Natural History and Distribution of Telesonix jamesii

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Ecology and Evolutionary Biology

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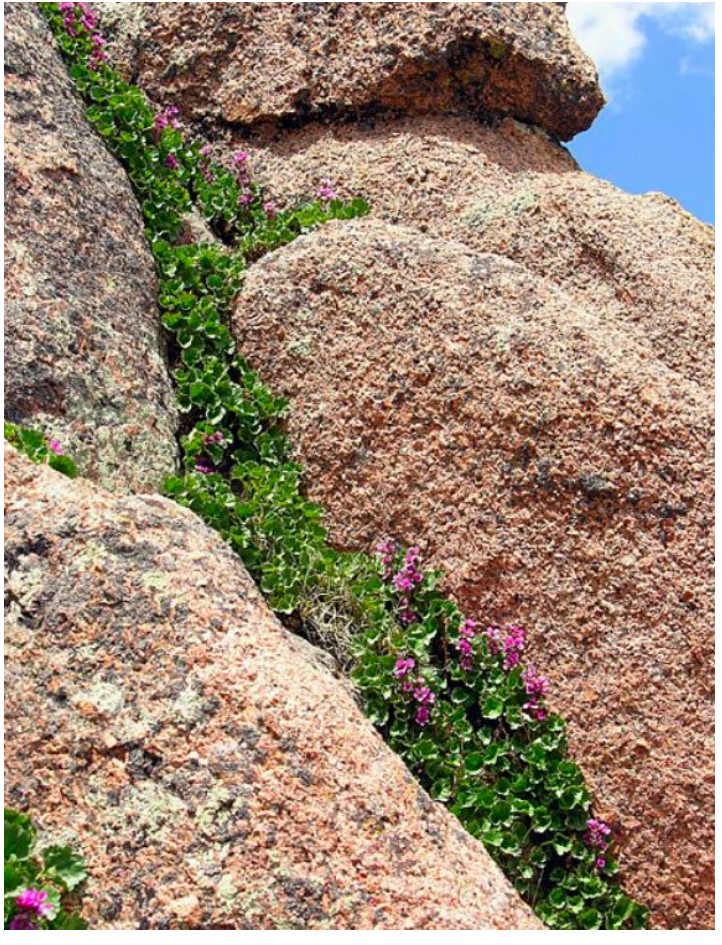
COLLEGE OF ARTS AND SCIENCES

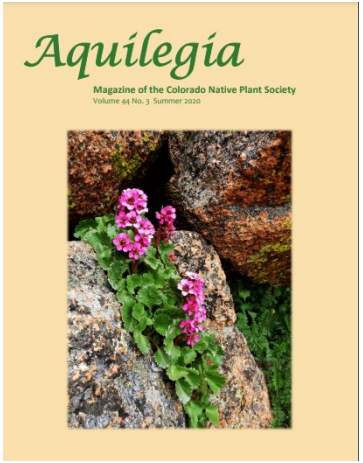
A Charismatic Chasmophyte

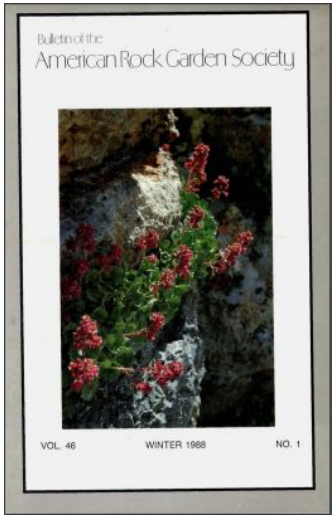
- Chasmophytes are plants that grow out of the crevices in rock



A Charismatic Chasmophyte

- *Telesonix jamesii* (Jame's False Saxifrage or "TELJAM")
  - Grows from montane to alpine (4,184 m)
  - Grows on boulders and granite tors in dry open areas
    - Conditions more common above treeline
    - G2/G3
  - Significant gaps in the literature (Gornall and Bohm 1985, Beatty et al. 2004)
    - Reproductive biology
    - Distribution modeling

