Understanding the Nutritional Status, Diet, and Demographic Structure of *Euphausia pacifica* through Multiple Organic Markers

Se-Jong Ju[1], H. Rodger Harvey[1], William T. Peterson[2], Leah Feinberg[2], Tracy Shaw[2]

[1]Chesapeake Biological Lab., UMCES, Solomons, MD 20688, USA
[2]NMFS, Hatfield Marine Science Center, Newport, OR 97365, USA

Funded by NOAA and NSF through NEP-GLOBEC

Background

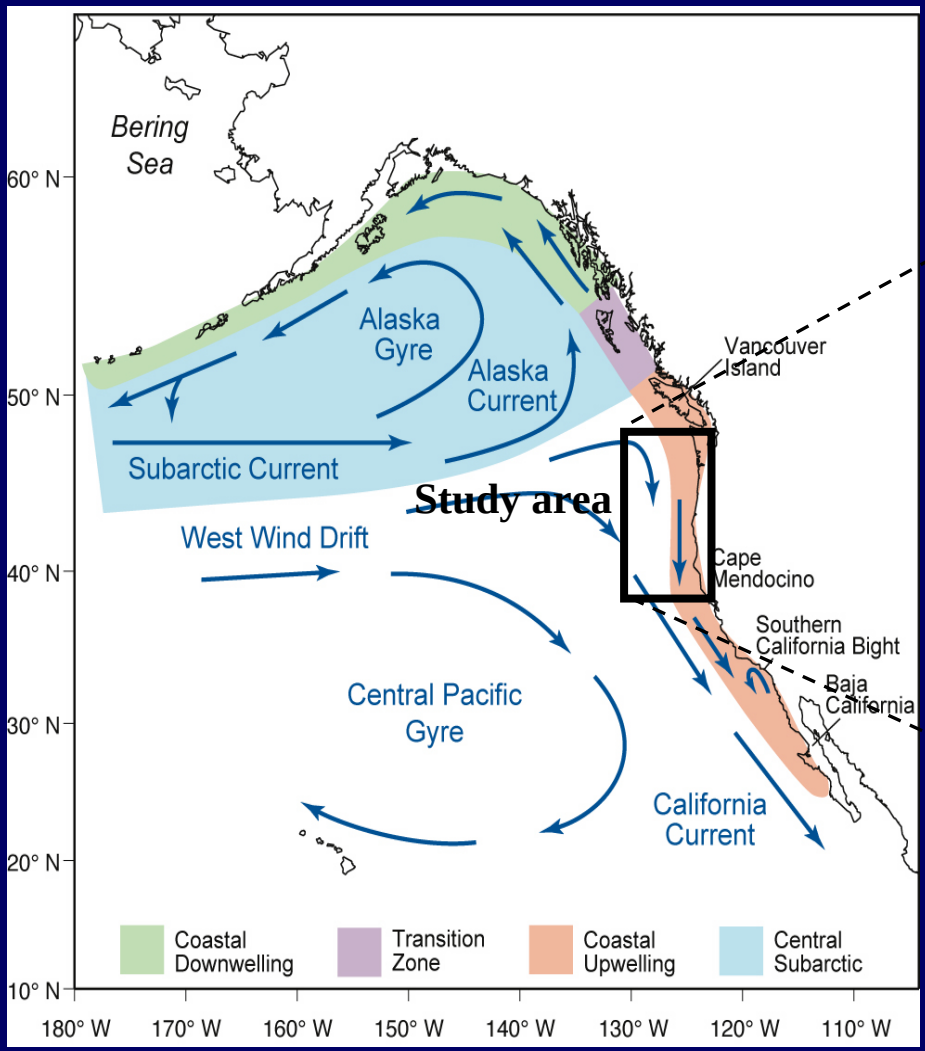
- Euphausiids (krill) - significant roles through the marine ecosystem as links between primary producers and top predators.
- In the Northeast Pacific Ocean region, krill populations are significantly affected by climatically-variable physical forcing, especially at large- to meso-scale processes (i.e. upwelling, meso-scale jets and eddies).
- Still poorly understood the biology and population dynamics of krill due to the lack of the information on growth, mortality, longevity, feeding ecology, etc.

