
Thysanoessa spinifera

Comparison of condition metrics and lipid content between *Euphausia pacifica* and *Thysanoessa spinifera* in the northern California Current, USA

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Euphausia pacifica

Intro and background

- Krill are an important food resource for higher trophic levels
  - Seabirds, Pacific Hake, forage fish species, salmon


Thysanoessa spinifera

***Euphausia pacifica* (Epac)**	***Thysanoessa spinifera* (Tspin)**
More abundant	Lower density
Associated with the shelf break and canyons	Distributed closer to shore on the continental shelf
Visually ‘leaner’	Visually ‘larger’
Lower lipid content (Ju et al. 2009)	Higher lipid content (Ju et al. 2009)


Euphausia pacifica

Question and Methods

1. *Are there differences in the body condition and lipid and fatty acid structure between the two dominant krill species in the NCC?*
2. *Do these metrics vary across season, year and life history stages?*


Thysanoessa spinifera

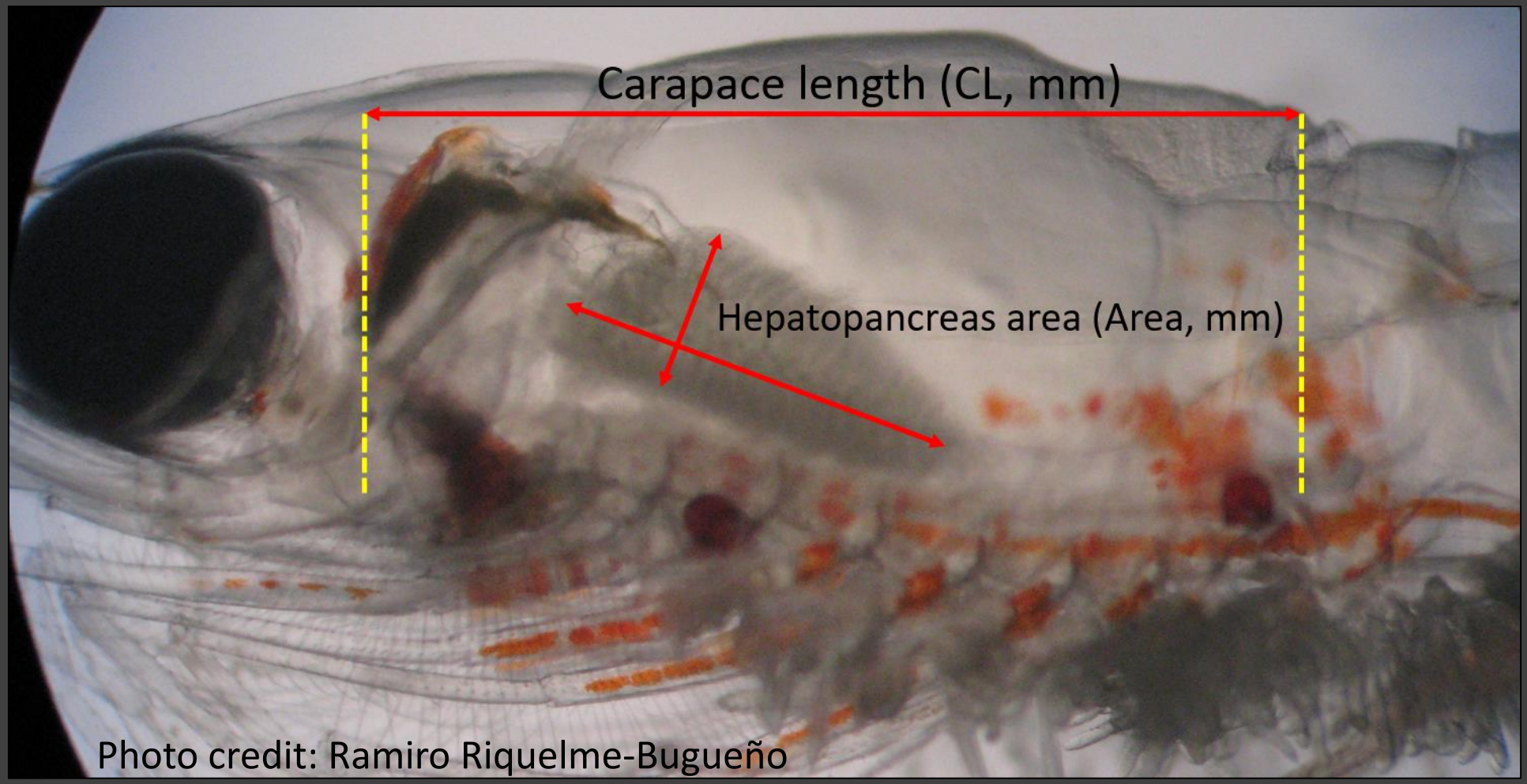
Body Condition

- Length-weight
    - Update existing L-W relationships for biomass
    - Inter-annual differences in body condition
- Carbon to Nitrogen (C:N)
- Hepato-somatic index (HSI- Ramiro Riquelme-Bugueño)
    - Measures recent or localized feeding conditions on daily to weekly time scales

Lipid and Fatty Acids (FA)


