

The reproductive cycles and temporal and spatial distribution of post disturbance freshwater shrimp in tropical ephemeral streams

Tanner J. Williamson¹ and Omar Perez²

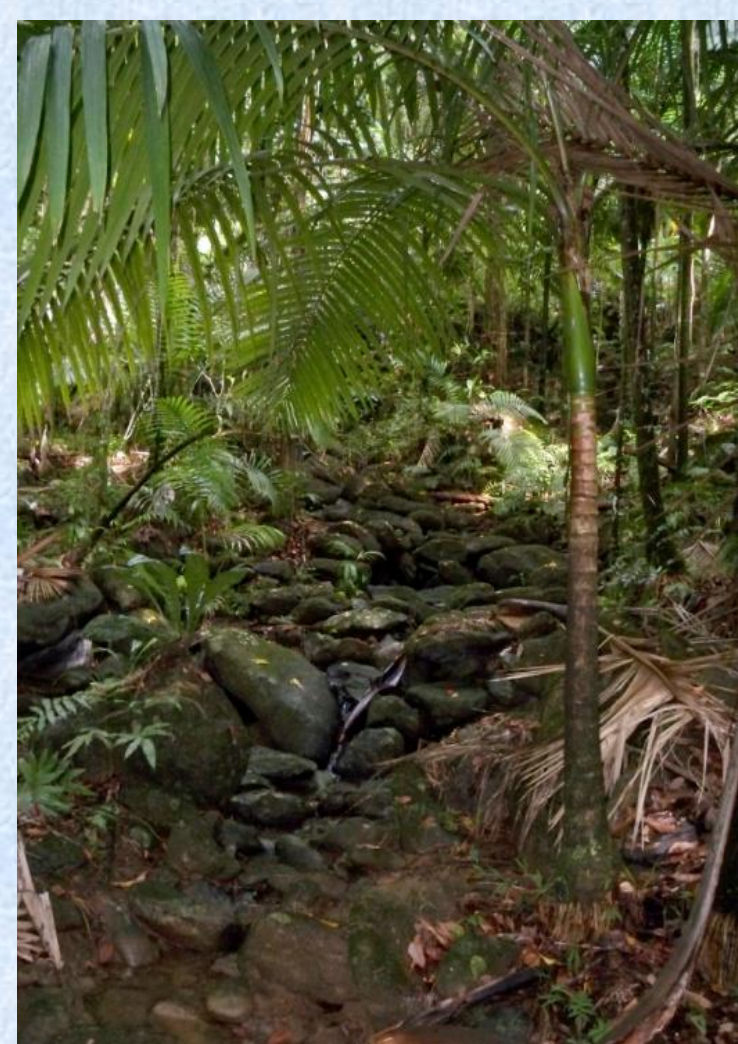
¹Rubenstein School for the Environment and Natural Resources, University of Vermont, Burlington, Vermont.

²Department of Watershed and The Ecology Center, Utah State University, Logan, Utah.

Introduction

Freshwater decapods are the dominant macro-invertebrates found in tropical Puerto Rican streams. Of the approximately 10 species of shrimp that inhabit the waterways of the El Yunque National Forest (EYNF), the following six are dominant: *Macrobrachium faustinum*, *Macrobrachium crenulatum*, *Xiphocaris elongata*, *Atya lanipes*, *Atya scabra*, and *Atya innocous*.

These shrimp are amphidromous, they mature and reproduce in freshwater, but have a larval stage that is dependent upon estuarine and marine salinity. Larvae are released into flowing waters and carried downstream to marine environments where they undergo metamorphosis before migrating upstream.



One of the ephemeral streams utilized in this study



A pool located on one of the ephemeral study streams.

Methods

Study site: Eight pools on two ephemeral streams located within the EYNF were utilized in this study.

