BIRD DIVERSITY AND ABUNDANCE ON RECLAIMED SURFACE COAL MINES IN ALABAMA: TEMPORAL AND HABITAT RELATED VARIATIONS

Richard Borthwick[1] and Yong Wang

[1]Richard Borthwick, Research Associate, Alabama A&M University
rborthwi@bulldogs.aamu.edu

Introduction

- Mining can shape and change landscapes
- Economic value and rising energy demands
- Reclamation success is hard to define and measure
- Looked at avian response to reclamation on highly productive, small-scale, surface coal mines in northwestern Alabama.
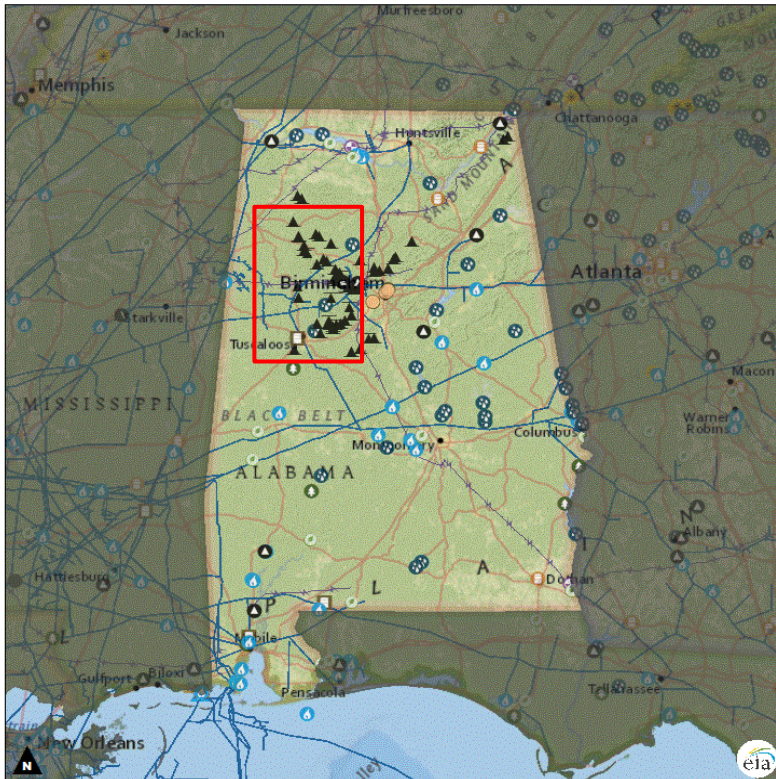
Objectives

- Contribute to cumulative effects information
- Identify species-specific habitat linkages
- Changes in diversity, richness and abundance through chronosequence and across habitats
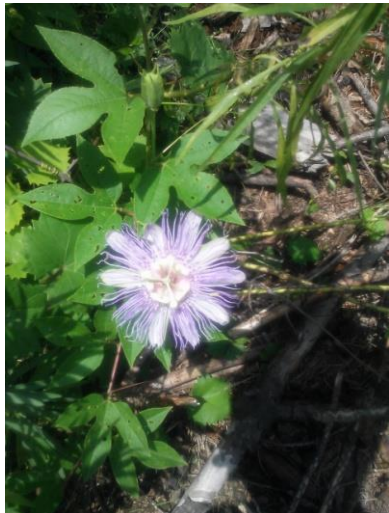
Methods

Grey Base:National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMC, USGS,

0   20   40   80 Miles

■ Mask	⊕ Hydroelectric Power Plant	⊕ Pumped Storage Power Plant
▲ Surface Coal Mine	⊕ Natural Gas Power Plant	✳ Solar Power Plant
⊥ Underground Coal Mine	⊕ Nuclear Power Plant	⊛ Wind Power Plant
⊚ Biomass Power Plant	● Other Power Plant	⊕ Wood Power Plant
⬢ Coal Power Plant	⬤ Other Fossil Gases Power Plant	☐ Petroleum Refinery
⊙ Geothermal Power Plant	⊖ Petroleum Power Plant	◇ Strategic Petroleum Reserve

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- ☐ Study area
  - ▫ Mine Site Selection
    - ■ Lemke et al. methods
      - ■ Permitted post-SMCRA
      - ■ Closed by 2008
      - ■ The Shale Hills Region
  - ▫ Land Use History-office collection and field collection
  - ■ Reclamation
  - ■ Time since reclamation

