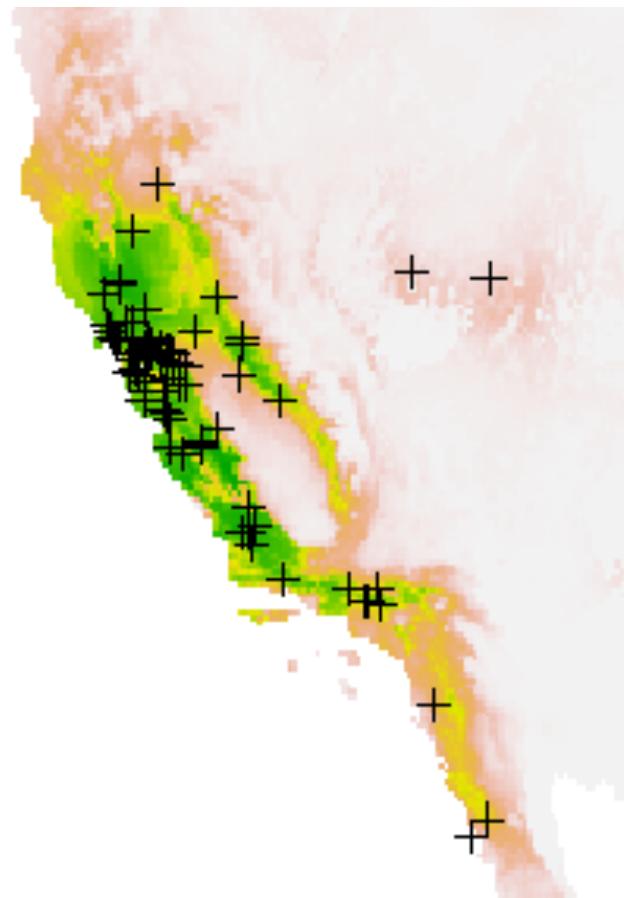


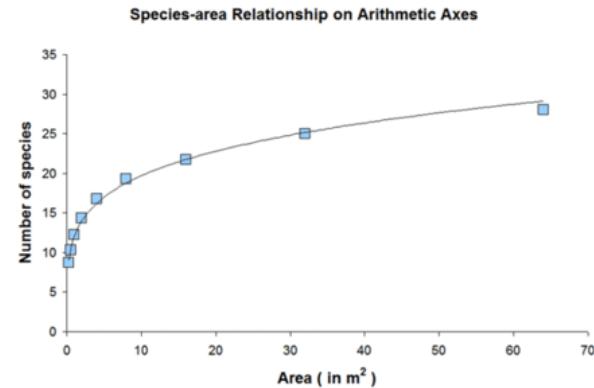
Estimating Species Climate Change Vulnerability With SDMs

Joseph Stewart



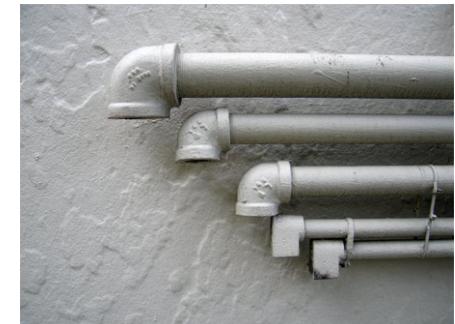
SDMs as Climate Vulnerability Tool

- Simple to interpret
- Easy to construct with already available occurrence data
- Thomas et al. 2004 approach for estimating extinction risk from climate change
 - SDMs
 - Species area relationship: $S = cA^z$



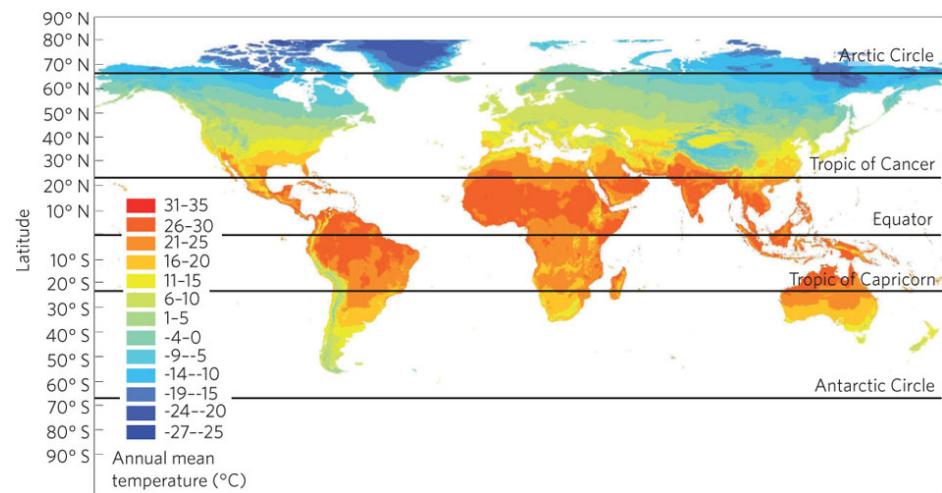
Methods

- Identified 20 potentially climate threatened species from Law's Guide to SN
- Obtained current and 2080 A2A WorldClim bioclimatic layers.
- Wrote R MaxEnt pipeline to process SDMs
- Compared current and future distribution maps to assess impact of climate change on species.



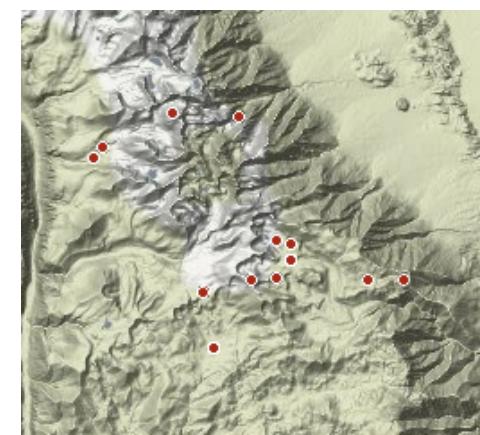
WorldClim Data Pipe

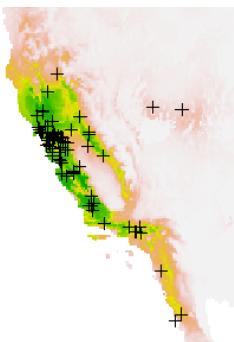
- Download ESRI bioclim layers
- Link to path
- Run import function
- That is it.



Species Occurrence Data Pipe

- Input CSV file with genus and species
- GBIF query
- Clean Data
 - Standardize species names
 - Eliminate data w/ NA or zero coordinates
 - Eliminate data w/o uncertainty
 - Eliminate data w/ uncertainty > 500 m
 - Correct longitude sign errors





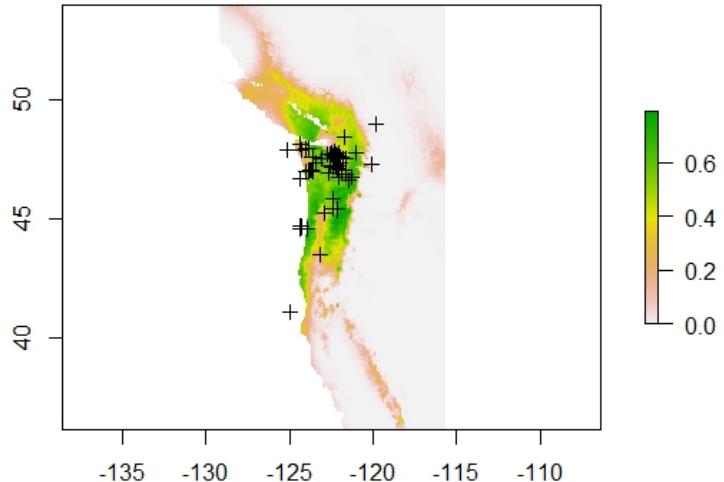
MaxEnt Pipe



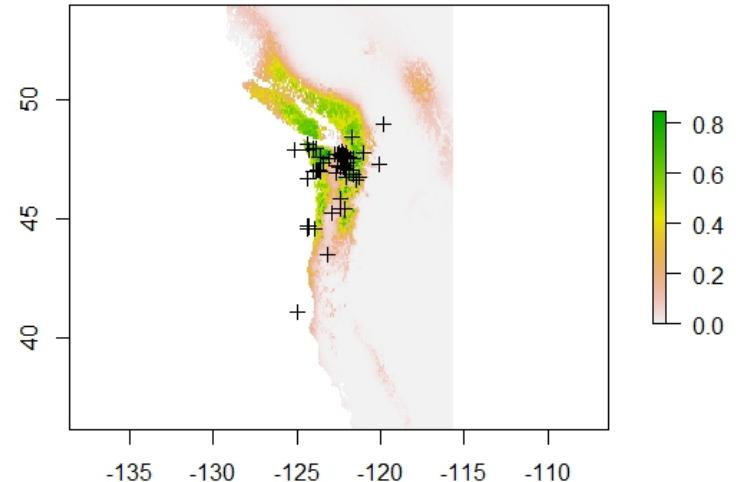
- Sets extent = taxa record extent plus 5 degree buffer.
- Processes and creates gradient and binary suitability maps for all species in current and future climates
- For binary distribution maps, sets $TPR=TNR$
- Compares current binary suitability to future binary suitability (assumes area = grid cells)
- Returns CSV file

