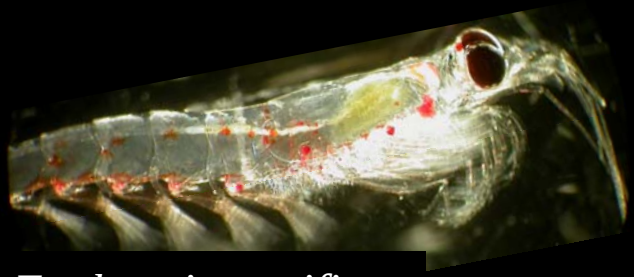
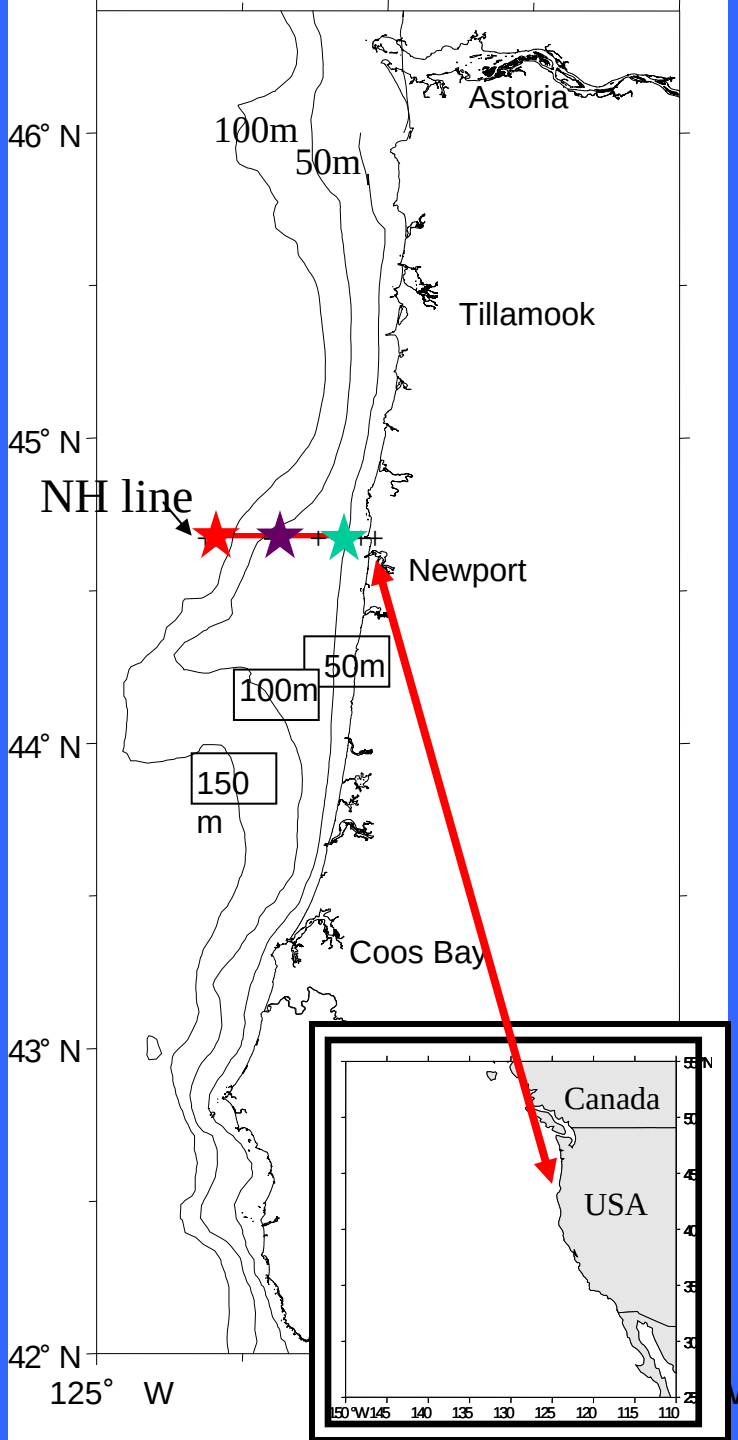
Population dynamics of the euphausiids *Euphausia pacifica* and *Thysanoessa spinifera* off Newport, OR, USA



Euphausia pacifica

Thysanoessa spinifera

C. Tracy Shaw, Leah R. Feinberg, and William T. Peterson



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


Euphausia pacifica

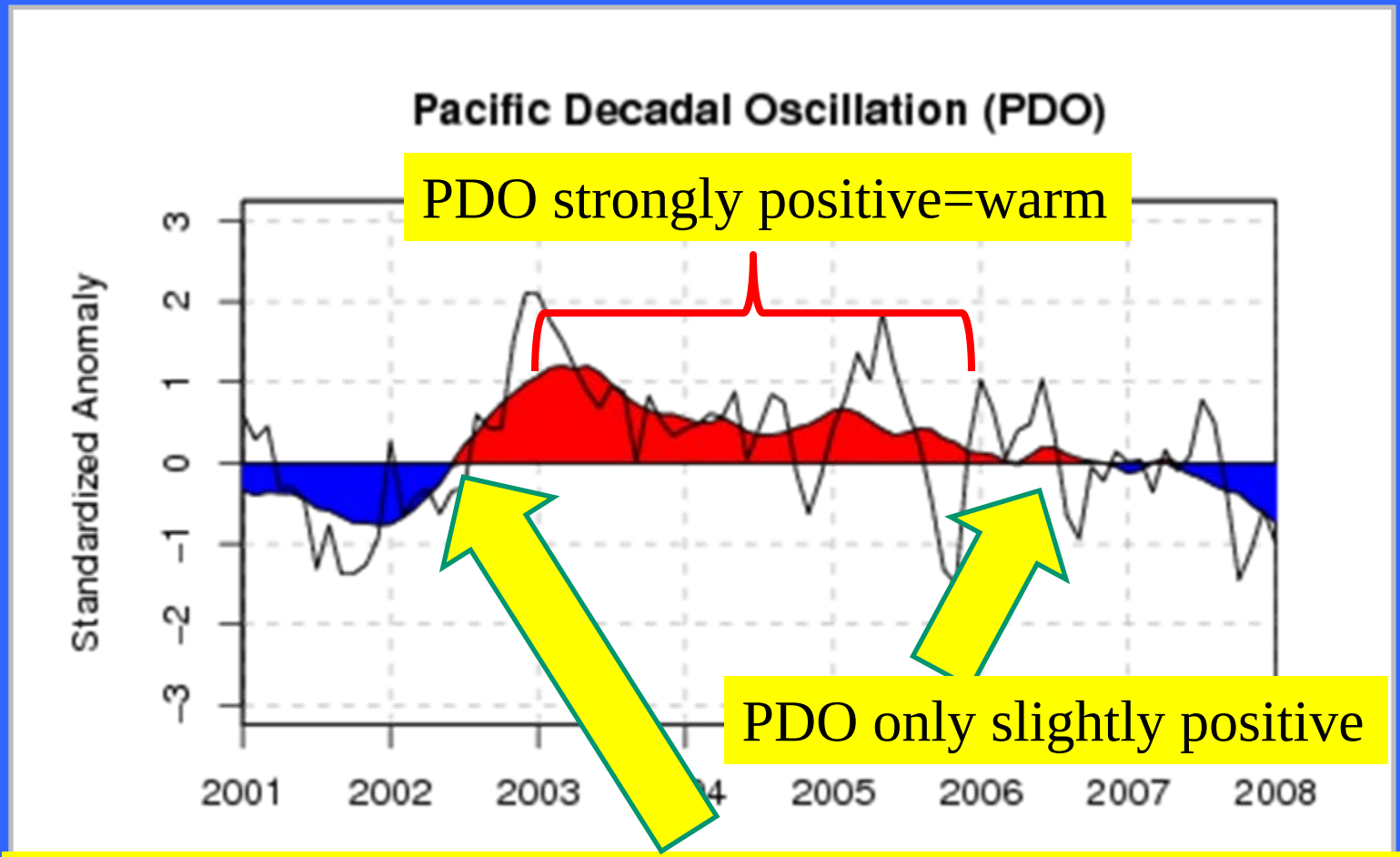
- Generally found at and beyond the shelf break (>200 m depth)
- Intense period of spawning during summer upwelling season
- Present in cool & warm ocean conditions


