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Gut 1997 Shrimp (Gut 1997) (Gut 1997, 1997)



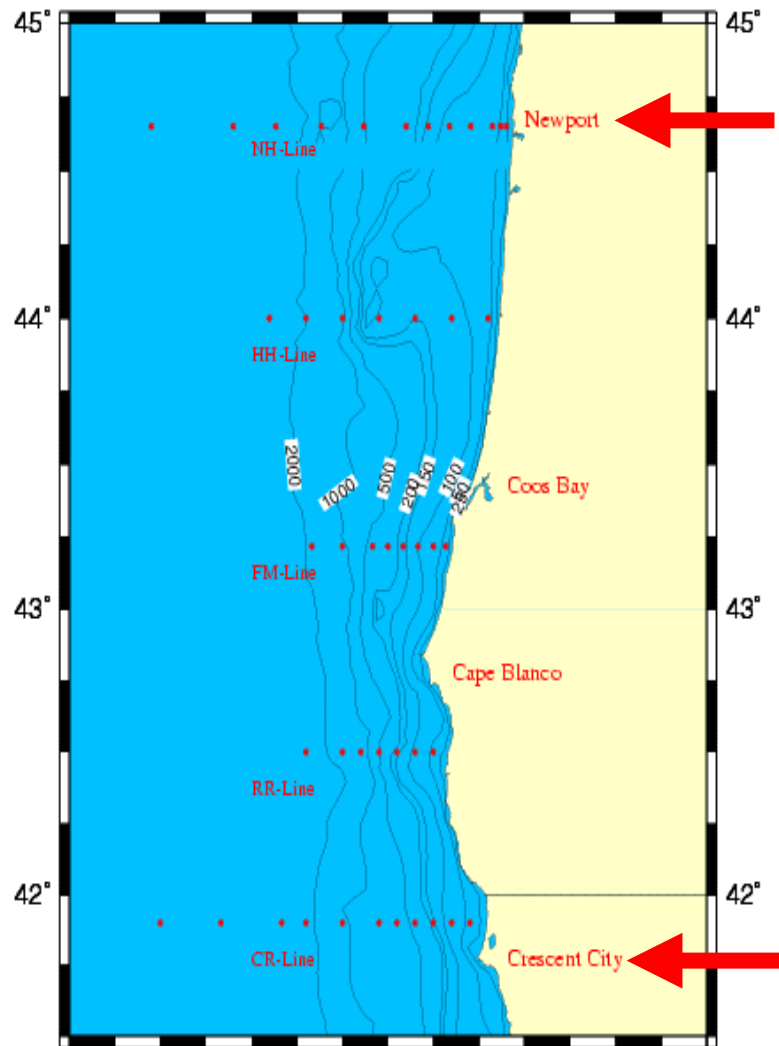
Seasonal variations in intermolt period and
growth of *Euphausia pacifica* and *Thysanoessa*
spinifera in the coastal Pacific Northwest



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US GLOBEC project
studying euphausiid life
histories

Study area between
Newport, Oregon and
Crescent City, CA

NH line sampled every two
weeks year-round, night
samples 2001-present

Other sampling as part of
longer GLOBEC cruises

Target Species



Generally found at and beyond the shelf break (>200 m depth)



Generally found on the shelf (<200 m depth)

Useful Information

- Long-lived (up to 2 yr)
- Molt regularly throughout their life: may stay the same size, grow, or shrink (negative growth)
- Size not a good indicator of age
- Often 50% or more of zooplankton biomass in our study area

Methods



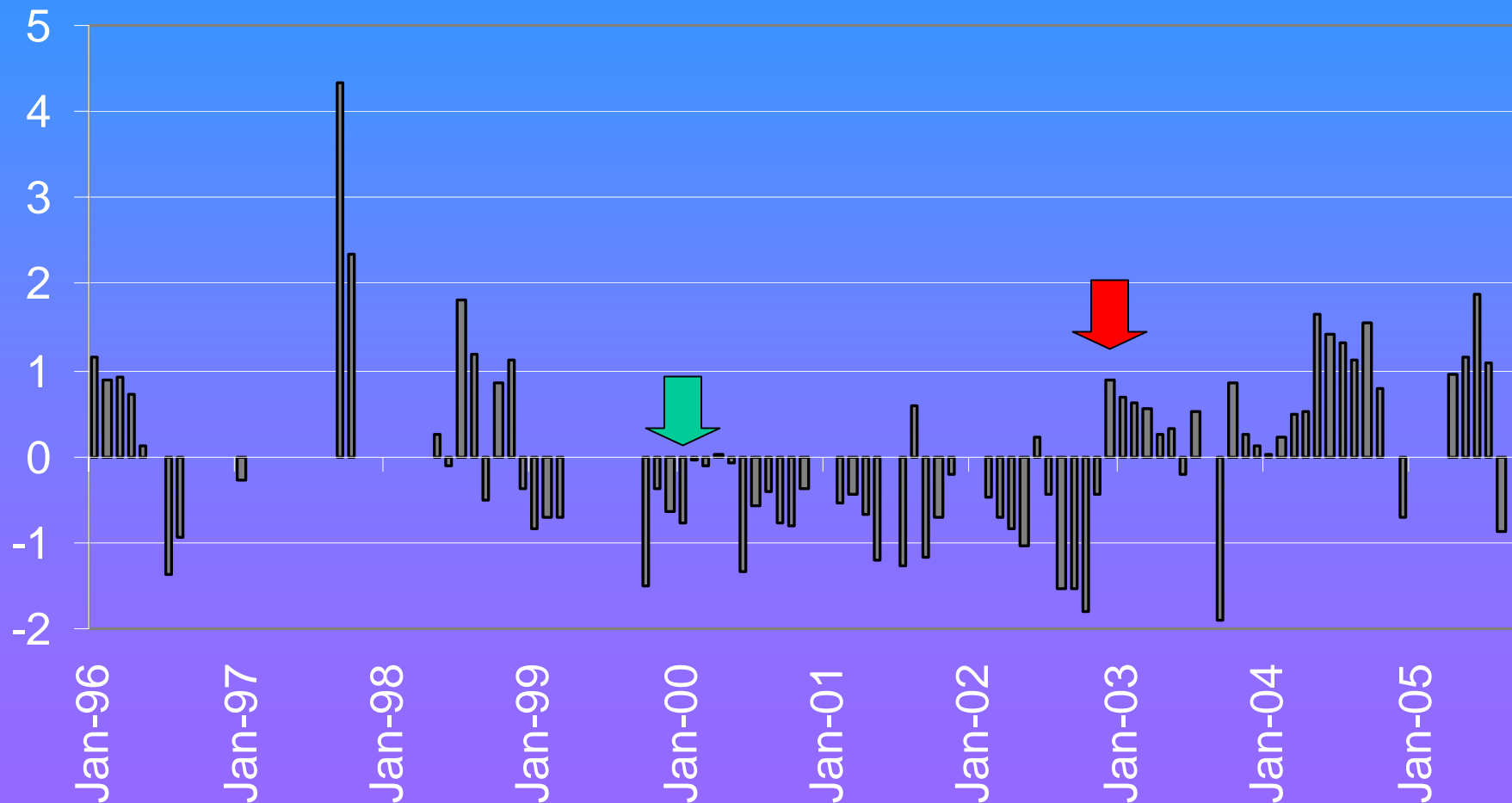
- Caught in oblique tows to 25m at night
- Instantaneous growth (IGR) rate protocol
- Incubate individual animals in jars for 48 hr
- Check every 12 hr for molts
- Measure telsons of preserved molt and animal to get growth increment
- Total of 165 experiments and 4842 animals incubated
- Experiments focused on adults and juveniles

Outline

- Data set for six years (2000-2005) which span warm and cool ocean conditions
- Intermolt periods for both species compared by seasons (spring, summer, fall/winter)
- Growth (in length) by species, stage, season and sex
- Growth vs. chlorophyll, station depth, and temperature
- Compare growth of individuals to growth derived from analysis of size-frequency distributions

