

The background is a traditional Chinese ink wash painting on a light yellowish-green paper. It features several stylized pine trees with dark green, textured foliage and dark brown, gnarled trunks. In the upper right corner, three birds are depicted in flight, rendered with simple black lines. The overall style is minimalist and elegant.

Effect of Habitat Change in Quay Woods on Avian Species Diversity and Community Similarity

Team 4

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Introduction

- In 1938, Dr. Quay utilized a complete census method whereby he aimlessly wandered through the plots and recorded all the birds seen and heard.
- Raleigh is developing quickly
 - ⊙ 3rd fastest growing metropolis in the U.S.
 - ⊙ 1st largest population increase in the U.S. in 2006.
- The development on Centennial Campus is changing the habitat composition of Quay Woods by further fragmentation and habitat conversion

Objectives

- Explore the effects of fragmentation and habitat change have on bird species diversity and difference between deciduous and pine stands
- Explore the effects of habitat change and time on bird species diversity and the similarity of deciduous and pine stands

Winter Bird Survey


- Methods: point counts, frequency sampling, and transects (distance observations)
- Possible error: differences in observers, time of day, duration, and season of the year
- Double-observer method reduces error



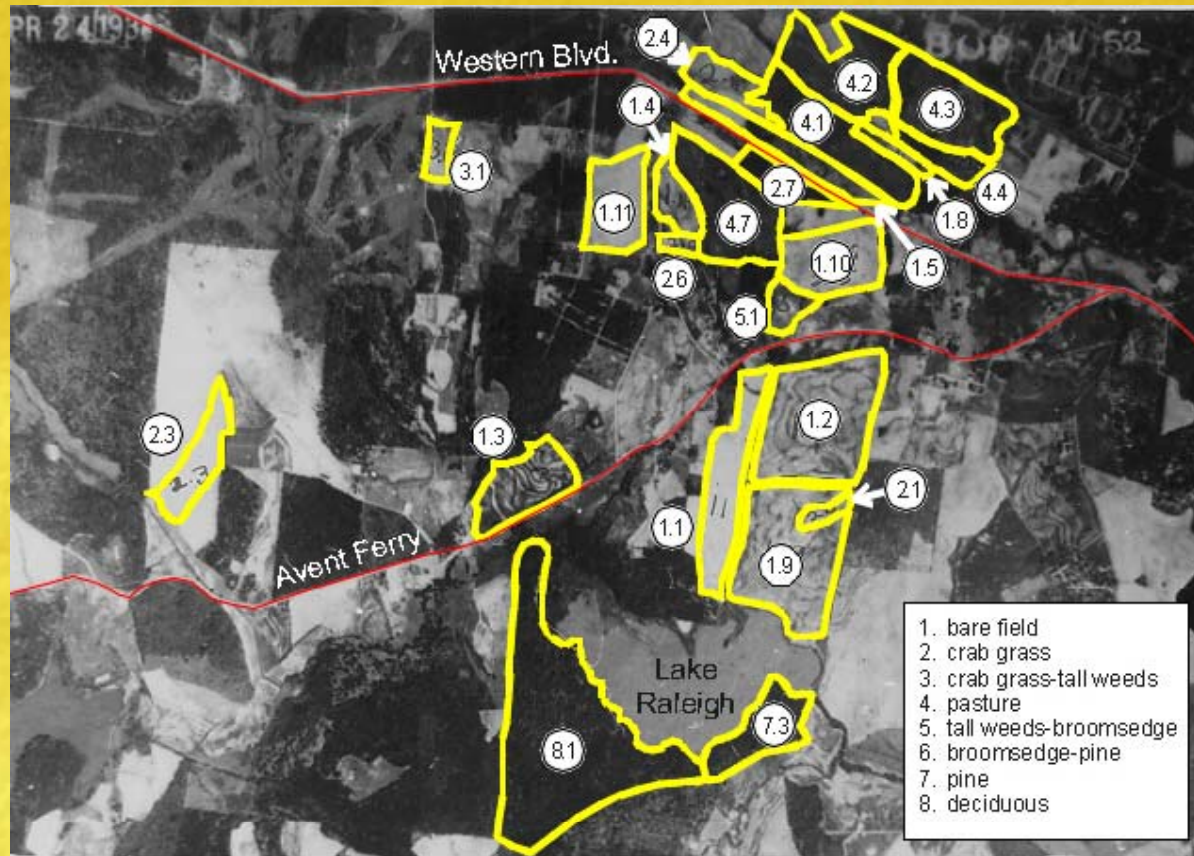
Contiguous Habitat v. Fragmented Habitat

- Fragmentation affords opportunities for predators and nest parasites.
- Contiguous habitat provides nesting and foraging opportunities for species that select for interior or edge.

