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Coastal Health Index for the Northern Gulf of Mexico: How Fisheries Contribute to Measuring Ecosystem Health

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SDAFS: January 27, 2019
**Background**

- **Ecosystem Based Management:** site specific approach to natural resource management that aims to protect the health, function and resilience of an entire ecosystem for the benefit of all organisms.

- **Integrate Metrics:**
  - Biological
  - Chemical
  - Remotely Sensed
  - Economic
  - Societal
Regional Health Indices

- Ecosystem-based management
- Raise public awareness
- Identify knowledge gaps
- Prioritize management & research

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sub-variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Provision (FP)</td>
<td>Fisheries (FIS)</td>
<td>Harvest of sustainably caught wild seafood</td>
</tr>
<tr>
<td></td>
<td>Mariculture (MAR)</td>
<td>Production of sustainably cultured seafood</td>
</tr>
<tr>
<td>Artisanal Fishing (AO)</td>
<td>Opportunity to engage in artisanal-scale fishing for subsistence or and/or recreation</td>
<td></td>
</tr>
<tr>
<td>Natural Products (NP)</td>
<td>Sustainable harvest of sustainably and renewable natural products other than food provision</td>
<td></td>
</tr>
<tr>
<td>Carbon Storage (CS)</td>
<td>Status of natural habitats affording long-lasting carbon storage</td>
<td></td>
</tr>
<tr>
<td>Coastal Protection (CP)</td>
<td>Status of natural habitats affording protection of the coast</td>
<td></td>
</tr>
<tr>
<td>Tourism and Recreation (TR)</td>
<td>Opportunity to enjoy coastal areas for recreation and tourism</td>
<td></td>
</tr>
<tr>
<td>Coastal Livelihoods and Economies (LE)</td>
<td>Jobs and wages from marine-related sectors</td>
<td></td>
</tr>
<tr>
<td>Coastal Economies (ECO)</td>
<td>Revenues from marine-related sectors</td>
<td></td>
</tr>
<tr>
<td>Lasting Special Places (LSP)</td>
<td>Cultural, or aesthetic connection to the environmental afforded by coastal and marine places of significance</td>
<td></td>
</tr>
<tr>
<td>Sense of place (SP)</td>
<td>Iconic Species (ICO)</td>
<td>Cultural or aesthetic connection to the environmental afforded by iconic species</td>
</tr>
<tr>
<td>Clean Waters (CW)</td>
<td>Clean waters that are free of nutrient and chemical pollution</td>
<td></td>
</tr>
<tr>
<td>Biodiversity (BD)</td>
<td>Habitats (HAB)</td>
<td>The existence of value of biodiversity measured through the conservation status of habitats</td>
</tr>
<tr>
<td></td>
<td>Species (SPP)</td>
<td>The existence value of biodiversity measured through the conservation status of marine-associated species</td>
</tr>
</tbody>
</table>

\[
CHI = a_1 V_1 + a_2 V_2 + \cdots + a_{10} V_{10} = \sum_{i=1}^{10} a_i V_i
\]
Stakeholder Survey

• Social Media
  • Targeted E-mail
  • Survey
    • Value importance when determining if a coastal ecosystem is healthy
      • Likert Scale
    • Differentially weight model

Do you live, work, or vacation along the Texas Gulf Coast? Please take a short survey on the health of your coast.
https://www.surveymonkey.com/r/TexasGulfCoast
Defining ecologically, geographically, and politically coherent boundaries for the Northern Gulf of Mexico coastal region: Facilitating ecosystem-based management

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Study Area
Food Provision

• Fisheries
  • Harvest of wild-caught seafood
    • Commercial landings by species
    • Fishery Sustainability Score (FSS) ← resiliency and vulnerability
  • Data Source: State Resource Agencies
  • Reference Point – Relative Target
    • All species harvested with high resilience and low vulnerability scores.

• Mariculture
  • Harvest of farm-raised seafood
  • Data Source: USDA – Agriculture Census
  • Reference Point – Established Target
    • Aquaculture supports increasing demand for seafood sustainably

<table>
<thead>
<tr>
<th>Common Name*</th>
<th>Species</th>
<th>Resilience**</th>
<th>Vulnerability</th>
<th>FSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bull shark</td>
<td><em>Carcharhinus leucas</em></td>
<td>Very Low</td>
<td>88</td>
<td>18.5</td>
</tr>
<tr>
<td>Red snapper</td>
<td><em>Lutjanus campechanus</em></td>
<td>Low</td>
<td>55</td>
<td>47.5</td>
</tr>
<tr>
<td>Southern flounder</td>
<td><em>Paralichthys lethostigma</em></td>
<td>Medium</td>
<td>44</td>
<td>65.5</td>
</tr>
<tr>
<td>Atlantic Thread Herring</td>
<td><em>Opisthonema oglinum</em></td>
<td>Medium</td>
<td>24</td>
<td>75.5</td>
</tr>
<tr>
<td>Eastern oyster</td>
<td><em>Crassostrea virginica</em></td>
<td>High</td>
<td>27</td>
<td>86.5</td>
</tr>
<tr>
<td>Blue crab</td>
<td><em>Callinectes sapidus</em></td>
<td>High</td>
<td>13</td>
<td>93.5</td>
</tr>
<tr>
<td>Stone crab</td>
<td><em>Menippe spp.</em></td>
<td>High</td>
<td>10</td>
<td>95.0</td>
</tr>
</tbody>
</table>

* 165 species commercially harvested in study area

*Resilience Metric: very low = 1, low = 2, medium = 3, high = 4
Artisanal Fishing Opportunity

• Opportunity to engage in artisanal-scale fishing for subsistence or recreation.
  • Contaminant levels
    • Metals (Arsenic and Mercury)
    • Pesticides (DDTs, Dieldrin and Mirex)
    • PCBs
  • Number of designated access points per impoverished population.
  • Proportion of designated access points free of charge

• Data Source: EPA NCCA, US Census, NOAA Pub. Access Register
• Reference Point - Relative Target
  • All fish are free of contaminants, and there is at least 1 designated access point available, free of charge, for every 500 people in poverty.

Photo Credit Johnny Hanson, Houston Chronicle
Tourism and Recreation

• Tourism-related jobs and economy
  • Establishments
  • Employment rate
  • Wages paid → Annual salary
  • GDP

• Data Source: NOAA Economics: National Ocean Watch

• Reference Point: Moving Target
  • Regional Tourism and Recreation sector compared to the regional total economy keeps pace with National (coastal)
  • 5 year moving average

\[
TR \ Score = \left( \frac{TR_i}{T_i} \right) / \left( \frac{TR_j}{T_j} \right)
\]

\[i = \text{Region} \]
\[j = \text{National-Coastal}\]
Stakeholder Survey

- 2,265 responses = 1,815 complete
Acknowledgements

• Data Sources and Data Managers
  • NOAA (C-CAP, ENOW)
  • EPA (NCCA)
  • State Resource Agencies (TPWD, LDWF, MDWFP, ADCNR, FWC)
  • USDA (NASS)
  • USGS (PAD)
  • Nature Serve
  • Jones and Kammen (2014)
  • US Department of Labor (BLS)
  • IUCN

• Financial Support
  • Texas A&M University, Marine Biology Interdisciplinary Program
  • Texas A&M University, Wildlife and Fishery Science
  • University of Houston-Clear Lake, and EIH
  • Texas Chapter of the American Fisheries Society
Thank You

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