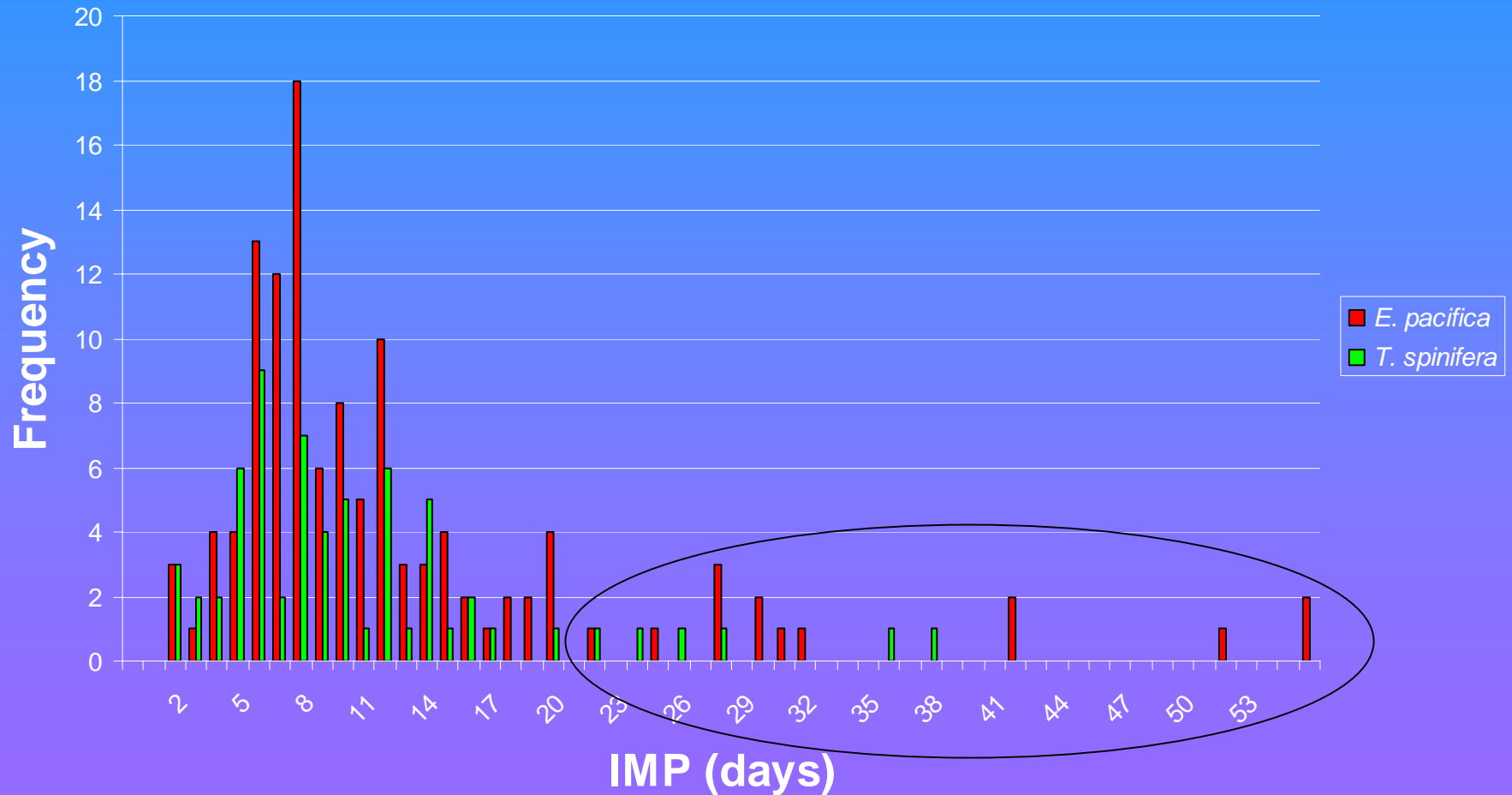
SST Anomalies

(from Buoy 46050 located at the shelf break off Newport)



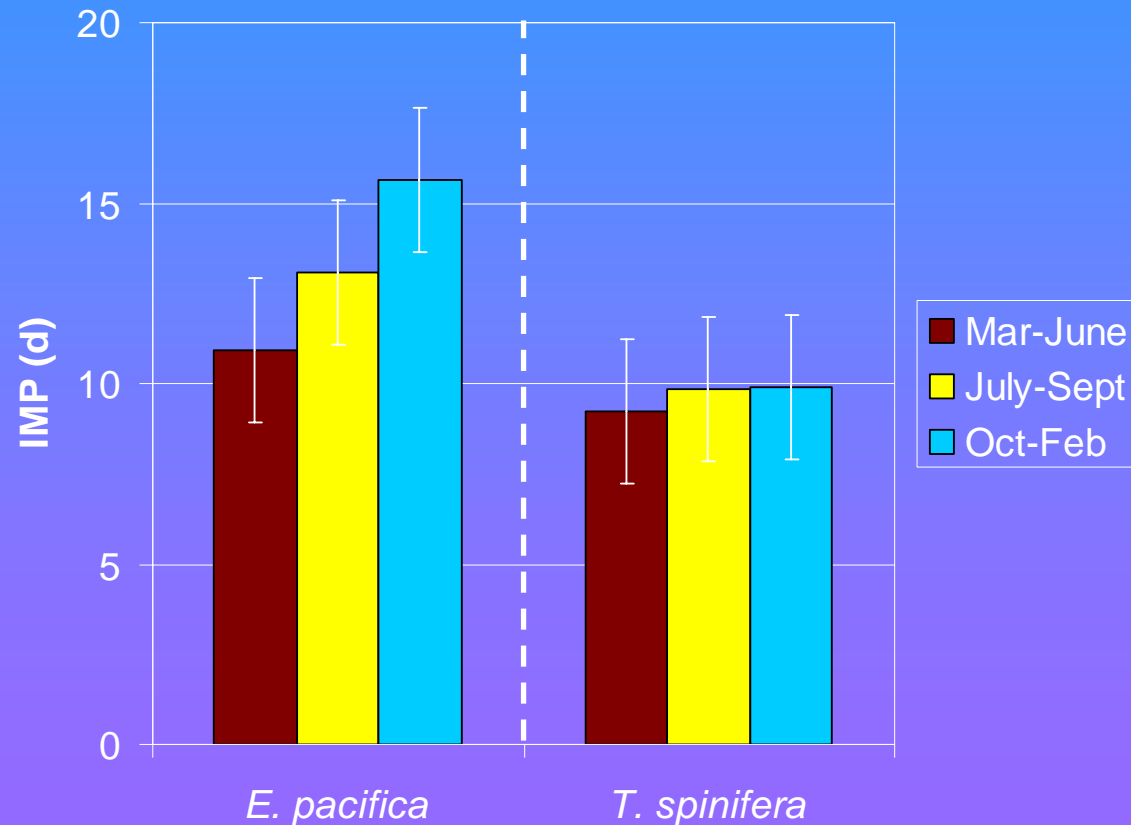
Frequency Distribution of Intermolt Periods (IMP)

- Most frequent IMPs 5-8 days



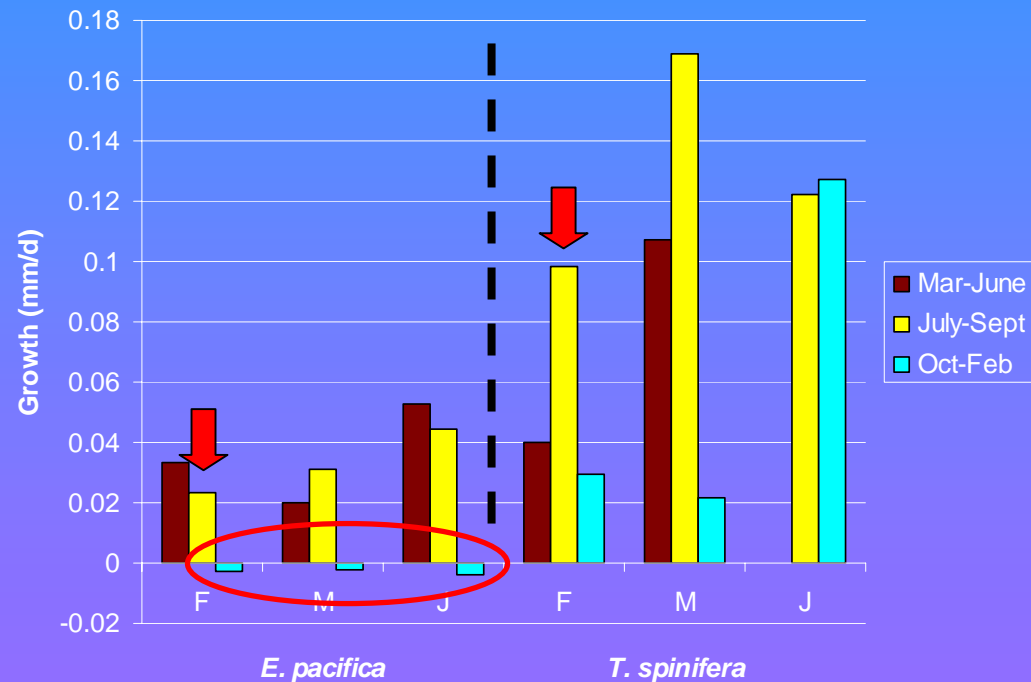
Seasonal Average IMP (Spring, Summer and Fall/Winter)