Methods

- Treatments
    - Habitat Type
        - Grassland (low density, CC, BA)
        - Conifer Forest (>60% Con)
        - Mixed Forest (<60% Con)
    - Time Categories, based on years since closure:
        - "Young" - <14 Years
        - "Medium" – 15-20 Years
        - "Old" - > 20 Years
- Sample point selection
    - Generalized Random Tesselation Stratification (GRTS) – Spatially balanced random site selection

Methods

- Point counts
  - Reuse sites established by Lemke et al. 2012
  - Better suited to patchy terrain and multiple species investigations
  - 15 min surveys, 3 min prep time
    - Surveys started 30 min before sunrise and proceed until 10:30am
- Bird Data
  - Species
  - Time of detection and intervals detected
  - Distance and behavior at time of detection

Methods

- Vegetation
  - $1/10^{th}$ of an acre circular plots (James and Shugart 1970)
  - Eight vegetation variables influencing songbird habitat were targeted (James and Wamer 1982)

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Statistical Analysis

- Diversity (Shannon 1948) and richness were calculated at each plot using "vegan" in the R software environment.

- General Linear Models were run to test time, habitat, and their interaction on habitat and species composition

- A principal component analysis (PCA) was conducted for habitat variables to assess their relationship and redundancy (Coetzee et al. 2009)

- Contrasts were done comparing non-mined sites with sites on reclaimed surface mines

Results – Diversity and Richness

- Highest in young grasslands, and medium and old conifer dominant forests.

- Significantly higher than young conifers

- Richness followed the same trends
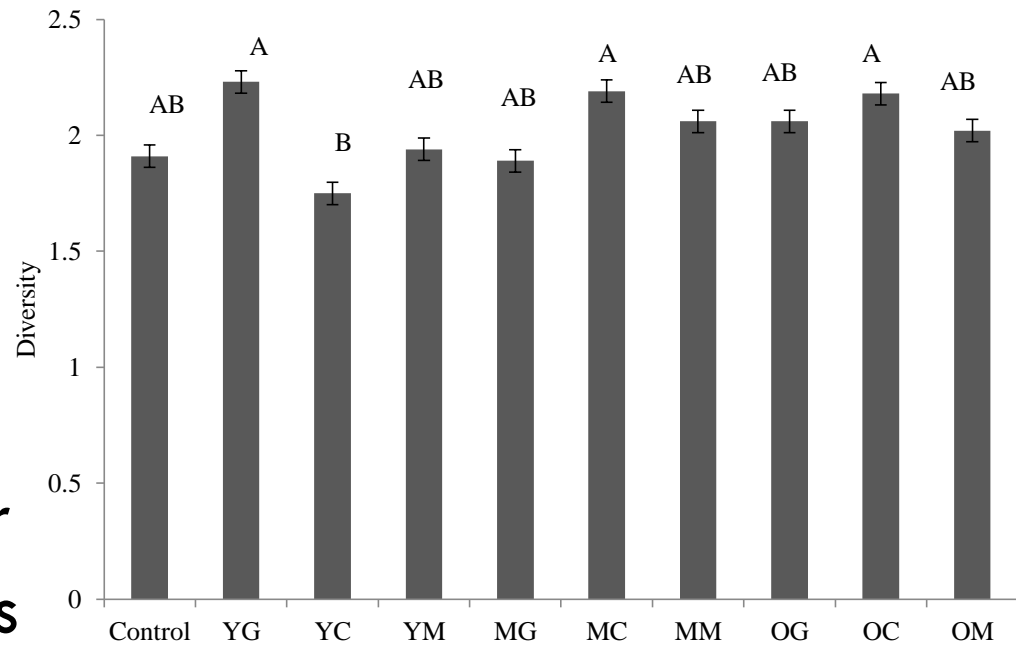
Results – GLM and Contrasts

☐ Species changed across treatments:

　☐ Significant changes:

　　■ 16 species showed interactive responses between time since mine closure and habitat type

　　　■ BANS, BGGN, BLGR, BLJA, CARW, CHSP, COYE, EAPH, FISP, MODO, REVI, RHWO, RWBB, SUTA, WITU, WEWA.

