

U.S. Environmental Protection Agency
Science Advisory Board
Integrated Nitrogen Committee
Public Teleconference Meeting June 8, 2007
Final Minutes

Committee: Integrated Nitrogen Committee

Date and Time: June 8 from 2 -4 Eastern Time as announced in the Federal Register on March 22, 2007, Volume 72, Number 55, Page 13492

Location: By Telephone Only

Purpose: On this conference call, members of the Committee will present the information they have developed, make recommendations for refining the agenda for the June 20-22 face-to-face meeting, and hear an invited briefing about the European Perspective on Nitrogen from J.W. Erisman of the Energy Research Centre of the Netherlands. This conference call was planned to help prepare the Committee for the June 20-22, 2007 face-to-face meeting at which the Committee will complete information gathering for the first phase of its work, relating to sources, transport, fate, effects, impacts and metrics relating to reactive nitrogen in the environment and make appropriate related writing assignments for its report. The Committee will also begin the second phase of its work addressing the relationship of nitrogen to ecosystem scale through case studies.

Materials Available: Materials made available for the INC's January 30-31 meeting and April 19 teleconference are identified in those minutes. The additional materials made available for this call are:

1. Final Agenda for the June 8 Public Teleconference
2. Revised Draft Agenda for the June 20-22 Public Meeting
3. Background for the June 8 INC Teleconference from Erisman
4. *The Dutch N-Cascade in the European Perspective* by J.W. Erisman, Nelleke Domburg, Wim DeVries, Hans Kros, Bronno de Haan, & Kaj Sanders, published in *Science in China Ser C. Life Sciences*, 2005 Vol 48 No 1 1-10.

Attendees: All members except Cowling, Hey, Mitsch and Shaw were present although Cassman, Dickerson and Moomaw were not able to be present for the full call. A roster of the Committee is attached. DFO Kathleen White of the SAB Staff Office was present. Agency staff included Jim Latimer, Jonathan Garber, Maggie Kerchner, Barry Korb, Rick Linthurst, and Randy Waite. Matt Shipman of Risk Policy report was present and J.W. Erisman joined the call at 3:10, shortly before his presentation.

Summary: In terms of content, the meeting went according to the agenda, but there was some re-ordering of agenda items and the call as a whole finished slightly earlier than expected.

After the DFO opened the meeting, the chair provided a brief review of the reactive nitrogen cascade which stands as approved. He asked each of the Working Groups to summarize the information they had developed and articulate the remaining needs. The Impacts and Metrics Working Group also spoke of the Millennium Ecosystem Assessment and its implications for the organization of impacts and metrics. J.W. Erisman gave a brief presentation on the European perspective on nitrogen and responded to questions.

The following actions resulted from the meeting:

1. All Working Groups will continue their efforts.
2. Relevant to SPARROW modeling, Dr. Boyer will send a more recent draft of the Mississippi paper (Alexander et al., in review) to the DFO, for use by the committee. The DFO will forward this update to the Committee.
3. Mr. Herz will send an email to Dr. Doering reminding him of his interest in the July 12-13 NAS seminar on biofuels and water quality and Dr. Doering will obtain an invitation for him.
4. DFO will confirm with Dr. Theis that the paper he referenced on nitrogen variability in the corn belt from 1992 to 2002, was indeed sent to the Committee. (After the conference call, the DFO confirmed this is *Use of Monte Carlo Analysis to Characterize Nitrogen Fluxes in Agroecosystems* by Miller, Landis and Theis, published in ES&T in 2006 which was distributed for the January 30-31 meeting. She sent it to the Committee again.)
5. The topic of marine derived nitrogen has been flagged for further discussion.
6. The DFO will make the MEA websites available to full INC. (Done)
7. Dr. Theis will send a specific request to the INC members for input on the matrix he developed and collate results before the June 20-22 meeting. (Done)
8. INC members will respond to the questions on the matrix in a timely, but not necessarily comprehensive, way.
9. The agenda for the June 20-22 meeting will exchange the times of the talks to be given by EPA's Garber and Linthurst.

