

Modelling Rare Plant Species in the Upper Las Vegas Wash: Prediction Models

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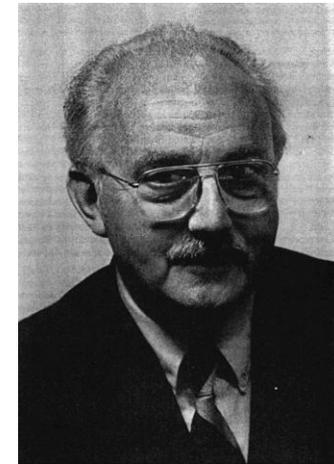
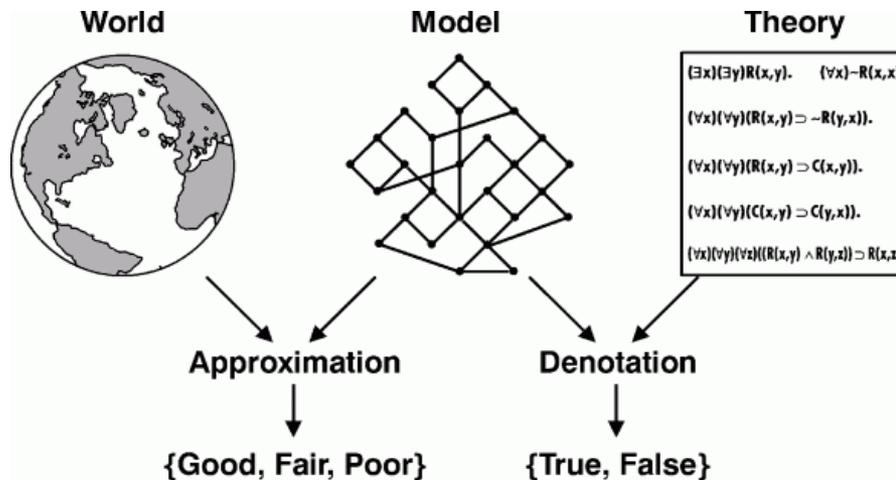
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Species Habitat Modelling in Conservation: Those Forgotten Caveats

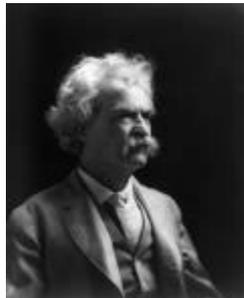
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 - G. P. E. Box, a truly distinguished Statistician



Species Habitat Modelling in Conservation: Those Forgotten Caveats

- “All models are wrong. Some are useful.”
 - G. P. E. Box, a truly distinguished Statistician
- “There are three kinds of lies: lies, damn lies, and *statistics*.”
 - Variousy attributed to B. Disraeli, British politician, and Mark Twain, American humorist

M. Twain



B. Disraeli



Rare Plant Models: Objectives

- Use selected abiotic, topographic and bioclimatic variables to model likely locations of two plant species of concern:
 - Golden bearclaw-poppy (*Arctomecon californica*)
 - Nile's wild buckwheat (*Eriogonum corymbosum* Bentham var. *nilesii*)
- Develop spatial map products for scenario modelling

Rare Plant Models: Modelling Process

- Develop and implement a sampling strategy for the plant species
 - Both purposive (ie targeted) and random designs
- Apply one (or more) classification models
 - Spatial, non-spatial, and mixed models evaluated
- Validate models using cross-validation techniques and independent field test
- Create map product(s) in a GIS

Rare Plant Models: Modelling Process – The Data

- Data sources from (i) 27 random transects covering wash, (ii) purposive sampling, and (iii) known locations (maps) provided by BLM
 - Random => Prevalence in wash, defined as ratio of “hits” of plant presence to number of sample points
 - Purposive => Boost sample size (after all, they’re rare!!)
 - BLM data => Initial model data

Rare Plant Models: Modelling Process – The Data

- Poppy modelling sample sizes by design type

	Random	Purposive	Total
Absent	203 (66.1%)	51 (16.6%)	254 (82.7%)
Present	15 (4.9%)	38 (12.4%)	53 (17.3%)
Total	218 (71.0%)	89 (28.9%)	307 (--)



Rare Plant Models: Modelling Process – The Models

- Evaluated 4 types of classification models
 - Discriminant function analysis,
 - logistic regression
 - logistic additive models
 - classification trees
- Each has different strengths and weaknesses given specific objectives of:
 - Ecological interpretability, translation into map products, high prediction capability

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Rare Plant Models: Modelling Process – Models Considered

- Spatial
 - Coarse-grained variables (eg, topographic) for map products and spatial extrapolation
- Non-spatial
 - Fine-grained variables (eg, soil structure, chemistry) for understanding plant ecology
- Mixed spatial and non-spatial
 - Relative contribution of model types for prediction



Rare Plant Models: Modelling Process – The Variables

- Topographic
 - Slope, Elevation, Aspect
- Bioclimatic
 - Precipitation, temperatures, solar radiation
- Soil – Geology / Structure / Chemistry
 - Soil type, geology class, parent material, physical/biological crust, % rock, shear, pH, % clay, gypsum
- Vegetation class

Rare Plant Models: Model #1 - Spatial

□ Variables selected included:

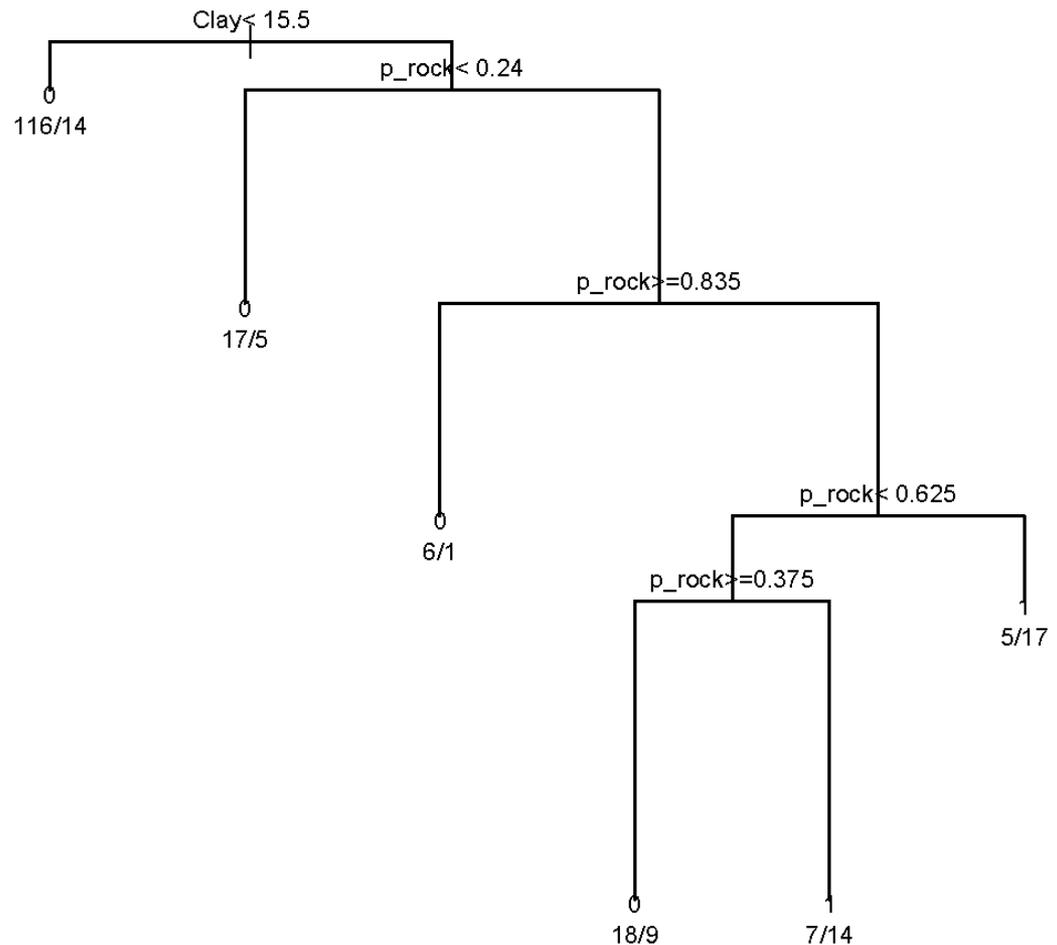
- Vegetation
- Soil type
- Slope
- Aspect
- Solar radiation



Rare Plant Models: Model #1 – Spatial Accuracies

	Resubstitution	Cross-classification
PCC	87.4	79.1
Specificity	41.5	30.2
Sensitivity	97.2	89.6
kappa	0.47	0.22
AUC	0.88	0.79

