

**Winter Ornithology**  
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The goal of this ornithology curriculum is to emphasize winter ecology of birds in the montane and sub-alpine environments in the Rocky Mountain region

Central Theme: Single-most important goal of birds in winter is survival

- I. Three major obstacles to over-winter survival: **cold, starvation, and predation.**
  - a. sub-freezing temps., unreliable, unpredictable, and diminished food resources, reduced cover & increased visual conspicuousness of birds in winter result in high over-winter mortality
  - b. Birds have evolved numerous physiological, morphological, and behavioral adaptations to overcome these obstacles and promote survival in harsh winter environment – often interact, working together to achieve success.
  - c. Most widespread adaptation to promote over-winter survival is **migration.**
    - i. ~2/3 of all birds species in N.A. perform semi-annual latitudinal migrations between breeding and wintering areas
    - ii. However, migration also has challenges → high mortality during migration
    - iii. Thus, neither strategy (resident vs. migratory) has clear advantages across all species; benefits of each strategy vary across diverse species groups
  - d. Bird families that are best represented among winter residents here include finches, jays & crows, chickadees & nuthatches, woodpeckers, grouse, and raptors

**II. Starvation**

- a. Food resources in winter are greatly diminished (no insects), and often unpredictable (i.e., varying cone crops), and unreliable (e.g., snow can eliminate access to otherwise available food sources)
- b. Birds have evolved physiological, morphological, and behavioral adaptations to mitigate against the nature of food availability in harsh winter environments
- c. **Diet** – most overwintering birds in subalpine environments are granivorous (sparrows, finches, chickadees, nuthatches, woodpeckers, etc), specializing on seeds of grasses/forbs, and pine and spruce trees, fruit, buds
  - i. Many are also omnivorous (jays, crows, ravens, magpies, also chickadees & nuthatches);
  - ii. a few are carnivorous (raptors, owls, shrikes)
  - iii. herbivory is rare, but practiced by grouse, ptarmigan
- d. **Food caching** involves physiological, morphological, and behavioral adaptations
  - i. exhibited by corvids, chickadees/nuthatches
  - ii. caches made **in bark**, among **foliage**, in and under **rocks** and **logs**, just about anywhere (including my deck)
  - iii. **Behavioral**
    1. Large **time investment** in summer/fall when food is abundant
    2. Birds make hundreds or **thousands of individual caches**
    3. Caches may include **seeds, fruit, insects**, even **vertebrates**
    4. Not sure whether behavior is **learned or innate**
  - iv. **Physiological**
    1. **Highly developed nervous system with advanced spatial recognition and memory capabilities**
      - a. Must be able to locate and recover hundreds or thousands of caches in a year
        - i. Clark's Nutcracker most developed in this regard (Fig 6.1, p.3)
        - ii. Not all caches are recovered, some seeds may germinate, other caches are raided by opportunistic foragers

## 2. Production of food-preserving enzymes

- a. Gray Jays cache regurgitated boli of food, saliva acts as preservative

## v. Morphological

1. **Bill** – most food-caching species (jays, crows, chickadees, nuthatches) have fairly long bills, allowing them to stash and retrieve food in crevices. Sharp contrast in bill size/shape compared to mostly granivorous species (sparrows and finches)

## 2. Sublingual pouch

- a. Found in corvids, used to store food items for transport, aids in **efficiency** in caching
- b. Size varies among species
  - i. Steller's Jay pouch can hold 4-6 avg. seeds
  - ii. Clark's Nutcracker can hold up > 60 seeds (Fig 5.3, p.3)

## e. Facultative migration

- i. **Irruptions** – boreal species migrate to temperate latitudes if food supply low, only in some years (finches, Cedar Waxwings)
- ii. **Altitudinal** (see §III.e.ii below)

