## Feeding and Digestion

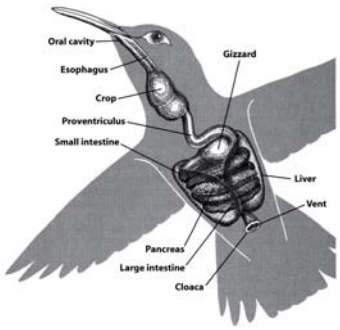
## Feeding and Digestion

- No teeth: bill mainly used to procure food, perhaps rip off chunks
- Little saliva, few tastebuds

## Feeding and Digestion

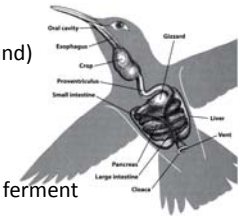
- Diverse tongue morphology

## Feeding and Digestion




## Feeding and Digestion

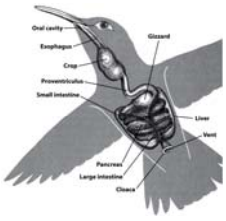
- Esophagus
  - Can be inflated (display, sound)
  - Pigeon "milk"
- Crop
  - Stores and softens food
  - In the hoatzin, expanded to ferment
- Proventriculus
  - Secretes gastric juices (0.2 – 1.2 pH)
  - Digest a cow vertebra in 2 days



## Feeding and Digestion

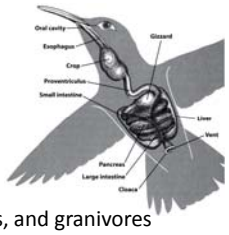
- **Gizzard**
  - Grinds food
  - Aided by stones


Ivor Lee
Black-sided Flowerpecker



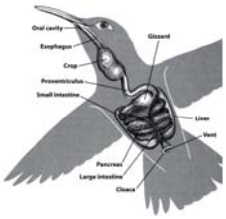
## Feeding and Digestion

- Gizzard
  - Grinds food
  - Aided by stones
- **Intestine**
  - Short in frugivores and carnivores
  - Long in herbivores, piscivores, and granivores
  - 3x to 20x body length (ave. 8.6x)
  - Food can go "backwards"




## Feeding and Digestion

- **Ceca**: Sacs off intestine
  - Bacteria aid digestion
  - Produce antibodies
  - Aid $H_2O$ absorption
  - Metabolize uric acid into amino acids

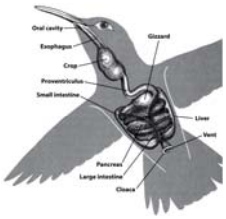



## Feeding and Digestion

- Rapid, efficient digestion
- Sugars, amino acids by active transport
- Other nutrients **passively**
  - Toxins included
  - Some birds eat clay

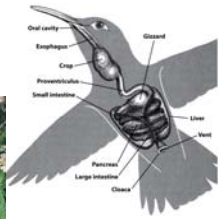

## Feeding and Digestion

- Assimilation
  - Raptors: 66 - 88%
  - Herbivores
    - 60 - 70% young plants
    - 30 - 40% mature plants
  - Fruits "predigested"
    - Simple Sugars, individual amino acids
    - Gut passage in 20 minutes



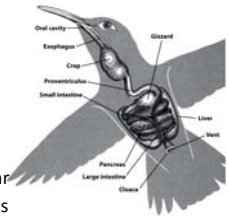

## Feeding and Digestion

- **Balance**
  - High sugar foods must be accompanied by high protein foods



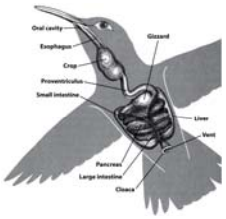

## Feeding and Digestion

- **Sucrose Digestion**
  - Disaccharide
    - Glucose + Fructose
  - Sucrase lacking
  - Hummingbirds have sucrase
    - 95 - 99% of the energy in nectar
    - Absorb glucose at highest levels among vertebrates



## Feeding and Digestion

- **Wax Digestion**
  - Seabirds
  - Yellow-rumped Warbler
  - Tree Swallow
  - Honeyguide




