Abalone diet: six-pack slimming reds or hip-fattening brown algae?

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Guest MA, Nichols P, Frusher SD, Hirst AJ (2008)

Marine Ecology, 153: 579-588.

UTAS

CSIRO

Background

- *Haliotis* species: world wide distribution
- Commercially valuable (TAS: $120m/y)
- Diet of wild-caught adult abalone unresolved
- Northern hemisphere: brown algae
- Southern hemisphere: red or brown?

Background

Southern hemisphere:

- Feeding preference trials – red algae (Shepherd & Steinberg 2002)
- Gut content analysis – brown algae (Wells & Keesing 1989)

BUT

Background

- High polyphenolic content of brown algae in southern hemisphere (Steinberg 1989)

AND

- Slow digestion of brown algae- gut content analysis overestimates brown algae contribution

- Discourages the idea that brown algae may be a major contributor to abalone diet

Chemical tracers

- Offer resolution to red vs brown question
- Advantage over gut content analysis: assimilation instead of ingestion
- Integrated record of diet

- Stable isotopes of carbon and nitrogen
- Fatty acid analyses

Chemical tracers

Stable isotopes

- Elements with a rare and common isotope (e.g. $^{13}C/^{12}C$)
- Primary producers have different ratios of the rare to common isotope
- Consumers take on the signature of their food source
- Can tell what plants are at the base of a consumer diet

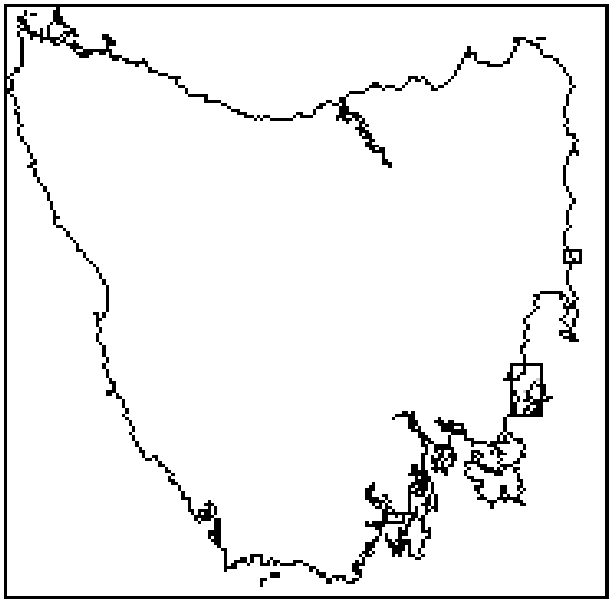
Chemical tracers

Fatty acids

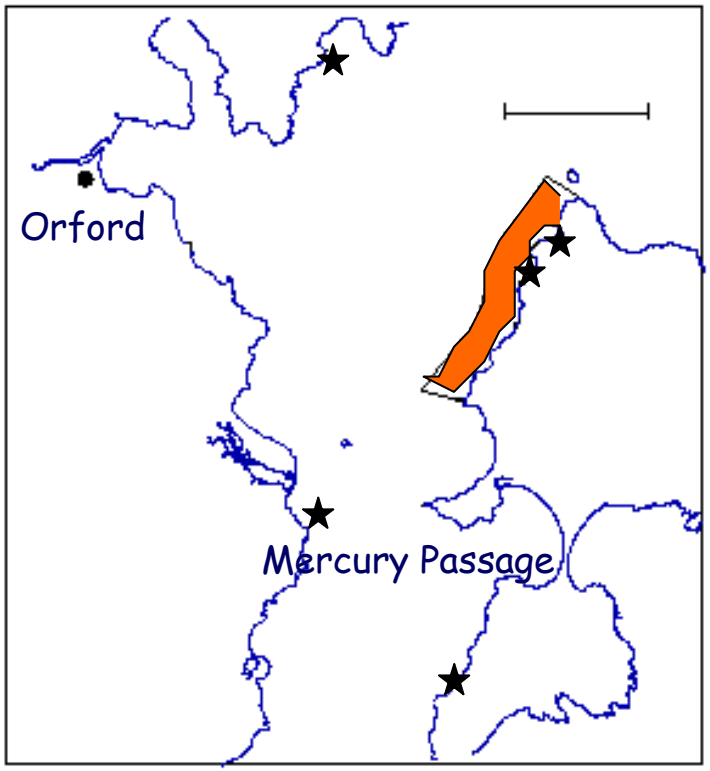
- Prey species have fatty acids that are rare or,
- Unique ratios of commonly occurring fatty acids
- Reflected in the consumer with minimal change

Sampling sites

Tasmania.