Pine v. Deciduous

- Heterogeneity of habitat, such as mixed stands or ecotones, foster diversity and abundance of avifauna.
 - Monoculture single-aged pine stands with little undergrowth have a lower diversity of avifauna
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Study Area



Study Area

- 1938, Dr. Thomas Quay wanted to “determine the ecological succession of winter birds in relation to the plant succession of upland areas”.
- Quay’s study area on Centennial was originally rural and agricultural.
- The study area has been changed by:
 - ⊙ Fragmentation
 - ⊙ Development
 - ⊙ Succession

Study Area



- Plots 8.1 and 7.3 located to the south and west of Lake Raleigh.
 - ⊙ Plot 8.1: Deciduous
 - ⊙ Plot 7.3: Pine
- Points
 - ⊙ Plot 8.1: points 4 - 10
 - ⊙ Plot 7.3: points 1 - 3



Methods of Sampling

Fixed Radius Point Counts


Complete Census

Vegetative composition





Fixed Radius Point Counts

- 100 m radius and 250 m apart.
 - Three points in pine forest plot (7.3 as described by Quay 1938)
 - Seven points in the oak forest (8.1)
 - Points stratified by elevation and habitat characteristics, then chosen at random.
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Fixed Radius Point Count

● Assumptions

- ⊙ Points are independent
- ⊙ Points are randomly located
- ⊙ Equal detectability of species
- ⊙ Closed population

Double Independent Observer Method

● Assumptions:

- ⊙ The population is closed
- ⊙ There are no matching errors
- ⊙ The observers are independent

Complete Census

- Two independent teams, one per plot
- Set time of census, same day and conditions
- Observers randomly wandered until total area was covered

Complete Census

● Assumptions

- ⊙ Closed population
- ⊙ Equal and complete detection of each species
- ⊙ Observer proficiency
- ⊙ No redundancy




Vegetative Composition

Percent pine: the estimated percent pine spp. within a 100 m. radius of each point

Basal area: the index of basal area in square feet per acre at each point using the Bitterlich method

Openness: the estimated percent understory openness of a site determined by the observer in regards to how dense the understory was, recorded in 5 categories



Analysis Methods

- SAS, with independent variables as percent pine, basal area, and openness. Dependent variables; total number of species at each point, total number of birds at each point
- Analysis of Covariance, t-test
- Non-experimental multiple regression analysis using FORWARD, MAXR, and RSQUARE variable selection techniques

Analysis Methods

- PC-ORD cluster analysis and detrended correspondance analysis
- Chi-square analysis of census results
- Shannon-Weiner Diversity Index analysis of census results

Shannon-Weiner Diversity Index

- 2007 Deciduous Plot Census had the highest diversity ($H' = 2.8$)
- 1938 Pine Plot Census had the lowest diversity ($H'=1.71$)
- 1938 Deciduous plot census and the 2007 Pine plot census were identical in their diversity ($H' = 2.27$)!!!
- Possible explanation: after over 60 years of succession within the pine plot, it has probably attained a structure similar to the early successional deciduous plot in 1938.

Results

- Detection Probability
- Point Count Data
- Complete Census Data

Detection Probability

Figure 1: Average Probability of Detection for Each Group Member

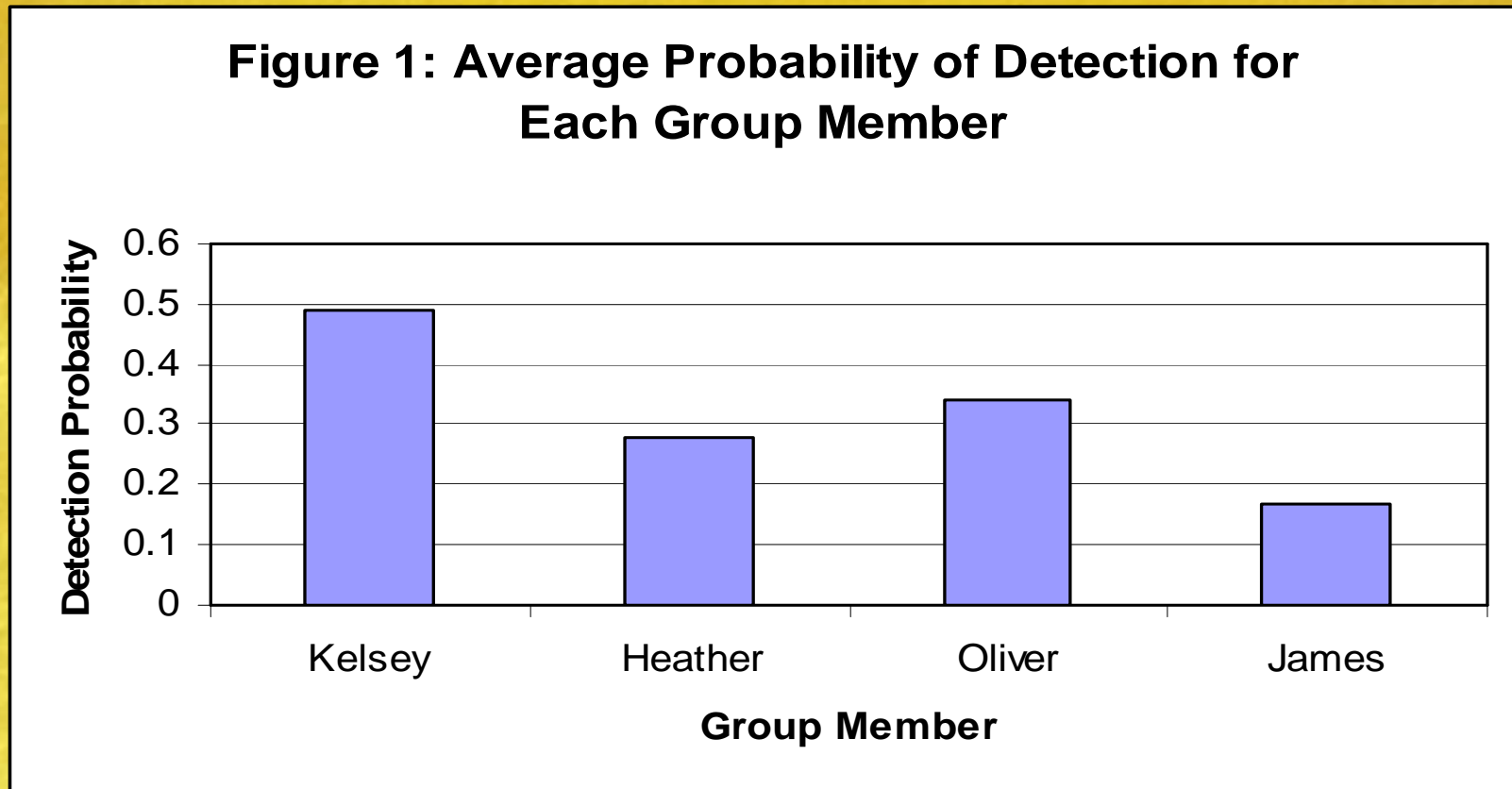
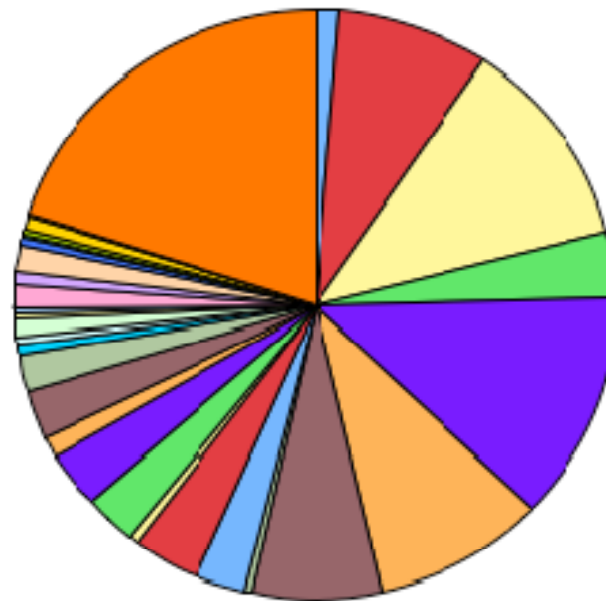


