A photograph of a field of orange-flowered plants, likely Sphaeralcea parvifolia, under a clear blue sky. The plants are in the foreground and middle ground, with some bare trees in the background.

# Combining species distribution models and disturbance to select native plant species for restoration

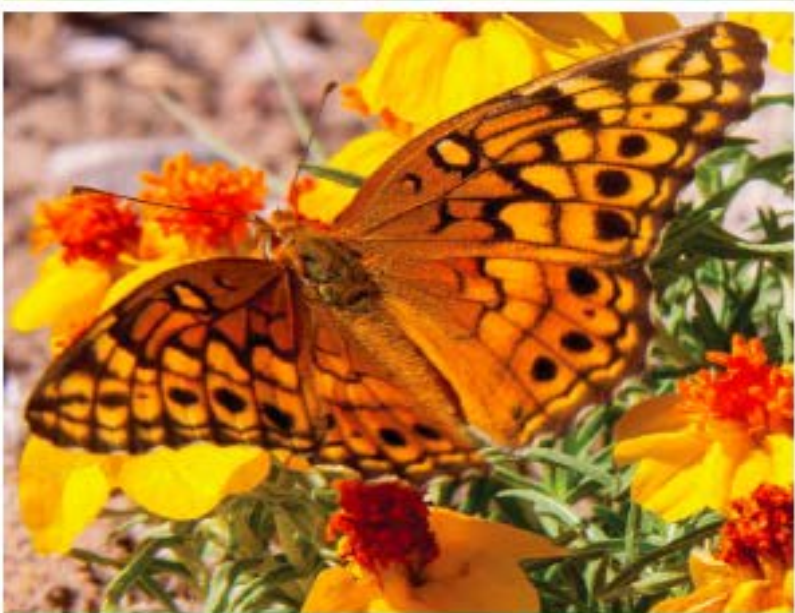
Lila Leatherman  
University of Utah

Rio Mesa Center and Natural History Museum of Utah



# NATIONAL SEED STRATEGY

## for Rehabilitation and Restoration



2015-2020



A background image of a dense field of white flowers, possibly daisies, with green foliage. The text is overlaid on this image.

# STRATEGY

## VISION AND MISSION

A background image of a field of bright yellow flowers, possibly cornflowers, with green foliage. The text is overlaid on this image.

### Vision

The right seed in the right place at the right time.

A background image of a field of purple flowers, possibly lupines, with green foliage. The text is overlaid on this image.

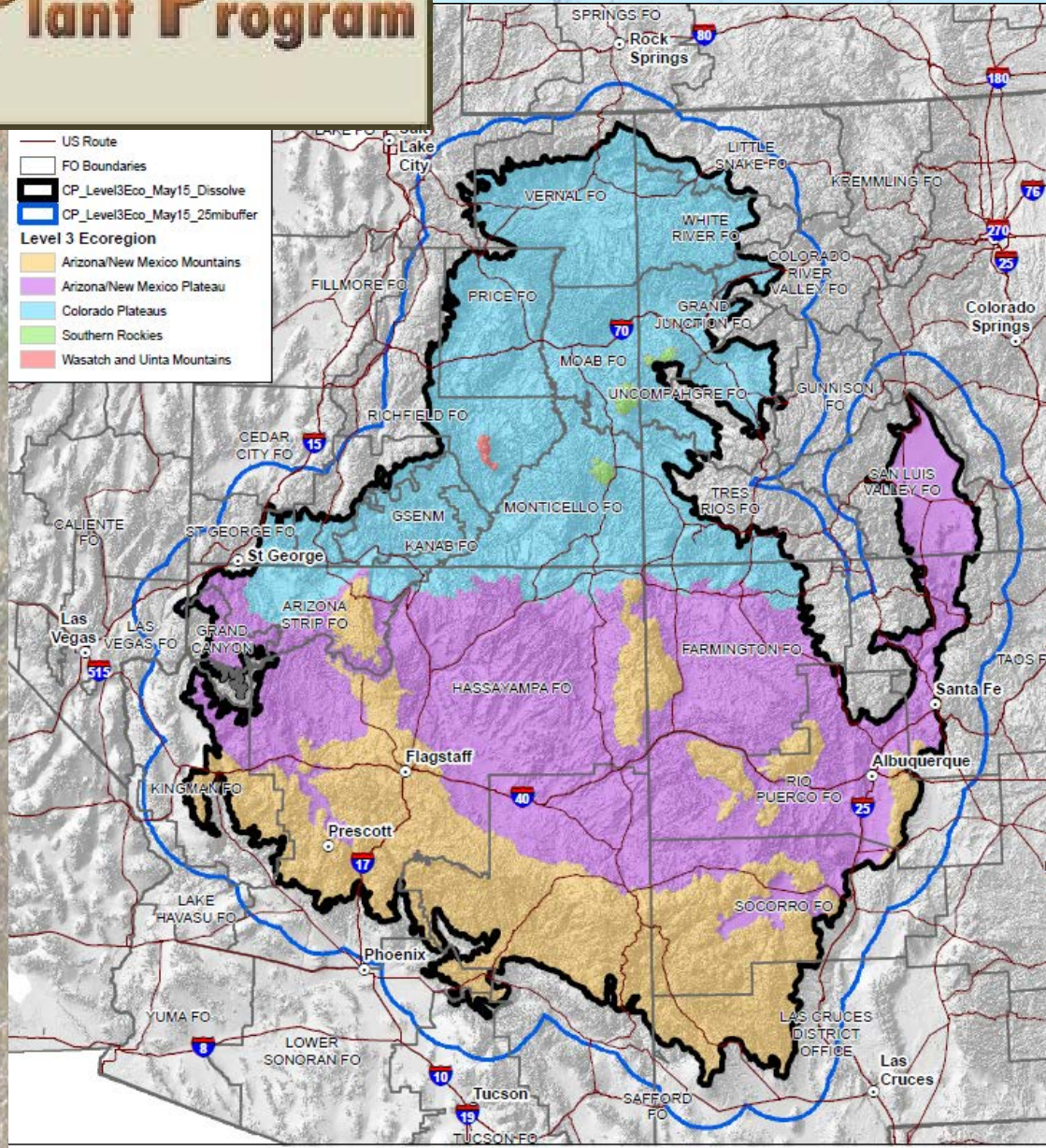
### Mission

To ensure the availability of genetically appropriate seed to restore viable and productive plant communities and sustainable ecosystems.

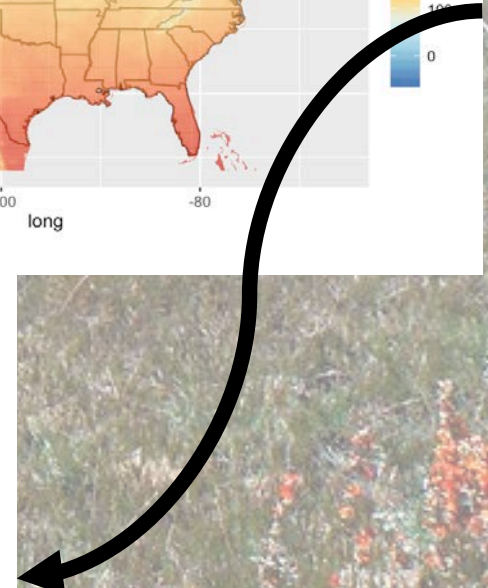
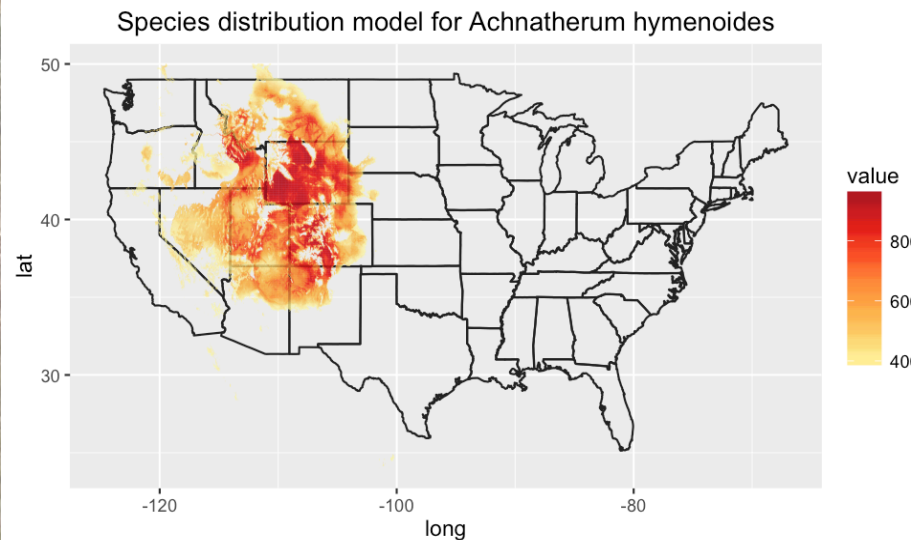
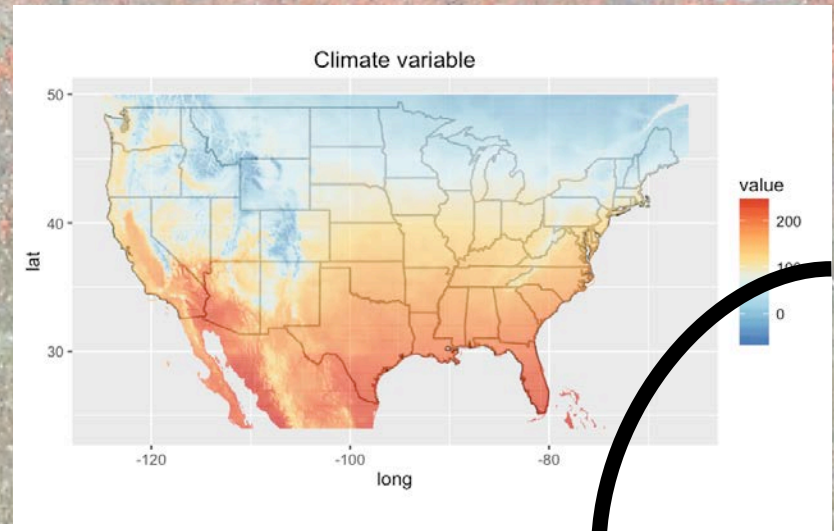
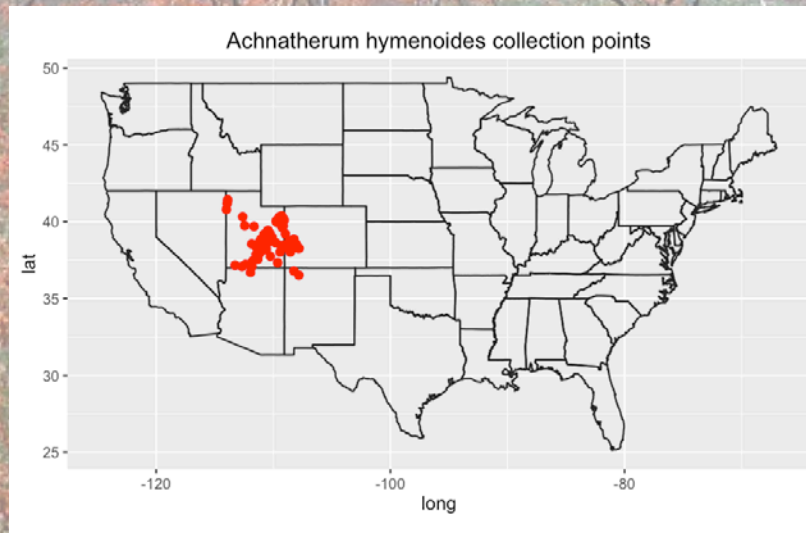