Maria Is.



N = 3 sites@each, all @ about 7m

Methods

Wet tissue

Freeze dry & grind

SIA

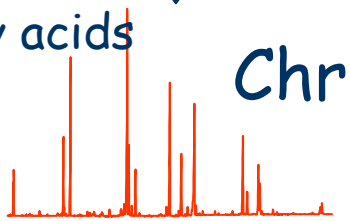
FA

Direct methylation

liberate fatty acids

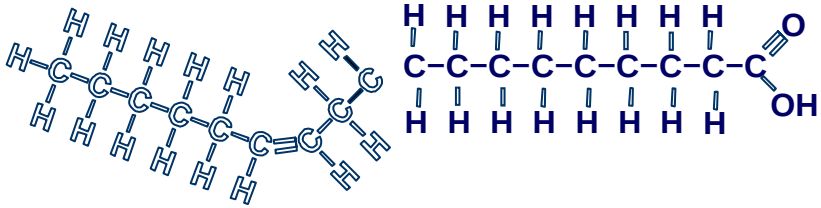
GC

separate fatty acids



Chromatogram

identify fatty acids



e.g. 18:2ω6

Analysis

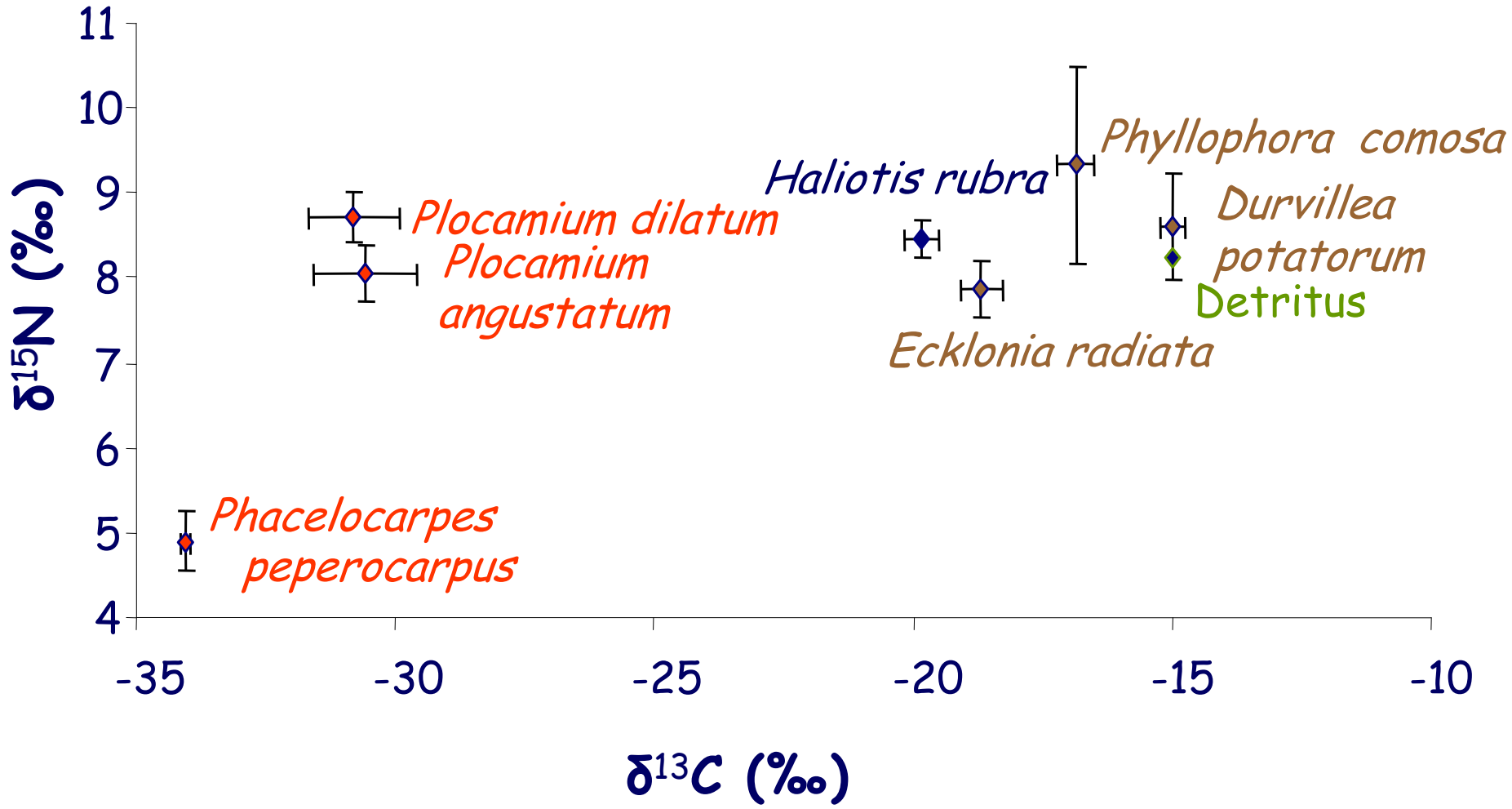
Stable isotope analysis (SIA)

