Saco River Estuary Food Web

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Ecopath

“All living organisms are linked together”

http://www.ecopath.org/
Establish Mass-Balance

1. biomass
2. consumption/biomass
3. production/biomass
4. ecotrophic efficiency (proportion of production used in the system)
   • Sets up series of linear equations to solve for unknown values
5. diet composition
Master Equations

Describes the production term for each group:

Production = catches + predation mortality + biomass accumulation + net migration + other mortality

Based on conservation of matter within a group:

Consumption = production + unassimilated food + respiration
Energy Balance

**Consumption** → **Respiration** → **Specific Dynamic Action**

- **Active Metabolism** → Costs from activity
- **ΔBiomass** → Growth
- **Egestion - F** & **Excretion - U**

**Consumption** = **production** + **unassimilated food** + **respiration**

\[
C = (ΔB) + (F + U) + (R + A + S)
\]

modified from Kitchell
Methods

• Focused on **Marsh habitat species** monitored in the Sustaining Saco Project.
• Biomass per area, live weight
• 2010-2013
• Production & Consumption rates & Diet Composition *parameter values taken from* literature & Fishbase & Cornell Ornithology Lab.
Ecosystem Health
Costanza & Magneau 1999

• An ecosystem must be free to develop in the absence of serious perturbation to realize its full potential while maintaining adequate resilience to insure against stress and vigor to quickly recover from small scale perturbation.
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Ecosystem Development

Energy Flow

Young (developing) ecosystem

Energy Flow

Growth (production)

Maintenance (respiration)

Mature (climax) ecosystem

Energy Flow

Growth (production)

Maintenance (respiration)
Ecosystem Development

Succession

Relative rates

Gross production (photosynthesis)

Biomass accumulation

Total community respiration

Pioneer stages

Successional age (time)

Mature stages

PP/R
• Mature = 1
• Developing >1
• SRE = 46
• NAR = 3.8
• GoM = 6.0
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Costanza & Magneau 1999

• An ecosystem must be free to develop in the absence of serious perturbation to realize its full potential while maintaining adequate resilience to insure against stress and vigor to quickly recover from small scale perturbation.

• Hypothesis: systems with balance between organization and resilience within a given range of system vigor can be characterized as “healthy”.
Sensitivity Analysis

1. Model Parameterization
2. Species Interactions
Policy implications

Applications of Ecopath food web modeling:

• ask ‘what if’ type questions
  – e.g. What if biomass of green crabs increases?

• calculate carrying capacity of specific species
  – define upper limits to inform conservative approach to resource management

• compare SRE to other estuarine systems
Questions?