## f. Bird feeders

- i. Increases survival locally, but many feeders across the landscape likely have regional implications that affect large segments of the population
- ii. Some mortality associated with feeders
  1. disease transmission – (e.g., salmonella)
  2. window collisions and cat predation are biggest source of feeder-related mortality
- iii. Effects of increased survival probably outweigh the effects of related mortality, resulting in a net increase in the proportion of the population surviving the winter
  1. Ecological effects? (increased competition for breeding resources, increased food availability for predatory species)
    - a. Overall, likely serves to increase the population size

## III. Temperature regulation

- a. Birds have higher base metabolic rate and higher body temps (avg 105°F) than mammals, thus the challenge for thermoregulation is even greater than in mammals
- b. As with starvation, birds have evolved physiological, morphological, and behavioral adaptations to meet thermoregulatory needs in extreme winter conditions
- c. **Morphological**
  - i. **Feathers** – highly efficient insulators
    1. Eider down is one of the most efficient insulators known
    2. Feathers can be “puffed up” to further increase insulative properties by increasing the airspaces in which feathers trap heat (behavioral modification to enhance a morphological trait)
  - ii. **Minimal exposure** of other body parts (i.e. bare skin); only bill, eyes, and feet/legs are exposed, and through certain behaviors, birds can further reduce heat loss through these areas
    1. tucking bill into wing/feathers
    2. closing eyes
    3. lifting up one leg, tucking it under feathers
  - iii. **Larger body size** – Relative to migratory species, a greater proportion of the resident avifauna have a larger body size (**lower surface area to volume ratio**) which birds promotes heat retention. However, there are some notable exceptions with chickadees and nuthatches – feathers may have overcome this issue.

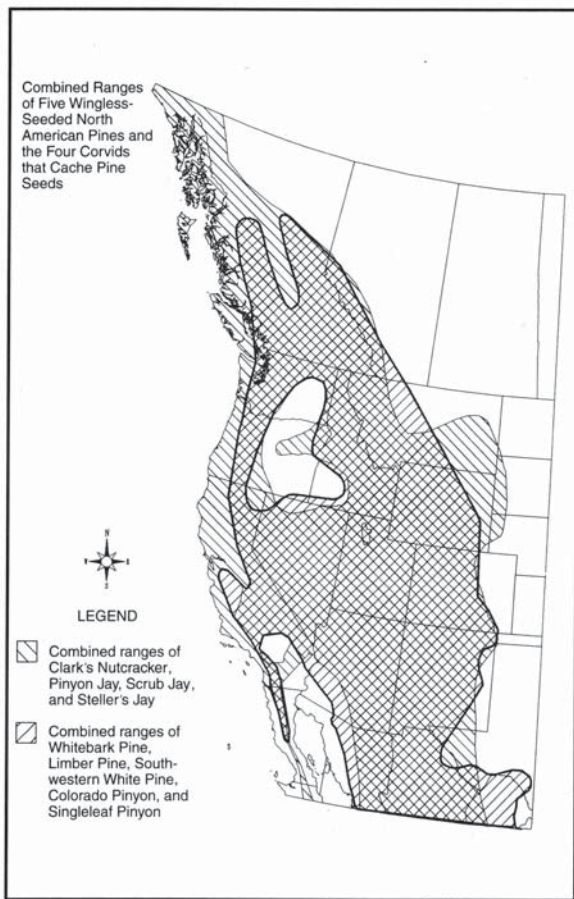


FIG. 1.1 There is a close correspondence between the ranges of the wingless-seeded soft pines of western North America and the corvids known to harvest, disperse, and cache their seeds.

