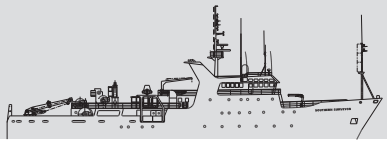

MARINE
NATIONAL FACILITY

2010 program

RV *Southern Surveyor*

voyageplan
SS2010-T04

(Sydney to Hobart)

An examination of the temperate reef and deep sea benthic fauna of the south eastern Australian shelf and the trophic relationships between euphausids and larval fish

Itinerary

Mobilise Sydney: 16:00hrs, Tuesday 2nd November 2010
Depart Sydney: 06:00hrs, Wednesday 3rd November, 2010
Arrive Hobart: 18:00hrs, Sunday 7th November, 2010
Demobilise: Monday morning, 8th November 2010

Principal Investigators

Dr Sebastian Holmes (Chief Scientist/Benthic Invertebrates
The University of Sydney (USYD).
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Dr Rudy Kloser (BOAGS) – CSIRO Marine and Atmospheric Research.
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Dr Ron Thresher (St Helens corals)
CSIRO Marine and Atmospheric Research.
Email: ron.thresher@csiro.au **Phone:** 03 6232 5378

CSIRO

Scientific Objectives

The focus of this program is to give students a taste of what it is like to live and work on an ocean going research vessel and to expose them to some of the different sampling methods and equipment that are used in biological research programs. The students will have three (quasi) scientific aims, which will contribute to our knowledge about Australian waters, as follows: 1) to characterise the macro-fauna inhabiting a unique geological feature (reef) off the coast of Wollongong; 2) to examine the effect of depth on species composition in Bass Canyon and 3) to examine the trophic relationships between euphausids and larval fish, extending the work of the Taylor cruise (ss2010_v08).

To a large extent aims 1 and 2 align with those of Dr Rudy Kloser (CMAR) and complement the piggyback project of Dr Ronald Thresher, which will provide the students with a window into another benthic habitat. For Kloser, the voyage provides an ongoing opportunity to use vessel transit time to complete a national mapping of the upper-mid slope seabed with multi-beam mapping and associated ecological interpretation. The upper-slope and mid-slope seabed 100 m to 1500 m depth range, are regions important for regional marine planning, biodiversity and conservation assessments and fisheries habitat mapping.

On this voyage we will use a ongoing and developing piece of equipment, the Benthic Optical Acoustic and Grab sampler (BOAGS), which can survey, by video and acoustically, and selectively sample (surface fired Smith-Macintyre grab) the benthos. The benthic sampling carried out by the students will supplement BOAGS. Conversely and importantly, BOAGS will allow the students to survey a much broader area and ensure the correct gear is deployed, thereby increasing their exposure to deep sea fauna.

In addition, depending on what is obtained, some of the benthic material collected (macro fauna) will be used by a postgraduate student at the University of Wollongong for their Ph.D. in natural products chemistry.

Voyage Objectives

The voyage objectives fall into three categories, pelagic sampling, benthic sampling and swath mapping.

Pelagic sampling

Sampling (Ben Harris) will be carried out two locations, Jervis Bay & Eden, with a vertical CTD cast, two N70 casts and three EZ net casts (deep/slope/shelf) at 5 depths from 200m to the surface. EZ net samples will be sorted to remove and ID any euphausids and larval fishes. A subset of these will be flash frozen for later use in lipid, stable isotope and RNA analyses. The remaining individuals will be examined under dissecting microscopes, separated into the main taxonomic groups, photographed and preserved for later examination. In addition, a few expendable bathythermograph (XBT) casts will be made to characterise the water masses and absorption and sound velocity profiles for calibrating the swath mapper.

Benthic sampling

Sampling will occur at three different sites:

Wollongong reef

The reef, which has extremely high back scatter reflectance, sits in 350 - 400 m of water, 38 km south east of Wollongong and is 32 km long and 2 km wide supporting a diverse and abundant fauna (a serendipitous observation was made during ss2009_T03). Sampling will take place at four stations along the reef, two on top and two on the sea-bed immediately adjacent to it. At each station, BOAGS will be deployed to provide a 30 minute video transect of the sea floor and obtain a sample of the sediment. The fauna observable on the video feed from BOAGS will be classified in real-time by the students and samples taken from the sediment for physical characterisation (organic content/grain size analysis), microbial diversity and meio-fauna. The water column will be profiled using the CTD (water samples will be taken at some stations and an XBT will be substituted at some of the stations) before the bottom is trawled/dredged (beam trawl/seamount sled).

Bass Canyon

Sampling will be made at 3 sites transiting from North to South up slope at 2500 m (or as close to as possible), 1500 m and 700 m. Sampling will follow a very similar schedule to that for the Wollongong reef with the Smith-MacIntyre grab being additionally deployed at the 700 m station.

St. Helen's seamount

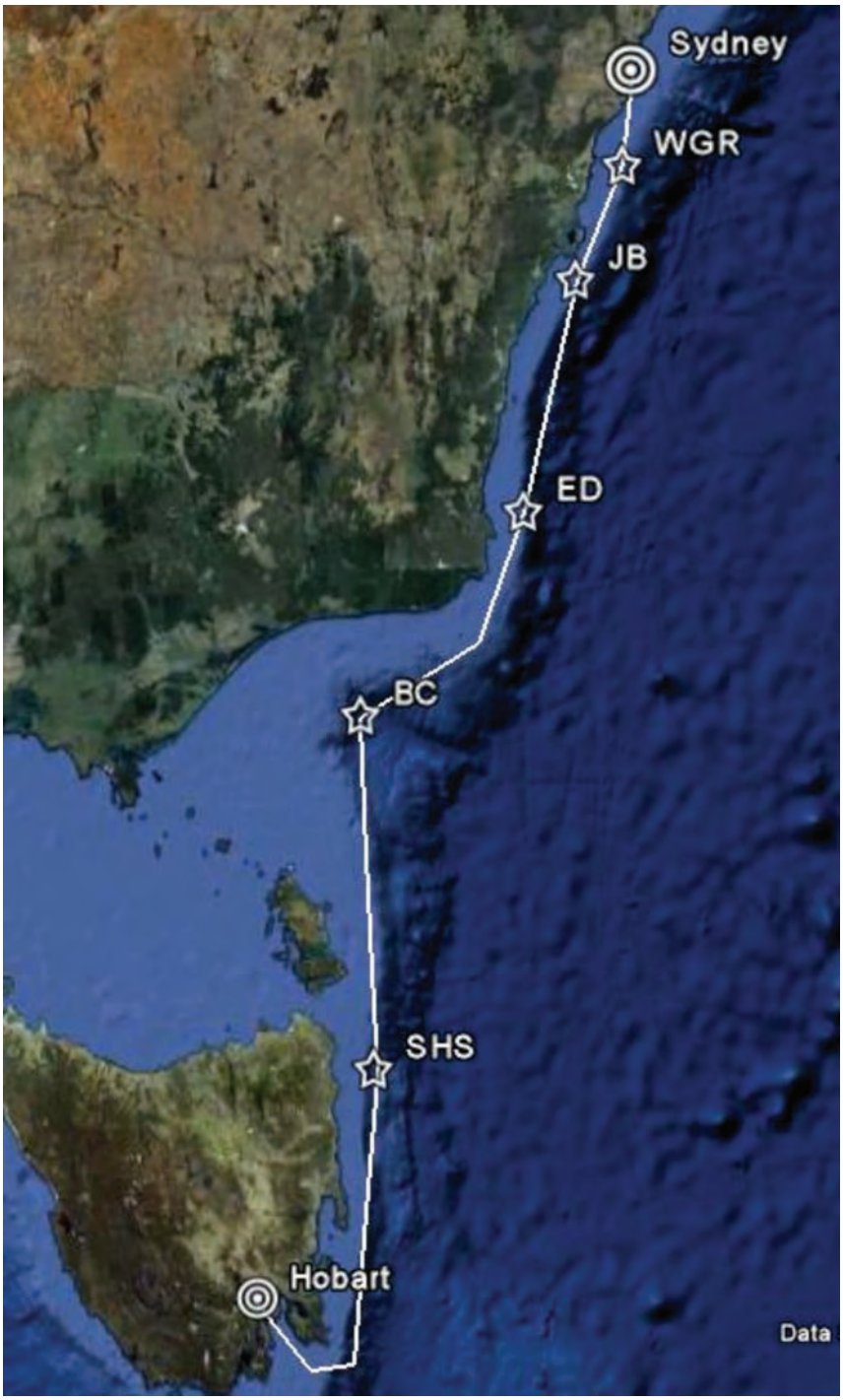
The water column will be profiled using the CTD to a depth of 2500 m, with water samples taken at 500, 750 and, thereafter, at 100 m intervals below 1000 m. Moving up slope to around 1100 m, BOAGS will be deployed, the seabed surveyed (30 min) and a live sample of coral collected at two different sites. Depending on the bottom composition a trawl/dredge will be deployed to collect further material from these sites.

All data and specimens collected by the students will be made freely available to the key voyage participants. In addition, during the voyage and outside of sampling stations, students will take it in turns to watch for marine mammals, assist with the swath mapping/processing and manually process water samples for dissolved oxygen content (weather dependant). In addition, we may supplement the sampling and research with a series of lectures and practicals utilising the material/data collected.

Swath mapping

Throughout the voyage the swath will be operated (see Table 1) with the Canyon Head off Jervis Bay being of particularly high priority.

Voyage Track



Indicative map of the transit from Sydney to Hobart, denoting the three main benthic sampling sites, Wollongong reef (WGR), Bass Canyon (BC), St Helens Seamount (SHS) and the two pelagic sampling sites Jervis Bay (JB) and Eden (ED).

Time Estimates

A full list of activities and timings are tabulated below. Highest priority tasks are in bold, medium priority tasks are underlined and lowest priority tasks are italicised.

Sydney to Wollongong reef (WGR) (~100 km/54 Nm), leg 1

Departing Sydney at 06:00 on Wednesday the 3rd of November, the vessel will steam south westerly along the NSW coastline arriving at Wollongong reef around midday. Once at the reef, sections will be swathed, BOAGS deployed (30 minute bottom times), CTD casts made and trawls/dredges taken. Thirty minutes are allocated for steaming between stations and deployment estimates are conservative.

Location	Day/time arrival	Day/time depart	Gear (deployment time)	Sampling depth	Lat/Long	Cumulative time arrival/departure (distance)
Sydney (White Bay)		Wednesday 06:00			Following swath route leg 1.	
Station 1 (WGR 1) reef top North	Wednesday 12:00	Wednesday 14:30	**Deployment and grab sample taken with BOAGS (60 min)*.** *Beam trawl/seamount sled (60 min).* **CTD cast (30 min).**	350-400 m	34:32 S, 151:12 E	6/**8.5** h (100 km/54 Nm)
Station 2 (WGR 2) adjacent to reef North	Wednesday 15:00	Wednesday 17:00	**Deployment and grab sample taken with BOAGS (60 min)*. Beam trawl/seamount sled (60 min).** XBT cast.	350-400 m		9/**11** h (105 km/57 Nm)
Station 3 (WGR 3) reef top South	Wednesday 17:30	Wednesday 19:30	**Deployment and grab sample taken with BOAGS (60 min)*. Beam trawl/seamount sled (60 min).** XBT cast.	350-400 m		11.5/**13.5** h (110 km/60 Nm)
Station 4 (WGR 4) adjacent to reef South	Wednesday 20:00	Wednesday 22:30	**Deployment and grab sample taken with BOAGS (60 min)*. Beam trawl/seamount sled (60 min).** CTD cast (30 min).	350-400 m		14/**16.5** h (115 km/63 Nm)
Depart for Jervis Bay		Wednesday 22:30	Gear on main winch to be changed from BOAGS/Beam to EZ net. Track following swath route leg 2.			

* depending on the gear configuration all BOAGS activities may be performed first before using the trawl/dredge.

Wollongong reef to Jervis Bay (JB) (~80 km/43Nm), leg 2

Departing Wollongong reef around 22:30, sailing directly to Jervis Bay to begin pelagic sampling (EZ net, N70 and CTD) in the early hours of the morning. CPR to be deployed for subsequent steam to Eden.

Location	Day/time arrival	Day/time depart	Gear (deployment time)	Sampling depth	Lat/Long	Cumulative time arrival/departure (distance)
Arrival Jervis Bay	Thursday 03:00				35:01 S, 150:51 E (TBC)	21 h (195 km/105 Nm)
Station 5 (JB PSS 1)	Thursday 03:00	Thursday 04:30	**EZ net to 200 m, 7 min tows at 5 depths (50 min).** CTD cast (20 min). 2 x N70 casts (10 min)	200 m	Deepwater (TBC)	21/**22.5** h (195 km/105 Nm)
Station 6 (JB PSS 2)	Thursday 05:00	Thursday 06:00	**EZ net to 200 m, 7 min tows at 5 depths (50 min).**	200 m	Slope (TBC)	23/**24** h (200 km/108 Nm)
Station 7 (JB PSS 3)	Thursday 06:30	Thursday 07:30	**EZ net to 200 m, 7 min tows at 5 depths (50 min).**	200 m	Shelf (TBC)	24.5/**25.5** h (205 km/111 Nm)
Station 8 (CPR 1)	Thursday 07:30		**CPR to be deployed for transit to Eden.**			24.5/**25.5** h (205 km/111 Nm)
Depart for Eden		Thursday 07:30	EZ net to remain on main winch, if possible. Track following swath route leg 3.			

Jervis Bay to Eden (ED) (~240 km/130 Nm), leg 3

Departing Jervis Bay at breakfast with a long steam to Eden, to begin the second series of pelagic sampling (EZ net, N70 and CTD). CPR to be deployed for subsequent steam to Bass Canyon.

Location	Day/time arrival	Day/time depart	Gear (deployment time)	Sampling depth	Lat/Long	Cumulative time arrival/departure (distance)
Arrival Eden	Thursday 20:30	CPR to be retrieved.			37:04 S, 150:01 E (TBC)	38.5 h (445 km/240 Nm)
Station 9 (JB PSS 1)	Thursday 20:30	Thursday 22:00	**EZ net to 200 m, 7 min tows at 5 depths (50 min).** CTD cast (20 min). 2 x N70 casts (10 min).	200 m	Deepwater (TBC)	38.5/**40** h (445 km/240 Nm)
Station 10 (JB PSS 2)	Thursday 22:30	Thursday 23:30	**EZ net to 200 m, 7 min tows at 5 depths (50 min).**	200 m	Slope (TBC)	40.5/**41.5** h (450 km/243 Nm)
Station 11 (JB PSS 3)	Friday 00:00	Friday 01:00	**EZ net to 200 m, 7 min tows at 5 depths (50 min).**	200 m	Shelf (TBC)	42/**43** h (455 km/246 Nm)
Station 12 (CPR 2)	Friday 01:00		**CPR to be deployed for transit to Eden.**			43/**43** h (455 km/246 Nm)
Depart for Bass Canyon		Friday 01:00	Gear on main winch to be changed from to EZ net to BOAGS, EZ net can be stowed. Track following swath route leg 4.			

Eden to Bass Canyon (BC) (~280 km/150 Nm to start of Bass Canyon (2500 m station) + ~ 111 km/60 Nm to end of Bass Canyon (700 m station)), leg 4

Departing Eden around midnight, arriving at Bass Canyon on Friday afternoon, starting with the deepest station BOAGS will be deployed (30 minute bottom time) followed by a trawl or a dredge. Exactly the same procedure will be followed at the 1500 and 700 m stations, sailing to St Helens seamount early Saturday morning. CPR to deployed for subsequent steam to St Helens seamount.

Location	Day/time arrival	Day/time depart	Gear (deployment time)	Sampling depth	Lat/Long	Cumulative time arrival/departure (distance)
Arrival Bass Canyon	Friday 16:00	CPR to be retrieved.			38:33 S 148:44 E	58 h (735 km/397 Nm)
Station 13 (BC 1). Waypoint 17 (47).*	Friday 16:00	Friday 20:30	**Deployment and grab sample taken with BOAGS (110 min). Beam trawl/seamount sled (160 min).** *CTD cast.*	<2500m		58/**62.5** h (735 km/397 Nm)
Station 14 (BC 2). Waypoint 21 (51). #	Friday 22:30	Saturday 01:30	**Deployment and grab sample taken with BOAGS (80 min). Beam trawl/ seamount sled (110 min).**	1500m (around 38:54 S, 148:41 E)		64.5/**67.5** h (778 km/420Nm)
Station 15 (BC 3). Waypoint 24 (54). #*	Saturday 03:30	Saturday 04:00*	*Deployment and grab sample taken with BOAGS (50 min). Beam trawl/ seamount sled (70 min).*	700m (around 39:29 S, 148:51 E)		69.5/**70** h (825 km/445Nm)
Station 16 (CPR 3)	Saturday 04:30		**CPR to be deployed for transit to St Helen's.**	200 m		70.5/**70.5** h (825 km/445 Nm)
Depart for St Helens Seamount		Saturday 04:30	Gear on main winch to be BOAGS. Track following swath route leg 5.			

choice and timing between stations subject to change. *Station 15 is very time dependant and will only occur if we have made time up on subsequent stations (i.e. 2 h needed for sampling schedules yet only ½ h allocated).

Bass Canyon to St. Helens seamount (SHS) (~185 km/ 100 Nm), leg 5

Arriving at St Helens seamount on Saturday afternoon an initial CTD cast will be made to 2500 m. Moving up slope to 1100 m, BOAGS will be deployed the bottom surveyed and an attempt made to select a coral specimen followed by a trawl or dredge, all repeated at a second site.

The vessel will then depart on the homewards leg back to Hobart around midnight arrive back in Hobart late Sunday afternoon.

Location	Day/time arrival	Day/time depart	Gear (deployment time)	Sampling depth	Lat/Long	Cumulative time arrival/departure (distance)
Arrival St Helens Seamount	Saturday 14:30				41:14 S, 148:49 E BOAGS to be deployed at both stations first before gear is changed over to beam/sled.	80.5 h (1010 km/545 Nm)
Station 17 (SHS 1)	Saturday 14:30	Saturday 17:30	**CTD cast (3 h)**	2500m		80.5/**83.5** h (1010 km/545 Nm)
Station 18 (SHS 2)	Saturday 18:00	Saturday 20:30	**Deployment and grab sample taken with BOAGS (70 min). Beam trawl/ seamount sled (90 min).**	1100 m:		84/**86.5** h (1015 km/548 Nm)
Station 19 (SHS 3)	Saturday 21:00	Saturday 23:30	Deployment and grab sample taken with BOAGS (70 min). *Beam trawl/ seamount sled (90 min).*	1100 m		87/**89.5** h (1020 km/550 Nm)
Station 20 (CPR 4)	Sunday 00:00		**CPR to be deployed for transit to Hobart**	200 m		90/**90** h (1020 km/550 Nm)
Depart for Hobart		Sunday 00:00				90h (1020 km/550 Nm)

St Helens seamount to Hobart (~335 km/180 Nm), leg 6

Location	Day/time arrival	Day/time depart	Gear (deployment time)	Sampling depth	Lat/Long	Cumulative time arrival/departure (distance)
Depart St Helens Seamount		Sunday 00:00				90h (1020 km/550 Nm)
Arrive Hobart	Sunday 18:00				N/A	108 h (1352 km/730 Nm)

NB for all dredges/trawls the vessel is assumed to be effectively stationary/not heading in a particular direction (normally ½ - 1 knot trawl speed) and for calculating winch times for the benthic sampling a rate of 60 m per minute has been used and the appropriate amount of extra wire added in. For the CTD casts a retrieval winch speed of 20 m per minute has been used.

Piggy-back Projects

Ocean chemistry at St Helens seamount: relationship to coral distribution

Ronald Thresher (CSIRO)

Ocean acidification has been suggested to pose a grave threat to the health and survival of Australia's deep-sea coral reefs. However, the relationship between carbonate saturation states and coral distributions, if there is one, is poorly known, in Australia and overseas. In 2009, the ROV Jason documented the distribution of deep-sea corals on seamounts off St. Helens (NE Tasmania).

Scientific objective:

It is proposed to collect data on carbonate saturation states at the St. Helen's seamount to: 1) test the hypothesized relationship between saturation levels and the distribution of the corals, and 2) to collect live reef-forming coral (Solenosmilia variabilis) for a pilot study of the coral's environmental tolerances. The data will also extend our knowledge of seasonal and spatial variability in ocean carbonate chemistry, to help validate regional models.

Voyage Objectives:

A standard hydrocasts will be taken off the St. Helen's seamount, to a depth of 2500 m, with water samples taken at 500, 750 and, thereafter, at 100 m intervals below 1000 m. Samples will be fixed on board for carbonate analysis. The seafloor will be surveyed and live corals collected using BOAGS and an epi-benthic dredge/seamount sled (bottom dependant), at a depth of about 1100 m.

Distribution of plankton along the east coast of Tasmania

Kerrie Swadling (UTAS)/Frank Coman (AusCPR)

Using the continuous plankton recorder (CPR) our knowledge about the distribution of plankton can be greatly improved without impacting ship-time and/or activities.

Scientific objective:

To obtain a transect of plankton distributions along the east coast of Tasmania.

Voyage Objectives:

The CPR will be deployed on 4 legs of 100-170 Nm during the voyage.

Southern Surveyor Equipment

– Smith-Macintyre grab
– Rock dredge
– Small epi-benthic sled
– XBT
– CTD + bottles
– Underway clean seawater supply
– Underway thermosalinograph, fluorometer and pCO2 monitoring
– systems running throughout the voyage duration
– Blast freezer
– EZ net
– Small winch set up for the continuous plankton recorder

User Equipment

– Beam trawl (Alan Williams, supported by Rudy Kloser)
– Neuston net (Iain Suthers/Matt Taylor)
– N70 net (Iain Suthers/Matt Taylor)
– BOAGS & winch for BOAGS (Rudy Kloser)
– Chilled seawater aquarium and pre-cleaned sampling bottles (Ron Thresher)
– Continuous sampling recorder (Kerrie Swadling/Frank Coman)
– Seamount Sled/Sherman dredge (CSIRO supported by Rudy Kloser)
– Liquid nitrogen + dewar.
– General sampling preservation equipment /material (ethanol < 20 l, formalin).

Special Requests

If it is possible we would like to come off board with the CTD/ XBT data (most important for the pelagic sampling)?

Because of the combination of heavy gear (BOAGS, beam trawl etc.), limited deck space and the need to change wires we will have to juggle what gear is deployed when, i.e. where possible gear changeovers need to minimised.

If possible, can we put an extra block on the A frame to deploy the CPR, i.e. so we don't have to change blocks over from main gear to CPR?

Personnel List

Sebastian Holmes	USYD	Chief Scientist (1st watch leader)
Natasha Henschke	UNSW	2nd watch leader
Rudy Kloser	CMAR	Scientist (BOAGS/swath)
Matt Sherlock	CMAR	Technician BOAGS
Ronald Thresher	CMAR	Scientist (St Helens seamount)
Ben Harris	UNSW	Ph.D. student (pelagic stations)
Ana Zivanovic	University of Wollongong	Ph.D. student
Daniel Harrision	University of the Sea	Student
Belinda Dechnik	USYD	Student
Amelia Shannon	USYD	Student (swath support)
Bevan Yiu	USYD	Student
Amanda Roe	USYD	Student
Jeff Cordell	CMAR	MNF Voyage Manager/ electronics support
Mark Lewis	CMAR	Gear support
Hiski Kippo	CMAR	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.**
Hiski Kippo	AS02377
Jeff Cordell	AS02398
Matt Sherlock	10603

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

Sebastian Holmes
Chief Scientist

Leg 1: Sydney to Wollongong reef

Way-point	Latitude	Longitude	Decimal latitude	Decimal longitude	Distance (m)	Distance (Nm)	Cumulative distance (Nm)#	Remaining distance#	Bearing	Comments
0	33 49.7482S	151 16.6610E	-33.8291	151.2777	0	0.0	0.0	712.0	0	Sydney Heads
1	33 50.4126S	151 19.8467E	-33.8402	151.3308	5,052	2.7	2.7	709.3	104	
2	33 50.2262S	151 21.6108E	-33.8371	151.3602	2,734	1.5	4.2	707.8	82	
3	33 50.3931S	151 22.6813E	-33.8399	151.3780	1,675	0.9	5.1	706.9	100	
4	34 12.1608S	151 24.5469E	-34.2027	151.4091	40,405	21.8	26.9	685.1	175	
5	34 23.5419S	151 16.6217E	-34.3924	151.2770	24,323	13.1	40.1	671.9	209	
6	34 24.6777S	151 16.8038E	-34.4113	151.2801	2,121	1.1	41.2	670.8	172	
7	34 32.3870S	151 12.7981E	-34.5398	151.2133	15,531	8.4	49.6	662.4	203	Start of Wollongong reef

Notes:
1.Starts from Sydney Heads not the wharf
2.#nominal distances, will increase/vary according to activities at sites.

Leg 2: Wollongong reef to Jervis Bay

Way-point	Latitude	Longitude	Decimal latitude	Decimal longitude	Distance (m)	Distance (Nm)	Cumulative distance (Nm)#	Remaining distance#	Bearing	Comments
0 (8)	34 48.6521S	151 10.6250E	-34.8109	151.1771	30,297	16.4	66.0	646.0	186	End WGR
1 (9)	34 55.0268S	151 08.5641E	-34.9171	151.1427	12,211	6.6	72.5	639.5	194	
2 (10)	35 01.9095S	151 05.9025E	-35.0318	151.0984	13,369	7.2	79.8	632.2	197	
3 (11)	35 11.6546S	150 59.4250E	-35.1942	150.9904	20,546	11.1	90.9	621.1	208	Jervis Bay (JB)

Notes:
1.#nominal distances, will increase/vary according to activities at sites.

Leg 3: Jervis Bay to Eden via Canyon heads

Way-point	Latitude	Longitude	Decimal latitude	Decimal longitude	Distance (m)	Distance (Nm)	Cumulative distance (Nm)#	Remaining distance#	Bearing	Comments
0 (12)	35 17.3433S	150 53.4521E	-35.2891	150.8909	13,881	7.5	98.4	613.6	220	Canyon head start
1 (13)	35 23.4460S	150 48.1087E	-35.3908	150.8018	13,891	7.5	105.9	606.1	215	Canyon head end
2 (14)	35 28.9287S	150 49.9680E	-35.4821	150.8328	10,532	5.7	111.5	600.5	164	
3 (15)	35 35.0243S	150 46.4229E	-35.5837	150.7737	12,489	6.7	118.3	593.7	205	
4 (16)	35 41.5972S	150 44.9013E	-35.6933	150.7484	12,383	6.7	125.0	587.0	190	
5 (17)	35 49.9682S	150 40.1041E	-35.8328	150.6684	17,097	9.2	134.2	577.8	204	
6 (18)	36 03.7384S	150 33.5948E	-36.0623	150.5599	27,308	14.7	148.9	563.1	200	
7 (19)	36 04.6939S	150 29.2235E	-36.0782	150.4871	6,778	3.7	152.6	559.4	254	
8 (20)	36 06.9453S	150 27.8364E	-36.1158	150.4639	4,656	2.5	155.1	556.9	206	
9 (21)	36 13.0914S	150 25.6647E	-36.2182	150.4277	11,834	6.4	161.5	550.5	195	
10 (22)	36 18.9459S	150 23.1428E	-36.3158	150.3857	11,476	6.2	167.7	544.3	199	
11 (23)	36 23.9436S	150 23.2409E	-36.3991	150.3873	9,254	5.0	172.7	539.3	179	
12 (24)	36 36.0584S	150 22.0920E	-36.6010	150.3682	22,495	12.1	184.9	527.1	184	
13 (25)	36 37.4702S	150 22.4143E	-36.6245	150.3736	2,657	1.4	186.3	525.7	169	
14 (26)	36 47.8370S	150 22.3862E	-36.7973	150.3731	19,194	10.4	196.7	515.3	180	
15 (27)	36 55.6953S	150 22.2683E	-36.9283	150.3711	14,550	7.9	204.5	507.5	180	
16 (28)	36 59.0671S	150 18.5416E	-36.9845	150.3090	8,331	4.5	209.0	503.0	221	
17 (29)	37 05.4178S	150 19.0844E	-37.0903	150.3181	11,785	6.4	215.4	496.6	176	Eden

Notes:
1.#nominal distances, will increase/vary according to activities at sites.
2. Canyon heads a priority.

Leg 4: Eden to Bass Canyon

Way-point	Latitude	Longitude	Decimal latitude	Decimal longitude	Distance (m)	Distance (Nm)	Cumulative distance (Nm)#	Remaining distance#	Bearing	Comments
0 (30)	37 10.5593S	150 19.7096E	-37.1760	150.3285	9,564	5.2	220.5	491.5	174	End Eden.
1 (31)	37 15.5250S	150 19.4440E	-37.2588	150.3241	9,202	5.0	225.5	486.5	182	
2 (32)	37 19.8176S	150 23.7278E	-37.3303	150.3955	10,151	5.5	231.0	481.0	141	
3 (33)	37 24.1060S	150 22.2575E	-37.4018	150.3710	8,229	4.4	235.4	476.6	195	
4 (34)	37 37.7996S	150 20.5728E	-37.6300	150.3429	25,474	13.8	249.2	462.8	185	
5 (35)	37 56.7116S	150 10.4975E	-37.9452	150.1750	38,016	20.5	269.7	442.3	202	
6 (36)	38 06.0482S	150 06.0926E	-38.1008	150.1015	18,446	10.0	279.7	432.3	200	
7 (37)	38 10.0533S	149 57.4138E	-38.1676	149.9569	14,663	7.9	287.6	424.4	239	
8 (38)	38 11.6750S	149 56.4947E	-38.1946	149.9416	3,287	1.8	289.4	422.6	204	
9 (39)	38 17.5132S	149 43.0347E	-38.2919	149.7172	22,382	12.1	301.5	410.5	241	
10 (40)	38 16.6592S	149 28.6703E	-38.2777	149.4778	20,935	11.3	312.8	399.2	274	
11 (41)	38 16.1017S	149 21.9218E	-38.2684	149.3654	9,863	5.3	318.1	393.9	275	
12 (42)	38 16.6403S	149 14.3102E	-38.2773	149.2385	11,110	6.0	324.1	387.9	264	
13 (43)	38 20.8997S	148 48.8264E	-38.3483	148.8138	37,887	20.5	344.5	367.5	257	
14 (44)	38 22.0984S	148 46.7767E	-38.3683	148.7796	3,712	2.0	346.5	365.5	233	
15 (45)	38 23.9193S	148 38.3141E	-38.3987	148.6386	12,741	6.9	353.4	358.6	254	Optional
16 (46)	38 27.7223S	148 43.9653E	-38.4620	148.7328	10,811	5.8	359.3	352.7	130	
17 (47)	38 33.0904S	148 44.6438E	-38.5515	148.7441	9,987	5.4	364.7	347.3	174	Bass Canyon 2500m
18 (48)	38 37.5212S	148 39.1670E	-38.6254	148.6528	11,412	6.2	370.8	341.2	223	
19 (49)	38 49.3801S	148 39.6726E	-38.8230	148.6612	21,968	11.9	382.7	329.3	178	
20 (50)	38 51.4009S	148 41.4982E	-38.8567	148.6916	4,575	2.5	385.1	326.9	144	
21 (51)	38 54.0520S	148 41.2410E	-38.9009	148.6873	4,922	2.7	387.8	324.2	184	Bass canyon 1500 m
22 (52)	38 59.4527S	148 40.6837E	-38.9909	148.6781	10,031	5.4	393.2	318.8	184	
23 (53)	39 00.8772S	148 42.6216E	-39.0146	148.7104	3,838	2.1	395.3	316.7	133	
24 (54)	39 29.7389S	148 51.0430E	-39.4956	148.8507	54,802	29.6	424.9	287.1	167	Bass Canyon 700 m

Notes:
1.#nominal distances, will increase/vary according to activities at sites.
2. Waypoints 17 (47) – 24 (54) cover Bass Canyon stations and may change.

Leg 5 Bass Canyon to St Helens seamount

Way-point	Latitude	Longitude	Decimal latitude	Decimal longitude	Distance (m)	Distance (Nm)	Cumulative distance (Nm)#	Remaining distance#	Bearing	Comments
0 (55)	39 35.2622S	148 52.6720E	-39.5877	148.8779	10,488	5.7	430.6	281.4	167	End Bass canyon
1 (56)	39 39.1394S	148 50.8043E	-39.6523	148.8467	7,657	4.1	434.7	277.3	200	
2 (57)	39 49.5405S	148 54.7417E	-39.8257	148.9124	20,060	10.8	445.5	266.5	163	
3 (58)	39 59.6895S	148 56.0331E	-39.9948	148.9339	18,880	10.2	455.7	256.3	174	
4 (59)	40 01.7570S	148 55.3432E	-40.0293	148.9224	3,951	2.1	457.8	254.2	194	
5 (60)	40 17.6636S	148 55.6085E	-40.2944	148.9268	29,453	15.9	473.7	238.3	179	
6 (61)	40 21.6034S	148 57.4306E	-40.3601	148.9572	7,735	4.2	477.9	234.1	160	
7 (62)	40 26.6478S	148 55.2901E	-40.4441	148.9215	9,816	5.3	483.2	228.8	197	
8 (63)	40 31.6723S	148 54.5825E	-40.5279	148.9097	9,356	5.1	488.3	223.7	186	
9 (64)	40 34.7622S	148 56.8822E	-40.5794	148.9480	6,573	3.5	491.8	220.2	150	
10 (65)	40 50.9506S	148 49.1721E	-40.8492	148.8195	31,880	17.2	509.0	203.0	199	
11 (66)	40 53.4499S	148 48.7972E	-40.8908	148.8133	4,657	2.5	511.6	200.4	186	
13 (67)	41 09.6029S	148 43.8448E	-41.1600	148.7307	30,703	16.6	528.1	183.9	192	St Helens seamount

Notes:
1.#nominal distances, will increase according to activities.

Leg 6 St Helens seamount to Hobart

Way-point	Latitude	Longitude	Decimal latitude	Decimal longitude	Distance (m)	Distance (Nm)	Cumulative distance (Nm)#	Remaining distance#	Bearing	Comments
0 (68)	41 15.9943S	148 45.3877E	-41.2666	148.7565	12,027	6.5	534.6	177.4	169	End St Helens seamount
1 (69)	41 25.6622S	148 45.6500E	-41.4277	148.7608	17,903	9.7	544.3	167.7	178	
2 (70)	41 27.7820S	148 49.3373E	-41.4630	148.8223	6,451	3.5	547.8	164.2	127	
3 (71)	41 34.2795S	148 48.7987E	-41.5713	148.8133	12,053	6.5	554.3	157.7	183	
4 (72)	41 35.4201S	148 42.2804E	-41.5903	148.7047	9,273	5.0	559.3	152.7	256	
5 (73)	41 37.7625S	148 39.3665E	-41.6294	148.6561	5,924	3.2	562.5	149.5	222	
6 (74)	41 47.6758S	148 39.2008E	-41.7946	148.6533	18,355	9.9	572.4	139.6	180	
7 (75)	41 55.8210S	148 41.4518E	-41.9303	148.6909	15,398	8.3	580.7	131.3	168	
8 (76)	42 06.0988S	148 40.6784E	-42.1016	148.6780	19,059	10.3	591.0	121.0	183	
9 (77)	42 10.7753S	148 37.8612E	-42.1796	148.6310	9,485	5.1	596.1	115.9	204	
10 (78)	42 17.4137S	148 36.9765E	-42.2902	148.6163	12,350	6.7	602.8	109.2	185	
11 (79)	42 20.6332S	148 34.7778E	-42.3439	148.5796	6,678	3.6	606.4	105.6	206	
12 (80)	42 24.1610S	148 33.8130E	-42.4027	148.5635	6,663	3.6	610.0	102.0	191	
13 (81)	42 26.0397S	148 32.2444E	-42.4340	148.5374	4,086	2.2	612.2	99.8	211	
14 (82)	42 29.6988S	148 31.9221E	-42.4950	148.5320	6,789	3.7	615.9	96.1	183	
15 (83)	42 38.1171S	148 27.5601E	-42.6353	148.4593	16,687	9.0	624.9	87.1	200	
16 (84)	42 43.6026S	148 25.6907E	-42.7267	148.4282	10,471	5.7	630.5	81.5	194	
17 (85)	42 48.0199S	148 25.5296E	-42.8003	148.4255	8,181	4.4	635.0	77.0	181	
18 (86)	43 03.0685S	148 19.1478E	-43.0511	148.3191	29,185	15.8	650.7	61.3	197	
19 (87)	43 05.7937S	148 18.6965E	-43.0966	148.3116	5,082	2.7	653.5	58.5	186	
20 (88)	43 10.2012S	148 10.8522E	-43.1700	148.1809	13,386	7.2	660.7	51.3	232	
21 (89)	43 15.1590S	148 04.8153E	-43.2526	148.0803	12,280	6.6	667.3	44.7	221	
22 (90)	43 15.4755S	148 00.3893E	-43.2579	148.0065	5,997	3.2	670.6	41.4	264	
23 (91)	43 15.4099S	147 49.2734E	-43.2568	147.8212	14,989	8.1	678.7	33.3	270	
24 (92)	43 15.2002S	147 46.1095E	-43.2533	147.7685	4,284	2.3	681.0	31.0	275	
25 (93)	43 12.9910S	147 41.6305E	-43.2165	147.6938	7,296	3.9	684.9	27.1	304	
26 (94)	43 03.8592S	147 23.9957E	-43.0643	147.3999	29,214	15.8	700.7	11.3	305	Iron Pot
27 (95)	43 03.0162S	147 23.2733E	-43.0503	147.3879	1,841	1.0	701.7	10.3	327	
28 (96)	43 00.6822S	147 22.9739E	-43.0114	147.3829	4,340	2.3	704.0	8.0	354	
29 (97)	42 54.7657S	147 23.2522E	-42.9128	147.3875	10,960	5.9	709.9	2.1	1	
30 (98)	42 53.1960S	147 21.4291E	-42.8866	147.3572	3,815	2.1	712.0	0.0	319	Hobart

Notes:
1.#nominal distances, will increase according to activities.