



Understanding variation in plant communities, with examples from the northern Black Range of New Mexico.
Patrick J. Alexander, New Mexico State University

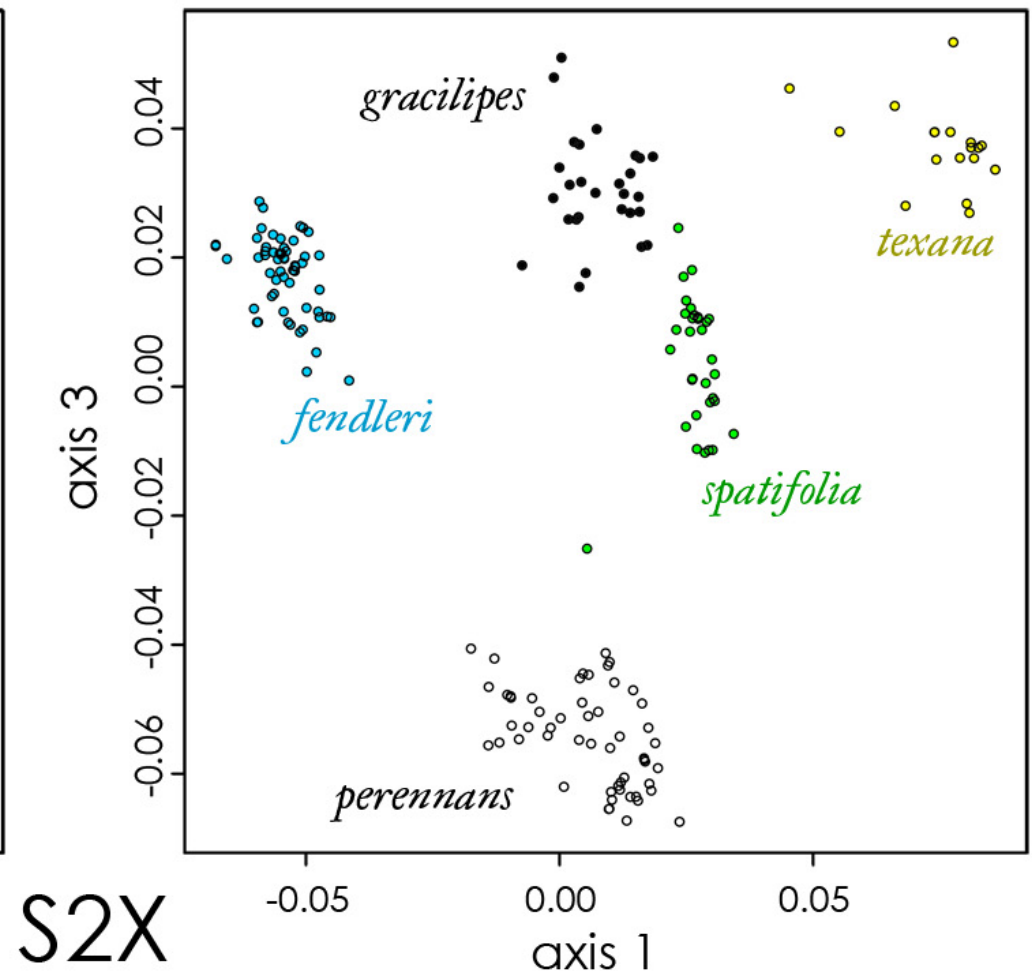
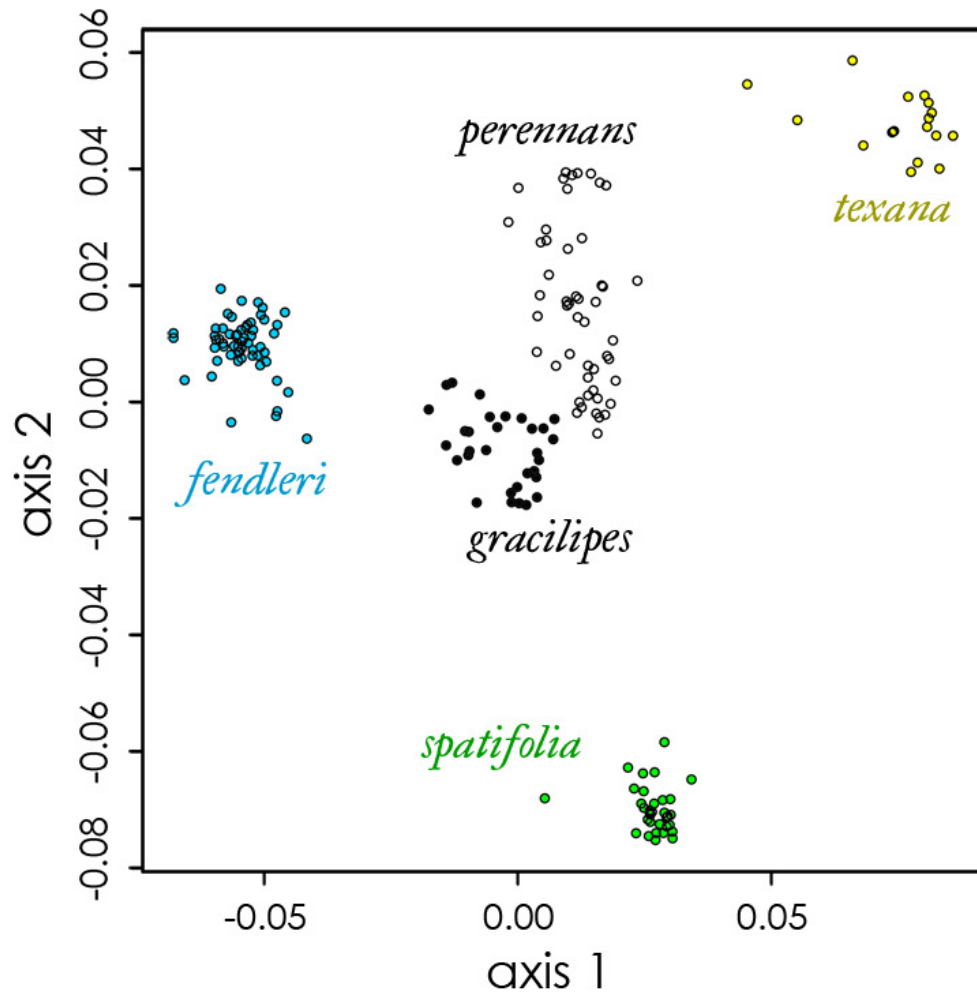
The problem...

I'm used to taxonomy, but want to understand how plants are grouped in geography and ecology, too.



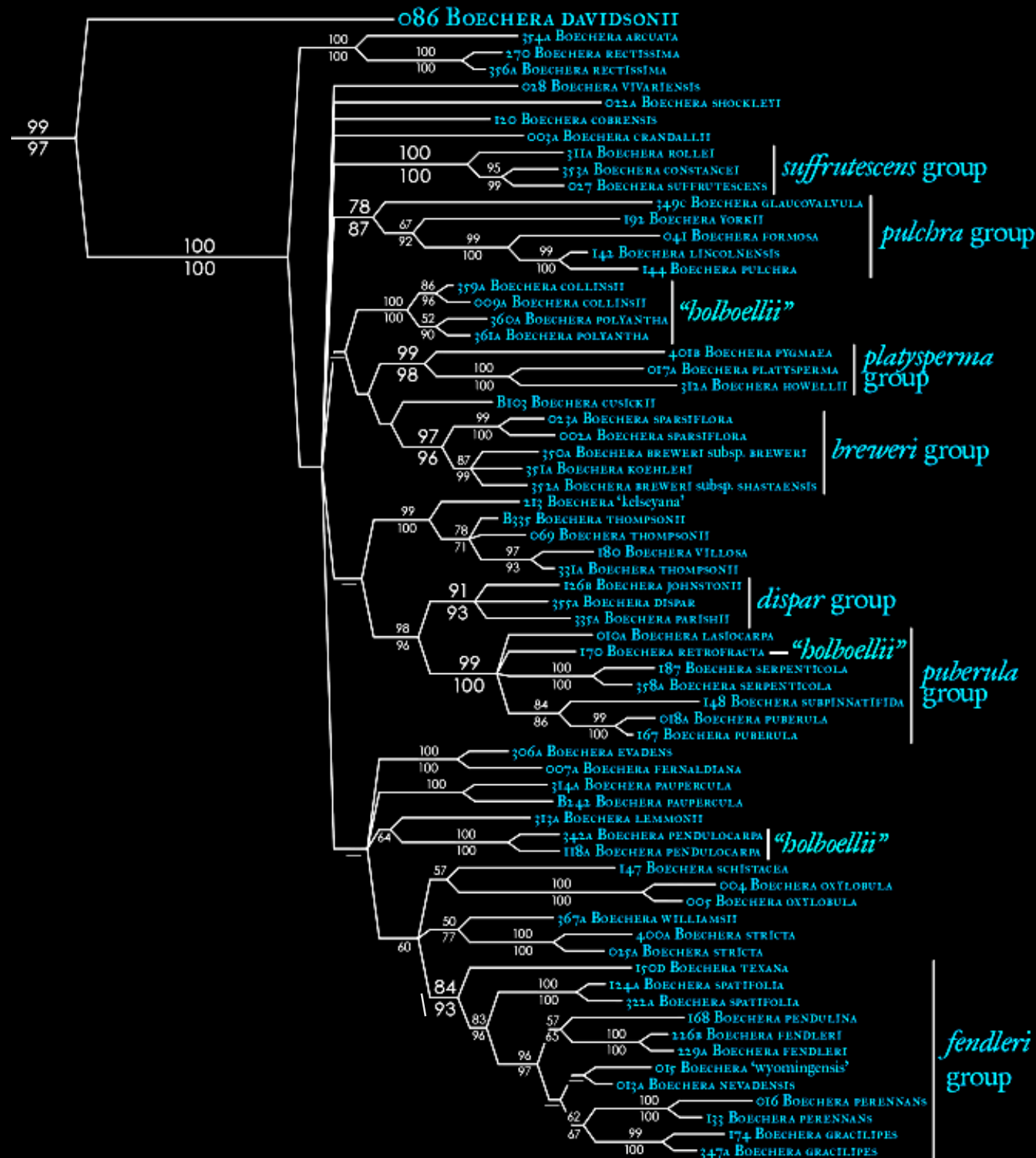
The problem...

