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

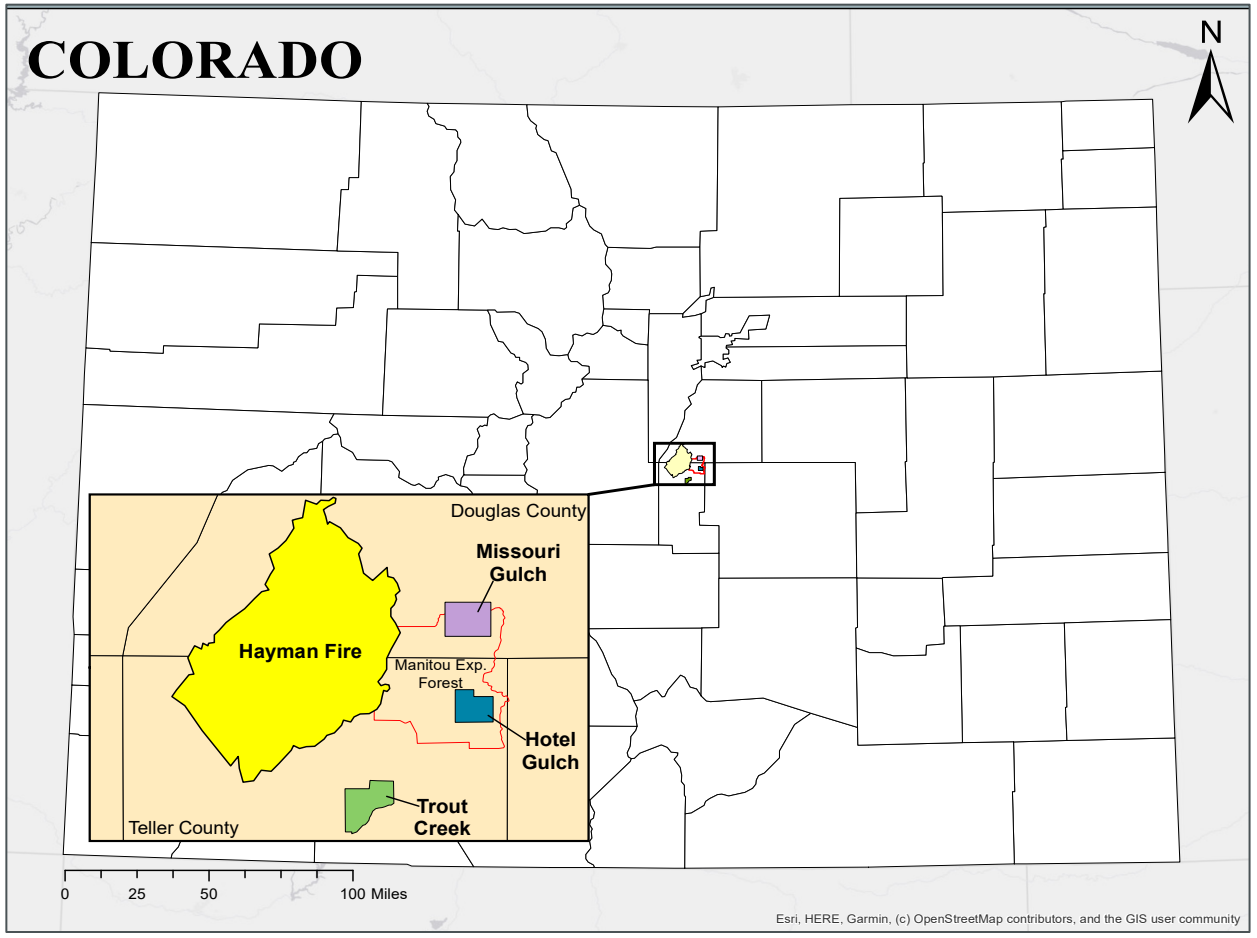
RESEARCH QUESTION AND HYPOTHESES

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

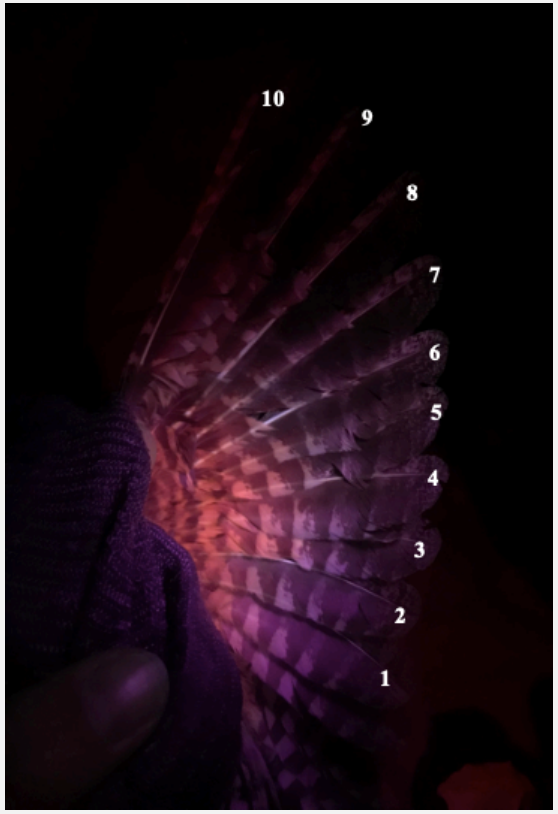
NEST DISCOVERY & OWL CAPTURE