Decapod collection: Baited minnow traps (0.5 traps m²) were utilized to capture shrimp from each pool. The following information was recorded for each individual:

- post-orbital carapace length (POL)
- reproductive status
- maturity level &
- sex

Population estimates: Shrimp densities per m² were estimated using a modified Lincoln-Peterson index.

$$N = \frac{(M+1)(C+1)}{(R+1)} - 1$$

N = Estimate of total population size

M = Total initial number of animals captured and marked

C = Total number of animals captured on the second visit,

R = Number of animals captured on the first visit that were then recaptured on the second visit

Marking: Shrimp were marked with a Visible Implant Elastomer.

Results

Populations: A significant difference in species density was found between the two study streams and a comparison stream with perennial flow ($F_{2,12} = 3.89$, $P = 0.047$).

A significant difference was found in sex ratios between the ephemeral and perennial streams ($df = 1$, $P < 0.010$).

No significant difference was found in species densities ($F_{1,7} = 5.59$, $P = 0.466$) and diversity ($F_{1,7} = 5.59$, $P = 0.670$) between the ephemeral streams. No significant difference ($F_{2,12} = 3.88$, $P = 0.113$) was found in species diversities between the ephemeral and perennial streams.

Migration: *A. lanipes* was found to be the primary migrator. Downstream migration occurred more frequently than upstream migration (Table 1).

Reproductive Cycles: A relationship was found between high flow events and the reproductive status of *A. lanipes* (Figure 2).



An *X. elongata* captured during sampling on one of the ephemeral streams.



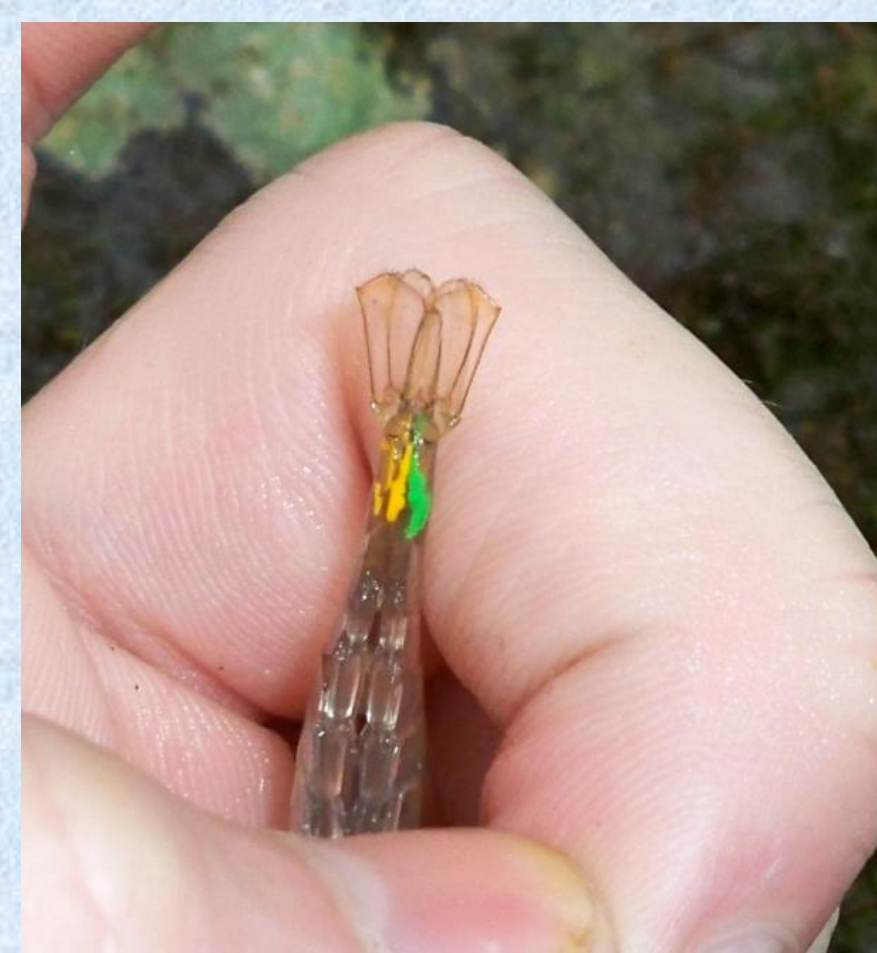
An *Atya* species caught during sampling on Quebrada Prieta.

