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# This Week's Citation Classic™

**Johnels A G, Westermark T, Berg W, Persson P I & Sjöstrand B.** Pike (Esox lucius L.) and some other aquatic organisms in Sweden as indicators of mercury contamination in the environment. *Oikos* **18**:323-33, 1967.
[Swedish Museum of Natural History; Div. Nuclear Chemistry, Royal Inst. Technol.; and Isotope Techniques Lab., Stockholm, Sweden]

Neutron activation analysis of mercury (Hg) content of muscular tissue of pike (*Esox lucius*) has been used as a means of estimating contamination by Hg in the water environment. The relation between Hg content and weight/age of fish specimens is discussed. The effect of various sources of contamination was described and it was shown that Hg concentrations exceed natural levels in many cases. It was indicated that Hg also appears as an airborne pollution. [The *SCI*® indicates that this paper has been cited in over 115 publications, making it one of the most-cited papers for this journal.]

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"Our studies of mercury (Hg) as a noxious element in the environment started with a conversation over a cup of coffee after a meeting at the Royal Swedish Academy of Engineering Sciences in May 1964. We had never met before but knew of each other's existence and specialities (Johnels—vertebrate zoology with an inclination toward the water environment, Westermark—nuclear chemistry activation analysis and amateur botany and ornithology). Our discussion touched upon results reached by Borg *et al.* known from reports in newspapers concerning the effects on fauna of the use of Hg compounds as a seed dressing agent in agriculture.[1] We also noted a discussion among alert Swedish ornithologists noting a decrease of birds of prey, seed-eating birds, etc.

"We decided to make a few analyses of mercury in material from the water environment. The result was a surprise. We found 'high' levels in tissues of fish and considered this a motivation to continue. We initially had difficulties in getting the expensive analyses financed. One surprise was that there were sometimes higher levels of Hg in the fish from lakes in remote areas than in many industrialized regions. We postulated an aerial transport of so far unknown nature, also considering the possibility of an influence from the bedrock. Figures for Hg concentrations in fish exceeded a provisional 'health level' (several thousand ng/g as compared with 50 ng/g).

"Our work is an example of how to select organisms and organs within an organism for a study of noxious substances in the environment, and the advantage of a close interaction between the analyst and the biologist for a rewarding cooperation between the field and the laboratory. New sources of Hg and their relative effects on the water environment were detected, and a natural background level of Hg—a ubiquitous element due to its physical and chemical properties—could be discussed. Methods of sampling, analysis, and source detection were studied. Our work was summarized in a later paper,[2] also describing Hg analyses of birds' feathers and other materials leading to distinctions of terrestrial and aquatic ecology.

"Our studies helped distinguish between Hg sources affecting the terrestrial habitats on one side and the aquatic environment on the other. When this was understood, the case was a clear-cut story of environmental contamination, combining quantitative metal ecology and societal (food) risk management even on a governmental level. The blacklisting of many water areas threatened the interests of professional as well as sport fishing. It brought up the dreaded experiences of the Japanese Minamata and Niigata accidents as a pointed risk for humans with a high fish consumption in affected areas, although cases have not been observed in Sweden. It caused contacts between researchers and ministers, administrators, journalists, and large numbers of other environmentally interested persons.

"W. Berg made the preparations, B. Sjöstrand the activation analyses, and P.I. Persson collected and identified the insect species."

1. **Borg K, Wanntorp H, Erne K & Hanko E.** Alkyl mercury poisoning in terrestrial Swedish wildlife. *Viltrevy* 6:301-79, 1969. (Cited 90 times.)
2. **Johnels A G, Tyler G & Westermark T.** A history of mercury levels in Swedish fauna. *Ambio* 8:100-68, 1979. (Cited 5 times.)

 