Gradient Suitability Maps

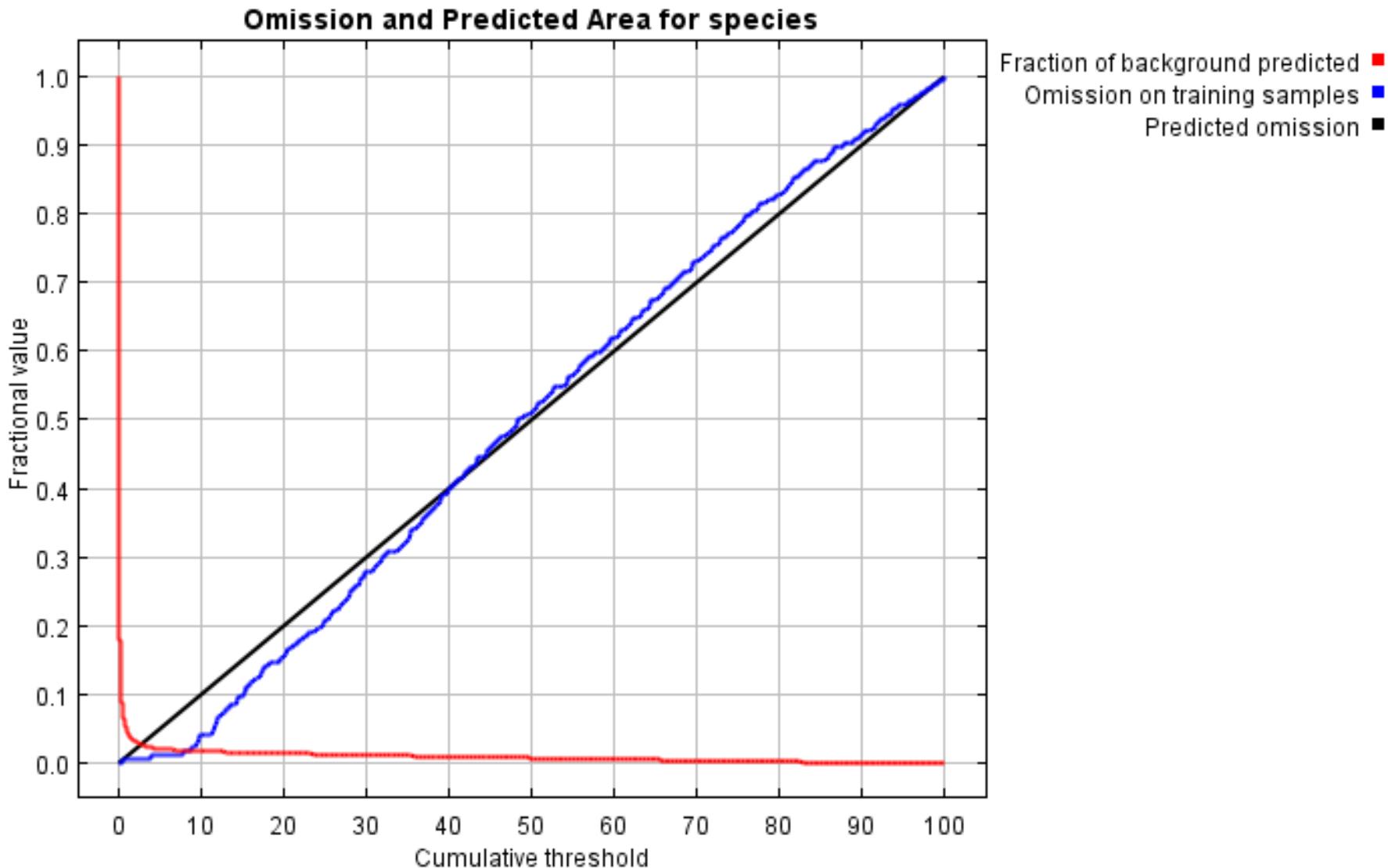
Current Habitat Suitability for *Aplodontia rufa*



Future Habitat Suitability for *Aplodontia rufa*

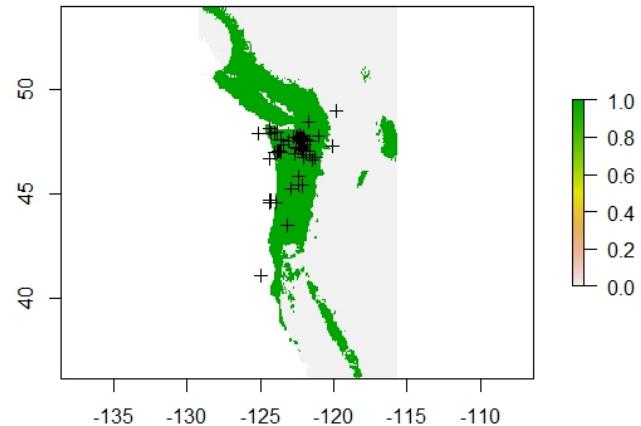


Threshold Gradients to Binary

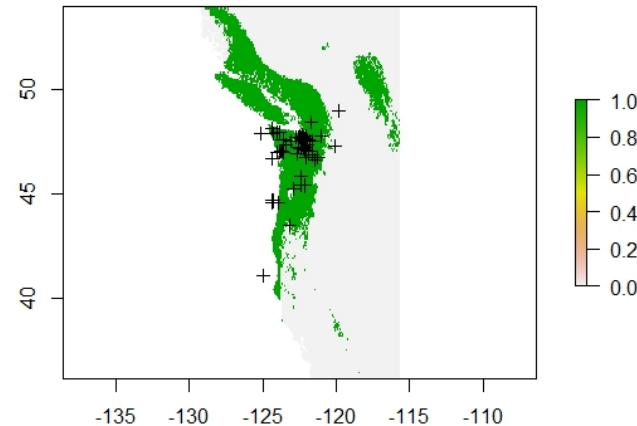


Binary Suitability Maps

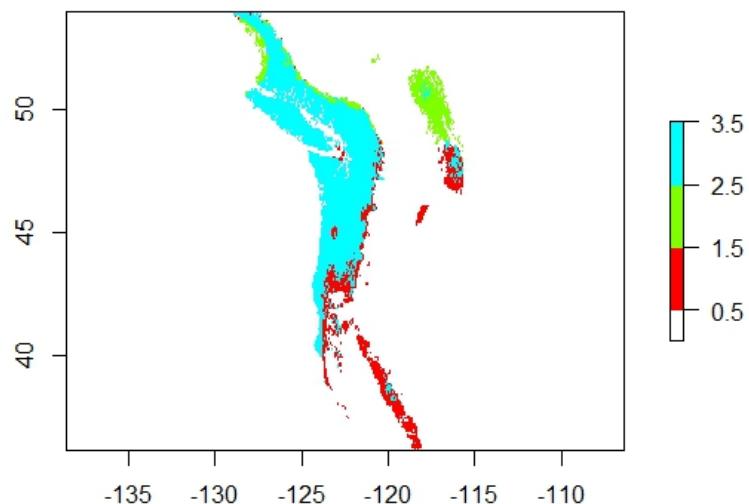
Current Habitat Suitability for *Aplodontia rufa*



