Fatty Acids of Zooplankton of 34 to 22 °S

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National Research FLAGSHIPS Wealth from Oceans

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Aims

- examine the variability in zooplankton feeding from south to north off Western Australia in three water masses: inshore of Leeuwin Current, in Leeuwin Current and offshore of Leeuwin Current

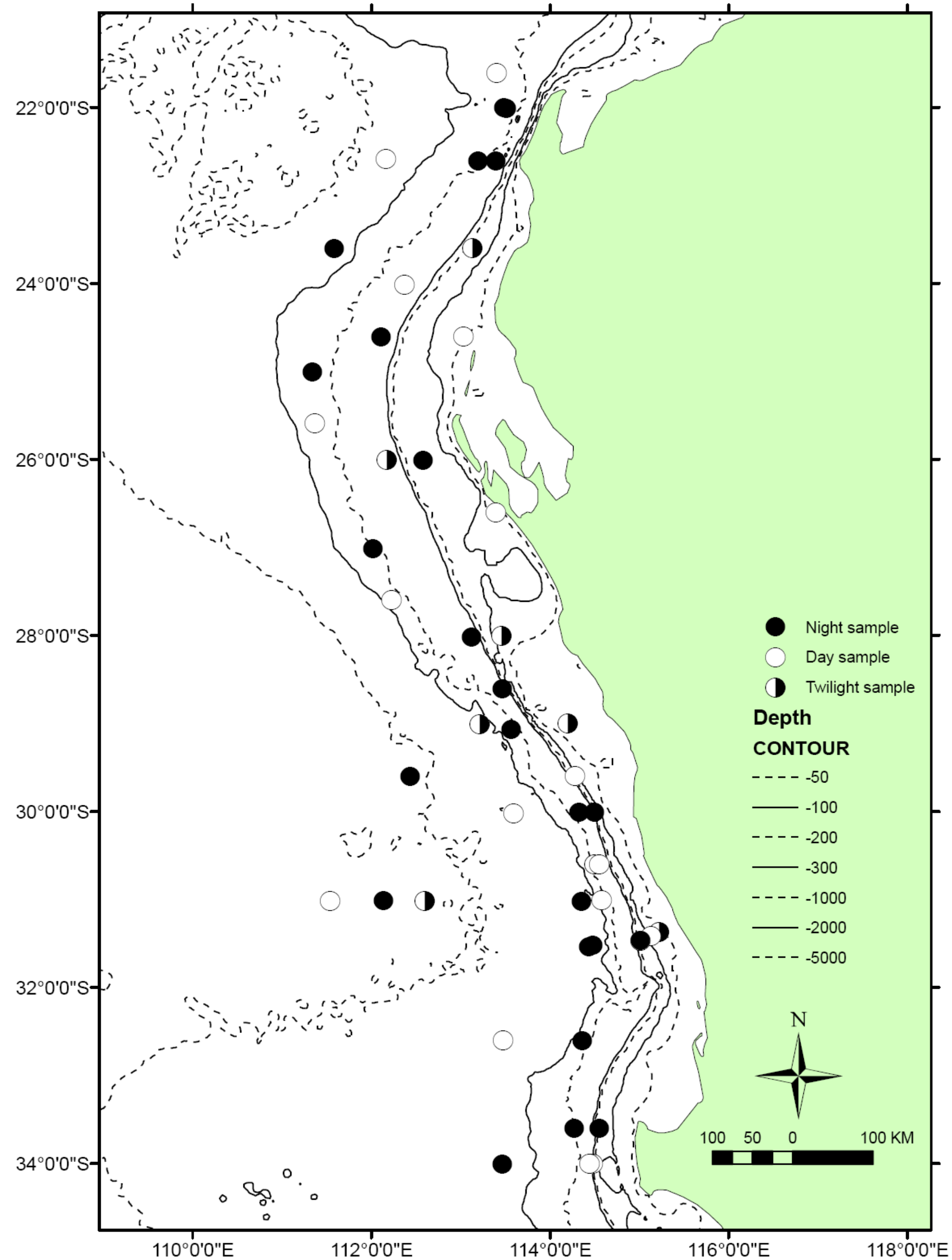
  zooplankton: a key trophic link in marine ecosystem and an important mediator of carbon flux; uses a wide range of prey including phytoplankton, microzooplankton, bacteria and marine snow.