In taxonomy, the lines are already there (at least, mostly); we just need to find them.



The problem...

We also have a good handle on understanding relationships among species.



The problem...

What about plant communities?



Clearly there's a lot of variation out there:



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Clearly there's a lot of variation out there:



But how do we make sense of it?

There are two main conceptual approaches:

1) What are the dominant species?

creosote shrubland

pinyon/juniper woodland

ponderosa forest

2) What is the habitat?

gravelly ecological site

limestone hills ecological site

mountain meadow ecological site

But how do we make sense of it?

Both of these approaches divide plants into distinct communities.

Claim 1:

Plant communities are distinct entities with objective, identifiable boundaries.

Dominant species

This requires another claim:

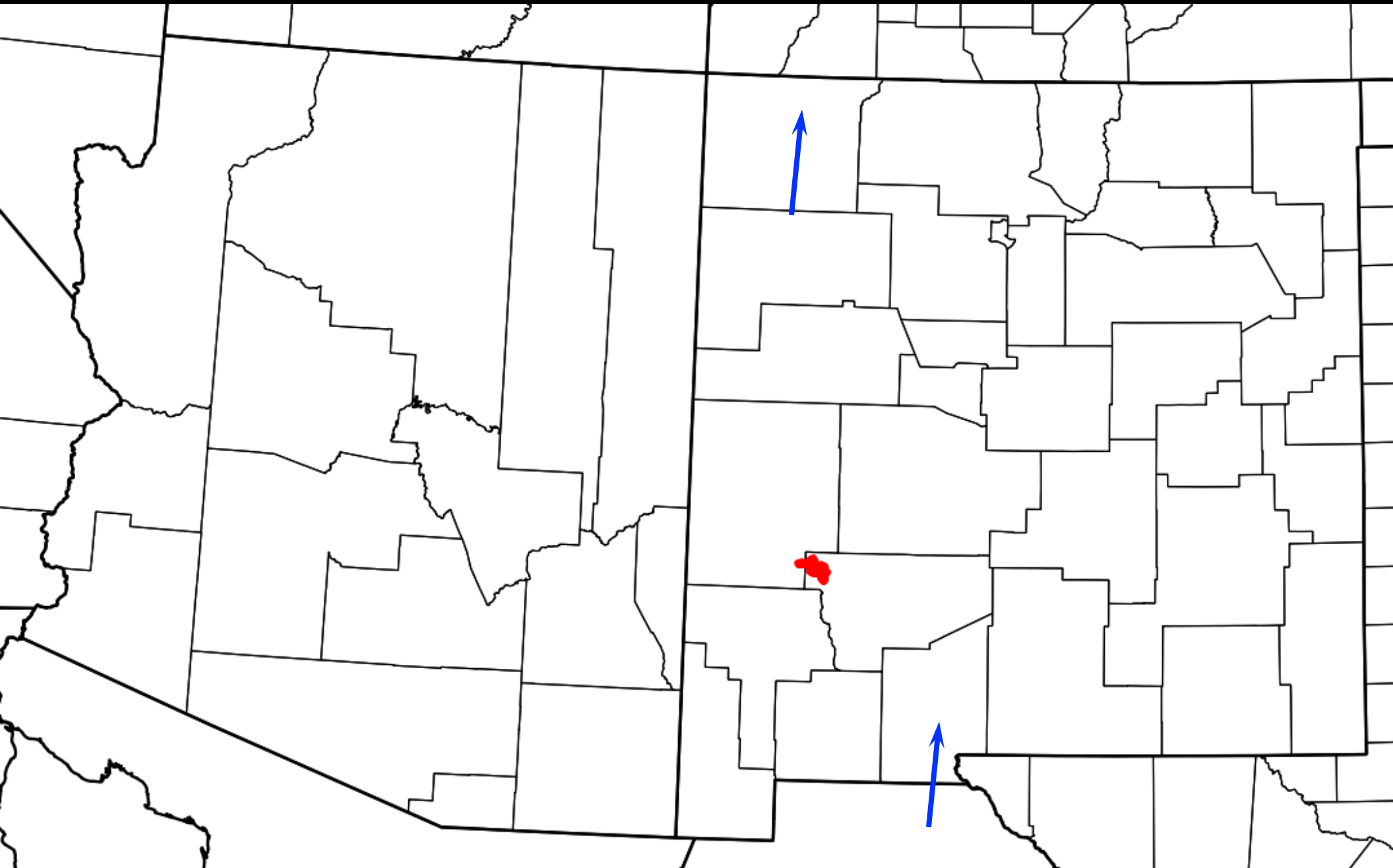
We can understand variation in ca. 4000 plant species
by looking at a small set of common plants.

Habitat classification

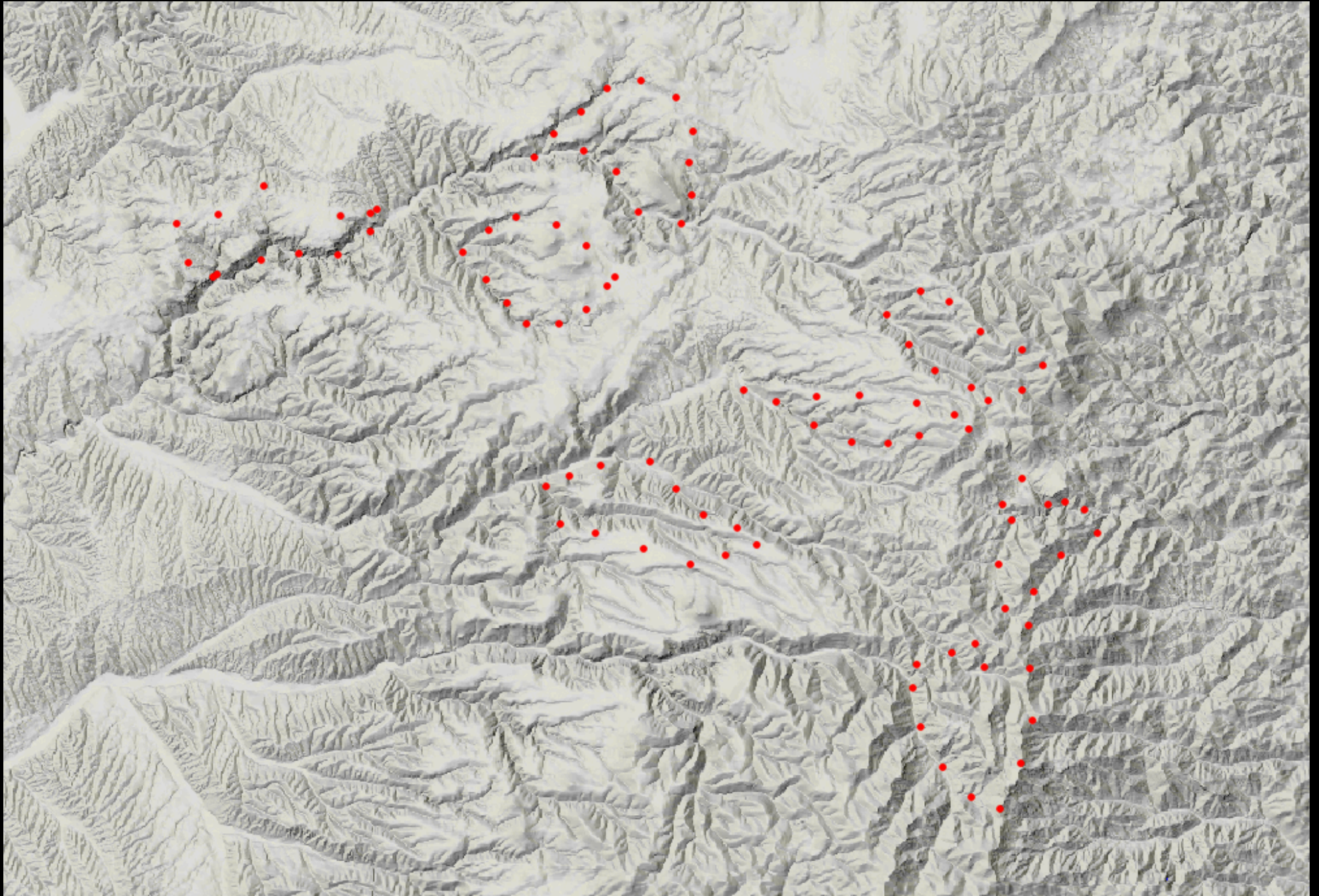
This requires a third claim:

We can predict what plants occur at a site (or “should” occur) by measuring the abiotic conditions at that site.

