Impacts of the Deepwater Horizon Oil Spill on Red Snapper (*Lutjanus campechanus*) Larvae in the Northern Gulf of Mexico

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About Me

• Hometown: Seattle, WA
• University of Portland (2015), OR
  o B.S. Biology
  • Minor: Psychology
Dr. Frank J. Hernandez, Jr.

- Fisheries oceanography
- Current Projects
  - Natural Resource Damage Assessment
  - Marine Debris
  - Gulf of Mexico Research Initiative (GoMRI)*
- Year 4

Dr. Jesse E. Filbrun

- Ph.D. in Evolution, Ecology, and Organismal Biology
- Lower food web dynamics
  - Natural and human impacts on aquatic and marine ecosystems
- Southern Arkansas University
### Introduction

<table>
<thead>
<tr>
<th>Deepwater Horizon Oil Spill</th>
<th>Red Snapper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macondo Well 100 mi south, 1500 m deep (Atlas et al. 2011)</td>
<td>Larvae occupy shallow waters 15 – 30 m deep (Szedlmayer et al. 2014)</td>
</tr>
</tbody>
</table>
Introduction

- Survival affected by mortality events
- Investigate diets (gut content), growth (size at age), and condition (size)
Null Hypothesis

- $H_{01}$: Larval red snapper diets, growth, and condition will not differ across periods (before, during, and after the oil spill).
Methods: Overview

- Fisheries Oceanography of Coastal Alabama (FOCAL)
  - Long-term ichthyoplankton and zooplankton survey
  - 2004 – 2011
- Sample Sites:
  - T20: 20 m deep
  - T35: 35 m deep
- 357 Red snapper larvae
Methods: Condition

• Imaging
  o Camera-mounted dissecting microscope
    • 5x magnification
Methods: Condition

8458_Fish_01_L_campechanus

Head Length

Head Height

Lower Jaw Length

Eye Diameter

Depth at Pectoral Fin

Depth at Anus

Notochord Length 4.89 mm
Methods: Growth

- Otolith extraction
- Imaging
- Measuring
  - Longest radius
  - Daily rings
- Size vs. Age
Results: Condition

- **Notochord length (mm)**
- **Depth at pectoral fin (mm)**
- **Depth at anus (mm)**
- **Head length (mm)**
- **Head height (mm)**
- **Eye diameter (mm)**
- **Lower jaw length (mm)**

Equations:

- **DPF** = 0.401 NL - 0.119, \( r = 0.94, P < 0.001 \)
- **DA** = 0.318 NL - 0.237, \( r = 0.94, P < 0.001 \)
- **HL** = 0.383 NL + 0.003, \( r = 0.96, P < 0.001 \)
- **ED** = 0.113 NL - 0.009, \( r = 0.96, P < 0.001 \)
- **LJL** = 0.201 NL + 0.001, \( r = 0.96, P < 0.001 \)
- **HH** = 0.354 NL + 0.010, \( r = 0.95, P < 0.001 \)

\( P \) values are significant.
## Results: Condition

<table>
<thead>
<tr>
<th>Body dimension</th>
<th>NMS Axis 1 ($R^2 = 0.92$)</th>
<th>NMS Axis 2 ($R^2 = 0.05$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$r$</td>
<td>$P$</td>
</tr>
<tr>
<td>Depth at pectoral fin (DPF)</td>
<td>0.93</td>
<td>$&lt; 0.001$</td>
</tr>
<tr>
<td>Depth at anus (DA)</td>
<td>0.89</td>
<td>$&lt; 0.001$</td>
</tr>
<tr>
<td>Head length (HL)</td>
<td>0.71</td>
<td>$&lt; 0.001$</td>
</tr>
<tr>
<td>Head height (HH)</td>
<td>0.94</td>
<td>$&lt; 0.001$</td>
</tr>
<tr>
<td>Eye diameter (ED)</td>
<td>0.65</td>
<td>$&lt; 0.001$</td>
</tr>
<tr>
<td>Lower jaw angle length (LJL)</td>
<td>0.62</td>
<td>$&lt; 0.001$</td>
</tr>
</tbody>
</table>
Results: Condition

- NMS Axis 1: $R^2 = 0.92$
- NMS Axis 2: $R^2 = 0.05$

Shallow Body vs. Deep Body

- MRPP: $A = 0.06$, $P < 0.0001$

May June July August September October

- MRPP: $A = 0.06$, $P < 0.0001$
Results: Condition

Station T20
Station T35

NMS Axis 2 ($R^2 = 0.05$)

NMS Axis 1 ($R^2 = 0.92$)

MRPP
$A = 0.02$
$P < 0.0001$

Shallow Body
Deep Body

Station T20
Station T35

MRPP
$A = 0.02$
$P < 0.0001$
Conclusion

• Morphometrics: Condition
  o Fish caught in earlier months were smaller-bodied than fish in later months
  o Fish caught at T20 were smaller-bodied than those at T35
Conclusion: Future Direction

- Otolith (length at age), gut (diet), isotope (diet), and dry weight (weight at length/condition) analyses still pending
Conclusion

• Other studies:
  o 2010 and 2011 were the worst recruitment years since 1994 (SEDAR 2013)
  o Red snapper abundance was lower after the spill (Patterson and Jagoe)
  o Preliminary results show a decline in growth rate at age after 2010 (Herdter and Murawski 2014)
  o No decline in juvenile red snapper abundance in 2011 (Szedlmayer et al. 2014)
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