- unveil information about the potential of food quality to higher trophic levels

Hypotheses:

- Zooplankton from coastal waters will have higher % of diatom FA

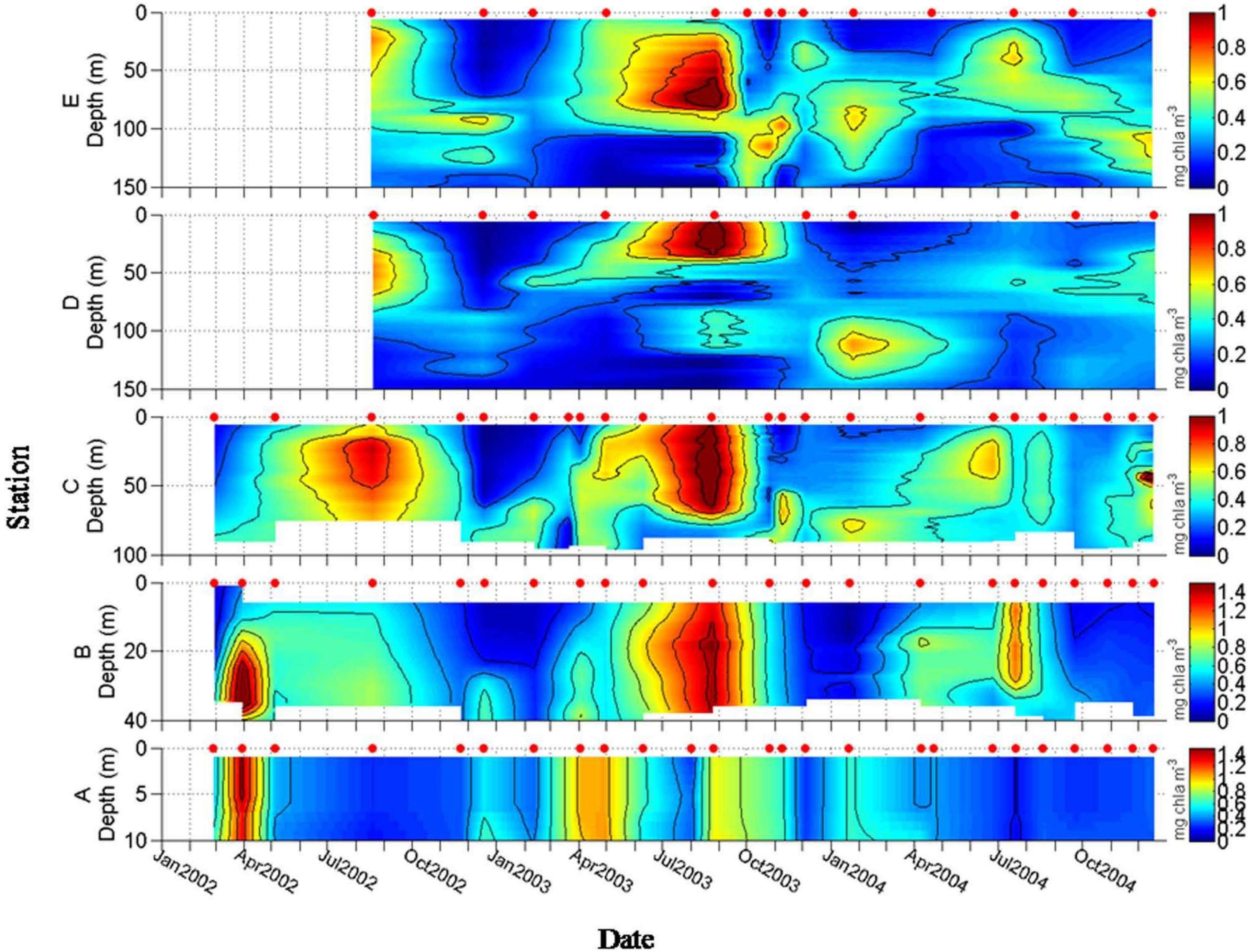
- Zooplankton from oceanic waters will have higher % of FA associated with small phytoplankton and higher carnivory/omnivory markers



Zooplankton sampling stations

Mid May – early June 2007

Timing of the cruise was linked to seasonal chlorophyll dynamics



Summer:
low chl,
deep chl max

Autumn/winter:
chl shoals
& blooms

Koslow, J A *et al* (2008), The effect of the Leeuwin Current on phytoplankton biomass and production off Southwestern Australia, *J. Geophys. Res*., *113,*

Zooplankton sampling

- Bongo nets
  - 355 and 100 µm mesh nets
  - ~ 150 m^3 of water filtered
  - Oblique tows to 150 m (or maximum depth of the station)

  - Mesozooplankton size fractionated and frozen immediately after collection. Fatty acids are a mixture of fatty acids from the food in the guts and fatty acids assimilated into the mesozooplankton body tissues.