Thysanoessa spinifera

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

Methods

- Collected lots of net samples (data presented are from 2001-2006 but project is ongoing)
- Counted and identified to species euphausiid 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



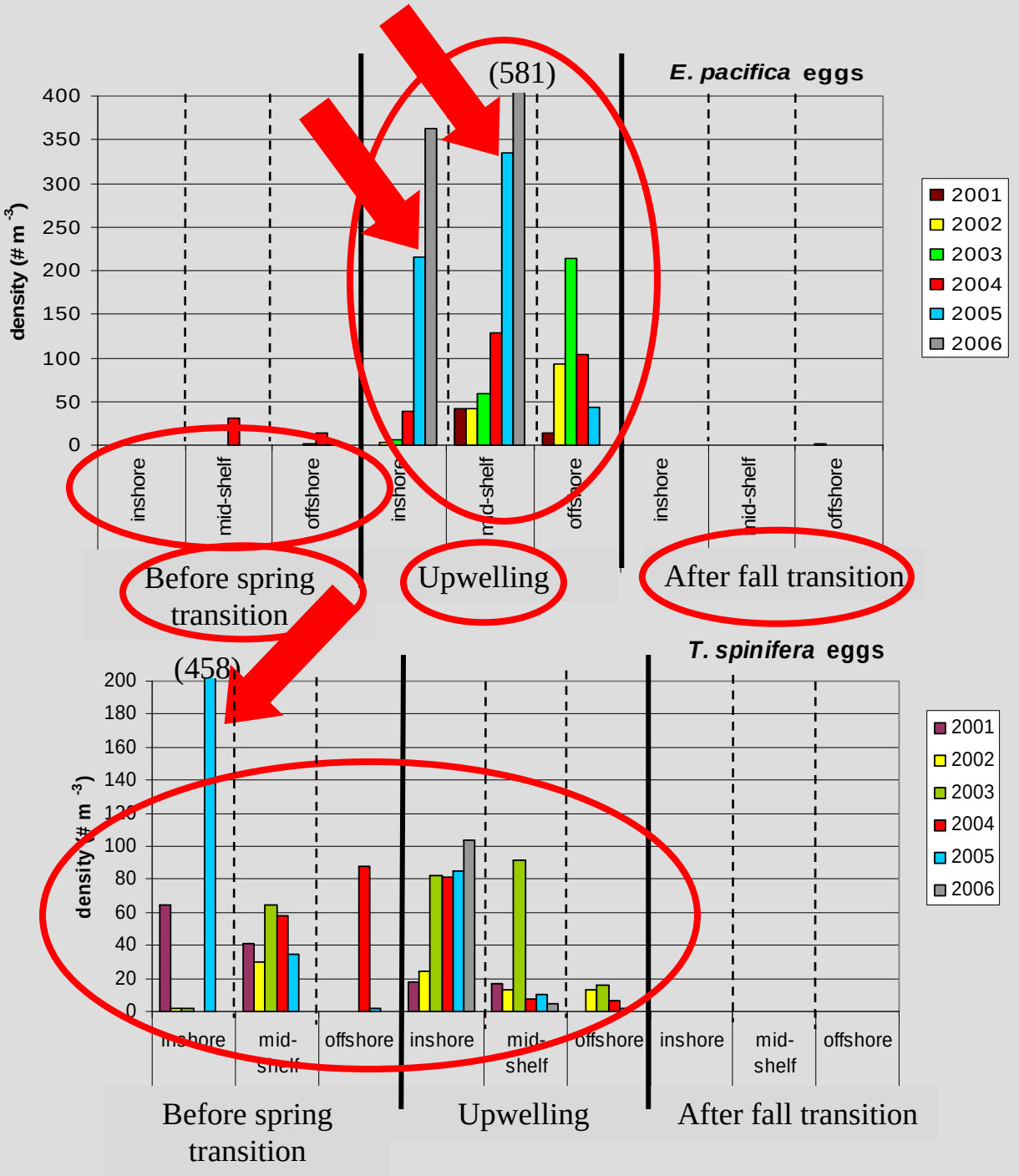
Note: local SST off Newport, OR lags behind the PDO so while the PDO was warming in 2002 the ocean in our study area was still cold

