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Do older cetaceans die from mercury contamination?

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In the frame of an interdisciplinary study of seabirds and marine mammals found dead (stranded and bycaught) including veterinarian (anato-pathology, microbiology, parasitology) and ecotoxicological aspects, we determined the concentraion of stable pollutants - organochlorine pesticides, PCBs, heavy metals - in cetaceans collected in the North Sea, the Kattegat and the French Atlantic coast. The sampling concerned different tissues (muscle, liver, kidney and blubber) from 30 common dolphins *Delphinus delphis*, 17 harbour porpoises *Phocoena phocoena*, 7 bottle-nose dolphins *Tursiops truncatus*, 2 striped dolphins *Stenella coeruleoalba*, 1 sperm whale *Physeter macrocephalus*, as well as 6 Norwegian minke whales *Balaenoptera acutorostrata*.

The study of mercury concentrations showed an important increase of total Hg with age (when age data are not yet available, the difference in concentration between juveniles and adults is highly significant)(fig. 1); organic (methyl) Hg was increasing as well, but at a much lower rate. As a consequence, the ratio MeHg to ΣHg (i.e. %MeHg) was strongly decreasing with increasing ΣHg level, and thus with age (fig. 2), providing a confirmation of the existence of a slow mineralization process in small cetaceans (Koeman *et al.*, 1973; Thibaud and Duguy, 1973; Capelli *et al.*, 1989; Joiris *et al.*, 1991, 1992).

This resulted, for older adults, in very high concentrations of inorganic Hg in the liver and 4 times higher liver to muscle and liver to kidney ratios for adults than for juveniles. In the case of the harbour porpoise, the level of detoxification was also determined: about 50% of the inorganic Hg in the liver of the adults were not bound to metallothioneins nor to selenium, and were thus potentially toxic.

PCB levels were relatively high, as expected, and indications were collected, reflecting the possible existence of problems of high Cd concentrations, while the other heavy metals did not seem to reflect the existence of any harmfull effect (table 1).

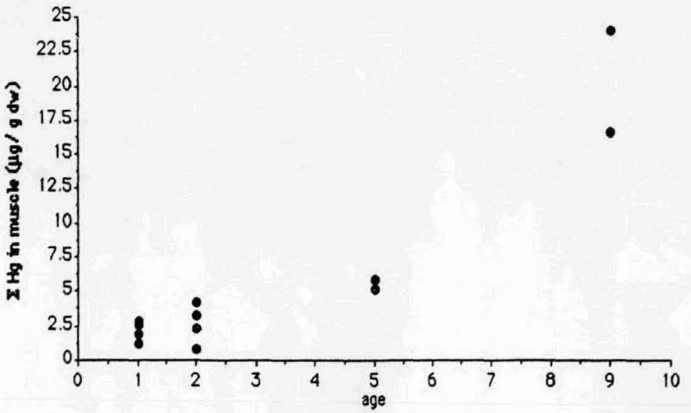

Figure 1: Relationship between total Hg concentration in muscle and age of harbour porpoises *Phocoena phocoena* from the North Sea and Kattegat areas.

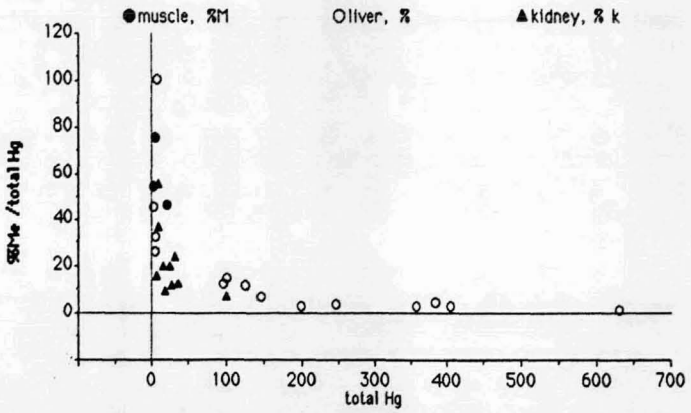

Figure 2: Percentage of Methyl mercury (%MeHg) in muscle, liver and kidney of common dolphins *Delphinus delphis* stranded on the French Atlantic coast, as a function of total mercury contamination (µg/ g dry weight).

Table 1: Synopsis of the data on heavy metals and organochlorines levels in harbour porpoises *Phocoena phocoena* from the North Sea and Kattegat areas (µg / g dw); mean (std dev); n = 21.

	Tissue muscle mean	std dev	liver mean	std dev	kidney mean	std dev
Σ PCBs	7.41	8.18			2.98	2.64
DDE	0.02	0.04			0	0
Σ Hg	5.6	6	71.66	144.9	8.96	8.31
MeHg	6.04	3.39	5.87	3.69	3.84	
% MeHg	79.3		44.5		60	
Zn	70.1	37.1	140.7	78.4	92.8	18.6
Pb	0.9	1.55	1.13	2.18	0.97	1.17
Cd	0.23	0.22	0.31	0.24	1.81	2.75
Fe	1105	596	2026	1162	1061	362
Cr	0.32	0.31	0.29	0.25	0.42	0.25
Cu	6.63	3.2	45.56	73.96	15.5	4.74
Ti	1.55	6.71	0	0	0	0.01

Pinnipeds and cetaceans present the exceptional phenomenon that their health status, more especially their reproduction potential, could be actually affected by pollution in nature, like it was the case for raptors in the sixties. It is generally recognized that the main threat is due to high PCBs concentrations. These effects of PCBs could be at the origin of viral mass mortalities of marine mammals, by repressing their immunological defense mechanisms, or on the contrary be a consequence of physiologcal stress, such as viral infection or starvation. In the frame of both interpretations, PCBs might anyway hinder the recovery of populations after the occurence of mass mortalities.

In the frame of a broader study of stable pollutants, however, it appears that one should take into account the levels of other residues as well. In our results, this seems to be the case for Hg and, possibly, for Cd.

Mercury contamination of small cetaceans and its evolution in time could be interpreted as follows: they are contaminated by methyl mercury, the main form of mercury in their food. Most of the mercury is present as MeHg in juveniles where it is accumulating in lipids. Later on, it is than slowly mineralized and remobilized (or first remobilized, as it seems to be the case for two dolphins from the Tyrrhenian Sea (Carlini and Fabbri, 1989), and then mineralized), and is accumulating as inorganic Hg in the liver, where it reaches very high levels. A detailed study of the speciation of this inorganic Hg is necessary, in order to detect which proportion is detoxified by metallothioneins or selenium, or remains potentially toxic. So that it does not seem excluded that not only PCBs, but also inorganic Hg might influence the health status of older animals.

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