Endothermy and Mammal Ecology

Chapter 22 and 23
Endothermy

• Birds and mammals
  – Regulate body temperature by precisely balancing metabolic heat production with heat loss
Endothermy continued

• Heat production
  – Resting metabolic rate
    • The rate that we burn calories at rest through cellular processes (burning ATP to ADP to AMP)
  – Specific dynamic action
    • Heat increase after eating from assimilating molecules and synthesizing proteins
  – Activity (muscle contraction)
    • During locomotion heat production can exceed BMR by 10 to 15 times
    • Shivering
    • Pythons
Costs and Benefits of Endothermy

• Endotherms can maintain high body temps when external temps are cold

• Energetically expensive – must consume much more food than an ectotherm to maintain its metabolism
Hummingbirds

• The smallest endotherm 3.5 – 4.5 grams
  – Migrate across the gulf
  – Are able to store enough fat (2 grams) to burn for 24 to 26 hours

• Shrews
Torpor

- Torpor = adaptive hypothermia
  - In response to low temperature or limited food supply
  - Enormous savings of energy and water
  - Deep torpor is a comatose condition, voluntary motor function is reduced
  - Some species can spontaneously come out of torpor using heat production from brown fat
Body size and torpor

- Only the smallest groups of mammals and birds go into deep torpor.
- Torpor is common in Rodents and Bats; in birds it is found in goatsuckers, hummingbirds, swifts, mousebirds, and some passerines.
- Largest deep torpor is Marmot at 5 kgs.
- Some small cold climate birds go through daily torpor (Chickadees and hummingbirds).
Endotherms in the heat

- Hot and dry is more demanding than polar areas
  - Maintaining temps 10 C below ambient is harder than 100 C above
  - Also evaporative cooling is the main mechanism but most hot deserts are also dry.
Desert survival strategies

• Relaxation of homeostasis – they tolerate greater variation in body temperature

• Avoidance – avoid the harshest conditions (nocturnal etc.)

• Specializations – physiological mechanisms, daily torpor to conserve energy
  – Countercurrent exchange of blood to the brain, venous blood is cooled by evaporation and reduces the temp of arterial blood (in a rete mirabile)