Population dynamics of the euphausiids *Euphausia pacifica* and *Thysanoessa spinifera* off Newport, OR, USA

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Time series off Newport, OR (NH line)

- Sampled twice per month for zooplankton by the Peterson lab since 1996
- Sampling for adult euphausiids using night bongo tows starting in 2001
- Sampling stations:
  - NH05 (8km, 60m) - inshore
  - NH15 (24km, 90m) – mid-shelf
  - NH25 (40km, 296m) – offshore
Target Species

- Generally found at and beyond the shelf break (>200 m depth)
- Intense period of spawning during summer upwelling season
- Present in cool & warm ocean conditions

- Generally found on the shelf (<200 m depth)
- Spawn before & during upwelling, no intense period
- Prefer cooler ocean conditions

*Euphausia pacifica*  
*Thysanoessa spinifera*
Methods

- Collected lots of net samples (data presented are from 2001-2006 but project is ongoing)
- Counted and identified to species euphausioid eggs, nauplii, calyptopis, and furcilia from 1/2m vertical net samples, measured furcilia
- Counted and measured juvenile and adult euphausiids (E. pacifica (Ep) and T. spinifera (Ts)) from nighttime bongo nets
- PDO & local buoy 46050 for temperature data
- Dates of spring and fall transitions from Logerwell et al. 2003 & http://www.cbr.washington.edu/data/trans_data.html
Note: local SST off Newport, OR lags behind the PDO so while the PDO was warming in 2002 the ocean in our study area was still cold.
## Summary of Ocean Conditions

<table>
<thead>
<tr>
<th>Year</th>
<th>Spring transition (ST)</th>
<th>Fall transition (FT)</th>
<th>Duration of upwelling (mo)</th>
<th>Ocean temp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>2-Mar</td>
<td>12-Nov</td>
<td>8.5</td>
<td>Cool</td>
</tr>
<tr>
<td>2002</td>
<td>21-Mar</td>
<td>6-Nov</td>
<td>7.7</td>
<td>Cool</td>
</tr>
<tr>
<td>2003</td>
<td>22-Apr</td>
<td>15-Oct</td>
<td>5.9</td>
<td>Warm</td>
</tr>
<tr>
<td>2004</td>
<td>20-Apr</td>
<td>7-Nov</td>
<td>6.7</td>
<td>Warm</td>
</tr>
<tr>
<td>2005</td>
<td>25-May</td>
<td>29-Sep</td>
<td>4.2</td>
<td>Warm</td>
</tr>
<tr>
<td>2006</td>
<td>22-Apr</td>
<td>31-Oct</td>
<td>6.4</td>
<td>Warm</td>
</tr>
</tbody>
</table>
Eggs

- *E. pacifica* eggs clearly have a strong association with upwelling.
- *T. spinifera* eggs present at similar densities before and during upwelling.
- *T. spinifera* eggs common prior to spring transition but eggs of both species present only in 2004.
- High *E. pacifica* reproductive effort in 2005 after late onset of upwelling; high density of *T. spinifera* eggs before upwelling.
Eggs

- Ep eggs clearly have a strong association with upwelling
- Ts eggs present at similar densities before and during upwelling
- Ts eggs common prior to spring transition but eggs of both species present only in 2004
- High Ep reproductive effort in 2005 after late onset of upwelling; high density of Ts eggs before upwelling
Nauplii
(includes metanauplii)

• Patterns similar to eggs since hatching time ~36h: hence Ep nauplii also associated with upwelling
• Ts nauplii highest densities before upwelling season;
• Ts present at low densities during upwelling at the inshore station
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• Ts present at low densities during upwelling at the inshore station
Calyptopis

• Ep still strongly associated w/upwelling, but also present prior to spring transition
• Ts values highest before spring transition
• Ts consistently found inshore during upwelling
• Ep & Ts at all stations before spring transition in 2004 (red bars)
Calyptopis

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- Ts values highest before spring transition
- Ts consistently found inshore during upwelling
- Ep & Ts at all stations before spring transition in 2004 (red bars)
Furcilia

• Densities usually <4 for both species
• In spite of low densities, Ep still associated with upwelling
• Ts densities >4 only in 2002: a cold year with lots of Ts spawning
• Ep & Ts present across the shelf before spring transition in 2004 (red bars)
Furcilia

• Densities always <4 for Ep and usually for Ts
• In spite of low densities, Ep still associated with upwelling
• Ts densities >4 only in 2002: a cold year with lots of Ts spawning
• Ep & Ts present across the shelf before spring transition in 2004 (red bars)
Juvenile

- Ep densities generally <10, often <5
- Ep shifting to offshore
- Lots of Ep juveniles after fall transition in 2005 when spawning effort was delayed by late start to upwelling
- High Ep density before spring transition in 2006 may be these same animals after overwintering
- Juvenile Ts densities generally <4, often <2, high Ts reproductive effort in 2002 led to density ~15
- Ts before ST in 2006 but still a very low density
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Adult

- Adult Ep consistently found offshore in all seasons
- Interestingly, adult Ep density is consistently lowest during upwelling
- Adult Ts density never very high (usually <1)
- Too few adult Ts to determine seasonal abundance patterns
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Preliminary Results

• Cross-shelf distribution of life stages
  – *E. pacifica*: early life stages found inshore; juveniles & adults predominantly offshore
  – *T. spinifera*: eggs-furcilia consistently found inshore & mid-shelf; juvenile & adult densities too low to determine a cross-shelf pattern

• Seasonal patterns
  – *E. pacifica* eggs clearly associated with upwelling
  – *T. spinifera* start spawning prior to the spring transition
  – Early stages of both species present across the shelf prior to the spring transition in 2004 – the only year when Ep were present at this time of year
Relationship between *E. pacifica* spawning and timing of spring transition

- Consistent pattern for all six years of data regardless of PDO and upwelling conditions
- Timing of *E. pacifica* spawning tightly associated with upwelling
- Changes in upwelling off the Oregon coast are likely to affect this pattern of euphausiidi spawning
Future Plans

• Compare interannual variability in abundance with finer-scale environmental information - interannual abundances highly variable with no clear association with cool or warm years but using finer-scale temperature data than the PDO may be better at identifying whether such an association exists.

• Closer look at conditions in 2004: Early life stages of both species present prior to the spring transition in 2004 – the only time Ep were present at this time of year. May be related to blooms that sometimes form in the study area in February.

• Why are adult *E. pacifica* densities lowest during upwelling?
Acknowledgements

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