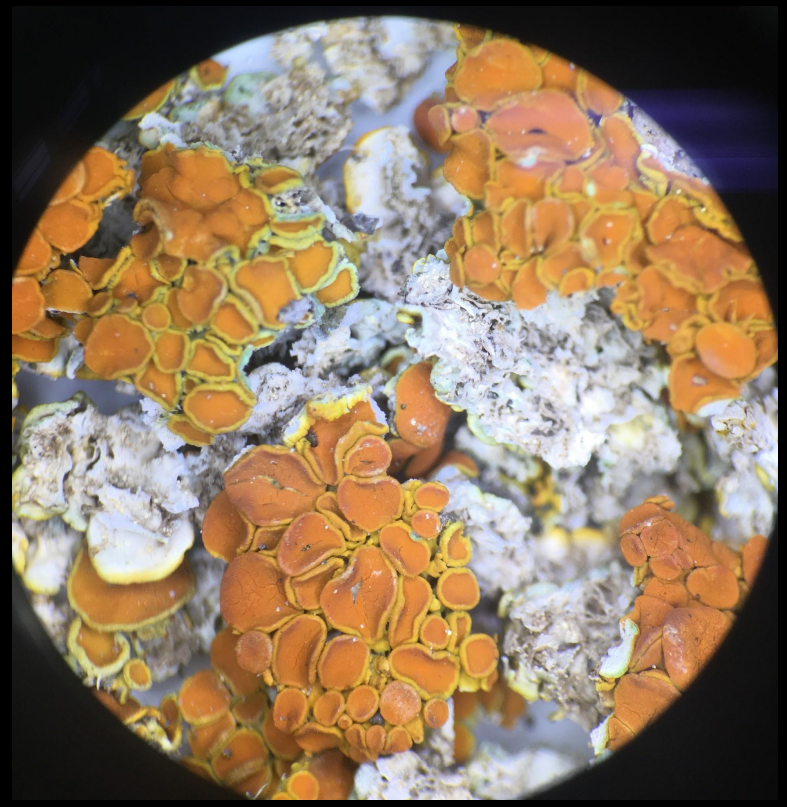
Lichen bioindicators of nitrogen and sulfur deposition in dry forests of Utah and New Mexico, USA

Heather T. Root, Sarah Jovan, Mark Fenn, Michael Amacher, Josh Hall, John D. Shaw



- Why forests?
- Why lichens?
- What did we do?
- What did we find?
- What do we still want to know?