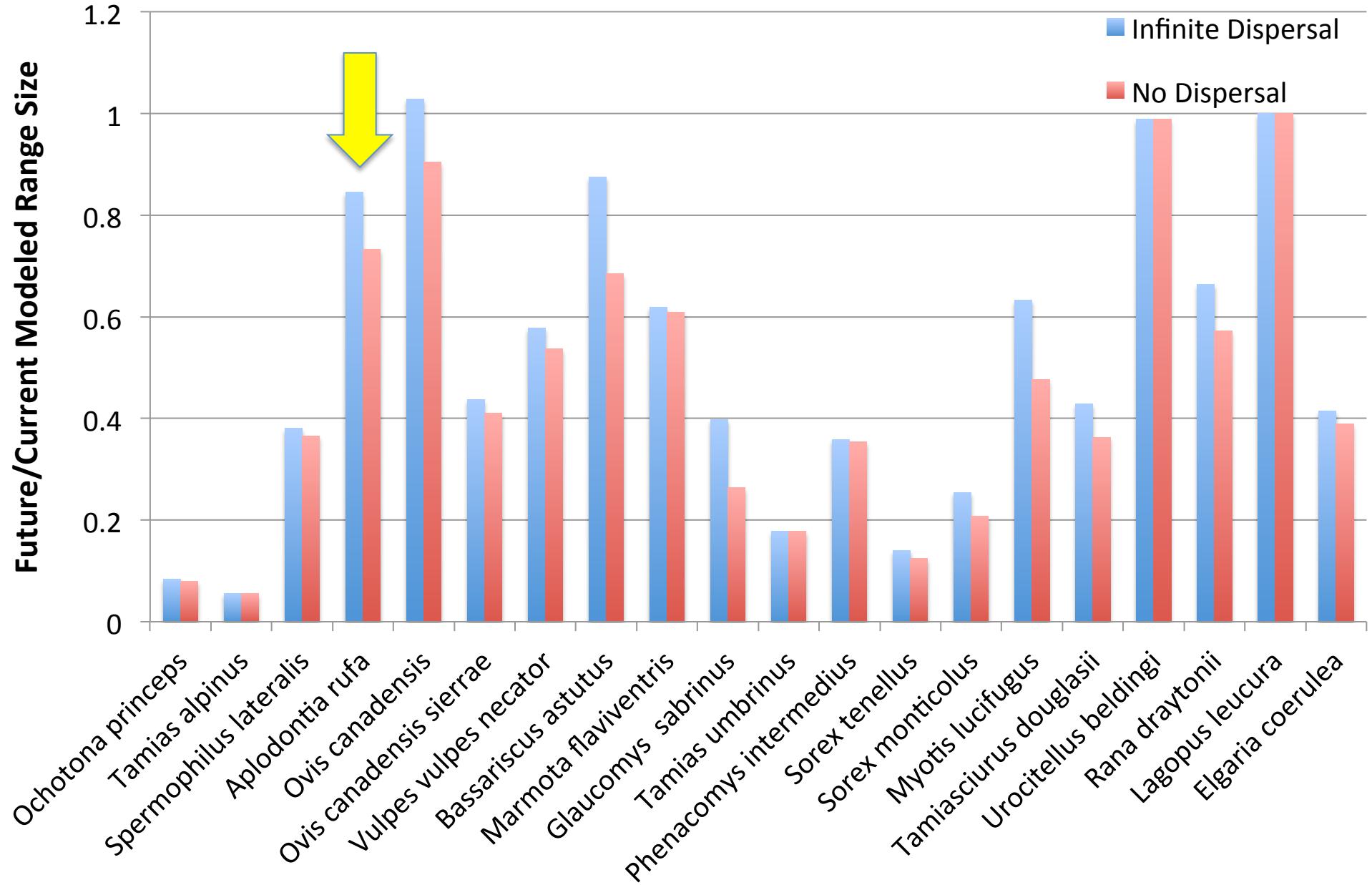
Future Habitat Suitability for *Aplodontia rufa*



