BODY CONDITION OF SPRING MIGRATORY FEMALE NORTHERN PINTAILS AND MEASURES OF PLASMA LIPID METABOLITES TO ASSESS HABITAT QUALITY IN THE RAINWATER BASIN

Dustin J. Casady
Department of Biology
University of Nebraska at Kearney
Advisor: Dr. Letitia M. Reichart

Photo by M. Vesey

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Northern Pintails

- **Northern Pintail**
  - Medium sized with long, thin neck
  - Sexually dimorphic – females brown/tan

- **Omnivorous** – plant material, seeds, invertebrates
  - Plants and seeds provide the majority of lipids
  - Invertebrates provide most of the proteins

Source: Mery Casady
Source: www.ducks.org
Wintering Grounds

- **Playa Lakes region**
  - New Mexico and Texas

- **Gulf Coast region**
  - Mexico, Texas and Louisiana.
Breeding Grounds

- North America and Northern Eurasia
  - South Dakota to Alaska to the Hudson Bay
  - Northern Europe and Asia

Source: jnaoutfitters.com

Importance of Stopover Sites

• Allow migrants to rest & refuel

• Fall stopover
  – Meet energetic requirements
    • ↑ Survival

• Spring stopover
  – Meet energetic requirements
    • ↑ Survival
  – Increase lipid reserves
    • ↑ Reproductive success

Source: J. Drahota

Source: Mery Casady
(Myers et al. 1987, Gersib et al. 1992)
Current Role of RWB

• Resting area and food resources for 7-10 million waterfowl
• Support nutrient reserve acquisition for spring migration

Source: birdwatchireland.ie

Source: Mery Casady

Source: sdakotabirds.com

Source: www.ttlwithchrisgamel.com

(Gersib et al. 1998)
Northern Pintail Population

• Population goal set by North American Waterfowl Management Plan (NAWMP)
  – Current 3.3 million pintail, goal 5.6 million pintail

• Possible reasons for decline
  – Nesting in grain stubble
  – Depredation of nests
  – Disease
  – Changing agricultural trends
  – Lack of nutrient acquisition on stopover sites

(Gersib et al. 1998, Newton 2006, USFWS 2013)
Northern Pintail Population

Average latitude for nesting pintails

Recruitment reflected as carrying capacity by latitude

Runge and Boomer 2005
Nutrient Reserves

• Migration and Reproduction are energetically expensive

• Recruitment
  – Early arrival on breeding grounds better
  – Nest early better

• Stopover site (RWB)
  – Provide rest and cover
  – Support pair formation
  – Fat acquisition (carbohydrates) eating high energy foods (95% seeds)

Photo by M. Vesey

(Pearse et al. 2011)
Importance of Nutrients

• Fat stores
  – Supports survival and migration
  – Provides an energetic advantage
    • ↑ Survival
    • ↑ Successful reproduction

• Protein
  – Less important as an energy resource
    • Important in egg formation
  – ↓ food available will catabolize protein

(Anteau and Afton 2008)
Study Objectives

• BODY CONDITION OF SPRING MIGRATORY FEMALE NORTHERN PINTAILS IN THE RAINWATER BASIN

• USING PLASMA LIPID METABOLITES OF SPRING MIGRATORY FEMALE NORTHERN PINTAILS IN THE RAINWATER BASIN TO ASSESS HABITAT QUALITY
Body Condition in RWB

• Body Condition
  – Mass
  – Total Fat
  – Total Protein

• Relationships tested
  – Age Class
  – Date Collected
  – Region Collected

Source: Dustin Casady
Variables

• Age Class
  – After Hatch Year (AHY) versus Hatch Year (HY)

• Date Collected
  – Early Arrival versus Late Arrival

• Region Collected
  – Eastern Basins versus Western Basins
Age Class

• After Hatch Year (AHY) versus Hatch Year (HY)
  – Determining Age
    • Secondary covert – barring
    • Tertial coverts
      – frayed
      – narrow or wide
    • Speckling on bill

• Significance of Age Class
  – AHY birds
    • are more likely to nest
    • arrive earlier to breeding grounds
    • nest earlier
    • more likely to re-nest
    • lay larger clutches

Date Collected

• Early vs. Late Arrival
  Separated by peak of migration
  (Drahota and Casady unpublished)

• Significance
  – Early arrivals to breeding grounds
    • More likely to nest
    • Best nesting areas
    • ↑ nest success
    • ↑ survival

(Ankney and MacInnes 1978, Raveling and Heitmeyer 1989, Goudie and Jones 2005, Drent et al. 2006)
Region Collected

• Eastern Basins versus Western Basins
  – Divided by Highway 281

• Sub-populations
  – Gulf Coast = Eastern Basins
  – Playa Lakes = Region Western Basin

(Pearse et al. 2011)
Collection

- 160 female pintail
- WPA’s and WMA’s that had ponded water
- Both eastern and western basins
- Both early and late
- Field Mass
- Morphological Measurements
  - Culmen, head length, tarsus, and wing cord
- Body Condition Analysis
  - Plucked feathers
  - Removed ingested materials
  - Removed portion of liver

Source: Mery Casady

(Anteau and Afton 2008)
Whole Body Condition

- Long Point Waterfowl
  - Carcass Wet Mass
  - Total fat
    - Petroleum ether
  - Ash
    - Muffled furnace
  - Total protein
    - Ash subtracted from lean dry mass

Source: longpointwaterfowl.org
Correcting for Structural Size

• Principal Components (PC) Analyses
  – Combines Morphological Measurements
  – PC1 explained 58.4% of variation in structural size