https://www.allsaveutah.com/wp-content/uploads/2019/06/uinta-3710703_1920.jpg

Photo by Leia Larson, Standard Examiner

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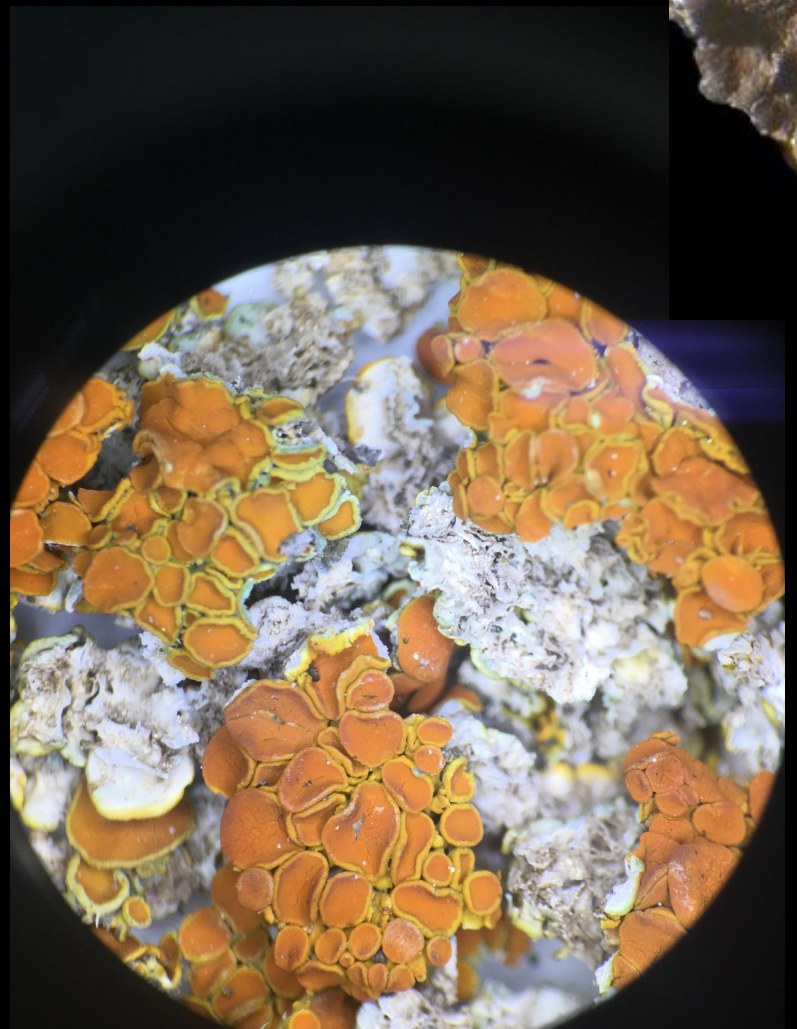
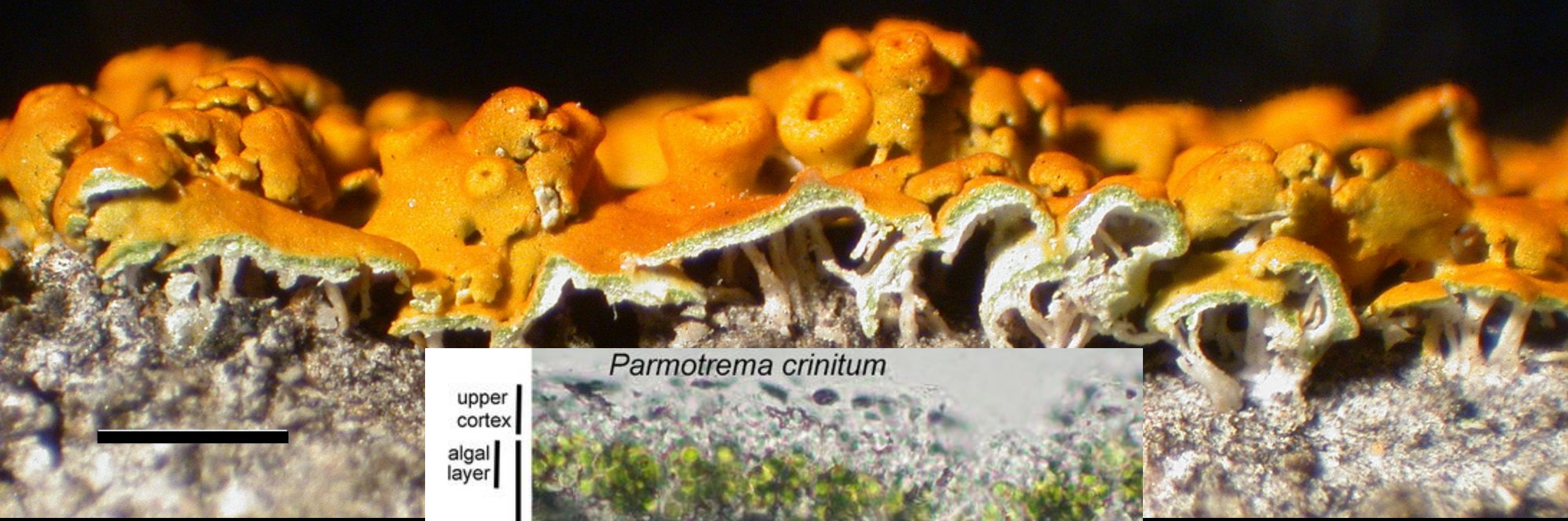
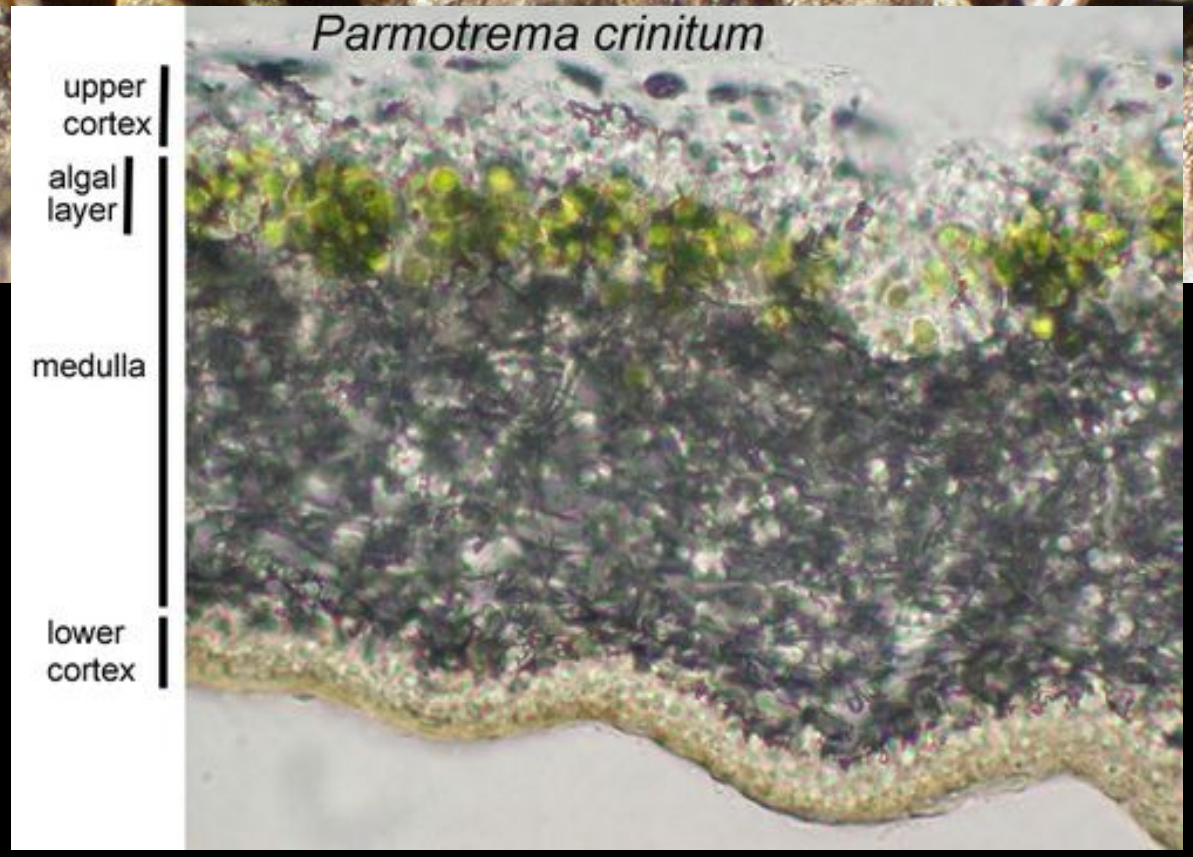
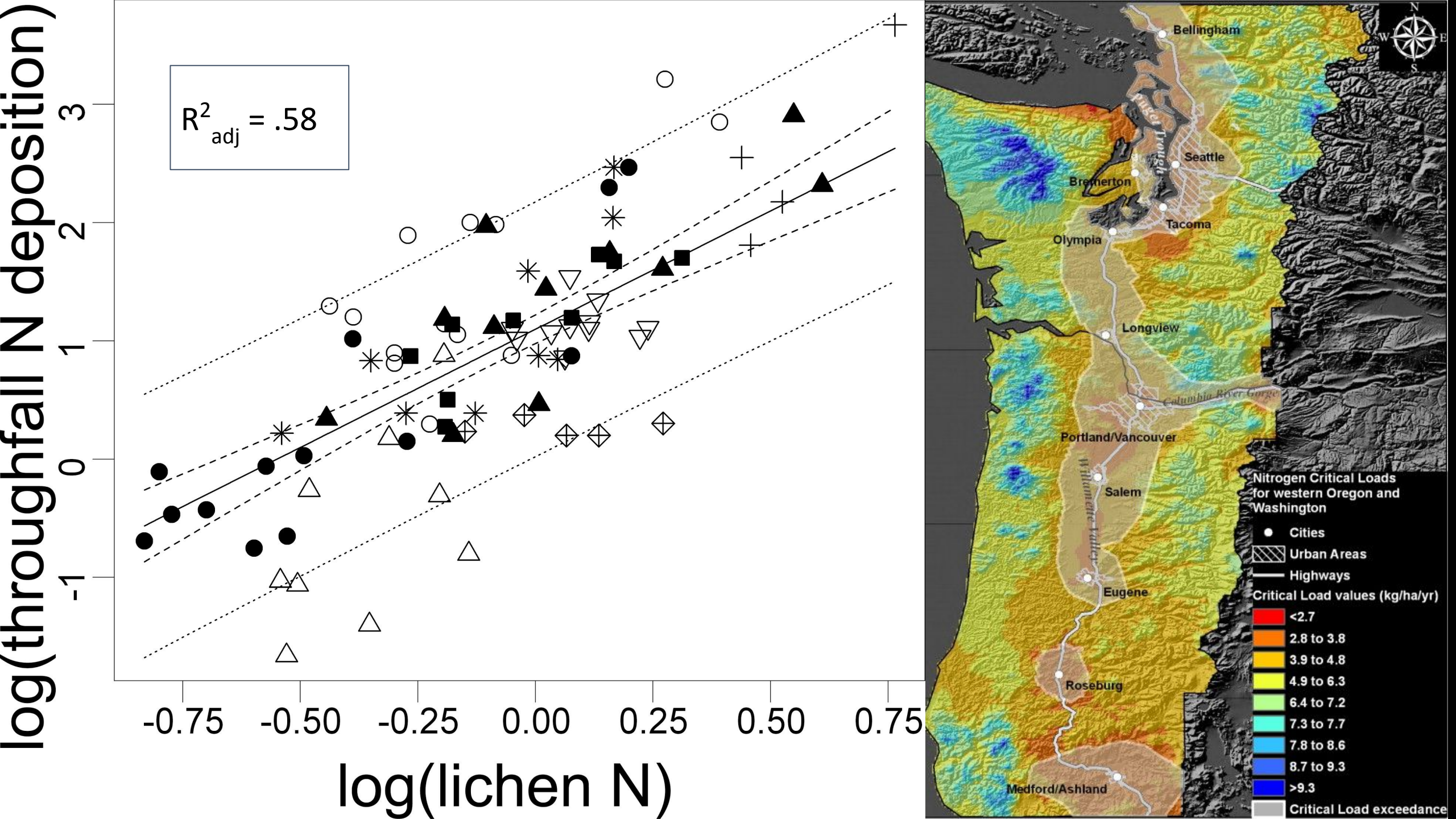