# Colorado Plateau Native Plant Program

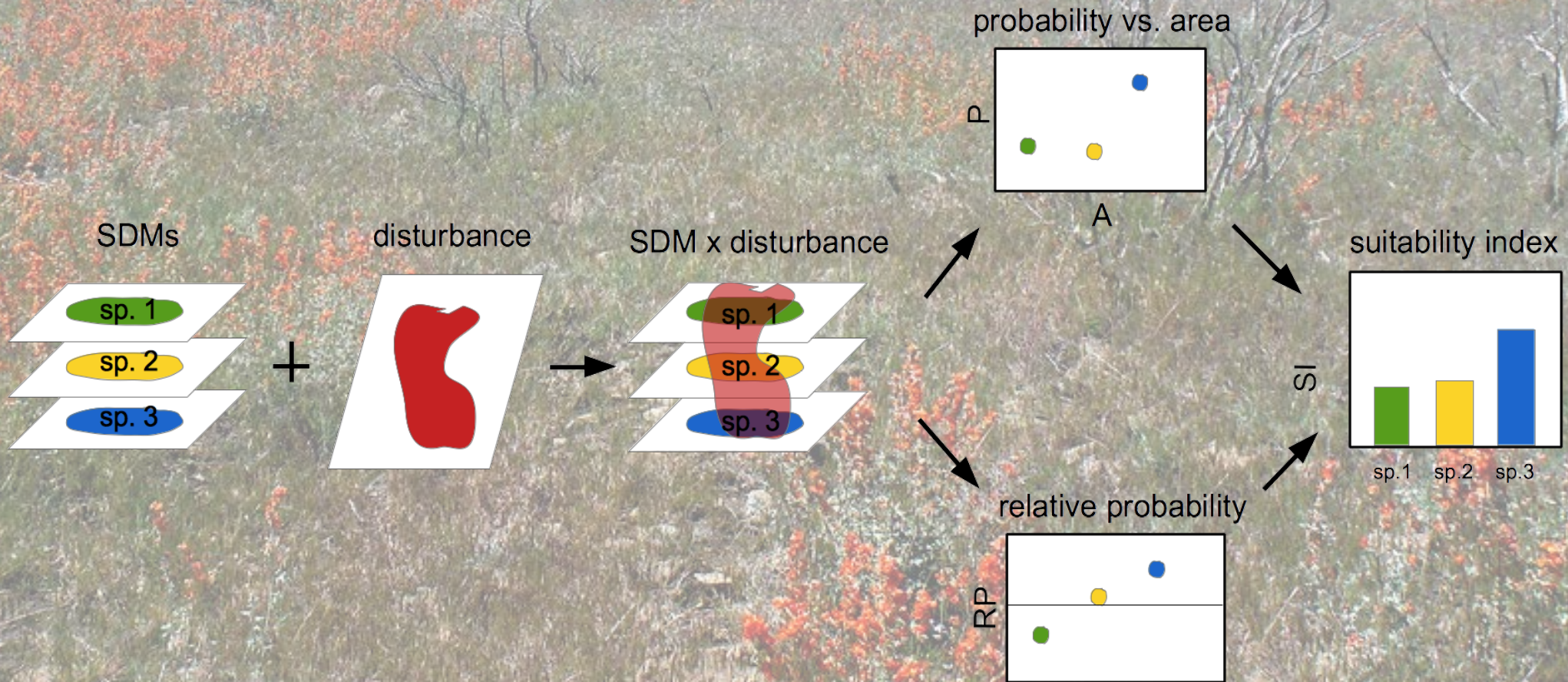
- US Route
- FO Boundaries
- ▬ CP\_Level3Eco\_May15\_Dissolve
- ▬ CP\_Level3Eco\_May15\_25mbuffer
- Level 3 Ecoregion**
- Arizona/New Mexico Mountains
- Arizona/New Mexico Plateau
- Colorado Plateaus
- Southern Rockies
- Wasatch and Uinta Mountains



# species distribution models (SDMs) model species occurrences with environmental variables in order to predict probability of occurrence



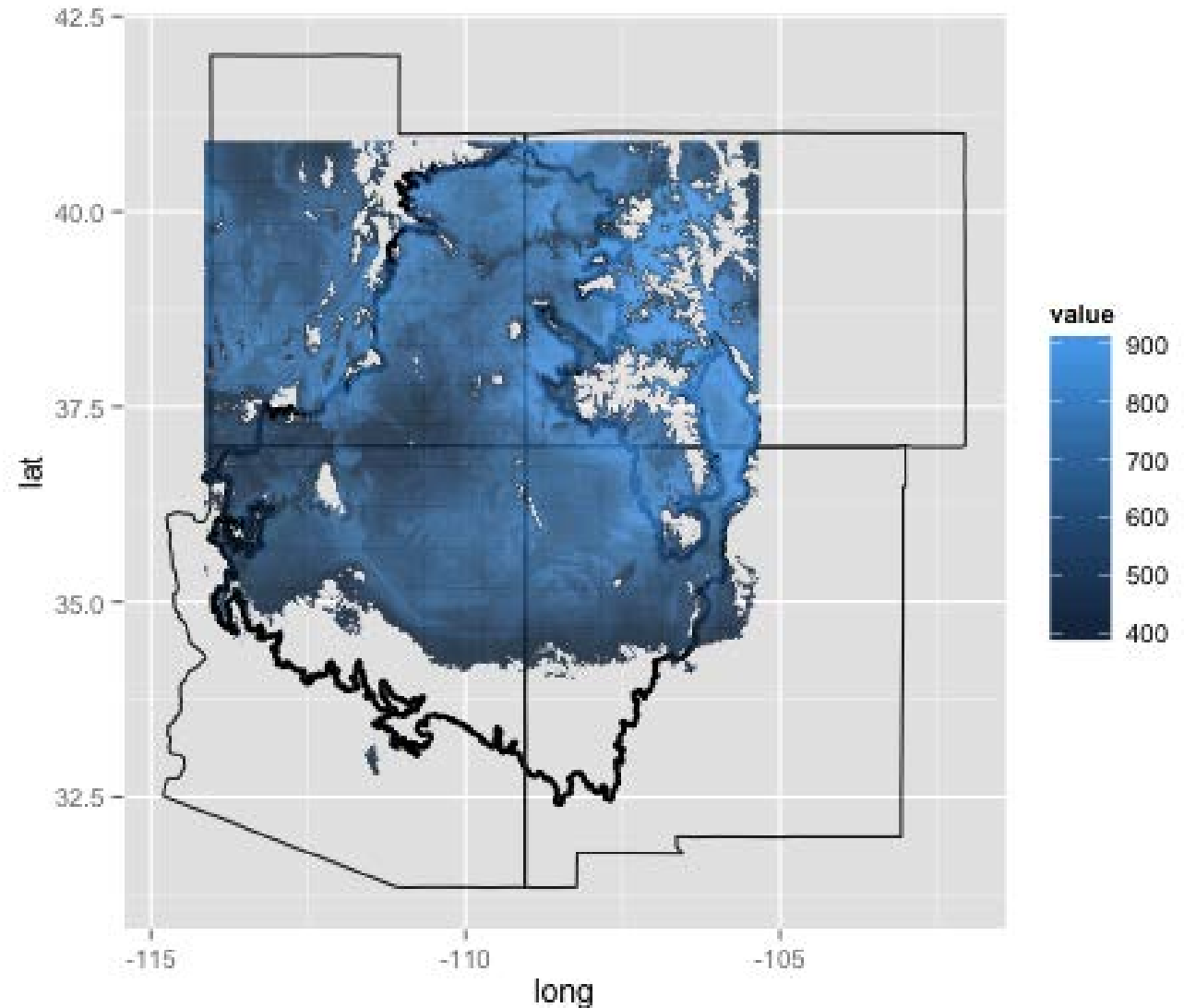
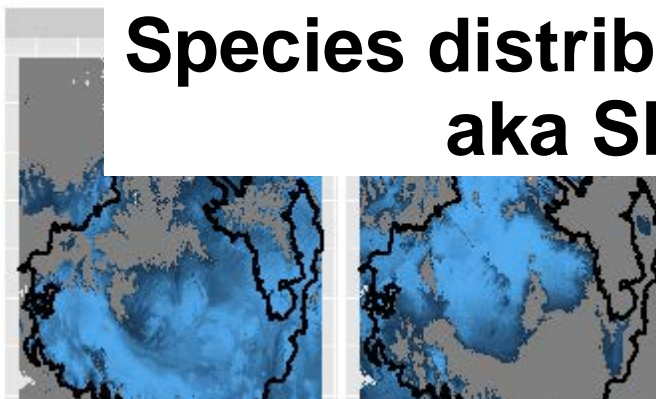
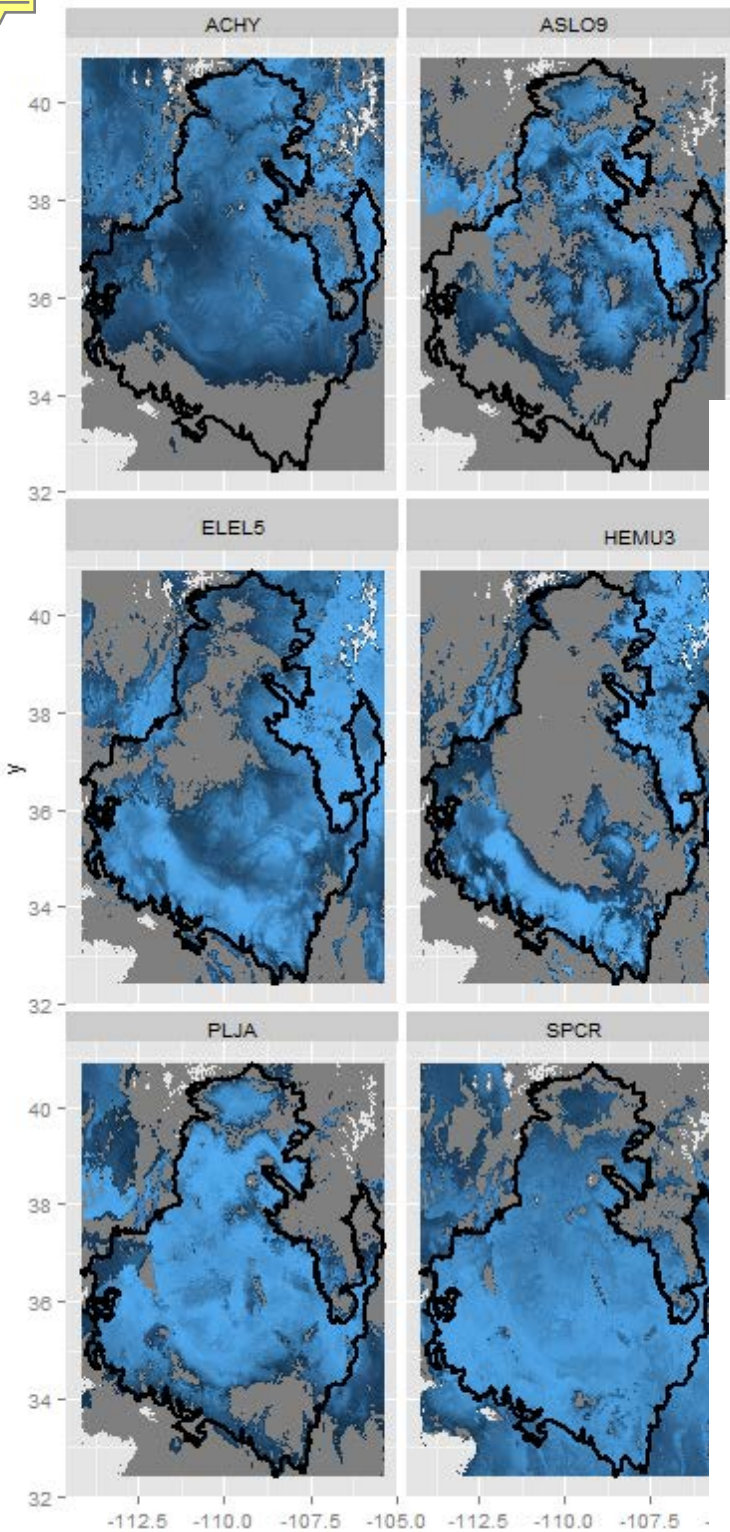
developing a **framework** to intersect **SDMs** with **disturbance** to identify which species are predicted to perform **best** in areas where restoration is likely to occur





