

# MEASUREMENTS OF NITROGENOUS AIR POLLUTANTS AND IMPACTS ON VEGETATION COMMUNITIES ACROSS THE SNAKE RIVER PLAIN

**Michael D Bell**

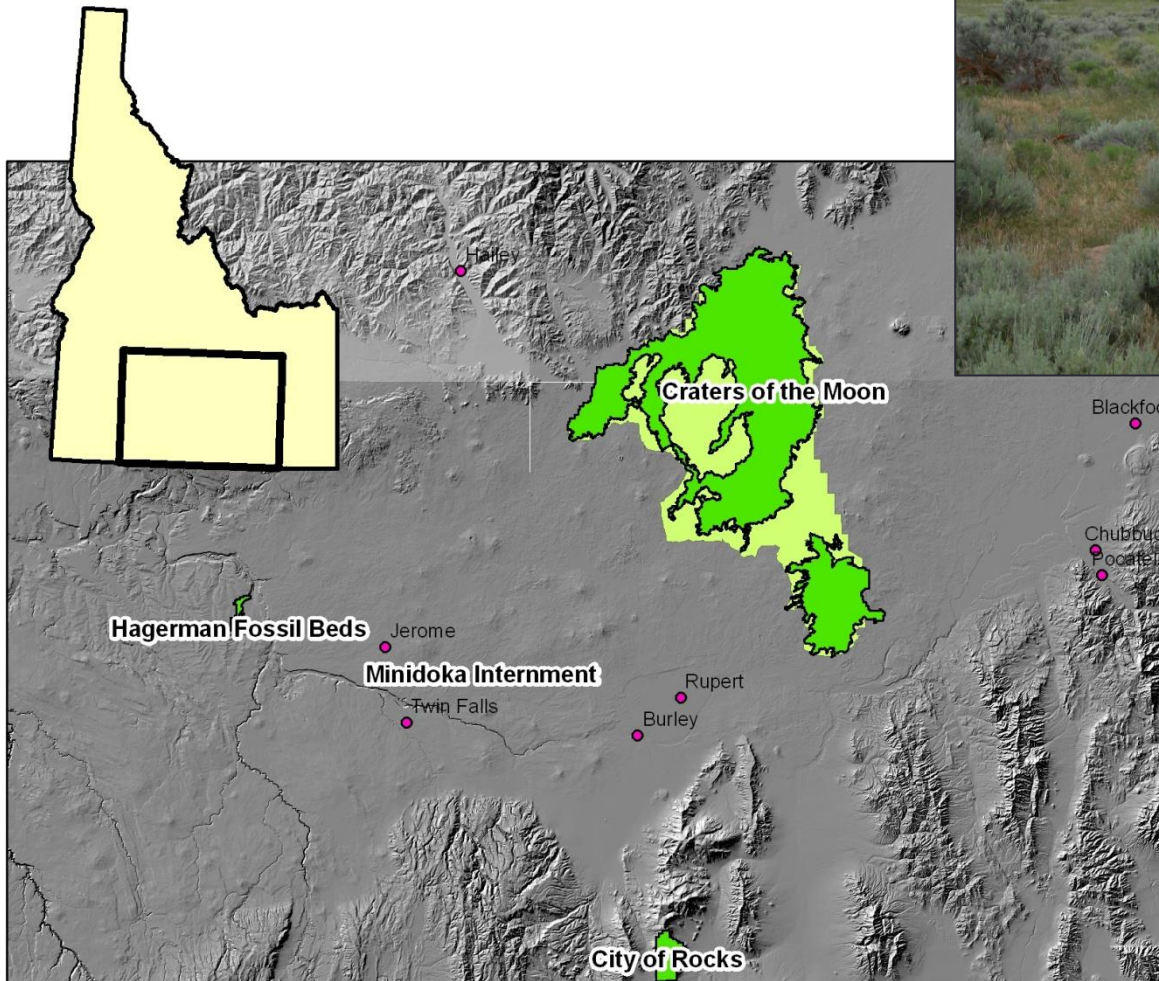
Edith B. Allen, Andrzej Bytnerowicz,  
Mark E. Fenn



# Questions

1. Are empirical atmospheric N deposition values equivalent to CMAQ modeled values (2006)?
2. Does increased nitrogen deposition increase the abundance of *Bromus tectorum* in sagebrush-steppe habitat?

# Study Sites



**Sagebrush-Steppe Habitat**

- Craters of the Moon National Monument
- Hagermann Fossil Beds
- Minidoka Internment National Monument
- City of Rocks National Reserve

# Cheat Grass



# Sources of N

- Agriculture
  - Largest exports: potatoes, wheat, and hay
- Concentrated Animal Feeding Operations (CAFO)
  - dairy farms, beef cattle
- Automobiles / Industry

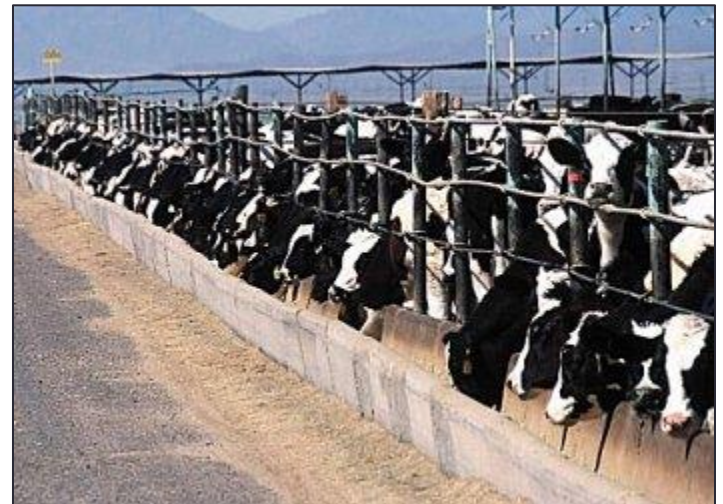


Photo: [www.epa.gov](http://www.epa.gov)



## Forget potatoes: Idaho now grows CAFOs

By [Twilight Greenaway](#)

When the [Prevention of Farm Animal Cruelty Act](#) (Proposition 2) passed in California in 2008, it granted laying hens nominally more space in their cages.

Proponents of humane animal husbandry cheered the fact that these birds would now have a little more room to stretch their wings. But industrial egg producers — claiming their costs would go up — threatened to leave the state before 2015, when key portions of the law go into effect.



Aerial view of a CAFO.

Photo: Kestrel Aerial

# BOISE weekly

## Cow Country: The Rise of the CAFO in Idaho

As mega-dairies and feedlots make up more of Idaho's dairy industry, the conflicts between people and cattle are increasing

by [Scott Weaver](#)

# High Country News

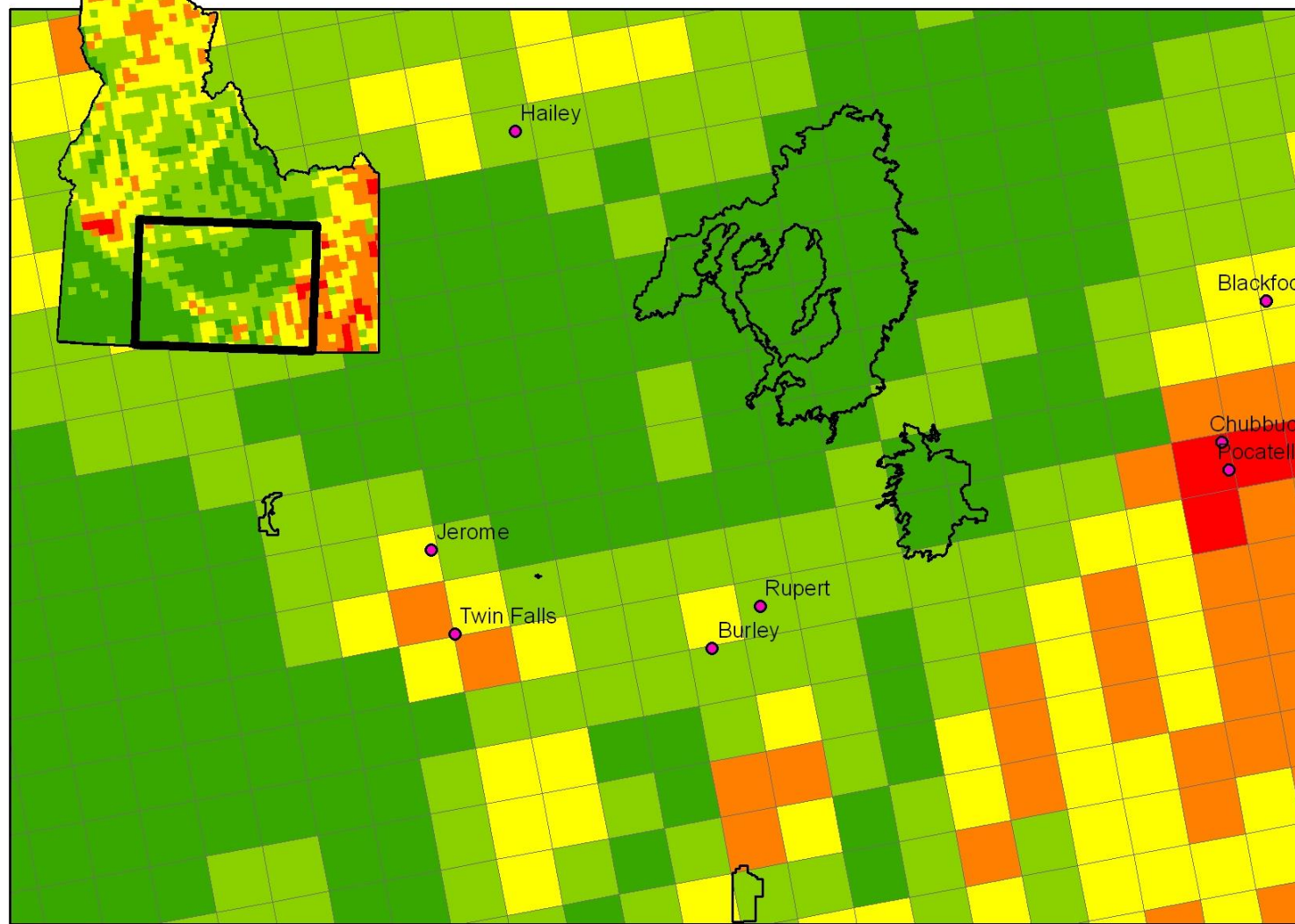
For people who care about the West

## Idaho: The CAFO state?



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# 2006 12km CMAQ – Total NO<sub>y</sub> Deposition