## Similar Birds – Different Lives

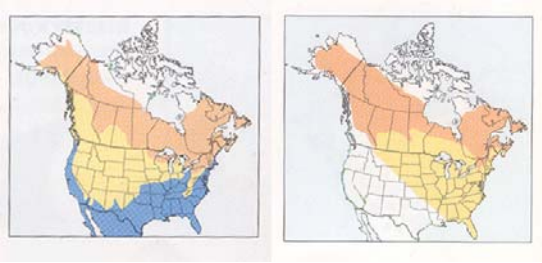


Yellow-rumped Warbler
*Dendroica coronata*
9.25" wingspan, weighs 12.3 g



Blackpoll Warbler
*Dendroica striata*
9" wingspan, weighs 13g

## Range



Yellow-rumped Warbler



Blackpoll Warbler

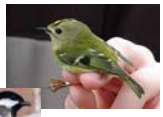
Maps taken from The Sibley Guide to Birds

## Feeding and Digestion

- Yellow-rumped Warblers can feed on wax-coated berries; the Yellow-rumped's unique ability allows it avoid the dangers of a long migration.
- **Trade-offs**: Extreme, sometimes unexpected temperatures, winter predators

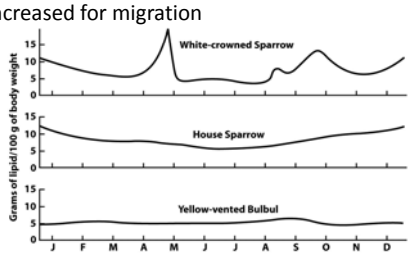
## Feeding and Digestion

- **Foraging Effort**
  - 90% of the day
  - 1,100 trees/day
  - 24 insects/minute
  - Tropical frugivores
    - May only forage for 10% of the day



## Feeding and Digestion

- **Fat Reserves**
  - Minimized, reduce weight
  - Increased for migration

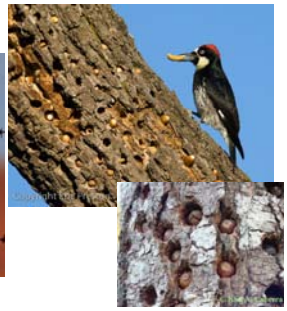


## Feeding and Digestion

- **Fat Reserves**
  - Larger birds able to survive longer
  - Emperor Penguins: 120 days

## Feeding and Digestion

- **Storing Food**



## Feeding and Digestion

- **Storing Food**
  - Crested Tits, up to 60% of food consumed in winter comes from stored provisions
  - Requires good spatial memory

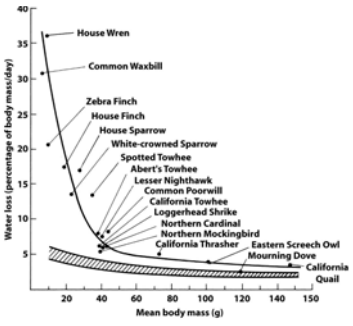

## Feeding and Digestion

- **Water**
  - California Towhee water use quadruples when temperature goes from 30 ° to 40° C


  - Some species obtain all water from food (fruits and insects)
  - Metabolic Water
    - Zebra Finch

## Feeding and Digestion

- **Water**




## Feeding and Digestion

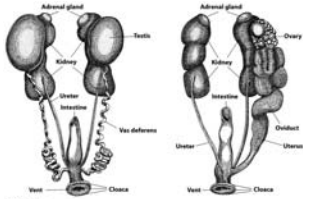
- **Water**

## Feeding and Digestion

- **Water**

## Feeding and Digestion

- **Excretion**
  - Uric Acid (more efficient than mammals' urea)
    - Mammal requires 18x as much water to excrete same amount of nitrogenous waste
  - Urine and feces combine, exit cloaca




## Feeding and Digestion

- **Hummingbirds have <u>too much</u> water**
  - Anna's Hummingbird consumes and secretes 3.3x body mass in one day
  - High rates of evaporation
  - Absorb sugar without filtering through kidneys


## Feeding and Digestion

- **Salt Excretion**
  - Birds are unable to concentrate salts in urine
  - Short Henle's loops
    - Seawater 3% salt, body fluids 1%
  - Salt Glands
    - Empty from nostril
    - Concentrate salt up to 5%
      - Increases metabolic rate up to 7%
      - No Passeriformes have salt glands