Fatty acids as trophic biomarkers.

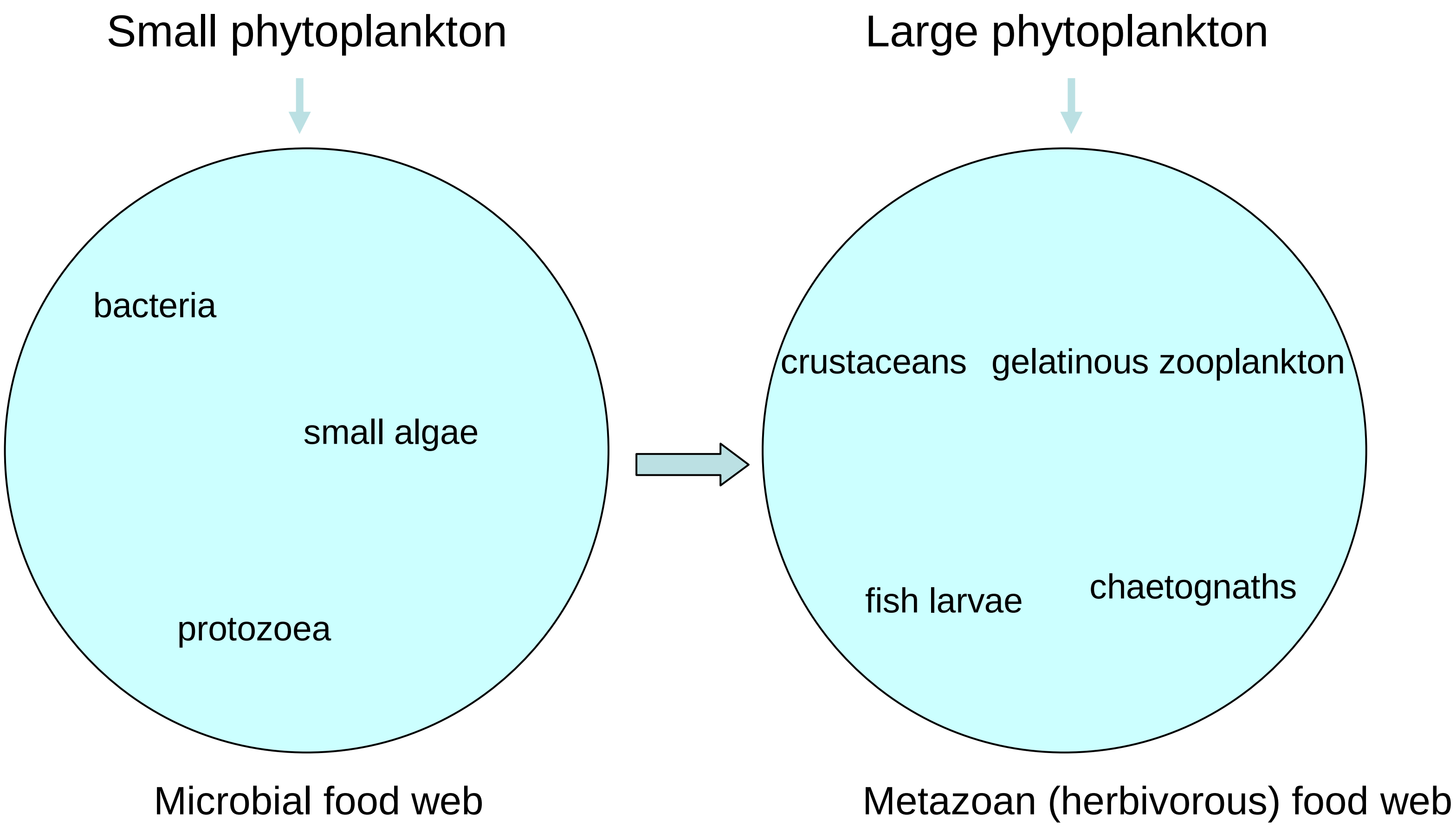
- Phytoplankton, microzooplankton and bacteria all produce taxon-specific fatty acids which are retained by their predators.
- Feeding experiments (early 1970s) have verified that dietary fatty acids are transferred largely unmodified from phytoplankton to zooplankton
- Fatty acid signature analysis has been used for many years to study marine food webs

