

Project information

Project title

COPOL - methylmercury in Arctic marine food webs

Year

2013/2014

Project leader

Anders Ruus, NIVA

Participants

Participants from NIVA, 2013:

- Anders Ruus
- Katrine Borgå
- Hans Fredrik Veiteberg Braaten

In addition, Ida B. Øverjordet (PhD student on the original COPOL-project, affiliated with NTNU), has been involved.

Flagship

Hazardous substances, Theme: The impact of climate change on transport and fate of contaminants in the Arctic

Funding Source

Fram Centre

Summary of Results

Previously, we initiated analysis of methylmercury (MeHg) of material collected through the IPY project "COPOL". This (first) set of samples is analyzed, and the results were subject to data analysis. Preliminary results indicated:

As expected, tissue concentrations of methylmercury increase with higher trophic level in the food web (biomagnification) in an exponential manner, however steeper than observed in several earlier studies (a trophic magnification factor of, TMF, of approximately 10). Preliminary results also indicate similar TMFs among seasons, with a trend towards slightly higher TMF in July, than in May and October. Highest TMFs in July were previously observed for organochlorine contaminants. There was good correlation between the MeHg and the TotHg content through the food web as a whole, showing an average proportion of approximately 65% MeHg (of TotHg) in all organisms studied. Thus, although MeHg has a much higher bioaccumulative potential than inorganic mercury, measures of MeHg and TotHg depict similar trends. The tissue selected for the analysis may, however, be of importance, as the amount of MeHg (relative to TotHg) was lower in kittiwake liver, compared with muscle. It was earlier noted that that inter tissue comparisons were based on few samples.

In 2013, 100 additional samples have been analyzed (the data material has been doubled) and are currently subject to data treatment. Some additional samples have also been analyzed for Stable isotopes (of carbon and nitrogen) to increase resolution of data. We have put more emphasis on the intertissue differences in birds, and now have data on MeHg in eider duck (kidney, liver and muscle; October 2007) and kittiwake (liver and muscle: May, July and October, 2007; Kidney: October, 2007). A PhD student from the original COPOL-project (affiliated with NTNU), has been involved in the treatment of these bird-data.

The analytical work with the samples also revealed an interesting aspect: The most widely utilized and accepted technique for preparing biological tissue samples for the analysis of MeHg involves an alkaline digestion of the sample. Recent studies suggest however, that this technique is inadequate to produce satisfactory recoveries for certain biological samples, including fish, fur, feathers and other "indicator" tissues which contain relatively high levels of MeHg. Thus an improved acidic extraction method has been proven to produce more satisfactory results for a wide range of biological tissues. A comparison has been made (within this project) between the two methods on our samples and shows how this could lead to misinterpretation of analytical results. A manuscript has been submitted highlighting this issue.

For the Management

As mentioned: The analytical work with the samples revealed an interesting additional aspect: The most widely utilized and accepted technique for preparing biological tissue samples for the analysis of MeHg involves an alkaline digestion of the sample. Recent studies suggest however, that this technique is inadequate to produce satisfactory recoveries for certain biological samples, including fish, fur, feathers and other "indicator" tissues which contain relatively high levels of MeHg. Thus an improved acidic extraction method has been proven to produce more satisfactory results for a wide range of biological tissues. A comparison has been made between the two methods and shows how this mismatch could lead to misinterpretation of analytical results.

Published Results/Planned Publications

"Methylmercury in Arctic marine food webs":

- We plan to publish this work in a respected journal with peer review.
- It was presented at the SETAC-conference in Glasgow, 2013.
- It will be presented at Arctic Frontiers, 2014. (Relevant abstracts are enclosed)
- Additionally we have an ambition to prepare a manuscript on intertissue differences in methylmercury concentrations in Arctic sea birds.
- A manuscript showing different results regarding methylmercury concentrations in different samples using common alkaline sample digestion and an improved acidic extraction method, respectively, and how this could lead to misinterpretation of analytical results, is submitted to *International Journal of Environmental Analytical Chemistry*.

Communicated Results

As mentioned, the work on “Methylmercury in Arctic marine food webs” was presented at the SETAC-conference in Glasgow, 2013.

A manuscript showing different results regarding methylmercury concentrations in different samples using common alkaline sample digestion and an improved acidic extraction method, respectively, and how this could lead to misinterpretation of analytical results, is submitted to *International Journal of Environmental Analytical Chemistry*.

Interdisciplinary Cooperation

We have benefited from the collaboration with our partners in the COPOL project (and parallel “Flaggskip” initiatives) as we reported in the final report of the COPOL project, the IPY grant gave the participating institutions (each with their expertise) an important foundation for future scientific collaboration. In our opinion, this collaboration is now flourishing, and the “Flaggskip” gives opportunity to follow up on some specific research questions that has come out of our previous activities.

Disciplines: Marine biology, ecotoxicology, analytical chemistry, environmental monitoring

Budget in accordance to results

The budget has been used for the planned activities. It has been crucial for our participation and direct involvement in ongoing activities with Fram Centre collaborators.

The analytical work from this project has also highlighted some methodological aspects that is followed up by internal funding from NIVA.

Could results from the project be subject for any commercial utilization

No

Conclusions

a) The dynamics of methyl mercury vs. total mercury in bird tissues is an interesting and largely unknown aspect. It is obviously important for interpretation of mercury dynamics in the food chain and highlights the need for knowledge regarding choice of tissue for sampling. Furthermore, the dynamics of methyl mercury vs. total mercury (and other elements, such as selenium) in the food chain is an aspect that these results will lead to insight in.

b) Need for development of current used models with modules for MeHg. The project has shown how the widely used alkaline sample digestion for methylmercury analysis may lead to misinterpretation of results.