Spacing, Movements, and Orientation

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Distribution, Dispersion, and Dispersal

- A little review…
- Distribution: the area occupied by the population or species (line drawn around dispersion)
- Dispersion: the spatial pattern exhibited by the animas of a population
- Dispersal: the movement an individual makes from its place of birth to the place where it reproduces

What factors can contribute to movements?

- Intrinsic
  - Age
  - Life history stage
  - Size
  - Sex
  - Reproductive status
- Extrinsic
  - Environmental quality
  - Season
  - Temperature
  - Humidity

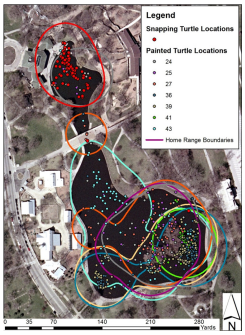
Local Dispersion of Individuals

- Dispersion of individuals occurs at a number of levels
- Species tend to be associated with specific microhabitat patches
- What is a microhabitat?

- Salamanders
  - Eastern Newts
- Frogs
  - Tree frogs vs. Pond frogs
- Snakes
  - Rat Snakes
  - Rattlesnakes
- Lizards
  - Anole vs. ground skink
- Turtles
  - Bog Turtle
  - Spotted turtle

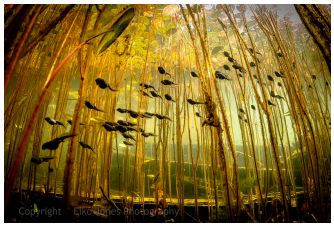
Local Dispersion of Individuals

- Home ranges
  - What is a home range?
  - What is included in a home range?
- Territories
  - Why are territories important?
- Other patterns of space use
  - What are some other important uses of space?

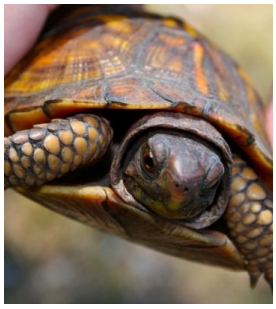


Other patterns of space use

- Brooding/Nest Guarding
- Aggregations
  - Breeding
  - Schooling
  - Environmental factors
    - Drought
    - Overwintering
  - Homing



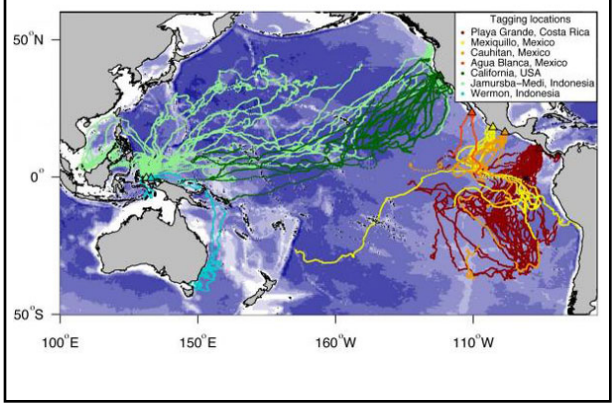
Movements, Homing, and Migrations



- Most movements occur within the home range
- What are some of the costs and benefits to moving?
- How can managers take advantage of movement data?

Mass Movements

- Migration
  - Amphibians
  - Turtles
  - Garter snakes



Dispersal

- What is dispersal again??
- Undirected movement to locations unknown by the moving animal and commonly refers to juveniles leaving the home ranges of their parents to find a home of their own.
- Why is this important?

Homing and Orientation

- Ability of a displaced individual to find its way home
- Migration
- What about translocation in conservation?

Movements and Amphibian Decline

- Climate Change
- Invasive Species
- Pollution
- Pet Trade
- Disease
- Habitat Loss

Adult *A. tigrinum*

Management Issues

- Habitat Use/Quality
- Movement/Buffer Zones
- Population genetics
- Relocation, Repatriation, Translocation

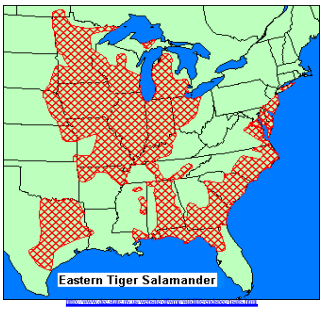
Typical *A. tigrinum* breeding pond

Eastern Tiger Salamander

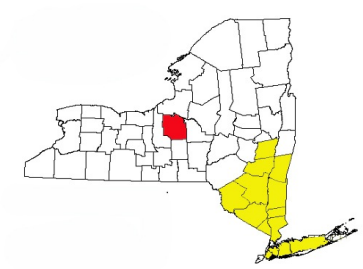
- *Ambystoma tigrinum*
- NYS Endangered
- Decreasing throughout their range
- Many areas on Long Island are in danger of development

Pre-metamorphic *A. tigrinum*

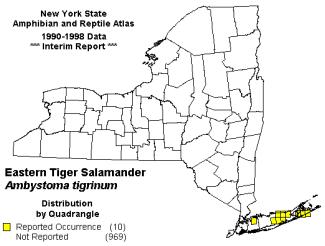
Current Range



Historic Range in N.Y.