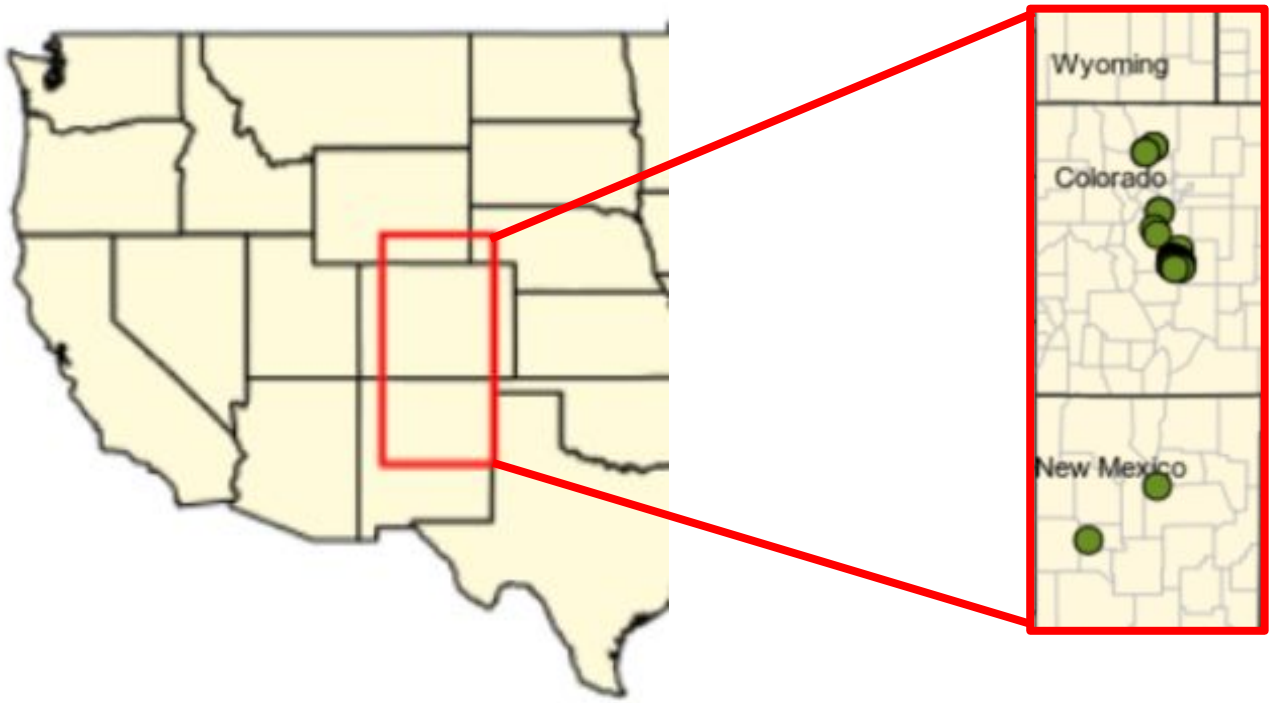


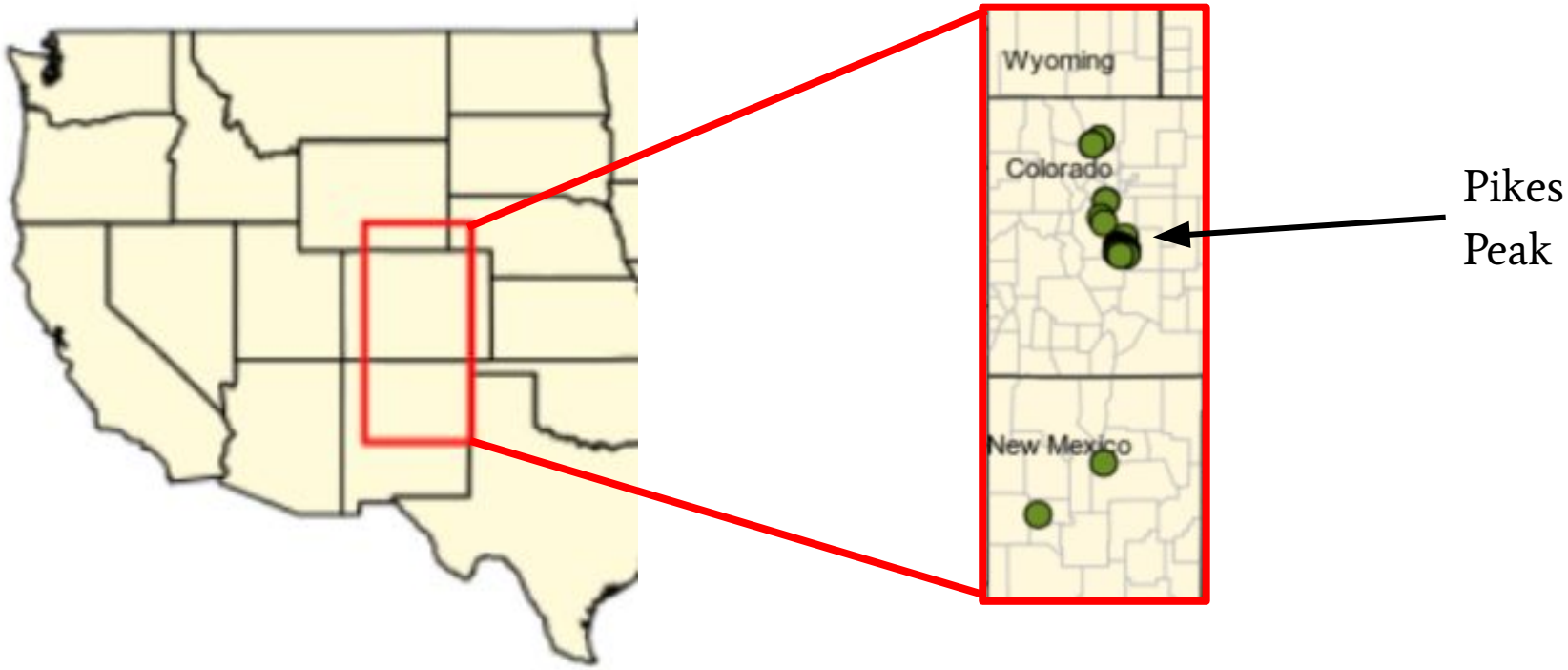


Thesis Objectives

Chapter One: Investigate the Pollination Ecology of *T. jamesii*

Chapter Two: Model the potential distribution of *T. jamesii* with considerations for different data sources


Wyoming
Colorado
New Mexico


Wyoming
Colorado
New Mexico
Pikes
Peak

Pollinator Surveys

Objectives

1. What animals visit *T. jamesii* flowers?
2. Are these effective pollinators?
3. How does species richness compare between effective pollinators and total pollinators?

Pollinator Surveys - Methods

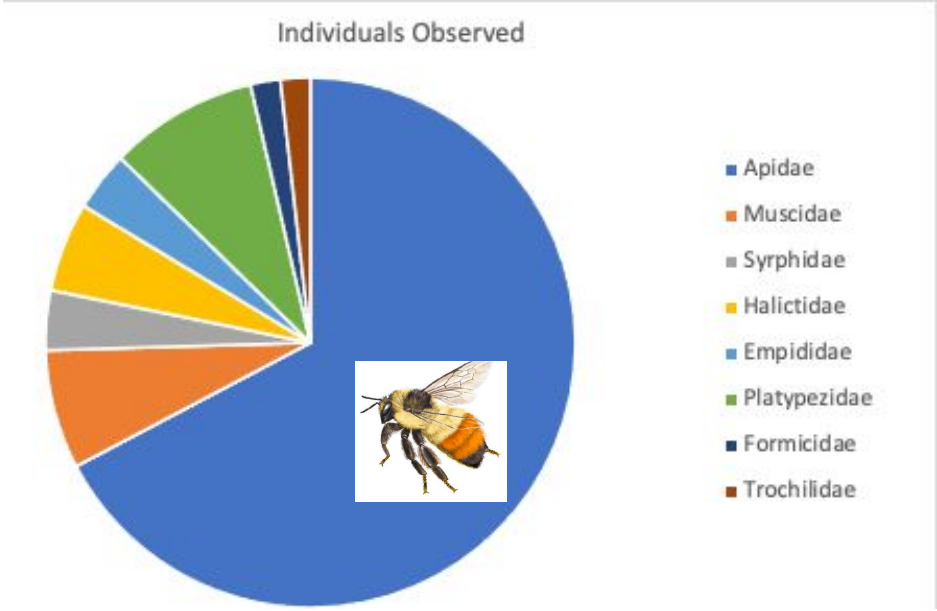
- Summer of 2020
- 20 minute rate observations across multiple sites on Pikes Peak
- Observations were carried from June to August
- Floral visitors collected in the field and brought back to lab for identification

Pollinator Surveys - Results

- A total of 55 floral visitors (19 species) visited *T. jamesii* across 900 minutes of observation
    - Average of one visitation every 16.4 minutes

Pollinator Surveys - Results

- A total of 55 pollinators (19 species) visited *T. jamesii* across 900 minutes of observation
  - Average of one visitation every 16.4 minutes
- Apidae was the most frequently collected family
  - Primarily *Bombus* - 7 different species
    - *B. balteatus*
    - *B. bifarius*
    - *B. centralis*
    - *B. flavifrons*
    - *B. huntii*
    - *B. melanopygus*
    - *B. sylvicola*



Pollinator Effectiveness - Methods

- *T. jamesii* pollen must was identified, described, and distinguished from closely related species

Pollinator Effectiveness - Methods

- Pollen loads from each individual was mounted on glycerine slides
  - Used a fine point artists brush
  - Pollen only taken from body parts where it could be later deposited
- Slides were then scanned systematically for any pollen grains that matched *T. jamesii*