Photo by Bruce McCune





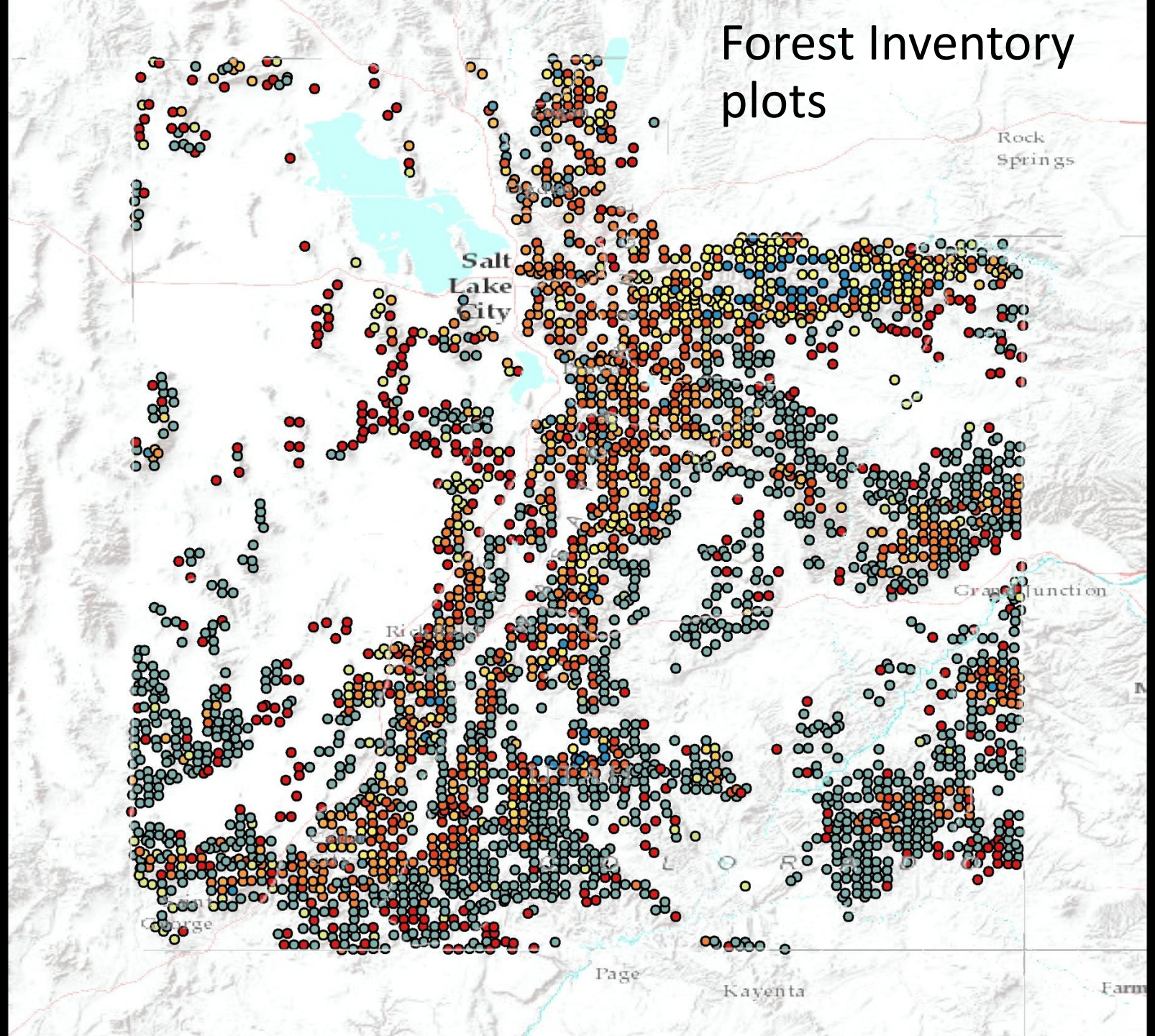
photos by Bruce McCune


log(throughfall N deposition)
3
2
1
0
-1
R^2_{adj} = .58
-0.75
-0.50
-0.25
0.00
0.25
0.50
0.75
log(lichen N)
Bellingham
Seattle
Bremerton
Tacoma
Olympia
Longview
Columbia River Gorge
Portland/Vancouver
Willamette Valley
Salem
Eugene
Roseburg
Medford/Ashland
Nitrogen Critical Loads for western Oregon and Washington
Cities
Urban Areas
Highways
Critical Load values (kg/ha/yr)
<2.7
2.8 to 3.8
3.9 to 4.8
4.9 to 6.3
6.4 to 7.2
7.3 to 7.7
7.8 to 8.6
8.7 to 9.3
>9.3
Critical Load exceedance

Goals

How is lichen N related to N deposition in the forest?

Use lichen N to map N deposition in forests all across the region.



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lichen N concentration

throughfall N deposition

Service Layer Credits: Sources: Esri, USGS, NOAA

changed out throughfall deposition collectors each fall and spring

ICP analysis of throughfall deposition collectors and lichens N concentration (and S, C, cations, metals….)

