

RV Investigator Voyage Plan

Voyage #:	IN2021_V04
Version number:	FINAL
Voyage title:	Biodiversity Assessment of Australia's Indian Ocean Territories (IOT)
Medical clearance	Fort Hill Wharf, Darwin, Northern Territory: 0800 Monday 28 June 2021
Mobilisation:	Fort Hill Wharf, Darwin, Northern Territory: 28 – 30 June 2021
Depart:	Fort Hill Wharf, Darwin, Northern Territory: Wednesday 30 June 2021
Return:	Henderson, Fremantle, Western Australia: Friday 13 August 2021
Demobilisation:	Henderson, Fremantle, Western Australia: Friday 13 August 2021
Voyage Manager:	Max McGuire
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Principal Investigators:	Shane Ahyong
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Principal Investigators:	Nerida Wilson
Affiliation:	Western Australian Museum
Principal Investigators:	Lisa Kirkendale
Affiliation:	Western Australian Museum
Principal Investigators:	Andrew Hosie
Affiliation:	Western Australian Museum

Scientific objectives

1. Characterise benthic biodiversity from seamounts (100-3500 m) across the EEZ in Australia's Indian Ocean Territories (IOT) for the first time.
2. Provide specimens and tissues samples to taxonomists for species identification and descriptions.
3. Test whether the proposed bioregionalisation for the territories (Brewer et al 2009, derived from environmental data) is an adequate surrogate for patterns of seafloor diversity across a series of depth strata.
4. Assess the conservation significance of these seamount communities, particularly the presence of Vulnerable Marine Ecosystems (VME) including cold water coral and sponge communities.
5. Document spatial and bathymetric patterns of oceanographic characteristics and plankton distribution.
6. Substantially contribute to the AusSeabed project by maximising new multibeam coverage.
7. Understand the biogeographical relationships of the fauna through community and evolutionary (DNA) comparisons with other Australian, west Pacific and Indian Ocean faunas.

Voyage objectives

1. Complete the multibeam mapping of shallow water features prior to biological sampling.
2. Conduct biological sampling on 12 seamount clusters, around the flanks of the 2 islands and at four sites on the abyssal plain, using 4m beam trawls and a heavy dredge (Sherman). In the event of bad weather some seamounts in the Karma, Raitt Ridge and S Cocos clusters will be abandoned.
3. Conduct video transects of up to five selected (20-2000 m) shallow water seafloor features.
4. Compile CTD/ADCP/echosounder data from selected seamount locations
5. Collect water samples for eDNA analyses from the CTD casts.
6. Collect plankton net samples from shallow water environments and zooplankton aggregations.
7. Transit along unmapped tracks to maximise multibeam coverage of the area.
8. Communicate with the local island communities through live video links with schools and community centres on the islands.
9. Engage with Australian schools from the vessel through facilities set up by the Bush Blitz program.
10. Communicate with Australian and International public and media through blogs, media releases and interviews from the vessel.

Voyage Specific Risk Assessment

This voyage has undergone a comprehensive risk assessment process.

Overall activity plan including details for first 24 hours of voyage

The first six days at sea will be the transit from Darwin to Christmas Island. The only scientific activities during this time will be multibeam/underway data collection, seabird/cetacean observation, and communication/outreach activities. This will give us ample time to prepare the laboratories and personnel.

The voyage track will deviate slightly from a direct route in order to avoid the Indonesian EEZ, and instead multibeam a transect canyon system in the Argo-Rowley MP and across two shallow seamounts on the Roo Ridge (high seas).

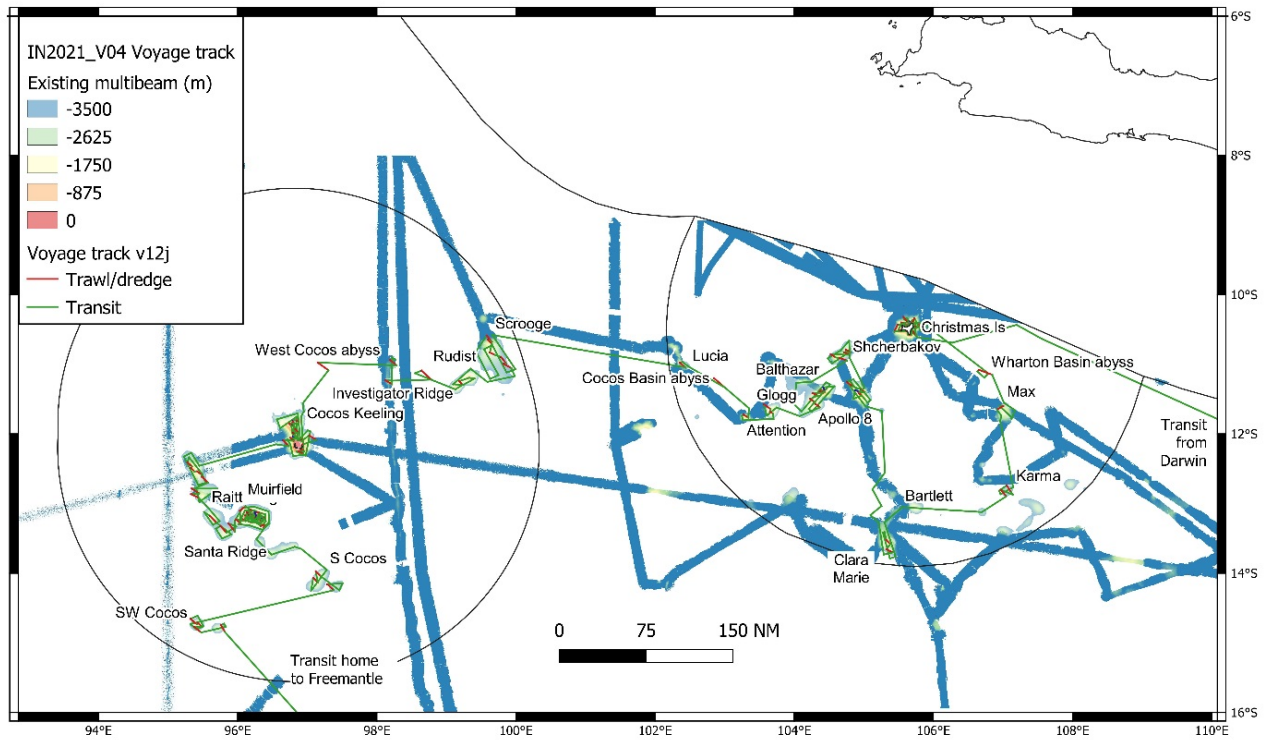
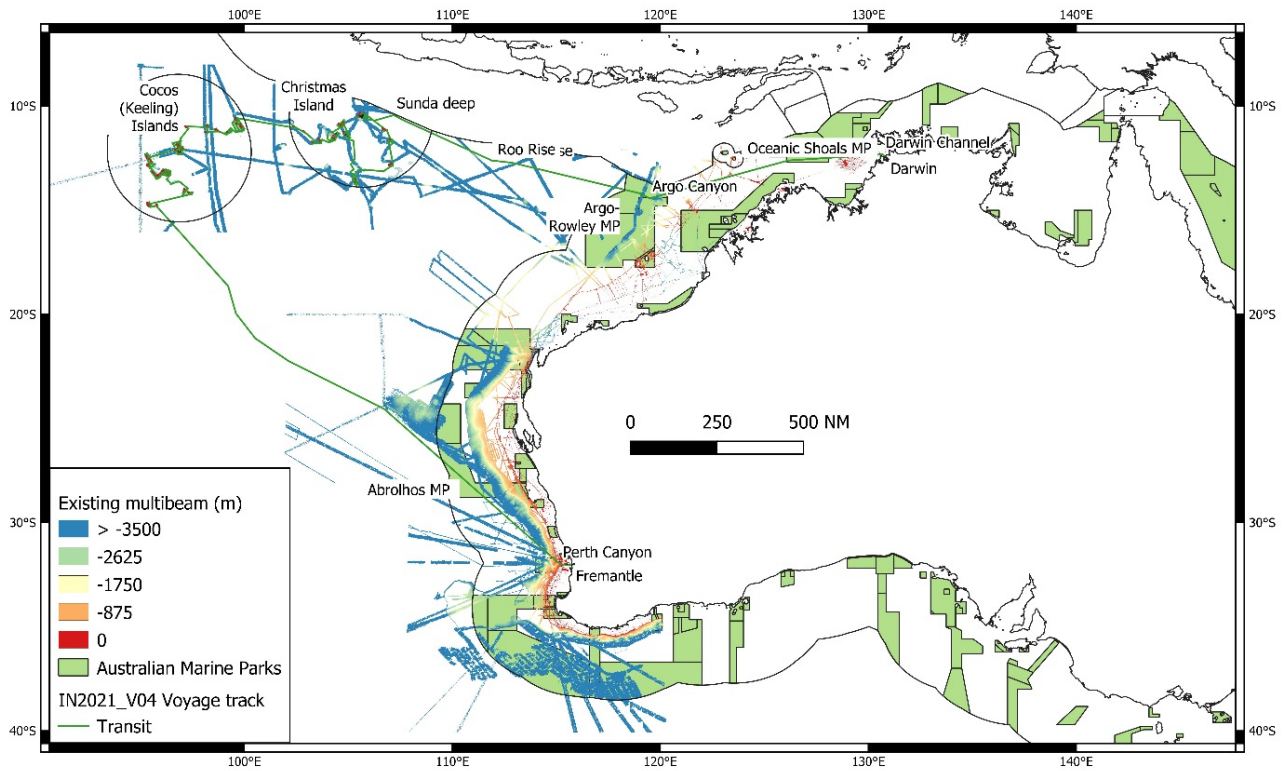
Piggyback Project

Dr Will White: Exploring the genomics of convergent snout elongations in deep-sea fishes (National Science Foundation)

Fresh muscle samples from spikefishes (Triacanthodids) and sharks and rays (Chondrichthyes) will be placed into a dry shipper for rapid freezing. These samples will be used for several genomic projects that the Australian National Fish Collection (CSIRO) is working on with US colleagues (University of Oklahoma and Florida Museum of Natural History). Representative samples for these projects will be frozen rapidly with liquid nitrogen so that chromosomal and transcriptomic data can be obtained.