Pollinator Effectiveness - Results

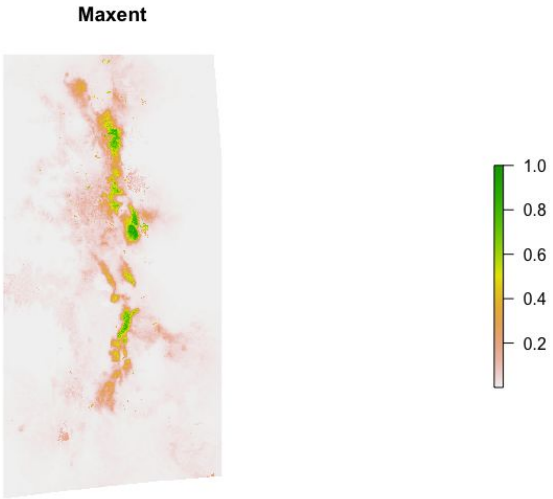
Top: *B. huntii* Bottom: *B. bifarius*

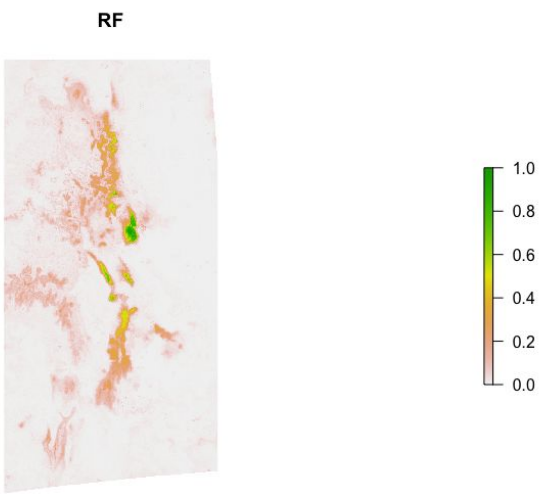
- Conspecific pollen only found on 3 species
  - *Bombus bifarius*
  - *Bombus sylvicola*
  - *Bombus huntii*

Conclusions

- *T. jamesii* is visited by a generalized group of birds and insects
- Bumble bees were the major pollinators of *T. jamesii*
- *T. jamesii* pollen is inefficient at attaching to pollinators
  - The fuzzy bodies of *Bombus* could be more adapted for carrying such pollen grains
  - Primarily vegetative reproduction - minimal pollination to maintain geneflow

Using Herbarium and iNaturalist Data to Model the Distributions of *Telesonix jamesii*





- Great urgency for identifying and protecting habitat for rare species
  - But rare species can be some of the most difficult to model
    - “The rare species modeling paradox” (Lomba et al. 2010)

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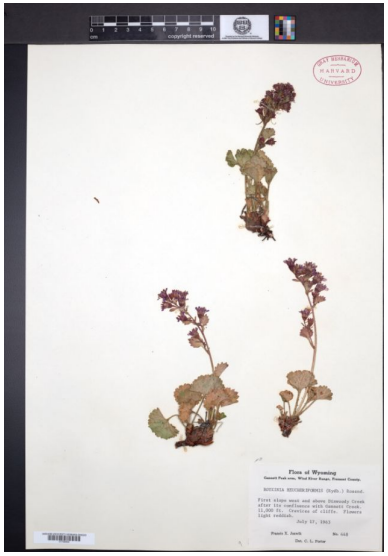
- Limited occurrence data

iNaturalist Data

- iNaturalist is another source for presence-only data
  - Users upload species observations
  - Not as reliable as herbaria data
    - Misidentification
    - Incorrectly uploading species data
    - Sample selection bias

Activity

andrewggaier suggested an ID — Improving 2y

James's False Saxifrage
Telesonix jamesii

Compare

jackerfield suggested an ID — 2y

James's False Saxifrage
Telesonix jamesii

jresasco commented — 2mo

Location looks off

Here, we used a combination of herbarium and iNaturalist records, as well as five different modeling techniques, to address the challenges of developing SDMs for rare species and propose an approach for overcoming these challenges

Methods - Occurrence Data

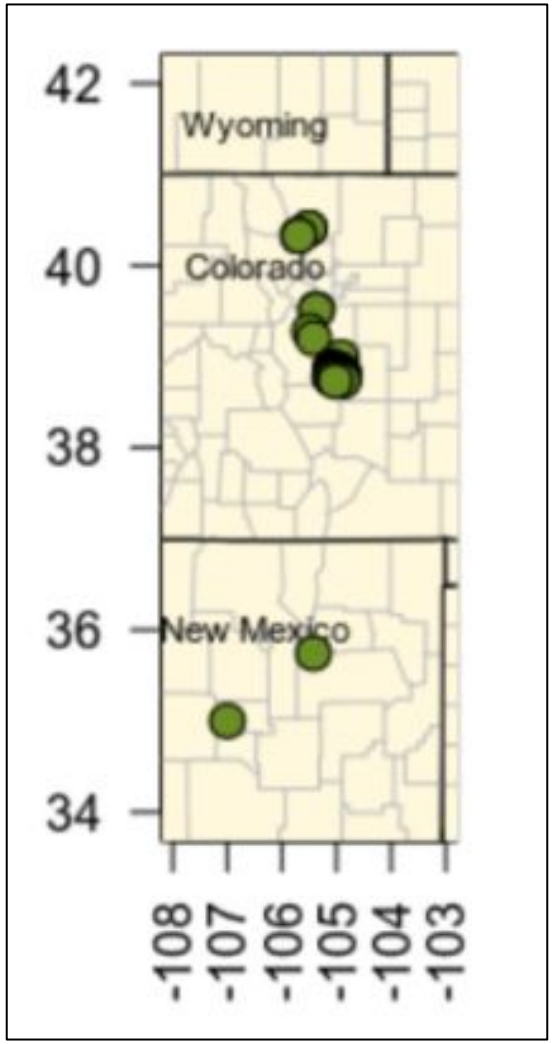
Presences downloaded from iNaturalist and SEInet and then thinned