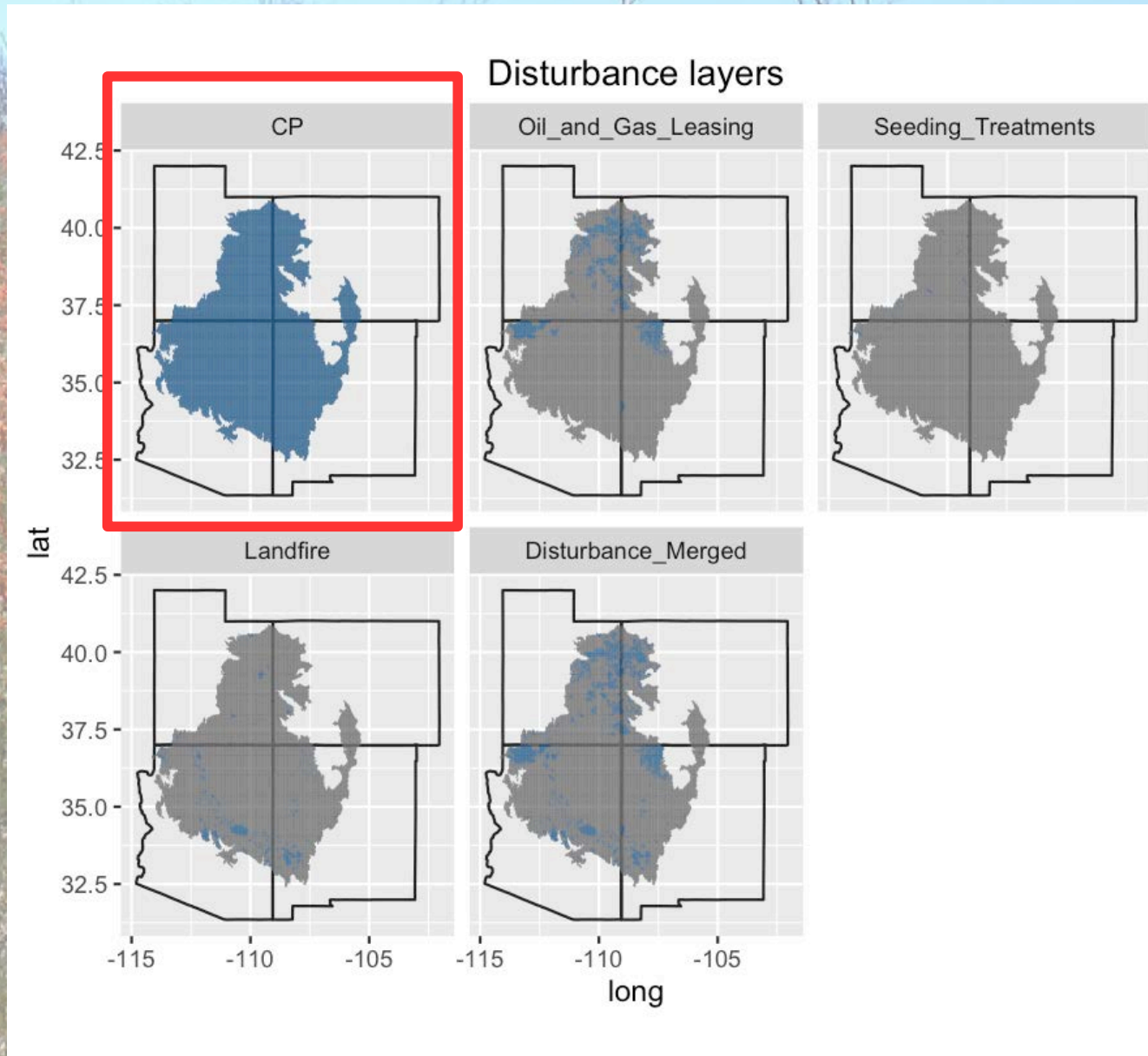
<b>Scientific Name</b>	<b>Species Code</b>	<b>Common Name</b>	<b>Family</b>	<b>Type</b>
<i>Achnatherum hymenoides</i>	ACHY	Indian ricegrass	Poaceae	Grass
<i>Astragalus lonchocarpus</i>	ASLO3	rushy milkvetch	Fabaceae	Forb
<i>Bouteloua gracilis</i>	BOGR2	blue grama	Poaceae	Grass
<i>Cleome lutea</i>	CLLU2	yellow spiderflower	Capparaceae	Forb
<i>Elymus elymoides</i>	ELEL5	squirreltail	Poaceae	Grass
<i>Heliomeris multiflora</i>	HEMU3	showy goldeneye	Asteraceae	Forb
<i>Koeleria macrantha</i>	KOMA	prairie Junegrass	Poaceae	Grass
<i>Machaeranthera canescens</i>	MACA2	hoary tansyaster	Asteraceae	Forb
<i>Pleuraphis jamesii</i>	PLJA	James' galleta	Poaceae	Grass
<i>Sporobolus cryptandrus</i>	SPCR	sand dropseed	Poaceae	Grass
<i>Sphaeralcea parvifolia</i>	SPPA2	small-leaf globemallow	Malvaceae	Forb

# Species distribution models aka SDMs

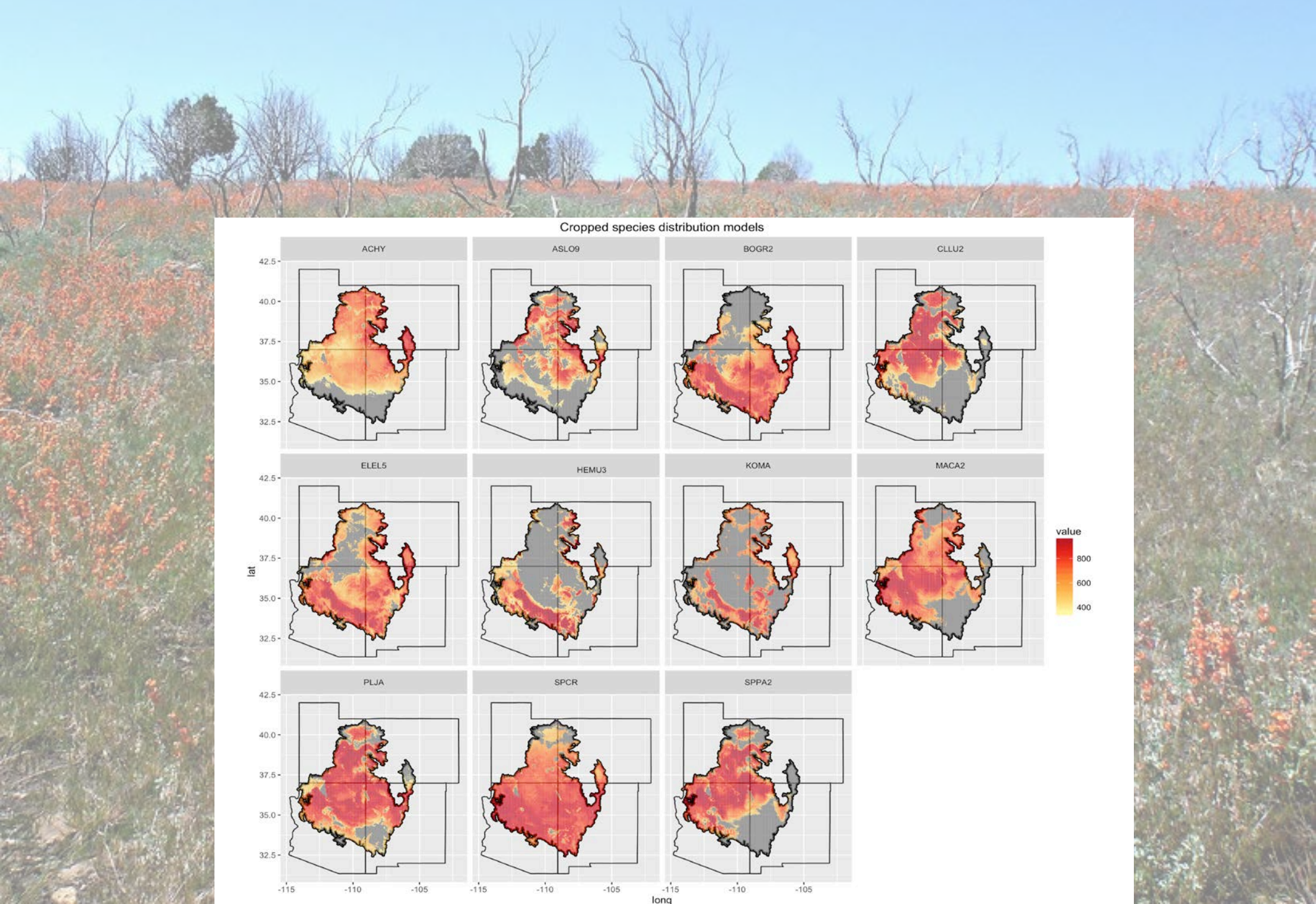




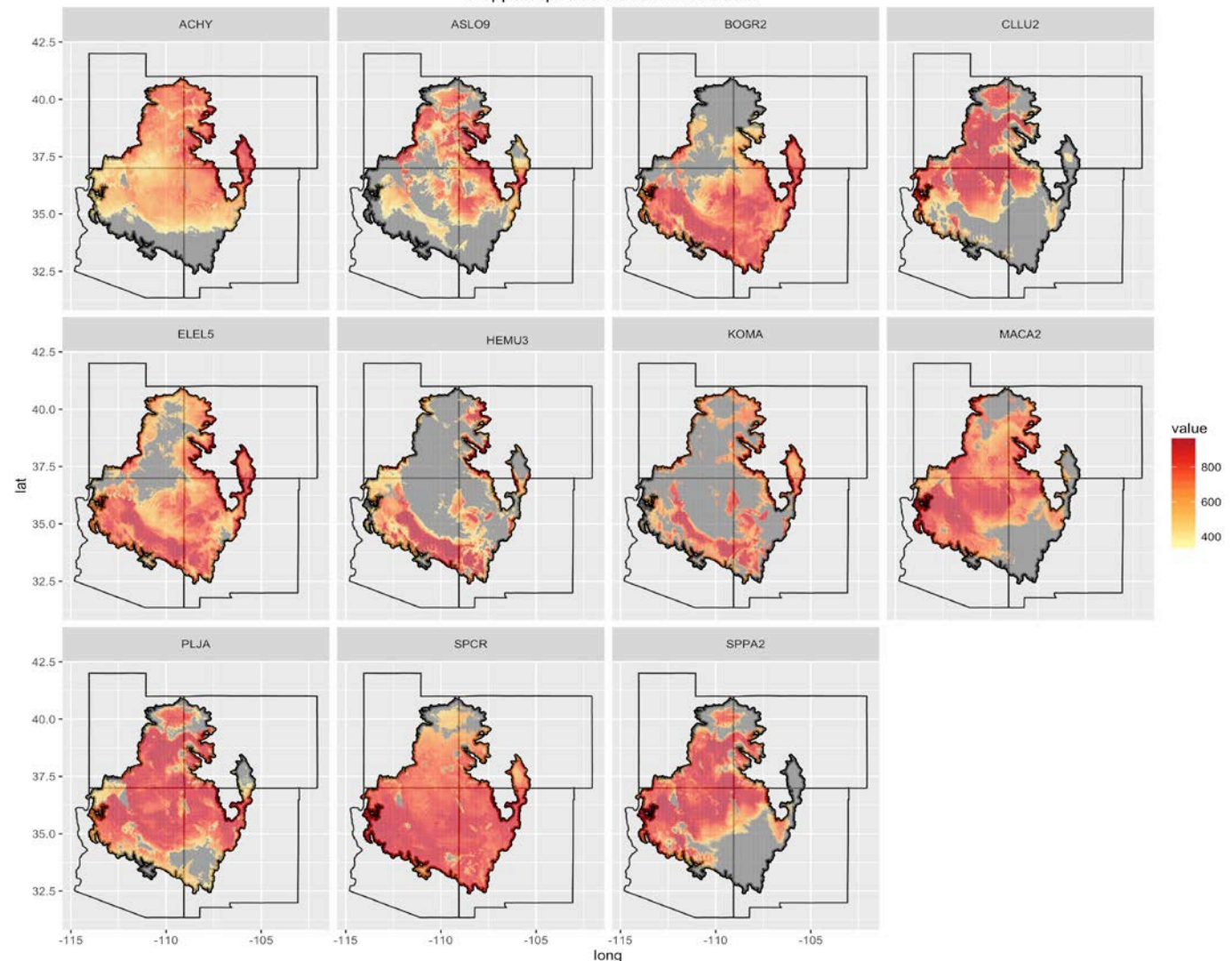
# disturbance and predictors of restoration need



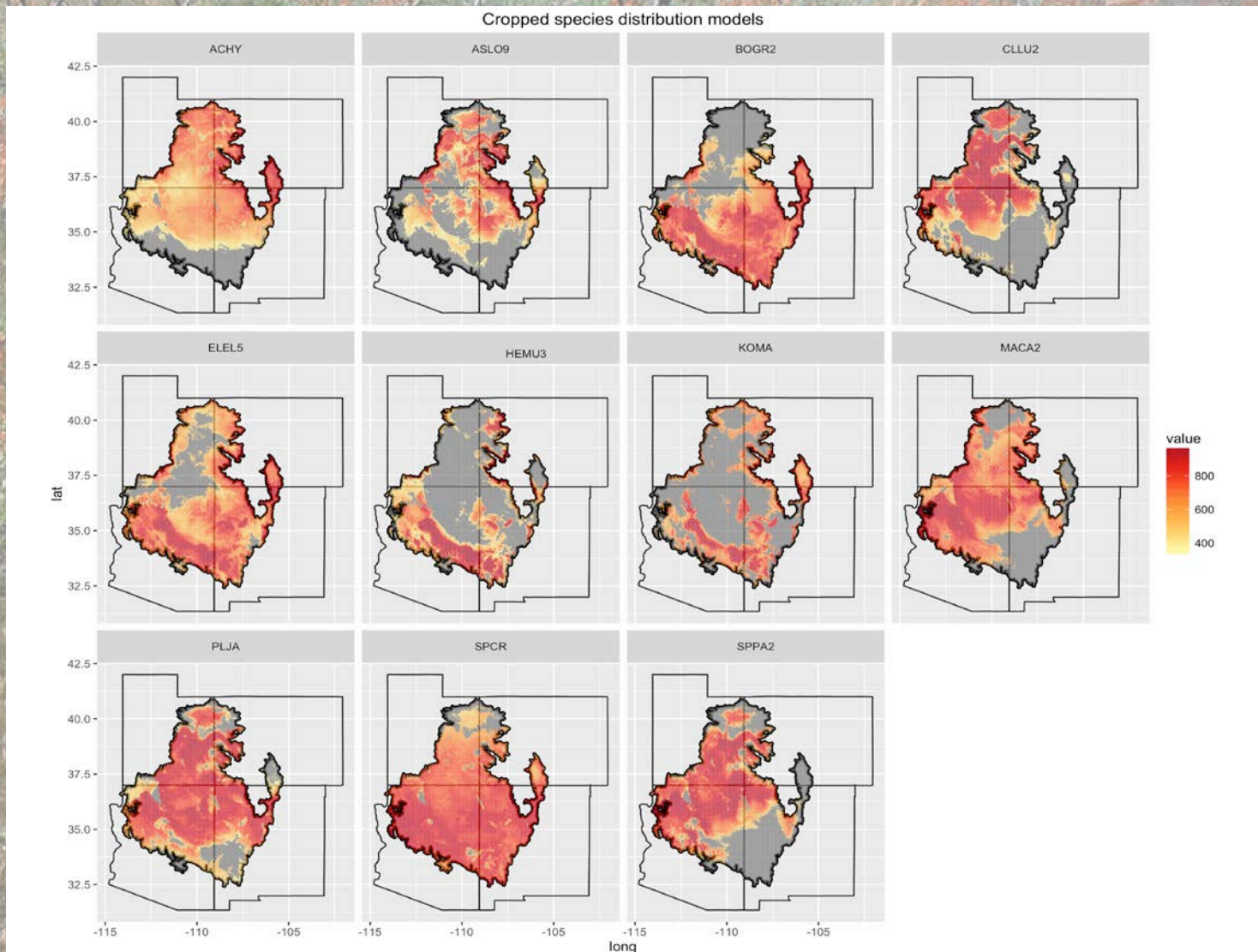
- Colorado Plateau boundary
- BLM oil and gas leases in UT, CO, AZ, NM
- USGS Land Treatment Digital Library (LTDL) Seeding treatments
- Landfire vegetation disturbance



