Pacific-Wide Assessment of Bigeye Tuna

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Catch History

**Eastern Pacific**

- **Other**
- **Purse seine**
- **Longline**

**Western and Central Pacific**

- **Other**
- **Purse seine**
- **Longline**
Spatial Structure

Catch (t) 1996-99
15,000
7,500
1,500

Legend:
- LL
- PS
- OT
Model Structure

- 9 region spatial structure, including 2 regions comprising the EPO. Movement parameters for adjacent regions are estimated.
- 28 fisheries differentiated by fishing method, nationality, and region.
- Time period referenced is 1952–2004 (with quarterly stratification).
- Tagging data are included.
- Weight-frequency as well as length-frequency data used for the longline fisheries.
- CPUE and effort for the main (primarily Japanese) longline fisheries standardised using a GLM. CPUEs therefore provide an index of relative abundance for each region.
- Catchability of the main longline fishery in each region assumed to be constant over time and among regions.
- Selectivity of longline fisheries is monotonically increasing with age.
- Use the same (fixed) natural mortality at age (40 quarterly age classes) as for the EPO assessment. Also used the same female maturity at age.
Longline CPUE – abundance index
Growth Estimates

Length-at-age

Variability of length-at-age

Weight-at-age
Recruitment Estimates

![Graph showing recruitment estimates with different models: PO model - estimated growth, PO model - IATTC growth, EPO model. The x-axis represents years from 1950 to 2010, and the y-axis represents recruitment numbers from 0 to 16,000,000.]
Biomass Estimates

Region 1


Region 2


Region 3


Region 4


Region 5


Region 6


Region 7


Region 8


Region 9


Total

Total Biomass – EPO

- PO model - estimated growth
- PO model - IATTC growth
- EPO model
Relative Fecundity – EPO

Population fecundity

- PO model - estimated growth
- PO model - IATTC growth
- EPO model
Fishing Mortality – EPO

Age-classes 1-10

Year/quarter

Age-classes 11-20

Age-classes 21-40

1975-1984

1985-1994

1995-2004

Fishing mortality

Age-class
Yield Estimates – Whole PO

Equilibrium yield (t per quarter) vs. Multiple of 2001-2003 F-at-age

- Estimated growth
- IATTC growth

Equilibrium yield:
- Estimated growth: 0.85
- IATTC growth: 0.75
“SBR” – Whole PO

![Graph showing population fecundity ratio over time with two lines representing estimated growth and IATTC growth. The x-axis represents years from 1950 to 2010, and the y-axis represents the population fecundity ratio. The graph illustrates a decline in population fecundity ratio over time.]
# Movement & Stock Structure

<table>
<thead>
<tr>
<th>Likelihood component</th>
<th>With Spatial Structure</th>
<th>Without Spatial Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total catches</td>
<td>787.64</td>
<td>934.86</td>
</tr>
<tr>
<td>Length frequency</td>
<td>-497,948.10</td>
<td>-495,336.30</td>
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<tr>
<td>Weight frequency</td>
<td>-728,036.41</td>
<td>-725,739.09</td>
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<tr>
<td>Tagging</td>
<td>3,237.05</td>
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</tr>
<tr>
<td>Penalties</td>
<td>7,911.64</td>
<td>8,998.31</td>
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<tr>
<td>Total</td>
<td>-1,214,048.18</td>
<td>-1,211,142.22</td>
</tr>
</tbody>
</table>
Spatial Model

Longline Region 1

Longline Region 2

Longline Region 3

Longline Region 7

Single-Region Model

Longline Region 1

Longline Region 2

Longline Region 3

Longline Region 7
Movement

Population number

Region 1 recruits

Region 2 recruits

Region 3 recruits

Region 4 recruits

Region 5 recruits

Region 6 recruits

Region 7 recruits

Region 8 recruits

Region 9 recruits

Age class (quarter)
Summary

- On a Pacific-wide basis, over-fishing is occurring, stock approaching over-fished state
- Very consistent results from EPO regions of PO model and EPO assessment – some discrepancies in absolute estimates due to differences in estimated growth patterns
- Stock mixing across the Pacific is restricted – a single, instantaneously mixed stock assumption results in a poor fit to the data
  - But growth assumptions may impact this interpretation