Exam 2 summary

- Mean = 85%
- Min = 56%
- Max = 106%
- Clarification:
  - 6 “off” questions missed by > 50% of class…
  - Email indicted number questions answered correctly not % correct – email me to confirm.
  - My apologies
- Final during finals week and non-cumulative
Some local mole salamander lineages are actually ancient, unisexual, all-female triploid species in which eggs develop directly without fusion of egg and sperm via the process of:
- Parthenogenesis
- Kleptogenesis
- Gynogenesis
- Gametogenesis

Internal fertilization has arisen in anurans only rarely to deal with:
- hot hypoxic waters
- fast moving well-oxygenated waters
- intense predation
- disease resistance

Aerobic scope in reptiles and amphibians is achieved mostly via:
- Anaerobic respiration
- Aerobic respiration
- Salt glands
- Oscillatory locomotion
“off” questions

- The rear lung (the “saccular lung”) in snakes is primarily used for
  - Gas exchange
  - Flotation
  - **Maintaining air pressure**
  - Inflation against predation

- In terms of ionic composition which form of foraging is likely optimal for any predatory species:
  - Herbivory
  - Omnivory
  - Carnivory
  - **Cannibalism**

- Foraging in most non-Elapid and non-Viperid serpents is associated with
  - Neurotoxins, elongate prey, short front fangs
  - Cardiotoxic venoms, relatively large mammalian prey, extended and mobile front fangs
  - Reduced toxicity venoms (with some exceptions), rear-fangs, extended bite time
  - **Constriction without envenomation**
EXAM II: April 12 Weds (those taking exam at ODS please get *ESF grading sheet* from instructor first!)

- Defense
- Communication
- Population biology
- Ecological roles
- Conservation biology

< Movement

\[ \text{Lecture and reading} \]

\[ \text{Reading} \]
Avoiding Predation: Defense And Escape
Predators and Prey…

- “Herps” are predator and prey

- Very few exceptions: turtles, large snakes and crocs are less likely to be eaten

- Early life stages: survival rates often just 1-10%.

- Premature death = strong fitness effect can drive rapid selection
Figure 15.21  Predators of amphibian and reptile eggs

Eggs (above) and post-natal (below):
Every event in the sequence represents an opportunity for adaptations by prey and their predators.
How to not get eaten:

Avoid detection - hiding, crypsis
Crypsis (Camouflage)

Stick-like Agamid lizard

Texas horned lizard blending into sand

Copperhead on dry leaves
Crypsis (Camouflage)

Vietnamese mossy frog

*Theloderma cortacale*
Leaf litter frogs
Uroplatus Geckos
Figure 15.24  
Crypsis: Background mimicry 

Bokermannohyla alvarengai
Even brightly-colored body parts needed for courtship or warning are often positioned so that they can be discreetly flashed only when needed.
Banding and striping: camouflage in motion

- Create the image of a uniformly colored prey when in motion that becomes strikingly banded when it suddenly stops.
- An optical illusion that causes the prey to effectively disappear and confuse the predator.
Optical illusion as a defense mechanism

Crawling

Motionless
Eastern Garter Snake combining strategies
Structural camouflage

Add spines or other appendages to break up outline and escape stereotyped search image of predator, e.g., the Australian moloch (l) and flat-tailed horned lizard (r).
Live camouflage

Red-eared slider

Musk turtle

Basicladia (algae)

Epistylis (protozoan)
How to not get eaten:

Be poisonous, taste bad, or be otherwise unpalatable
Noxious Substances

- Many salamanders will exude a whitish sticky substance if highly stressed.
- Occasionally small snakes can be found in the woods glued together -- this is the explanation!
Horned lizards (*Phrynosoma*) -- squirt blood from eyes (orbital sinuses).

- Usually only triggered after animal is seized by a predator, typically a canid.
- May stimulate the prey tossing behavior in the predator.
- Eat ants – blood mildly toxic.
- Gives the lizard a last chance to escape.
Other chemical defenses of reptiles

- Usually just offensive but not harmful, e.g., the musk of musk turtles
- Snakes have paired cloacal glands that are aimed and emptied on predators
- Urination and defecation are standard ploys
Chemical deterrents

- In amphibians, usually involves release of toxic chemicals in skin.
- E.g., toads, newts, dendrobatids

- Bad taste vs. poisonous...
Bufotoxins

- Steroid toxins (25% protein) with cardiotonic effects on animals
- Cause blood pressure to rise
Dendrobatids

- Spectacularly colored.
- Forage diurnally on the forest floor.
- Skins are loaded with highly lethal compounds.
- Preferentially forage for leaf-litter prey (small beetles, ants and small millipedes).
- Repackage as skin toxins or use compounds as precursors to manufacture toxins.
- These often shut down nerve and muscle systems by blocking sodium channels.
“Poison dart frogs”

- Only 3 species used to poison blow-darts
  - Noanamá Chocó and Emberá Chocó of western Colombia

*Phyllobates terribilis*
An evolutionary arms race: partners in co-evolution

- *Taricha granulosa* newts can have tetrodotoxin (TTX)
- 1 newt kills 25,000 mice (or a few humans)
- *Garter snakes* (*Thamnophis sirtalis*)
Predator-Prey: prey toxicity

The most resistant snake population is from a locality with toxic newts.