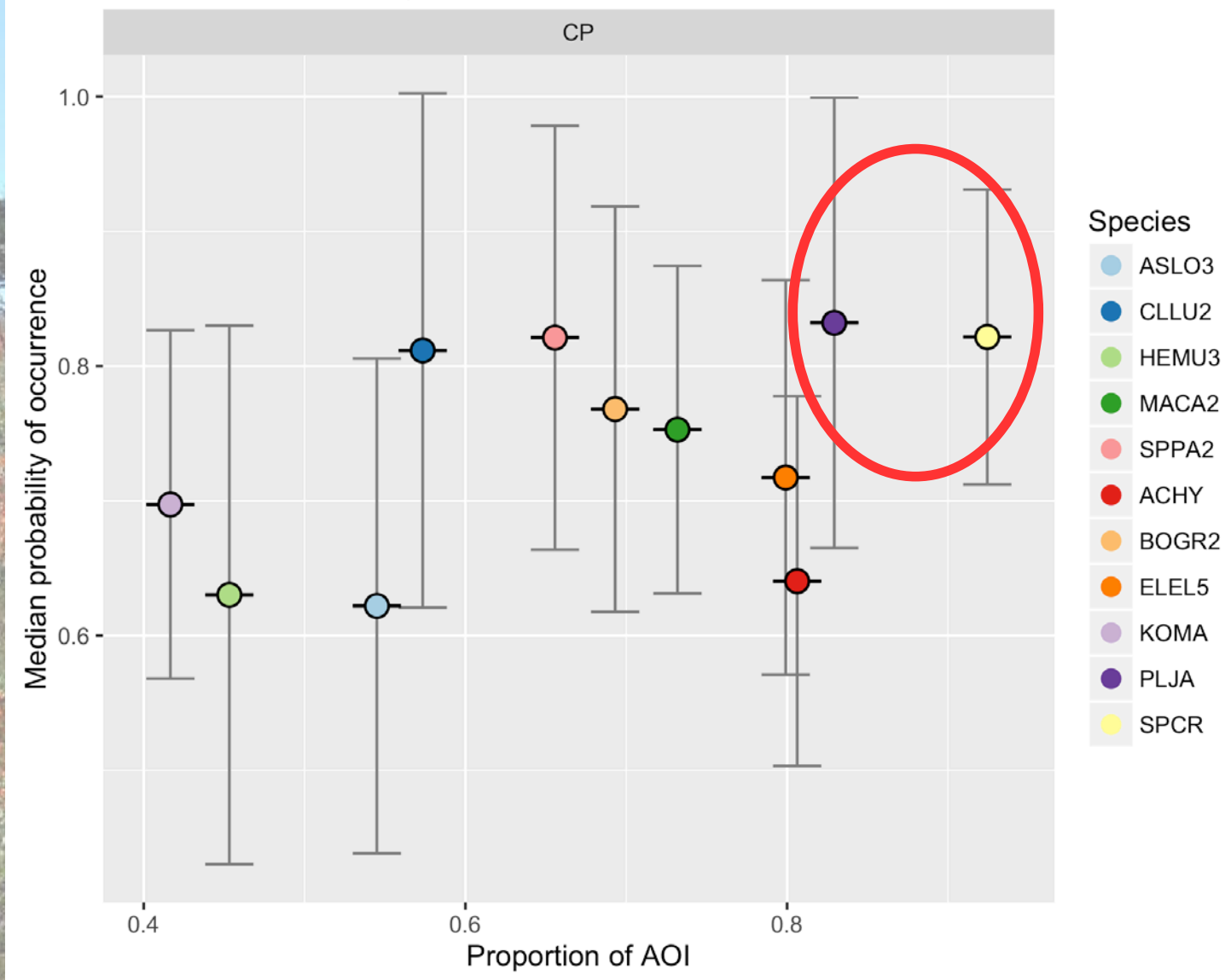
Cropped species distribution models



- which species have the **highest probability** of occurrence over the **largest area**?
- which species are **relatively more probable** in the area of interest?

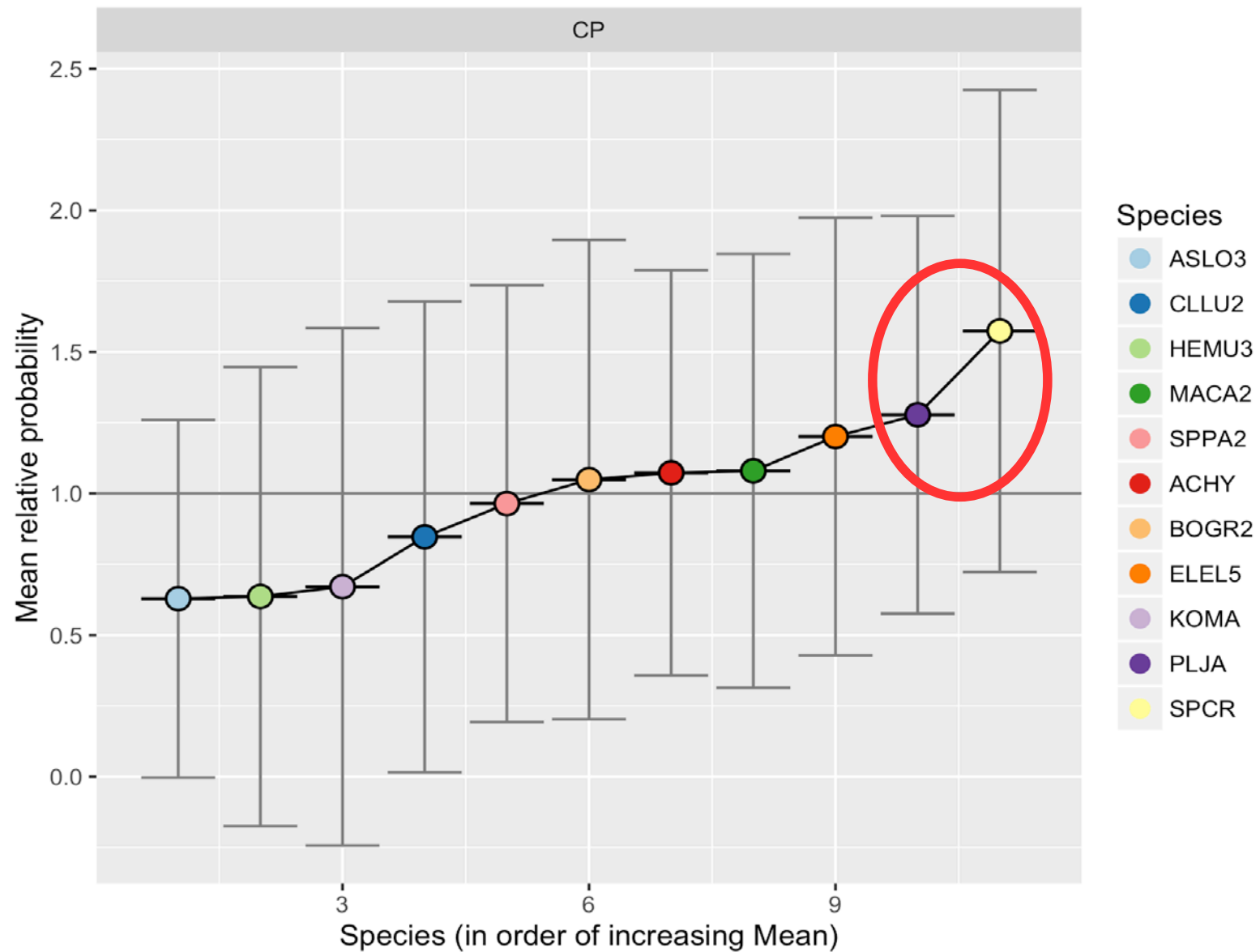


## Probability of Occurrence vs. Area, all spp



- $P_{sp} i = \text{median}(\text{Prob}_{sp} i)$
- $A_{sp} i = (\text{area of species range}) / (\text{area of interest})$
- $P_{sp} i * A_{sp} i \rightarrow 0-1$  index of suitability

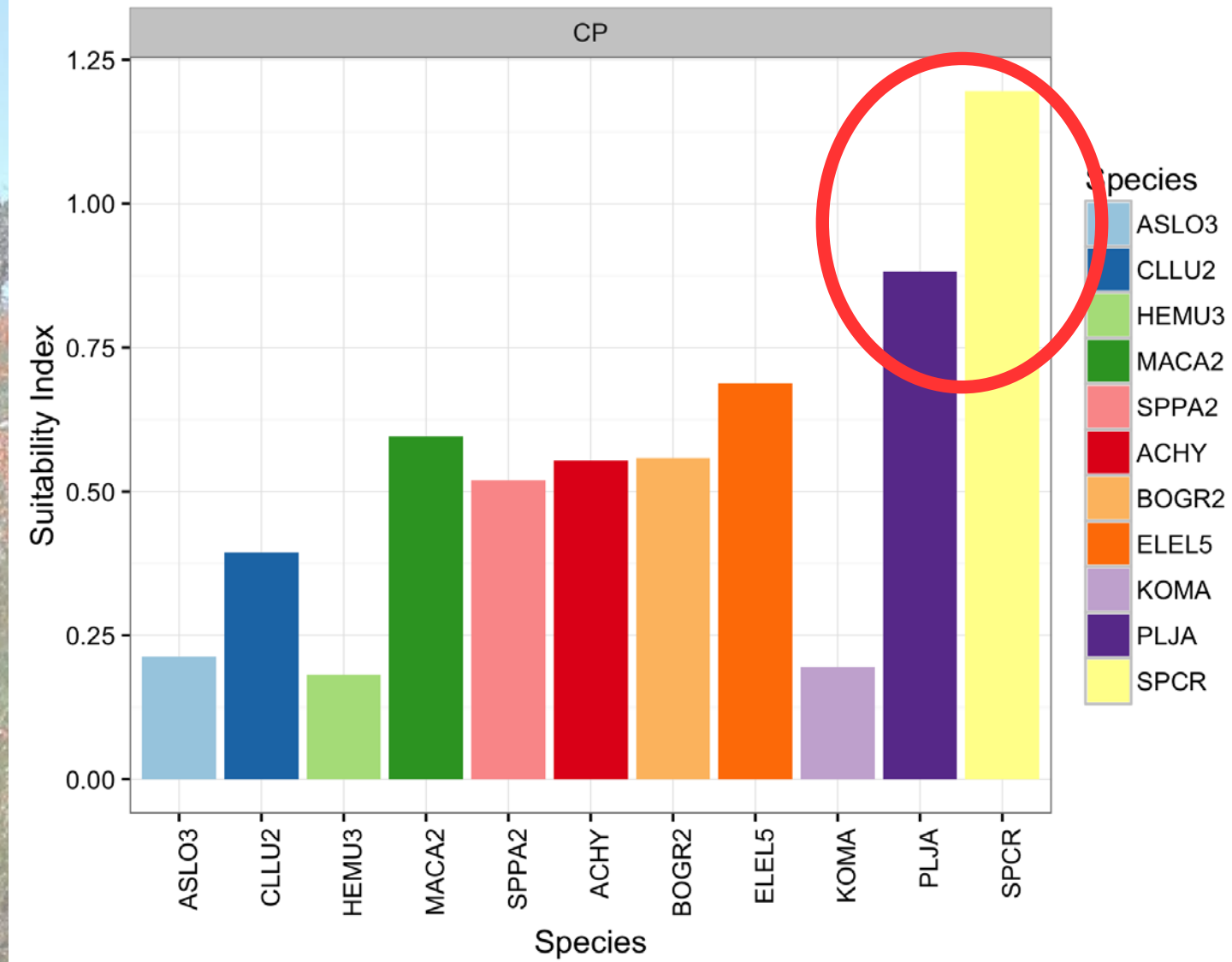
Avg: Rank-probability plot for all spp



- Relative probability

- $RP_{sp} i = \text{mean} \left( \frac{\text{Prob}_{sp} i}{\text{mean}(\text{Prob}_{sp} i : \text{Prob}_{sp} n)} \right)$