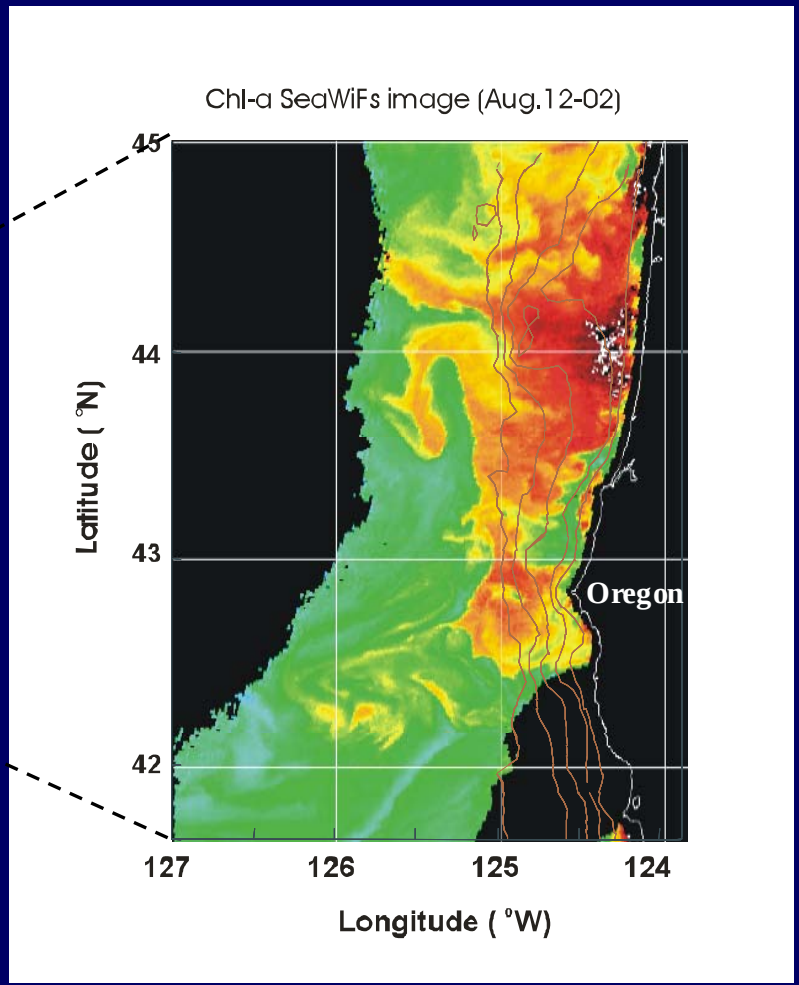
Objectives

I. Understanding the nutritional status and diets of *Euphausia pacifica* within a highly dynamic meso-scale environment (North-East Pacific Ocean) using organic biomarkers.

II. Determination of the demographic structure of *Euphausia pacifica* using the biochemical ageing method (Ju et al. 1999, 2001) for crustacean.

General circulation pattern and Chl-a SeaWiFs image of study area





Analytical procedures

eye & eye-stalk

Seston (GF/F)

Age pigment (Lipofuscin) analysis

Lipid analysis

Extracts

Extracts

Saponification

HPLC

TLC-FID

GC & GC-MS

Lipofuscin index (LF ng/ug protein)

Total Lipid & Class

Fatty acids

Sterols

Demographic structure

Nutritional status

Diets

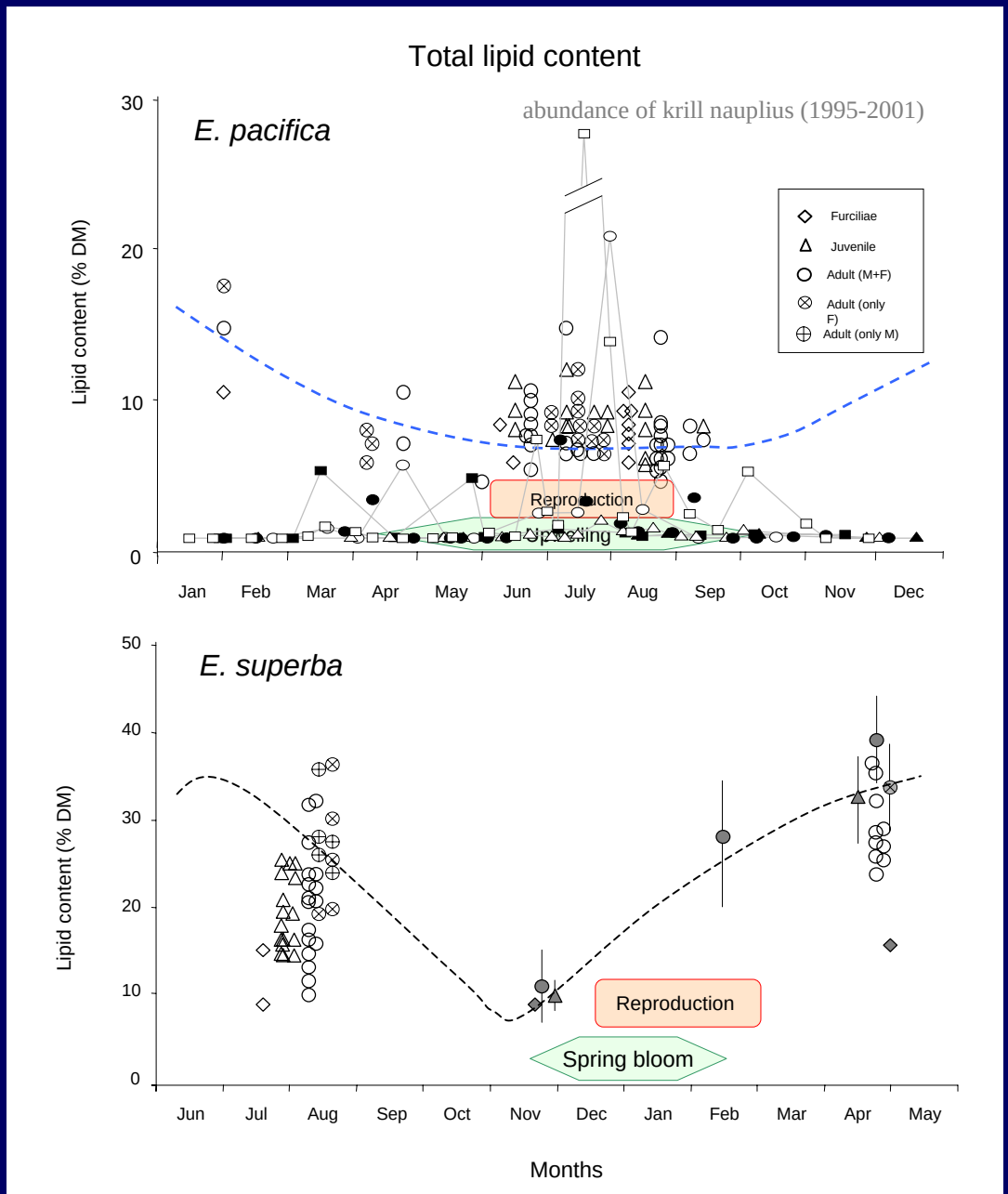
Part I.
Understanding nutritional status and diets of krill using lipid biomarkers.