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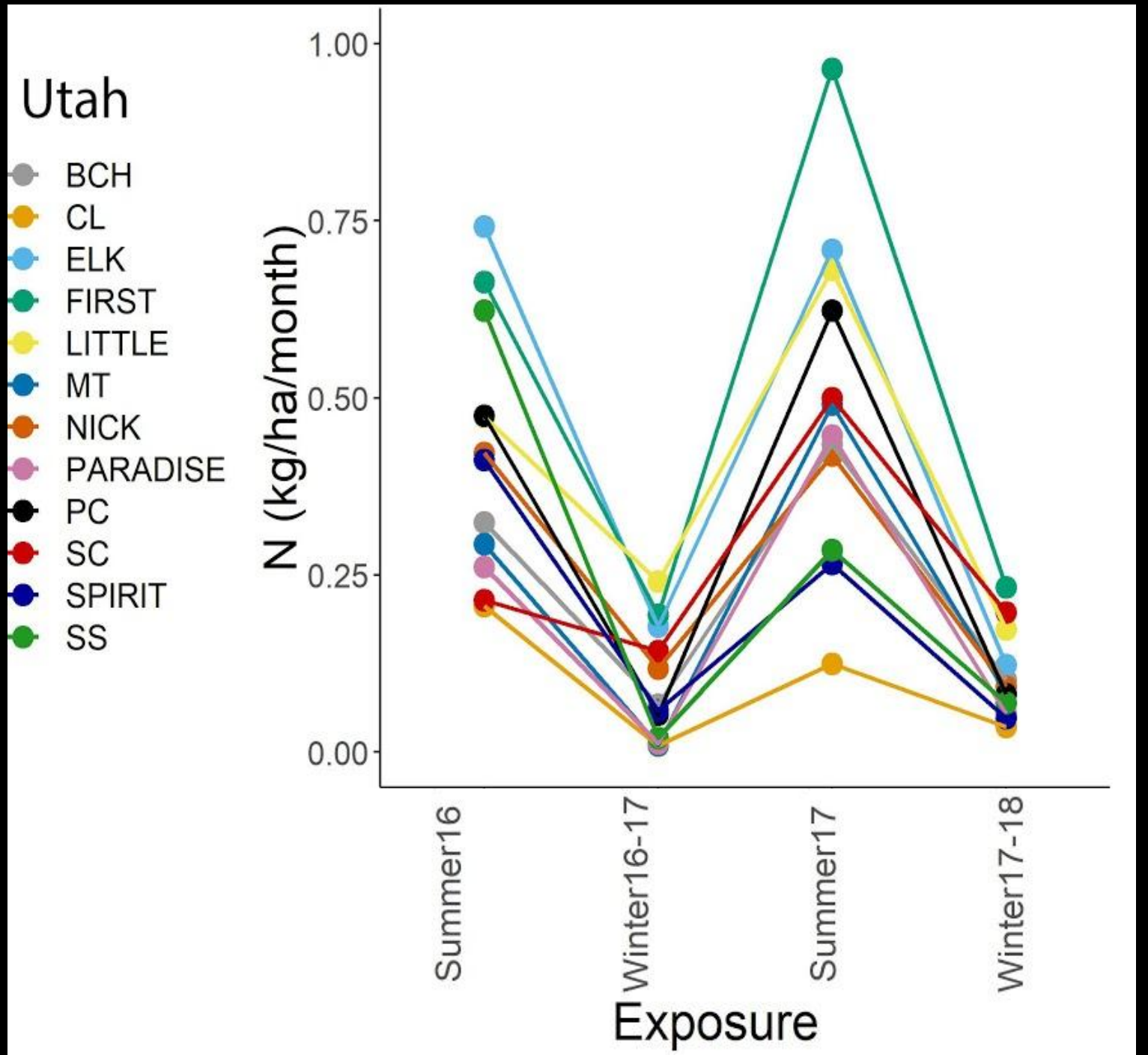