Advantage of fatty acids

- Gut content analyses provide a snapshot clues but lipid data integrate dietary information over a time scale of several weeks to months
- Some food items in gut can not be identified

Pelagic food webs

Size of phytoplankton determines type of food web:



- Microbial food web supports the metazoan food web
- Metazoans graze phytoplankton, flagellates and ciliates $\geq$ 5 µm
- In oligotrophic oceans main trophic links to the metazoa is via protozoea

Herbivorous food web

Usually large diatoms

Efficient transfer of energy to higher trophic level

Microbial food web

Usually flagellates

Dinoflagellates 2 to 6 x more proteins & calories than diatoms Growth and production of copepods increased

Protist → trophic upgrading (18:3 n-3… →LC n-3 EPA & DHA

Diatoms vs dinoflagellates food web

- → 16:1 n-7/16:0 ≥ 1
- → 20:5 n-3 high
- → ∑C16/ ∑C18 high
- → EPA (20:5 n-3)/DHA (22:6 n-3) high

Herbivorous diet

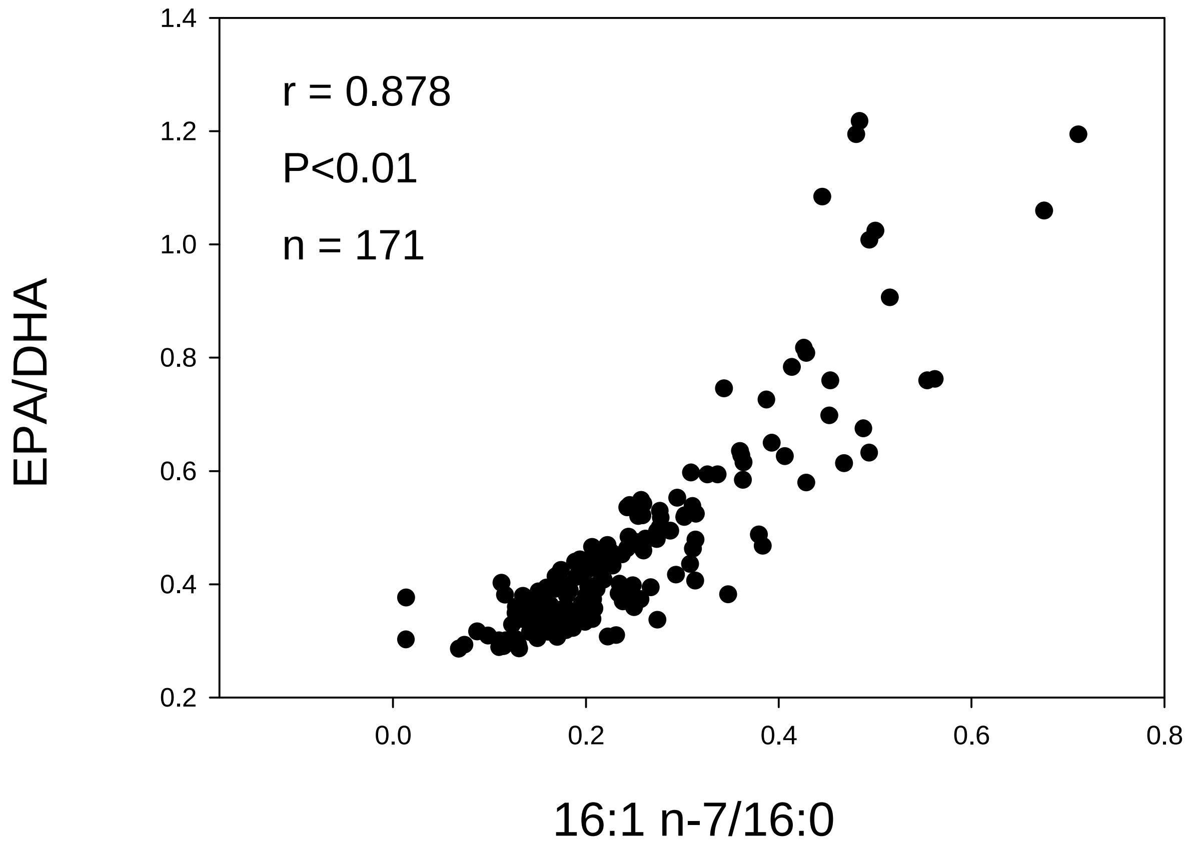
- → n-3/n-6PUFA high
- → 16:1 n-7/16:0 >1
- → PUFA higher (not always)
- → 20:1n-9 & 22:1 n-11 higher
- → 18:1n-9 lower
- → 18:4 n-3 high