Current Range in N.Y.



http://www.dec.state.ny.us/website/dfwmr/wildlife/herp/estsala.gif

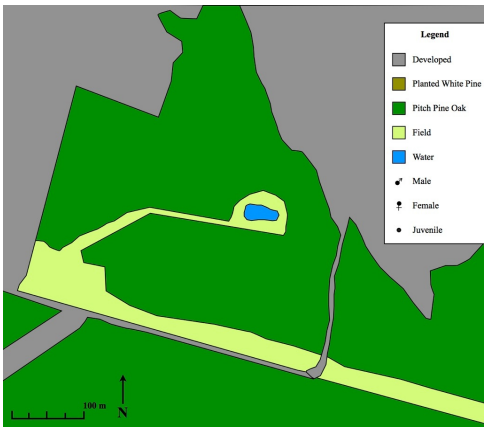
Legal Protection

- New York State Freshwater Wetland Act: 30 m buffer surrounding wetlands
- NYS DEC Recommendations: 164 m, no more than 50% upland habitat within 305 m of breeding pond be converted to unusable habitat (based on Semlitsch 1998)

Recent metamorph

Movements

- Brookhaven National Laboratory, Long Island, N.Y.
- Over 5000 acres
- 22+ confirmed salamander ponds on site
- 3 Focal Ponds: L1, L3, L7
- Tiger Salamander management and monitoring protocols already in place



Methods

- Collected males and females upon emigration from breeding ponds
- Collected juveniles upon emigration or just before final metamorphosis

Pre-metamorphic *A. tigrinum*

Results

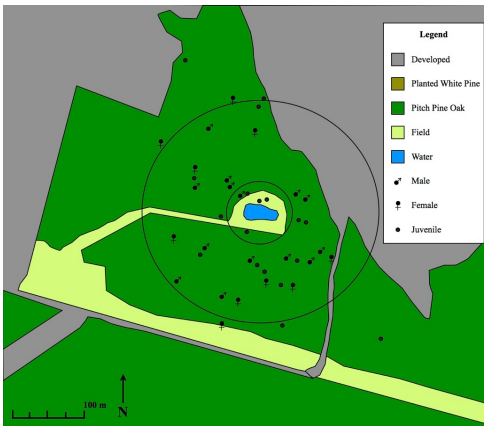
- Tracked 33 males, 26 females, 47 metamorphs
- Predation: Bullfrog, Eastern Hognose Snake, Raccoon, Northern Short-Tailed Shrew, Eastern Ribbon Snake

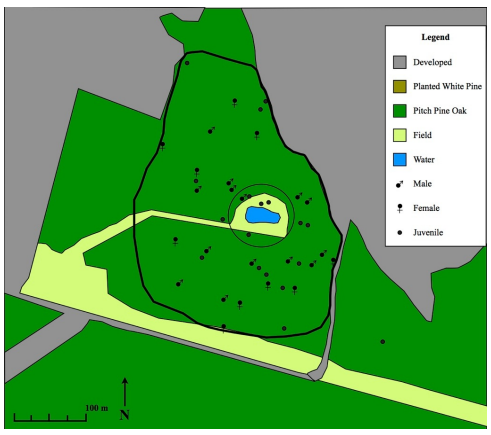
Radiotransmitter with *B. brevicauda* tooth marks

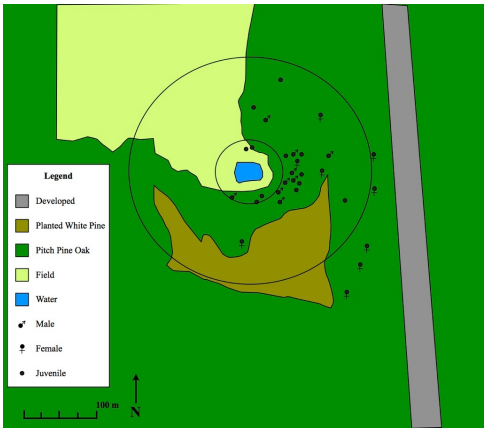
Results

- Movements at night during rain event
- Some short movements after implant replacement
- Avoided open fields, development, planted white pine stands

Adult *A. tigrinum* outside burrow






Legend
Developed
Planted White Pine
Pitch Pine Oak
Field
Water
Male
Female
Juvenile
100 m
N


