RV *Investigator* Voyage Plan

Voyage #:	**IN2018_V06**		
Voyage title:	Status and recovery of deep-sea coral communities on seamounts in iconic Australian marine reserves		
Mobilisation:	Hobart, Thursday 22 November 2018		
Depart: Leg 1	08:00 Hobart, Friday 23 November 2018		
Leg 1 ends / Leg 2 begins:	10:00 Southport, 5 December 2018		
Leg 2 ends / Leg 3 begins:	10:00 Southport, 6 December 2018		
Leg 3 ends / Leg 4 begins:	10:00 St Helens Point, 14 December 2018		
Return:	08:00 Hobart, Wednesday, 19 December 2018		
Demobilisation:	Hobart, Wednesday, 19 December 2018		
Voyage Manager:	Max McGuire	Contact details:	max.mcguire@csiro.au
Chief Scientist:	Dr Alan Williams		
Affiliation:	CSIRO	Contact details:	alan.williams@csiro.au
Principal Investigators:	Dr Nic Bax, Dr Malcolm Clark, Dr Thomas Schlacher		
Supplementary Project:	Spatial and temporal variability in the distribution and abundance of seabirds		
Affiliation:	Dr Eric Woehler Birdlife Australia / UTAS	Contact details:	eric.woehler@gmail.com

Scientific objectives

Our proposed work on Australian and New Zealand seamounts addresses international biodiversity management research priorities (e.g. CBD 2015-053) by providing data on recovery trajectories of deep-sea coral communities following direct human (trawling) impacts.

The distributional extent, habitat associations, composition, biodiversity, and biological traits of deep-sea coral communities off Tasmania, both inside and outside the Huon and Tasman Fracture reserves, will be determined and mapped for the first time. This information will contribute to a status report on coral communities and provide context for the recovery study. The status report and an understanding of changes in coral communities through time will inform future planning by the Australian and other management agencies to monitor and manage deep-sea coral reefs as conservation assets. Our results also have international relevance to understanding and managing fishing impact on comparable deep-sea coral communities, including in High Sea areas beyond national jurisdictions.

New data will be combined with previous surveys of the seamounts in the Huon and Tasman Fracture CMRs in 1997 and 2007, the St. Helens Seamount in 2008, and parallel New Zealand studies in 2001, 2006, 2009 and 2015, to address three broad objectives:

1. Determine the extent, ecological characteristics, and conservation status of deep-sea coral reefs on Tasmanian seamounts inside and outside of existing reserves.

2. Measure recovery trajectories and dynamics of deep-sea coral communities (multi-species and successional changes) following cessation of bottom trawling.

3. Provide the first set of empirical data on conservation status, resilience and recovery potential to enhance management and conservation of deep-sea coral habitats nationally.

Voyage objectives

The voyage has two primary objectives

(1) Repeat tow camera surveys of previously sampled seamounts

(2) Tow camera surveys to ground-truth predictive maps of coral community distribution

(3) Ancillary sampling for additional data to support Objectives 1 and 2 (drop camera and baited video imagery, water chemistry, and biological collections).

The voyage will focus primarily on surveys of seamounts at mid-slope depths (~700-2000 m) within and immediately adjacent to the Huon and Tasman Fracture Commonwealth Marine Reserves off southern Tasmania (Figure 1), and on the St Helens Seamount on Tasmania's east coast. Any unused contingency days, plus two additional awarded days, will be used to survey the Cascade Plateau and the Big Horseshoe Canyon in Bass Strait. Towed camera transects will be the most important and numerous operations undertaken, and they will be complemented with CTD sampling of water chemistry, static camera drops for very close and high resolution imagery, and beam trawl and benthic sled collections of fauna.

There will also be some targeted multi-beam sonar mapping of gaps in study area coverage. The DeepBRUVS baited-video samplers will be deployed at the Patience Seamount, and if opportunity permits, in the Flinders Canyon area (on the way to the Big Horseshoe Canyon). A line fishing operation (power reel and rod) will be used to capture specimens of basketwork eels from the aggregation on the Patience Seamount.