NO<sub>x</sub> (kg h<sup>-1</sup> yr<sup>-1</sup>)

0.7 - 1.2

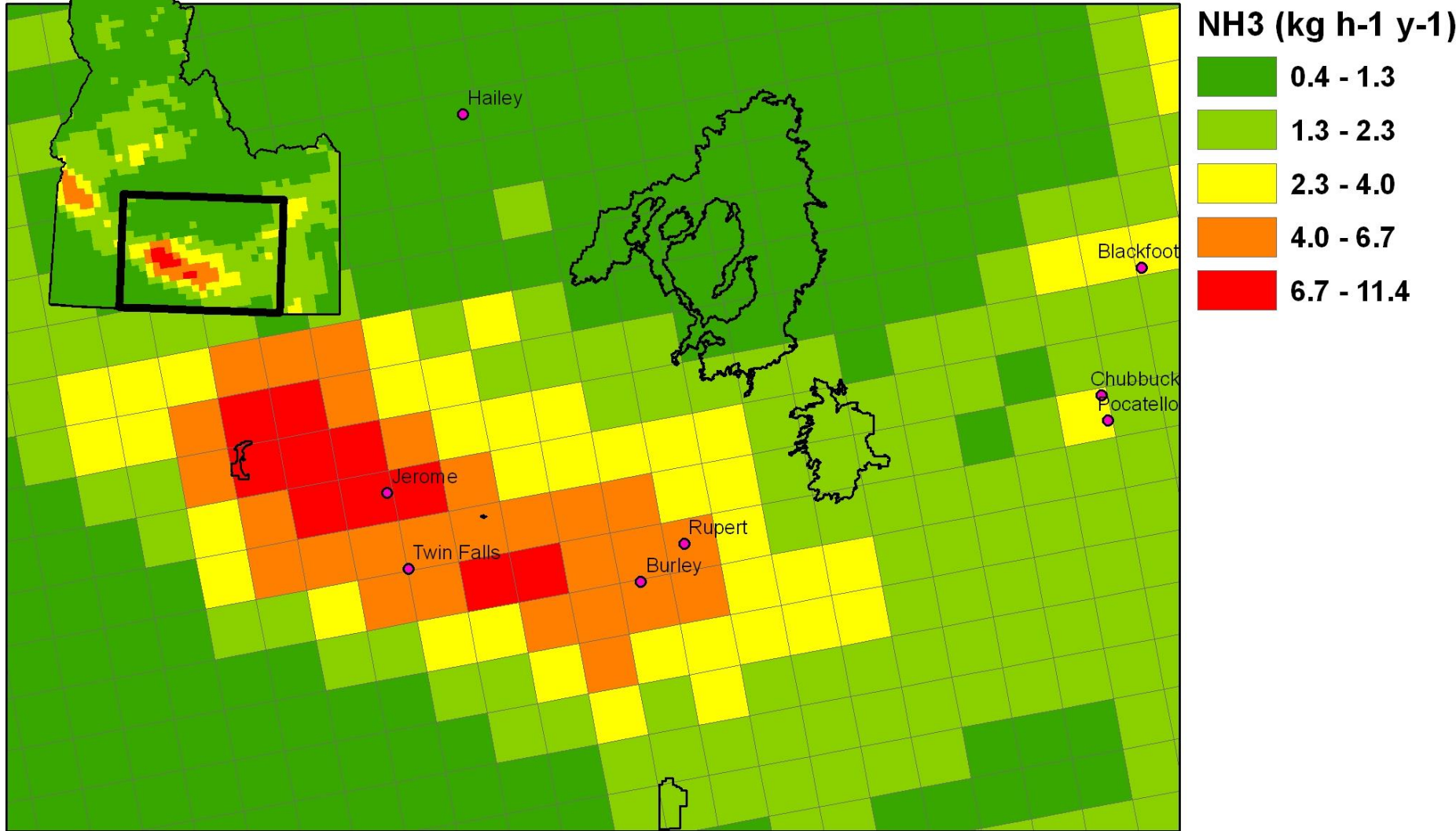
1.2 - 1.5

1.5 - 1.8

1.8 - 2.3

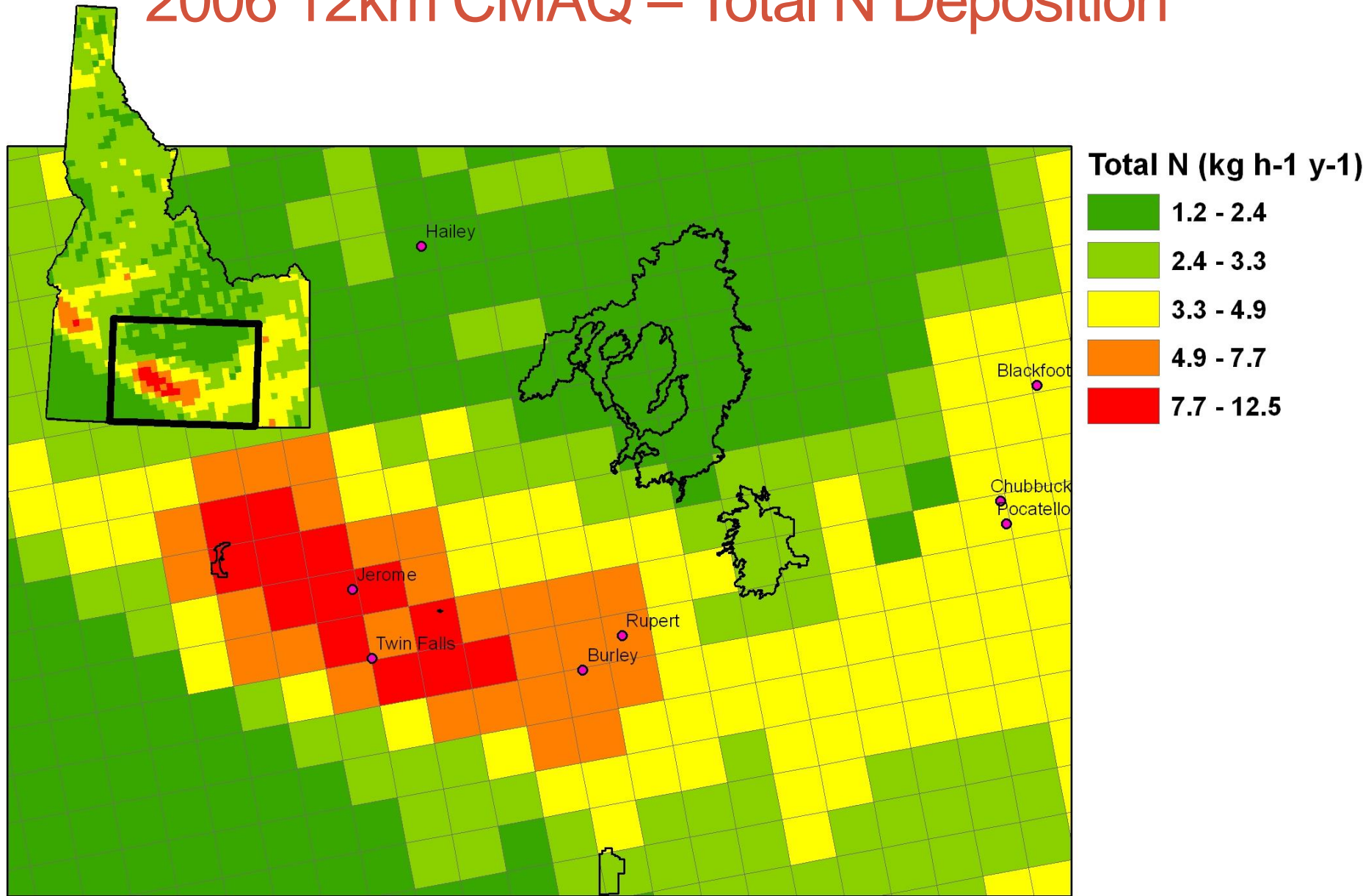
2.3 - 3.7

# 2006 12km CMAQ – Total NH<sub>3</sub> Deposition

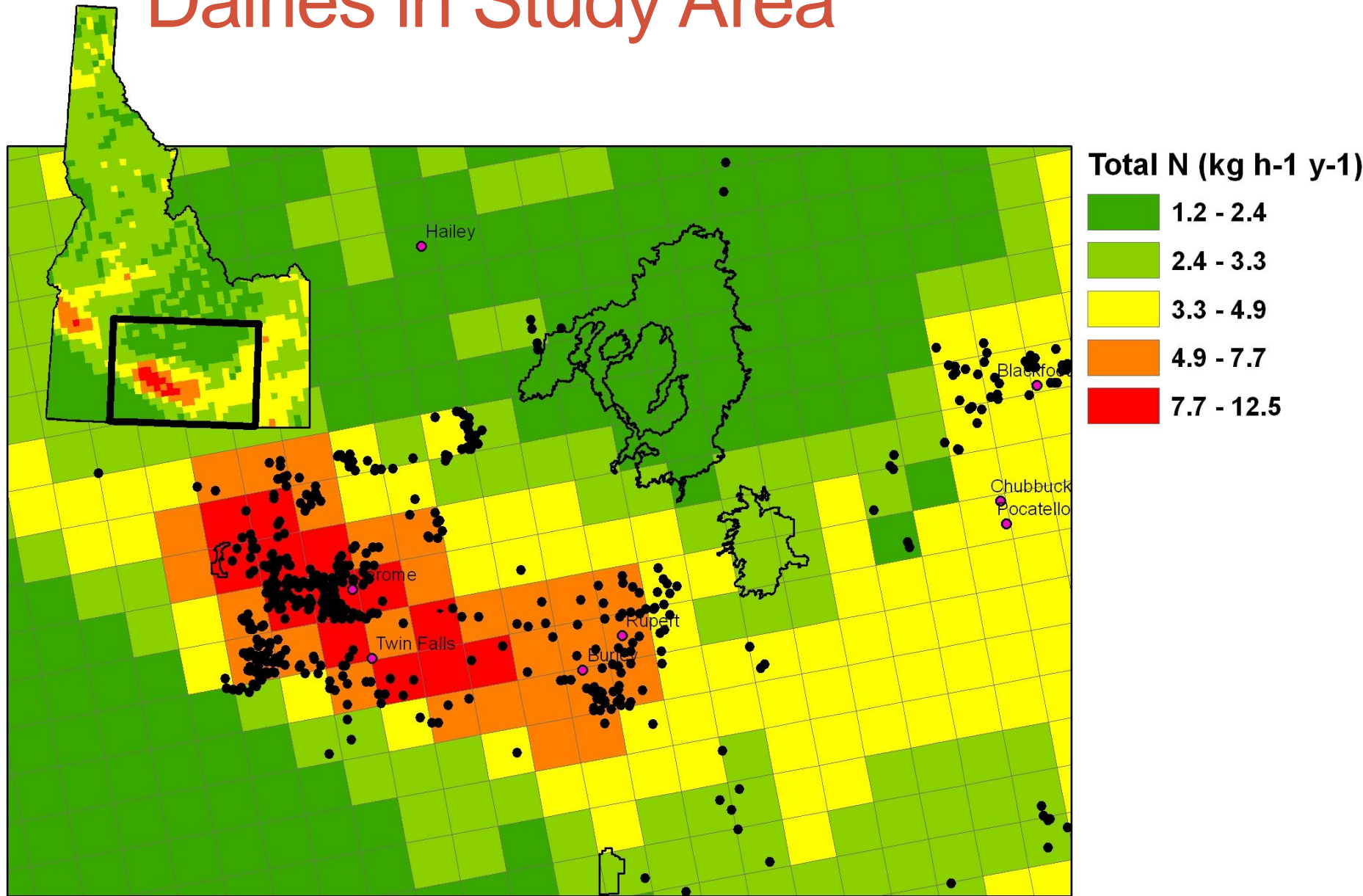