Euphausia pacifica

Hepato-somatic index (HSI)- method developed by Ramiro Riquelme-Bugueño

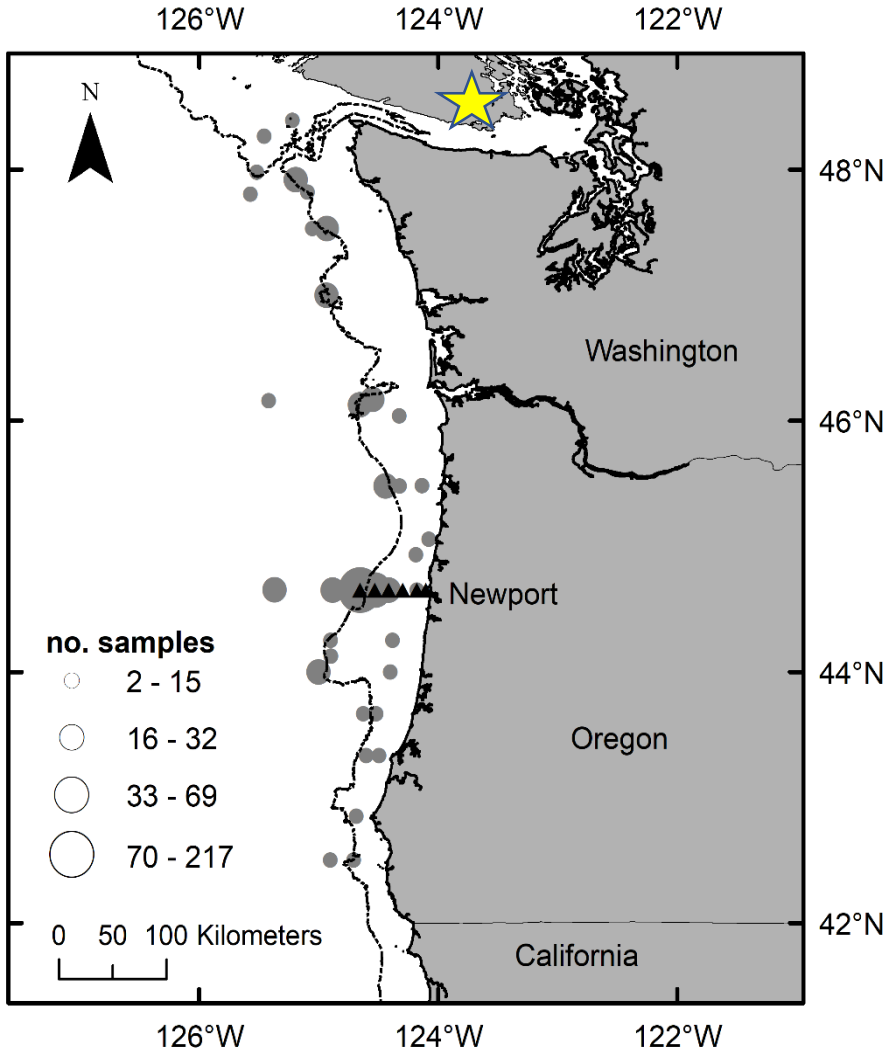


Hepatopancreas =
Digestive gland
(short-term storage organ)

