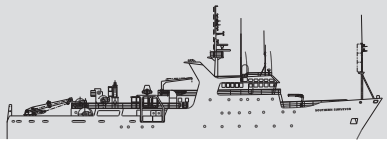


MARINE
NATIONAL FACILITY

2011 program

RV *Southern Surveyor*

voyageplan
ss2011_t02

Towards an understanding of mid-trophic biomass, distribution, variability and energetics in ocean ecosystems

Itinerary

Mobilise Auckland 0800hrs, Monday 6 June, 2011
Depart Auckland 0800hrs, Tuesday 7 June, 2011
Arrive Hobart 0800hrs, Wednesday 15 June, 2011 and demobilise

Principal Investigators

Dr Rudy Kloser (Chief Scientist) – CSIRO Marine and Atmospheric Research
Castray Esplanade, Hobart 7001 Australia

CSIRO

Scientific Objectives

The water column comprises more than 90% of the earths living space and its deep water component is probably the largest and least-known major faunal group on Earth despite its obvious importance at the global scale (Robison, 2009). Biological communities in these habitats are dominated by meso-zooplankton and micronekton (fishes, crustaceans, squids and gelatinous zooplankton, 2-20 cm length) that are crucial to the foodwebs of pelagic and demersal predators (e.g. Bulman et al. 2001. The micronekton of the ocean is involved in a vertical migration from deep to shallow depths and, again, while little understood, probably accounts for the bulk of global ocean biomass. This ecological system is under threat from a broad range of influences including climate change and carbon dioxide (ocean acidification) (Robison, 2009). The Tasman Sea is a high priority region as it is predicted to be a global temperature change hot spot (Cai et al., 2005). This large predicted temperature shift in the Tasman Sea will have major impacts on the structure and function of the ecosystem from biogeochemistry, plankton, micronecton and nekton to depths in excess of 400 m. During this voyage we will be refining methods to interpret basin scale acoustic sampling with targeted mid-water net sampling and multi-frequency acoustic and optical sensing. This refinement will contribute to the IMOS bio-acoustic sampling program.

Voyage Objectives

Objectives:

1. On the transit collect bio-acoustic information from the vessel mounted sounders at multiple frequencies to characterise the day- night distribution and abundance of mid-trophic micronekton organisms.
2. Using the MIDOC net collect physical, acoustic and optical samples from discrete depth stratified layers for paired day and night distribution of micronekton and zooplankton.
3. Using the acoustic optical system (AOS) obtain several night profiles of the micro-nekton and zooplankton (Figure 1).
4. Tow the IMOS CPR to compare zooplankton diversity and abundance between different sampling methods.
5. Retrieve an acoustic mooring in Storm Bay and deploy a plankton net.

Objective 1:
The calibrated vessel mounted acoustic system should be set as per designated IMOS bio-acoustic collection protocols.

Objective 2:
As the vessel is on transit from New Zealand to Australia we will deploy a fine mesh net during day and night hours to sample micronekton to 1000 m. Experience from previous transit voyages tells us that net tows take approximately 3 hrs. Therefore, there is the potential to take 8 trawls, totalling 24 hours, over the course of the transit. We aim to take 1 day-time trawl (between approx. 12:00 hrs to 15:00 hrs)

and 1 night-time trawl (between approx. 18:00 hrs and 21:00 hrs) at each of 4 locations between New Zealand and Australia, as shown in Figure 2. The vessel will steam normally between the day-time and night-time location and thus the 2 trawls in each location will be separated by some distance. We plan to take 2 net tows in New Zealand waters, 4 in international waters and 2 in Australian waters.

To sample the zooplankton to 1000 m, the MIDOC will be fitted with 335 um mesh for 2 trawls during day and night at one location in the central Tasman.

Whilst the MIDOC trawl net is deployed, two plankton tows will be conducted from the surface using a plankton net with 335 um mesh.

Objective 3:

For at least 3 day and night stations lower the AOS whilst stationary to 950 m to obtain detailed acoustic and optical measures of biomass (Figure 1.). These casts will be used to refine the acoustic and optical sampling capability of the equipment. Of particular interest on this voyage is the differentiation of gas bladdered zooplankton (1-10 mm) and fishes of lengths 1 cm to 10 cm.

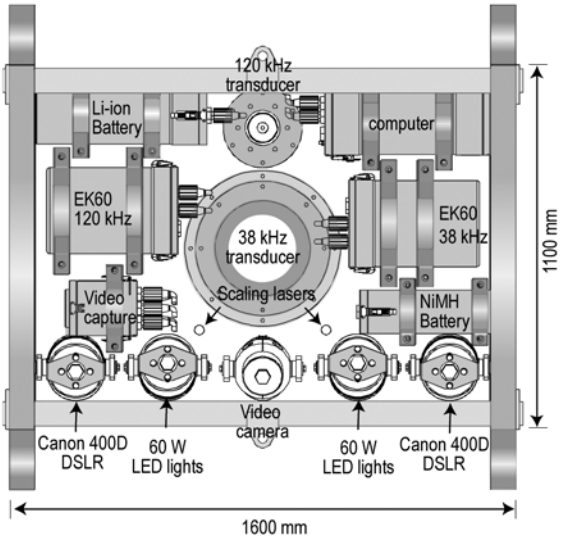


Figure 1: General assembly of the AOS showing acoustic and optical components, for this voyage extra optical and acoustic sensors will be added.

Objective 4:

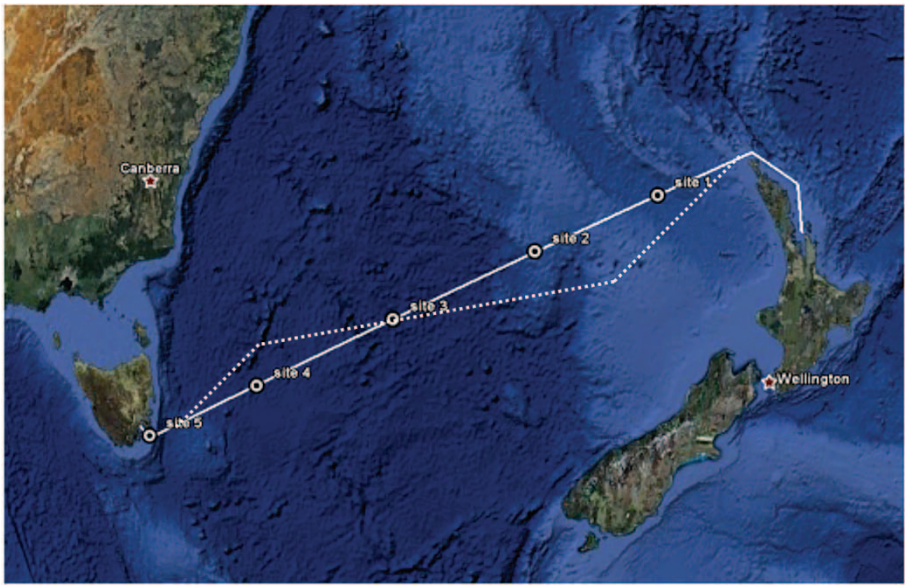
We will run the Continuous Plankton Recorder (CPR) on the transect and it will form part of the cross-Tasman line in the IMOS project, This will provide information on the phytoplankton and zooplankton communities continuously across the transect, providing the larger-scale context in relation to oceanographic features that the 5 fixed stations may not be able to. It will also allow us to correlate the abundances from the CPR with that from net samples at the fixed stations. Finally, we will be able to relate the zooplankton abundances to the micronekton abundances from acoustics. (Anthony Richardson)

Objective 5:

Retrieve an ASL multi-frequency mooring in Storm Bay to test the functionality of new instruments and to deploy a newly designed ring net to capture zooplankton at the site.

Voyage Track

Figure 2: Proposed voyage track of MNV *Southern surveyor* departing from Auckland and arriving in Hobart with proposed sampling sites subject to change based on updated oceanographic conditions and weather constraints.



Time Estimates

Table 1.
Estimate of operation and voyage time for transit from Auckland to Hobart

Operations	Priority	Operation Time	Voyage Time	Number	Total (hrs)	Comment
Port		3	3	2	6	Departing and Berth times
Steaming 1548 n.m		155	155	1	155	Transit time at 10 knots
MIDOC 5mm	High	4	3	6	18	Day/Night pairs
AOS drop	High	2	2	6	12	Day/Night pairs
Plankton 335 um	Medium	0.5	0	8	0	Done whilst trawling
CTD		0	0	12	0	On MIDOC/AOS
Oxygen		0	0	4	0	If available
Florescence		0	0	4	0	If available
MIDOC 335um	Medium	3	2.5	2	5	Day/Night pair zooplankton
			Transit Time		196	

Piggy-back Projects

1. Spatial and vertical distribution of the salp Thetys vagaina in the Tasman Sea: a valuable contributor to benthic productivity

Sebastian Holmes (University of Western Sydney)

Particulate organic matter (POM) sinking out of the water column is the primary source of nutrition for benthic deep-sea fauna. However, despite occasional food fall events (e.g. whale carcasses) most of the POM reaching the deep-sea benthos is of little nutritional value. The salp, Thetys vagina, can form dense annual blooms in the Tasman Sea (in the top 150 m) and have been observed as carcasses on the sea floor. Although primarily gelatinous and hence often regarded as of little nutritional value, salp carcasses because of their abundance, size and the speed at which they reach the benthos may be a very important contributor to deep sea benthic productivity.

Scientific objective:
The vertical and spatial distribution of slaps in the Tasman Sea will be examined by serendipitously sampling the hauls already proposed for the MIDOC and through opportunistic surface tows (dip net/plankton net). In addition, the stable isotope signature of surface POM will be characterised.

Voyage objectives:
All hauls made by the MIDOC (depth stratified sampling) will be examined for salps, the salps removed, identified, quantified and frozen. During the voyage, outside of the normal surface plankton sampling schedule, a dip net and/or surface towed plankton net will be deployed to increase the spatial resolution of salp distribution/density. In addition, characterisation of the stable isotope signature of surface POM will be made using the underway seawater supply system.

2. Horizontal and vertical distribution of zooplankton in the Tasman Sea

Briony Hutton (supervisors Kerrie Swadling and Rudy Kloser)

The broad objective is to improve our understanding of the Tasman Sea zooplankton communities and our ability to quantify their abundance using remote acoustic and optical sensors as part of the IMOS sampling program.

Aims:

- To describe the day/night surface Tasman Sea zooplankton community noting east-west differences in diversity, biomass and trophic signatures (isotopes).
- Identify to major species groups the East-West Tasman Sea vertical structure (to 1000 m) of zooplankton and linkages with other mid-trophic organisms.
  - Characterise the siphonophora zooplankton and note species that have pneumatophores and their vertical habitat.
- Characterise the main zooplankton groups with vertical profiling acoustics at 38, 120 and 333 kHz and optics.

3. Red blood cell physiology of Maurolicus sp. fishes.

Dr. Stuart Fraser of Uni. Sydney and Adrian Flynn (Uni of Qld)

Pilot studies indicate that Maurolicus sp. is unique among fishes in that its red blood cells are enucleated (i.e. lack nuclei). The species, and others in the family (Sternoptychidae), therefore provides a potential model to understand the mechanisms, genetic regulation and evolution of red blood enucleation. All mammals lack nuclei in their red blood cells, while birds, reptiles, amphibians and fishes (except Maurolicus sp.) have nucleated red blood cells. It is possible, that the enucleation of red blood cells may be a major branching point in the divergence of mammals from other higher vertebrates. In Maurolicus, enucleation of red blood cells may have significance in the evolution of tolerance of deep-sea oxygen minimum zones.

These samples will be collected during the normal course of biological sampling operations with the MIDOC net.

Aims:

- Collect kidney tissue samples from representative specimens of Maurolicus, Sternoptyx and Polyipnus species. Samples to be stored in non-hazardous "RNA-Later" preservative.
- Preserve representative whole specimens of Maurolicus, Sternoptyx and Polyipnus species. Samples to be fixed in 10% formaldehyde, transferred to 70% ethanol at the end of the voyage.

4. Ecological Study of the Dana lanternfish (Diaphus danae)

Adrian Flynn (Uni of Qld)

Over the continental slope of eastern and southern Tasmania and Tasman Sea abyssal basin, lanternfishes comprise over 90% of the biomass of small fishes. Diaphus danae is in the top-3 most abundant lanternfishes over the continental slope. The species, therefore, contributes significantly to the mid-trophic biomass in this region. However, Young et al. (1987) reported that the species has not been found in breeding condition off Tasmania and that it may be a non-breeding expatriate to these waters. The species provides a model to study the import, retention and export of 2nd-3rd trophic-level biomass in the Tasman Sea.

Aims:

- Collect muscle tissue for stable isotope studies. Tissue preserved frozen.
- Collect muscle tissue for genetic studies. Tissue preserved in 99% absolute ethanol.
- Collect otoliths for ageing and microchemistry studies. Otoliths stored without preservative.
- Collect gonad samples from representative males and females. Dissected gonads stored in 10% formaldehyde.
- Preserve representative whole specimens of Diaphus danae. Fix specimens in 10% formaldehyde and transfer to 70% ethanol at end of voyage.

These samples will be collected during the normal course of biological sampling operations with the MIDOC net.

Southern Surveyor Equipment

- Simrad EK60 acoustics at 12, 38 and 120 kHz
- Trawl winches operational and trawl doors suitable for deployment to 1000 m
- Fish/zooplankton processing room suitable to process specimens
- Blast freezer and large walk in freezer for sample storage
- CPR
- EM300 multi-beam with XBT's

User Equipment

- D&N Francis winch mounted behind the port trawl winch.
- IYGPT mid-water trawl
- Acoustic Optical System
- Seawater filter setup (as Tom Trull)
- 1m ring net with 335um mesh

Special Requests

We require the vessel to operate the fishing gear during a combined day/night period between approximately midday to midnight. We do not require the capability to perform 24 hr fishing.

Side net to be deployed when mid-water trawl is in the water with approx 2 tows of 15 minute duration.

Introductory training for the EM300 multi-beam for opportunistic use throughout the voyage.

Personnel List

Rudy Kloser	CSIRO	Chief Scientist
Tim Ryan	CSIRO	Acoustics/Optics
Mark Lewis	CSIRO	Gear technologist/biological
Matt Sherlock	CSIRO	Engineer
Adrian Flynn	PhD U Qld	Biological -fish
Briony Hutton	Masters U Tas./IMAS	Zooplankton
Ryan Downing	IMOS/CSIRO	Acoustics
Sebastian Holmes/ Will Figueria	UWS/USYD	
Student	USYD	
Student	USYD/UWS	
Student	UWS	
Student	UWS	
Jeff Cordell	CSIRO	MNF Electronics Support/ Voyage Manager
Anoosh Sarraf	CSIRO	MNF Computing Support

As per AMSA requirements for additional berths on *Southern Surveyor*, the following personnel are designated as System Support Technicians and are required to carry their original AMSA medical and AMSA Certificate of Safety Training on the voyage:

Name	**AMSA Certificate of Safety Training No.**
Jeff Cordell	ACM40581
Anoosh Sarraf	ACM41414

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

Rudy Kloser
Chief Scientist

Appendix

Permits for operations:

1. Australian fishing permit (AFMA, AUS)	yes
2. New Zealand fishing permit (MAF, NZ)	yes
3. Animal Ethics permit (DPIPWE, AUS)	yes
4. Quarantine (AQIS, AUS)	in process
5. Equipment manifest	yes
6. Chemical manifest	yes