Scholars Day Conference   Scholars Day 2024

Apr 24th, 2:10 PM - 2:25 PM

Tree Canopy Cover Influences Habitat Use of Breeding Birds at Jack Mountain Wildlife Management Area

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Yellow-billed Cuckoo

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Introduction

- Bird species are declining (Rosenburg et al, 2019).

- Multivariate analysis

- Statistical analysis was completed using the statistical software R (R Core Team, 2020).
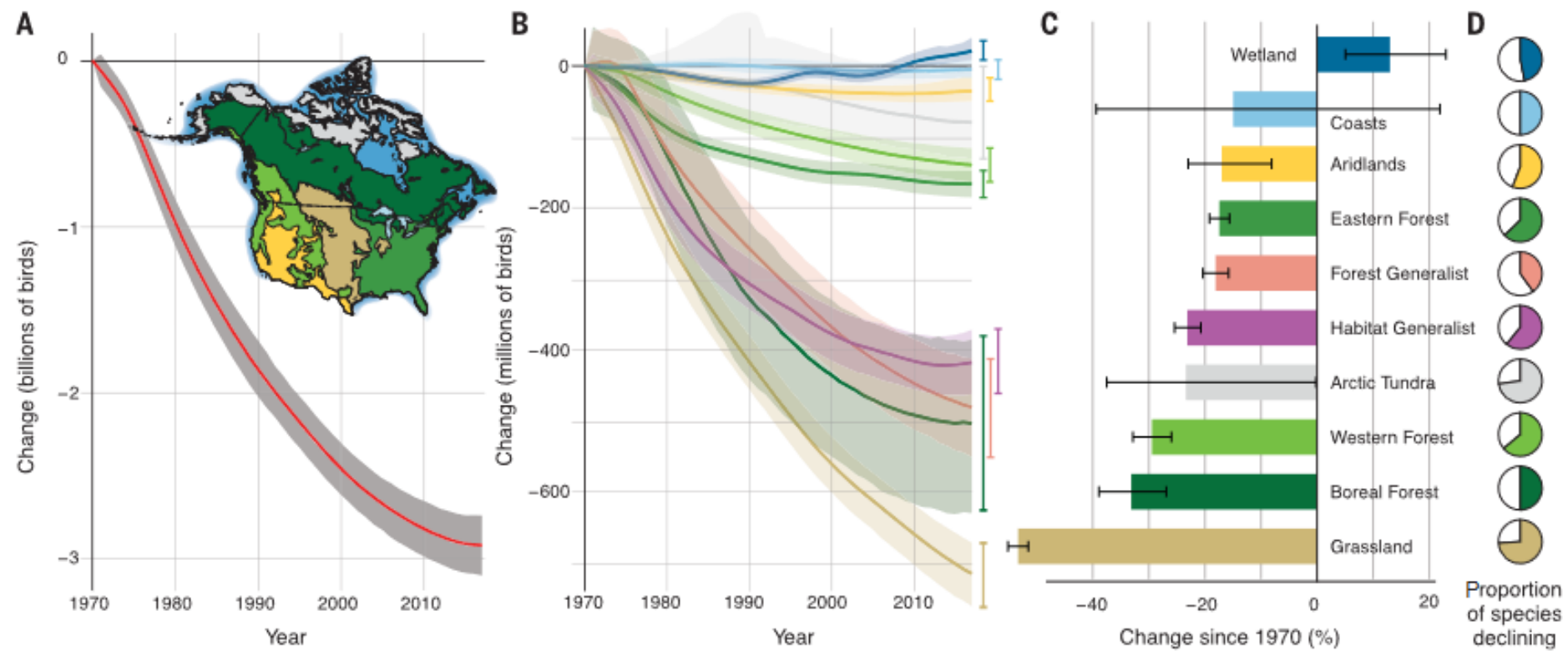
Wood Thrush
(Kaufman, 2024)

Fig. 1. Net population change in North American birds. (**A**) By integrating population size estimates and trajectories for 529 species (*18*), we show a net loss of 2.9 billion breeding birds across the continental avifauna since 1970. Gray shading represents the 95% credible interval (CI) around total estimated loss. Map shows color-coded breeding biomes based on Bird Conservation Regions and land cover classification (*18*). (**B**) Net loss of abundance occurred across all major breeding biomes except wetlands (see Table 1). (**C**) Proportional net population change relative to 1970, ±95% CI. (**D**) Proportion of species declining in each biome.

