Habitat use, site fidelity, and growth of juvenile black sea bass, *Centropristis striata*, in the Maryland Coastal Bays using mark-recapture

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Family: Serranidae
   - Grouper

Demersal species

Protogynous hermaphrodite

Large distribution range: Gulf of Maine to the Gulf of Mexico
   - Commercially and recreationally harvested

Genetic and life history differences along the Atlantic coast cause the stock to be split at Cape Hatteras, NC.
   - Northern stock: Gulf of Maine to north of Cape Hatteras, NC.
   - Southern stock: south of Cape Hatteras, NC to northern Florida.
“those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.”

However, this definition is very broad causing every estuary throughout black sea bass’ range to be considered essential!
Introduction: Previous Study

- Able and Hales 1997:
  - Black sea bass exhibit a high degree of site fidelity to structured habitats in boat basin (RUMFS boat basin and adjacent marsh creeks).
  - Suggested they may exhibit habitat specific growth rates.
We can delineate essential fish habitat for juvenile black sea bass in estuarine habitats by answering the following:

1. *What structured habitats do juveniles exhibit the highest site fidelity to?*

2. *How does growth rate in the MCBs compare to the Great-Bay estuary in NJ?*

3. *Do they exhibit habitat specific growth rates within estuaries?*
Methods: Sampling Sites

- **Bridge Piling:** Sites 3 and 9
- **Wood Piling:** Sites 1, 6, and 8
- **Marsh Edge:** Sites 7, 11, and 13
- **Rock Jetty:** Site 2
- **Buoy/Channel:** Sites 5 and 12
- **Seagrass Beds:** Sites 4 and 10

[Map and images of sampling sites]

Methods: Field Sampling

• Used 36” double chamber eel traps.

• Traps checked weekly.

• Temperature (°C), salinity (ppt), dissolved oxygen (mg/L), secchi depth (m), and water depth (m) were recorded at each site.

• Number of fish and lengths (total and standard length, mm) were recorded for each black sea bass caught.

• Tagged each black sea bass using different individually numbered tags in 2015 and 2016.
## Methods: Tagging

### 2015

- Tagged each black sea bass in the dorsal muscle with an external ¾” FLOY t-bar anchor tag using a Mark II fine fabric tagging gun.
- In 2015 only FLOY tags were used.
  - Monitoring studies of groupers in Belize recommend these tags for juveniles (Heyman and Requena 2003).
- A tag loss study in aquaria from June 2015 to June 2016 determined high tag loss rates.

### 2016

- In 2016 internal Biomark HPT8 8mm PIT tags were used, and implanted in the dorsal muscle with an MK165 implanter.
- About 500 fish were also tagged with external FLOY tags for double tagging.
- PIT tags were detected with a Biomark 601 Reader.
Methods: Analyses

Catch per unit effort (CPUE) was used as an index of abundance.

\[
CPUE = \frac{\text{# of black sea bass caught}}{\text{# of days fished}}
\]

Used abundance at each habitat along with recapture frequency to determine which habitats are important for juveniles.

\[
\text{Recapture Frequency (\%)} = \left( \frac{\text{Number Recaptured}}{\text{Number Tagged}} \right) \times 100
\]

Calculated growth rate of all fish recaptured in the MCBs.

\[
\text{Growth Rate (mm day}^{-1}) = \frac{TL_{\text{recapture}} - TL_{\text{initial capture}}}{\text{days between capture}}
\]

Compared fish lengths among habitat types to determine if smaller or larger lengths are at one habitat type over another.
Results: Temp, Salinity, and DO

When variables significantly differed between years:

**Temperature**: March, May, August, October

**Salinity**: May, September, October

**DO**: May, July, August, September, October
# Results: Recapture Results

<table>
<thead>
<tr>
<th></th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Number Tagged</strong></td>
<td>665</td>
<td>875</td>
</tr>
<tr>
<td><strong>Total Recaptured</strong></td>
<td>62</td>
<td>87</td>
</tr>
<tr>
<td><strong>Recapture Frequency</strong></td>
<td>9.32%</td>
<td>9.94%</td>
</tr>
<tr>
<td><strong>Days Between Recapture</strong></td>
<td>3-48</td>
<td>4-73</td>
</tr>
<tr>
<td><strong>Number of fish recaptured twice</strong></td>
<td>2</td>
<td>12 (one fish recaptured four times at the same site)</td>
</tr>
<tr>
<td><strong>Tag Loss</strong></td>
<td>78% (aquaria experiment)</td>
<td>27.9% (double tagging experiment)</td>
</tr>
<tr>
<td><strong>Number of tagged fish recaptured at other sites</strong></td>
<td>0; <strong>100% site fidelity</strong></td>
<td>2 (site 9 to site 6 and site 5 to site 10); <strong>97.6% site fidelity</strong></td>
</tr>
<tr>
<td><strong>Growth Rate (mm/day)</strong></td>
<td>0.39 (+/- 0.07 SE) n=59</td>
<td>0.27 (+/- 0.02 SE) n=73</td>
</tr>
</tbody>
</table>
Results: Abundance at Each Habitat

- Bridge Piling
- Buoy/Channel
- Marsh Edge
- Rock Jetty
- Seagrass Bed
- Wood Piling

**Year**
- 2015
- 2016

**CPUE (+1 SD)**

**Habitat Type**
Results: Recapture Frequency

<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>Total Tagged 2015</th>
<th>Total Tagged 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge Piling</td>
<td>251</td>
<td>148</td>
</tr>
<tr>
<td>Wood Piling</td>
<td>131</td>
<td>259</td>
</tr>
<tr>
<td>Marsh Edge</td>
<td>133</td>
<td>129</td>
</tr>
<tr>
<td>Rock Jetty</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>Seagrass Bed</td>
<td>31</td>
<td>64</td>
</tr>
<tr>
<td>Channel</td>
<td>101</td>
<td>251</td>
</tr>
</tbody>
</table>

Average Recapture Frequency 2015 / 2016:
- Bridge Piling: 11.98
- Wood Piling: 10.76
- Marsh Edge: 6.89
- Rock Jetty: 8.34
- Seagrass Bed: 3.13
- Channel: 6.56
Results: Growth Rate at Habitat

Growth rates did not significantly vary between habitat types (Kruskal-Wallis, p>0.05).
Results: Lengths at Habitat

Pooled 2015 and 2016 lengths differed among habitat types (Kruskal-Wallis, p<0.05).

In 2015 and 2016: Lengths at each habitat are different (Kruskal-Wallis, p<0.05).

At all habitat types average lengths were significantly lower in 2016 than 2015 (t-test, p<0.05).
Conclusion: Growth

• Juvenile black sea bass experienced growth rates of 0.39 mmd$^{-1}$ in 2015 and 0.27 mmd$^{-1}$ in 2016 in the MCBs.

• 2015 growth rate estimate is comparable (0.45 mmd$^{-1}$) to estimate in Great Bay – Little Egg Harbor, NJ (Able and Hales 1997).

• Slower growth rate in 2016 could be due to low DO seen in August and September.

• DO levels of < 2 ppm caused reduced growth of juvenile black sea bass (Hales and Able 1995).
  • In August and September dissolved oxygen was < 2 mg/L in 22% of recorded (n=45) DO readings and found at sites 4, 7, 8, 9, 12, and 13.
Recapture frequency, abundance, average growth rates, and presence of larger and smaller fish were highest at two habitats in the MCBs: bridge piling and wood piling. Bridge piling and wood piling habitats are important habitats in the MCBs for juvenile black sea bass.
Discussion: Why are they more attracted to these habitats?

- More complex habitats reduce predation risk and increase survival (Scharf et al. 2006).

- Presence of shelter also increased growth rates of juvenile black sea bass (Gwak 2002).

- More complex habitats tend to have higher prey densities (Connell and Jones 1991).
Discussion: Why are they more attracted to these habitats?

Bridge and wood piling habitats are more complex than the buoy and marsh edge habitats.

- Interfere with pursuit and lower probability of predator encounter (Scharf et al. 2006).
- More prey densities at these complex habitats, that favor a higher growth rate.
Acknowledgements

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- Advisor: Dr. Paulinus Chigbu
Dissolved Oxygen

Average Dissolved Oxygen (mg/L) +/- SE

Minimum Dissolved Oxygen Reading per month (mg/L)

Month

April May June July August September October

MDDNR UMES NPS