- 53 herbarium, 36 iNat

Psuedo-absences generated across study extent

SEINet

iNaturalist


42
40
38
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34
Wyoming
Colorado
New Mexico
-108
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-106
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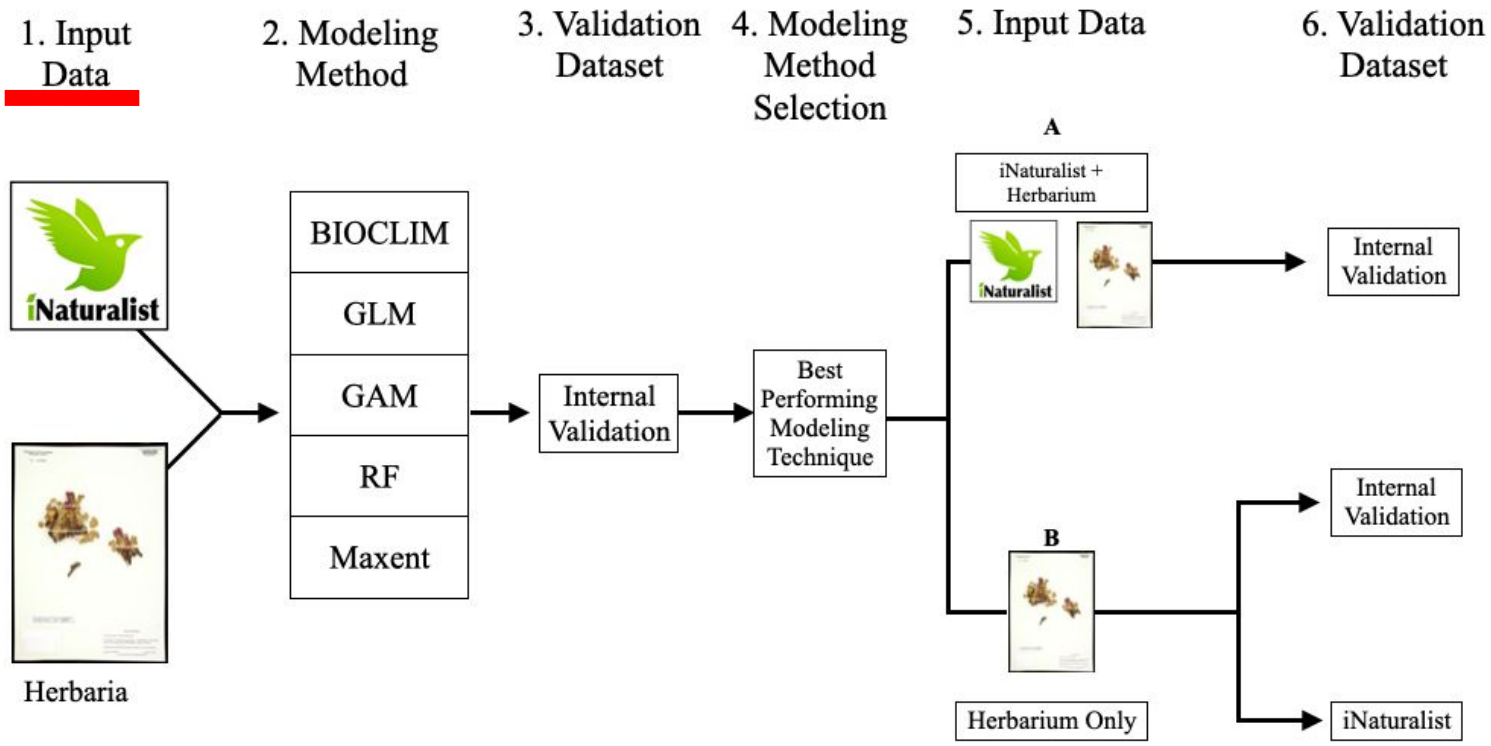
-103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2. Modeling Method
3. Validation Dataset
4. Modeling Method Selection
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iNaturalist