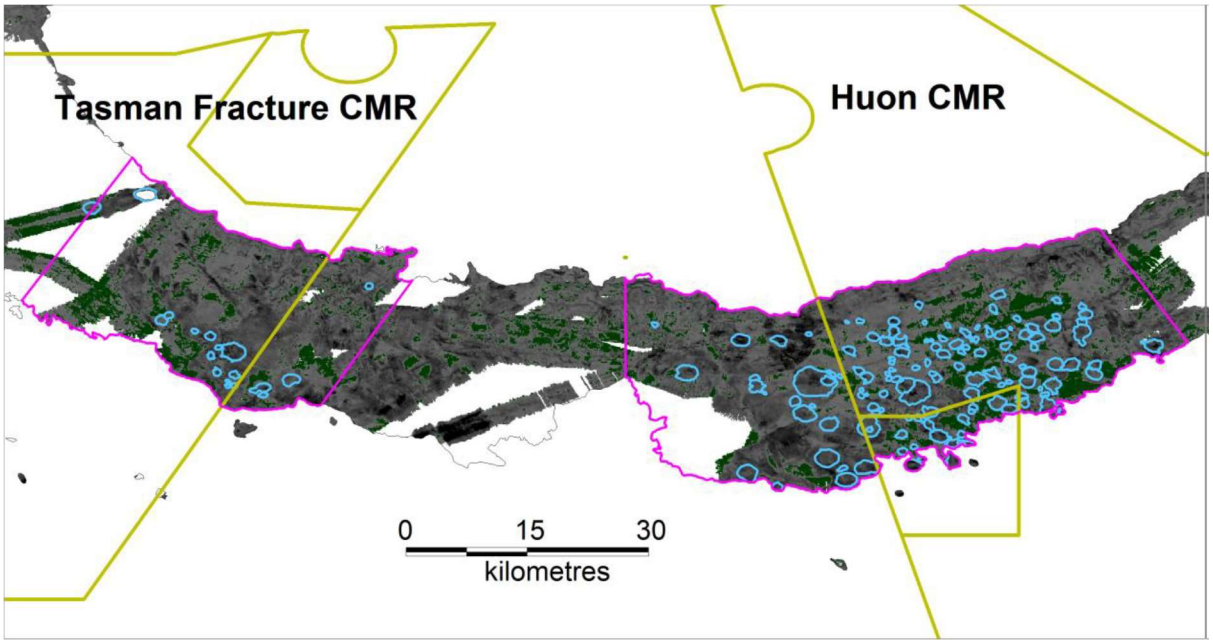

Figure 1: The two survey areas (pink boundaries) representing the areas containing the clusters of seamounts (blue outlines) off southern Tasmania, and bounded by the 500 and 2000 m isobaths. Map underlay shows high resolution multi-beam sonar mapping coverage. Labels and yellow boundaries are for the Tasman Fracture and Huon Australian Marine Parks (formerly Commonwealth Marine Reserves, CMR).

Repeat towed camera surveys of previously sampled seamounts will extend the time-series dataset on the recovery trajectory of deep-sea coral communities: these seamounts have known trawling histories: (1) the large 'Sisters Seamount' where trawling ceased (after the declaration of the Huon CMR; (2) the large seamount 'Pedra' where trawling is still permitted; and (3) three seamounts, 'Hills U', 'K1' and 'Z16' that have never been trawled (Figure 2). There will be supplementary sampling on the heavily trawled St. Helens Seamount which was surveyed in 2008.