Rosenberg et al., 2019
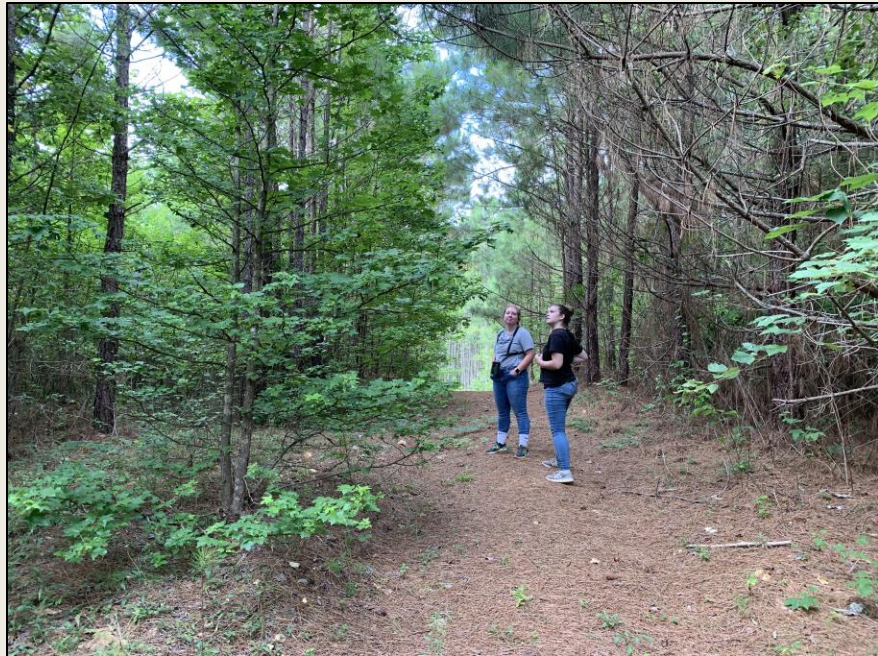
Field Methods

Data Collection
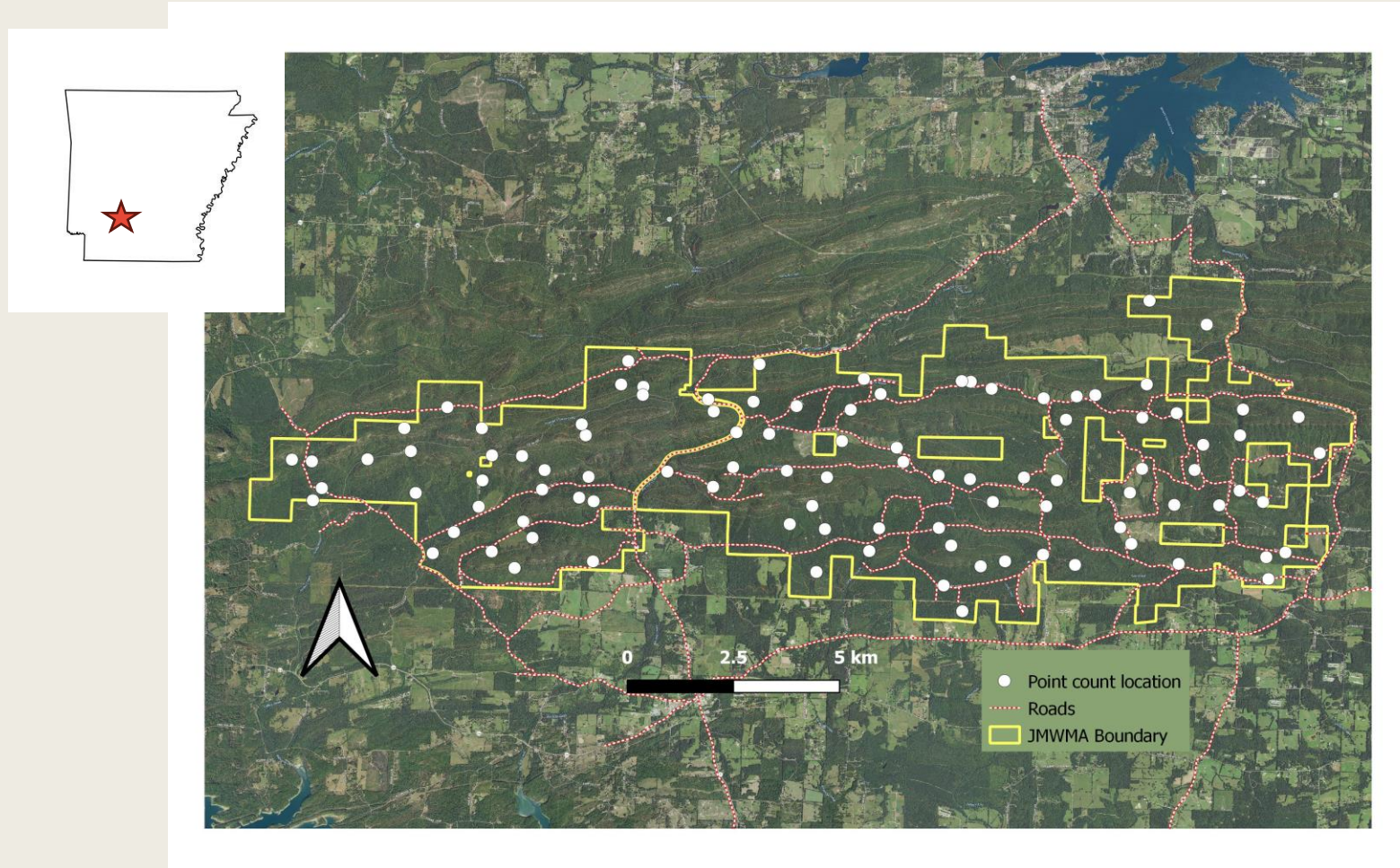
Map of 94 collection points (white dots) at Jack Mountain Wildlife Management Area in southwestern Arkansas. The yellow line denotes the boundary of the wildlife management area (Ross Foundation, 2010).

