A REPORT OF HEAVY METAL AND PORPHYRINS LEVELS IN PENGUINS

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Introduction: The monitoring of trace metals in biotic matrices and its possible effects due to prolonged exposure in time is a topic of global concern (Lavoie et al., 2013). The main source of metals is from anthropogenic activities, such as mining, metallurgical industries, vehicular traffic, among others (Garelick et al., 2008). Due to metals are accumulative and persistent, they can concentrate in top predators, so their effects can be more severe (Burger et al., 2000). For that reason, wild birds are useful animals to study the effects of contaminants (Takekawa et al., 2002). Little is known about the effects of heavy metals on penguins (Espejo et al., 2014; Celis et al., 2015). Penguins are seabirds that inhabit exclusively in the Southern Hemisphere (Garcia et al., 2013). These birds are among the most threatened species of animals, and about two-thirds of penguin species are in the Red List of Threatened Species IUCN (UICN, 2015). Pollution, climate change, fishing, inhabit modification, diseases, even tourism, are their main threats (Garcia et al., 2013). These birds, can be a useful indicator of pollution level because its wide distribution, and they are placed at the top of the food web (De Moreno et al., 1997). There is evidence showing a direct correlation between metal pollution and accumulation of porphyrins in organs and excreta (Leonzio et al 1996).

Methods During austral summer 2011/2012/2013/2014, excreta and feather samples were collected from different species of Pygoscelis penguins that live in several locations of the Antarctic Peninsula Excreta samples were obtained from colonies of *Spheniscus humboldti* that live in the Chilean coast at Pan de Azucar Island, Chañaral Island and Cachagua Island, during 2012. The levels of several metals were determinated by atomic absorption spectrophotometry, whereas the levels of porphyrins were measured by colorimetric analysis.

Results: In Antarctica, we found the highest levels of Hg (7.55 ± 1.28 µg/g) and Cd (1.68 ± 0.71 µg/g) in excreta of *P. papua* from Base O'Higgins and Base Videla, respectively). Excreta of penguins from Base O'Higgins showed higher levels of copro- (1.81 ± 0.61 nmol/g), uro- (1.74 ± 0.72 nmol g-1) and protoporphyrins (1.24 ± 0.46 nmol g-1), directly related to higher levels of Hg and Pb measured. In the coast of Chile, we found the highest levels of Cu (199.67 µg/g), As (7.85 µg/g) and Pb (12.78 µg/g) in excreta of *S. humboldti* at Cachagua island, and also the highest levels of copro- (2.16nmol/g), uro- (2.20nmol/g) and protoporphyrins (2.23 nmol/g). There was a positive correlation among As, Pb, Cu and with uro, copro-, y protoporphyrins. In the Antarctic campaign 2011/2012 we observed that *P. papua* excreta from Base O´Higgins had higher levels of metals (2.89 µg/g for Pb, 199.95 for Cu and 379.99 for Zn) and Base Videla (2.74 for Pb and 222.51 for Cu). The levels of Cd in excreta of *P. antarctica* were higher on Narębski Point (3.13 µg/g). In the Antarctic campaign 2012/2013, data showed that excretas of *P. adeliae* had higher levels (µg/g) of As, Cd, Hg, Pb y Cu on Base Arctowski and Kopaitic island, both sites with major anthropogenic activities. Samples collected during 2014 showed higher levels of Cd, Cu, Cr, Mn, Ni, Pb and Zn in excreta, feathers and ground at Base O'Higgins and Stranger Point, whereas the lowest levels were found at Neko Port and Doumer island, both sites with minor human presence. The levels of metals in penguins of Antarctica are lower than those levels in penguins of higher latitudes.

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Conclusion

Levels of metals in biotic samples of *Pygoscelis* penguins from the Antarctic Peninsula are similar or even higher than those reported in excreta of previous studies in Antarctica. Those levels, are lower than the levels of metals in excreta and feathers of other animals living at higher latitudes. However, our findings reveal that some colonies of *P. papua* and *S. humboldti* living around sites with major anthropogenic activities are potentially likely to suffer some illness by metal pollution. The spatial and temporal data obtained in the Antarctic Peninsula and in the coast of Chile suggest a direct relationship between levels of metals with major human presence. However, large-scale transportation of pollutants cannot be neglected.

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