

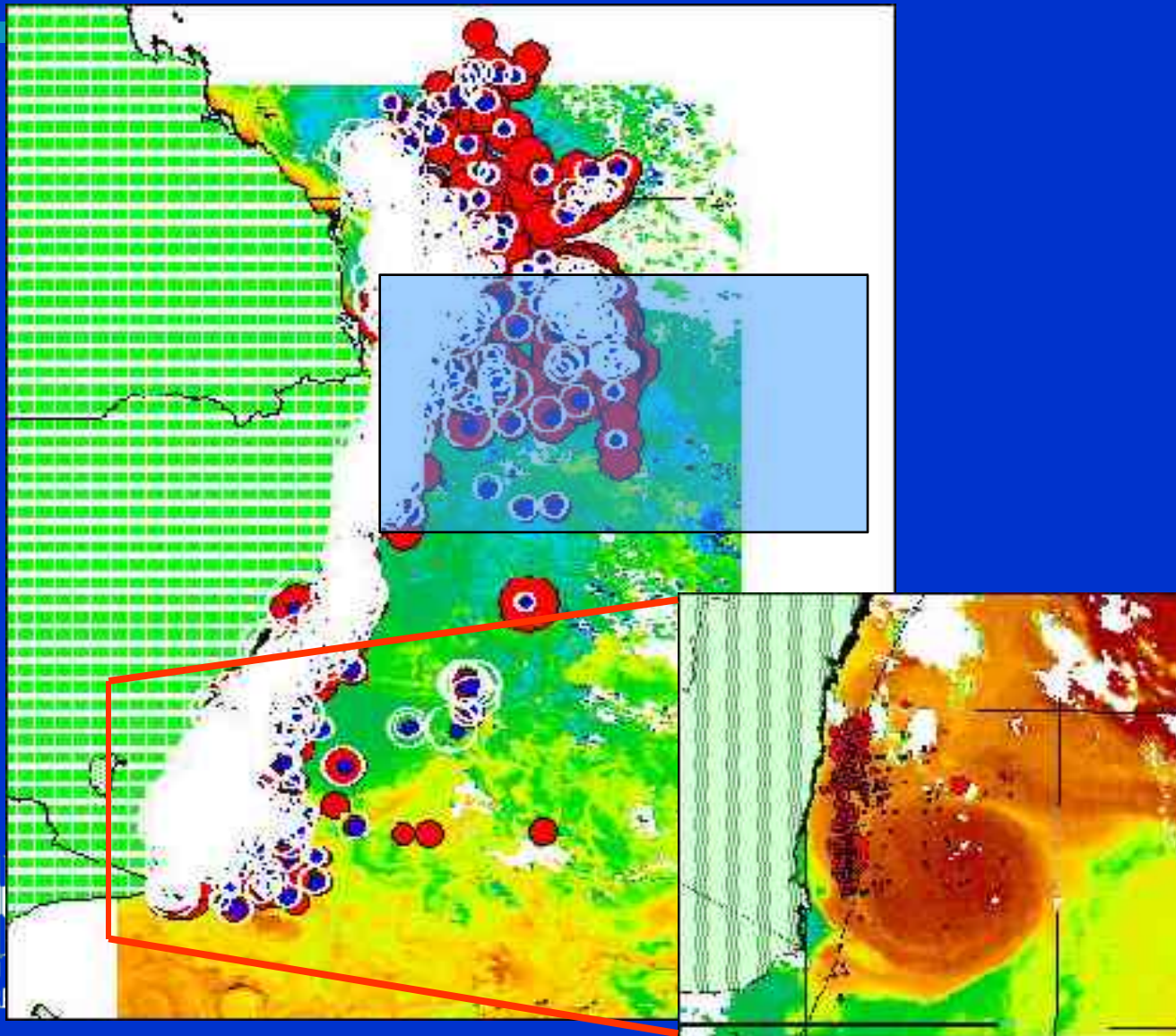
# **Spatial variations in micronekton distribution off eastern Australia from nets and acoustics**

**Jock Young, Alistair Hobday, Tim Ryan and  
Brian Griffiths**

**CSIRO Marine Research**

**Acknowledgements: FRDC, National Facility Steering Committee, CSIRO  
Pelagic Fisheries and Ecosystems program; PFRP, Hawaii**

# Overview of the fishery



swordfish 

yellowfin 

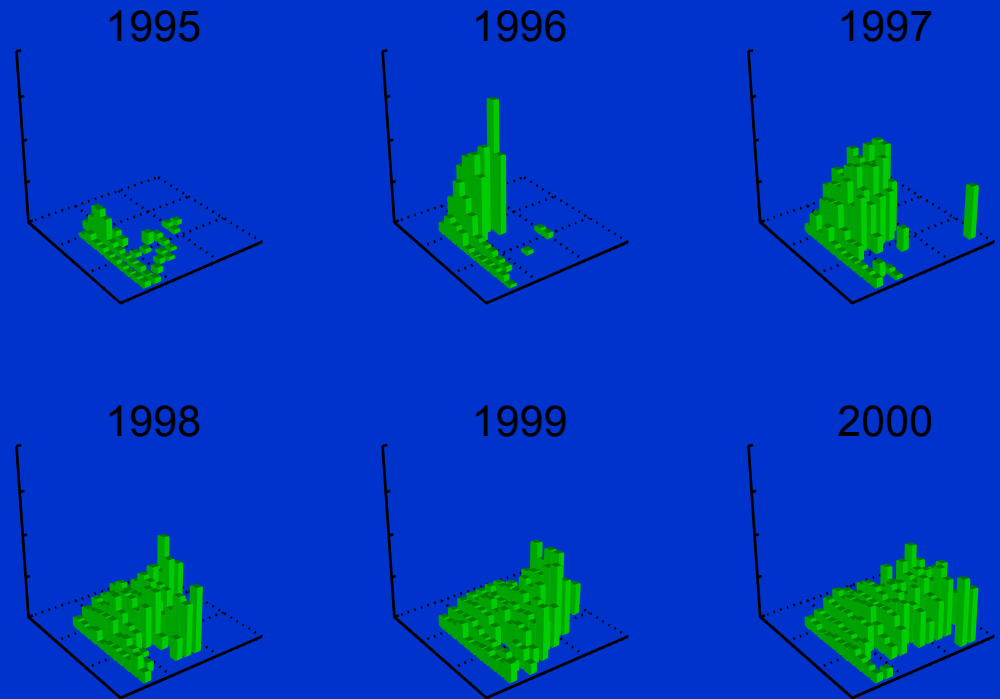
bigeye 

(striped marlin)

Bycatch ~100 spp.

May 1996

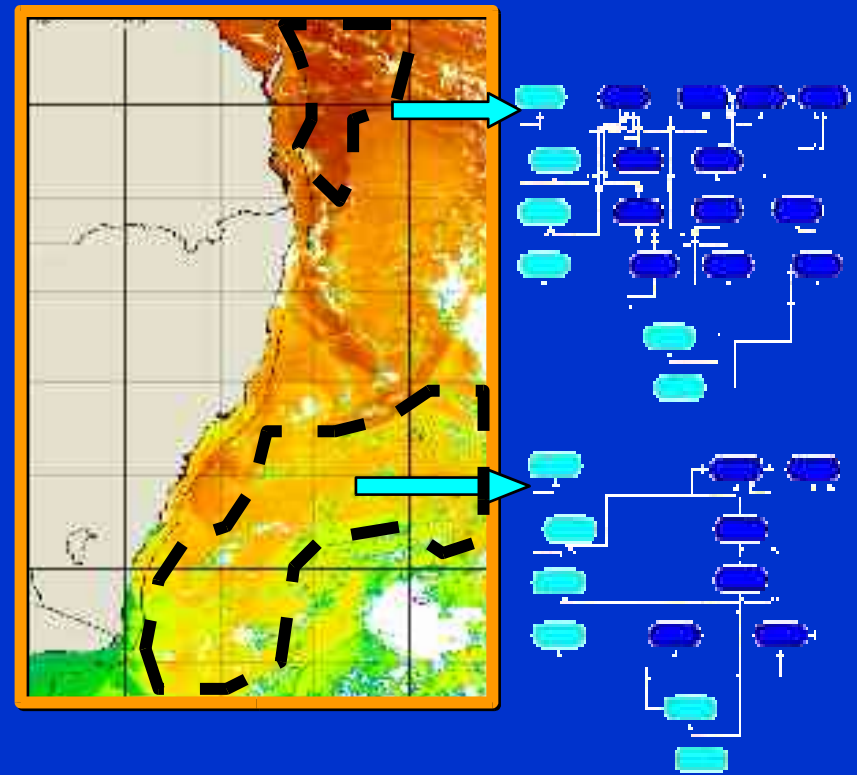
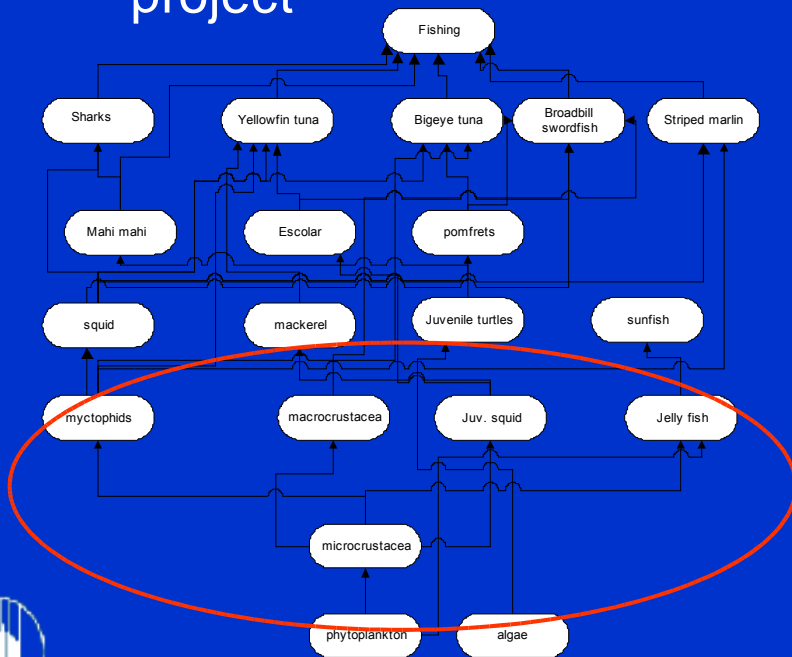
# Impacts of fishing – decline in swordfish cpue off eastern Australia



(Rob Campbell)

# Background

- Ecosystem characterization of longline fishing waters off eastern Australia (Young, Hobday, Dambacher) FRDC project



# Objectives

- Characterize the physical and biological environment of the main fishing areas of the Eastern Tuna and Billfish fishery
  - Distribution of primary and secondary production
  - Distribution of top predators (ongoing)
  - Trophic links (sample collection underway)
  - Development of qualitative and quantitative models
  - Input to management

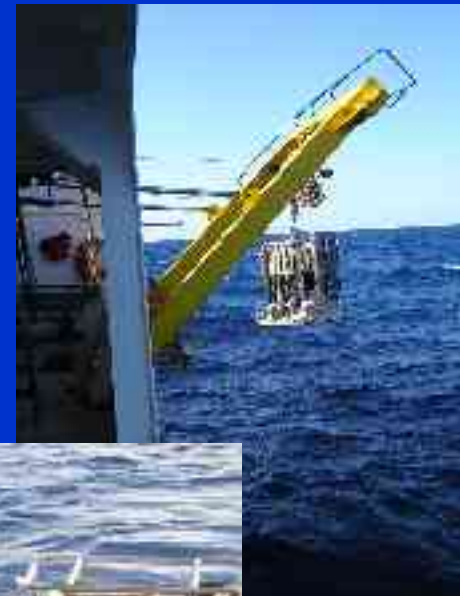




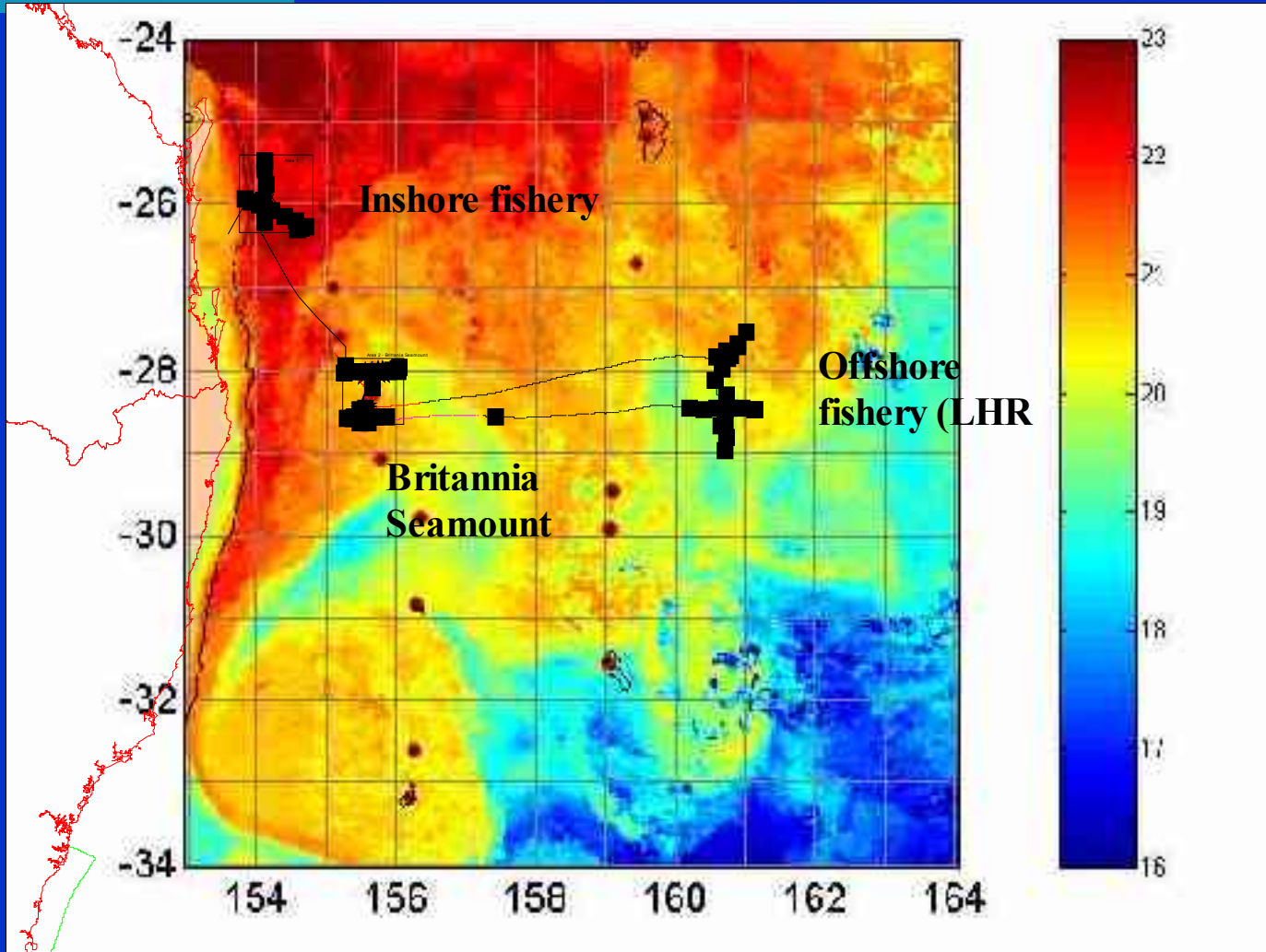
# Methods

Research voyage Sep 2004

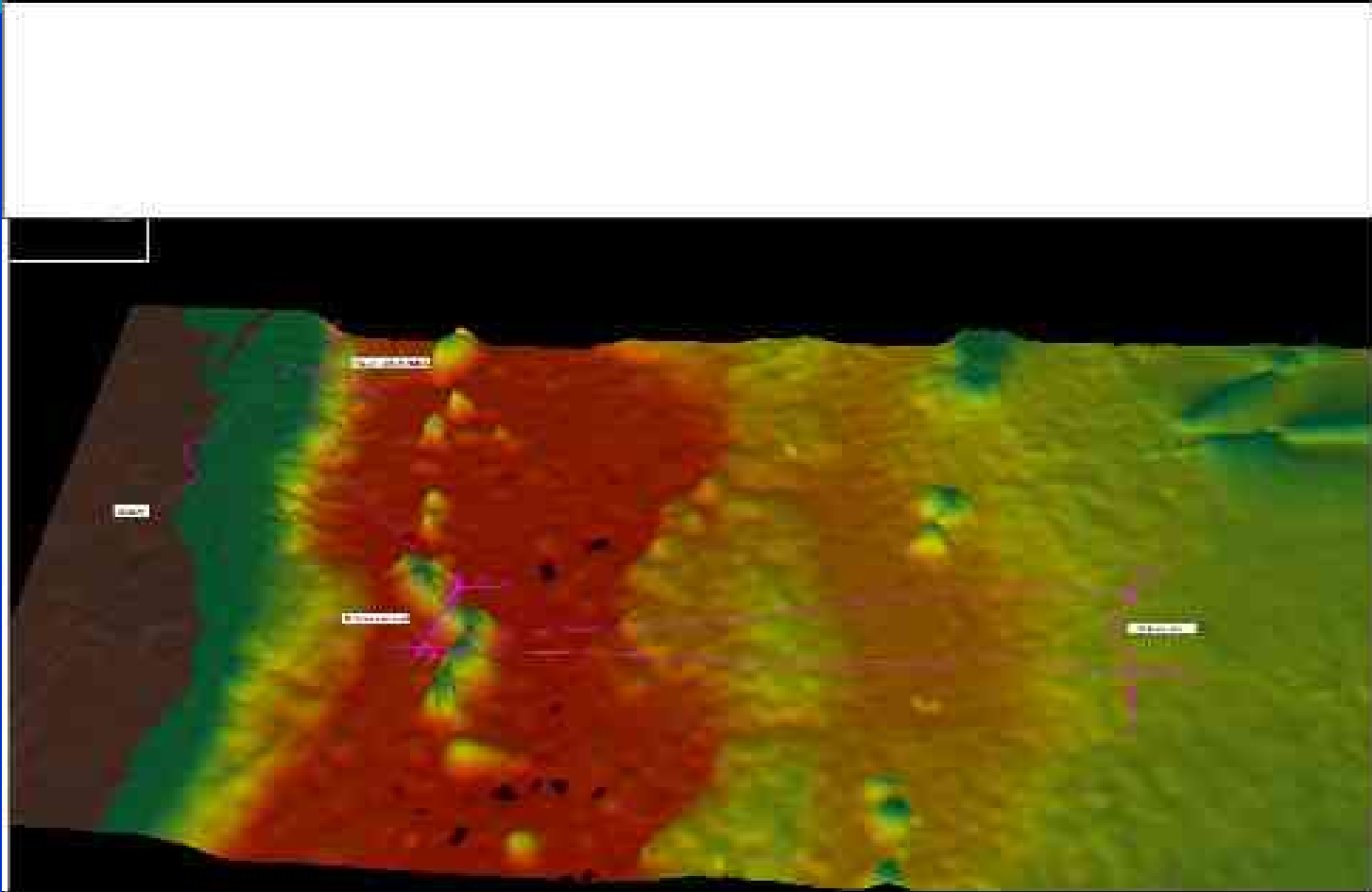
- CTD casts
- primary productivity incubations
- acoustics (EK 500 and Fat buoy (in situ target strength))
- Replicate net sampling at discrete depths
- independent longline sampling – tagging using satellite and archival tags
- Stomach collections from AFMA observers



# Voyage track showing main study areas

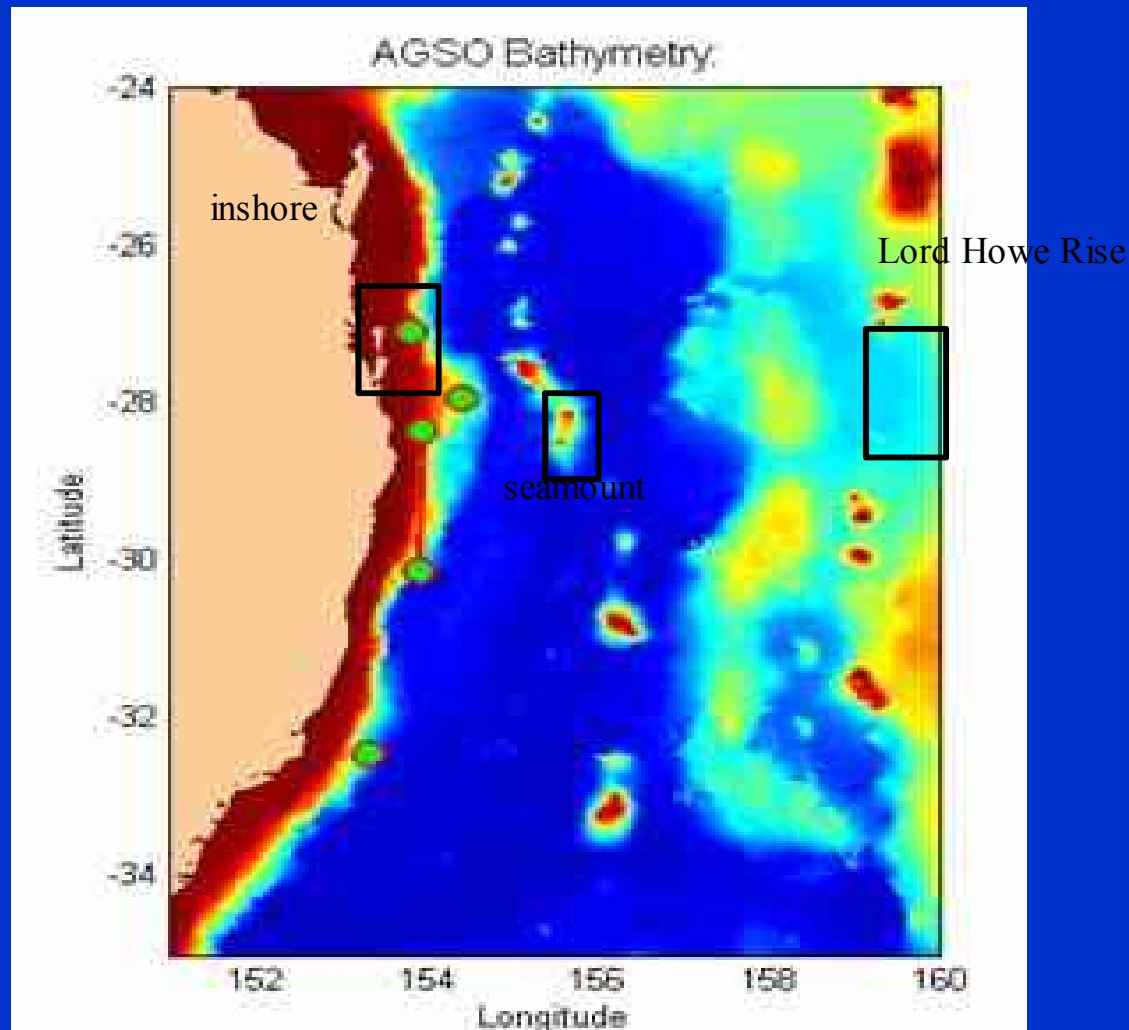


# 3-D plot of seabed topography off eastern Australia with voyage track overlaid

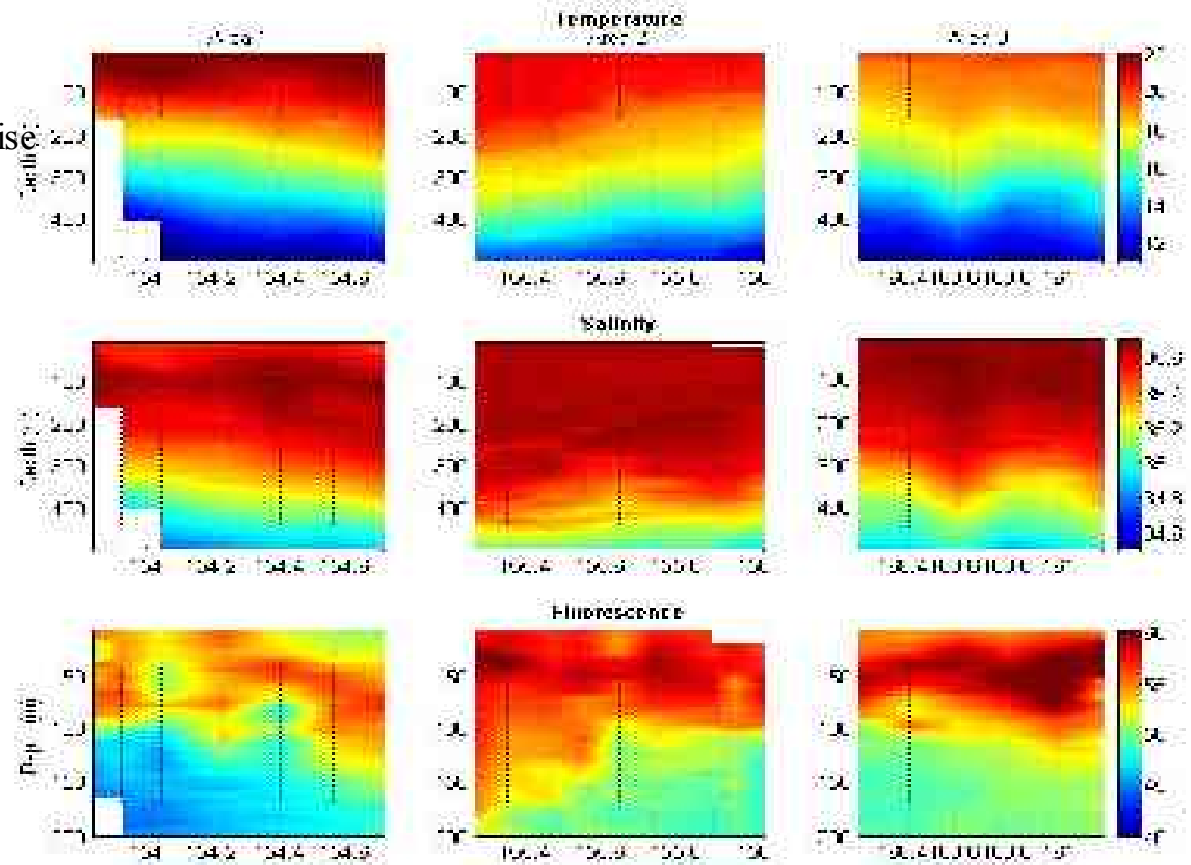
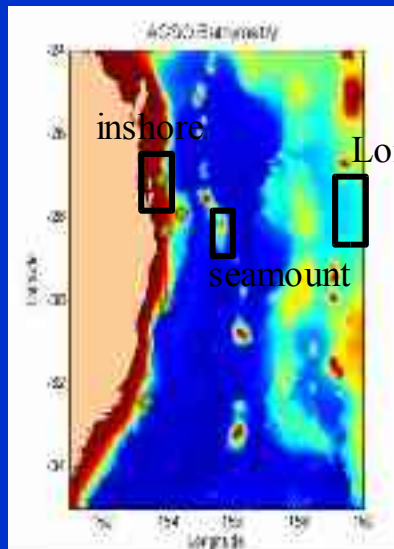




# Map of study area showing main sampling areas overlaid on seabed topography

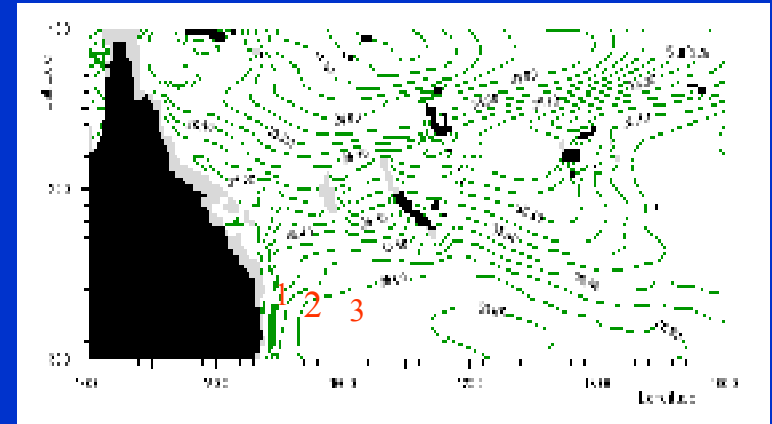
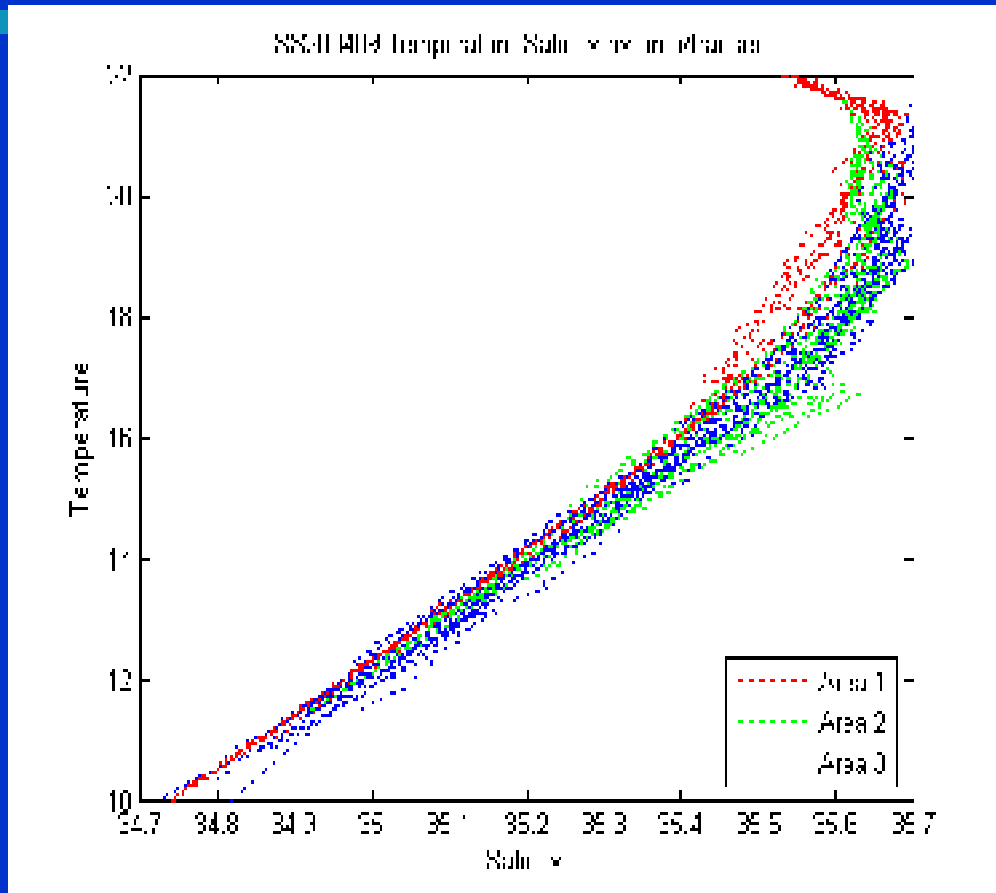


# Temperature, salinity and fluorescence for inshore (Area 1), Britannia Seamount (Area 2) and Lord Howe Rise (Area 3) in September 2004



- West to east cooling away from EAC
- Increasingly saline
- Higher Chl

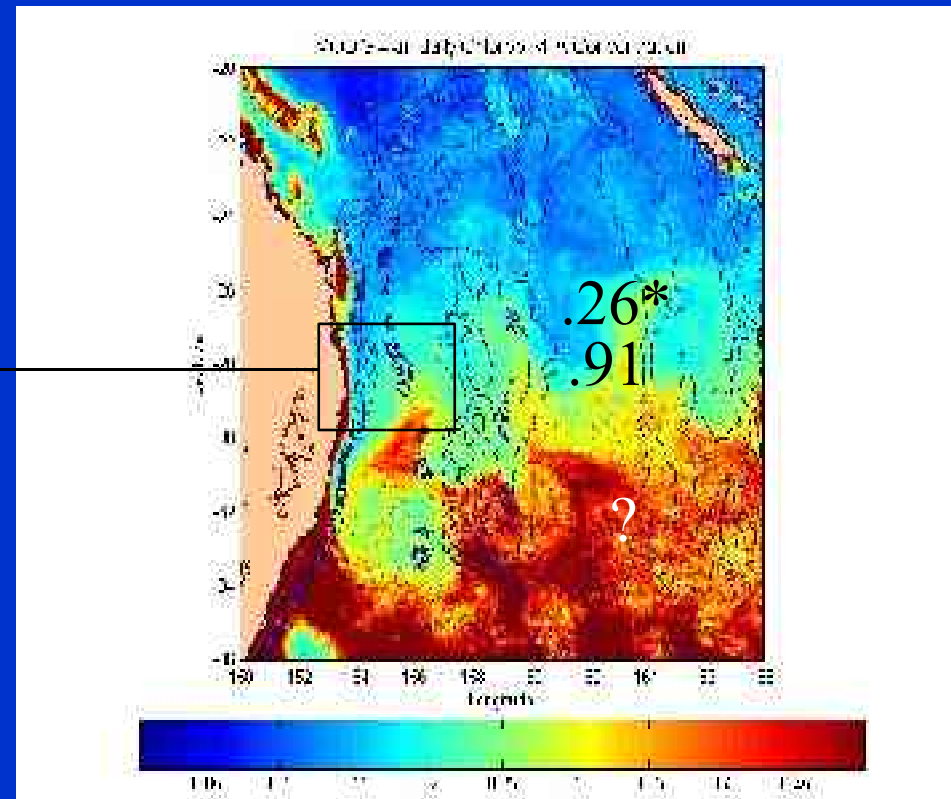
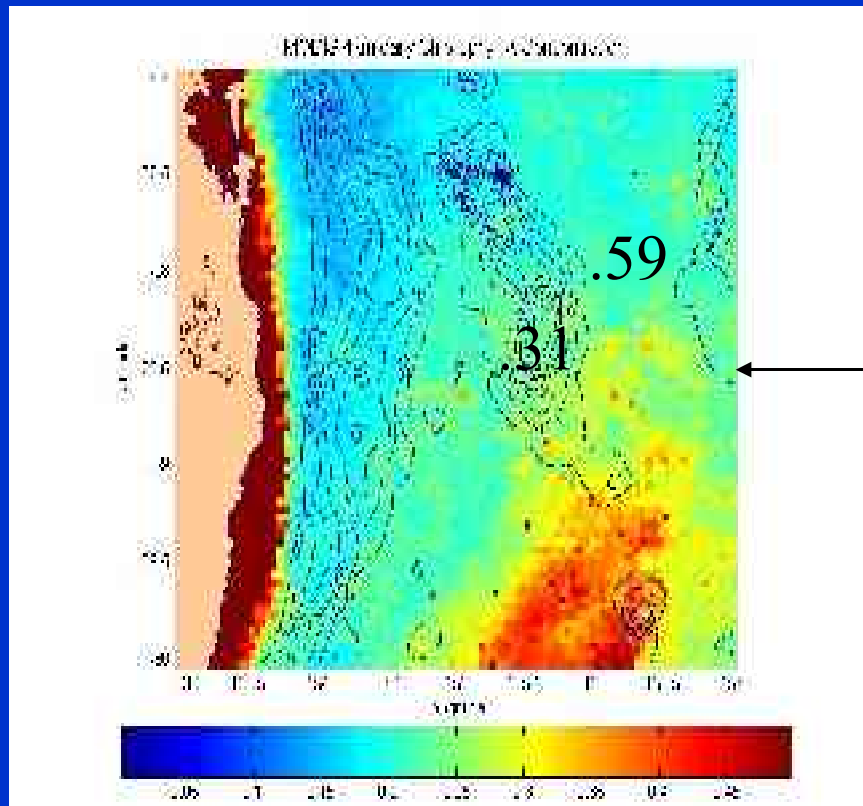
# Water masses sampled