Figure 2: Total Number of Birds for all Points and Days



- Canada Goose
- Carolina Wren
- Northern Cardinal
- Eastern Towhee
- Carolina Chickadee
- Pine Warbler
- American Crow
- Goldfinch
- Mallard
- Golden Crowned Kinglet
- Warbler spp.
- American Robin
- Eastern Phoebe
- Blue Jay
- Red-bellied Woodpecker
- Hairy Woodpecker
- Wood Pecker
- Wood Thrush
- Mourning Dove
- Scarlet Tanager
- Acadian
- Flycatcher
- Field Sparrow
- Common Grackle
- Song Sparrow
- Red Tailed Hawk
- Northern Flicker
- White-throated Sparrow
- Whip-poor-will
- Winter Wren
- Unidentified Bird

Point Count Data continued...

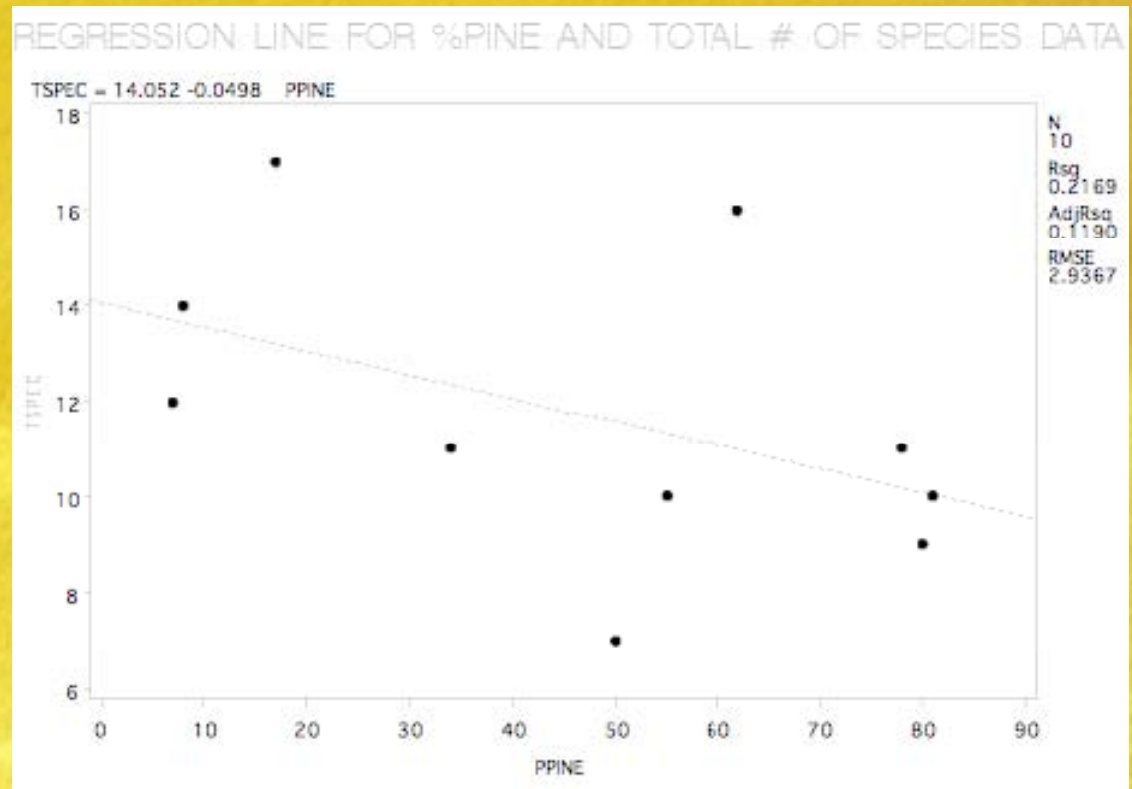
- Point 8 and 9 (in deciduous plot 8.1) had the greatest number of species ($n=17$).
- Point 2 (in pine plot 7.3) had the least ($n=7$).
- Point 5 (deciduous drainage pond) had the greatest number of recorded birds ($n=43$).
- On average the deciduous plots showed a greater species composition than the pine plots.

