

Decrease in eggshell thickness of the White-tailed Eagle in Finland during 1884—1971

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The thicknesses of the eggshells of the White-tailed Eagle *Haliaeetus albicilla* collected quite recently (1967—1971) were compared with older ones (1884—1935) from museums. Statistically highly significant decrease ($P < 0.001$) was noticed. The writers suggest that this may be caused by polychlorinated hydrocarbons.

The nesting results of the White-tailed Eagle have during the 1960's continuously decreased in the Quarken area of the Gulf of Bothnia (PALOKANGAS *et al.* 1970, KOIVUSAARI 1972). It has been suggested that a main reason for this is the increase in toxic agents in the environment (KOIVUSAARI *et al.* 1972).

The carcasses of two White-tailed Eagles found dead in the Quarken Straits contained noticeable amounts of mercury (HENRIKSSON *et al.* 1966, Andersson & Karppanen, pers. comm.) and the same was noticed in two addled eggs (KOIVUSAARI *et al.* 1972). The concentrations of PCB (polychlorobiphenyls) and DDE (1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene) of the same two eggs were measured and they were also high.

BORG *et al.* (1969) have shown that mercury in the diet of birds does not affect the number of eggs but rather their hatchability. Polychlorinated hydrocarbons are known to cause a diminished calcium carbonate content in the eggshell which increases the chances of the eggs being broken during incubation. They also lower the estradiol concentration in the blood with a consequent retardation in egg-laying (BITMAN *et al.* 1969, RATCLIFFE 1970).

The purpose of this study was to compare the thicknesses of eggshells of White-tailed Eagles in recent years (1967—1971, "test group") with specimens from a period when noxious pesticides were not used (1884—1935, "reference group"). This study is a part of a larger investigation by the authors into the ecology of the White-tailed Eagle in the Quarken Straits.

Material and methods

Pieces of eggshells were collected from nests after breeding (1967—1971) in the region of the Quarken Straits. The egg collections of the Zoological Museums of the Universities of Turku and Helsinki were used as reference group. Some eggs were also received from private collections.

To determine the thickness of the eggshell the lateral part of the egg was measured using a dial indicator (Käfer K20). The shell membrane was not removed. The mean of five measurements is used in the results.

Results

The results are given in figure 1. The thickness of the eggs in the reference group, in which the eggs were mostly from the Åland (Ahvenanmaa) archipelago in southwest Finland, was 0.614 ± 0.007 mm (\pm S.E., $n = 52$)

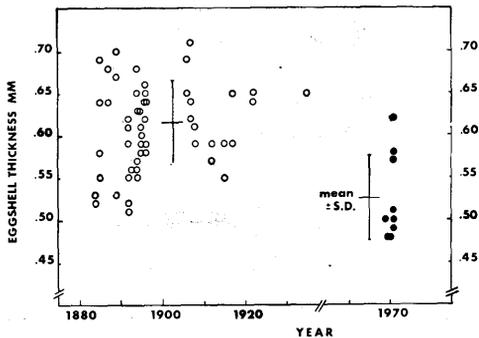


FIG. 1. The eggshell thicknesses of White-tailed Eagle *Haliaeetus albicilla* in Finland during 1884—1971.

and that of the eggs in the test group 0.525 ± 0.017 mm (\pm S.E., $n = 9$), respectively. The difference is statistically highly significant ($P < 0.001$, Student's t -test).

Comment

The shell thickness of many other birds of prey has also significantly decreased during recent decades (RATCLIFFE 1967, HICKEY & ANDERSON 1968, ODSJÖ 1971, BLUS *et al.* 1972). Experimentally it has been shown that DDT induces a decrease in eggshell calcium (BITMAN *et al.* 1969) and that dieldrin causes a decrease in eggshell thickness (LEHNER & EGBERT 1969).

ODSJÖ (1971) has measured the eggshell index ($= \frac{\text{weight} \times 1000}{\text{length} \times \text{width}}$) of Osprey eggs

collected in Finland ($n = 305$) and Sweden ($n = 342$) and shown that there has been a marked decrease in the index. We measured the shell thicknesses of osprey eggs from the Quarken Straits and a significant decrease ($P < 0.005$) was noticed between recent eggs (1970—1971, 0.365 ± 0.014 mm, $n = 9$) and older ones (1900—1944, 0.428 ± 0.010 mm, $n = 4$).

The decrease in eggshell thickness seems to be a general phenomenon among birds which are at a high level in the ecological food chain. In the light of the experimental data mentioned above the reason for this might be noxious pesticides, especially polychlorinated hydrocarbons.

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Selostus: Merikotkan munankuorten ohentuminen Suomessa 1884—1971.

Merikotkan munankuoret ovat vuosina 1967—1971 Merenkurkun alueelta kerättyssä aineistossa tilastollisesti erittäin merkitsevästi ($P < 0.001$) ohuempia kuin vuosisadan vaihteen molemmiin puoliin kerättyssä vertailuaineistossa (Kuva 1). Ohentumisen synnä saattavat olla ympäristömyrkyt, ennenkaikkea klooratut hiilivedyt, joiden on kokeellisesti osoitettu häiritsevän lintujen munien kehittymistä.

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