Modeling trophic flows in the wettest mangroves of the tropical Eastern Pacific region

St. Augustine, July 19th 2016, MMM4
Mangroves & precipitation regimes

Rainfall (mm yr\(^{-1}\))

Gulf of California (Mexico)  
Ciénaga de Santa Marta (Colombia)  
Moreton Bay (Australia)  
Gazi Bay (Kenya)  
Everglades (USA)  
Terminos Lagoon (Mexico)  
Sundarbans (Bangladesh)  
Caeté estuary (Brazil)  
Baimuru (Papua New Guinea)  
Douala (Cameroon)  
Kosrae (Micronesia)  
Bahía Málaga (Colombia)  

Rainfall distribution across different mangrove regions.

Modeling trophic flows in the wettest mangroves of the world

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What can these mangroves tell us?

The far Eastern Pacific Fresh Pool - salinity is permanently lower than 33 (<30 in estuarine areas)

- Great mangrove development (above-ground biomass)
- But, poor fish and macrobenthic biomass

Bahía Málaga, tropical Eastern Pacific

- Estuarine system (4 m tidal range)
- ca. 160 km² (1/3 mangroves)
- Low salinities (< 23) throughout the year
- Low human population density (1.5 persons km⁻²)
- One of the best studied mangroves in the Colombian Pacific

Mangrove areas in dark grey color
How does this system function?

- Mass balance models (*Ecopath with Ecosim, EwE*)
- Why? - easily comparable with other mangrove and coastal ecosystem models

Production = Predation + Fishery + Biomass accumulation + net migration + other mortality  \( \text{(Eq 1)} \)

Consumption = Production + unassimilated food + Respiration  \( \text{(Eq 2)} \)

Input parameters
- Biomass (t km\(^{-2}\))
- Production / Biomass (year\(^{-1}\))
- Consumption / Biomass (year\(^{-1}\))
- Ecotrophic efficiency (proportion)
- Diets (proportions)
- Catches (t km\(^{-2}\) year\(^{-1}\))
17 functional groups
Detritus group includes mangrove litter fall
Three primary producers
12 consumer groups
Two main fisheries:
  - Mangrove cockles
  - Finfish (mainly detritivores and zoobenthivores)
    - *Ucides occidentalis* rarely exploited
Most biomass concentrated in detritus and macroalgae (94%)
Extremely low macrobenthic (e.g. fiddler crabs) and fish biomass
Comparison to other models in the Neotropics

- At least three more Ecopath mangrove models:
  - Caeté estuary (Wolff et al. 2000)
  - Huizache-Caimanero (Zetina-Rejon et al. 2003)
  - Gulf of Nicoya (Wolff et al. 1998)
  - Celestun Lagoon (Vega-Cendejas & Arreguin-Sanchez 2001)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Bahía Málaga, Colombia</th>
<th>Caeté estuary, Brazil</th>
<th>Huizache Caimanero, Mexico</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional groups</td>
<td>17</td>
<td>20</td>
<td>26</td>
</tr>
<tr>
<td>Mean trophic level of the catch</td>
<td>2.16</td>
<td>2.08</td>
<td>2.5</td>
</tr>
<tr>
<td>Total system biomass (t km(^{-2}))</td>
<td>155.4</td>
<td>13132.2</td>
<td>486.33</td>
</tr>
<tr>
<td>Total system throughput (t km(^{-2}) yr(^{-1}))</td>
<td>6490</td>
<td>10559</td>
<td>6658</td>
</tr>
</tbody>
</table>
Outlook

• A very rainy area with high above-ground mangrove biomass does not necessarily translates into a high productivity ecosystem.

• Other factors (e.g. salinity) may play important roles determining mangrove system productivity.

• Existing EwE mangrove models in the Neotropics can provide insights about generalities in the functioning of these ecosystems.

• Further EwE simulations will look at the ecosystem-level effects of projected changes in these mangroves (increased fishing pressure, ENSO).
Thanks!

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