

MARINE
NATIONAL FACILITY

2004

RV Southern Surveyor
program

voyageplan

SS08/2004

High resolution dynamics of frontal systems and the zooplankton biomass size spectrum.

Itinerary

Depart Sydney 1000hrs, Thursday 2 September, 2004

Arrive Brisbane 1000hrs, Monday 13 September 2004

Principal Investigators

- Professor Jason Middleton (Chief Scientist) and A/Prof Iain Suthers
University of New South Wales, Sydney 2052.

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CSIRO
MARINE RESEARCH

Scientific Objectives

The northern New South Wales continental shelf off Smoky Cape (ca. 31°S), narrows by half in <0.5° latitude to just 16 km wide, generating marked upwelling signatures in Sea Surface Temperature (SST) and chlorophyll a. Our two Franklin voyages in the summer of 1998/99 (FR14/98, 01/99) examined the physics and biology of this feature, identifying upwelling processes and consequent stimulation of phytoplankton populations. We found the upwelling is responsible for many of Sydney's red tides, as well as stimulating growth in larval trevally, and is the precursor to the enigmatic Tasman Front. Our surveys were large-scale and the smaller scale structure of the separation front was not able to be resolved. Yet the small scale structure is indicative of the 3-dimensional circulation, which is responsible for the slow but persistent upwelling observed just south of Smoky Cape.

In the proposed voyage we intend to:

- 1) Observe using the SeaSoar with an optical plankton counter, the detailed hydrodynamic structure of the front from its separation point near the coast, and to follow it into deeper waters (the Tasman Front); (Suthers & Middleton)
- 2) Examine the bio-physical structure in the wake around a shelf island (the South Solitary Island); (Suthers & Middleton)
- 3) To compare the zooplankton size structure with the growth of larval fish (pilchards) over a range of oceanographic conditions; (Suthers)
- 4) To investigate the early life history of pilchards in the Tasman Front, in comparison with the Kuroshio extension; (Suthers)
- 5) To compare these data against a size-based mechanistic model of the pelagic ecosystem (Baird, Suthers and Middleton)

Voyage Objectives

- 1) To make CTD casts at stations along 8 cross-frontal transects of the Tasman Front, using the full rosette sampler and fluorometer. We will take standard nutrients (NO_x, P, Si) at 4-8 depth intervals at each station. We anticipate there will be 8 transects, each with 7 stations, with casts to 300 or 500 m deep. Transects 1-4 will be 18 nautical miles long, approximately located along 33.5°S, 33.0°S, 32.5°S and 32.0°S (Fig. 1). The precise scheduling will depend on the SST image recorded a week before departure. Transects 5-8 will be 8 nm long and probably between 32 and 31°S around the East Australian Current separation area, with the shallowest stations being at the 30 m isobath;
- 2) To separately undertake ADCP and SeaSoar profiles along these transects at 8 knots. The SeaSoar will have the Optical Plankton Counter mounted onto it. If possible we would like to conduct some ADCP and SeaSoar transects (especially #5-8) at slower speeds for finer spatial resolution – to be discussed;
- 3) To take neuston net samples simultaneously with Rectangular Midwater Trawl (RMT) plankton samples from the stern, at 3 locations across each transect (locations will be named “Inshore”, “frontal” and “offshore”, Fig. 2). At each location a CTD cast to 300 m will 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. Nearly all plankton sampling will take place at night, usually between 19:00-24:00, 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. We anticipate that pilchard larvae will be larger and older at Transect 1 (and the plankton sizes larger), than at the separation area near Transects 5-8;

Notes on the RMT. It is 2 m wide and 75 cm deep, with a 7 m long net of 0.5 mm mesh. It has a top and bottom bar, with the bottom bar containing 150 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 and will be testing it from a trawler in August.

- 4) To conduct an ADCP and SeaSoar profile back along the 18 nm transect at 8 knots (generally between 24:00 and 03:00. If time permits additional RMT tows will be made at the Front, before steaming north to the next transect of CTD stations starting around 07:00. Plankton sampling may be more limited at Transects 5-8, depending on conditions.
- 5) To deploy two current meter moorings north (upstream) of North Solitary Island (~29°55'S). Moorings will be deployed for only 3 days, and will have a pick-up rope for easy retrieval. The area is a Commonwealth Marine Park and a permit application has been submitted to the EA office in Coffs Harbour (May 2004).
- 6) To conduct ADCP and SeaSoar transects across the main axis of flow. Two transects are north of the island and 5 are south (an additional transect may be run between North Solitary and NW Rock, depending on advice).
- 7) To make rapid, continuous 3 minute deployments of the neuston net along some of these transects at 3 knots, at night, with the SeaSoar sampling at a set depth (10 m from the surface).

Voyage Track

The details of our voyage track and addressing our aims above will depend on the Sea Surface Image during the week before we depart. Using the animations of SST from Dave 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.

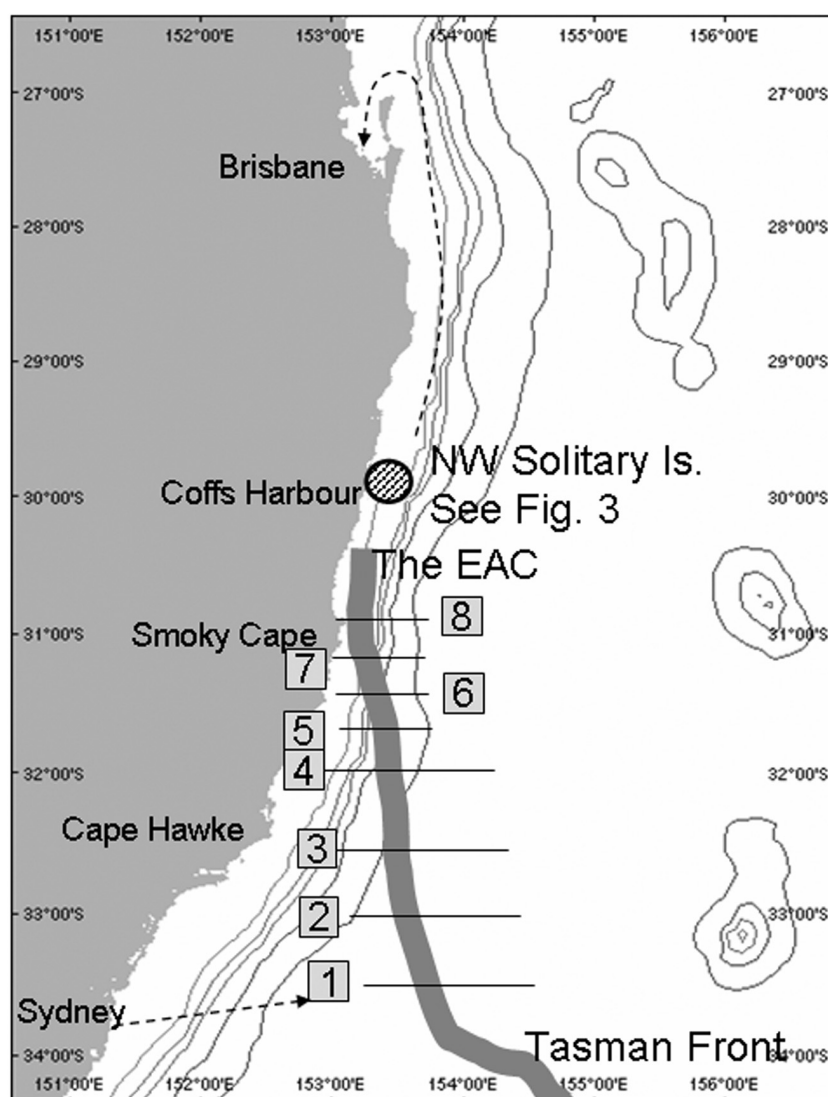
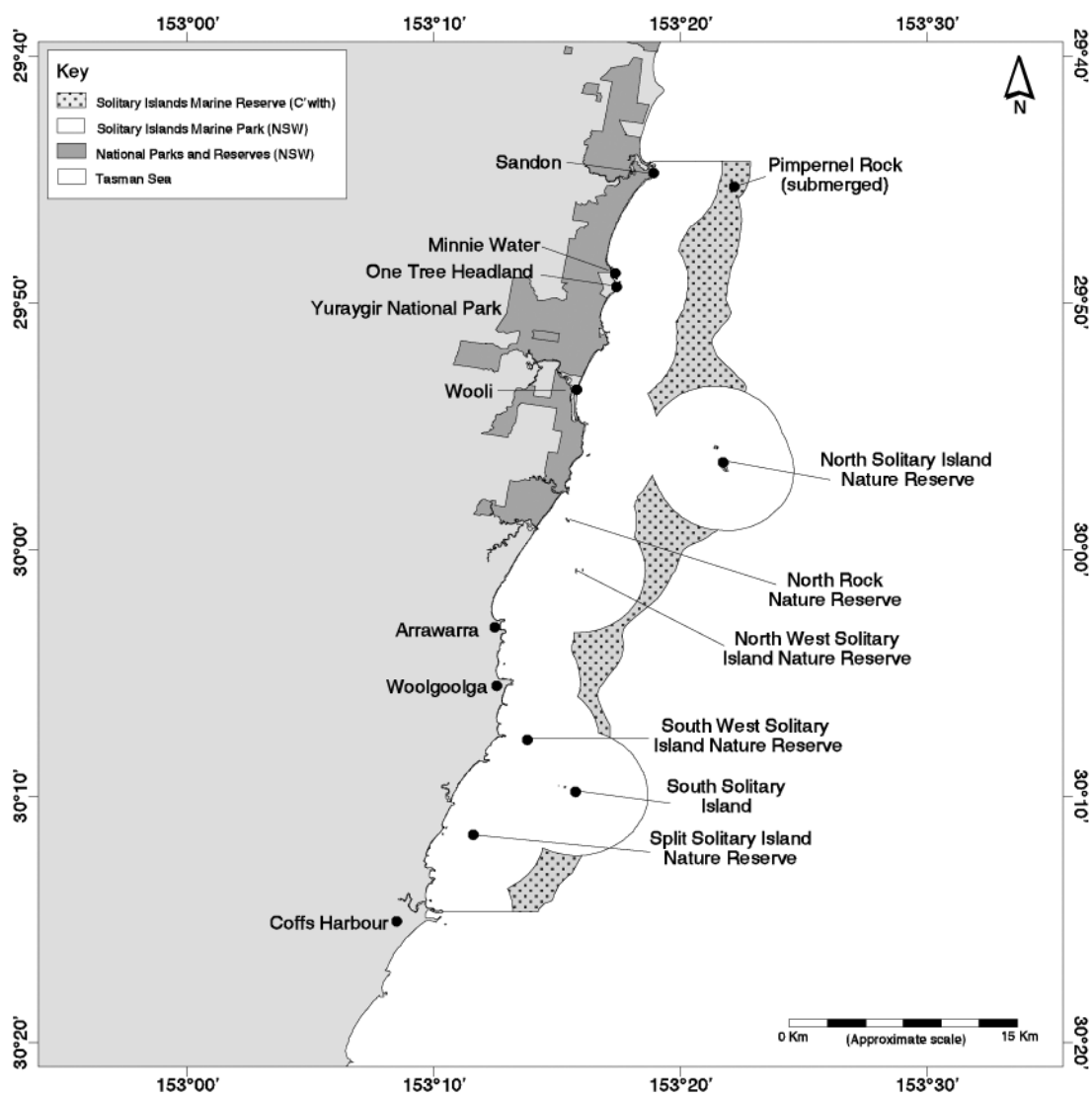


Figure 1: Proposed voyage track (dashed line) from Sydney to Brisbane via 8 cross-front transects of the Tasman Front (7 days), up to the separation point and 4 days at NW Solitary Island.

Figure 2: Specific area to be surveyed around North Solitary Island.



Source:
 AUSLIG 1998: Coast and State Borders (250K)
 AUSLIG 1998: Australian Maritime Boundaries Information System (AMBIS)
 AUSLIG 1996: National Gazetteer of Australia
 Caveat: Data used are assumed to be correct as received from the data suppliers.

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 December 2000
 Commonwealth of Australia, 2000



Time Estimates

September

- 2 Leaving Sydney 10 am steam east to Tasman Front, test CTD cast to >1,000 m and thence to Transect 1 by morning of Sept. 3
- 3 Daytime: 7 CTD stations @ 1 hour ea, followed by Sea Soar transect (totalling 10 hours) and night: 3 locations which include a limited CTD cast, 3* 10 min plankton trawls and returning at 8 knots SeaSoar transect (totalling 8-10 hours), steam 30 nm north to next transect (3 hours);
- 4 Transect 2;
- 5 Further sampling as necessary around Transect 1 and 2;
- 6 Transect 3;
- 7 Transect 4;
- 8 Transect 5, 6, 7
- 9 Transect 7, 8, steam to North Solitary Island leaving midnight;
- 10 ~ 7 am, deploy moorings, begin ADCP and SeaSoar transects;
- 11 Continue ADCP and SeaSoar transects across wake, with some plankton tows;
- 12 Retrieve moorings and depart Nth Solitary by early afternoon;
- 13 Dock in Brisbane 10 am.

Southern Surveyor Equipment

The main special need is for the SeaSoar, and it is to be interfaced with our Optical Plankton Counter by Lindsey Pender and Mark Underwood. We met last February, and a new card is being installed at FOCAL, Canada to provide format for the SeaSoar. The instrument will then be shipped to Lindsey in early August.

A beam for towing the neuston net needs to be located somewhere from the bow (as per the Franklin), so that so that the neuston net may be deployed and retrieved from the CTD 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 mobilesats 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 (std)	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)	Y
Milli-Q water supply (used in hydrochem analysis)	
Radiation Sensors (requires user contribution and support)	
CTD/Water Sampling	
CTD (Seabird SBE 911 plus)	Y
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) nb this request was not on the original application!	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 – 0.5 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 near the CTD access, from a beam located near the bow, so the net is towed near the surface and 2-3 m from the side of the vessel
- 4) Oceanographic moorings and railway wheels
(to be loaded during vessel's visit in Sydney 28 June).

Personnel List

Jason Middleton – UNSW, Chief Scientist

Iain Suthers – UNSW, Co-principal Investigator

Greg Nippard – UNSW, CTD & other ops, Watch B

Patrick Timko – UNSW, CTD & other ops, Watch B

Mark Baird – UNSW, CTD & other ops, Watch A

Tom Mullaney (PhD) – UNSW, CTD & other ops, Watch A

Peter Burns (honours student) – UNSW, CTD & other ops, Watch A

Debbie Cox (PhD) – UNSW, CTD & other ops, Watch B

Lindsay Pender – National Facility, Voyage Manager/Computing/SeaSoar

Mark Underwood – National Facility, Electronics/SeaSoar

Drew Mills – National Facility, Electronics trainee/deck support

Neale Johnston – National Facility, Hydrochemistry

Note possible additional participants TBA.

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