Habitat characteristics & landscape associations of Alabama's three known Cerulean Warbler populations

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Introduction

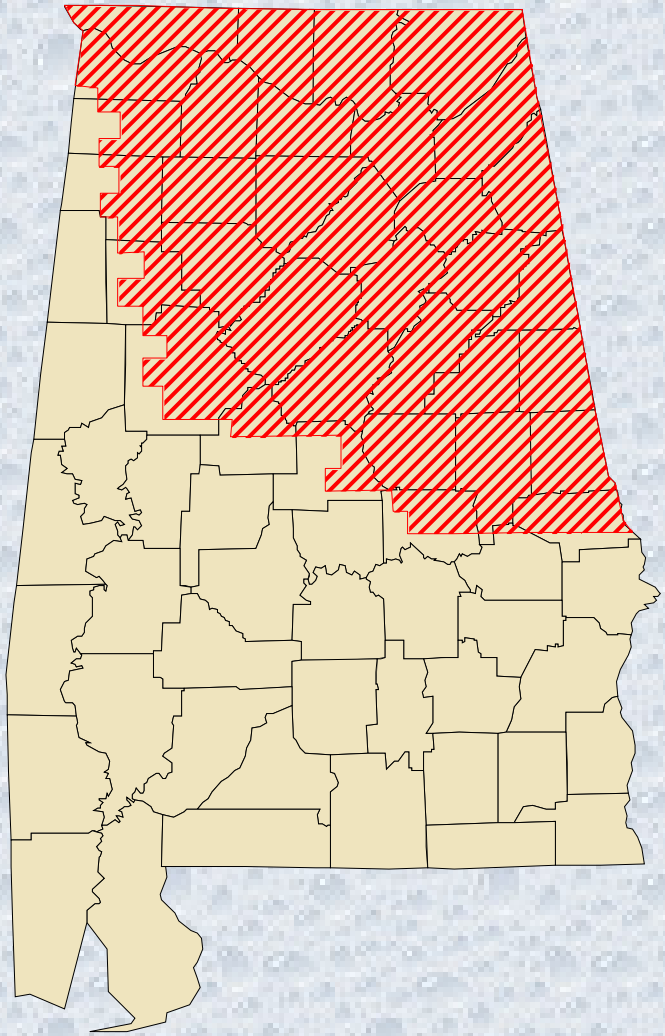
- Cerulean Warblers (CERW) have declined 4% annually from 1966-2000 (Sauer 2002).
- Recently petitioned for protection under the Endangered Species Act (Hamel 2004).

- Prefer mesic forests with large diameter trees, complex canopy structure, and sparse understory (Hamel 2000a).

Introduction (cont'd)

CERW in Alabama

- Common and even numerous north of the "Fall Line" (Imhof 1976).
- Currently classified as a Priority One Species (Highest Conservation Concern).
- Today only three breeding populations are known to exist.