Bird survey

- Response variables

o Species Diversity

o Species Abundance

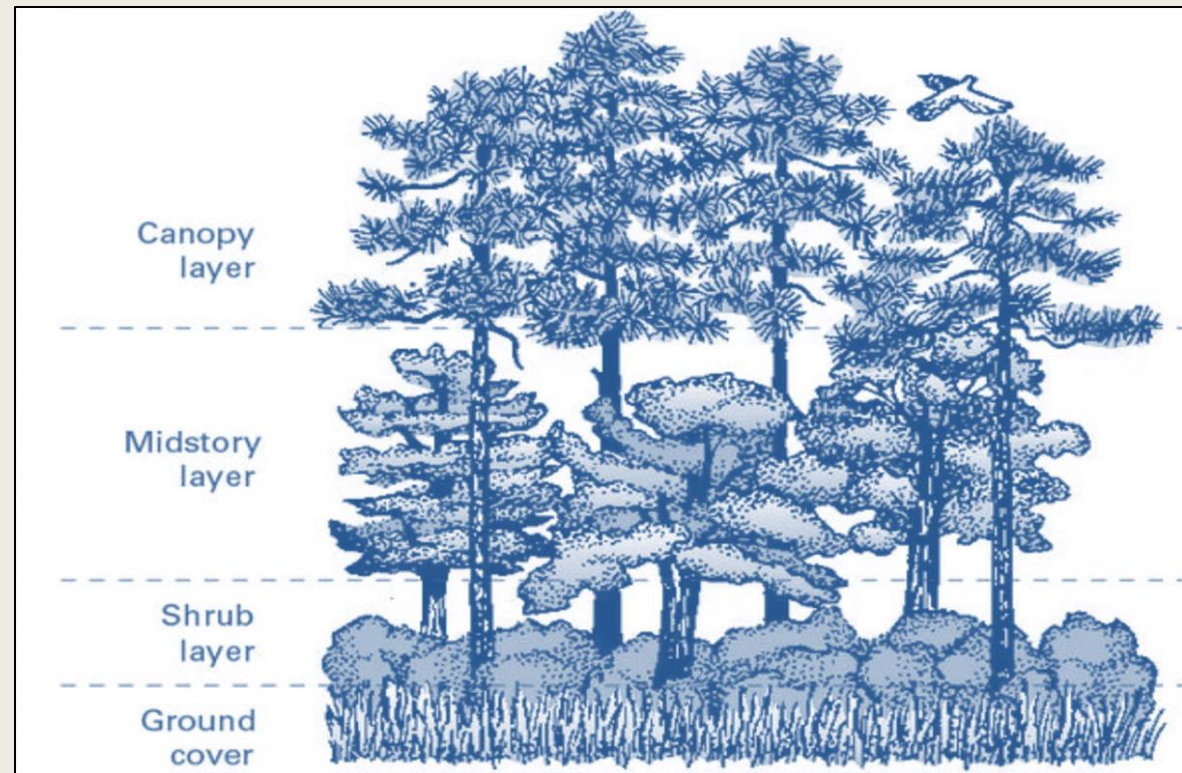Indigo Bunting

References: (Bibby et al. 2000), (Huff et al. 2000)

Habitat Survey

Explanatory variables

- Canopy Coverage

- Midstory Coverage

- Shrub Coverage

- Ground Coverage
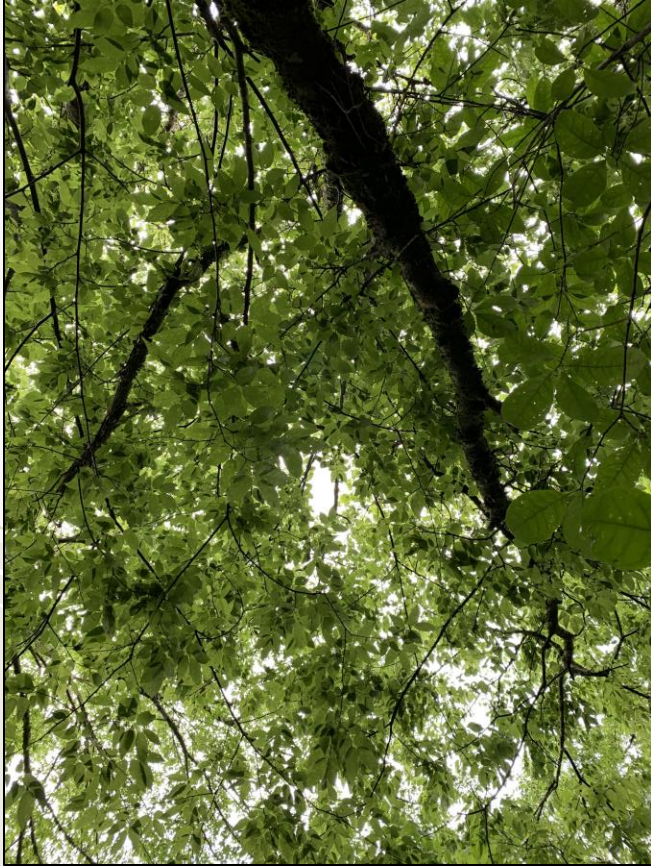
References: (Sam et al. 2019)

Data Analysis

Scarlet Tanager

R Statistical Environment

- A free-statistical environment that can do a variety of statistical analyses and create many different types of charts and graphs (R Core Team, 2020)

- Sample code:

```
library(tree)

modeltree<-tree(Species_Diversity~.,data=Complex_birds)

plot(modeltree)

text(modeltree)
```
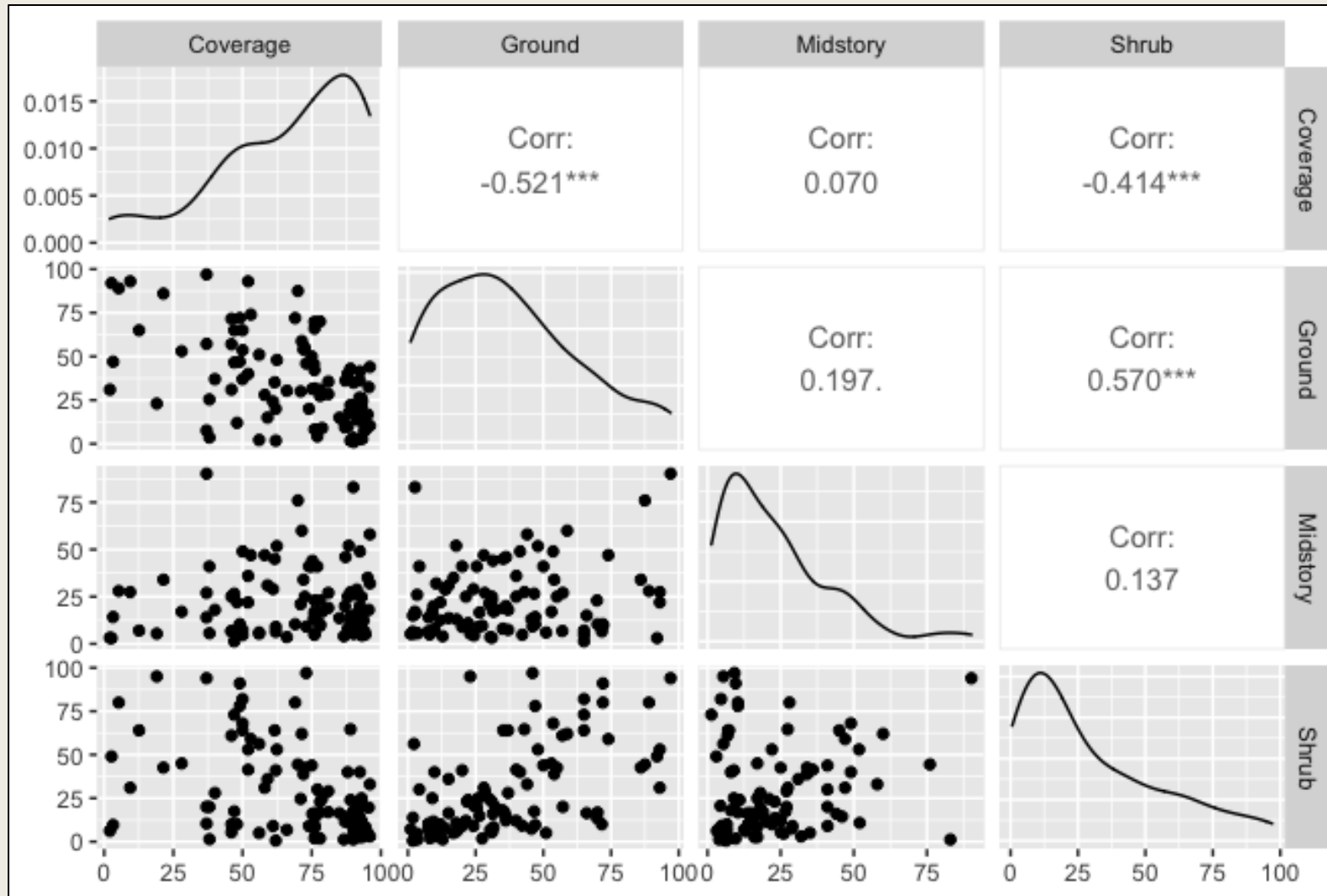
Scatter-plot matrices that show the correlations between explanatory variables.