$$\mathrm{HSI} = \frac{\mathrm{Area}}{\mathrm{CL}}$$

Estimate of recent feeding conditions on the order of weeks

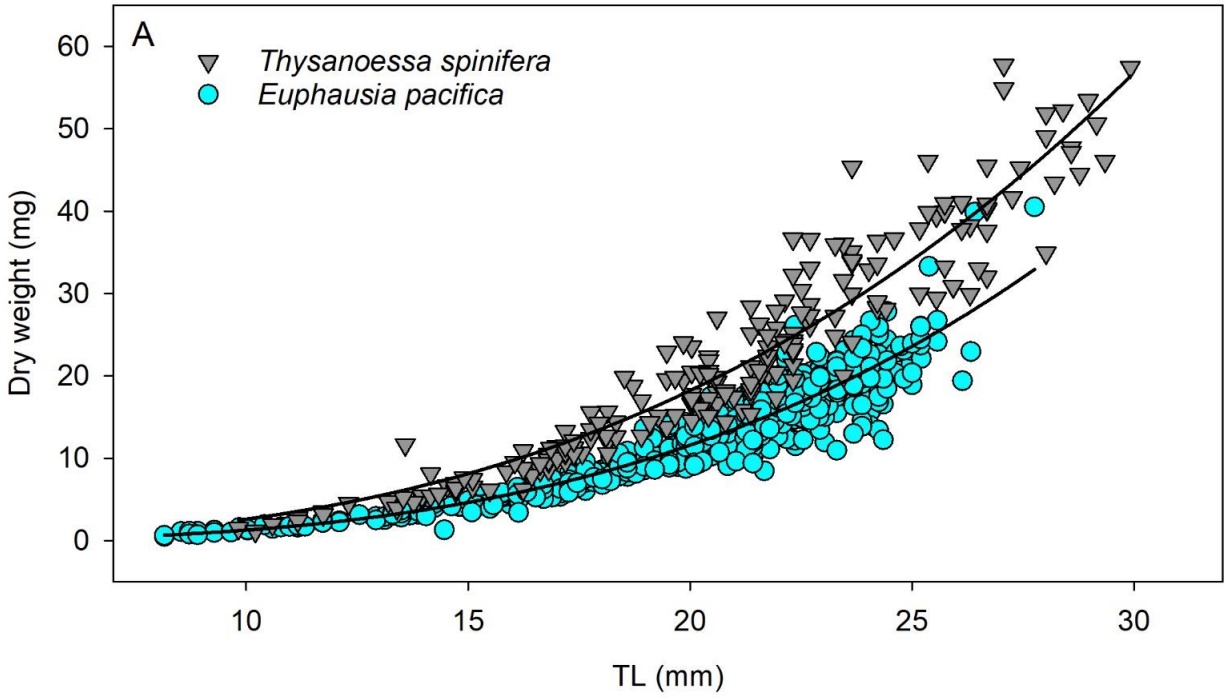
Sampling effort- year round



	Euphausia pacifica				***Thysanoessa spinifera***			
	Juvenile	Sub-adult	Female	Male	Juvenile	Sub-adult	Female	Male
Body Condition								
2007-2010	33	58	290	209	8	59	61	56
Lipid and Fatty Acids								
2010-2012, 2014	11	23	28	42	3	42	28	13

Juvenile ≤ 10 mm
Sub-adult > 10 mm (no defining sexual characteristics)

Length weight by species and life history stage



- *T. spinifera* reach longer lengths
- *T. spinifera* higher weight per length
- No differences in LW by year or life history stage for either species

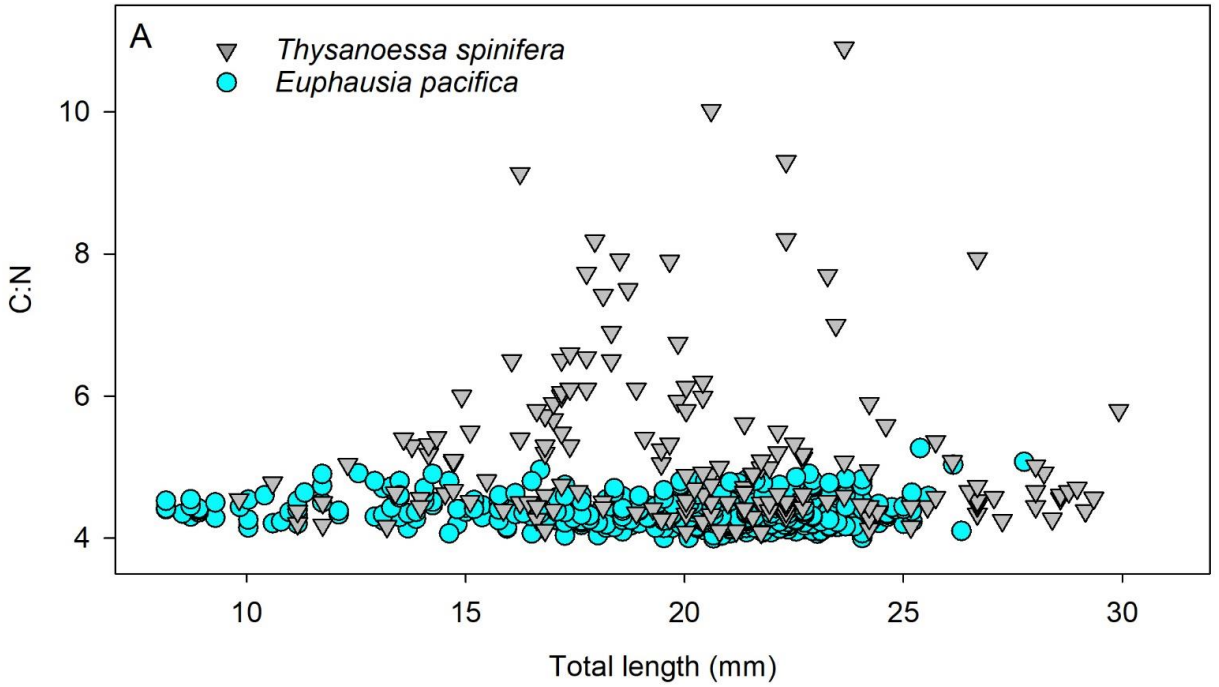
E. pacifica:

$DW = 0.0008 * TL^{3.19}$ ($n = 633$; $R^2 = 0.88$)

T. spinifera:

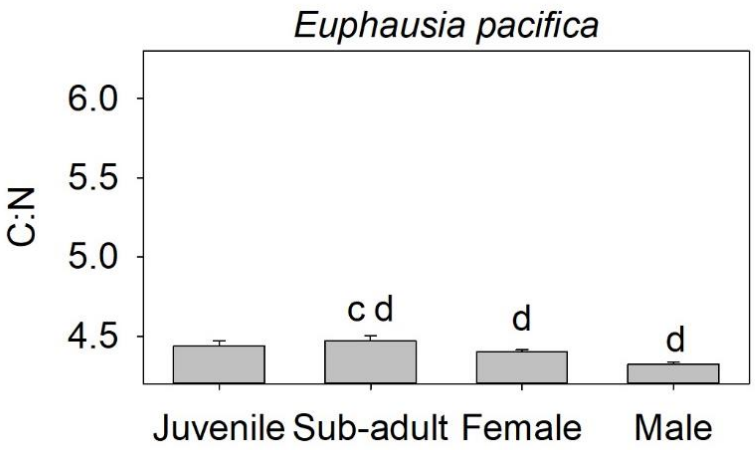
$DW = 0.004 * TL^{2.81}$ ($n = 201$; $R^2 = 90$)