　　■ 3 Species showed habitat responses: CACH, DOWO, and PIWA

　　■ 2 Species showed temporal responses: PIWA and YBCH

☐ Mined Vs. Non-mined

　☐ 7 species showed response to mined sites versus controls

　　■ Carolina Chickadee, Red-Headed Woodpeckers, Chipping Sparrow, Field Sparrow, Hooded Warbler, Pine Warbler, Prairie Warbler

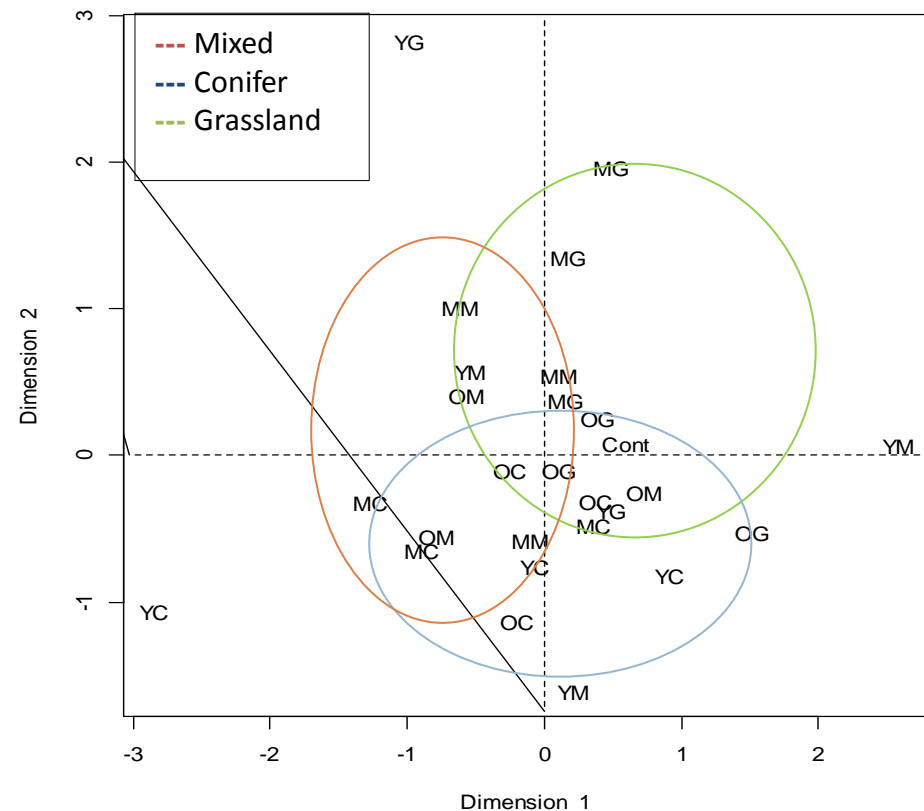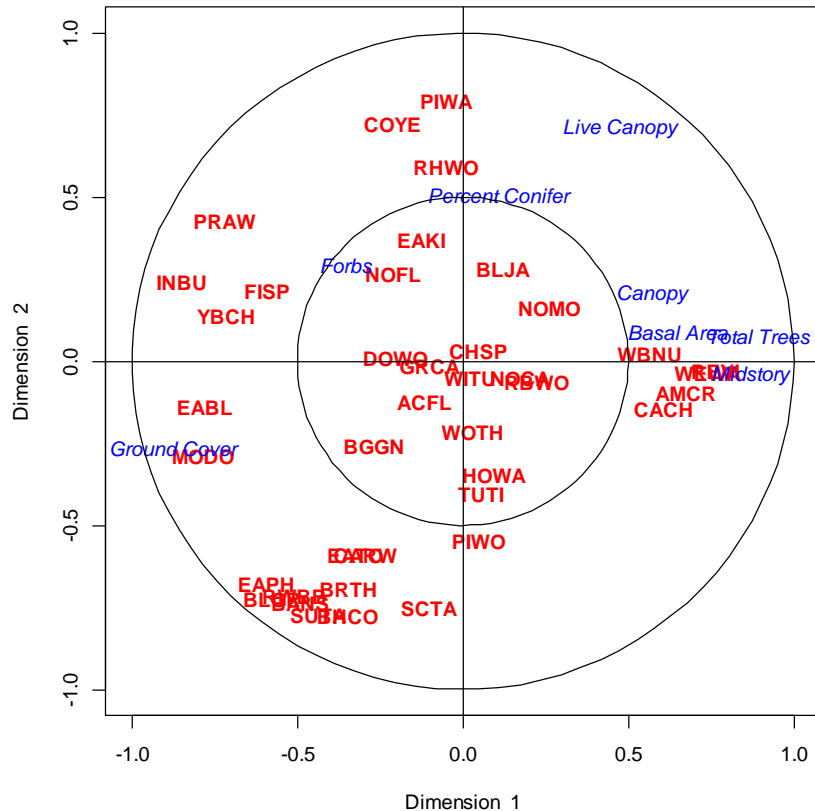　　■ Only two negative responses
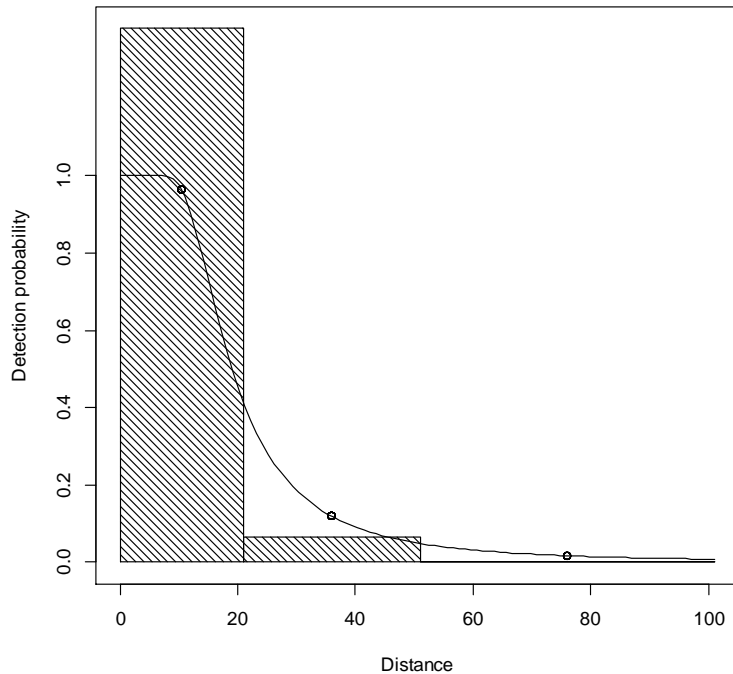
Results – GLM Interactions
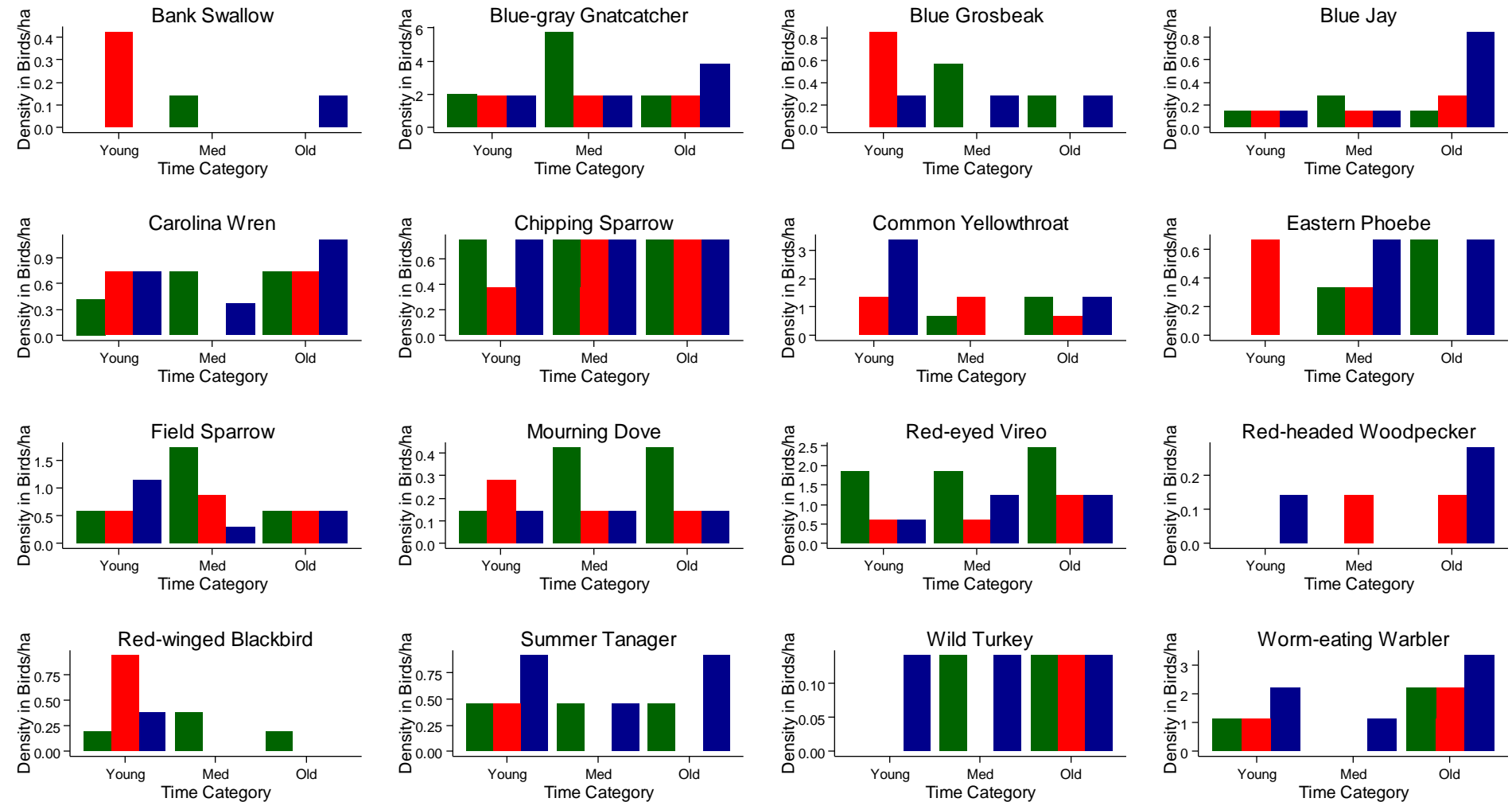
Results - CCA