- Two-way ANOVA (Location: random, 5 levels; and taxa, fixed, 3 levels) for each element
- Isoerror (Phillips and Gregg 2001): Single isotope, dual source mixing model

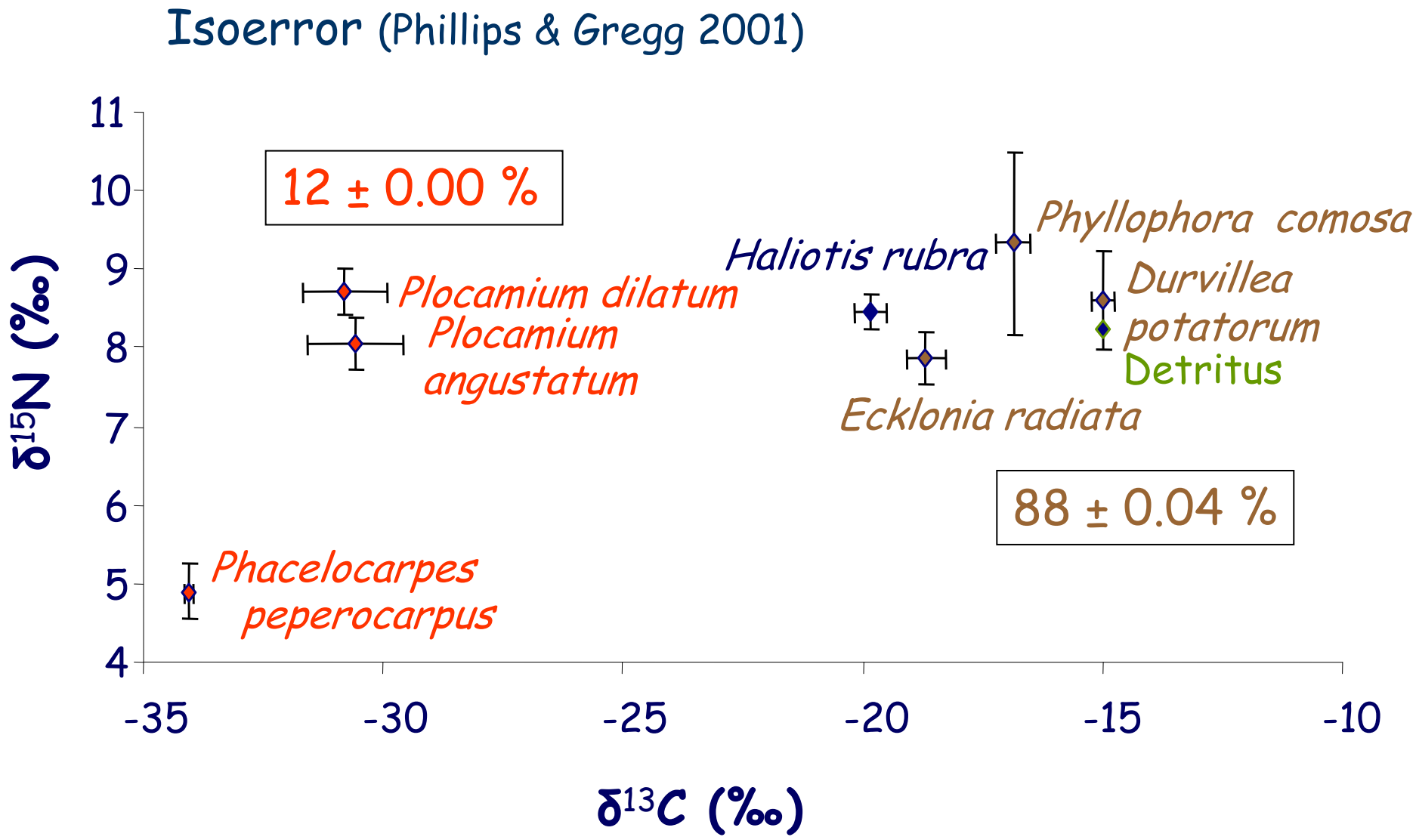
Fatty acid analysis (FA)

- Taxa: Principal Components analysis
- MDS- ANOSIM determine differences among locations
- Only major FA (>1%) in Abalone profile included

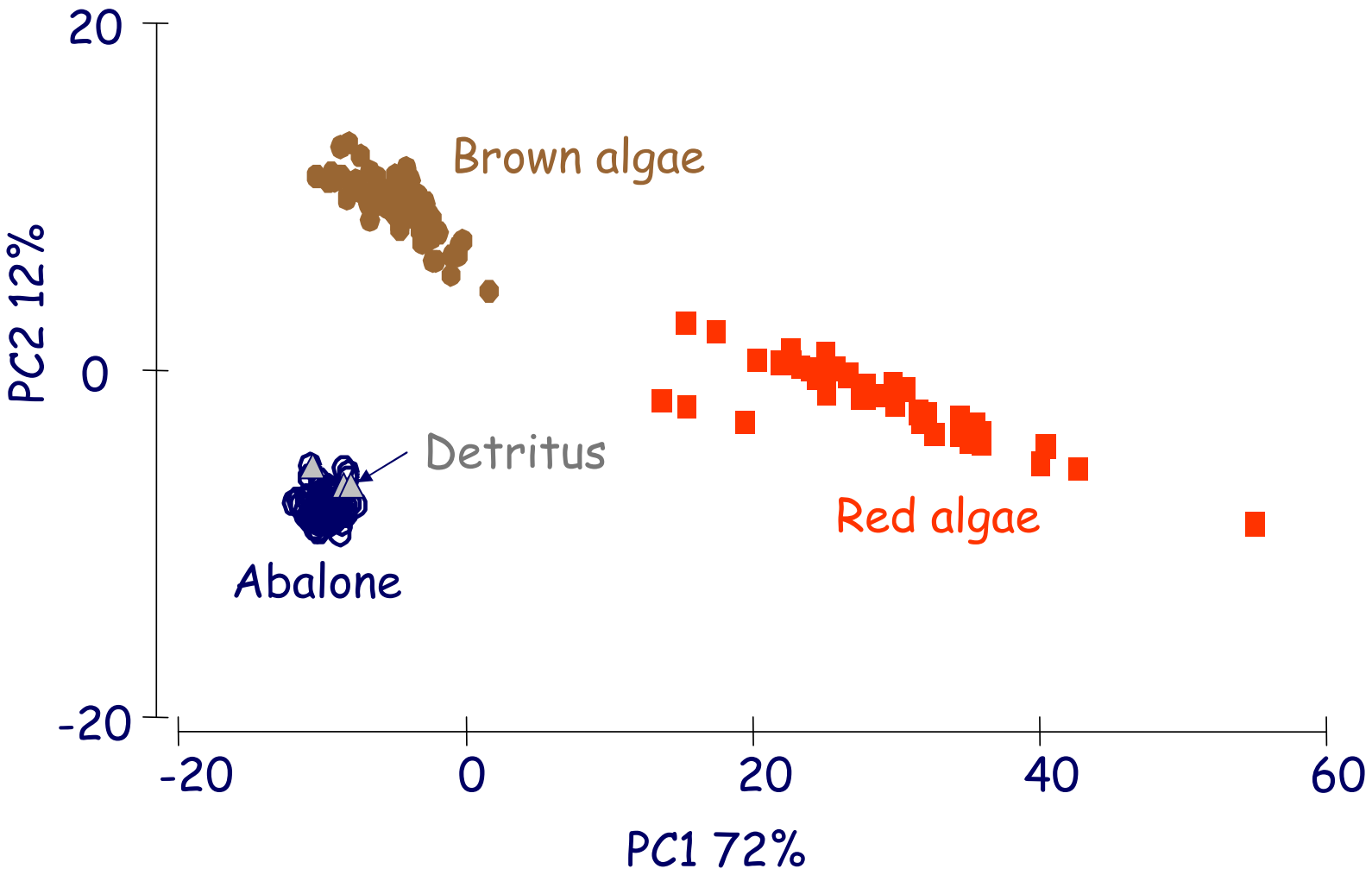
Abalone diet:SIA



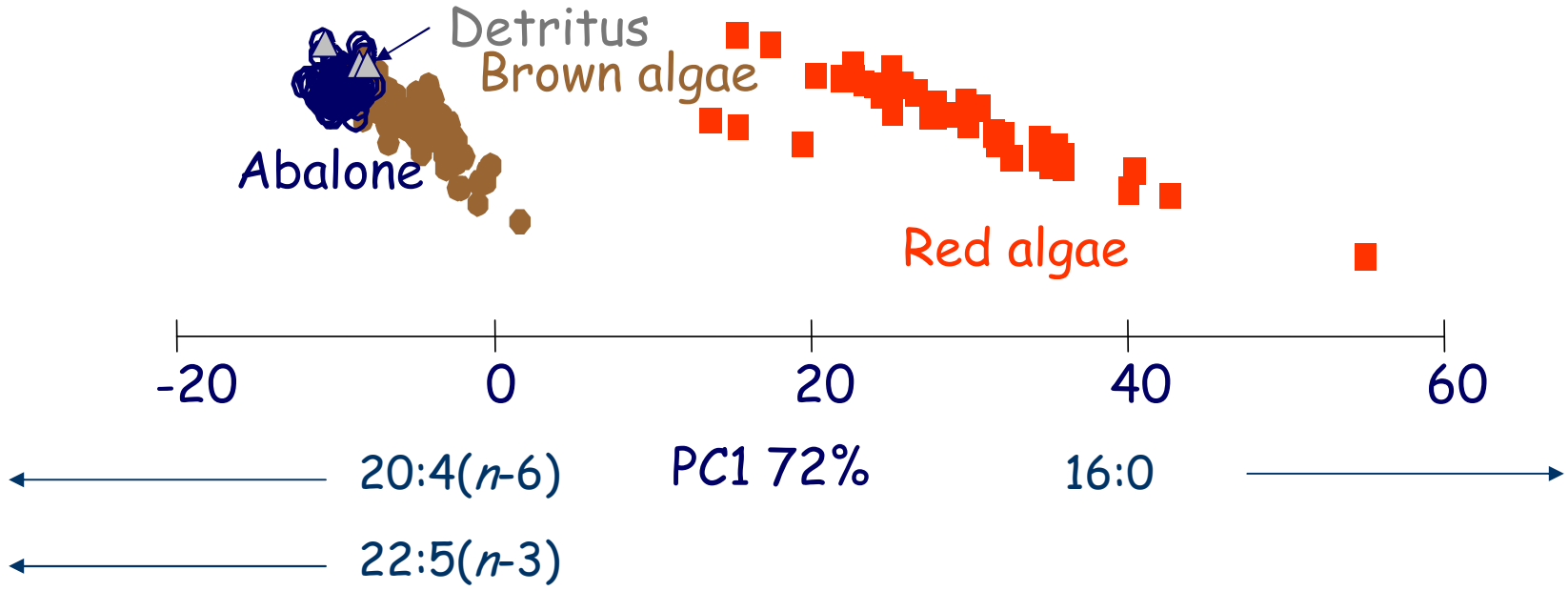
Abalone diet:SIA