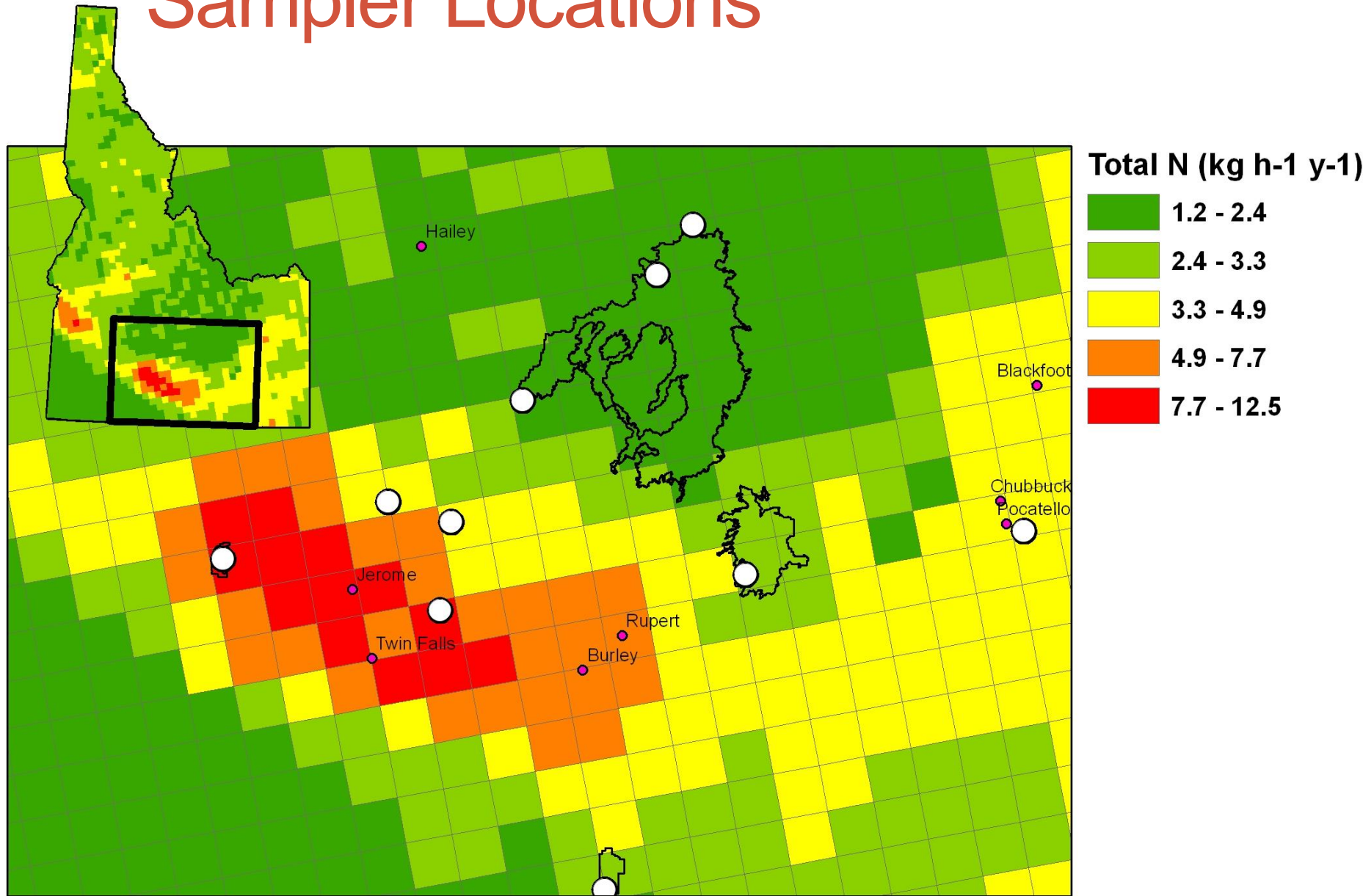
# 2006 12km CMAQ – Total N Deposition



# Dairies in Study Area



# Sampler Locations



# Atmospheric Samplers – 10 sites



Passive Collection

Nylasorb  
 $\text{HNO}_3$



Ogawa  
 $\text{NO}_2$   
 $\text{NO}_x$   