- *E. pacifica*
 - IMP 10 d in spring
 - IMP 12-16 d summer and fall/winter
- *T. spinifera*
 - IMP 9-10 days all seasons



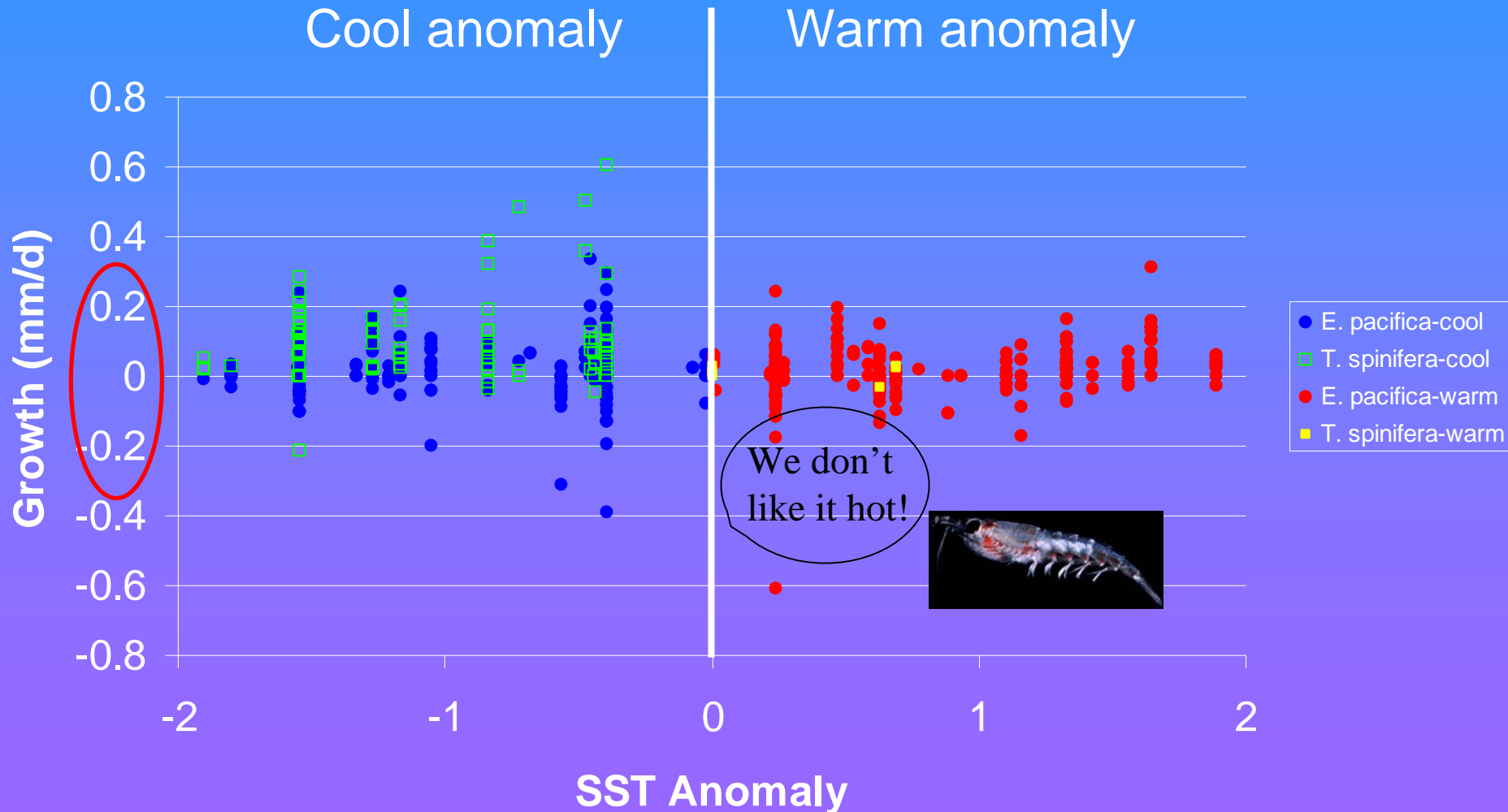
Average Growth Rate by Season (adult females, adult males and juveniles)

- SPECIES: *E. pacifica* grow at a slower rate than *T. spinifera*
- STAGE: Growth rates usually highest for juveniles
- SEASON: *E. p.* negative growth in winter; *T. s.* positive growth, but lower growth than other seasons
- SEX: Female *E.p.* slow in summer, *T.s.* high in summer.



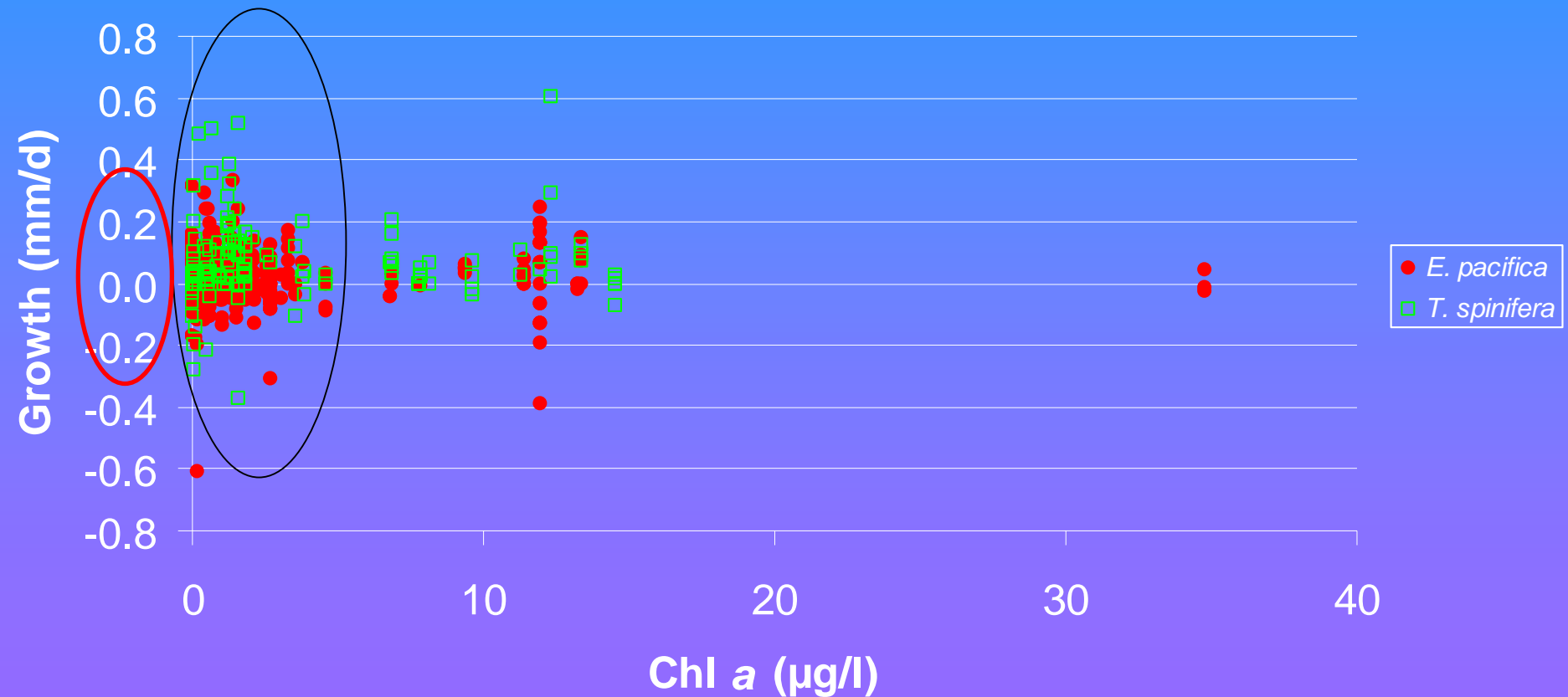
SST Anomaly v Growth

- *T. spinifera* have higher & positive growth rates when cool;
- *T. spinifera* absent when warm

