Master project opportunity in marine mammal ecotoxicology

Persistent organic pollutants (POPs) are synthetically manufactured chemicals extensively used during the 20th century in numerous industrial, commercial and agricultural applications. In addition to the numerous synthetic chemicals, other contaminants are naturally present on Earth as is the case for mercury (Hg). However, despite its natural origin, human activities have considerably increased the global amount of Hg cycling around the world. POPs and Hg are assimilated by living organisms and biomagnified along marine food webs. Harmful for living organisms, POPs and Hg are in the spotlight of toxicological studies leading to past and on-going national and international restrictions/ regulations, well-illustrated by the Stockholm Convention adopted in 2001 to protect human health and environment. Despite overall temporal declining trends, the so-called "legacy POPs", a group of prohibited contaminants, are still present in high concentrations and highly toxic for wildlife.

As long-lived predators, marine mammals can accumulate high concentrations of contaminants, as is the case in several cetacean species including both toothed and baleen whales. Marine mammals are chronically exposed to a complex cocktail of contaminants including the polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs), brominated flame retardants (BFRs) and Hg. Killer whales are among the most contaminated animals in the world, raising concerns about health consequences. Besides, there is currently an ongoing discussion about the vulnerability of killer whales towards POPs contamination and many scientific publications recently came out around this topic. It has been reported that high levels of PCBs, a group of chemicals banned during the 1980s, may contribute to the global population collapse.

The last years, large numbers of killer whales and humpback whales have been observed in the vicinity of Tromsø, feeding in aggregate on the Norwegian spring-spawning herring. This assemblage creates a unique opportunity to study these two species. Killer whales from this population are herring-specialized eaters and follow herring seasonal migrations throughout their annual movements in the Norwegian and Barents Sea. Humpback whales are generalist feeders that migrate annually over long-distances between high-latitude feeding grounds and tropical breeding areas.

Despite high levels of POPs reported in killer whales from Northern-Norway 15 years ago, limited attention has been given to their health-associated consequences. In addition, levels of contaminants in humpback whales present along the coast of Norway have never been examined so far. Environmental lipidomic is a growing discipline in the field of ecotoxicology that can give important insights about how living organisms react to environmental pollution. Specifically, measuring simultaneously a wide range of lipids involved in several metabolic process can provide a good overview of organismal health and help to understand contaminant-induced physiological effects.

The aim of this master project is **"to investigate the levels of contaminant mixture (including PCBs, OCPs, PBDEs and Hg) in humpback and killer whales along the coast of Northern-Norway; and to study the potential consequences of such contaminant exposure on whale health by focusing on lipidomic profiles"**. The master student will be involved in a multidisciplinary project and should focus on the following topics:

1/ Describe and compare the lipidomic profiles of killer and humpback whales.
2/ Assess the potential effects of contaminant exposure on lipidomic profiles.

Fieldwork and lab analyses are already performed which guarantee the student to have valuable data for the master thesis. The student will be involved in paper writing and included as an author in the scientific publications related to his work (key asset to get a PhD grant). The student will be highly encouraged to disseminate the results though oral presentations. Depending on funding applications, it may have some opportunity to do fieldwork and lab analyses. This is unfortunately a non-paid

internship. The student will be based at Akvaplan-niva in Tromsø, Norway (https://akvaplan.niva.no/en/home/).

We are looking for an autonomous and highly motivated student able to communicate in English. It is preferable to have skills in R-software to perform statistical analyses. Knowledge on lipid metabolism is an asset.

If you are interested, please send a CV + motivation letter and references to pbl@akvaplan.niva.no.

The student will be supervised by Pierre Blévin (Researcher at Akvaplan-niva; https://www.pierreblevin.com/) and by Anita Evenset (Formal adviser; Department director at Akvaplan-niva); and will be in contact all along the project with several international collaborators.

For more information about the topic:

AMAP, 2018. AMAP Assessment 2018: Biological Effects of Contaminants on Arctic Wildlife and Fish. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. vii+84pp

AMAP, 2011. AMAP Assessment 2011: Mercury in the Arctic. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. xiv + 193 pp.

Stockholm convention website:
http://www.pops.int/TheConvention/ThePOPs/tabid/673/Default.aspx

Desforges, J. P., Hall, A., McConnell, B., Rosing-Asvid, A., Barber, J. L., Brownlow, A., ... & Levin, M. (2018). Predicting global killer whale population collapse from PCB pollution. Science, 361(6409), 1373-1376.

Wolkers, H., Corkeron, P. J., Van Parijs, S. M., Similä, T., & Van Bavel, B. (2007). Accumulation and transfer of contaminants in killer whales (Orcinus orca) from Norway: indications for contaminant metabolism. Environmental Toxicology and Chemistry: An International Journal, 26(8), 1582-1590.

Lydic, T. A., & Goo, Y. H. (2018). Lipidomics unveils the complexity of the lipidome in metabolic diseases. Clinical and translational medicine, 7(1), 4.

Li, M., Fan, P., & Wang, Y. (2015). Lipidomics in health and diseases-beyond the analysis of lipids. Journal of Glycomics & Lipidomics, 5(1), 1.

Tartu, S., Lille-Langøy, R., Størseth, T. R., Bourgeon, S., Brunsvik, A., Aars, J., ... & Torget, V. (2017). Multiple-stressor effects in an apex predator: combined influence of pollutants and sea ice decline on lipid metabolism in polar bears. Scientific reports, 7(1), 16487.

Jourdain, E., & Vongraven, D. (2017). Humpback whale (Megaptera novaeangliae) and killer whale (Orcinus orca) feeding aggregations for foraging on herring (Clupea harengus) in Northern Norway. Mammalian Biology, 86, 27-32.