Comparing sea turtle trends in the Pacific and Atlantic: an integrative approach to determine the relative role of fishing mortality

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Leatherbacks:
Pacific

Malaysia

French Guiana

y = 13625e^{0.0359x}

R^2 = 0.1509

Mexiquillo

Florida

Number of nests

Year
Japanese loggerheads: Sum of beaches with complete records, 1990-2000

\[ y = 4007.3e^{-0.1202x} \]

\[ R^2 = 0.8769 \]

Loggerheads: Index beaches, Florida  

\[ y = 49032e^{-0.0018x} \]

\[ R^2 = 0.0028 \]
## Life history characteristics

<table>
<thead>
<tr>
<th></th>
<th>Loggerhead <em>Caretta caretta</em></th>
<th>Leatherback <em>Dermochelys coriacea</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age at maturity</strong></td>
<td>~25 years</td>
<td>~10 years</td>
</tr>
<tr>
<td><strong>Pelagic phase</strong></td>
<td>Hatchling, small juvenile (Atl) Large juvenile, adult? (Pac)</td>
<td>Entire life cycle</td>
</tr>
<tr>
<td><strong>Pelagic diet</strong></td>
<td>Gelatinous organisms, crustaceans, fish?</td>
<td>Exclusively gelatinous organisms</td>
</tr>
<tr>
<td><strong>Breeding frequency</strong></td>
<td>2-7 years</td>
<td>1-4 years</td>
</tr>
<tr>
<td><strong>Fecundity</strong></td>
<td>4 x 100 eggs</td>
<td>5 x 80 eggs</td>
</tr>
<tr>
<td><strong>Population status – Pacific Atlantic</strong></td>
<td>Declining Stable</td>
<td>Steeply declining Increasing</td>
</tr>
</tbody>
</table>
Factors for decline vary in scale

• Local perturbations
  – Egg harvest
  – Adult female harvest on nesting beaches

• Regional perturbations
  – Nearshore fisheries (gillnet)

• Large scale perturbations
  – Offshore fisheries (driftnet and longline)
  – Oceanographic conditions and natural mortality
    • Habitat quality and quantity
    • Food web changes (indirect effects)
The general idea:

<table>
<thead>
<tr>
<th></th>
<th>Atlantic</th>
<th>Pacific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loggerhead</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Leatherback</td>
<td>++</td>
<td>--</td>
</tr>
</tbody>
</table>

- We do not have sufficient biological and demographic information to parameterize realistic simulation models for any of these without a great deal of uncertainty
- Contrasts in time series data, life history characteristics, habitat requirements and distribution may allow rejection of alternative hypotheses for Pacific declines
Time lags and factors affecting recovery – Pacific leatherback

Lewison and Heppell in prep
Project components

• Quantification of anthropogenic impacts through time
  – Egg harvest and beach protection
  – Longlines and driftnets
  – Nearshore fisheries bycatch

• Population dynamics
  – Time series analysis
  – Age-structured models
  – Size structure analysis: evidence for recruitment?

• Habitat and distribution
  – Habitat definition and quantification
  – Migration behavior (satellite telemetry)
  – Overlap with fisheries
  – Likely distribution of hatchlings – A-D models?
Data?

- Published
  - Some nesting beach data
  - Some satellite tracks
  - Some bycatch data

- Unpublished
  - Bycatch, nesting beach trends, satellite tracks
  - How do we get these??

HOST A WORKSHOP!
Plan for year 1

• Data accumulation
  – Focus on spatio-temporal variance in perturbations for both species, both basins

• Life history models

• Habitat definition and mapping

• Hypothesis formulation

• Workshop
Plan for year 2

- Synthesis of spatio-temporal variance in perturbations and habitat quality (including overlap with fisheries) for both species, both basins
- Size-structure analysis
- Hypothesis testing with simulated time series and distribution models
- Develop recommendations for research, management prioritization
- Workshop
Justification

It is important to decompose the relative contributions of various factors to decline, even if the “answer” is “everything” or “a combination of factors”.

This analysis can guide research efforts by identifying major gaps in our knowledge of the species, particularly those gaps that prevent us from rejecting alternative hypotheses for decline.