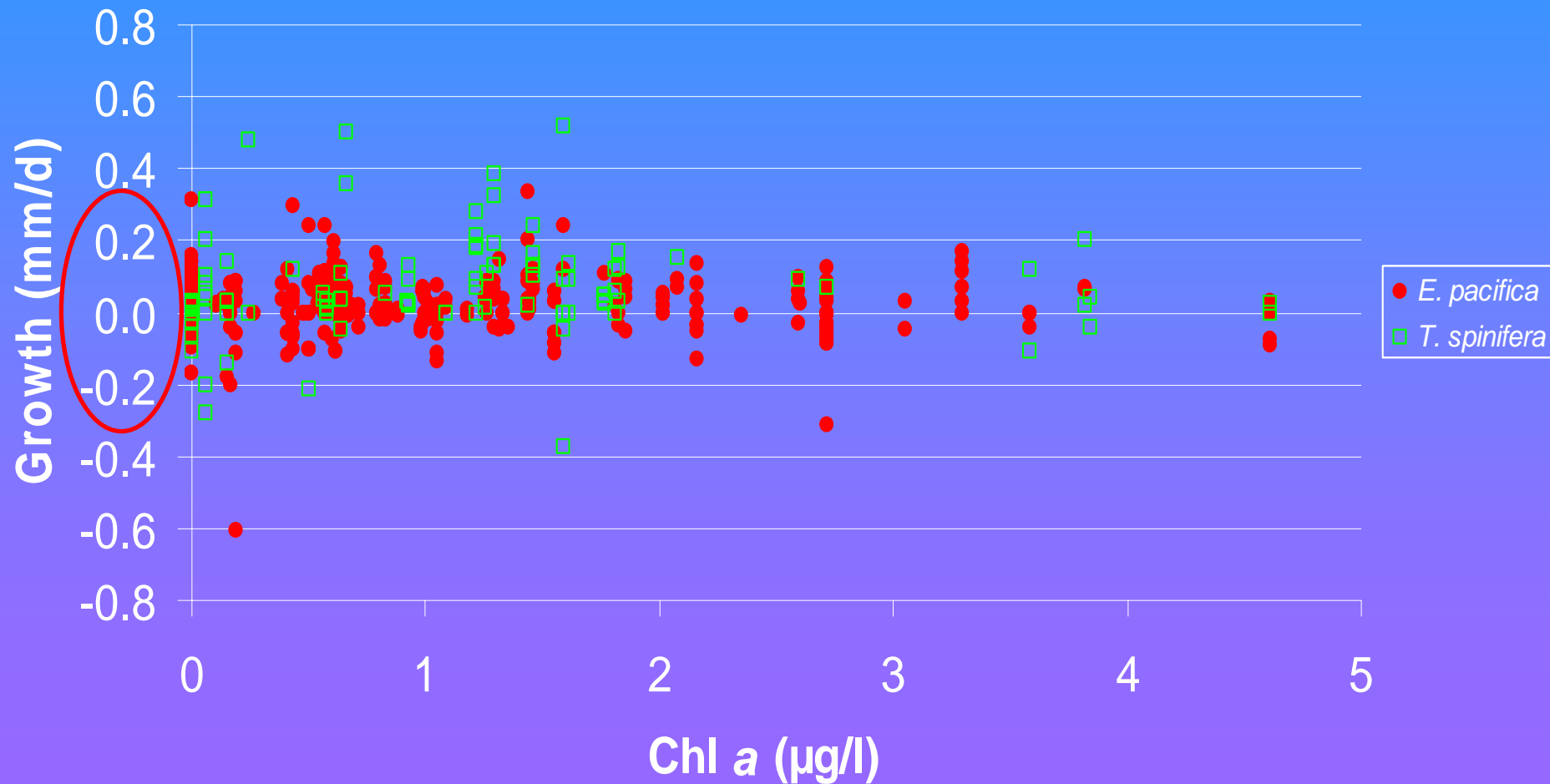


Chl a v. Growth

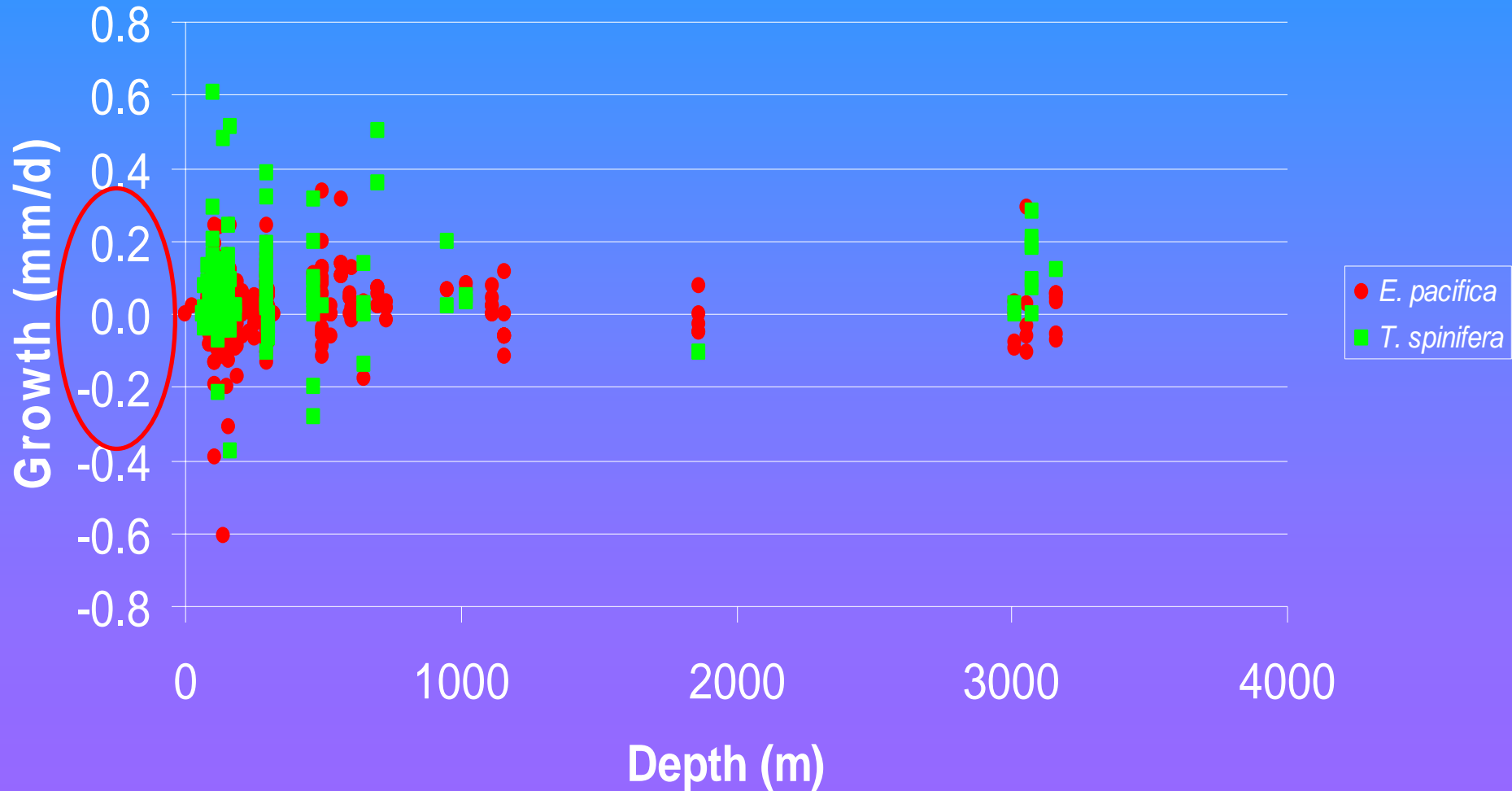
No relationship because animals integrate 5-10 days of feeding before molting