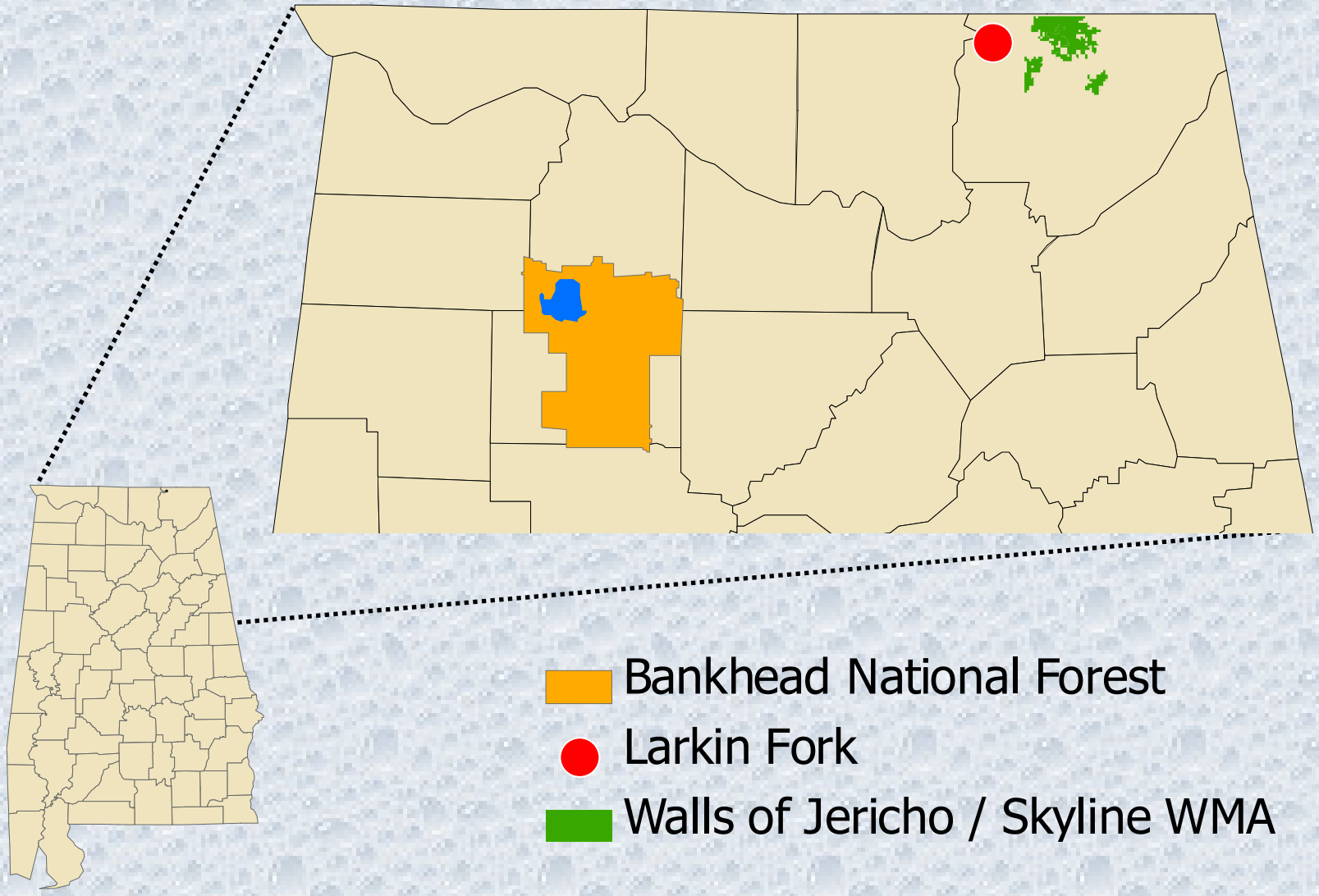


Objectives

Provide baseline data for management and conservation of Cerulean Warblers in Alabama by examining:

1) Tree use,
2) Plot-level habitat characteristics, &
3) Spatial relationships with surrounding landscape features.

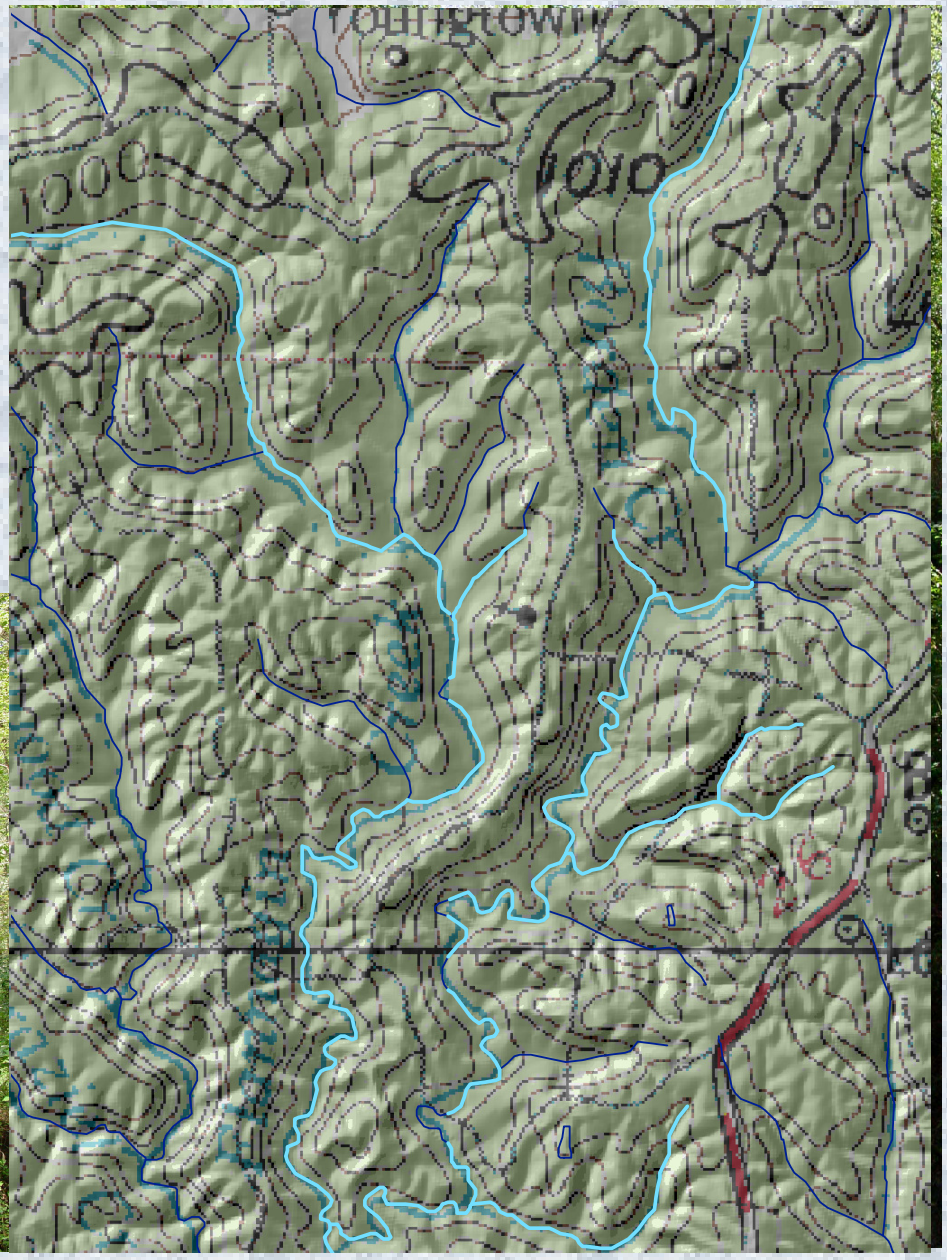
Study Areas


Bankhead National Forest
Larkin Fork
Walls of Jericho / Skyline WMA

Study Areas (cont'd)

Bankhead National Forest

12-15 pairs CERW



Study Areas (cont'd)

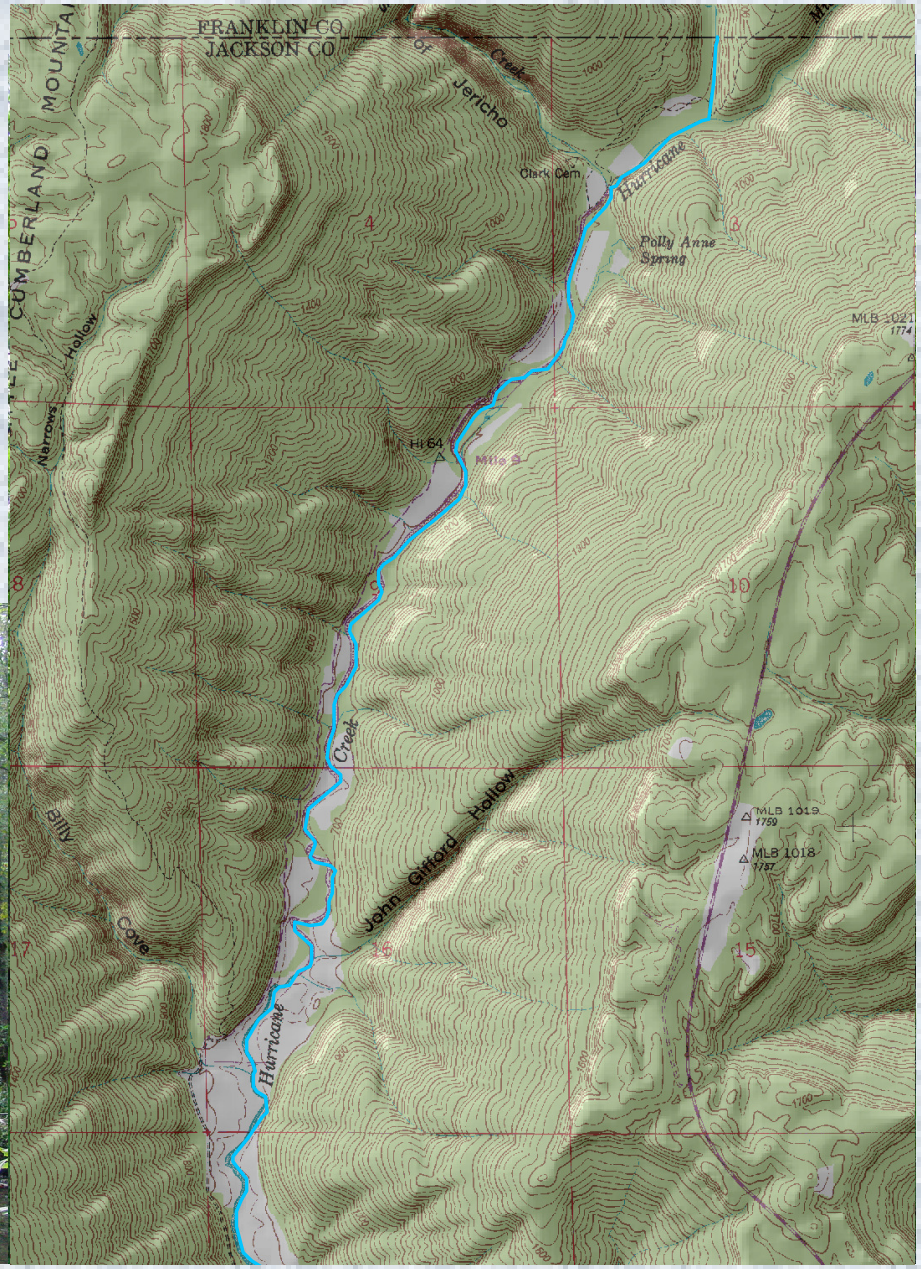
Larkin Fork

12-15 pairs CERW

Study Areas (cont'd)