Summary of Ocean Conditions

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

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



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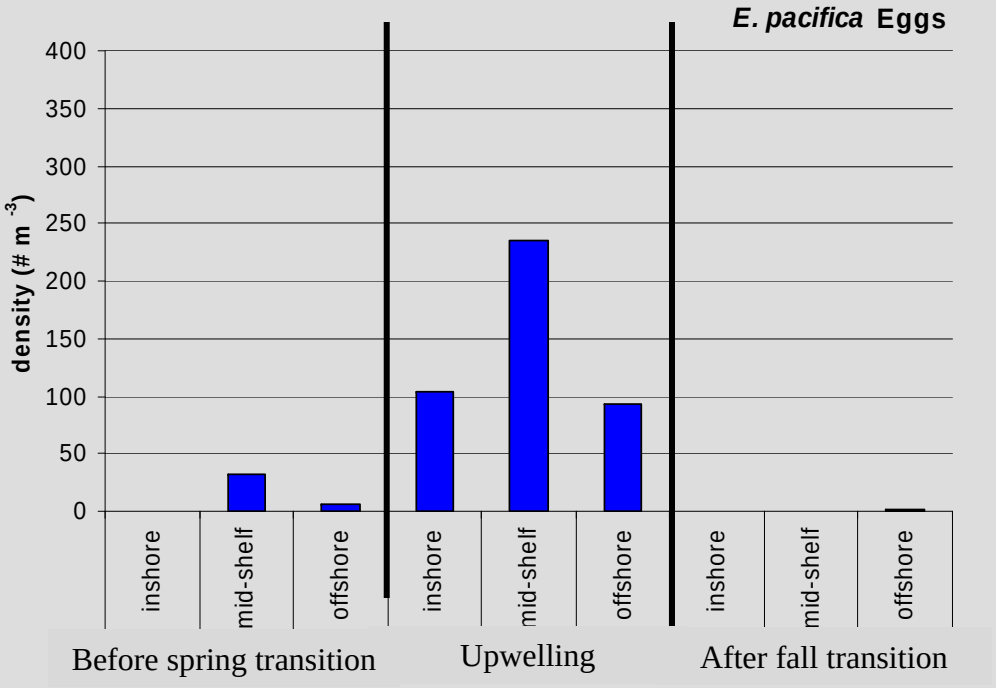
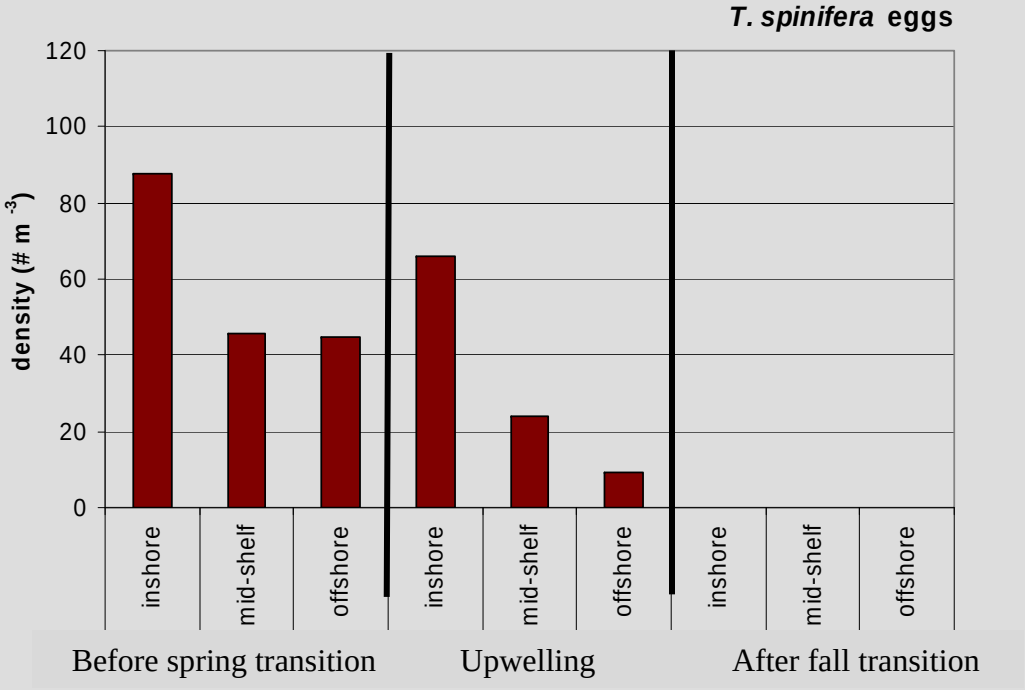
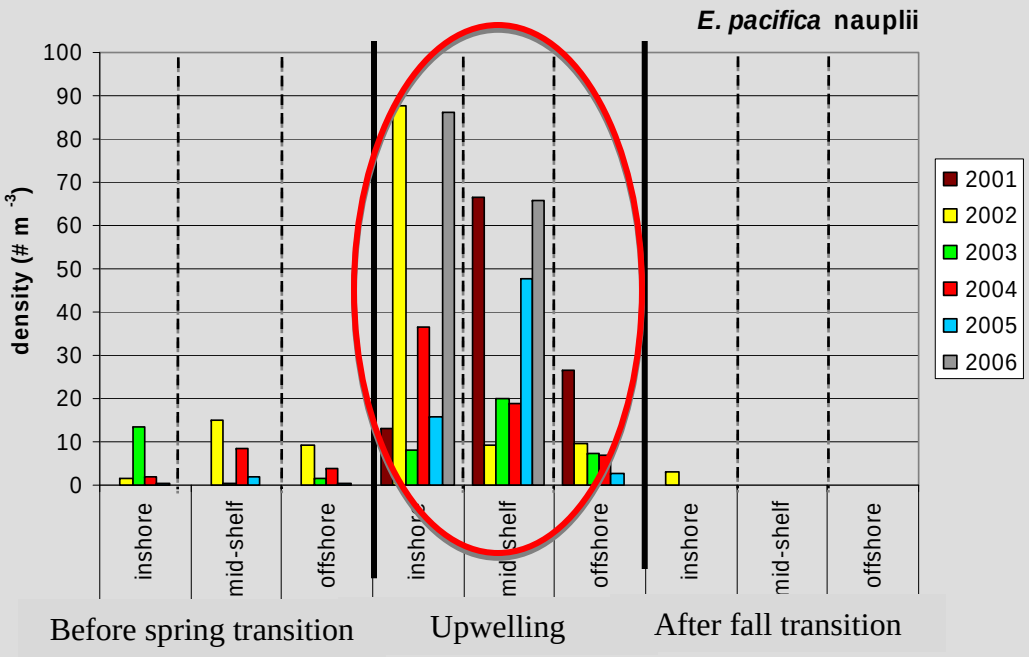


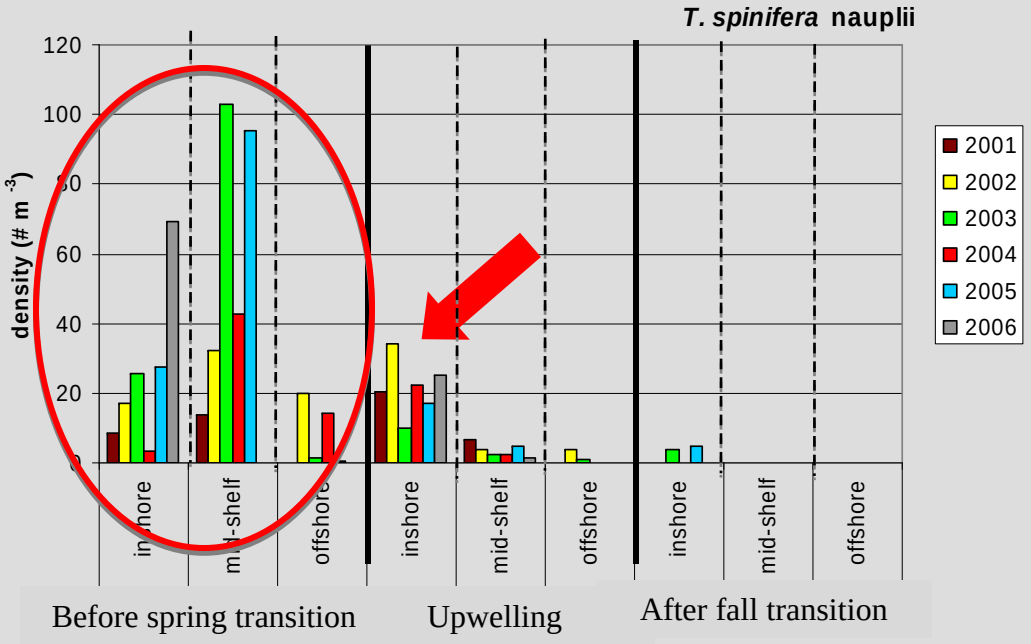


Nauplius

(includes metanauplius)