Herbaria
BIOCLIM
GLM
GAM
RF
Maxent
Internal Validation
Best Performing Modeling Technique
A
iNaturalist + Herbarium
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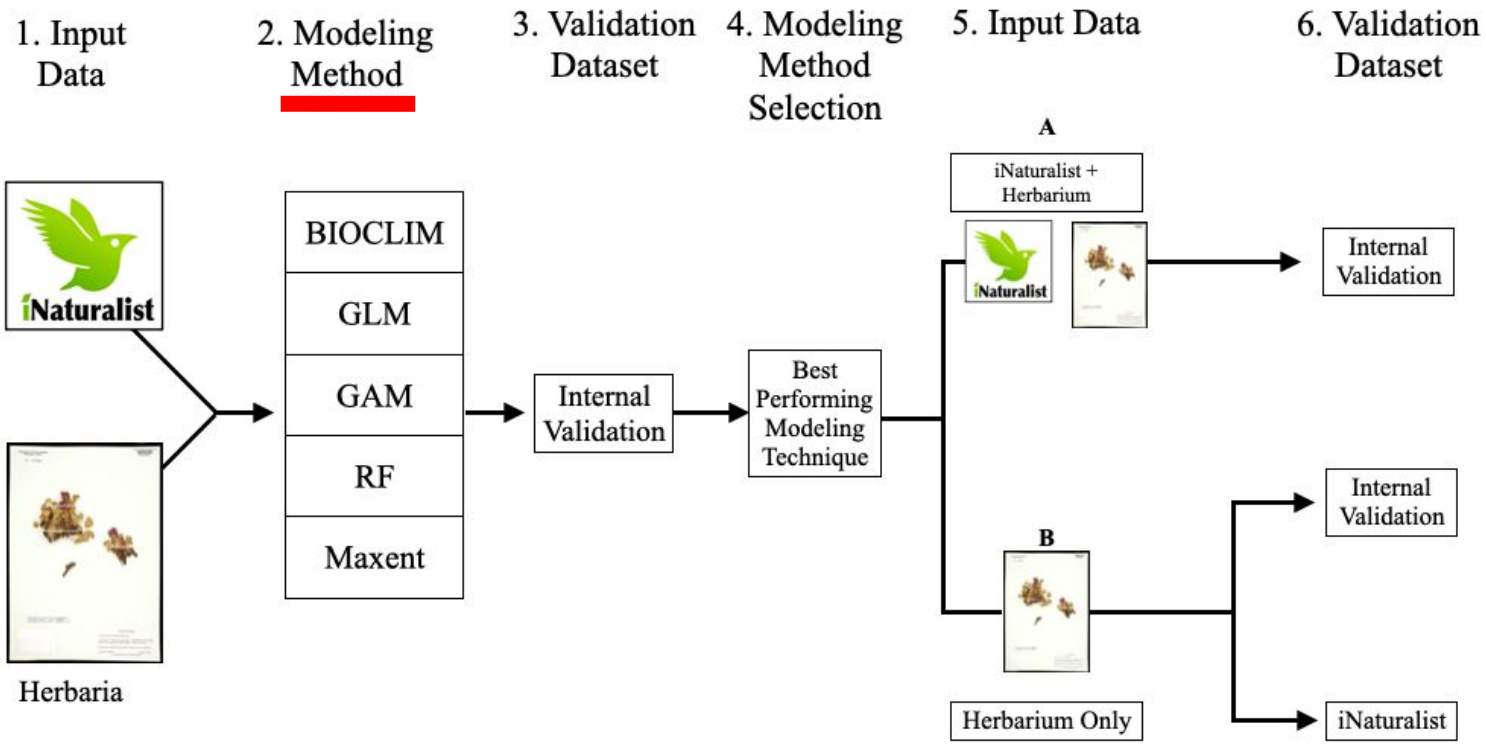
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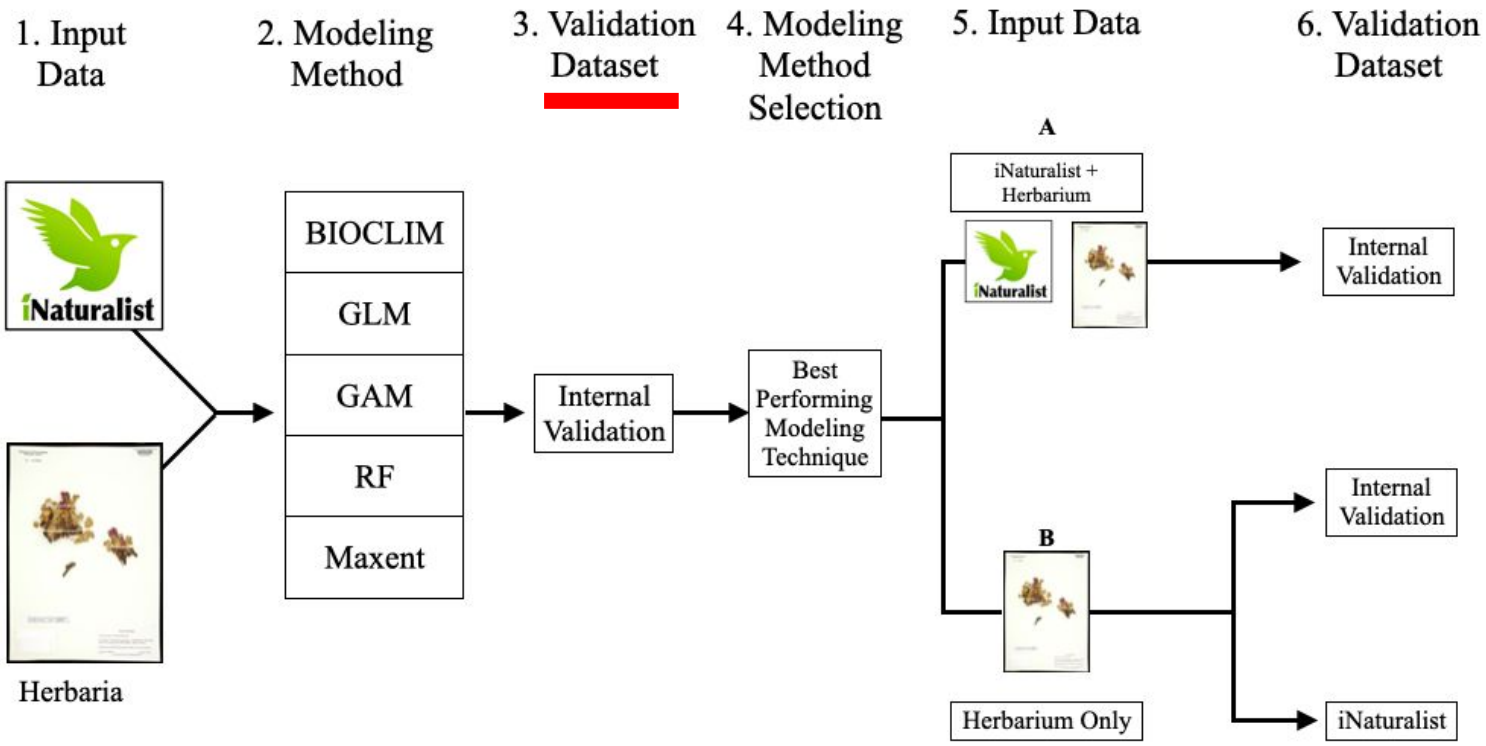
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Model	AUC	TSS	Threshold
Bioclim	0.968	0.761	0.020
GLM	0.981	0.905	0.079
GAM	0.964	0.883	0.386
RF	0.990	0.939	0.135
Maxent	0.977	0.932	0.330