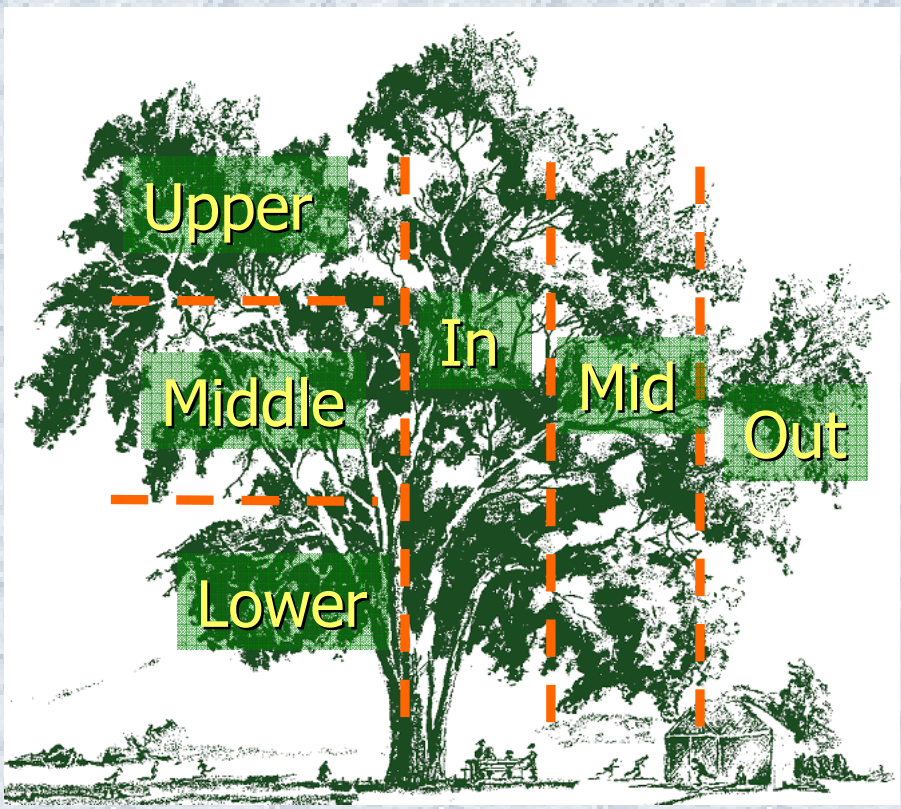
Walls of Jericho

15-20 pairs CERW



Methods: Bird Surveys

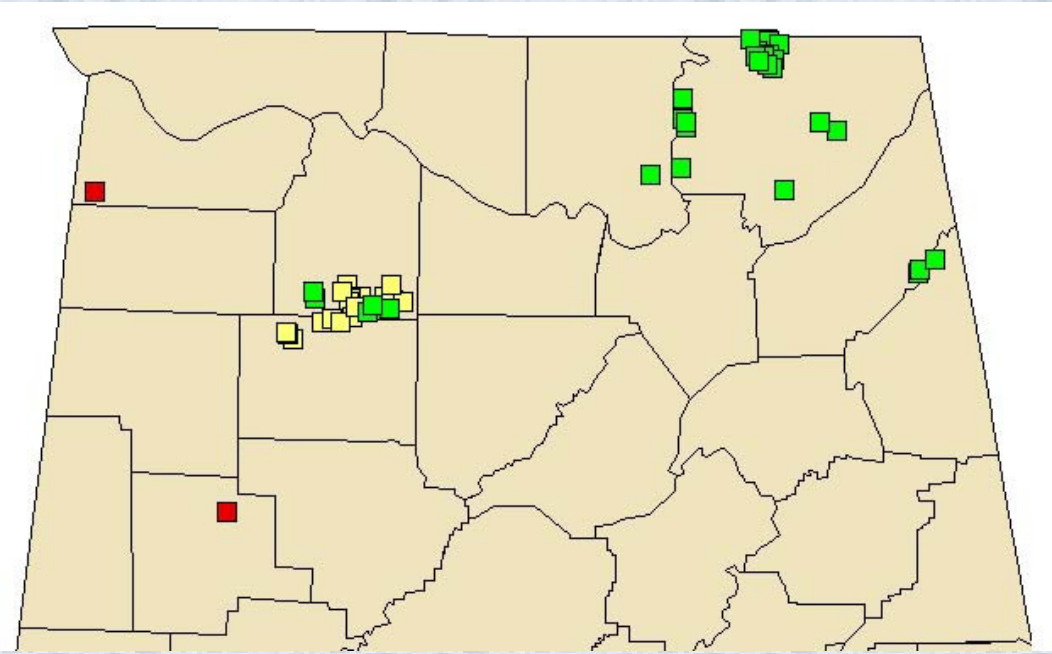
- Conducted April-July in 2005 & 2006.
- GPS coordinates of CERW encounters.
- Point counts
- Observed CERWs assigned relative locations in tree.
  - Height, DBH, & crown class.



(Hamel 1981)

Methods: Habitat Characteristics

- "*Used*": GPS coordinates.
  - Priority given to point count and observed locations.
- "*Random*":
  - GIS
  - BBA sightings (1999 & 2001)
  - BNF point count stations



Methods: Habitat (cont'd)

0.04 ha plots (James & Shugart 1970, Noon 1981, Runkle 1992)

Measurements:

1) Trees ≥ 3 cm DBH
2) Snags ≥ 7.5 cm DBH
3) Shrubs < 3 cm DBH (cardinal directions)
4) % Canopy Cover (40 +/- densitometer readings)
5) Canopy structure (0,<5m, ≥5<15m, ≥15-25m, ≥25m)
6) Canopy heights (each crown class)
7) Canopy gaps (distance to nearest ≥10m^2)
8) Aspect & slope

Methods: Landscape Associations

ArcGIS 9.0/9.1 (ESRI 2004)

- Hawth's Analysis Tools extension (www.spatialecology.com)

