2010 program

RV *Southern Surveyor*

MARINE NATIONAL FACILITY

voyageplan
ss2010_v08

Krill in 3D – Vertical stratification and spatial distribution of krill communities in the East Australian Current.

Itinerary

Mobilise Sydney 0800, Wednesday 22 September, 2010
Depart Sydney 1600, Wednesday 22 September, 2010
Arrive Sydney 1100, Tuesday 5 October, 2010 and demobilise

Principal Investigators

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CSIRO

Scientific Objectives

Marine predator-prey relationships should remain within certain boundary conditions (Michener and Kaufman, 2007), but few examples consider interspecific interactions in planktonic communities in pelagic marine ecosystems (Hairston et al., 1960; Schlosser, 1982). These ecosystems are often structured with high species diversity at lower and higher trophic levels, but a lower diversity of secondary consumers at mid trophic levels (i.e. a wasp-waist ecosystem, Bakun, 2006), such as pelagic fishes. Euphausiids (krill) likely represent an invertebrate analogue to pelagic fishes in these systems (Bakun, 2006), but this concept is yet to be explored. Competition between larval euphausiids and abundant primary consumers capable of dominating ecosystem resources (i.e. salps) likely control the progression toward a wasp-waist structure, and these competitive interactions are potentially mediated by connection between epipelagic and mesopelagic food webs.

The epipelagic and mesopelagic zones of the ocean are defined as 0 – 100 m (euphotic zone) and 100 – 1000 m depth respectively. Greater than 90% of the organic matter exported from the epipelagic zone is remineralised into nutrients, microelements and CO2 in the mesopelagic zone, and returned to the surface on decadal scales or less (Karl et al., 2008). The mesopelagic zone therefore significantly dampens the downward transfer of organic matter to the deep ocean, and acts as a positive feedback to global warming. Despite their importance in understanding the efficiency of the biological pump, little is known about the processes that control the remineralisation of CO2 in the mesopelagic zone, or its regional variation. These are considered to be related to the structure of, and relationship between, the epipelagic and mesopelagic food-webs, both of which are generally poorly studied in temperate systems. This project will advance our understanding of the importance of secondary consumers such as krill to wasp-waist ecosystem dynamics, by exploring linkages between epi- and mesopelagic food webs, and hydrographic controls, in dynamic oceanic environments. This is necessary to understand outcomes of climate variation from nutrients to fish and whales, and the rapid adaptation of models that govern our conservation and use of ecosystem services (e.g. Game et al., 2009). We will achieve this by characterising the energetic linkages between epipelagic and mesopelagic food webs, to determine both the storage and passage of energy; and identifying how oceanographic variability affects the outcomes of interspecific interactions across spatially separated communities, and the consequences for ecosystem dynamics.

The overall scientific objective of this voyage is to provide a comprehensive description of the euphausiid community in the temperate EAC, and establish linkages between euphausiids and other zooplankton; and euphausiids and oceanography. Specifically this project will:

1. Investigate krill diversity and life histories in the temperate EAC in 3 dimensions, accounting for variation in community composition across latitudinal, cross-shelf, and vertical gradients;

2. Evaluate the relationship between oceanography, and krill and fish biomass and distribution;

3. Determine trophic relationships amongst co-occurring euphausiid species using stable isotope analysis, and trophic interactions with other zooplankton;

4. Investigate the ecosystem properties of krill in different habitats through size frequency analyses, using a Laser Optical Particle Counter (L-OPC) to detect euphausiids, and evaluate the effect of euphausiids on biomass size spectrum (BSS) model parameters and fish larvae.

The study will survey vertical stratification in euphausiid and zooplankton communities between the epi-pelagic and mesopelagic zone, and connectivity between these two zones during the day and night. Four cross-shelf transects will be undertaken along the NSW coast:

1) Tasman Current (~34.5°S);

2) Stockton Bight (~33.0°S);

3) EAC separation zone (~32°S);

4) The EAC (~30.5°S).

Final latitudes will be determined just prior to the voyage from MODIS SST and chlorophyll images. MOCNESS deployments will occur at 3 stations along each transect over two days, with the net being towed along the respective isobaths at each station.

Voyage Objectives

1) To sample krill on the shelf, slope and ocean at 4 latitudes off the NSW coast, by deployments of the Multiple Opening Closing Environmental Sampling System (MOCNESS). This unit will comprise the standard *Southern Surveyor* EZ net, which has been equipped with environmental sampling equipment belonging to the University of New South Wales and fitted to the net frame. This equipment will include a Seabird19plus SEACAT CTD equipped with Wetlabs Ecotriplet, a Brooke Ocean Laser Optical Plankton Counter (L-OPC) with a SBE37, and a strobe light.

2) Deployment of the CTD and vertical hauls of the N70 net from 50 m depth at each station to collect high resolution oceanographic information, collect water samples for phytoplankton, and zooplankton in the upper mixed layer.

3) Continual collection of acoustic backscatter data from that EK500 at 38 kHz and 120 kHz frequency along the voyage track.

4) Possible deployment of the profiling CTD to collect vertical CTD and Eco-triplet profiles whilst travelling between sampling transects, particularly at the shelf break (200 m).

Voyage Track

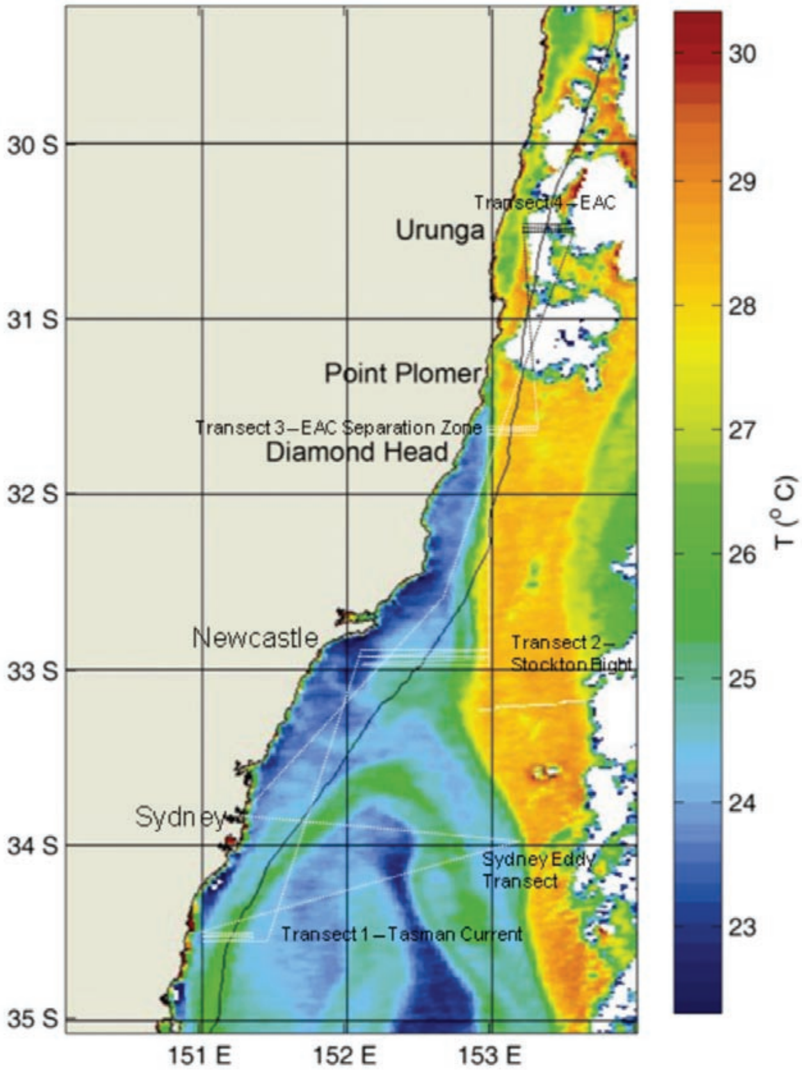

Figure 1: Proposed voyage track for SS2010_v08. Voyage track is indicated by a dotted line, and major transects (corresponding with Table 1) indicated.

Time Estimates

Please see Appendix 1 for a detailed description of time associated with the activities described here. In general, Transects 1-4 will each be using a CTD from the coast (200 m) – offshore stations (4000 m), and then this will be followed by a 4 zig-zag sampling transects with the MOCNESS. Transects are 40-45 nm long. If time is limited, the final transects off Urunga could be dropped from the plan.

22/09/2010

In port: Inductions and tour of the ship, get gear configured and ready to go

1600 Depart Sydney and move to Transect 1. Prepare for net deployments over the following 5 h transit

1600 onwards, toolboxes for MOCNESS and CTD

2000 Test CTD cast

23/09/2010

0400 Arrive on station to commence Sydney Eddy transect. Conduct CTD deployments along transect

1030 Commence Transect 1 CTD sampling

1900 Commence Transect 1 MOCNESS sampling, continue through to next day

24/09/2010

Continue Transect 1 MOCNESS sampling through day and night

25/09/2010

Continue Transect 1 MOCNESS sampling

1700 Conclude Transect 1 MOCNESS sampling and undertake glider retrieval

Transit to Transect 2

26/09/2010

0600 Arrive Transect 2 and commence Transect 2 CTD sampling

1900 Commence Transect 2 MOCNESS sampling, continue through to next day

27/09/2010

Continue Transect 2 MOCNESS sampling through day and night

28/09/2010

Continue Transect 2 MOCNESS sampling

1830 Conclude Transect 2 MOCNESS sampling

Transit to Transect 3

29/09/2010

0430 Arrive Transect 3 and commence Transect 3 CTD sampling

1900 Commence Transect 2 MOCNESS sampling, continue through to next day

30/09/2010

Continue Transect 3 MOCNESS sampling through day and night

1/10/2010

Continue Transect 3 MOCNESS sampling

1700 Conclude Transect 3 MOCNESS sampling

Transit to Transect 4

2/10/2010

0100 Arrive Transect 4 and commence Transect 4 CTD sampling

0700 Commence Transect 4 MOCNESS sampling, continue through to next day

3/10/2010

Continue Transect 4 MOCNESS sampling through day and night

4/10/2010

Continue Transect 4 MOCNESS sampling

0600 Conclude Transect 4 MOCNESS sampling – TRIP SAMPLING CONCLUDED

Transit to Sydney, pack up scientific equipment

5/10/2010

Continue transit to Sydney, clean cabins, labs and ops room

1100 Arrive in Port and demobilise.

Southern Surveyor Equipment

1. *Southern Surveyor* workboat for Glider deployments and retrieval
2. Walk in freezer
3. Simrad EK500 sounder for biological research (12, 38 and 120 kHz)
4. Simrad EA500 sounder for bottom detection (12 kHz)
5. ADCP set for shallow water profiling (to 600 m) with bins set at 0-20 m, 20-40, 40-60, 60-80, 80-100 etc until 580-600 m.
6. General purpose lab
7. Controlled temperature lab/cool room – ambient water temperature at time of voyage
8. Hydrochemistry laboratory
9. Wet lab/CTD room
10. Fish lab
11. Fish sorting room
12. CTD/Hydro winch (8 mm single core conducting cable)
13. Towed-body winch (12 mm 7 core conducting cable
14. Hydrographic A-frame
15. Stern A-frame (SWL 15 tonne)
16. General purpose depth sensor (Sonardyne, for coastal EZ work)
17. CTD (Seabird SBE 911 plus)
    - Rosette (24 bottles up to 10 litres)
    - 10 L Niskin bottles
    - Transmissometer
    - Profiling fluorometer
    - Light (PAR)
    - Dissolved oxygen
    - Eco triplet sensor
18. Underway fluorometer
19. Milli-Q water supply
20. Profiling CTD
21. EZ net, with supplied equipment retrofitted (SEACAT, Laser OPC)
    - 330 um nets fitted to unit (in position 2, 4, 6, 8, 10)
    - 330 um net spares (at least 5)
    - 500 um nets (to be fitted on voyage if required)
    - 500 um nets spares (what ever is available)

User Equipment

1. Laser Optical plankton Counter (to be attached to the EZ net)
2. Rectangular Midwater Trawl Net (+ spare) to be supplied by UNSW (will use coring wire winch with MNF Sonardyne)
3. Surface neuston net to be supplied by UNSW
4. N70 net
5. Triple net tucker-trawl for use in the case of catastrophic EZ failure
6. Seabird SEACAT 19plus (to be attached to the EZ net)
7. Wetlabs Ecotriplet (to be attached to the EZ net)
8. High power strobe (to be attached to the EZ net)
9. Vacuum pump, filters for chlorophyll, isotopes
10. Fibrox oxygen probe and flow chamber for lab respiration experiments
11. Liquid Nitrogen dewer, filled
12. Formalin, alcohol, 500 jars, consumables
13. Microscopes in Fish Lab and General Purpose Lab
14. 25 x 44 litre tanks (nally bins)
15. 40 x 5 L perspex fish tanks for CT room

Special Requests

I have conversed with Lindsay MacDonald regarding the mounting of our new Laser OPC, and SBE19plus Profiling CTD on the EZNet, to convert it to a Multiple Opening Closing Net and Environmental Sampling System (or MOCNESS, as described above). I have purchased this equipment especially for the voyage.

Both units will be self powering, but it would be useful (but not essential) to have the Laser OPC communicating with the ship such that it can display data in real time. Attachment of this equipment would involve the manufacture of some new brackets, and some wiring into the EZ net for Laser OPC communications. The LOPC is being shipped directly from the manufacturer to CSIRO in early August.

Our special requirements can be summarised as:

1. A bracket to mount the Laser OPC atop the EZ net. Also, the LOPC should be wired such that it will send data in real time to the OPS room, and receive power from the ship if possible.

2. A bracket to mount the SBE19plus atop the EZ net. There is no requirement to hard wire this as it will log and power remotely. If there is no possible way that the SBE19plus is going to fit, then we would like to deploy our SBE37 CTD which mounts onto the LOPC (and receives power from and logs to the LOPC unit).

3. We also wish to keep using the strobe that I purchased for SS2009/05 (contact Stephen Thomas who is holding on to this unit).

4. An hydraulic pot hauler, fixed to the aft side of the CTD hydro-frame, for our vertical haul net ("N70"),

5. A forward neuston net boom and pulley (as for SS05/2009)

Personnel List

Scientific Staff	Affiliation	Duties (cabin)	Shift
1. Dr. Matt Taylor	SIMS/UNSW	Chief Scientist (CS Cabin)	A/B
2. Prof. Iain Suthers	SIMS/UNSW	Supporting Chief Scientist (Sc 4/5), Shift leader A	A: 14:00 – 02:00
3. Dr. Will Figueira	SIMS/USyd	Supporting Scientist (Sc 6/7), Shift leader B	B: 02:00 – 14:00
4. Dr. Brendan Keleher	SIMS/MPA	Supporting Scientist (Sc 6/7)	A: 14:00 – 02:00
5. Mr. Ben Harris	SIMS/UNSW	PhD Student (Sc 4/5)	B: 02:00 – 14:00
6. Mr. Josh Humphries	SIMS/UNSW	PhD Student (Sc 8/9)	A: 14:00 – 02:00
7. Ms. Natasha Henschke	SIMS/UNSW	PhD Student (Sc 10/11)	B: 02:00 – 14:00
8. Ms. Lauren Ooi	SIMS/UNSW	MPhil Student (Sc 8/9)	B: 02:00 – 14:00
9. TBC	SIMS/UNSW	TBC (Sc 2/3)	B: 02:00 – 14:00
10. Ms. Nikki Best	UNSW	UGrad Student (Sc 10/11)	A: 14:00 – 02:00
11. Dr. Brian Hunt	UBC	Supporting Scientist (Sc 2/3)	A: 14:00 – 02:00
16. Stephen McCullum	CSIRO	MNF Voyage Manager (Sc 1)	B: 02:00 – 14:00
13. Drew Mills	CSIRO	MNF Elect Support (Sc/Cr 2)	TBC
14. Anoosh Sarraf	CSIRO	MNF Comp Support (Sc/Cr 3)	TBC
15. Mark Rayner	CSIRO	MNF Hydrochemist (Sc/Cr 4)	TBC

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.
Stephen McCullum	BB03845
Drew Mills	AS02348
Anoosh Sarraf	BB03210
Mark Rayner	AS02432

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

Dr. Matthew D, Taylor
Chief Scientist

Appendix 1 – Detailed voyage plan

Date	Transect	Station	Diel Factor	Station Ref	Time	Station Lat_DD	Station Long_DD	Bearing	Distance (nm)	Duration (h)	Details
22/09	Port				9:00	Port	Port				Safety induction and briefing
22/09	Port				10:00	Port	Port				Load equipment and set up
22/09	SYDEDDY			Transit	16:00	Port			50.00	5.5	Steam to Tranns 1, toolboxes, test CTD cast
22/09	SYDEDDY		SYDEDDY TRANSECT	4:00	6 X CTD/N70 STATIONS			Coastward	6.5		
23/09	1	Shelf		CTD1	10:30	34.50000	151.16667			1.0	
23/09	1			Transit	11:30			125	22.22	2.0	
23/09	1	Slope		CTD2	13:31	34.58667	151.50333			1.0	
23/09	1			Transit	14:31			125	25.93	2.4	2 more Transect 1 CTDs can be done here
23/09	1	EAC		CTD3	16:52	34.73333	151.91667			1.0	
23/09	1	EAC	N1	EZ1	19:00	34.73333	151.91667	305	4.50	1.5	
23/09	1	EAC	N1	EZ2	20:30	34.42000	151.82500	305	4.50	1.5	
23/09	1			Transit	22:00			305	12.43	1.1	
23/09	1	Slope	N1	EZ3	23:07	34.64167	151.62500	305	4.50	1.5	
24/09	1	Slope	N1	EZ4	0:37	34.58667	151.50333	305	4.50	1.5	
24/09	1			Transit	2:07			305	13.22	1.2	
24/09	1	Shelf	N1	EZ5	3:19	34.51667	151.25000	305	4.50	1.5	
24/09	1	Shelf	N1	EZ6	4:49	34.50000	151.16667	125	4.50	1.5	
24/09	1	Shelf	D1	EZ7	7:00	34.51667	151.25000	305	4.50	1.5	
24/09	1	Shelf	D1	EZ8	8:30	34.50000	151.16667	125	4.50	1.5	
24/09	1			Transit	10:00			125	13.22	1.2	
24/09	1	Slope	D1	EZ9	11:12	34.58333	151.44250	125	4.50	1.5	
24/09	1	Slope	D1	EZ10	12:42	34.58667	151.50333	125	4.50	1.5	
24/09	1			Transit	14:12				16.93	1.5	
24/09	1	EAC	D1	EZ11	15:44	34.74167	151.85000	125	4.50	1.5	
24/09	1	EAC	D1	EZ12	17:14	34.73333	151.91667	305	4.50	1.5	
24/09	1	EAC	N2	EZ13	19:00	34.74167	151.85000	125	4.50	1.5	
24/09	1	EAC	N2	EZ14	20:30	34.73333	151.91667	305	4.50	1.5	
24/09	1			Transit	22:00			305	16.93	1.5	
24/09	1	Slope	N2	EZ15	23:32	34.64167	151.62500	305	4.50	1.5	
25/09	1	Slope	N2	EZ16	1:02	34.58667	151.50333	305	4.50	1.5	
25/09	1			Transit	2:32			305	13.22	1.2	
25/09	1	Shelf	N2	EZ17	3:44	34.51667	151.25000	305	4.50	1.5	
25/09	1	Shelf	N2	EZ18	5:14	34.50000	151.16667	125	4.50	1.5	
25/09	1	Shelf	D2	EZ19	7:00	34.51667	151.25000	305	4.50	1.5	
25/09	1	Shelf	D2	EZ20	8:30	34.50000	151.16667	125	4.50	1.5	
25/09	1			Transit	10:00			125	13.22	1.2	

Date	Transect	Station	Diel Factor	Station Ref	Time	Station Lat_DD	Station Long_DD	Bearing	Distance (nm)	Duration (h)	Details
25/09	1	Slope	D2	EZ21	11:12	34.58333	151.44250	125	4.50	1.5	
25/09	1	Slope	D2	EZ22	12:42	34.58667	151.50333	125	4.50	1.5	
25/09	1			Transit	14:12			125	12.43	1.1	
25/09	1	EAC	D2	EZ23	15:19	34.74167	151.85000	125	4.50	1.5	
25/09 151.91667	1	EAC 125	D2 4.50	EZ24 1.5	16:49 Glider retrieval can be done here	34.73333					
25/09	Transit to Transect 2			Transit	18:19				125.92	11.4	
26/09	2	Shelf		CTD4	5:46	33.00000	152.23333			1.0	
26/09	2			Transit	6:46			140	22.22	2.0	
26/09	2	Slope		CTD5	8:47	33.19167	152.52167			1.0	
26/09 25.93	2 2.4	4 more Transect 2 CTDs can be done here		Transit	9:47			140			
26/09	2	EAC		CTD6	12:09	33.42500	152.86667			1.0	
26/09	2	EAC	N1	EZ25	19:00	33.42500	152.86667	320	4.50	1.5	
26/09	2	EAC	N1	EZ26	20:30	33.37500	152.80000	320	4.50	1.5	
26/09	2			Transit	22:00			320	12.43	1.1	
26/09	2	Slope	N1	EZ27	23:07	33.24167	152.57500	320	4.50	1.5	
27/09	2	Slope	N1	EZ28	0:37	33.19167	152.52167	320	4.50	1.5	
27/09	2			Transit	2:07			320	13.22	1.2	
27/09	2	Shelf	N1	EZ29	3:19	33.03333	152.29167	320	4.50	1.5	
27/09	2	Shelf	N1	EZ30	4:49	33.00000	152.23333	140	4.50	1.5	
27/09	2	Shelf	D1	EZ31	7:00	33.03333	152.29167	320	4.50	1.5	
27/09	2	Shelf	D1	EZ32	8:30	33.00000	152.23333	140	4.50	1.5	
27/09	2			Transit	10:00			140	13.22	1.2	
27/09	2	Slope	D1	EZ33	11:12	33.15833	152.46667	140	4.50	1.5	
27/09	2	Slope	D1	EZ34	12:42	33.19167	152.52167	140	4.50	1.5	
27/09	2			Transit	14:12				16.93	1.5	
27/09	2	EAC	D1	EZ35	15:44	33.37500	152.80000	140	4.50	1.5	
27/09	2	EAC	D1	EZ36	17:14	33.42500	152.86667	320	4.50	1.5	
27/09	2	EAC	N2	EZ37	19:00	33.37500	152.80000	140	4.50	1.5	
27/09	2	EAC	N2	EZ38	20:30	33.42500	152.86667	320	4.50	1.5	
27/09	2			Transit	22:00			320	16.93	1.5	
27/09	2	Slope	N2	EZ39	23:32	33.24167	152.57500	320	4.50	1.5	
28/09	2	Slope	N2	EZ40	1:02	33.19167	152.52167	320	4.50	1.5	
28/09	2			Transit	2:32			320	13.22	1.2	
28/09	2	Shelf	N2	EZ41	3:44	33.03333	152.29167	320	4.50	1.5	
28/09	2	Shelf	N2	EZ42	5:14	33.00000	152.23333	140	4.50	1.5	

Date	Transect	Station	Diel Factor	Station Ref	Time	Station Lat_DD	Station Long_DD	Bearing	Distance (nm)	Duration (h)	Details
28/09	2	Shelf	D2	EZ43	7:00	33.03333	152.29167	320	4.50	1.5	
28/09	2	Shelf	D2	EZ44	8:30	33.00000	152.23333	140	4.50	1.5	
28/09	2			Transit	10:00			140	13.22	1.2	
28/09	2	Slope	D2	EZ45	11:12	33.15833	152.46667	140	4.50	1.5	
28/09	2	Slope	D2	EZ46	12:42	33.19167	152.52167	140	4.50	1.5	
28/09	2			Transit	14:12			140	12.43	1.1	
28/09	2	EAC	D2	EZ47	15:19	33.37500	152.80000	140	4.50	1.5	
28/09	2	EAC	D2	EZ48	16:49	33.42500	152.86667	140	4.50	1.5	
28/09	Transit to Transect 3			Transit	18:19				110.00	10.0	
29/09	3	Shelf		CTD7	4:19	31.79167	153.09167			1.0	
28/09	3			Transit	5:19			122	11.13	1.0	
28/09	3	Slope		CTD8	6:20	31.85833	153.27167			1.0	
28/09	3			Transit	7:20			122	21.21	1.9	
28/09	3	EAC		CTD9	9:16	31.94667	153.60333			1.0	
29/09			Glider deployment in morning								More Transect 3 CTDs can be done here
29/09	3	EAC	N1	EZ49	19:00	31.94667	153.60333	302	4.50	1.5	
29/09	3	EAC	N1	EZ50	20:30	31.93000	153.52833	302	4.50	1.5	
29/09	3			Transit	22:00			302	7.26	0.7	
29/09	3	Slope	N1	EZ51	22:39	31.88333	153.34500	302	4.50	1.5	
30/09	3	Slope	N1	EZ52	0:09	31.85833	153.27167	302	4.50	1.5	
30/09	3			Transit	1:39			302	1.70	0.2	
30/09	3	Shelf	N1	EZ53	1:48	31.81667	153.16667	302	4.50	1.5	
30/09	3	Shelf	N1	EZ54	3:18	31.79167	153.09167	122	4.50	1.5	
30/09	3	Shelf	D1	EZ55	7:00	31.81667	153.16667	302	4.50	1.5	
30/09	3	Shelf	D1	EZ56	8:30	31.79167	153.09167	122	4.50	1.5	
30/09	3			Transit	10:00			122	2.13	0.2	
30/09	3	Slope	D1	EZ57	10:11	31.82500	153.19333	122	4.50	1.5	
30/09	3	Slope	D1	EZ58	11:41	31.85833	153.27167	122	4.50	1.5	
30/09	3			Transit	13:11				11.76	1.1	
30/09	3	EAC	D1	EZ59	14:15	31.93000	153.52833	122	4.50	1.5	
30/09	3	EAC	D1	EZ60	15:45	31.94667	153.60333	302	4.50	1.5	
30/09	3	EAC	N2	EZ61	19:00	31.93000	153.52833	122	4.50	1.5	
30/09	3	EAC	N2	EZ62	20:30	31.94667	153.60333	302	4.50	1.5	
30/09	3			Transit	22:00			302	11.76	1.1	
30/09	3	Slope	N2	EZ63	23:04	31.88333	153.34500	302	4.50	1.5	
1/10	3	Slope	N2	EZ64	0:34	31.85833	153.27167	302	4.50	1.5	
1/10	3			Transit	2:04			302	2.13	0.2	

Date	Transect	Station	Diel Factor	Station Ref	Time	Station Lat_DD	Station Long_DD	Bearing	Distance (nm)	Duration (h)	Details
D1/10	3	Shelf	N2	EZ65	2:15	31.81667	153.16667	302	4.50	1.5	
1/10	3	Shelf	N2	EZ66	3:45	31.79167	153.09167	122	4.50	1.5	
1/10	3	Shelf	D2	EZ67	7:00	31.81667	153.16667	302	4.50	1.5	
1/10	3	Shelf	D2	EZ68	8:30	31.79167	153.09167	122	4.50	1.5	
1/10	3			Transit	10:00			122	2.13	0.2	
1/10	3	Slope	D2	EZ69	10:11	31.82500	153.19333	122	4.50	1.5	
1/10	3	Slope	D2	EZ70	11:41	31.85833	153.27167	122	4.50	1.5	
1/10	3			Transit	13:11			122	7.71	0.7	
1/10	3	EAC	D2	EZ71	13:53	31.93000	153.52833	122	4.50	1.5	
1/10	3	EAC	D2	EZ72	15:23	31.94667	153.60333	122	4.50	1.5	
1/10	Transit to Transect 4			Transit	16:53				87.15	7.9	
2/10	4	Shelf		CTD10	0:49	30.70000	153.27000			1.0	
2/10	4			Transit	1:49			114	7.04	0.6	
2/10	4	Slope		CTD11	2:27	30.72500	153.38333			1.0	
2/10	4			Transit	3:27			114	13.40	1.2	More Transect 4 CTDs can be done here
2/10	4	EAC		CTD12	4:40	30.76667	153.60333			1.0	
2/10	4	EAC	D1	EZ73	7:00	30.80417	153.60333	348	4.50	1.5	
2/10	4	EAC	D1	EZ74	8:30	30.72917	153.60333	168	4.50	1.5	
2/10	4			Transit	10:00			294	13.40	1.2	
2/10	4	Slope	D1	EZ75	11:13	30.68750	153.38333	348	4.50	1.5	
2/10	4	Slope	D1	EZ76	12:43	30.76250	153.38333	168	4.50	1.5	
2/10	4			Transit	14:13			294	7.04	0.6	
2/10	4	Shelf	D1	EZ77	14:51	30.73750	153.27000	348	4.50	1.5	
2/10	4	Shelf	D1	EZ78	16:21	30.66250	153.27000	168	4.50	1.5	
2/10	4	Shelf	N1	EZ79	19:00	30.73750	153.27000	348	4.50	1.5	
2/10	4	Shelf	N1	EZ80	20:30	30.66250	153.27000	168	4.50	1.5	
2/10	4			Transit	22:00			114	7.04	0.6	
2/10	4	Slope	N1	EZ81	22:38	30.68750	153.38333	348	4.50	1.5	
3/10	4	Slope	N1	EZ82	0:08	30.76250	153.38333	168	4.50	1.5	
3/10	4			Transit	1:38			114	13.40	1.2	
3/10	4	EAC	N1	EZ83	2:51	30.80417	153.60333	348	4.50	1.5	
3/10	4	EAC	N1	EZ84	4:21	30.72917	153.60333	168	4.50	1.5	
3/10	4	EAC	D2	EZ85	7:00	30.80417	153.60333	348	4.50	1.5	
3/10	4	EAC	D2	EZ86	8:30	30.72917	153.60333	168	4.50	1.5	
3/10	4			Transit	10:00			294	13.40	1.2	
3/10	4	Slope	D2	EZ87	11:13	30.68750	153.38333	348	4.50	1.5	
3/10	4	Slope	D2	EZ88	12:43	30.76250	153.38333	168	4.50	1.5	

Date	Transect	Station	Diel Factor	Station Ref	Time	Station Lat_DD	Station Long_DD	Bearing	Distance (nm)	Duration (h)	Details
3/10	4			Transit	14:13			294	7.04	0.6	
3/10	4	Shelf	D2	EZ89	14:51	30.73750	153.27000	348	4.50	1.5	
3/10	4	Shelf	D2	EZ90	16:21	30.66250	153.27000	168	4.50	1.5	
3/10	4	Shelf	N2	EZ91	19:00	30.73750	153.27000	348	4.50	1.5	
3/10	4	Shelf	N2	EZ92	20:30	30.66250	153.27000	168	4.50	1.5	
3/10	4			Transit	22:00			114	7.04	0.6	
3/10	4	Slope	N2	EZ93	22:38	30.68750	153.38333	348	4.50	1.5	
4/10	4	Slope	N2	EZ94	0:08	30.76250	153.38333	168	4.50	1.5	
4/10	4			Transit	1:38			114	13.40	1.2	
4/10	4	EAC	N2	EZ95	2:51	30.80417	153.60333	348	4.50	1.5	
4/10	4	EAC	N2	EZ96	4:21	30.72917	153.60333	168	4.50	1.5	
4/10				Transit	5:51			South	324.00	29.5	Return to Port
5/10					11:18						Dock and demobilise