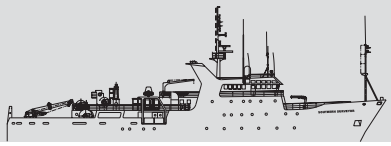


MARINE
NATIONAL FACILITY

2004 program

RV *Southern Surveyor*

CSIRO
MARINE RESEARCH

voyage summary SS09/2004

SS09/2004

Pelagic habitat and community comparisons in the fishing grounds of the tuna and billfish fishery off eastern Australia.

Itinerary

Departed Brisbane 1000hrs, Wednesday 15 September 2004
Arrived Brisbane 1000hrs, Thursday 30 September 2004

Principal Investigators

- Dr Jock Young (Chief Scientist)
  CSIRO Marine Research
  GPO Box 1538 Hobart Tasmania 7001
  Phone: (03) 6232 5222 **Fax:** (03) 6232 5000 **Email:** Jock.Young@csiro.au
- Dr Alistair Hobday
  CSIRO Marine Research
  GPO Box 1538 Hobart Tasmania 7001

Scientific Objectives

Our primary objective was to characterise the physical ocean habitat and biological community structure of the main areas of the Eastern Tuna and Billfish fishery through systematic description using a CTD, nets and acoustics. The voyage will collect data to address the observations that CPUE for target species such as swordfish is consistently higher over seamounts and in relation to frontal features. Predictions that prey biomass will be higher and vertical ocean structure uplifted over the regions with higher CPUE, identified a-priori, will be tested. The data collected will also be incorporated into a spatially-explicit ecosystem model to define the major ecosystem habitats and communities within which the fishery operates and to determine the lower order trophic linkages in the system.

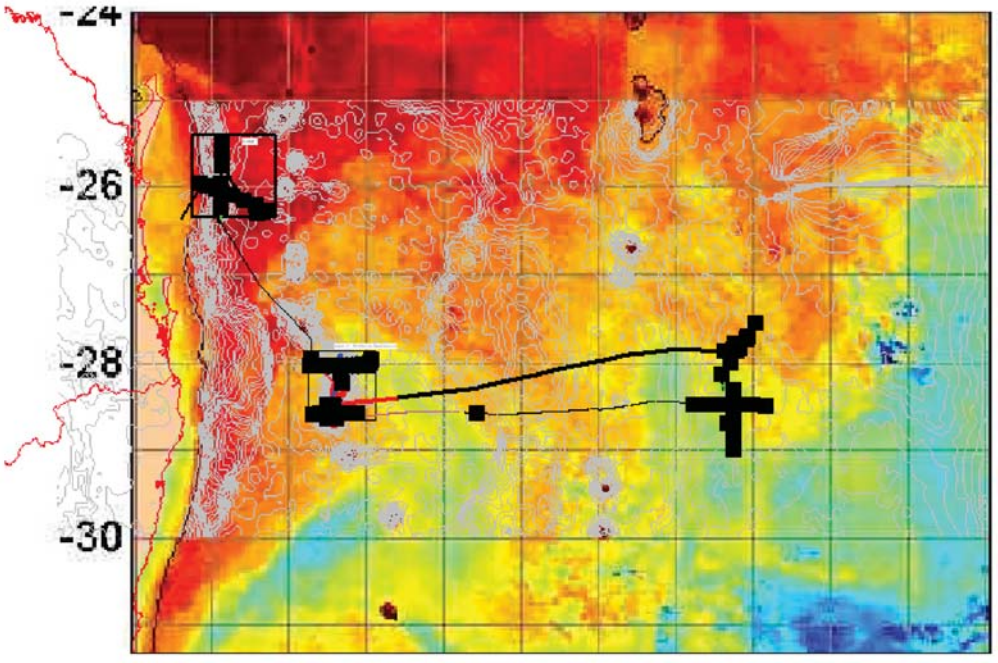
Voyage Objectives

We will collect oceanographic and biological data and samples to:

1. describe the physical water column structure of the three regions, and in the case of the seamount if water column structure relates to seabed topography,
2. estimate the primary productivity, distribution of chlorophyll and pigments, and phytoplankton species composition in the three regions,
3. establish stable isotope signals for the base of the food chain in the three regions,
4. quantify the zooplankton and micronekton biomass in the three regions using nets and acoustics,
5. determine, in cooperation with the longline fleet and AFMA observers, the food chains leading to species targeted by the fishery (tuna and billfish) in the three regions through stomach collections and stable isotope analysis of predators and prey and
6. begin, in conjunction with the longline fleet, a study of longline setting characteristics to determine average feeding depths (and times) of target species.

Voyage Track

Figure 1: Voyage track showing the three areas sampled off eastern Australia



Results

We completed two CTD transects in each of the three areas we visited (Figs. 2 to 4); the inshore fishery off Fraser Island, Britannia Seamount and the Lord Howe Rise. In all, a total of 51 CTD casts to a depth of 500 m were completed (Table 1)). The inshore area of the fishery was dominated by waters of the East Australia Current. Britannia Seamount was dominated by a mixture of EAC and Tasman Sea water with an indication that the seamount acted as a partial barrier to the eastward spread of the EAC. The third area at the edge of the Lord Howe Rise had a similar oceanography to that over the seamount; both areas were relatively more saline than waters found inshore.

Samples were collected from each of the regions to quantify primary productivity, chlorophyll and pigment composition from the CTD casts. Samples were also collected to identify stable isotopes of carbon and nitrogen. We aim to test whether the combination of the resulting analyses can provide a signature for the base of the food chains in each of the regions sampled.

We completed a total of 63 daytime plankton (Bongo) tows to a depth of 200 m. Each tow was accompanied by a surface tow. We also completed 20 depth-stratified tows from a depth of 600 m to the surface using an opening-closing midwater trawl (Midoc). All but two Midoc tows were completed at night and wherever possible, replicated. The remaining two were towed at daytime to examine micronekton patchiness at depth. The plankton tows were preserved for later analysis while the midwater catches from each stratum from each tow were photographed, sorted to major taxa, weighed, and frozen for later detailed identification. The biomass of each taxon was compared with respect to depth strata and area at sea to identify potential differences (Figs. 5 and 6). Fish and crustacean were identified to species from tows from each area to determine whether community differences existed between the regions. In conjunction with the net sample we ran underway and *in situ* acoustic estimation experiments to quantify the catches by the plankton and midwater tows (Fig. 7).

With financial support from CSIRO Marine Research we chartered the longliner *Ocean Odyssey* for the period of the voyage to catch top predators from which we could gather samples for trophic analysis. We also had the cooperation of the AFMA Observer program to support gut collections and to record information on longline behaviour using equipment we had provided. The longliner worked with us throughout the voyage enabling us to sample the larger fauna of the three areas.

A secondary objective to calibrate satellite derived sea surface temperature was carried out on the voyage.

Voyage Narrative

The Inshore fishery

We departed Brisbane at 1000h on Wednesday 15 September and headed for the shelf to begin a study of the inshore longline fishing area, Area 1, centred on 25° 56 S, 153° 40 E. This was the first of three areas we aimed to survey. On route we established procedures for the various aspects of the work we were intending to complete. The longliner, *Ocean Odyssey*, we chartered left Mooloolaba at 1500 h heading for the same position. We began a west to east CTD transect to describe vertical structure of the water column. We continued the transect through the night. The last CTD was completed midmorning after which we began a set of 3 bongo and surface tows at the eastern end of the transect. *Ocean Odyssey* hauled their first set but only caught two small yellowfin tuna. They then moved north to 25° 35 S, 154° 01 E for their next set along the 1000 m contour. As we were 50 n.miles away we steamed north to reconnect with them. We began stratified sampling of the micronekton to a depth of 600 m using the Midoc net through the night and into Friday morning. We spent Friday completing continuous sets of 3 plankton tows using bongo and surface net tows interspersed with CTD casts until dark. After dark we continued Midoc sampling interspersed with target strength calibration using the 'Fat boy', a device which is lowered to the depths sampled by the Midoc to estimate the acoustic signal of individual targets (in our case mainly lantern fishes (family Myctophidae)).

Britannia Seamount

At completion of the Midoc sampling we steamed south to Britannia Seamount (Area 2) where we arrived Saturday afternoon (18 September). An acoustic transect along the way showed a progressive increase in the concentration of backscatter up against the northwestern edge of the Queensland Seamount. We then headed south to Britannia Seamount. We completed a light cast for the productivity experiment to be run the next day. We then began a west to east CTD transect across the northern end of the seamount.

We completed the dawn productivity experiment and then started a CTD/Bongo transect and began mapping the seamount topography using the swath mapper. The acoustic transect showed a concentration of backscatter at 600 m close to the western side of the northern edge of the Britannia Seamount. At 1830 h we deployed the first of two Midocs for the night bracketed by one Fat boy deployment. Each Midoc was deployed on a NE-SW course to follow the 600 m contour.

We continued mapping the seamount and then deployed a daytime Midoc in the same area. A light cast we made at midday was our one hundredth operation to that point. The longliner had set its line on the eastern side of the seamount at the same latitude on Sunday evening. They hauled Monday morning and were able to tag a swordfish and a sunfish as well as collect some biological information from other fish that had died on the line. We then headed to the south of the seamount to repeat the sampling pattern of the previous night. We completed a transect of bongo tows and CTDs up to 1700 h. We then tested the Fat boy over deep water before heading back onto the seamount to begin a set of Midoc tows along the southwestern edge of the seamount. *Ocean Odyssey* set their longline on the southeastern edge of the seamount. After consulting the AFMA Observer on Ocean Wanderer we set coordinates for Area 3 at position 28° 30S 160° 30E and informed *Ocean Odyssey*. They would meet us there late Wednesday. After completing the second of two Midocs in the region and initiating another productivity experiment we began the 260 n.mile steam eastward to Area 3 at the above position on the Lord Howe Rise.

Lord Howe Rise

We arrived at Area 3 at 0430 h (Wednesday 22 October) and began a CTD transect along 28ø 30' S starting at 160ø E. The crossing of a one degree surface temperature front in the area set up the possibility of a warm/cold comparison over the coming days. We began the first set of Midocs in cooler water to the west of *Ocean Odyssey*. We completed a second Midoc followed by a productivity cast to 150 m. We then continued a bongo ctd transect through the day followed by netting at night. We continued with bongo tows and CTDs during the day to the north (Friday 24).The transect was concluded at 1700 h, the end of which put us about 40 n.miles to the northeast of *Ocean Odyssey*. We headed south to be within 10 n.miles of their line. The current was moving to the southeast so we began our Midoc trawl to the northeast trawling towards the longline position. When finished we completed a Fatboy deployment followed by the second Midoc of the night.

Following the second Midoc a productivity cast was completed before dawn (Saturday 25). We then completed a daytime Midoc at 600 m to examine patchiness of micronekton at that depth. Tagging and biological collections continued on *Ocean Odyssey*. Two yellowfin tuna, a swordfish and a blue shark were captured live and released with satellite tags. At midday we began the steam, with *Ocean Odyssey*, to Britannia Seamount to continue sampling there. Our aims in this final part of the voyage were to continue mapping the acoustic biomass over the seamount and to complete micronekton tows on its eastern side, as well as tag large fish in the area.

Return to Britannia Seamount

We arrived at the southern end of the seamount on nightfall (Sunday 26 October) and began an acoustic transect to map the scattering layers along the boundaries of the seamount at a depth of 800 m. The transect continued through the night during which time we used the swath mapper as the contour map we were using differed significantly from our observations.

The acoustic transect continued through till dawn (Monday 27 October). We then began a CTD/Bongo transect from the west to the east of the southern end of the seamount.

On completion of the transect we steamed to the southeast edge of the seamount and began the first of two Midocs at 1900 h in about 1500 m of water. *Ocean Odyssey* had set their line in the area the previous night with little result, although they tagged a thresher shark and a broadbill swordfish. The swordfish died in the water during release and the tag was retrieved.

We completed a daytime acoustic transect following the same course as that followed by the night acoustic transect to examine diel movements of the deep scattering layer. At 1900 h we began the last set of Midoc tows off the northeastern section of the seamount under a full moon and calm seas. *Ocean Odyssey* deployed their last set for the trip slightly to the north east along the 2000 m contour.

We departed the seamount at 0600 h for the return journey to Moreton Island where we met the pilot and headed to our berth on the Brisbane River. We berthed at 1000 h at Forgacs wharf on Thursday 30 October.

Summary

All objectives of the voyage were met. The equipment used in the study was well prepared and professionally deployed allowing a smooth flow of tasks during the study. The combination of the former together with settled weather and enthusiastic personnel all helped to ensure a safe and productive time at sea.

Personnel

Scientific staff

Jock Young – CMR, Chief Scientist/watch leader
Alistair Hobday – CMR, Alternate watch leader
Jeff Dambacher – CMR, Biologist (nets, ctd)
Ron Plaschke – Nat Fac, Voyage Manager
Russ Bradford – CMR, Biologist (nets, ctd)
Mark Rayner – Nat Fac, Hydrochemist
Miroslaw Ryba – Nat Fac, Computing
Lindsay MacDonald – Nat Fac, Electronics
Tim Ryan – CMR, Acoustics
Mark Lewis* – CMR, Midoc net specialist
Pru Bonham – CMR, Biologist (primary productivity, isotopes)
Klaas Hartmann – CMR, Biologist

Ship's crew

L. Morrow – Master
J. Boyes – Chief Mate
D. Meincke – Second mate
R. Thomas – Chief Engineer
R. Cave – 1st Engineer
J. Hinchcliffe – 2nd Engineer
G. McDougall – Bosun
P. French – Greaser
B. Messenger – IR
P. Germann – IR
P. French – IR
M. Johnson – IR
D. McPherson – IR
R. Williams – IR
M. Cleworth – IR
A. Goss – Chief Cook
P. Williams – Chief Steward
G. Byrne – Second Cook

Acknowledgments

This research voyage was the result of a proposal to the National Facility. However, extra financial support was provided by FRDC through their funding of a major ecosystem study of the waters of the Eastern Tuna and Billfish fishery granted to Drs Jock Young and Alistair Hobday. We would like to thank the skipper and crew of the Southern Surveyor and the participating scientists for their efforts during the voyage.

Jock Young
Chief Scientist

Figure 2: East to west CTD transect of Area 1 (inshore area) showing the influence of East Australian Current (EAC) water adjacent to the shelf.

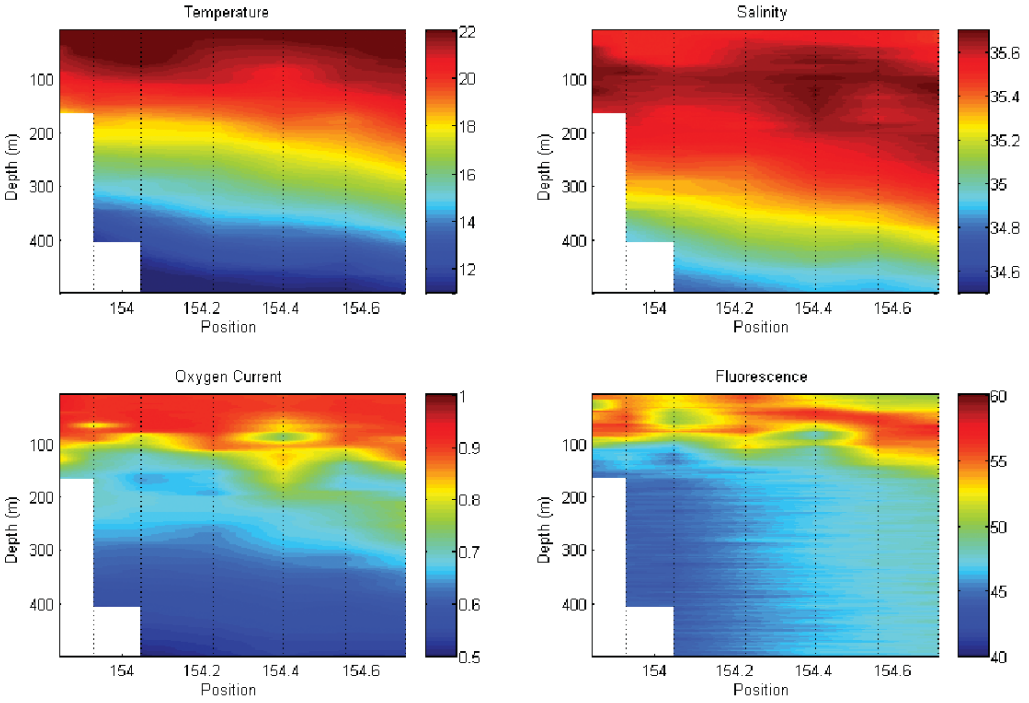
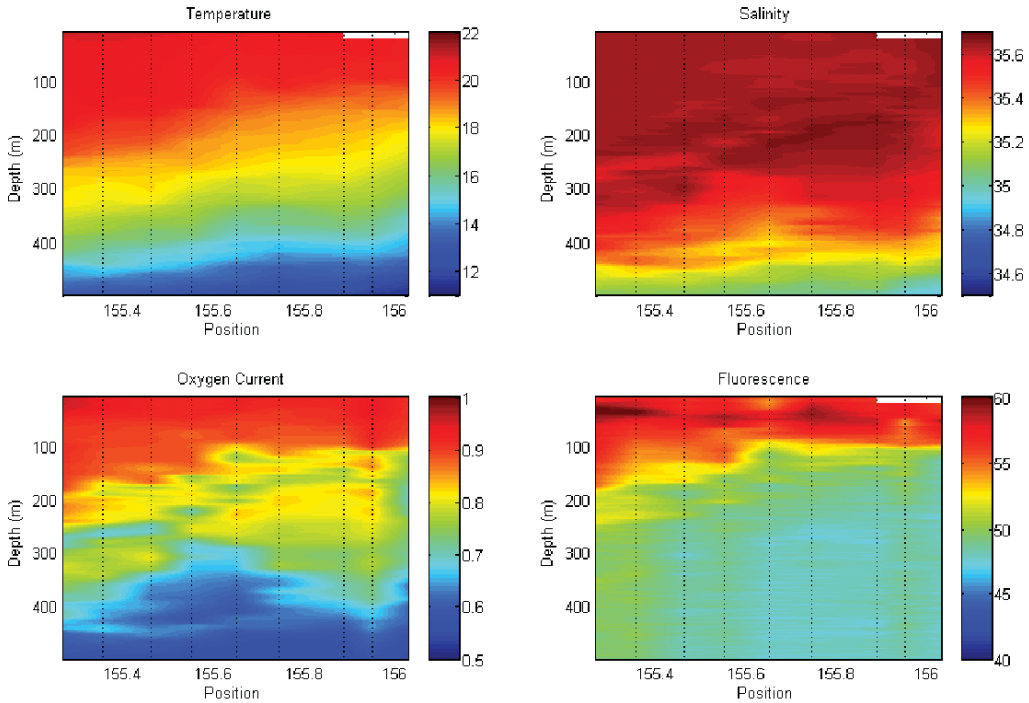


Figure 3: East to west CTD transect over Area 2 (Britannia Seamount) indicating a shallowing of isotherms over the seamount.



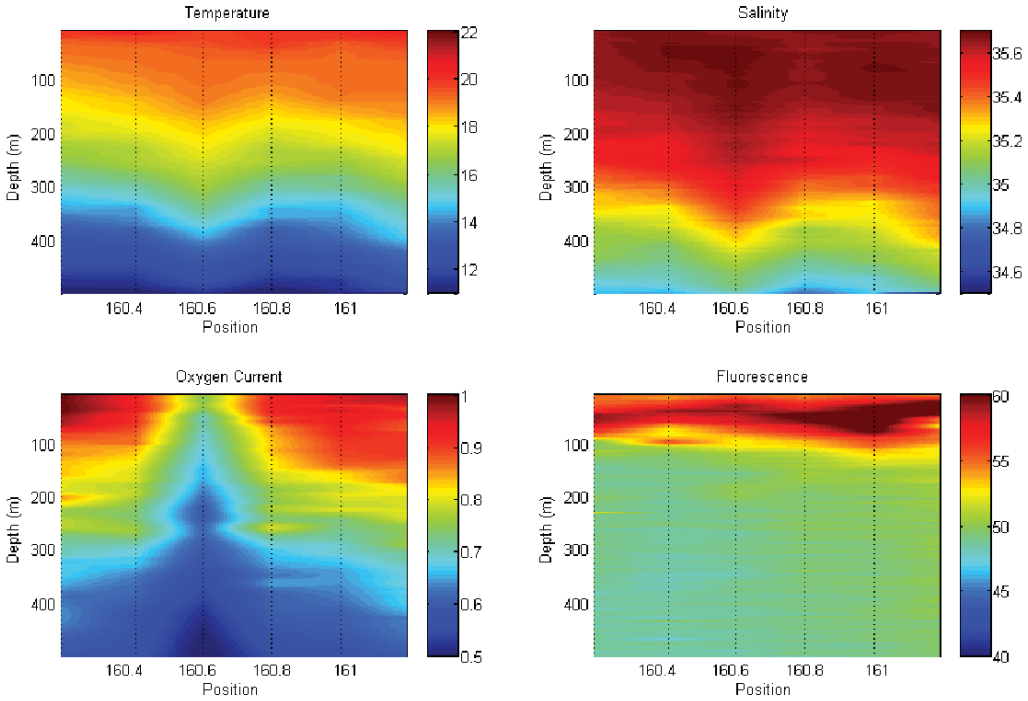


Figure 4: East to west CTD transect over Area 3 (Lord Howe Rise) indicating the increasing influence of cooler Tasman Sea water over the area.

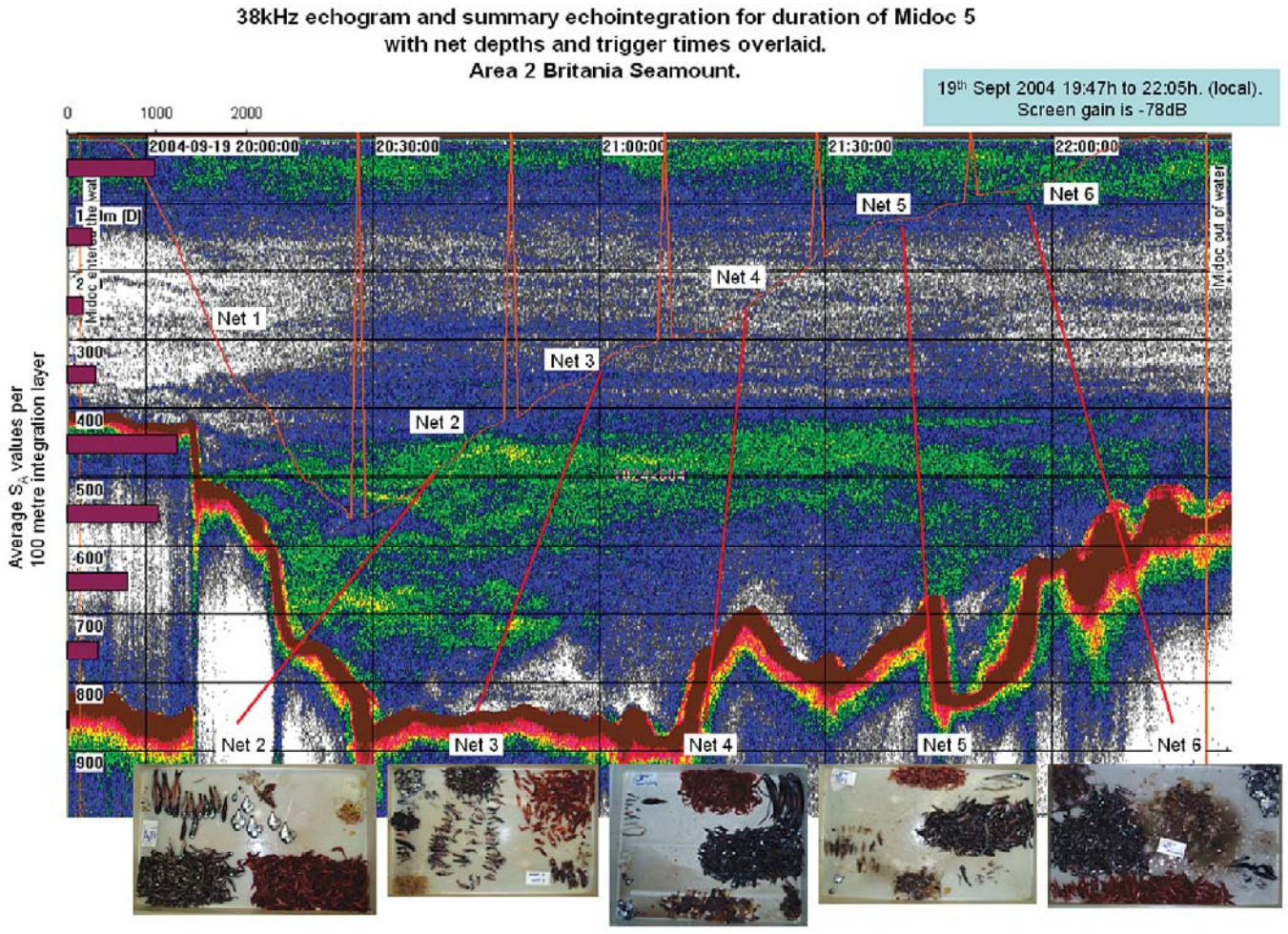


Figure 5: Time at depth composite of a typical 'Midoc' tow over the Britannia Seamount showing concentrations of acoustic "biomass" at the surface and between 400 and 600 m depth. The deep scattering layer was comprised mainly of crustaceans (Net 2) and of myctophids at the surface.

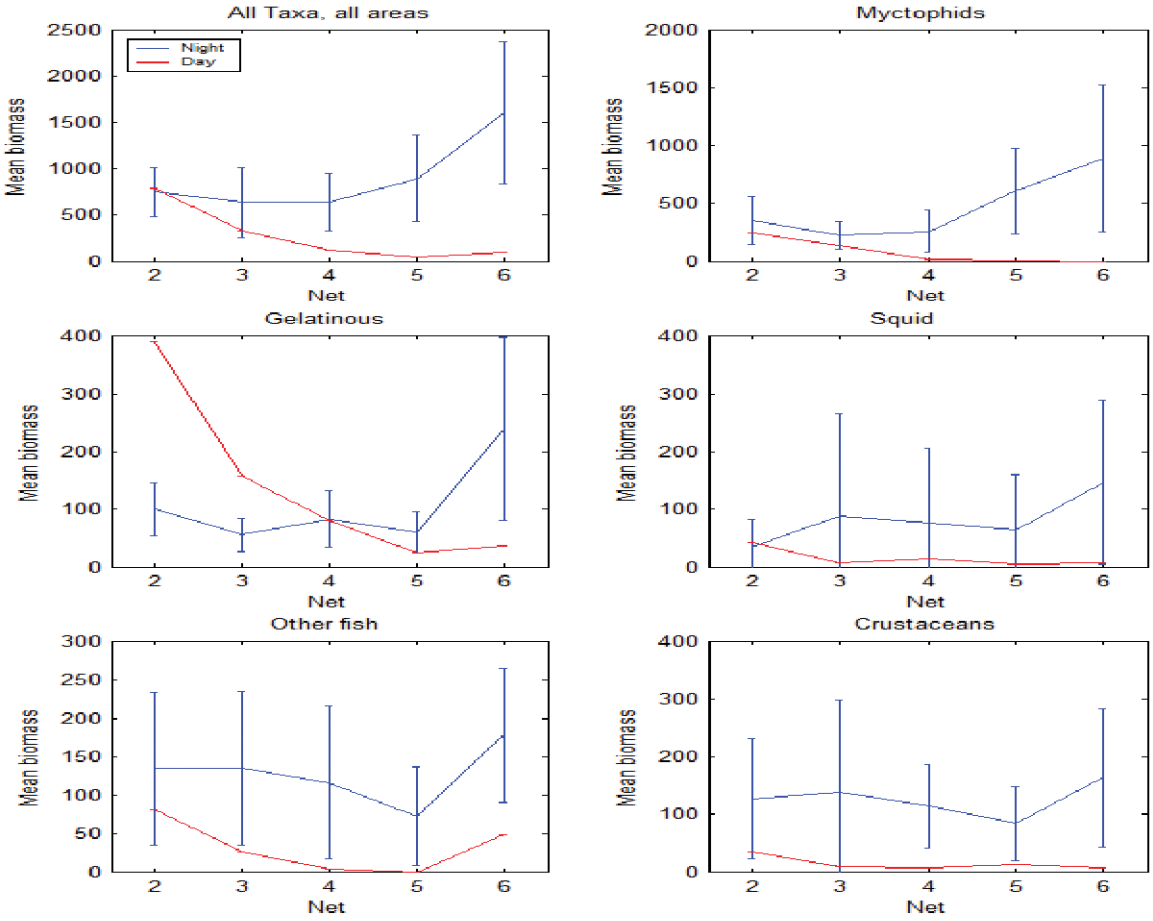


Figure 6: Mean biomass of each taxon in relation to depth. Samples were collected from previously nominated depth strata with the opening closing midwater trawl (Midoc). The depth strata were from 600 m depth to 400 m (Net 2), thereafter at 100 m intervals to the surface (Net 6) (blue, night sets; red, day set).

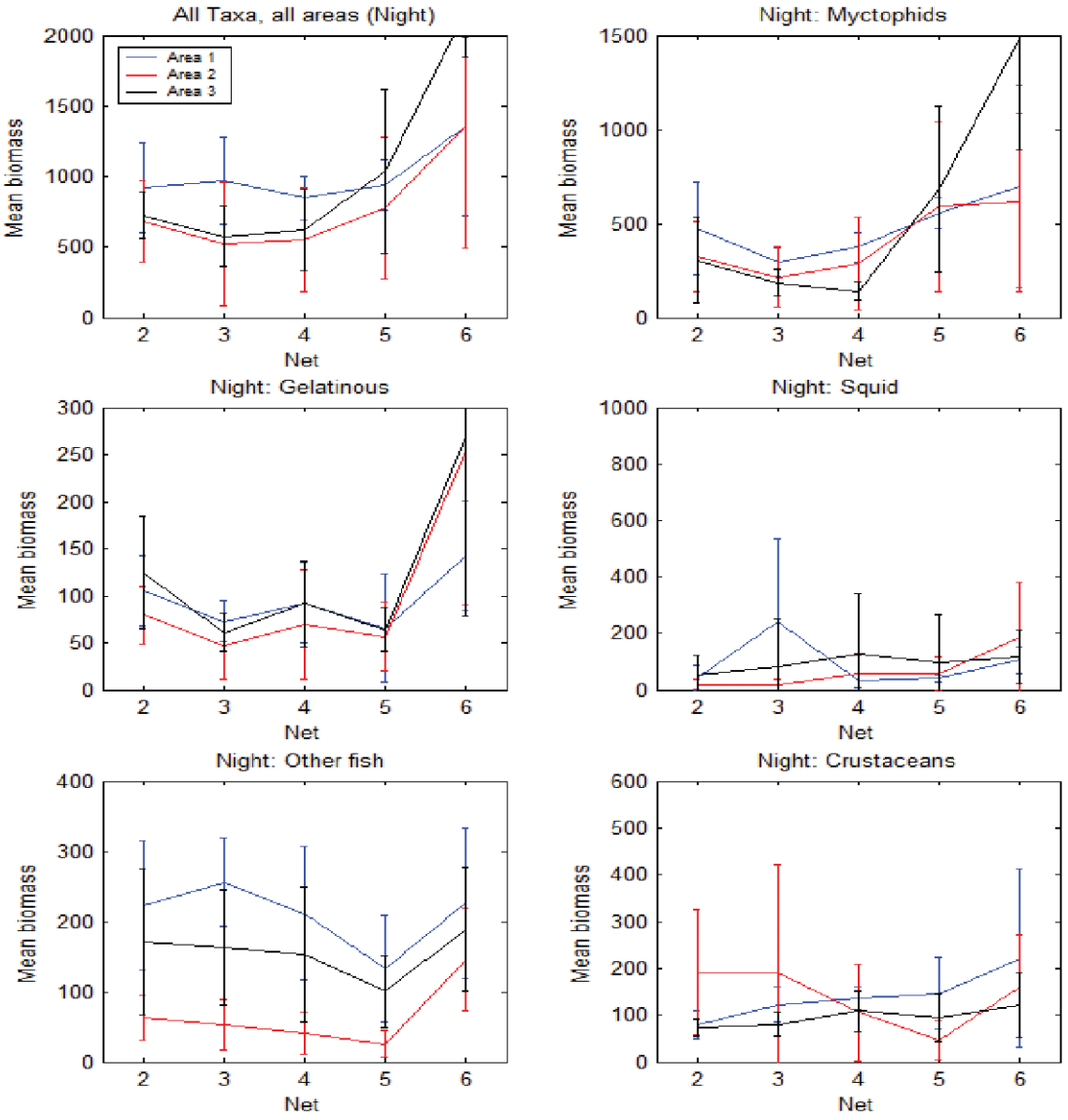


Figure7: Biomass of taxa in relation to area sampled showing that Myctophid biomass was highest in Area 3 (Lord Howe Rise) in surface waters. Crustacean biomass was highest in Area 2 (Britannia Seamount) when the deeper strata were compared indicating potential concentration of prey on the edge of the seamount at depths greater than 400 m.

Figure 8: Release positions of fish caught and released with satellite tags during the study (n=14).

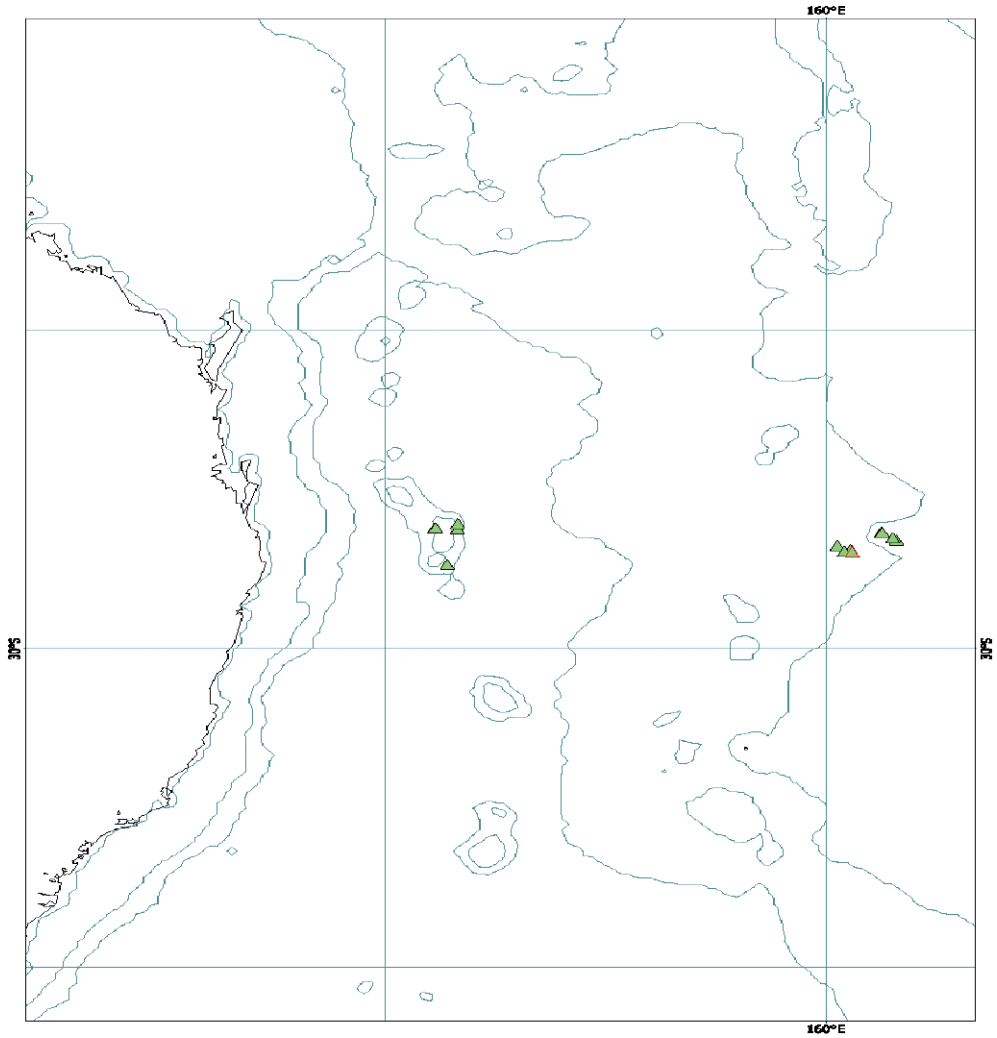


Table 1: Summary of samples collected from each area during the voyage

Area	CTD casts	Bongo/Surface tows	Midwater (Midoc) tows	Fat Buoy casts	Longline sets*
Inshore fishery	14	15/15	4	2	3
Britannia Seamount	25	27/26	9	6	3
Lord Howe Rise	19	21/21	7	7	3

* A separate report on the collections by Ocean Odyssey available on request