PRIMARY FEATHER MOLT PATTERNS IN FLAMMULATED OWLS (*PSILOSCOPS FLAMMEOLUS*) OF THE PIKES PEAK REGION

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UNDERSTANDING AGE STRUCTURE

• Can change across space and time
• Relative ages of territorial vs. non-territorial males (floaters) important indicators of population stability (Ferrer et al. 2003)
• Ability to construct age-sex pyramid provides indicator to anticipate future population growth/decline (Caswell 1989; Holmes and York 2003)
• Early warning sign for changes in health of population
• Crucial for future conservation/management
MOLT & ENERGETICS

• 3 processes in annual cycle: **molt, breeding, migration**
  
  • Energy taxing → mutually exclusive (Kendeigh 1949; Pietiäinen et al. 1984)

• Feathers retained for at least one year & deteriorate (Newton 2009; Zuberogoitia et al. 2013)
  
  • Must be replaced annually (molt)
  
  • Varies by taxa, age, sex (Pyle 1997)
  
  • Crucial for successful migration (Berthold 1975)

• Known patterns = indicators to understand age structure (Ricklefs and Rohwer 2005)
FLAMMULATED OWL
(PSILOSCOPS FLAMMEOLUS)

- Insectivorous, nocturnal, territorial raptor
- Neotropical migrant
- Indicator species in Western montane forests
- Age/breeding class structure unknown
- Primary molt sequences not extensively studied
Primary Question:
1. Is molt pattern a reliable indicator of sex and age class in Flammulated Owls?

Hypotheses:
1. Molt pattern will be similar to other small, migratory owls
2. Breeders will have more energy constraints and will molt fewer primary feathers than non-breeders
3. Molt process will commence in late nestling/early fledgling period and terminate prior to fall migration
STUDY AREA

- Ponderosa Pine (*Pinus ponderosa*) ecosystem
- Elevation = ~2500 m
- Summer breeding grounds
NEST DISCOVERY & OWL CAPTURE

• Nest discovery:
  • Examined cavity contents with camera
  • Observed nesting behaviors at night

• Capturing after hatching year (AHY) owls
  • At nests (breeders)
    • Males captured throughout nesting period
    • Females ONLY captured with homeothermic young (July)
  • In lure nets (mostly males – breeders & non-breeders)
    • Late May-late July, sometimes late August/September
  • UV light/primary wear examinations to assess molt patterns
**PRIMARY CONDITION ASSESSMENT UNDER UV LIGHT AND WEAR OBSERVATIONS**

**UV LIGHT**
- Causes Porphyrin pigments in feathers to fluoresce
- Rated on scale from 0-3:
  - 0 = dullest pink color (oldest feathers)
  - 3 = brightest pink color (newest feathers)

**PRIMARY WEAR**
- Describes degree of fraying and abrasions in primaries
- Rated on scale from 0-3:
  - 0 = no wear (newest feathers)
  - 3 = very worn (oldest feathers)
DATA ANALYSIS

- 9 years (2011-2019) of primary observations
- 553 observations, 371 unique owls
- 16 known age AHY owl (2\textsuperscript{nd}-6\textsuperscript{th} year) observations, 463 unknown age AHY
- 375 observations of primaries \textit{in molt}
  - 273 Breeding Males (3 known age)
  - 71 Breeding Females (2 known age)
  - 31 Floater Males (1 known age)
  - 74 HY
  - 104 Ambiguous (2 known age)
MOLT PATTERNS OF KNOWN-AGE BIRDS

- Sparse AHY known age bird observations
- Variations in date of observation
- Timeline and sequence of primary molt similar across known age classes
- No age-based molt patterns apparent with current data

\[ X^2(1, N = 18) = 0.112, p = 0.738 \] (for 2\textsuperscript{nd}- and 3\textsuperscript{rd}-year owls)

Molt observations of known age owls as broken down by year. Sample sizes for individuals observed by age (regardless if molt occurred) are as follows: 7 second-years, 2 third-years.
• Primary molt process of all Flammulated Owls began later in breeding season and continued just prior to fall migration
• Consistent across breeding status and sex
• Partial reflection sampling efforts: majority of captures in June & July
Primary molt is sequential
Consistent across sex and breeding class

Data analysis indicating a timeline of the months in which Flammulated Owls typically molted each primary feather. Numbers on top of the bars indicate sample size.
MOLT PATTERNS ACROSS SEX AND BREEDING CLASSES

- Significant difference between some groups
  - ANOVA \[ F(2,238) = 5.94, p = 0.003 \]
  - Floater males in molt (M = 0.722, SD = 0.461) significantly different from breeders
  - No significant difference between breeding males (M = 0.335, SD = 0.474) and females (M = 0.310, SD = 0.466) in molt

Graph depicts the percentage of molt observations indicating at least one primary feather was in molt in three groups of Flammulated Owls: breeding males (BM), breeding females (BF), and floater males (FM). Groups that do not share a letter are statistically significant.
DISCUSSION

• No apparent age-based molt patterns
  • Data lacking secondary molt pattern observations – potentially crucial to distinguishing age (Evans and Rosenfield 1987; Pyle 1997)
• Primary molt sequence like other migratory Strigidae
  • Burrowing Owl (Poulin et al. 2020) and Elf Owl (Ligon 1968)
• More floaters observed in molt than breeders
  • No parental obligations = more energy allocated to physical condition
  • Suspended molt in breeders? (Zuberogoitia et al. 2009)
FUTURE RESEARCH

• Investigate evolutionary differences between migrant and resident populations
  • Molt-breeding overlap cannot occur in long-distance migrant populations; more likely in resident populations with low intensity molt (Foster 1975; Rowher et al. 2009)

• Compare territory quality and examine molt scores in high vs. low quality territories
  • Molt may serve as indicator of territory quality (Espie et al. 1996)

• Compare molt scores in years of disturbance (i.e. fire, drought) vs. normal years
  • May serve as indicator of disturbance events (Barshep et al. 2013)
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