- 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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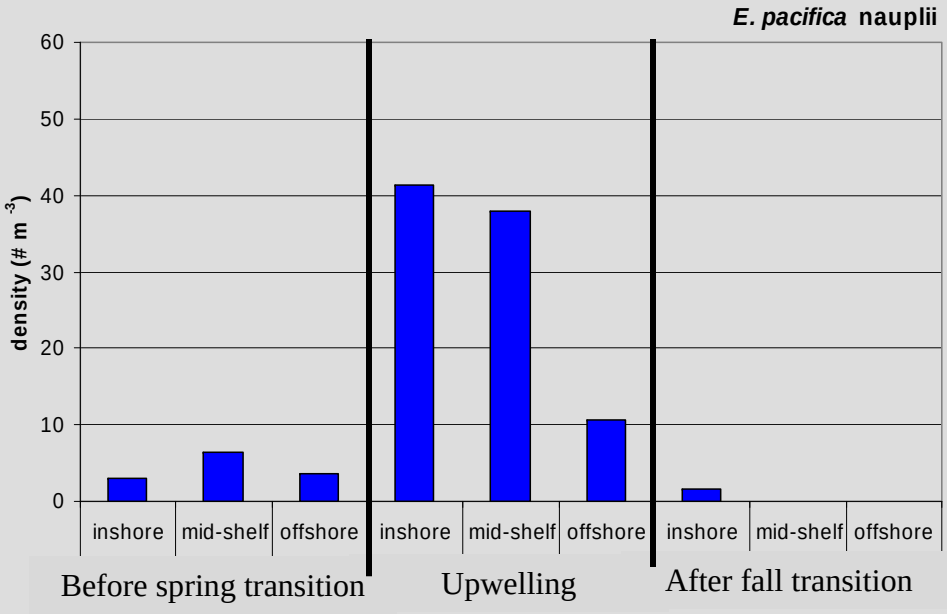
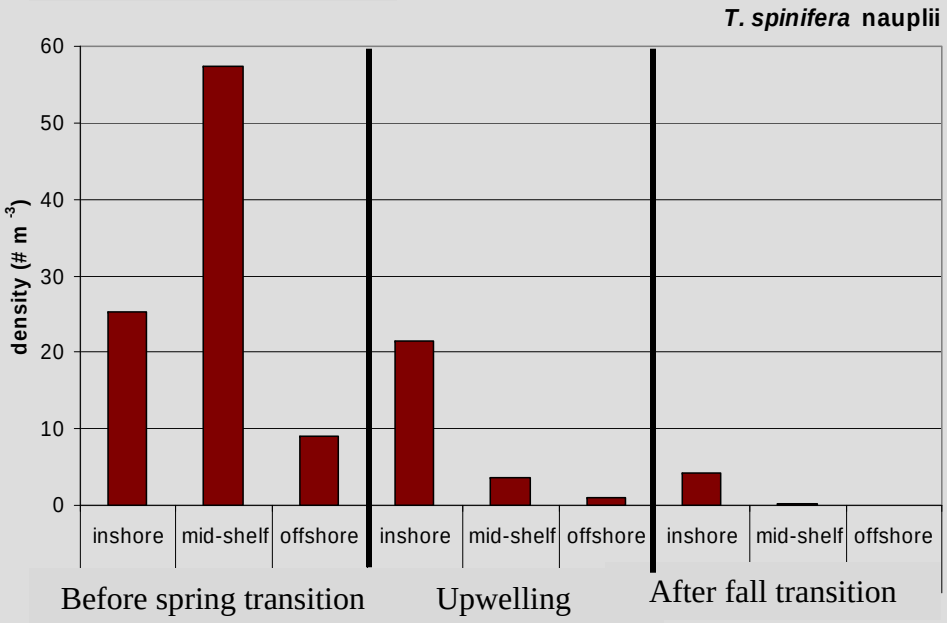
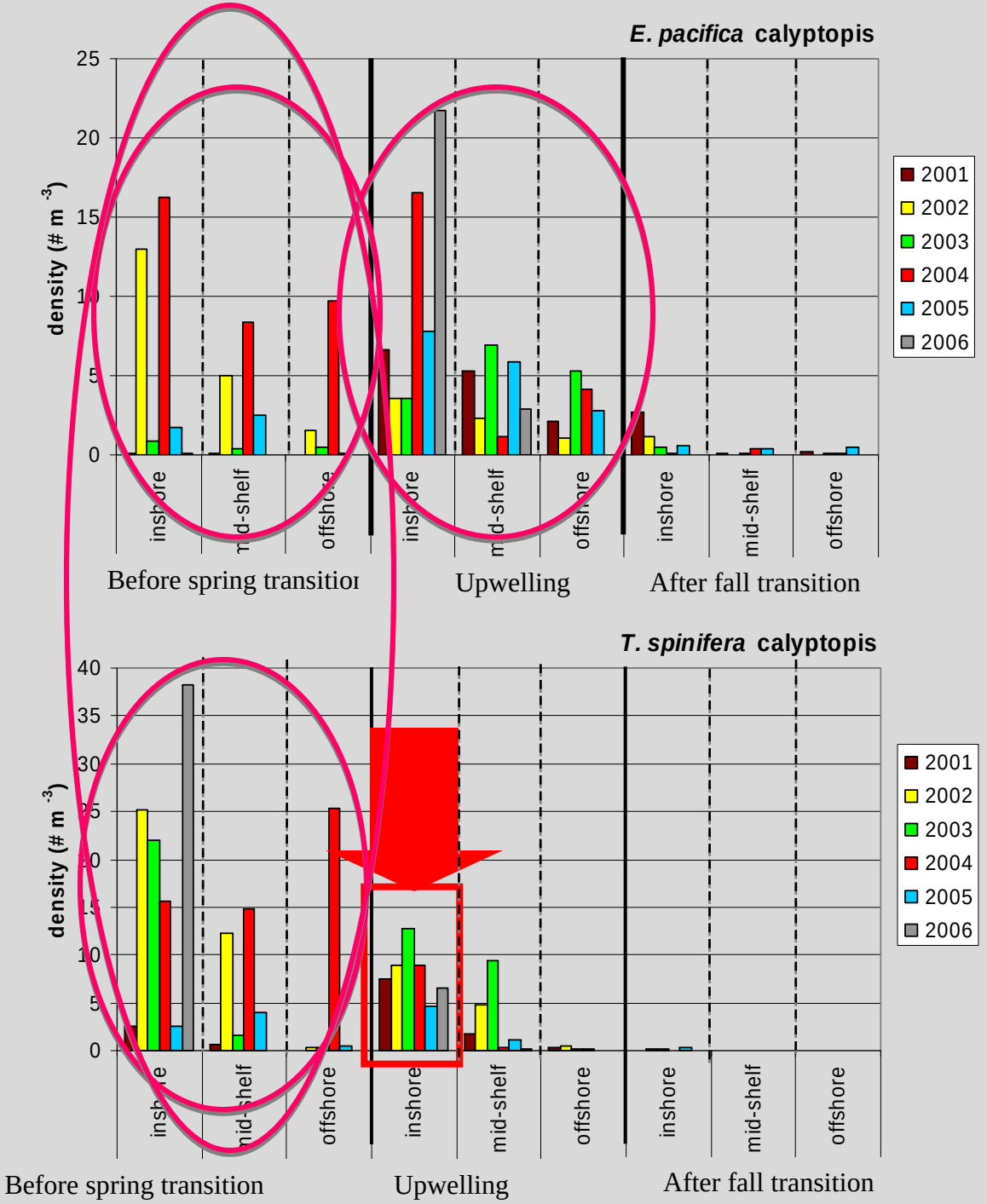




Calyptopis

- 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)