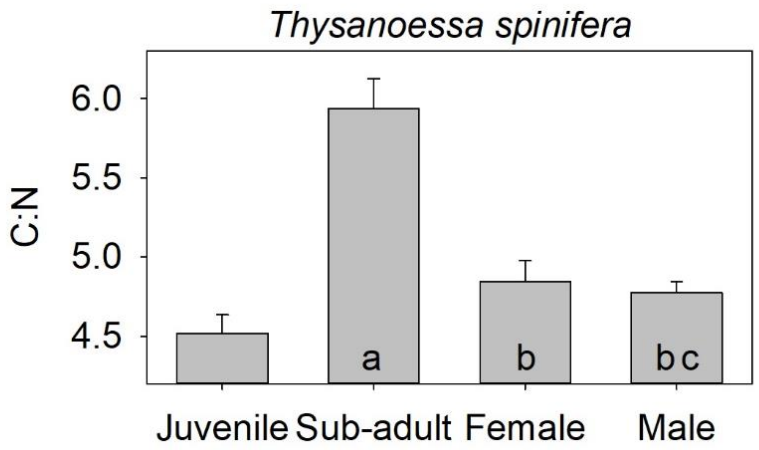
Carbon to nitrogen by species and life history stage



- Little difference in C:N by length for *E. pacifica*
- *T. spinifera* higher C:N per length
- *T. spinifera* sub-adults higher C:N compared to other life history stages
- No differences in C:N by year either species