References: (Emerson et al, 2012), (Asuero et al., 2007), (Kuhn, 2021), (Fox and Weisburg, 2019), (Stine, 1995)
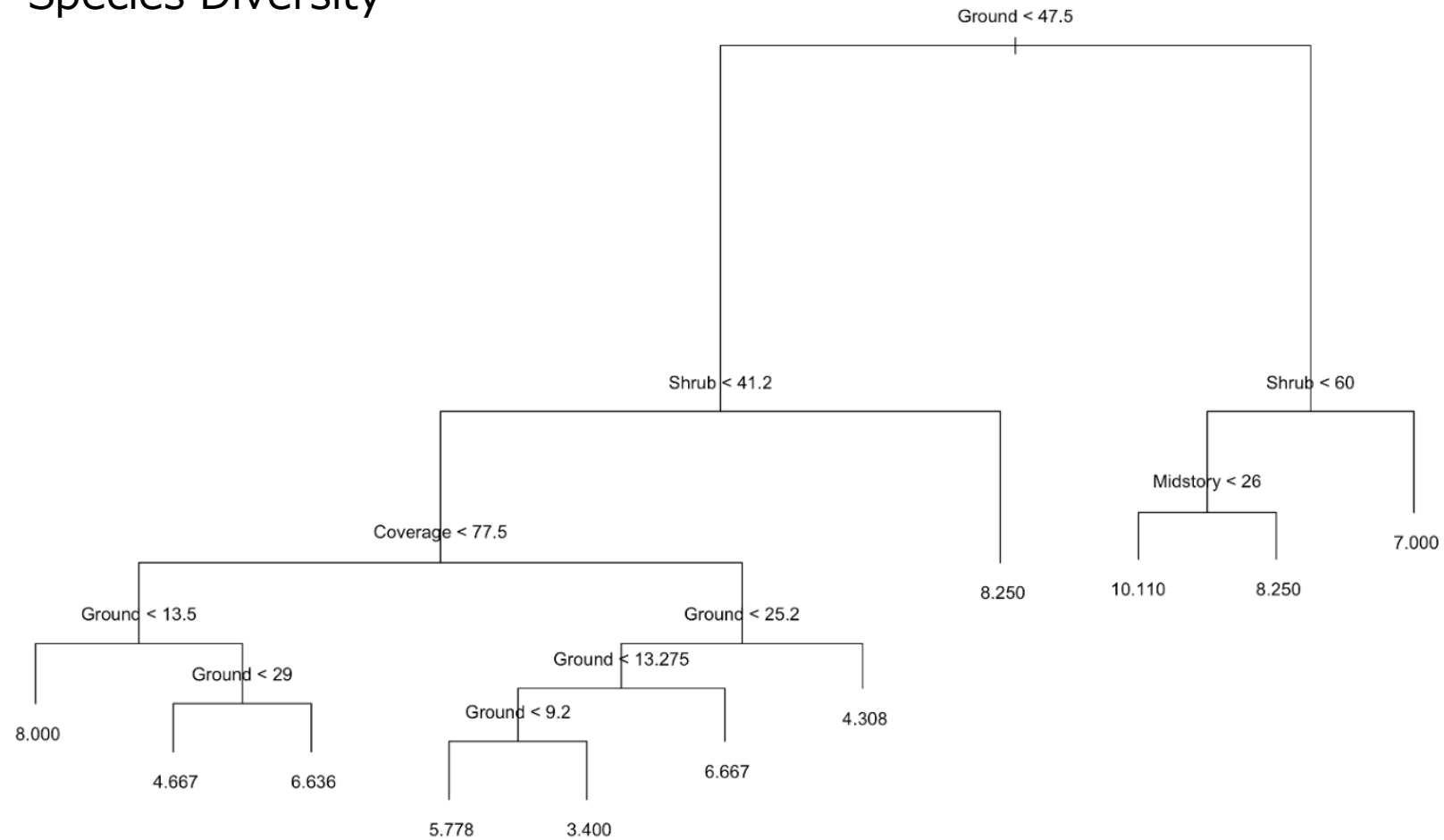
Species Diversity

The regression-tree plots show the ranking of variables in order of significance in how they affect species diversity.