A 25L liquid nitrogen Dewar will be brought onto the vessel during mobilisation and a dry shipper will be placed in a laboratory. As per the directions in the MNF LN SWI, the Dewar will remain on the deck or the sheltered science space and the dry shipper will be used in the laboratories.

Voyage track example



Waypoints, stations and time estimates

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
1	Darwin	Port	12° 29.4 S	130° 53.4 E							30/06/2021 16:00
2	Darwin Channel	Waypoint	12° 19.2 S	130° 41.4 E	15.6	15.6	1.4	1.4		0	30/06/2021 17:24
3	Oceanic Shoals	Waypoint	12° 36.6 S	126° 9.6 E	266.1	281.7	24.2	25.6		0	01/07/2021 17:36
4	Argo Canyon	Waypoint	14° 25.8 S	119° 29.4 E	404.3	686	36.8	62.4		0	03/07/2021 6:21
5		Waypoint	14° 11.4 S	119° 1.2 E	30.9	716.9	2.8	65.2		0	03/07/2021 9:10
6	Roo Rise	Waypoint	12° 43.2 S	112° 52.2 E	369.7	1086.6	33.6	98.8		0	04/07/2021 18:47
7		Waypoint	12° 36.6 S	111° 53.4 E	57.8	1144.4	5.3	104		0	05/07/2021 0:02
8		Waypoint	10° 38.04 S	107° 33.54 E	281	1425.4	25.5	129.6		0	06/07/2021 1:34
9	Sunda deep	Waypoint	10° 25.98 S	107° 11.76 E	24.6	1450	2.2	131.8		0	06/07/2021 3:49
10		Waypoint	10° 41.4 S	106° 16.38 E	56.6	1506.6	5.1	137		0	06/07/2021 8:58
11	Christmas Is	Transit	10° 36.71 S	105° 46.26 E	30	1536.6	2.7	139.7		0	06/07/2021 11:41
12	Christmas Is	MB	10° 32.93 S	105° 42.5 E	5.3	1541.9	0.5	140.2		0	06/07/2021 12:10
13	Christmas Is	MB	10° 28.04 S	105° 45.64 E	5.8	1547.7	0.5	140.7		0	06/07/2021 12:42
14	Christmas Is	MB	10° 21.9 S	105° 42.24 E	7	1554.7	0.6	141.3		0	06/07/2021 13:20
15	Christmas Is	MB	10° 22.57 S	105° 41.36 E	11.7	1555.8	1.1	141.4		0	06/07/2021 14:23
16	Christmas Is	MB	10° 24.34 S	105° 41.58 E	4.2	1557.6	0.4	141.6		0	06/07/2021 14:46
17	Christmas Is	Net	10° 24.52 S	105° 40.07 E	2.3	1559.1	1.1	141.7		0	06/07/2021 15:55
18	Christmas Is	MB	10° 20.28 S	105° 37.34 E	5.3	1564.1	0.5	142.2		0	06/07/2021 16:23
19	Christmas Is	MB	10° 20.9 S	105° 34.51 E	3.4	1567	0.3	142.5		0	06/07/2021 16:42
20	Christmas Is	MB	10° 25.26 S	105° 40.14 E	2.4	1574	0.2	143.1		0	06/07/2021 16:55
21	Christmas Is	Position	10° 25.26 S	105° 40.14 E	3.6	1574	0.4	147.1		0	06/07/2021 17:16
22	Christmas Is	CTD	10° 26.58 S	105° 37.62 E	0	1576.8	0	147.3	2	2	06/07/2021 19:16
23	Christmas Is	Beam trawl	10° 26.57 S	105° 34.33 E	4.8	1580.1	2.4	147.6	0.4	2.4	06/07/2021 22:03
24	Christmas Is	Position	10° 24.6 S	105° 32.58 E	7.9	1582.7	0.8	147.9		2.4	06/07/2021 22:51
25	Christmas Is	CTD	10° 31.34 S	105° 29.36 E	0	1590.2	0	148.6	1	3.4	06/07/2021 23:51
26	Christmas Is	Beam trawl	10° 31.32 S	105° 31.14 E	2.3	1591.9	1.2	148.7	0.4	3.8	07/07/2021 1:25
27	Christmas Is	Position	10° 31.14 S	105° 32.7 E	3.2	1593.5	0.3	148.9		3.8	07/07/2021 1:44
28	Christmas Is	CTD	10° 30.6 S	105° 33.78 E	0	1594.6	0	149	2	5.8	07/07/2021 3:44

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
29	Christmas Is	Beam trawl	10° 31.32 S	105° 37.2 E	6	1598.1	3	149.3	0.4	6.2	07/07/2021 7:07
30	Christmas Is	Position	10° 34.44 S	105° 38.22 E	12.1	1601.4	1.2	149.6		6.2	07/07/2021 8:19
31	Christmas Is	CTD	10° 34.38 S	105° 40.98 E	0	1604.1	0	149.8	1	7.2	07/07/2021 9:19
32	Christmas Is	Beam trawl	10° 31.39 S	105° 42.17 E	3.3	1607.3	1.6	150.1	0.4	7.6	07/07/2021 11:21
33	Christmas Is	Position	10° 31.39 S	105° 42.17 E	8.7	1607.3	0.9	152.1		7.6	07/07/2021 12:14
34	Christmas Is	CTD	10° 35.19 S	105° 45.12 E	0	1612.1	0	155	2	9.6	07/07/2021 14:14
35	Christmas Is	Beam trawl	10° 27.35 S	105° 43.82 E	6.2	1620	3.1	155.7	0.4	10	07/07/2021 17:44
36	Christmas Is	Position	10° 27.35 S	105° 43.82 E	5.5	1620	0.6	156.7		10	07/07/2021 18:17
37	Christmas Is	CTD	10° 28.2 S	105° 46.02 E	0	1622.4	0	158.3	1	11	07/07/2021 19:17
38	Christmas Is	Beam trawl	10° 25.44 S	105° 47.57 E	3	1625.5	1.5	158.6	0.4	11.4	07/07/2021 21:11
39	Christmas Is	Position	10° 25.44 S	105° 47.57 E	6.2	1625.5	0.6	160.6		11.4	07/07/2021 21:48
40	Christmas Is	CTD	10° 31.21 S	105° 49.1 E	0	1631.5	0	164.1	2	13.4	07/07/2021 23:48
41	Christmas Is	Beam trawl	10° 20.35 S	105° 43.78 E	6.7	1643.5	3.3	165.2	0.4	13.8	08/07/2021 3:33
42	Christmas Is	Position	10° 20.35 S	105° 43.78 E	4.7	1643.5	0.5	166.2		13.8	08/07/2021 4:01
43	Christmas Is	CTD	10° 23.14 S	105° 42.06 E	0	1646.8	0	168.3	1	14.8	08/07/2021 5:01
44	Christmas Is	Beam trawl	10° 23.34 S	105° 42.3 E	1.4	1647.1	0.7	168.3	0.4	15.2	08/07/2021 6:06
45	Christmas Is	MB			1.8	1647.1	0.2	169.3		15.2	08/07/2021 6:16
46	Christmas Is	MB	10° 24.4 S	105° 43.32 E	3.7	1648.5	0.3	170.5		15.2	08/07/2021 6:36
47	Christmas Is	CTD	10° 24.4 S	105° 41.28 E	0	1650.6	0	170.7	1	16.2	08/07/2021 7:36
48	Christmas Is	Beam trawl	10° 24.4 S	105° 41.28 E	1.4	1650.6	0.7	171.7	0.4	16.6	08/07/2021 8:42
49	Christmas Is	MB	10° 24.5 S	105° 40.32 E	1.9	1651.5	0.2	172.6		16.6	08/07/2021 8:53
50	Christmas Is	Position	10° 25.4 S	105° 39.48 E	0.8	1652.7	0.1	172.7		16.6	08/07/2021 8:58
51	Christmas Is	CTD			0	1652.7	0	173.7	1	17.6	08/07/2021 9:58
52	Christmas Is	Beam trawl	10° 26.5 S	105° 37.75 E	1.1	1654.8	0.5	175.2	0.4	18	08/07/2021 10:53
53	Christmas Is	MB	10° 26.2 S	105° 38.02 E	2.5	1655.2	0.2	175.3		18	08/07/2021 11:07
54	Christmas Is	MB	12° 29.4 S	130° 53.4 E	4.6	1655.2	0.4	176.3		18	08/07/2021 11:32
55	Christmas Is	MB	12° 19.2 S	130° 41.4 E	4.2	1658	0.4	178.2		18	08/07/2021 11:54
56	Christmas Is	MB	12° 36.6 S	126° 9.6 E	2.6	1659.6	0.2	178.3		18	08/07/2021 12:09
57	Christmas Is	MB	14° 25.8 S	119° 29.4 E	5.1	1661.7	0.5	181.5		18	08/07/2021 12:36
58	Christmas Is	MB	14° 11.4 S	119° 1.2 E	2	1664.7	0.2	181.8		18	08/07/2021 12:47
59	Christmas Is	Position	12° 43.2 S	112° 52.2 E	5.4	1666.3	0.5	181.9		18	08/07/2021 13:19