• Regressed PC1 values
  – Mass and Protein correlated
  – Total Fats not correlated
  – Corrected for structural size
  • $Y_{\text{obs}} - (a + b \times (\text{PC1})) + \bar{Y}_{\text{obs}} \cdot Y_{\text{obs}}$
  – Corrected values were used
Analyses of Body Condition

• Variables
  – Tested normality (Shapiro-Wilk’s test)
  – Tested variance (Levene’s test)
  – Log transformed to achieve normality
  – Non-parametric if failed to meet criteria

• Statistical test
  – Parametric = ANOVA
  – Non-parametric = Wilcoxon rank-sum tests
Results

• Total Fat of AHY birds Early vs. Late (mean mass 683.3 g ± 8.4)

• Early AHY birds had ↑ Total Fat ($F_{1,73} = 5.460, P = 0.022$)
Results

• % Fat of AHY birds Early vs. Late

• Early AHY birds ↑% Fat ($F_{1,73} = 6.253$, $P = 0.015$)
Discussion

• **Significant Relationship**
  – Early AHY birds ↑ Body Condition

• No Date of Collection relationship for HY birds
• No Age Class relationship
  – Similar to Playa Lakes Region
  – Research needed for Gulf Coast
• No Region Collected relationship
  – Similar conditions between regions of wintering grounds

(Smith and Sheeley 1993, Moon and Haukos 2009)
Discussion

• AHY birds
  – Early = Better Body Condition
  – Support Recruitment
    • More likely to nest
    • Better condition get best habitat
    • Higher nest success
    • More likely survival
  – Supports Carry-over Effect
    • Body Condition of AHY show same pattern in the RWB compared to breeding grounds
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Assessing RWB Habitat

• Plasma Lipid Metabolites
  – Triglycerides
  – β-Hydroxybutyrate

• Relationship of Metabolites
  – Age class
  – Date collected
  – Region collected

Plasma Lipid Metabolite Levels

• Nutrient intake exceeds nutrient use
  – Triglycerides in plasma ↑
  – Fat being deposited into adipose tissue
    • Esterification – formation of triglycerides

• Nutrient use exceeds nutrient intake
  – β-hydroxybutyrates in plasma ↑
  – Fats being broken down to be used as energy
    • Lypolysis – break down of triglycerides

(Guglielmo et al. 2002, Anteau and Afton 2008)
Collection of Plasma

• Cardiac Puncture
  – Centrifuge to separate plasma from serum
  – Plasma kept at -20°C

• Influence of habitat on body condition
  – > 2 hours after morning feeding period

Collection Restraints

• Plasma Lipid Metabolites Factors
  – Capture stress
  – Migratory Flight
  – Overnight fasting

• Reducing these factors
  – Lethal methods
    • ↓ capture stress
  – Observe foraging
    • ↑ odds ingesta of habitat is changing metabolites
  – Collect >2 hours after sunrise
    • Avoids collecting new arrivals
    • Avoids influence of fasting

(Anteau and Afton 2011)
Plasma Lipid Metabolite Analyses

• Endpoint assays (microplate spectrophotometer)
  – Total Triglycerides – Glycerol = Triglycerides

• Kinetic assays (microplate spectrophotometer)
  – β-hydroxybutyrate

Results

• Triglycerides of HY birds Early vs. Late

• Early HY birds ↑ triglycerides ($Z = 2.679, P = 0.007$). This suggest habitat provides more resources for early HY birds.
Results

- **β-Hydroxybutyrate of HY birds Early vs. Late**

  ![Graph showing comparison of β-Hydroxybutyrate levels between Early and Late HY birds](image)

  - **Early HY birds** ↓ β-Hydroxybutyrate ($F_{1,82} = 6.270, P = 0.014$). This suggests habitat provides more resources for early HY birds.

  ![Graph showing β-Hydroxybutyrate levels for AHY birds](image)

  - β-Hydroxybutyrate of AHY birds ($F_{1,74} = 2.48, P = 0.12$).
Discussion

• No Age Class relationship

• No Region Collected relationship
  – Similar conditions existed between eastern and western basins

• No Date of Collection relationship for AHY birds
  – Body Condition may only need to be maintained

(Smith and Sheeley 1993, Moon and Haukos 2009)
Discussion

• HY birds
  
  **Early** = ↑ Triglycerides & ↓ β-Hydroxybutyrate
  
  – Habitat provides greater likelihood of accumulating lipids for early HY birds
  – Early birds have access to ↑ food resources
  – Supported by research on seed depletion

(Drahota 2012)
Management Implications

• ↑ habitat quality throughout spring migration
  – Late arriving birds have ↓ forage available (Drahota 2012)

• Land management and protection efforts to continue
  – Grazing, haying/shredding, and spraying
  – Acquisition, Easements, Private Lands initiatives that increase ponded water

• Restoration Practices to Continue
  – Temporary ponding initiatives
  – Sediment removal
  – Restoring Hydrology
  – **Supplementing Water**
Management Implications

• Maintain current resource management for early birds
  – Lipids can be maintained
  – Lipids accumulation is occurring
  – No additional resources needed

• Add resources for late birds
  – $\uparrow$migration success
  – $\uparrow$nesting likelihood
  – $\uparrow$reproductive success
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Literature Cited

Protein

Oneway Analysis of CR-Protein By Early/Late Age=AHY

F = 2.503, P = 0.118

Oneway Analysis of Log 10 CR-Protein By Early/Late Age=HY