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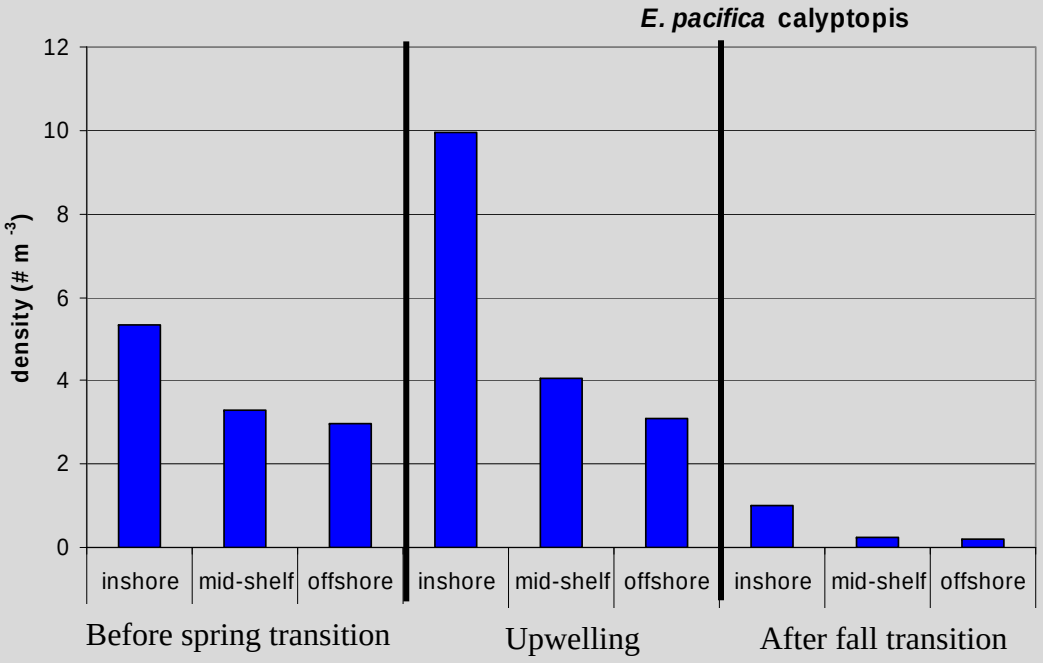
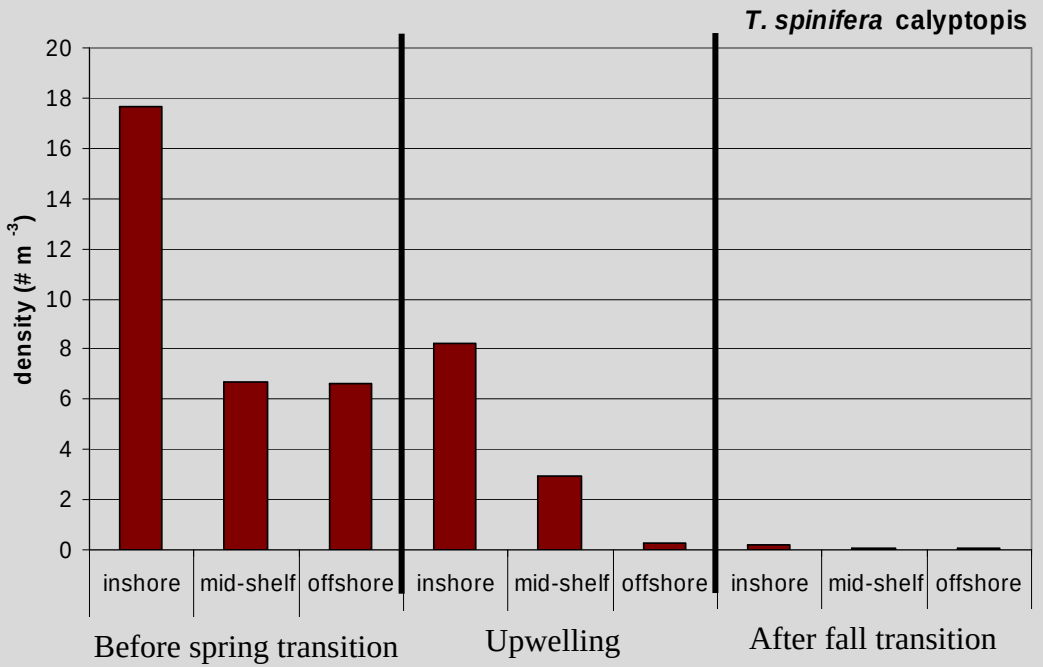
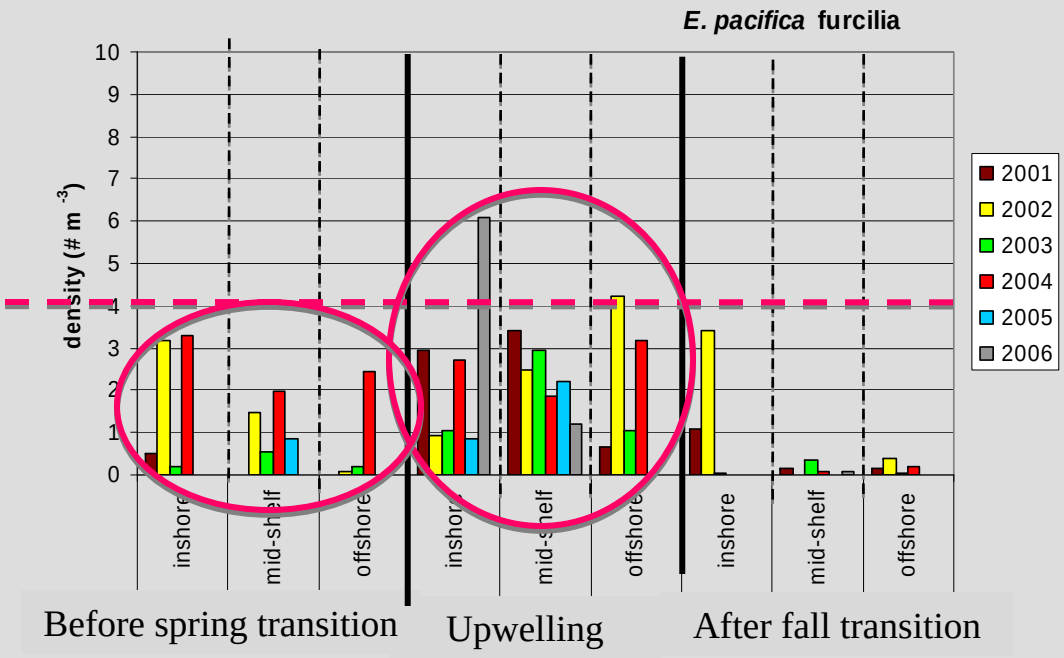
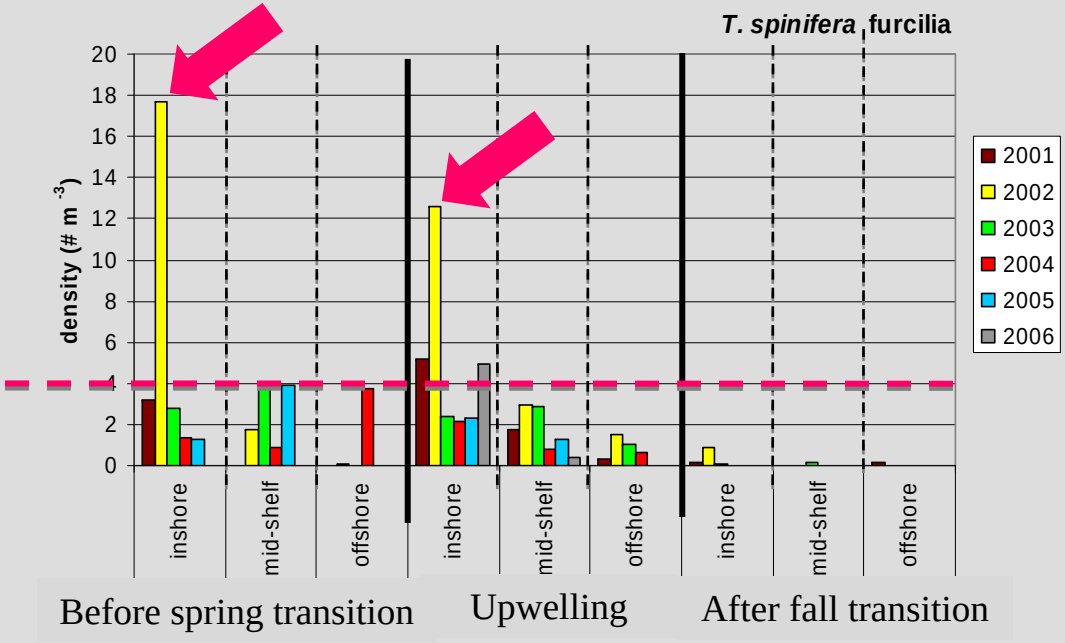




Furcilia

- 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)