Vegetation Data

Point 3 (pine plot 7.3) had the most dense understory.

Failed to find a significant difference between the two groups of plots based upon percent pine composition ($p=0.17507$).

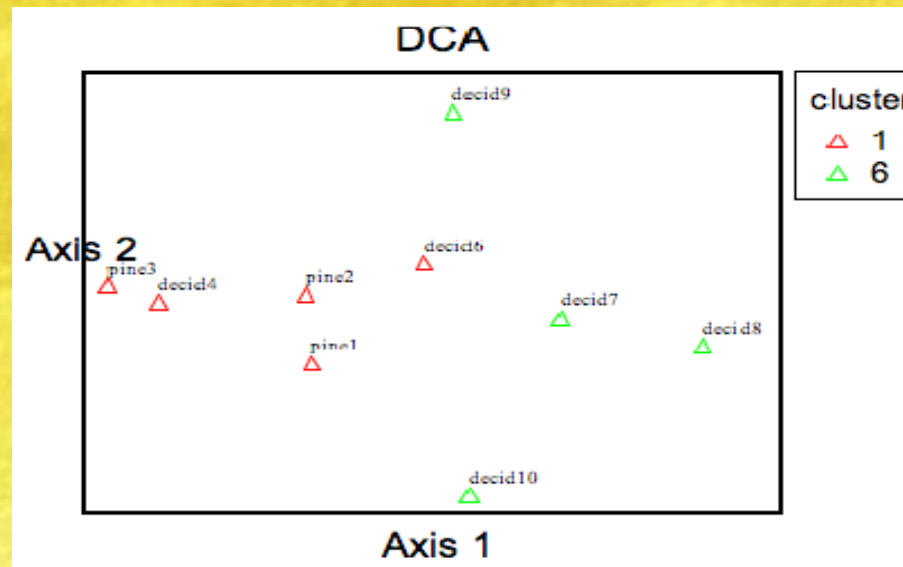
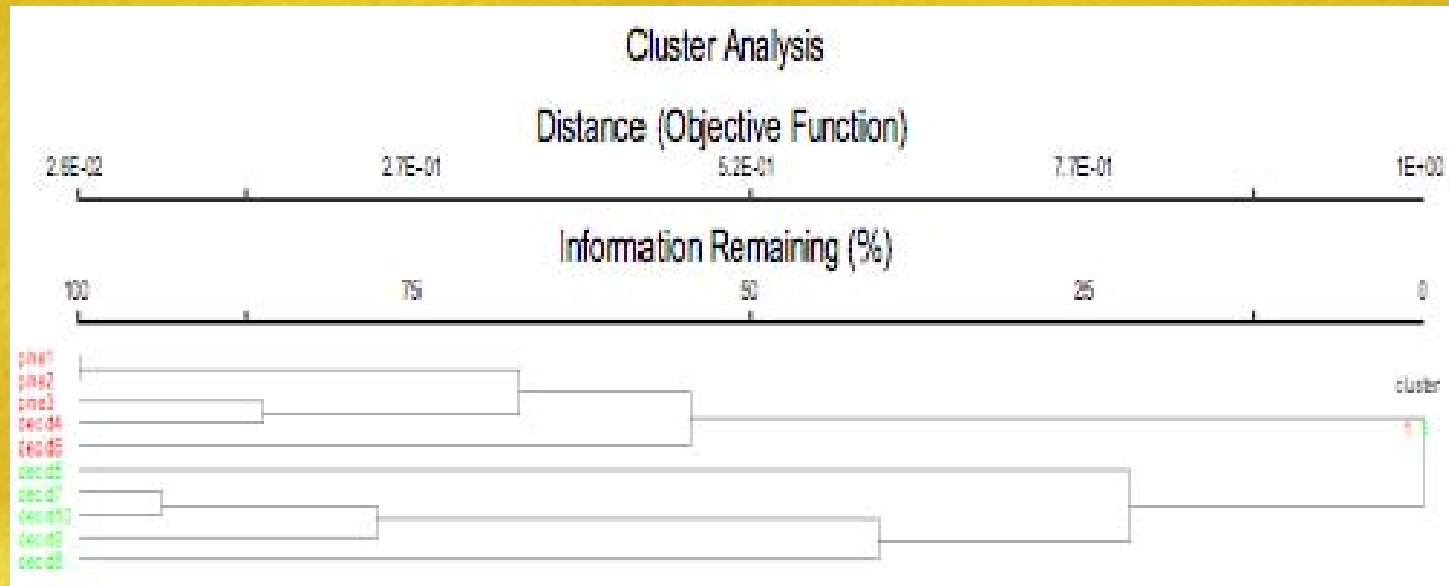
None of our habitat characteristics are correlated with our dependent variables.