 $\text{NH}_3$

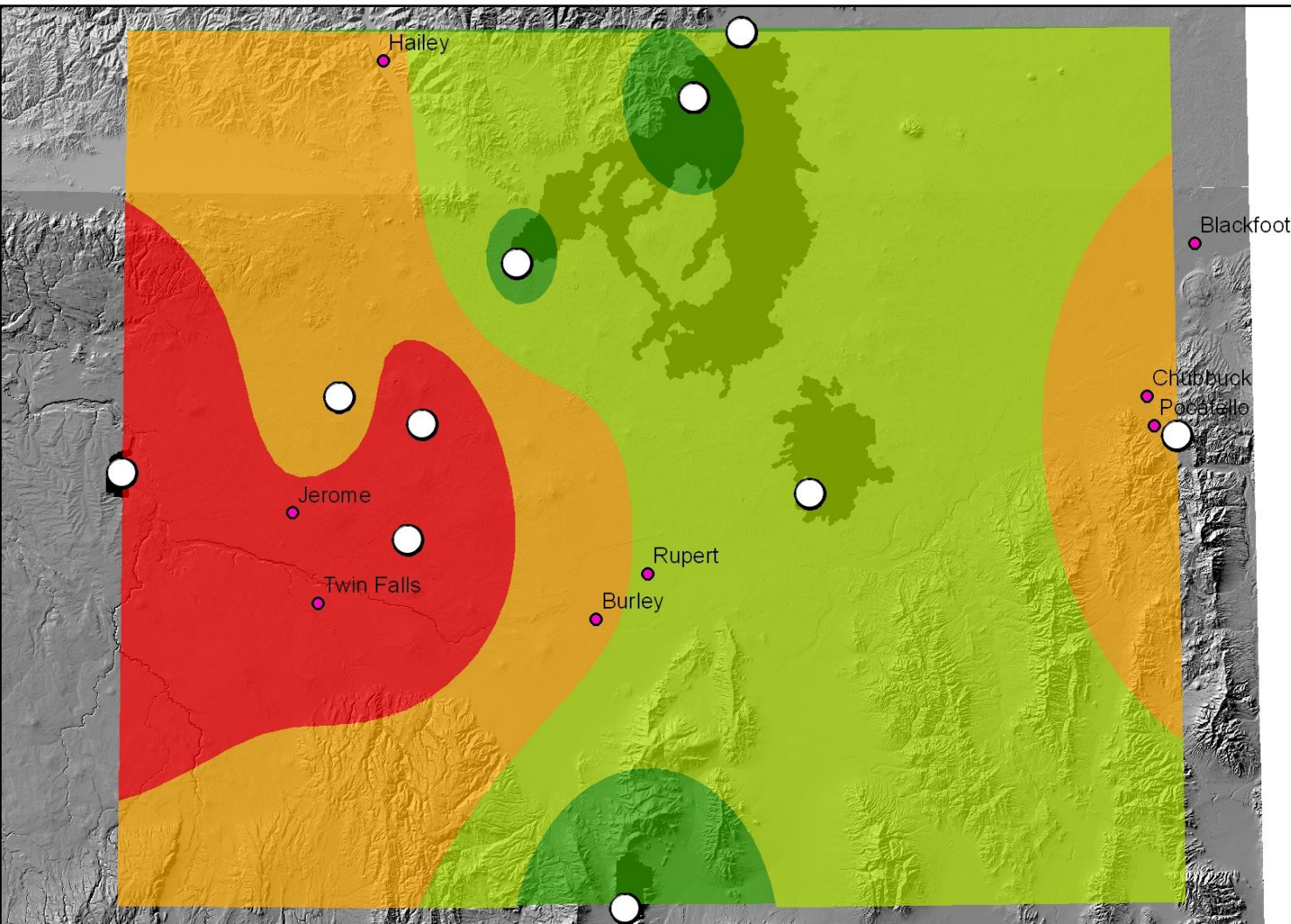


# Bulk Deposition Samplers

## 10 Sites



# NO<sub>2</sub>



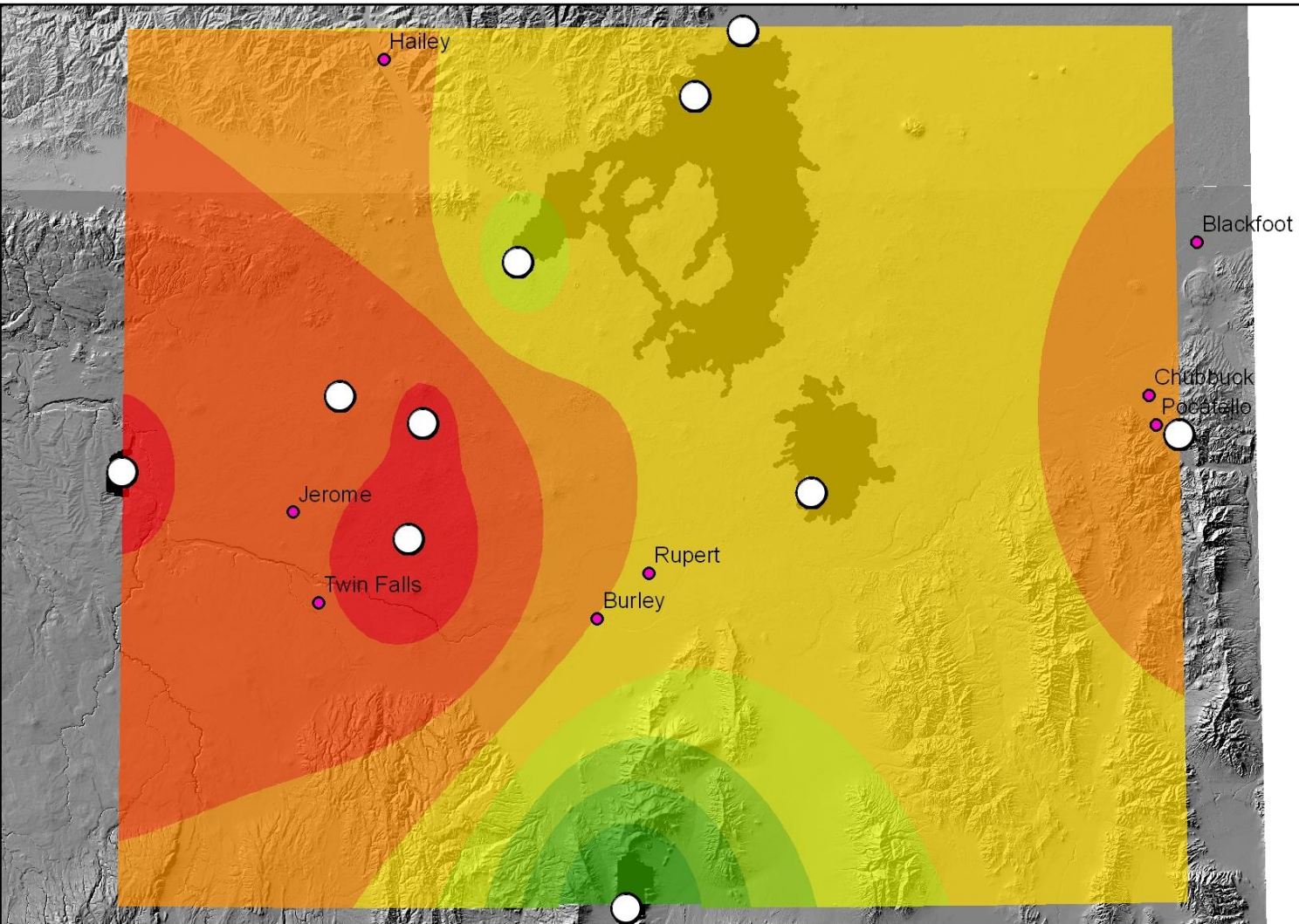
## Average NO<sub>2</sub>

06/2011 - 06/2012

ppb



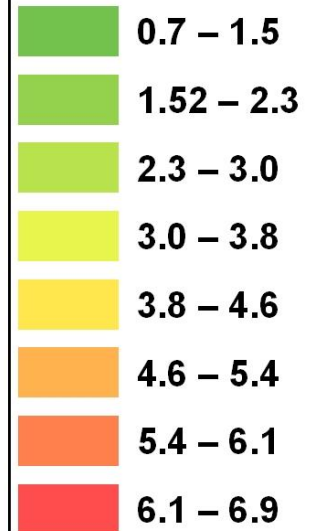
