes for the 'between site' and 'between sex' comparison are to small to test for significance. The major result was that levels lie within the range 0.45-7.8 µg/g (mean value 2.4). Levels of 2.6-2.8 in an adult bird (table 2) decreased after one year in captivity to levels ranging from 0.46 to 1.0 µg/g. Similar low levels (0.45-0.85 µg/g) were found in the two other Scottish Peregrines kept in captivity.

DISCUSSION

The mean ± S.D. of levels for the adult birds, 2.4 ± 2.1 µg/g, was low and similar to levels considered to be the normal background level for Peregrines in Sweden before the pesticide-era. The mean level for feathers from eleven Swedish Peregrine skins collected in 1834-1940 was 2.6 ± 1.1 µg/g (BERG et al. 1966). High levels (ca 15-20 µg/g) are still found in Peregrines

TABLE 1. Hg contents of moulted feathers from adult Peregrines in Scotland, 1975-77. Levels (µg/g,dry-weight) reflect contamination at least one year before collection date.

Locality	Type of feather	Sex	Collected	Hg µg/g	Mean Hg µg/g according to sex and site
A	prim.4-5	F	June-July 1976	2.6	
B	prim.3-4	F	June-July 1976	1.2	1.2 F (n=2)
	sec.	F	" " "	1.2	
C	prim.4-5	F	June-July 1976	2.6	1.4 F (n=4)
	" 5-6	F	26.7.1977	1.2	
	sec.	F	" "	0.45	
	sec.	F	" "	1.2	
D	prim.3-4	F	26.7.1977	1.1	1.0 F (n=3)
	tail 3	M	" "	1.3	
	sec.	F	" "	1.0	
	sec.	F	July 1976	0.84	
E	prim.4-5	F	July 1977	7.8	4.3 F (n=2)
	prim.9	M	April-May 1977	1.9	
	tail 5	F	" " "	0.73	
F	prim.1	M	22.8.1976	2.7	4.0 M (n=4)
	tail 2	M	" "	3.2	
	sec.	M	" "	3.0	
	sec.	M	April-July 1975	7.1	
G	prim.4-5	F	June 1976	5.5	3.0 F (n=2)
	prim.9	F	" "	0.56	
H	prim.6-7	F	June 1976	2.3	

TABLE 2. Hg contents of feathers from Scottish Peregrines kept in captivity in Sweden. The levels from locality III reflect the contamination of mercury in the natural prey the young have been fed in the wild. The levels from group Ib and II are from feathers cut from the 2nd plumage and hence reflect the diet in captivity.

Group	Locality, origin	Collected	Sample technique	Type of feather	Sex	Age	Hg µg/g	$\bar{x}$ µg/g
Ia	Speyside, Inverness	July 1975	prox. part	tail 1st plum.	F	Juv	2.8	
		" "	" "	prim. " "	F	"	2.6	2.7
Ib		20.8.1976	dist. part cut	tail 2nd plum.	F	Ad	0.46	
		" "	" " "	sec. " "	F	"	1.0	0.74
II	Speyside, Inverness	20.8.1976	dist. part cut	tail 2nd plum	F	Ad	0.45	
		" "	" " "	sec. " "	F	"	0.57	
		" "	" " "	tail " "	M	Ad	0.56	
				sec. " "	M	"	0.85	0.61
III	Killwheny, Inverness	15.8.1976	dist. part cut	tail 1st plum.	M	Juv	1.0	
		" "	" " "	sec. " "	M	"	0.70	
		" "	" " "	tail " "	F	Juv	0.40	
		" "	" " "	sec. " "	F	"	0.84	0.74

from northern Fennoscandia, probably due to the high proportion of waders in the diet. The aquatic food web in Sweden is more contaminated with mercury than the terrestrial web.

Peregrines transported from Scotland to Sweden showed a decrease in mercury levels in the second moult. This is due to the change from wild caught prey to controlled food - day old chicks, laboratory rats and pigeons. Two young Peregrines from N.E. Scotland (table 2) had levels comparable to falcons in captivity. This is either because the wild prey had low mercury levels or because the young had been exposed to mercury in the food webs for only a short time.

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