återvänt. Med stor pliktkänsla och aldrig svikande noggranhet ledde mag. Nordström ringmärkningsbyrån. Det lavinartat växande intresset för fåglar och även för ringmärkning krävde allt mera av byråns personal, och speciellt av dess föreståndare. Genom sin lugna läggning och sitt vinnande sätt höll han den ofta ungdomligt entusiastiska ringmärkarskaran under kontroll och han klagade aldrig över den arbetsbörda, som mänskligt att se dock de senaste åren var för tung. Inom Ornitologiska föreningen innehade mag. Nordström tvenne förtroendeuppdrag: Han var redaktionssekreterare för Ornis Fennica från 1950 till sitt frånfälle och var föreningens skattmästare sedan år 1952.

Mag. Nordström var en mycket kunnig ornitolog. Han har publicerat ett flertal uppsatser av fältornitologiskt innehåll, de flesta i Ornis Fennica. Därjämte var han en intresserad botanist, och hans exkursioner resulterade även i flera botaniska uppsatser. Största delen av hans ca 50 publikationer utgöres emellertid av de årligen återkommande synnerligen noggranna och digra sammanställningarna över utförda ringmärkningar och gjorda återfynd. Vidare har han sammanställt återfynden av ett flertal arter samt gett ut översikter över fynd av utländska ringfåglar i Finland.

Ornitologiska föreningen och landets ornitologer hedrar minnet av en hängiven naturvän, en exakt vetenskapsman och en god kamrat.

High residue of mercury in Finnish white-tailed eagles

Kurt Henriksson [1], Eeva Karppanen [1] and Matti Helminen [2]

The numbers of the white-tailed eagle (*Haliaëtus albicilla*) have been gradually decreasing in the coastal areas and archipelagos of Finland during this century. In the Gulf of Finland area the species disappeared during the First World War. At present the main breeding areas of the species are the Åland Islands and the Southwestern Archipelago. A few pairs also nest in the Quarken area in the central part of the Gulf of Bothnia. Bergman (1964) has estimated that the number of the breeding pairs in Finland two decades ago was around 35. However, the number is now rapidly decreasing; this is due particularly to the fact

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that nesting of most of the pairs remains without success. Since virtually no more offspring are being produced in Åland and in the Southwestern Archipelago, it is possible that within a decade the white-tailed eagle may totally vanish in these areas (BERGMAN op.cit.).

Several factors may have contributed to the decrease of the species in Finland. Earlier, in particular, shooting of birds and indiscreet plundering of the eyries may have constituted the severest threat to the species. The increase in summer cottages and boating in the archipelago may also disturb the birds during the nesting season. On the other hand, the propaganda of the last decades for the protection of the white-tailed eagle has resulted in a more lenient attitude towards the species and thus secure nesting in some places.

Low fertility now poses a new threat to the survival of Baltic eagle populations. For instance, in 1962 the 13 breeding pairs observed in Åland produced at the most 4 young to fledge and in the year 1964 probably only one fledgling was brought up in the 10—12 occupied eyries in the same area (BERGMAN 1964). In summer 1966 the eagles of the Åland area probably did not nest at all: no eggs were found in the eyries checked (J. Harberg, Mariehamn, personal note) Furthermore, it may be mentioned that 8 fully-grown birds were found dead in Åland in the spring and summer of 1966 (only 4 of them were received for investigation, see below; 4 additional carcasses were not sent in due to their poor condition when found). Poor nesting success has been observed in some other breeding areas, too. It has been supposed that the poor reproductive success is caused by pesticide contamination, in particular, by seed dressings containing mercury (Hg) and by organochlorine pesticides. In Sweden, BORG et al. (1965) have found high contamination of mercury in addled eggs of this species, and BERG et all. (1966) have shown that the Hg concentration in its feathers has increased considerably since the early 1950's.

There is reasonable evidence that the organochlorine contamination has resulted in poor nesting success of the bald eagle (*Haliaëtus leucocephalus*) especially in the central Atlantic States of U.S.A. (U.S. Fish and Wildlife Service 1963, 1964, 1965) and of the golden eagle (*Aquila chrysaëtos*) in Scotland (LOCKIE & RATCLIFFE 1964). Furthermore, many other species of raptorial birds have recently suffered a serious decline connected with poor nesting success in at least part of their geographical range, e.g. peregrine (*Falco peregrinus*) (LINKOLA 1959 and 1964, RATCLIFFE 1963 and 1965), kestrel (*F. tinnunculus*) and sparrow hawk (*Accipiter nisus*) (Cramp 1963) as well as osprey (*Pandion haliaëtus*) (U.S. Fish and Wildlife Service 1963, 1964, 1965).

Experimental studies have shown that hatching success and chick survival of some bird species are reduced on diets containing chlorinated hydrocarbons (U.S. Fish and Wildlife Service 1963, 1964, 1965, see also deWitt et al. 1960) or seed dressings with mercury (Borg et al. 1965).

In studies made at the State Veterinary Medical Institute special attention has been paid to the eventual rôle of pesticides in the decline of the white-tailed eagle in Finland. These investigations are carried out as a part of a larger pesticide research project in co-operation with the State Game Research Institute.