# NO<sub>x</sub>



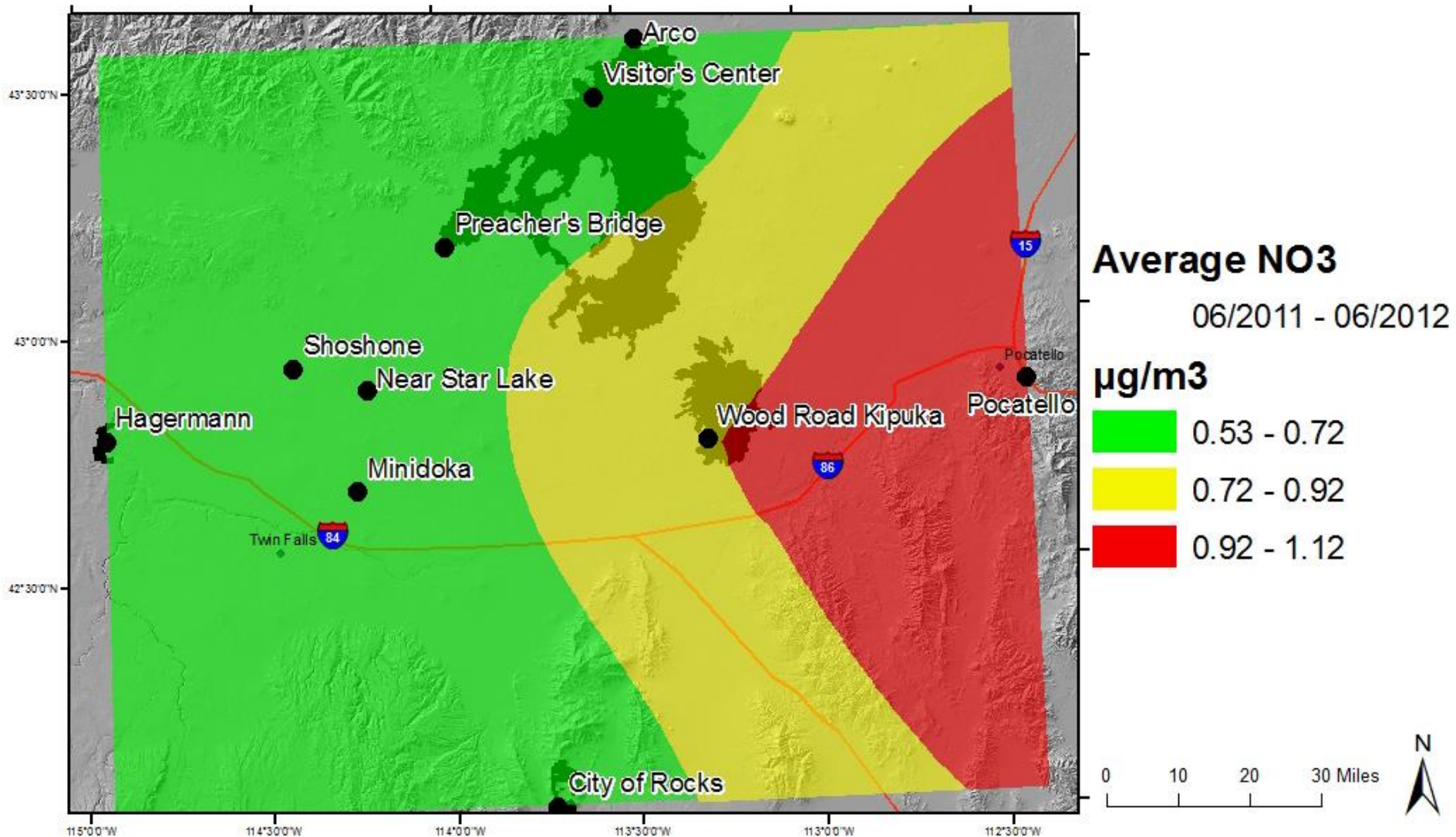
## Average NOx

06/2011 - 06/2012

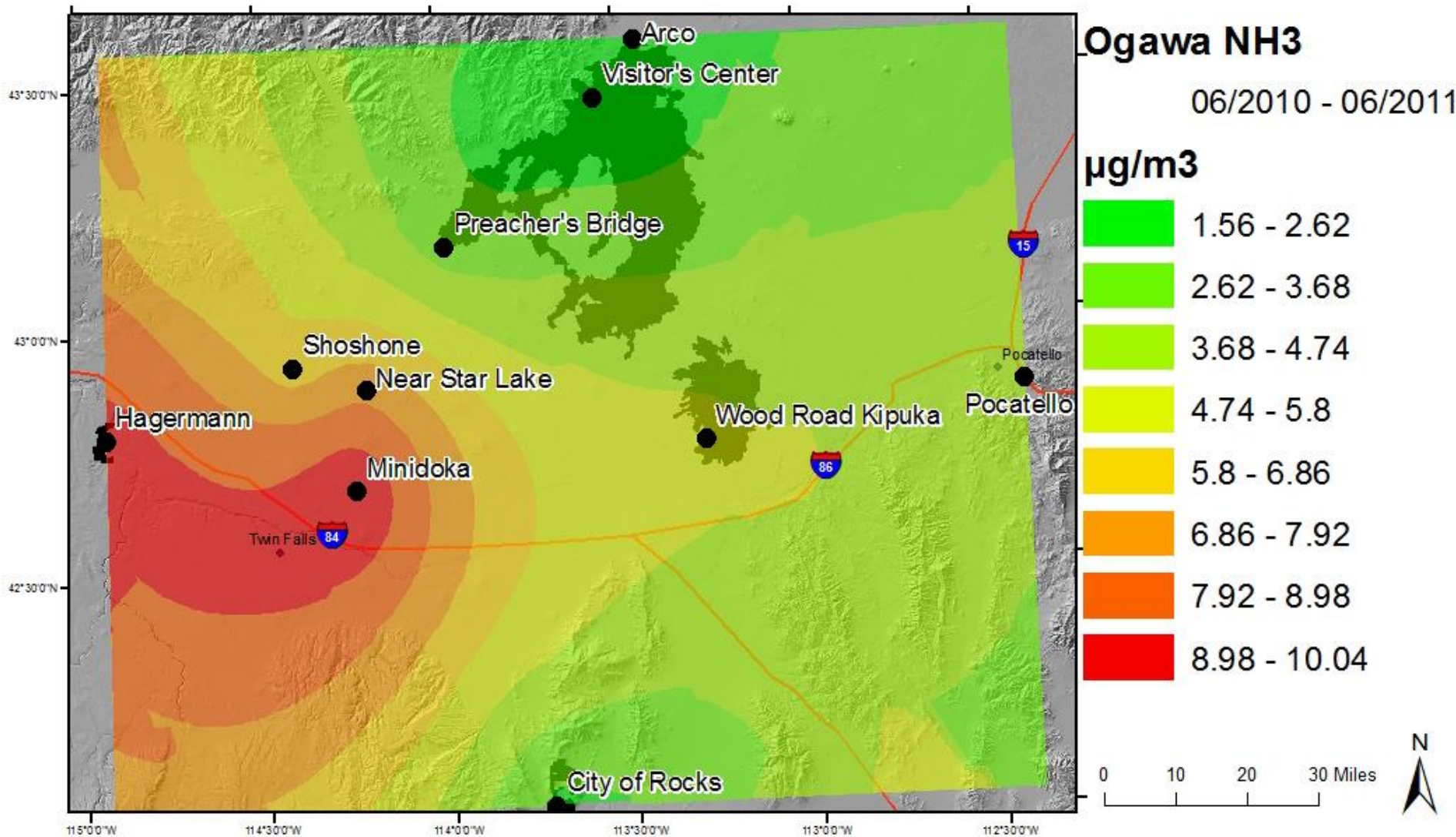
ppb



# HNO<sub>3</sub>

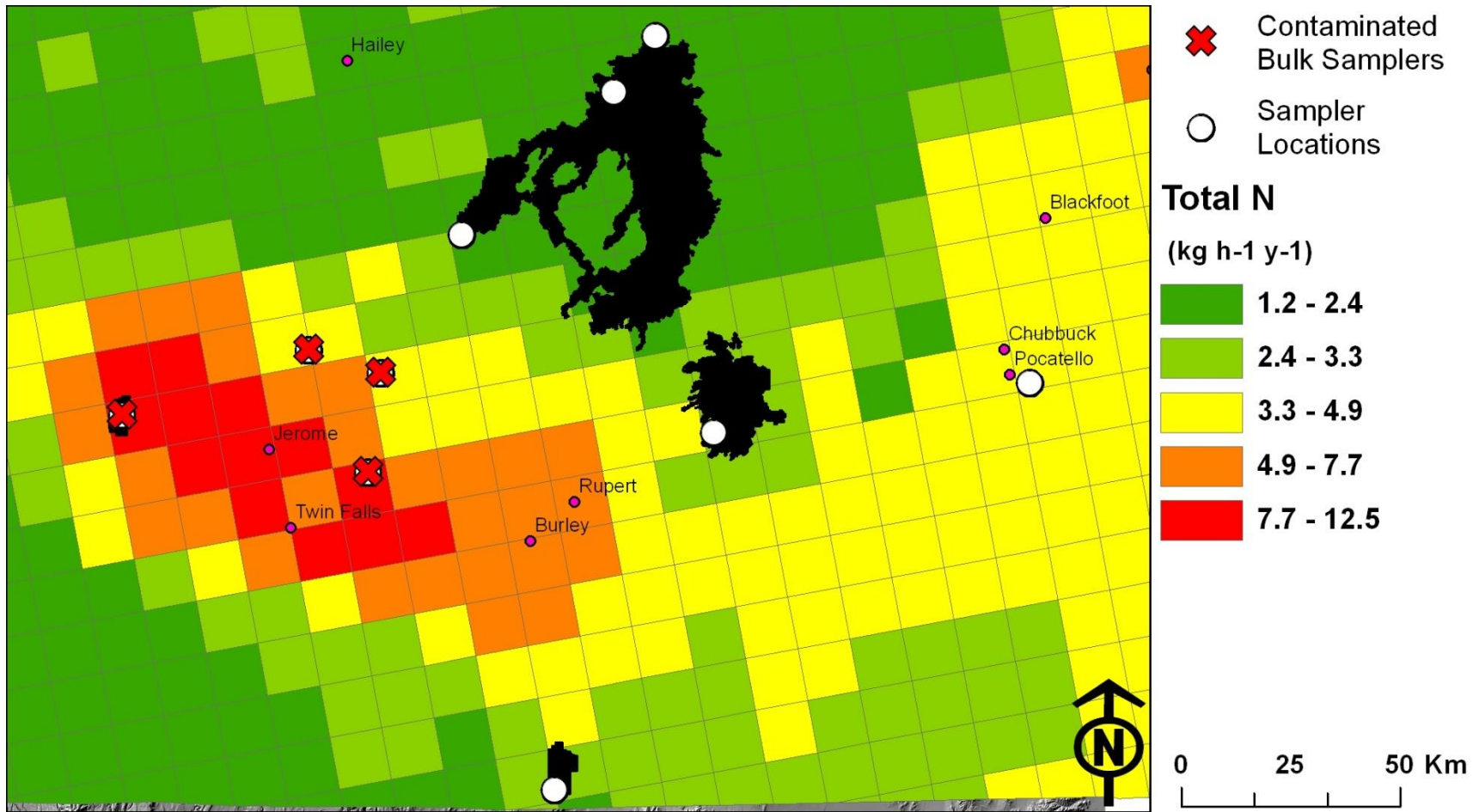




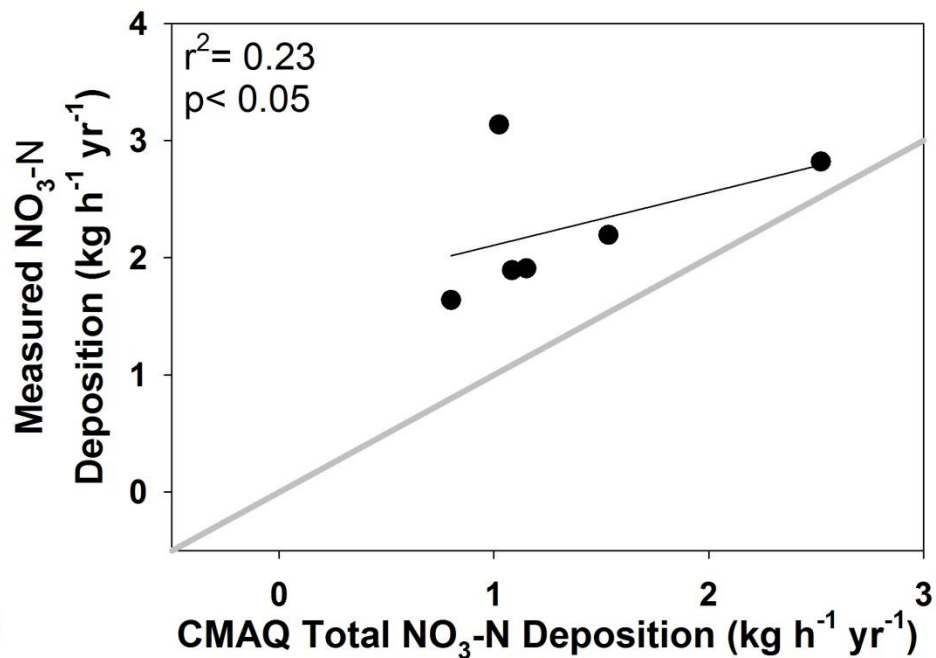
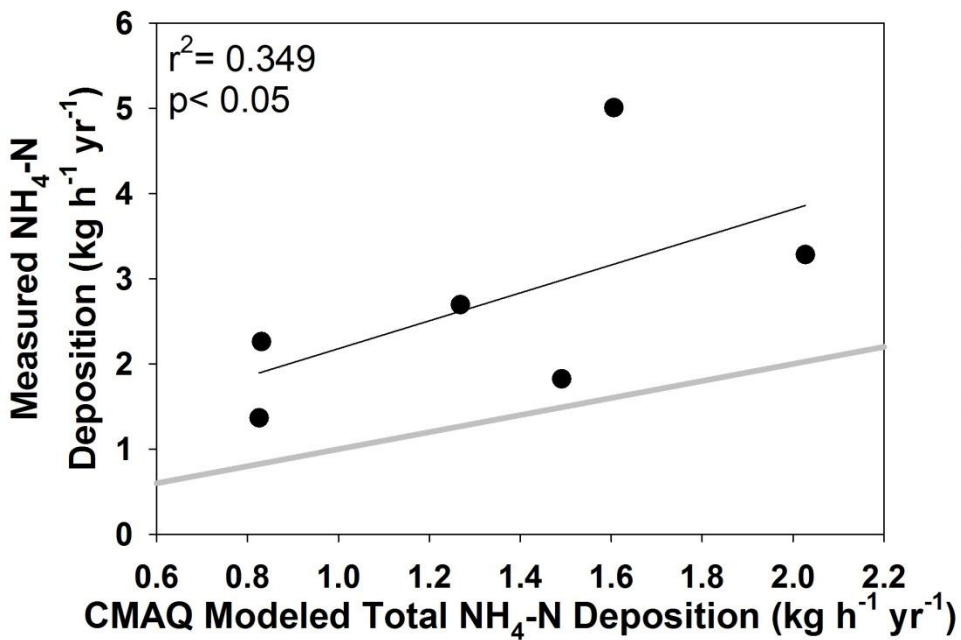


# Bulk Deposition

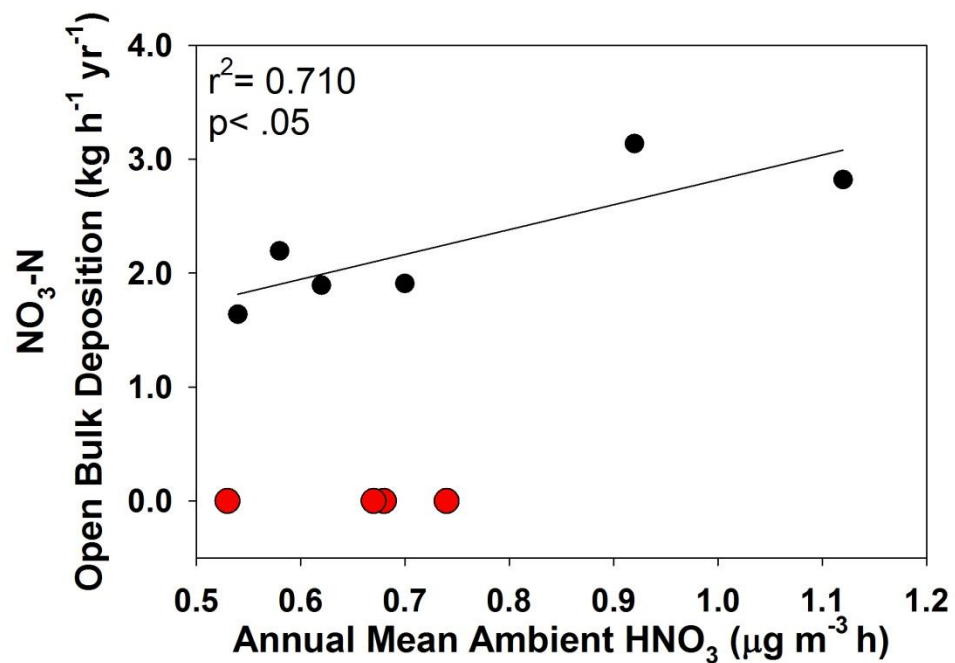
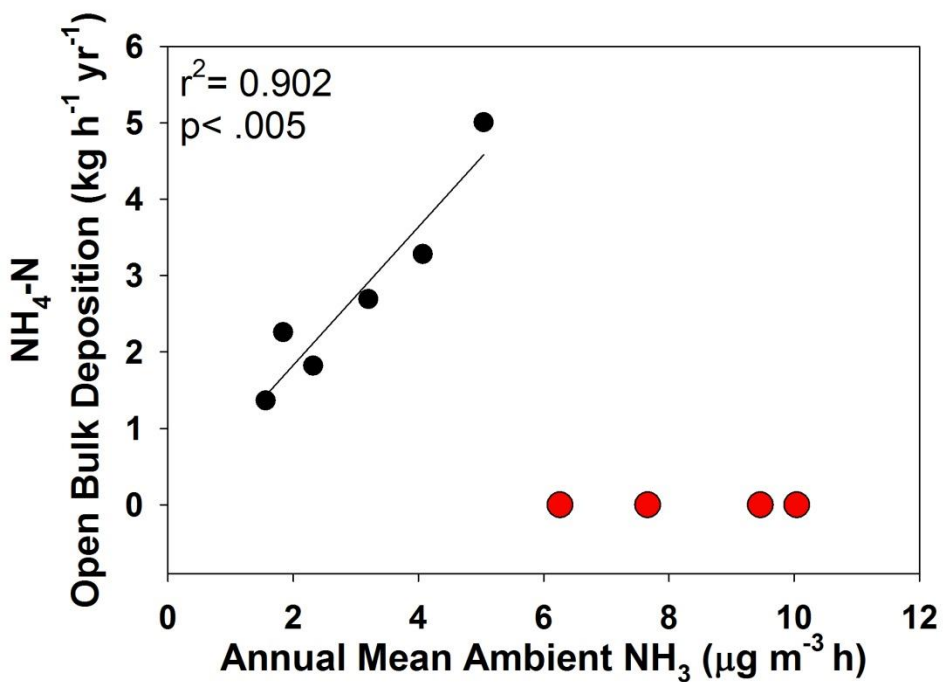
- Contamination at the high deposition sites by birds



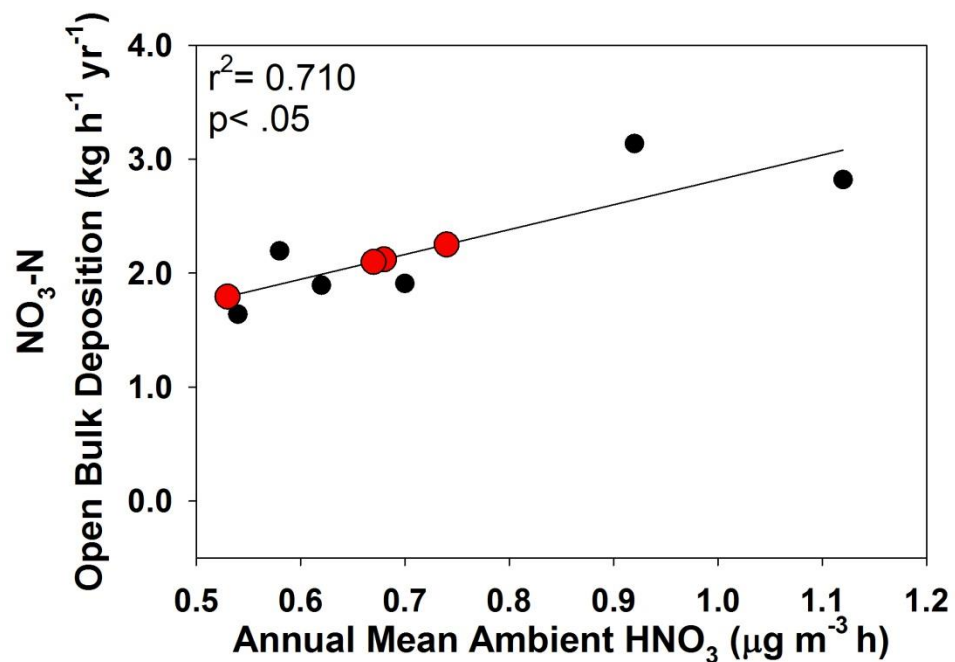
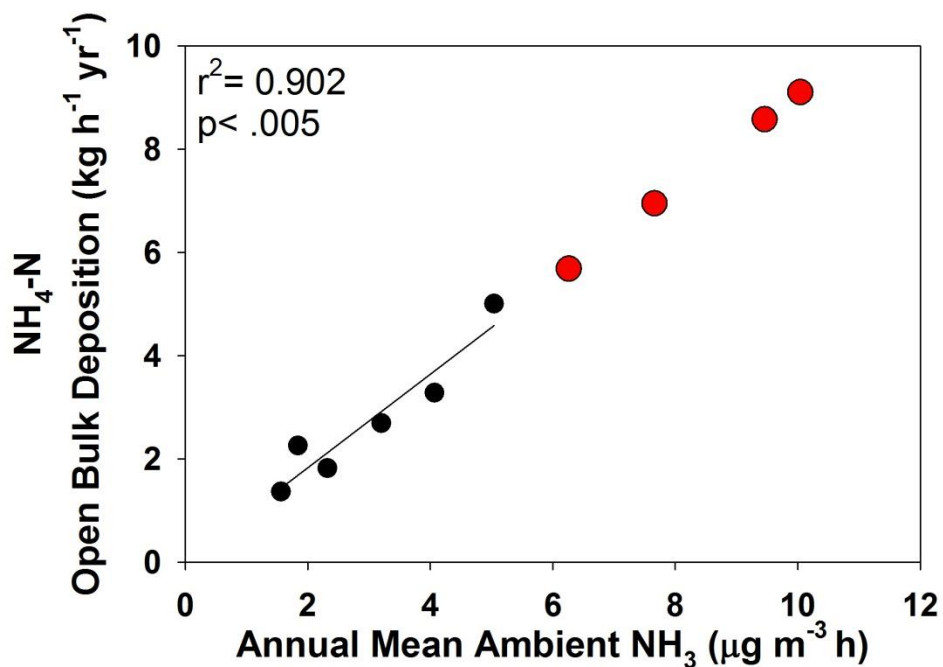
# CMAQ 2006 vs Bulk Deposition