References: (Ripley, 2021)

Species Diversity

Short-hand Names of Linear Models	Full Names of Linear Models
G	Ground Coverage
C	Canopy Coverage
G,C	Ground Coverage and Canopy Coverage
G,S	Ground Coverage and Shrub Coverage
S,C	Shrub Coverage and Canopy Coverage
G,C,S	Ground Coverage, Canopy Coverage, and Shrub Coverage
G,S,M	Ground Coverage, Shrub Coverage, and Midstory Coverage
C*S	Interaction between Canopy Coverage and Shrub Coverage
C*M	Interaction between Canopy Coverage and Midstory Coverage
G*C	Interaction between Ground Coverage and Canopy Coverage

The full names of the linear models used in the multiple regression for
bird diversity.
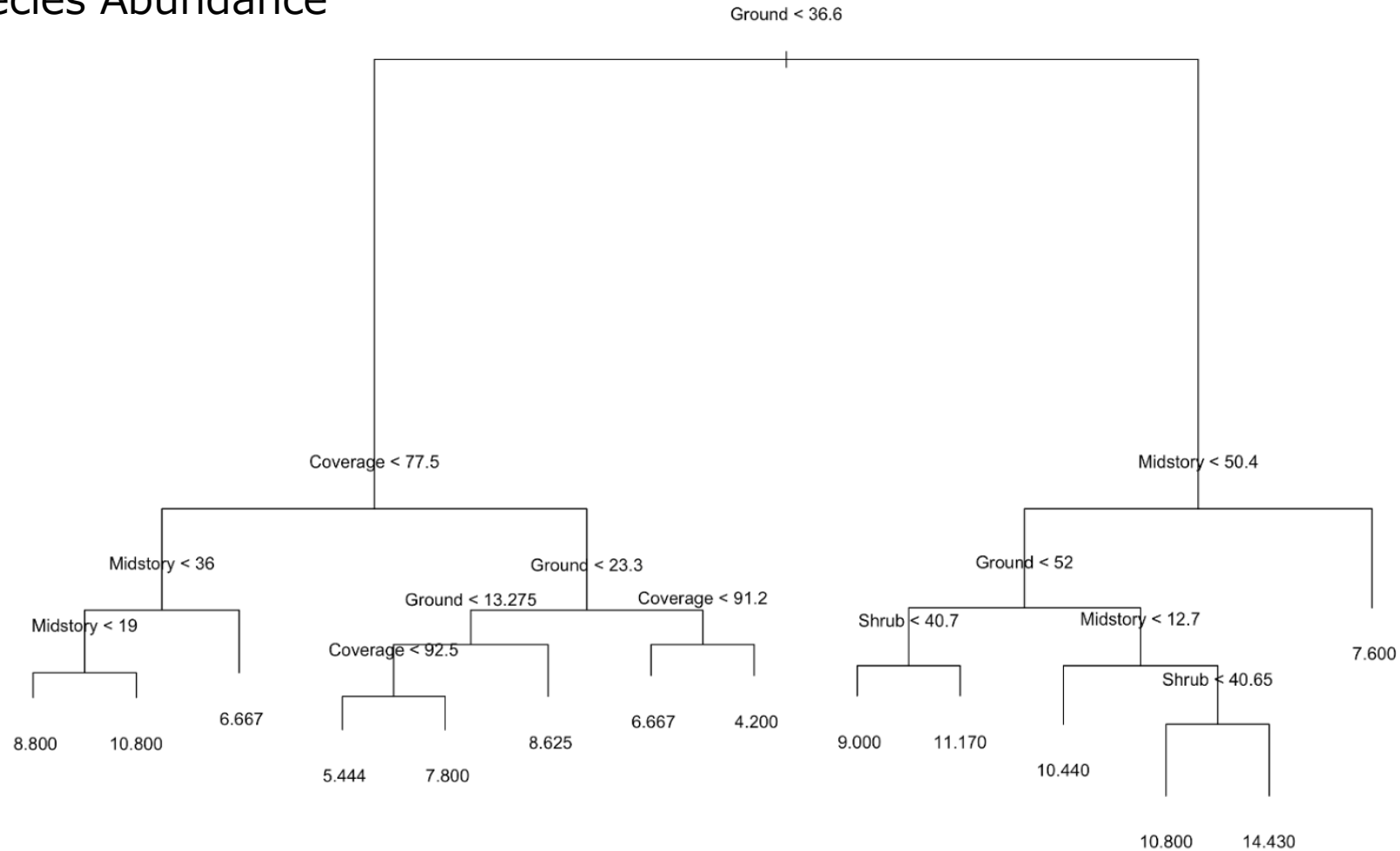
References:(Crawley, 2015)

Species Abundance

The regression-tree plots show the ranking of variables in order of significance in how they affect species abundance.

References:(Ripley, 2021)

Species Abundance

Short-hand Names of Linear Models	Full Names of Linear Models
G	Ground Coverage
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G,C	Ground Coverage and Canopy Coverage
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C,M	Canopy Coverage and Midstory Coverage
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G,M,S	Ground Coverage, Midstory Coverage, and Shrub Coverage
G*C	Interaction between Ground Coverage and Canopy Coverage
C*S	Interaction between Canopy Coverage and Shrub Coverage

The full names of the linear models used in the multiple regression for **bird abundance.**

References:(Crawley, 2015)

Northern mockingbird

Common yellowthroat

Black and white warbler

Results

Bird species diversity & abundance

- 42 species observed at points

- 854 individuals

Kentucky Warbler

Models	R²	AIC	Δ AIC	AICcWt
G,C	0.1661	428.340	0.00	0.330
G*C	0.1755	429.500	1.16	0.180
G	0.1280	430.360	2.02	0.120
G,C,S	0.1661	430.670	2.23	0.110
C	0.1246	430.720	2.38	0.100
S,C	0.1321	432.090	3.75	0.050
G,S	0.1287	432.470	4.13	0.040
C*S	0.1401	433.450	5.11	0.030
G,S,M	0.1392	433.560	5.22	0.020
C*M	0.1247	435.130	6.79	0.010

