

Understanding the significance and challenges of juvenile migration in amphibians



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Outline

- Background – life history, definitions, migratory events in life cycle
- Juvenile emigration – a critical migratory event?
- Direct effects on migratory success – habitat alteration and importance of connectivity
- Indirect effects on migratory success– carryover effects from one stage to another



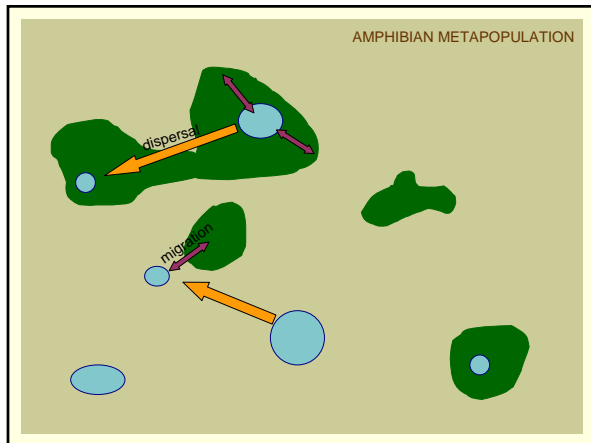
Aquatic-breeding amphibians

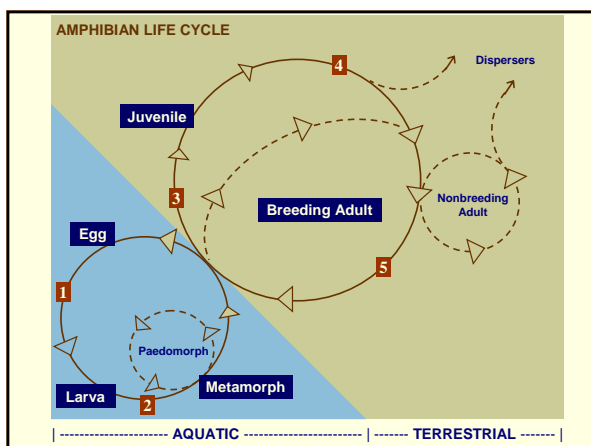
- Egg and larval development in aquatic habitats (*Ambystoma*, *Bufo*, *Hyla*, *Rana*)
- Most of life is spent on land
- Juvenile stage often lasts 2-3 years
- Some species require specific terrestrial habitats during nonbreeding season

Definitions




- **Homing** – navigation to a familiar home range
 - Returning to breeding pond every year (or following a displacement)
- **Migration** – round-trip, seasonal movements between habitats (*within a population*)
 - Annual breeding migrations of adults
- **Dispersal** – one-way, usually once-in-a-lifetime movements (*between populations*)
 - Permanent movement away from natal pond



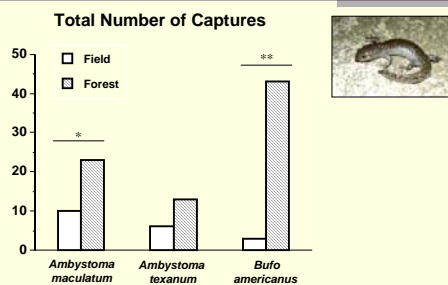


Migration distances

(reviewed by Semlitsch & Bodie 2003)

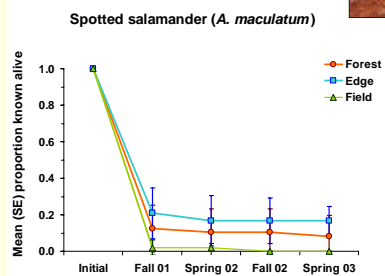
	Salamanders (<i>Ambystoma</i>)	Frogs (<i>Rana</i>)	Toads (<i>Bufo</i>)
			
Mean maximum migration distance	248 m	362 m	425 m
Maximum distance in any study	625 m (<i>A. jeffersonianum</i>)	1,046 m (<i>R. catesbeiana</i>)	1,600 m (<i>B. bufo</i>)
Type(s) of nonbreeding habitat	Forest or grassland Burrows	Wet meadows (summer) Permanent aquatic (winter)	A variety of terrestrial habitats (generalists?)