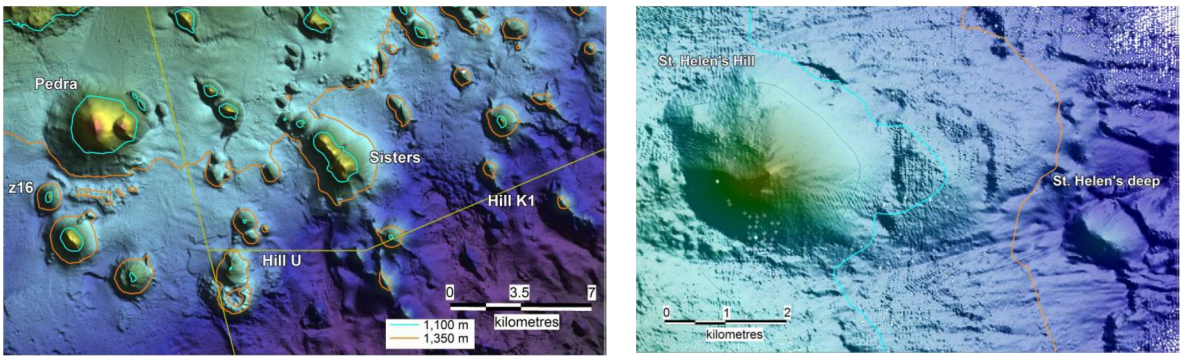

Figure 2: The seamounts to be sampled for the recovery study off southern Tasmania (left) and the St Helens Seamount (right)

Towed camera surveys of seamount and non-seamount areas to ground-truth predictive maps of coral community distributions will be based on strata defined by 'on' or 'off seamount'; 'shallow', 'deep', or 'very deep' (500, 1100, 1350, 2000 m boundaries); and 'trawled' or 'untrawled', using a spatially-balanced survey design that reflects the predicted probabilities of coral community occurrence within each stratum.

We anticipate a total of ~48 camera transects to meet the coral recovery objective – 6 seamounts x 8 transects – and ~60 camera transects to meet the coral mapping objective – 6 strata x 10 transects, plus a total of ≤ 30 beam trawl/sled samples; 2 CTD samples; and 2 static camera drops.

Sampling will be undertaken according to a spatially-balanced design. Sampling will commence in the Huon AMP, continue in the Tasman Fracture AMP, then move to the St Helens Seamount area. Any impact on sampling opportunities due to lost time (bad weather or gear issues) will be managed in real time by adapting the design.

Ancillary sample collection – biological sampling with the beam trawl/ sled, water samples using the CTD, imagery from the static camera and DeepBRUVs, and collection of fishes with baited hooks– will be scheduled around the camera transects. To the extent possible, the samples will be taken in closely adjacent locations to minimise transit times.

Any time remaining following the completion of sampling at the St Helen's Seamount will be used to extend the geographical range of the survey of coral communities to the two other locations where they are known to exist in this region: the Cascade Plateau and Big Horseshoe Canyon (see Figure 3). The choice of location(s) will be determined towards the completion of sampling at St Helens. The sampling program will be similar – a focus on towed camera transects followed by selected sampling with the other gears.

Supplementary Projects

Dr Eric Woehler (Birdlife Australia)

Spatial and temporal variability in the distribution and abundance of seabirds.

Seabirds are distributed patchily over the oceans, both in space and in time. The deployment of tracking devices on seabirds provides an initial insight into at-sea movements, but do not report on non-breeding or juvenile birds. The survival of these life stages can have dramatic impacts on population dynamics. The documentation of at-sea distributions of seabirds around Australia can facilitate a better understanding of seabird dynamics in the marine environment. The proposed study using at-sea observations collected alongside oceanographic data will improve our understanding of seabirds and the way in which they relate to our changing ocean environments.

Operational Risk Management

The major items of equipment to be deployed on this voyage, and the associated deck operations, are standard for *RV Investigator*; each has a well-established Job Hazard Analysis and Toolbox procedure for deployment and recovery that aim to mitigate risks to personnel and equipment. For this voyage, these are:

Equipment	Activity	Risk management
Towed camera	Deck operations, deployment, recovery, towing	SOP, Toolbox and pre-deployment risk assessment. All staff safety briefing regarding toolbox attendance and generally about wires under tension. PPE
Drop camera	Deck operations, deployment, recovery, static drop	SOP, Toolbox and pre-deployment risk assessment. All staff safety briefing regarding toolbox attendance and generally about wires under tension. PPE
Towed bottom-contact samplers (Beam Trawl, Benthic sled)	Deck operations, deployment, recovery, towing	SOP, Toolbox and pre-deployment risk assessment. All staff safety briefing regarding toolbox attendance and generally about wires under tension. PPE
DeepBRUVS	Deck operations, deployment, recovery	SOP, Toolbox and pre-deployment risk assessment. All staff safety briefing regarding toolbox attendance. PPE
CTD	Deck operations, deployment, recovery	SOP, Toolbox and pre-deployment risk assessment. Hydrochemistry staff safety briefing regarding toolbox. PPE
Fishing rod	Deck operations, deployment, recovery	Toolbox required for selected staff in relation to recovery of long line of baited hooks and catch of eels.
Use of laboratory chemicals (ethanol, formalin)	Laboratory operations and transfers from laboratory to HAZMAT container	HAZMAT container, toolbox, training, restricted access, limited volumes, flammable liquid management. All staff safety briefing regarding toolbox attendance. PPE

Overall activity plan, including details for first 24 hours of voyage

The first 24 hours at sea will be used to transit to the first sampling area in the 'Huon' marine park (Figure 3 and Table 1). The activities will be a combination of towed camera operations on seamounts, and filling gaps in the swath mapping coverage.

The remaining sampling in the Huon and adjacent Tasman Fracture marine parks will be determined by a survey design that is currently being formulated. Much of the detail is provided above in the Voyage Objectives section. In brief, approximately 48 camera tows will be targeted at the previously studied seamounts where data were taken in 1997 and 2007 for the recovery objective, and approximately 60 camera transects allocated to strata defined by known modifiers of coral community abundance ('on' vs 'off' seamount; depth; level of historic trawling) to meet the coral distribution objective. There will be supplementary sampling on the heavily trawled St. Helens Seamount which was surveyed in 2008 later in the survey.

Ancillary sample collection – biological sampling with the beam trawl/ sled, water samples using the CTD, imagery from the static camera and DeepBRUVs, and collection of fishes with baited hooks– will be scheduled around the camera transects. To the extent possible, the samples will be taken in closely adjacent locations to minimise transit times.

Areas without multi-beam sonar coverage (white) will be mapped using the ship's multibeam system to provide a full coverage of the key bathymetric and backscatter variables for future modelling. Some of this will be completed in the first 24 hours; other coverage will scheduled into convenient time slots between deployments of sampling gears.

Small boat transfers will occur off Southport and St Helens (as noted on the cover page) to transfer a small number of staff.

Voyage track example

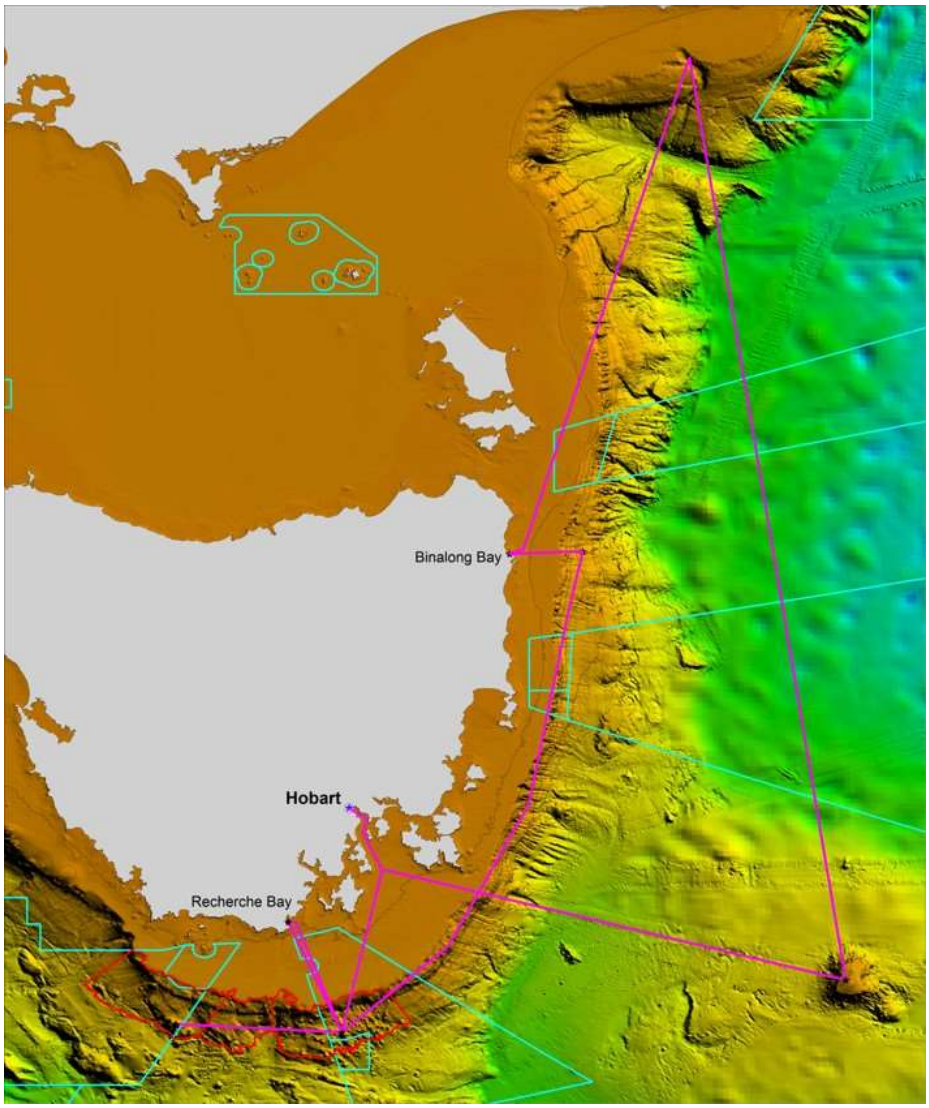

Figure 3 Intended voyage track shown in red (noting the offshore Cascade Plateau and Big Horseshoe canyon in eastern Bass Strait are options for additional sampling if time permits)

Waypoints and stations

Table 1 List of waypoints for survey areas. Multiple stations will be sampled in each area; their exact locations will be determined during the survey.

	Decimal Latitude	Decimal Longitude	Distance (nm)	Total Distance (nm)	Steaming time (hrs)	Total Steam (hrs)
Hobart	42° 52.2	147° 21.0	0	--	--	--
Huon (Sisters Seamount)	44° 16.0	147° 14.6	88	88	8	8
Tasman Fracture (Main Matt Seamount)	44° 12.8	146° 11.5	46	134	4	12
Huon (Sisters Seamount)	44° 16.0	147° 14.6	46	180	4	16
Southport - Huon (return trip x2)	43° 34.1	146° 54.1	180	360	16	33
St Helens Seamount	41° 58.0	148° 46.1	201	561	18	51
St Helens	41° 14.5	148° 18.2	21	582	2	53
Big Horseshoe Canyon	38° 06.3	149° 26.6	196	778	18	71
Cascade Seamount	43° 56.2	150° 25.9	353	1131	32	103
Hobart	42° 52.2	147° 21.0	160	1291	15	117

Time estimates

The following time estimates are based on a steaming speed of 11 knots.

Date	**Time**	**Activity**
Nov 23	0800	Depart port and steam to Huon area to commence operations
Nov 30	1200	Move to Tasman Fracture area to commence operations
Nov 4	1200	Return to Huon area
Dec 5 and Dec 6	1000	Operations in Huon area, and steam into Southport for small boat transfer of some staff (twice, during consecutive days)
Dec 6	1000	Continue operations in Huon area
Dec 10	1200	Steam to St Helens Seamount
Dec 14	1000	Small boat transfer off St Helens & steam to Big Horseshoe Canyon
Dec 16	1200	Steam to Cascade Plateau (time permitting)
Dec 19	0800	Return to port

Personnel transfer details

Small boat transfers have been planned to enable participation by some key staff, and to permit involvement of science policy staff for a 24-hour period. These transfers are feasible because the vessel will be close to shore at locations where transfers can be conducted safely and at minimal cost to survey time. These changes of staff may require some reorganisation of cabin allocations and additional support from ship's staff to facilitate this. We apologise for any inconvenience, ask for your cooperation, and thank you in advance.

ASP have provided their preferred following locations to conduct personnel transfers via small boat as chartered by the science group:

- **Southport:** 43 29.0S 147 04.0E Lies approx. 2.0NM SE of the Huon PBG/Harbour Limits Alternatively if they require Adventure Bay: 43 19.8S 147 24.0'E
- **St Helens:** 41 14.5S 148 23'E lies approx. 2.0NM from closest danger outside the entrance to Georges Bay.

Piggy-back Projects

Acquire bioacoustics data on orange roughy aggregations from seamounts that will be surveyed with camera tows. The Tasmanian seamount region is a known summer feeding ground for orange roughy. The species is subject to a fisheries recovery plan following a period of overfishing.

The piggy-back will enable a formal process of quality-assured data acquisition from the Investigator's echosounders during the voyage and assess if there are potential aggregations of orange roughy in the region that may trigger future detailed surveys of the region. Because deep-water acoustic surveys of orange roughy at 38 kHz in Australia, New Zealand and Indian Ocean rely on accurate knowledge of sound absorption, survey echo-sounder data will be complemented with experiments to advance our knowledge of sound absorption at 38 kHz using a low cost rod and reel 'winch' and suspended glass spheres whilst the vessel is stationary.

Investigator equipment (MNF)

1. Sherman sled
2. Beam trawls with spare beams and nets
3. MNF towed camera system – to be configured as HD drop camera
4. Large diameter block mounted on stern A-frame
5. USBL system
6. CTD
7. Multi-beam sonar, ADCP, Sub-bottom Profiler
8. Echo-sounder
9. Rear deck facilities
10. Hazmat container
11. Wet laboratory facilities
12. Biological processing areas
13. -80 and walk-in freezers
14. Shaved saltwater ice machine
15. Communication/control systems (e.g. Operations Room, Bridge, rear deck).
16. Conference facilities

User Equipment

1. CSIRO towed camera system
2. CSIRO beam trawl (x 2) with mountable camera
3. Fishing rod fitted with electric reel to deploy separately (1) baited hooks to sample fishes, or (2) deep-water glass float and weight, or (3) small pelagic camera
4. Laboratory equipment (trays, cameras, microscopes, balances, DNA sequencers)
5. Containers (drums, plastic jars, bags, labels)
6. Preservatives (95% ethanol, formaldehyde, RNALater)
7. D&N Frances winch
8. Large diameter block for use with the D&N Frances winch and CSIRO towed camera
9. DeepBRUVS
   Self-contained multiband acoustic unit

Special Requests

The CSIRO O&A (project) towed camera system will be deployed and retrieved by the ship's crew, but piloted by project staff when taking data near the seabed.

The MNF Hazmat container will be located on the main deck area (flammables door aft) for ease of access to the ethanol and formalin.

The ASP deck crew may need training for the recovery of the DeepBRUVS lander as there have only been two prior deployments from *RV Investigator*.

The Clean Wet Lab will be set up as the winch command for operations involving the D&N Frances winch (i.e. operations using the CSIRO towed camera).

The Clean Dry Lab will be set up to process and annotate video data.

A Communications Plan is being developed which will require the MNF and ASP to inform stakeholders, including the commercial fishing industry, about the voyage plans and vessel movements.

Permits

1. Animal Ethics Permit (2018-26) - permit issued.
2. Commonwealth Waters Permit - permit application completed but requires permit issued from Marine Parks first as the application needs demonstration that the Director of Parks has approved the operations.
3. Australian Marine Parks Permit - online permit application submitted on 19/9.
4. Australian Fisheries Management Authority Permit - permit application submitted via email on 19/9.

Personnel List

	NAME	ROLE	ORGANISATION	Legs
1.	Max McGuire	Voyage Manager	CSIRO MNF	1, 2, 3, 4
2.	Aaron Tyndall	SIT Support	CSIRO MNF	1, 2, 3, 4
3.	Ian McRobert	SIT Support	CSIRO MNF	1, 2, 3, 4
4.	Dave Watts	GSM Support	CSIRO MNF	1, 2, 3, 4
5.	Frances Cooke	GSM Support	CSIRO MNF	1, 2, 3, 4
6.	Anoosh Sarraf	DAP Support	CSIRO MNF	1, 2, 3, 4
7.	Karl Malakoff	DAP Support	CSIRO MNF	1, 2, 3, 4
8.	Christine Rees	Hydrochemistry	CSIRO MNF	1, 2, 3, 4
9.	Stephen Tibben	Hydrochemistry	CSIRO MNF	1, 2, 3, 4
10.	Mark Lewis	Field Operations	CSIRO MNF	1, 2, 3, 4
11.	Damian Pretyman	Field Operations	CSIRO MNF	1, 2, 3, 4
12.	Andrew Terhell	Comms-videographer	Crow's Nest Media	1
13.	Fraser Johnston	Comms-videographer	Crow's Nest Media	2, 3, 4
14.	Bethany Green	Comms - Journalist	UTAS	1, 2, 3, 4
15.	Alan Williams	Chief Scientist	CSIRO O&A	1, 2, 3, 4
16.	Nic Bax	PI (Communications)	CSIRO O&A	1, 2, 3, 4
17.	Malcolm Clark	PI (Operations)	NIWA	1, 2, 3, 4
18.	Thomas Schlacher	PI (Data products)	USC	1
19.	Matt Sherlock	Tow cam ops	CSIRO O&A	1
20.	Jeff Cordell	Tow cam ops	CSIRO O&A	2, 3, 4
21.	Karl Forcey	Tow cam ops	CSIRO O&A	1, 2, 3, 4
22.	Nick Mortimer	Image data processing	CSIRO O&A	1, 2, 3
23.	Mark Green	Image data management	CSIRO O&A	1, 2, 3, 4
24.	Candice Untied	Image data management	CSIRO O&A	1, 2, 3, 4
25.	Karen Gowlett-Holmes	Biodiversity lead	CSIRO O&A	1, 2, 3, 4
26.	Simon Grove	Biodiversity processing	Tasmanian MAG	1, 2, 3, 4
27.	Kirrily Moore	Biodiversity processing	Tasmanian MAG	1, 2, 3, 4
28.	Ricky Lee Erickson	Biodiversity processing	Museum Victoria	1
29.	Alexandra Weber	Biodiversity processing	Museum Victoria	1, 2, 3, 4
30.	Ingo Burghardt	Biodiversity processing	Australian Museum	3, 4
31.	Laetitia Gunton	Biodiversity processing	Australian Museum	1
32.	Alison Miller	Biodiversity processing	Australian Museum	3, 4
33.	Francesco Criscione	Biodiversity processing	Australian Museum	1
34.	David Logan	Biodiversity processing	Parks Australia	3,4
35.	Cath Sampson	Biodiversity processing	Parks Australia	1
36.	Cassie Layton	Biodiversity processing	Parks Australia	1
37.	Emily Harris	Biodiversity processing	Parks Australia	4
38.	Gemma Boyle	Biodiversity processing	Parks Australia	3
39.	Rudy Kloser	Single beam acoustics	CSIRO O&A	1, 2
40.	Ben Scoulding	Single beam acoustics	CSIRO O&A	1, 2
41.	Eric Woehler	Seabird observations	UTAS	1, 2, 3, 4
42.	Zara King	Seabird observations	UTAS	1, 2, 3, 4
43.	Alice Forrest	Seabird observations	UTAS	1, 2, 3, 4
44.	Jan Jansen	Modelling data	UTAS	1
45.	Nick Johannsohn	Backscatter data	UTAS	3, 4
46.	Kylie Maguire	Image data	Southern Cross University	3, 4
47.	Craig Johnson	Image data management	UTAS	4
48.	Jason Mundy	Science policy	Parks Australia	4
49.	Tiffany Sih	Image data management	James Cook University	1, 2, 3, 4
50.	Matt Cahill	Science policy	DOEE	2
51.	Tony Worby	Science logistics	CSIRO	2

Signature

Your name	Dr. Alan Williams
Title	Chief Scientist
Signature	
Date:	August 27, 2018

List of additional figures and documents

Scientific equipment and facilities provided by the Marine National Facility

Some equipment items on the list may not be available at the time of sailing. Applicants will be notified directly of any changes.

Indicate what equipment and facilities you require from the Marine National Facility by placing an **X** in the relevant box.

(i) Standard laboratories and facilities

Name	Essential	Desirable
Aerosol Sampling Lab		
Air Chemistry Lab		
Preservation Lab	X	
Constant Temperature Lab		X
Underway Seawater Analysis Laboratory		
GP Wet Lab (dirty)	X	
GP Wet Lab (Clean)	X	
GP Dry Lab (Clean)		
Sheltered Science Area	X	
Observation deck 07 level		
Walk in Freezer	X	
Clean Freezer	X	
Blast Freezer	X	
Ultra-Low Temperature Freezer	X	
Walk in Cool Room	X	

(ii) Specialised laboratory and facilities

(May require additional support)

Name	Essential	Desirable
Modular Radiation Laboratory		
Modular Trace Metal Laboratories		
Modular Hazchem Locker	X	
Deck incubators		
Stabilised Platform Container		

(iii) Standard laboratory and sampling equipment

Name	Essential	Desirable
CTD - Seabird 911 with 36 Bottle Rosette		
CTD -Seabird 911 with 24 Bottle Rosette	X	
LADCP		
Sonardyne USBL System	X	
Milli -Q System		
Laboratory Incubators		
Heavy Duty Electronic Balance		
Medium Duty Electronic Balance	X	
Light Duty Electronic Balance	X	
Surface Net		
Bongo Net		
Smith Mac grab		
Dissecting Microscopes		

(iv) Specialised laboratory and sampling equipment

(May require additional support)

Name	Essential	Desirable
TRIAXUS – Underway Profiling CTD		
Continuous Plankton Recorder (CPR)		
Deep tow camera	X	
Piston Coring System		
Gravity Coring System		
Multi Corer		
XBT System		
Trace Metal Rosette and Bottles		
Sherman epibenthic sled	X	
Trace- metal in-situ pumps		
Rock Dredges		
EZ Net		
Rock saw		
Portable pot hauler		
Beam Trawl	X	
Trawl doors (pelagic or demersal)		
Stern Ramp	X	
Trawl monitoring instrumentation (ITI)		
Radiosonde		

(v) Equipment and sampling gear requiring external support

(May require additional support from applicants)

Name	Essential	Desirable
Seismic compressors		
Seismic acquisition system		

(vi) Underway systems

Acoustic Underway Systems

Name	Essential	Desirable
75kHz ADCP		
150kHz ADCP		
Multi Beam echo sounder EM122 12kHz (100m to full ocean depth)	X	
Multi Beam echo sounder EM710 70-100kHz (0-1000m approx.)	X	
Sub-Bottom Profiler SBP120	X	
Scientific Echo Sounders EK60 (6 bands, 18kHz-333kHz)	X	
Gravity Meter		
Trace metal clean seawater supply		

Atmospheric Underway Sensors

Name	Essential	Desirable
Nephelometer		
MAAP (multi angle absorption photometer)		
SMPS (scanning mobility particle sizer)		
Radon detector		
Ozone detector		
CPC (Condensation Particle Counter)		
Picarro spectrometer (analysis of CO_2/CH_4/H_2O)		
Aerodyne spectrometer (analysis of N_2O/CO/H_2O)		
Aerosol Manifold instrumentation (intake temperature and humidity)		
Air Chemistry manifold instrumentation (intake temperature and humidity)		
CCN (Cloud Condensation Nuclei)		
Polarimetric Weather Radar		

Underway Seawater Instrumentation

Name	Essential	Desirable
Thermosalinograph		
Fluorometer		
Optode		
CO2		