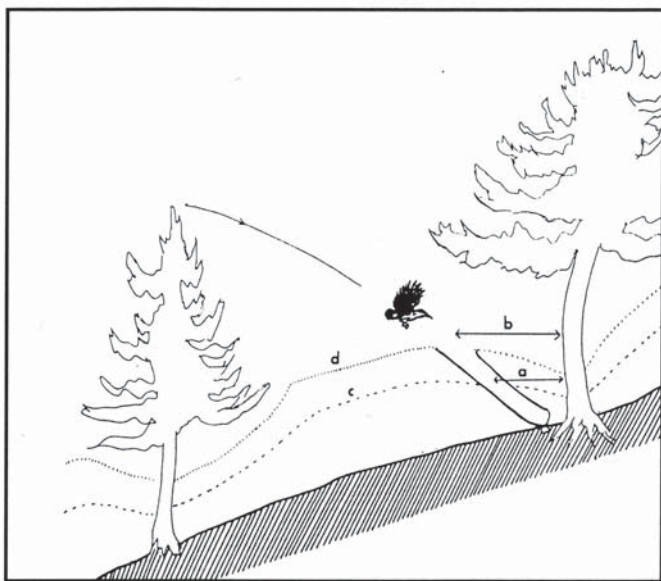
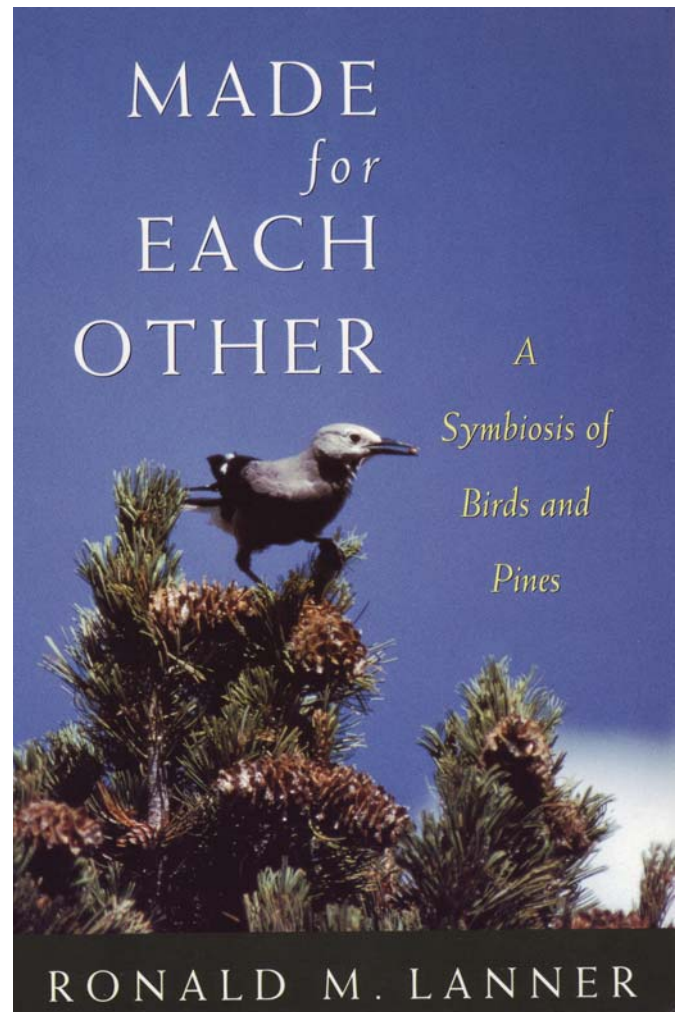


FIG. 6.1 This nutcracker made its seed cache close to the base of a tree, which serves as a visual landmark. But to recover the seeds it must start its tunnel at distance  $a$  from the tree if the snow is shallow ( $c$ ); or at distance  $b$  if the snow is deep ( $d$ ). Sketch by Claude Crocq.

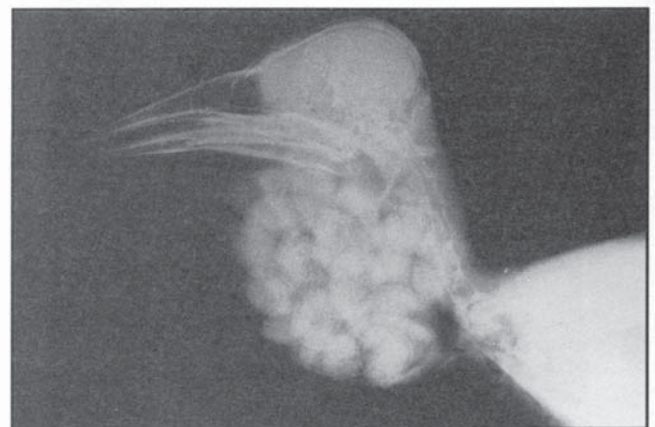


FIG. 5.3 X-ray image of Clark's Nutcracker with 28 singleleaf pinyon seeds in its sublingual pouch. The seeds weigh 31 grams; the bird weighs 141 grams. These seeds are about twice the size of whitebark pine seeds. Photo courtesy of S. B. Vander Wall.

