

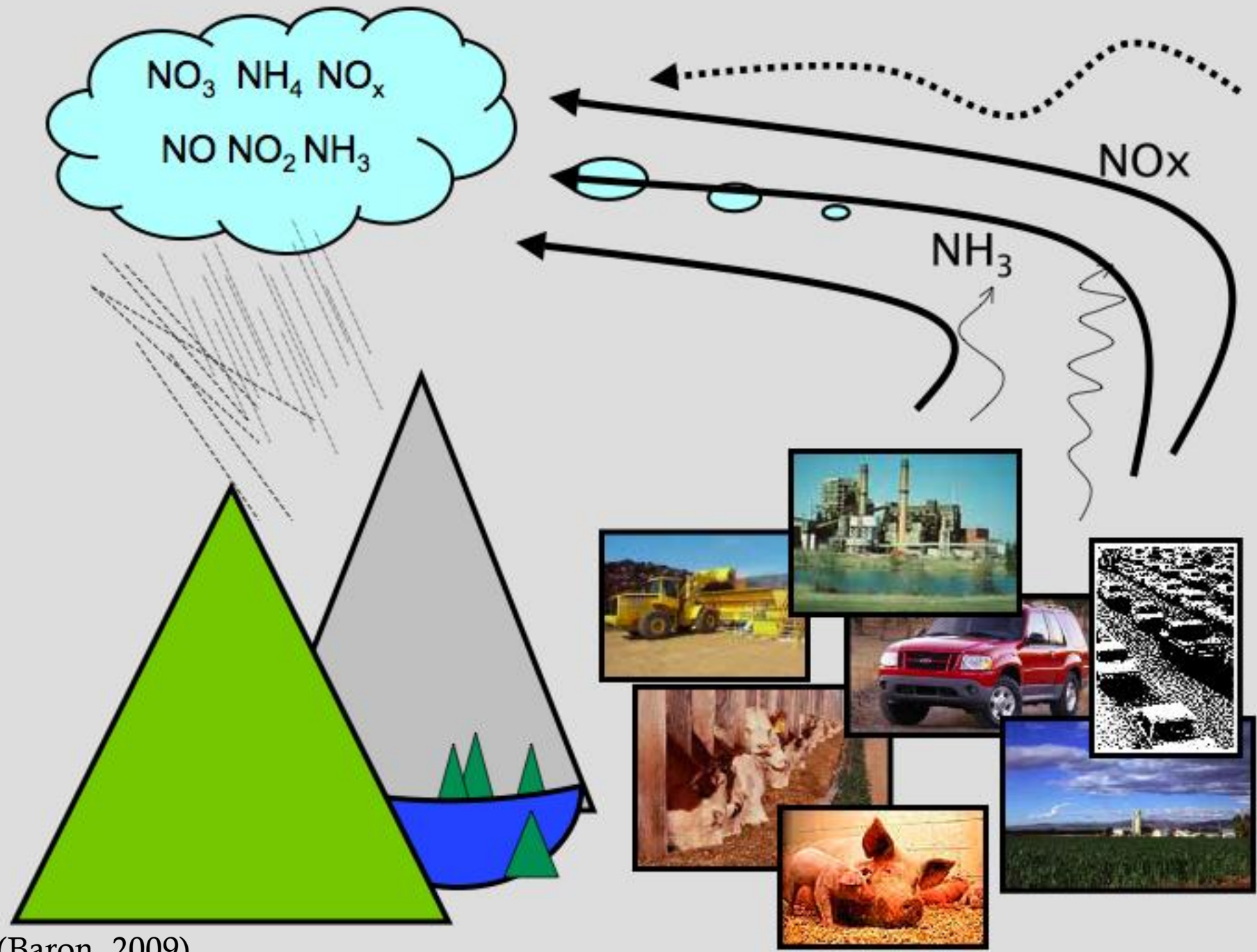
Nitrogen's Impact on the Eastern Slope of Colorado



ATOC 3500

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(Baron, 2009)

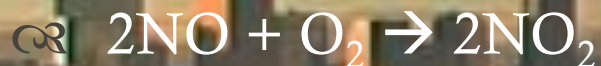
Importance

- ⌘ NO_x pollution's affect on eastern Rocky Mountain wilderness and water
 - ⌘ NO_x pollution from agriculture and vehicles/cities
- ⌘ Runoff accounts for 80% of our water
- ⌘ Nitrogen not used by plants is deposited into the water system (Rocky Mountain National Park)