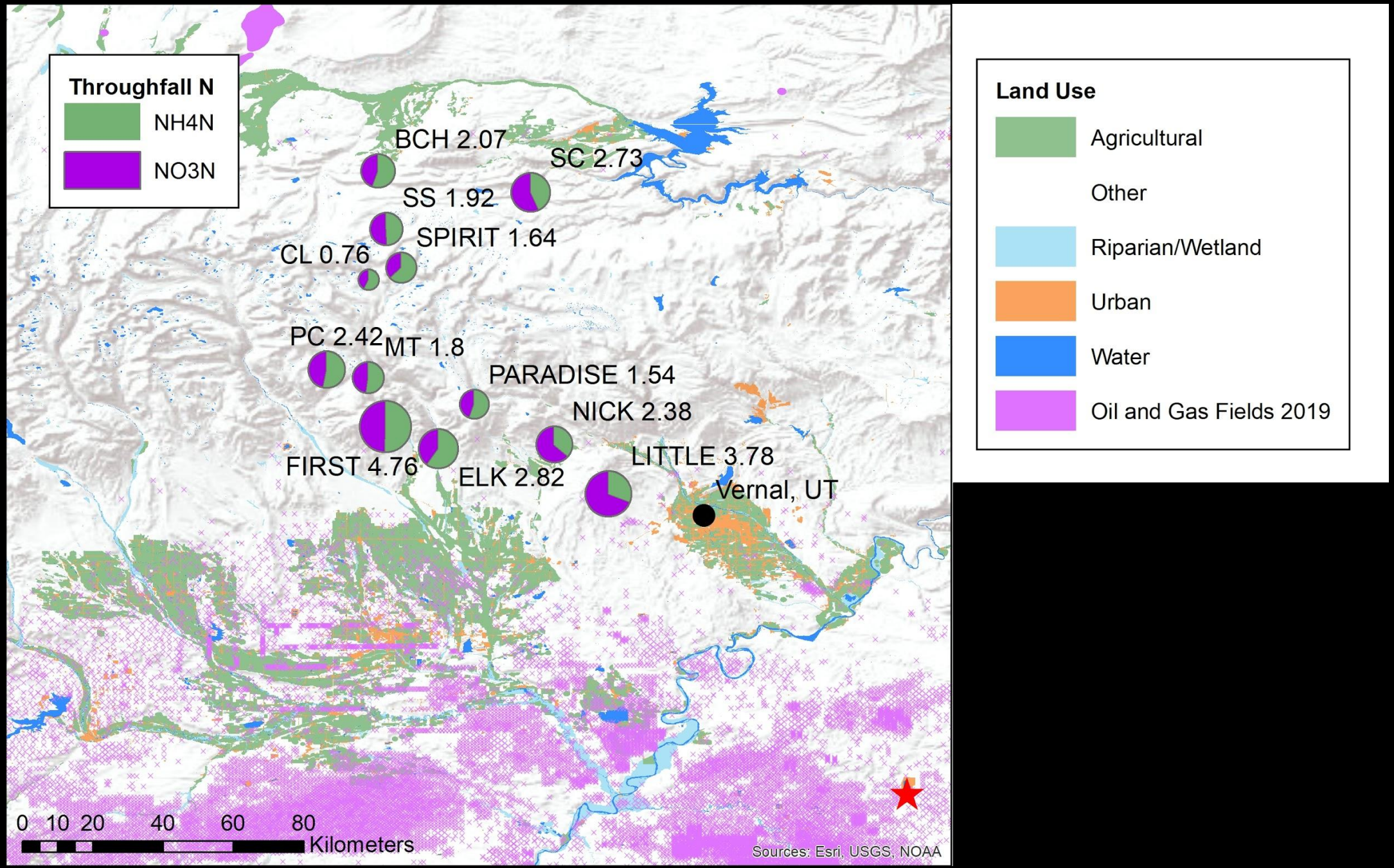
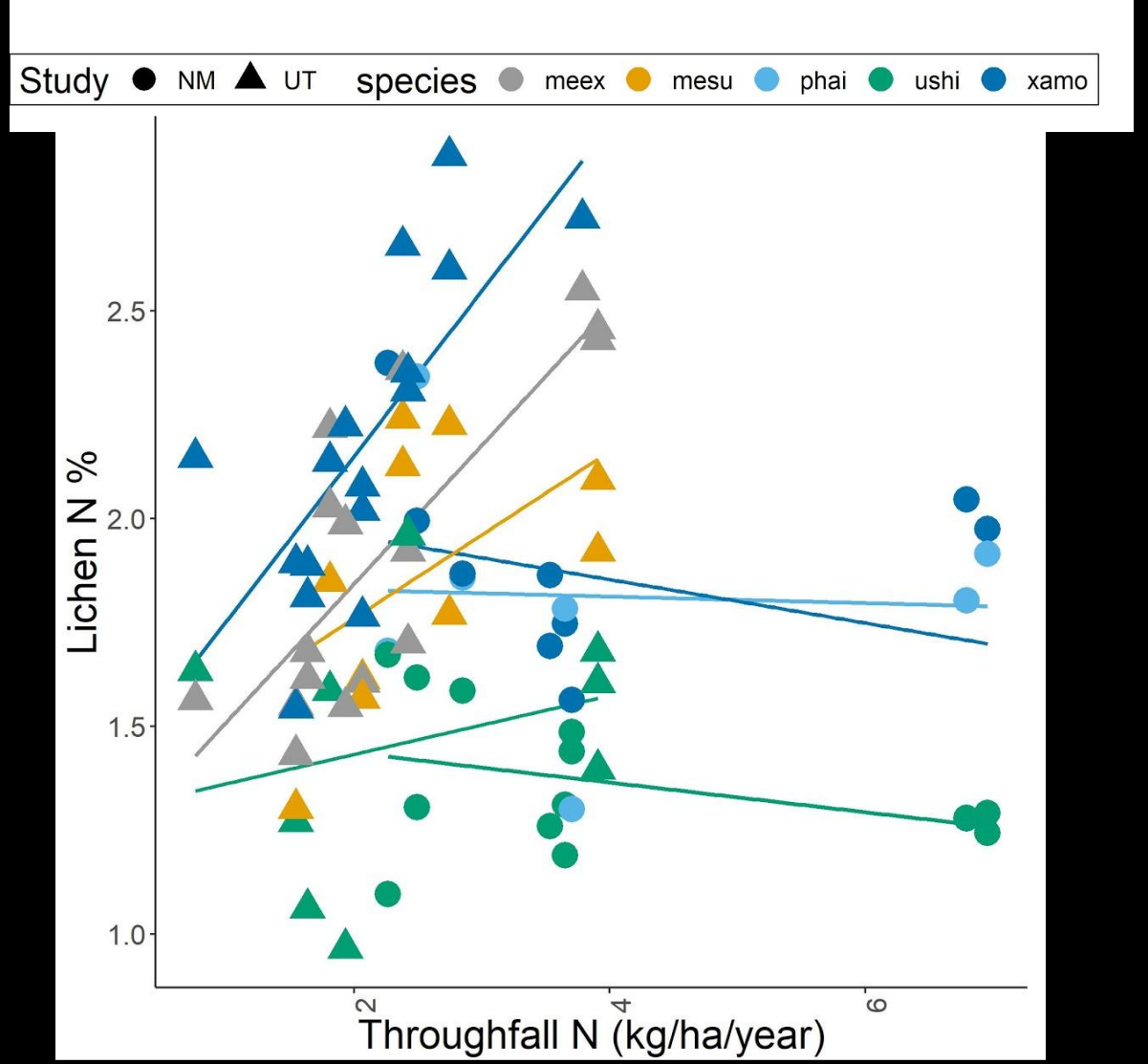
throughfall deposition over time

