EFFECTS OF HURRICANE DISTURBANCE ON LEAF BREAKDOWN AND METABOLIC PROCESSES IN NEOTROPICAL HEADWATER STREAMS

Steve Strella
Rubenstein School of Environment and Natural Resources
University of Vermont

Pedro J. Torres
Odum School of Ecology
University of Georgia

Hurricanes have been demonstrated to be important disturbance regimes for many Caribbean forests, but how do they affect freshwater Ecosystems?

Goals:

- To investigate how changes in proportions of energy inputs to streams, such as those resulting from canopy disturbance, influence ecosystem processes.
- Exploring how ecosystem processes relate to each other.
- To support field treatments using artificially simulated environments

Methods

Decomposition was studied in both a field experiment and within an artificial environment:

Field: Three first order streams with similar physical and chemical characteristics were selected Variables were combined, with a high litter density (Toma de Agua) and a low litter treatment (Buruquena). Canopies were disturbed at both site by removing low-lying branches. Prieta B served as a control stream, free of manipulation.

Freshly fallen *Cecropia schreberiana* leaves were arranged into bundles of known mass and deposited within each 25m reach of stream (5 replicates per stream).

One leaf pack from each replicate was retrieved every six days to develop a decomposition rate (k').

Methods Continued

Artificial: A Parallel experiment was arranged in artificial stream pools. Four treatments consisted of exposed or shaded lighting conditions in combination with high or low litter densities.

Leaf packs were also deposited as in the field experiment; the total change in mass was measured after three weeks.

Metabolic processes were calculated after measuring the change in dissolved oxygen through time within a water-tight chamber containing a fixed area of substrate.

- Community respiration was measured with total exclusion of light
- Photosynthesis was measured under natural lighting conditions; photosynthesis rates were calculated as the sum of the net gain of DO under light **and** the net loss of DO in darkness.

Results

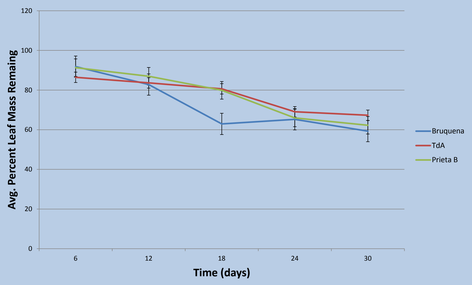

Figure 1: Average percentage of ash free dry mass remaining over time in leaf packs for each study stream, high light reduced litter(Bruquena), high light added litter (Toma de Agua) and Control (Prieta B). Error bars represent +/- 1SE.

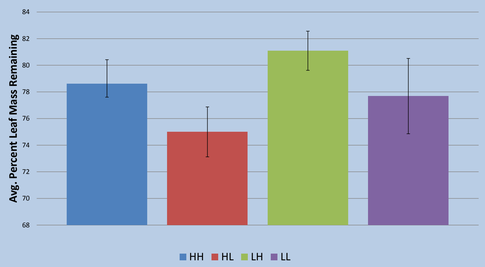

Figure 2: Average percentage dry mass (% DMr) in leaf packs for the four treatments: high litter-high light (HH), high litter-low light (HL), low litter-low light (LL), and low litter-high light (LH). Error bars represent +/- 1SE.

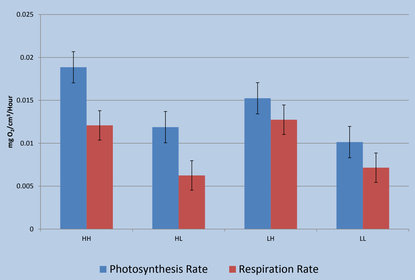

Figure 4: Photosynthesis and respiration rates for the four treatments: high litter-high light (HH), high litter-low light (HL), low litter- low light (LL), and low litter-high light (LH). Error bars represent +/- 1SE.

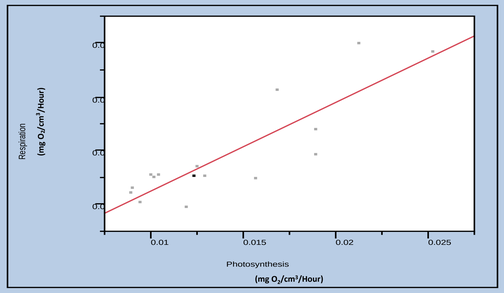

Figure 6: Regression of community respiration rate to photosynthesis rate among all artificial pool treatments.

Discussion

Litter Breakdown:
Decomposition rates (k') in the field experiment were not significantly different among treatments (F_6=1.755, p= .2392). The limitations of small scale manipulations may have limited the influence of treatments in the field.
The artificial environment was under more consistent conditions that the field treatments, and the results may suggest an inverse relationship between decomposition and litter density (f_3= 3.5652, p=.0602).

Metabolic Processes
Light was not significant for both photosynthesis and respiration. However, **litter density was significant for both photosynthesis (p=0.0117) and respiration (p=0.0092).**

Results suggest that benthic ecosystems have high potential to rebound from hurricane disturbance following an initial starving phase; breakdown of debris provides both detrital food source and stimulates algal growth via nutrient release.

Acknowledgments

EPSCoR VT and the Streams Project Staff
Alonso Ramirez- program Director
El Verde Field Station Staff
Karleen Wagner
For Assistance in the field:
Marisa Cross
Ashley Curry
Lelanee Ortiz
T.J. Hegan
Jacob Menkin
Whitney Reyes
Stephanie Simpson