Linear models for **species diversity** listed in order of increasing Δ AIC

References: (Awad, 1995), (Mazerolle, 2020)
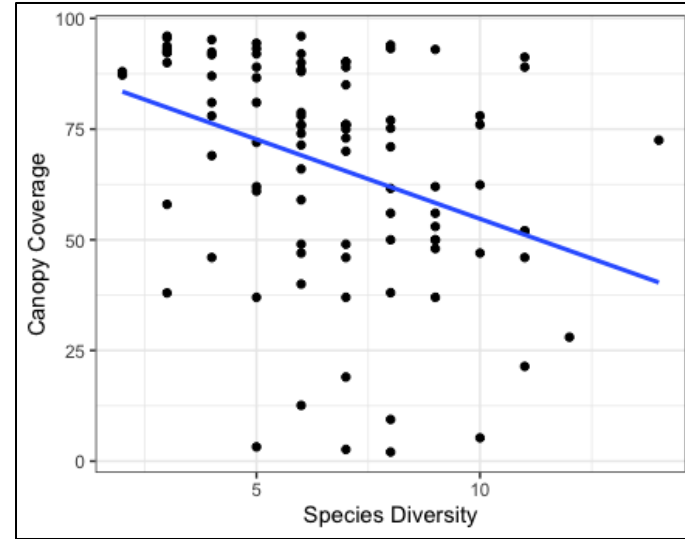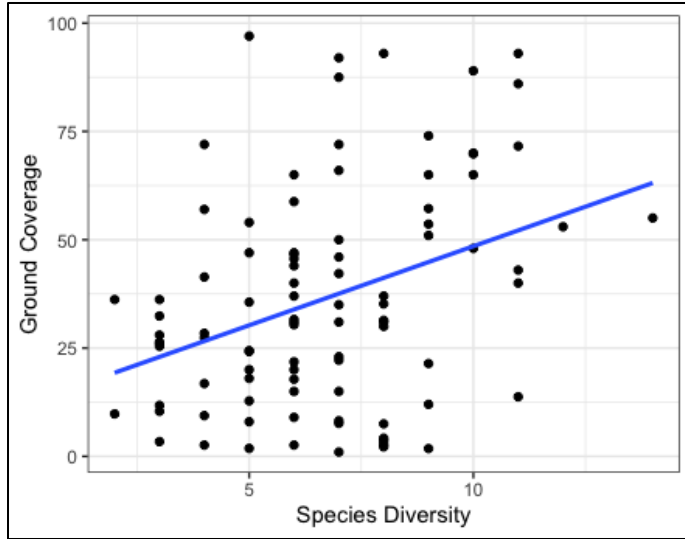
P<0.001
R²=0.1192

P<0.001
R²=0.1515

P=0.3851
R²=0.008

P=0.0246
R²=0.0536
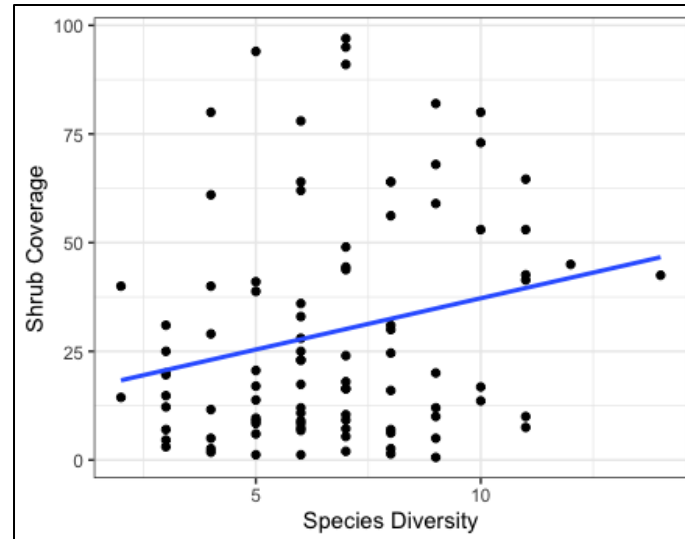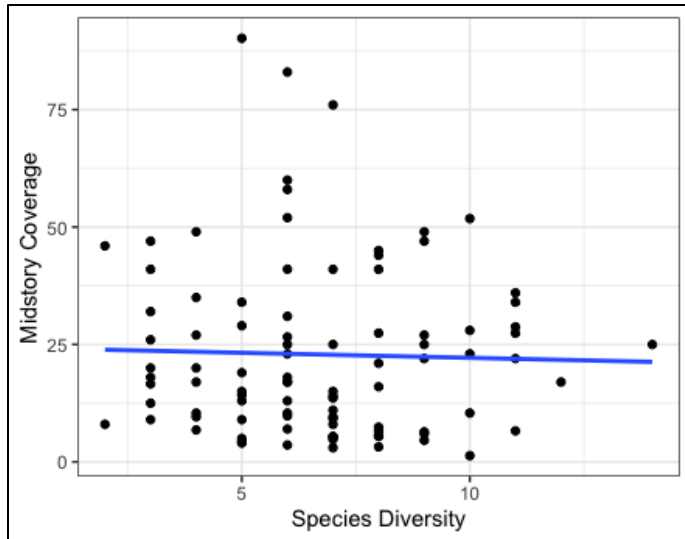
References: (Wickham, 2016)

Model	R²	AIC	Δ AIC	AICcWt
G,M	0.181	494.600	0.000	0.220
G,M,C	0.181	494.730	0.130	0.200
G,C	0.181	494.750	0.150	0.200
G	0.181	495.700	1.100	0.130
G*C	0.184	496.420	1.820	0.090
G,M,S	0.181	496.800	2.200	0.070
G,S	0.152	497.870	3.270	0.040
C	0.119	499.210	4.620	0.020
C,M	0.124	500.920	6.330	0.010
C*S	0.143	501.110	6.510	0.010