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- Densities always <4 for Ep and usually for Ts
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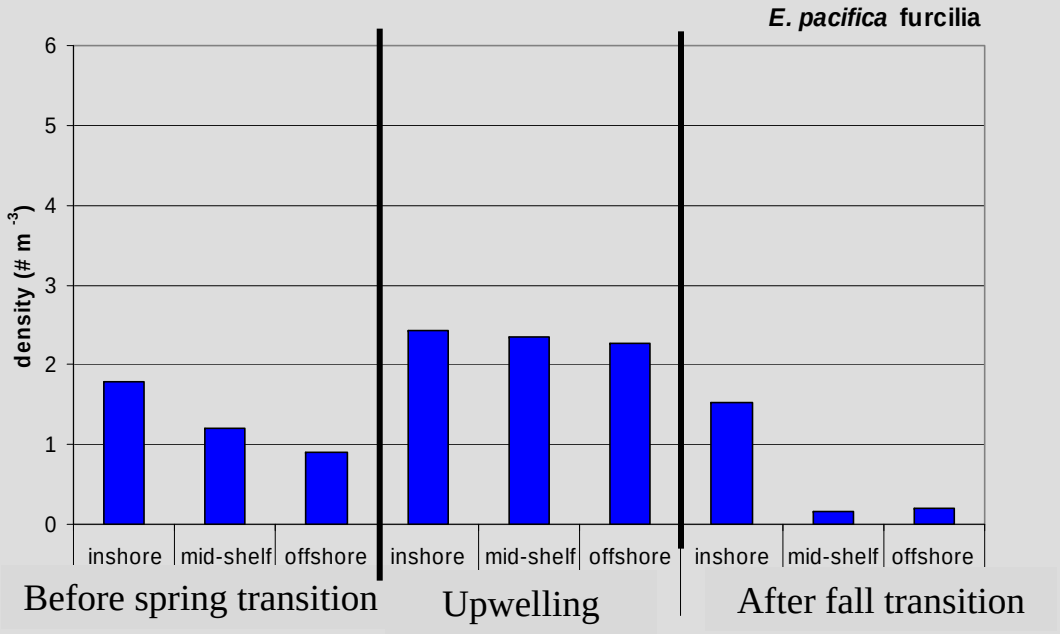
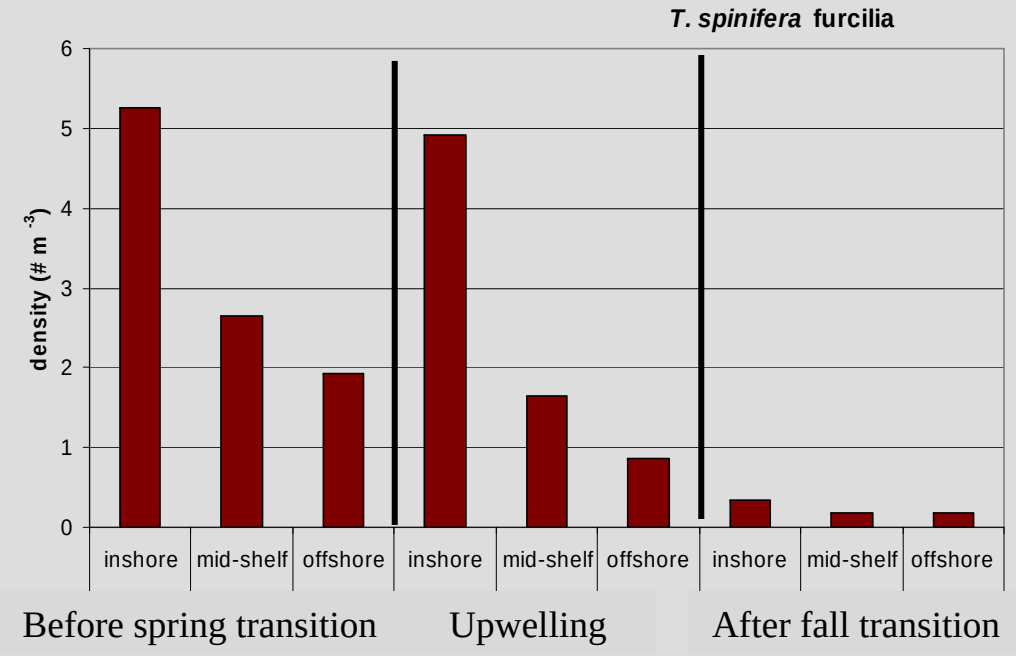
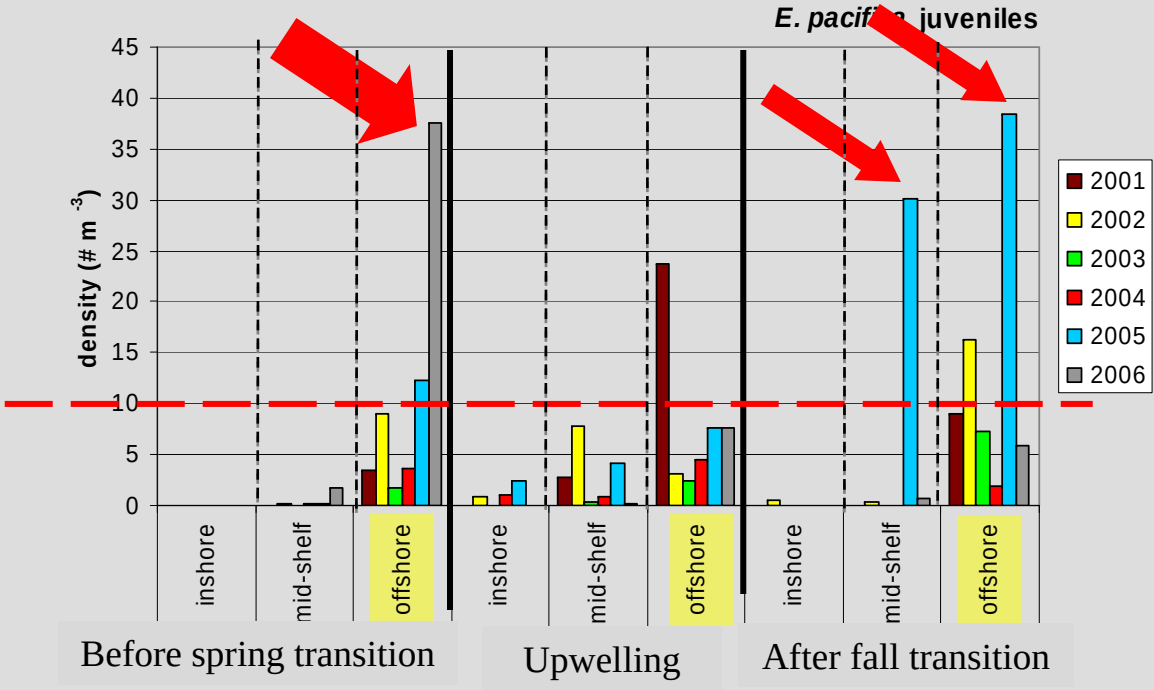
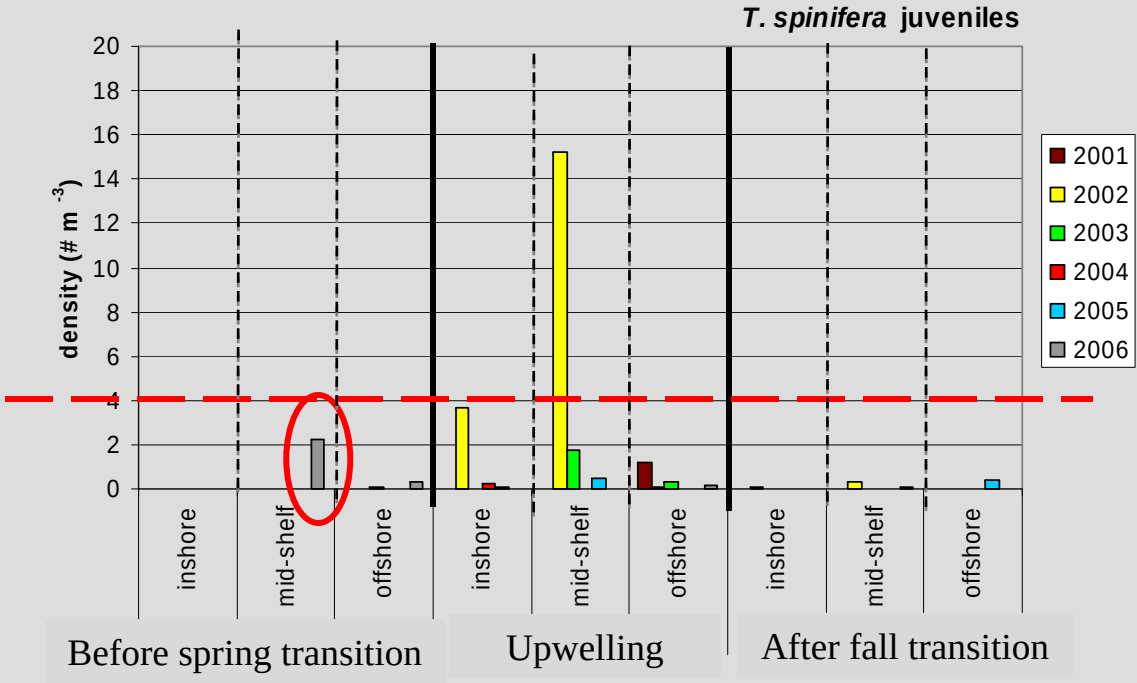




