Topic 19: Diets and Foraging

- What factors influence diet and foraging mode?
- Diets
  - What do amphibians and "reptiles" eat?
  - What are some adaptations for different diets?
  - How do specialists and generalists differ?
  - What is opportunism?
  - How can species vary in diet?
- Foraging mode
  - How do sit-and-wait & active foraging differ?
  - What are the ecological implications of these differences?
  - Examples

What factors influence diet and foraging mode?

- Diet refers to what an organism eats
- Foraging mode refers to how prey are obtained
- Many factors influence diet & foraging mode

Photos © PJB
**What do herps eat?**

- Amphibians and “Reptiles” are:
  - Most herps: ~90%
  - Mostly
  - Often viewed as generalists
  - Opportunism
  - Relatively few species
  - A number of important adaptations

**Adaptations for Diet**

- Species that eat large prey either have:
  - Relatively ____________
  - High ____________
  - Crocodilians
    - Robust teeth
    - Secondary palates
    - Death roll behavior
  
**Adaptations for Diet**

- Macrostomatan snakes
  - Eat large prey
  - Must be accommodated
    - Have stretchy ________, is large and stretches
    - Limits potential for armor, osteoderms, etc.
  - Have large ____________
    - Allows storage of bile
    - Emulsification of large sporadic quantities of fat

**Adaptations for Diet**

- To eat a prey item, it has to fit
  - Big mouths, wide heads for large prey
  - Small mouths, narrow heads for small prey

**What are differences between generalists & specialists?**

- Generalists eat a broad range of prey
  - Sometimes ____________
  - Not all generalists are omnivores

- Specialists eat specific types of prey
  - Often associated with adaptations for a specific type of prey

- This is a continuum
  - Most herps are insectivores
  - Is insectivory generalist or specialist?
Some herps have highly specialized diets, which may be poor at foraging for alternate food sources. Examples include:

- **Phelsuma**: Low emargination
- **Dermochelys**: __________
- **Ophiophagus**: __________
- **Dasypeltis**: __________

What are differences between generalists & specialists?

- Many generalists are __________
  - Will eat items outside their regular diet if given the chance
  - Often anecdotal evidence
    - Snakes, turtles eating carrion
    - Available protein source

What are differences between generalists & specialists?

- Some herps have highly specialized diets
  - May be poor at foraging for alternate food sources:
    - **Phelsuma**: Low emargination
    - **Dermochelys**: __________
    - **Ophiophagus**: __________
    - **Dasypeltis**: __________

How can a species vary in diet?

- _Ambystoma tigrinum_
  - In amphibians:
    - Only some individual larvae become cannibals
    - Triggered by environmental cues
    - High
    - Eating a __________
    - Results in different morphology that is carried over into adulthood
      - Longer head and mouth
      - Stronger jaws
      - Larger body size

How can a species vary in diet?

- Dietary shifts:
  - The larger you are, the larger your prey can be
    - **Varanus komodoensis**
      - Young are insectivores
      - Adults are carnivores
      - Adults also eat young
        - Young are arboreal
        - Adults are terrestrial

Photos © DA Northcott-Corbis; JD Parker; J Maentz; RDL Mastenbroek

Photos © J McDonald; MJ Connor; N Gribler

Pough et al. 2004, Fig 15-3

Pough et al. 2004, Fig 15-6
Ontogenetic dietary shifts
- Relates to larger body size
- Increase in range and maximum prey size
- Can shift in habitat use
- At ~50 cm SVL, *Nerodia erythrogaster* switch from eating fish to amphibians

Some young are more agile:
- *Iguana iguana*
  - Young are insectivores
  - Adults are herbivores
- *Basiliscus sp.*
  - Young are insectivores
  - Adults are omnivores

Relative Importance

Myrmecophagy coevolved with toxic skin and aposematic coloration in Dendrobatidae (traits 2-4)

These traits have been lost in *Epipedobates boulengeri*

*Phyllobates* has evolved further toxins (batrachotoxin)

Seasonal or yearly variation
- Depends on availability
- *Thamnophis elegans* in CA
  - Prefers young toads
  - Toads breed in wet conditions
  - 1976, 1977, 1979, 1980 were dry years

"Good years": ____________
"Bad years": ____________

How might one test these dietary scenarios more rigorously?

Two main foraging modes
- Sedentary animals
  - Wait for prey to come to them
  - Often stocky
- Constantly moving animals
  - Come to the prey
  - Often streamlined

Foraging Mode

Pough et al. 2004, Fig 15-5; Photo PJB

Pough et al. 2004, Fig 15-7; Photo © KP Bergmann

Pough et al. 2004, Fig 3-28, 15-9, 15-13, LA Coloma, AA Acevedo, wikipedia, PJB
### Foraging Mode

#### Foraging behavior

<table>
<thead>
<tr>
<th>Character</th>
<th>Sit &amp; Wait</th>
<th>Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of movement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate of movement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily energy use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensory mode</td>
<td></td>
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<tr>
<td>Prey volume captured per day</td>
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</tbody>
</table>

Modified: Pough et al. 2004, Table 15-1; Huey & Pianka 1981; Photos © KP Bergmann

### Foraging Mode

#### Physiology

<table>
<thead>
<tr>
<th>Character</th>
<th>Sit &amp; Wait</th>
<th>Active</th>
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<tbody>
<tr>
<td>Endurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sprint speed</td>
<td></td>
<td></td>
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<tr>
<td>Aerobic capacity</td>
<td></td>
<td></td>
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<tr>
<td>Anaerobic cap.</td>
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<td></td>
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<tr>
<td>Heart mass</td>
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<td></td>
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<tr>
<td>Active body temp</td>
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</tbody>
</table>

Modified: Pough et al. 2004, Table 15-1; Huey & Pianka 1981; Photos © PJB
Foraging Mode

- Predator-Prey interactions

<table>
<thead>
<tr>
<th>Character</th>
<th>Sit &amp; Wait</th>
<th>Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prey type</td>
<td>Mobile</td>
<td>Sedentary/unpredictable</td>
</tr>
<tr>
<td>Predator type</td>
<td>Active</td>
<td>Sit &amp; wait/Active</td>
</tr>
<tr>
<td>Predator defense</td>
<td>Crypsis, jump/sudden movement, venom</td>
<td>Flight, Skin toxins</td>
</tr>
</tbody>
</table>

What are the implications of this?

Modified: Rough et al. 2004, Table 15-1; Huey & Pianka 1981; Photos © KPB ??

Foraging Mode

- There are phylogenetic effects on foraging mode
  - Sit & wait foraging is ancestral for squamates
  - Iguania and Gekkota are primarily ___________ foragers
  - Other lizards tend to be active foragers
  - There are many exceptions
  - Snakes are all over the place (not on graphs)

Foraging Mode

- Are phylogenetic effects borne out?

- Adaptation for sit & wait foraging
  - Integration of _______ and morphology
  - Mechanism to bring prey to you instead of just waiting for it
  - Increases _______ with prey

Modified: Rough et al. 2004, Fig 15-10