Results – total lipid content

- Lipid content (10% of dry mass) in *E. pacifica* were significantly lower than other polar relatives (i.e. *E. superba*).

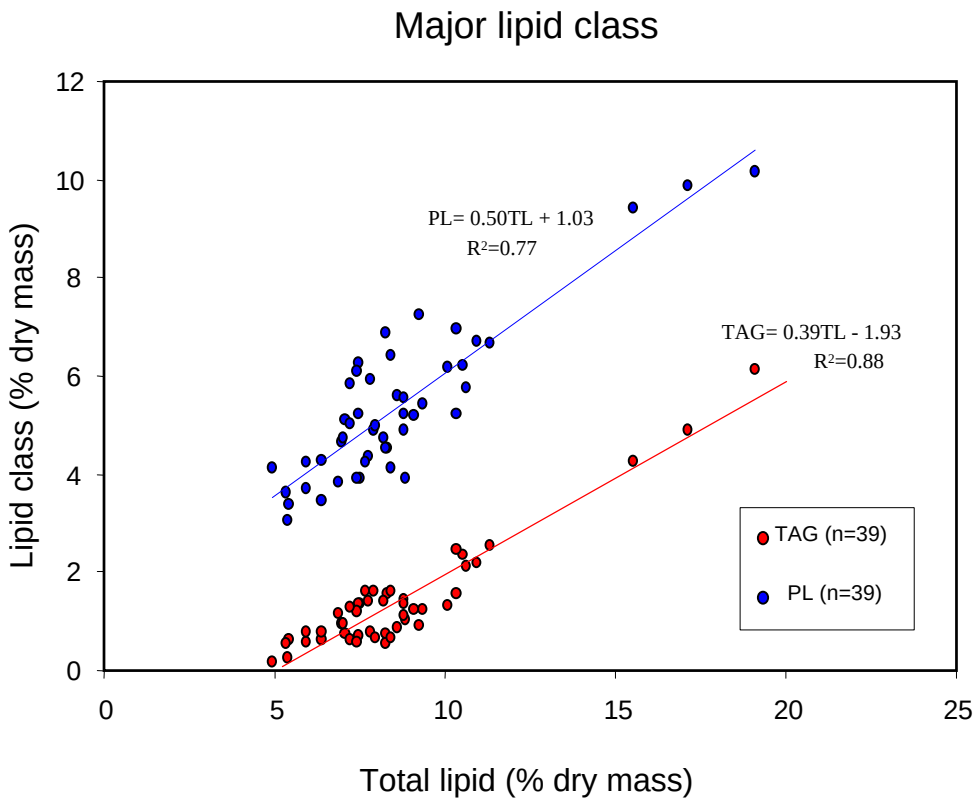
- Ontogenetic differences of lipid levels were not detected.

- Seasonal variation of lipid levels in *E. pacifica* were closely linked with reproduction.

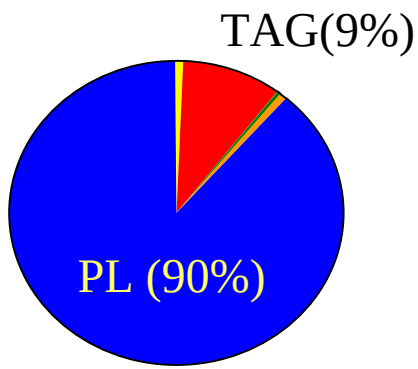


Results – lipid class composition

- Phospholipids (PL) were the dominant lipid class (> 80 % of total).
- Although known as structural lipids, PL seem to be accumulated – energy storage for reproduction (dominant lipid in their egg).

