Nitrogen - Alerts
International Nitrogen Initiative - Europe

INI Nitrogen Alerts – December 2018 (8/18)

Editorial

Dear colleagues,

Firstly, it has been an eventful year, and it is with great sadness that I report the death of our great friend and colleague Mike Ashmore. Mike was a Professor here at the Environment (& Geography) Dept. and more recently enjoyed a flexible retirement working with myself and colleagues in the Stockholm Environment Institute at York. Mike was a truly inspirational colleague, mentor and friend and he will be very sadly missed by all who knew him. The nitrogen issue has lost one of its clearest and insightful thinkers. His spirit will live on in his many publications and the papers that are still to emerge that he was working on with colleagues in 2018.

Remembering Professor Mike Ashmore, (1950-2018)
Read Mike's obituary

In this issue to round off 2018 we feature an important new study from Denmark on the link between Nitrate in drinking water and colorectal cancer risk, shine the spotlight on the rapidly evolving situation in the UK with the help of Plantlife UK, report on the latest news and upcoming events across Europe and highlight some of the new literature in the nitrogen field.

Please keep your contributions and feedback coming and here's wishing you all a fantastic seasonal break and a great 2019.

Best wishes

Kevin

Feature

Nitrate in drinking water and colorectal cancer risk:

A study from Aarhus University and the Geological Survey of Denmark and Greenland (GEUS) shows that there is an increased risk of colon and rectal cancer in connection with nitrate in drinking water. Also at concentrations far below the current drinking water standard. The highest nitrate concentrations are mainly seen in small private water supplies.

Nitrate in groundwater and drinking water, which primarily comes from fertilisers used in the agricultural sector, has not only been subject to decades of environmental awareness – it has also been suspected of increasing the risk of cancer. The largest epidemiological study ever carried out in this area now shows that there is a correlation – also when the amount of nitrate in the drinking water is far below the current drinking water standard. The results have just been published in the scientific journal International Journal of Cancer.

Risk of cancer even with small amounts of nitrate
The researchers have calculated how much nitrate Danes have been exposed to where they lived and compared this to information about cancer diagnoses in Denmark. Researchers have managed to follow a total of 2.7 million Danes during the period 1978-2011 and the study is based on nitrate analyses from more than 200,000 drinking water samples, making the study the largest and most detailed in this area.

"*Each year, approximately 5,000 Danes contract colorectal cancer, which can have many causes. Our study shows that nitrate in drinking water may be one of them. In the study, people who were exposed to the highest concentration of nitrate in drinking water (above 9.3 mg per litre of water) had a 15 per cent greater risk of getting colorectal cancer compared to those who had least exposure (less than 1.3 mg per litre of water). The current threshold value is 50 mg nitrate per litre of water, but the increased risk of cancer could already be seen at concentrations greater than approximately 4 mg nitrate per litre of water*," says Jörg Schullehner, PhD from the Department of Public Health at Aarhus University. He is the person behind the

Aarhus University.

The drinking water standard in Denmark and the EU complies with the recommendations of the World Health Organization WHO. These recommendations have been determined in order to avoid cases of 'Blue Baby Syndrome', where nitrite poisoning prevents oxygen saturation in the body. This syndrome only affects infants and very rarely occurs in Denmark.