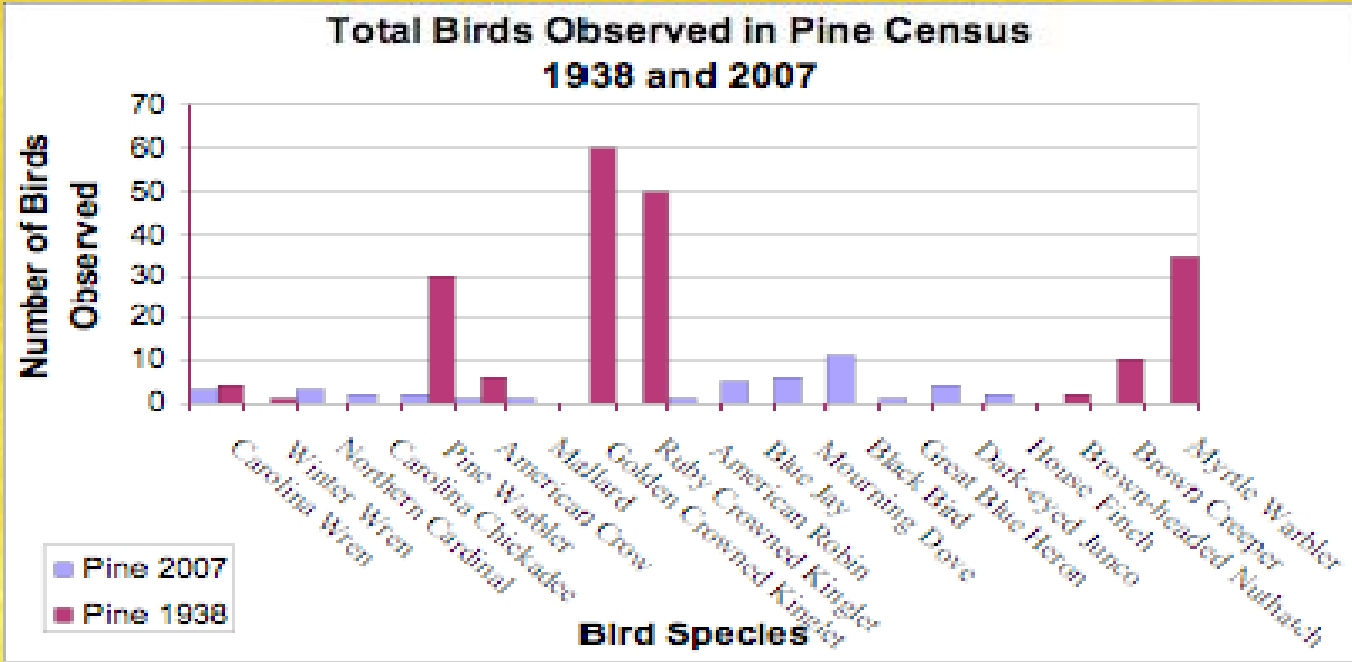
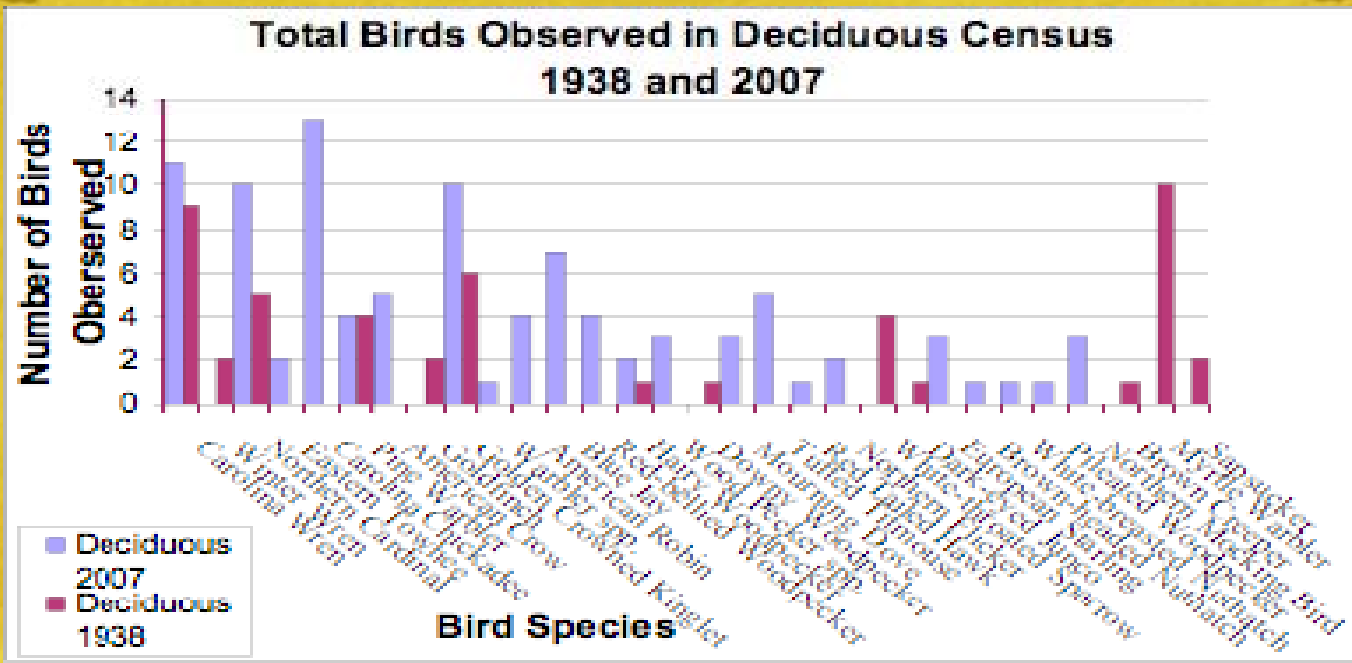