Chemical Issues

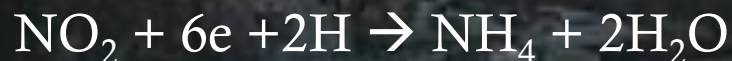


☞ Nitrogen



☞ (Division of Chemical Education, Inc., 1999)

☞ Nitrogen Fixation/Nitrification



☞ (Kapiolani Community College)

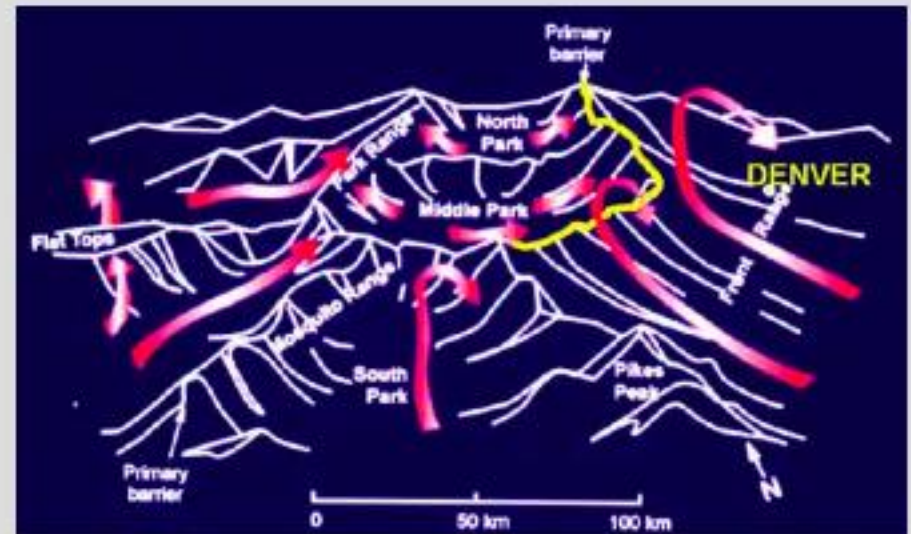
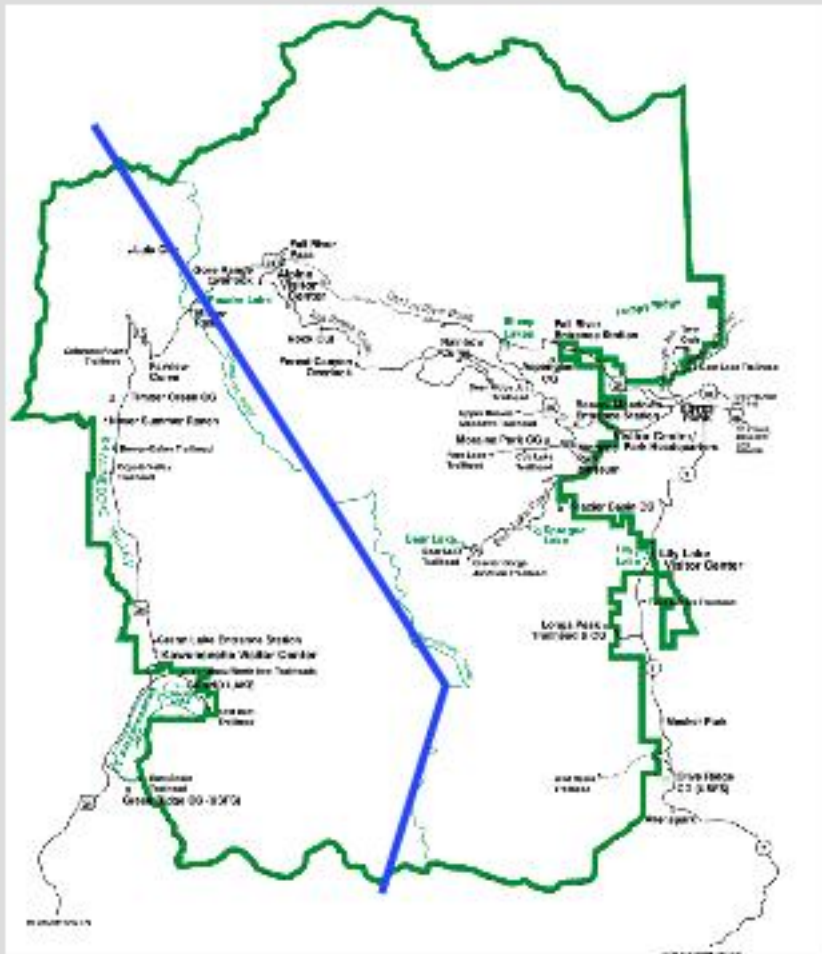
☞ NH_3 neutralizes acidity to become NH_4