Linear models for **species abundance** listed in order of increasing Δ AIC

References: (Awad, 1995), (Mazerolle, 2020)
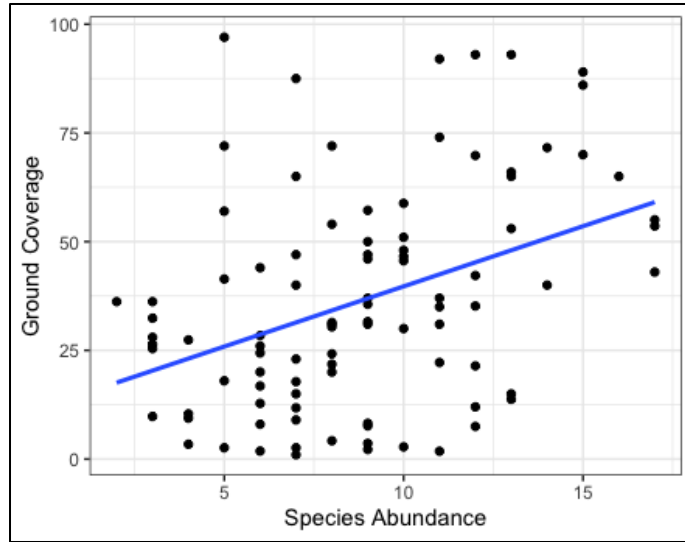
P<0.001
R²=0.0048

P<0.001
R²= 0.128
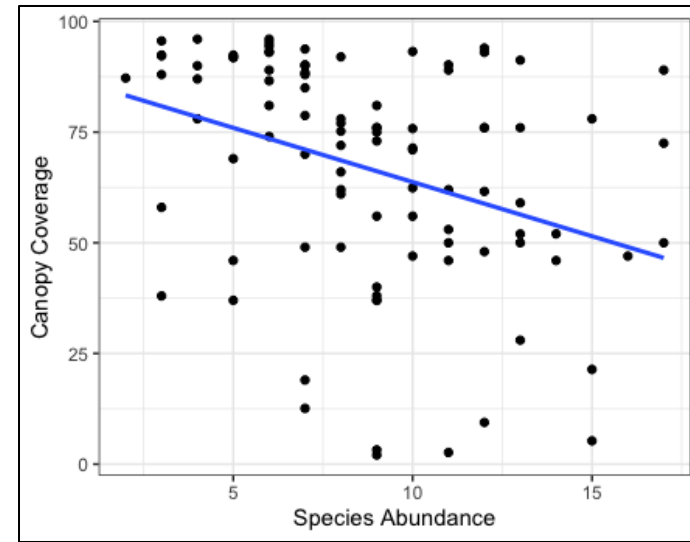
P=0.7805
R²<0.001

P=0.029
R²=0.050

References: (Wickham, 2016)
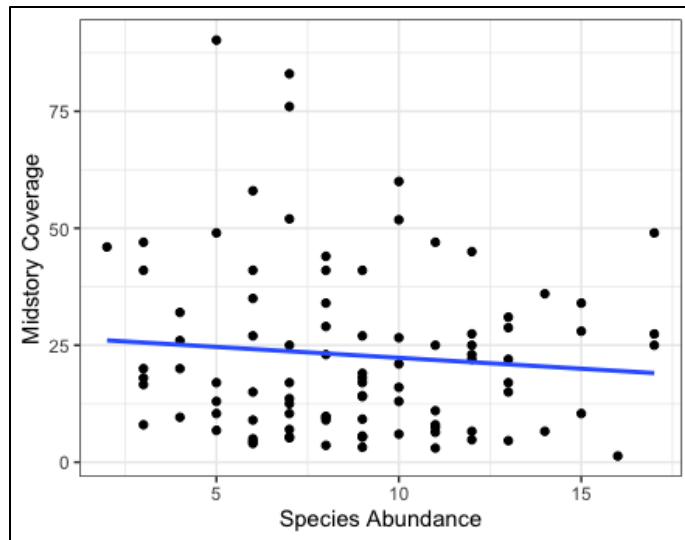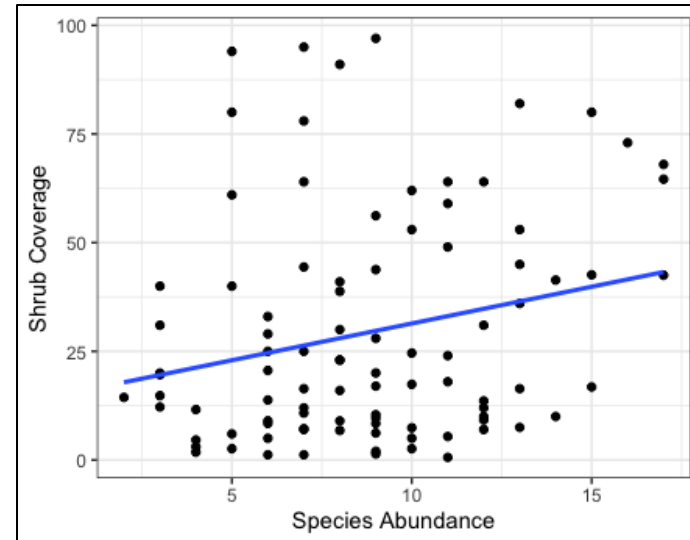
Discussion

Summer Tanager

- Significant findings:

o As canopy cover decreases, bird species diversity and bird abundance increases.

o As shrub and ground coverage increases, bird species diversity and bird abundance increases.

Conservation implications

- Maintaining habitat complexity is important for birds in eastern forests

- It is essential that large areas with overlapping habitats be preserved for the use of wildlife (Dietz et al, 2020).

- Moderate disturbance of habitats will likely be beneficial; providing additional nesting habitats (Lewandowski et al., 2020).