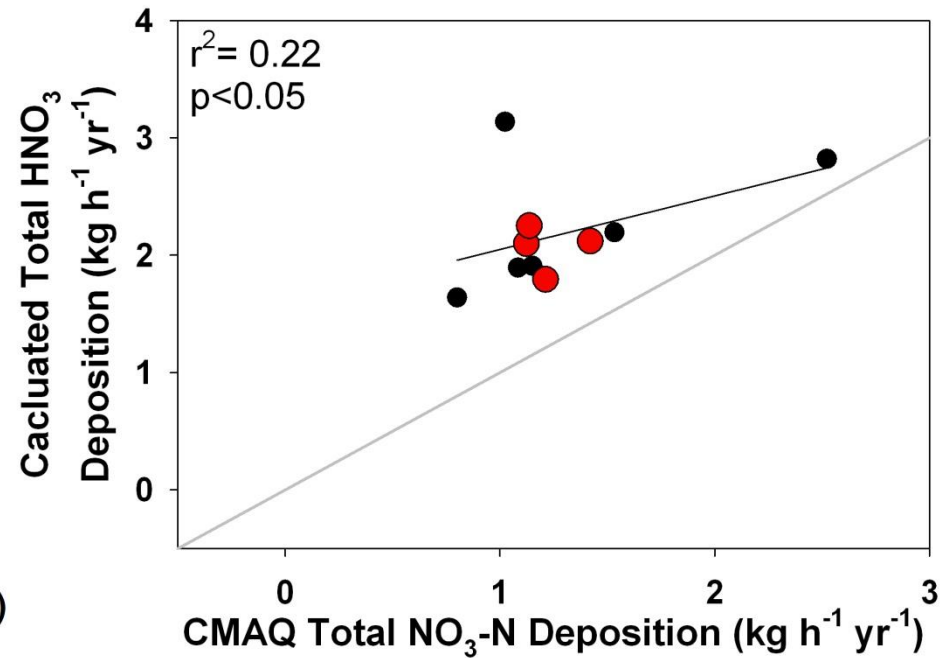
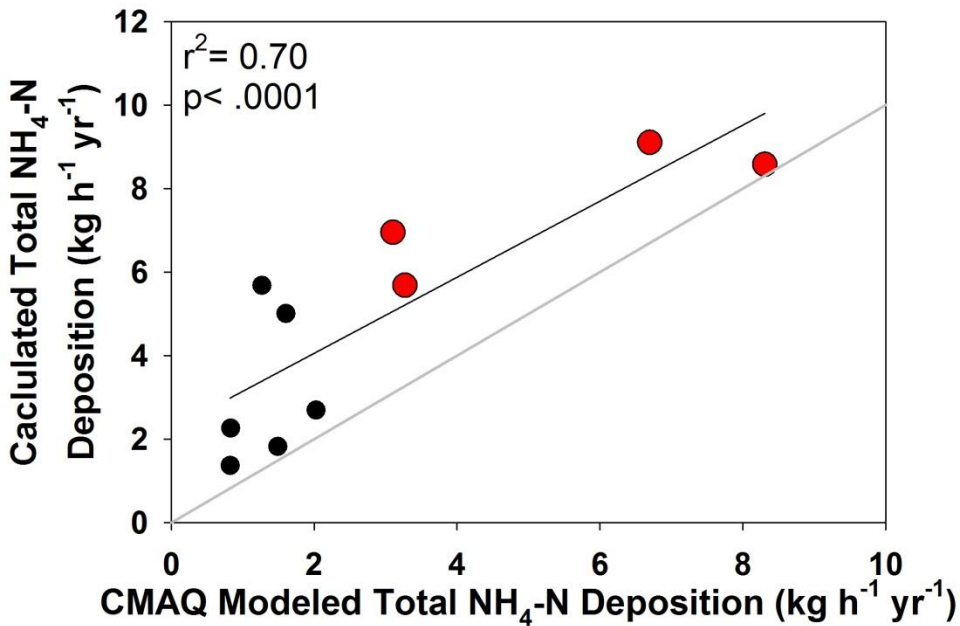
# Ambient vs Bulk Deposition



# Ambient v Deposition + Calculated



# CMAQ 2006 v Calculated N Deposition



# Vegetation Response

- Observational Notes

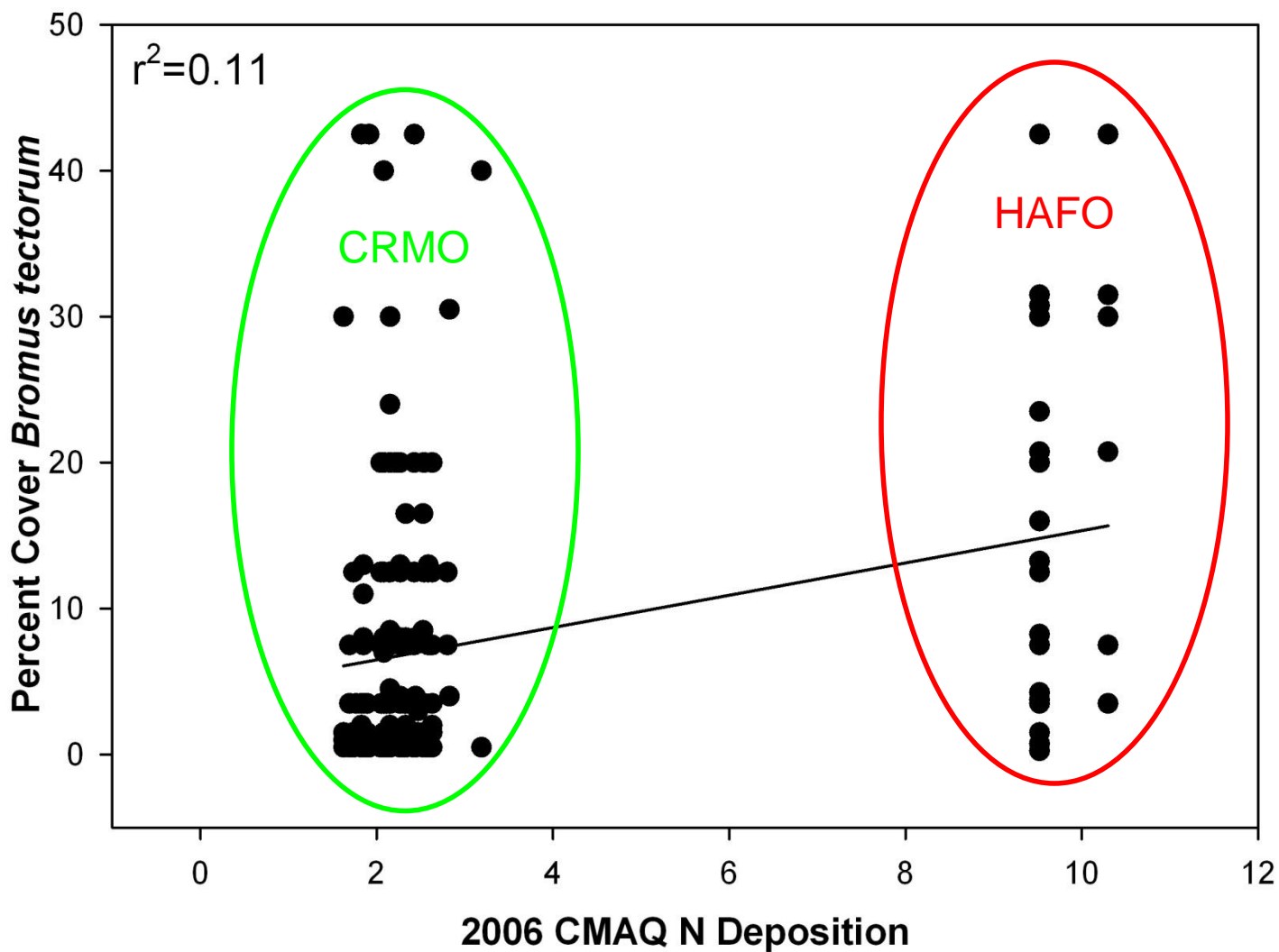


# Vegetation Response

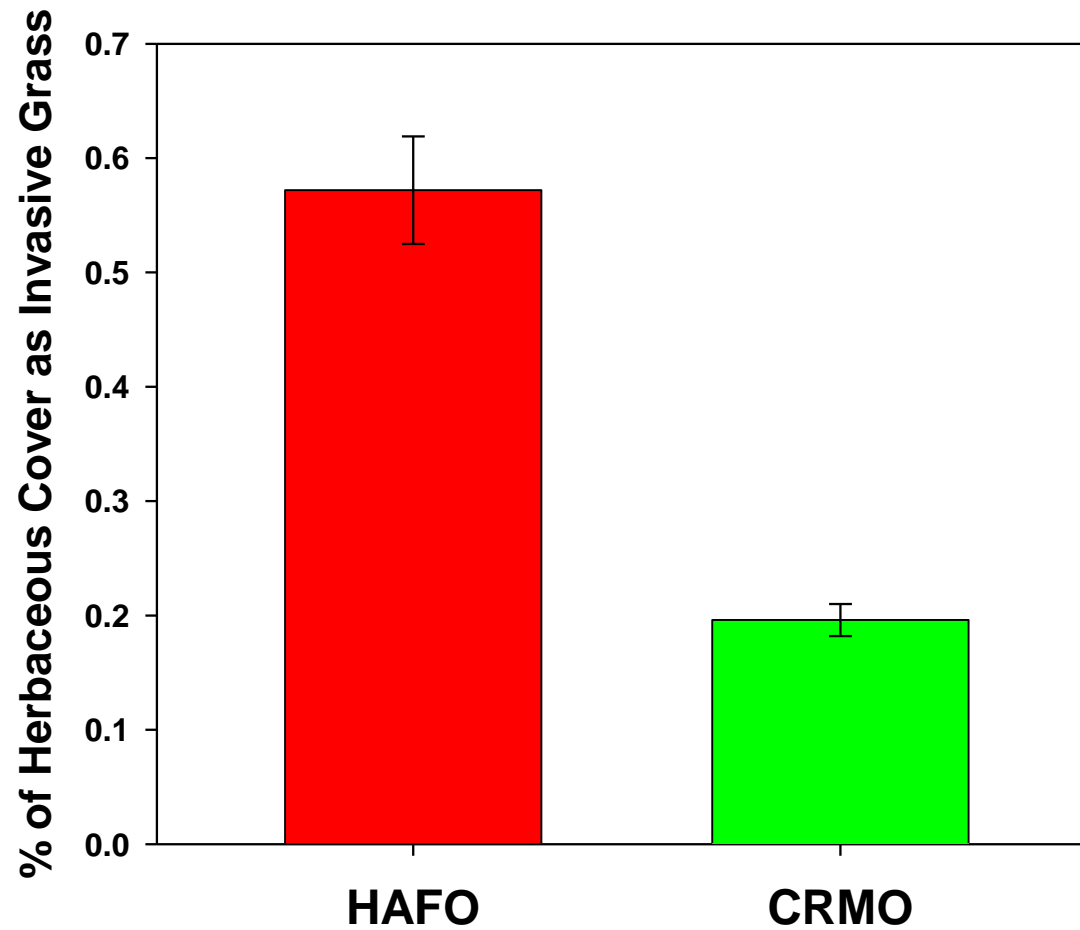
- 2 Data Sets from UCBN Online Database
- **Data Set 1**
- Spring 2006
  - CRMO (204 Plots), HAFO (52 Plots)
  - Vegetation as functional groups / nativity
- **Data Set 2**
- Spring 2009
  - CIRO, HAFO (5 sites), CRMO (10 Plots)
  - Vegetation Data recorded as functional group