#### d. Physiological

##### i. Anatomy of feet and legs

1. Legs and feet have **few muscles** (which have high metabolic demands) and instead are mostly **tendons** that are controlled by muscles that are above the exposed tarsi in the feet.
2. Thus lower body temp in legs and feet is possible because of lower metabolic demands by such tissues

##### ii. Counter-current blood circulation

1. body temperature of exposed feet and “legs” (i.e. metatarsus) can be significantly lower than body temperature due to specialized circulatory system that minimizes flow of blood between legs and rest of body. (Fig 38, p.6)
2. Countercurrent flow of blood between legs and body allows for exchanges of gases, nutrients, and cellular wastes yet minimal exchange of fluids, thus reducing loss of body heat into the legs, and eventually the environment.
3. Especially pronounced in waterbirds, in which temps in legs and feet can be near freezing, while body temp is over 100 degrees

##### iii. Torpor

1. State of sleep – drop in temperature (Common Poorwill 106°→67°F), slow-down of metabolic and stimulus-reaction processes (nightjars, swifts, hummingbirds)
2. Not reported for resident boreal species

#### e. Behavioral

##### i. Temperature regulation

1. Puffing feathers
2. Holding up one leg (e.g., gulls standing on ice)

##### ii. Altitudinal migration

1. some montane birds are altitudinal migrants that may migrate to other elevations to deal with **food shortages** or take advantage of more **abundant resources** elsewhere (ex. Chickadees, nuthatches, corvids, finches)
2. Species can be either **obligate** altitudinal migrants or **facultative** altitudinal migrants (more common)
3. Most species migrate **downslope**, but at least one species is an obligate altitudinal migrant that typically migrates upslope (“**reverse**” altitudinal migration) – **Blue Grouse**
  - a. Breeds between elevations of 5,000 – 9,000 feet in shrubby or open areas of forests; winters at elevations between 9,000-12,000 feet where it feeds largely on conifer needles during winter
  - b. This may be a more common strategy in tropical wintering areas

##### iii. Communal roosting

1. common among smaller birds (chickadees, nuthatches, kinglets, bluebirds)
2. birds may line-up on a branch in a row (kinglets)
  - a. largest documented roost of this kind was 27 kinglets
3. birds may congregate in a cluster on tree trunk (creepers)
4. birds may pile into a tree cavity (chickadees, nuthatches, bluebirds)