# Suitability Index for allsp

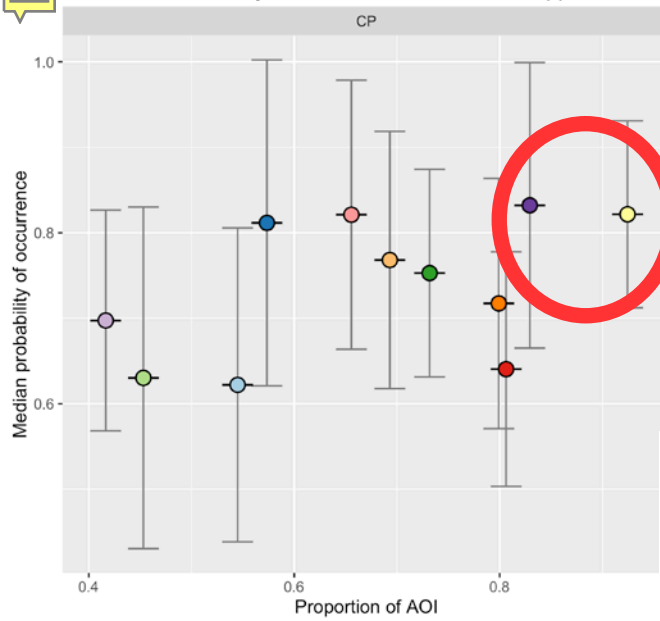


- Suitability index

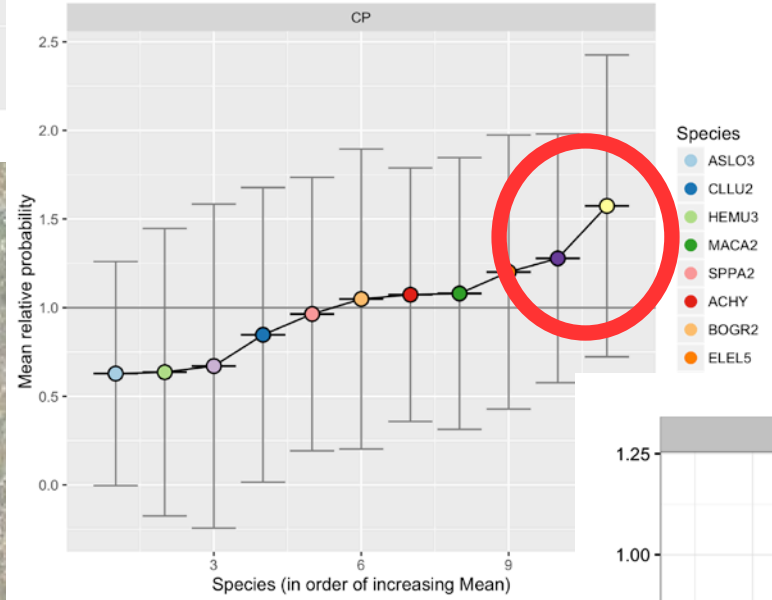
- $= P_{sp}^i * A_{sp}^i * RP_{sp}^i$



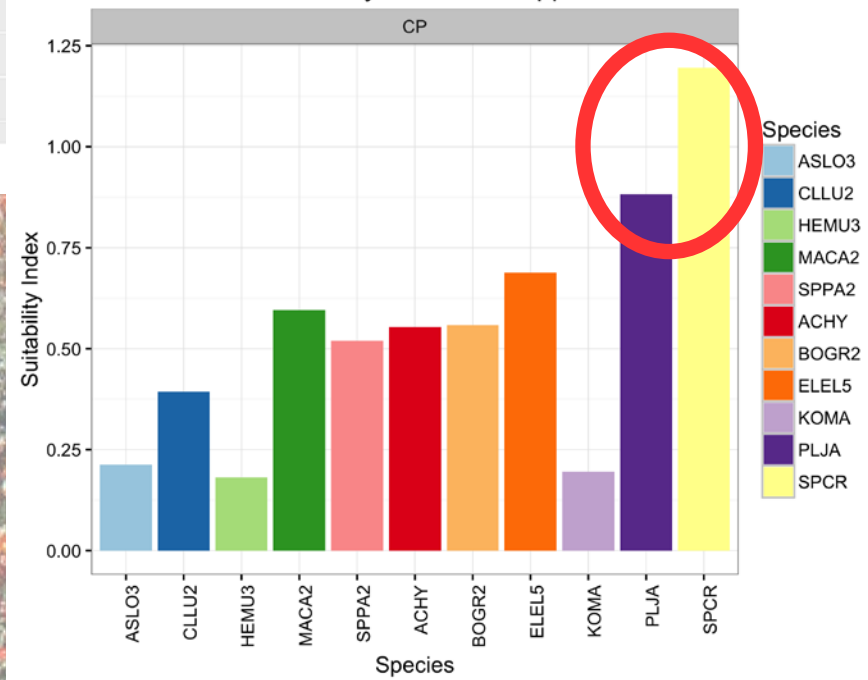
Probability of Occurrence vs. Area, all spp



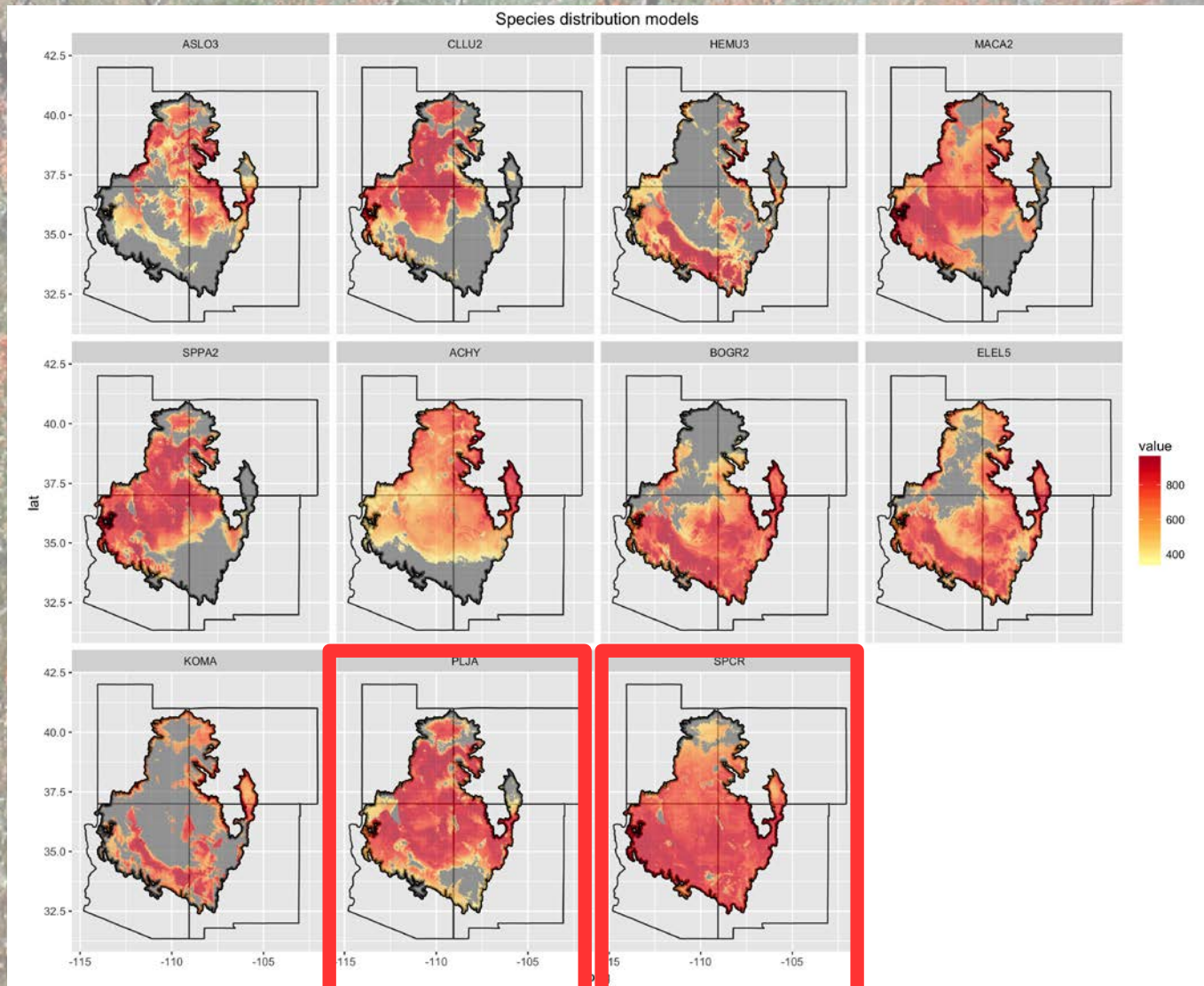
Avg: Rank-probability plot for all spp



Suitability Index for all spp



- which species have the **highest probability** of occurrence over the **largest area**?
- which species are **relatively more probable** in the area of interest?



