Why SPAs (Marine Reserves) are Necessary for the Sustainable Management of Queen Conch in the Florida Keys (and elsewhere)

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The Questions

How can Conch Biology Guide us to Develop Sustainable Management Approaches?

(traditional fishery methods, ecosystem-based methods such as MFRs)

Does Existing Zoning within FKNMS Protect Conch should a limited recreational fishery be opened?
The Fishery has Been Closed Since 1986
The First Order of Business:
Where do the Larvae Come from?

- Plankton Surveys
- Drift Vials

In Concert With:

- Satellite Imagery
- Drifters
- Hydrodynamics
- Patterns in population recovery
The Oft-Cited Synthetic Model

Loop Current

Tortugas Gyre

Pourtales Gyre

Spin-Off Eddies

Florida Current
Florida Current Sheer

Florida Keys Entrainment Zone

Delgado and Glazer, 2005
Focus of Surveys on Reproductive Behavior
Conch Distribution

Florida Bay

Gulf of Mexico

Everglades National Park

Nearshore Aggregation
Hawk Channel
Offshore Aggregation

N
W
E
S

0 60 120 Kilometers
Surveying the Aggregations

- Density of Adults
- Density of Spawning Conch
DEPENSATION AT LOW DENSITIES

N = 286

Mating Density (adult conch • hectare\(^{-1}\))

Density (adult conch • hectare\(^{-1}\))

\begin{align*}
\text{0-200} & \quad 42 \\
\text{200-400} & \quad 49 \\
\text{400-600} & \quad 65 \\
\text{600-800} & \quad 57 \\
\text{800-1000} & \quad 25 \\
\text{1000-1200} & \quad 19 \\
\text{1200+} & \quad 28
\end{align*}
DENSITY DEPENDENT RESPONSE

N = 286
Equilibrium (unfished)

N= 286
Density (adult conch • hectare⁻¹)

Mating Density (adult conch • hectare⁻¹)

N=286
Results of the Surveys

Queen conch in sparse aggregations
Can’t mate due to strong depensation
But when densities per sector
Exceed 200 per hectare
The conch resume normal relations
Densities of Queen Conch Aggregations

- **Fished**
  - < 200 adults per ha
  - > 200 adults per ha
  - ≥ 800 adults per ha

- **Unfished**

Maps show locations of Berry Islands and San Andres with different density levels.

- Berry Islands: 200 adults per ha
- San Andres: 800 adults per ha

Florida Keys and ECLSP areas also indicated with density levels.
...Slippery Slope to Extinction

Density (adult conch • hectare$^{-1}$)

<table>
<thead>
<tr>
<th>Density Range</th>
<th>Probability of Mating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200+</td>
<td>0.8</td>
</tr>
<tr>
<td>1000-1200</td>
<td>0.7</td>
</tr>
<tr>
<td>800-1000</td>
<td>0.6</td>
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<tr>
<td>600-800</td>
<td>0.5</td>
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<td>400-600</td>
<td>0.4</td>
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<tr>
<td>200-400</td>
<td>0.3</td>
</tr>
<tr>
<td>0-200</td>
<td>0.0</td>
</tr>
</tbody>
</table>

unfished
To Recap...

Conch must achieve at least 200 conch/ha for any reproduction to occur

There is a bonus relative to per capita reproductive encounters for densities between 200 conch/ha and 800 conch/ha

An unfished population can be expected to approach or exceed 800 conch/ha
Conclusions – Question 1

- It’s All About Density – Management of Conch Must Focus on Density
  - Any open fishery will likely reduce Most Adult Aggregation Densities to < 200 per hectare
- therefore...No-Take Marine Fishery Reserves are Absolutely Essential for Sustainable Management of Conch in Florida AND Elsewhere
- Relatively Sedentary, Dioecious Species (e.g., Urchins, Abalone) also Likely Benefit Greatly from Reserves
Question 2: Guided by These Principles, Does Existing Zoning in FKNMS Protect Conch Within a Hypothetical Scenario of a Recreational Fishery?
Are the SPAs as Currently Designed (a) Large Enough and, (b) Correctly Placed if a Limited Recreational Conch Fishery Opens?
Conclusions – Question 2

Caveat: ...if a recreational fishery opens

➤ The SPAs as Currently Designed ARE Large Enough

➤ ...but, in many cases, the SPAs are Not Well-Placed for Florida’s Conch Conservation so They Would Need to be Resized or Adjusted

➤ Many Aggregations are Not in Close Association with SPAs
Thanks to

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- The University of Florida Institute of Food and Agricultural Sciences Environmental Statistics
- NOAA
- The Nature Conservancy of the Florida Keys.
The Conch Republic
Thanks You For Visiting.
THE FLORIDA KEYS & KEY WEST
Q1. What if We Used a Traditional Fisheries Approach?

The Problems with Spawning Potential Ratio (SPR)*

*Reproductive Output Fished / Reproductive Output Unfished

SPR=0.5

N=286
Density (adult conch m\(^{-1}\))

Mating Density (adult conch hectare\(^{-1}\))

N=286

NO REPRODUCTION

Adult Conch Density (adults \cdot hectare\(^{-1}\))

Depensation
Representative of an Unfished Population

Adult Conch Density (adults • hectare⁻¹)

Mating Density (adult conch • hectare⁻¹)

N=286
Extending the Concept
Egg count by carapace length for Florida Keys fishery and Dry Tortugas sanctuary lobsters

The only significant overlap in size of egg bearers between the Keys and Tortugas is from 85 to 90 mm CL.

Bertelsen et al. 2001
Red Snapper (*Lutjanus campechanus*)

One, 61 cm, 12.5 kg female produced as many eggs as 212 females, 42 cm, 1.12 kg!!!

Grimes 1987