Webb, D.J., 2000: *Journal of Physical Oceanography*, 30 (4), 706-720

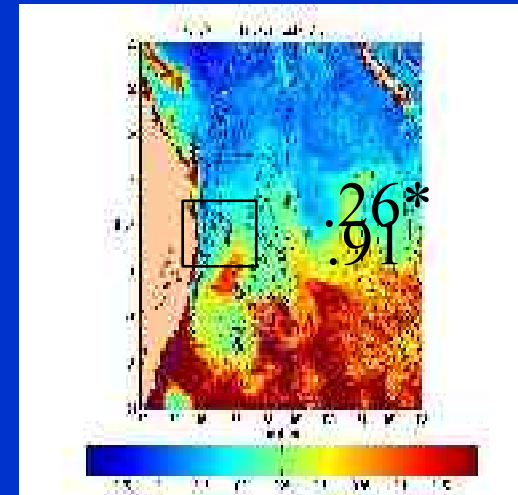
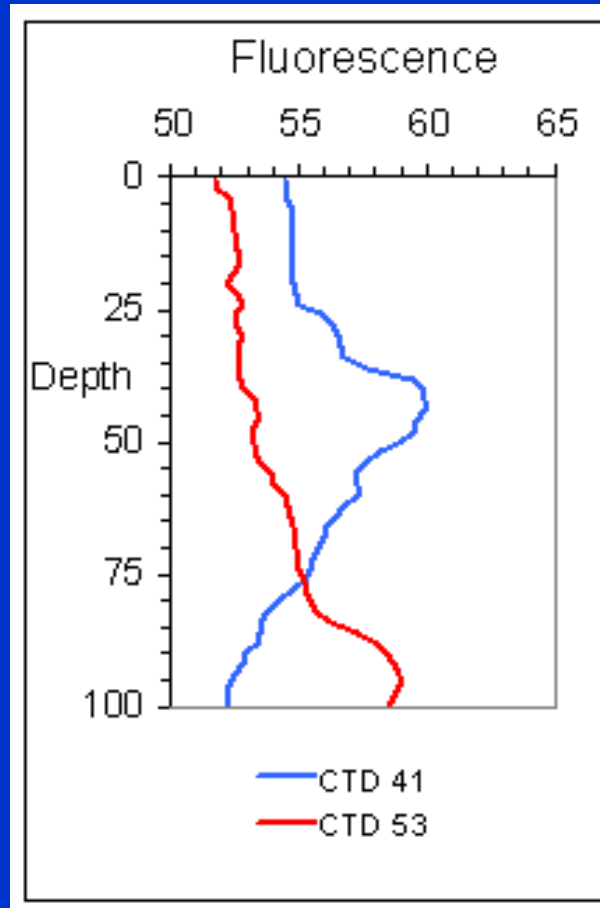
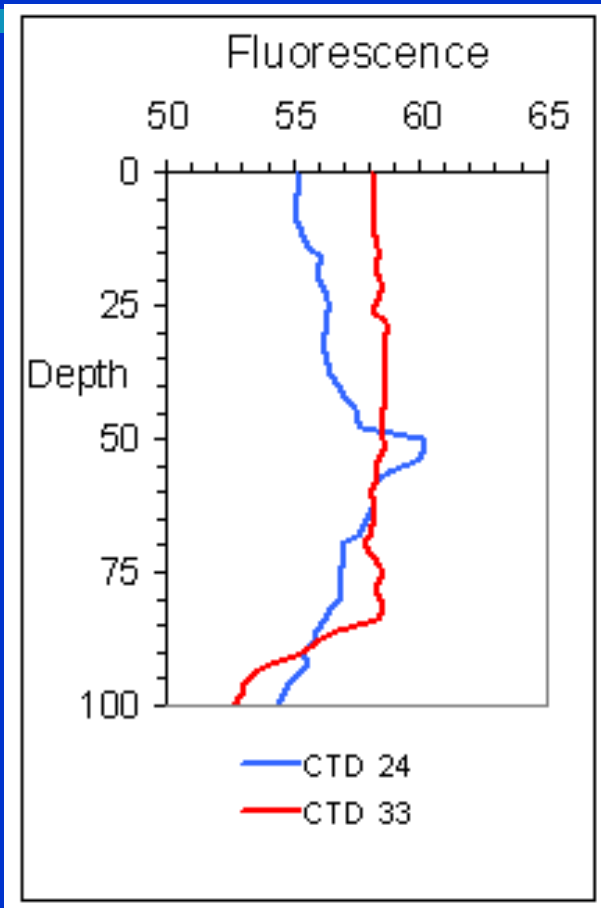


# Chl a for September 2004 (Modis – accessed from SDODE)



\* Net primary production (grams C m<sup>-2</sup> d<sup>-1</sup>)

# Fluorescence casts

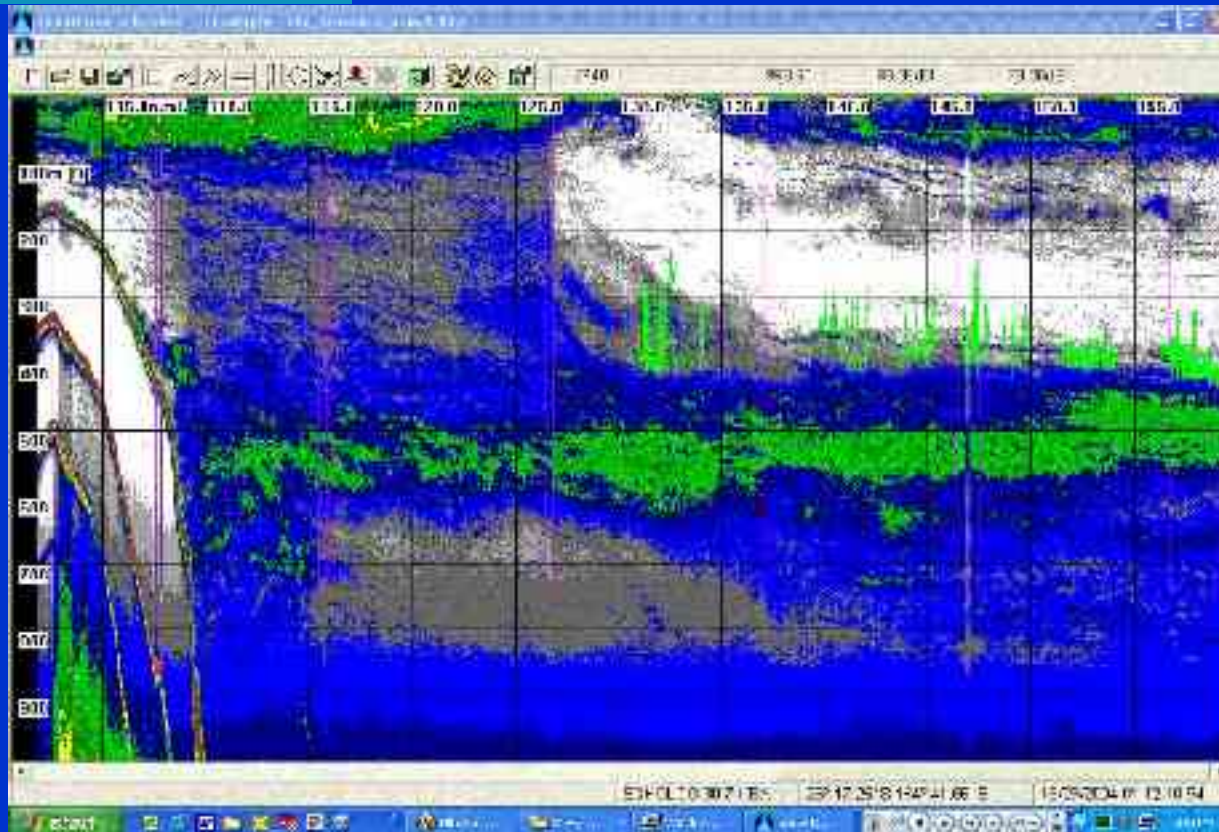


Britannia Seamount

Lord Howe Rise



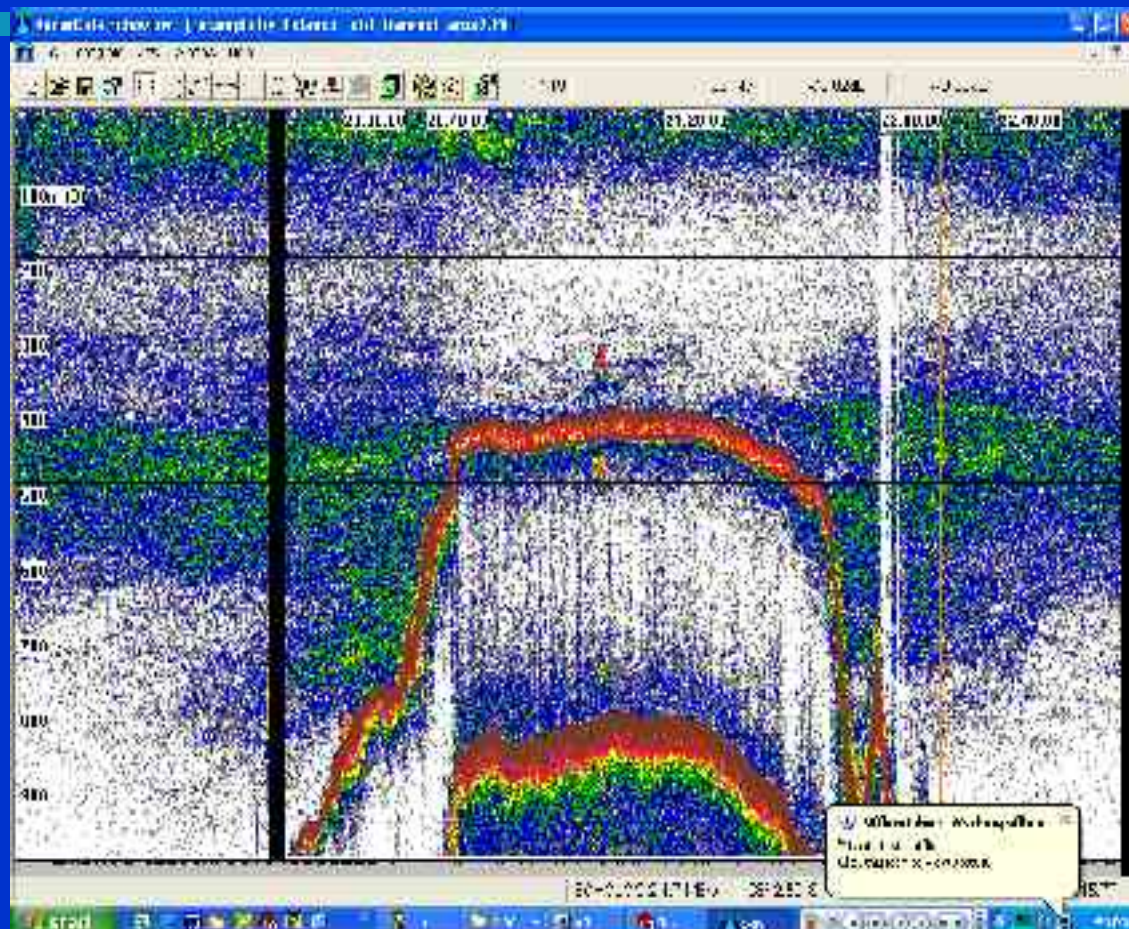
# Acoustic transect : Area 1 inshore



- 50 n.mile transect to east
- Diurnal variation
- Conc. at surface and between 400-600 m



# Britannia Seamount



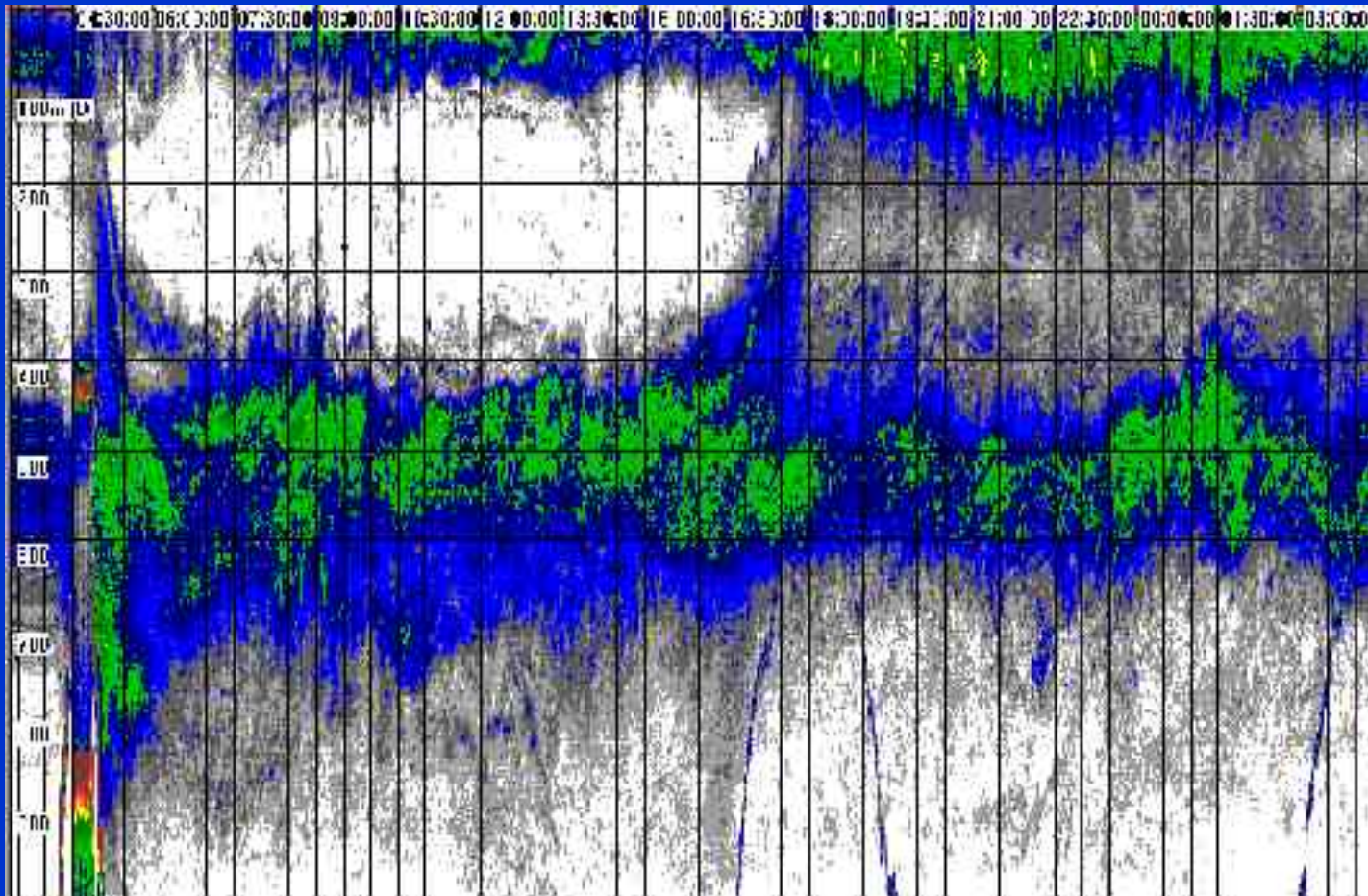
Concentrations at bw 400-700 m at edge of seamount



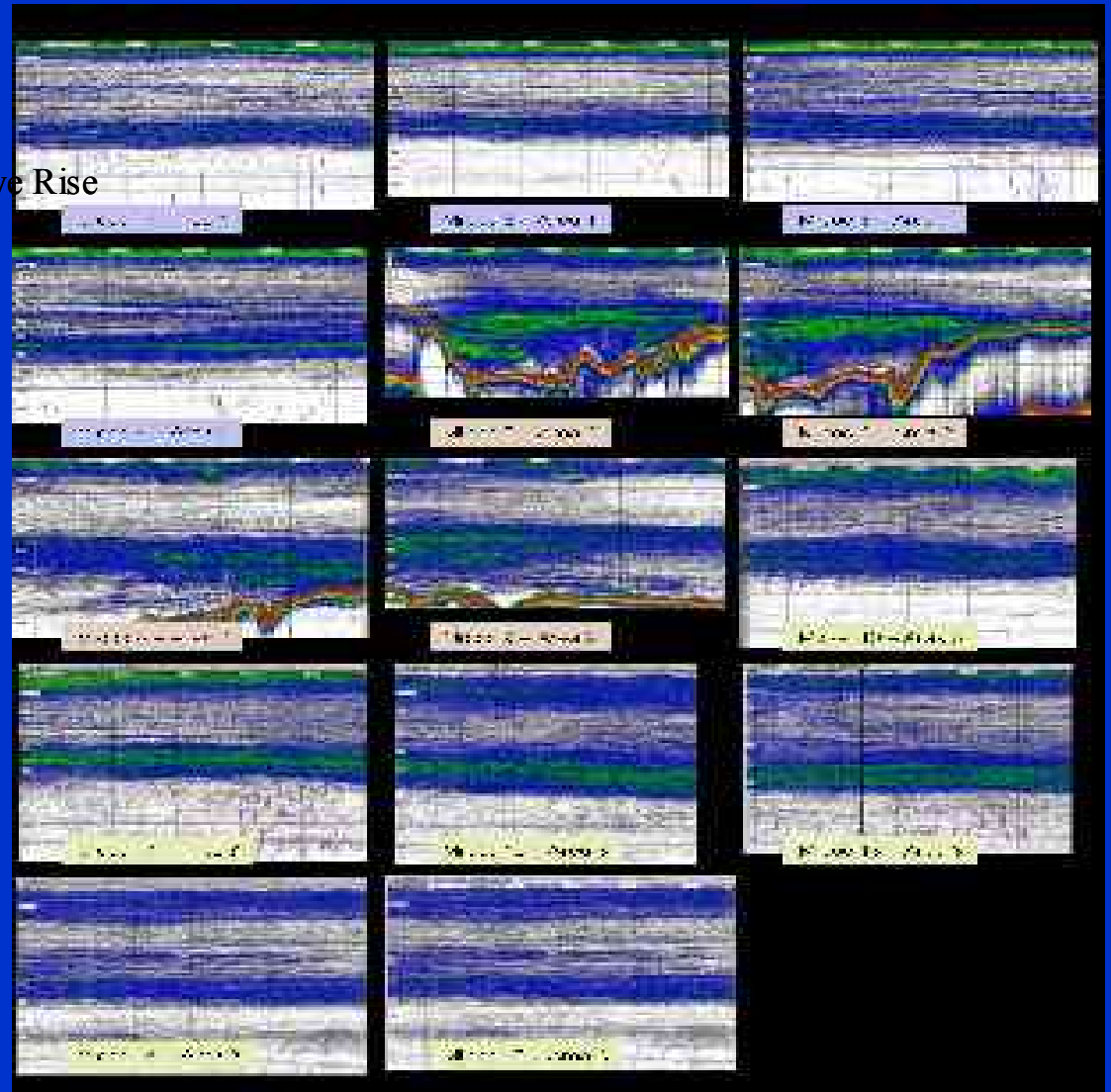
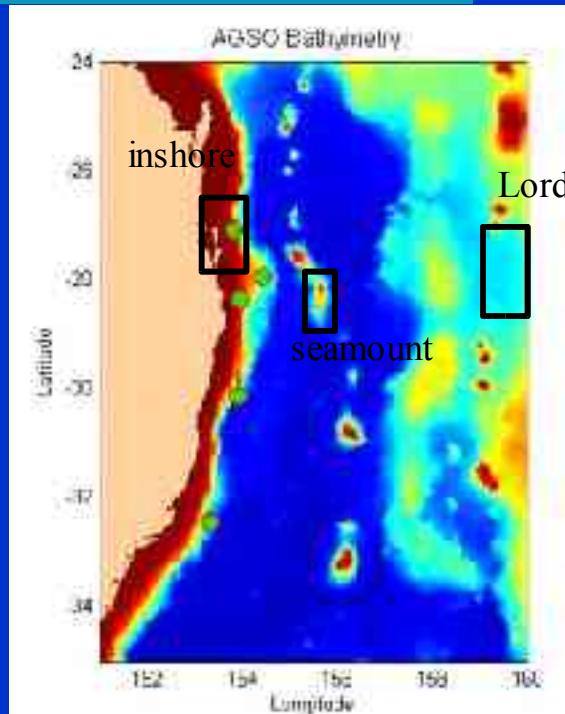
# On route from Area 2 to Area 3 showing diurnal movement of DSL

dawn

dusk



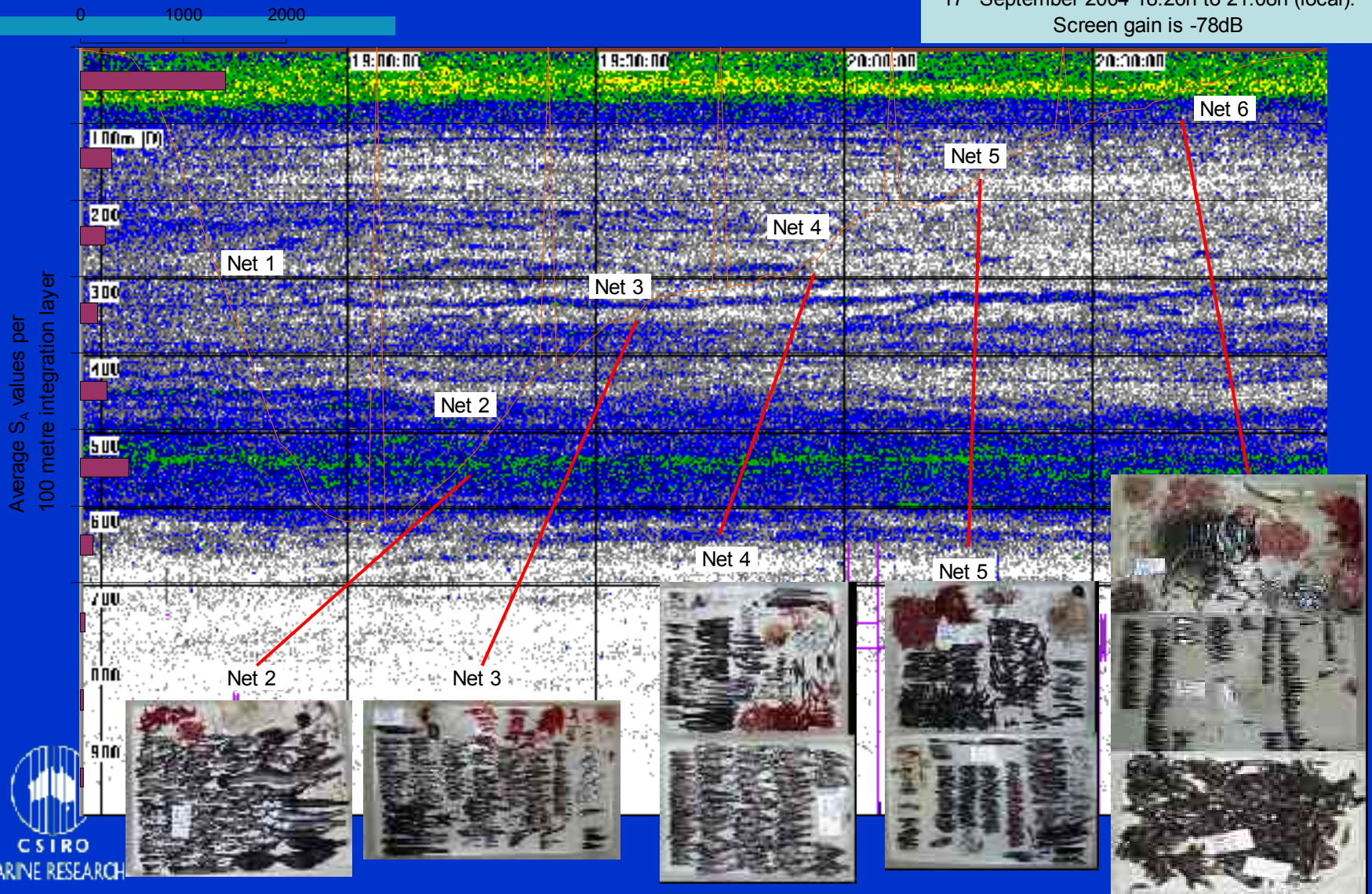
# Comparison of echograms at 38kHz recorded during midoc trawls for the three study areas (1-4, inshore; 5-9, seamount; 10-15, offshore)





# Area 1 (Inshore). 38kHz echogram and summary echointegration for duration of Midoc 3 with net depths and trigger times overlaid.

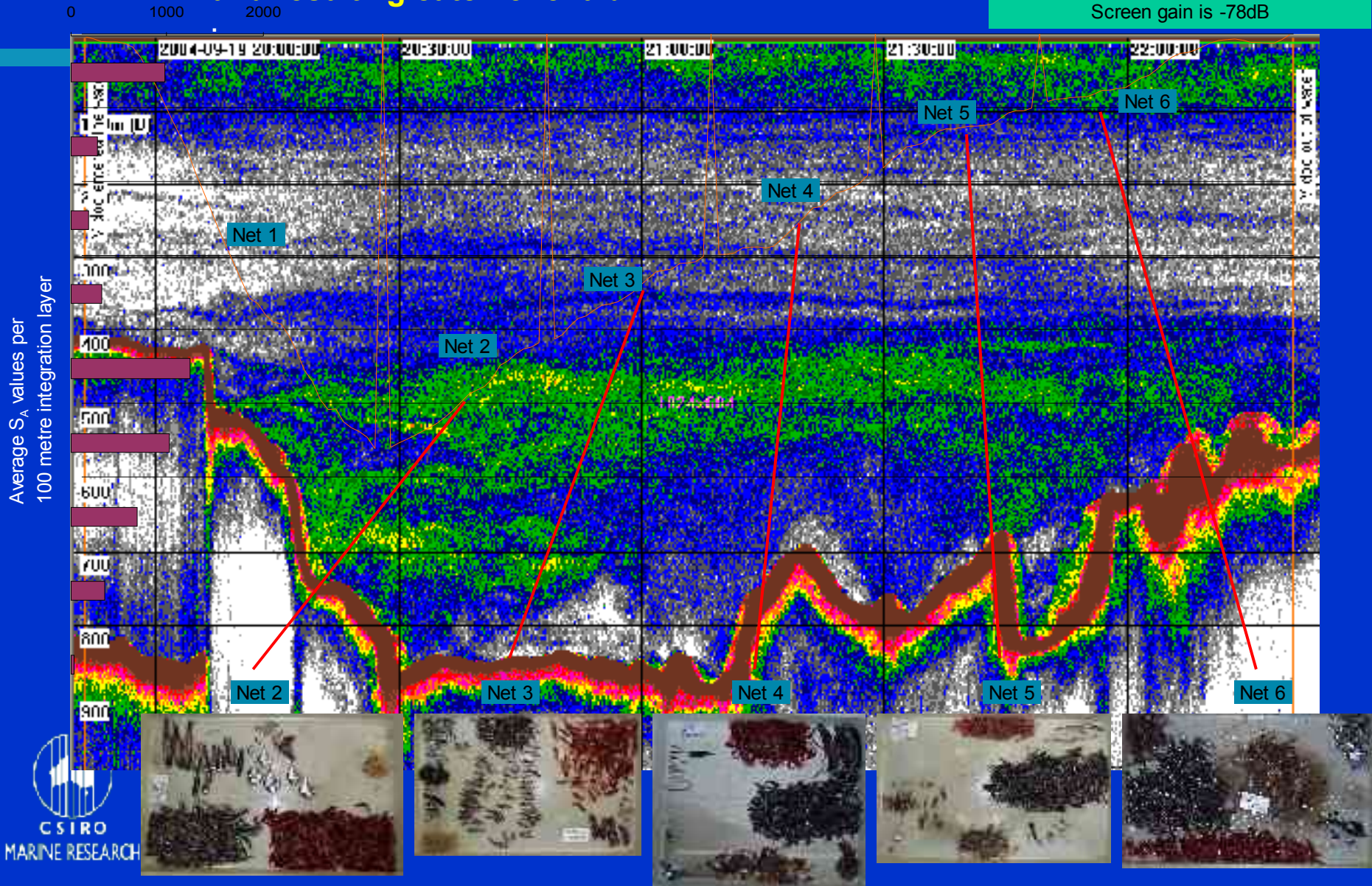
17<sup>th</sup> September 2004 18:26h to 21:08h (local).  
Screen gain is -78dB





# Britannia Seamount: 38kHz echogram and summary echartegration for duration of Midoc 5 with net depths and resulting catch overlaid.

19<sup>th</sup> Sept 2004 19:47h to 22:05h. (local).  
Screen gain is -78dB





# Net 6 (shallow)

Sternoptychidae

Juvenile squid

Mainly *C. warmingii*

Crustacea – mix of species  
*Oplophorus*, *AcanthePHYra*,  
*Sergestes* spp.,

# Net 2 (deep)



Juvenile squid

Sternoptychidae

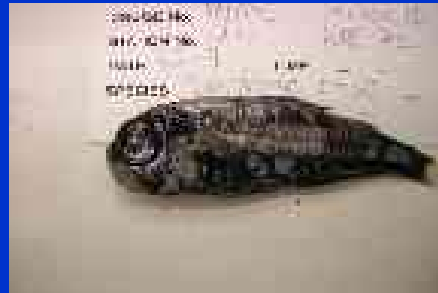
Myctophidae

Crustacea – mix of species  
*Acanthephyra*, *Gennadas*  
*Sergestes* spp.,



# Species composition of inshore (1), seamount (2) and offshore (3) areas

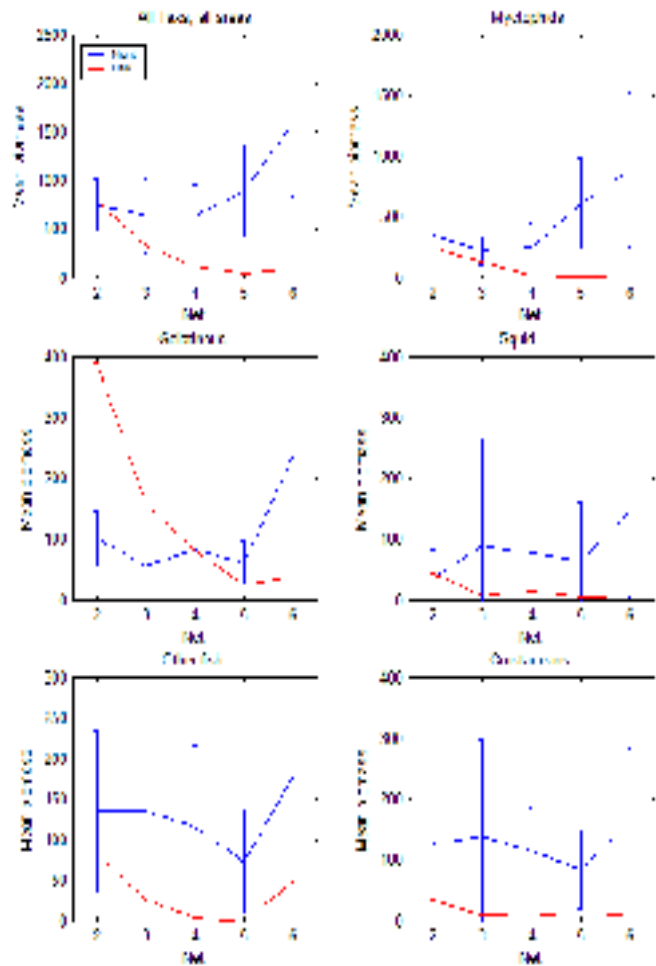
- Dominance of *C. warmingii*, particularly in area 3
- *H. hygomii* in inshore waters



Trawl (midoc) net (6=shallow) Species	%n		
	Area 1	Area 2	Area 3
Astronesthidae	0.4	0.0	0.0
Bathylagidae	0.0	0.0	0.0
Dalatiidae	0.0	0.0	0.0
Melamphaidae	0.4	0.0	0.0
Myctophidae	99.3	93.5	98.3
<i>Bolinichthus</i> spp.	2.1	0.0	0.0
<i>Ceratoscopelus warmingii</i>	37.2	26.5	86.4
<i>Diaphus brachycephalus</i>	0.0	15.2	0.1
<i>Diaphus meadi</i>	1.1	0.0	0.0
<i>Diaphus metoplocampus</i>	7.8	0.0	0.2
<i>Diaphus fragilis</i>	0.0	11.8	0.0
<i>Diaphus garmani</i>	2.1	0.0	0.0
<i>Diaphus hudsoni</i>	0.7	0.0	0.0
<i>Diaphus mollis</i>	0.7	2.7	0.1
<i>Diaphus perspicillatus</i>	0.0	0.0	3.2
<i>Diaphus termophilus</i>	0.0	3.5	1.2
<i>Diaphus watersii</i>	0.0	0.0	0.7
<i>Diaphus</i> spp.	0.0	2.3	0.0
<i>Electrona risso</i>	0.0	0.7	0.2
<i>H. hygomii</i>	22.7	2.4	2.7
<i>Lampadena luminosa</i>	1.8	0.0	0.0
<i>Lampanyctus</i> spp	2.1	8.3	0.6
<i>Lampichthys procerus</i>	0.0	0.9	2.5
<i>Myctophum nitidulum</i>	0.4	0.0	0.0
<i>Myctophum phengodes</i>	0.0	0.0	0.0
<i>Notoscopelus caudispinosus</i>	0.0	0.0	0.0
<i>Scopelopsis multipunctatus</i>	0.0	7.1	0.0
<i>Symbolophorus rufinus</i>	2.8	0.4	0.0
unid. Myctophids	17.7	8.1	0.0
<i>Gonorhynchus greyii</i>	0.0	1.2	0.0
STOMIIFORMES	0.0	0.0	0.0
Photichthyidae	0.0	0.0	0.0
<i>Chauliodus</i>	0.0	0.3	0.0
<i>Polymetme corythaeola</i>	0.0	0.0	0.0
<i>Ichthyococcus</i> spp.	0.0	0.1	0.0
<i>Diplophos rebainsi</i>	0.0	0.1	0.0
<i>Gonostoma</i>	0.0	0.0	0.0
<i>Polyipnus</i>	0.0	0.1	0.0
Sternoptychidae	0.0	1.6	0.0
<i>Vinciguerria attenuata</i>	0.0	2.8	1.8
<i>Argyropelacus</i>	0.0	0.1	0.1
<i>Howella sherbonii</i>	0.0	0.1	0.0
<i>Persarsia kopua</i>	0.0	0.0	0.0
<i>Leptocephalus</i>	0.0	0.0	0.0
<i>Trachurus</i> spp.	0.0	0.0	0.0



# Biomass of taxa from individual depth strata combined for all areas

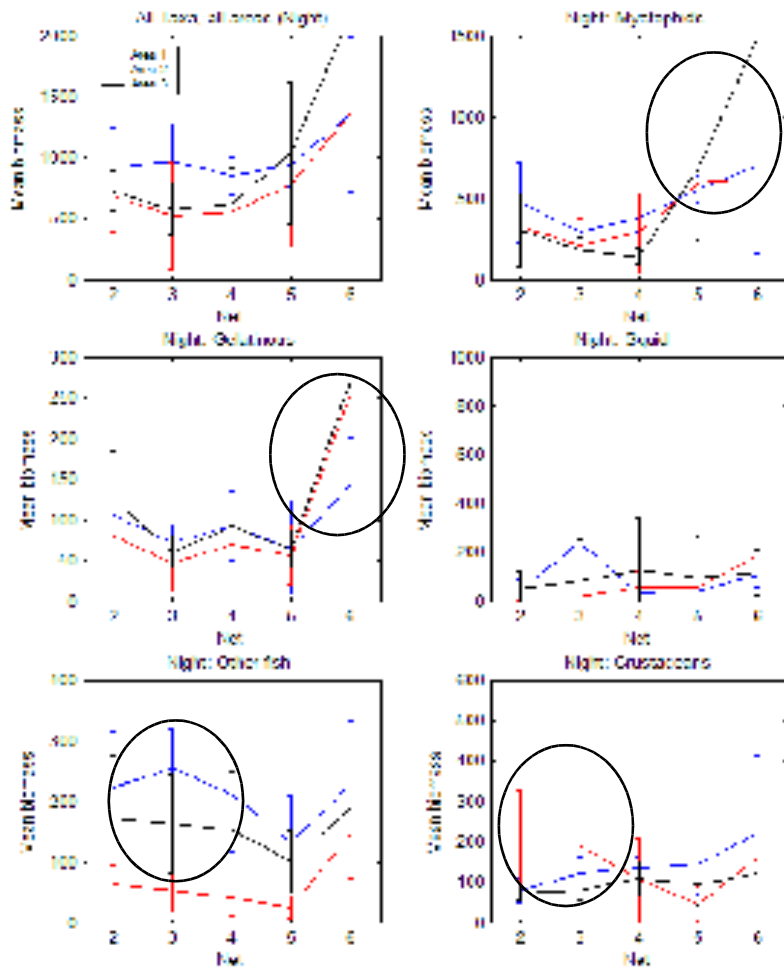


- 0-100 m smaller size classes dominate, particularly myctophids
- 200-300 m wider mix of species
- 300-400m increase in larger sized species
- 400 m+ increasing presence of DSL in daytime tow



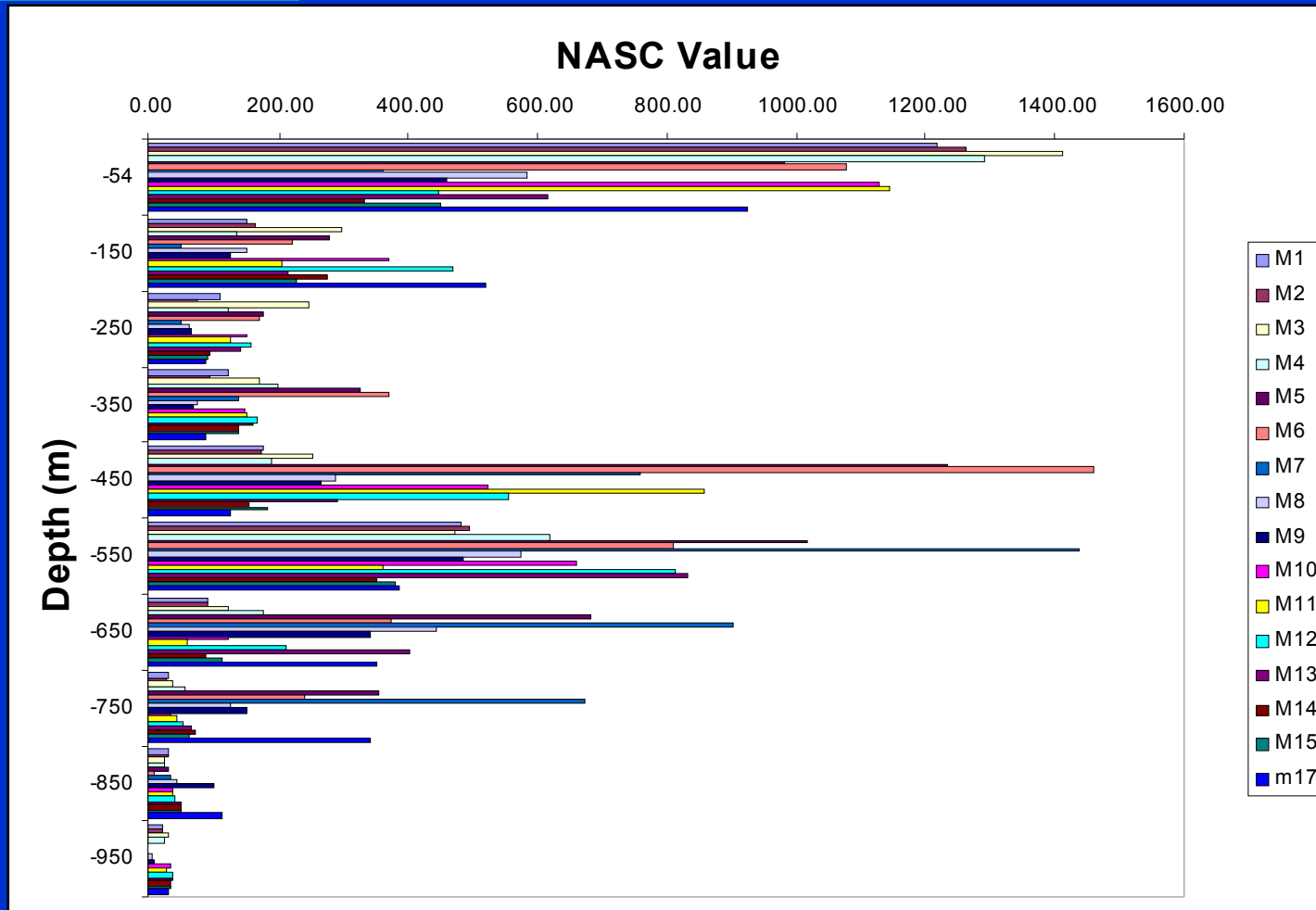


# Variation in vertical distribution by taxa



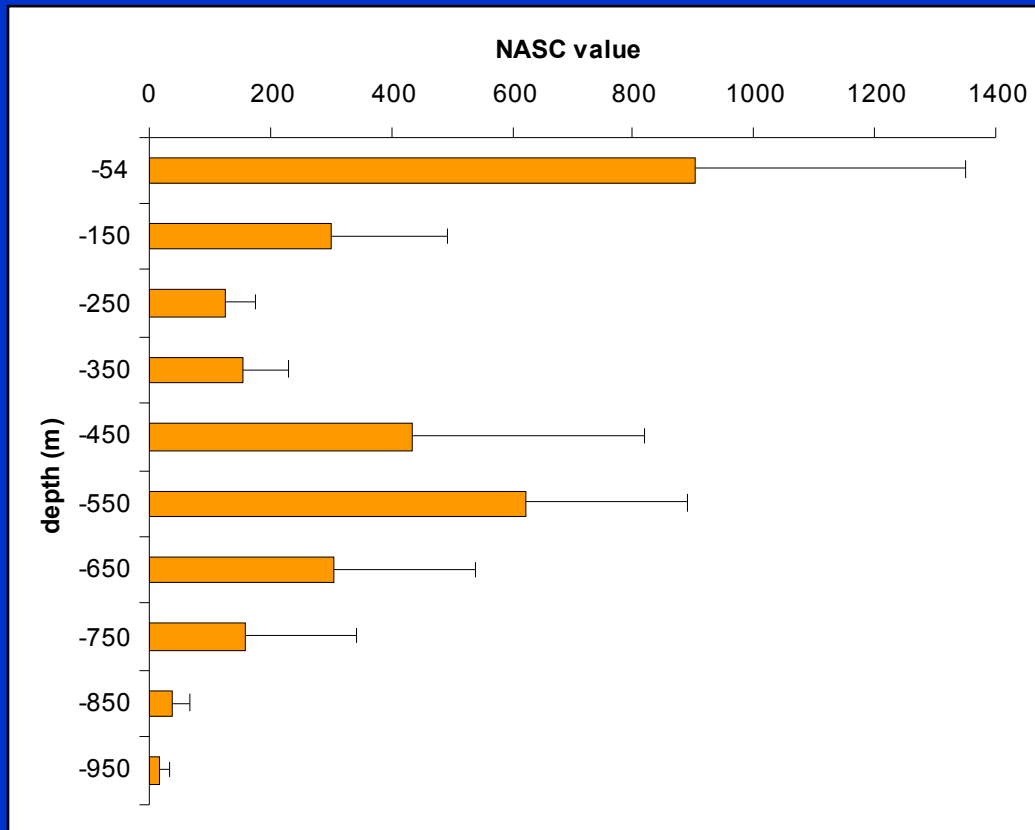
- Myctophids, gelatinous zooplankton higher biomass in surface waters, particularly offshore
- Cephalopods poorly represented
- Stomatoid fishes (e.g. *Cyclothone* spp) in deeper waters
- Crustaceans concentrated in deeper water around seamount

# Acoustic “biomass”: Comparison of echo strength recorded during each midoc tow



Nautical area scattering coefficient (NASC) units are:  
 $m^2 \text{ nmi}^{-2}$ , i.e. meters squared per nautical mile squared

# Mean night time backscatter ( NASC) by 100 m depth bins (from eighteen two-hour night-time tows)

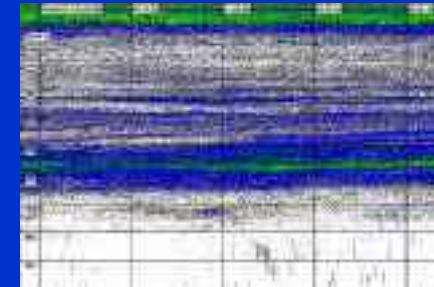
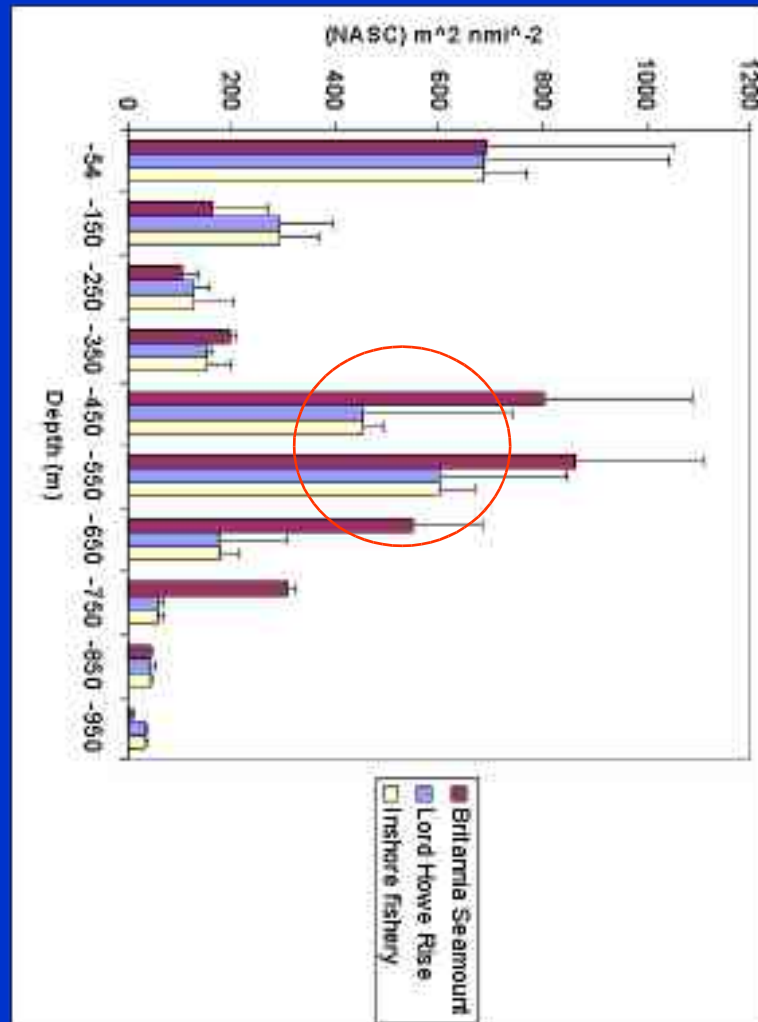


- Significantly higher NASC values in epipelagic zone

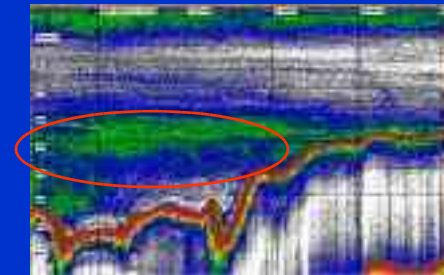


Nautical area scattering coefficient (NASC) units are:  $m^2 nmi^{-2}$ , i.e. meters squared per nautical mile squared

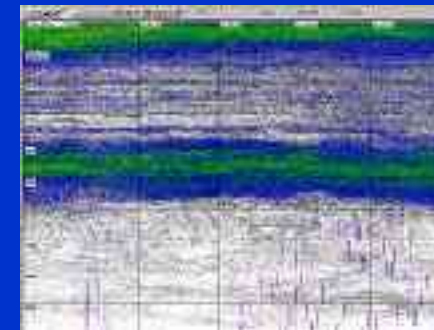
# Mean NASC values compared between sites and depths



inshore



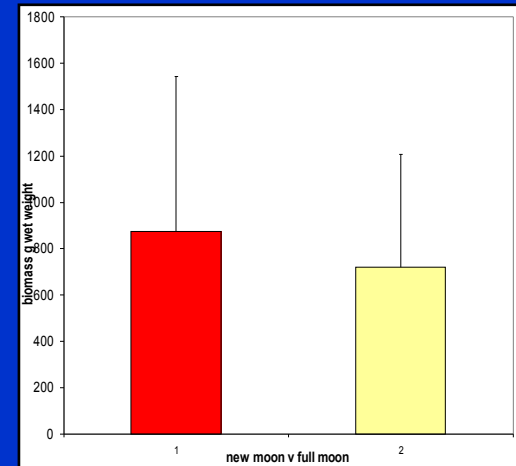
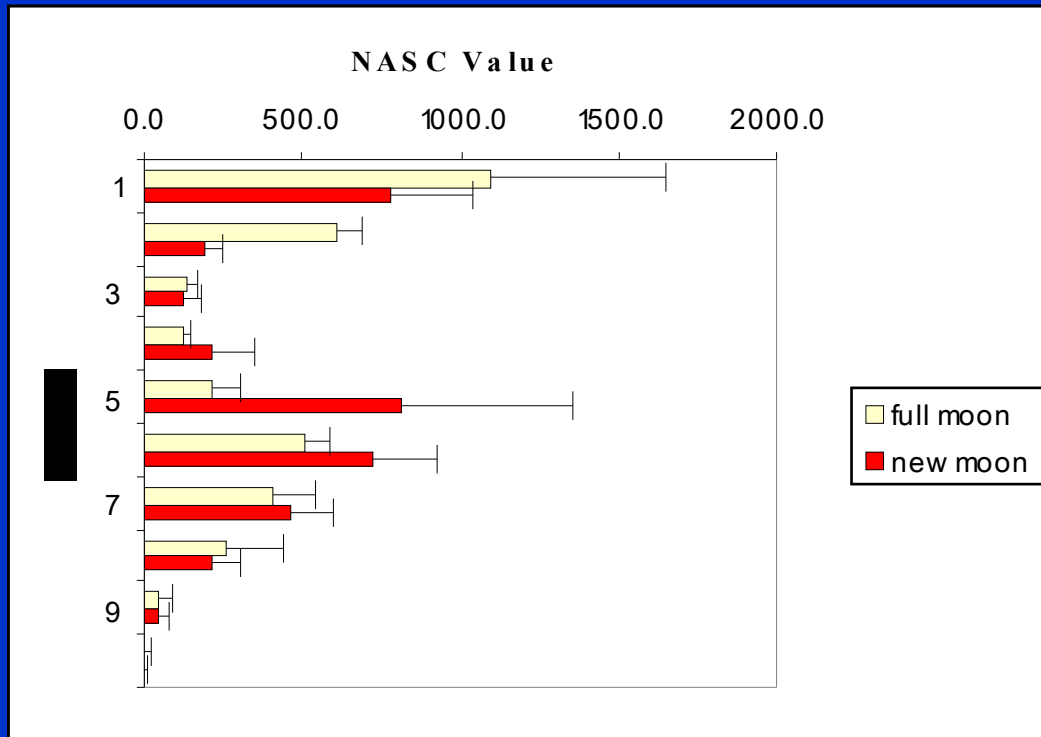
seamount  
(ns)



offshore



# Acoustic backscatter compared over seamount – new moon v full moon

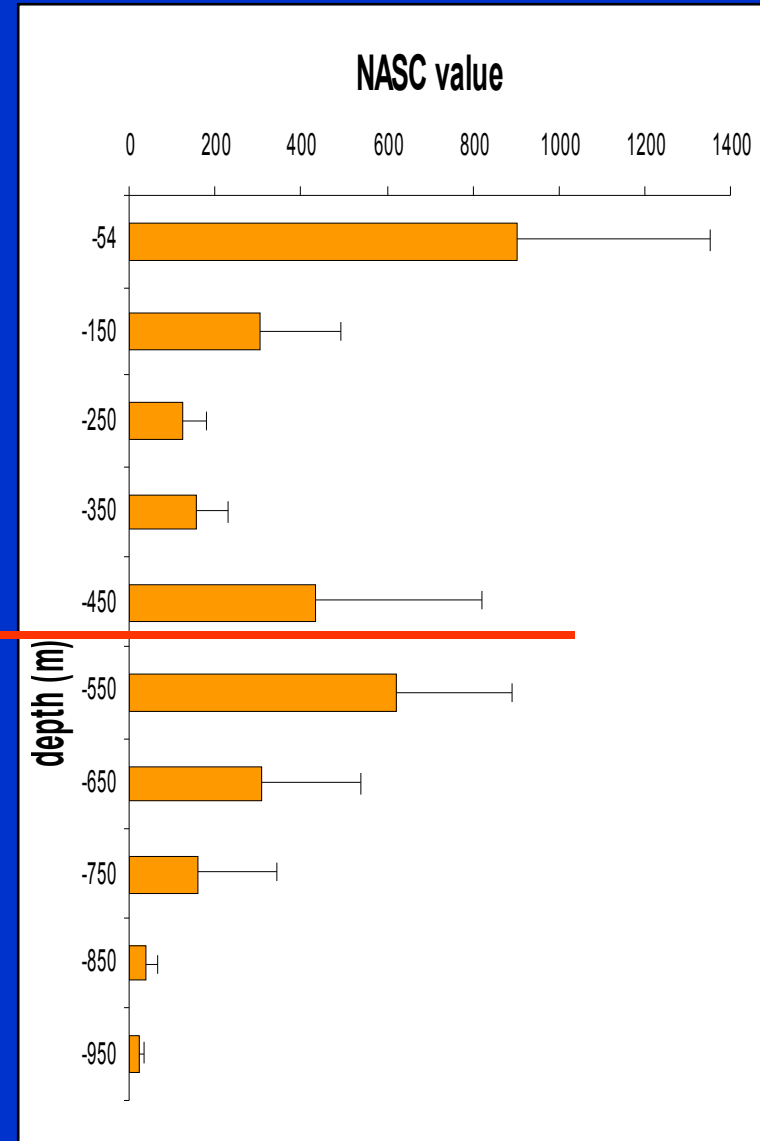
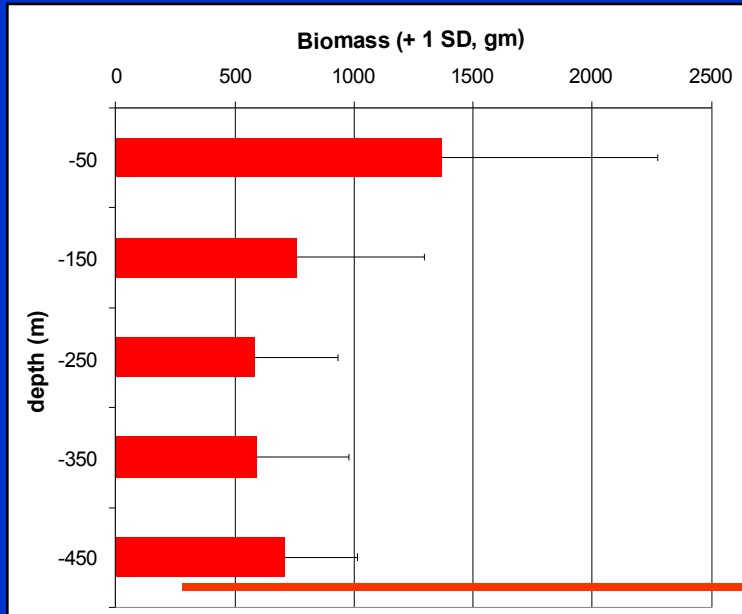


- difference in vertical distribution but no difference in biomass

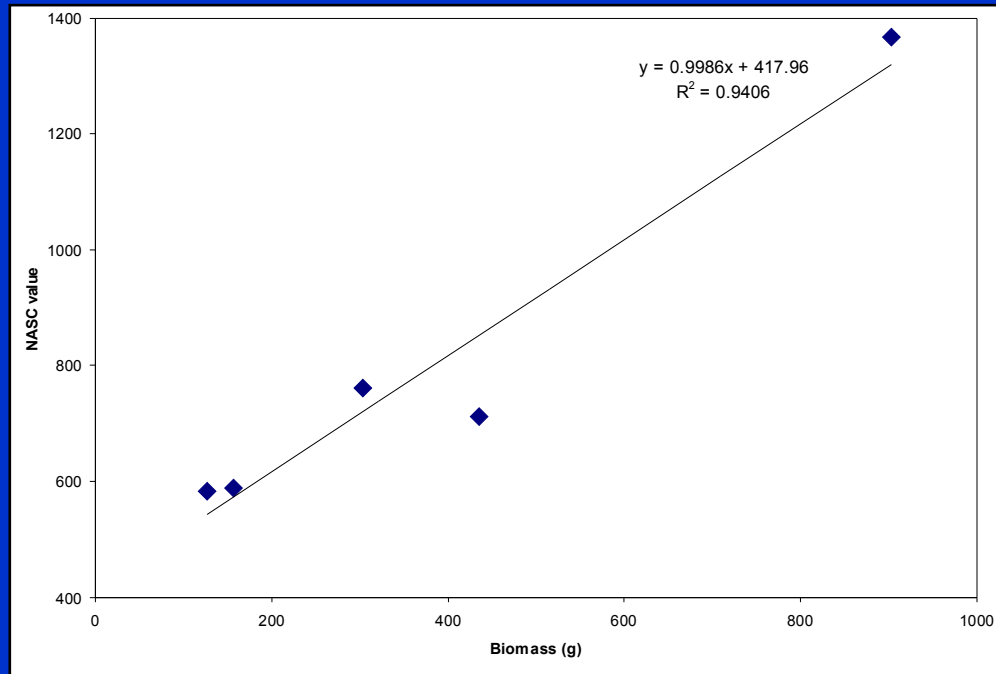




# Comparison between actual and acoustic biomass



# Comparison of NASC values with actual biomass of catch



$r^2 = 0.94$



# Ongoing studies

- Calibrating echograms to actual biomass through target strength studies (fat buoy)
- Linking micronekton distributions to top predators
- Gut contents analysis (conventional and stable isotopes)
- Distribution of top predators



# Movements of blue sharks tagged during SS0904