Ontogenetic change in body condition

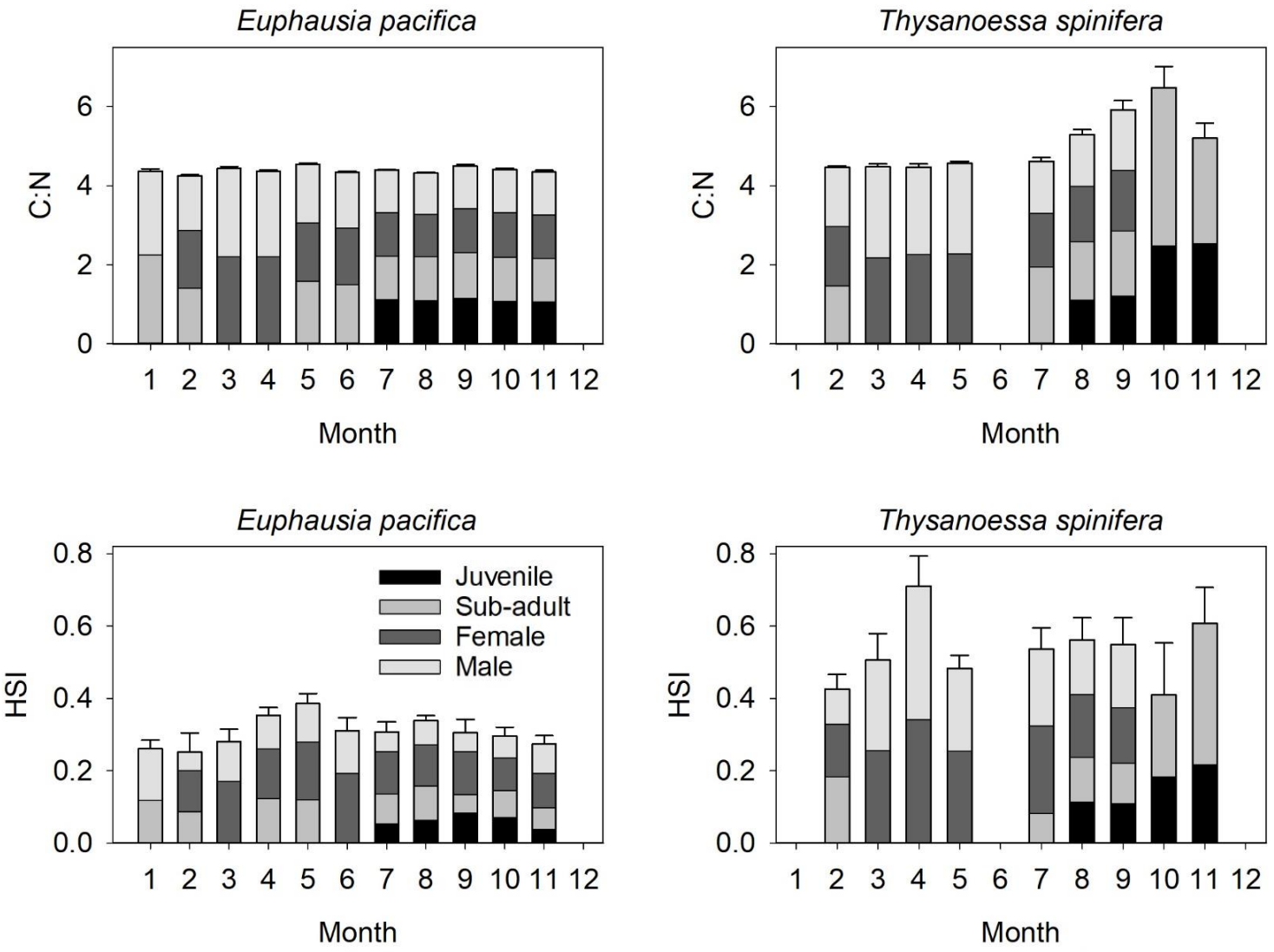




- *T. spinifera* sub-adults higher C:N compared to other life history stages

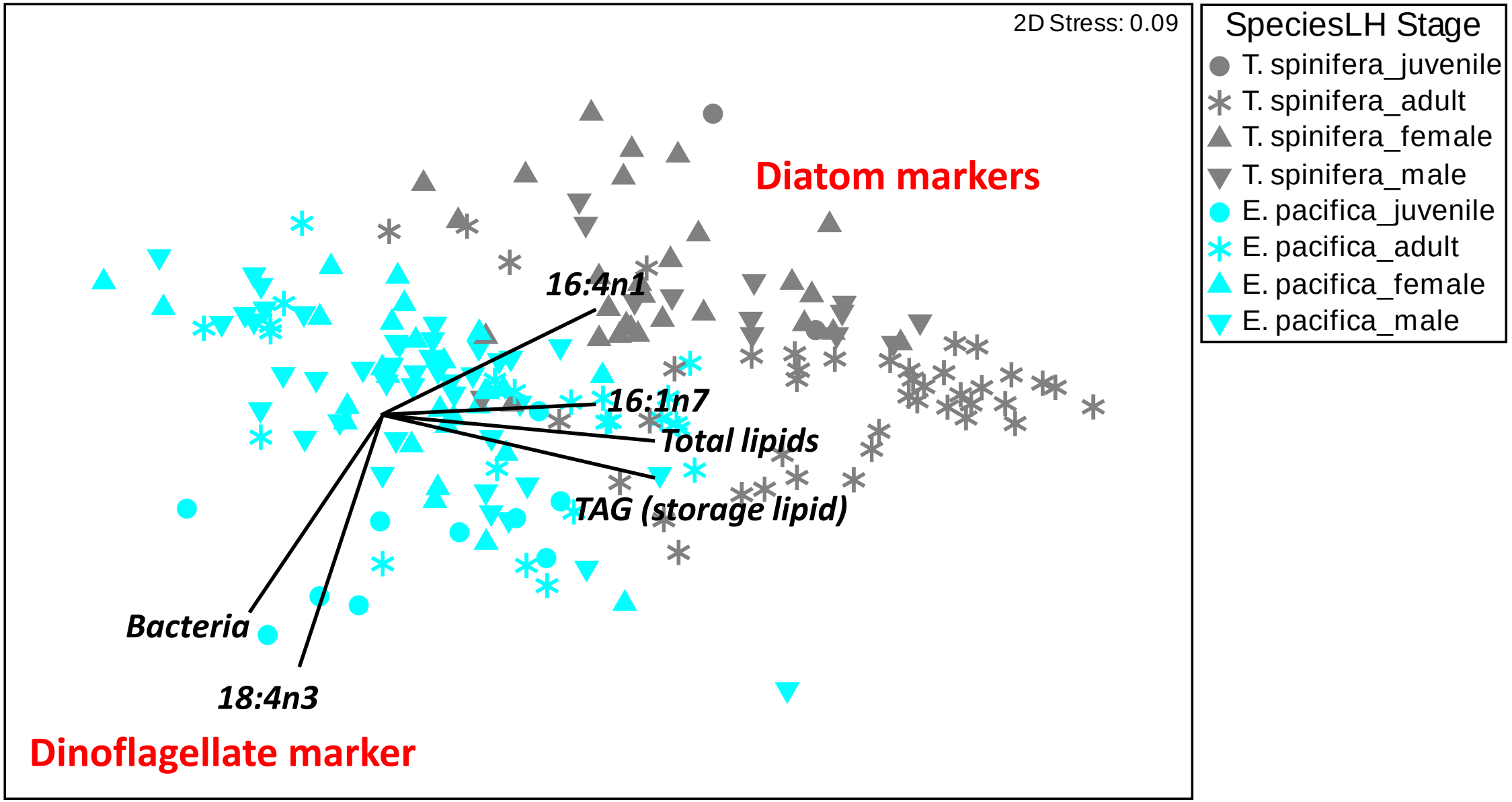
*Juveniles were excluded from statistical analysis due to low sample sizes