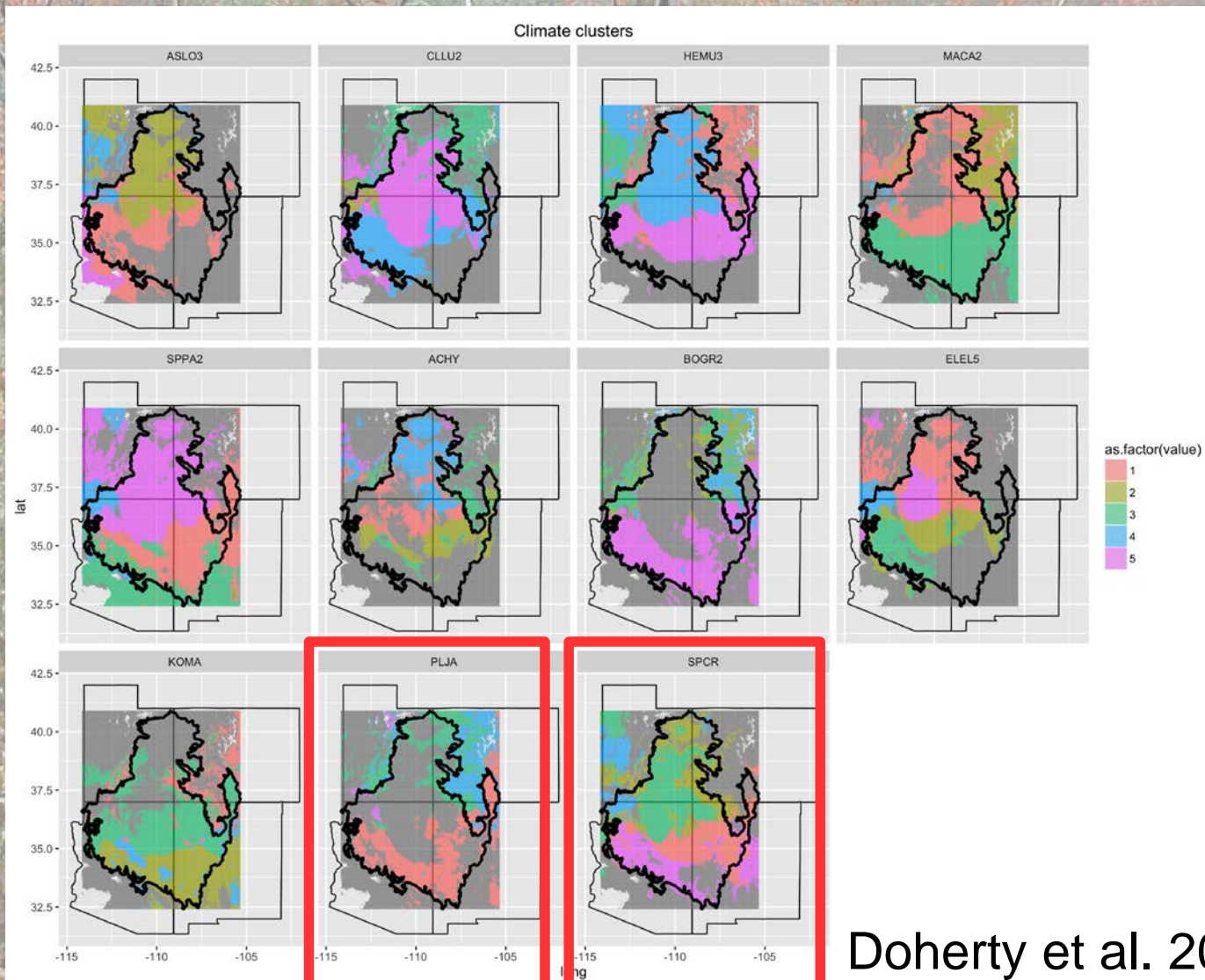




**flexible framework** can be applied to varied groups of species or areas of interest

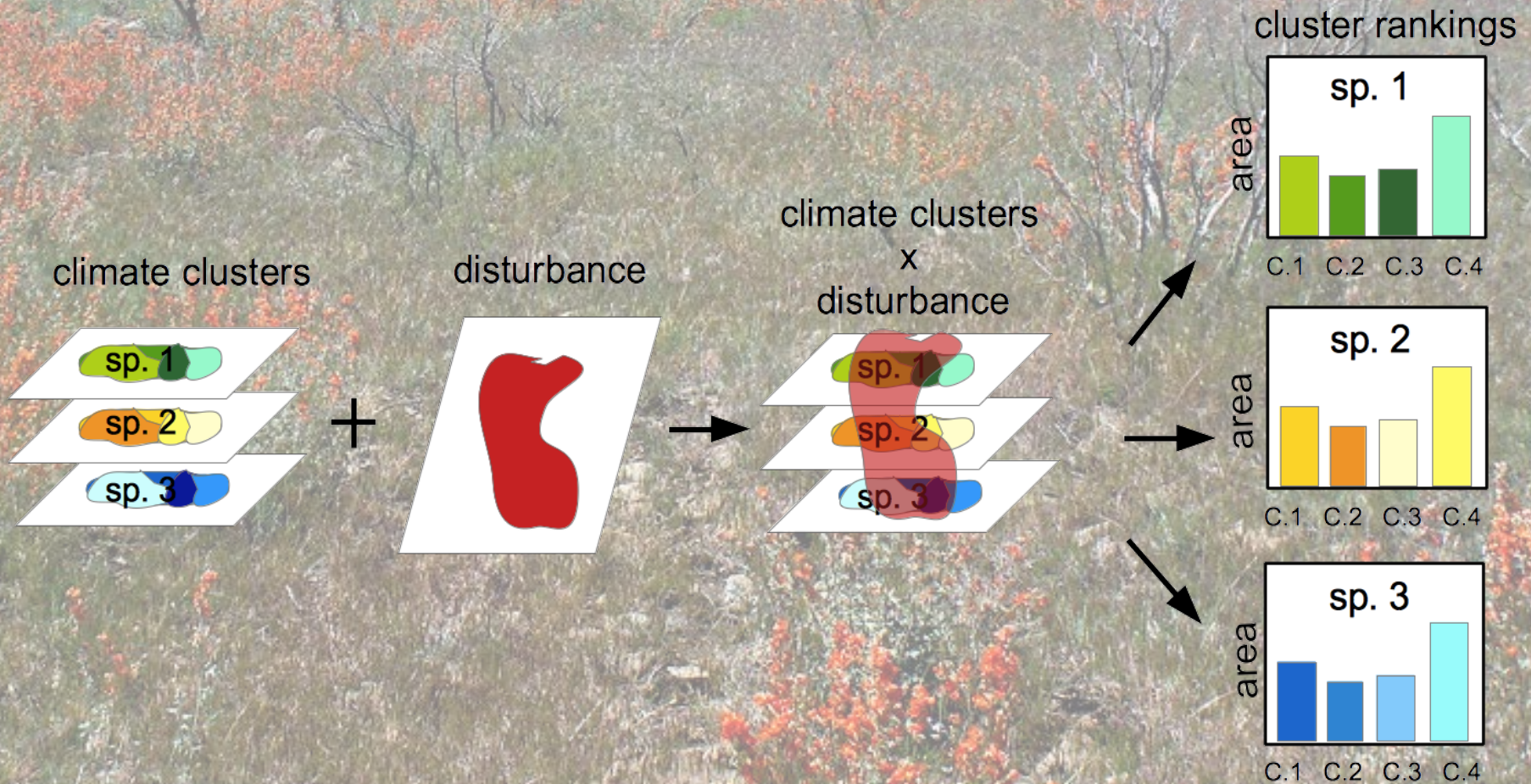
provides a **quantitative metric** for selecting species for restoration use on a **broad ecological scale**

similar framework can be applied to **climate clusters** in order to select **accessions** of species for restoration use

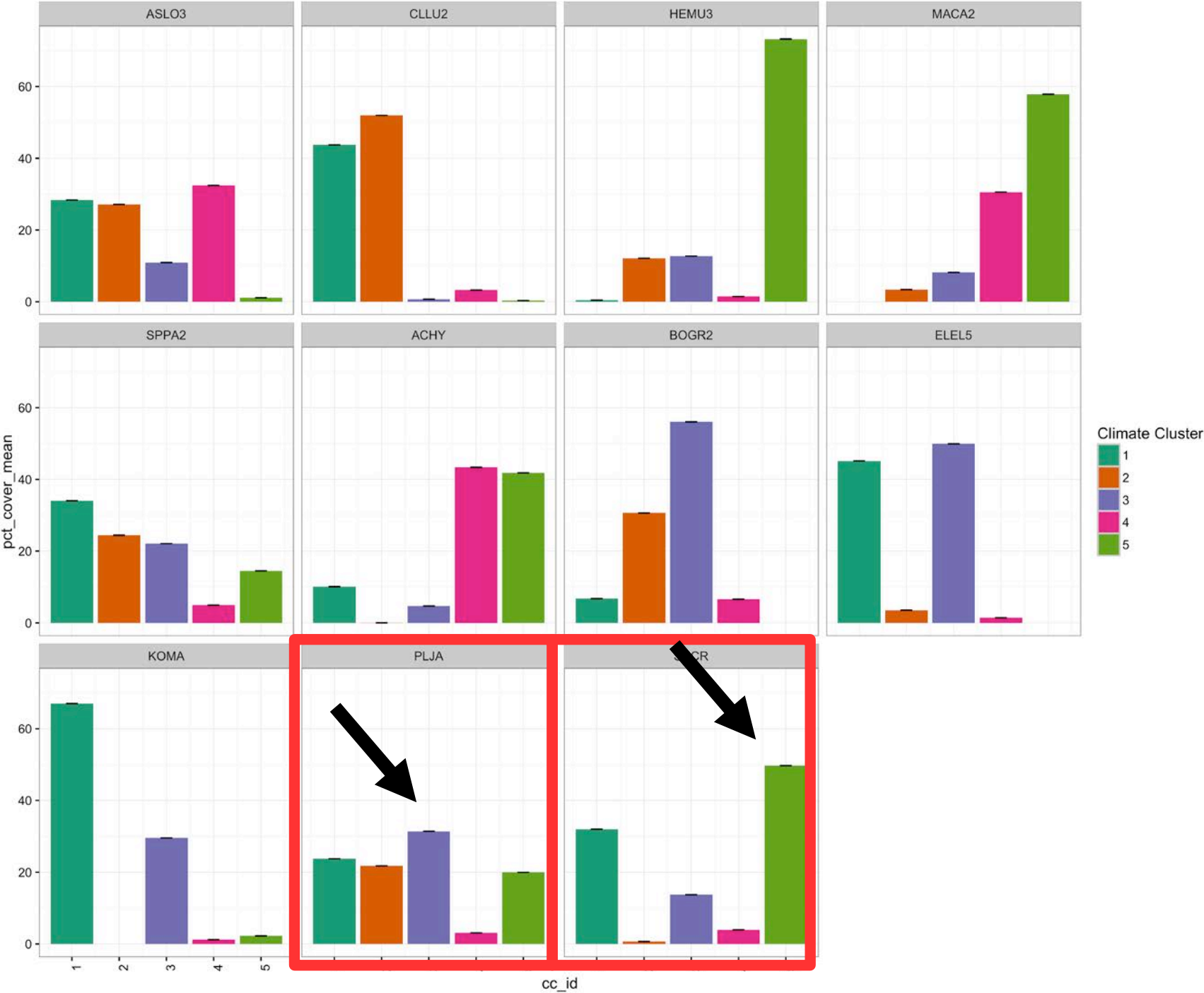


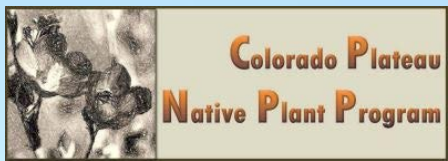
Doherty et al. 2016, in review

similar framework can be applied to **climate clusters** in order to select **accessions** of species for restoration use



# climate clusters x disturbance for all species, in the Colorado Plateau





# Thank you!

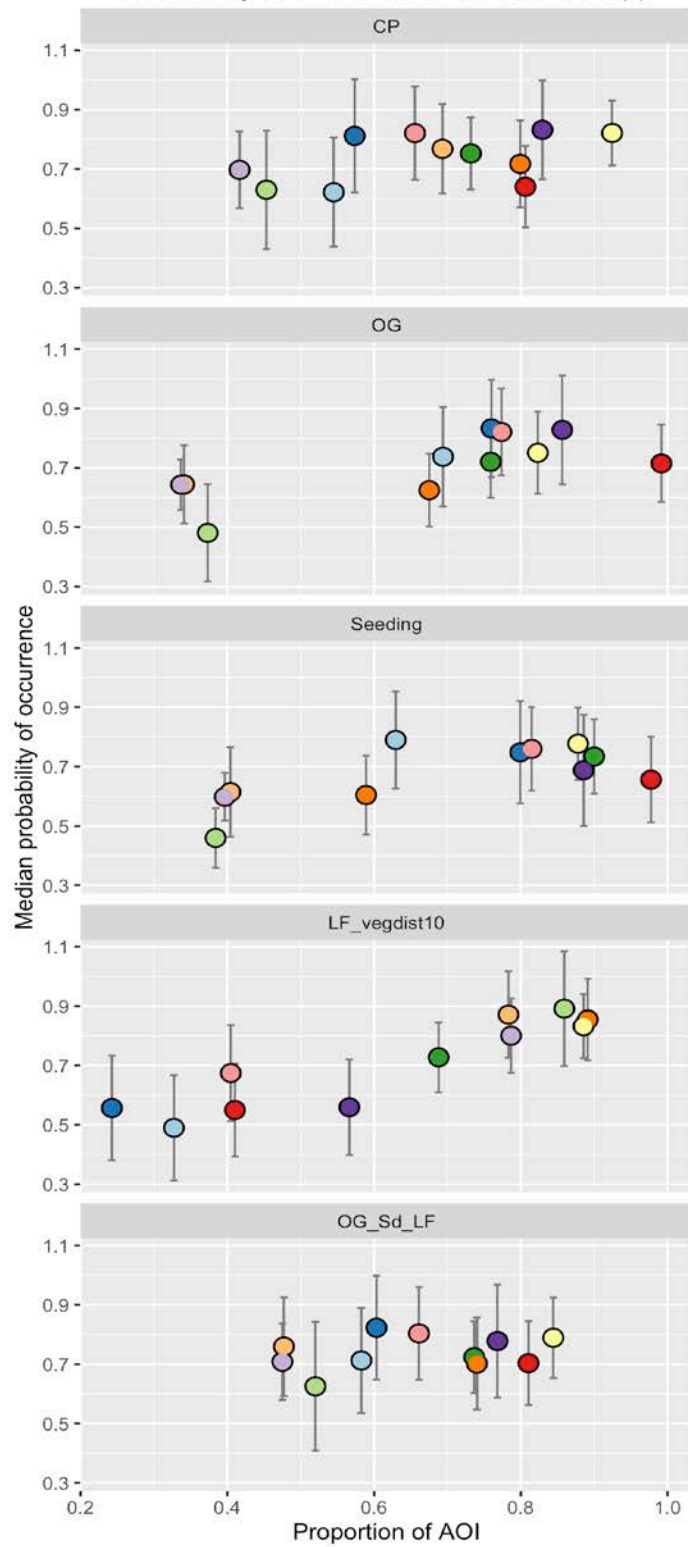
- Troy Wood
  - Kyle Doherty
  - Brad Butterfield
  - Mitch Power
  - Simon Brewer
  - Zach Lundeen
  - Adrienne Pilmanis
  - Justin Welty
  - Chris Calvo
- Utah Bureau of Land Management  
and Colorado Plateau Native  
Plant Program
- University of Utah Rio Mesa Center  
National History Museum of Utah  
University of Utah's Garrett  
Herbarium
- U.S. Geological Survey  
Northern Arizona University  
Great Basin Institute