Drinking water standard should be reconsidered

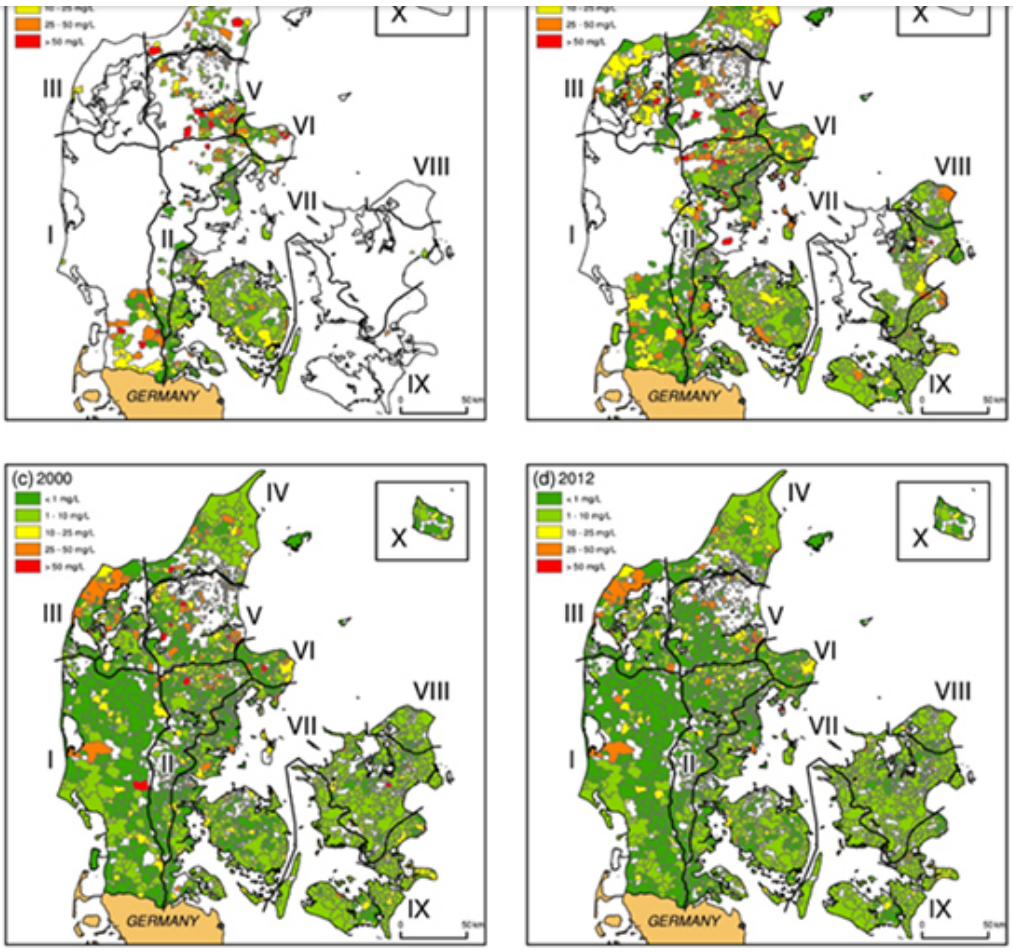
The research results confirm a suspicion that has long been held; that nitrate increases the risk of colon and rectal cancer. The health risk arises when nitrate is converted into carcinogenic substances that are known as N-nitroso compounds in the body. Colorectal cancer is one of the most common forms of cancer in Denmark and the third most frequent worldwide.

"*The conclusion in our study is in line with the findings of several international studies, which indicates that the drinking water standard ought to be lower in order to protect against chronic health effects and not only acute effects such as Blue Baby Syndrome. With identical results from different studies, this points towards a need for reconsidering the drinking water standard,*" says Professor Torben Sigsgaard from the Department of Public Health at Aarhus University, who has also been involved in the research project.

Nitrate concentrations are generally low

Research from GEUS shows that over the last decades, nitrate concentrations have been reduced by the public waterworks from which the vast majority of people in Denmark get their water.

"*Nitrate concentrations are low in the majority of public waterworks. Today, the problem is mainly concentrated in the small private wells, as well as places where there is a lot of nitrate leaching and where the local soil characteristics and geological factors mean that nitrate can more easily seep into the groundwater. It therefore makes sense to focus our efforts here*," says Jörg Schullehner.



Concentrations of nitrates in groundwater sites (1976-2012) - Courtesy Jörg Schullehner

The research results - more information

- Type of study: Nationwide register-based cohort study with 2.7 million participants. Information about nitrate exposure taken from the national geodatabase Jupiter has been merged with the national health registers.
- Partners: Researchers from the National Centre for Register-based Research and the Centre for Interdisciplinary Register-based Research, Aarhus University, together with the Geological Survey of Denmark and Greenland (GEUS).
- External funding: Innovation Fund Denmark (the DNMARK research alliance).

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Read the article in the International Journal of Cancer

Spotlight on the UK

We need to Talk about Nitrogen:

Amid the political wranglings over the UK's exit from the EU, a Clean Air Strategy is due for publication in the next few weeks. This mostly applies to England as air quality is a devolved matter, but it includes reports from the Scottish Government, Welsh Government and Northern Ireland Executive. This will finish off a busy year for public policy on ammonia, spurred on by rising annual emissions and greater awareness of its harmful impacts on human health and wildlife.

Back in May, the government set out three options for regulating farm ammonia in a public consultation on the draft strategy: i) introducing a statutory limit on fertiliser use; ii) extending the environmental permitting system to large dairy herds (which already applies to large pig and poultry units); and iii) requiring farmers to use low-emissions practices and equipment for animal wastes and other fertilisers. The draft strategy also suggests a best-practice certification scheme to tackle rising emissions from anaerobic digestion and the spreading of the leftover digestate.