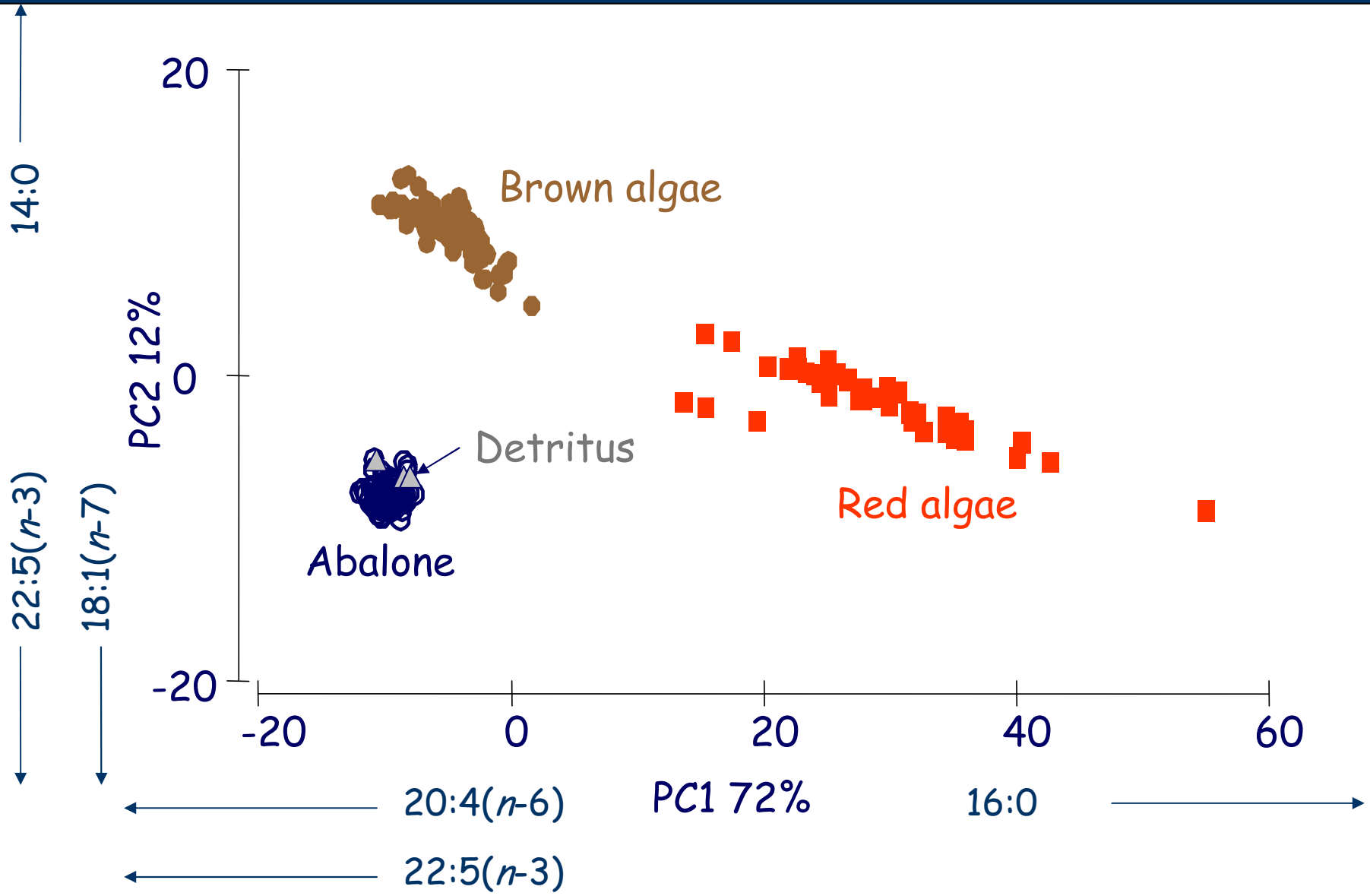
Abalone diet: FA



Abalone diet: FA



Abalone diet: FA



Conclusions

- Brown algae & detritus make a greater contribution to abalone diet than red algae.
- Combined marker techniques can be a powerful tool to clarify diet.
- Provide some evidence of induced tolerance to polyphenolic rich brown algae by abalone (Estes & Steinberg (1988)

Acknowledgements

- Ben Mooney, CSIRO/UTas
- Daniel Holdsworth, CSIRO
- Andy Revill, CSIRO,
- Kathryn Wheatley, UTas,
- Abalone Group, TAFI