Mercury in Antarctic marine ecosystems

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Information Paper submitted by Portugal, Bulgaria, France, Germany, Japan, United Kingdom

***Summary***

Mercury is one of the most toxic elements, highly bioaccumulative in organisms and biomagnifies along food webs, but information for the Antarctic region is lacking. This paper describes the most recent scientific information on total mercury in Antarctic marine foodwebs. Mercury concentrations increase with trophic levels, with highest concentrations in top predators (e.g. with known negative effects in some seabirds). Biomagnification of mercury is greater in Antarctic foodwebs than in foodwebs in subtropical and tropical regions. We encourage greater information exchange between Parties, more monitoring research and increased use of coordinated methodologies related to mercury and other trace elements/contaminants that have an Antarctic environmental impact.

### *Introduction*

Mercury (Hg) is one of the most known hazardous elements, with a global dispersion that reaches remote areas of the planet such as Antarctica, despite the absence of any manufacturing industry in the region. Mercury can be transported by atmospheric currents to Antarctica, where it condenses and precipitates in rain or snow, with katabatic winds redistributing mercury within Antarctica (Bargagli 2008). Furthermore, mercury accumulates in aquatic organisms and biomagnifies within foodwebs, and can be toxic to top predators. For the Antarctic region, there is a general lack of monitoring for mercury, which has prevented identification of the factors controlling the distribution of mercury and their effects (Cossa et al. 2011, Seco et al. 2021a, Matias et al. 2022).

Following the entry into force of the Protocol on Environmental Protection to the Antarctic Treaty, there have been scientific investigations for monitoring of environmental impact by persistent organic pollutants (POP´s) (ATCM XXXI/IP097, ATCM XXXII/IP069), emerging contaminants (ATCM XLIV/IP4) and trace element contamination (e.g. ATCM XXXIX/IP22; ATCM XXXIX/IP8). This paper reports on the most recent scientific evidence concerning mercury in Antarctic foodwebs.

***Recent developments concerning mercury levels***

An international consortium of scientists from Portugal, Bulgaria, France, Italy, Germany, Japan, Spain and the United Kingdom, carried out research to evaluate the mercury in organisms in Antarctic marine foodwebs. Total mercury levels were obtained from Antarctic marine food webs (Seco et al. 2021a, Matias et al. 2022), including detailed research on Antarctic krill (*Euphausia superba*) (Seco et al. 2019, Seco et al. 2021b), octopods (Matias et al. 2019, Matias et al. 2020), squid (Seco et al. 2020a) and fish (Seco et al. 2020b).

Mercury concentrations increased with trophic levels. Values of mercury were lowest in particulate organic matter (POM) and zooplankton at the base of the food web (e.g., Antarctic krill), followed by squid and some species of fish (e.g., myctophid fish). The highest mercury concentrations were found in predators higher in the food web (e.g., seabirds, such as wandering albatrosses, giant petrels and skuas) (Seco et al. 2021a, Matias et al. 2022), with increasing mercury concentrations in years of lower Antarctic krill abundance (Seco et al. 2021a; see Figure 1). Biomagnification of mercury was greater in Antarctic foodwebs than in lower latitude foodwebs.

Diagram

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***Figure 1****. Illustrations of a Southern Ocean food web in years with high Antarctic krill abundance (left/ A) and in years with low Antarctic krill abundance (right/ B). Shaded/clear areas represent different trophic levels, boxes represent mercury concentrations (more Hg and higher concentration) (Seco et al. 2021a).*

Increased mercury exposure is likely to negatively impact marine biota (e.g., reproduction, survival), including in Antarctic fauna (e.g., seabirds) (Goutte et al. 2014, Mills et al. 2020). As mercury impacts on the structure and functional dynamics of the Antarctic food webs, levels are likely to increase in certain groups of marine organisms (e.g., top predators). Therefore, we encourage further monitoring of contaminant levels (including mercury) throughout the Antarctic Treaty area with a view to assessing where contamination is taking place, the levels of biomagnification and identifying further possible negative impacts on the fauna.

Following the requirements of Annex I to the Protocol, and mindful of recent work on the revision of the *Guidelines for Environment Impact Assessment in Antarctica* (ATCM XXXVIII/WP13), we would like to promote greater information exchange between Parties on contamination to help inform future research (including long-term monitoring) and policy development. Capacity building and Antarctic pollution awareness should also be supported. Finally, we encourage national Antarctic programmes to (i) have a more structured process for collection of samples and data concerning environmental contamination in the Antarctic (following ATCM XLIII/IP21; ATCM XLIV/WP11; ATCM XLIV/IP7) and (ii) engage all relevant stakeholders, including by seeking advice from the Scientific Committee on Antarctic Research (SCAR) and Council of Managers of National Antarctic Programs (COMNAP).

***Supporting documentation***

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