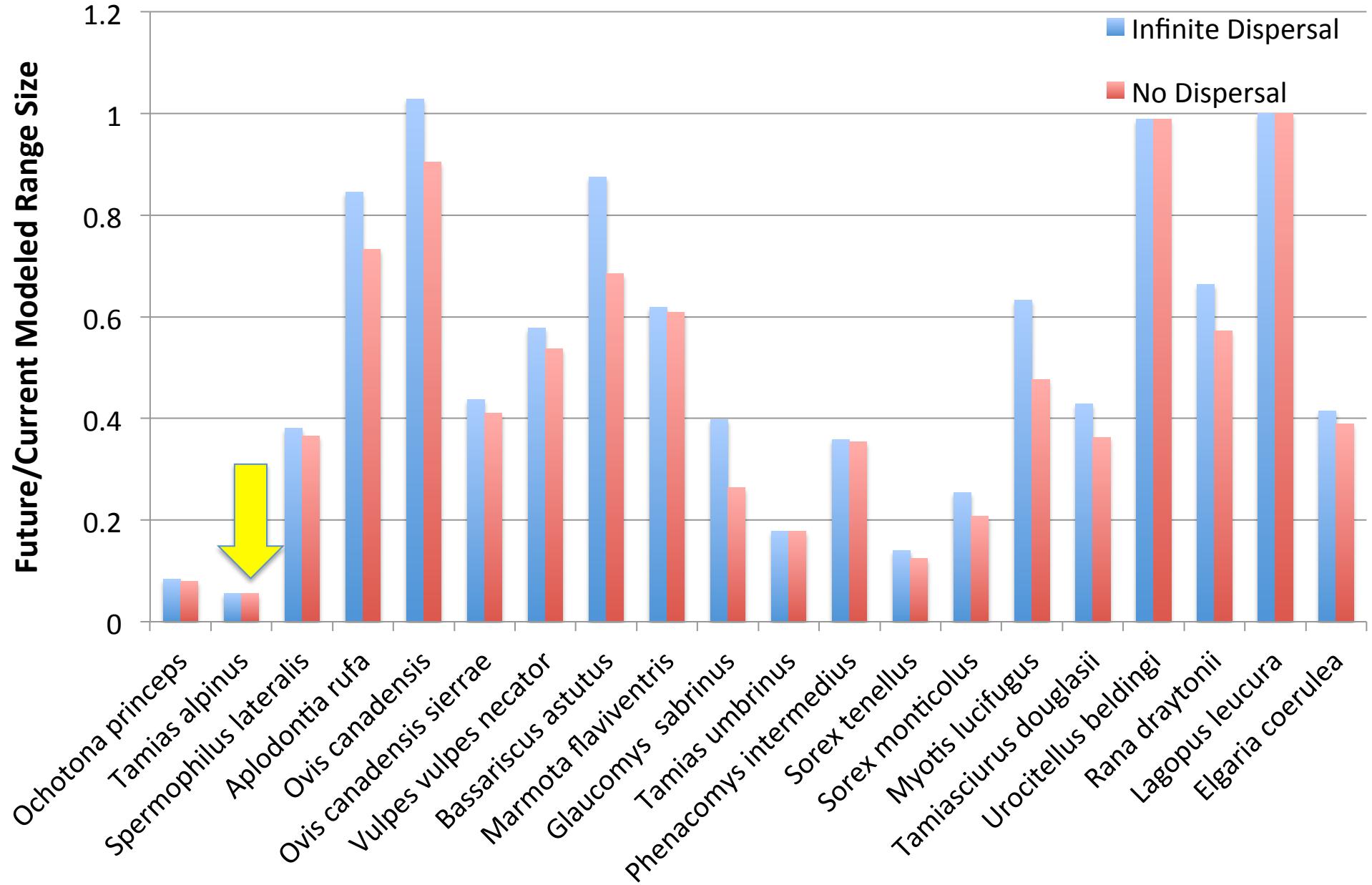
Aplodontia rufa: Red=Cur, Green=Fut, Blue=Cur&Fut



Change in Species Climate Niche, Current-2080

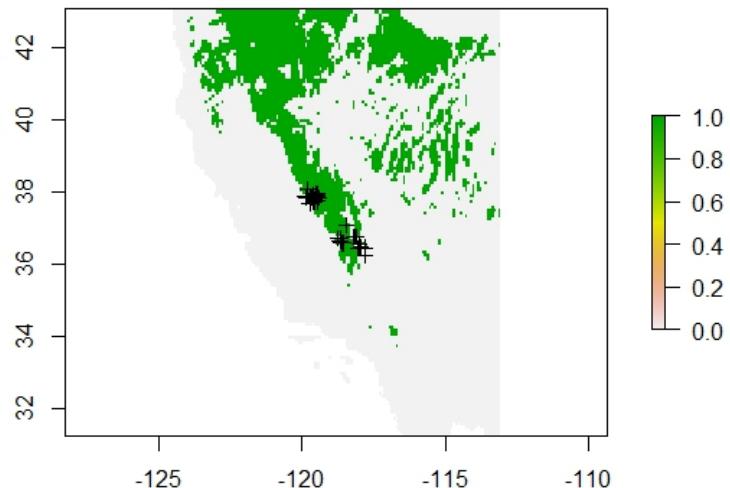


Change in Species Climate Niche, Current-2080

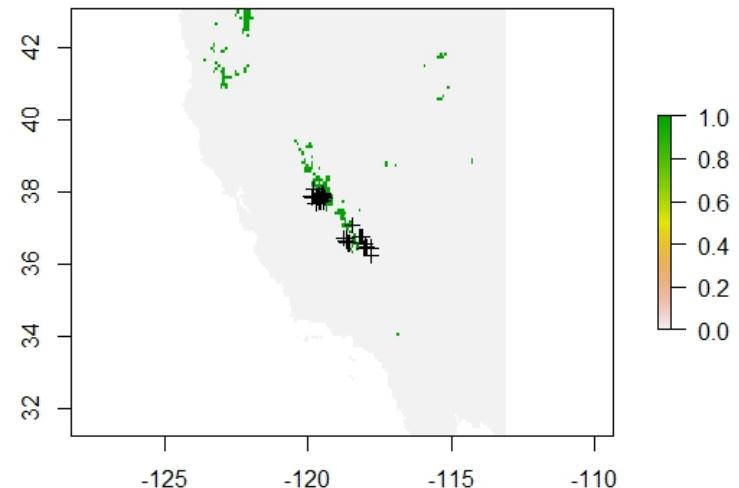


And the Winner (Loser) is...

Current Habitat Suitability for *Tamias alpinus*



Future Habitat Suitability for *Tamias alpinus*



FYI, *T. alpinus* is a bit tricky to ID in the field

- “Behaviorally, *T. alpinus* runs with its tail held horizontally, undulating it frequently; when stationary, the tail is held relatively still, with the tip not flicking up and down.”