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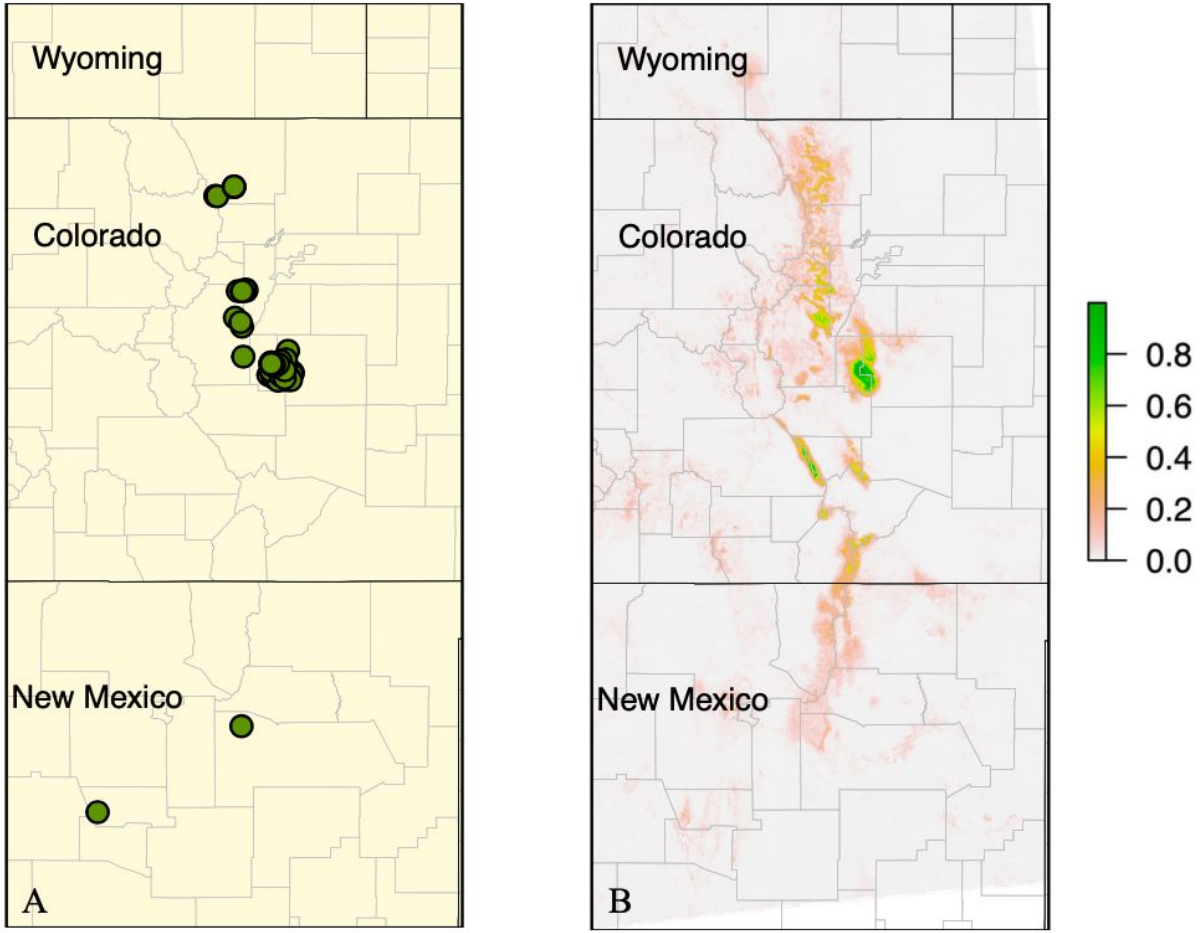
Wyoming
Colorado
New Mexico
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Wyoming
Colorado
New Mexico
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0.6
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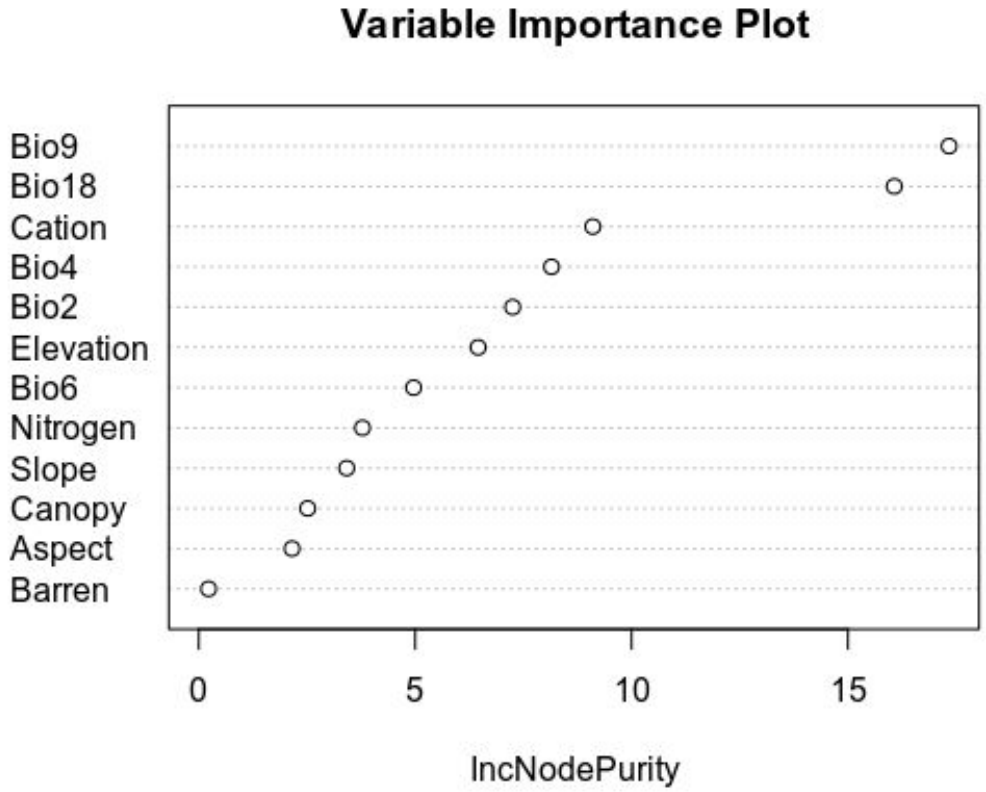
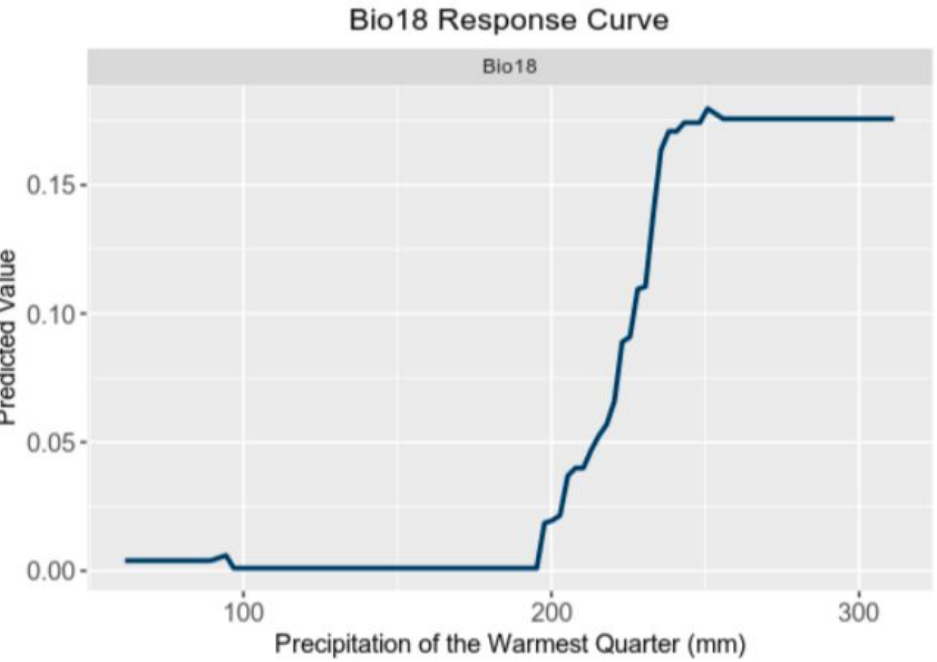
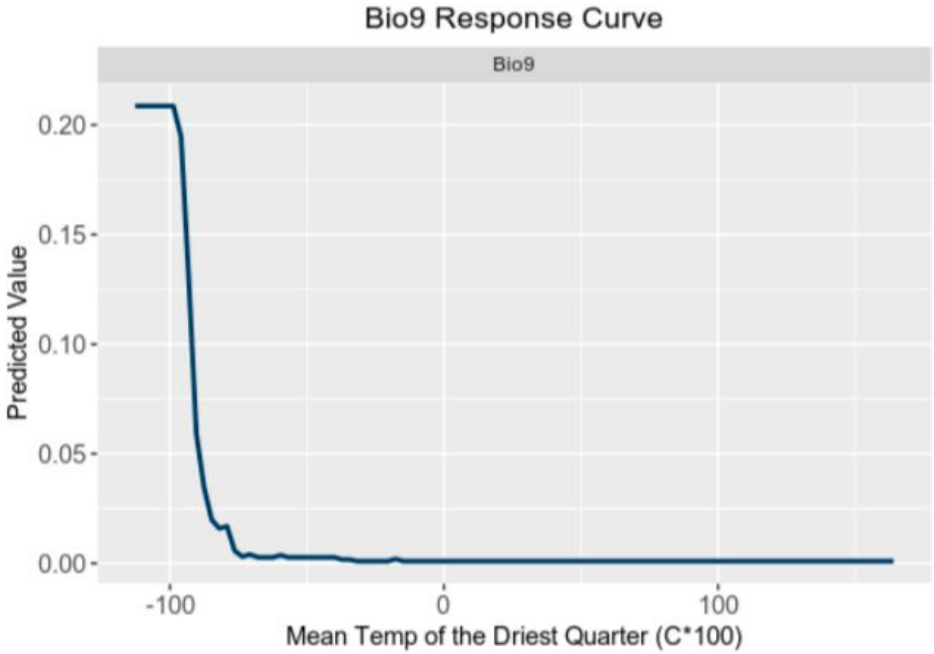
0.0