Omnivorous diet

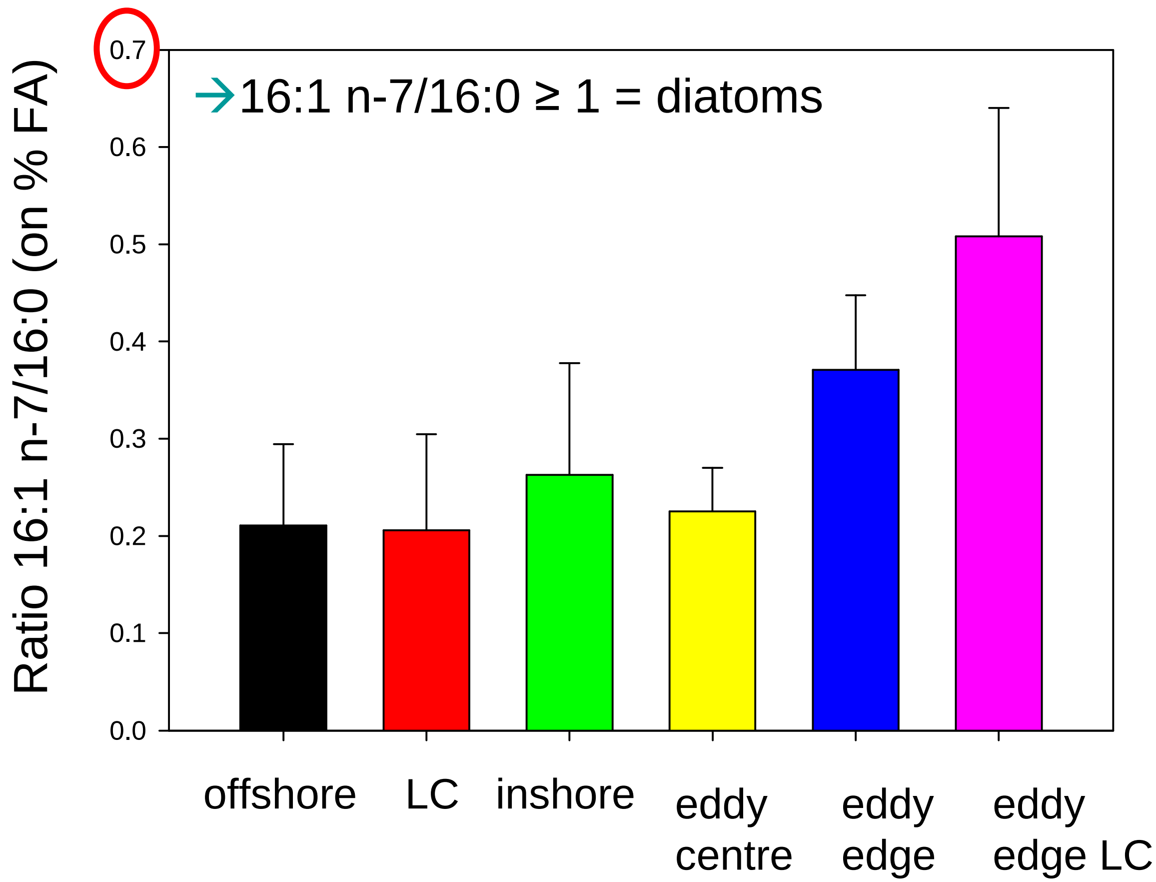
- →18:1 n-9/18:1n-7 high
- →PUFA/SFA high (not always)
- →DHA/EPA high

Degree of correlation r = Pearson's product movement correlation coefficient

Between diatoms and dinoflagellates markers



Diatoms vs dinoflagellate food web

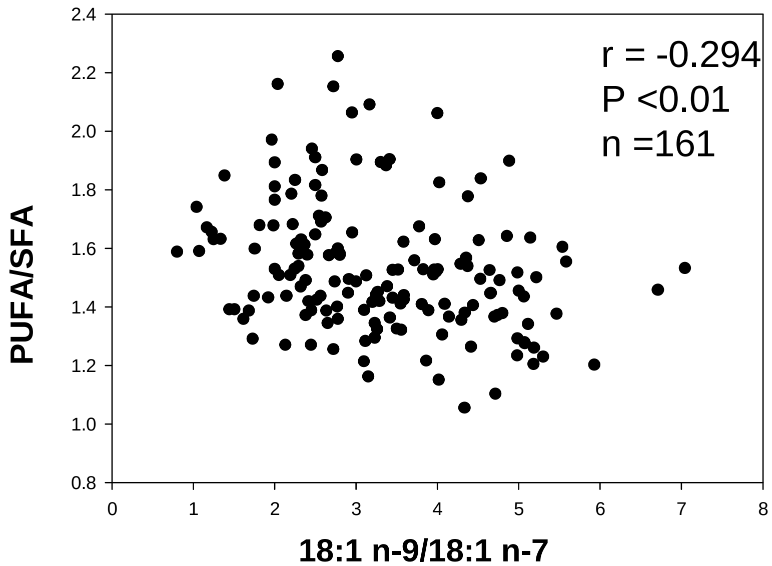


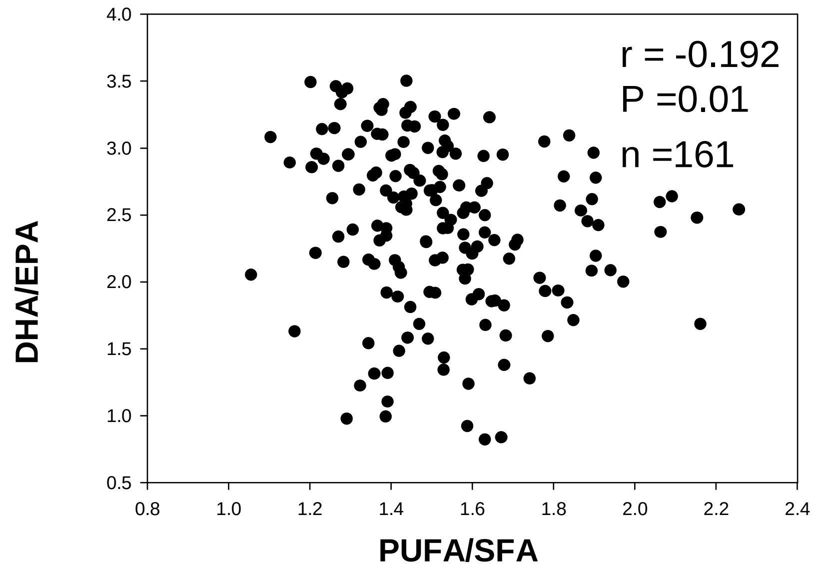
Hypothesis 1.

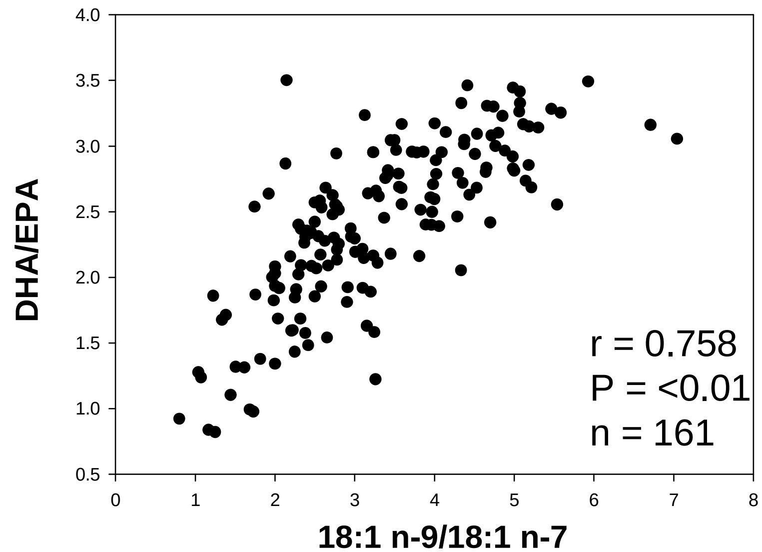
We found no difference between inshore and offshore or LC water masses in diatom food web markers in zooplankton (Mann Whitney P = 0.9)

