Natural History of Birds of Interior Alaska
Session 4: Monday, 1 October 2018

• Follow-up
• Breeding seasons (end)
• Fall migration (briefly)
• Wintering strategies in Interior Alaska
• Photos: Bohemian Waxwing, Dark-eyed Junco
Follow-up: Female song I

- White-crowned Sparrow
  - Rare, more variable relative to males
  - Territorial interactions with other females
  - Can be induced to much higher levels with testosterone treatment in captivity
  - Distinguishing males vs females in wild?
    - (head of female more gray (less white) and with marginally narrower mid-crown stripe)
Follow-up: Female Song II

• Dark-eyed Junco
  – Through 2016: “absent” or “rare”
  – Captive females: testosterone implants induce song
  – Resident population in San Diego, CA:
    • pre-laying females presented with caged female and recording of a female’s pre-copulatory call
    • 3 of 17 sang “quiet” male-like song as they attacked caged female and their own mate (polygyny prevention?)
  – Female plumage is duller: Watch carefully and listen next spring?
Follow-up: Siblicide in Sandhill Cranes?

• Likely overstated in earlier studies, and
  – Nidifugous; Usually one chick stays with one parent (brooding and feeding): little opportunity
  – Contrast to well-documented and prevalent siblicide in 2-chick broods of Black-legged Kittiwakes and American White Pelicans
Reproductive attempts: Duration

• Dark-eyed Junco:
  - ~ 3 days: Nest building (~ 1 May in Fairbanks)
  - ~ 4 days between nest completion and 1st egg
  - ~ 4 days: laying 4-egg clutch
  - ~ 12 days: incubation, only by female
  - ~ 11 days: Nestling period
  - ~ 14 days?: Post-fledging dependence
  - ~ 45 days: Entire effort (complete in mid-June)

  - In the north, at most 1 successful breeding attempt/summer
Dark-eyed Junco Demography

• Age at first breeding:
  – 1 year for all females
  – 1 year for some males, 2 for those unable to obtain territories and mates

• Annual Survival
  – 15% in first year
  – 50% after that
  – longest-lived in wild > 11 years

• Both typical for small songbirds

• Larger species: longer delay until first breeding, higher survival
Golden Eagles: breeding schedules

• Clutch size typically 1-3 eggs, laid several days apart
• ~ 42 days: Incubation period
• ~ 64 days: Chick period (highly variable)
• Post-fledging care: highly variable, ends before migration
Golden Eagles in Denali National Park

• Arrive as early as late February
• Laying: Late April-early May
• Nestlings:
  – late May-early August
  – when ground squirrels most abundant
• Departures: when ground squirrels entering hibernation
• Ground Squirrels: key prey for nestlings and fledglings but still hibernating early in breeding season
Golden Eagle Breeding Success

- Parallels numbers of Snowshoe Hares and Willow Ptarmigan, key prey in late winter
  - Thin blue line: hare abundance
  - Thin red line: Willow Ptarmigan abundance
Golden Eagle demography

- Adult plumage: 5\textsuperscript{th} summer
- Age at first breeding: 4 (2\% of females breeding in Denali Park) - 7 years-old
- Annual Survival
  - 1\textsuperscript{st} year: 18-46\% (Denali Park)
  - Adult: ~ 90\% in California
  - Oldest in wild: 24 years-old
- Where do one-year-olds spend their summer?
Golden Eagles: 1st Fall Migration

- Juveniles migrate independently of parents and siblings
- Danger: power poles

Departed mid-September through early October
Traveled 31 to 86 days
Covered: 900 to 6,000 km
Golden Eagles: Second summer

- Birthplace: Denali National Park
- Some range far north of the Alaska Range
  - Includes areas distant from natal area where no adults breed
  - Mistakes a young bird makes?
Subadult strategies

- Some: Go to areas where food is plentiful but few or no nesting sites for breeding adults
- North Slope and Arctic Coastal Plain
  - Few adult breeding Golden Eagles
  - Many subadult Golden Eagles
  - Major predator on caribou calves
First migrations

• Many bird species breeding here in the Interior: Adults leave before their fledglings leave

• How do young birds find their way?
  – Genetic program on when to migrate and what direction to migrate (one non-Alaskan example)?
  – Other options?
Old World “Leaf” Warblers

• Subadults fly long complex migration routes on their own

• Family Sylviidae (Eurasian)

• Not closely related to New World “wood warblers” (Family Parulidae)

• How do they find their way?

