



Changes in Mercury Exposure in the Great Lakes Area, USA, as Shown by the Mercury Content of Moose Molars.

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1) INTRODUCTION

The Great Lakes area in the United States of America suffers from contamination by mercury. There are indications that the mercury flux to lakes in the northern part of USA has been increasing throughout this century. Animal experiments and human studies have suggested that molars act as indicators of mercury exposure. Teeth from a freeranging natural population of moose (*Alces alces*) dating back to 1915 are available from Isle Royale National park in Lake Superior (Fig. 1).

2) OBJECTIVES

It would be of value to establish whether the increase in mercury flux is reflected in biological media. The objective of the present pilot study was thus to investigate the use of moose molars to establish long-term trends in mercury content.

3) MATERIALS AND METHODS

Molars from 44 moose born between 1946 and 1977 were used in this investigation. The age of the animals was determined by counting growthlines in the dental cementum of teeth. One molar from each animal was embedded in plastic and cut in mesio-distal direction through the pulp with a mounted, watercooled diamond disc. Two samples of dentine were taken from each tooth and analysed in triplicate for mercury by cold vapor atomic absorption spectrophotometry. The mean of the mercury concentrations in the two samples were used in the calculations. The means were normally distributed. The statistical analysis was done using SPSS for Windows ver. 7.

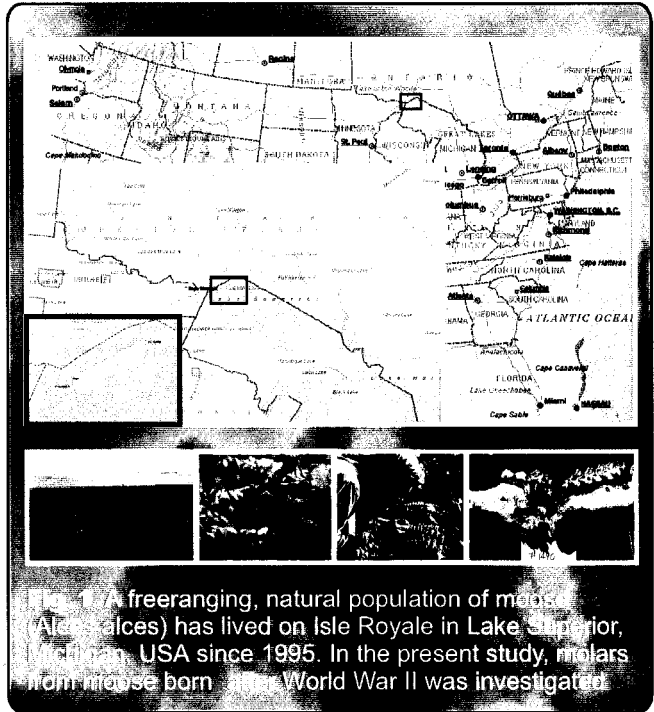


Fig. 1. A freeranging, natural population of moose (*Alces alces*) has lived on Isle Royale in Lake Superior, Michigan, USA since 1905. In the present study, molars from moose born since World War II was investigated.

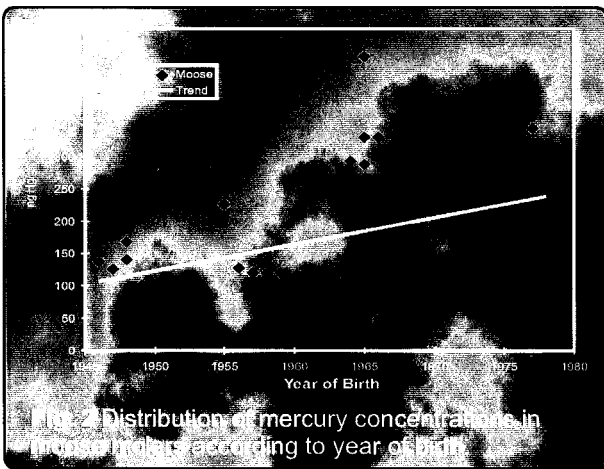


Fig. 2. Distribution of mercury concentration in moose molars according to year of birth.

Table 1

Year of Birth	Mean	SD	Median
Before 1960	135.0	35.8	125.3
1961-1970	182.9	97.3	161.6
After 1970	253.7	85.9	243.1
Total	180.6	90.4	150.9

Mean mercury concentrations, standard deviations (SD) and median mercury concentrations in moose molars grouped according to year of birth. All values are in ng Hg/g tooth-substance.

4) RESULTS AND DISCUSSION

The mean mercury content was 180.6 ng Hg/g tooth substance (Table 1). A significant correlation was found between the mercury content and the year of birth ($r = 0.36$, $p < 0.05$ - Fig.2). Partial correlation while controlling for the effect of the age of the animal gave $r = 0.40$, $p < 0.01$. One-way ANOVA with the Bonferroni adhoc procedure showed a statistically significant difference in the mean tooth mercury content between animals born before 1960 and after 1969 at the $p=0.05$ level. It has been shown that most of the mercury contamination in lakes and streams of nonindustrialised regions of USA is derived from atmospheric deposition. There is no local industry at Isle Royale or indeed any regular human residents. The moose of Isle Royale are isolated on the island with very little communication with animals on the mainland. Any increase in mercury content in the animals organs must therefore reflect long distance changes to the local environment. Molars can be used as biomarkers because they accumulate mercury during dentinogenesis and act as records of exposure. Our findings thus support the indications from other studies of increased flux of mercury into the lakes of the Northern part of USA and establish that molar teeth of moose provide an effective biomonitor of mercury exposure. The results also show that the increased mercury in the environment has reached large herbivores high up in the food-chain. A comparable situation can be assumed for fish at the top of the food-chain, producing a potential human health problem for consumption of fish.

5) CONCLUSIONS

- * There has been an increase in the mercury content of moose molars since World War II indicating an increased mercury exposure to higher animals.
- * The higher levels probably reflect an increase in the atmospheric deposition of mercury in the environment of Isle Royale.