

Global Amphibian Declines: What Have We Done?



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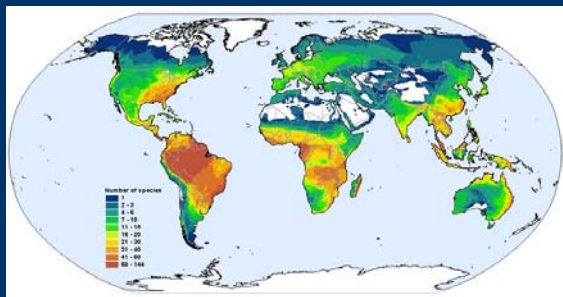


Outline

- Current status of declining amphibian populations
- Amphibian biology - characteristics making them susceptible to declines
- Direct anthropogenic (human caused) effects on amphibian declines
- Indirect effects on amphibian declines
- Future directions for the conservation of amphibians

Current Status of Amphibian Populations

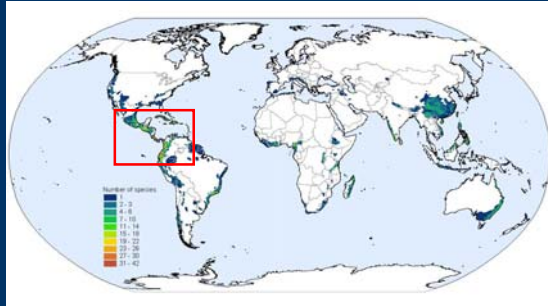
Amphibian Species Diversity



Global Amphibian Assessment

Current Status of Amphibian Populations

Threatened Species



Global Amphibian Assessment

Current Status of Amphibian Populations

- 32% of amphibians are threatened (1,896 spp.)
 - 12% birds, 24% mammals
- 43% of populations are declining
 - 1% are increasing
- At least 34 species are extinct – another 130 haven't been seen in years

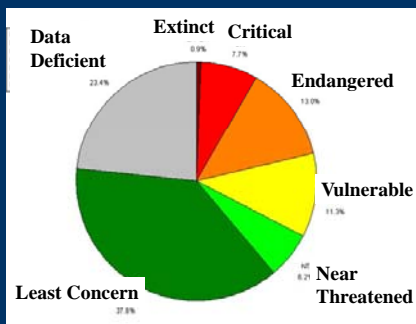


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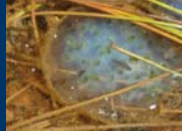
Global Amphibian Assessment

Extinct Species



Amphibian Biology

- “double life” – aquatic larvae, terrestrial adult
- Ectotherms with permeable skin that must remain moist
 - Respiration & osmoregulation
- Eggs lack shells or protective membranes



Ecological Applications 18: 724-734

Anthropogenic Effects on Amphibian Declines

- Direct** → **HABITAT DESTRUCTION**
Chemical pollution of water
Road disturbance
Introduced amphibian and fish species
- Indirect** →
Global warming
UV-B radiation
Acid precipitation
Pathogen exposure

Habitat Destruction

#1 Cause of Amphibian Decline
Majority of amphibians depend on forests

- Expanding agriculture
- Logging
- Road construction
- Species richness positively correlated with forest cover
 - Importance of loss of habitat
 - Effect on metapopulation dynamic = increased predation
 - Forested buffers protect wetlands from contaminants

Can. J. Fish. Aquat. Sci. 60: 1078-1094

Chemical Pollution of Water

- Pesticides and herbicides
 - Break down slowly, gather in sediment, bioaccumulate in amphibians
 - Herbicide Roundup killed **98%** of tadpoles within 3 weeks as a result of direct mortality
- Fertilizers
 - Mortality rate was **85%** among Southern Leopard frog tadpoles exposed to nitrate
 - Nitrate delayed time to metamorphosis from 58 days to 93 days

Ecological Applications 15: 1118-1124,
Arch. Environ. Contam. Toxicol. 53: 639-646