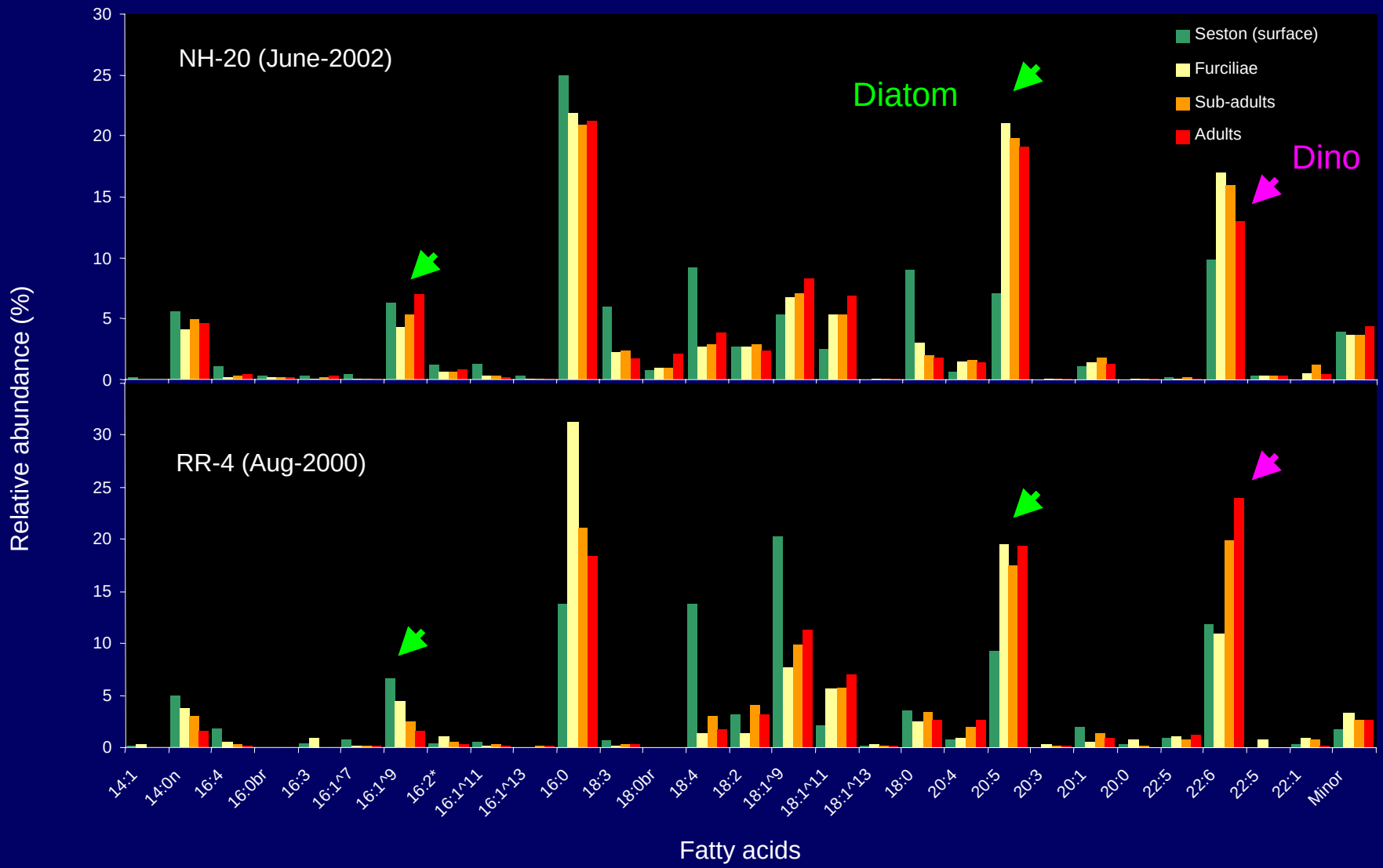


Lipid class composition of *E. pacifica* eggs (early embryonic stage)