Interdisciplinary Connection
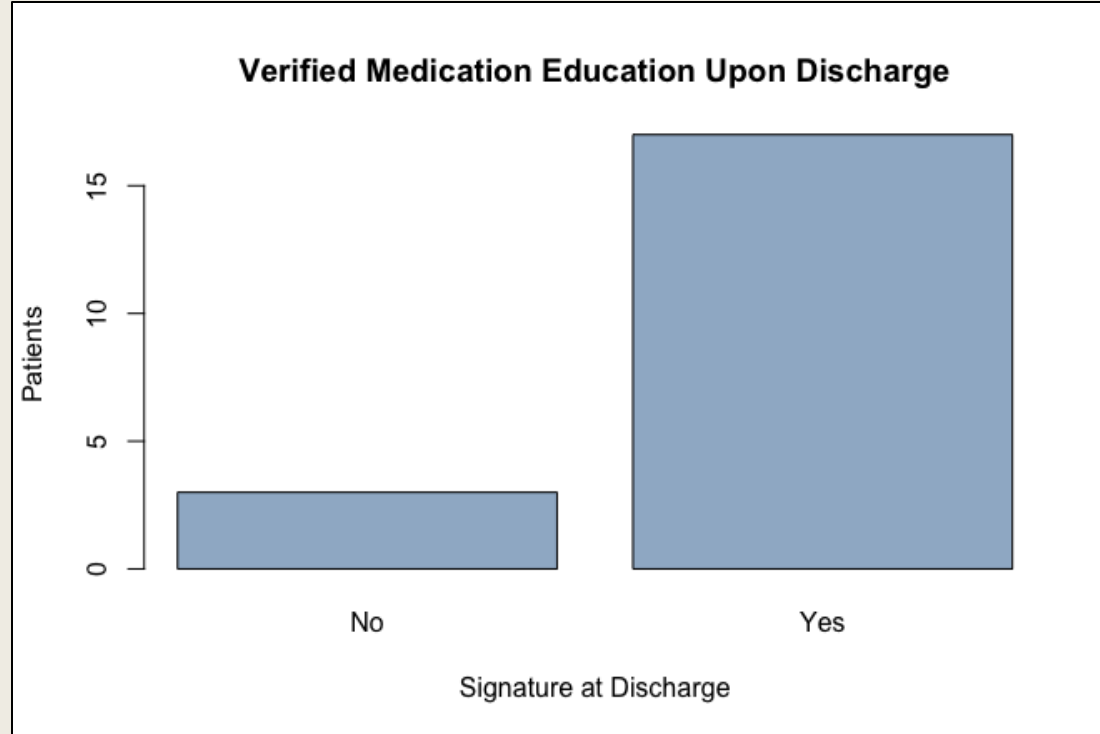
- X-squared = 9.8, df = 1, p-value = 0.001745

- Chi squared goodness of fit test: 9.8
- P value: 0.001745

References: (Frazier, n.d), (Tutorialspoint, n.d)

Acknowledgements

- Ross Foundation for funding this project and allowing access to Jack Mountain

- Grace Tidwell and Kelsey Bester for field data

- Honors committee

- Dr. Pruett, Dr. Carter, and Dr. Curlin

References

Asuero, A. G., et al. "The Correlation Coefficient: An Overview." *Critical Reviews in Analytical Chemistry*, vol. 36, no. 1, 12 Jan. 2007, pp. 41–59.

Awad, Adnan M. "PROPERTIES OF THE AKAIKE INFORMATION CRITERION." *Microelectron. Reliab.*, vol. 36, no. 4, 18 July 1995, pp. 457–464.

Bibby, C.J., Burgess, N.D., Hill, D.A. and Mustoe, S. 2000. Bird census techniques. Elsevier.

Crawley, Michael J. Statistics: An Introduction Using R. Wiley, 2015.

Dietz, M.S., Belote, R.T., Gage, J. and Hahn, B.A. 2020. An assessment of vulnerable wildlife, their habitats, and protected areas in the contiguous United States. Biological Conservation 248: 108646

Emerson, John W., Green, Walton A., Schloerke, Barret., Crowley, Jason., Cook, Dianne., Hofmann, Heike., Wickham, Hadley. The Generalized Pairs Plot. Journal of Computational and Graphical Statistics, vol. 22, no. 1, pp. 79-91, 2012.

Fox, John. Weisburg, Sanford (2019). An {R} Companion to Applied Regression, Third Edition. Thousand Oaks CA: Sage.

References

Frazier, M. (n.d.). *R color cheatsheet*. National Center for Ecological Analysis and Synthesis-University of California Santa Barbara. https://www.nceas.ucsb.edu/sites/default/files/2020-04/colorPaletteCheatsheet.pdf

Huff, M.H., Bettinger, K.A., Ferguson, H.L., Brown, M.J. and Altman, B., 2000. A habitat-based point-count protocol for terrestrial birds, emphasizing Washington and Oregon. UNITED STATES DEPARTMENT OF AGRICULTURE FOREST SERVICE GENERAL TECHNICAL REPORT PNW.

Kaufman, K. (2024, April 18). *Wood thrush*. Audubon. https://www.audubon.org/field-guide/bird/wood-thrush

Kuhn, Max (2021). caret: Classification and Regression Training. R package version 6.0-90.

Lewandowski, P., Przepióra, F., & Ciach, M. (2020, October 25). *Single dead trees matter: Small-scale canopy gaps increase the species richness, diversity and abundance of birds breeding in a temperate deciduous forest*. Forest Ecology and Management. https://www.sciencedirect.com/science/article/abs/pii/S0378112720314626

References

Mazerolle, Marc J. (2020) AICcmodavg: Model selection and multimodel inference based on (Q)AIC(c). R package version 2.3-1.

R - bar charts. Tutorialspoint. (n.d.). https://www.tutorialspoint.com/r/r_bar_charts.htm

Recreational Opportunities. The Ross Foundation. (2010). https://rossfoundation.us/recreational_opportunities.html#:~:text=Additionally%2C%20th e%20Ross%20Foundation%20also,Jack%20Mountain%20Wildlife%20Management%20Area.

R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. R version 4.0.3 (2020-10-10)

Ripley, Brian. (2021). tree: Classification and Regression Trees. R package version 1.0-41.

Rosenberg, K.V., Dokter, A.M., Blancher, P.J., Sauer, J.R., Smith, A.C., Smith, P.A., Stanton, J.C., Panjabi, A., Helft, L., Parr, M. and Marra, P.P., 2019. Decline of the North American avifauna. *Science*, *366*(6461), pp.120-124.

References

Sam, K., Koane, B., Bardos, D.C., Jeppy, S. and Novotny, V. 2019. Species richness of birds along a complete rain forest elevational gradient in the tropics: Habitat complexity and food resources matter. Journal of Biogeography 46: 279-290.

Stine, Robert A. "Graphical Interpretation of Variance Inflation Factors." *The American Statistician* , vol. 49, no. 1, Feb. 1995, pp. 53–56.

Wickham, H. ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag New York, 2016.

Questions?