Intro to Amphibians

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Amphibian Ark
In the end we will conserve only what we value. We will value only that which we understand. We will understand only what we are taught or allowed to experience. - Senegalese conservationist Baba Dioum
AMPHIBIANS 101

• from the Greek

• creature with a “dual life”
  – within a lifetime
  – day to day
Breakdown by numbers:

- 3 orders
- 45 families
- 446 genera
- 5504 species (Apr 2004)
- from www.AmphibiaWeb.org:
  - “The current number of amphibian species:
    - 6254 (Dec 29, 2007)”
    - 6179 (Apr 9, 2007)
    - 6017 (Apr 17, 2006)
% of Amphibians Compared to Other Vertebrates

- Fishes: 50%
- Mammals: 9%
- Amphibians: 10%
- Birds: 19%
- Reptiles: 12%
FROGS AND TOADS
Anura (Salientia)

• tailless amphibians, aka anurans
• all toads are frogs, not all frogs are toads
• on all continents but Antarctica
• 33 families, 352 genera, 4837 species (88%)
• long legs, no tail, fused/reduced vertebrae
• distinct larvae
• diversity of reproductive modes
• 1 to 40 cm (0.4” to 16”)

• Anura (Salientia)

“RANIDAE”

- *Rana catesbeiana* - bullfrog
“RANIDAE”

- *Conraua goliath* - Goliath frog
NEWTS AND SALAMANDERS

Caudata (Urodela)

- tailed amphibians, aka caudates (urodeles)
- primarily northern hemisphere
- 10 families, 61 genera, 502 species (9%)
- 3 cm – 2 m (1”+ - 5’+)
- built as generalists, lizard-like
- almost every habitat (ex. extreme desert)
- most with internal fertilization (spermatophore) and direct development
PLETHODONTIDAE: Plethodontinae

- *Aneides aeneus* - green salamander
CRYPTOBRANCHIDAE

• *Andrias japonicus* - Japanese giant salamander
AMBYSTOMATIDAE

- *Ambystoma mexicanum* - axolotl
CAECILIANS
Gymnophiona (Apoda)

- limbless amphibians, aka gymnophionans
- pantropical distribution
- 5 families, 33 genera, 165 species (3%)
- 10 – 152 cm (4” - 5’)
- built for burrowing
  - limbs and girdles absent
  - eyes covered with skin or bone
  - lungs reduced (left) or absent
  - dermal scales, annuli in some species
- protrusible tentacles and phallodeum (int. fert.)
- oviparity in 70% of species known, parental care
CAECILIIDAE: Caeciliinae

- *Dermophis mexicanum* - Mexican caecilian
ICH T Y OPHI IDAE

• *Ichthyophis glutinosus*
4 amphibian characteristics

- vertebrates
4 characteristics

• vertebrates
• “cold-blooded” = ectothermic
## 4 Body Temp Regulation Types

<table>
<thead>
<tr>
<th>Constancy</th>
<th>Homeotherm</th>
<th>Poikilotherm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>Inside</td>
<td>Outside</td>
</tr>
<tr>
<td>Endotherm</td>
<td>Endotherm</td>
<td>Ectotherm</td>
</tr>
<tr>
<td>Constant</td>
<td>Human, dog</td>
<td>Icefish, cave salamander</td>
</tr>
<tr>
<td>Variable</td>
<td>Hummingbird, woodchuck</td>
<td>Waxy monkey or canyon treefrog</td>
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</tbody>
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Regional heterotherm = tuna, leatherback, fowl in ice water
Behavioral Thermoregulation

• poikilothermy, but with options!
• microhabitat selection – thermal gradient
• basking and thigmohtermy to increase body temperature during digestion, disease
• hibernation and estivation to stabilize body temp and metabolism during extremes
freeze avoidance & freeze tolerance
4 characteristics

• vertebrates
• “cold-blooded” = ectothermic
• permeable, glandular skin
permeable skin
-naked
-thin
-vascularized
poison glands

all amphibians have poison glands!
4 characteristics

- vertebrates
- "cold-blooded" = ectothermic
- naked, permeable, glandular skin
- tied to moist environs for breeding
But with many spectacular exceptions!
Why are amphibians important?

