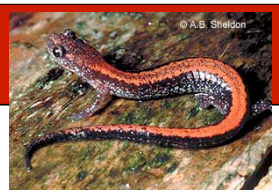

Effects of Hurricane Sandy on the Terrestrial Eastern Red-Backed Salamander

Erica Gaeta[1], Dr. Karen Pope[1,2], and Jessica A. Schuler[3],

[1]Humboldt State University, Arcata, CA [2]USDA Forest Service, Arcata, CA [3]New York Botanical Garden, Bronx, NY

Introduction

Worldwide amphibian populations are observed to be declining and are predicted to continue to decline due to habitat degradation, disease, and global climate change (Noël et al. 2006). Eastern red-backed salamanders (*Plethodon cinereus*) have been monitored using artificial cover boards in The Thain Family Forest, an urban old-growth forest. Due to the forest's urban surrounding it is highly impacted by both anthropogenic and natural disturbances.

On October 29, 2012 Hurricane Sandy struck The Forest, caused tremendous damage by snapping tree trunks and causing many trees to become uprooted, creating canopy gaps (Image on the left).

Objective

- **Assess the effect of Hurricane Sandy on the distribution and abundance of Eastern red-backed salamanders**
- **Examine salamander distribution and abundance in relation to leaf litter and canopy cover**

Questions

1. **Did Hurricane Sandy affect eastern red-backed salamanders?**
2. **If there are effects to the population, are they correlated to changes in response to canopy cover and leaf litter depth?**

Methods

The Thain Family Forest is located within the New York Botanical Garden, Bronx, New York. The Forest is 20 ha (50 acre) urban old growth forest composed of mixed deciduous forest.

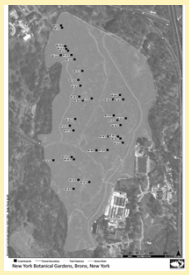

Figure 1. Long- term salamander monitoring study sites throughout the Thain Family Forest, New York Botanical Garden, Bronx, NY.

Estimating Salamander Population Index

- **Long-term salamander monitoring was initiated 2010, but only data from 2012 to 2013 was used**
- **36 sample plots (3 m²) consisting of four artificial cover boards (bottom right)**
- **Plots were randomly placed through out the forest**

Habitat variables

Fall data was analyzed to compare leaf litter depth, and percent canopy cover across similar structural variables before and after Hurricane Sandy

- **Percent canopy cover was estimated with a spherical densitometer (Center, N, S, E, & W)**
- **Leaf litter depth was taken in cm (N, S, W & E)**

Artificial cover boards after Hurricane Sandy.

Results

1) Did Hurricane Sandy affect eastern red-backed salamanders?

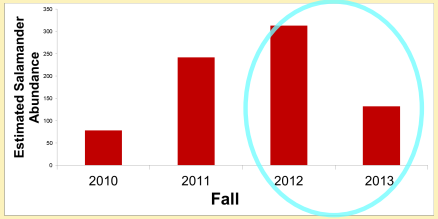

Figure 2. Annual estimates of the salamander population during Fall sampling. Fall 2013 salamander estimates were significantly reduced (t= 3.87, P= 0.0002, df= 70) in comparison to fall 2012.

2) If there is effects to the population, are they correlated to changes in response to canopy cover and leaf litter depth?

Percent Canopy Cover

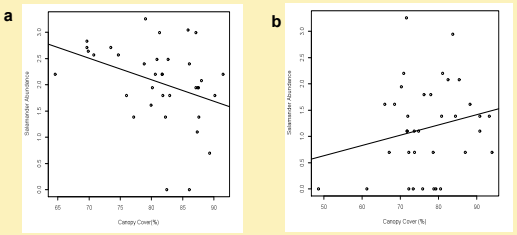

Figure 3. Percent canopy cover in relation to red-backed salamander distribution within plots (n=36) in Fall 2012 (a) vs. Fall 2013 (b). Percent canopy cover was significantly reduced in Fall 2013 in comparison to Fall 2012 (t= 2.25, P= 0.03, df= 70).

Leaf Litter Depth

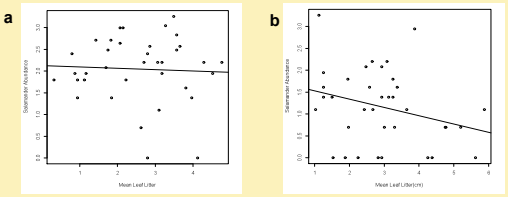

Figure 4. Leaf litter depth in relation to red-backed salamander distribution within plots (n=36) in Fall 2012 (a) vs. Fall 2013 (b). Leaf litter depth (cm) before and after disturbance did not show a significant difference (t=-1.307, P=0.20, df= 70).

Results

TABLE 1. Linear regression model comparing salamander abundance with percent canopy cover and leaf litter depth (cm) between Fall 2012 and 2013.

	Salamander X Canopy cover		Salamander X Leaf litter depth	
	2012	2013	2012	2013
mean	81.20	76.90	2.57	2.95
p-value	0.03258	0.216	0.788	0.0949
R^2	0.1274	0.04469	0.002149	0.07989
AIC	82.632	94.521	87.462	93.17

Discussion

1. **Red-backed salamander abundance under cover boards was significantly reduced after Hurricane Sandy in fall 2013 than previously observed in fall 2012.**
2. **No strong associations with either canopy cover or leaf litter depth was found to be correlated with the reduction of salamander abundance and distribution.**

This could be do to:

- **Sampling method = unable to detect salamanders**
- **Increase coarse woody debris = more natural cover objects**
- **Fall 2013 was a severe drought season with very little rain**

Literature Cited

Greenberg, C. H. 1968. Response of reptile and amphibian communities to canopy gaps created by wind disturbance in the southern Appalachians. Forest Ecology and Management 148:135–144.

Heatwole, H. 1962. Environmental factors influencing local distribution and activity of the salamander, *Plethodon cinereus*. Ecology 43:460-472.

National Oceanic and Atmospheric Administration [NOAA]. 2013. Tropical Cyclone Report Hurricane Sandy <http://www.nhc.noaa.gov/data/tcr/AL182012_Sandy.pdf>

Noël, S., M. Ouellet, P. Galois, and F. –J. Lapointe. 2007. Impact of urban fragmentation on the genetic structure of the eastern red-backed salamander. Conserv Genet 8:599–606.

Acknowledgments

Thank you to my peers, mentors, and all the staff in the New York Botanical Garden for your support, guidance and collaboration.

THE NEW YORK BOTANICAL GARDEN