Graph showing the TTX resistance in garter snake population (as percentage of baseline speed) against TTX dose (mass adjusted mouse units). The graph includes three lines:
- Orange: Taricha absent
- Blue: Taricha present but lacks TTX
- Red: Taricha present and toxic

Notes:
- The most resistant snake population is from a locality with toxic newts.

Geographic variation in resistance of *Thamnophis sirtalis* to TTX toxicity of *Taricha granulosa*
How to not get eaten:

Announce your unattractiveness (or at least fake out your predators)

Example: the red eft (juvenile stage, red-spotted newt)
Aposematism

- = warning advertisement
- clearly indicates the prey item is unpalatable, dangerous, or lethal.
- Found in salamanders, frogs, and snakes
- All salamandrids (e.g., newts) are aposematic with highly toxic secretions of skin glands
Aposematic coloration of amphibians

HERPETOLOGY 4e, Figure 15.25
Photographs: A–E, Martha L. Crump; F, Edmund Brodie, Jr.
Fake them out: Aposematism and mimicry

- The redback salamander is considered, by some, to be a mimic of the eft of the red-spotted newt
- Erythristic morph in particular
- A “Batesian” mimic in which the mimic is quite palatable
Naive blue jays fed efts first eat fewer redback salamanders than those not previously fed efts.
Mullerian mimicry

- In this same complex is the red salamander (*Pseudotriton ruber*)
- Moderately toxic and moderately unpalatable.
- Reinforces the red warning coloration pattern to the predator community.
Coral snakes and their mimics
An experimental test of coral snake mimicry
Rattlesnakes buzz their rattles as a form of “audio” aposematism.
Structural deterrance

- Turtles and their shells
- Crocs and their scales underlain by bony osteoderms
Enlarged and spiny scales on body, head, and tails, especially in desert lizards.
**Structural deterrents**

- **Reptiles** – structures assoc. with highly keratinized skin
- **Amphibs** - posture
Amphibians have few structural defenses, but fusion of skin to skull is possibly one -- head used to block burrow entrances.
How to not get eaten:

Specialized behaviors
Specialized behaviors

- **Startling behaviors, erratic movements, frightening displays**
  - [http://www.youtube.com/watch?v=948rhsRvlkw](http://www.youtube.com/watch?v=948rhsRvlkw)

- *Lithobates clamitans!* The “exclaiming frog”

- **Hold off attack momentarily while prey escapes or better positions itself for defense.**

Physalaemus nattereri (Cuyaba Dwarf Frog)
Death feigning (thanatosis)

- Occurs sporadically and infrequently in unrelated taxa (e.g., *Eleutherodactylus, Echinosaura, Natrix*).
- Many predators avoid carrion
- Some cannot locate prey without movements to guide vision
- Toxins from toads?

Hognose snake (*Heterodon*)

[Video]
Inventing the wheel. A lungless salamander before *(above)* and after *(right)* as it curls up to flee.

**Downhill racers**

15 other species of salamanders to coil and roll. Some of these coiled when tapped gen-

**Hydromantes platycephalus**
How to not get eaten:

Give up an expendable body part...
Caudal autotomy (*auto* = ?; *tomy* = ?)

- = self-induced loss of a body part.
- Usually occurs along established break-points in tail
- Common in plethodontids, many lizards, tuatara, and a few snakes.
- Detached part often wiggles fervently and draws predators attention away from rest of animal
fish-scale geckos
Costs of autotomy

- Protein and fat that goes into tail replacement shunted from reproduction
- Lost tail interferes with locomotion
- Increases susceptibility to later predation
- Alters social status
Tadpole diversionary tactics

Acris crepitans

© Greg Sievert
Question…
Why do juvenile skinks have blue tails?

*Eumeces skiltonianus* Western Skink
BUMMER

WHY LIZARDS SHOULD NEVER BUNGEE JUMP
India's Corbett National Park: Madhuri – an elephant who specializes in playing with monitor lizards …