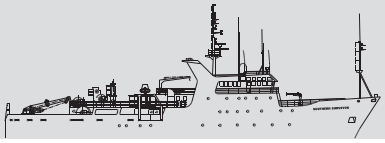

MARINE
NATIONAL FACILITY

2006 program

RV *Southern Surveyor*

voyageplan

A comparison of nutrient supply processes and biological productivity in upwelling and frontal regions of the Lord Howe Ridge.

Itinerary

Depart Sydney 1100hrs, Wednesday 27 September, 2006
Arrive Sydney 0800hrs, Wednesday 11 October, 2006

Principal Investigator

Professor Jason Middleton (Chief Scientist), A/Prof Iain Suthers and Dr Mark Baird – University of New South Wales, Sydney 2052

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CSIRO

Scientific Objectives

The behaviour and significance of the East Australian Current (EAC) and its Tasman Front is the least understood when compared to the other four major western boundary currents, yet it dominates our phytoplankton and most likely our fisheries. Its role in the biogeography of tropical fauna, the early life history of South East Trawl fishes and the nutrient budgets is unknown. Past *Franklin* and *Southern Surveyor* voyages have revealed the mechanisms and significance of the EAC's separation zone off northern NSW. Farther offshore, we began investigating the Tasman Front in September 2004. Even farther east, the Tasman Front interacts with the Lord Howe Rise, and Middleton/Elizabeth Reefs, with anecdotal reports of 3-5°C temperature fluctuations and up to 3-5 knot currents, and sporadic chlorophyll concentrations. The nearshore and slope current circulations, and their effects, are unknown. Our aims are:

1) to extend our physical and biological study of the Tasman Front to the Lord Howe Rise, a region recognised for it's significant conservation value and unusual combination of tropical and temperate marine species,

2) to study the dynamics and significance of currents and upwelling around the Lord Howe Rise, and

3) to further assess our coupled oceanographic-zooplankton models, from oligotrophic to eutrophic waters that occur in this region.

Voyage Objectives

The on-board observational program will utilise the following observational equipment.

(a) CTD casts at stations along transects of the Tasman Front and Lord Howe topography, using the full rosette sampler and fluorometer. We will take standard nutrients (NOx, P, Si), salinity and oxygen at up to 8 depths at each station. Transects will have casts to 300 or 500 m depth.

(b) ADCP and SeaSoar profiles along transects at 8 knots. The SeaSoar will have the UNSW Optical Plankton Counter mounted.

(c) Neuston net samples simultaneously with Rectangular Midwater Trawl (RMT) plankton samples from the stern. Nearly all plankton sampling will take place at night, usually between 1900-2400, but where pilchard or gemfish larvae are particularly abundant we plan to sample them during the day as well. Plankton will be preserved in 5% formalin at an appropriate location on the back deck. The first and last tows of the 3 replicates will be iced and be pre-sorted for pilchard larvae for separate preservation in 95% alcohol.

(d) Recent SST and ocean colour satellite images will be downloaded throughout the voyage to ensure transects are related to current/topography areas of interest.

(e) Underway measurements of SST and fluorescence from automatic analysis of thermosalinograph intake waters.

(f) a single current meter mooring will be deployed at the saddle point between Lord Howe and Ball's Pyramid, for the period of a few days that the ship will be working in the region.

Operationally the decisions as to locations of transects can only be made with current knowledge of the position of temperature fronts and ocean colour. In general, we plan:

1) by day to make CTD casts at stations along 2 - 3 cross-frontal transects of the Tasman Front, 4 -5 transects of the Lord Howe region and 4 -5 transects of the Elizabeth/Middleton Reef region, using the full rosette sampler and fluorometer. We anticipate there will be a total of 12 transects, each with 10 stations, with casts to 300 or 500 m deep, and each 10-15 nm long. Transects 1 to 3 will lie on the Tasman front, in deeper waters west of the Lord Howe Rise. Transects 3-12 will be 8-12 nm long and will lie in regions where steep topography in the 50m to 300m depth range is also associated with strong currents upstream or wakes downstream. The shallowest stations will be at the 30 m isobath;

2) by day to separately undertake ADCP and SeaSoar (with optical plankton counter) profiles along these transects at 8 knots. We plan to conduct some ADCP and SeaSoar transects at slower speeds for finer spatial resolution, depending on the circumstances at the time;

3) by night to take neuston net samples simultaneously with Rectangular Midwater Trawl (RMT) plankton samples from the stern, at 3 locations across each transect. At each location a CTD cast to 300 m may be made (minimal rosette sampling), before undertaking three replicate 10 minute plankton tows at ~3 knots at each location, and then steaming onto the next location. We anticipate that pilchard larvae and the plankton sizes will vary in size according to water mass and location relative to the front and topography;

   <u>Notes on the RMT.</u> It is 2 m wide and 75 cm deep, with a 7 m long net of 1.0 mm mesh. It has a top and bottom bar, with the bottom bar containing 100 kg lead, and supporting two lead rollers of 25 kg each. Within the triangle of the tow bridle there will be a small 20 cm diameter, 0.1 mm mesh plankton net with the cod end loosely attached to the RMT net, to prevent foul-ups. There are no electronics: it has a GO flow meter and a self contained time-temperature-depth recorder. We will bring two complete RMTs on board.

4) by night to conduct ADCP and SeaSoar profiles back along the transects at 8 knots (generally between 2400 and 0300. If time permits additional RMT tows will be made at the Front, before steaming north to the next transect of CTD stations starting around 0700. Plankton sampling may be more limited at some transects, depending on conditions.

Voyage Track

See attached figures for the general topography of Lord Howe and Middleton/ Elizabeth Reef and schematic voyage tracks and hydrographic sections.

The final details of our voyage track to address our aims above will depend on the Sea Surface Temperature structure deduced from images obtained during the week before we depart.

Using the animations of SST from David Griffin (http://www.marine.csiro.au/~griffin/SEF/index.htm#contents), we expect to steam east from Sydney approximately 200 km to the southern end of the Tasman Front, spend two days there then steam to the Lord Howe Rise and Middleton/Elizabeth reef area. Some underway transects of the frontal region may be undertaken, as well as cross-front transects. Most of the work will be undertaken in these regions investigating flow topography interactions, wakes and fronts

Time Estimates

September

27 Depart Sydney 1100, steam east towards Tasman Front, test CTD cast to >1,000m and thence to Transect 1 by morning of Sept. 28

28 Daytime: 9 CTD stations @ 1 hour ea, followed by Sea Soar transect (totalling 10 hours). Night: 3 locations which include RMT trawls, limited CTD casts, 3* 10 min plankton trawls and returning at 8 knots SeaSoar transect (totalling 8-10 hours), steam to next transect (est 3 hours);

29 Transect 2; then steam to Lord Howe area

30 Transect 3;

October

1 Transect 4;

2 Transect 5,

3 Transect 7, then steam to Elizabeth/Middleton Reef

4 Transect 8

5 Transect 9

6 Transect 10

7 Transect 11

8 Transect 12

9 Track west, identifying Tasman front regions to conduct final transects. Depart for Sydney

10 Arrive Sydney 0800.

Southern Surveyor Equipment

The main special requirement is for the SeaSoar.

The fwd towing boom needs to be extended for towing the neuston net, so that so that it may be deployed and retrieved from the hero platform.

1. Standard Equipment and Services

Underway Data and Services	
Inmarsat B & C, Minisat M, Optus Mobilesat, CDMA - Voice/Data/Fax	Y
Navigation – One minute archiving of the underway data including Time, GPS position and bottom depth (plus DGPS within Optus mobilesat footprint)	Y
3DGPS (for accurate heading, pitch and roll) Y	
Meteorological Data (temp, humidity, wind speed & dir, barometric pressure)	Y
Chart and Navigation package Y	
Simrad EK 500 sounder (12, 38 and 120KHz) and EA 500 sounder (12 kHz)	Y
Sea Surface Temperature and Salinity Y	
Sea Surface Fluorescence (requires support from users for calibration)	Y
Laboratory Facilities and Scientific Equipment	
Wet and Dry Laboratory Spaces Y	
Controlled Temperature Laboratory/Cold Room	
Dark room	
Photo/Preservation Lab	
Walk-in Freezer	
Laboratory Fridges and Freezer	
UNIX Computers, Personal Computers Y	
Pinger * 2 (for monitoring altitude of underwater packages)	
Transducer (low power, 12 KHz wide beam)	
Winches and A-frames and Crane	
Trawl winches with 5,000m of 24mm wire Y	
Towing winch with 5,000m of 19mm wire	
CTD/Hydro winches each with 7,000m of 8mm single core conducting cable	Y
Towed-body winch with 3,000m of 12mm 7 core conducting cable	Y
Hydrographic A-frame (stbd) Y	
Stern A-frame (SWL 15 tonnes) Y	
7.0 tonne knuckleboom crane Y	
Gilson winches (15 tonne, 5 tonne)	
General purpose winch on stern A-frame (5 tonne)	Y

2. Equipment and Services with Special Requirements (available by request)

Laboratory Facilities and Scientific Equipment	
Clean Air Cabinet and Fume Hood	
Scintillation counter	
Balloon Launcher and Radiosonde Receiver	
SeaSoar (towed undulating CTD system)	
Milli-Q water supply (used in hydrochem analysis)	
Radiation Sensors (requires user contribution and support)	
CTD/Water Sampling	
CTD (Seabird SBE 911 plus)	
Rosette (12 bottles up to 10 litres or 24 bottles to 2.5 litres)	
Rosette (24 bottles up to 10 litres)	Y
Transmissometer	
Fluorometer (requires support from users for calibration)	Y
Light (PAR) <u>nb this request was not on the original application!</u>	**Y**
Salinity Analysis (requires hydrochemistry support staff)	Y
Oxygen Analysis (requires hydrochemistry support staff)	Y
Nitrate Analysis (requires hydrochemistry support staff)	Y
Nitrite Analysis (requires hydrochemistry support staff)	Y
Silicate Analysis (requires hydrochemistry support staff)	Y
Phosphate Analysis (requires hydrochemistry support staff)	Y

User Equipment

1) Optical Plankton Counter – to be mounted and interfaced onto the SeaSoar

2) Rectangular midwater trawl – 1.0 mm mesh, 0.75 m by 1.5 m wide. No electronics except for a small self contained time depth recorder. A 0.1 mm mesh, 20 cm diameter ring net will be mounted within the RMT's bridle.

3) Neuston nets; 0.75 x 0.75 m square nets – to be deployed from under the hydrographic A-frame, so the net is towed near the surface from the fwd towing boom and 2-3 m from the side of the vessel.

Personnel List

Jason Middleton	UNSW	Chief Scientist
Iain Suthers	UNSW	Co-Principal Investigator
Mark Baird	UNSW	Co-Principal Investigator
Greg Nippard	UNSW	CTD & trawl ops
Philippe Estrade	UNSW	CTD & trawl ops
Debbie Cox (PhD)	UNSW	CTD & trawl ops
Moninya Roughan	UNSW	CTD & trawl ops
Tom Mullaney (PhD)	UNSW	CTD & trawl ops
Ash Fowler	UNSW	CTD & trawl ops
Jason Everett	UNSW	CTD & trawl ops
Alexis Watson	UNSW	CTD & trawl ops

Lindsay Pender	CMAR/MNF	Voyage Manager/Computing Support/SST
Mark Underwood	CMAR/MNF	Electronics Support/SST
Karl Forcey	CMAR/MNF	Electronics Support
Mark Rayner	CMAR/MNF	Hydrochemistry/SST

UNSW – University of New South Wales
CMAR – CSIRO Marine and Atmospheric Research
MNF – Marine National Facility
SST – Systems Support Technician

This voyage plan is in accordance with the directions of the National Facility Steering Committee for the Research Vessel Southern Surveyor.

Jason Middleton
Chief Scientist

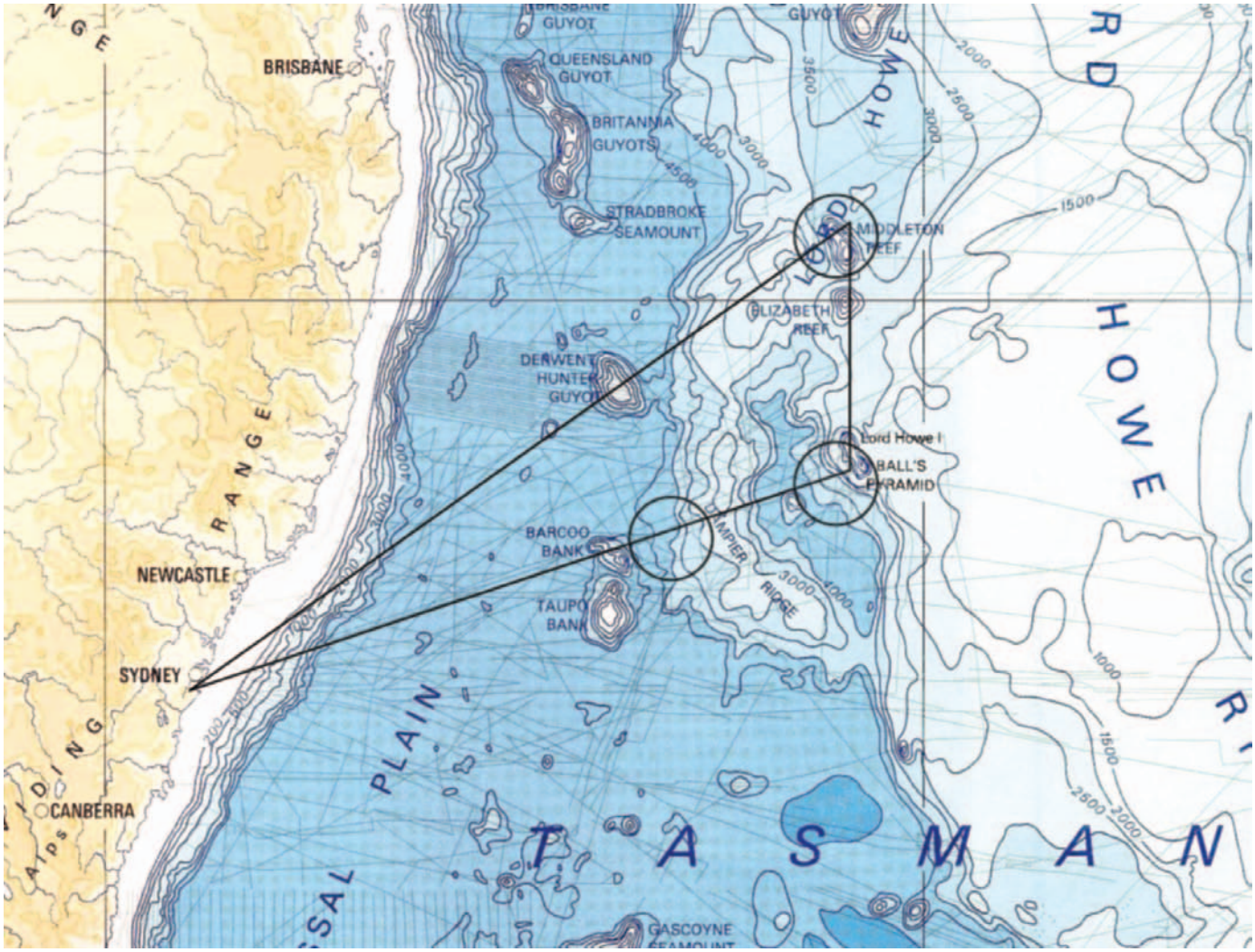

Figure 1: GEBCO Chart of the general region from Sydney to the Lord Howe Rise. Straight lines show general voyage track with circles indicating areas of work.

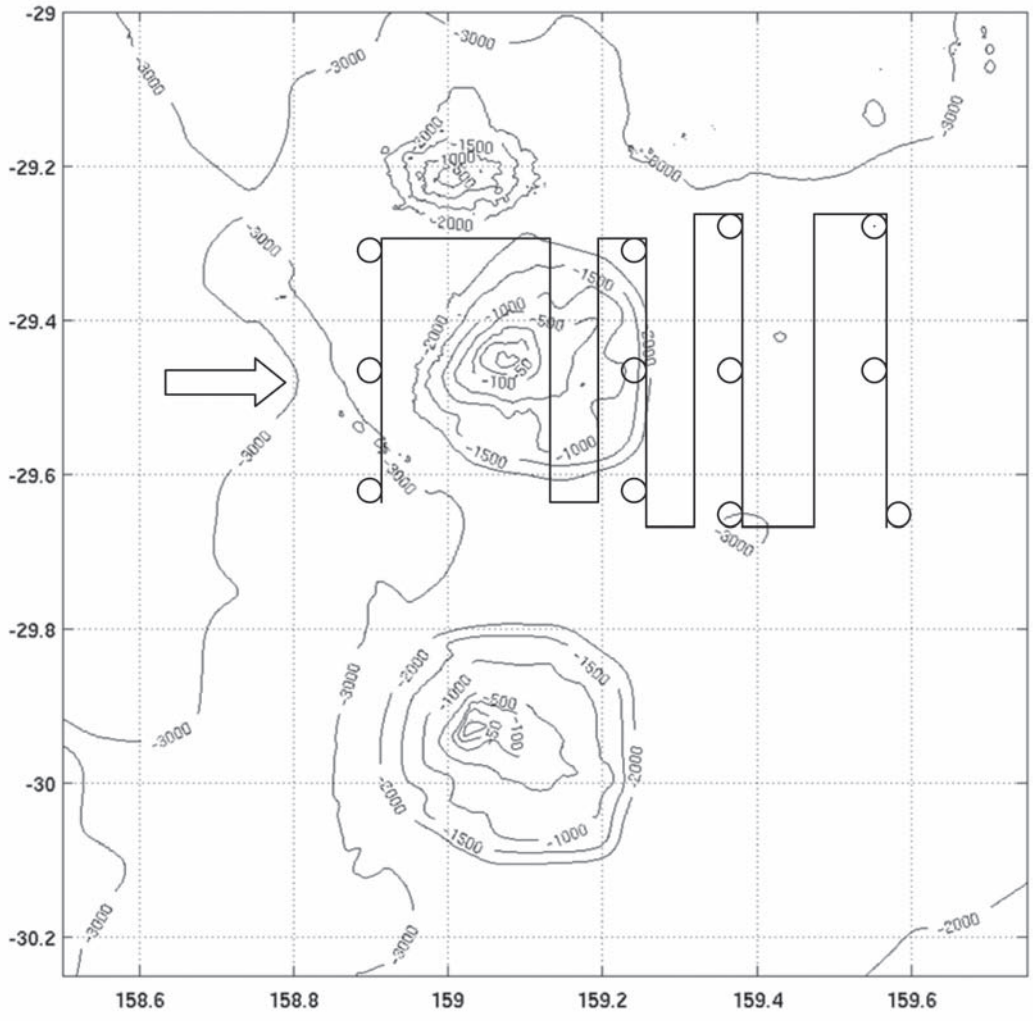

Figure 2: Topography of Middleton and Elizabeth reefs. The straight lines indicate Seasoar, ADCP and net transects, assuming a current flowing from the east, while the small circles indicate CTD stations. This diagram is schematic only, and exact transects will be determined based on SST and ocean colour images. CTD stations will be 3 to 4 times more numerous than indicated here.

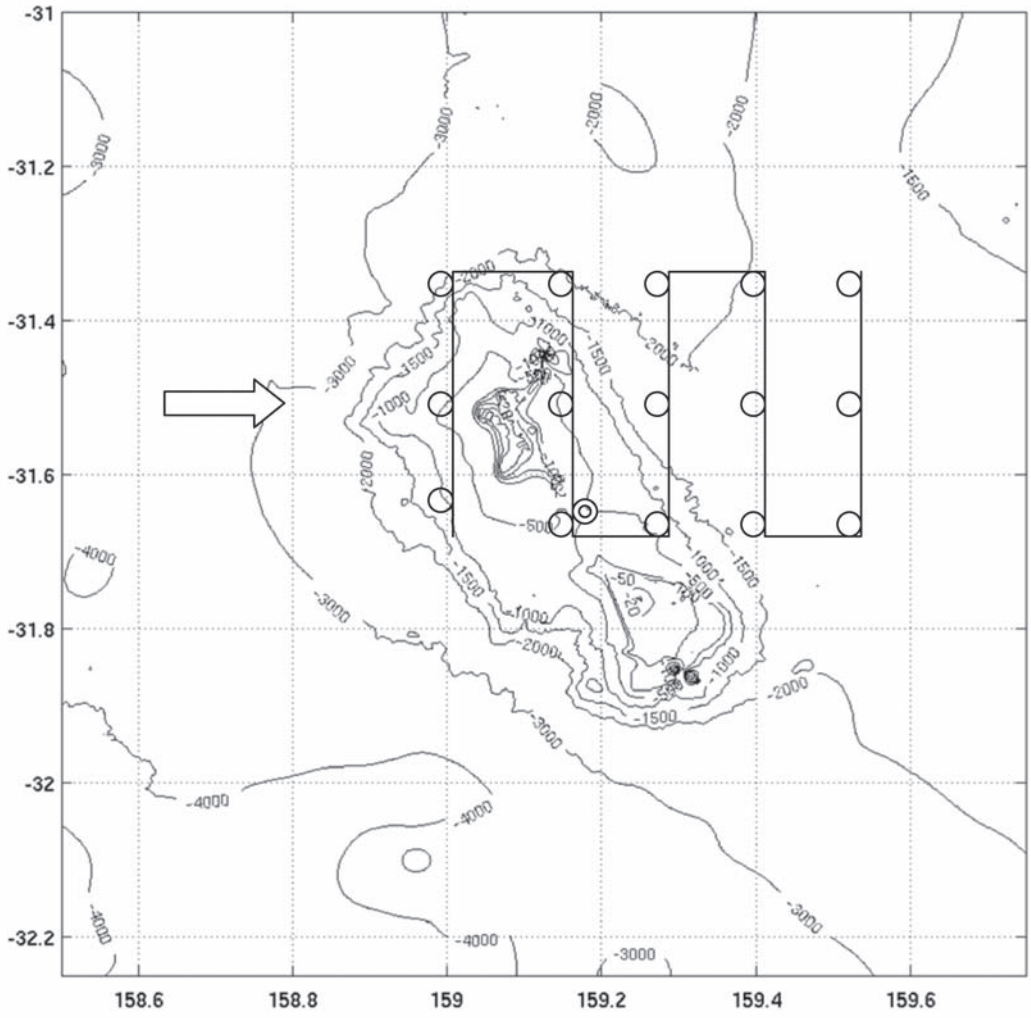

Figure 2: Topography of the Lord Howe Island, Balls Pyramid region. The straight lines indicate Seasoar, ADCP and net transects, assuming a current flowing from the east, while the small circles indicate CTD stations. This diagram is schematic only, and exact transects will be determined based on SST and ocean colour images. It is possible that a smaller scale wake study may also be done for Ball's Pyramid. CTD stations will be 3 to 4 times more numerous than indicated here. The doughnut shape is the location for a current meter mooring, to be located in the saddle point between Lord Howe and Ball's Pyramid.