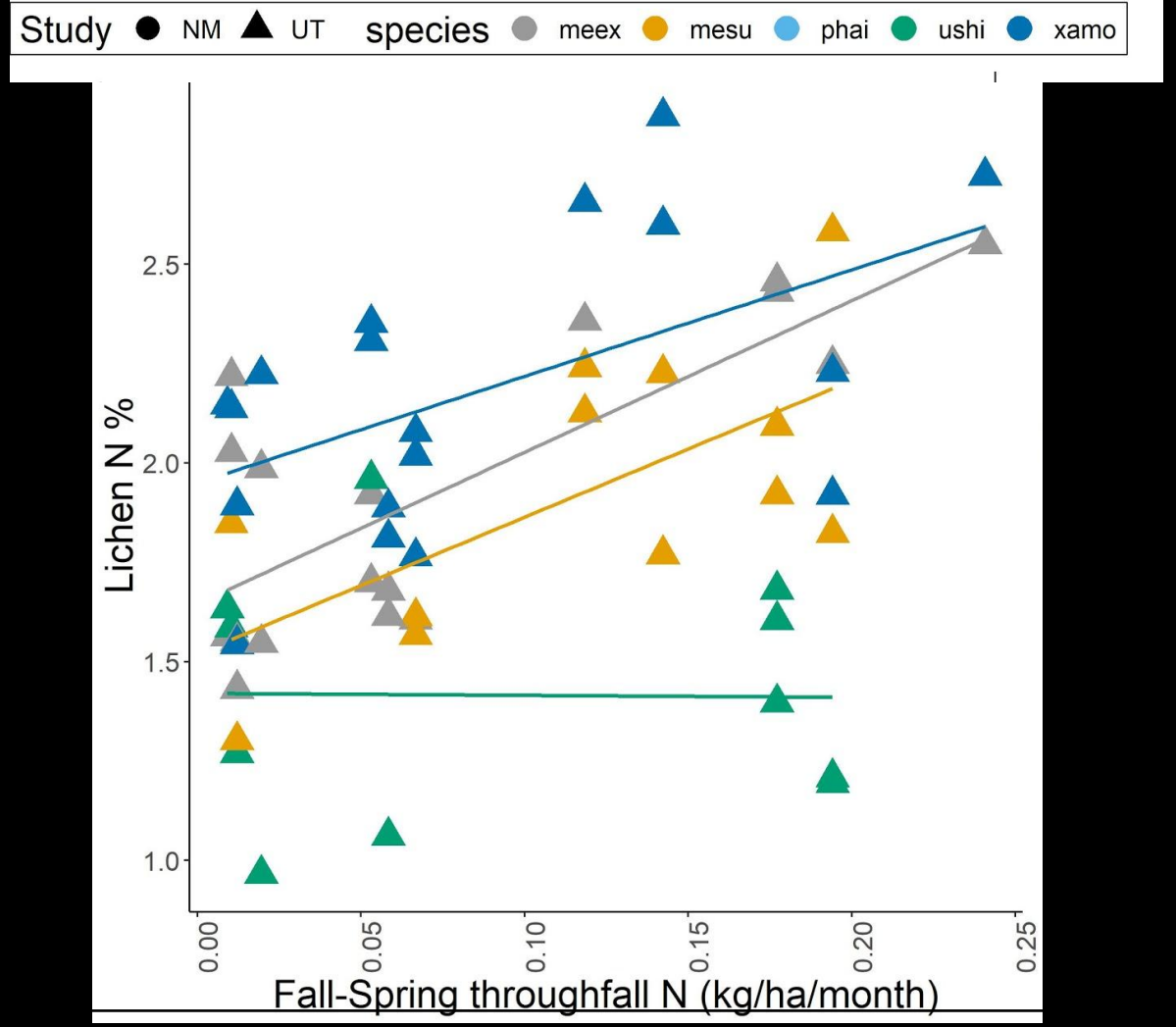


throughfall deposition - spatial





Lichen species	Predictor	Estimates (intercept, slope)	R^2	p
Melanohalea exasperatula	annual throughfall N	1.30, 0.266	0.58	0.0004
Melanohalea subolivacea	annual throughfall N	1.43, 0.171	0.31	0.062



Lichen species	Predictor	Estimates (intercept, slope)	R^2	p
Melanohalea exasperatula	Fall-Spring throughfall N	1.645, 3.817	0.59	0.0003
Melanohalea subolivacea	Fall-Spring throughfall N	1.520, 3.436	0.42	0.0227
Xanthomendoza montana	Fall-Spring throughfall N	1.950, 2.682	0.28	0.0238