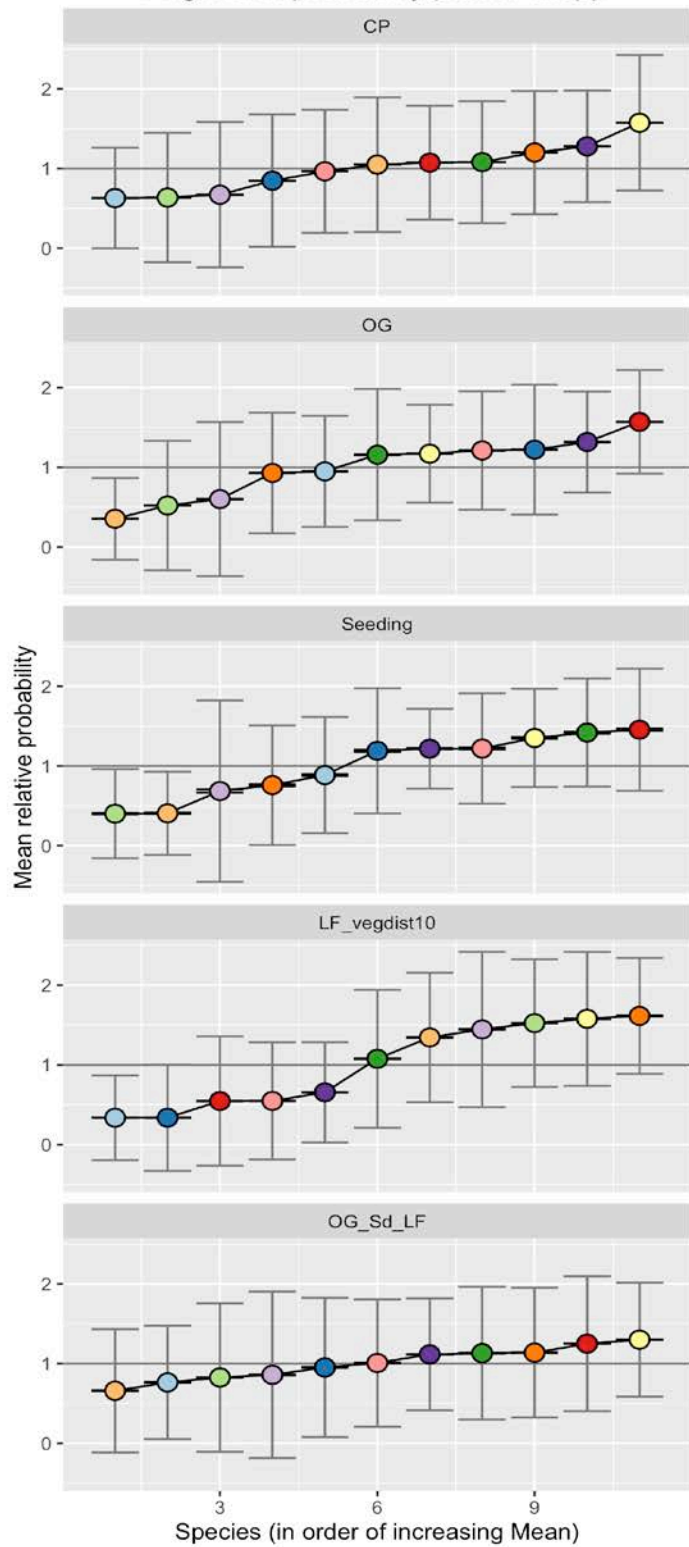
NATURAL  
HISTORY  
MUSEUM  
OF UTAH



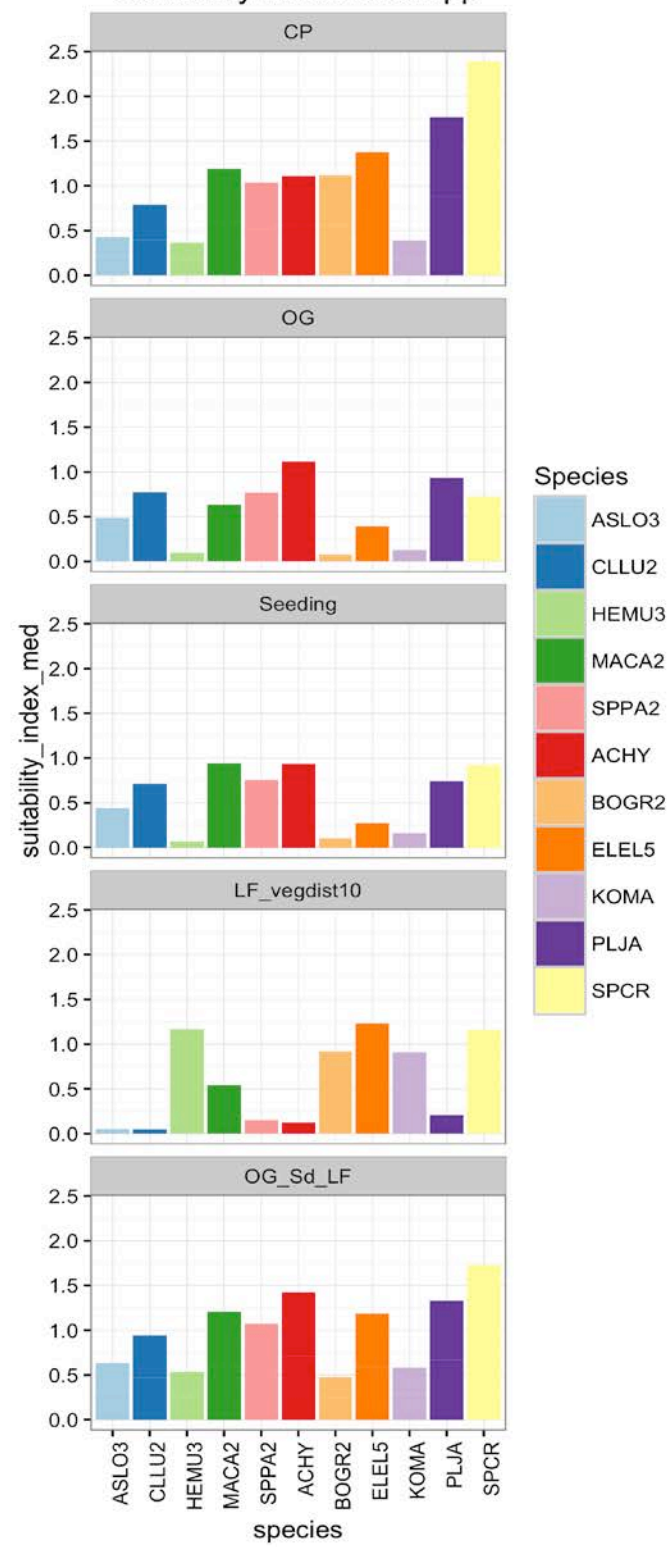
Probability of Occurrence vs. Area, all spp