Material and methods

In 1965 one carcass and in 1966 five carcasses of white-tailed eagle found dead were sent in for investigation (see Case histories, p. 44). Regrettably all the samples were more or less decayed. In connection with postmortem examinations organs (see table 1) were removed for analyses of mercury (in 1966 also of organochlorines). Bacteriological and parasitological examinations were made of the fresher samples.

In analysing mercury a modified dithizon method based on the methods described by Gutenmann and Lisk (1960) and by Rajama, Hiltunen and Hilpi (1964) was used. The presence of organochlorine compounds was demonstrated by gas chromatography with electron capture detector but owing to difficulties in identifying the various residues no quantitative results can be published at this stage of the work.

Results

Results of the autopsies and chemical analyses are shown in the list of case histories and in table 1. Bacteriological and parasitological examinations revealed nothing of significance. In addition to mercury all five eagles of 1966 carried organochlorine residues of which one, supposed to be DDE (1,1-dichloro-2,2-bis(p-diphenyl)-ethylene, a metabolite of DDT), was present in large quantities.

Table 1. Mercury residues (mg/kg) in the organs of 6 Finnish white-tailed eagles (— = not analysed).

Sample no.	1970/65	3885/66	4005/66	4130/66	4191/66	4331/66
Liver	4.6	27.1	19.8	12.2	24.7	19.0
Kidney	—	123.1	115.7	48.6	—	86.7
Muscle	2.4	8.5	1.9	3.5	3.5	3.3
Brain	—	—	—	—	8.1	—
Heart	—	—	—	—	—	4.6
Ovary	—	24.7	—	8.0	—	—
Feather	—	8.7	—	—	28.5	—

Discussion

High concentration of mercury in the organs gives evidence that the residues assumed to be toxic caused the death of the 5 eagles in 1966. Similar concentrations of mercury were demonstrated by Borg et al. (1965) in experimental pheasants, jackdaws and magpies fed lethal doses of grain dressed with an alkyl-mercury compound. However, the concentration in muscle tissue was higher in the experimental pheasants than in the eagles. This may be due to the fact that the intake of mercury was more intensive in the experiment than in the natural environment.

Borg et al. (op.cit.) also showed that alkyl-mercury compounds reduced the hatchability of pheasant eggs. They also found high concentrations of mercury in addled eggs of white-tailed eagle collected in Sweden. Although no Finnish eagle eggs have been available for analyses, we consider it evident that the eggs contain mercury also in Finland, as a natural consequence of the high contamination found in the mature female birds investigated. The two female birds whose ovaries were analysed had growing follicles with a high amount of mercury (see table 1).

Besides mercury, residues of chlorinated hydrocarbons found in the organs may have contributed to the weakening of the birds. However, very little is known of the possible coeffects of chlorinated hydrocarbons and mercury. The findings of Borg (1958) refer to cumulative toxicity in simultaneous application of mercury and organochlorine compounds.

In trying to find the origin of the mercury in the Finnish white-tailed eagles attention must be paid to the different toxicity and use of the seed dressings of various types. The alkyl-mercury compounds have at least in the experiments, caused severe symptoms of intoxication and deaths (Borg et al. 1965). On the other hand, in our own experiments with pheasants and domestic chicken (unpublished material) the alkoxyalkyl-mercury compounds have so far caused no visible symptoms of intoxication. As regards the use of the compounds, relatively small amounts of alkyl-type seed dressings have been used in Finland (P. Köppä, Plant Protection Inspector, personal note). The same seems to hold true in the Åland Islands (R. Vennström, District Veterinary Officer, Mariehamn, Åland, in litt.). As a consequence of this no deaths among wildlife caused by the seed dressings have so far been diagnosed, although sublethal amounts of mercury have been found in some animals (Henriksson et al. 1966, and unpublished data). These observations agree the recently published data on mercury content in feathers of Swedish birds (Berg et al. 1966): use of seed dressings of alkoxyalkyl-types during the 1930's did not cause accumulation in birds' feathers; increased residue levels were found only after the introduction of the alkyl-Hg-compounds in the 1940's.

Furthermore, the use of chlorinated hydrocarbons is rather limited in Finland (Köppä 1965), and the few analyses so far made have shown only very low or no organochlorine contamination in resident bird species (unpublished data). Thus it is improbale that the mercury and organochlorine residues found in the white-tailed eagles originate in the pesticides used in the breeding area.

Although it is not possible to find the origin of the mercury with certainty, it is probable, judging by what has been said above, that the residues are obtained outside the breeding area. If this assumption holds good two possible ways of biological transport may be suggested: (1) the eagles may obtain the residues when living outside the summer range and (2) contaminated prey individuals may bring them in from their wintering grounds.

(1) Although the adult eagles breeding in the Åland area and in the Southwestern Archipelado tend to winter within their summer range, the immature birds are regular migrants up to the age of 5—6 years and winter mainly in the coastal areas of Southern Sweden and Denmark. It should also be noted that such cold winters as that of 1965—66, with the Baltic Sea largely freezing, may force even adult birds to

move southwards. It is likely that during their wintering trips the eagles reach areas where mercury contamination of the prey species is common (see Borg et al. 1965).