– J. Patton



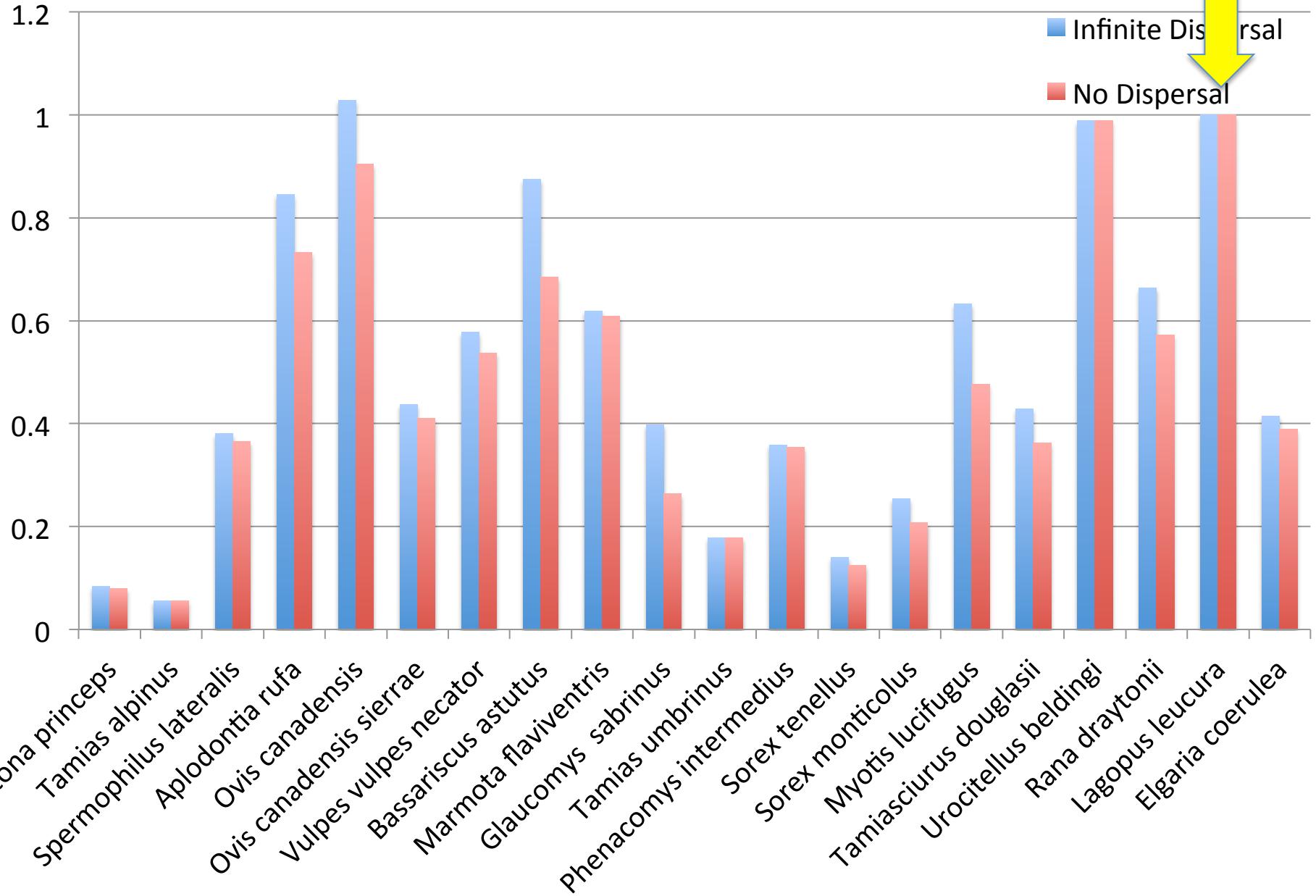
Variable	Percent contribution	Permutation importance
bio_8	36.7	37.6
bio_19	25.1	0
bio_15	14.9	1.2
bio_1	10.1	2.4
bio_3	8.2	3.9
bio_14	1.4	0.1
bio_11	0.9	9.8
bio_18	0.9	26.2
bio_4	0.6	18.6
bio_16	0.4	0
bio_12	0.3	0
bio_5	0.2	0
bio_17	0.2	0.1
bio_7	0.1	0
bio_2	0	0
bio_13	0	0
bio_10	0	0
bio_6	0	0