Meet the northwest side of the Black Range



I went out for eight hikes...



Stopped about every $\frac{3}{4}$ mile...

took a picture...



recorded my location...

33.2758°N 107.8443°W

and listed all plants
identifiable in 10m radius...

Osmorhiza depauperata

Cirsium

Taraxacum officinale

Alnus incana

Mertensia franciscana

Hypericum scouleri

Pteridium aquilinum

Cystopteris reevesiana

Geranium caespitosum

Ribes pinetorum

Prunella vulgaris

Pseudotsuga menziesii

Bromus

Fragaria vesca subsp. *bracteata*

Geum macrophyllum

Prunus virginiana

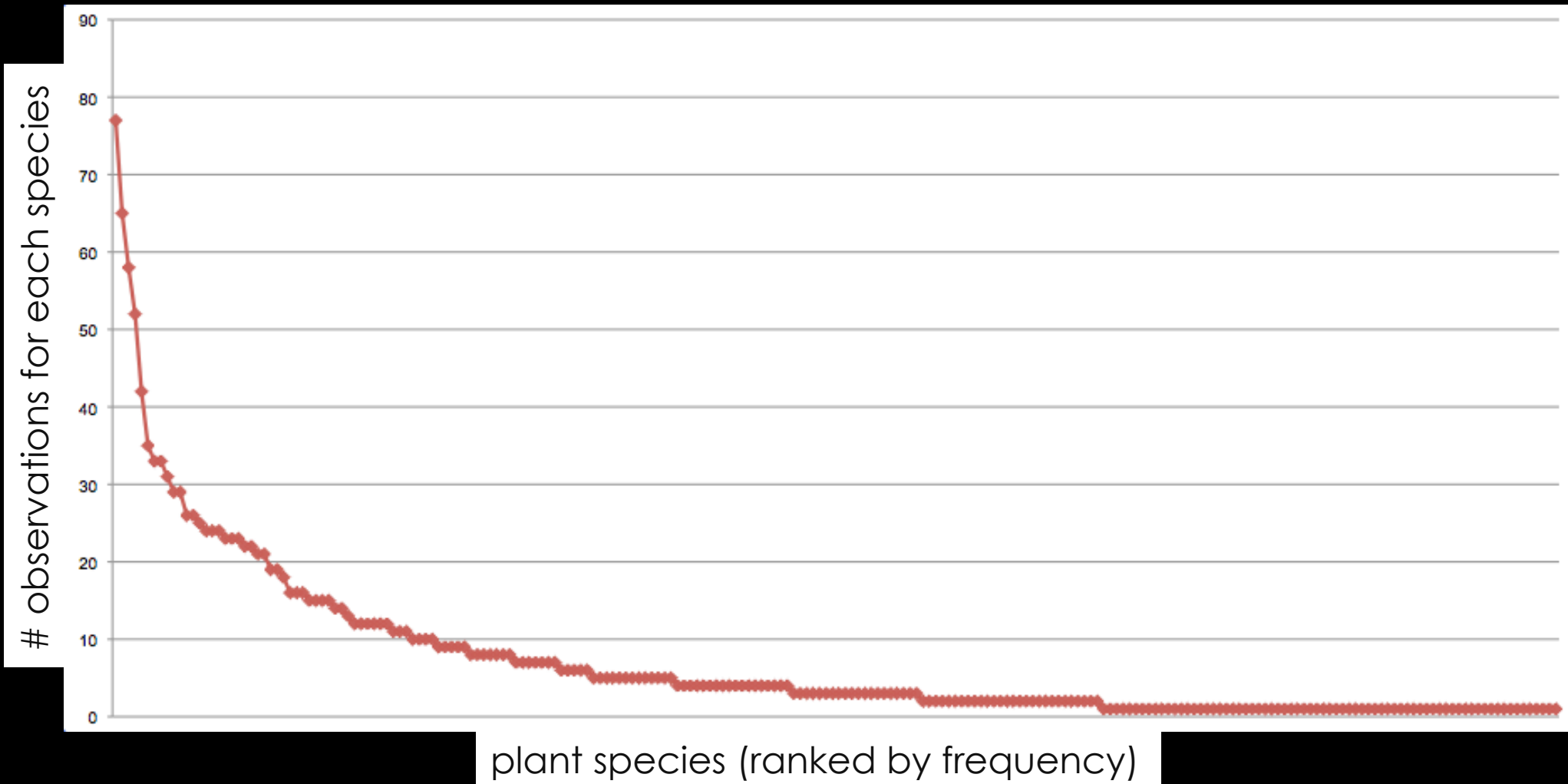
Rosa woodsii

Rubus parviflorus

Viola nephrophylla

Ultimately:

- 97 sites in ca. 70 miles of wandering
- 6,670 to 9,220 feet elevation
- on average, 17 plant species per site
- 219 plant species total



Most ubiquitous plants:

<i>Pinus ponderosa</i> (ponderosa pine)	77 sites
<i>Quercus gambelii</i> (Gambel oak)	65
<i>Pseudotsuga menziesii</i> (Douglas fir)	58
<i>Achillea millefolium</i> (yarrow)	52
<i>Bromus</i> (brome)	50
<i>Poa fendleriana</i> (muttongrass)	42
<i>Geranium caespitosum</i> (pineywoods geranium)	35
<i>Amauriopsis dissecta</i> (ragleaf bahia)	33
<i>Thalictrum fendleri</i> (Fendler's meadow-rue)	33
<i>Muhlenbergia montana</i> (mountain muhly)	31

Then I gathered some information for each site...

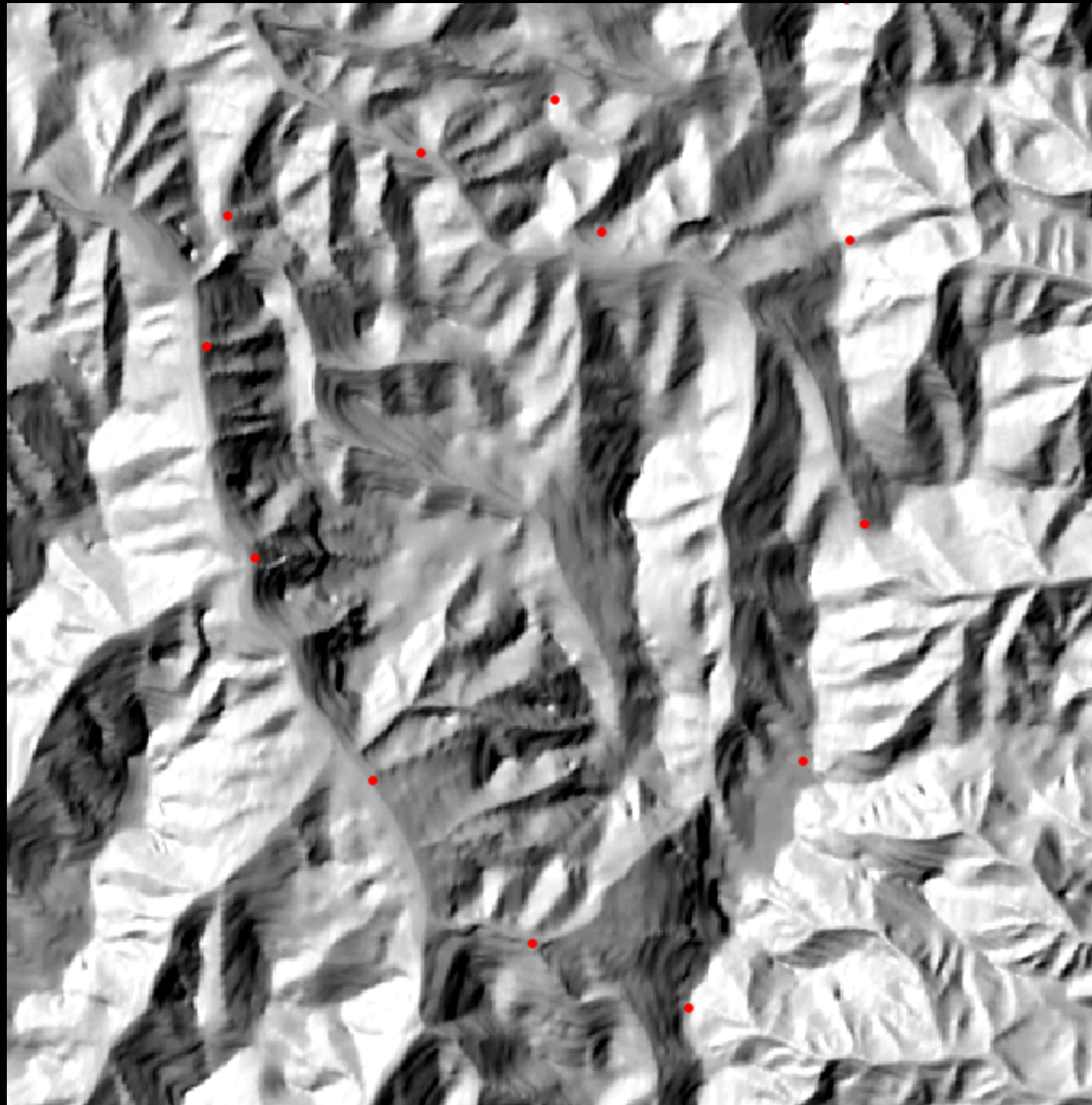
- elevation (6,670 to 9,220 feet)
- slope (0° to 44°)
- southness (deviation from north; 0° to 180°)
- how much sunlight the site gets
- topographic position index (TPI)