These new regulations would apply to all farm businesses and farmers would be supported in meeting them through new capital grant schemes and a new agri-environment scheme to be phased in after Brexit. This is good news, although Plantlife is concerned that the Environment Agency will be unable to police the regulations effectively, having suffered several years of funding cuts, unless it is given extra resources.

Plantlife is calling on the government to adopt all three options for cutting farm ammonia and to go further and faster in implementing these. We made detailed recommendations for action to protect and restore wildlife from the impacts of excess nitrogen deposition, which was sorely missing from the draft, but it remains to be seen whether these will be adopted in the final strategy.

In the meantime, back in July, a voluntary 'Code of good agricultural practice for reducing ammonia emissions' (COGAP) for England was published, which draws heavily from the UNECE 'Framework Code'. This was followed in September by the announcement of a £3 million (€3.3 million) fund for training, advice and support to farmers to implement the COGAP and take advantage of the existing Countryside Productivity grant scheme.

The new fund is being managed under the Catchment Sensitive Farming partnership, bringing together farm advice on reducing air and water pollution. Hopefully, this signals a more integrated approach to nutrient management, which has long been promoted by researchers and practitioners alike. To add grist to this mill, a Westminster parliamentary inquiry into nitrates also called for an integrated approach after Brexit, citing the combined benefits for air and water quality, climate change mitigation and business efficiency.

There's never a dull moment in British politics just now; an Environment Bill and an

quality and to secure a progressive, integrated new farming policy. With air quality rated as the highest risk environmental issue in Brexit, We hope the government's New Year's resolution will be to see through a strong Clean Air Strategy.

More info from Jenny Hawley : Jenny.Hawley@plantlife.org.uk at Plantlife https://www.plantlife.org.uk/uk

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Events

Workshop: Yorkshire Integrated Catchment Solutions Programme (iCASP), York, March 1st 2019

iCASP is an ambitious and exciting programme to generate benefits for Yorkshire by applying environmental science to catchment challenges. With funding from NERC iCASP (https://icasp.org.uk/), Kevin Hicks and colleagues at the University of York are holding a workshop in York on March 1st 2019 to co-design a project on adopting integrated nitrogen management strategies at farm scale in the UK.

JRC launching a Knowledge Hub for Water and Agriculture, Brussels on 22nd January 2019

In the context of the initiatives launched by the publication of the Commission Staff Working Document (SWD) on Agriculture and Sustainable Water Management in the EU, the Commission has proposed the creation of a Knowledge Hub on Water and Agriculture, where the available knowledge is appropriately tested, organised and shared among EU, national and regional institutions and stakeholders.

The "Knowledge Sharing Workshop on Water and Agriculture" to be held in Brussels on 22 January 2019 intends to analyse how to implement this idea and translate knowledge needs into an operational support to stakeholders and policy makers. DG AGRI, ENV and JRC will discuss together with experts from Member States'

Further information is available from: Bruna Grizzetti JRC
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Publications

In Acid News December 2018

Two interesting articles in the December issue of Acid News:

- **Cut methane to reduce ozone**
  Global action to reduce methane emissions could by 2050 avoid 70,000 to 130,000 annual premature deaths due to ozone pollution globally, and 6,000 to 11,000 in the EU alone. (pg 14 - 15).

- **Livestock sector must contract**
  Numbers of farm animals in the European Union are not within a “safe operating space” for the climate and nitrogen, states a new report from the RISE foundation (pg 20 - 21).

Read the full newsletter online.

van Grinsven, H.J., van Dam, J.D., Lesschen, J.P., Timmers, M.H., Velthof, G.L. and Lassaletta, L., 2018. ***Reducing external costs of nitrogen pollution by relocation of pig production between regions in the European Union.*** Regional Environmental Change, pp.1-13.

This paper just came out in Regional Environmental Change and provides an example of how N costing (results from European N Assessment) can be used to design EU (spatial) policies for reducing N pollution from the pig industry. Perhaps also an interesting option for the US or East Asia, but we realize that already in the EU there are many barriers to introduce spatial policies.

https://link.springer.com/article/10.1007%2Fs10113-018-1335-5

C. M. Singleton, C. K. McCalley, B. J. Woodcroft, J. A. Boyd, P. N. Evans, S. B. Hodgkins, J. P. Chanton, S. Frolking, P. M. Crill, S.R Saleska, V. I. Rich, G. W. Tyson. ***Methanotrophy across a natural permafrost thaw environment.*** In the ISME Journal Vol 12, pp 2544–2558

This publication presents analysis of methanotrophs communities in the permafrost

they moderate release by oxidising 20 - 60 per cent of methane before it is released into the atmosphere.

