A Global Crisis for Seagrass Ecosystems?

Bob Orth, Tim Carruthers, Bill Dennison, Carlos Duarte, Jim Fourquean, Ken Heck, Randall Hughes, Gary Kendrick, Jud Kenworthy, Suzanne Olyarnik, Fred Short, Michelle Waycott, Susan Williams

tcarruth@umces.edu
www.ian.umces.edu
Outline

• Seagrass services
• Seagrass history
• Seagrass pressures
• Seagrass response
• Human response
• Communication
Seagrasses are abundant in tropical and temperate regions

- *Halophila*: Bocas del Toro, Panama
- *Thalassia*: Kuna Yala, Panama
- *Ruppia*: Morro Bay, USA
- *Zostera*: Ria Formosa, Portugal
Seagrass provides critical food source in tropical regions.

Manatee (*Trichechus*)
In *Thalassia* meadow, Puerto Rico

Green Sea Turtle (*Chelonia*)
In *Cymodocea* meadow, Yucatan, Mexico
Seagrass provides critical habitat in temperate regions

Seahorse (*Hippocampus*)
In *Cymodocea* meadow, Mediterranean Sea

Zebra fish (*Girella*)
In *Posidonia* meadow, Perth, Western Australia
Seagrasses are valuable and threatened compared to other major marine habitats.

<table>
<thead>
<tr>
<th>Ecosystem</th>
<th>Area ($10^6$ ha)</th>
<th>Loss (% year$^{-1}$)</th>
<th>Value (US$ ha$^{-1}$ year$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seagrass</td>
<td>18</td>
<td>2–5</td>
<td>19,004</td>
</tr>
<tr>
<td>Salt marsh</td>
<td>140</td>
<td>1–2</td>
<td>9,990</td>
</tr>
<tr>
<td>Mangrove</td>
<td>15</td>
<td>1–3</td>
<td>9,990</td>
</tr>
<tr>
<td>Coral</td>
<td>62</td>
<td>4–9</td>
<td>6,075</td>
</tr>
<tr>
<td>Tropical forest</td>
<td>1,900</td>
<td>0.5</td>
<td>2,007</td>
</tr>
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</table>
Approach to building synthesis

• Building on many discussions (including ISBW6)
• Took approx 50 cases of loss documented in literature
• Assessed historical change in key global environment parameters
• Documented some metrics comparing seagrass knowledge and communication of that knowledge in relation to other systems
Approach to building synthesis

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The not so secret ‘secret’ weapon
Seagrasses evolved in a very different marine environment from today.
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- Hydrocharitaceae
- Cymodoceaceae
- Posidoniaceae
- Zosteraceae

**Graph:**

- Global ocean morphology
- CO2 concentration (ppm) vs Mean global temperature (°C)
- 100 MYA to Present
- Tethys Sea closes
- Panama Isthmus closes
- Hominids

**CO2 concentration (ppm):**

- 2000 ppm
- 1000 ppm
- 0 ppm

**Mean global temperature (°C):**

- 22°C
- 17°C
- 12°C

**Images:**

- Hydorcharitaceae
- Cymodoceaceae
- Posidoniaceae
- Zosteraceae
Seagrasses evolved in a very different marine environment from today.

- Hydrocharitaceae
- Cymodoceaceae
- Posidoniaceae
- Zosteraceae

Timeline:
- Tethys Sea closes
- Panama Isthmus closes
- Hominids

Global ocean morphology

CO₂ concentration (ppm)

Mean global temperature (°C)

Mean sea level, relative to present (m)
Pressures to seagrass: human population

- First human use of seagrass
- Centralized agriculture begins
- Aristotle refers to seagrass
- Expansion of shipping shipping
- Industrial Revolution
- Present

CO₂ concentration (ppm)

- 0
- 200
- 400

Egypt ca. 10,000 years ago

Pacific northwest, seagrass use

Washington DC, 2006
Pressures to seagrass: human population

- First human use of seagrass: 10,000 years ago
- Centralized agriculture refers to seagrass:
- Expansion of shipping utilizes seagrass species:
- Industrial revolution:

**CO$_2$ concentration (ppm)**

- 400
- 200
- 0

**Mean sea level, relative to present (m)**

- 0
- -10
- -20
- -30

- Pacific northwest, seagrass use
- Egypt ca. 10,000 years ago
- Washington DC, 2006
Pressures to seagrass: human population

- First human use of seagrass
- Centralized agriculture
- Aristotle refers to seagrass
- Expansion of shipping
- Linnaeus identifies seagrass species
- Industrial revolution

**CO₂ concentration (ppm)**

10,000

**Mean sea level, relative to present (m)**

0

**Global human population (x10⁶)**

0

**Location Images**

- Pacific northwest, seagrass use
- Egypt ca. 10,000 years ago
- Washington DC, 2006
Pressures to seagrass: increased invasive species

- Expansion of shipping
- Suez canal opened
- Water used for ballast
- Panama canal opened
- Increase in shipping

1850  1900  1950  2000

Caulerpa taxifolia
Pressures to seagrass: increased invasive species

Cumulative invasive species introductions to seagrass

% introductions to seagrass

Negative  Inferred negative  Unknown  Positive  Neutral

Panama Canal, 1907

Ballast pumping

Expansión de la navegación
Canal de Suez abierto
Agua usada como balasto
Canal de Panamá abierto
Aumento en la navegación

1850  1900  1950  2000
Pressures to seagrass: increased nutrient input (Fertilizer and sewage)

Global nitrogen fertilizer use

- Fertilizer applied in agriculture
- Wastewater Treatment Plant
- Fertilizer applied to lawns
Seagrass response: multiple losses

<table>
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<tr>
<th>km²</th>
<th>Tropical</th>
<th>Temperate</th>
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<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1</td>
<td>5 Vessel grounding</td>
<td>8 Dredging</td>
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<tr>
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<td>7 Herbivory</td>
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<tr>
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<td>1 Hurricane</td>
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The diagram shows the number of reported cases over time, with data points indicating the number of cases in temperate and tropical regions.
### Seagrass response: multiple losses

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![Graph showing reported cases over time](image)

- **temperate**
- **tropical**
## Seagrass response: multiple losses

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<tr>
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<td>-</td>
<td>1 Wasting disease</td>
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<tr>
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![Graph showing the number of reported cases over time](image)
Human response: increasing management and monitoring
Human response:
increasing management and monitoring

Marine protected areas

Seagrass monitoring effort
Research effort on seagrasses increasing, but lagging behind other coastal habitats.
Within widely accessed media, reports of seagrass are lacking.
Bottom line: less seagrass research done AND it isn’t broadly publicised
Conclusions

- Extensive seagrass losses have occurred in temperate and tropical regions.
- Nutrients and sediment inputs are the primary pressures.
- Research and understanding of seagrass communities is increasing…
- BUT – despite a lot of effort, the importance and issues of seagrass habitats are still lagging behind other coastal communities in effective communication to the public and ultimately policy makers.
Acknowledgments

- ISBW 6 participants and seagrass colleagues

- You! Once the database is set up on the web we aim for it to be a resource for all seagrass scientists to add data for your regions and also access this global resource

- Tanzania!!