

Tadpole Development, Ecology, and Metamorphosis



Matthew J. Gray, Ph.D.
College of Agricultural Sciences and
Natural Resources
University of Tennessee-Knoxville



Goal of the Lecture

To familiarize students with tadpole
development and ecology, including
metamorphosis.

Reading Assignments:

- 1) See Website: Wells (2007)
- 2) Altig et al. (2007): *Freshwater Biology* 52:386-395 (Req: website)
- 3) Petranka and Kennedy: *Oecologia* 120:621-631 (Suppl: website)

Lecture Structure

I. Embryonic Development

II. Hatchling Development

III. Larval Development & Ecology

IV. Metamorphosis

Tadpole Community Ecology

Tadpole Densities

Fishless
•700/m²

Fish
•5/m²

Competitors:

- Invertebrates (algae)
- Fish (inverts)
- Conspecifics/Congeners (both)

Predators:

- Eggs: Inverts, Fish, Amphibians
- Larvae: Inverts, Fish, Amphibians

Gape-limited: Fast Growth

Fecal Input

5 mg/day
•3.5g/m²
35 kg/ha
31 lb/ac

Role of Tadpoles?

Predatory Defense

- Palatability
- Activity
- Schooling

Metamorph Development

Gosner (1960) Stages Stages 42-46

Forelimbs Emerge through Opercular Wall

ureotely

Duration of Larval Development

Temperate: 2-3 Months
Tropical: 1-2 Months
Spea: 10-14 days

(Overwintering: Permanent Ponds)

Metamorphosis

Hormone Regulation

T₃: Triiodothyronine

T₄: Thyroxine

T₃ & T₄ : Peak at Gosner 39

Organism Effects:

- Intestines: Shorten
- Tail & Gills: Degeneration
- Skin: Vascularization/Chromatophores/Thickens

- Lungs: Functional (44)
- Kidneys: Urea
- Mandibles & Eyelids: Develop

Immune System: Dismantled

Factors Triggering Metamorphosis

Factors: •Density of Conspecifics and Congeners

- Competition
- Cannibalism/Predation

Ecology 63:905-911,
Ecology 71:2313-2322,
Ecology 79:1859-1872

•Density of Predators

- Growth rate increases
- Activity decreases in presence



•Water Characteristics

Mortality vs. Growth

Werner (1986, 1988)
Rowe and Ludwig
(1990, 1991)

- Water quality
- Water volume vs. temperature vs. concentration
- ➡ Volume and Proximity to Water Surface

Adaptive Plasticity:

BioScience 42(9):671-678

Evolutionary capability to exhibit different phenotypes depending on environmental conditions.

- Developmental Plasticity
- Polyphenism (carnivorous vs omnivorous)
