Developing a Spatial Model of Yellow-billed Cuckoo Breeding Habitat

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Project Objectives

- Characterize Yellow-billed Cuckoo breeding habitat
- Develop spatially explicit models of cuckoo breeding habitat
- Identify all potential cuckoo habitat on the Lower Colorado River
- Extrapolate the model to other parts of the state
- Use the predictive model for habitat restoration and enhancement effectiveness monitoring
Modeling Approach

Conceptual Model

Territory, Satellite & DEM Data

GIS

Model Extrapolation

Territory Locations

NDVI

Terrain ruggedness

Proximity Variables

Logistic Regression

Verification Data

Cuckoo Breeding Habitat Map

Habitat enhancement and restoration effectiveness monitoring

Legend
- data
- process
- decision
Sample Locations - 2006

Lake Mead Delta

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Sample
Absence
Presence

0 40 80 160 Kilometers
Exploratory Variables

- Terrain roughness (30-m DEMs)
- Distance to water
- Distance to agriculture or cities
- Vegetation density (Thematic Mapper)
  - NDVI
  - Tasseled Cap
- Vegetation heterogeneity
- Patch size and configuration
  - Multiple scales
- Hydro-geomorphic classification
  - Different approaches
Distance to Water

Distance to water
- 0 - 1 km
- 1 - 2 km
- 2 - 3 km
- 3 - 4 km
- 4 - 5 km

Lake Mead Delta
Bill Williams

Distance
0  25  50  100 Kilometers
Patch (120-m radius)

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Amount of dense vegetation within 120-m radius

Sample
Absence
Presence

0 1.25 2.5 5 Kilometers

Low
Moderate
High
Significant Variables

- **Terrain ruggedness**
  4 classes: flat, low, moderate, high

- **Patch density**
  Amount of dense vegetation (NDVI > 0.41) within 120-m radius (4.5 ha)

- **Patch heterogenity**
  Variation in vegetation density (SD of NDVI) inside a 480-m radius (72 ha)
Significant Covariates

Vegetation coverage (120-m radius):

60
50
40
30
20
10
0
-10

Vegetation heterogeneity (480-m radius):

7
6
5
4
3
2
1
84
85
147
148
14

SAMPLE
Significant Covariates

[Box plot diagram with two samples labeled 0 and 1, showing the distribution of data.]
Model Outputs

- Probability grids
- Spatially explicit maps
- Multiple classification approaches
Probability Surface - 2006

SAMPLE
- Absence
- Presence

Model probability
- High: 0.999999
- Low: 0.0122897

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Potential Cuckoo Habitat 2007

Legend

Cuckoo Potential 2007
Verde River YBCU Model Results
San Pedro YBCU Model
Conclusions

Terrain ruggedness most important
- moderate terrain ruggedness the best (>20 times as likely to have YBCU as flat terrain)

Patch size and composition important
- 120 m radius (core density)
- 480 m radius (vegetation heterogeneity)
- Each 10% of core area covered in dense vegetation = 15% increase in YBCU
- Each 1SD increase in vegetation heterogeneity = 68% increase in YBCU

Classification accuracy ~75%

Extrapolation produced results on the Verde and San Pedro that were not as specific as on the LCR.
Southwestern Willow Flycatcher Modeling

Predicted SWFL Breeding Habitat: Salt/Roosevelt 1994 – 2005
Temporal Model Accuracy: 1994 - 2004

Predicted habitat (ha)

Territories

R Sq Linear = 0.746