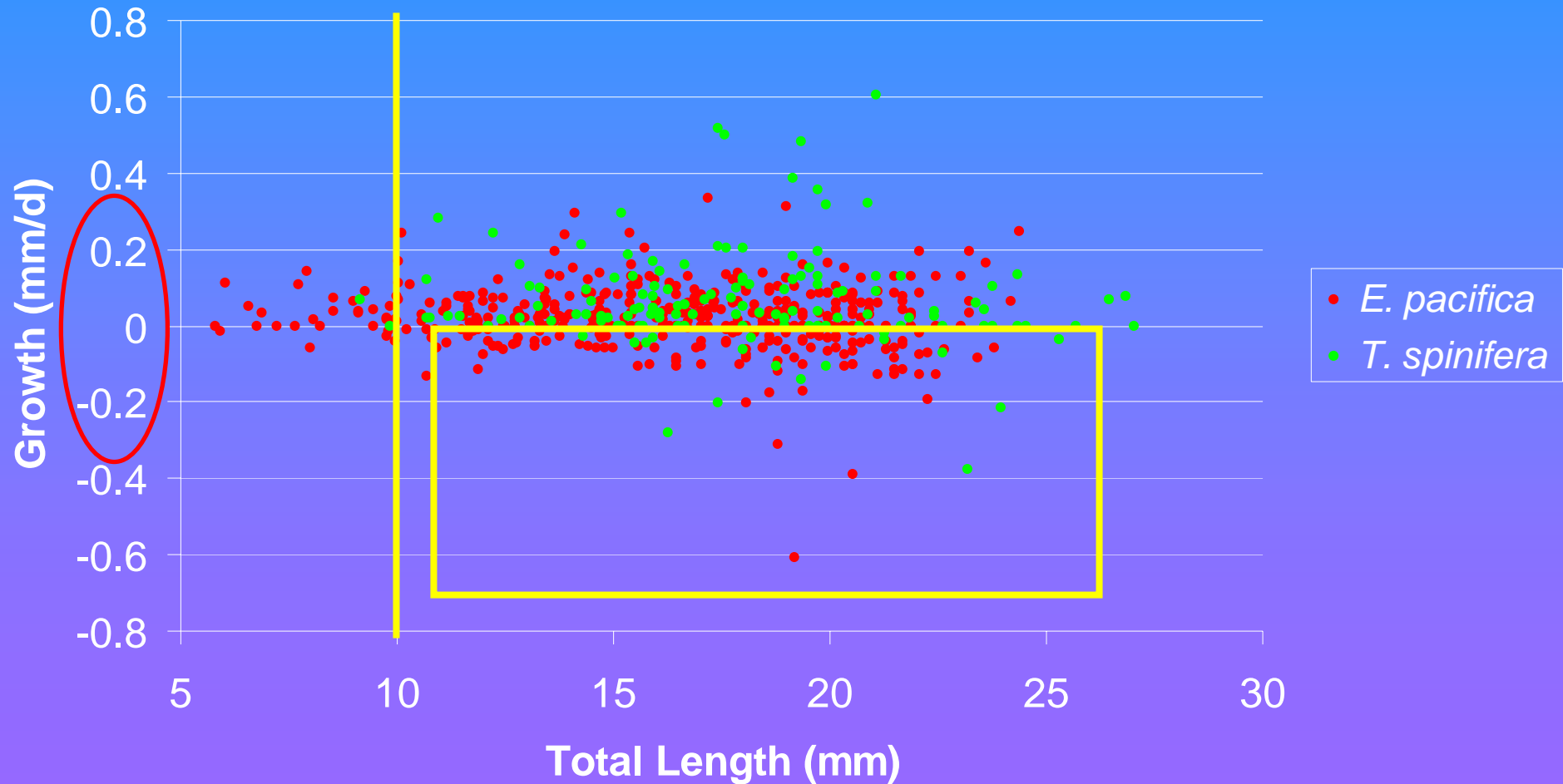
Chl a v. Growth 0-5 $\mu\text{g/l}$



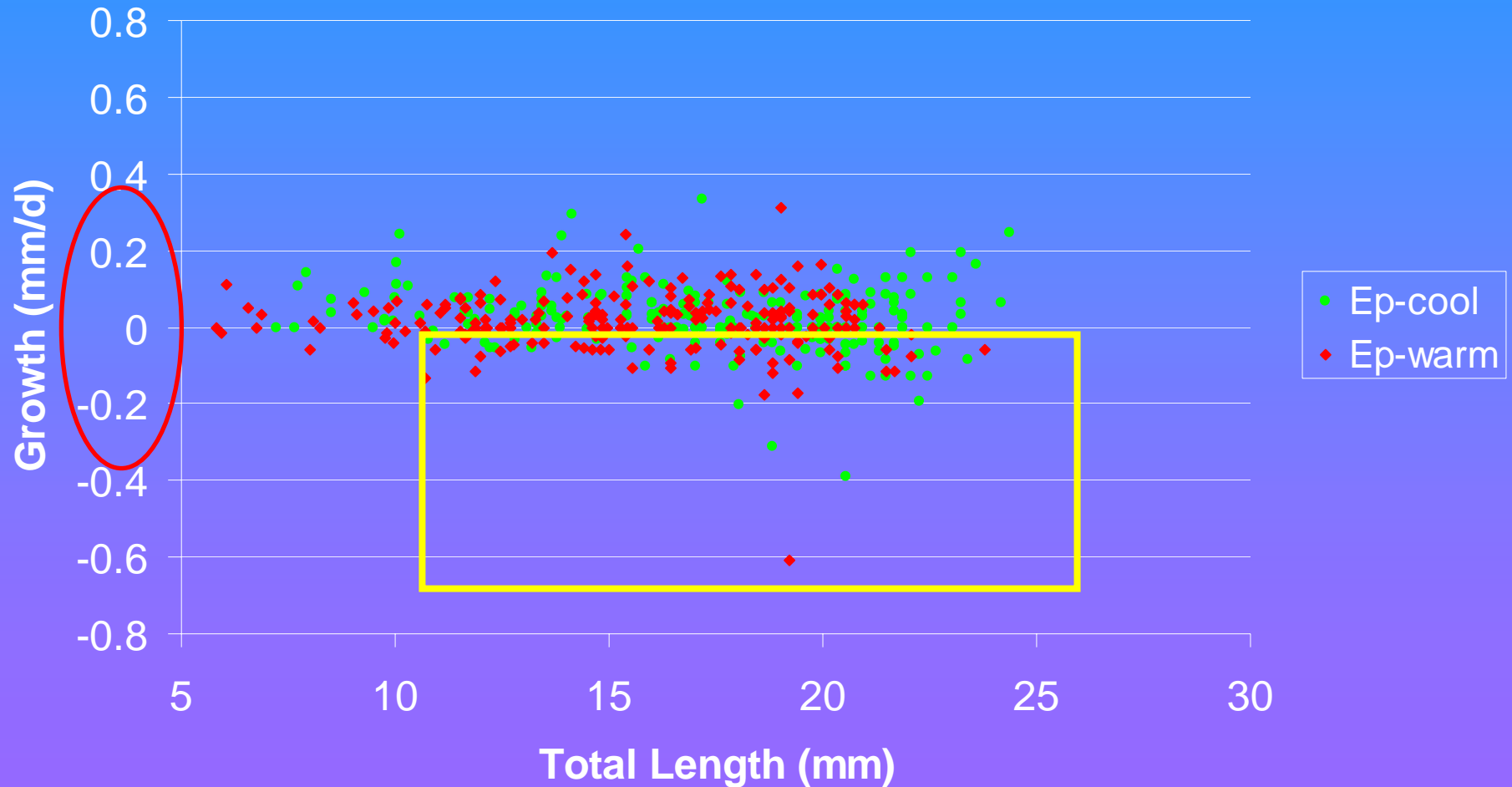
Station Depth v. Growth



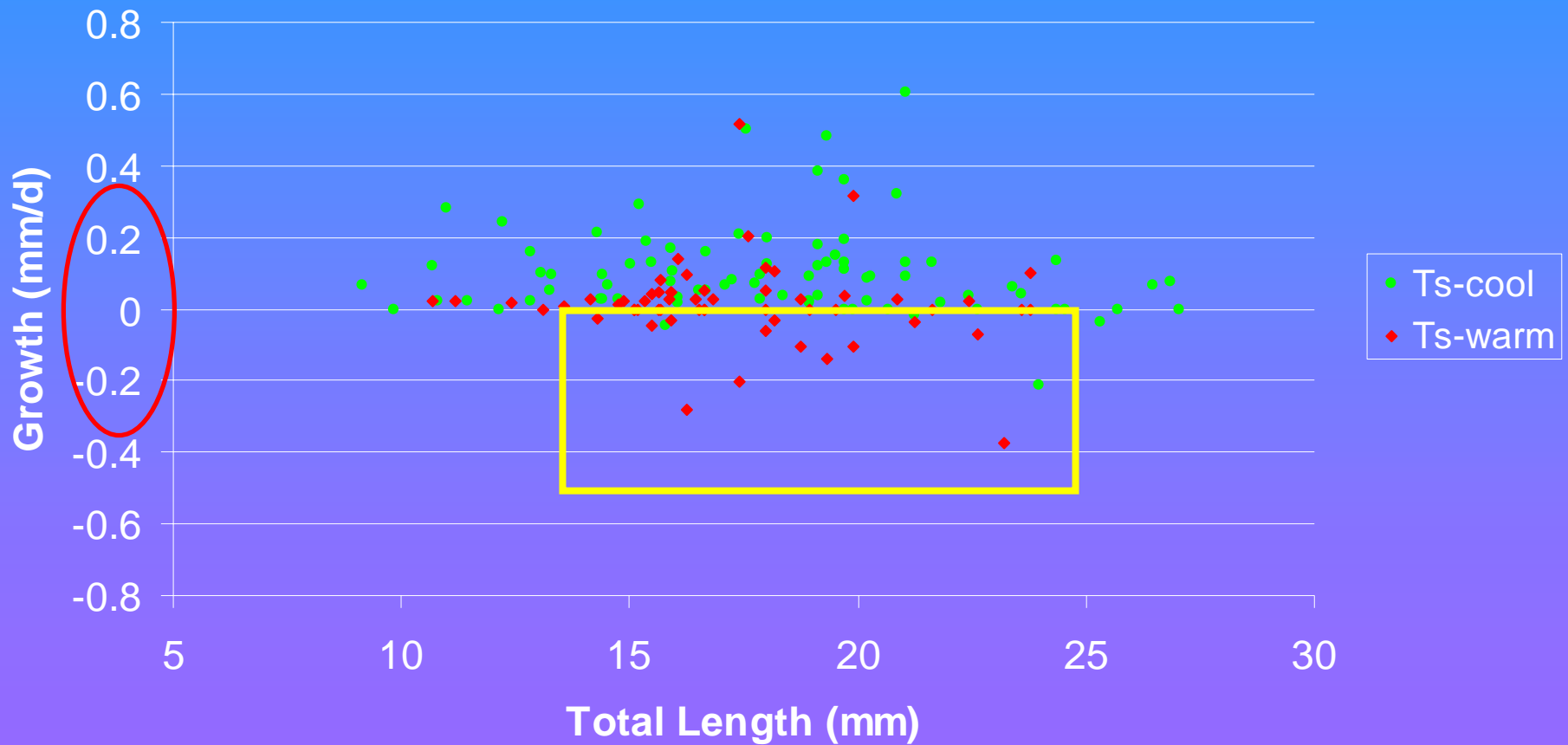
Length vs growth



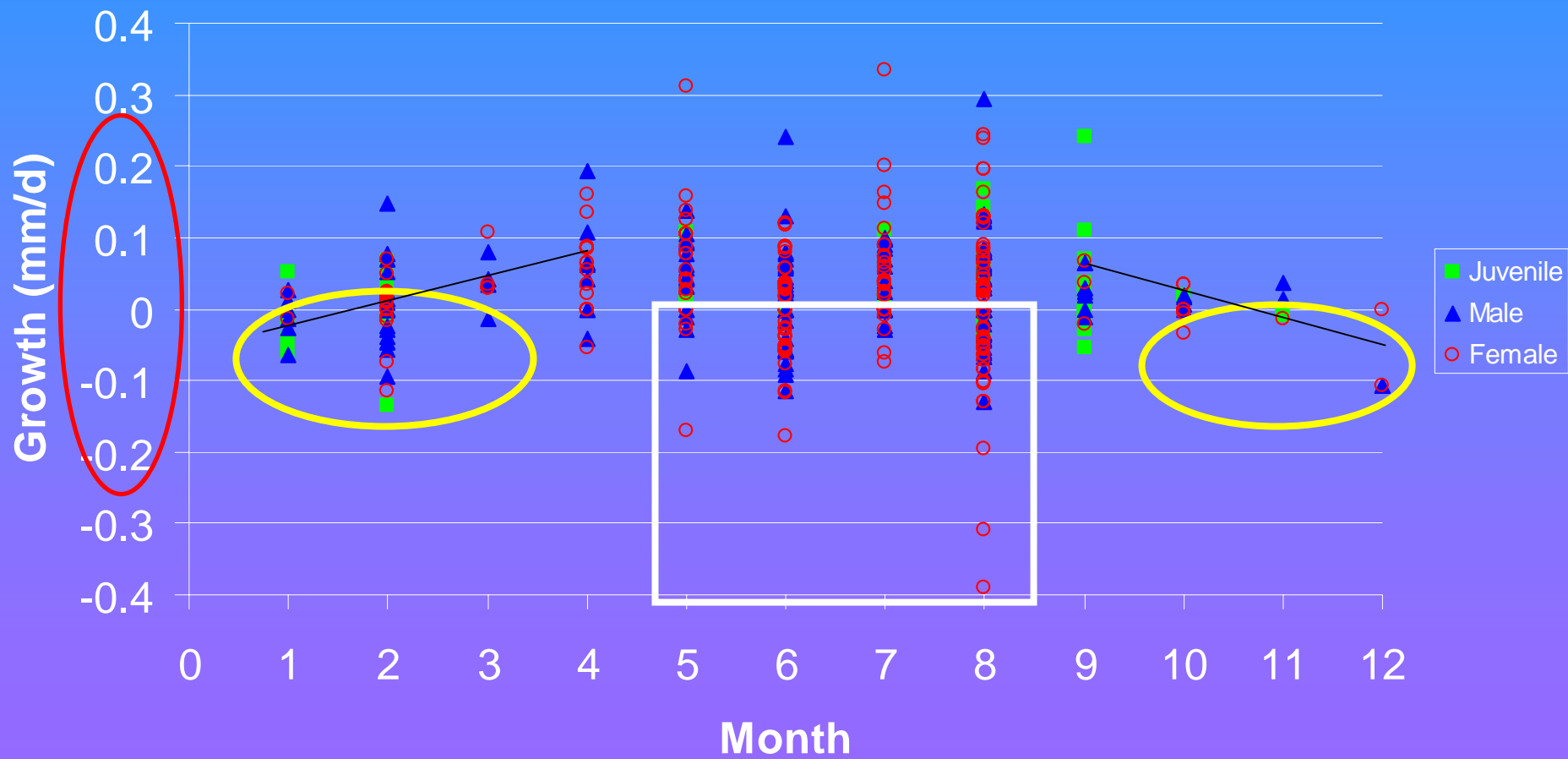
E. pacifica – cool and warm years



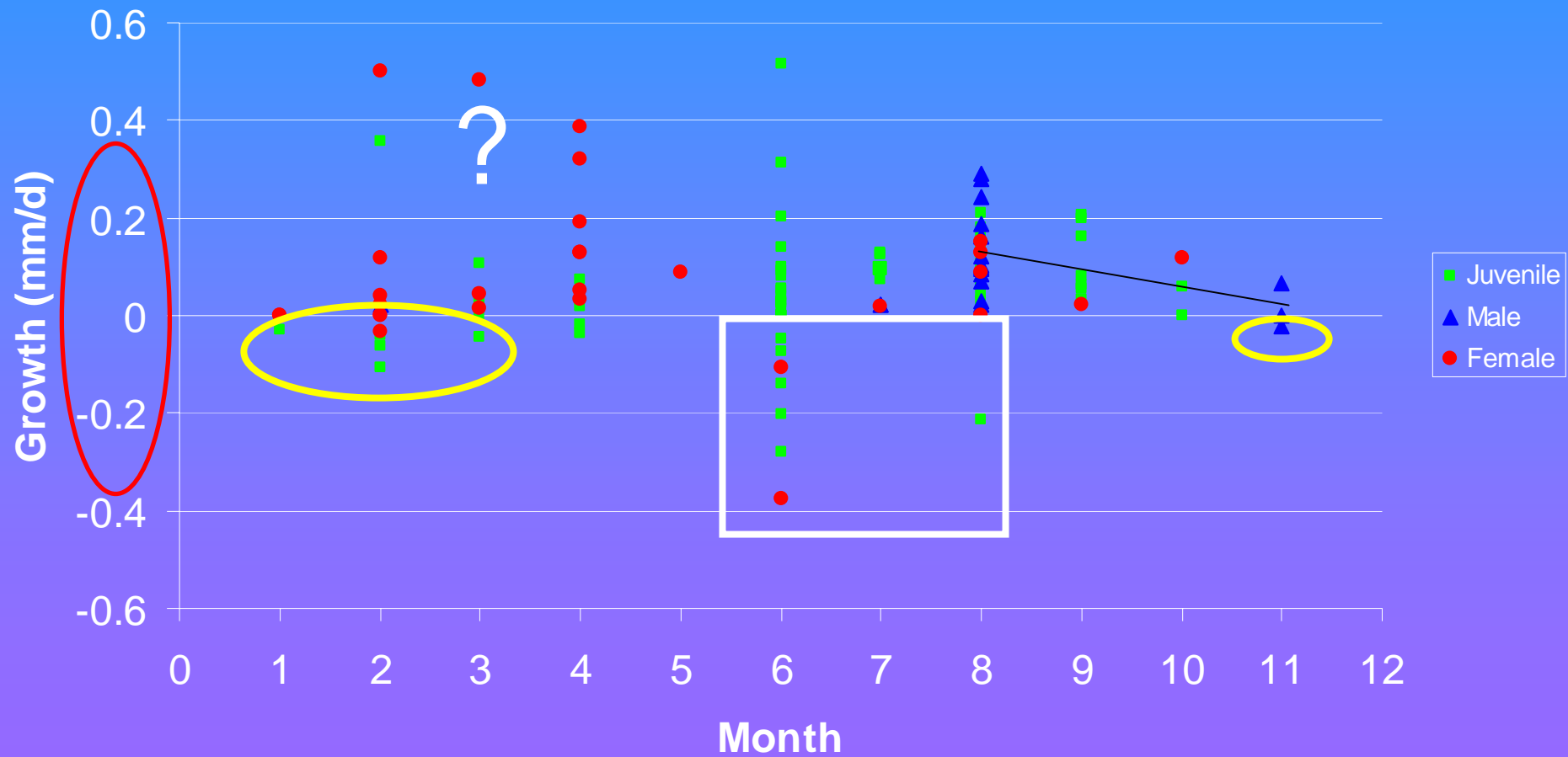
T. spinifera – cool and warm years



E. pacifica

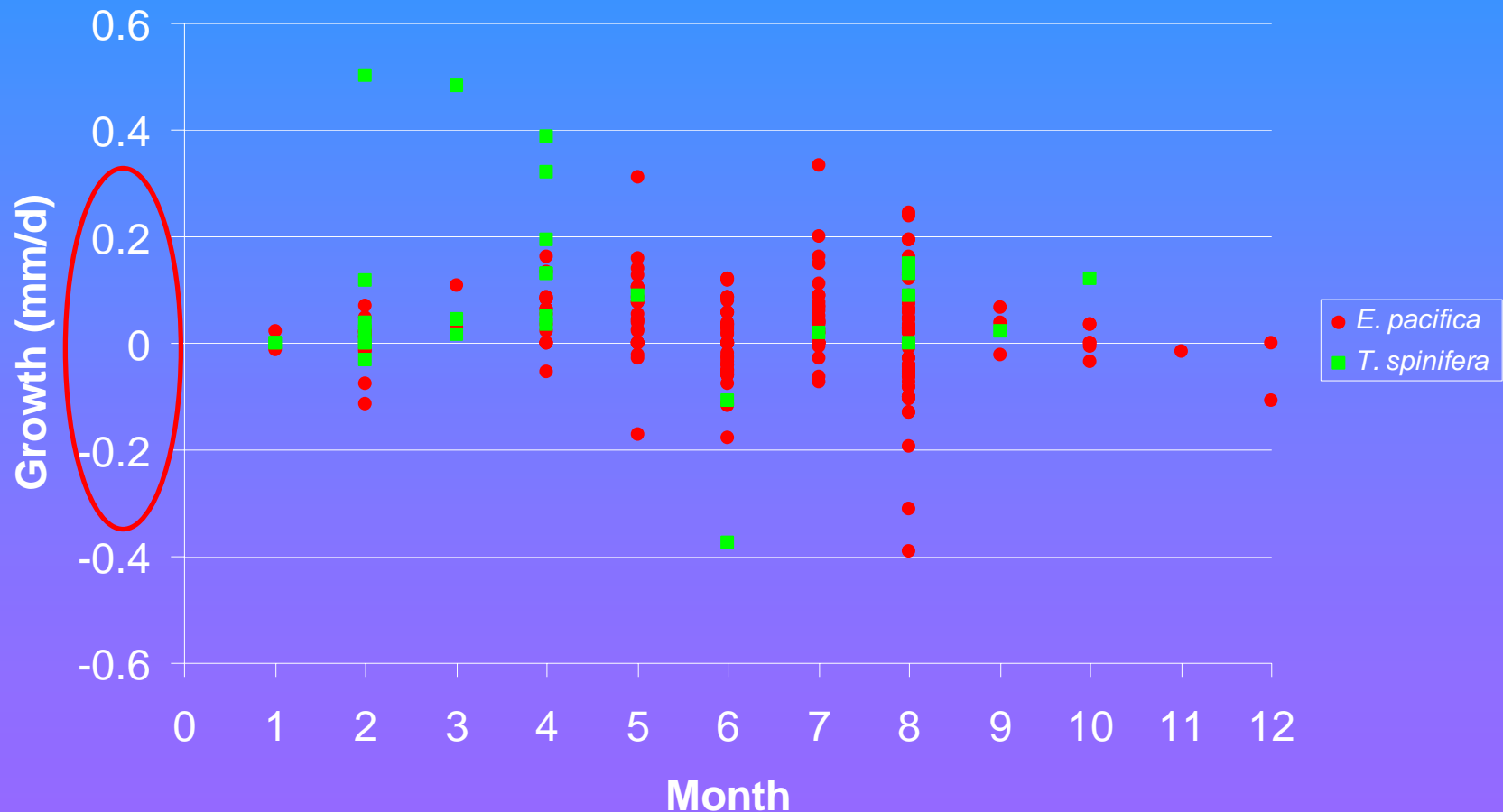


T. spinifera

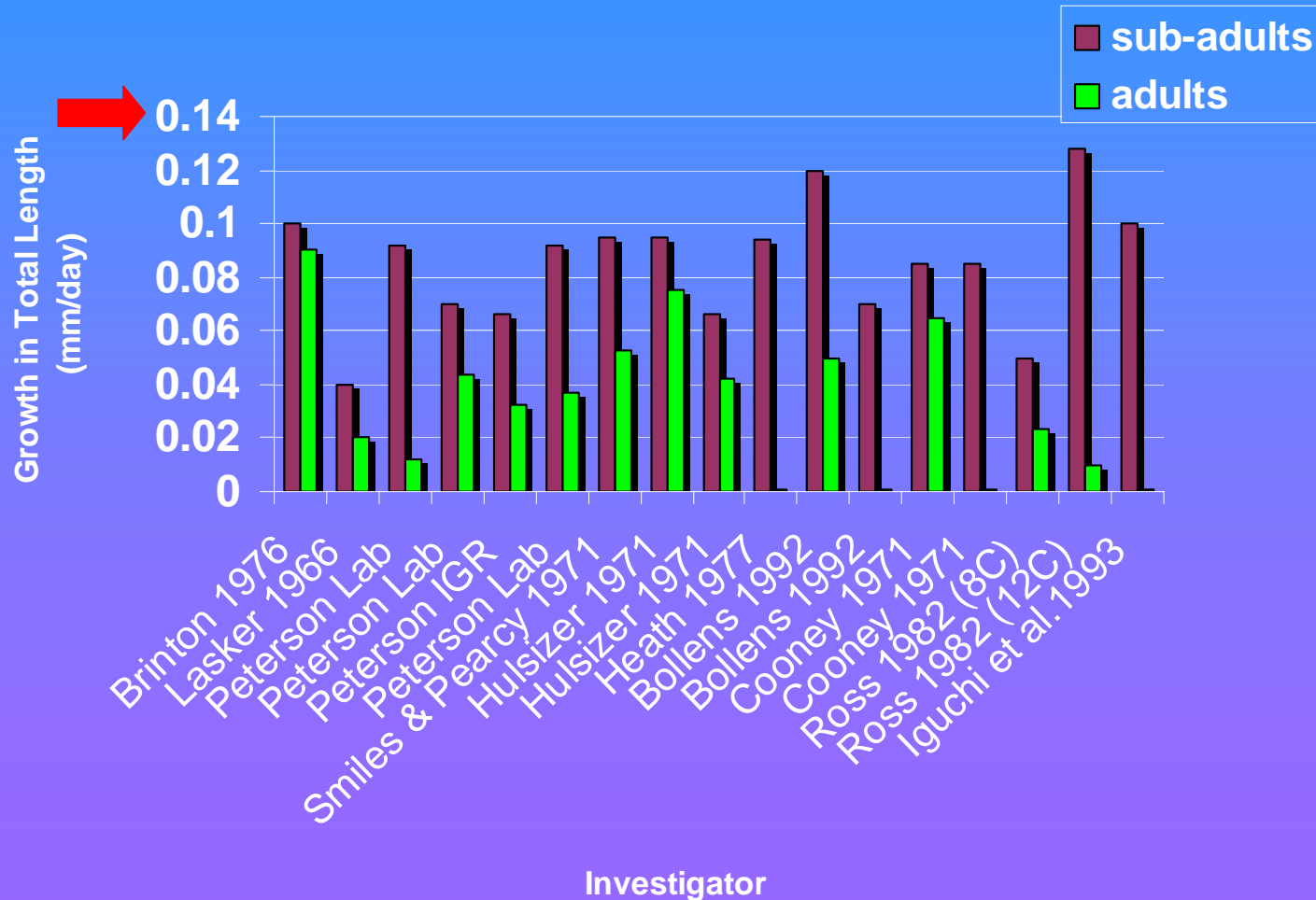


Ep & Ts female growth comparison

- Growth of *T. spinifera* females usually positive
- Negative growth may indicate intense spawning activity

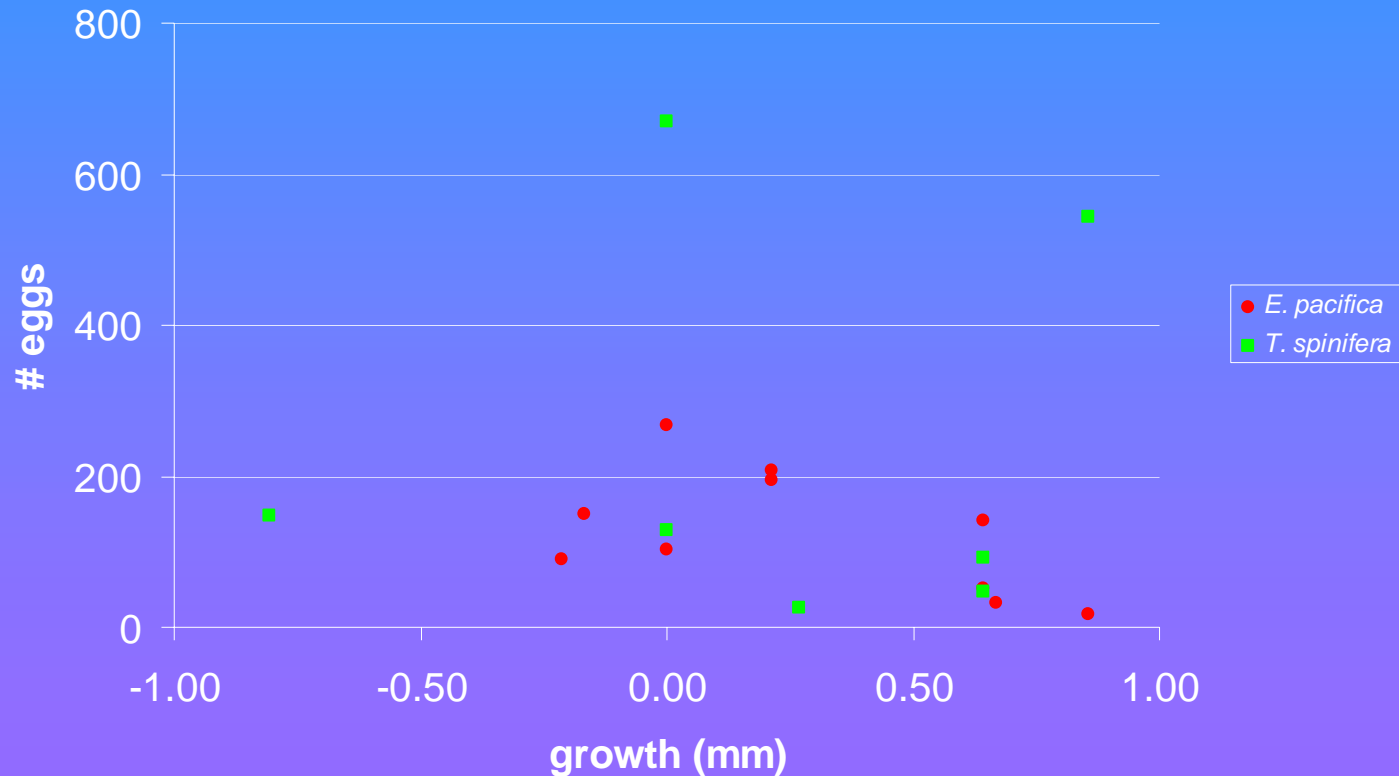


Comparison of growth with other published studies