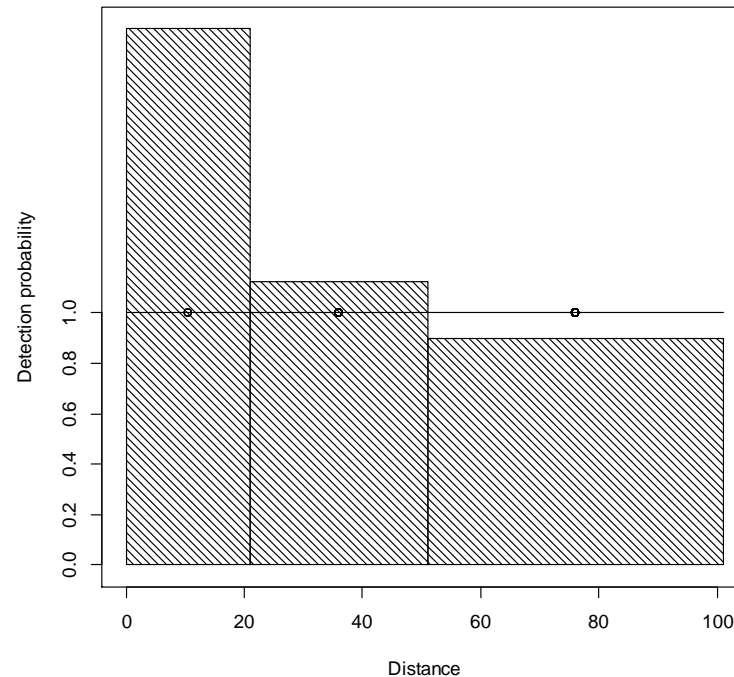□ Canonical Correlation Analysis (CCA) was used to assess the relationship between habitat variables and bird species

Results – Abundance and Density

☐ Abundance was estimated using the "Distance" package within the R environment - no covariates

Discussion – Species Time Responses

- Average diversity increased through time
  - Increasing complexity
  - Reflective of a restorative process
- Individual species responded generally as expected
  - Grassland birds responded better earlier
  - 15-20 years appeared to be the sweet spot
    - Intermediate Disturbance Hypothesis
    - Disturbance dependence
    - Mixed vegetation
    - Thick midstory
    - Moderate canopy
- Coarse-scale surveys had limitations
  - No link between species and habitat
  - Ordination techniques are important for support

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