Relief map...



Sunlight

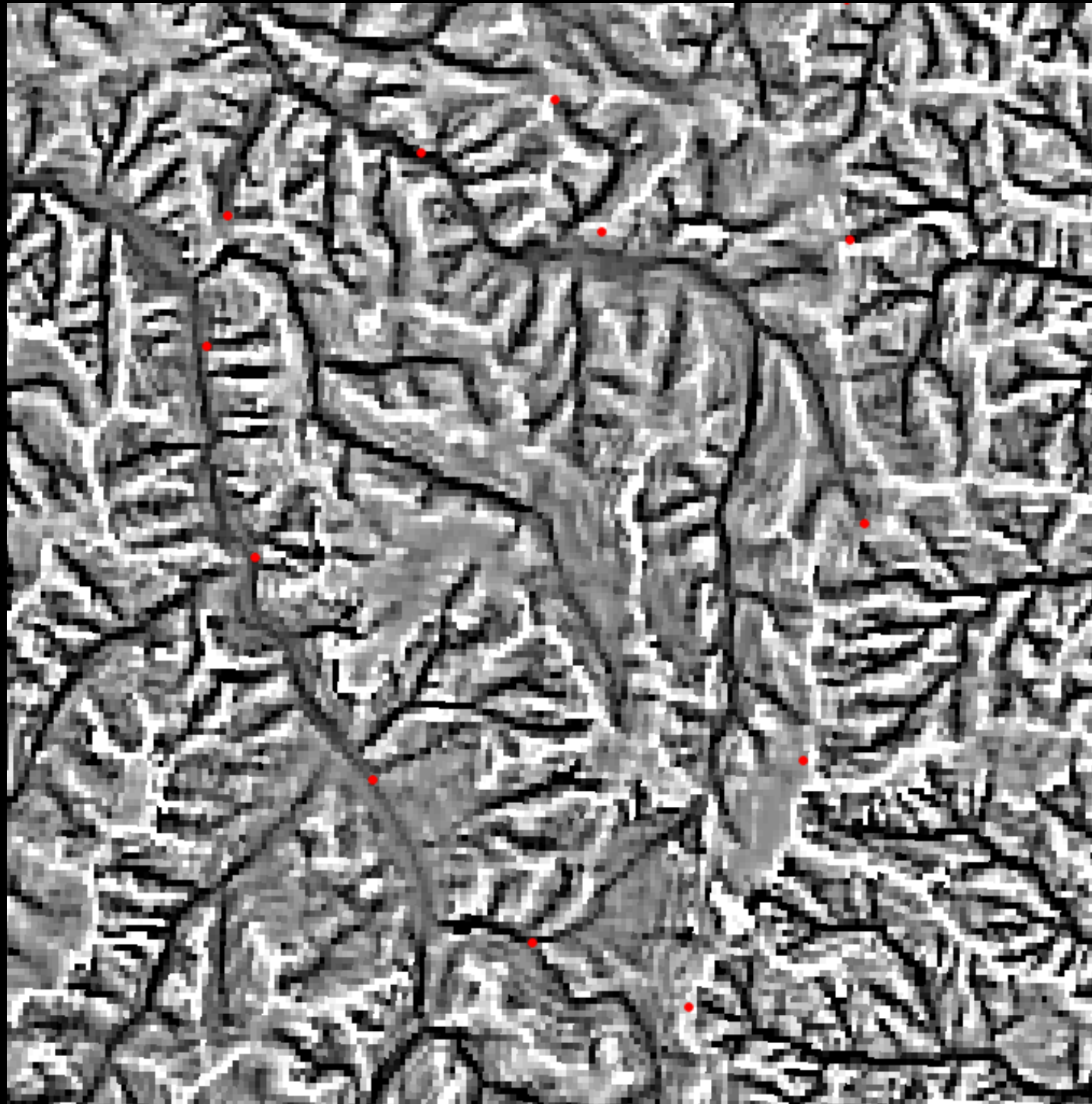
at right, illumination
at 10:15 AM on the
equinox



TPI

measures topographic position:

- are you in a canyon?
- on flat ground?
- on a ridge?



