Rare Plant Models: Model #2 – Non-spatial



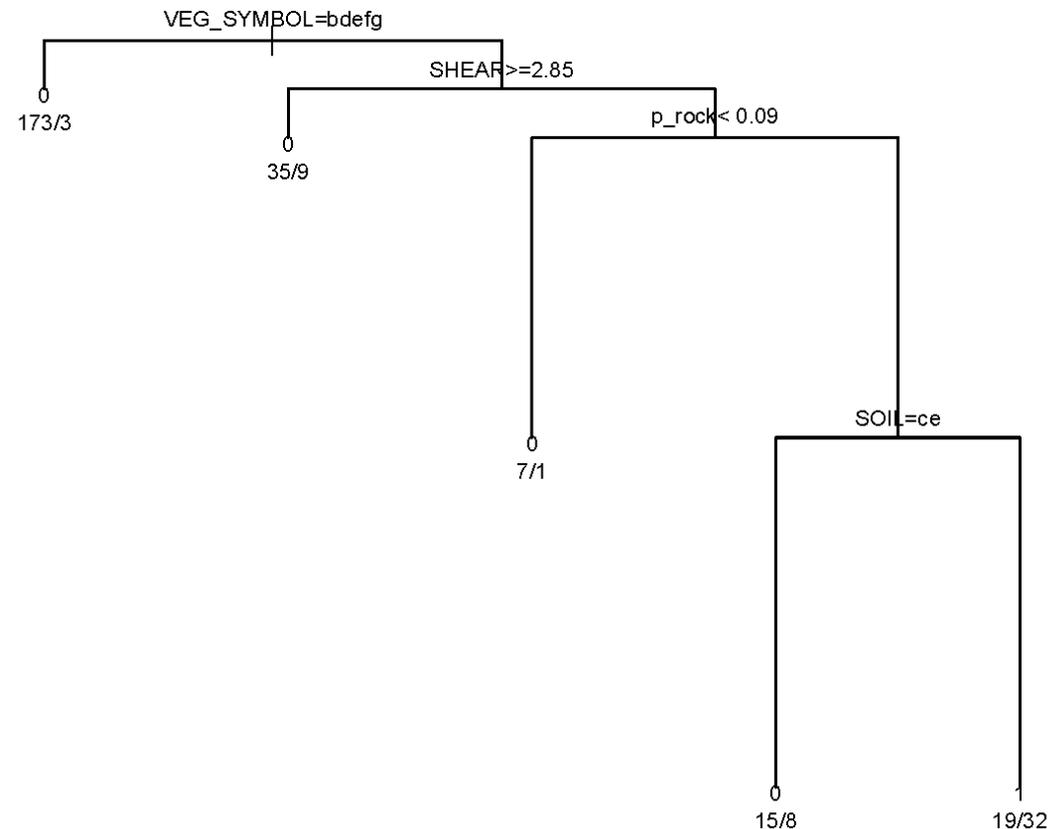
□ Variables selected included:

- Clay
- % rock

Rare Plant Models: Model #2 – Non-spatial Accuracies

	Resubstitution	Cross-classification
PCC	82.1	74.2
Specificity	51.7	30.0
Sensitivity	92.9	89.9
kappa	0.49	0.23
AUC	0.79	0.71

Rare Plant Models: Model #3 - Mixed



□ Variables selected included

- Vegetation
- Shear strength
- % rock
- Soil type

Rare Plant Models: Model #2 – Non-spatial Accuracies

	Resubstitution	Cross-classification
PCC	86.7	79.8
Specificity	60.4	44.5
Sensitivity	92.4	91.6
kappa	0.53	0.38
AUC	0.88	0.69