Molting Spawner Data

On one cruise, we measured both brood size
and growth of the same females



Negative growth and reproduction

- *E. pacifica* showed negative growth at almost any time
- Other work in our lab found that a brood of eggs represents, on average:
 - E. pacifica* ~ 10% BW as eggs
 - T. spinifera* ~ 5% BW as eggs

By this measurement, *E. pacifica* allocates more energy to reproduction than *T. spinifera*

- *T. spinifera* seems to allocate more energy to growth; as adults they are larger and heavier than *E. pacifica*

Summary and Conclusions (1)

- Most IMP 5-8 days, regardless of time of year or species
- Average IMP varies seasonally for *E. pacifica* but not *T. spinifera*
- Both species show increased growth in spring; decreased in winter
- *E. pacifica* and *T. spinifera* both may shrink during the winter
- Adult *E. pacifica* and *T. spinifera* often shrink during spring/summer reproductive season
- Shrinking in winter related to food limitation; shrinking in summer related to energetic costs of reproduction
- We suspect that females that shrink have probably already spawned several broods of eggs during that season

Summary and Conclusions (2)

- *E. pacifica* exhibit the same range of growth during warm and cool years
- *T. spinifera* were found in low numbers and were less likely to grow during warm years

Future collaborative efforts

- Comparison of brood size and molting rates of *E. pacifica* and *T. spinifera* from other locations in the Eastern Pacific
- Comparison of brood sizes and molting rates of *E. pacifica* and *Thysanoessa* spp at points in Western Pacific
- We have had good results raising and maintaining *E. pacifica* in the laboratory on a diet of phytoplankton. They develop to adult, and produce multiple broods for months on end. We have been unable to raise very many *T. spinifera* beyond F2/F3 nor do field-collected females produce multiple broods in the lab. Thus we need to establish dietary requirements of *T. spinifera*.

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