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
60	Christmas Is	DTV	12° 36.6 S	111° 53.4 E	2.2	1669.5	1.6	182.2	0.4	18.4	08/07/2021 15:16
61	Christmas Is	Position	10° 38.04 S	107° 33.54 E	5.9	1671.7	0.6	185.4		18.4	08/07/2021 15:52
62	Christmas Is	DTV	10° 25.98 S	107° 11.76 E	2.1	1672.4	1.5	185.5	0.4	18.8	08/07/2021 17:45
63	Christmas Is	Net	10° 41.4 S	106° 16.38 E	0.6	1672.4	0.3	189.5		18.8	08/07/2021 18:02
64	Christmas Is	Position	10° 36.71 S	105° 46.26 E	0.6	1680.8	0.1	190.2		18.8	08/07/2021 18:06
65	Christmas Is	CTD	10° 32.93 S	105° 42.5 E	0	1680.8	0	192.2	1	19.8	08/07/2021 19:06
66	Christmas Is	Beam trawl	10° 28.04 S	105° 45.64 E	2.9	1687	1.4	195.8	0.4	20.2	08/07/2021 20:56
67	Christmas Is	MB	10° 21.9 S	105° 42.24 E	0.6	1692.6	0.1	196.3		20.2	08/07/2021 20:59
68	Christmas Is	Net	10° 26.6 S	105° 31.42 E	0.5	1692.6	0.3	197.3		20.2	08/07/2021 21:15
69	Christmas Is	Position	10° 30.54 S	105° 30.06 E	0.5	1695.6	0.1	199.3		20.2	08/07/2021 21:18
70	Christmas Is	CTD	10° 32.15 S	105° 31.7 E	0	1701.8	0	199.9	1	21.2	08/07/2021 22:18
71	Christmas Is	Beam trawl	10° 31.64 S	105° 37.02 E	2.1	1701.8	1	201.9	0.4	21.6	08/07/2021 23:43
72	Christmas Is	Position	10° 34.75 S	105° 38.31 E	1.2	1708.5	0.1	205.7		21.6	08/07/2021 23:51
73	Christmas Is	CTD	10° 34.66 S	105° 40.73 E	0	1713.1	0	206.1	1	22.6	09/07/2021 0:51
74	Christmas Is	Beam trawl	10° 31.39 S	105° 42.17 E	1	1713.1	0.5	207.1	0.4	23	09/07/2021 1:43
75	Christmas Is	Position	10° 31.39 S	105° 42.17 E	1.4	1714.5	0.1	208.2		23	09/07/2021 1:52
76	Christmas Is	CTD	10° 35.19 S	105° 45.12 E	0	1719.9	0	208.7	1	24	09/07/2021 2:52
77	Christmas Is	Beam trawl	10° 27.35 S	105° 43.82 E	1.4	1719.9	0.7	209.7	0.4	24.4	09/07/2021 3:59
78	Christmas Is	MB	10° 27.35 S	105° 43.82 E	6.9	1721.3	0.6	210.9		24.4	09/07/2021 4:37
79	Wharton Basin abyss	Transit	10° 28.2 S	105° 46.02 E	71.2	1723.2	6.5	211.1		24.4	09/07/2021 11:05
80	Wharton Basin abyss	Position	10° 25.44 S	105° 47.57 E	5.1	1724.1	0.5	211.2		24.4	09/07/2021 11:35
81	Wharton Basin abyss	Position	10° 25.44 S	105° 47.57 E	8.1	1724.1	0.8	212.2		24.4	09/07/2021 12:24
82	Wharton Basin abyss	Position	10° 31.21 S	105° 49.1 E	1.8	1725.1	0.2	213.2		24.4	09/07/2021 12:35
83	Wharton Basin abyss	CTD	10° 20.35 S	105° 43.78 E	0	1727.6	0	213.4	2	26.4	09/07/2021 14:35
84	Wharton Basin abyss	Beam trawl	10° 20.35 S	105° 43.78 E	12	1732.1	6	213.8	0.4	26.8	09/07/2021 21:00
85	Max	Transit	10° 23.14 S	105° 42.06 E	26.3	1735.9	2.4	214.1		26.8	09/07/2021 23:23
86	Max	MB	10° 19.2 S	105° 34.16 E	11.2	1743.7	1	214.8		26.8	10/07/2021 0:24
87	Max	MB	10° 19.2 S	105° 34.16 E	8	1814.9	0.7	221.3		26.8	10/07/2021 1:08
88	Max	MB	10° 24 S	105° 38.03 E	2.4	1819.9	0.2	221.8		26.8	10/07/2021 1:21
89	Max	MB	10° 24 S	105° 32.41 E	12.8	1828	1.2	222.5		26.8	10/07/2021 2:31
90	Max	Position	10° 24 S	105° 32.41 E	3.2	1829.8	0.3	222.7		26.8	10/07/2021 2:50

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
91	Max	CTD	10° 25 S	105° 35.32 E	0	1829.8	0	224.7	2	28.8	10/07/2021 4:50
92	Max	Beam trawl	10° 26 S	105° 29.12 E	6.4	1841.9	3.2	231.2	0.4	29.2	10/07/2021 8:27
93	Max	MB	10° 26 S	105° 29.12 E	6.1	1868.1	0.6	233.5		29.2	10/07/2021 9:00
94	Max	MB	10° 32.1 S	105° 26.27 E	5.1	1879.3	0.5	234.6		29.2	10/07/2021 9:28
95	Karma	Transit	10° 30.7 S	105° 30.83 E	58	1887.4	5.3	235.3		29.2	10/07/2021 14:44
96	Karma	MB	10° 30.7 S	105° 30.83 E	12.2	1889.8	1.1	235.5		29.2	10/07/2021 15:51
97	Karma	MB	10° 31.6 S	105° 31.88 E	3.4	1902.6	0.3	236.7		29.2	10/07/2021 16:09
98	Karma	Position	10° 31 S	105° 33.6 E	7.7	1905.8	0.8	237		29.2	10/07/2021 16:55
99	Karma	CTD	10° 31.4 S	105° 37.36 E	0	1905.8	0	239	2	31.2	10/07/2021 18:55
100	Karma	Beam trawl	10° 31.4 S	105° 37.36 E	7	1912.2	3.5	242.6	0.4	31.6	10/07/2021 22:48
101	Karma	MB	10° 32.7 S	105° 37.75 E	2.5	1918.4	0.2	243.2		31.6	10/07/2021 23:02
102	Karma	Position	10° 34.4 S	105° 38.58 E	11	1923.5	1.1	243.7		31.6	11/07/2021 0:08
103	Karma	CTD	10° 34.5 S	105° 39.42 E	0	1981.5	0	248.9	2	33.6	11/07/2021 2:08
104	Karma	Beam trawl	10° 34.5 S	105° 39.42 E	7.3	1993.7	3.7	250	0.4	34	11/07/2021 6:12
105	Karma	Waypoint	10° 34.5 S	105° 40.49 E	24.6	1997	2.2	250.4		34	11/07/2021 8:26
106	Bartlett	Transit	10° 32 S	105° 40.92 E	67.1	2004.7	6.1	251.1		34	11/07/2021 14:32
107	Clara Marie	MB	10° 28.1 S	105° 43.2 E	19.8	2004.7	1.8	253.1		34	11/07/2021 16:20
108	Clara Marie	MB	10° 23.9 S	105° 42.83 E	31	2011.7	2.8	257		34	11/07/2021 19:09
109	Clara Marie	MB	10° 24.34 S	105° 40.19 E	5	2014.2	0.5	257.2		34	11/07/2021 19:36
110	Clara Marie	MB	10° 27.28 S	105° 36.01 E	23.2	2025.2	2.1	258.2		34	11/07/2021 21:43
111	Clara Marie	MB	10° 25.95 S	105° 34.52 E	1.3	2025.2	0.1	260.2		34	11/07/2021 21:50
112	Clara Marie	Position	10° 22.9 S	105° 39.02 E	6.9	2032.6	0.7	264.4		34	11/07/2021 22:32
113	Clara Marie	CTD	10° 24.6 S	105° 40.39 E	0	2057.1	0	266.6	2	36	12/07/2021 0:32
114	Clara Marie	Beam trawl	10° 24.8 S	105° 34.36 E	5	2124.3	2.5	272.7	0.4	36.4	12/07/2021 3:25
115	Clara Marie	Position	10° 26.8 S	105° 34.67 E	5.6	2144	0.6	274.5		36.4	12/07/2021 3:58
116	Clara Marie	CTD	10° 26.8 S	105° 35.25 E	0	2175.1	0	277.3	2	38.4	12/07/2021 5:58
117	Clara Marie	Beam trawl	10° 26.2 S	105° 35.11 E	6.1	2180.1	3	277.8	0.4	38.8	12/07/2021 9:24
118	Clara Marie	MB	10° 26.2 S	105° 35.11 E	7.9	2203.3	0.7	279.9		38.8	12/07/2021 10:07
119	Clara Marie	MB	10° 26.2 S	105° 38.02 E	27.9	2204.6	2.5	280		38.8	12/07/2021 12:39
120	Clara Marie	MB	10° 26.8 S	105° 38.25 E	9.6	2211.6	0.9	280.6		38.8	12/07/2021 13:31
121	Bartlett deep	MB	10° 27 S	105° 37.79 E	12.2	2211.6	1.1	282.6		38.8	12/07/2021 14:38

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
122	Bartlett deep	MB	10° 26.5 S	105° 37.746 E	16.3	2216.5	1.5	285.6		38.8	12/07/2021 16:07
123	Unnamed	Waypoint	10° 26.5 S	105° 37.746 E	17.8	2222.1	1.6	286.1		38.8	12/07/2021 17:44
124	Unnamed	Waypoint	10° 25.4 S	105° 39.48 E	53.3	2222.1	4.8	288.1		38.8	12/07/2021 22:35
125	Apollo 8	Transit	10° 24.5 S	105° 40.32 E	14.5	2228.2	1.3	291.6		38.8	12/07/2021 23:54
126	Apollo 8	MB	10° 24.5 S	105° 40.32 E	26.1	2236	2.4	292.3		38.8	13/07/2021 2:16
127	Apollo 8	MB	10° 24.4 S	105° 41.28 E	6	2263.9	0.5	294.8		38.8	13/07/2021 2:49
128	Apollo 8	MB	10° 23.34 S	105° 42.3 E	23.2	2273.5	2.1	295.7		38.8	13/07/2021 4:56
129	Apollo 8	MB	13° 2.1 S	105° 15.3 E	3.4	2285.7	0.3	296.8		38.8	13/07/2021 5:14
130	Apollo 8	MB	12° 47.7 S	105° 7.44 E	24.7	2302	2.2	298.3		38.8	13/07/2021 7:29
131	Apollo 8	Position	12° 33.4 S	105° 18.24 E	2.6	2319.8	0.3	299.9		38.8	13/07/2021 7:44
132	Apollo 8	CTD	11° 40.2 S	105° 15.6 E	0	2373.1	0	304.8	2	40.8	13/07/2021 9:44
133	Apollo 8	Beam trawl	11° 36.1 S	105° 1.4 E	6.3	2387.6	3.2	306.1	0.4	41.2	13/07/2021 13:18
134	Apollo 8	Position	11° 15.3 S	104° 45.31 E	7.2	2413.8	0.7	308.5		41.2	13/07/2021 14:01
135	Apollo 8	CTD	11° 12.9 S	104° 50.91 E	0	2419.7	0	309	1.5	42.7	13/07/2021 15:31
136	Apollo 8	Beam trawl	11° 30.9 S	105° 5.9 E	3.9	2442.9	2	311.1	0.4	43.1	13/07/2021 17:53
137	Apollo 8	Position	11° 33 S	105° 3.28 E	5.4	2446.3	0.5	311.4		43.1	13/07/2021 18:25
138	Apollo 8	CTD	11° 13.8 S	104° 47.5 E	0	2471	0	313.7	1	44.1	13/07/2021 19:25
139	Apollo 8	Beam trawl	11° 15.4 S	104° 45.42 E	3.4	2473.6	1.7	313.9	0.4	44.5	13/07/2021 21:30
140	Apollo 8	MB	11° 15.4 S	104° 45.42 E	7.5	2473.6	0.7	315.9		44.5	13/07/2021 22:11
141	Apollo 8	Position	11° 19.1 S	104° 50.58 E	7.5	2479.9	0.8	319.5		44.5	13/07/2021 22:56
142	Apollo 8	DTV	11° 21.6 S	104° 57.47 E	4	2487.1	2.8	320.2	0.4	44.9	14/07/2021 2:10
143	Apollo 8	MB	11° 21.6 S	104° 57.47 E	5.3	2487.1	0.5	321.2		44.9	14/07/2021 2:39
144	Shcherbakov	Transit	11° 23.7 S	105° 0.8 E	28.4	2491	2.6	323.6		44.9	14/07/2021 5:13
145	Shcherbakov	MB	11° 24.7 S	104° 55.43 E	15	2496.4	1.4	324.1		44.9	14/07/2021 6:35
146	Shcherbakov	MB	11° 26.9 S	104° 55.43 E	10.8	2496.4	1	325.1		44.9	14/07/2021 7:34
147	Shcherbakov	MB	#REF!	104° 58.05 E	13	2499.8	1.2	327.3		44.9	14/07/2021 8:45
148	Shcherbakov	MB	11° 29.8 S	104° 50.97 E	5.8	2507.3	0.5	328		44.9	14/07/2021 9:17
149	Shcherbakov	MB	11° 22.4 S	104° 52.5 E	14	2514.8	1.3	328.6		44.9	14/07/2021 10:33
150	Shcherbakov	Position	11° 23.6 S	104° 56.34 E	4.3	2518.8	0.4	332		44.9	14/07/2021 10:59
151	Shcherbakov	CTD	11° 20.2 S	105° 0.49 E	0	2524.1	0	332.5	1.5	46.4	14/07/2021 12:29
152	Shcherbakov	Beam trawl	10° 54.7 S	104° 47.94 E	4.6	2552.4	2.3	335.1	0.4	46.8	14/07/2021 15:11

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
153	Shcherbakov	Position	10° 39.8 S	104° 47.34 E	5.1	2567.4	0.5	336.4		46.8	14/07/2021 15:42
154	Shcherbakov	CTD	10° 47.9 S	104° 40.1 E	0	2578.2	0	337.4	1.5	48.3	14/07/2021 17:12
155	Shcherbakov	Beam trawl	10° 54.8 S	104° 28.86 E	4.5	2591.2	2.2	338.6	0.4	48.7	14/07/2021 19:50
156	Shcherbakov	Position	10° 59.4 S	104° 32.54 E	15.5	2597.1	1.6	339.1		48.7	14/07/2021 21:23
157	Shcherbakov	CTD	10° 51.5 S	104° 44.37 E	0	2611.1	0	340.4	2	50.7	14/07/2021 23:23
158	Shcherbakov	Beam trawl	10° 47.2 S	104° 44.6 E	5.1	2615.5	2.6	340.8	0.4	51.1	15/07/2021 2:22
159	Shcherbakov	Position	10° 47.2 S	104° 44.6 E	3	2615.5	0.3	342.8		51.1	15/07/2021 2:39
160	Shcherbakov	CTD	10° 49.7 S	104° 48.48 E	0	2620	0	345.6	2	53.1	15/07/2021 4:39
161	Shcherbakov	Beam trawl	10° 49.7 S	104° 43.24 E	6.9	2625.2	3.4	346	0.4	53.5	15/07/2021 8:30
162	Balthazar	Transit	10° 49.7 S	104° 43.24 E	35.6	2625.2	3.2	347		53.5	15/07/2021 11:45
163	Balthazar	MB	10° 51.8 S	104° 47.22 E	12.5	2629.7	1.1	349.7		53.5	15/07/2021 12:53
164	Balthazar	MB	10° 51.3 S	104° 31.44 E	18.7	2645.2	1.7	351.1		53.5	15/07/2021 14:35
165	Balthazar	MB	10° 51.3 S	104° 31.44 E	8.9	2645.2	0.8	353.1		53.5	15/07/2021 15:23
166	Balthazar	MB	10° 54.1 S	104° 35.82 E	32.8	2650.3	3	356.2		53.5	15/07/2021 18:22
167	Balthazar	MB	10° 54.6 S	104° 38.82 E	3.8	2653.3	0.3	356.4		53.5	15/07/2021 18:43
168	Balthazar	MB	10° 54.6 S	104° 38.82 E	27.7	2653.3	2.5	358.4		53.5	15/07/2021 21:14
169	Balthazar	MB	10° 56.7 S	104° 45.5 E	3.5	2660.2	0.3	362.4		53.5	15/07/2021 21:33
170	Balthazar	MB	11° 15.2 S	104° 14.58 E	29	2695.8	2.6	365.6		53.5	16/07/2021 0:11
171	Balthazar	Position	11° 15.9 S	104° 1.88 E	9.5	2708.3	1	366.7		53.5	16/07/2021 1:08
172	Balthazar	DTV	11° 34.4 S	103° 59.82 E	3.5	2727	2.5	368.4	0.4	53.9	16/07/2021 4:00
173	Balthazar	Position	11° 40.7 S	104° 6.3 E	2.8	2735.9	0.3	369.2		53.9	16/07/2021 4:17
174	Balthazar	CTD	11° 15.4 S	104° 27.54 E	0	2768.6	0	372.2	1	54.9	16/07/2021 5:17
175	Balthazar	Beam trawl	11° 17.4 S	104° 30.84 E	2.9	2772.4	1.5	372.6	0.4	55.3	16/07/2021 7:09
176	Balthazar	Position	11° 38.5 S	104° 12.54 E	4.1	2800.2	0.4	375.1		55.3	16/07/2021 7:34
177	Balthazar	CTD	11° 40.8 S	104° 15.26 E	0	2803.7	0	375.4	1	56.3	16/07/2021 8:34
178	Balthazar	Beam trawl	11° 19 S	104° 34.68 E	3.1	2832.7	1.5	378	0.4	56.7	16/07/2021 10:30
179	Balthazar	Position	11° 19.8 S	104° 25.04 E	8.9	2842.2	0.9	378.9		56.7	16/07/2021 11:23
180	Balthazar	CTD	11° 23 S	104° 26.27 E	0	2845.7	0	382.2	2	58.7	16/07/2021 13:23
181	Balthazar	Beam trawl	11° 22.5 S	104° 23.47 E	5	2848.5	2.5	382.5	0.4	59.1	16/07/2021 16:17
182	Balthazar	Position	11° 22.5 S	104° 23.47 E	7.2	2848.5	0.7	383.5		59.1	16/07/2021 17:00
183	Balthazar	CTD	11° 23.9 S	104° 26.12 E	0	2851.4	0	385.4	1.5	60.6	16/07/2021 18:30

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
184	Balthazar	Beam trawl	11° 23.1 S	104° 21.97 E	4.1	2855.5	2.1	385.8	0.4	61	16/07/2021 20:59
185	Balthazar	Position	11° 23.1 S	104° 21.97 E	2.5	2855.5	0.2	387.8		61	16/07/2021 21:14
186	Balthazar	CTD	11° 24.5 S	104° 24.79 E	0	2858.6	0	389.8	1.5	62.5	16/07/2021 22:44
187	Balthazar	Beam trawl	11° 24.8 S	104° 15.76 E	4.5	2867.5	2.3	390.6	0.4	62.9	17/07/2021 1:24
188	Balthazar	MB	11° 24.8 S	104° 15.76 E	18.8	2867.5	1.7	392.6		62.9	17/07/2021 3:06
189	Glogg	Transit	11° 26.9 S	104° 20.38 E	20.7	2872.5	1.9	395.6		62.9	17/07/2021 4:59
190	Glogg	MB	11° 29.9 S	104° 13.72 E	10.9	2879.6	1	396.2		62.9	17/07/2021 5:59
191	Glogg	Position	11° 29.9 S	104° 13.72 E	10.3	2879.6	1	398.2		62.9	17/07/2021 7:00
192	Glogg	CTD	11° 32.2 S	104° 17.21 E	0	2883.8	0	400.8	2	64.9	17/07/2021 9:00
193	Glogg	Beam trawl	11° 34.3 S	104° 18.6 E	7.2	2886.3	3.6	401	0.4	65.3	17/07/2021 12:59
194	Glogg	Position	11° 34.3 S	104° 18.6 E	2.2	2886.3	0.2	403		65.3	17/07/2021 13:13
195	Glogg	CTD	11° 37.2 S	104° 22.16 E	0	2890.8	0	405.7	1	66.3	17/07/2021 14:13
196	Glogg	Beam trawl	11° 44.6 S	104° 4.56 E	3.4	2909.6	1.7	407.4	0.4	66.7	17/07/2021 16:20
197	Glogg	MB	11° 37.3 S	103° 44.82 E	4.4	2930.3	0.4	409.3		66.7	17/07/2021 16:44
198	Attention	Transit	11° 44.3 S	103° 36.35 E	26	2941.2	2.4	410.3		66.7	17/07/2021 19:05
199	Attention	MB	11° 34.3 S	103° 33.8 E	3.9	2951.5	0.4	411.3		66.7	17/07/2021 19:26
200	Attention	Position	11° 34.3 S	103° 33.8 E	1.8	2951.5	0.2	413.3		66.7	17/07/2021 19:37
201	Attention	CTD	11° 38.6 S	103° 39.62 E	0	2958.7	0	417.3	1.5	68.2	17/07/2021 21:07
202	Attention	Beam trawl	11° 40.7 S	103° 39.02 E	4.7	2960.9	2.3	417.5	0.4	68.6	17/07/2021 23:51
203	Attention	MB	11° 40.7 S	103° 39.02 E	8.1	2960.9	0.7	418.5		68.6	18/07/2021 0:35
204	Cocos Basin abyss	Transit	11° 42.7 S	103° 41.9 E	39.4	2964.3	3.6	420.7		68.6	18/07/2021 4:10
205	Cocos Basin abyss	CTD	11° 47 S	103° 42.18 E	0	2968.7	0	421.1	2	70.6	18/07/2021 6:10
206	Cocos Basin abyss	Beam trawl	11° 48.3 S	103° 15.71 E	11.9	2994.6	6	423.5	0.4	71	18/07/2021 12:32
207	Lucia	Transit	11° 44.5 S	103° 14.87 E	34.3	2998.5	3.1	423.8		71	18/07/2021 15:39
208	Lucia	MB	11° 43.4 S	103° 16.38 E	7.5	3000.3	0.7	424		71	18/07/2021 16:20
209	Lucia	Position	11° 43.4 S	103° 16.38 E	2.4	3000.3	0.2	425		71	18/07/2021 16:34
210	Lucia	CTD	11° 45.9 S	103° 20.39 E	0	3005	0	427.8	2	73	18/07/2021 18:34
211	Lucia	Beam trawl	11° 37.9 S	103° 21 E	6.7	3013.1	3.3	428.5	0.4	73.4	18/07/2021 22:19
212	Lucia	MB	11° 11.9 S	102° 50.76 E	0.4	3052.5	0	432.1		73.4	18/07/2021 22:21
213	Scrooge	Transit	11° 11.9 S	102° 50.76 E	166	3052.5	15.1	434.1		73.4	19/07/2021 13:27
214	Scrooge	MB	11° 19.8 S	102° 59.84 E	35.5	3064.4	3.2	440.5		73.4	19/07/2021 16:40

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
215	Scrooge	MB	11° 2.5 S	102° 29.7 E	8	3098.7	0.7	443.6		73.4	19/07/2021 17:24
216	Scrooge	MB	10° 58 S	102° 23.52 E	26.6	3106.3	2.4	444.3		73.4	19/07/2021 19:49
217	Scrooge	MB	10° 58.5 S	102° 21.14 E	7.8	3108.7	0.7	444.5		73.4	19/07/2021 20:32
218	Scrooge	MB	10° 58.5 S	102° 21.14 E	25.5	3108.7	2.3	446.5		73.4	19/07/2021 22:51
219	Scrooge	MB	11° 2.8 S	102° 26.34 E	7.9	3115.3	0.7	450.4		73.4	19/07/2021 23:34
220	Scrooge	MB	11° 2.6 S	102° 26.04 E	26.5	3115.7	2.4	450.4		73.4	20/07/2021 1:58
221	Scrooge	Position	10° 34.7 S	99° 39.6 E	16.5	3281.7	1.6	465.5		73.4	20/07/2021 3:37
222	Scrooge	CTD	11° 4.3 S	99° 59.58 E	0	3317.2	0	468.7	2	75.4	20/07/2021 5:37
223	Scrooge	Beam trawl	11° 7.1 S	99° 51.96 E	6.9	3325.2	3.5	469.4	0.4	75.8	20/07/2021 9:28
224	Scrooge	Position	10° 43.5 S	99° 39.6 E	4.1	3351.8	0.4	471.9		75.8	20/07/2021 9:53
225	Scrooge	CTD	10° 47 S	99° 32.46 E	0	3359.6	0	472.6	2	77.8	20/07/2021 11:53
226	Scrooge	Beam trawl	11° 9.2 S	99° 45 E	5	3385.1	2.5	474.9	0.4	78.2	20/07/2021 14:47
227	Scrooge	Position	11° 12.6 S	99° 37.68 E	7.6	3393	0.8	475.6		78.2	20/07/2021 15:33
228	Scrooge	CTD	10° 49 S	99° 25.56 E	0	3419.5	0	478	2	80.2	20/07/2021 17:33
229	Scrooge	Beam trawl	10° 35.2 S	99° 34.8 E	4.9	3436	2.4	479.5	0.4	80.6	20/07/2021 20:24
230	Scrooge	Position	10° 35.2 S	99° 34.8 E	5.3	3436	0.5	481.5		80.6	20/07/2021 20:55
231	Scrooge	CTD	10° 40.5 S	99° 39.34 E	0	3442.9	0	485.4	2	82.6	20/07/2021 22:55
232	Scrooge	Beam trawl	10° 38.9 S	99° 35.54 E	7.4	3447	3.7	485.8	0.4	83	21/07/2021 3:00
233	Scrooge	Position	10° 38.9 S	99° 35.54 E	2.6	3447	0.3	487.8		83	21/07/2021 3:16
234	Scrooge	CTD	10° 42.4 S	99° 39.18 E	0	3452	0	490.8	2	85	21/07/2021 5:16
235	Scrooge	Beam trawl	10° 49.8 S	99° 37.5 E	7.7	3459.6	3.9	491.5	0.4	85.4	21/07/2021 9:31
236	Scrooge	MB	10° 49.8 S	99° 37.5 E	7.5	3459.6	0.7	493.5		85.4	21/07/2021 10:12
237	Scrooge	MB	10° 52 S	99° 41.96 E	23.8	3464.5	2.2	496.4		85.4	21/07/2021 12:22
238	Rudist	Transit	10° 53.6 S	99° 47.04 E	18.1	3469.7	1.6	496.9		85.4	21/07/2021 14:01
239	Rudist	MB	10° 53.6 S	99° 47.04 E	20	3469.7	1.8	498.9		85.4	21/07/2021 15:49
240	Rudist	MB	10° 59.3 S	99° 51.78 E	8.6	3477.1	0.8	503		85.4	21/07/2021 16:36
241	Rudist	MB	10° 59.5 S	99° 49.12 E	10.9	3479.7	1	503.3		85.4	21/07/2021 17:36
242	Rudist	MB	10° 59.5 S	99° 49.12 E	4.5	3479.7	0.4	505.3		85.4	21/07/2021 18:00
243	Rudist	Position	11° 3.3 S	99° 55.97 E	8.9	3487.4	0.9	509.6		85.4	21/07/2021 18:54
244	Rudist	CTD	11° 10.2 S	99° 59.04 E	0	3495	0	510.3	1.5	86.9	21/07/2021 20:24
245	Rudist	Beam trawl	11° 15.2 S	99° 35.34 E	4.2	3518.8	2.1	512.4	0.4	87.3	21/07/2021 22:55

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
246	Rudist	MB	11° 3.9 S	99° 20.94 E	7.2	3536.9	0.7	514.1		87.3	21/07/2021 23:34
247	East Cocos abyss	Transit	11° 17.2 S	99° 5.82 E	36.9	3556.8	3.4	515.9		87.3	22/07/2021 2:55
248	East Cocos abyss	Position	11° 17.8 S	99° 14.58 E	5.9	3565.4	0.6	516.7		87.3	22/07/2021 3:31
249	East Cocos abyss	CTD	11° 12.3 S	99° 24.18 E	0	3576.3	0	517.7	2	89.3	22/07/2021 5:31
250	East Cocos abyss	Beam trawl	11° 11.6 S	99° 19.68 E	11.4	3580.8	5.7	518.1	0.4	89.7	22/07/2021 11:38
251	Investigator Ridge	Transit	11° 14.5 S	99° 11.1 E	32.9	3589.7	3	518.9		89.7	22/07/2021 14:38
252	Investigator Ridge	Position	11° 14.5 S	99° 11.1 E	6	3589.7	0.6	519.9		89.7	22/07/2021 15:14
253	Investigator Ridge	CTD	11° 17.7 S	99° 13.98 E	0	3593.9	0	522.5	2	91.7	22/07/2021 17:14
254	Investigator Ridge	Beam trawl	11° 21.6 S	99° 7.8 E	6.6	3601.1	3.3	523.1	0.4	92.1	22/07/2021 20:56
255	Investigator Ridge	MB	11° 7.7 S	98° 32.98 E	23.2	3638.1	2.1	526.5		92.1	22/07/2021 23:02
256	Investigator Ridge	MB	11° 5.4 S	98° 38.55 E	3.5	3644	0.3	527		92.1	22/07/2021 23:21
257	Investigator Ridge	Position	11° 5.4 S	98° 38.55 E	4.6	3644	0.5	529		92.1	22/07/2021 23:49
258	Investigator Ridge	CTD	11° 13.3 S	98° 46.98 E	0	3655.4	0	535.2	2	94.1	23/07/2021 1:49
259	Investigator Ridge	Beam trawl	11° 14.1 S	98° 13.5 E	7.7	3688.3	3.8	538.2	0.4	94.5	23/07/2021 6:03
260	West Cocos abyss	Transit	11° 13.8 S	98° 7.38 E	67.1	3694.3	6.1	538.7		94.5	23/07/2021 12:09
261	West Cocos abyss	CTD	11° 13.8 S	98° 7.38 E	0	3694.3	0	540.7	2	96.5	23/07/2021 14:09
262	West Cocos abyss	Beam trawl	11° 17.2 S	98° 13.18 E	11.4	3700.9	5.7	544.5	0.4	96.9	23/07/2021 20:14
263	Cocos Keeling	Transit	10° 54 S	98° 13.05 E	35.9	3724.1	3.3	546.6		96.9	23/07/2021 23:30
264	Cocos Keeling	MB	10° 56.1 S	98° 15.89 E	7.1	3727.6	0.6	546.9		96.9	24/07/2021 0:09
265	Cocos Keeling	MB	10° 56.1 S	98° 11.22 E	4.8	3732.2	0.4	547.4		96.9	24/07/2021 0:35
266	Cocos Keeling	MB	10° 56.1 S	98° 11.22 E	22	3732.2	2	549.4		96.9	24/07/2021 2:35
267	Cocos Keeling	MB	11° 1 S	98° 17.24 E	6.6	3739.9	0.6	553.7		96.9	24/07/2021 3:11
268	Cocos Keeling	MB	10° 58.5 S	97° 8.96 E	6.1	3807	0.6	559.8		96.9	24/07/2021 3:44
269	Cocos Keeling	MB	10° 58.5 S	97° 8.96 E	8.5	3807	0.8	561.8		96.9	24/07/2021 4:31
270	Cocos Keeling	MB	11° 5.1 S	97° 18.35 E	21.3	3818.4	1.9	567.9		96.9	24/07/2021 6:27
271	Cocos Keeling	MB	11° 33.6 S	96° 56.16 E	2.3	3854.2	0.2	571.2		96.9	24/07/2021 6:39
272	Cocos Keeling	Position	11° 40.7 S	96° 57.06 E	11.7	3861.4	1.2	571.8		96.9	24/07/2021 7:49
273	Cocos Keeling	CTD	11° 44.9 S	96° 54.78 E	0	3866.2	0	572.3	1	97.9	24/07/2021 8:49
274	Cocos Keeling	Beam trawl	12° 5.8 S	96° 56.15 E	1.1	3887.1	0.6	574.2	0.4	98.3	24/07/2021 9:47
275	Cocos Keeling	Position	12° 5.5 S	96° 51.84 E	0.8	3891.3	0.1	574.5		98.3	24/07/2021 9:52
276	Cocos Keeling	CTD	12° 5.5 S	96° 51.84 E	0	3891.3	0	578.5	1	99.3	24/07/2021 10:52

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
277	Cocos Keeling	Beam trawl	12° 5.1 S	96° 52.02 E	2.8	3891.7	1.4	578.6	0.4	99.7	24/07/2021 12:38
278	Cocos Keeling	Position	12° 5.1 S	96° 52.02 E	6.5	3891.7	0.7	579.6		99.7	24/07/2021 13:18
279	Cocos Keeling	CTD	12° 4.9 S	96° 53.14 E	0	3892.9	0	580.6	2	101.7	24/07/2021 15:18
280	Cocos Keeling	Beam trawl	12° 6.9 S	96° 56.21 E	7.2	3896.5	3.6	580.9	0.4	102.1	24/07/2021 19:19
281	Cocos Keeling	Position	12° 13.5 S	96° 56.63 E	12.5	3903.1	1.2	581.5		102.1	24/07/2021 20:34
282	Cocos Keeling	CTD	12° 15.3 S	96° 50.71 E	0	3909.1	0	582.1	1	103.1	24/07/2021 21:34
283	Cocos Keeling	Beam trawl	12° 18.7 S	96° 58.69 E	1.5	3917.7	0.8	582.9	0.4	103.5	24/07/2021 22:43
284	Cocos Keeling	Position	11° 57.8 S	97° 2.66 E	3.3	3938.9	0.3	584.8		103.5	24/07/2021 23:03
285	Cocos Keeling	CTD	11° 56.9 S	97° 0.5 E	0	3941.2	0	585	1	104.5	25/07/2021 0:03
286	Cocos Keeling	Beam trawl	12° 4.2 S	96° 53.64 E	2.7	3951.2	1.4	585.9	0.4	104.9	25/07/2021 1:49
287	Cocos Keeling	Position	12° 4.2 S	96° 53.64 E	4.9	3951.2	0.5	586.9		104.9	25/07/2021 2:18
288	Cocos Keeling	CTD	12° 5.2 S	96° 56.27 E	0	3953.9	0	588.8	1.5	106.4	25/07/2021 3:48
289	Cocos Keeling	Beam trawl	12° 1.3 S	97° 1.66 E	4.5	3960.5	2.3	589.4	0.4	106.8	25/07/2021 6:28
290	Cocos Keeling	Net	12° 1.3 S	97° 1.66 E	1.3	3960.5	0.7	591.4		106.8	25/07/2021 7:08
291	Cocos Keeling	MB	12° 5.1 S	97° 7.94 E	9.3	3967.7	0.8	595.4		106.8	25/07/2021 7:59
292	Cocos Keeling	MB	12° 9.1 S	96° 55.84 E	10	3980.2	0.9	596.6		106.8	25/07/2021 8:53
293	Cocos Keeling	MB	12° 9.1 S	96° 55.84 E	4.9	3980.2	0.4	597.6		106.8	25/07/2021 9:20
294	Cocos Keeling	MB	12° 10.4 S	96° 56.56 E	5.7	3981.7	0.5	598.8		106.8	25/07/2021 9:52
295	Cocos Keeling	MB	12° 13.4 S	96° 55.07 E	2.7	3985	0.2	599.1		106.8	25/07/2021 10:06
296	Cocos Keeling	MB	12° 13.4 S	96° 55.07 E	9.6	3985	0.9	600.1		106.8	25/07/2021 10:59
297	Cocos Keeling	MB	12° 14.9 S	96° 57.45 E	2.9	3987.8	0.3	601.9		106.8	25/07/2021 11:14
298	Cocos Keeling	MB	12° 14.9 S	96° 52.48 E	2.6	3992.6	0.2	602.4		106.8	25/07/2021 11:29
299	Cocos Keeling	MB	12° 14.9 S	96° 52.48 E	11.8	3992.6	1.1	603.4		106.8	25/07/2021 12:33
300	Cocos Keeling	Position	12° 16.8 S	96° 56.71 E	1.8	3997.2	0.2	606.1		106.8	25/07/2021 12:44
301	Cocos Keeling	DTV	12° 18.1 S	96° 57.18 E	2.2	3998.5	1.6	606.2	0.4	107.2	25/07/2021 14:43
302	Cocos Keeling	MB	12° 19 S	96° 47.7 E	1.1	4007.8	0.1	607.1		107.2	25/07/2021 14:49
303	Cocos Keeling	MB	12° 9.2 S	96° 45.48 E	11.9	4017.8	1.1	608		107.2	25/07/2021 15:54
304	Cocos Keeling	MB	12° 4.9 S	96° 42.96 E	2.1	4022.8	0.2	608.5		107.2	25/07/2021 16:05
305	Cocos Keeling	Net	12° 5.7 S	96° 48.77 E	12.4	4028.5	6.2	609		107.2	25/07/2021 22:18
306	Cocos Keeling	MB	12° 3.2 S	96° 47.75 E	1.8	4031.2	0.2	609.2		107.2	25/07/2021 22:28
307	Cocos Keeling	MB	11° 53.7 S	96° 46.4 E	21.7	4040.8	2	610.1		107.2	26/07/2021 0:26

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
308	Cocos Keeling	MB	11° 51.2 S	96° 45.05 E	18.5	4043.6	1.7	610.4		107.2	26/07/2021 2:07
309	Cocos Keeling	MB	11° 51.4 S	96° 47.74 E	8.2	4046.3	0.7	610.6		107.2	26/07/2021 2:51
310	Cocos Keeling	MB	12° 3.1 S	96° 49.22 E	17.2	4058.1	1.6	611.7		107.2	26/07/2021 4:25
311	Cocos Keeling	MB	12° 2.4 S	96° 47.5 E	5.9	4060	0.5	611.8		107.2	26/07/2021 4:57
312	Cocos Keeling	MB	12° 3.9 S	96° 49.15 E	2.5	4062.2	0.2	615		107.2	26/07/2021 5:10
313	Cocos Keeling	Position	12° 3.1 S	96° 50.02 E	2.8	4063.3	0.3	615.1		107.2	26/07/2021 5:27
314	Cocos Keeling	DTV	11° 51.3 S	96° 48.75 E	2.1	4075.2	1.5	616.2	0.4	107.6	26/07/2021 7:22
315	Cocos Keeling	Position	11° 51.4 S	96° 50.89 E	2.8	4077.3	0.3	616.4		107.6	26/07/2021 7:39
316	Cocos Keeling	DTV	12° 3.7 S	96° 52.02 E	2.7	4089.7	2	617.5	0.4	108	26/07/2021 10:00
317	Cocos Keeling	Position	12° 3.7 S	96° 53.81 E	4.3	4091.5	0.4	617.7		108	26/07/2021 10:26
318	Cocos Keeling	CTD	11° 42.2 S	96° 51.91 E	0	4113.2	0	619.7	1	109	26/07/2021 11:26
319	Cocos Keeling	Beam trawl	11° 47.5 S	96° 33.8 E	2.6	4131.7	1.3	621.4	0.4	109.4	26/07/2021 13:07
320	Cocos Keeling	Position	11° 55.1 S	96° 36.68 E	1.5	4139.8	0.1	622.1		109.4	26/07/2021 13:16
321	Cocos Keeling	CTD	11° 45.1 S	96° 50.89 E	0	4157	0	623.7	1	110.4	26/07/2021 14:16
322	Cocos Keeling	Beam trawl	11° 50.9 S	96° 50.43 E	1	4162.9	0.5	624.2	0.4	110.8	26/07/2021 15:09
323	Cocos Keeling	Net	11° 50.8 S	96° 47.93 E	1.4	4165.3	0.7	624.4		110.8	26/07/2021 15:50
324	Cocos Keeling	CTD	11° 48 S	96° 47.71 E	0	4168.1	0	624.7	1	111.8	26/07/2021 16:50
325	Cocos Keeling	Beam trawl	11° 48.5 S	96° 47.47 E	2.3	4168.7	1.1	624.7	0.4	112.2	26/07/2021 18:23
326	Cocos Keeling	Position	11° 51 S	96° 48.6 E	2.9	4171.4	0.3	628		112.2	26/07/2021 18:40
327	Cocos Keeling	CTD	11° 51.1 S	96° 44.21 E	0	4175.7	0	628.4	1	113.2	26/07/2021 19:40
328	Cocos Keeling	Beam trawl	11° 51.1 S	96° 44.21 E	2.2	4175.7	1.1	629.4	0.4	113.6	26/07/2021 21:09
329	Cocos Keeling	Position	11° 53 S	96° 46.1 E	6.4	4178.3	0.6	631.1		113.6	26/07/2021 21:48
330	Cocos Keeling	CTD	11° 51.7 S	96° 46.87 E	0	4179.8	0	631.3	1.5	115.1	26/07/2021 23:18
331	Cocos Keeling	Beam trawl	11° 51.7 S	96° 46.87 E	3.9	4179.8	2	632.3	0.4	115.5	27/07/2021 1:40
332	Cocos Keeling	Position	11° 51.1 S	96° 47.68 E	4	4180.7	0.4	633.2		115.5	27/07/2021 2:04
333	Cocos Keeling	CTD	11° 49.8 S	96° 47.41 E	0	4182.1	0	633.3	1	116.5	27/07/2021 3:04
334	Cocos Keeling	Beam trawl	11° 49.8 S	96° 47.41 E	2	4182.1	1	634.3	0.4	116.9	27/07/2021 4:29
335	Cocos Keeling	Position	11° 48 S	96° 48.88 E	4.5	4184.4	0.5	635.9		116.9	27/07/2021 4:56
336	Cocos Keeling	CTD	11° 48.4 S	96° 51.12 E	0	4186.6	0	636.1	1	117.9	27/07/2021 5:56
337	Cocos Keeling	Beam trawl	11° 48.4 S	96° 51.12 E	3.7	4186.6	1.8	637.1	0.4	118.3	27/07/2021 8:11
338	Cocos Keeling	Position	11° 50 S	96° 52.64 E	8.8	4188.8	0.9	638.7		118.3	27/07/2021 9:03

