Shrub encroachment, land management, and litter decomposition

Heather Throop\textsuperscript{1} and Steve Archer\textsuperscript{2}

\textsuperscript{1}Biology Department, New Mexico State University; throop@nmsu.edu
\textsuperscript{2}School of Natural Resources, University of Arizona

1951 SRER
Intergovernmental Panel on Climate Change, 2001

The present carbon cycle
Volumes and exchanges in billions of tonnes of carbon

Intergovernmental Panel on Climate Change, 2001
US Carbon Sink

Pacala et al. 2001, Science
- US C sink ~0.30-0.58 Pg C yr$^{-1}$
  - Forest trees -- 0.11 - 0.15
  - Woody encroachment -- 0.12 - 0.13
  - Other forest organic matter -- 0.03 - 0.15
  - Exports (rivers + trade) -- 0.07 - 0.13
  - Wood products -- 0.03 - 0.07
  - Sedimentation -- 0.01 - 0.04
  - Cropland soils -- 0.00 - 0.04
Woody encroachment at the SRER

Rob Wu, Santa Rita Experimental Range
Land Management at SRER
Abiotic Forces
- Temperature
- Moisture
- UV

Decomposition Dynamics
- Rates
- Composition

Biotic Forces
- Decomposers
- Vegetation
  Litter quality/quantity
  Canopy structure

Climate variables strongly predict globally decomposition patterns …
... except in drylands

Parton et al. 2007 Science
SRER Decomposition & Land Management Study

- 2 litter types
  - mesquite
  - Lehmann lovegrass

- 7 land cover trts

- Litterbags deployed 0, 1, 3, 6, 12 months

- Analyses: mass, %C, %N
Soil movement drives decomposition microbial colonization? microclimate buffering? abrasion?

A) Mesquite

<table>
<thead>
<tr>
<th>Time (month)</th>
<th>$R^2$</th>
<th>Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0004</td>
<td>0.013 ns</td>
</tr>
<tr>
<td>1</td>
<td>0.002</td>
<td>-0.014 ns</td>
</tr>
<tr>
<td>3</td>
<td>0.544</td>
<td>-0.131***</td>
</tr>
<tr>
<td>6</td>
<td>0.600</td>
<td>-0.098***</td>
</tr>
<tr>
<td>12</td>
<td>0.727</td>
<td>-0.118***</td>
</tr>
</tbody>
</table>

In (% ash); soil deposition index
Conceptual model of brush management/decomp at SRER

Throop & Archer 2007 *Ecological Applications*
Meanwhile in the Southern Hemisphere...
Solar radiation strongly affected decomposition

Patagonian steppe

faster decay

[Graph showing decomposition rates under different conditions]

slower decay

Austin & Vivanco 2006 *Nature*
Santa Rita Experimental Range

UV Environment
- High
- Intermediate
- Low

K (yr\(^{-1}\))

% ash (≈ soil deposition)

Throop & Archer 2008 *Progress in Botany*
How do soil movement and UV interact to affect decomposition?
Check back in a few years…

Decomposition in drylands: Soil erosion and UV interactions

Differentiation of biotic and abiotic decomposition using stable isotopes

Fire, vegetative cover, and decomposition in the Chihuahuan Desert
Thanks to…

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