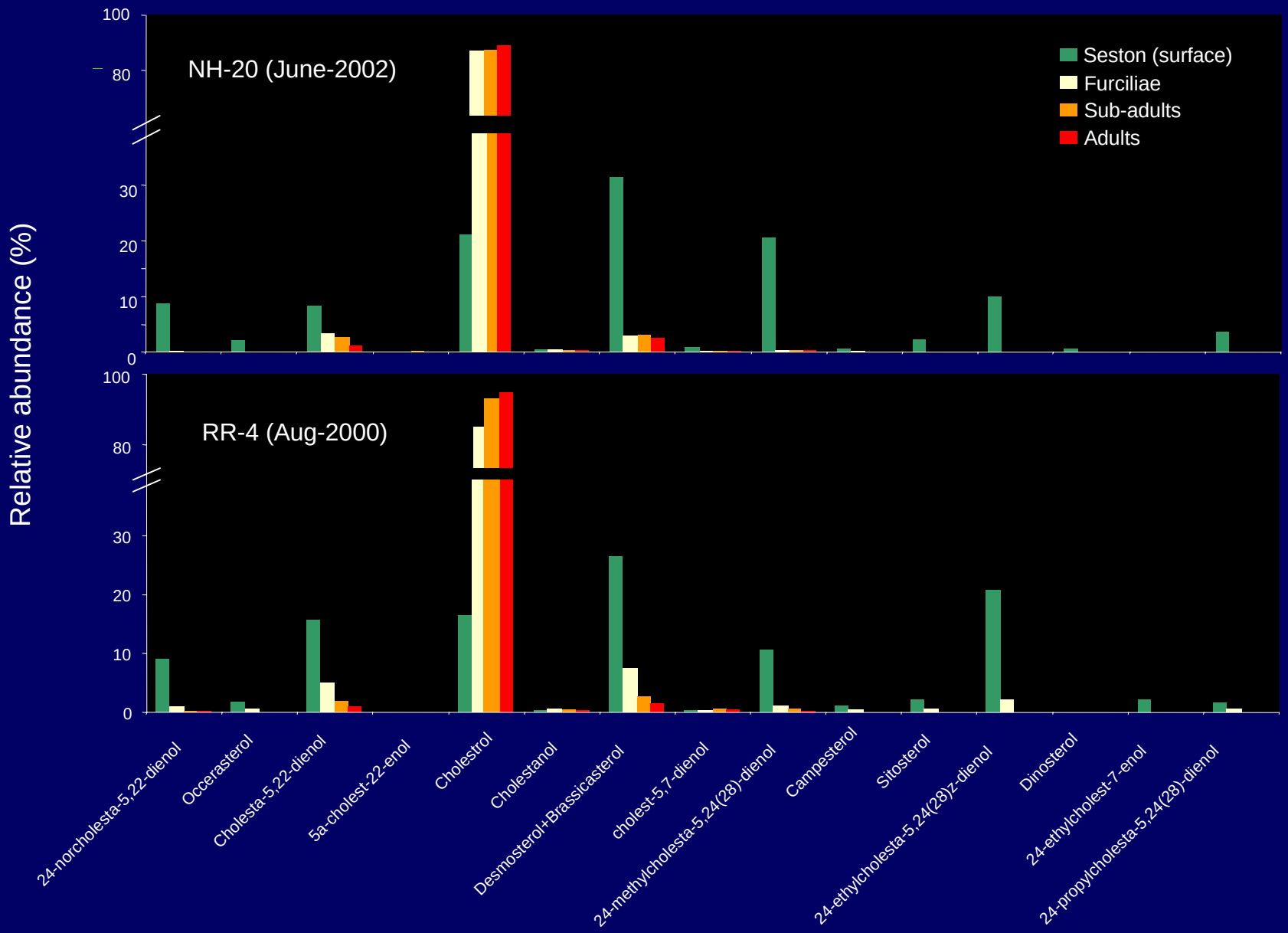


Lipid content = 4.45ug/egg

Results - Fatty acid composition in seston and krill



Sterol composition in seston and krill



Results – trophic lipid biomarkers (fatty acids and sterols)

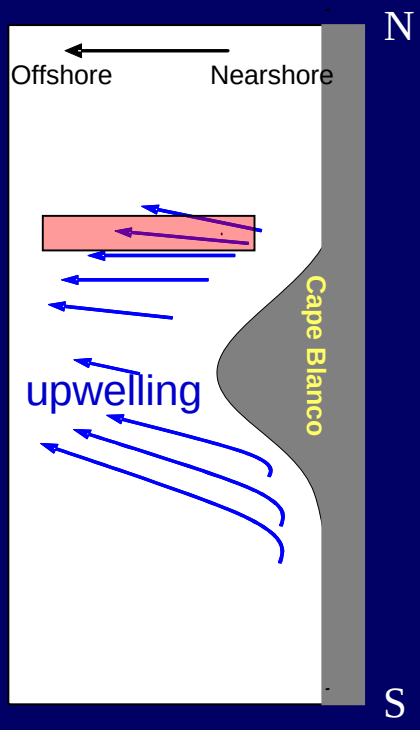
- According to the biomarker distribution, major food source of krill appears to be diatom, which is dominated in upwelling region with minor variability.

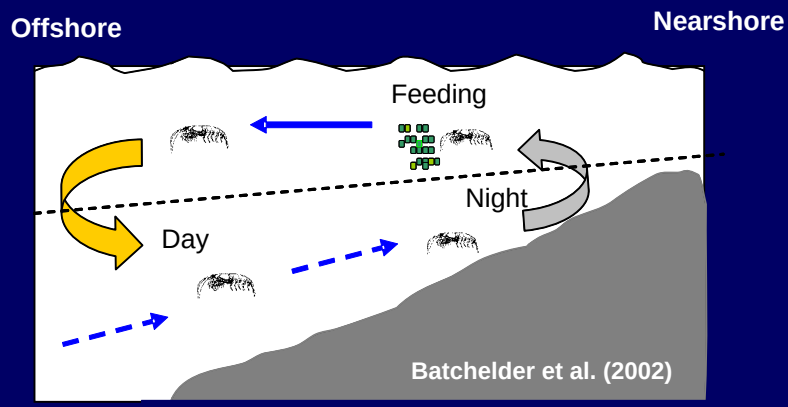
- While lipid biomarkers in adult krill is often similar (despite varied phytoplankton), younger stages (i.e. furcilia) of krill is more variable and likely feed on surface particles: food selectivity (or niches), retention, or/and different turnover rate of lipid.

- Lipid biomarker composition in krill may reflect the coupling of biological (e.g. feeding, vertical migration) and physical processes (e.g. current).

Implication of trophic biomarkers in krill
– understanding the interaction of physical and biological processes