T. alpinus

Change in Species Climate Niche, Current-2080

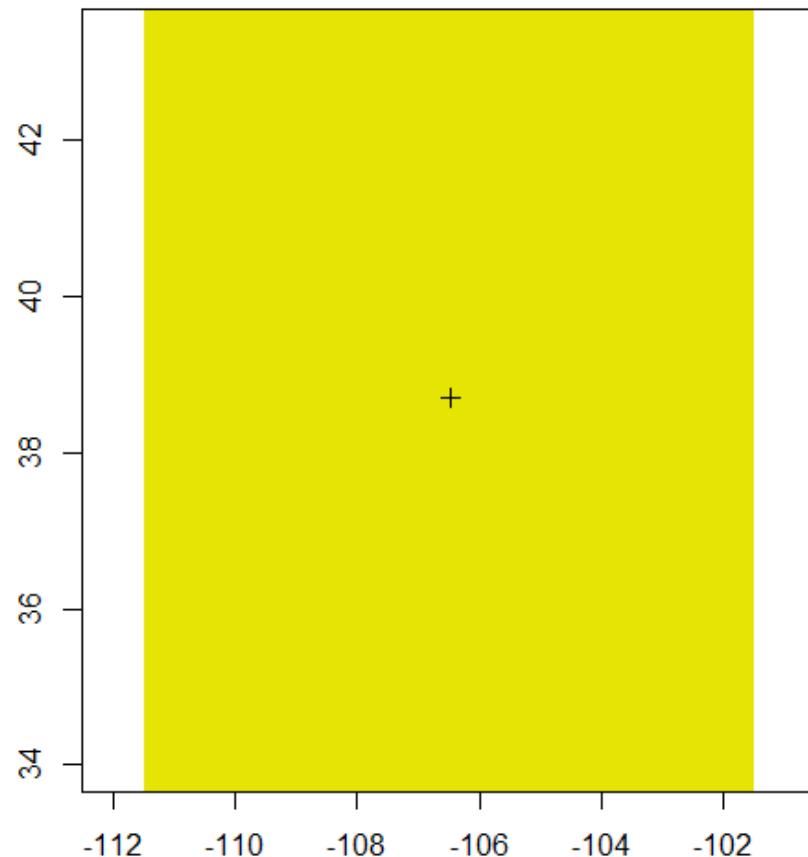
Future/Current Modeled Range Size



Only one cleaned record for White-tailed Ptarmigan

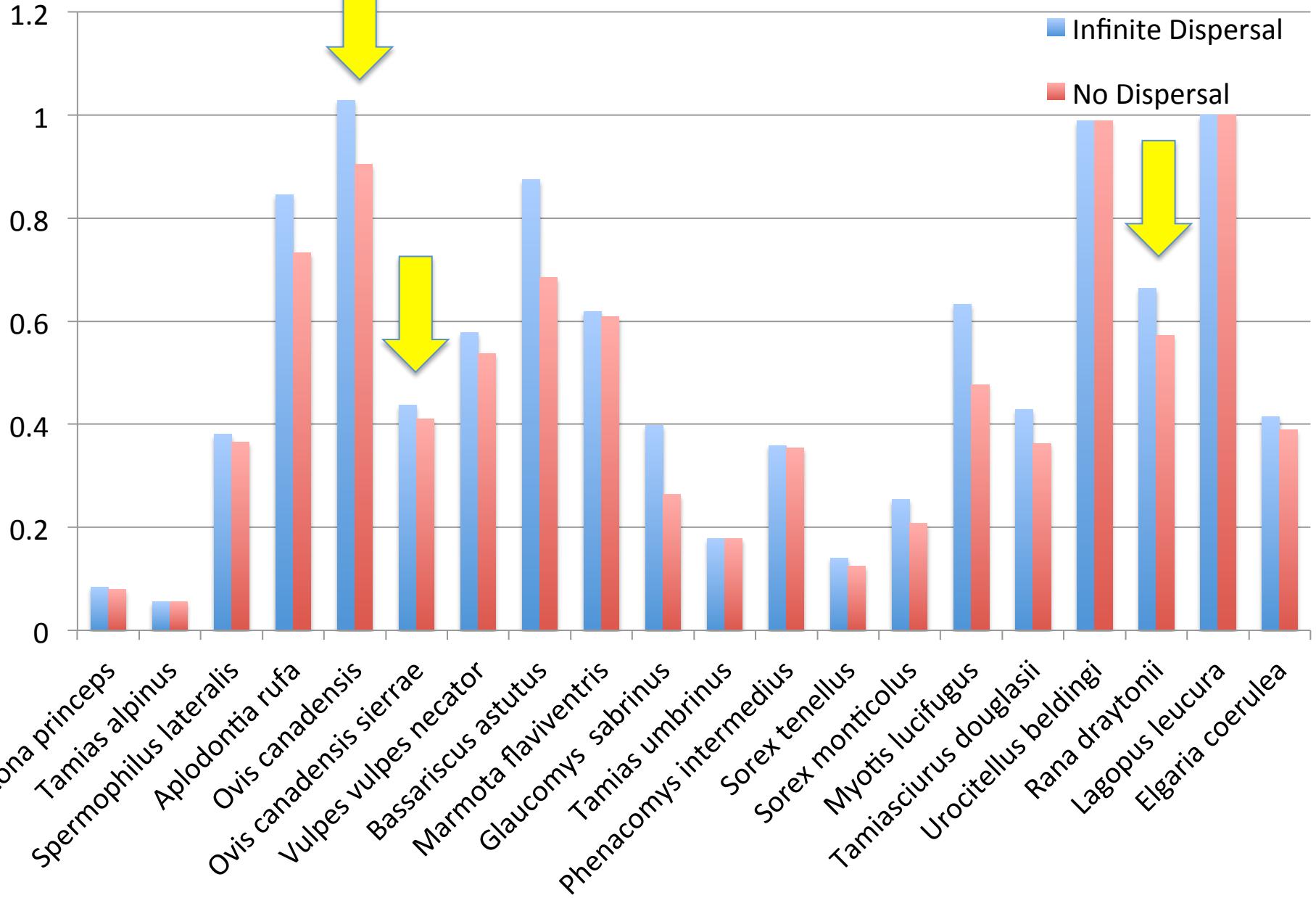


Future Habitat Suitability for *Lagopus leucura*



Change in Species Climate Niche, Current-2080

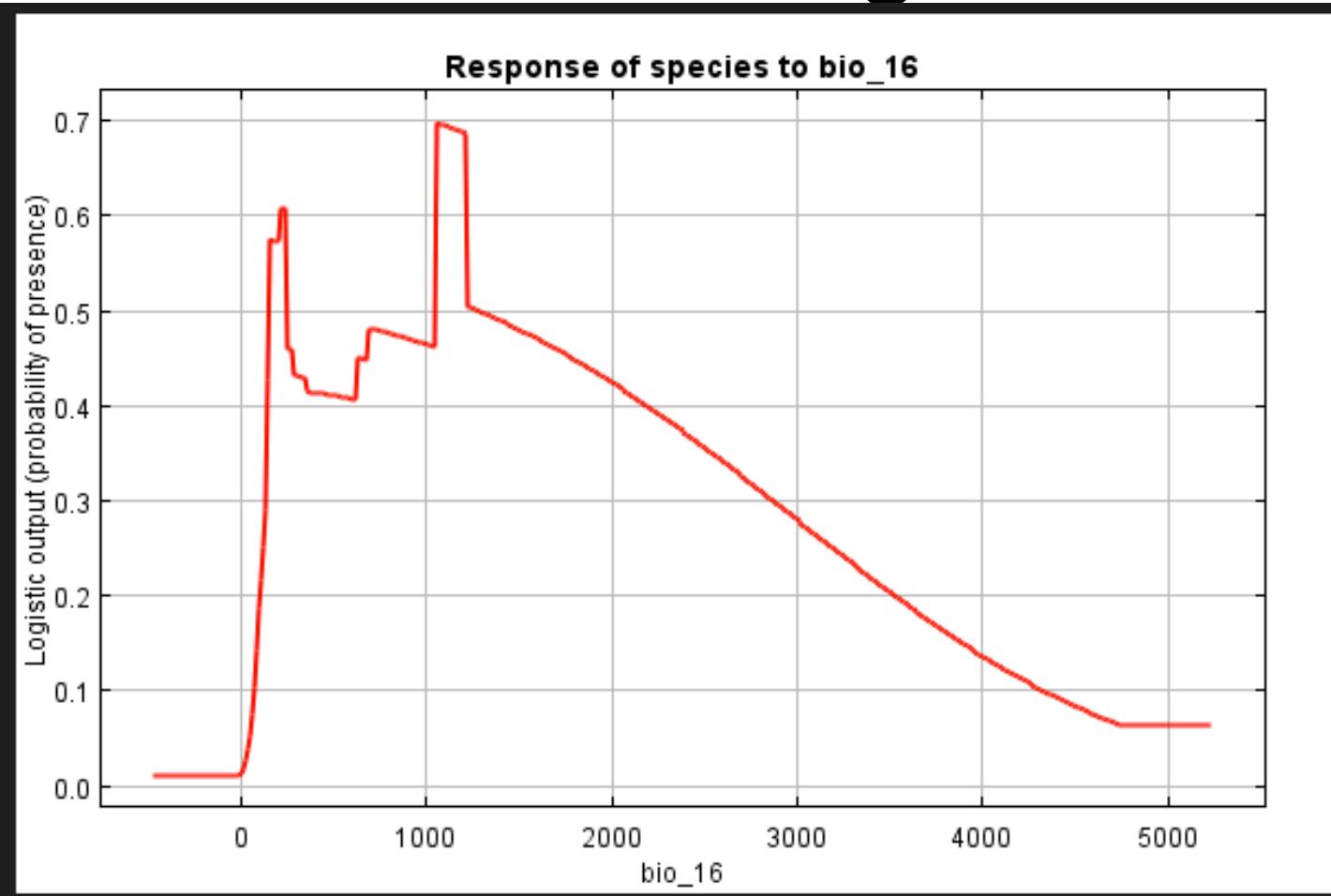
Future/Current Modeled Range Size



Issues with SDMs (generally & the ones I ran) and Climate Forecasting

- Models should attempt to incorporate bias in detection effort
- SDMs overwhelmingly predict range contraction. Realistic? Which species will be winners?
- Spatial Autocorrelation
- Validation with spatially autocorrelated samples
- Overfitting