Table 1. Counts and distances traveled by four freshwater decapods species in two ephemeral streams over 22 days (Stream A) and 35 days (Stream B).

Stream	Count		Upstream distance (m)		Downstream distance (m)	
	A	B	A	B	A	B
<i>A. innocuous</i>	2	2	0	0	162	132
<i>A. lanipes</i>	10	3	80	42	218	42
<i>A. scabra</i>	0	1	0	42	0	42
<i>X. elongata</i>	2	6	0	70	40	280

Table 2. Average decapod density per m² in the two ephemeral study streams (Stream A & Stream B) and a comparison stream with perennial flow located within the same drainage basin (Quebrada Prieta).

	Stream A	Stream B	Quebrada Prieta
<i>Atya</i>	162.36	83.56	23.17
<i>Epilobocera</i>	0.12	0.28	22.14
<i>Macrobrachium</i>	0.93	0.29	0.05
<i>Xiphocaris</i>	46.29	30.8	0.05



X. elongata marked with Visible Implant Elastomer.



Dye released to measure pool flow.

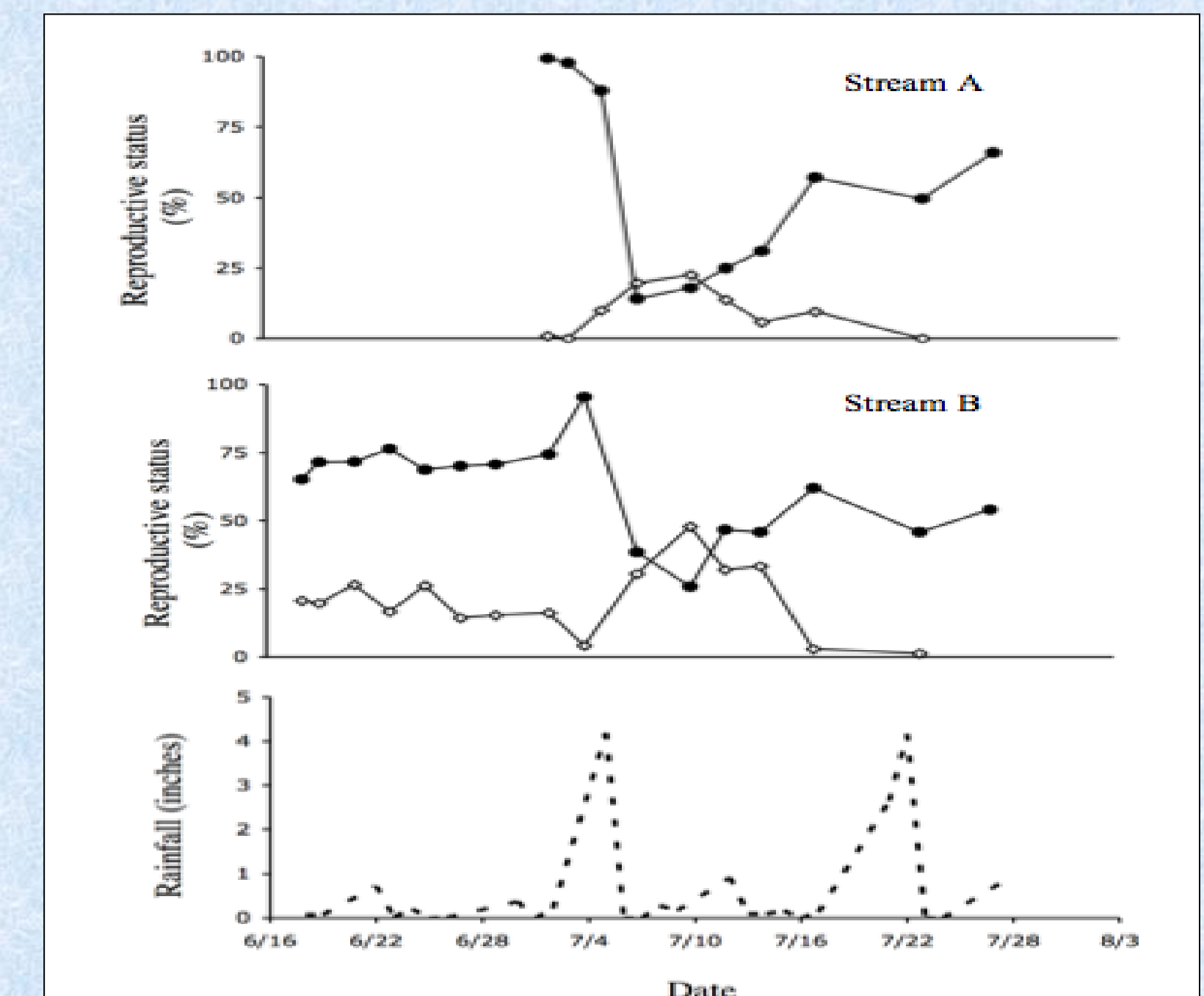


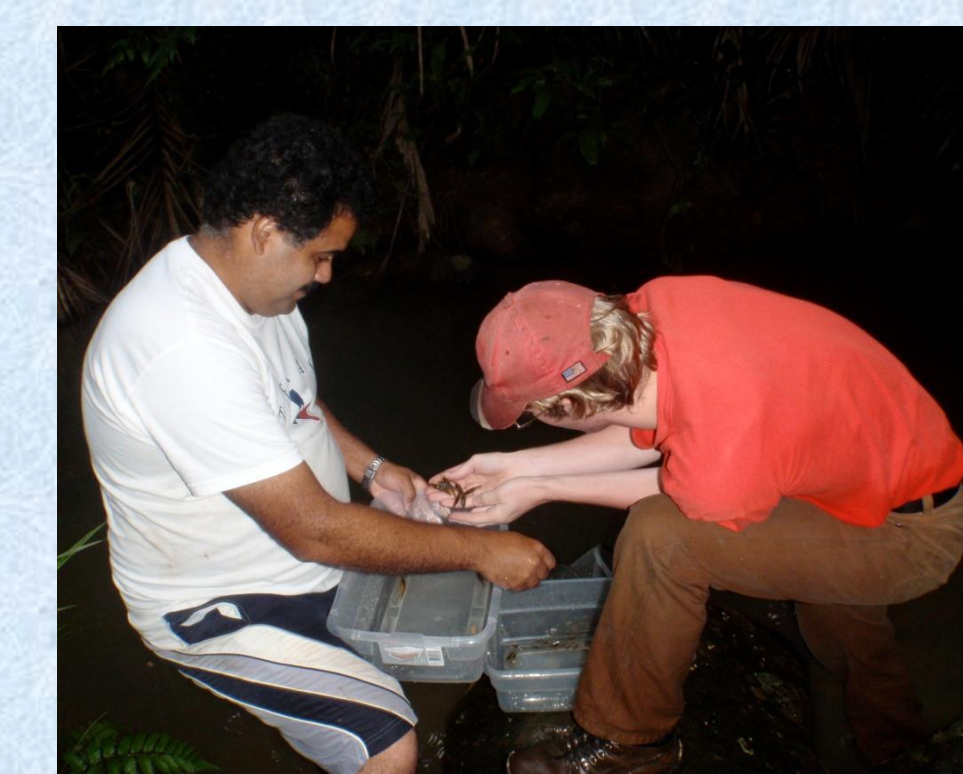
Figure 2. Relationship between the percentage of gravid female *A. lanipes* (solid circles) and non-gravid female *A. lanipes* (open diamonds) and precipitation in two ephemeral streams (A & B).