Nearshore retention of sub- and adult krill

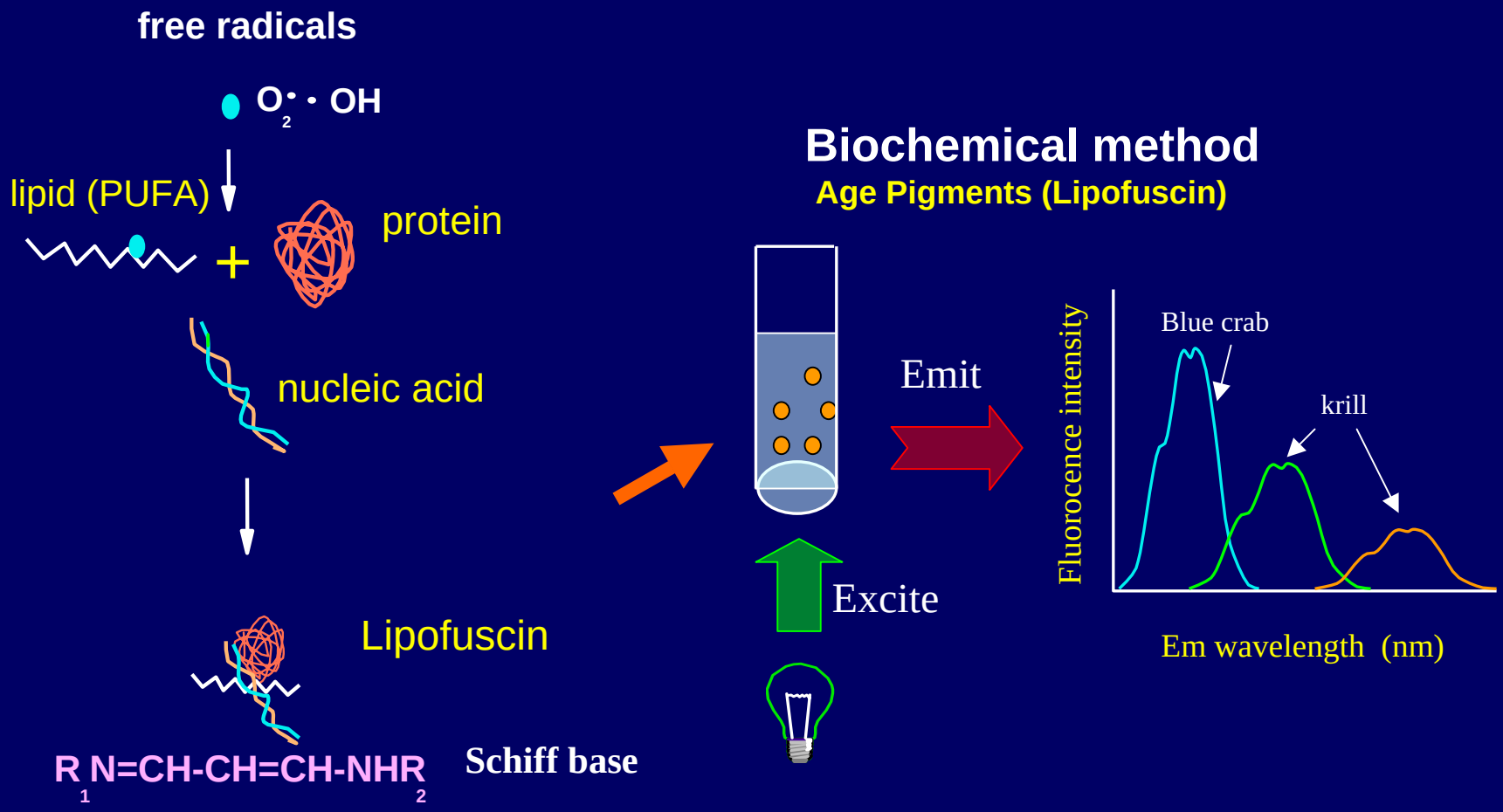




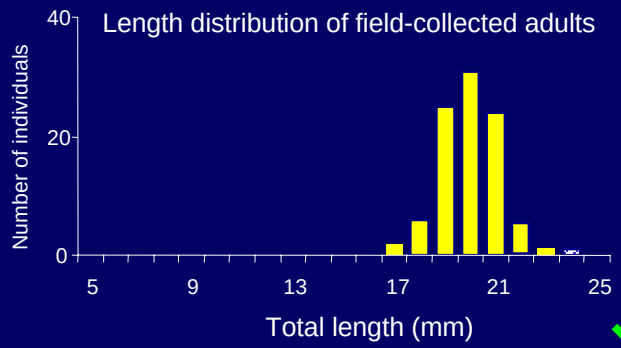
• Juvenile and adult krill retain nearshore (i.e. high produtive region) due to combination of circulation pattern and dial vertical migration but larvae could be advected out from the high productive region (i.e. upwelling region) because they are unable to migrate vertically yet –which could affect the recruitment of *E. pacifica*.

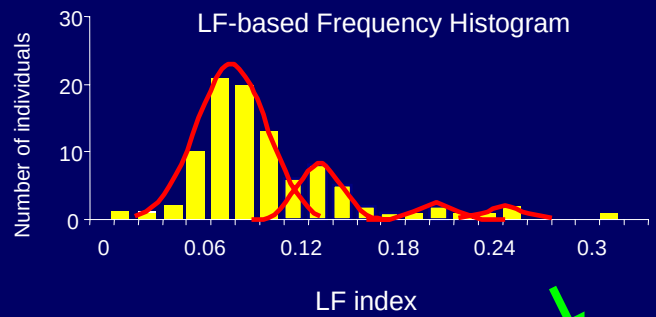
Part II.
Determination of demographic structure of *E. pacifica* using the biochemical age marker

