Overview

Terrestrial Hibernation

Two options: avoid or tolerate

Deep supercooling not an option for amphibians

Water-permeable skin
- Fully encased by environmental ice

Two options: avoid or tolerate

Most avoid by burrowing below the frost line

Others tolerate the formation of ice in extracellular fluid spaces
- Hibernate under leaf litter and snow

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Freeze Tolerance Biology

Mostly seen in invertebrate groups, plants
- Insects, snails, barnacles, mussels

Vertebrates
- Four species of frog
- One salamander species
- Hatchlings of the midland painted turtle (Chrysemys picta marginata)

Freeze Tolerance Biology: Basic Strategy

- Initiation of extracellular freezing at high subzero temp (> -10°C)
- Withdrawal of pure water into ice
- Cells shrink and dehydrate
- Minor osmotic adjustments with subsequent temp changes
Freeze Tolerance Biology: Biochemical Adaptations

Example Species
- Lithobates sylvaticus – Wood frog
- Hyla versicolor – Gray tree frog
- Hyla crucifer – Spring peeper
- Pseudacris triseriata – Western chorus frog
- Salamandrella keyserlingii – Siberian salamander
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Current Research: Hepatocellular Response

- Investigation of hepatocellular features of frog indigenous to Alaska and Ohio
- Liver cell damage was similar between populations
- Pre-incubation in media containing cryoprotectants reduced freezing damage
- Results suggest that tolerance in native populations does not imply enhanced ability of the liver to avoid freezing or rapid mobilization

Current Research: MicroRNA and Neuroprotectants

- Study of cryoprotective mechanisms of microRNA orchestrated tissue recovery
- Microarray analysis
- Immunoblotting
- qRT-PCR
- Bioinformatics target enrichment

MicroRNAs are actively coordinating tissue cryoprotective mechanisms
Future Research

- Efficacy of urea as a cryoprotectant
- Relative abundance of adrenergic receptors

Kahoot!

- [https://create.kahoot.it/share/freeze-tolerance-in-amphibians/3b08bfeb-dee2-42d6-a376-d9b70189479](https://create.kahoot.it/share/freeze-tolerance-in-amphibians/3b08bfeb-dee2-42d6-a376-d9b70189479)

References

- Churchill TA, Storey KB. Dehydration tolerance in wood frogs: a new perspective on development of amphibian and terrestrial animal strategies for winter survival. Integrative and Comparative Physiology. 1993;265: