

Fatty acid profiling of top predators off eastern Australia

Peter D Nichols^{1,2}

¹ CSIRO Marine & Atmospheric Research

² Antarctic Climate & Ecosystems CRC



Signature Lipids:

Utas / IASOS / ACE-CRC Students & Collaborators

- **Krill and other zooplankton** - Patti Virtue (Utas), Fred Alonzo, Steve Nicol & So Kawaguchi (AAD), Rick Phleger & Matt Nelson (SDSU), Willy Hagen (Univ Bremen), Kerrie Swaddling, Colleen O'Brien, Matt Brown, Toshi Yoshida
- **Fish and shell fish** - Gareth Wilson, Heidi Pethybridge, Rick Phleger & Matt Nelson (SDSU), Michaela Guest & Stewart Frusher (TAFI), Ben Mooney (CSIRO & Utas), Jock Young, Miriam Fluckiger, Arani Chandrapavan
- **Squid** - George Jackson, Katrina Phillips, Heidi Pethybridge, Christine Jackson
- **Seals and whales** - Narelle Best, Mary-Anne Lea, Kathryn Wheatley, Mark Hindell, Corey Bradshaw, Andrea Walters, Karen Evans, Harry Burton (AAD)

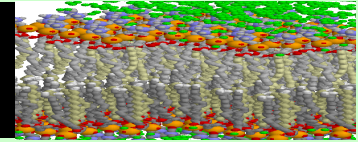


Signature Lipids

‘You are what you eat’



Lipids as Dietary Tracers

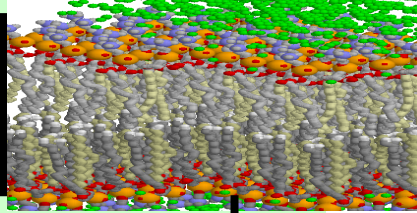


Traditional techniques problematic, e.g. gut content analysis

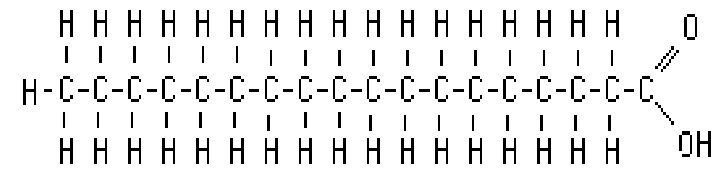
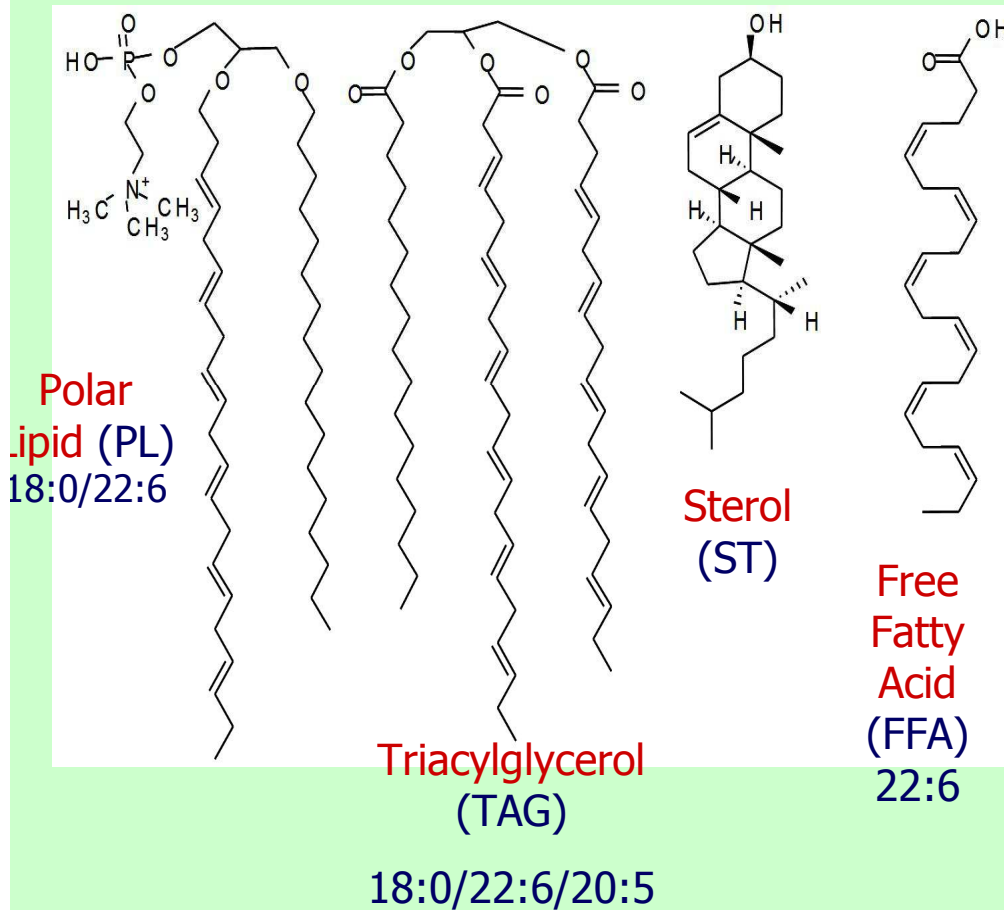
- Prey species have unique lipid / fatty acid (FA) compositions
- Many FA readily transferred from prey to predator with minimal modification
- Constituent FA therefore represent, to some extent, a temporal integration of diet (FASA)
- Can be quantitative and allows temporal integration (cf gut content analysis) (QFASA)
- **Signature fatty acids: combinations of FA preserved as they pass up the food chain**
- *Complement other approaches*



What are Lipids?

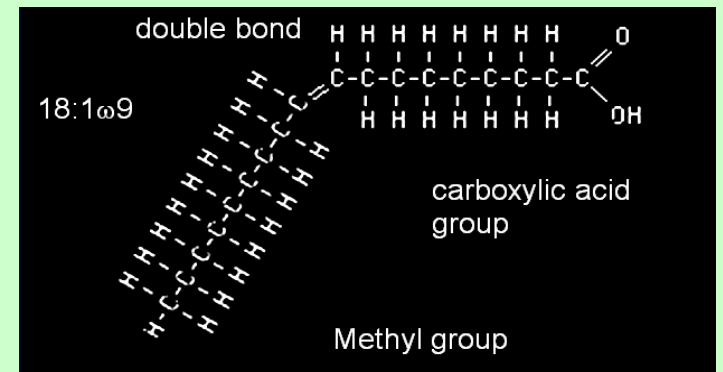


Fatty Acid (FA) Structure

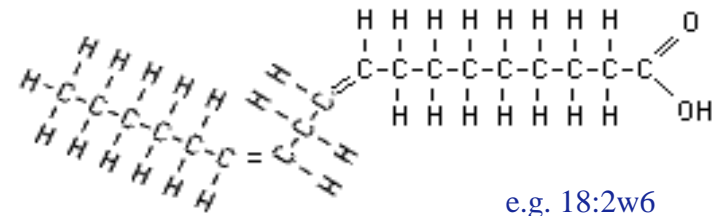


e.g. 18:0

Saturated fatty acid (SAT)



Monounsaturated fatty acid (MUFA)



Polyunsaturated fatty acid (PUFA)

Methodology

FA profile

SAT	16:0 18:0
MUFA	18:1ω7 20:1ω9 22:1ω11
PUFA	20:5ω3 22:6ω3



- Compare predator profiles to known & potential prey species
- Statistical analyses
e.g. MDS, ANOVA, Primer, etc
- Other treatment / modeling (future)

Signature FA:



Myctophids:

18:1 ω 9
16:0



Bathylagus:

20:1 ω 9
18:1 ω 9



Squid:

22:5 ω 6
18:1 ω 9



Decapods:

20:5 ω 3 (EPA)
16:0

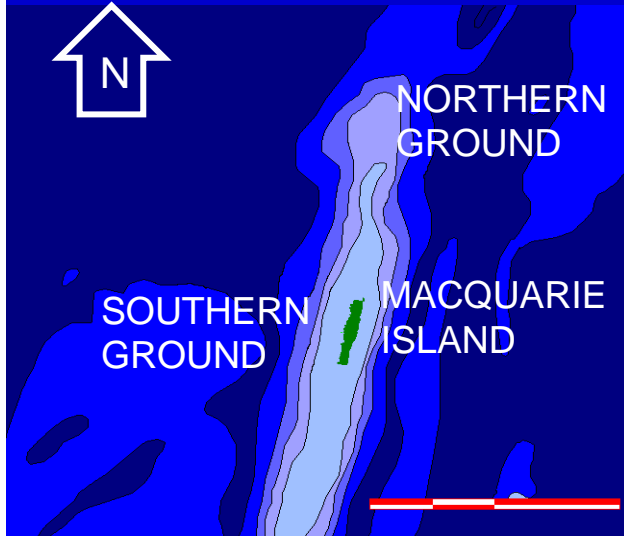


Amphipods:

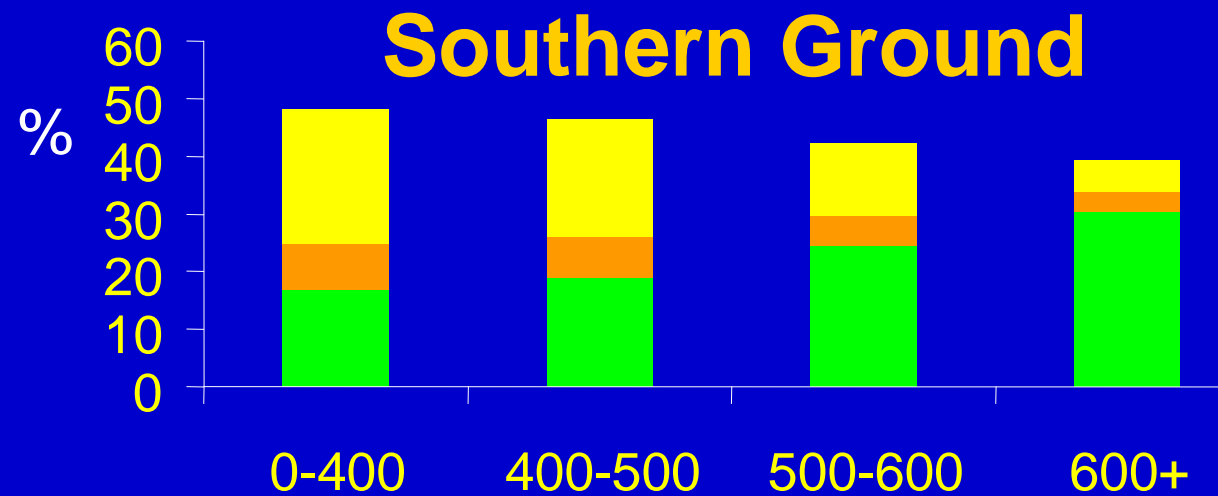
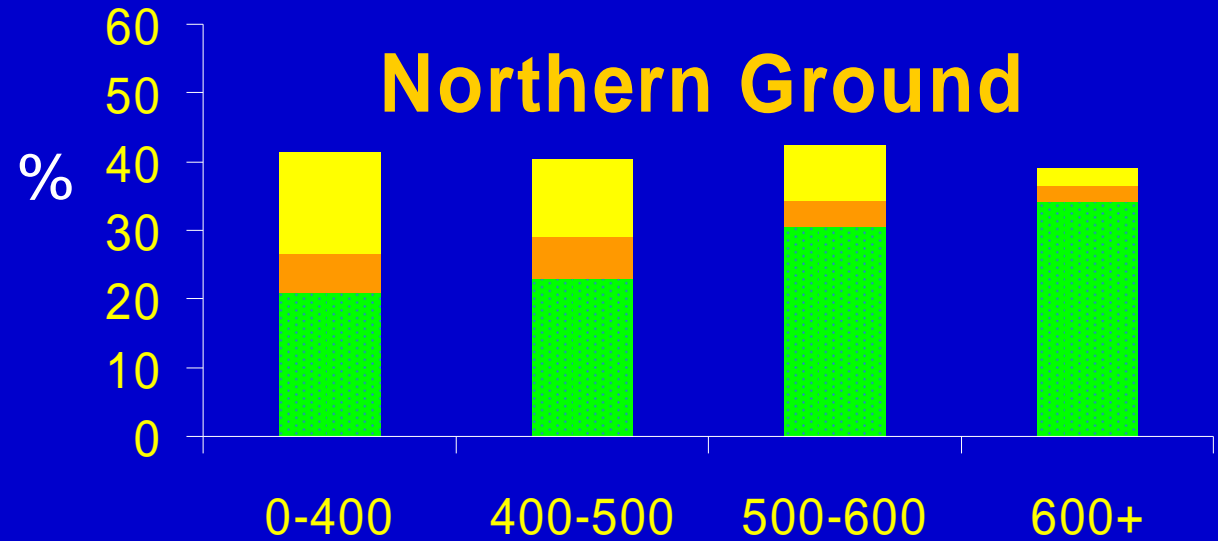
20:5 ω 3 (EPA)
22:6 ω 3 (DHA)

Patagonian toothfish

(Gareth Wilson, PhD Thesis)



■ 18:1w9c ■ EPA ■ DHA



Toothfish - Comparison with Prey

Stomach content analysis

- Diet dominated by fish (58% by mass) and cephalopods (32%)
- Most important fish: *Bathylagus antarcticus*

Fatty Acid Profiles

- Smaller toothfish: similarities with squid & TAG-rich myctophids (↑PUFA ↓MUFA)
- Larger toothfish: less similar to squid, closer to fish including *Stomias* sp. & selected WE-rich Myctophids (↓PUFA ↑MUFA)



Rudderfish – poison fish? (Ben Mooney)

- Symptoms – mild to severe orange diarrhoea, discomfort, nausea
- SA, QLD and NSW > than 200 reported cases



Research into rudderfish poison risk

By BELINDA HEGGEN

THE Public and Environmental Health Service is investigating a possible link between rudderfish and eight cases of food poisoning.

The cases – reported in South Australia since 1997 – have involved mild to severe diarrhoea.



DEPARTMENT OF
HUMAN SERVICES

MEDIA RELEASE

Friday, 17 December 1999

ILLNESS REPORTS ASSOCIATED WITH "RUDDERFISH"

The Department of Human Services' Public & Environmental Health Service (P&EHS) has conducted an investigation into reports of illness associated with the sale of a fish described as "rudderfish" in South Australia.

It has been determined that the fish has the scientific name of *Lepidocybium flavobrunneum*. It is described in the Australian Seafood Handbook as "vacuolar".

A joint industry government committee has established the approved marketing names for fish listed in the Handbook. Use of standardised names is largely voluntary and depends on support from the industry.

The P&EHS has received reports of 98 cases of illness attributed to the consumption of "rudderfish" (vacuolar). Most of these reports followed recent media attention to the issue. The illnesses ranged from mild diarrhoea to severe diarrhoea with nausea and vomiting. It is thought that the cause of the problem is the quantity and composition of the oil in the fish.

Rudderfish vs Escolar

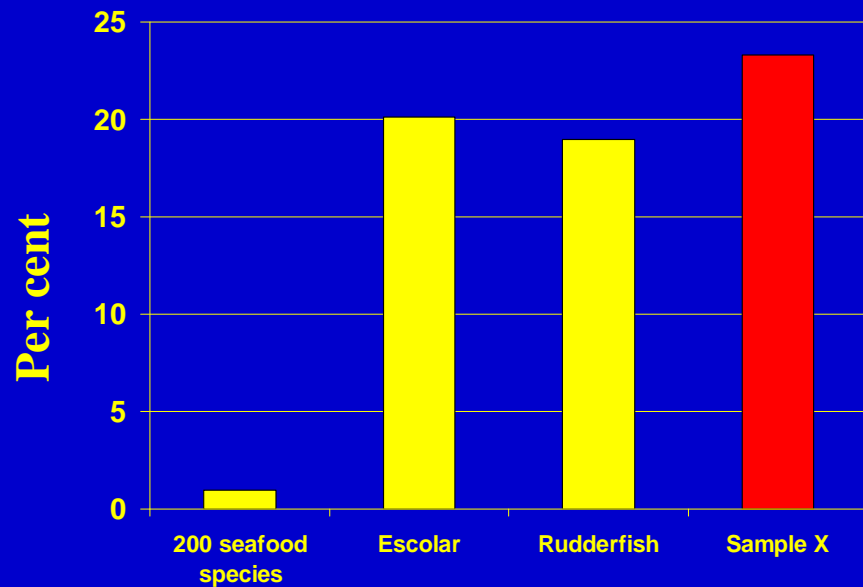
(J Chomatogr)



