Graphical results of sensitivity analyses to the base sex-specific catch multiple survey blue crab stock assessment model for Chesapeake Bay

Michael Wilberg

Chesapeake Biological Laboratory

University of Maryland Center for Environmental Science

July 25, 2011

This working paper contains the graphical results of sensitivity analyses of the sex-specific catch multiple survey model for blue crab in Chesapeake Bay. In particular, we reran the model assuming values of 0.6 and 1.2 for natural mortality, 0.3 and 0.9 for partial recruitment of age-0 crabs, and conducted runs that estimated the natural mortality rate for males (2M model), the sex ratio of recruits, and the partial recruitment of age-0 crabs. We also conducted two additional analyses suggested by the reviewers: a model that estimated catchability of adults for the winter dredge survey and one that included a combined sex stock recruitment model. The header on each figure notes the model configuration.
M = 0.6
Total Catch

Female Catch

Male Catch

M = 0.6
M = 0.6

1+ Female

1+ Male

Abundance x 10^6

Year
Equilibrium N female

\[ \frac{F(\text{male})}{F(\text{female})} \]

M = 0.6
The graph shows the catch data from 1970 to 2008, with total catch, female catch, and male catch plotted over time. The total catch data is represented by a line graph with data points marked by black dots. The female catch data is also represented by a line graph with data points marked by black dots. The male catch data is represented by a line graph with data points marked by black dots. The data suggests a decline in catches over time, with some fluctuations. The graphs indicate that the total catch and female catch generally follow similar trends, while the male catch shows a different pattern. The M = 1.2 notation is likely a reference to a specific parameter or model in the context of the analysis.
Recruitment

M = 1.2

Adult

Abundance x10^6

Year


500 1000 1500 2000 0

0 100 200 300 400 500 100


500 1000 1500 2000 0

0 100 200 300 400 500 100
Equilibrium N female

$M = 1.2$

$F(male)/F(female)$
Partial recruitment = 0.3
Partial recruitment = 0.3
Partial recruitment = 0.3

Total Catch

Female Catch

Male Catch
Partial recruitment = 0.3
Partial recruitment = 0.3

Recruitment

Female

Male

Year

Abundance $\times 10^6$

Abundance $\times 10^6$

CPUE
Partial recruitment = 0.3

Recruitment

Adult
Partial recruitment = 0.3

Abundance x10^6

Year


1+ Female

1+ Male
Partial recruitment = 0.3

- Female
- Male
- F(male)/F(female)

Year

Exploitation rate (%)

F ratio

F(male)/F(female)
Partial recruitment = 0.3

VIMS Trawl

MD Trawl

WDS

Predicted vs. Observed for different trawl methods with a partial recruitment rate of 0.3.
Partial recruitment = 0.3

Equilibrium $N_{female}$ vs. $F(male)/F(female)$
Partial recruitment = 0.3
Partial recruitment = 0.9
Partial recruitment = 0.9
Partial recruitment = 0.9

10%
Partial recruitment = 0.9

Recruitment

Female

Male
Partial recruitment = 0.9

Recruitment

Female

Male

Year

Abundance x10^6

CPUE
Partial recruitment = 0.9

**Recruitment**

Abundance x10^6

<table>
<thead>
<tr>
<th>Year</th>
<th>Abundance x10^6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>1500</td>
</tr>
<tr>
<td>1980</td>
<td>1000</td>
</tr>
<tr>
<td>1990</td>
<td>500</td>
</tr>
<tr>
<td>2000</td>
<td>0</td>
</tr>
</tbody>
</table>

**Adult**

Abundance x10^6

<table>
<thead>
<tr>
<th>Year</th>
<th>Abundance x10^6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>8</td>
</tr>
<tr>
<td>1980</td>
<td>200</td>
</tr>
<tr>
<td>1990</td>
<td>300</td>
</tr>
<tr>
<td>2000</td>
<td>100</td>
</tr>
</tbody>
</table>

---

8
Partial recruitment = 0.9

Abundance x 10^6

1+ Female

1+ Male

Year

Partial recruitment = 0.9

Female

Exploitation rate (%)

Male

Exploitation rate (%)

F(male)/F(female)

F ratio

Partial recruitment = 0.9
Partial recruitment = 0.9
Partial recruitment = 0.9

Equilibrium N female

F(male)/F(female)
Partial recruitment = 0.9
The image contains three graphs showing CPUE (catch per unit effort) data over the years from 1980 to 2010. The graphs are labeled as 'Recruitment', 'Female', and 'Male'. Each graph displays a series of data points with a trend line connecting them. The y-axis represents CPUE on a linear scale, and the x-axis represents the years from 1980 to 2010. The data points are distributed across the graph, indicating variability in CPUE across different years and categories.
Sensitivity - 2M

1+ Female

1+ Male
Estimate sex ratio at recruitment

Catch x 10^6

Female u (%)
Estimate sex ratio at recruitment

Catch x10^6

Females x10^6
Estimate sex ratio at recruitment

10%
Estimate sex ratio at recruitment

Recruitment

Female

Male

Year

CPUE

Recruitment

Female

Male
Estimate sex ratio at recruitment

Recruitment

Female

Male
Estimate sex ratio at recruitment
Estimate sex ratio at recruitment

![Graph showing abundance of 1+ Female and 1+ Male over years from 1970 to 2010.](image)
Estimate sex ratio at recruitment

VIMS Trawl

MD Trawl

WDS
Estimate sex ratio at recruitment

Equilibrium N female

F(male)/F(female)
Estimate partial recruitment

Catch $\times 10^6$ vs. Females $\times 10^6$
Estimate partial recruitment

10%
Estimate partial recruitment

Recruitment

Female

Male
Estimate partial recruitment

Recruitment

CPUE

Female

Abundance x10^6

Male

Abundance x10^6

Year
Estimate partial recruitment

**1+ Female**

**1+ Male**
Estimate partial recruitment

Equilibrium N female

F(male)/F(female)
Estimate partial recruitment
Estimate WDS catchability
Estimate WDS catchability
Estimate WDS catchability
Estimate WDS catchability

Female u (%)
Estimate WDS catchability

Abundance x10^6

Recruitment

Adult

Year
Estimate WDS catchability

Abundance $\times 10^6$

1+ Female

1+ Male
Estimate WDS catchability

- Female
- Male
- F ratio

Exploitation rate (%)

Year

F(male)/F(female)
Estimate WDS catchability

Equilibrium N female

F(male)/F(female)
Estimate WDS catchability

![Scatter plot of lnrs vs SPT](image)
Combined sex stock-recruitment

Catch \times 10^6

Age−0+ Female u (%)
Combined sex stock-recruitment

Catch $\times 10^6$ vs Females $\times 10^6$
Combined sex stock-recruitment

10%

Female u (%)
Combined sex stock-recruitment

Abundance $\times 10^6$

Year

1+ Female

1+ Male
Combined sex stock-recruitment