Legend
Developed
Planted White Pine
Pitch Pine Oak
Field
Water
Male
Female
Juvenile
100 m
N


100 m
N
Legend
Developed
Planted White Pine
Pitch Pine Oak
Field
Water
Male
Female
Juvenile

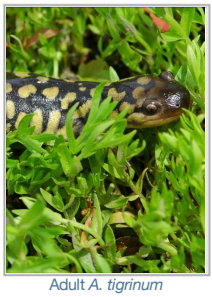
Conclusions

- Circular buffer zones may be inadequate for this species
- Fails to protect 20% of individuals in this study, however, incorporating a 50 m edge effect, only protects 62%
- May encompass unsuitable habitat and reduce availability of good habitat

Pre-metamorphic *A. tigrinum*

Connectivity

- Fragmented landscapes resulting from anthropogenic habitat modification can have a significant impact on dispersal, gene flow, and persistence of wildlife populations
- Reduced genetic variation can severely compromise the ability of a population to respond to subsequent environmental change



Adult *A. tigrinum*

Goals

- Assess population genetic diversity of remaining tiger salamander populations
- Quantify genetic and landscape connectivity among ponds and populations to identify potential corridors and barriers to migration

Adult *A. tigrinum*

Methods

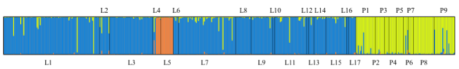
- Collected samples from 17 breeding sites across Long Island and 9 sites in New Jersey
- Collected as many samples as possible (N=2-93) from each site
- Genotyped 439 individuals across 12 microsatellite loci
- Samples included toe and tail clips and individual eggs from egg masses

A. tigrinum egg mass

Results- Regional Population Structure and Migration

- Low allelic diversity
- Markers not highly polymorphic (1-13 alleles)
- Mean numbers of alleles ranged from 1.1 to 3.3 in New York and 1.7 to 2.4 in New Jersey

Results- Regional Population Structure and Migration



Source of Variation	d.f.	Sum of Squares	Fixation index	Percent variation	*P* value
Including admixed populations					
Within populations	740	507.53	$\Phi_{ST} = 0.398$	60.2	**<0.001***
Among populations within clusters	23	38.15	$\Phi_{SC} = 0.049$	3.1	**<0.001***
Among clusters	2	131.94	$\Phi_{CT} = 0.367$	36.7	**<0.001***
Excluding admixed populations					
Within populations	729	487.45	$\Phi_{ST} = 0.404$	59.60	**<0.001***
Among populations within clusters	22	33.45	$\Phi_{SC} = 0.043$	2.67	**<0.001***
Among clusters	2	125.35	$\Phi_{CT} = 0.377$	37.73	**<0.001***

Results- Regional Population Structure and Migration

- High levels of population differentiation between NY and NJ (average *Fst*=0.217) (FSTAT Goudet 1995; Weir and Cockerham 1984).
- Few individuals were assigned to the pond at which they were sampled with either 80% or 95% confidence, and many of these individuals were assigned to other ponds with high confidence (GENECLASS2; Piry et al. 2004)

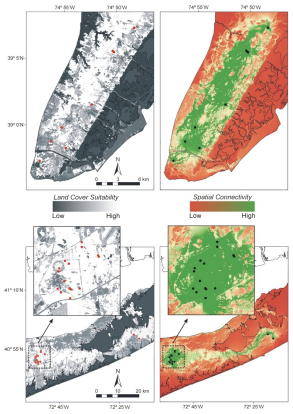
Results- Landscape Barriers to Migration

- Defined land cover resistance values from Compton et al. (2007) and Greenwald et al. (2009)
- Calculated euclidean distance and surface resistance (using CIRCUITSCAPE version 3.3; McRae and Shah 2009);
- Correlated these values with *Fst* using a Mantel test (Rosenburg and Anderson 2011)

Adult *A. tigrinum* in burrow

Results- Landscape Barriers to Migration

- No relationship between connectivity indices and *Fst* in either New York (euclidean distance: r = -0.044, p = 0.827; surface resistance: r = -0.056, p = 0.786) or New Jersey (euclidean distance: r = 0.120, p = 0.388; surface resistance: r = 0.226, p = 0.246)



Management

- Calculate protection (buffer zones) on a case-by-case basis
- Estimate probable dispersal habitat and determine available corridors
- Individual breeding ponds can be susceptible to perturbations that may limit migration and dispersal

So What?

- Global amphibian declines
- Desire to know how to properly conserve and manage this and other amphibian species
- Disease outbreaks; already confirmed *Bd* and *Ranavirus* on site
- Can we actively manage this species (e.g. relocation, assisted migration)?