Seasonal change in C:N and HSI

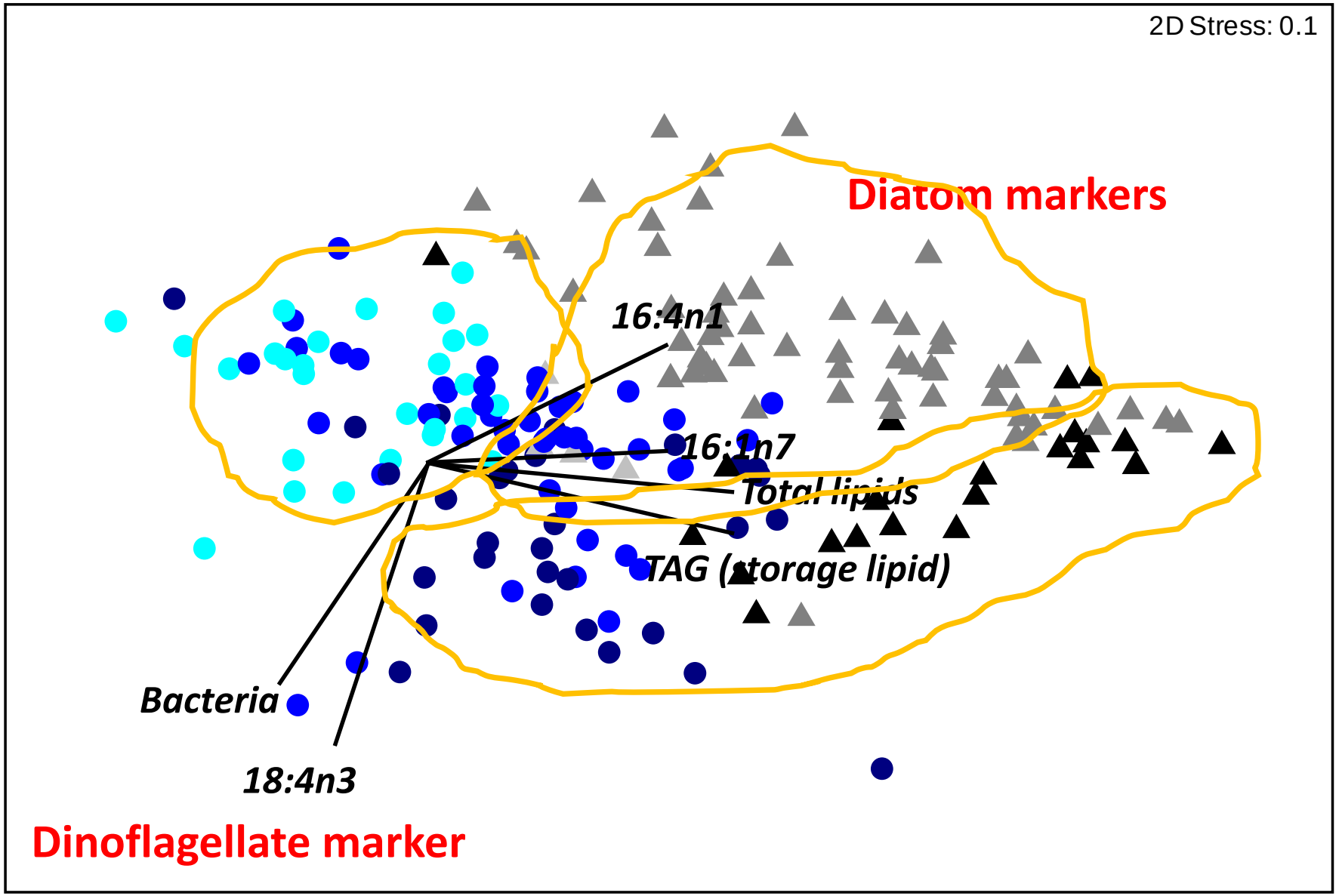


- Little change in C:N for *E. pacifica*
- C:N highest in *T. spinifera* in the Fall wen sub-adults were present
- HSI peaks for both species in the spring

Lipid and fatty acid classes by species and life history stage



Lipid and fatty acid classes by species and upwelling cycle



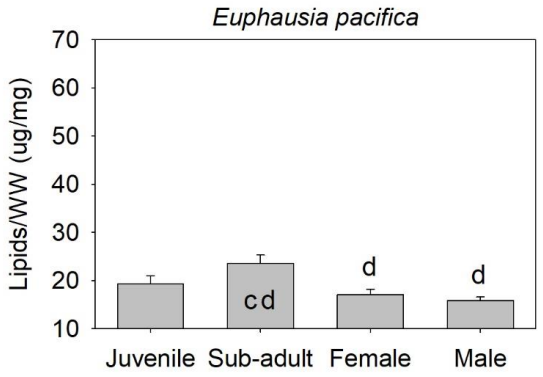
SpeciesUpwelling status
- T. spinifera_Pre-Upwelling
- T. spinifera_Upwelling
- T. spinifera_Post-upwelling
- E. pacifica_Pre-Upwelling
- E. pacifica_Upwelling
- E. pacifica_Post-upwelling

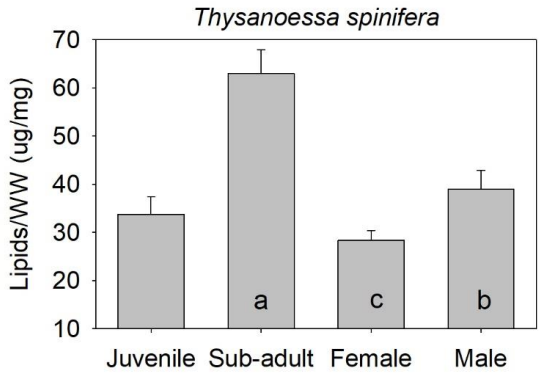
Pre-upwelling
↓ lipids

Upwelling
↑ lipids
↑ TAG (storage lipid)
↑ diatom

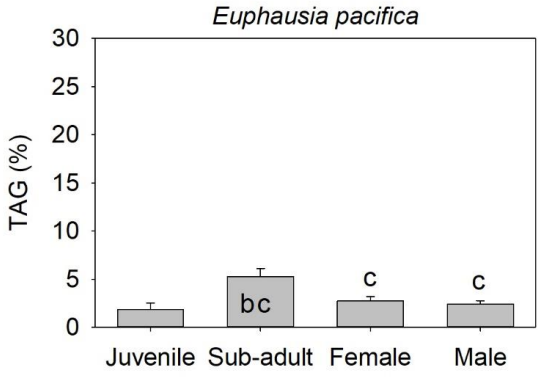
Post-upwelling
↑ dinoflagellate
↑ bacteria