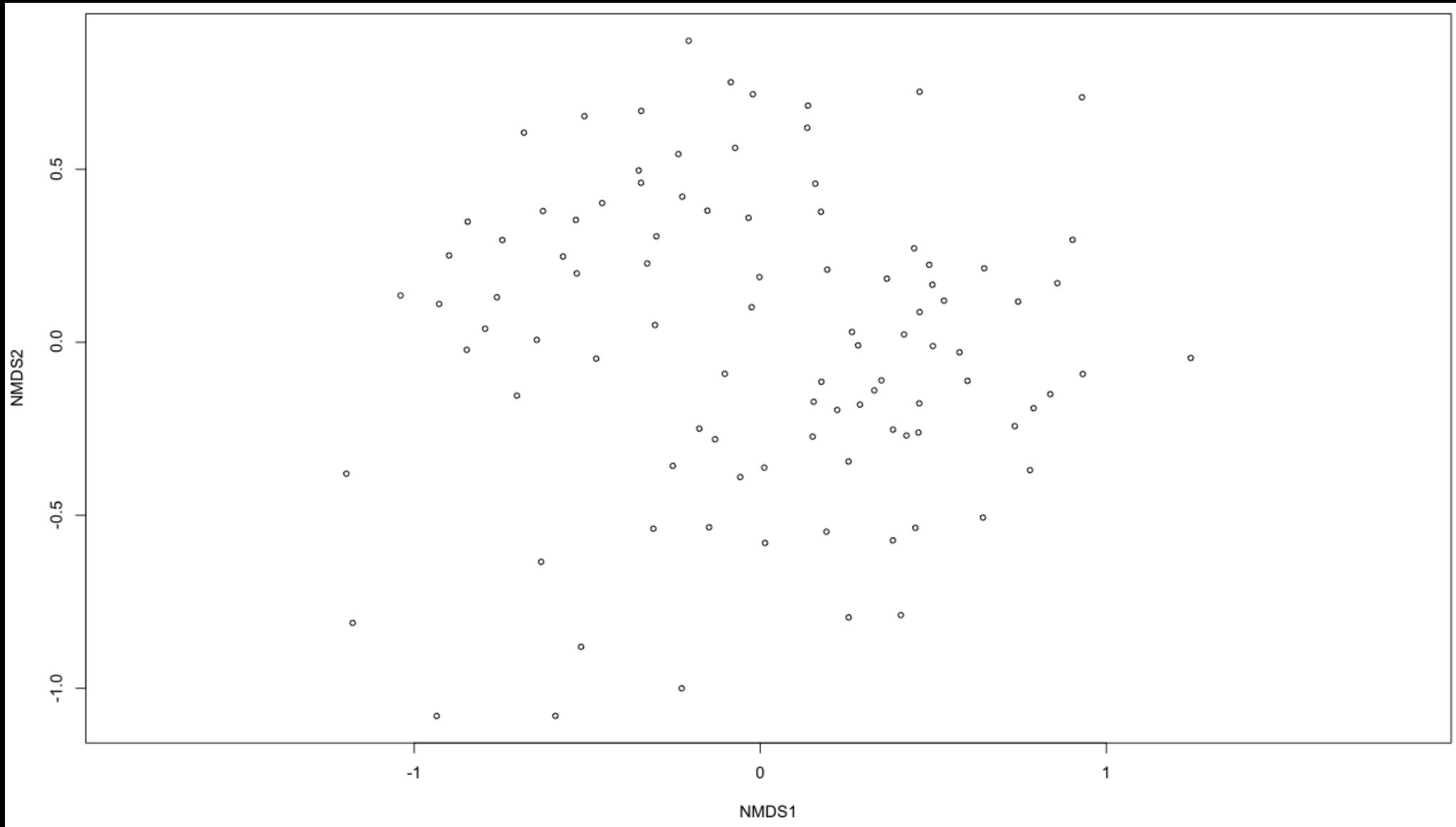




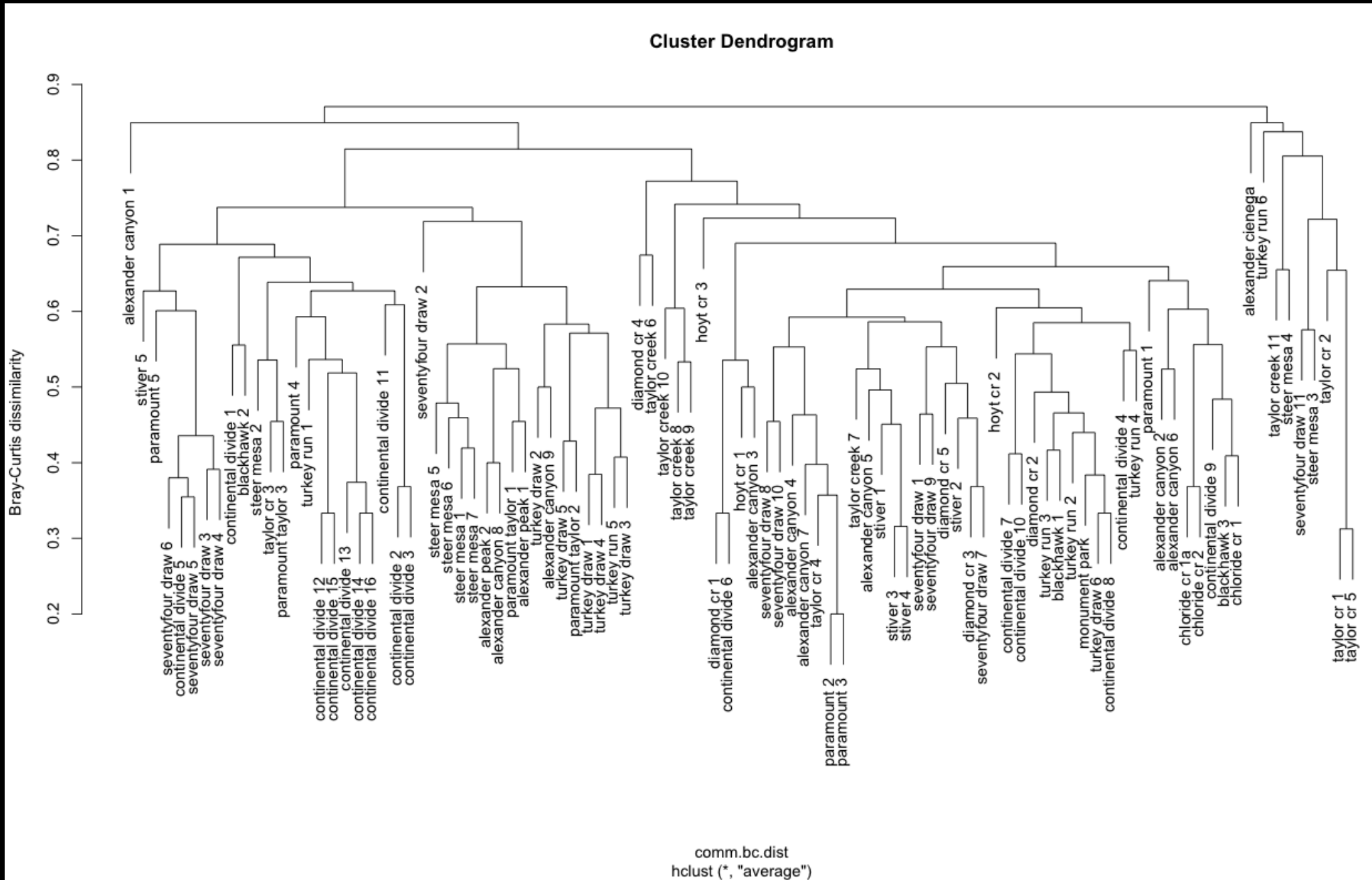


So, what can we do with this information?

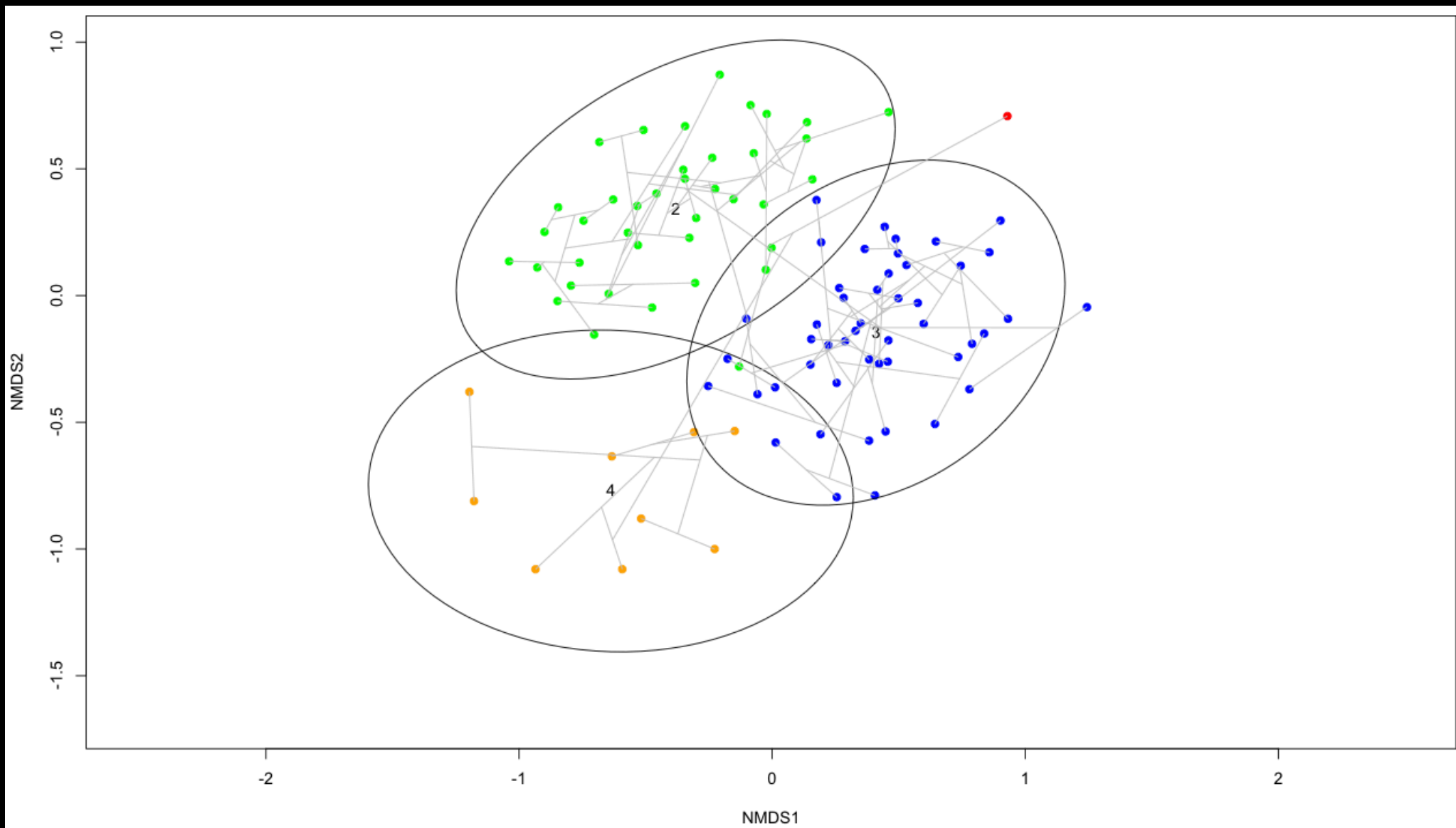
Claim 1: Plant communities are distinct entities with objectively identifiable boundaries.

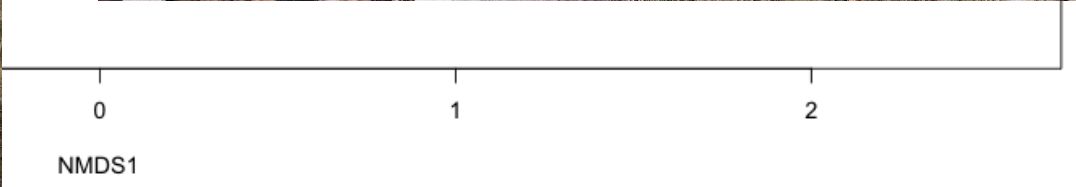
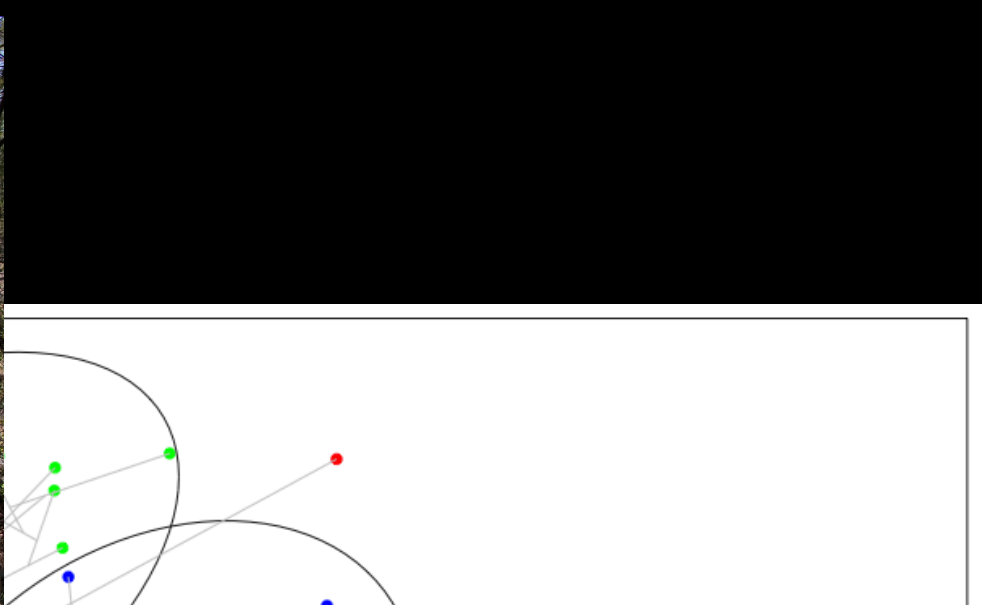


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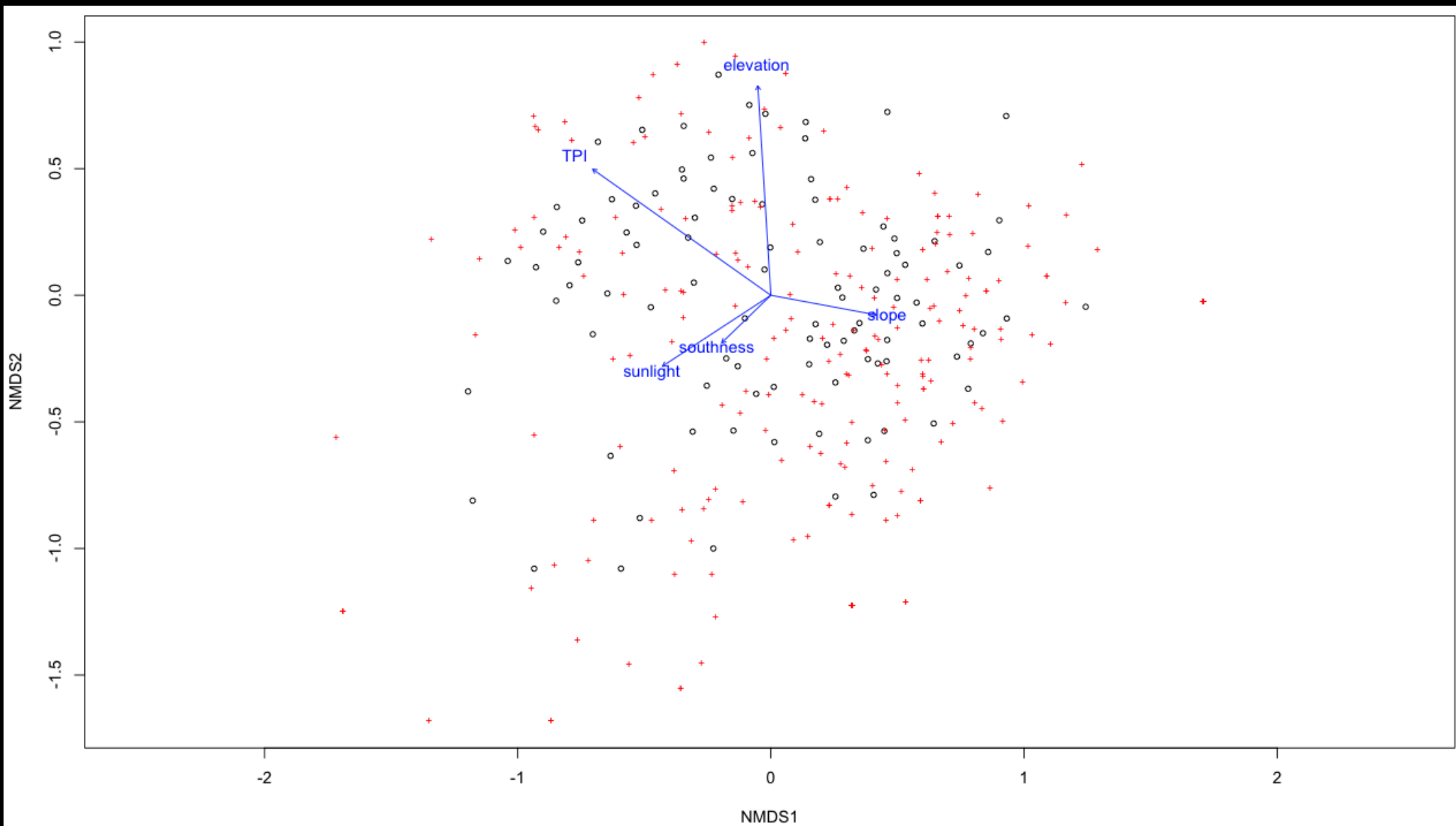


Claim 1: Plant communities are distinct entities with objectively identifiable boundaries.





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	elevation	southness	slope	TPI	sunlight
R ²	0.066	0.014	0.036	0.084	0.025
p-value	0.001	0.162	0.001	0.001	0.005

Claim 1: Plant communities are distinct entities with objectively identifiable boundaries.

Journal of Arid Environments (2000) 44: 305–325

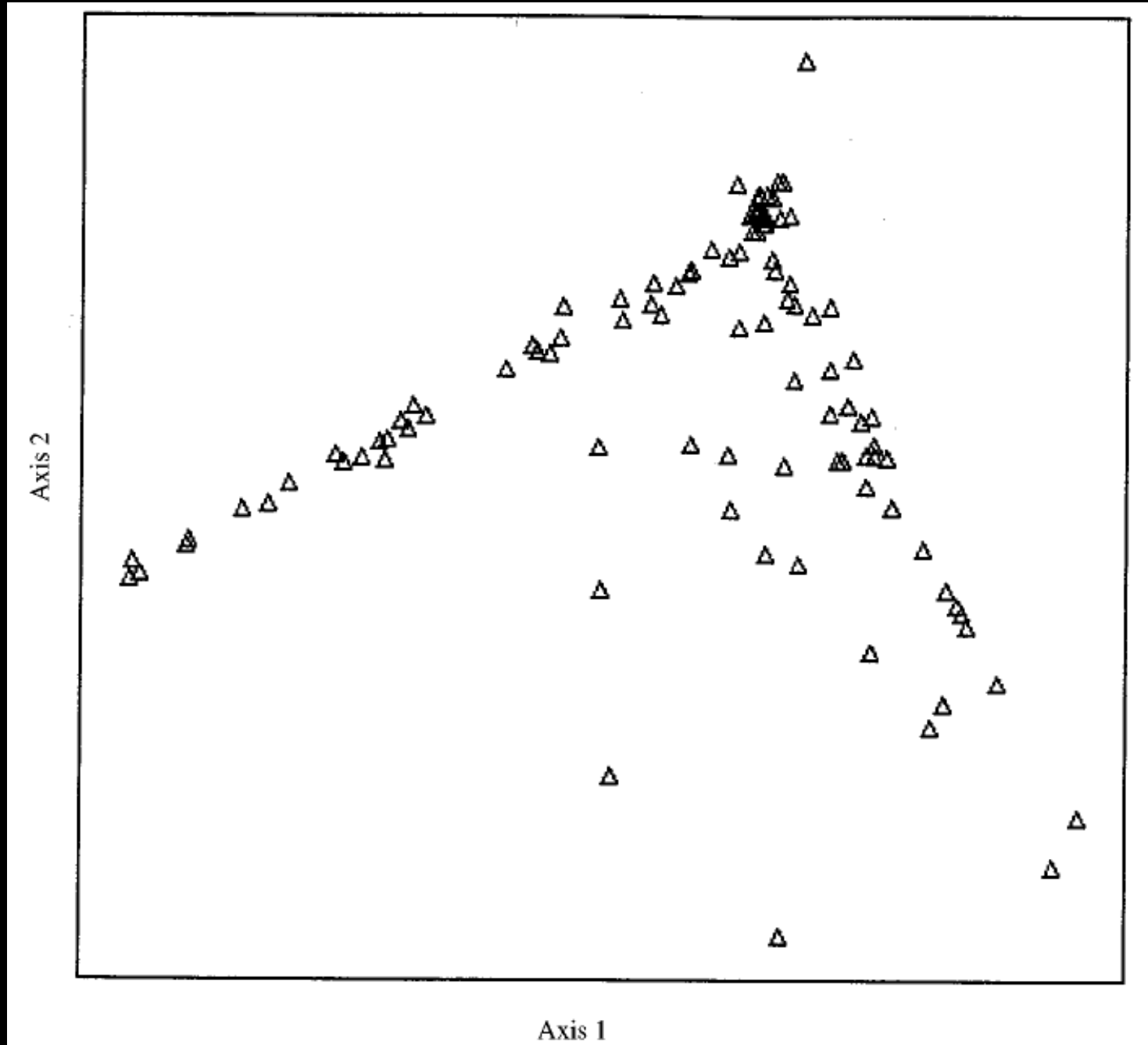
doi:10.1006/jare.1999.0597, available online at <http://www.idealibrary.com> on IDEAL[®]