##### iv. Burrowing into snow

1. common among grouse, ptarmigan

#### IV. **Predator avoidance**

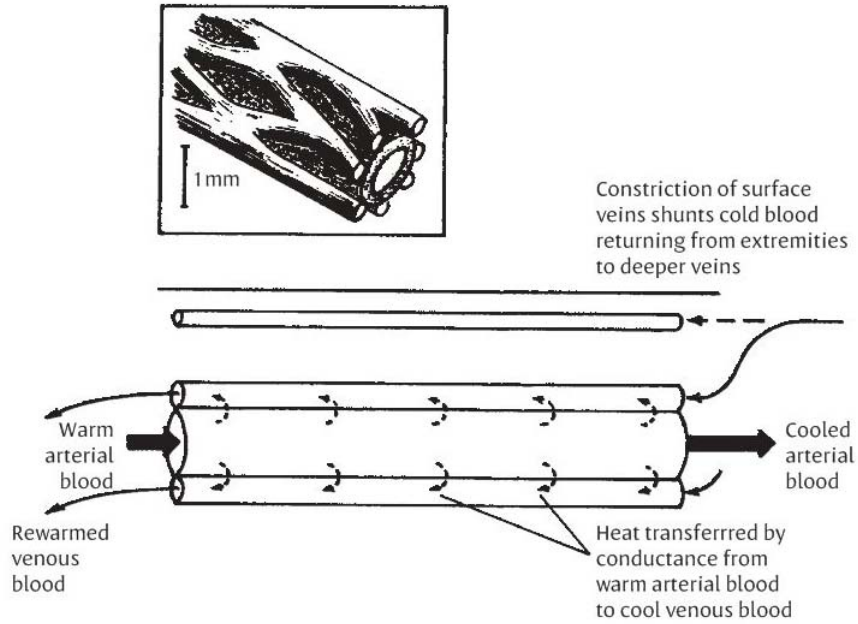
- a. Not unique to sub-alpine environments, nonetheless little room for misjudgment in avoiding predators
- b. **Mixed-species flocking**
  - i. Common strategy among smaller birds (chickadees, nuthatches, woodpeckers)
    - 1. Single species flocking may also serve this purpose
    - 2. May serve food-related benefits as well
  - ii. **Reduced numerical probability** of being singled out by a predator, once one is encountered
  - iii. Birds can alert each other to the presence of a predator
    - 1. **More eyes** in more locations (i.e. in understory, in canopy, etc.) reduces the probability of a surprise attack
    - 2. some species may serve as “**sentinels**”, while receiving food-related benefits from associating with the flock
  - iv. Confuse predators
- c. **Camouflage**
  - i. Winter-specific camouflage is rare among birds – ptarmigan notable exception
  - ii. Ptarmigan is the best example. Extremely hard to see if you’ve ever tried to look for them in winter! (Guanella Pass)

#### V. Other topics (mainly covered during walk in Wild Basin)

- a. **Greatly reduced bird densities** away from feeders!
- b. **Habitat heterogeneity** and the importance of individual habitat features and landscape component to the overall diversity of birds wintering (and breeding) in the area
  - i. Snags (for communal roosting)
  - ii. Junipers (for frugivores)
  - iii. Aspen stands (buds eaten by some birds, also mammals)
  - iv. Deciduous thickets (protective cover from predators, unique foraging opportunities, standing fruit crop)
  - v. Riverine bottomland (dense spruce groves, reduced heat loss due to wind, less snow cover)
  - vi. Creek (source of water, food)
- c. **Ground-dwelling birds** and travel on snow – **avian snowshoes?**
  - i. grouse grow fringe of scales along toes which increase surface area of feet and reduce sinking in snow
  - ii. ptarmigan take it a step further, develop dense feathers on feet which further aid in increasing surface area, while also insulating
- d. **Alternate evolutionary strategies** of wintering birds
  - i. **Townsend’s Solitaire** – the only strict **frugivore** among wintering birds at this elevation; feeds largely on juniper berries in winter
  - ii. **American Dipper** – the only **aquatic** songbird – highly adapted to foraging in stream bed (oily and highly insulative feathers, transparent inner eyelids)-can winter at high elevations wherever there is shallow open water, facultatively migrates downslope when creeks freeze over

Resources used:

Handbook of Bird Biology, by Podulka et al. 2004, Cornell Lab of Ornithology  
 The Birder’s Handbook, by Ehrlich et al. 1988, Simon & Schuster Inc.



*Figure 38 Countercurrent heat exchange.* Warm arterial blood gives up its heat to cold blood returning from the extremities through veins lying in close contact with the arteries. Thus, the flow of heat, not blood, is short-circuited – arterial blood is precooled on its way out and venous blood prewarmed on its way back. This system of heat conservation is particularly well developed in the legs of birds (insert), where a dense network of veins surrounds the central artery. Drawn from photomicrographs by Uffe Midtgard in K. Schmidt-Nielsen, *Animal Physiology: Adaptation and Environment*, 3rd ed. (New York: Cambridge University Press, 1983), 276.