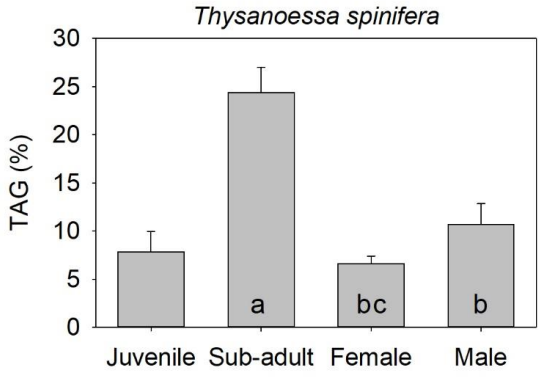
Lipid and FA differences by species and life history stage





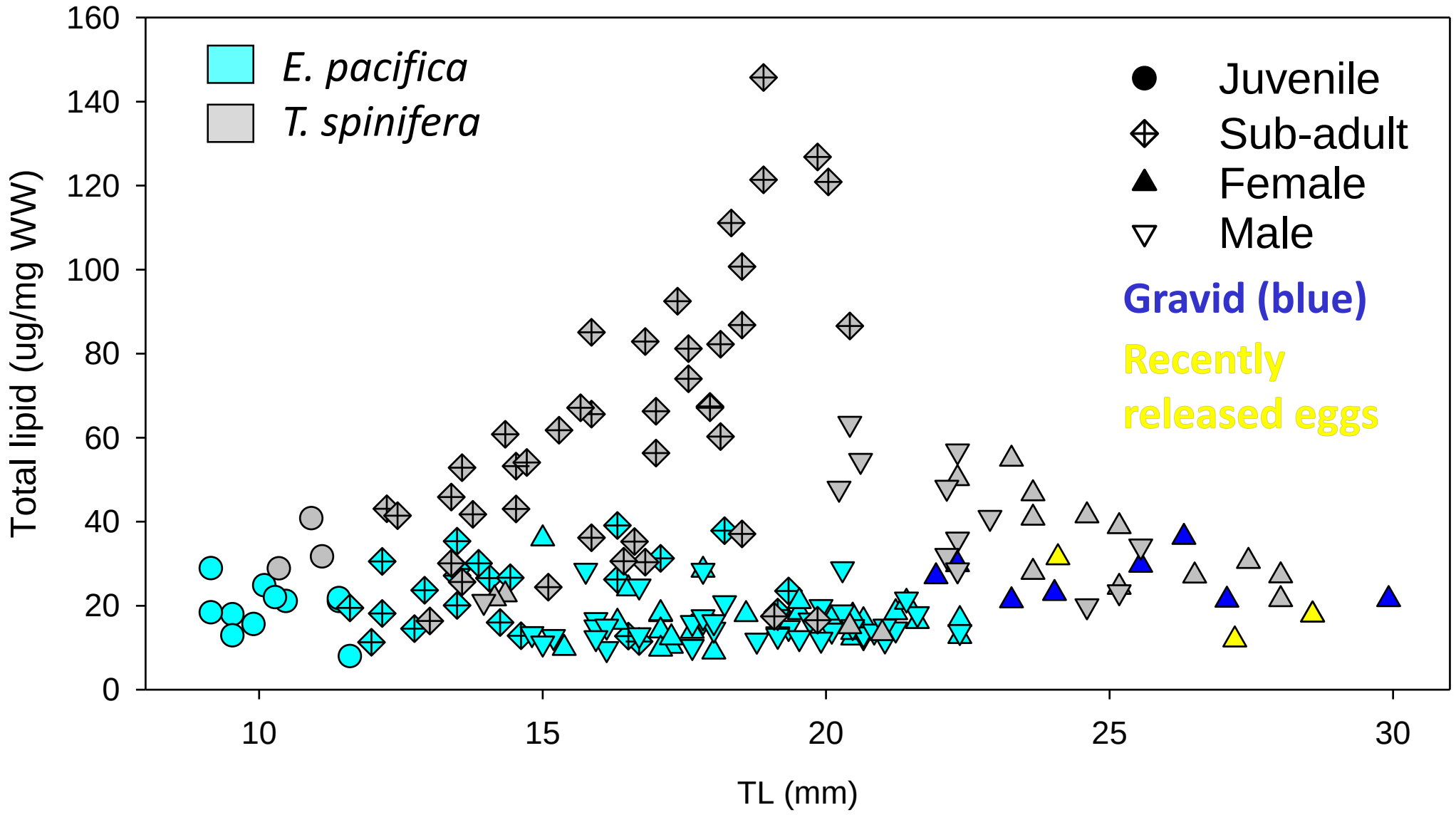
Total lipids





Triacylglycerols (TAG) (storage lipids)

Total lipid density by species and length



Summary

- *T. spinifera* had a higher C:N, total lipids, and proportions of storage lipids (TAG)
  *Higher energetic value for predators

- The lipid and FA profile of both species differed, but they both followed the seasonal progression of the upwelling cycle

