Impacts of the Spotted Spiny Lobster (*Panulirus guttatus*) on Coral Patch Reef Communities of the Florida Keys

Meredith Kintzing and Mark Butler
Old Dominion University
Linking Science to Management
Duck Key, FL
Coral reefs worldwide are in a state of decline

- Eutrophication
- Overfishing
- Bleaching
- Disease
- Global climate change
- Ocean acidification
The mass mortality of *Diadema antillarum* led to a rapid phase shift on Caribbean reefs.
Proximate causes of coral reef decline

- Fewer herbivores
- More algae
- Higher coral mortality
- Less coral successfully recruiting
Predation is important in controlling populations and shaping communities
Lobsters are keystone predators in many temperate systems

- Wharton and Mann 1981
- Robles 1987
- Shears and Babcock 2002
There are two abundant species of lobster in the Caribbean

Panulirus argus

Panulirus guttatus
Questions:

• What impact does *P. guttatus* density have on patch reef communities?

• What impact does *P. guttatus* have on *D. antillarum* behavior?

• Are any behaviors exhibited by *D. antillarum* unique to *P. guttatus* cues?
Manipulative field experiment

Study site
Manipulative field experiment

Rubble trays

*Mithrax spinossiumus* density
Rubble tray data

Mean number of macroinvertebrates per rubble tray

- Summer 2008: Low density (n = 62), high density (n = 35)
- Winter 2008: Low density (n = 36), high density
- Summer 2009: Low density, high density

Lobster density treatment and sampling period

p = 0.027
Impact of *P. guttatus* on herbivorous crab

![Graph showing the relationship between *Panulirus guttatus* density and *Mithrax spinosissimus* density. The correlation coefficient is \(r = -0.568\), with a significance level of \(p = 0.0038\), and the sample size is \(n = 24\).]
Does *P. guttatus* impact substrate stability?

- Trays with large and small rubble
- Piece of bait shrimp under rubble
Before and after
Percentage of red rock visible before and after *P. guttatus* foraging

![Bar graph showing percentage of red rock visible before and after foraging with large and small rubble.](image)

- Before large rubble: 90%
- After large rubble: 70%
- Before small rubble: 60%
- After small rubble: 40%

**n = 20**

*p < 0.0005*
Shrimp consumption in large and small rubble

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Percent consumption of shrimp piece by P. guttatus</th>
</tr>
</thead>
<tbody>
<tr>
<td>small rubble</td>
<td>100</td>
</tr>
<tr>
<td>large rubble</td>
<td>60</td>
</tr>
</tbody>
</table>

\[ n = 20 \]
\[ p < 0.0005 \]
*P. guttatus* impact on *Diadema*
Diadema movement in response to *P. guttatus* chemical cues

![](image)

\[ p = 0.009 \]
Diadema feeding in response to \textit{P. guttatus} cue

\begin{center}
\begin{tabular}{lcc}
\textbf{Treatment} & \textbf{Mean amount consumed (g)} \\
Halimeda sp. with \textit{P. guttatus} & 0.0 \\
Halimeda sp. control & 0.2 \\
Dictyota sp. with \textit{P. guttatus} & 0.4 \\
Dictyota sp. control & 1.0 \\
\end{tabular}
\end{center}

\textit{n} = 19; \textit{F} = 5.45; \textit{df} = 2, 35; \textit{p} = 0.009
Diadema movement in response to P. argus

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean movement (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. argus control</td>
<td>n = 10</td>
</tr>
<tr>
<td>P. argus cue</td>
<td>n = 15</td>
</tr>
<tr>
<td>P. guttatus cue</td>
<td>n = 18</td>
</tr>
<tr>
<td>P. guttatus control</td>
<td>n = 20</td>
</tr>
</tbody>
</table>
Conclusions

• *P. guttatus* is an important consumer on patch reef communities

• *P. guttatus* causes *D. antillarum* to exhibit a flight response and decrease algal consumption
Applications to management

• MPAs-more lobster predators could naturally control lobster abundance and behavior

• Need to carefully plan sites to transplant *Diadema*

• Need sufficiently large *Diadema*

• Beware of “sleeping functional groups”
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