Juvenile

- 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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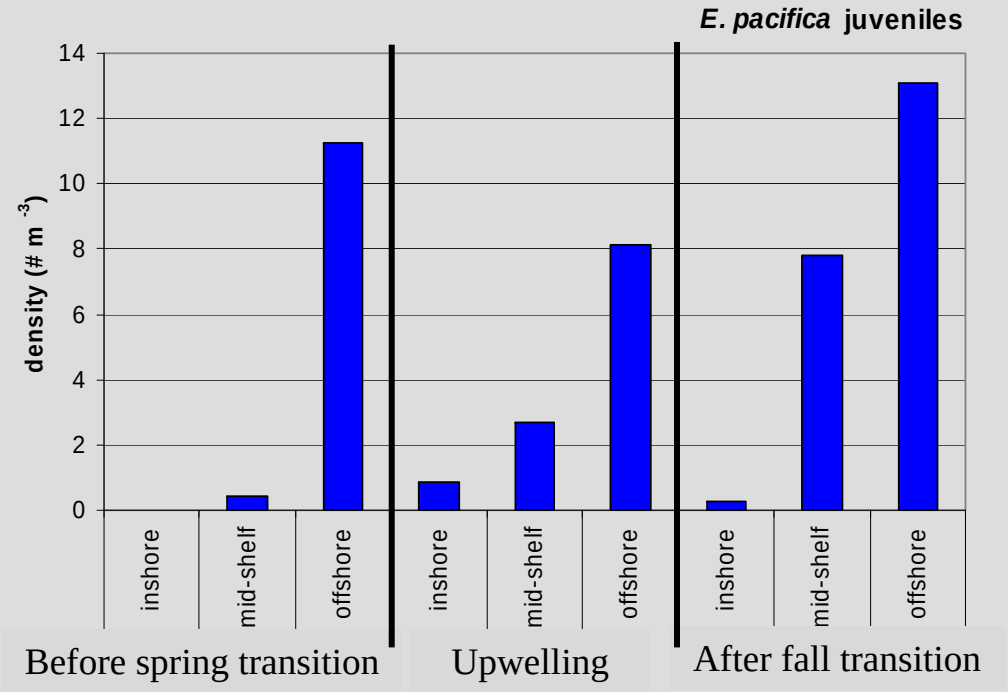
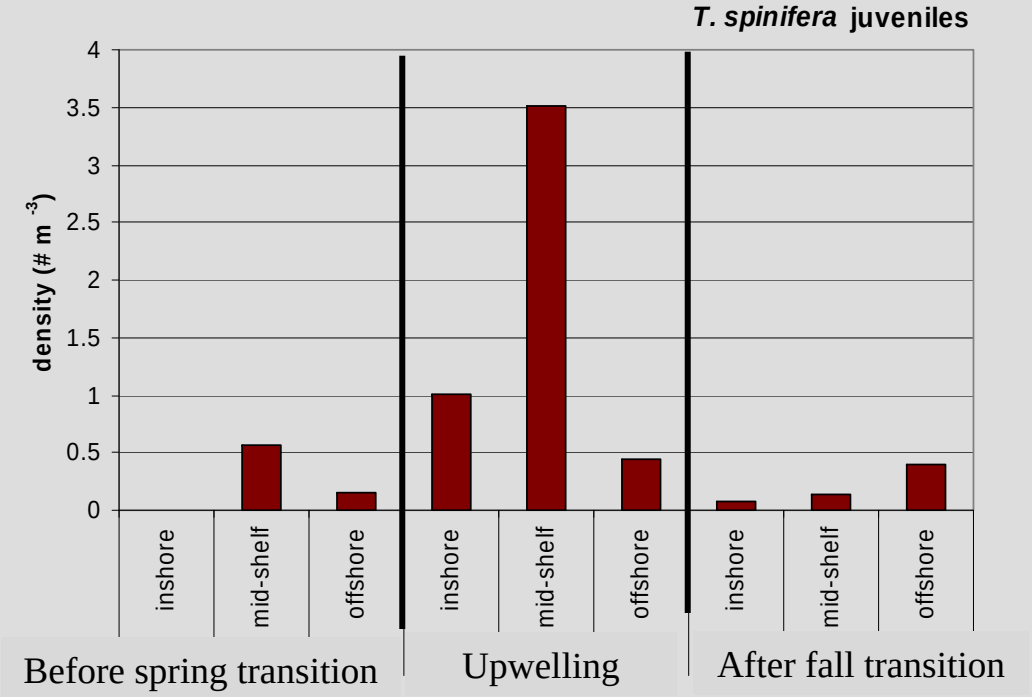
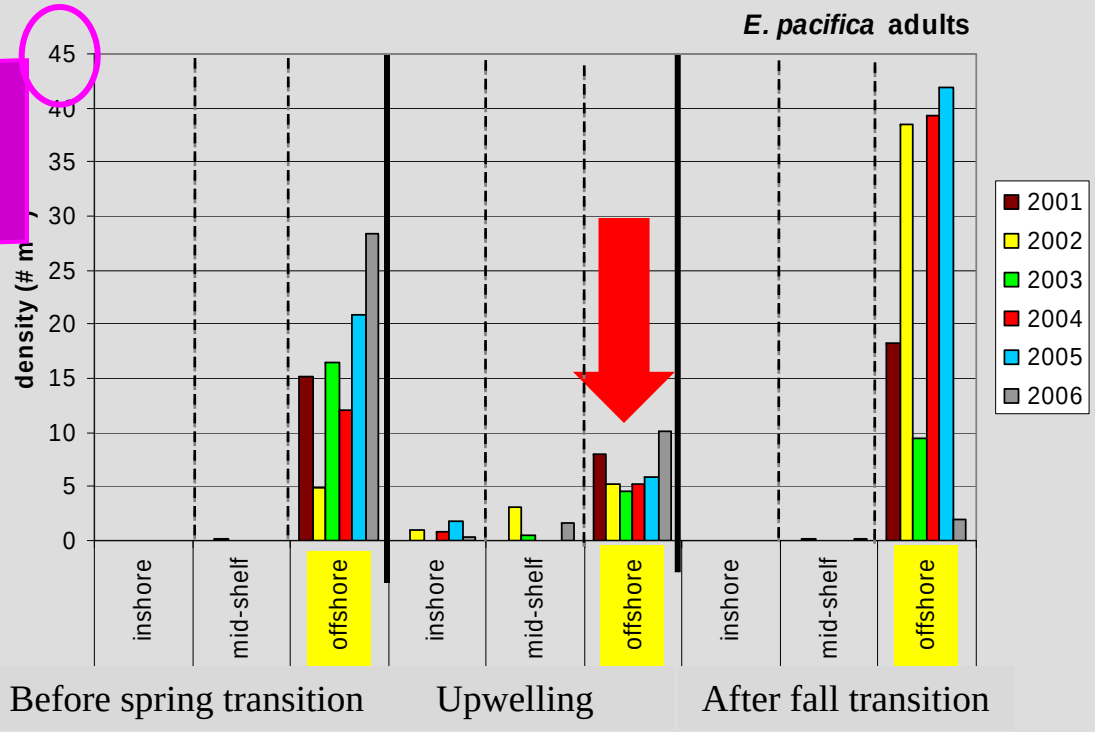
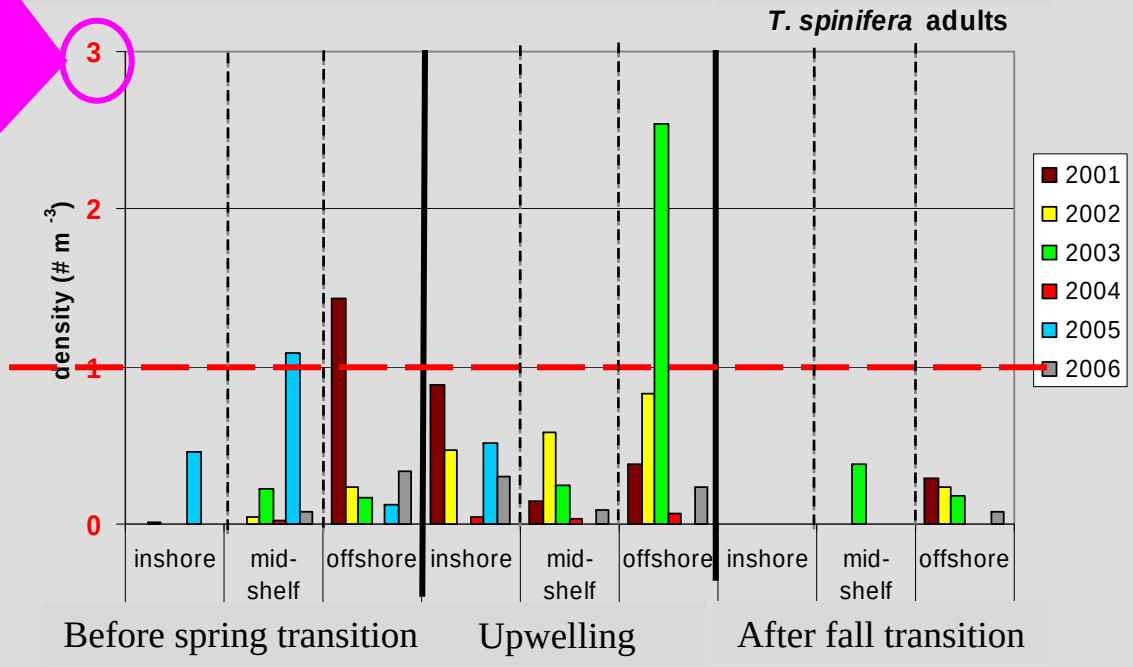




