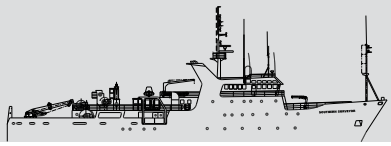

MARINE
NATIONAL FACILITY

2011 program

RV *Southern Surveyor*

CSIRO

voyage summary SS2011_t02

SS2011_t02

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

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Voyage period

Start: 07/06/2011

End: 15/06/2011

Port of departure: Auckland, New Zealand

Port of return: Hobart, Tasmania

Responsible laboratory

Dr Rudy. J. Kloser, CSIRO Marine Laboratories, Castray Esp, Hobart, Tas. 7000 Australia

Chief Scientist

Dr R. J. Kloser – CSIRO Marine and Atmospheric Research

Dr Will Figueria – University of Sydney

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, micronekton and nekton to depths in excess of 400m. 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

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.
6. Provide training to students in operational marine science.

Results

1. During the voyage the acoustic system operated at three frequencies with the 38 kHz performing the best due to weather and noise characteristics. The 120 kHz acoustic system was only viable to a depth of 350 m whilst the 38 kHz was useful to a depth of xx m with a Sv level of xx dB. Generally higher backscatter was experienced in the west of the Tasman than the east and this was reflected in the catches from the MIDOC. Of note was that the deep scattering layer was deeper in the east than the west of the Tasman (Figure 1).

2. The MIDOC net collected depth stratified 200 m to 1000 m samples across the Tasman with three day night stations and two night stations (Figure 2). In general the size composition of fishes was smaller in the east and larger in the west of the Tasman Sea. Diversity of catches for fishes was higher in the west (77 species) compared to east (46 species). A preliminary assessment of catch data indicated that the IYGPT + MIDOC net combination was successful in sampling a wide range of micronekton size classes. Fishes were collected in very good condition with relatively minor net damage. Several species were collected that were not recorded from previous Trans-Tasman voyages. Notable records included: Large telescopefish (*Rhynochohyalus* sp.) that is of taxonomic interest, several species of deep-sea squids that are of taxonomic interest, Specimens collected will add significantly to the knowledge of deep sea pelagic fauna in the region and contribute to various sub-studies of taxonomy and physiology. The stations in the west Tasman were located near major changes in water temperature ranging from 16.5 to 14.0 degrees presumably due to cold and warm water eddies in the region. Sampling resulted in the collection of approximately 211 taxa (pending identification checks). A summary of micronekton biomass (g) results from MIDOC samples in the Eastern, Central and Western sectors of the Tasman Sea is given in the following table.

	West			Central			East		
	Day	Night	Total	Day	Night	Total	Day	Night	Total
Fish biomass	3343	3887	7229	1170	4224	5394	681	1211	1892
Invert biomass	5417	5372	10789	14253	9685	23938	12539	9421	21960
Others TBD	5	15	19	3	10	14	0	3	3
Total biomass	8764	9274	18038	15426	13920	29346	13220	10635	23855
Fish Species	56	60	77	50	83	92	31	37	46

3. The acoustical optical system (AOS) was deployed at each night time station to record the acoustic signature of animals and if possible their coincident optical image. Three acoustic frequencies at 38 kHz, 120 kHz and 333 kHz were used and calibrated with a tungsten carbide sphere suspended 20 m below the transducers. All frequencies performed well and acoustic profiles down to 950 m were insightful into the density of single targets. Unfortunately the platform was unstable in this mode of operation and good weather was required to obtain the best data. The optical systems included stereo cameras focused at 5 m a single camera focused at 1 m and stereo HD cameras. Optical images from the digital still cameras were obtained with mixed success due to intermittent strobe failures. Despite this images of fish, crustaceans and gelatinous material were regularly obtained and depending on the location of the organisms be matched to the acoustic records. OF NOTE??

4. Surface plankton stations were done at each MIDOC station day and night and very large catches of salps and pyrosomes were obtained in the east and central part of the Tasman. Copepod abundance during the day was much higher in the west Tasman. These surface results will assist in interpreting the CPR data that was obtained whilst transiting throughout the voyage. As well as sampling for plankton a specially designed net was used to sample for surface plastics. An observer (Julie) also kept watch on the bridge to identify floating debris.

5. Due to a change in schedule the mooring was not retrieved but swath data was collected in Storm Bay to gap fill historical sampling.

6. Two undergraduate students (University of Sydney) as well as four post-graduate students (University of Queensland, University of Western Sydney, University of Tasmania and University of West Australia) participated in the voyage. All students were actively involved in the collection and processing of samples from plankton and MIDOC nets. Students also took charge of dust sampling equipment left on board by Ed Butler and collected samples throughout the journey. CIs ran a series of talks/discussions about the technology being used on the voyage and the scientific questions it was being employed to answer. A large volume of seawater was successfully filtered throughout the entire voyage. All analyses will take place at the University of Western Sydney. This will be the first catalogue of bacterial and fungal diversity across the Trans-Tasman.

Voyage Narrative

Tuesday 7th June

Departed Auckland at 08:00 with pilot and once out of navigation channels we increased speed and steamed North. On route we streamed the IYGPT net behind the vessel. The CPR was deployed.

Wednesday 8th June

We made reasonable progress through the night covering 220 nm. The vessel was averaging below 10 knots and given the long transit there were concerns that a higher average speed was required to meet voyage objectives. During the afternoon we tested the AOS system to 100 m for deployment procedures and functional testing

A test MIDOC was deployed at 19:00 hrs to 600 m and both net and MIDOC functioned well with good catches retained. Processing of the catch was completed at 01:00 hrs. Plankton samples were obtained with two surface nets whilst the vessel was trawling the MIDOC.

Thursday 9th June

Vessel made good headway during the night with a tail wind averaging approximately 10.7 knots. Long fire drill was held at 10:30 hrs and CPR deployed at 11:30 hrs.

Tested the AOS at 15:30 hrs to fix the optical sampling equipment with strobe lighting. After some changes retested at 21:00 hrs to a depth of 600 m. All worked well despite the lack of biota in the water. CPR was deployed. Clocks were retarded 1hr.

Friday 10th June

Vessel made good headway during the night making 10.4 knots. Weather forecast is looking favourable as the low that had caused strong winds in Hobart the previous days is dissipating and moving north. CPR was retrieved and we deployed the day MIDOC to 1000 m at 12:00 hrs. Very erratic tow due to timing and winch problems

MIDOC deployed at 19:00 hrs to 1000 m and operated well with good catches of fish and salps. AOS operated with ongoing issues with strobes and suspected overheating.

Saturday 11th June

Weather deteriorated during the evening with 25-30 knots of wind during the morning. After some deliberation a day MIDOC was done. Unfortunately delayed by one hour which meant the last net was fishing during some vertical migration. Night MIDOC was deployed at 18:30 hrs with some good catches. Net 1 only retained a small catch whilst net 2 retained a large catch of some curious shallow species (arrow squid). AOS deployed to 1000 m was successful in abating winds and slight seas. Suspect that the MIDOC system was twisting during deployment. Clocks retarded 1 hour.

Sunday 12th June

Made reasonable progress steaming through the night 188 n.mile for previous 24 hrs and deployed a MIDOC at 18:30 hrs to 1000 m. Good catches were obtained although a sorting mix up resulted in nets 1 and 6 being contaminated with each other. To rectify this a set of large scales were found and mounted in the wet lab by the Voyage Manager. An AOS was deployed to 750 m with extra stops for long pulse lengths. CPR deployed at midnight.

Monday 13th June

The vessel averaged 10 knots during the night in good weather conditions and variable currents. Deployed MIDOC at 12:30 hrs and poor catches were obtained from nets 1, 2 and 3. It appears that there was a twist in the net and most animals were retained in net 4. Nets 4, 5 and 6 had good catches. Appears to be an issue of the MIDOC net rotating during deployment. During the day sea surface temperature was variable by 2 degrees probably due to warm and cold water eddies. Large catches of copepods were collected from the surface nets. Altered course to the west to avoid sampling in the Freycinet MPA. MIDOC deployed at 18:30 hrs and good catches retained in all nets with an increase in the mean size of the fishes when compared to east Tasman Sea. Several new and unusual species were encountered that had not previously been observed. The AOS was deployed but the cameras failed to fire and had to be retrieved and no obvious fault could be found. System was redeployed to 800 m using the acoustics and HD cameras.

Tuesday 14th June

Made good passage through the night in fair weather conditions of 10 knot southerly. Of interest was a large cold water mass that showed a distinctive pattern on the vessel mounted 38 kHz echo sounder. Steamed to 14:00 hrs to be outside the Freycinet marine reserve and deploy a test day MIDOC with 335 um codends to 600 m.

Wednesday 15th June

Vessel docked at 08:00 hrs.

Summary

This transit voyage was an operational and scientific success in that all the objectives were met and the scientific samples were collected in good condition. This success was only possible by the good weather and hard work put in by the ships officers, engineers and crew and the dedicated scientific personnel on board. At times long hours were required to complete stations. The biological samples show very clearly there is a significant difference in the fish community between east to west of the Tasman Sea. Importantly the number of species retained in the east (46) and catch size (1892 g) was very much less than that retained in the west (n=77) for a catch size of (3887 g). The central Tasman contained the highest number of species (n=92) and biomass. (5394 g). This difference in biomass is reflected in the acoustic backscatter that showed the integrated volume reverberation from 20 to 1000 m depth was higher in the west of the Tasman Sea. Detailed acoustic and optical measurements were obtained from the lowered AOS to enable a detailed analysis of acoustic biomass to be obtained. Detailed samples were also obtained for a range of projects being zooplankton, surface plastics, dust, gelatinous organisms and bacterial and fungal diversity from seawater samples. The results from these collections will form the basis of several PhD, Masters and honours projects. Several students joined the voyage and made a great positive contribution to the science being conducted.

PROJECT:

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

Coordinating body:

CSIRO Marine and Atmospheric Research

PRINCIPAL INVESTIGATORS

A. Dr R. J. Kloser

B. A. Flynn

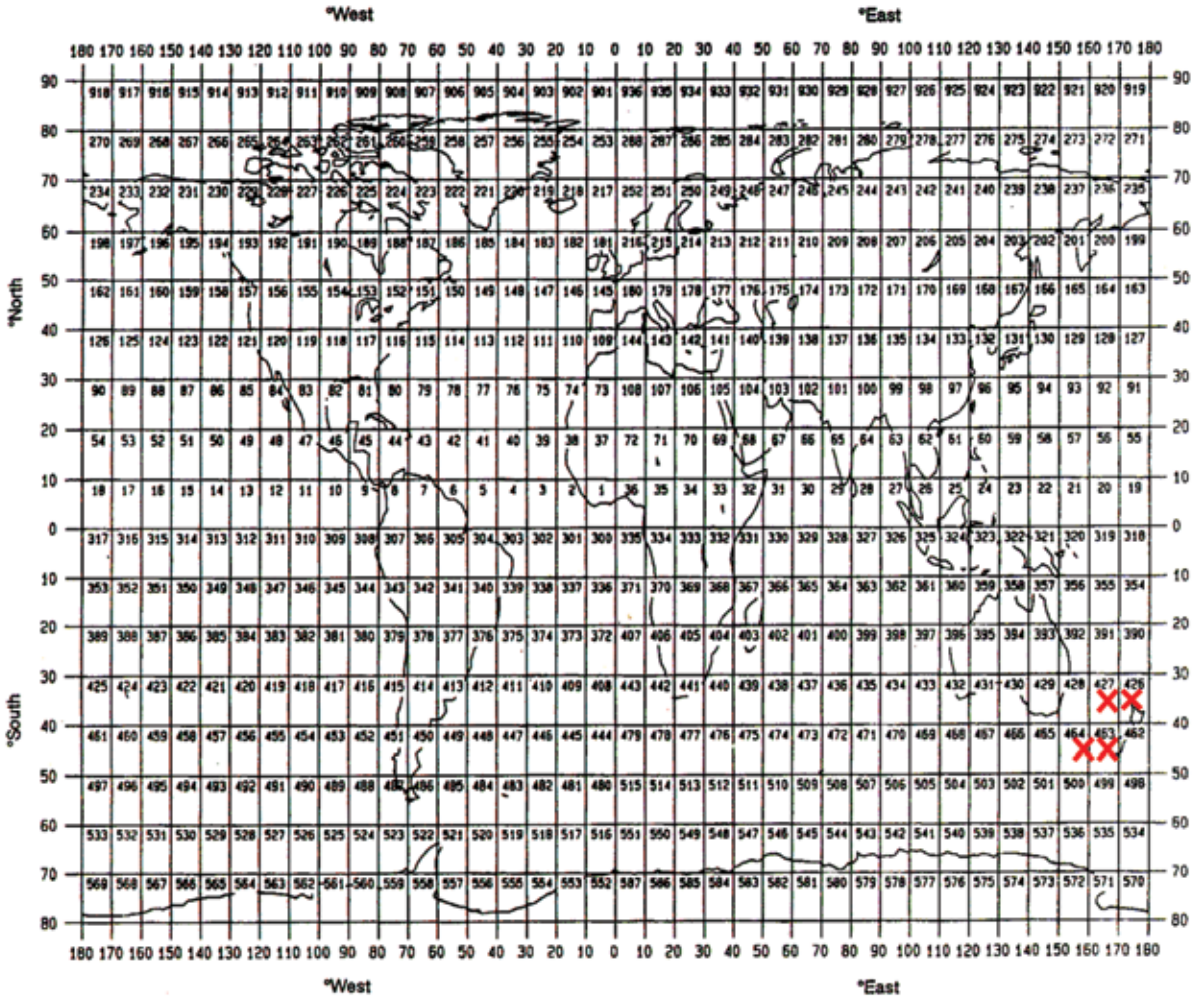
C. Dr W. Figueira

D. Briony Hutton

E. Julia Reisser

F. Mailie Gall

GEOGRAPHIC COVERAGE - 'X' IN EACH SQUARE IN WHICH DATA WERE COLLECTED



SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN					
Item No.	**PI**	**NO**	**UNITS**	**DATA TYPE**	**DESCRIPTION**
1	Kloser and Flynn	9	trawls	B14, B11 B09, B21	Pelagic trawl sampled from 1000 to 0 m in 200 m depth strata using a multiple opening and closing codend net (MIDOC)
2	Hutton	20	Plankton tows	B08,B09	1 m Ring Net
3	Riser	19	Surface net	B08, B09	Neuston Net
4	Kloser	x	Cast	B28	Acoustic optical measurements to 1000 m obtained with a lowered probe with 38 kHz, 120 kHz and 333 kHz acoustic sensors and stereo digital still cameras, stereoHD video cameras and single digital still camera
5	Kloser	1550	n.miles	B28	Acoustic data at 12, 38 and 120 kHz underway sampling
6	Gall	60	filters		Water filtration unit to collect particulate organic matter, microbial and fungal material. Seawater was continuosly filtered using glass fibre filter papers. Samples will later be analysed for organic content, isotopic values and using T-RFLP's, fungal and bacterial communities identified and quantified.

Curation Report

Item No.	DESCRIPTION
1	Frozen fish and invertebrate specimens from 9 MIDOC trawls. Samples to remain frozen and lodged at CSIRO Quarantine Approved Premises (Fish Taxonomy Lab). Over the following months, specimens will be sub-sampled, dissected as required for biochemical analyses, preserved and taxonomically identified in finer detailed and will be logged into the CSIRO Fish Collection.
2	Formalin-preserved fish specimens (10% formalin). Specimens of high interest were formalin-preserved onboard. These will be lodged at CSIRO Quarantine Approved Premises (Fish Taxonomy Lab). Specimens will be shared with specialist taxonomists and researchers in Australian institutions via the Principal Investigators. Specimens that remain at CSIRO will be logged into the CSIRO Fish Collection.
3	DNA samples from formalin-preserved fishes (98% ethanol)). These will be lodged at CSIRO Quarantine Approved Premises (Fish Taxonomy Lab) and be registered into the collection along with the fish specimens.
4	*Maurolicus australis* kidney tissue (preserved in RNALater). These samples will be delivered to Dr. Stuart Fraser of University of Sydney as part of a collaborative study.
5	*Maurolicus australis* taxonomic samples (10% formalin). These preserved specimens (from which kidneys were dissected) will be lodged at the Melbourne Museum via Adrian Flynn.
6	*Sternoptyx sp.* kidney tissue (preserved in RNALater). These samples will be delivered to Dr. Stuart Fraser of University of Sydney as part of a collaborative study.
7	*Sternoptyx sp.* taxonomic samples (10% formalin). These preserved specimens (from which kidneys were dissected) will be lodged at the Melbourne Museum via Adrian Flynn.
8	*Diaphus danae* otolith samples (unpreserved). These will be lodged at the Melbourne Museum via Adrian Flynn as part of a collaborative ecological study on this species.
9	*Diaphus danae* frozen muscle samples. These will be lodged at the Melbourne Museum via Adrian Flynn as part of a collaborative ecological study on this species..
10	*Diaphus danae* formalin-preserved samples (10% formalin). These will be lodged at the Melbourne Museum via Adrian Flynn as part of a collaborative ecological study on this species..
11	*Diaphus danae* DNA samples (98% ethanol). These will be lodged at the Melbourne Museum via Adrian Flynn as part of a collaborative ecological study on this species.
12	*Protomyctophum sp.* eye samples (4% formalin). These will be delivered to University of Western Australia as part of a collaborative study.
13	*Protomyctophum sp.* taxonomic samples (10% formalin). These will be lodged at the CSIRO Fish Taxonomy Lab and Melbourne Museum to confirm identification.
14	Electrona risso eye samples (4% formalin). These will be delivered to University of Western Australia as part of a collaborative study.
15	Electrona risso taxonomic samples (10% formalin). These will be lodged at the CSIRO Fish Taxonomy Lab and Melbourne Museum.
16	Formalin-preserved zooplankton samples (4% formalin). All samples were formalin-preserved onboard. These will be lodged at CSIRO Quarantine Approved Premises (Fish Taxonomy Lab). Specimens will be shared with specialist taxonomists and researchers in Australian institutions via the Principal Investigators. Over the following months, samples will be sub-sampled, dissected as required for taxonomic identification.
17	Particulate organic material collected using glass-fibre filters (frozen). These will be lodged at CSIRO Quarantine approved facility and later transported to the University of Western Sydney where they will be analysed by the principal investigator (Gall) as well as other researchers within UWS as part of collaborative studies.
18	Salps (frozen). These will be lodged at CSIRO Quarantine approved facility and later transported to the University of Western Sydney.

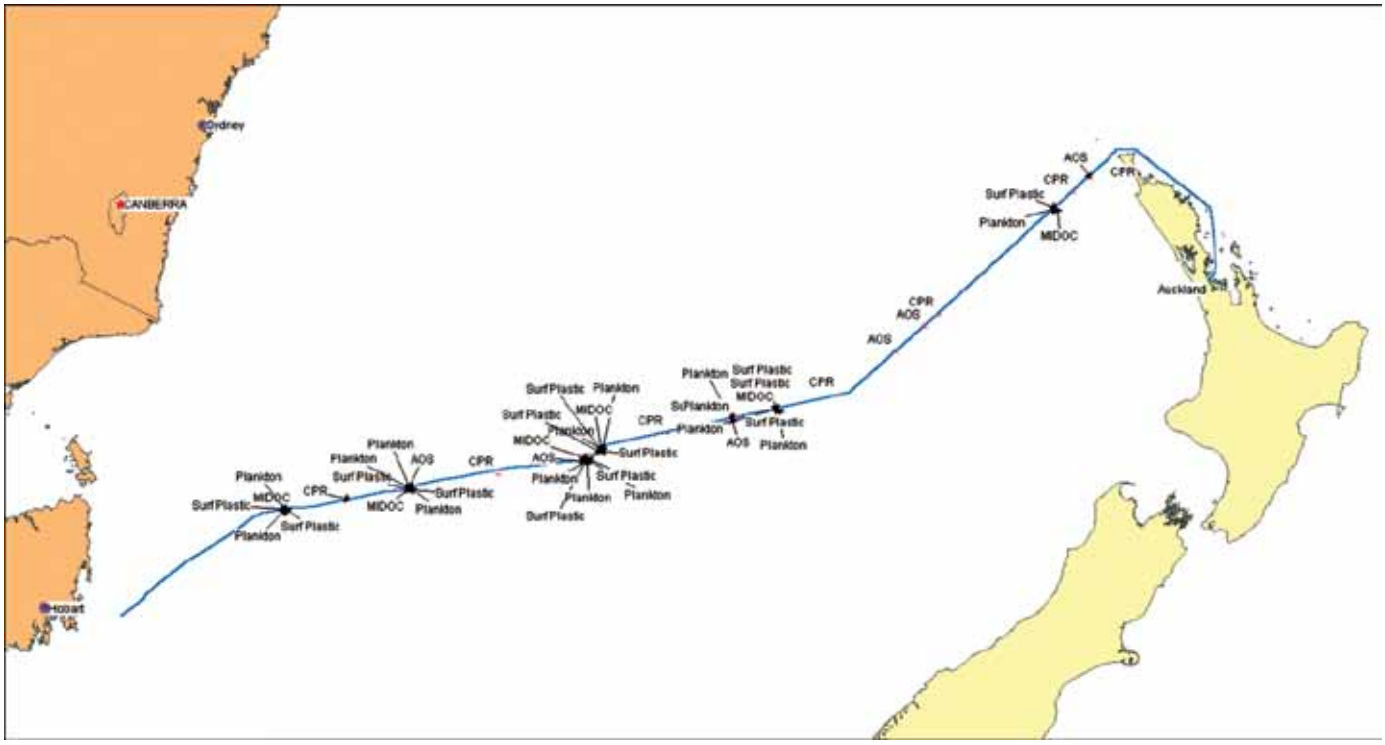


Figure 1. Voyage track and location of samples from New Zealand to Tasmania. Specific area: Tasman Sea.

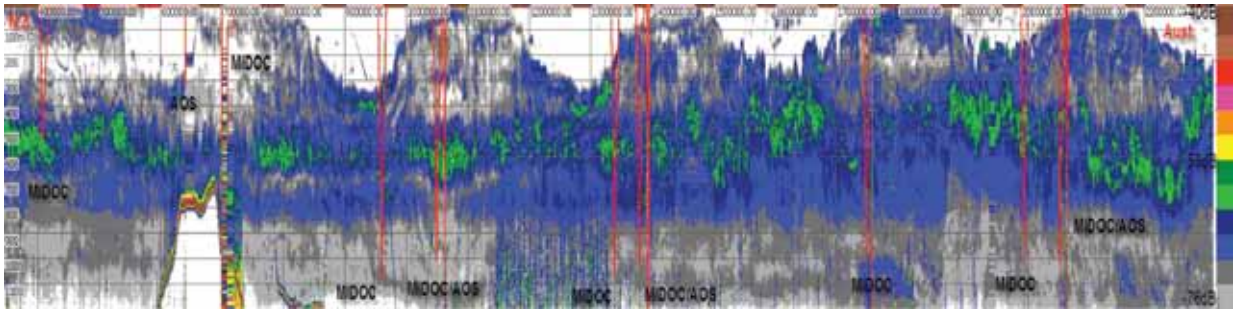


Figure 2. Acoustic backscatter (Sv dB re 1 m) from the New Zealand to Tasmania transit showing the position of the net sampling and the distribution of the water column backscatter from 0 to 1200 m depth.

Personnel list

Scientific Participants

Name	Affiliation	Role
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
Will Figueria	UWS/USYD	PhD leader students
Mailie Gall	UWS	PhD student
Rachel Clark	USYD	student
Louise Nott	USYD	student
Julia Reisser	UWA/CSIRO	PhD student
Jeff Cordell	CMAR	MNF Electronics Support/Voyage Manager
Anoosh Sarraf	CMAR	MNF Computing Support

Marine Crew

Name	Role
John Barr	Master
Mick Tuck	1st Mate
John Boyes	2nd Mate
Upendra Kapu	Chief Engineer
Mike York – Barber	1st Engineer
Graham Perkins	2nd Engineer
Tony Hearne	Chief IR
Gareth Gunn	IR
Nathan Arahanga	IR
Graham McDougall	IR
Rod Langham	IR
Peter Taylor	Trainee IR
Cassandra Rowse	Chief Steward
Robert Dittko	Chief Cook
Brooke Saal	2nd Cook

Acknowledgements

It is with pleasure that we acknowledge the contributions to this voyage from the following personnel. Firstly the MNF ships group and in particular Don McKenzie for guiding the voyage planning and facilitating our embarkation in New Zealand. Secondly we would like to thank the Science Equipment and Technology group at CMAR for the preparation of the AOS and MIDOC system and necessary engineering works. Finally, we would like to thank the ships officers, engineers and crew and in particular John Boyes for ensuring that the net was successfully deployed and retrieved with minimal down time

Dr Rudy Kloser
Chief Scientist

APPENDICES

Appendix 1 - Science Report

Voyage ST02/2011

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

Dr Rudy Kloser, (Chief Scientist)

Itinerary
Departed Auckland, 08:00
Tuesday, 07 June 2011
Arrived Hobart, 08:00
Wednesday, 15 June 2011

Contribution to Australia's national benefit:

This transit voyage developed and applied new methods to understand the zooplankton and micronekton of the Tasman Sea. This voyage value adds ongoing data collections from bio-acoustic and continuous plankton recorder (CPR) facilities within the Integrated Marine Observing System (IMOS). The Tasman Sea is a climate change hot spot with temperature predicted to rise due to East Australian Current strengthening. A baseline and monitoring of the ecosystem responses and its potential flow on effects to the goods and services that the ecosystem provides in this region has high priority. Monitoring the zooplanktonic and micronekton communities ~2 to 20 cm length (including small fish, crustaceans, squids and gelatinous) at basin scales should provide valuable inputs to ecosystem-based fisheries management, marine planning and monitoring impacts of climate change for the region. Despite the enormous pelagic realm these organisms occupy and their pivotal role in the functioning of ecosystems linking biogeochemistry to the distribution and abundance of predators they remain one of the least known components of the ecosystem.

As a result of this voyage:

1. We have a better understanding of the community structure and biomass of zooplankton and fish species across the Tasman Sea.

2. We have found fish diversity and biomass is low in the East Tasman and High in the West Tasman along the 41o S latitude. This appears to be in direct contrast to ecosystem model predictions of biomass for the region.

3. We have mapped the distribution of micronekton using acoustic methods from New Zealand to Tasmania across the Tasman Sea to a depth of 1200 m and physically sampled this distribution with depth stratified nets. Data collected will form the basis of several student PhD, masters and honours works.

4. We have commenced a program to understand mid-trophic biomass, distribution, variability and energetics in ocean ecosystems that should enable better modelling of the ecosystems and input into ecosystem-based fisheries management, marine planning and monitoring impacts of climate change for the region.

CSR/ROSCOP PARAMETER CODES

M01 Upper air observations
M02 Incident radiation
M05 Occasional standard measurements
M06 Routine standard measurements
M71 Atmospheric chemistry
M90 Other meteorological measurements

PHYSICAL OCEANOGRAPHY

H71 Surface measurements underway (T,S)
H13 Bathythermograph
H09 Water bottle stations
H10 CTD stations
H11 Subsurface measurements underway (T,S)
H72 Thermistor chain
H16 Transparency (eg transmissometer)
H17 Optics (eg underwater light levels)
H73 Geochemical tracers (eg freons)
D01 Current meters
D71 Current profiler (eg ADCP)
D03 Currents measured from ship drift
D04 GEK
D05 Surface drifters/drifting buoys
D06 Neutrally buoyant floats
D09 Sea level (incl. Bottom pressure & inverted echosounder)
D72 Instrumented wave measurements
D90 Other physical oceanographic measurements

CHEMICAL OCEANOGRAPHY

H21 Oxygen
H74 Carbon dioxide
H33 Other dissolved gases
H22 Phosphate
H23 Total - P
H24 Nitrate
H25 Nitrite
H75 Total - N
H76 Ammonia
H26 Silicate
H27 Alkalinity
H28 PH
H30 Trace elements
H31 Radioactivity
H32 Isotopes
H90 Other chemical oceanographic measurements

MARINE CONTAMINANTS/POLLUTION

P01 Suspended matter
P02 Trace metals
P03 Petroleum residues
P04 Chlorinated hydrocarbons
P05 Other dissolved substances
P12 Bottom deposits
P13 Contaminants in organisms
P90 Other contaminant measurements