- 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

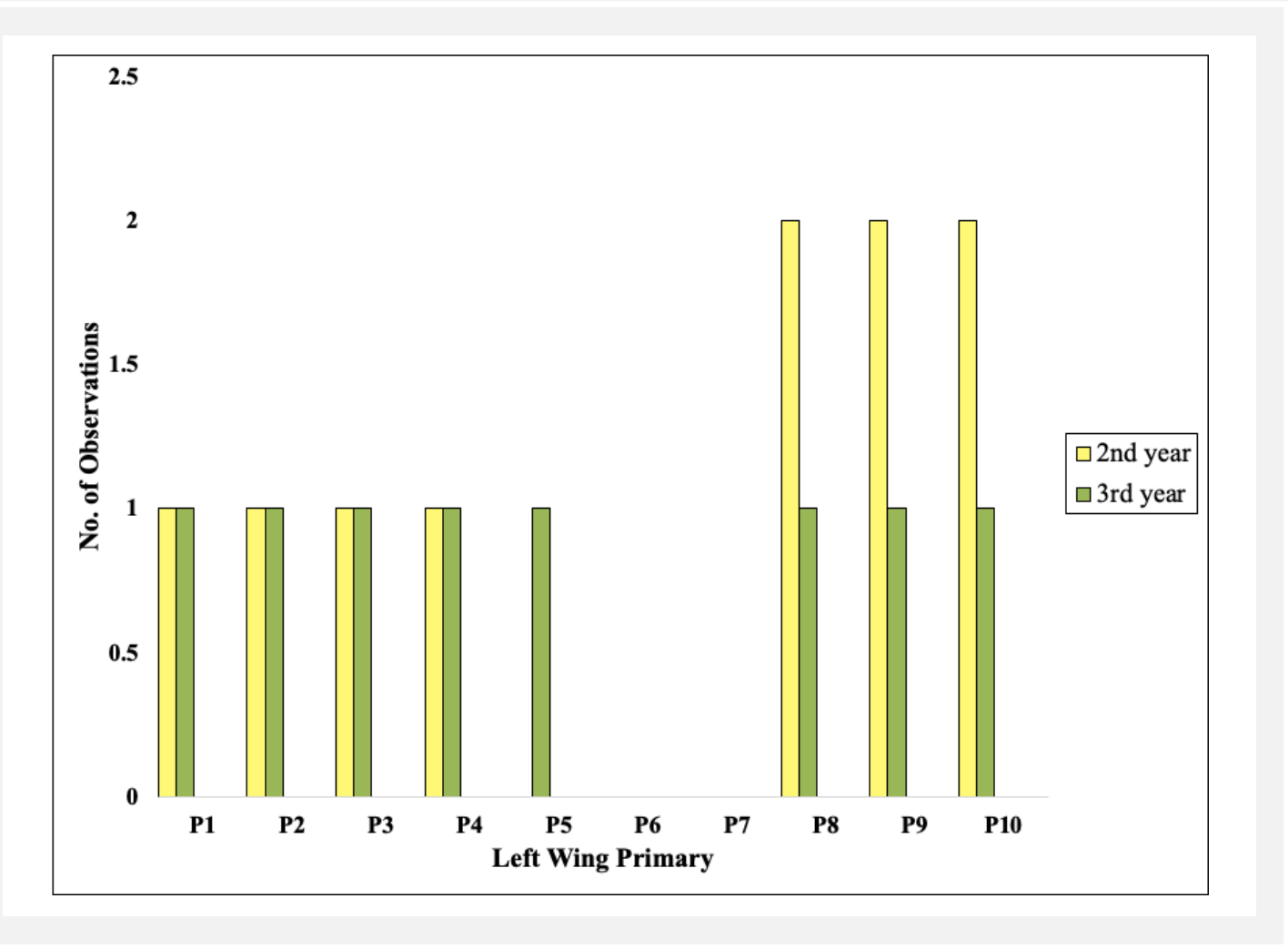
- Describes degree of fraying and abrasions in primaries
- Rated on scale from 0-3:
  - 0 = no wear (newest feathers)
  - 3 = very worn (oldest feathers)

