Main Points

1) Metabolism and allometries continued

- 2) Optimal Foraging Theory
 - -- key assumptions
 - -- heritability of foraging behavior in ground squirrels
 - -- Tinker et al
 - -- CSI special mammal edition with man-eating lions

Pre-reading: Weds 4 Oct = Jesmer et al; Mon 11 Oct = Emlen and Oring

Q5 available Weds at 5pm, covers today and Weds 4 Oct, due Mon 23 Oct.

Terms: search time, handling time, optimal foraging theory, culture

Punchline #1: we discussed hindgut (cecal) fermentation, in which cellulose is broken down in the cecum after passing through the small intestine. In contrast, foregut (ruminant) fermentation occurs in a chambered stomach, and is characterized by a longer rate of passage, higher cellulose use, and reingestion of cuds.



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Punchline #2: populations of different sizes of mammals that cooccur often consume the same amount of energy; this is known as the energetic-equivalence rule. It occurs because two allometries—between population density and body size, and because of whole-organism metabolic rate and body size—cancel out.



Punchline #3: Bergmann's Rule is the tendency for larger-bodied organisms to occur in colder temperatures (or at higher latitudes). We discussed examples with bears and woodrats. Alston et al extended Bergmann's Rule by evaluating hypotheses for body size of bats through time.



Metabolism and body size

- Trade-offs between body size, metabolism, and fitness
- Small individuals/species
 - -- high mass-specific metabolic rates
 - -- fast conversion of energy into offspring, compared to ability to obtain energy

3.0 g African pygmy mouse (right)

1.8 g Etruscan shrew

2.0 g bumblebee bat





Metabolism and body size

- Trade-offs between body size, metabolism, and fitness
- Large individuals/species
 - -- low mass-specific metabolic rates
 - -- slow conversion of energy into offspring, compared to ability to obtain energy

700 kg polar bear



1500 kg gaur



3500 kg bush elephant





on landmass

on landmass











Basics of foraging









Basics of foraging

- Two components of foraging
 - -- searching/finding = <u>search time</u>
 - -- subduing/pursuit/digesting = <u>handling time</u>

mountain lion and mule deer



black-footed ferret and white-tailed prairie dog



- <u>Optimal Foraging</u> = processes through which animals maximize energy acquired per unit time, energy, and risk involved in finding food.
- Key assumption: natural selection favors animals that maximize energy gain. There are two ways that this can occur:
 - -- through learning
 - -- through inheritance of optimally foraging parents

- Test of OFT assumption:
 - -- ecologists calculated "optimal" diet of adult female Columbian ground squirrels, based on plant availability

Columbian ground squirrels







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- Test of OFT assumption:
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 - -- calculated differences between observed diet (what squirrels actually ate) against calculations of the "optimal" diet







- Test of OFT assumption:
 - -- ecologists calculated "optimal" diet of adult female Columbian ground squirrels, based on plant availability

-- calculated differences between observed diet (what squirrels actually ate) against calculations of the "optimal" diet

-- compared kids' differences to mom's differences







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Ritchie. 1987.







Ritchie. 1987.

<u>Discussion Q</u>: From the graph below, what can we conclude about if and how foraging behavior is transferred from mom to kids?

If foraging behavior were entirely learned (or entirely inherited), would these graphs look different? How?



 Foraging in Columbian ground squirrels required <u>culture</u> = the transmission of information from one generation to the next, through learning.



• Two decisions required of optimal foragers

mountain lion and mule deer







Two decisions required of optimal foragers
1. what do I include in my diet? (diet choice)
2. when do I quit foraging? (patch-leaving decisions)

mountain lion and mule deer



American red squirrel



Decision 1. What do I include in my diet? Should depend on:
 -- ease of searching (finding) and handling (subduing/pursuing/digesting)



-- site 1 = sea otters close to carrying capacity; resources limiting

-- site 2 = sea otters recently reintroduced; resources abundant





-- site 1 = sea otters close to carrying capacity; resources limiting

-- site 2 = sea otters recently reintroduced; resources abundant





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Decision 1. What do I include in my diet? Should depend on:
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• In 1898, between 30-135 humans killed by lions in southern Kenya while constructing Kenya-Uganda railway.









 Both individuals were shot and donated to Chicago Field Museum in 1898, where they currently are on display.





) bone collagen (years)

hair keratin (months)





bone collagen (years)

hair keratin (months)

Question from last week: how do we get people to care about mammals across the globe?