Adult

- 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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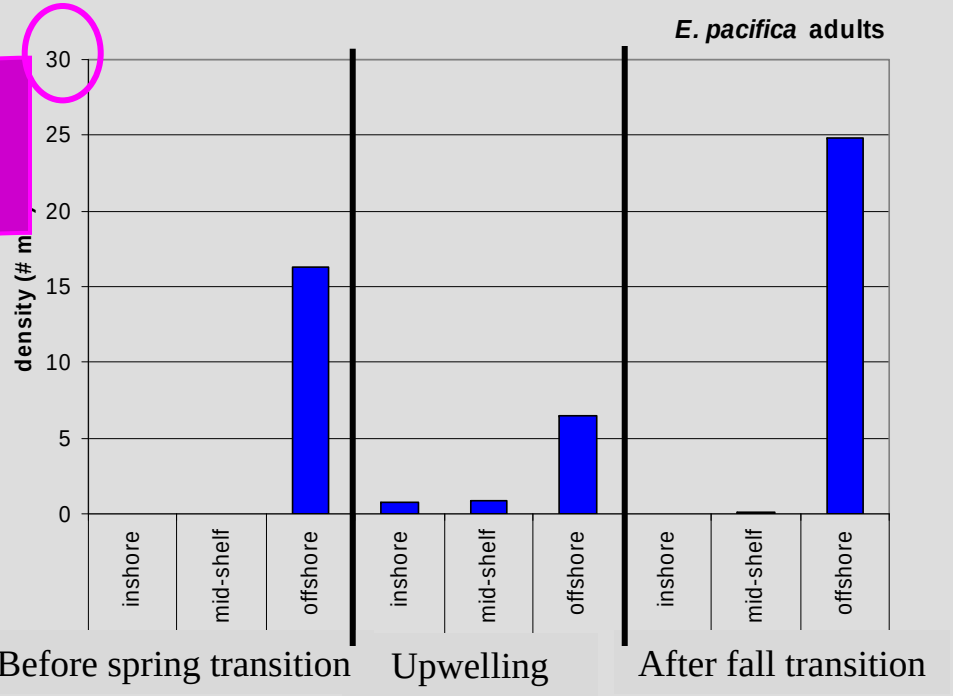

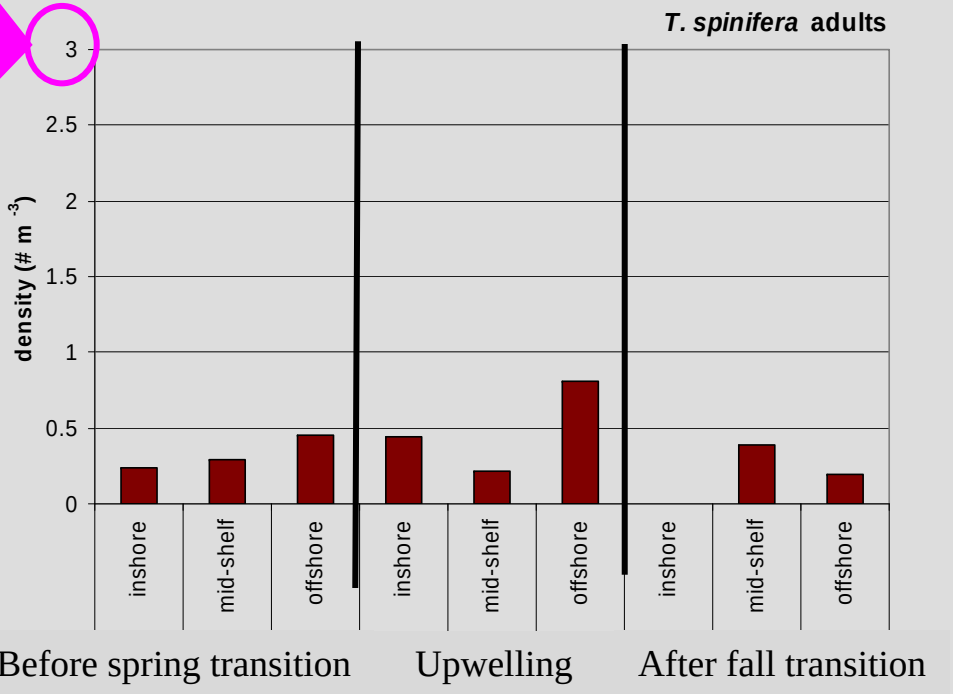

Preliminary Results

- 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

Spring transition → ~4 months → Peak in euphausiid egg density → ~2 months → Juveniles

- 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 euphausiid 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

- Research vessels: *R/V Sacajawea*, *R/V Elakha*, *R/V Wecoma*, *R/V Atlantis*, *R/V Frosti*, *R/V Miller Freeman*, *R/V McArthur II*, *R/V New Horizon*
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