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

Richard Borthwick\textsuperscript{1} and Yong Wang

\textsuperscript{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

- **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
  - 1/10th of an acre circular plots (James and Shugart 1970)

- Eight vegetation variables influencing songbird habitat were targeted (James and Wamer 1982)
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, REV, 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

Bank Swallow

Blue-gray Gnatcatcher

Blue Grosbeak

Blue Jay

Carolina Wren

Chipping Sparrow

Common Yellowthroat

Eastern Phoebe

Field Sparrow

Mourning Dove

Red-eyed Vireo

Red-headed Woodpecker

Red-winged Blackbird

Summer Tanager

Wild Turkey

Worm-eating Warbler
Canonical Correlation Analysis (CCA) was used to assess the relationship between habitat variables and bird species.
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
Acknowledgements

- Alabama A&M University
- Alabama Ornithological Society
- Alawest
- Birmingham Audubon Society
- Department of Conservation and Natural Resource
- Saga Petroleum
- USDA Forest Service
- Westervelt Company