- source of human medicine
- indicators of environmental health
- control insects and insect-borne diseases
- vital link in the food web
- role in nutrient cycles
- role in culture/religion
- amphibians are declining
- aesthetics
LINKS IN THE FOOD WEB

- energetic efficiency
- ability to be small
- biomass contribution
PEST CONTROL
CULTURE & RELIGION

Shaman piece, 8th century BC

Heket, Egyptian god of childbirth
Days With Frog and Toad

by Arnold Lobel

An I CAN READ Book®
Cyclorana sp.
Australian water-holding frogs
Rana Boedada (Elephantopus varius). Las antiguas poblaciones creían que cuando estas ranas se convertían en oro. Se encuentran en el valle de Arica y han sido motivo de muchas investigaciones.

SORTEO TRES GOLPES INTERMEDIO
PRECIOS VEINTISIETE
B/0.25 DE MARZO DE 1996
SERIE 1771
FOLLO

SERIE 17
493 9 6 1
7 96 9 7

1
1
MEDICINE
tricolor dart-poison frog
Epipedobates tricolor

- Source of epibatidine
  - blocks pain receptors in brain
  - 200x more effective than morphine
  - no addictive side effects
strawberry dart-poison frog

*Dendrobates pumilio*

- Source of pumiliotoxin
  - being refined for use as cardiac stimulant for heart attack patients
  - also found now in other dendrobatids and mantellas
common Indian toad – *Bufo melanostictus*

- Source of “an 880 Dalton conjugated aromatic compound with a hydroxyl and carbonyl functional group”
  - being refined for use as a sleep aid
giant monkey frog - *Phyllomedusa bicolor*

- Source of adenoregulin
- derivatives being refined to treat:
  - depression
  - stroke
  - seizures
  - Alzheimer’s disease
White’s treefrog - *Litoria caerulea*

- Source of caerulein
- derivatives used to:
  - diagnose gallbladder and pancreatic malfunction
  - treat intestinal ailments
  - relieve pain
African clawed frog
*Xenopus laevis*

- Pregnancy tests (historically)
- Source of antimicrobial peptide magainin
  - kills bacteria, fungi, viruses, protozoa
  - also kills skin cancer cells, sparing adjacent healthy cells
  - derivatives are being developed:
    - to treat diabetic foot ulcers
    - to treat drug-resistant bacterial infections in cystic fibrosis patients
    - for plaque-fighting toothpaste additive
    - as a nontoxic glue in human organ surgery
    - to treat ovarian cancer and melanoma
Australian red-eyed treefrog

*Litoria chloris*

- 3/14 skin peptides tested completely inhibited HIV infection of T cells, directly, and by dendritic cells (normal exposure) 8 hours after exposure to virus
- potential as topical inhibitors of mucosal HIV transmission
ENVIRONMENTAL INDICATORS
More than 61 million prescriptions for anti-depressants were prescribed by U.S. doctors in 2001 ....

In 2002, 80 percent of 139 streams in 30 states sampled by the U.S. Geological Survey showed evidence of drugs, hormones, steroids and personal care products such as soaps and perfumes.

.... evidence of Prozac, an anti-depressant, in the brains, livers, and muscles of bluegill, caught downstream from [a waste treatment plant] ....

.... scientists are now studying aquatic species in the lab ....

.... low levels of common anti-depressants, including Prozac, Zoloft, Paxil and Celexa, cause development problems in fish, and metamorphosis delays in frogs.
Two tadpoles after 57 days of development in the lab. The one on the right, which has yet to sprout limbs, was exposed to fluoxetine, also known as Prozac.
Atrazine: most widely used herbicide in USA
Scientific studies have found that atrazine may cause a variety of cancers and harm human and animal reproductive and hormone systems, and it has been detected in more than 1 million Americans' drinking water at levels higher than EPA's drinking water standard.

Although lawsuits brought against the EPA by NRDC date back to 1999, the EPA announced on October 31 2003 that it had negotiated a deal with industry that would not require any new restrictions on atrazine use.
Extinction Crisis

- 43% of amphibian species are experiencing decline
- 32%-50% are globally threatened
- more than 120 species are possibly extinct
- at least 1 family is gone

- IUCN Global Amphibian Assessment
What happens when they disappear?

- streams without tadpoles suffer from increased sedimentation and algae blooms, and lower invertebrate diversity.
- Observations also suggest that species that feed heavily on amphibians (e.g., some snakes) are also declining.
AESTHETICS

They are simply beautiful in form and function!
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Physalaemus nattereri