DATA ANALYSIS

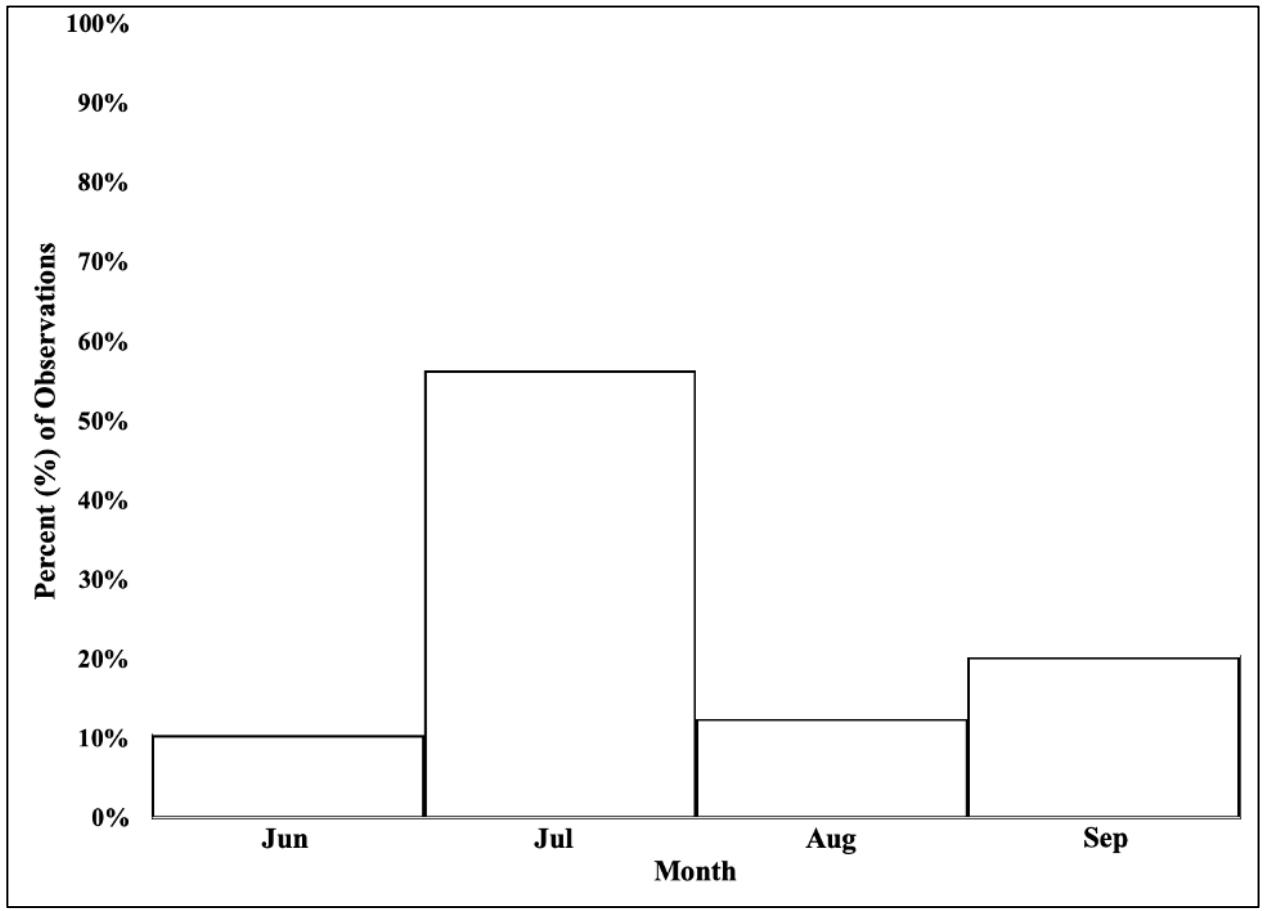
- 9 years (2011-2019) of primary observations
- 553 observations, 371 unique owls
- 16 known age AHY owl (2^{nd}-6^{th} year) observations, 463 unknown age AHY
- 375 observations of primaries *in molt*
  - 273 Breeding Males (3 known age)
  - 71 Breeding Females (2 known age)
  - 31 Floater Males (1 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 2nd- and 3rd-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