Complete Census Data

- 5 species were recorded in plot 7.3, while 11 species were recorded in plot 8.3.
- 11 species occurred in point count surveys that did not occur in the census.
- 10 species occurred in the censuses that did not occur in the point count surveys.

Dendrogram and Ordination Diagram





Reasons for Low Detection Probability

- Small Sample size
- Study area
- Identification skills increasing with time can lead to low initial counts and higher counts later
- Bird response to sampling movement




Species Composition/ Coniferous

● Census to Census:

◎ 1938 census results lists 6 species seen not seen in 2007

◎ 2007 results show 10 species not found in 1938



Species composition/ Deciduous

● Census to Census:

- ⊙ Eight species found in 1938 census not found in 2007
- ⊙ 17 species seen in 2007 census not found in 1938
 - Species range expansion
 - Difference in seasonal sampling
 - False detections inflating species counts

False Detection

- Our most commonly recorded bird:
“Unidentified Bird”
- Spring Migrants, (i.e. scarlet tanager)
- Experience is the name everyone gives
to their mistakes –Oscar Wilde

Assumptions

- Detection Probability at the center of the plot is 1...
- Distance to each detected bird is recorded accurately
- Birds do not move in response to the observer prior to detection

Complications

- Vegetation density
- Activity and singing level of birds
- Inexperience of observers

60 years have gone by...

- 60 years of succession may affect species range and composition
- 60 years of NC State, Raleigh and America growing and expanding
- Background noise has undoubtedly increased in these plots... I-440

Thank You Very Much !!