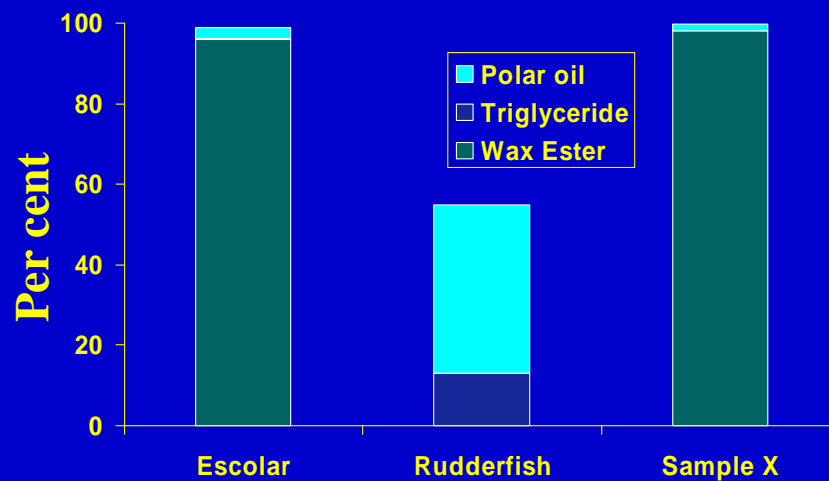
Loss of identity



Oil content



Oil profile



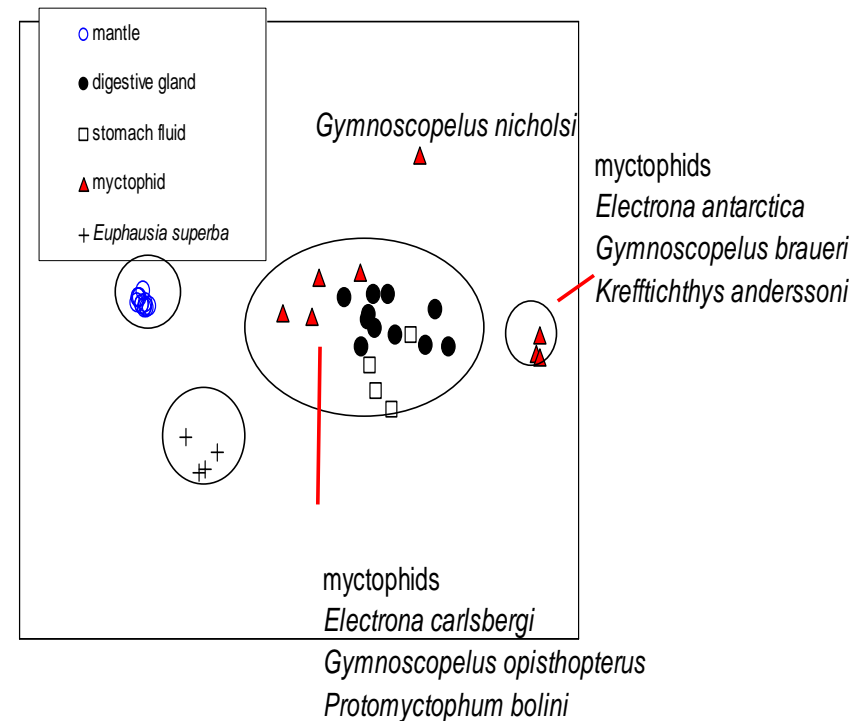
Moroteuthis ingens (Katrina Phillips)

- Digestive gland as a source of FA dietary tracers
- Temporal variations in diet at Macquarie Is.
- Spatial variations in diet at 4 Southern Ocean sites
- Size-related dietary changes (Falkland Is.)
- Interspecies comparison (4 species)

(*Mar. Biol., MEPS, Ant. Sci.*)



MDS of FA from *M. ingens* - mantle, digestive gland & stomach fluid, myctophids & Antarctic krill.



Swordfish:

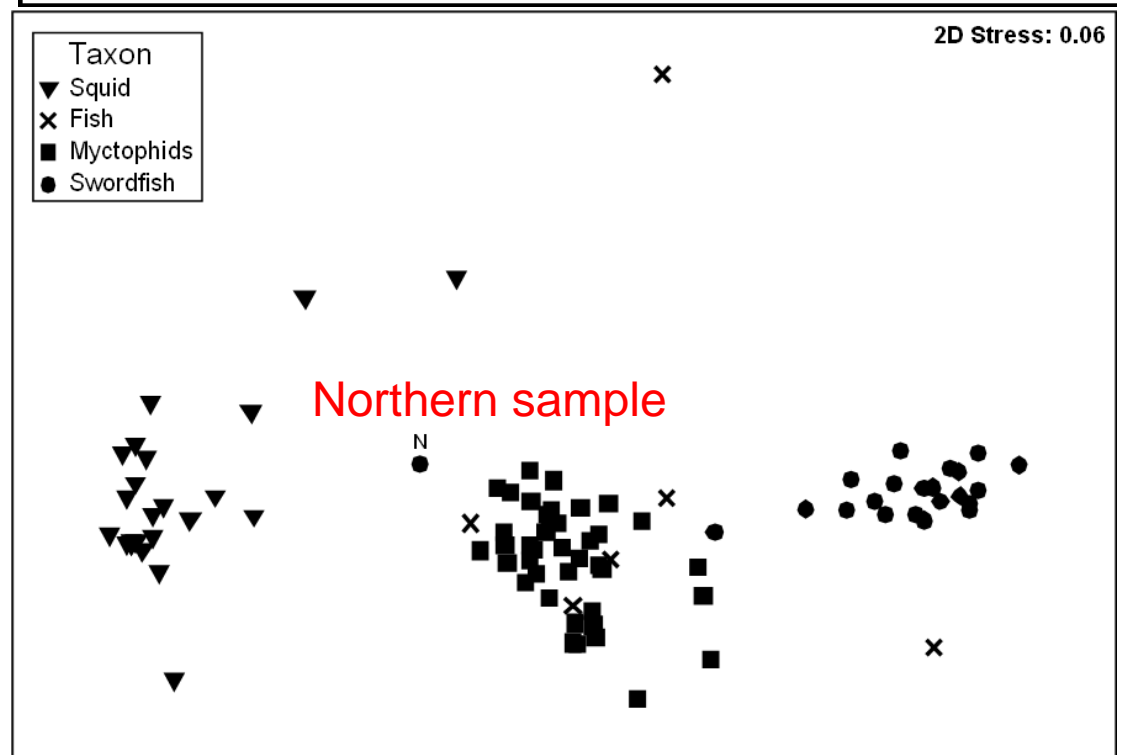
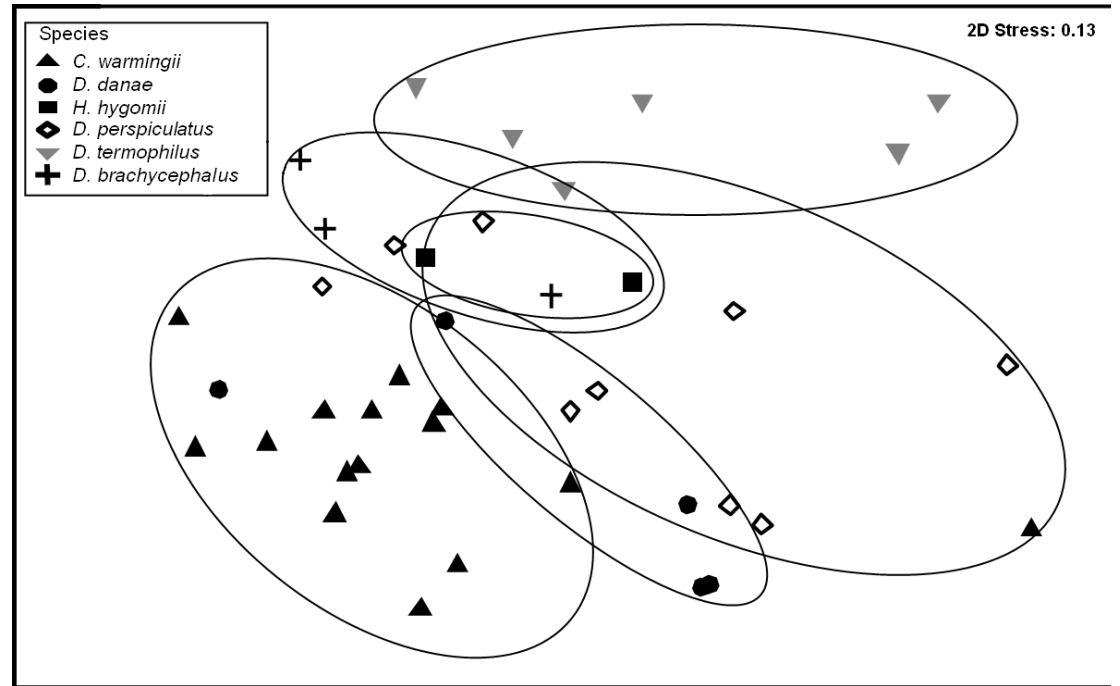
(Rick Phleger et al.)

Myctophid prey



Swordfish & prey

(Prog Oceanog - MS submitted)



Summary – Signature Lipids

- **Signature lipid approach is being developed & applied to key Australian & southern ocean fish & squid**
- **Food-web, taxonomic & stock discrimination information can be gained using signature lipids – *complements other methods***
- **Better understanding on transport & use of essential lipids in the marine food-web & in aquaculture**