Multivariate characterization of perennial vegetation in the northern Chihuahuan Desert

A. R. Johnson^{*}, S. J. Turner[†], W. G. Whitford[‡], A. G. de Soyza[§]
& J. W. Van Zee[¶]

Claim 1: Plant communities are distinct entities with objectively identifiable boundaries.





Axis 1

Claim 2: We can understand variation in ca. 4000 plant species by looking at a small set of common plants.



Achillea millefolium
Antennaria parvifolia
Hieracium fendleri
Packera hartiana
Pseudognaphalium macounii
Carex geophila
Astragalus tephrodes
Pedicularis centranthera
Pinus ponderosa
Muhlenbergia
Muhlenbergia montana
Verbascum thapsus

Dysphania graveolens
Allium cernuum
Pseudocymopterus montanus
Achillea millefolium
Antennaria parvifolia
Cirsium
Packera neomexicana
Noccaea fendleri
Pinus ponderosa
Blepharoneuron tricholepis
Bromus ciliatus
Dactylis glomerata
Koeleria macrantha
Muhlenbergia montana
Poa
Fragaria virginiana
Potentilla anserina
Verbascum thapsus

Achillea millefolium
Pseudognaphalium macounii
Senecio actinella
Juniperus deppeana
Pinus ponderosa
Blepharoneuron tricholepis
Bouteloua gracilis
Koeleria macrantha
Verbascum thapsus

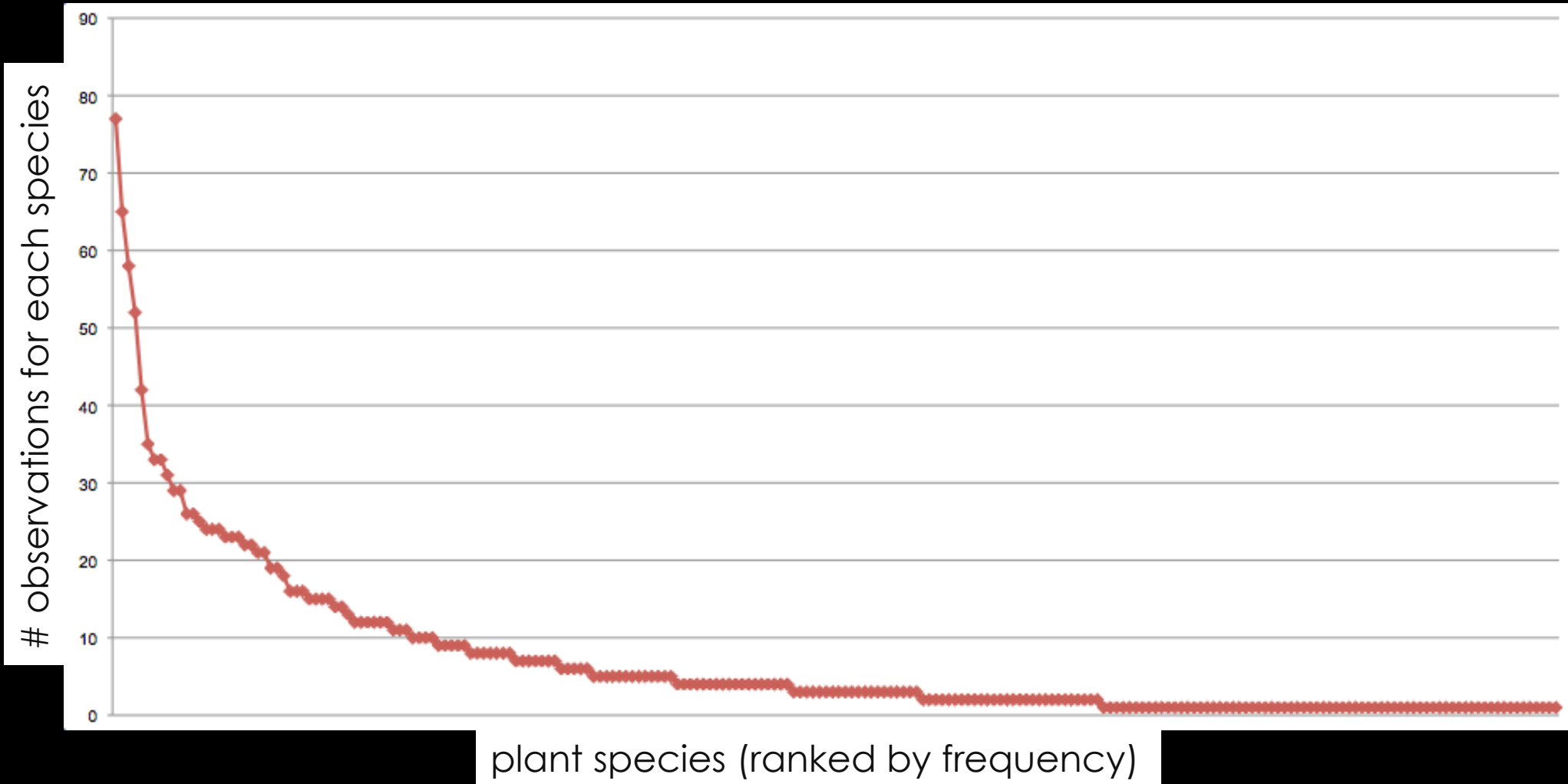
Claim 2: We can understand variation in ca. 4000 plant species by looking at a small set of common plants.



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Claim 3: We can predict what plants occur at a site (or “should” occur) by measuring the abiotic conditions at that site.



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What about existing ESDs for the northwestern Black Range?

- short version: there aren't any.
- the “least inapplicable” is F039XA007NM, ‘montane slopes 12-18”’

F039XA007NM, ‘montane slopes 12-18’’