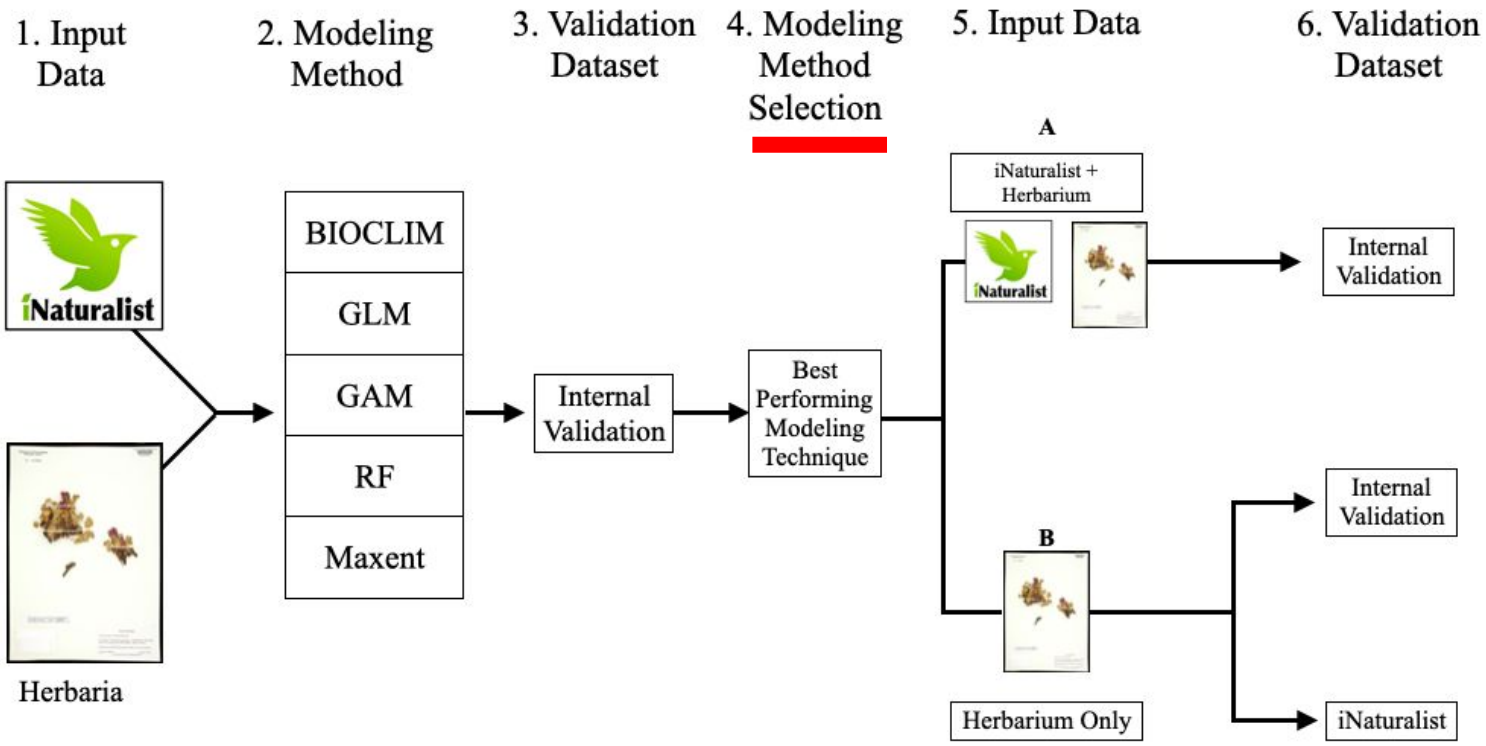


Bio9 (mean temperature of driest quarter) and Bio18 (precipitation of warmest quarter)





T. jamesii is preferably distributed in areas with high summer rainfall and colder temperatures during winter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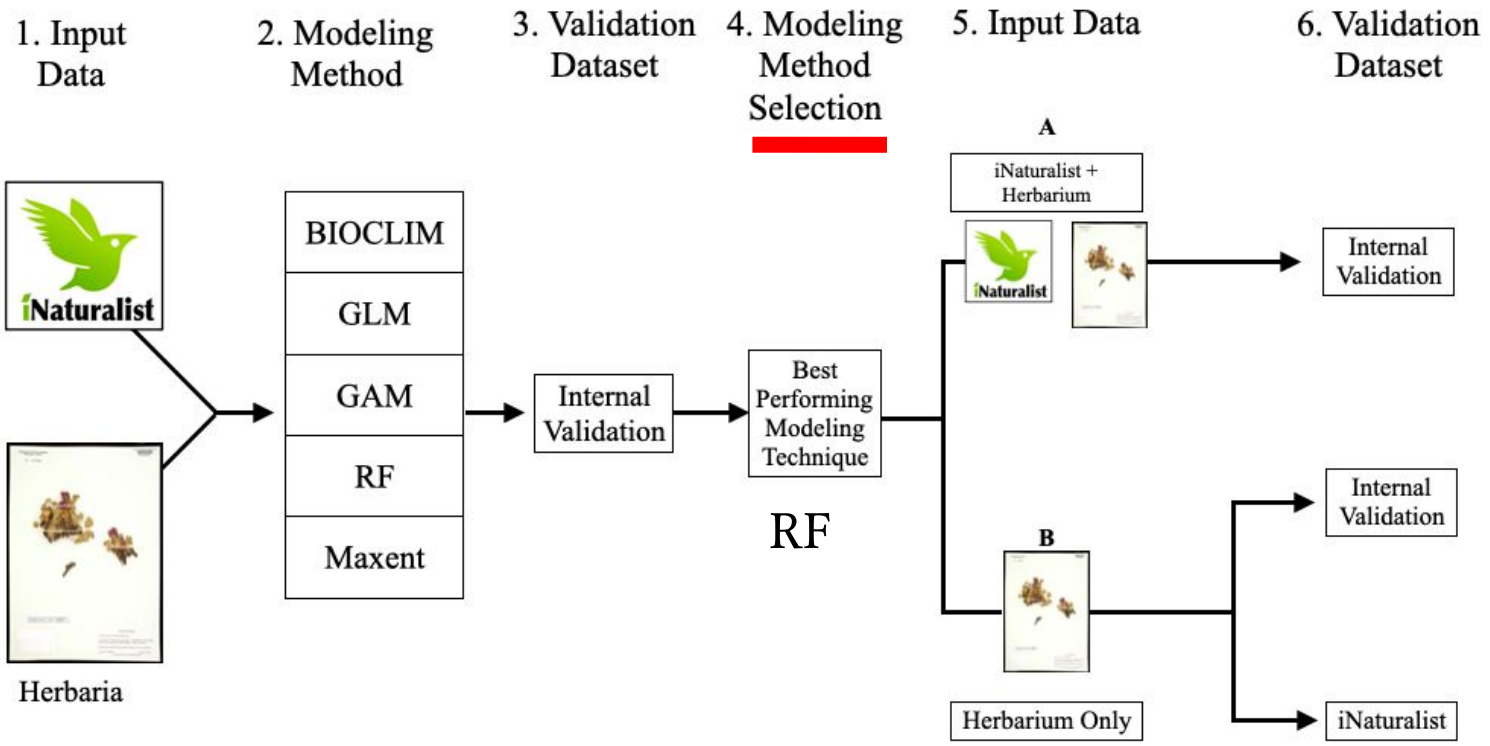
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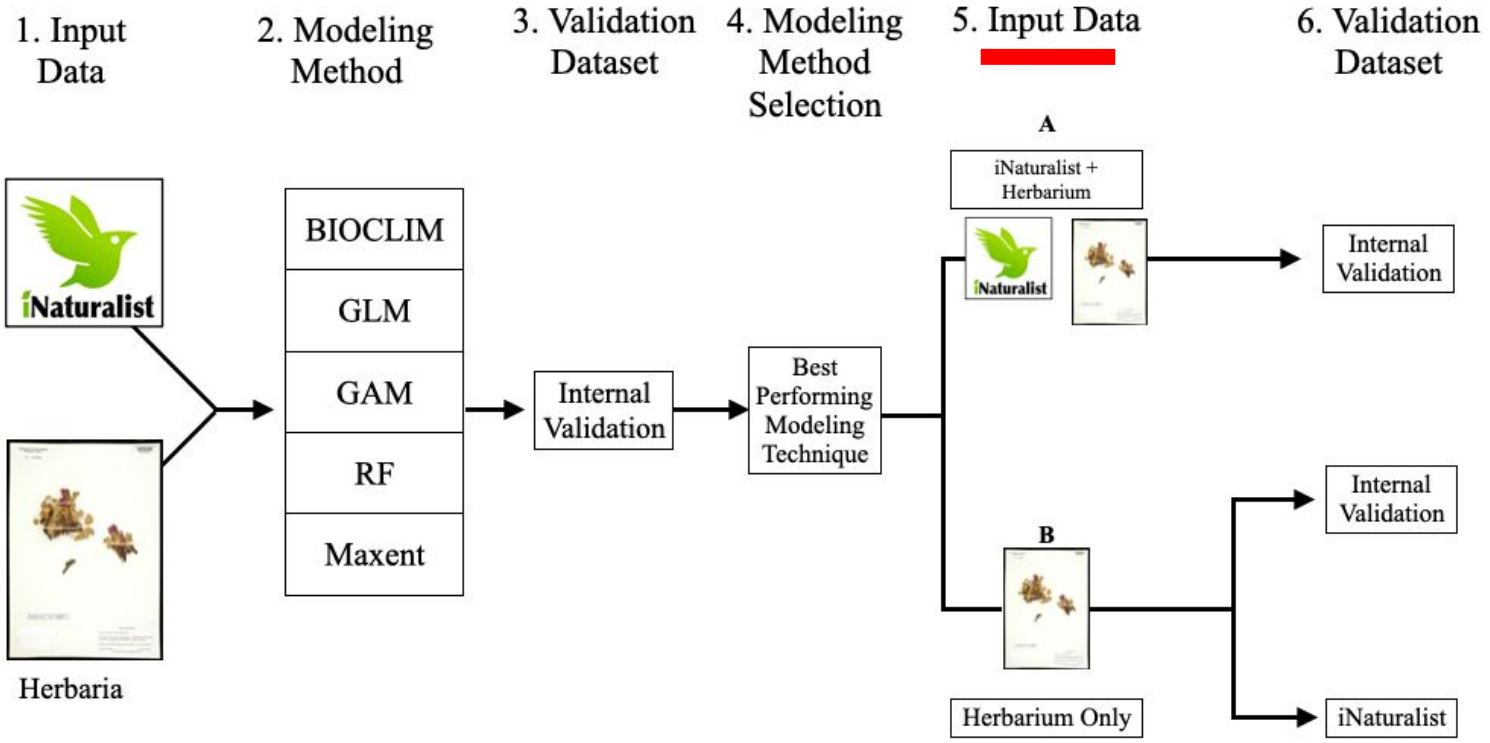
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Training Data	Testing Data	TSS	AUC
Herbaria	Herbaria	0.857	0.963
Herbaria	iNaturalist	0.969	0.996
Herbaria and iNaturalist	Herbaria and iNaturalist	0.939	0.990