Further Information on Matters Discussed:

Background: At the January 30-31, 2007 public meeting, the Committee formed working groups to prepare for the planned meeting June 20-22, 2007. The Producers Working Group consists of Aneja, Boyer, Cassman, Doering, Herz, Kohn, Lighty, Shaw. The Environmental Working Group consists of Boyer, Dickerson, Hey, Mitsch, Mosier. The Impacts & Metrics Working Group consists of Cowling, Doering, Moomaw, Paerl, Stacey, Theis. The leads and co-leads for each group are: Aneja and Cassman for producers, Mosier and Dickerson for environmental system; and Moomaw and Theis for impacts and metrics. The Working Groups have had non-public preparatory calls supported by the DFO to prepare for this meeting and the next one.

Meeting: The DFO, Kathleen White, opened the meeting, called roll, reminded those present of the purpose of the meeting. Dr. James Galloway, chair, welcomed those present and provided a brief review of the reactive nitrogen cascade which the Committee is using to organize its work. Each of the Working Groups then addressed the information they had developed and articulated the remaining needs. The Impacts and Metrics Working Group also spoke of the Millennium Assessment and its implications for the organization of impacts and metrics.

Aneja spoke for the Producers Working Group. Aneja said that the producers organized by human activities and agro-ecosystems within five major US watersheds.

Boyer is conducting research on nitrogen inputs to watersheds, using a budgeting approach. Boyer is working (with collaborators) to calculate contemporary N budgets for the USA, describing nitrogen using a modified NANI approach. The Net Anthropogenic Nitrogen Inputs Approach (originally put forth by Howarth et al. 1996) is a method to quantify and sum the new inputs of reactive N to regions (in this case, the regions are watersheds of the USA). “New” refers to reactive N that was either fixed within a region or newly transported into a region, (in other words, they are not aiming to tally *all* N within the system, including things such as local emissions & re-deposition within the watershed). Anthropogenic sources of the new N include fertilizers, biological N fixation in cultivated croplands, net imports of N in human food and animal feedstuffs, and atmospheric N deposition. Animal waste and human waste are not considered new N inputs because they are recycled within a region; the N in these wastes originated either from N fertilizer, N fixation in agricultural lands, or N imported in food & feed. However, they can partition out and explicitly consider the human & animal waste component of the budgets as needed. Many of the details of the budgeting method are in Boyer et al. 2002. For the budget she is currently preparing she will use a modified version, with just anthropogenic input terms, with a different method for atmospheric N deposition, and some modified coefficients. She will aggregate the calculations to the scale of the large water regions of interest for this group. Boyer hopes to have preliminary numbers to share on inputs at the Committee’s June meeting.

Considering outputs of nitrogen in streamflow, Boyer indicates that both monitoring data and modeling results from the SPARROW model may be useful. Though data will not be

available for the June meeting, Boyer will provide an update on what is available. From SPARROW, current model simulations that will be available to this group are for a base year of 1992; making estimates for 2002 is more challenging due to changes in long-term monitoring.

Galloway asked if there were any remaining needs. Aneja remarked he was aware of no additional needs. Galloway asked Aneja about the degree to which the WG had been able to assess the state of knowledge in EPA; Aneja expects this will be done at the June 20-22 meeting. Galloway asked for inputs by other WG members. Doering mentioned the NAS seminar on biofuels and water quality July 12-13 in DC; if someone from EPA or the group would also like to attend he can get an invitation. Herz said he was interested.

Stacey had a question about weather influences on nitrogen export. Boyer discussed how the modeled estimates from SPARROW reflect long-term hydrological conditions. They noted that everyone points to 1993 as the big wet year for the mid-west where all the data are skewed. He asked if there was a correlation with wet weather and hypoxic activity. Doering responded that some studies show that, at the mouth of the river, the amount of nitrogen passing through correlates almost perfectly. Paerl said that this "perfect" correlation is complicated by the fact that hypoxia also correlates quite strongly with freshwater flow, which enhances stratification and hence hypoxia. Teasing apart the nitrogen signal from hydrologic discharge as causative agents for hypoxia has been difficult, both for the Mississippi plume region and other estuaries (Chesapeake Bay, Neuse-Pamlico). There is agreement that excess N inputs lead to excess productivity in these systems, and this productivity is the "fuel" for hypoxia. To what degree this controls the degree and extent of hypoxia is the subject of ongoing research and debate.