Chemical Pollution of Water

- Lead
 - All tadpoles exposed to 3940 mg/kg or higher died within 5 days
 - Skeletal defects were present at 75 mg/kg and higher
- Road deicing salt
 - Increased conductivity in pond water
 - Survival of embryonic spotted salamanders only **3%** at 3000 μ S
 - Embryonic period = 5-6 weeks, duration of exposure is factor in survival

Ecological Applications 18: 724-734,
Arch. Environ. Contam. Toxicol. 51: 488-466

Road Disturbance

- Discourage dispersal
 - Return rates reduced **51%** in red-backed salamanders
- Direct mortality
- Traffic noise interferes with vocalizations in anurans
 - Decreased response time and ability to locate male in female grey treefrogs
- Introduce contaminants
 - Road deicing salt, gas and oil
- Habitat destruction

Animal Behaviour 74: 1765-1776, Conservation Biology 19:2004-2008,
Biological Conservation 138: 399-411

Introduced Species

- **Brown and rainbow trout**
 - In Australia, predation on native Spotted tree frog tadpoles was higher than native fish species
 - Rainbow trout reduced survival of tadpoles by **50%** in one week or less
- **Bullfrogs**
 - Act as predators and competitors
 - Reduced survival of threatened CA red-legged frog tadpoles to **5%**

Biological Conservation 100:187-198,
Conservation Biology 13: 613-622

Indirect Anthropogenic Effects

- **Global Warming**
 - Increase in temperatures due to build up of greenhouse gases
 - Alters habitat
- **UV-B exposure**
 - Ozone depletion
 - Reduced hatching success and increased rate of embryonic deformities
- **Acid precipitation**
 - Decrease in pH from SO₂ and NO₂ deposits
 - Direct mortality, reduced hatching

Conservation Biology 14: 277-282

Indirect Anthropogenic Effects

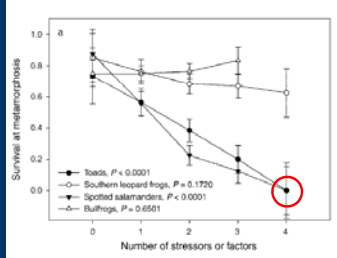
- **Chytrid fungus**
 - Cool temperatures, high elevations
 - Occurs in keratinized tissues
 - Creates extra layers of skin, limb paralysis
- **Ranavirus**
 - Widespread, all elevations
 - Mostly affects larvae
 - Emaciation, toxicosis, heart failure
- **Parasites**
 - Trematodes – Extra/missing limbs
 - Nematodes – Decreased survival, slower growth
 - Cestodes – Cavities in muscle, loss of use of legs

Science 284: 802-804, Oecologia 89: 161-165, Emerg. Infect. Diseases 5: 735-748

Effect of Multiple Stressors

Synergistic relationship between effects is most likely causing declines

- Multiple stressors:
 - Bullfrog tadpoles
 - Bluegill
 - Insecticide carbaryl
 - Ammonium nitrate fertilizer
- Combined effects are not always predictable



Ecological Applications 17: 291-301

Why Should We Care?

- Critical to the balance of ecosystems
 - Consume algae and insects
 - Prey for snakes and other animals
- Biomedicine development
 - Anti-microbial substance in skin prevents HIV infection
- Early warning system
 - Good indicators of ecosystem health
 - Are amphibians the first to go?



Journal of Virology 79: 11598-11606

Future Directions

- Captive Breeding
 - Amphibian ARK - collects critically endangered species from wild to rescue them for future release
 - Expensive, requires large amount of space
- Reintroductions
- Non-native species removal
- Habitat restoration
 - Restore buffer zones around wetlands

What Can You Do?

- NAAMP – North American Amphibian Monitoring Program
- TAMP – TN Amphibian Monitoring Program
 - Volunteer organization
 - Monitor vocal amphibians by performing call surveys 4x/year
 - Contact Bob English: 615-395-4166 or email ENG205@aol.com