Conclusions

- RF was the best performing model
- No models found barren land cover or canopy cover to be important predictors
- Models heavily used variables relating to precipitation
- Herbaria -> iNaturalist gave most robust fit

Funding Sources

Ecology and Evolutionary Biology

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Acknowledgements

Dr. Julian Resasco

Dr. Erin Tripp

Dr. Dan Doak

Resasco Lab

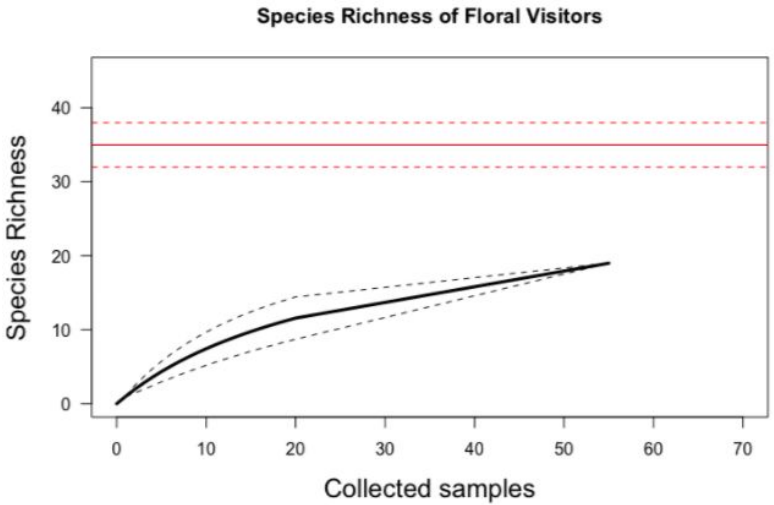
University of Colorado Herbarium

Dina Clark

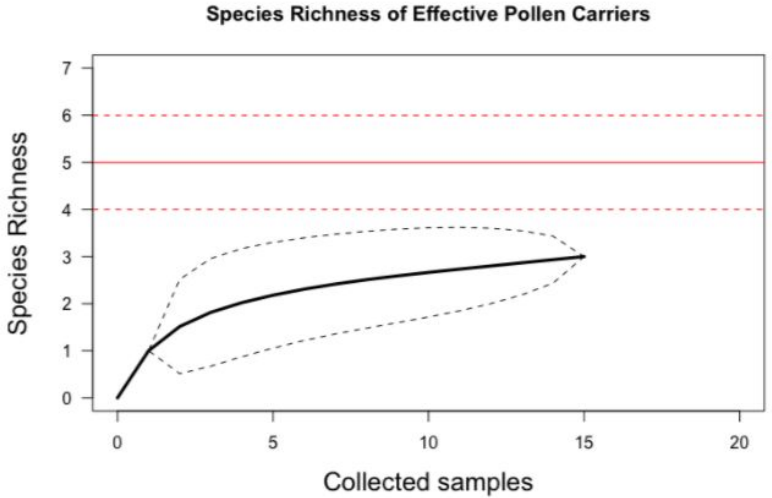
Herbaria Staff

- Grace Kostel
- Mark Gabel
- Dan Potter
- Ernie Nelson
- Jerry Tiehm
- Mitchell McGlaughlin
- Bob Dorn

Pollinator Richness



- Estimated species richness of 35
- Sampling efforts accounted for 54.32% of total richness



- Estimated species richness of 5
- Sampling efforts accounted for 60.04% of total richness

Methods - Environmental Data

Variable Type	Source
Climate Variables	Worldclim 19 bioclim variables
Land cover type and canopy cover	MRLC products
Elevation	SRTM DEM
Soil Maps	Soilgrids.org
Slope and Aspect	Calculated from DEM

- Once rasters were obtained, they were resampled to a resolution of 90m x 90m and clipped to the model extent (-108, -103, 34, 42)