Discussion

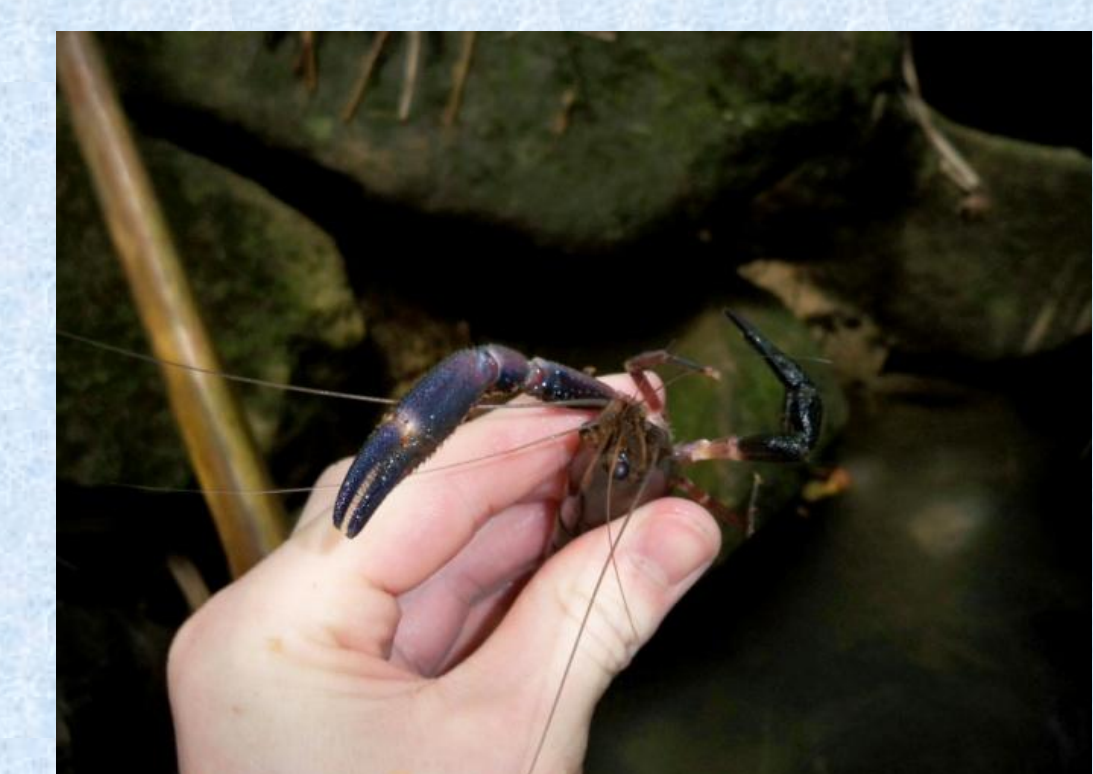
Populations: The significant difference noticed in species densities found between the ephemeral streams and the reference stream is potentially a function of the differences in hydrologic regime.

Migration: Downstream migration was primarily seen. This is possibly a result of downstream flushing of decapod species during high-flow events.

Reproductive cycles: Findings indicate that gravid *A. lanipes* potentially time larval releases to coincide with high-flow events. This would be advantageous as larvae cannot survive extended periods in freshwater, and high flow events generally expedite passage through the drainage basin and into estuarine systems.



The authors sampling decapods on Quebrada Prieta (a stream with perennial flow).



A *Macrobrachium* species captured during sampling on one of the ephemeral streams.

Acknowledgments

The authors would like to thank the National Science Foundation, Vermont Experimental Program to Stimulate Competitive Research (EPSCoR), and the University of Vermont Streams Program for providing funding for this project. The authors gratefully acknowledge Pablo Hernandez, Maria Ocasio, and the students of the summer 2009 El Verde Field Station REU program for their assistance throughout the duration of this work.