Policy Implications



- ❧ Clean Air Act 1990
 - ❧ EPA assess the situation for regulatory possibilities (Williams, 2000)
 - ❧ “The uncertainties associated with effects of N on ecosystems are such that critical loads cannot be set at this time” (Williams, p. 1649, 2000).
- ❧ EPA
 - ❧ Inventory Reports but no laws/regulations
- ❧ Local vs. federal actions
 - ❧ Must be regulated regionally according to EPA (Williams, 2000)
 - ❧ Ex: eastern slope different than western slope

The Continental Divide separates airsheds in Rocky Mountain National Park



Spring/summer upslope winds
move
Front Range air to mountains

Importance of Mountains as Water Source



- ∞ As Elevation Increases Temperature decreases =
Higher precipitation amounts
- ∞ “Pristine” Water Source
- ∞ Release of Water at Critical times (Spring Run-off)

High Elevation Ecosystems are Pollution Indicators



❧ High Elevation Ecosystems sensitive to changes in energy and chemicals due to...

❧ Limited extent of vegetation and soil

❧ Short growing seasons

❧ Hydraulic flush of snowmelt

❧ Extensive areas of exposed and un-reactive bedrock

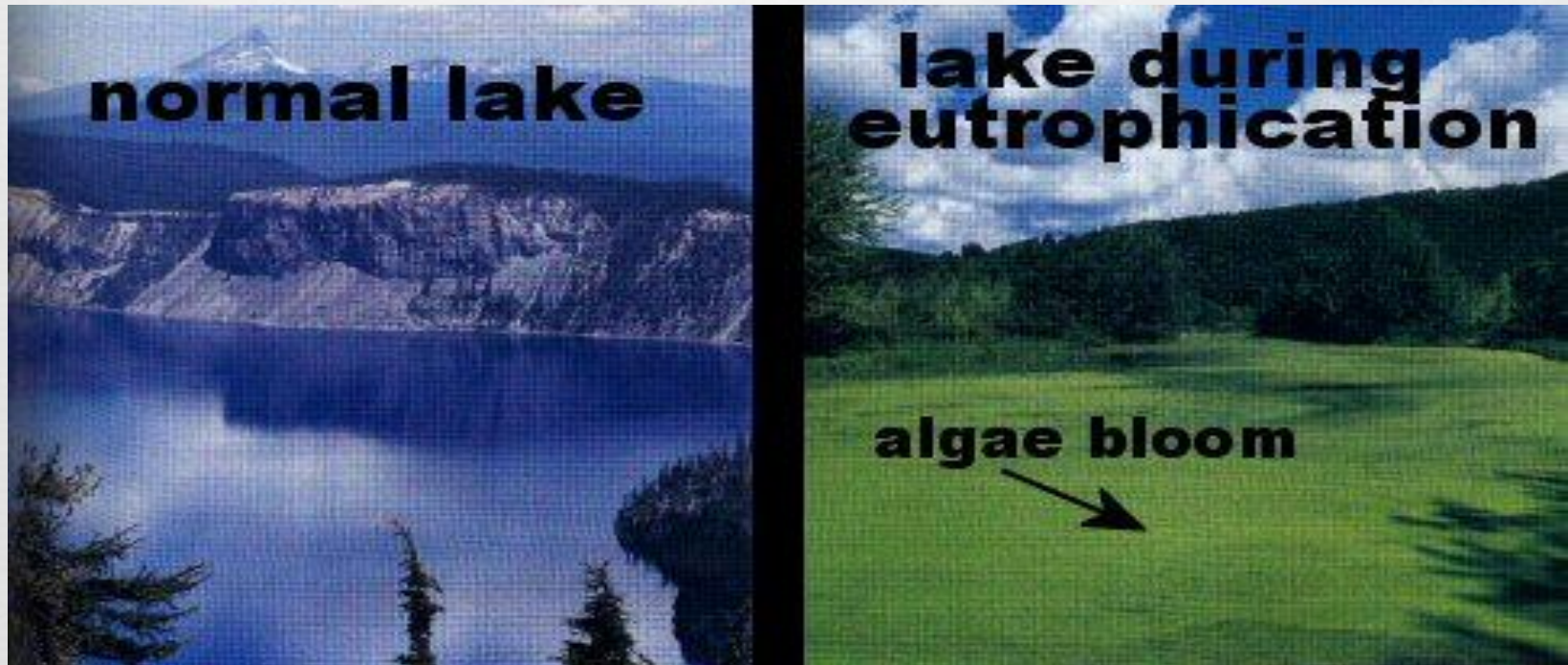
Hence small changes in atmospheric deposition have the potential to result in significant changes in ecosystem dynamics and water quality

Ecological Impacts



- ❧ More Nitrogen Deposited in High elevation environments than plants can use
- ❧ Less Flowering Plant species as sedges and grasses take over
- ❧ Excess Nitrogen Leaking into streams and lakes at certain times of the year
- ❧ Excess Nitrogen has altered diatom species composition (algae and other small oxygen producing plants)
- ❧ Excess N reduces natural buffering chemicals in lakes and soils
- ❧ Leads to eutrophication and acidification of aquatic environments

Potential for Eastern Slope Mountain Lakes



East vs. West



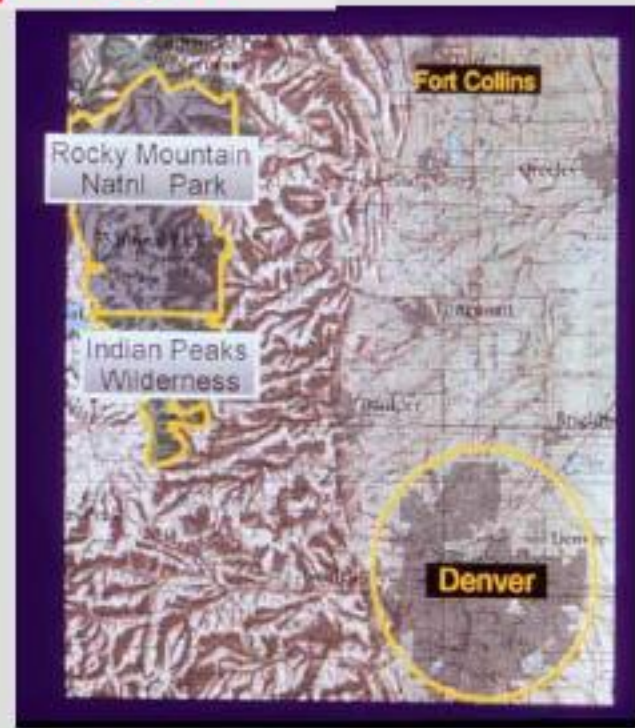
Means (ueq/L)

East 10.5 (5.0)

West 6.6 (4.3)

n=44, p = 0.02

East has
higher levels
of N



Baron et al. 2000

Conclusion



- ❧ N Deposition in RMNP has increased 2% per year the last two decades
- ❧ N concentration is 2-4 times higher on Eastern Slope due to Point-source and Non-Point Source emissions
- ❧ N saturation and excess fertilization can change terrestrial and aquatic ecosystems
- ❧ Significant changes in aquatic species in high elevation watersheds leads to eutrophication and acidification of water sources which in turn effect downstream ecosystems

References

- ❧ Williams M, Tonnessen K. (2000). *Critical Loads for Inorganic Nitrogen Deposition in the Colorado Front Range, USA*. Ecological Society of America. 10(6), 1648-1665.
- ❧ Environmental Protection Agency. (2010). *Sources and Emissions*. Retrieved April 18th, 2010, from <http://www.epa.gov/nitrousoxide/sources.html>.
- ❧ National Park Service Department of the Interior. *Nitrogen Deposition: Issues and Effects in Rocky Mountain National Park*. Retrieved April 18th, 2010, from <http://www.cdphe.state.co.us/ap/rmnp/exhibita.pdf>.
- ❧ Division of Chemical Education, Inc. (1999). *Reaction of Nitrogen Monoxide with Oxygen to form Nitric Acid*. Retrieved April 19th, 2010, from <http://jchemed.chem.wisc.edu/JCESoft/CCS/CCS3/MAIN/RAINN102/PAGE1.HTM>.
- ❧ Kapi'oliani Community College. Nitrogen Fixation. Retrieved April 19th, 2010, from http://library.kcc.hawaii.edu/external/chemistry/everyday_nitrogen.html.
- ❧ Williams M, Tonnessen K. (2000). *Critical Loads for Inorganic Nitrogen Deposition in the Colorado Front Range, USA*. Ecological Society of America. 10.6, 1648-1665.
- ❧ Baron, Jill. (2009). *Consequences of Nitrogen Deposition to Rocky Mountain National Park*. USGS. Retrieved April 18th, 2010, from, <http://snobear.colorado.edu/Markw/Mountains/07/Ndep/baron>