Dinoflagellate food web dominated off WA in May/June 07

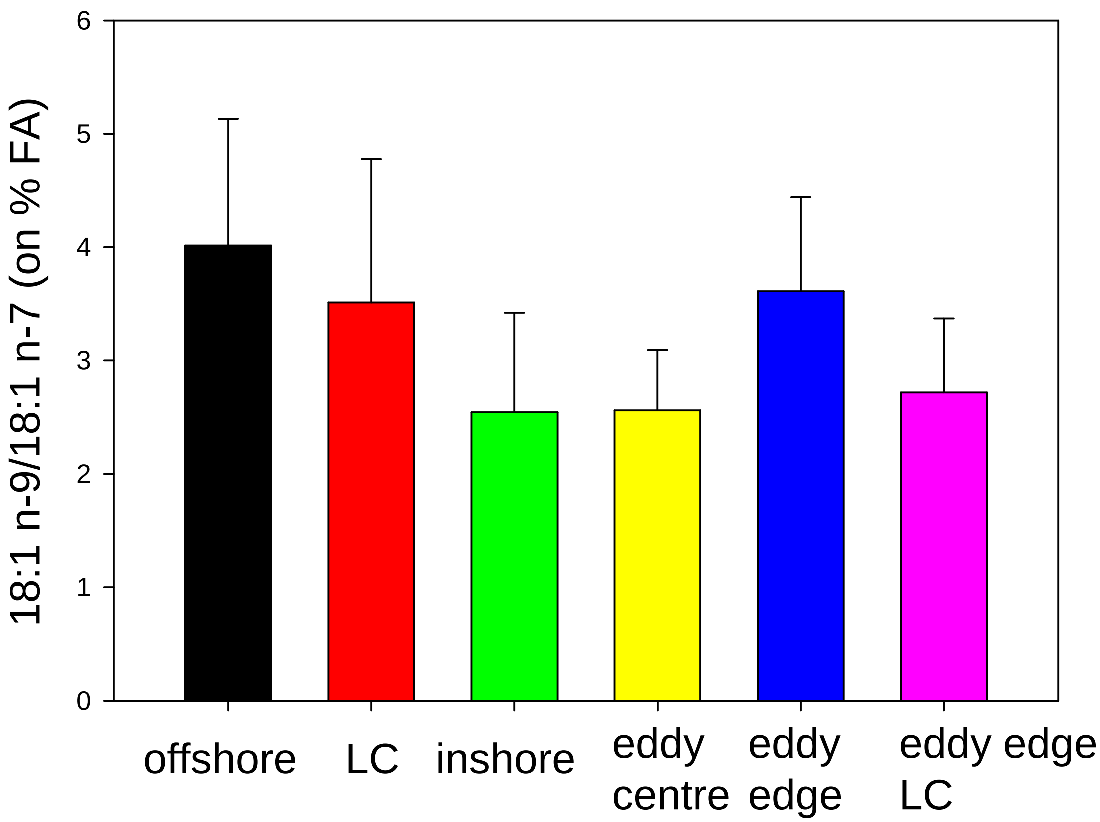
Degree of correlation r = Pearson's product movement correlation coefficient between omnivory markers