• Zugunruhe studies
Juvenile Garden Warblers

• Genetic program for changes in intensity and direction
  – 1. Aug., Sept: SW to Strait of Gibraltar
  – 2. Then: SE to equatorial Africa
  – 3. Next spring: North to Europe
Fig. 10. Right-hand diagram: spontaneous seasonal changes of directional preferences in garden warblers (*Sylvia borin*) during nocturnal migratory restlessness. Garden warblers were kept throughout the experiment under a constant 12:12-hr light/dark cycle and tested repeatedly in circular orientation cages. The birds had no view of the sky but were exposed to the natural earth’s magnetic field. The three circular diagrams summarize the results obtained in August and September (left), in October through December (middle), and in April through June (right) of the following year. The data are plotted on a relative scale such that the radius equals the greatest amount of activity in any one 15° sector. The large arrows at the periphery of the diagrams show the directions of the mean vectors calculated for each test series. The graph at the bottom shows the variations in nocturnal activity (hatched areas) and body weight (curve) as well as the occurrence of molt (black bars) in an individual representative bird. Left-hand diagram: approximate changes in migratory direction known to occur in free-living garden warblers in the course of the year (after Gwinner and Wiltshko, 1978, 1980).
Interpretation

- Internal “circannual” program for timing and direction of migration, including marked changes in direction
- ALSO: This cycle continues year after year if kept in captivity in constant conditions!
- Alaskan migrants?
Migration Extreme: Blackpoll Warbler

- Small songbird
- Nocturnal neotropical migrant
- Breeding habitat: black spruce and tamarack forests
- Gleans insects from conifer branches
  - Left: breeding male
  - Right: adult female
Blackpoll Warbler: Fall Migration Route

1. From Alaska in late August to New England by early October (5,000 km; 3,000 miles)
2. Nonstop, New England to Venezuela

Evidence
- Sightings
- Band returns and recoveries
- Radar
- Photo: basic plumage, early October
Blackpoll Warblers over the ocean

- Most individuals fly far out to sea
- None can rest on water and survive
- NONSTOP
  - 3,500 km (2,200 miles) “as the crow flies”
  - 80-90 hours
- Favorable tail winds
  - Once past Bermuda, Trade Winds provide favorable tail winds for turn to Southwest
- Hurricanes?
Blackpoll Warbler: Boston to Caracas

• How do they navigate?
  – Simplest answer: genetic program to fly on a bearing of 155° (SSE)
  – Wind direction takes care of the rest
  – Evidence: Headings at Miami, Bermuda, and Antigua of songbirds and shorebirds: all 155°

• IN ANY CASE: WHAT A LEAP OF FAITH FOR A YOUNG BIRD: HEAD OUT OVER THE OCEAN!
Blackpoll Warbler: Fuel

• Blackpoll Warbler:
  – Body Weight:
    • 11g (normal)
    • 21g (~4 quarters) before nonstop flight
  – To 47% body fat
  – Fuel for the entire leg: ~ 2 butter pats

• Issues:
  – mobility and endurance when almost 50% body fat?
  – Continuous exercise for days with no sleep?
  – 350 km (220 miles) /gram of fat
Why Fairbanks to Caracas via Boston?

- VERY INDIRECT ROUTE!

- Historical perspective?
  - Breeding distribution matches distribution of black spruce in North America
Spruces, 21,000 ya to present

- Note spread from eastern North America
Blackpoll Warblers: 21,000 years ago to present?

- Likely spread with spruces from eastern North America
- Gradual adjustments and refinements of genetic program for migration route (timing, distance)?
Resident Birds in Interior Alaska

- ~ 30 species

General Problem:
  - Cold and Dark

Solutions:
  - Variety of adaptations: physiological and behavioral

Photos:
  - Northern Goshawk and Bohemian Waxwing
  - Christmas Bird Count summary
Willow Ptarmigan

- Alaska State Bird
- Key Winter Adaptations:
  - White plumage (cryptic)
  - Key predator: Gyrfalcon (Inupiat: *Okiotak* = The one that stays all winter)
  - Increased insulation
  - Lower basal (resting) metabolic rate
Willow Ptarmigan: Metabolic Rate

- If ambient temperature is lower than $t_c$: must shiver or work to keep warm
- Summer: $t_c = +8^\circ C$ (45°F)
- Winter: $t_c = -6^\circ C$ (25°F)
  - BIG ENERGY SAVINGS
  - BUT ambient temperature typically much lower!
Ptarmigan: Night-time Burrows

- If snow is deep enough and temperature is low: digs into snow until under surface and then moves forward
- Advantage: MUCH warmer in burrow than above snow
- **Fig. 5.** Thermal blanket in the snow burrow of a Willow Grouse measured at the Kolyma upland area, 64°N, January 1986
  - Burrow: -5° to -7°C
  - Air -35°C to -50°C
Under ENOUGH new snow, ground remains about 0°C (32°F)

- Key to survival of:
  - Most small mammals: voles, shrews, etc.
  - (Ptarmigan, Ruffed Grouse, Spruce Grouse, …)