Mosier spoke for the Environmental System Working Group. Mosier said the WG focused on choke points in nitrogen flows. They are developing two-page papers on:
Wetlands as a choke point for Nr flowing into rivers (Hey and Mitsch)
Nitrogen use efficiency in agricultural systems (Cassman and Mosier)*
Swine and poultry waste (Dickerson)
Urban turf grass (Cassman and Mosier)*
* will certainly be ready for June 20 meeting

Mosier noted that when he and Cassman spoke with Petrovic from Cornell, they had learned that turf grass is about 30-40 million acres; about 10% of the nitrogen fertilizer used in the US goes on turf grass.

Mosier said that he spoke with USDA's Darryl Lund and Jeff Goebel about the NRI dataset. He learned that the NRI researchers are working to consider changes in N storages with the massive dataset, but that learning about some questions of interest to this group are currently areas of active research and likely won't be publicly-available for a number of years. Mosier said that they are currently using Paustian's method. Boyer said that Paustian made this type of calculation, whereby NRI data are used in an inventory approach to consider changes in soil nutrient stores, for the 1992 nitrogen

budgets for 16 watersheds in the northeast (Boyer et al. 2002). Mosier thinks there may be some value to taking what Boyer is developing for the Producers Working Group and trying to add flows.

Doering asked Boyer about use of averages in the models. She responded by reiterating that the SPARROW model considers long-term average hydrological conditions. Doering asked if there was value in having the extremes of wet and dry available as an indicator of what can happen. Boyer replied that the long term monitoring data from stations p, and gave an example from a site for which she has analyzed data. He thinks that is very helpful in understanding the kinds of variability that can occur. Theis thinks that relevant information along these lines is available in a paper circulated to the INC on nitrogen variability in the corn belt for 1992 to 2002, which calculates means and deviations.

Galloway asked if there were more questions for this WG and got none. Then he asked how well we know about nitrogen which is captured in fish at sea (marine derived nitrogen) which then bring it into the coastal region, capture fisheries, and fish meal. Boyer knows of some work in the northwest regarding MDN in spawning salmon, which could provide a sense of this possible contribution. Doering mentioned Chilean anchovies and animal feed. Stacey has seen figures on menhaden redistributing energy. All agreed that this is an area to explore further.

Theis spoke for the Impacts & Metrics Working Group. The WG has gone through a process starting with seven classic nitrogen categories (global warming, eutrophication, ecotoxicity, human health, acidification, smog formation, and effects on ozone) and weighs to measure them such as mass per unit time or dollar impact. At the suggestion of EPA's Rick Linthurst the WG looked at the Millennium Ecosystem Assessment (MEA) documents which frame environmental consequences within four sets of ecosystem services (provisioning, regulating, cultural, and supporting). He believes the INC members are all fairly comfortable with the classic impact categories and understand the kind of data that would be needed to address them. The MEA services are more anthropocentric and would require a different type of metric.

Theis drew up a matrix (attached, and see excerpt below) with both the classic categories and the MEA ecosystem services which has been distributed to the INC. He would like to poll the INC about the intersections asking whether the services and classic impacts are positively correlated (indicated by an up arrow), negatively correlated (down arrow), there is no correlation (zero), or we don't know (a question mark). Although he listed 31 ecosystem services, the MEA gets into much deeper detail, which the INC can if it chooses. He thought this would be a good approach to generating discussion on this topic at the next meeting.

The WG plans to address the issues both ways. There are indications that EPA is coming around to the idea of assessing ecosystems the way the MEA does and providing recommendations in that format would add utility to the INC's advice.

Paerl suggests adding marine to freshwater under provisioning. Theis suggests just using water or aquatic resources.

Galloway invited EPA’s Linthurst to react to Theis’s comments. Linthurst had just joined so Theis summarized his previous remarks, first thanking Linthurst for putting the INC onto the MEA. Theis asked him to comment on the MEA in the light of the INC’s charge. Linthurst agrees implementing the MEA approach is a challenge. The question is, “Can we identify which services are most sensitive to nitrogen and how they are correlated with nitrogen?”

Paerl suggested that the first table, the one with classical impacts, be revisited a bit as it deals with sensitivity. Stacey wonders about spatial scale and how the ecosystem services relate to one another. At this time, Theis thinks the way forward is through polling the INC. Galloway concurs that the helicopter view that Theis suggests will help them focus on areas of agreement and disagreement, which may be the most fruitful. Further conversations among the WG might sort out issues like those Paerl and Stacey raised.