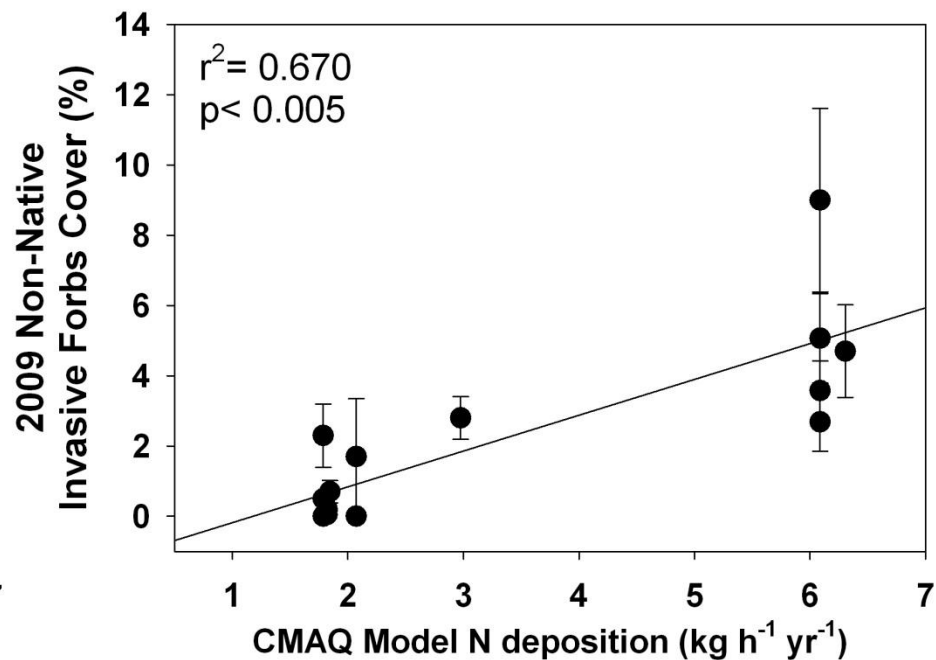
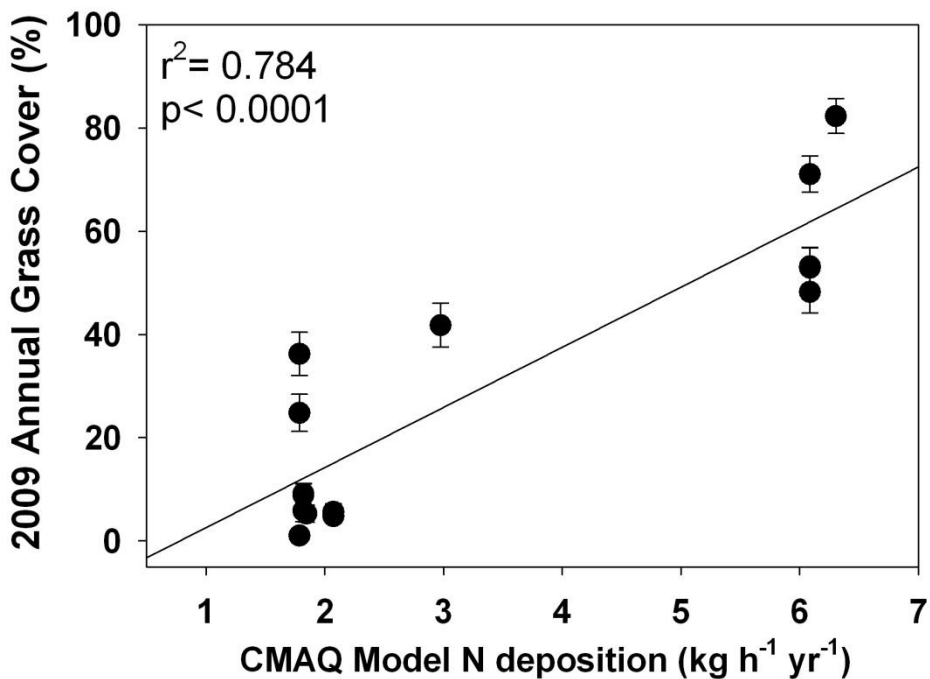
# Data Set 1 – 2006



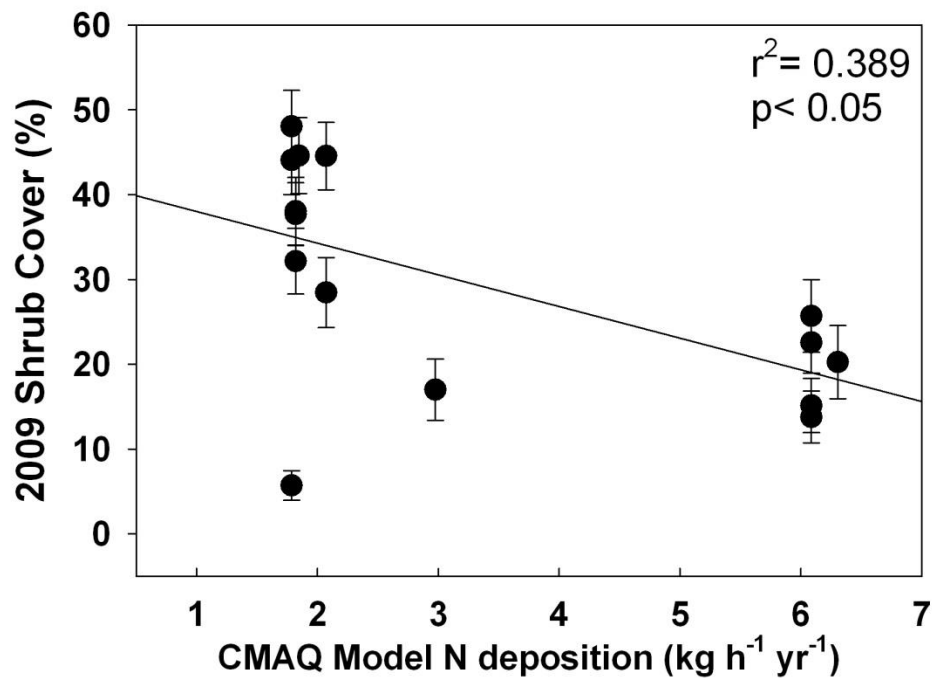
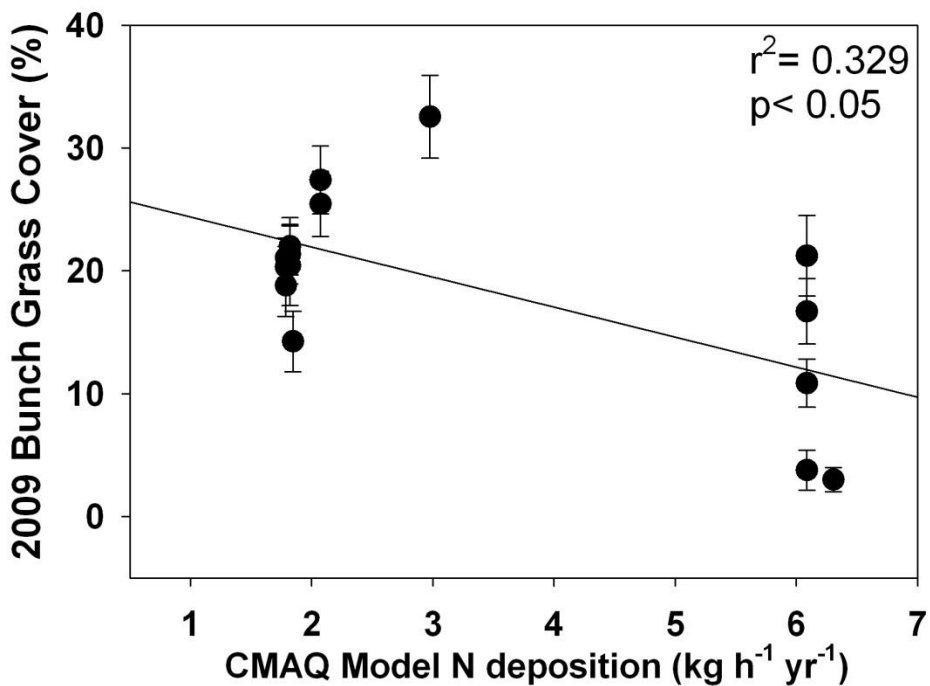
# Data Set 1 – 2006



# Data Set 2 – 2009



# Data Set 2 – 2009



# Conclusions – Question 1

- ARE EMPIRICAL ATMOSPHERIC N DEPOSITION VALUES EQUIVALENT TO CMAQ MODELED VALUES (2006)?
- Relatively, low deposition sites measured higher amounts of nitrogen deposition ( $\text{NO}_3$  &  $\text{NH}_4$ ) when compared to CMAQ modeled values.
- Average change of total deposition was 200% higher than previously modeled.
- For future studies, bird deterrents must be improved to protect samplers from contamination.

# Conclusion – Question 2

- Does increased nitrogen deposition increase the spread of *Bromus tectorum* in sagebrush-steppe habitat?
- Exotic annual grass cover increased from low deposition to high deposition sites.
- *Bromus tectorum* makes up a higher percentage of herbaceous cover at sites.
- Shrub cover decreases at high deposition sites relative to low.

# Conclusion – Question 2

- Due to land use history and environmental heterogeneity (lava flows, steep slopes, age of substrate) it is difficult to find similar sites across the gradient.
- Future research using fertilization plots at high and low deposition sites will provide a direct response of *B. tectotrum* to nitrogen additions.

# Discussion

- Increasing agricultural/CAFO operations within the Snake River Plain is likely has increased N deposition to the surrounding area.
- As more CAFOs are developed in the area the intensity of the ecosystem impacts are likely to increase.
- More data is needed in intermediate deposition areas and in areas protected from grazing disturbance.



# Acknowledgements

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Thank you

Questions?

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