![Diagram of nighttime temperature profile over snow-covered ground. Air temperature is lowest on a clear night, right at the snow surface—in this case 7°C colder than at a height of 2 m above the snow. The temperature increases rapidly beneath the snow surface.](image)

![Graph showing snowpack temperatures over a two-week period in mid-winter. Air temperatures ranged from −35°C to just above freezing with a rain. The small mammal active under the snow, however, ambient temperatures remained very stable and near 0°C—a situation typical for all but extreme northern latitudes, where subnivean temperatures may be lower.](image)
Chickadees and Nuthatches: Resident Insectivores

• Chickadees: 3 Species
  – Black-capped Chickadee
  – Boreal Chickadee
  – Gray-headed Chickadee ("Siberian Tit")

• Red-breasted Nuthatch
Black-capped Chickadee

- Small (10-14g)
- Black cap and bib
- Large white cheek patch
- RESIDENT, deciduous woods
- Range includes all of Interior Alaska
Chickadees in winter

- Exceptionally well-studied
- Anatomical adaptations
  - PLUMAGE
- Physiological adaptations
  - Nocturnal hypothermia
  - Daily fat deposition
- Behavioral adaptations
  - Piloerection
  - Start and end daily activity at lower light levels when cold
  - Use small cavities for night-time roosting (but do not roost in groups!)
  - Cache food items for later use
Chickadees: Winter plumage

- Exceptionally dense for body size
- High quality feathers (full replacement in Autumn)
- Piloerection (feather-fluffing)
  - increases thickness of insulation
  - trapped, still air: GREAT insulator
- Note bent tail: spent last night in a small hole
Thermoneutral zone (again)

- **Lower Critical Temperature (LCT)**
  - LOWEST ambient (outside) temperature a **resting** bird or mammal can tolerate without shivering

- **Upper Critical Temperature (UCT)**
  - HIGHEST ambient temperature a **resting** bird or mammal can tolerate without panting, perspiring, etc.

- $20^\circ\text{C} = 68^\circ\text{F}$
Do chickadees shiver?

- YES, at least in captivity
- (amplitude = shivering intensity)
- Shivering more intense and frequent when ambient temperatures colder
- SHOWN: captive chickadees at mid-day
- If resting: Start shivering when $T_a$ below LCT $\sim 20^\circ C$ (68°F) — ROOM TEMPERATURE, SIMILAR TO HUMANS!
- Also shiver to rewarm at start of day
Chickadees: % Body fat

- Similar to a pre-migratory bird (as high as 40%)?
- Or “lean machines”?  
- Your guess, answer?
Fattening: doubling (or more) every day!

- Percent body fat in mid-winter
  - LOW but with distinct daily pattern
  - Morning: ~ 2-3%
  - Late afternoon peak: 7-8%
  - Highest in mid-Winter

Fig. 8-5. Seasonal changes in amount of stored fat in Black-capped Chickadees. Afternoon fat levels (upper line) were essentially double the morning fat levels (central line) and amount of fat stored per day (bottom line) was actually higher in the short days of February than it was during the longer days of September or April. (data from Chaplin 1974: table 1, courtesy of Journal of Comparative Physiology.)
Chickadees: Overnight "Hibernation"

- Body temperature lowers as much as 10-12°C, to about 32°C (89°F) minimum
- Reset internal thermostat (Not passive!) by reducing rate of shivering
- Savings in energy: to 50%
- Temperature lowering similar to a black bear but on a daily basis
Chickadees: night-time thermostat settings

- Lowering depends on air temperature
- Graph: captive birds held at 3 ambient temperatures: +20°C, 0°C, -30°C
Chickadees: Foraging rate vs. Temperature

• More intense at lower temperatures
• Work hardest at coldest temperatures
• Why not hunker down?
  – Only alternative: shiver and burn fat reserves needed at night
Chickadees: caching

- Food stored for later use
- Scatter-caching: cache individual items separately over big area
- Under bark of trees
- Memory excellent for at least overnight, possibly much longer
- Anchorage vs Fort Collins
  - In captivity: 70 potential caching sites (covered tubes)
  - Seeds cached vs eaten
  - Retrieval accuracy
Hippocampus

- Spatial orientation and memory
- Seed-caching chickadees: hippocampus enlarges greatly (30%; “Experienced” on graph)
- Major contribution to understanding of neurogenesis (production of new nerve cells)
Chickadee Hippocampus: Geographic Variation

- Fairbanks (harshest winters): Biggest and most complex
- “Our” chickadees are “smartest”