Galloway asked if there were further questions from the INC. There were none.

Although Erisman’s talk was the next item on the agenda, it was not scheduled until 3:15 and the time was only 2:55 so the chair moved the INC to a discussion of the preliminary agenda for the June 20-22 meeting. No one had any suggestions; the DFO asked permission to switch the times of the Garber and Linthurst presentations and got it.

Since there was no further business and Erisman was not on the line, Galloway encouraged Theis to take the INC through an example from his table.

Ecosystem Services	Nitrogen Impacts and Species						
	Global warming (direct/indirect) N ₂ O/NO _x	Eutrophication NO _x , NH ₃ , NO ₃ ⁻ , Organic-N	Eco-toxicity NH ₃	Human health (cancer/non-cancer) Organo-N compounds/ NO _x , NH ₃	Acidification NO _y , NH _x	Smog formation NO _x	Stratospheric ozone N ₂ O
Provisioning							
Food & Fiber							
Fuels							

Theis began with the upper left cell (Global Warming x Food and Fiber). He observed that, if you add nitrogen, there is an impact on global warming and food and fiber production goes up. Galloway indicated that might not be universally so. Theis agreed there would be regional variation. Stacey thinks a decrease in nitrogen inputs might actually increase methane.

For the next cell down (Global Warming x fuel), Galloway asked what fuel was. Theis said he would have to look that up in the MEA, but thought it would be all known forms

including biomass. Cassman thought there would have to be a positive correlation because even forests are getting nitrogen that increases their production. Stacey said, “If I make more biofuel, I should get more nitrogen emissions.” Theis disagreed saying that the cell addresses the impact of adding nitrogen. Cassman said the question is “what is the impact of that service on making fuel, independent of the environmental consequences?”

Theis thinks this is working. Stacey is troubled that we are coming up with different answers based on the wording. Doering asked Theis to provide some clarifications. Theis said, in some situations, if we add nitrogen, we increase global warming; if so, what does that do for the ecosystem services in the left hand column. Similarly, there are a variety of nitrogen species that can cause eutrophication; where this happens, what is the effect on the ecosystem services? Paerl thinks that an arrow is not sufficient; you need more of a trend indicator. Theis thinks that it is exactly these differences that illuminate what needs to be addressed. Galloway found the exercise useful and clarifies what needs to be done.

At 3:10 Galloway introduced Dr. J.W. Erisman Unit Manager for Biomass, Coal & Environmental Research at the Energy Research Centre of the Netherlands. Galloway noted that the Committee had invited Dr. Erisman because of his good and broad knowledge of the European perspective on nitrogen. (Please see the two documents Dr. Erisman provided in advance of the conference call; both are attached.)

Erisman briefly summarized the European Perspective on Nitrogen by saying that Europe finally put ammonia on the agenda. By dealing with ammonia you get problems at local to regional scales, but also linkages to other effects. It does not matter what form of reactive nitrogen is formed in the upper atmosphere, you need to focus on the processes where Nr is produced and its movement through the environment. At 3:15 Galloway invited questions from the INC

Aneja asked Erisman to help him understand the implications of “integrated” – does it mean multi-media, different kinds of nitrogen, or what? Erisman said multi-everything: multi-source, multi-media, multi-effect. He asks himself, “Why nitrogen?” He thinks it is because if you can deal with nitrogen, you can deal with all the other issues.

Stacey asked how the European water framework directive fits into the integrated approach. The directive seems similar to how EPA implements the CWA. Erisman said it began with the atmospheric people and has moved into water. The water framework directive, in some sense, is also effects based. It is easy to share it with the atmospheric community. The water framework focuses on groundwater and, somewhat coastal areas, but not to the extent that coastal areas are important in the US.

Aneja thanked Erisman and asked, considering that Europe has a nitrogen policy and has achieved a reduction in nitrogen emissions, can you project the impact in ten years. Erisman responded a 30% reduction. The Netherlands started with a minerals

accounting system in agriculture; they found it relatively cheap to reduce by 30%. After that, it gets quite expensive. He thinks the same will be found for the rest of Europe.

Aneja asked what would be the impact of these reductions on the environment as a whole. Erisman thinks the long range transport will be effected so that the distance to effects will be shortened and hot spots will appear; similarly with water systems. Particulate Matter (PM) is a hot issue in both Europe and America; therefore there are relevant immediate benefits to ammonia production, which is not an integrated approach. He thinks it is more important to work on the longer term urgent issues in an integrated framework than those issues which are more immediately of concern to society in the short-term.

