UV-B Radiation and its Effects on Amphibian Declines

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UV-B Radiation: What is it?
- One of three types of ultraviolet radiation (UV-A; UV-B; UV-C)
- UV-B = Only type particularly harmful to living organisms
- Levels have risen significantly over last few decades
  - Stratospheric Ozone Depletion
  - Clear-cutting and habitat destruction
- Most intense in summer months
- Damages DNA, causes cell death and mutations

Blaustein et. al; 2003

UV-B Radiation = Problem for Amphibians!
When?
All Life Stages!
- Particularly detrimental to embryos

Blaustein et. al; 2003
UV-B Radiation = Problem for Amphibians!

Why?

- **Embryo:**
  - No shell
  - Eggs usually laid in shallow water or near surface/terrestrial
- **Larvae:**
  - Thin, permeable skin
- **Adult:**
  - Thin, permeable skin

Source: ecotrend.org

UV-B Radiation = Problem for Amphibians!

What Kind?

- Lethal effects
- Sub-lethal effects: Impaired growth, slowed development, hatching success, predation risk, malformations, altered behavior, retinal damage/blindness (Searle et al.; 2009)
- Species-specific (Romansic et. al; 2009)
- Vary with life stage (Romansic et. al, 2009)
- Vary with ecological context (Romansic et. al; 2009)
- Synergistic relationship
  - Interacts with pH, contaminants, disease (Blustein et al; 2003)

UV-B Radiation affects embryos:

- *Ambystoma mexicanum*
  - 60% decline
  - Listed as Critically Endangered by IUCN
  - Were exposed to 3 UV-B treatments:
    1. 99% of UV-B blocked
    2. Control
    3. Direct exposure to natural daylight (maximum natural UV-B Radiation that A. mexicanum might experience)

Source: nationalgeographic.com

Friaz-Alvarez et. al; (2010)
UV-B Radiation affects embryos:

* Without successful hatching or with high deformity rates, there is the conclusion of new individuals into a population!

Friaz-Alvarez, et. al; 2010

UVB-Radiation affects larvae:

Experimental examination of the effects of ultraviolet-B radiation in combination with other stressors on frog larvae

Catherine Laura Smith · Lisa H. Bulter · Henry A. Bochar; Barrows, A. Han, Lomask M. Ivy ·
Searle et. al; (2009)

* Rana cascadae
  - Important ecological role as larvae and adults
  - Documented population declines
  - Exposed to 2 levels of UV-B (Exposed and Shielded)
  - Exposed to 2 temperatures (Hot and Cold)

Searle et. al; (2009)

UV-B Radiation affects larvae:

* Reduced Activity
  - Decreased feeding rates
  - Smaller size at metamorphosis
  - Inability to escape predators

* Cold temperatures reduce a larva’s ability to prevent UV-B damage because repair enzymes work faster at warm temperatures.
UV-B Radiation affects adults:

- *Dendrobates pumilio* and *D. auratus*
- No documented population declines
- *D. pumilio* considered among most abundant anuran species in lowland forests of Costa Rica
- *D. pumilio*—excellent parental care by both males and females
- Transport tadpoles on their back to suitable locations
- Diurnal
- Perch in light gaps to maximize call effectiveness

Results:

- Both species spent significantly more time under the Mylar
- Randomly sampled sites received 6X the amount of UV-B as sites where *D. pumilio* were observed calling

Putting it all together:

What does all of this mean?

"UV-B Radiation is THE MOST important factor when considering amphibian declines!"

- Directly and indirectly affects individuals and populations
- Lethal and sub-lethal effects
- Affects ALL LIFE STAGES!
Literature Cited:


