RV *Investigator* Voyage Plan

VOYAGE #:	IN2020_V10
Voyage title:	**MNF Trials, Storm Bay Modelling and Information System Data Collection, and Bathymetric and Benthic Habitat mapping of the Huon AMP**
Mobilisation:	Hobart, Monday, 09 to Tuesday, 10 November 2020
Medical Testing and Clearance Period	Hobart, Wednesday, 11 to Thursday 12, November 2020 *(all participants and crew to remain onboard once tested)*
Depart:	Hobart, 0800 Friday, 13 November 2020 *(or when testing results are returned)*
Return:	Hobart, 0800 Sunday, 22 November, 2020
Demobilisation:	Hobart, 0800 Sunday, 22 November, 2020
Voyage Manager:	John Hooper
Deputy Voyage Manager	Jason Fazey
Principal Investigators:	Cath Samson, Karen Wild-Allen
Project 1:	**Mapping of the Huon AMP**
Affiliation:	Parks Australia
Project 2:	**Storm Bay Modelling & Information System Data Collection**
Affiliation:	CSIRO

Scientific objectives

Project 1: Complete trials and testing of MNF equipment (50%)

Testing and trials of MNF and some non-MNF equipment (PLAOS) is to be completed during approximately 50% of the voyage. These trials are to optimise design and deployment characteristics and methods to ensure continued and optimal support of scientific objectives during the 20-21 Voyage Schedule.

Project 2: RV Investigator Storm Bay Sampling for the FRDC Project 'Storm Bay Modelling & Information System'.

We propose the RV Investigator completes a targeted sampling program to characterise the deep water south of Storm Bay and, its nutrient concentration which is currently uncertain. Water samples and sensor data will assist in resolving whether deep water intrusions into Storm Bay have the potential to modify water quality.

Background:

The objectives of the Storm Bay Modelling & Information System Project are to develop a modelling and information system to report:

- current water quality conditions from models and observations
- hindcast analysis and short-term model forecasts
- analysis of scenario projections for planning
- link to decision support tools to optimise management and monitoring including the capability for rapid deployment of high-resolution local models within Storm Bay

The system will have the capability for future expansion to multiple sub-regions around Tasmania and Australia.

To achieve these objectives the project is 2 years into a 3.5 year program of hydrodynamic, sediment, optical and biogeochemical model developments and a targeted observation program including benthic lander and glider deployments; IMOS profiling mooring and local industry data have also assisted the project by facilitating model calibration and water mass characterisation.

In the 1st 2 years of the project the hydrodynamic modelling team has identified episodic deep-water intrusions into Storm Bay associated with East Australia Current mesoscale activity south of the Tasman peninsular. This deep water is cool with low oxygen content and we hypothesise that it may be rich in dissolved inorganic nutrients, however this has not yet been confirmed by observations. A shelf intrusion of nutrient rich deep water into Storm Bay has the potential to stimulate primary production and significantly modify water quality in the Bay.

Project 3: Bathymetric and seafloor survey of the Huon Australian Marine Park, Southern Tasmania

Investigator will undertake benthic habitat mapping within the Huon Marine Park during IN2020_V10 on behalf of Parks Australia.

The research objectives associated with the benthic habitat mapping operations include:

- Building a framework for better prediction and mapping of deep-sea coral communities by creating quantitative spatial estimates of seafloor characteristics from multibeam bathymetry and backscatter data; and
- Test the repeatability backscatter measurements to provide estimates of uncertainty to the prediction models for habitats across the marine park. This will be achieved through perpendicular line approaches over previously mapped areas.

Operations will be Multi-beam echo sounder (MBES) backscatter mapping including benchmark remapping, azimuth repeatability and supplementary data acquisition. This process will also include concurrent bathymetry data.

Voyage objectives

Project 1: MNF/CSIRO testing

Equipment	Activity	Hours (indicative)
EM122:	Mapping of a deep-water reference surface for yearly calibrations and multi-agency collaboration.	12
EM122/EM710	Backscatter Calibration Lines	0
ADCP/Drop Keels	Study of the effects of drop keel height on ADCP data.	2
PLAOS	Testing.	(4x2.5h)
pCO2 sensor testing (USL)	Testing of new pCO2 sensors in the Underway Seawater Lab.	0
ISARs	SST comparison of ISARs	0
Underway Nutrient Instrument	Setup, test and run underway nutrient analyser (GPCW)	0
Triaxus	Trials of new sensor configuration	6 (+20hr science)
Deep Towed Camera	Final commissioning.	4 x 5h
RMT16 Net	Testing of new recovery bridles and sliders	8 (2 x 4h)
Hydro-Bios multi net	First trial of vertical deployment	4
Multi-corer (new)	Trial	4

Project 2: RV Investigator Storm Bay Sampling: FRDC Project 'Storm Bay Modelling & Information System' in November 2020.

CTD CASTS

Its proposed to complete 6 CTD casts distributed as in Figure 1.

- 2 CTD at around 130m
- 2 CTD On the shelf break at around ~ 250m
- 2 CTD further offshore at around ~900-1000m

The 24 bottle CTD rosette should be enough for good resolution of the vertical nutrient profile with the sensor combination noted in Table 1. Water samples would also be required for salinity, dissolved oxygen, suspended particulate matter, chlorophyll + pigments, phytoplankton species, and isotopes. These data will be used to confirm the CTD sensor values and characterise the microbial community.

2 CTD at around 130m

2 CTD On the shelf break at around ~ 250m

2 CTD further offshore at around ~900-1000m

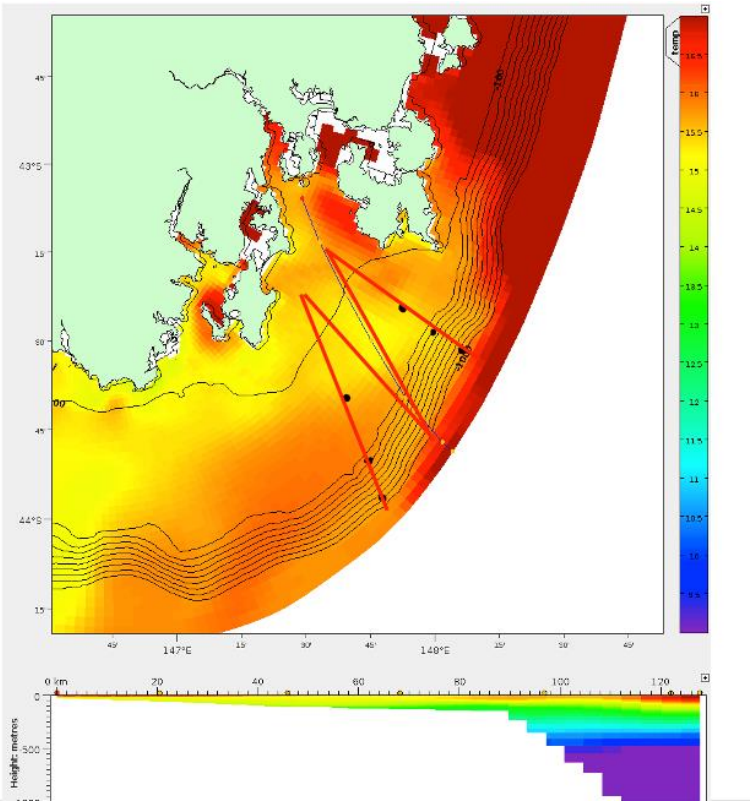


Figure 1: Proposed locations of 6 CTD casts (black dots) with contour lines at 100m intervals from 100m to 1000m (black lines) and plan B triaxus track (red lines)

Fundamentals:	
Which CTD rosette to be used for this voyage (24 or 36 Niskin bottles):	24
Likely total number of casts:	7
Likely maximum depth of deepest cast:	3800m
Lowered ADCP required:	no
Instrumentation (maximum 6 auxiliary channels in addition to 2x DO):	
2x pumped Temperature, Conductivity, Dissolved Oxygen circuits:	(Standard)
Altimeter (required if operating anywhere near the sea floor):	yes

PAR Sensor (Biospherical QCP-2300):	yes
Transmissometer (Wetlabs C-Star 25cm):	Yes (or Nephelometer)
Fluorometer – Chlorophyll-a (Chelsea Aquatracka III – 430/685nm):	
Fluorometer – CDOM (Wetlabs FLCDOM – 370/460nm)	
Nephelometer (Seapoint Turbidity Meter)	
ECO-Triplet (Chlorophyll-a, CDOM & backscatter – maximum depth 2000m)	Yes (or equivalent)
SUNA (UV Nitrate Sensor)	Yes (check max depth)

Table 1: Sensor combination required on CTD rosette

TRIAXUS TOWS

An undulating triaxus tow zigzagging across the shelf to provide the spatial characterisation of water masses present in the region for the interpretation of the CTD casts and to map the distribution of nitrate will be completed. For this purpose, a SUNA will be added to the sensor payload on the triaxus.

Plan A: If EAC water is not present in the region at the time of the voyage a single zigzag transect that coincides with the CTD casts would be sufficient to characterise the spatial distribution of water masses (Figure 2).

Plan B: If EAC water is present in the region at the time of the voyage we would value a 2-zigzag transect as shown in Figure 3 to distinguish EAC influenced water to the southeast from that in the southwest.

The presence or absence of EAC water in the region will be determined from remote sensing of sea surface temperature in the days leading up to the voyage. Being in November, it is more likely that the EAC water will not yet be present off southeast Tasmania so plan A (Figure 2) is more likely).

During the triaxus tow underway water samples will be taken every hour for analysis of nutrients, salinity, dissolved oxygen, suspended particulate matter, chlorophyll + pigments, phytoplankton species, and isotopes.

To optimize time, the 3 eastward CTD could be taken on the way out, followed by the triaxus tow (keeping the triaxus in the water when changing direction along the zigzag track), and then the 3 westward CTD on the way back inside the bay.

Before EAC water gets into the domain

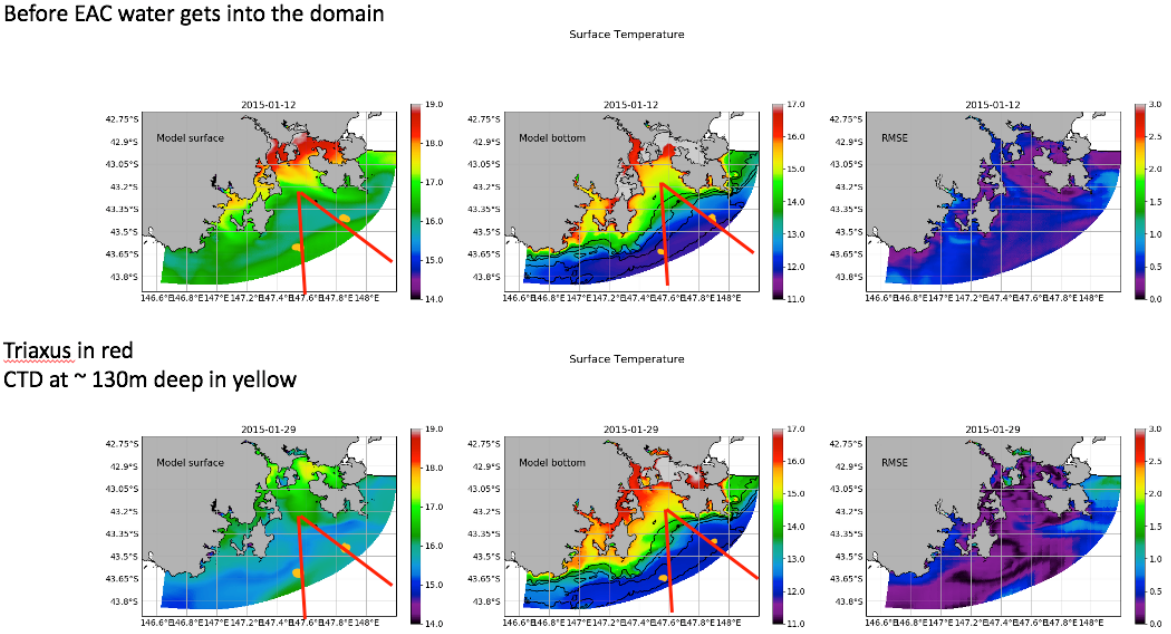


Figure 2: Plan A: If EAC water is not present in the region at the time of the voyage, one zigzag triaxus tow is proposed.

When EAC water is in the domain

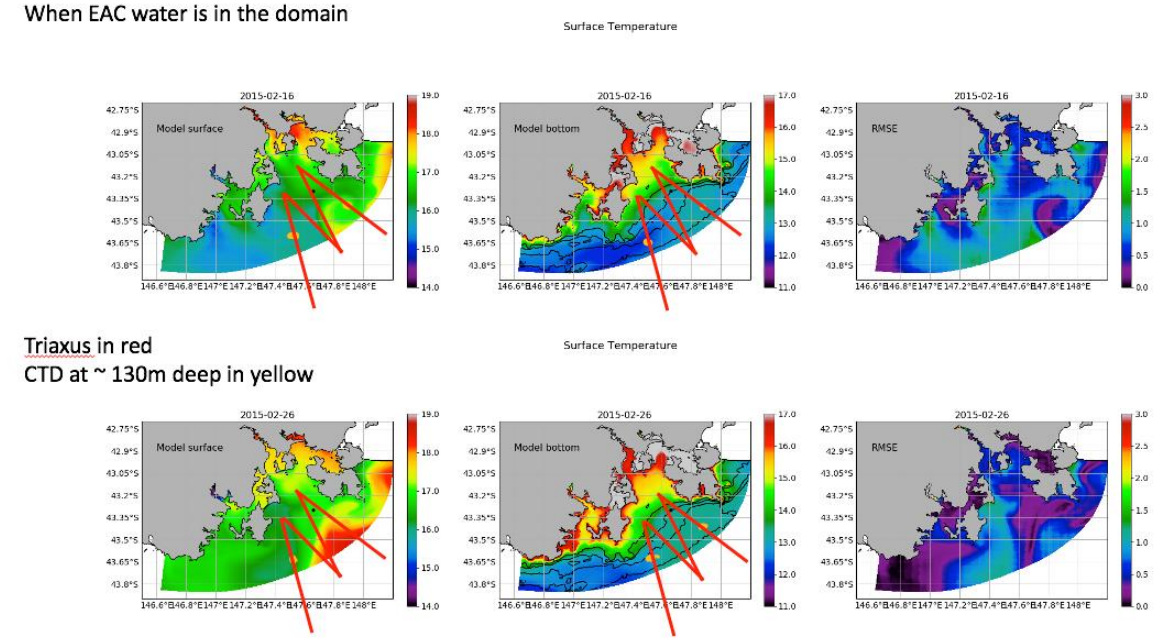
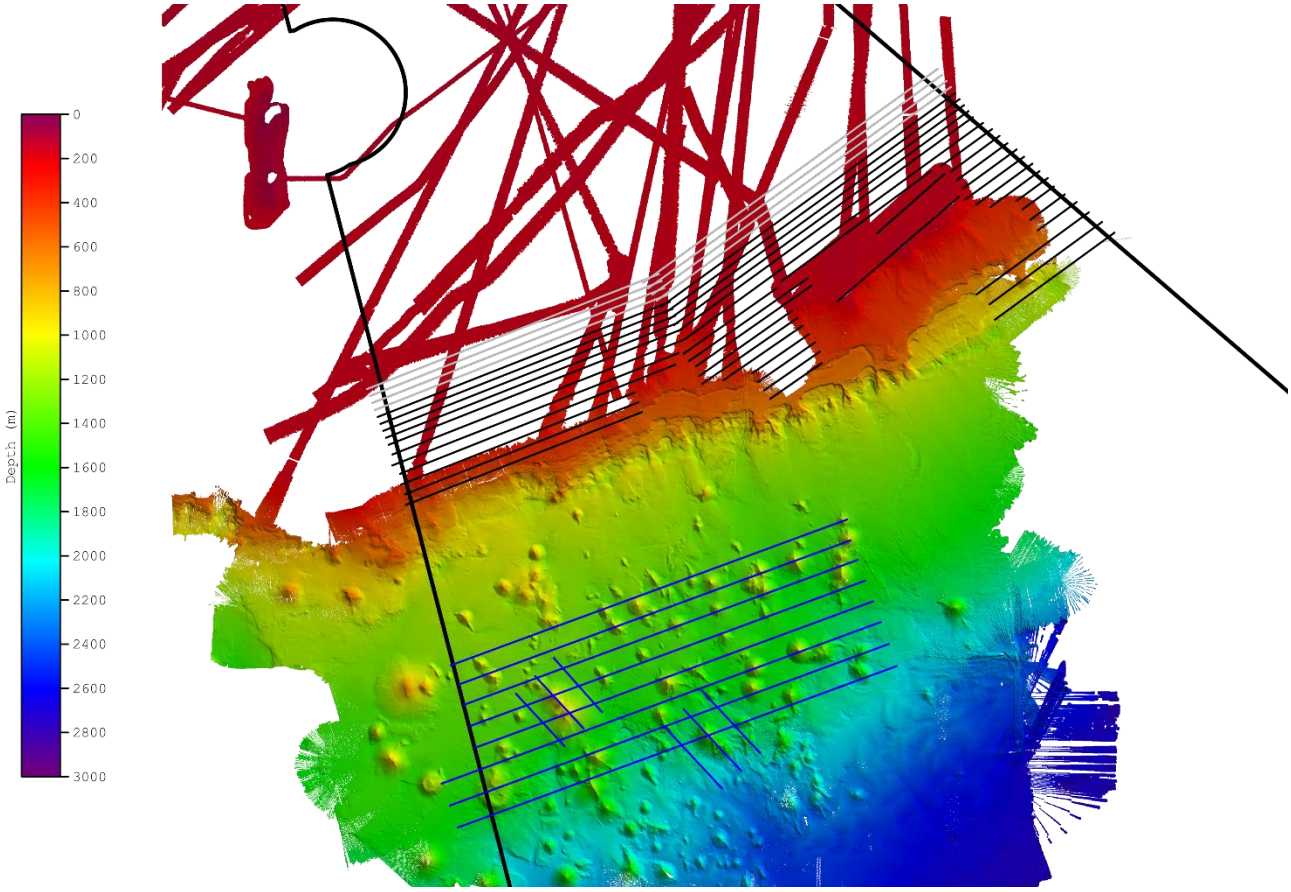


Figure 3: Plan B: If EAC water is present in the region at the time of the voyage we would value 2 zigzags across the shelf for the triaxus tow.

Project 3: Undertake sea floor mapping of the Huon Australian Marine Park

Using the EM710 and EM122 multibeam systems, the MNF will complete seafloor mapping of the priority 1 Huon AMP area on behalf of Parks Australia. There are two subprojects:



Map of Huon Marine Park showing lines for multibeam mapping:

Black lines: Outer shelf and shelf break down to 300m (priority 1) and for filling mapping gaps on the upper slope between depth of 300m and 700m depth (priority 3).

Grey lines: Lower priority mapping lines on the outer shelf. With the time limits it is unlikely that this will be achievable but if time permits coverage of this areas is desirable (priority 4).

Blue lines: Seamount backscatter (priority 2)

3A) Multibeam mapping (including backscatter) – outer shelf /shelf break and filling mapping gaps in upper slope between 300-700m depth.

Distance: 432 nautical miles

Predicted time: ~ 43.5 hours (speed 8 knots) – note doesn't include line turns,

Resolution: goal to map 2m resolution <300m and 15m resolution in 300-700 depths.

Note: For the shelf lines, it is likely that the speed will need to be reduced to less than 5 knots (rather than the 8 knots used in the predicted time calculations) in the shallower regions to get the 2 m resolution. From a park management perspective, it is more important to map a smaller area at the finest resolution possible than a larger area at a coarser resolution.

i) outer shelf /shelf break down to 300m: black lines (priority 1) and grey lines (priority 4)

ii) filling gaps on upper slope between 300-700m: black lines (priority 3)

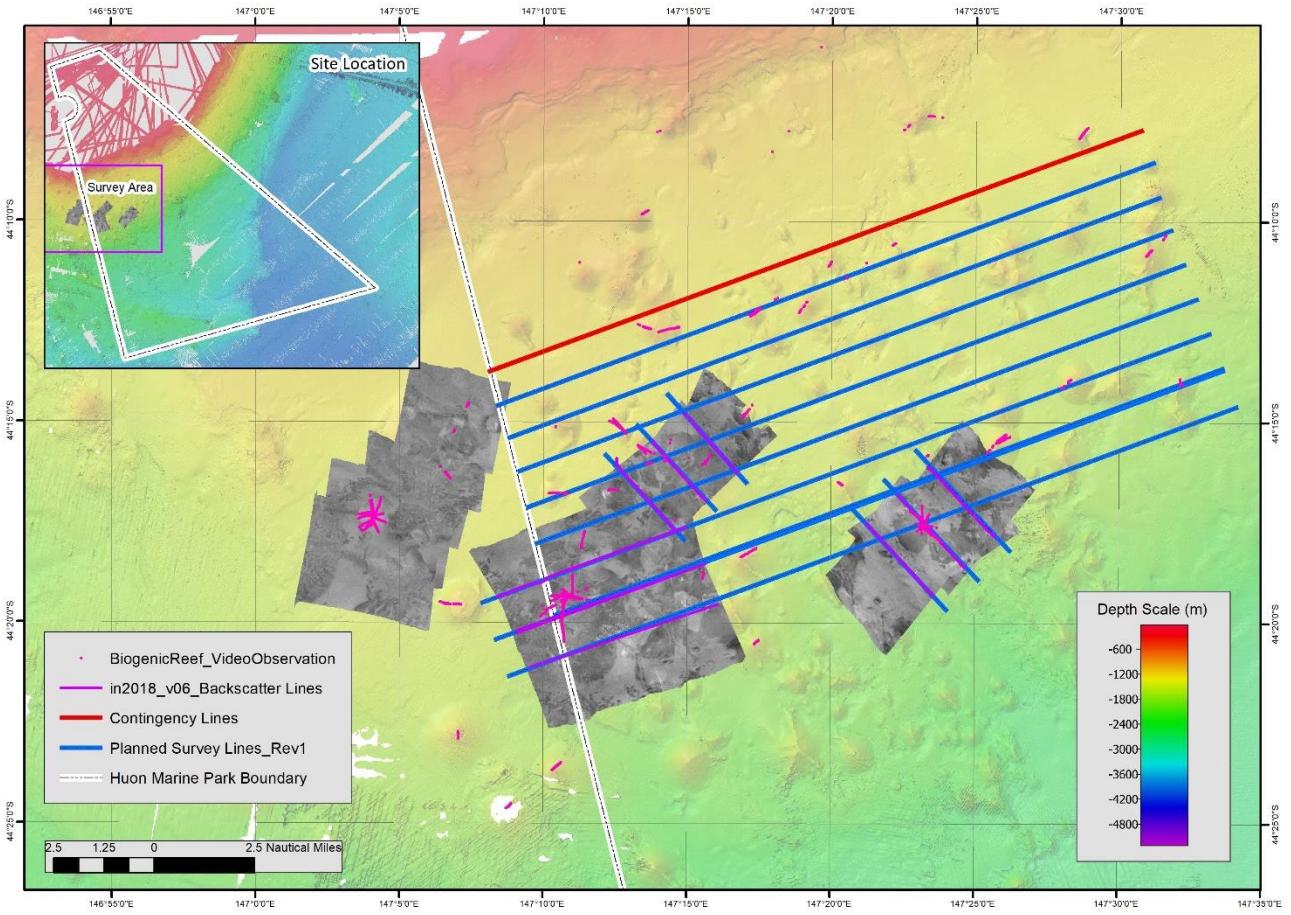
3B) Seamount backscatter (priority 2)

Distance: 183 nautical miles

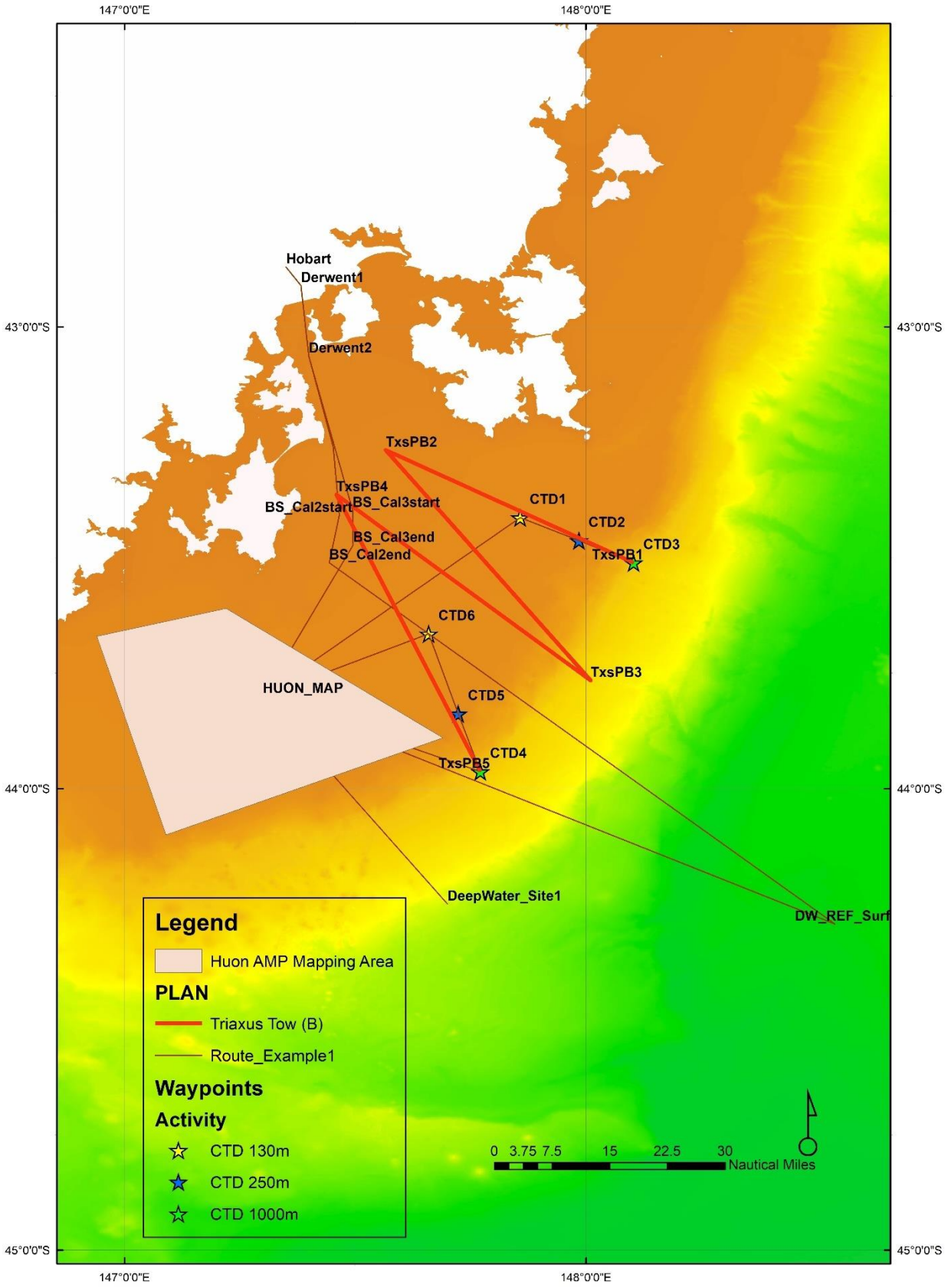
Predicted time: ~42 hours (speed 5 kts, with transits, turns, SVPs etc)

This work is a priority for Parks Australia as it will significantly improve the ability to predict the distribution of deep-sea coral communities and hard substrate on the seamounts. This will feed into a national reef model that we are developing to inform management and monitoring priorities.

An alternative back up option in the event of bad weather making the Huon MP work unachievable is Freycinet AMP – 1) fill gaps in the inner shelf within the park and 2) fill gaps on upper, mid and lower slope within the park. However, this will require a significant re-organisation of voyage activities and is therefore highly undesirable.



Voyage track example



Waypoints and stations

Time and distance estimates based on vessel speed of 11knots except for mapping and triaxus operations which are calculated at 8knots but may include 11knot speeds whilst transiting to and from the mapping areas. Table doesn't account for on station manoeuvring or deep towed camera ops (~1.5 knots).

Site	Degrees Decimal Minutes Latitude	Degrees Decimal Minutes Longitude	Distance (nm)	Total Distance (nm)	Steaming time (hrs)	Total Steam (hrs)
HBA	42° 52.200' S	147° 21.000' E	0	0	0	0
BS_Cal2start	43° 24.478' S	147° 27.939' E				
BS_Cal2end	43° 30.632' S	147° 26.618' E	40	40	5	5
HUON AMP MAP AREA	43° 53.400' S	147° 41.400' E	33	73	3	8
HUON AMP MAPPING			50	123	10	18
HUON AMP MAPPING			60	183	12	30
HUON AMP MAPPING			96	279	13	43
DeepWater_Site1	44° 15.000' S	147° 42.000' E	12	291	1	44
HUON AMP MAPPING			80	371	10	54
Triaxus Trial			48	419	6	60
CTD6	43° 39.888' S	147° 39.564' E	18	437	1.5	61.5
CTD5	43° 50.286' S	147° 43.386' E	6	443	0.5	62
CTD4	43° 57.792' S	147° 46.254' E	22	465	2	64
Deepwater Ref (DWR) Site	44° 17.600' S	148° 32.700' E	66	531	6	70
MAPPING DWR SURFACE			112	643	14	84
CTD3	43° 30.654' S	148° 06.198' E	50	693	0	84
CTD2	43° 27.768' S	147° 59.094' E	6	699	0.5	84.5
CTD1	43° 24.780' S	147° 51.444' E	6	705	0.5	85
TRANSIT BACK TO HUON	43° 53.400' S	147° 41.400' E	55	760	5	90
HUON AMP MAPPING			187	947	36.25	126.25
TxsPB5	43° 57.792' S	147° 46.254' E	22	969	2	128.25
TxsPB4	43° 21.792' S	147° 27.540' E	38.4	1007.4	5	133.25
TxsPB3	43° 45.930' S	148° 00.600' E	34	1041.4	4.25	137.5
TxsPB2	43° 16.008' S	147° 33.960' E	36	1077.4	4.5	142
TxsPB1	43° 30.654' S	148° 06.198' E	28	1105.4	4	146

Hobart	42° 52.200' S	147° 21.000' E	55	1160.4	5	151

Activity Plan and Time estimates

The following time estimates are based on a steaming speed of 11 knots except for Triaxus tows (8 knots), and mapping (5-8knots). Plan will be adjusted according actual departure time (based on medical test results) and to weather and sea states.

DATE	TIME	ACTIVITY
Fri 13/11/2020	1300	Depart Hobart PW4 (When PCR Test Results are returned) transit via Backscatter calibration Line 2.
	1800	Finish Backscatter calibration Line 2. Transit to Huon AMP
	2100	Commence multibeam mapping of **Huon AMP**
Sat 14/11/2020	0700	Deep Towed Camera #1 (150-200m)
	1200	RMT 16 #1
	1500	PLAOS #1
	1800	Mapping of Huon AMP
Sun 15/11/2020	*0700*	Deep Towed Camera #2 (150 - 200m)
	1200	*RMT16 #2*
	1600	*PLAOS #2*
	1800	Mapping of Huon AMP
	0500	Transit to **Deepwater Site #1** (~2000m)
Mon 16/11/2020	0600	Deep Towed Camera #3
	1100	HydroBios
	1500	PLAOS #3
	1700	Transit and continue mapping of Huon AMP
Tue 17/11/2020	0600	*Triaxus Trial*
	1330	CTD6
	1600	CTD5
	2000	CTD4
	2200	Transit **Deepwater Reference Surface Site**
Wed 18/11/2020	0400	PLAOS #4
	0700	Full Depth CTD 3800m
	1000	Mapping Deepwater Reference Site

DATE	TIME	ACTIVITY
Thu 19/11/2020	0500	Transit and complete CTD3
	0730	CTD2
	1030	CTD1
	1230	Triaxus
Fri 20/11/2020	1000	Transit and continue mapping of Huon AMP
	1200	Multi-Core Trial
	1600	Mapping of Huon AMP
Sat 21/11/2020	0900	Deep Towed Camera #4
Sun 22/11/2020	0300	Depart for Hobart
	0800	Arrive PW4, Hobart

Permits

Storm Bay Project – Access to Biological Resources (State Territory): Permit #20062. Valid 29 July 2020 – 28 July 2021.

Appendix A

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.

STANDARD LABORATORIES AND FACILITIES		
NAME	**REQUIRED**	**NOTES/COMMENTS**
Aerosol Sampling Lab		
Air Chemistry Lab		
Preservation Lab	X	Biology
Constant Temperature Lab (Min temp: 2°C / Max temp 35°C)		
Underway Seawater Analysis Laboratory	X	pCO2 sensor testing (Craig Neill)
GP Wet Lab (Dirty)	X	Field Operations
GP Wet Lab (Clean)	X	Biological Sorting/Filtering
GP Dry Lab (Clean)	X	PLAOS Team Designated Area
Sheltered Science Area	X	Deep Towed Camera/Triaxus
Observation Deck 07 Level		
Internal Freezer (Dirty Wet lab) (Min temp -25°C / Max temp 0°C) Volume: >20m^3		

STANDARD LABORATORIES AND FACILITIES		
NAME	**REQUIRED**	**NOTES/COMMENTS**
Clean Freezer (Dirty Wet lab) (Min temp -25^{o}C / Max temp 0^{o}C) Volume: >2.5m^{3} Co-located within the Internal freezer and separated by a door	X	
Blast Freezer (Dirty Wet lab) (Min temp -30^{o}C / Max temp 0^{o}C) Internal volume >1.5m^{3} Capable of reducing the temperature of 150kg of water from +20C to -30C in one hour.		
Cool Room (Dirty Wet lab) (Min temp 0^{o}C / Max temp 10^{o}C)	X	
Ultra-Low Temperature Freezers x2 (Main Deck) Min temp -80^{o}C / Max temp -80^{o}C)	X	Sample preservation and storage
YODA Freezers (x2) (Clean Dry lab) (Min temp -20^{o}C / Max temp 10^{o}C)		

MOBILE LABORATORY AND FACILITIES *(MAY REQUIRE ADDITIONAL SUPPORT)*			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Modular Isotope Laboratory			If nominated, additional processes to be completed.
Trace Metal Niskin Sampling Container (TM1-blue)			

MOBILE LABORATORY AND FACILITIES *(MAY REQUIRE ADDITIONAL SUPPORT)*			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Trace Metal Seawater Analysis Laboratory (TM2-white)			Cannot be overstacked
Trace Metal Rosette and Niskin Storage Container			10-foot container
Modular Hazchem Locker			
Stabilised Platform Container			Please indicate what instruments are to be installed in the container Cannot be overstacked
Clothing Container			The use of this container will be identified by MNF

STANDARD SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
CTD - Seabird 911 with 36 Bottle Rosette			
CTD - Seabird 911 with 24 Bottle Rosette	X		
Lowered ADCP			
Continuous Plankton Recorder (CPR)			

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
TRIAXUS – Underway Profiling CTD	X		Triaxus is a pilotable towed vehicle capable of carrying a variety of instrumentation. Constant depth towing or undulating profiles (e.g. cyclic depth pattern from the surface to 200m) are possible. Towing speed depends on the tow profile, instrumentation payload and prevailing conditions. Typically, undulations from the

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
			surface to 200m are possible at 8knt, with slower speeds for deeper profiles and faster for constant-depth towing. Maximum achievable depth typically 300m Usual instrumentation: SBE9plus (pressure sensor and communication hub) and dual pumped temperature/conductivity/dissolved oxygen circuits. Usual auxiliary instrumentation includes an ECO-Triplet (Chl, CDOM, backscatter), transmissometer, PAR sensor, and Laser Optical Plankton Counter. Contact MNF for further details on other instrumentation and capability.
Desired towing profile:			Undulating with parameters determined during voyage.
Additional instrumentation: (please supply, make and model and datasheets and a contact person for discussion on integration)			SUNA plus standard ECO-Triplet (Chl, CDOM, backscatter), transmissometer, PAR sensor, and Laser Optical Plankton Counter.
Piston Coring System			
Gravity Coring System			
Multi Corer	X		
Kasten Corer			
Smith Mac Grab			
Rock Dredges			
Rock Saw			Requires trained science personnel
Seaspy Magnetometer			
Portable Pot Hauler	X		

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
Equipment to measure seawater sound velocity/CTD:			
XBT System			2 per day provided
Valeport Rapid SV			
Valeport Rapid CTD			
Valeport SVX2	X		
Trace Metal Rosette and Bottles			
Trace Metal In-situ Pumps (x6)			See non-MNF owned section below for additional 2 units
Deep Towed Camera	X		
Drop Camera			
Sherman Epibenthic Sled			
Brenke Sled			
EZ Net (Multiple net system, 1m x 1m)			Please specify 335-micron, 500-micron, or 1,000-micron mesh
Hydro-Bios MultiNet (1m x 1m)	X		Please specify 335-micron, 500-micron, or 1,000-micron mesh
Surface Net (1m x 1m)			Please specify 335-micron, 500-micron, or 1,000-micron mesh
Bongo Net 485mm diameter			500 micron mesh only
Beam Trawl			
MIDOC			Multiple opening/closing net system with cod ends- suitable for pelagic trawls
Pelagic Trawl System (net, doors)			Contact MNF to discuss net and mesh dimensions

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
Demersal Trawl System (net, doors)			Contact MNF to discuss net and mesh dimensions
RMT-8 (Rectangular Midwater Trawl) Utilises a single warp so can be deployed on the general-purpose towing wire in self-contained mode. Must be deployed with stern ramp covered.			8m2 mouth area Tow speed ≤2 knots
RMT-16 (Rectangular Midwater Trawl) Utilises a single warp so can be deployed on the general-purpose towing wire in self-contained mode. Must be deployed with stern ramp covered.	X		16m2 mouth area Tow speed ≤2 knots
Trawl Monitoring Instrumentation (ITI) (2,000m depth limit)			MNF to identify this need, dependent on pelagic or demersal trawling requirement
Stern ramp		**INSTALLED**	MNF to identify this requirement

RESEARCH SUPPORT INFRASTRUCTURE			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Salt Water Ice Machine (Dirty Wet lab)			
Radiosonde Receiver System			
Laboratory Incubators (Clean Dry lab)			
Deck Incubators			Temperature controlled deck incubators
Milli-Q System			

RESEARCH SUPPORT INFRASTRUCTURE			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Sonardyne USBL System			

SCIENTIFIC / SAMPLE ANALYSIS SYSTEMS				
MICROSCOPES:				**NOTES/COMMENTS**
BRAND / MODEL	**TYPE**	**ESSENTIAL**	**DESIRABLE**	Refer to the "MNF microscopes procedure" for more information
Leica / M80	Dissecting			
Leica / M80	Dissecting			
Leica /MZ6	Dissecting			
Olympus / CH	Compound			
Olympus /CH	Compound			
Leica / MTU282	Camera tube			
Adapters for tube / Nikon	Pentax			
Ring Light *2 / MEB121	LED			
Heavy Duty Electronic Balance (80kg)				
Medium Duty Electronic Balance (15kg/5g resolution)				
Light Duty Electronic Balance (3kg/1g resolution)				

Underway systems

ACOUSTIC UNDERWAY SYSTEMS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
75kHz ADCP	X		
150kHz ADCP	X		
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 Narrowband Echo Sounders EK60 (6 bands, 18kHz-333kHz)			EK60s will be onboard for use as a backup for EK80s and set in narrowband mode Quantitative measurements from scientific echosounders requires sphere calibration in the watermass of sampling
Scientific Narrowband/Broadband Echo Sounders EK80 (6 bands, 18kHz-333kHz)			EK80s will be used in narrowband mode unless otherwise requested Quantitative measurements from scientific echosounders requires sphere calibration in the watermass of sampling
Multibeam Scientific Echo Sounder ME70 (70-100 kHz)			
Omnidirectional Echo Sounder SH90			
Gravity Meter			

ATMOSPHERIC UNDERWAY SENSORS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Nephelometer			
Multi Angle Absorption Photometer (MAAP)			
Scanning Mobility Particle Sizer (SMPS)			
Radon Detector			
Ozone Detector			
Condensation Particle Counter (CPC)			
Picarro Spectrometer (analysis of CO_2/CH_4/H_2O)			
Aerodyne Spectrometer (analysis of N_2O/CO/H_2O)			
Cloud Condensation Nuclei (CCN)			
Polarimetric Weather Radar			

UNDERWAY SEAWATER SYSTEMS AND INSTRUMENTATION			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Thermosalinograph			
Fluorometer			
Optode			
pCO2	X		

SEAWATER SYSTEMS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Trace metal clean seawater supply			
Scientific clean seawater supplied to laboratories	X		
Raw seawater available on deck and in laboratories	X		

EQUIPMENT AND SAMPLING GEAR REQUIRING EXTERNAL SUPPORT (MAY REQUIRE ADDITIONAL SUPPORT FROM APPLICANTS)			
NAME	**ESSENTIAL**	**DESIRABLE**	**PLEASE GIVE THIS CAREFUL CONSIDERATION, AS THERE IS NO GUARANTEE THAT THESE RESOURCES WILL BE AVAILABLE UNLESS SPECIFICALLY REQUESTED. LIAISE WITH YOUR VOYAGE OPERATIONS MANAGER AS REQUIRED. ADDITIONAL STAFF MAY BE REQUIRED FOR THESE ACTIVITIES.**
Seismic Compressors			
Seismic Acquisition System			

NON-MNF OWNED EQUIPMENT WHICH MAY BE ACCESSED			
NAME	**ESSENTIAL**	**DESIRABLE**	**PLEASE GIVE THIS CAREFUL CONSIDERATION, AS THERE IS NO GUARANTEE THAT THESE RESOURCES WILL BE AVAILABLE UNLESS SPECIFICALLY REQUESTED. LIAISE WITH YOUR VOYAGE OPERATIONS MANAGER AS REQUIRED. ADDITIONAL STAFF MAY BE REQUIRED FOR THESE ACTIVITIES.**
D & N Francis winch			15mm electro-optical cable
Box Corer			
UTAS In-Situ Pumps (x2)			
EM2040			Shallow water multibeam echosounder system