Degree of omnivory

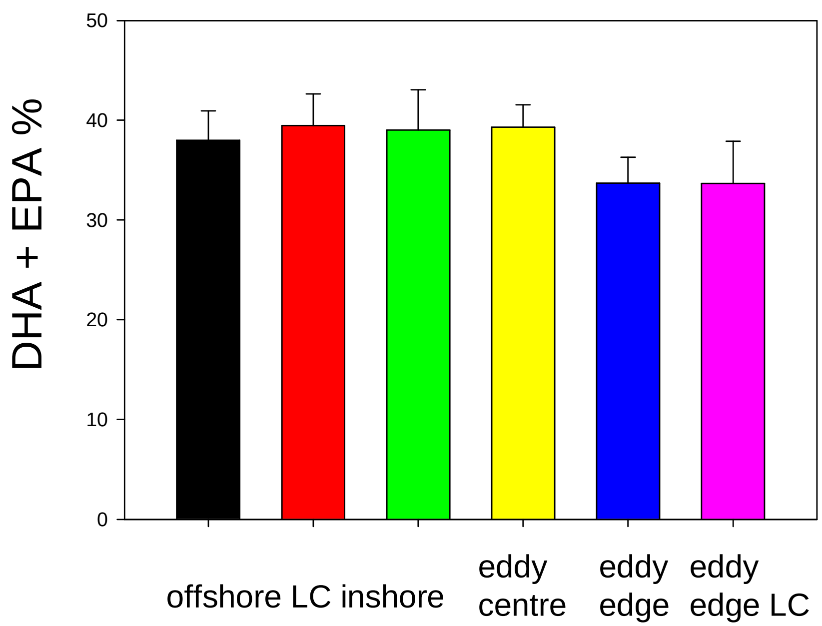


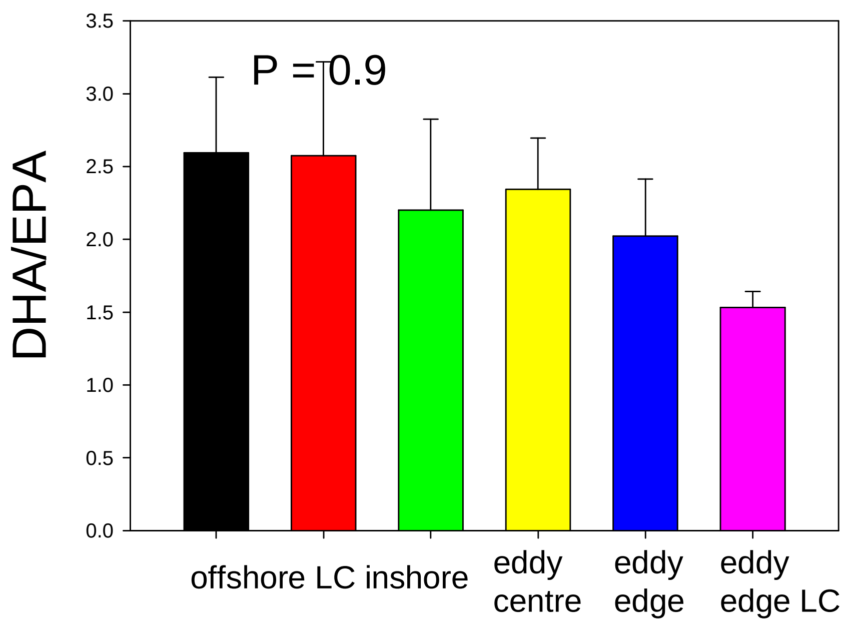
Hypothesis 2: higher degree of omnivory in oceanic waters comparing to LC and inshore

There is a trend of increased omnivory index from offshore to inshore but there is no statistical difference in degree of omnivory among water masses (Kruskal-Wallis P = 0.8)

Fish

- EPA & DHA important
- Fish can't convert short FA to EPA and DHA
- Lack of EPA and DHA= lower recruitment
- High DHA/EPA is critical for growth and development (neural, eyes) of larval and juvenile fish





Based on % data we do not know if these environments have sufficient amounts of FA or not – we need to consider also the pool of FA.

Fatty acids as trophic markers

- Provided information
  - on the dietary composition and trophic relationships of zooplankton of WA and defined the type of the pelagic food web
  - on food available to higher trophic levels allowing prediction of recruitment success and survival
- Longer time series would describe seasonality of fatty acids, match-mismatch in predator/prey that can occur when climate changes

Acknowledgements:

- Master and crew of Southern Surveyor
- Participants: especially for bucketing of 100’s of L of water
- Dirk Slawinski: for the map of the locations of Bongo tows
- Peter Nichols group for numerous references to fatty acid work