Litterflow, Quality and quantity of organic matter export from forested headwater streams

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Bisley Experimental Watersheds, (18°20’ N, 65°50’ W)  
Luquillo Experimental Forest in north-east Puerto Rico

Organic matter (CPOM> 12.7 mm) export study period, 1987-2005.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Bisley 1</th>
<th>Bisley 2</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drainage area, ha</td>
<td>6.70</td>
<td>6.34</td>
<td>13</td>
</tr>
<tr>
<td>Altitude collection point, m asl</td>
<td>261</td>
<td>267</td>
<td>261-267</td>
</tr>
<tr>
<td>Streambed area, m²</td>
<td>991</td>
<td>2249</td>
<td>3240</td>
</tr>
<tr>
<td>Stream channel length, m</td>
<td>918</td>
<td>868</td>
<td>1786</td>
</tr>
<tr>
<td>Mean annual rainfall 1993-2005, mm y⁻¹</td>
<td></td>
<td></td>
<td>3596</td>
</tr>
<tr>
<td>Mean annual run-off 1993-2005, mm y⁻¹</td>
<td>1738</td>
<td>1822</td>
<td>1780</td>
</tr>
<tr>
<td>Litterfall, g m⁻² d⁻¹</td>
<td></td>
<td></td>
<td>2.38–3.45</td>
</tr>
<tr>
<td>Hurricane litter, g m⁻² d⁻¹</td>
<td></td>
<td></td>
<td>477-868</td>
</tr>
<tr>
<td>Active channel width at collection net, m</td>
<td>1.08</td>
<td>2.59</td>
<td></td>
</tr>
<tr>
<td>Drainage density, m ha⁻¹</td>
<td>142</td>
<td>133</td>
<td>137</td>
</tr>
<tr>
<td>Mean weeks per year w/o CPOM export</td>
<td>6.6</td>
<td>6.5</td>
<td></td>
</tr>
</tbody>
</table>
Litter flow 1993 - 2005
- Total litter
- Leaves

Rainfall 1988 - 2003
Stream Discharge 1987 - 2006

Biomass g ha⁻¹ day⁻¹

Leaves molar C:N

Flux g m⁻² day⁻¹

Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec

Dry Season

Hurricane Season

Increased Shrimp & Snail Upstream Migration
Increased Shrimp Reproduction
Increased Leaf Fall
Hurricane Litter Pulses

Fig 7
Concluding remarks, succession and exports

- Mean daily and low-flow exports returned to pre-Hugo values, but high-flow exports have not returned to pre-hurricane values.
- These observations raise two questions.
  - 1st, why do subsequent hurricanes fail to produce similar high amounts of export as with Hurricane Hugo?
  - 2nd, what controls the long-term temporal pattern of export in these streams?

Interaction of event magnitude and forest.

Level of defoliation/biomass reduction.
Maturity of vegetation in relation to intensity of hurricane event.

   Storms that affect younger forests will export less
Concluding remarks, succession and exports

- Thus, the state of development or maturity of the vegetation places a limit on how much can be exported - independent of the level of hillslope or stream run-off.

- The synergy between hurricane intensity and frequency, and level of vegetation maturity, controls the long-term temporal pattern of export.
Concluding remarks, succession and exports

Contrary to our expectations, export does not recover at the same time scale as litterfall recovers following hurricane defoliation.

We initially expected that the recovery of CPOM export would follow the same general pattern as watershed litterfall rates, which took only 5 years to return to pre-hurricane amounts (Scatena et al. 1996).

After 15 years of succession in the study watersheds, riparian vegetation was just beginning to return to pre-hurricane stem density, while species composition had not (Heartsill Scalley et al. 2010).
Concluding remarks, seasonality of exports

(1) CPOM export follows the seasonal pattern of rainfall and streamflow, plus a dry season peak,

(2) Relative to litterfall inputs entering these streams, export is a very small fraction (0.024%).

(3) There is seasonal variation in CPOM quality as defined by nutrient concentrations.
Lastly,

On seasonality of exports

Seasonality in quantity and quality (nutrients) of organic matter exports from these streams is affected by dry season and storm events.

- Links to aquatic fauna foodwebs as source of energy and as habitat structure in forested tropical streams.
ACKNOWLEDGEMENTS

• This research is part of the USDA Forest Service contributions to the National Science Foundation, Long-Term Ecological Research Program (LTER) at the Luquillo Experimental Forest.

• Grant DEB-0218039 to the Institute for Tropical Ecosystem Studies, University of Puerto Rico, and the International Institute of Tropical Forestry, USDA Forest Service.

• This work was done in cooperation with the University of Puerto Rico.

• M. Salgado Herrera assisted with field data collection.