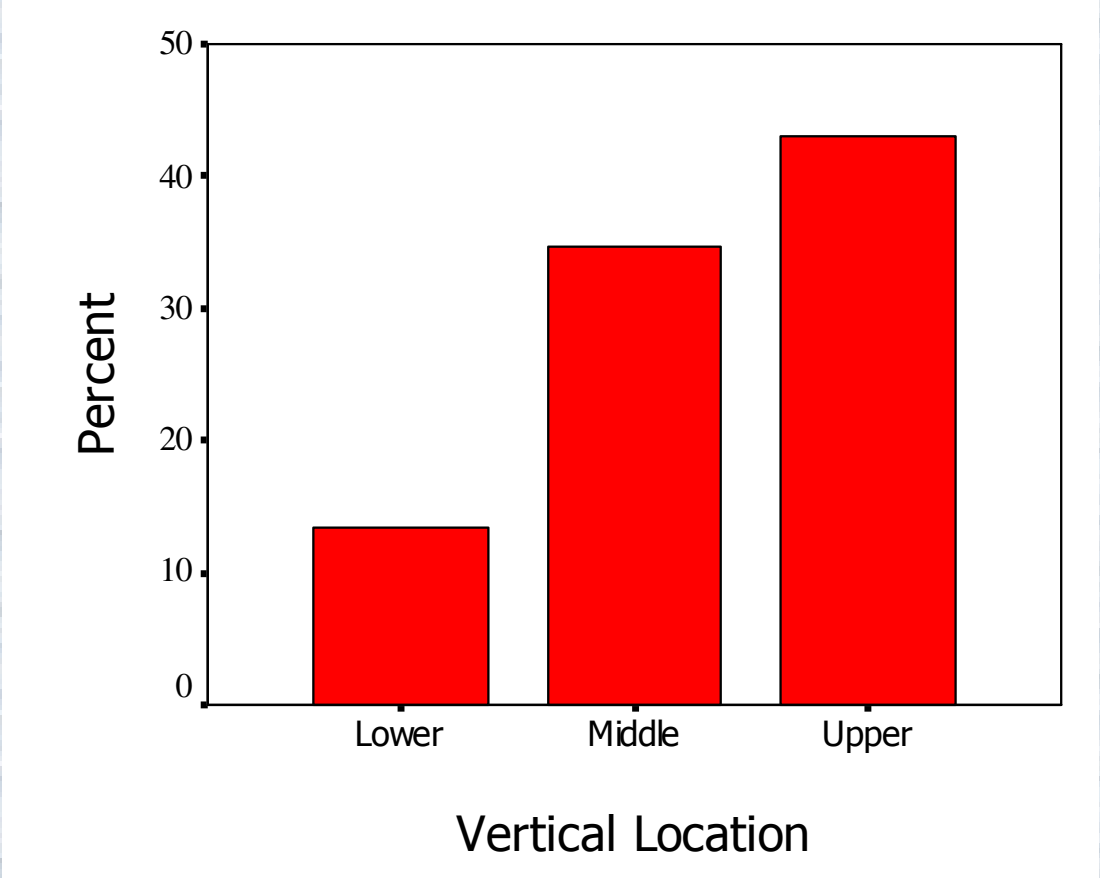
Measurements:	Data Used:
• Percents of land classes (0.5 km, 1 km, & 2 km buffers)	→ 2001 Land Use/Land Cover (30m)
• Distance to nearest agricultural and developed area ≥ 50 ha.	
• Distance to road,	→ 2000 Tiger road shapefiles
• Distance to stream,	→ 1999 National Hydrography Data
• Elevation	→ 30 m Digital Elevation Model

Methods: Statistical Approach

- Chi-square: detect preferences,
- Shannon-Weiner diversity index: assess canopy structure,
- T-tests: detect differences,
- Binary Logistic Regression: identify predictive variables

Results: Tree Use

- μDBH=37.9 cm
  SD±16.4,
  Range=2.2-120.5,
  N=396
- μHeight=25.7m
  SD±8.3,
  Range=5.25-49,
  N=367



X^2 (2, N=370) = 58.2, p<0.001

Results: Tree Use (cont'd)