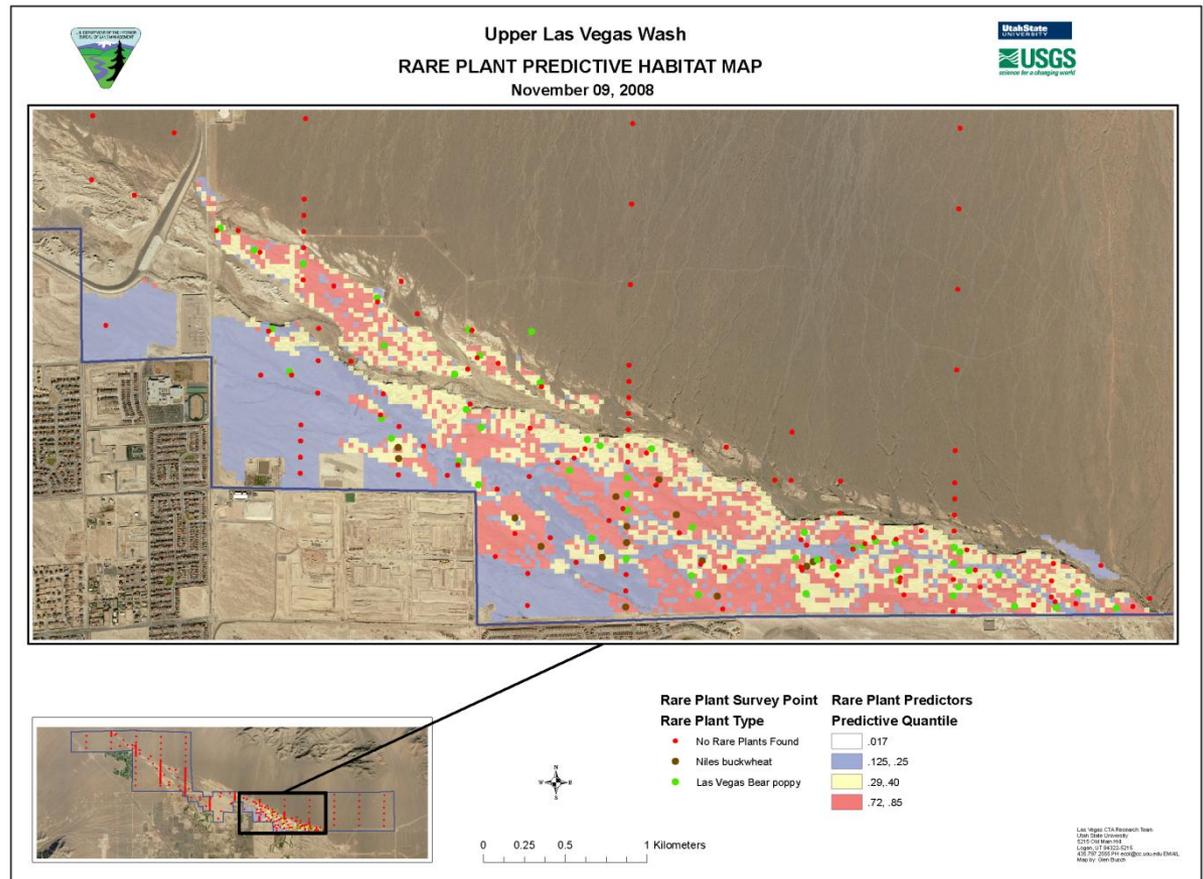


Rare Plant Models: Some General Poppy Conclusions

- Model fits using are within published values and are defensible
 - Model building emphasized ability to predict poppy locations (ie sensitivity) and thereby reduce omission error
 - Consequence is model over-prediction and an increase in commission error
- Given irruptive life history characteristics of the poppy, over-prediction is a conservative management strategy

Rare Plant Models: But Does The Model Work??

- Independent field assessment implemented
- Random points selected from prediction map and field tested



Rare Plant Models: But Does The Model Work??

	Spatial	Non-spatial	Mixed
PCC	77.0	66.0	73.0
Specificity	77.6	57.1	40.8
Sensitivity	77.0	90.2	88.2
kappa	0.54	0.31	0.46
AUC	0.79	0.66	0.76

Rare Plant Models: And What About The Buckwheat?

- Buckwheat samples too small for model-building
 - Since observed co-located with poppy, applied poppy model to buckwheat

	Random	Purposive	Total
Absent	202 (93.1%)	0 (0%)	202 (93.1%)
Present	4 (1.8%)	11 (5.1%)	15 (6.9%)
Total	206 (94.9%)	11 (5.1%)	217 (--)

Rare Plant Models: Buckwheat Applied to Poppy Model

	Spatial	Non-spatial	Mixed
PCC	95.4	93.2	90.2
Specificity	78.6	57.1	50.0
Sensitivity	97.5	97.5	94.9
kappa	0.76	0.60	0.46
AUC	0.98	0.98	0.90



Rare Plant Models: Some General Buckwheat Conclusions

- Caveats regarding over-prediction (omission vs. commission errors trade-offs) apply to buckwheat as well
 - Note: no independent evaluation of buckwheat model (not enough samples found)
- Accuracies of poppy model predicting buckwheat are high and defensible
 - Suggests both species could be managed as a single group

Questions??



Such interesting contrasts