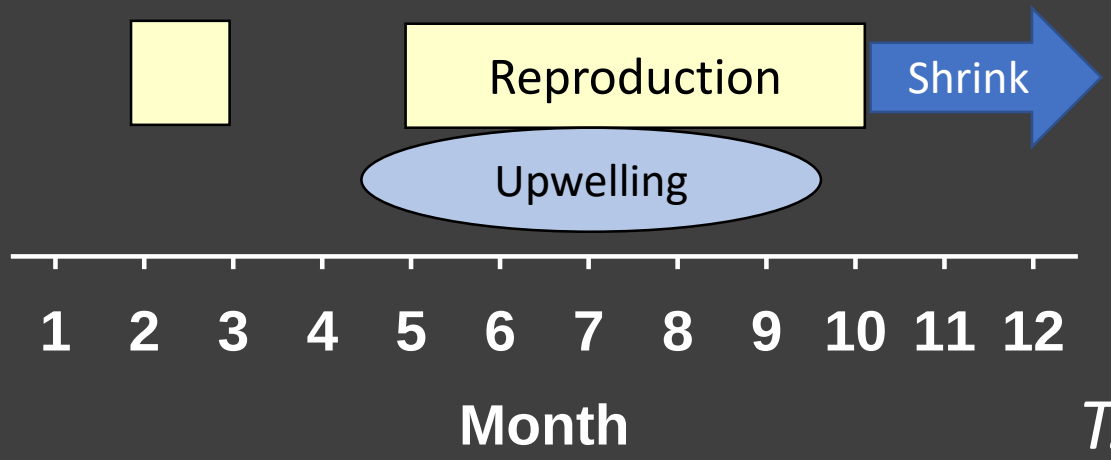
- The highest C:N and lipid occurred in non-reproductive *T. spinifera* from August to October

Thysanoessa spinifera

Euphausia pacifica

Seasonal cycle of reproduction

Euphausia pacifica




Thysanoessa spinifera

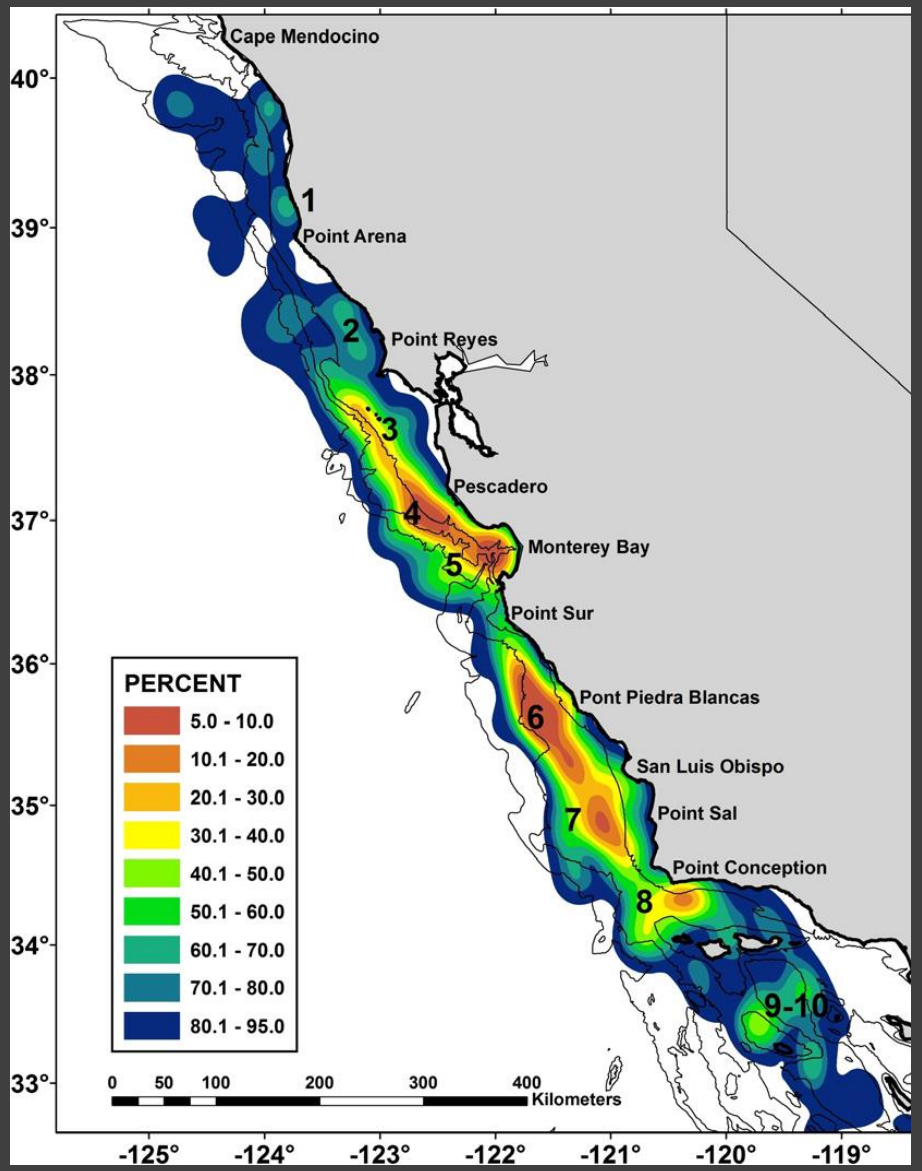
Krill known to store lipids as overwintering strategy

T. spinifera are likely storing lipids in the Fall for overwintering


Euphausia pacifica

Feinberg and Peterson 2003, Feinberg et al. 2010, CT Shaw unpublished data

Implications to higher trophic levels



Santora et al. 2011- Prog. Oc.

Thysanoessa spinifera

Localized hotspots might have different bioenergetics for predators

Euphausia pacifica

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