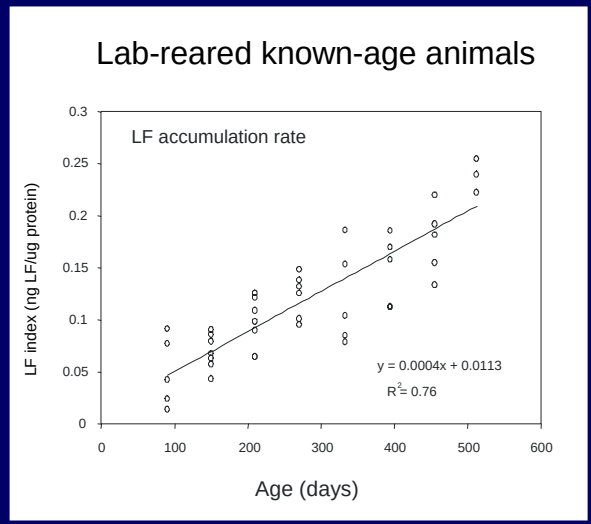
What's the biochemical age marker ?
Age pigments (Lipofuscin)



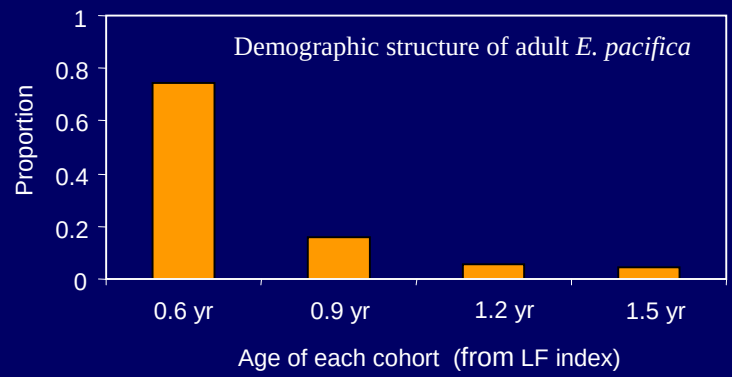
Age determination and field demographics of *E. pacifica*







calibration of age



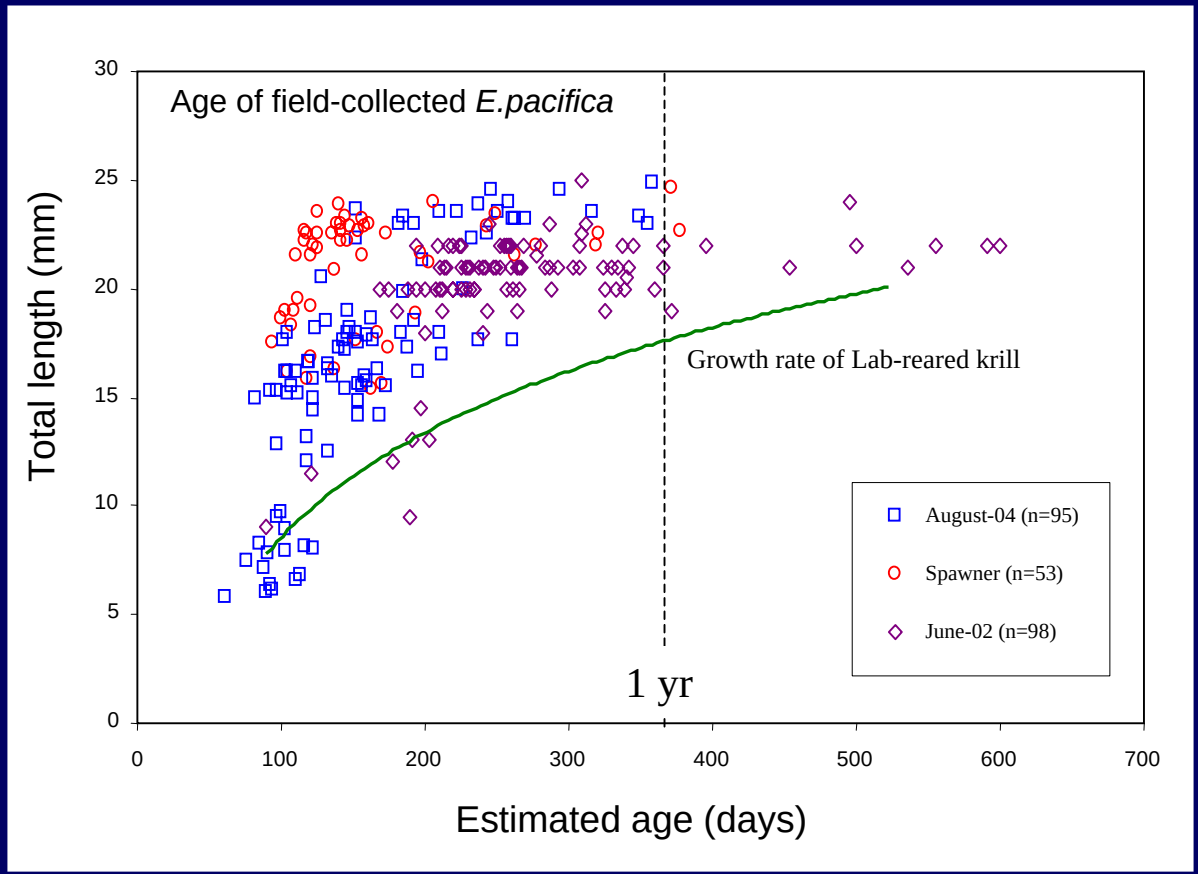
Vital rates
(longevity, growth, mortality, etc.)