- μDBH=37.9 cm
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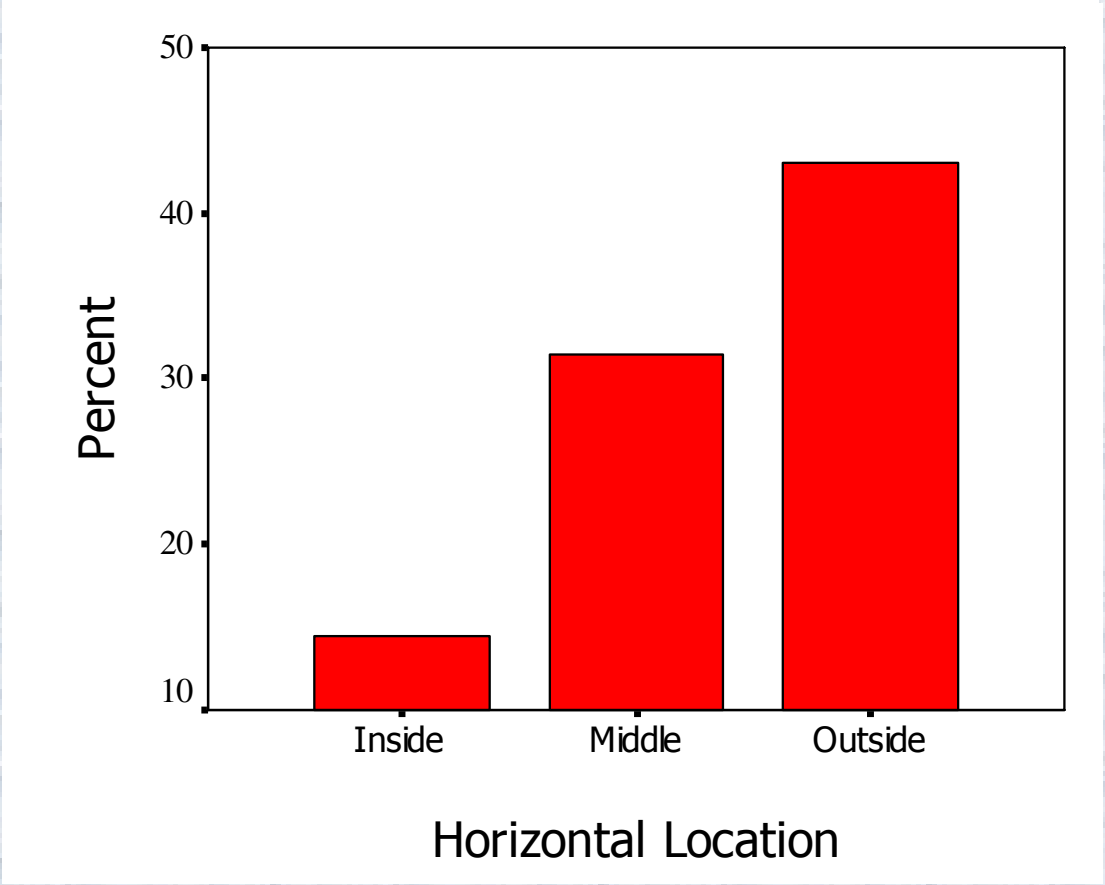
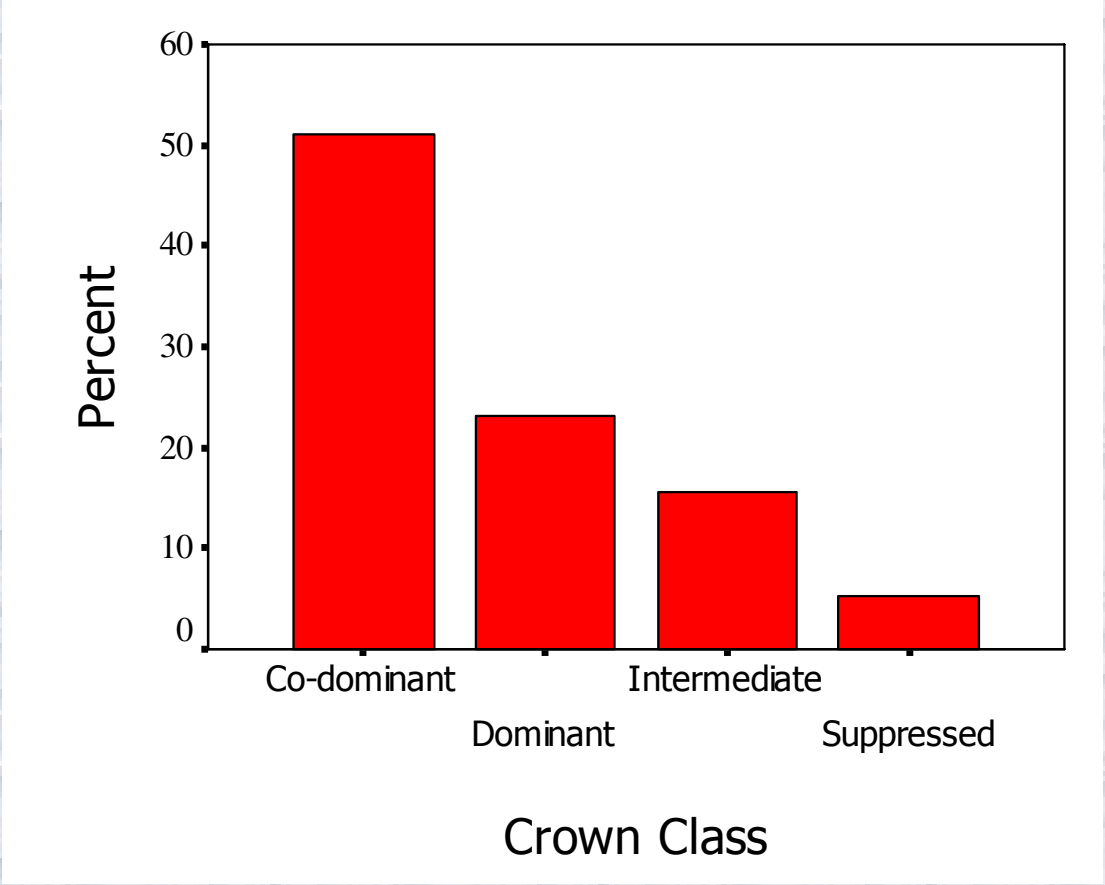


X^2 (2, N=379) = 63.6, p<0.001

Results: Tree Use (cont'd)

- μDBH=37.9 cm
  SD±16.4,
  Range=2.2-120.5,
  N=396
- μHeight=25.7m
  SD±8.3,
  Range=5.25-49,
  N=367