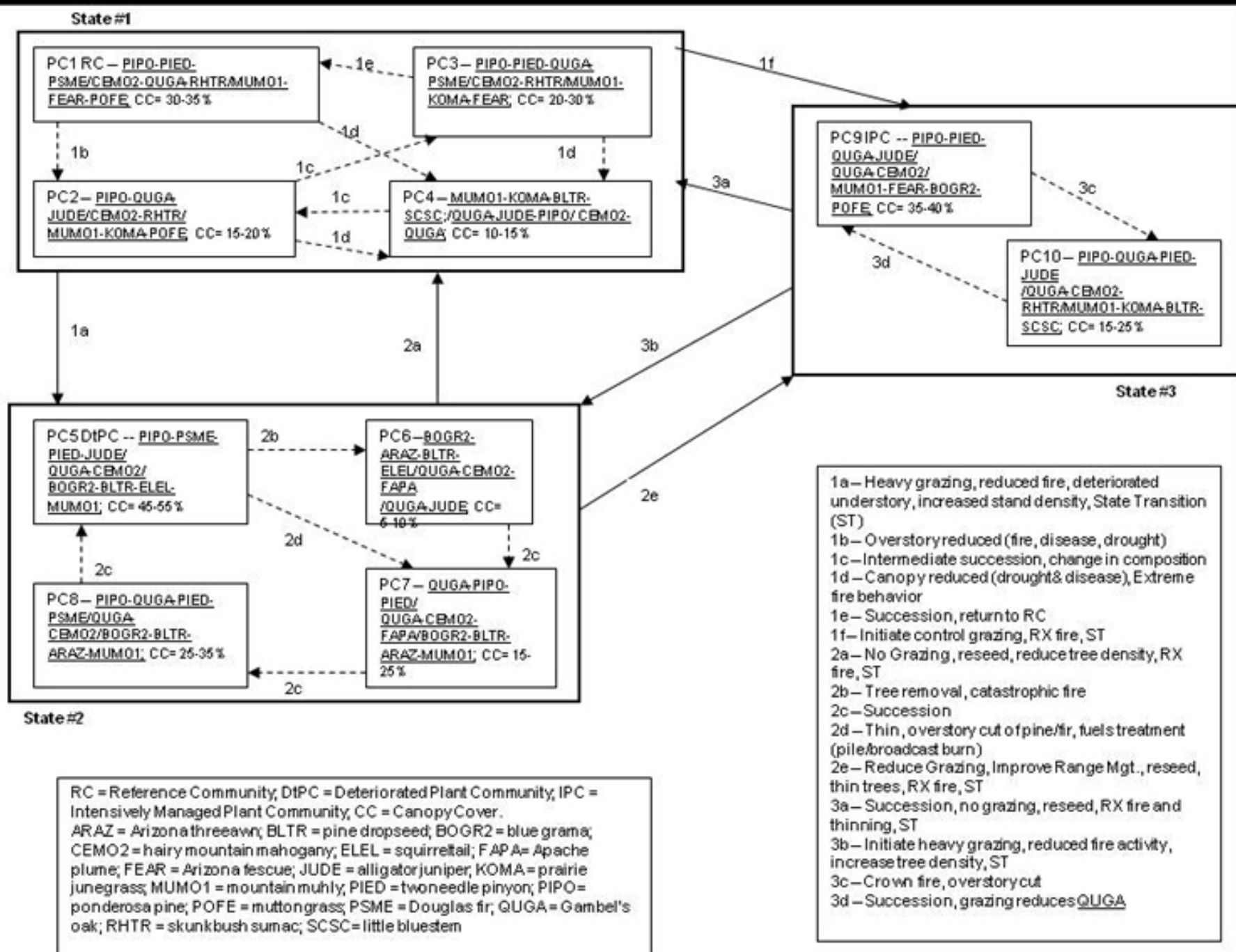
Most abundant plants observed in NW
Black Range:

Pinus ponderosa
Quercus gambelii
Pseudotsuga menziesii
Achillea millefolium
Bromus
Poa fendleriana
Geranium caespitosum
Amauriopsis dissecta
Thalictrum fendleri
Muhlenbergia montana

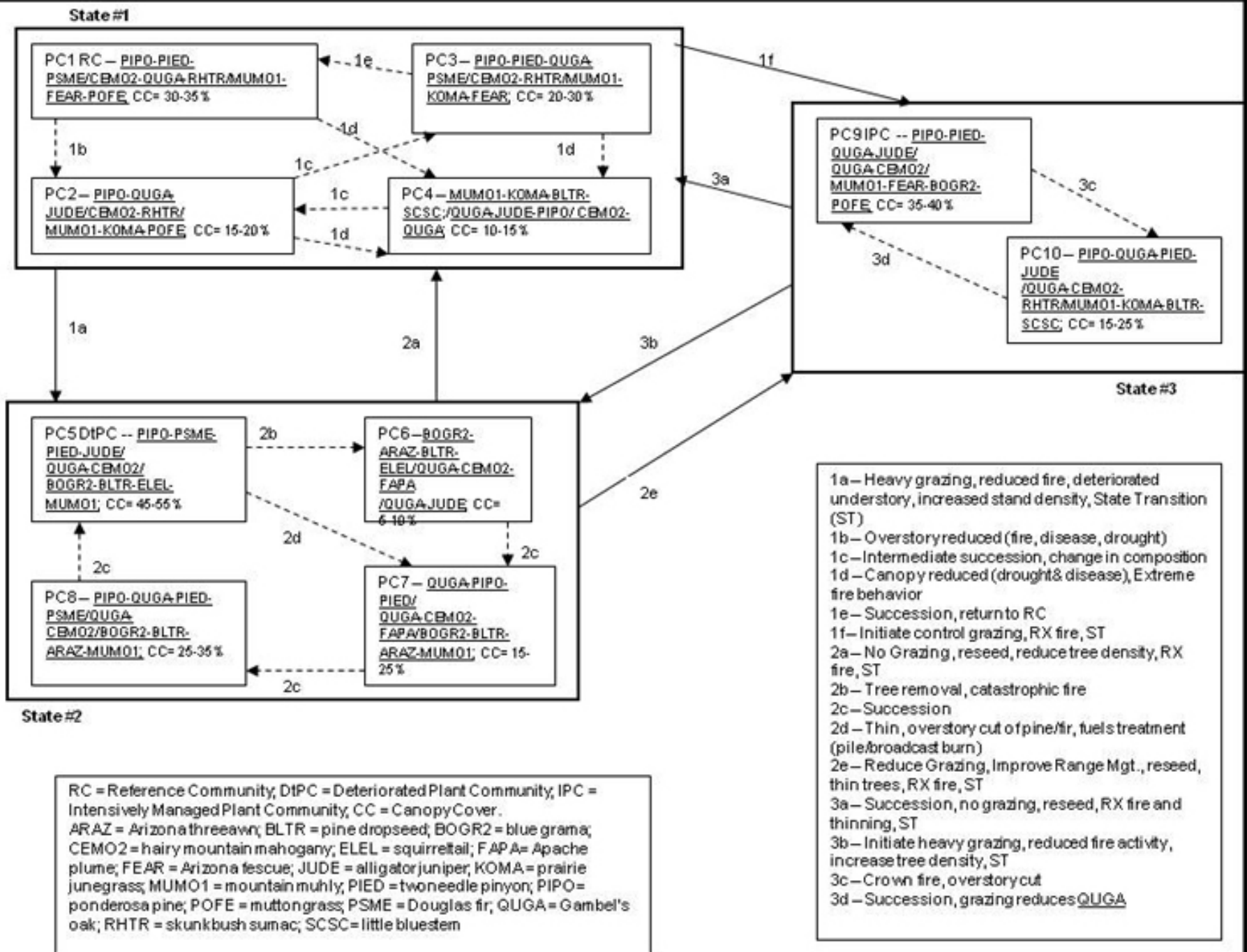
All plants in “plant communities” section
of the ESD:

Aristida arizonica
Blepharoneuron tricholepis
Bouteloua gracilis
Cercocarpus montanus
Elymus elymoides
Fallugia paradoxa
Festuca arizonica
Juniperus deppeana
Koeleria macrantha
Muhlenbergia montana
Pinus edulis
Pinus ponderosa
Poa fendleriana
Pseudotsuga menziesii
Quercus gambelii
Rhus trilobata
Schizachyrium scoparium

F039XA007NM, 'montane slopes 12-18"' ...and then there's this:



This is a claim to extensive and detailed knowledge. On what basis?



Why does it matter?

Well, apart from general curiosity...

federal agencies and others are using these plant community concepts to manage our lands.

For example: gravelly ecological site--“should” have grassland with occasional shrubs.



“should” have black grama grassland with occasional shrubs--something like this:



So, if we get rid of the creosote... the plant community will become what it “ought” to be?



Maybe... maybe not...



Maybe... maybe not...



Maybe... maybe not...



Maybe... maybe not...



Maybe... maybe not...



Or, a more local example...

What (some?) ponderosa forest
used to / ought to look like.



What (some?) ponderosa forest looks like now.



How to move from what is to what ought to be...



How to move from what is to what ought to be...

4FRI @flickr



So, given that how we manage land depends on ideas about plant communities, like:

- 1) Plant communities are distinct entities with identifiable boundaries. (FALSE)
- 2) We can understand variation in ca. 4000 plant species by looking at a small set of common plants. (KIND OF?)
- 3) We can predict what plants occur at a site (or “should” occur) by measuring the abiotic conditions at that site. (MAYBE?)
- 4) We know how to create a desired change in plant communities. (PROBABLY NOT, BUT SOMETIMES?)

We should, at the very least:

For any claims about plant communities, ask:

“Are these plant communities real?”

“How many species did you study?”

“How do we know what ‘ought’ to grow here?”

Or, if land management is involved, add:

“How do we know this land management plan will have the desired effect? And will that be good for plants as a whole?”

The answers might be great!

We might understand what's going on, or at least have a good idea what to do.



But we *cannot* take that for granted.

So, what can we do with this information?

Claim 1: Plant communities are distinct entities with identifiable boundaries.

