Apr 6th, 9:30 AM - 9:45 AM

Nitrogen Inventory in the Nooksack-Fraser Transboundary Watershed

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Speaker
Jiajia Lin, Jana Compton, Jill Baron, Chris Clark, Donna Schwede, Shabtai Bittman, David Hooper, Barb Carey, Peter Homann, Hanna Winter, Peter Kiffney, Nichole Embertson, Heather MacKay, Robert Black, and Gary Bahr

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Nitrogen Inventory in the Nooksack-Fraser Transboundary Watershed

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Outline

• Nooksack-Fraser Transboundary nitrogen study (NFT-N)
  • Project and our goals

• Nitrogen budget
  • Method and data sources
  • Preliminary results

• Future work
  • Link to International Nitrogen Management System
Nooksack-Fraser Transboundary Watershed

- Cities, farms, dairies, shellfish operations in BC and WA watershed
- Surface water, groundwater, and air quality issues related to nutrients
Surface water quality issue

- Nooksack River drains to the bay
- Algal bloom
- Biotoxin—shellfish closure
- Hypoxia
- Nutrient enhanced ocean acidification

(Photo by Miriam Godfrey)  (Photo credit: University of Washington) (Photo credit: EPA)
Groundwater/drinking water issue

- 29% ≥10 mg/L
- 44% ≥ 5 mg/L
- 14% ≥ 20 mg/L
- 73 mg/L max nitrate-N in private well
Air quality issue

- Visibility
- Connected airshed
- Requires attention to NOX, ammonia, SO2, organic carbon sources

Vancouver, British Columbia, Canada

Why a nitrogen budget?

- Quantitative information on N fluxes
- Examine N fates and transport
- Link sources to contamination: where and how to reduce N fluxes
- Ongoing project
- Cross boundary issues
Project Goals

• Develop a nitrogen inventory using local data

• Share among stakeholders
  o Anyone affected by nitrogen in some way is a stakeholder, who is welcome to participate, adding your information, knowledge, and perspective

• Identify and evaluate solutions that can be used by local stakeholders to meet community goals
  o Improve air quality and drinking water quality
  o Economic goals
NFT-N
Nooksack-Fraser Transboundary Nitrogen budget

Input → Watershed

Human, animals, crops

Pasture

Manure

Cows

Export
### NFT-N: Data sources

<table>
<thead>
<tr>
<th>Component</th>
<th>Parameter</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmospheric deposition</td>
<td>Total N deposition</td>
<td>EPA-CMAQ</td>
</tr>
<tr>
<td>Food and feed import</td>
<td>Nutritional requirement</td>
<td>USDA, literature</td>
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<tr>
<td></td>
<td>Population, human, pets and livestock</td>
<td>USDA census</td>
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<tr>
<td>Fertilizer import</td>
<td>Crop land</td>
<td>WSDA land use map</td>
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<td>Fertilization rate</td>
<td>Local ag. Expert</td>
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<td>Biological N fixation</td>
<td>Alder density</td>
<td>OSU-LEMA</td>
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<td>N fixing crop</td>
<td>WSDA land use map</td>
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<tr>
<td>Salmon import</td>
<td>Salmon population and size</td>
<td>NOAA, Lummi Nation</td>
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<tr>
<td>Food and feed export</td>
<td>Animal population</td>
<td>USDA census</td>
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<td></td>
<td>Animal product and production rate</td>
<td>USDA, WA extension</td>
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<td>N content</td>
<td>USDA Livestock &amp; Meat Domestic Data</td>
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<td>Crop land</td>
<td>WSDA land use map</td>
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<td>Crop N content</td>
<td>USDA nutrient tool</td>
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<tr>
<td>Smolt export</td>
<td>Smolt population and size</td>
<td>NOAA, Lummi Nation</td>
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<td>Groundwater</td>
<td>Flow and N concentration</td>
<td>USGS, Ecology, ECCC</td>
</tr>
<tr>
<td>Surface water</td>
<td>Flow and N concentration</td>
<td>Ecology, USGS, EPA</td>
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<tr>
<td>Human waste</td>
<td>Sewage</td>
<td>WTPs</td>
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<tr>
<td>Animal and food waste</td>
<td>Animal population</td>
<td>USDA, WSDA</td>
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<tr>
<td></td>
<td>Animal excretion rate</td>
<td>USDA waste characteristics</td>
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</tr>
</tbody>
</table>

- Plus extensive local knowledge
  - WCD
NFT-N
- crops
Crop area

- Grass Hay high intensity
- Corn, Field (silage, high intensity)
- Corn, Field (silage, low intensity)
- Caneberry
- Pasture
- Christmas Tree
- Barley
- Alfalfa Hay
- Apple

NFT-N - crops
NFT-N
- dairy animals and other livestock
NFT-N
– dairy manure losses

Dairy cow manure as excreted (4000 metric ton N)

Volatilization loss (ammonia), 35%

Applicable manure, 65% (ammonia, and organic N)

Plant uptake 47%

Immobilization 20%

Loss as ammonia 25%

Loss via denitrification 8%

Air pollution

Leaching; gw
Preliminary Result: N budget
US side, target year 2014
Unit: metric ton of nitrogen
Draft N inputs and output proportions, US side

Missing: Canadian inputs, Wildlife, Lawn fertilizer

Total Inputs = 5488 mt N

Missing: Wildlife, groundwater/leaching, non-manure gas losses (?)

Total output = 6114 mt N
River flux includes Canada; 2014 high streamflow year
Future work

• Refine results
• Combine with Canadian budget
• Share with local stakeholders to build trust and accuracy
• Identify implications for management
• Develop a modeling structure and scenarios of N use in the future using stakeholder input
International Nitrogen Management System (INMS)

• Bring together the science community, the private sector and civil society to synthesize evidence that can support international policy development to improve global nitrogen management.

• Implemented by the UN Environment with funding through the Global Environment Facility (GEF)

• There are over 70 global project partners, conducting eight regional demonstrations
Thank you!

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