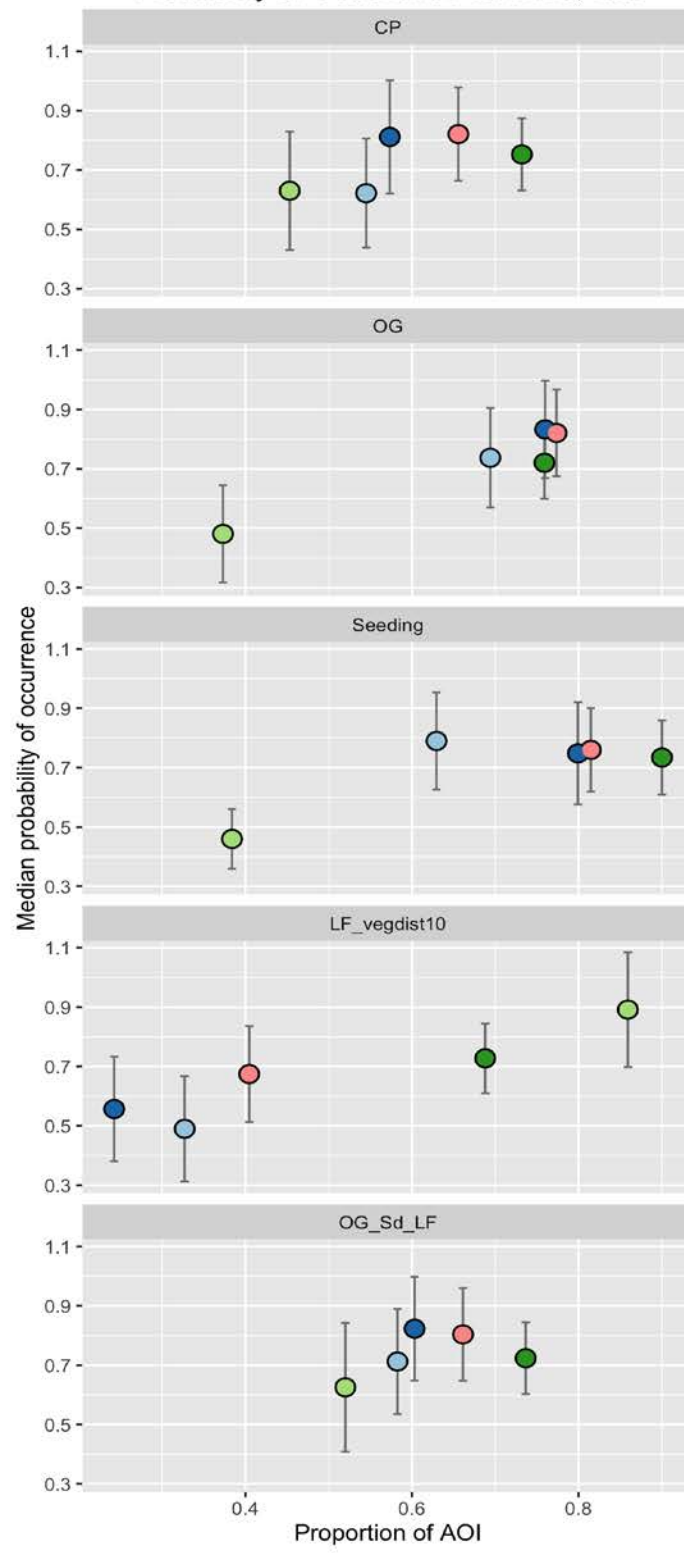
Avg: Rank-probability plot for all spp



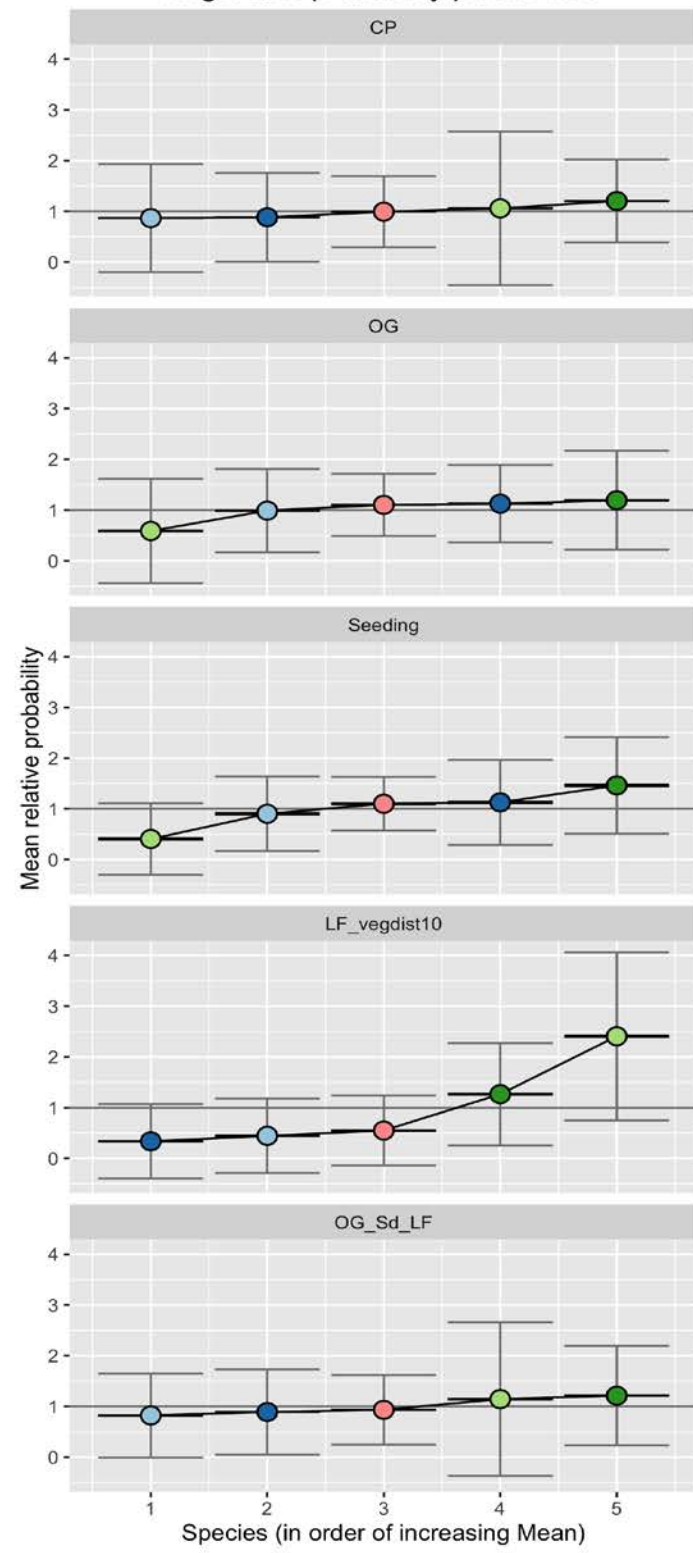
Suitability Index for all spp



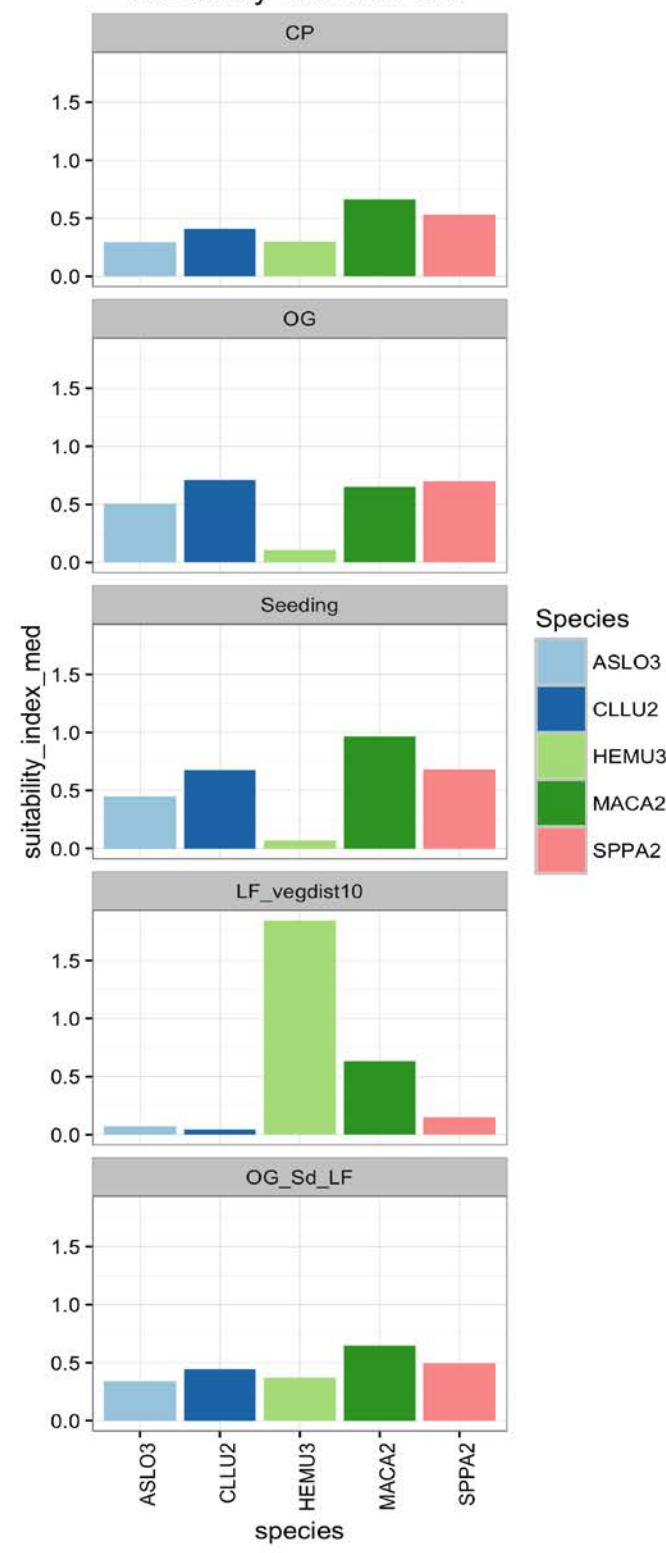
Probability of Occurrence vs. Area, forb



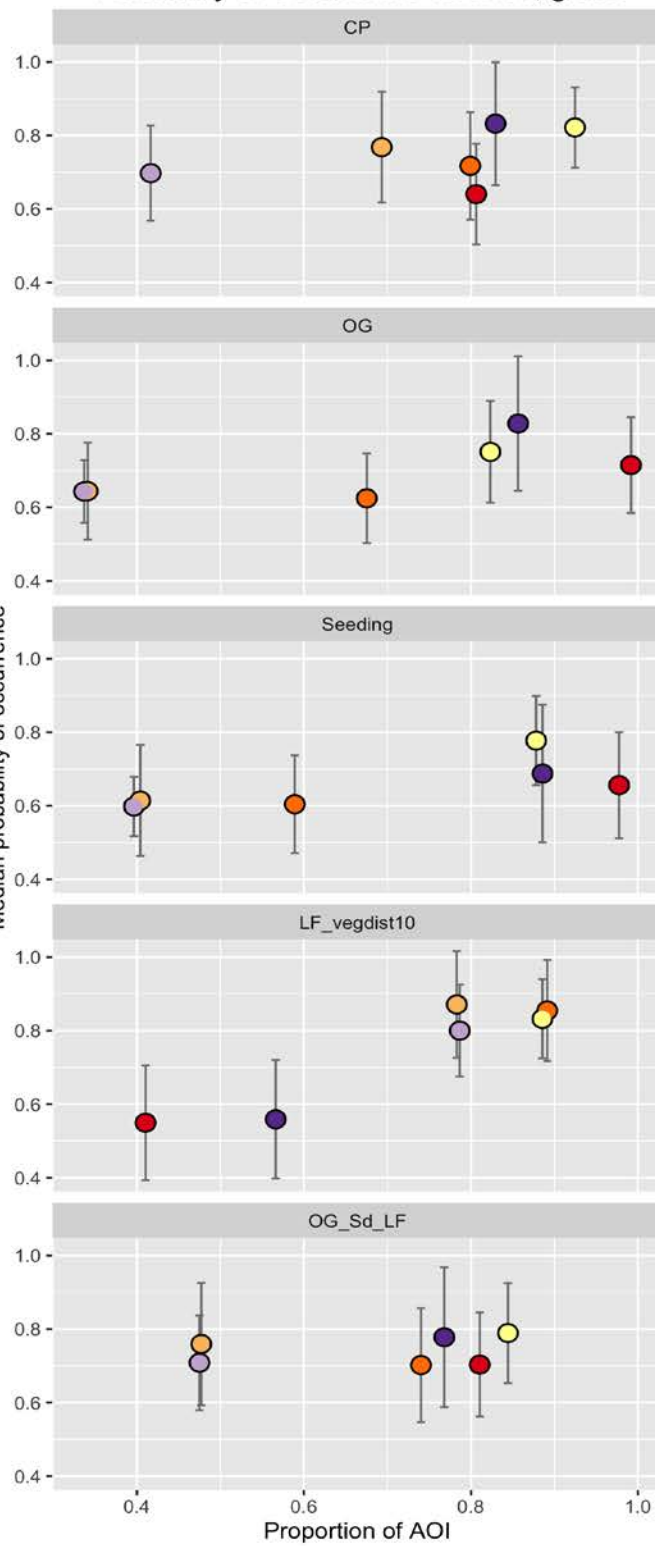
Avg: Rank-probability plot for forb



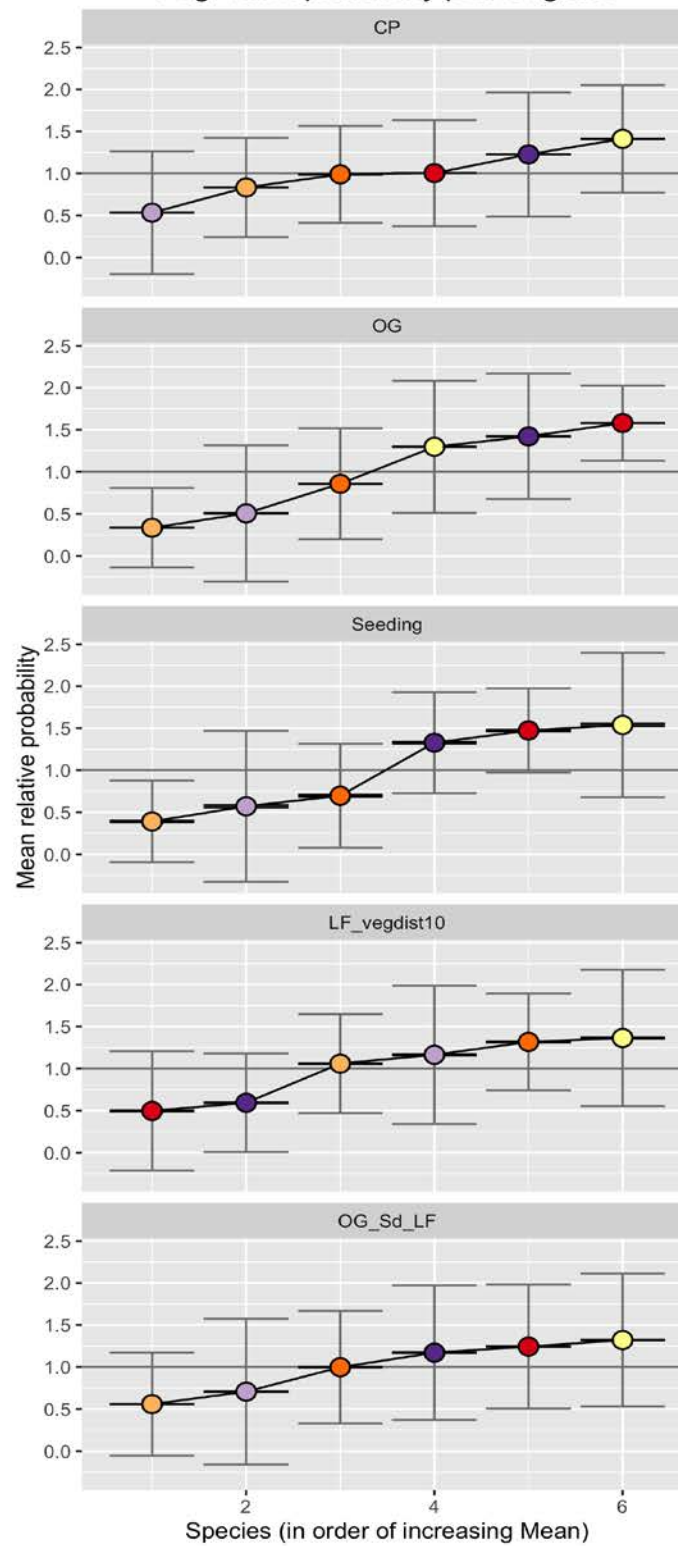
Suitability Index for forb



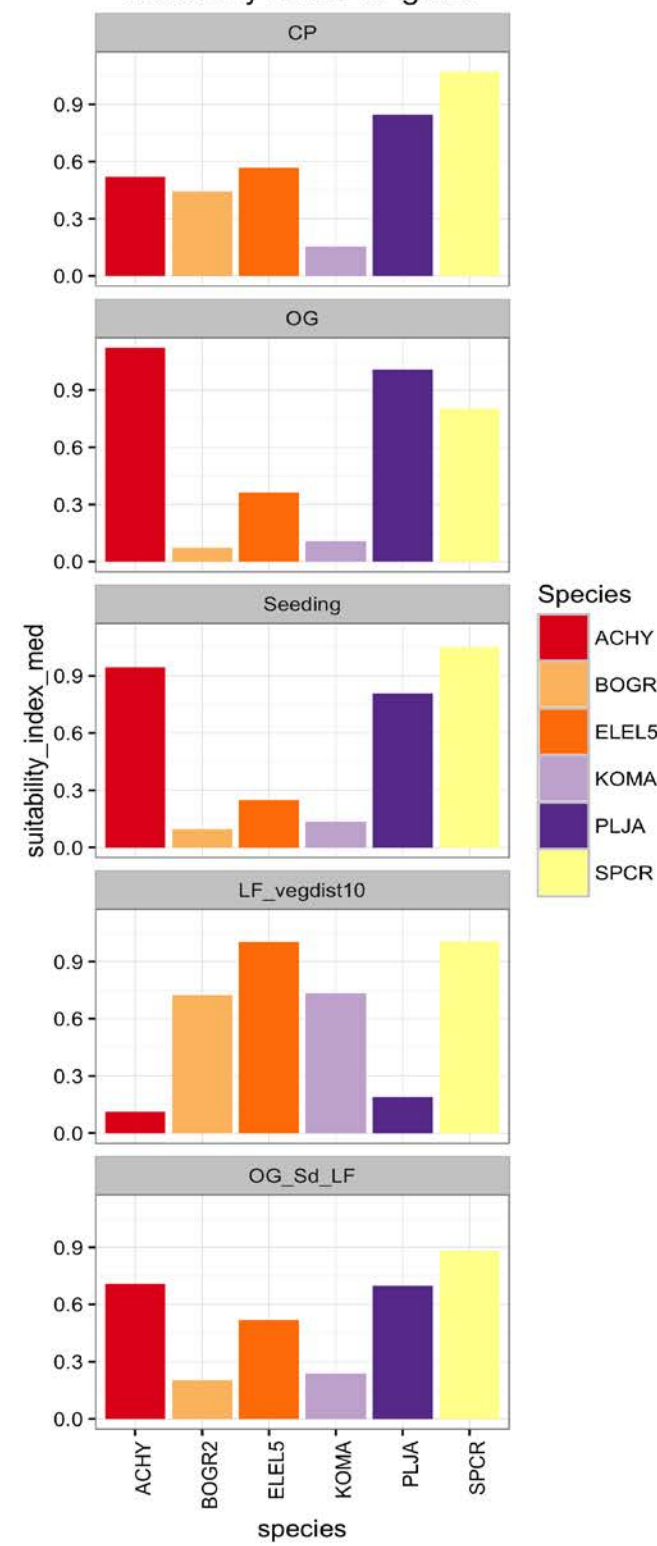
Probability of Occurrence vs. Area, grass



Avg: Rank-probability plot for grass



Suitability Index for grass



Species

- ACHY
- BOGR2
- ELEL5
- KOMA
- PLJA
- SPCR



# climate clusters x disturbance for all species, all areas of disturbance