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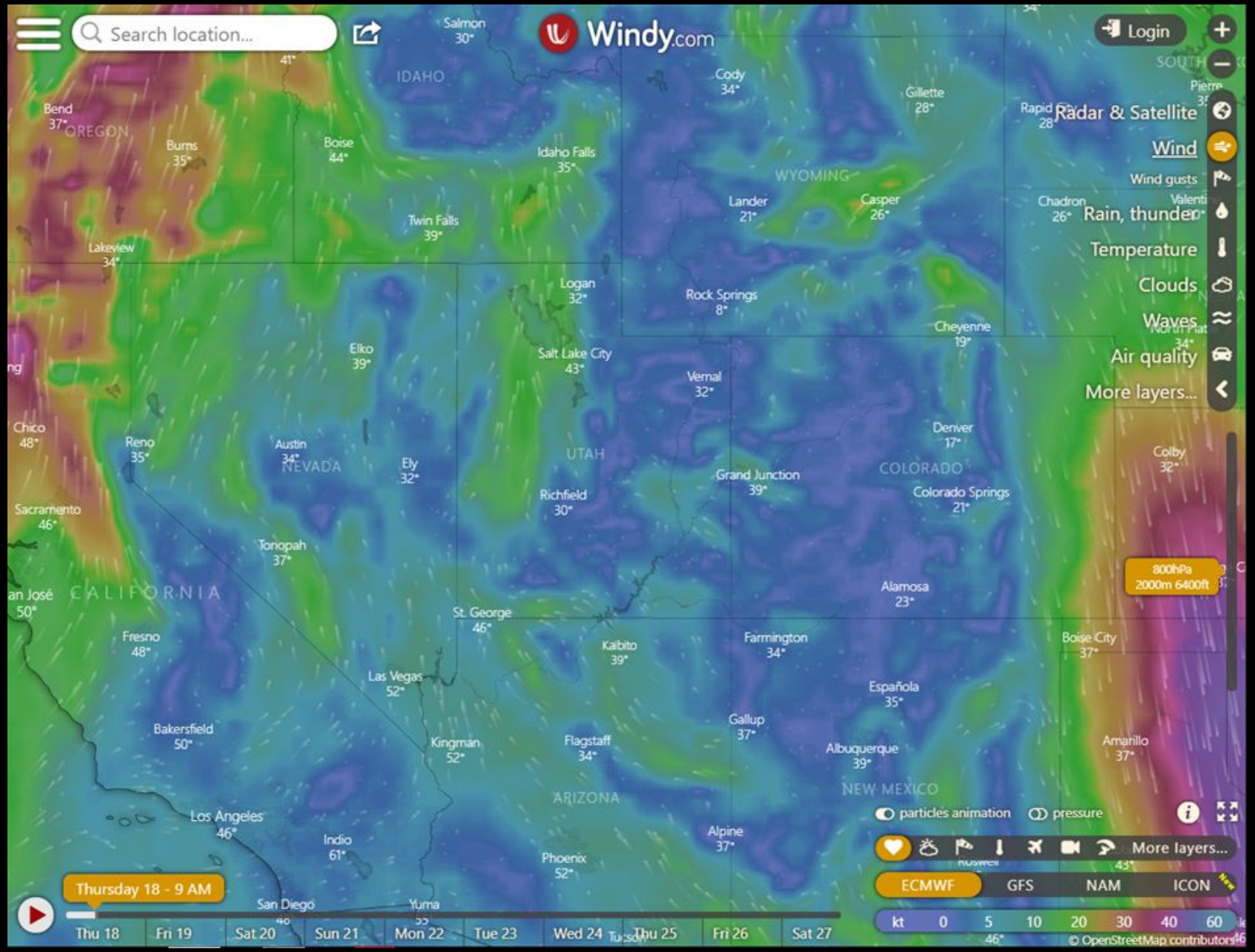
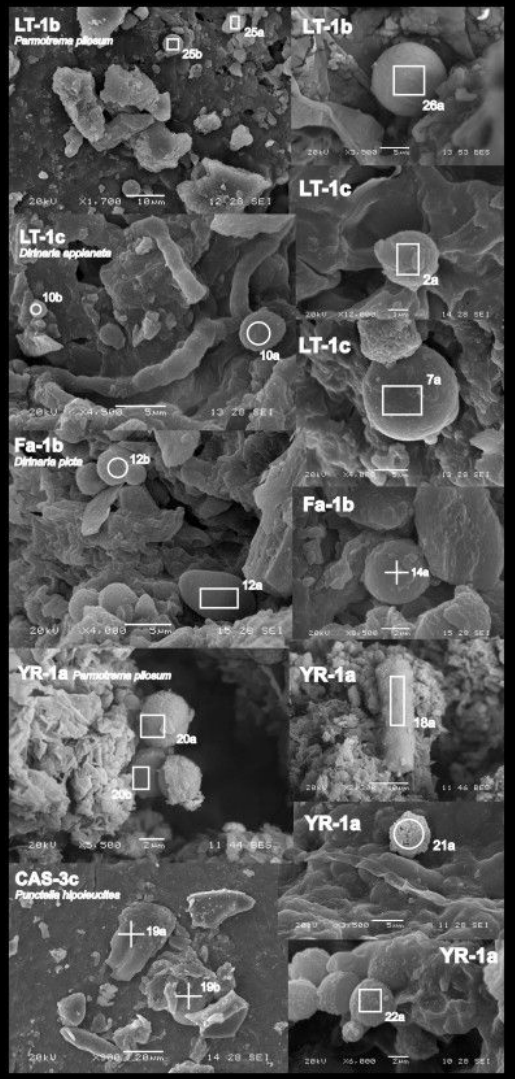
Where the deposition comes from



More dry deposition in SW
How do lichens absorb from different kinds of deposition?



Different kinds of forests add variability

Why no success in New Mexico?

- thunderstorms
- sample timing mismatch
- variability within plots

Photo from: http://cdn.c.photoshelter.com/img-get/I0000bgrokNctp1o/s/850/850/The-Altar-Of-The-Gas-Gods.jpg

Wrap-up

- Lichens - spatial patterns of deposition
- Limitations
  - correlation in Utah but not NM
  - Integrate over time
- Suggestions to improve
  - focus on best species
  - timing sample collection
  - washing samples

Acknowledgements

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