Movement behavior at habitat edges



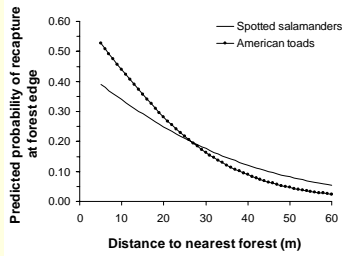
Rothermel & Semlitsch 2002

Juvenile Survival



Rothermel & Semlitsch 2006

Migratory success in fields



Rothermel 2004



Postdoctoral Research: Land-use Effects on Amphibian Populations



NSF Collaborative Study
2003-2007

University of Maine
M. L. Hunter

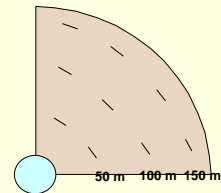
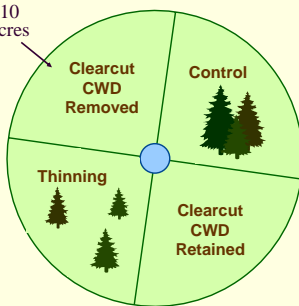
University of Missouri
R. D. Semlitsch, PI

University of Georgia - SREL
J. W. Gibbons, B. B. Rothermel

SUNY ESF
J. P. Gibbs

LEAP Experimental Array

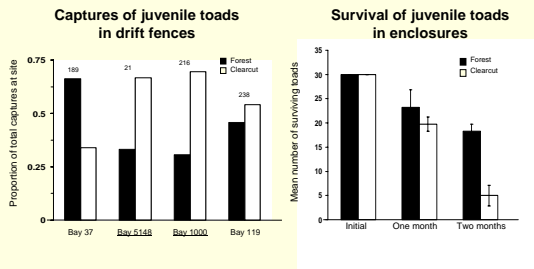
10
acres



Spring 2004



Habitat choice vs. survival



Todd & Rothermel 2006

Direct effects of habitat alteration

Disturbed/open habitats = barriers to movement due to:

- Behavioral avoidance
- Reduced survival and growth

Other potential risks:

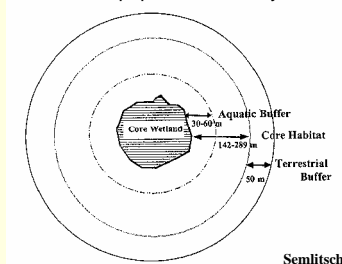
- Increased predation risk?
- Exposure to pesticides?

**Connectivity may be constrained more by migratory ability of juveniles than that of adults



Critical habitat and buffers

- Maintaining connectivity between aquatic/terrestrial habitats is critical to population viability

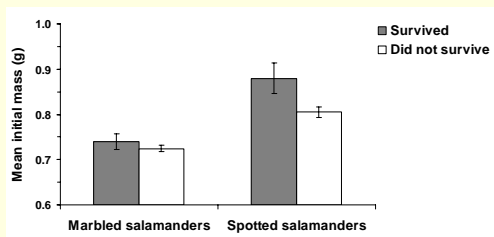


Semlitsch & Bodie 2003

Indirect (carryover) effects

- Juveniles
 - Via density-dependent dynamics operating in larval stage and affecting postmetamorphic fitness
- Adults
 - Via delayed costs of time spent in breeding site and affecting survival during postbreeding migrations
- Can be a function of either natural or anthropogenic stressors

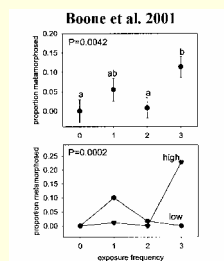
Indirect effects - size at metamorphosis



Rothermel & Semlitsch 2006

Mechanistic basis for indirect effects

- Natural
 - Hydrology (pond drying)
 - Parasites, disease
- Anthropogenic
 - Chemical stressors
 - Habitat alteration





More questions...

- Are short-term studies of migration a good proxy for what happens during dispersal?
- Does most mortality in terrestrial life stages occur during migratory events?
- How important is performance during the first postmetamorphic migration?
- Implications of indirect (carryover) effects for migratory success

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