Cassman was looking for more quantitative measures that what he found in the materials Erisman forwarded. He understands how reduced flows of nitrogen can be documented, but asked how successful they were in documenting impacts. Can they be documented or just modeled? Erisman said they can measure/document some emissions concentrations which show a decline of about 30%. It is more difficult to measure effects. There are some monitoring stations that show a change in effects, but this proceeds more slowly than the environmental measures. The ammonia network was established in 1985 and showed in 1997 that there was a gap between emissions and concentrations in the atmosphere which led to the supposition that manure injection systems were less effective than thought.

Cassman asked how important is the quantitative monitoring system? Erisman responded that monitoring is very important, not just of environmental concentrations, but of effects. Both scale and time make measuring effects difficult. It is more effective to show a farmer that, when he reduces emissions, there are improvements in the local area (such as the return of lichens), than

Cassman asked Erisman for his experience with effectiveness of incentives, education, and punitive measures. Erisman said you need them all, but, in the end, financial incentives work best. Then you don't have to teach the farmer how to deal with nitrogen.

Paerl was struck by the 30% number. It seems to come up everywhere nitrogen is discussed – Neuse River, Chesapeake Bay, and the Netherlands. Where does it come from? Erisman agrees 30% seems to be a magic number. It is based on hard data about their experience in the Netherlands. Paerl said their numbers were often based on historical nitrogen inputs and some understanding of the possible.

Doering said the 25-30% for the Gulf Hypoxia was calculated on how much of a reduction could be made without a serious economic impact on agriculture.

Boyer wondered about the Nitrogen in Europe (Nine) effort and wondered if there were parallels toward the goals of this group, regarding integrated research on nitrogen. Erisman indicated that NINE was formed to coordinate the science in Europe; all the universities report their results to NINE. It is a networking effort to bring all the science

that is there to one program and create new opportunities in science nationally or regionally. It will translate into integrated assessment and policy. Cassman asked whether additional funding was provided for the development of an integrated strategic plan, if so, how much? Erisman said that, so far, the only extra money has been for coordination.

Galloway noted that the US is part of the Convention on Long Range Transport; Erisman indicated that Bill Harnett at EPA (OAR/OAQPS) represents the US on this.

Stacey is struggling with the 30%. He thinks it may have to do with the variety of sources you have in the area. Erisman agrees. In the Netherlands they can maintain production while reducing fertilizer and manure use by 30%. Even for NOx reductions, the reductions you get from catalysts when you consider the increase of number of cars and mileage. Stacey thinks a 60% reduction is not out of the question in CT.

There were no more questions so Galloway asked Erisman if there was anything else he wanted to say. There wasn't. Galloway said the INC would be talking with him again and appreciated the thoughtful document he sent and the generous gift of his time.

At 3:40 Galloway asked if there was any Public Comment; there were none.

The chair summarized:

- Each WG will continue with its work.
- They will write an explanatory email about the new matrix and what the INC should address prior to the meeting.

At 3:40 Galloway asked if there were any other questions, there weren't. He reminded everyone of the June meeting.

The DFO adjourned the meeting at 3:45

Respectfully Submitted:

Certified as True:

/s/
Ms. Kathleen E. White
Designated Federal Official

/s/
Dr. James N. Galloway, Chair
SAB Integrated Nitrogen Committee

Attachments: Except for the items noted, attachments will be made available at the SAB website rather than being electronically attached to the minutes. Copies of all attachments will be found in the FACA file

Federal Register notice

INC roster

Final Agenda for the June 8 Public Teleconference

Revised Draft Agenda for the June 20-22 Public Meeting

Background for the June 8 INC Teleconference from Erisman

The Dutch N-Cascade in the European Perspective by J.W. Erisman, Nelleke Domburg, Wim DeVries, Hans Kros, Bronno de Haan, & Kaj Sanders, published in *Science in China Ser C. Life Sciences*, 2005 Vol 48 No 1 1-10. (Because journal articles are usually copyrighted, this paper will not be posted at the website.)

Matrix of Nitrogen Impacts and Species and Ecosystem Services

Chair's approval of minutes (in FACA file)