X^2 (2, N=395) = 201.2, p<0.001

Results: Habitat Characteristics

- T-test, sig. <0.1

Habitat Characteristic	**Used** μ ± SE, N=87	**Random** μ ± SE, N=51	t	df	Sig.
BA:#Trees	0.038 ± 0.002	0.026 ± 0.002	3.325	136.0	<0.01
% BA Deciduous	93.0 ± 1	77.0 ± 3	4.419	62.1	<0.00
# Trees	34.2 ± 1.3	52.1 ± 4.6	-3.776	58.2	<0.00
# Snags	1.6 ± 0.2	2.4 ± 0.3	-2.184	71.5	<0.03
Upper Canopy (m)	29.8 ± 0.65	27 ± 0.9	2.611	136.0	<0.01
Mid Canopy (m)	16.7 ± 0.4	14.9 ± 0.6	2.639	136.0	<0.01
Lower Canopy (m)	5.9 ± 0.2	5.2 ± 0.2	2.160	130.3	<0.03
% Canopy Cover	89.0 ± 0.01	83.0 ± 0.01	3.937	136.0	<0.00
J' (Shannon-Weiner)	0.713 ± 0.01	0.749 ± 0.01	-2.015	124.8	<0.05
Saplings/Shrubs (ha)	4042 ± 318	5316 ± 459	-2.343	136.0	<0.02

Results: Habitat (cont'd)

Stepwise Logistic Regression:

- 14 variables
- $r^2 = 0.546$

"Used" habitat accuracy = 86.2%,

"Random" = 58.8%

Overall 76.1%

Habitat Characteristic	Step	B	Sig.
% Deciduous BA	1	+6.27	0.02
# Trees	2	-0.54	0.001
J' (S-W)	3	-3.41	0.18
% Canopy Cover	4	+7.25	0.02
% Snag BA	5	+12.97	0.01
# Snags	6	-3.08	0.07

Results: Landscape

- T-test, sig. <0.1

Habitat Characteristic	**Used** μ ± SE, N=87	**Random** μ ± SE, N=51	t	df	Sig.
Dist. to Road (m)	775 ± 64.9	447.4 ± 81.4	3.152	108.4	<0.00
Dist. to Stream (m)	70.2 ± 5.5	310.5 ± 35.7	-6.645	52.4	<0.00
Elevation (m)	216.9 ± 2.2	293.1 ± 13.7	-5.487	52.6	<0.00
Dist. to Agri.>50ha (km)	4.1 ± 0.2	2.4 ± 0.3	4.851	136.0	<0.00
% Water	0.0 ± 0.0	2.5 ± 1.2	-1.77	50.0	<0.08
% Developed	0.7 ± 0.1	2.3 ± 0.4	-3.788	63.6	<0.00
% Deciduous	87.9 ± 0.8	55.4 ± 4.3	7.238	53.7	<0.00
% Evergreen	2.8 ± 0.6	16.5 ± 0.3	-4.797	54.1	<0.00
% Mixed	2.6 ± 1.1	14.5 ± 1.9	-6.301	54.8	<0.00
% Grassland	0.0 ± 0.0	4.0 ± 1.2	-2.496	50.3	<0.02

Results: Landscape (cont'd)

Stepwise Logistic Regression:

- 13 variables
- $r^2 = 0.885$

"Used" habitat accuracy = 98.8%,

"Random" = 92.2%

Overall 96.3%

Landscape Characteristic	Step	B	Sig.
% Deciduous (0.5 km)	1	+7.27	<0.07
Distance to Stream (m)	2	-0.03	<0.00
Dist. to Agri. >50ha (km)	3	+1.43	<0.02
Dist. to Devlpd >50ha (km)	4	-4.90	<0.07
% Mixed Forest	5	-30.62	<0.06
% Grassland	6	-285.32	<0.06
Distance to Road (m)	7	-0.00	<0.14
% Developed	8	-43.04	<0.29

Results: Habitat & Landscape

Stepwise Logistic Regression:

- 27 variables
- $r^2 = 0.864$

"Used" habitat accuracy = 97.7%,

"Random" = 90.2%

Overall 94.9%

Variable	Step	B	Sig.
% Deciduous Forest	1	+7.53	<0.00
Elevation (m)	2	-0.05	<0.00
Lower Canopy Ht. (m)	3	0.50	<0.00

Discussion

- Supports other CERW findings,
- Use AIC for better models,
- Include amount of edge in landscape analysis,

- Need more information on reproductive success.

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QUESTIONS?