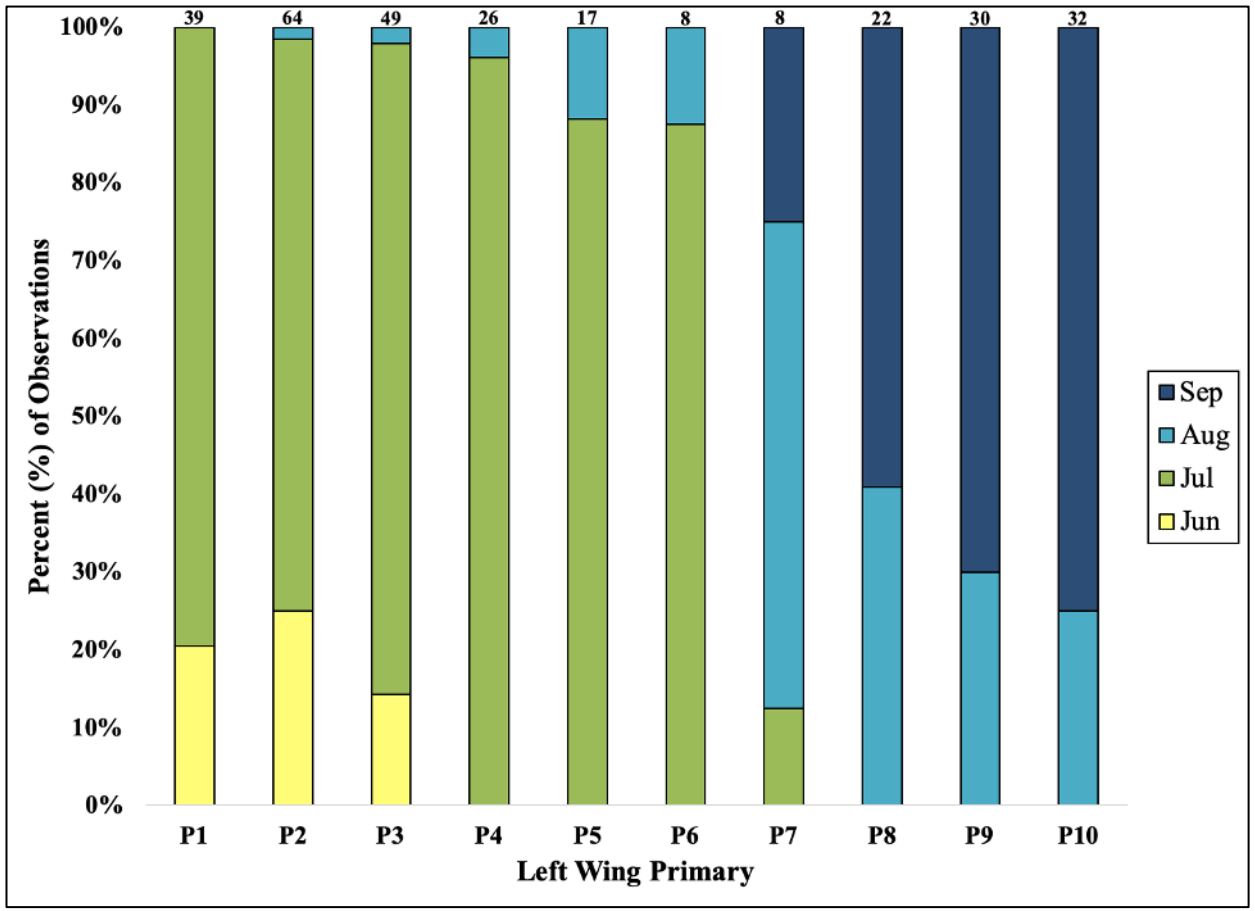


PRIMARY MOLT SEQUENCE

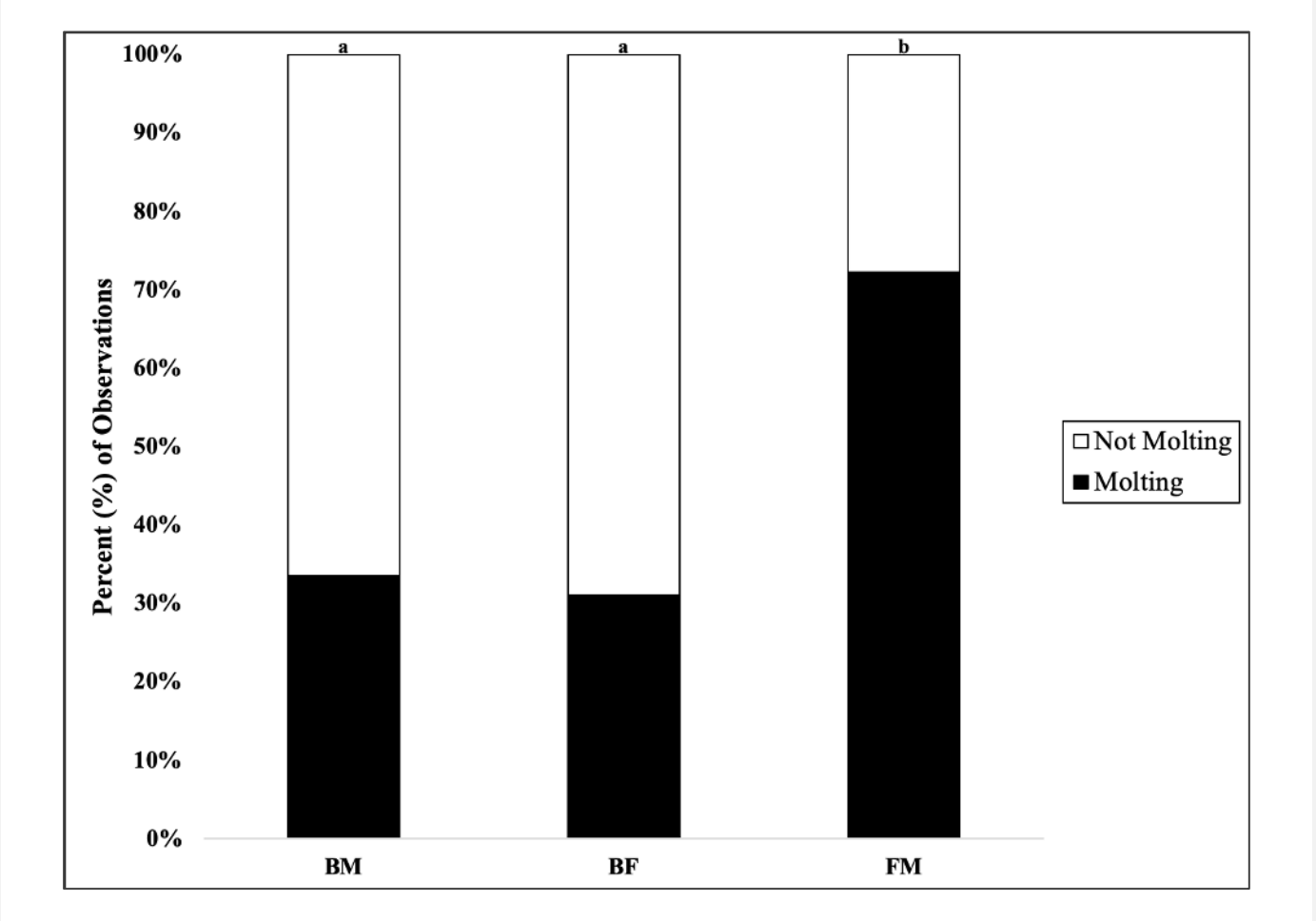
- Primary molt process of all Flammulated Owls began later in breeding season and continued just prior to fall migration
- Consistent across breeding status and sex
- Partial reflection sampling efforts: majority of captures in June & July

PRIMARY MOLT SEQUENCE TIMELINE

- 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.



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.

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

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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QUESTIONS?

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THANK YOU!