(2) The food of the white-tailed eagle in the breeding area consists mainly of fish and sea-birds (v. Haartman et al. 1965). Fish in some areas is known to contain high concentrations of mercury partly natural, partly originating in seed dressings and in fungicides used in the wood industry (Johnels 1966). Thus it is likely that mercury is accumulated in fish-eating birds, as in white-tailed eagles and, for instance, in goosanders (*Mergus merganser*) and red-breasted mergansers (*M. serrator*), which in their turn are preyed upon by the eagles. Another possible food chain in which aquatic mercury may accumulate is plankton — mussel (*Mytilus*) — eider duck (*Somateria mollissima*). Both of these food chains need further investigation, since mergansers and eider ducks are important food items of the eagles. Supporting the suggested rôle of eider duck in accumulating mercury are the high values observed in the one eider obtained from the area in question (muscle 3.9, liver 12.9, and kidney 1.6 mg/kg.)

The white-tailed eagle is known to be a poor catcher of prey and thus it often takes individuals which have already weakened for one reason or another. Some mercury and organochlorine compounds are thought to slow down the normal reflexes and to reduce the sensory activity. This increases the likelihood of individuals with chronic intoxication being caught by predators. Furthermore, the white-tailed eagle feeds on carrion, which may also be contaminated.

Conclusion

The high level of mercury and organochlorine compounds found in the white-tailed eagles investigated strongly supports the assumption that the recent decline of the species in Finland is mainly caused by pesticide contamination. This contamination seems to increase the mortality of the fully-grown birds and is assumed to be the cause of the reduced reproductive success.

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Case histories:

1970/65 Skinned carcass received on April 23, 1965. Found dead in Velkua, Southwestern Archipelago about two weeks earlier. Male. Nutritional state normal. Pneumonia necroticans, Aerocystitis caseosa. Cause of death: Pneumonia et aerocystitis (mycotica?) Note: organochlorine content of this individual was not analysed.

3885/66 Skinned carcass in poor condition received on May 25, 1966. Found dead in N. Degerskär, Eckerö, Åland. This bird and the other three Åland individuals, were found on dry land in places where they had lived for some weeks at least (judging by the amount of feces on the ground; J. Harberg, personal note). Female. Developing follicles in the ovary. Nutritional state poor. Cause of death: Intoxication by Hg-(and organochlorine) compounds.

4005/66 Badly rotten carcass received on June 2, 1966. Found dead in N. Koskär, Eckerö, Åland. Determination of sex not possible. Nutritional state normal. Cause of death: as above.

4130/66 Skinned carcass received on June 7, 1966. Found dead in Vandö, Finström, Åland. Female. Developing follicles in the ovary. Nutritional state normal. Intestinal hyperemia. Pulmonary hemorrhages. Cause of death: as above.

4191/66 Badly rotten carcass received on June 8, 1966. Found dead in Långkläpp, Björkör, Föglö, Åland. Determination of sex not possible. Part of the back, including kidneys and sexual organs, lacking. Nutritional state poor. Cause of death: as above.

4331/66 Skinned carcass in poor condition received on June 15, 1966. Found dead in Larsmo, Ostrobothnia on June 14. Female. Nutritional state poor. Myocardinal fatty changes. Cause of death: as above.

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Selostus: **Suuria elohopeapitoisuuksia Suomen merikotkissa.**

Pohdittaessa merikotkien viimeaikaisen vähenemisen syitä on tuotu esiin kasvinsuojeluaineiden eli biosidien aiheuttamien myrkytystilojen mahdollinen osuus pesintätulosta alentavana tekijänä. Kuuden kuolleena löytyneen merikotkan elimistä suoritetut kemialliset analyysit tukevat tätä olettamusta. Viiden keväällä ja kesällä 1966 löydetyn merikotkan sisältämät elohopeamäärät olivat niin suuria, että lintujen katsotaan kuolleen elohopeayhdisteistä aiheutuneeseen myrkytykseen. Mainituissa kotkissa todettiin myös suuria määriä kloorattuja hiilivetyjä. Täten biosidit näyttävät lisäävän aikuisten lintujen kuolleisuutta. Toisaalta on olemassa riittävät perusteet otaksua, että ne alentavat pesintätulosta. Merikotkien sisältämien biosidien arvellaan ainakin suurelta osalta olevan peräisin maamme rajojen ulkopuolelta. Nuoret kotkat voivat talvisilla muuttomatkoillaan kerätä niitä itseensä, ja toisaalta kotkan ravinnokseen käyttämät vesilinnut voivat elimistössään tuoda niitä meille talvehtimisalueiltaan.

Observations on the bird fauna in Koitilaiskaira (Finnish Lapland)

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Introduction

The observation area consists of a planned nature reserve around the fjeld Koitilainen north of the river Luiro (KemL), 67° 45′ N (Fig. 1). According to, for instance, MERIKALLIO (1958), the area lies in the southern part of Forest-Lapland (Metsä-Lappi).