Chickadees: Social organization in Winter

- Pair formation in late summer, early fall; again in spring (if mate dies)
- Flocks: stable associations of pairs, within winters and from one to the next, average 8-10 individuals (4-5 pairs); TERRITORIAL
- Dominance hierarchies by age and sex, older > younger, male > female, but females mated to high-ranking males may benefit
Black-capped Chickadee bills

• Deformed in many local birds
• Tends to increase with age
• Rhamphotheca (keratin) only, not bony portion of bill
  – A. deformed
  – B. Normal
• WHY? ________
Bill deformities in Alaskan birds

- Increasing numbers
- Mostly Black-capped Chickadees
- Mostly Anchorage to Fairbanks—Why?
- “Avian keratin disorder”
- Birds with deformed bills also have abnormal growth of claws

Avian Keratin Disorder

• Newly described virus, *Poecivirus*
  – In layer of beak where keratin is formed
  – 28/28 individuals with deformed bills infected
  – 6/96 with normal bills infected
  – Why here, why now?

Family Fringillidae, Subfamily Carduelinae

• “Cardueline Finches”
• Specialized Seed-eaters
• Feed nestlings regurgitated seeds (RARE, even among seed-eating birds)
• Adept at feeding on seeds while clinging to branches
• Generally nomadic (irruptive)
• Likely includes the Hawaiian Honeycreepers
• Also our RESIDENT Pine Grosbeak, White-winged Crossbill, and redpolls
Common and Hoary Redpolls

- Fairbanks CBC’s: mostly Common Redpolls
- Highly Irruptive: May winter far south of normal
- Travel throughout HUGE ranges following seed crops: a redpoll banded in Fairbanks (on Ballaine Rd.) turned up in Nova Scotia!
Redpolls in Winter

- Weigh slightly more than chickadees
- No caching
- Maintain relatively high body fat levels (>10%)
- No nocturnal hypothermia
- May roost under snow:
  - “Makes roosting chamber in snow: Drops from tree into snow, making tunnel 27–40 cm long to chamber 6–11 cm below snow surface; breaks roof to depart”
- Birch and alder seed specialists
- Esophageal diverticulum:
  - temporarily store seeds for later husking and ingestion
Chickadees vs. Redpolls

- Note differences (night-time body temperature and energy expenditure)
- “animals”: mostly insects and spiders

Table 8-3. A comparison of the daily energetics in winter of two northern temperate avian species, the Common Redpoll and the Black-capped Chickadee

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Common Redpoll</th>
<th>Black-capped Chickadee</th>
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<tbody>
<tr>
<td>Weight: winter</td>
<td>13–15 g&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11–12 g</td>
</tr>
<tr>
<td>Food habits</td>
<td>80–90% seeds&lt;sup&gt;a&lt;/sup&gt;</td>
<td>60–70% animals&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Evening fat reserve</td>
<td>11.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.5</td>
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<tr>
<td>(% body weight)</td>
<td></td>
<td></td>
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<tr>
<td>Oxygen consumption: 0°C</td>
<td>13.0 cm&lt;sup&gt;3&lt;/sup&gt;/g/h&lt;sup&gt;c&lt;/sup&gt;</td>
<td>6.8 cm&lt;sup&gt;3&lt;/sup&gt;/g/h</td>
</tr>
<tr>
<td>Body temperature: 0°C</td>
<td>39–40° C&lt;sup&gt;d&lt;/sup&gt;</td>
<td>31–34° C</td>
</tr>
<tr>
<td>Overnight energy expenditure:</td>
<td>12.23 kcal/bird</td>
<td>5.48 kcal/bird</td>
</tr>
<tr>
<td>14 h, 0°C</td>
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American Dipper

• **RESIDENT**
  – Pairs defend territories year-round

• **Distribution:**
  – Subarctic to Desert—From northern Brooks Range to desert streams in SW US and Mexico

• **Habitat:**
  – ice-free, fast-flowing streams

• **Walks and eats invertebrates on bottom**
  [https://www.youtube.com/watch?v=cV6IDY1TSC0](https://www.youtube.com/watch?v=cV6IDY1TSC0)
Dippers in winter

• Hyperactive:
  – typically dive 5-10 times/minute when feeding
  – each dive < 15 seconds

• Well-insulated:
  – 4,200 feathers average, (6,300 maximum) vs. expected 3,000; lots of down feathers
  – Thermoneutral zone extends down to 11°C (52°F): helpful, BUT still must shiver or work to stay warm at colder temperatures
  – Eyelids: feathered (white)
Dippers: Habitat in Interior Alaska

- Unfrozen stream reaches that occur regularly and predictably, even in Brooks Range
- Example: Shist Creek, Alaska Range
- American Dipper:
  - My vote for greatest ability to thrive in harshest winter conditions
That’s all folks!

• Special thanks to Biology and Wildlife Department, UAF, for loan of bird specimens