Results – age structure of field *E. pacifica*

- Most of sub-adults and adults were older than 100 days and younger than 1 yr.

- The lifespan of *E. pacifica* in Northeast Pacific Ocean may not be longer than 2 yrs with most spawning by younger than 1 yr old females.

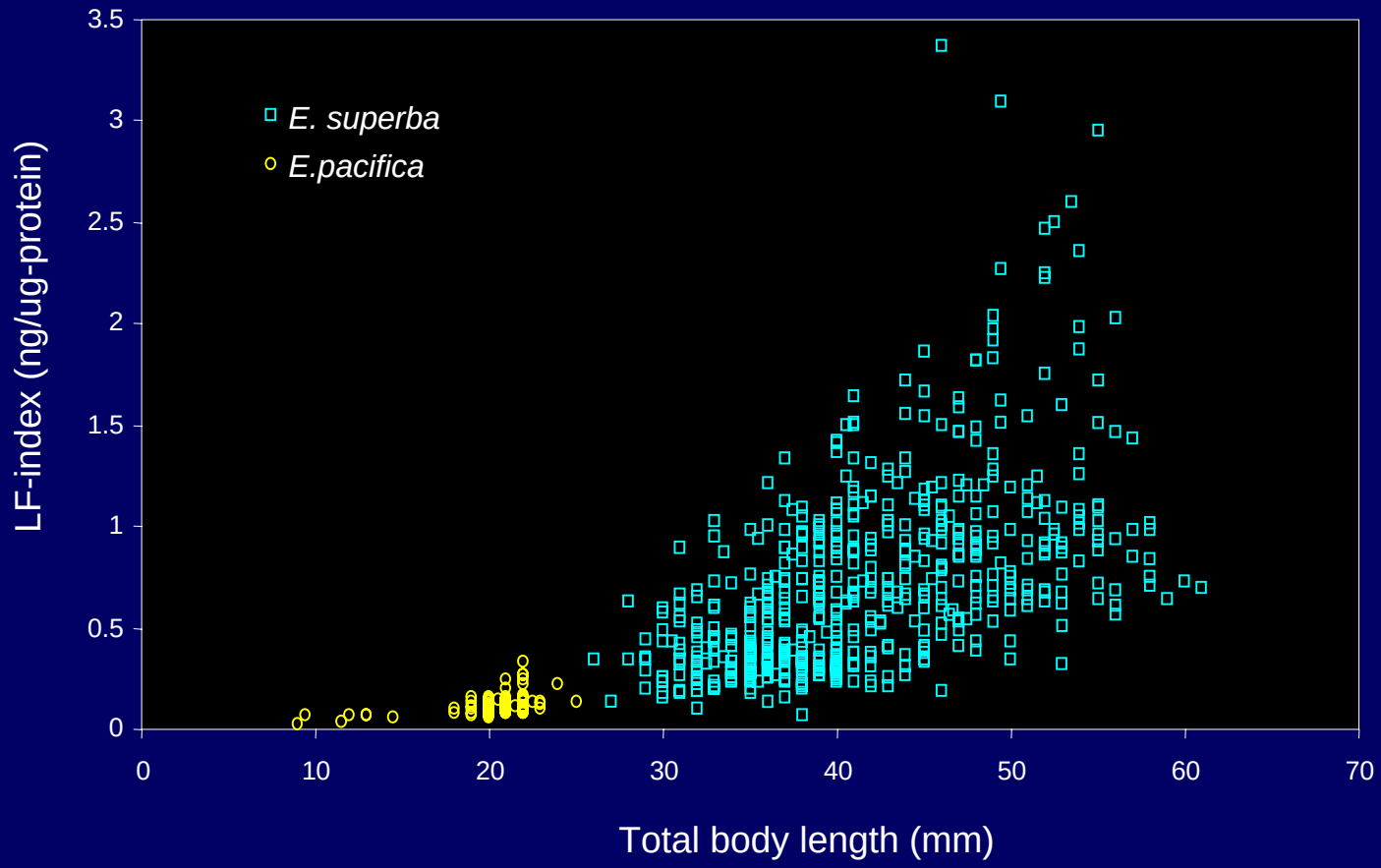
- Growth rate of krill in the field seem to be higher than that estimated from lab experiment.



Comparisons of LF between *E. pacifica* and Antarctic species (*E. superba)*

- Long-lived Antarctic species (*E. superba*) show continued accumulation of LF compared to *E. pacifica.*

- Based on LF accumulation rate of *E. pacifica*, *E. superba* might live up to 8 yrs.



Conclusions

I. Lipid dynamics of the krill are closely linked with their life cycle strategies (i.e. reproduction) and environmental conditions (i.e. food availability).

II. Lipid trophic signatures provide the habitat usage (i.e. food regime) of krill which also may provide the information to understand the physical (i.e. retention and advection) & biological (i.e. vertical migration) interactions.

III. Lipofuscin proved as a marker for age structure of field *E. pacifica* as well as insights on the other vital information, such as growth rate, mortality, longevity (~ 2yrs.) and the timing of spawning (< 1yrs old).

IV. Furthermore, lipofuscin ageing method can apply to other krill species and may provide a broad application to diverse populations.

Thank you! I am enjoying to be here.