- High climate uncertainty, esp. at high elevations, but uncertainty not yet incorporated
- Models need to incorporate non-climate environmental factors (e.g. soil)
- Models need to incorporate temporal data from occurrence records
- Grain, Detection Bias, Novel Climate Space, Data Quality...

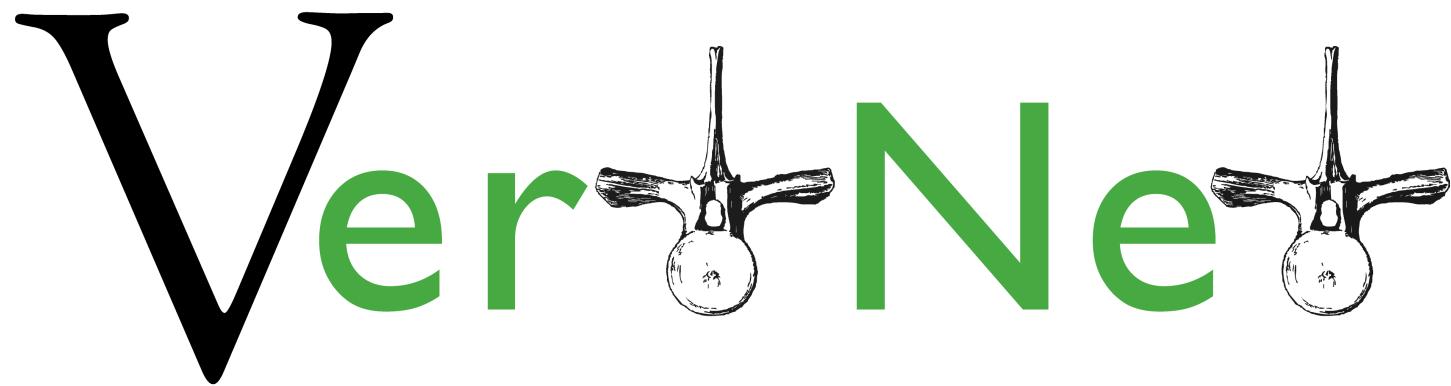
Overfitting



- But, R. Hijmans rumors solution in dismo package...

Thanks

VerNe

The word "VerNe" is written in a large, bold, black font. The letters "e" in both "Ver" and "Ne" are replaced by black and white illustrations of vintage-style light fixtures. Each fixture features a single bulb hanging from a curved arm, with two thin branches extending upwards from the base.