The study examines methanotroph communities from the active layer of a permafrost thaw gradient in Stordalen Mire (Abisko, Sweden) spanning three years. Methanotroph community composition and activity varied significantly as thaw progressed from intact permafrost palsa, to partially thawed bog and fully thawed fen.

Read the full article here (open access)

S. Uusheimo, T. Tulonen, S. L. Aalto, L. Arvola, ***Mitigating agricultural nitrogen load with constructed ponds in northern latitudes: A field study on sedimental denitrification rates*** Agriculture, Ecosystems & Environment, Volume 261, **1 July 2018, Pages 71–79**

Constructed agricultural ponds and wetlands can reduce nitrogen loading from agriculture especially in areas where warm climate predominates. However, in cold climate temperature-dependency of microbiological processes have raised the question about the applicability of constructed wetlands in N removal. This article looks at daily and seasonal variations in denitrification rates in agricultural ponds.

They conclude, that by following recommended wetland:catchment – size ratios, boreal agricultural ponds can efficiently remove nitrogen by denitrification in summer and in autumn, while in winter and in spring the contribution of denitrification might be negligible relative to the loading, especially with short residence time.

https://doi.org/10.1016/j.agee.2018.04.002

In brief

Le Noë, J., Billen, G., Esculier, F. and Garnier, J., 2018. *Long-term socioecological trajectories of agro-food systems revealed by N and P flows in French regions from 1852 to 2014.* Agriculture, Ecosystems & Environment, 265, pp.132-143. https://www.sciencedirect.com/science/article/pii/S0167880918302408

Schwede, D.B., D. Simpson, J. Tan, J.S. Fu, F. Dentener, E. Du and W. de Vries, 2018. *Spatial variation of modelled total, dry and wet nitrogen deposition on forests at global scale.* Environmental Pollution 243: 1287–1301. https://www.sciencedirect.com/science/article/pii/S0269749118327386

Springmann, M., M. Clark, D. Mason-D'Croz, K. Wiebe, B.L. Bodirsky, L. Lassaletta, W. de Vries, S.J Vermeulen, M. Herrero, K.M. Carlson, M. Jonell, M. Troell, F. DeClerck, L.J. Gordon, R. Zurayk, P. Scarborough, M. Rayner, B. Loken, J. Fanzo,

519–525.
https://www.nature.com/articles/s41586-018-0594-0

Schmitz, A., T. Sanders, A. Bolte, F. Bussotti, T. Dirnböck, J. Johnson, J. Peñuelas, M. Pollastrini, A.-K. Prescher, J. Sardans, A. Verstraeten and W. de Vries, 2019. *Responses of forest ecosystems in Europe to decreasing nitrogen deposition.* Environmental Pollution 244: 980-994.
https://www.sciencedirect.com/science/article/pii/S0269749118326897

Recent papers on the Baltic and Oceans

A number of papers have been produced on coastal deoxygenation and nitrogen flows to the coasts. It seems that the loss of oxygen is further developing - in the open ocean (also due to anthropogenic drivers such as acidification and atmospheric deposition) and in coastal zones. Even reductions of nitrogen input (eg Mississippi catchment) will not lead to the anticipated reduction in riverine nitrogen since rainfall increases (Sinha et al.). The Baltic Sea is especially. threatened due to numerous problems (Reusch et al.). For the Baltic and oceans warming is also a prime problem. We still lack an understanding how the impact of oxygen loss translates into other problems like the loss of denitrification capacity. These recent papers cover some of these issues.

Izett, J.G., Fennel, K., 2018. *Estimating the Cross-Shelf Export of Riverine Materials, Part II: Estimates of Global Freshwater and Nutrient Export.* Glob. Biogeoch. Cycles

Oschlies, A., Brandt, P., Stramma, L., Schmidtko, S., 2018. *Drivers and mechanisms of ocean deoxygenation.* Nature Geoscience 11, 467-473.

Reusch, T.B.H., Dierking, J., Andersson, H.C., Bonsdorff, E., Carstensen, J., Casini, M., Czajkowski, M., Hasler, B., Hinsby, K., Hyytiäinen, K., Johannesson, K., Jomaa, S., Jormalainen, V., Kuosa, H., Kurland, S., Laikre, L., MacKenzie, B.R., Margonski, P., Melzner, F.,
Oesterwind, D., Ojaveer, H., Refsgaard, J.C., Sandström, A., Schwarz, G., Tonderski, K., Winder, M., Zandersen, M., 2018. *The Baltic Sea as a time machine for the future coastal ocean.* Science Advances 4.

Sinha, E., Michalak, A.M., Balaji, V., 2017. *Eutrophication will increase during the 21st century as a result of precipitation changes*. Science 357, 405-408.

Goto to INI website