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
339	Cocos Keeling	CTD	11° 55.7 S	96° 49.73 E	0	4195.2	0	639.3	2	120.3	27/07/2021 11:03
340	Cocos Keeling	Beam trawl	11° 55.7 S	96° 49.73 E	6.8	4195.2	3.4	640.3	0.4	120.7	27/07/2021 14:51
341	Cocos Keeling	MB	11° 58.9 S	96° 52.08 E	10.7	4199.1	1	642.7		120.7	27/07/2021 15:50
342	Noel	Transit	11° 59.2 S	96° 48 E	67.3	4203.1	6.1	643.1		120.7	27/07/2021 21:57
343	Noel	MB	11° 59.2 S	96° 48 E	13.2	4203.1	1.2	644.1		120.7	27/07/2021 23:09
344	Noel	MB	12° 0.8 S	96° 49.26 E	7.1	4205.1	0.6	645.6		120.7	27/07/2021 23:47
345	Noel	MB	12° 5.5 S	96° 51.84 E	27.2	4210.5	2.5	646		120.7	28/07/2021 2:15
346	Noel	MB	12° 5.5 S	96° 51.84 E	6.6	4210.5	0.6	650		120.7	28/07/2021 2:51
347	Noel	MB	12° 4 S	96° 50.82 E	8.2	4212.2	0.7	650.2		120.7	28/07/2021 3:36
348	Noel	MB	12° 3.8 S	96° 49.38 E	18.4	4213.6	1.7	650.3		120.7	28/07/2021 5:16
349	Noel	Position	12° 3.4 S	96° 45.51 E	4.8	4217.5	0.5	650.7		120.7	28/07/2021 5:45
350	Noel	CTD	12° 3.4 S	96° 45.51 E	0	4217.5	0	651.7	2	122.7	28/07/2021 7:45
351	Noel	Beam trawl	12° 6 S	96° 48.2 E	5.4	4221.1	2.7	654	0.4	123.1	28/07/2021 10:51
352	Noel	Position	12° 5.5 S	96° 39.25 E	1.6	4229.9	0.2	654.8		123.1	28/07/2021 11:00
353	Noel	CTD	12° 5.5 S	96° 39.25 E	0	4229.9	0	656.8	1.5	124.6	28/07/2021 12:30
354	Noel	Beam trawl	12° 10.5 S	96° 43.9 E	4.4	4236.7	2.2	660.7	0.4	125	28/07/2021 15:06
355	Noel	Position	12° 8.9 S	96° 33.06 E	2.2	4247.5	0.2	661.6		125	28/07/2021 15:19
356	Noel	CTD	12° 27.5 S	95° 26.94 E	0	4314.7	0	667.8	2	127	28/07/2021 17:19
357	Noel	Beam trawl	12° 16.2 S	95° 19.98 E	5	4327.9	2.5	669	0.4	127.4	28/07/2021 20:12
358	Noel	Position	12° 19.4 S	95° 13.56 E	1.7	4335	0.2	669.6		127.4	28/07/2021 20:23
359	Noel	CTD	12° 43.8 S	95° 25.93 E	0	4362.2	0	672.1	2	129.4	28/07/2021 22:23
360	Noel	Beam trawl	12° 42.3 S	95° 32.51 E	7.1	4368.7	3.6	672.7	0.4	129.8	29/07/2021 2:21
361	Noel	MB	12° 34.7 S	95° 29.52 E	10.9	4376.9	1	673.4		129.8	29/07/2021 3:20
362	Noel	MB	12° 20.1 S	95° 18.06 E	12.6	4395.3	1.1	675.1		129.8	29/07/2021 4:29
363	Noel	MB	12° 24.7 S	95° 16.62 E	19	4400.1	1.7	675.5		129.8	29/07/2021 6:13
364	Noel	Position	12° 24.7 S	95° 16.62 E	21.6	4400.1	2.2	677.5		129.8	29/07/2021 8:22
365	Noel	CTD	12° 28.1 S	95° 20.89 E	0	4405.5	0	680.7	2	131.8	29/07/2021 10:22
366	Noel	Beam trawl	12° 29.2 S	95° 19.68 E	7.4	4407.1	3.7	680.8	0.4	132.2	29/07/2021 14:29
367	Noel	Position	12° 29.2 S	95° 19.68 E	6.9	4407.1	0.7	681.8		132.2	29/07/2021 15:11
368	Noel	CTD	12° 32.3 S	95° 22.77 E	0	4411.5	0	684.5	2	134.2	29/07/2021 17:11
369	Noel	Beam trawl	95° 25 S	95° 25.01 E	7.5	4413.7	3.7	684.7	0.4	134.6	29/07/2021 21:20

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
370	Raitt Ridge	Transit	95° 25 S	95° 25.01 E	12.2	4413.7	1.1	686.7		134.6	29/07/2021 22:26
371	Raitt Ridge	MB	95° 29 S	95° 28.98 E	14.3	4418.7	1.3	689.6		134.6	29/07/2021 23:44
372	Raitt Ridge	MB	12° 37 S	95° 29.22 E	6.4	4420.4	0.6	689.8		134.6	30/07/2021 0:19
373	Raitt Ridge	MB	12° 37 S	95° 29.22 E	13.4	4420.4	1.2	691.8		134.6	30/07/2021 1:32
374	Raitt Ridge	Position	12° 42 S	95° 34.36 E	6.2	4427.5	0.6	695.8		134.6	30/07/2021 2:09
375	Raitt Ridge	CTD	12° 46.4 S	95° 24.12 E	0	4438.4	0	696.8	2	136.6	30/07/2021 4:09
376	Raitt Ridge	Beam trawl	12° 58.7 S	95° 26.94 E	8	4451	4	698	0.4	137	30/07/2021 8:32
377	Raitt Ridge	MB	12° 47.2 S	95° 42.46 E	15.9	4470.1	1.4	699.7		137	30/07/2021 9:59
378	Raitt Ridge	MB	12° 47.2 S	95° 20.37 E	8.5	4491.6	0.8	701.7		137	30/07/2021 10:45
379	Raitt Ridge	MB	12° 47.2 S	95° 20.37 E	10	4491.6	0.9	703.7		137	30/07/2021 11:40
380	Raitt Ridge	Position	12° 51.2 S	95° 26.8 E	4.6	4499.1	0.5	707.9		137	30/07/2021 12:07
381	Raitt Ridge	CTD	12° 51.9 S	95° 19.72 E	0	4506	0	708.5	2	139	30/07/2021 14:07
382	Raitt Ridge	Beam trawl	12° 51.9 S	95° 19.72 E	7.7	4506	3.8	710.5	0.4	139.4	30/07/2021 18:22
383	Raitt Ridge	MB	12° 55.2 S	95° 26.63 E	9.8	4513.5	0.9	714.7		139.4	30/07/2021 19:16
384	Raitt Ridge	Position	13° 4.2 S	95° 34.98 E	6.9	4525.7	0.7	715.8		139.4	30/07/2021 19:57
385	Raitt Ridge	CTD	13° 15.1 S	95° 44.4 E	0	4540	0	717.1	2	141.4	30/07/2021 21:57
386	Raitt Ridge	Beam trawl	13° 18.4 S	95° 38.76 E	8.9	4546.3	4.5	717.7	0.4	141.8	31/07/2021 2:49
387	Muirfield	Transit	13° 7.3 S	95° 31.02 E	9.6	4559.7	0.9	718.9		141.8	31/07/2021 3:41
388	Muirfield	MB	13° 10.7 S	95° 36.3 E	13	4565.9	1.2	719.5		141.8	31/07/2021 4:52
389	Muirfield	MB	13° 10.7 S	95° 36.3 E	9.6	4565.9	0.9	721.5		141.8	31/07/2021 5:44
390	Muirfield	MB	13° 16.6 S	95° 41.88 E	12.8	4573.9	1.2	725.9		141.8	31/07/2021 6:54
391	Muirfield	MB	13° 26.6 S	95° 54.6 E	10.8	4589.8	1	727.4		141.8	31/07/2021 7:53
392	Muirfield	MB	13° 30.1 S	95° 46.62 E	7.6	4598.3	0.7	728.1		141.8	31/07/2021 8:35
393	Muirfield	MB	13° 21.6 S	95° 41.16 E	11	4608.3	1	729.1		141.8	31/07/2021 9:35
394	Muirfield	MB	13° 19.3 S	95° 45.18 E	9.5	4612.9	0.9	729.5		141.8	31/07/2021 10:27
395	Muirfield	MB	13° 19.3 S	95° 45.18 E	13	4612.9	1.2	731.5		141.8	31/07/2021 11:38
396	Muirfield	MB	13° 25.1 S	95° 50.34 E	8	4620.6	0.7	735.8		141.8	31/07/2021 12:22
397	Muirfield	MB	13° 19.7 S	95° 58.74 E	9.5	4630.4	0.9	736.7		141.8	31/07/2021 13:13
398	Muirfield	MB	13° 17.2 S	95° 52.14 E	6	4637.3	0.5	737.3		141.8	31/07/2021 13:46
399	Muirfield	MB	13° 17.2 S	95° 52.14 E	3.9	4637.3	0.4	739.3		141.8	31/07/2021 14:08
400	Muirfield	MB	13° 24.2 S	95° 57.72 E	8.6	4646.3	0.8	744.2		141.8	31/07/2021 14:55

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
401	Muirfield	MB	13° 14.7 S	95° 57.54 E	7.7	4655.8	0.7	745.1		141.8	31/07/2021 15:36
402	Muirfield	MB	13° 3.5 S	96° 4.32 E	7	4668.8	0.6	746.3		141.8	31/07/2021 16:15
403	Muirfield	MB	13° 2.7 S	96° 14.16 E	13.7	4678.4	1.2	747.2		141.8	31/07/2021 17:29
404	Muirfield	MB	13° 6.8 S	96° 26.64 E	3.9	4691.3	0.4	748.3		141.8	31/07/2021 17:50
405	Muirfield	MB	13° 17.5 S	96° 27.18 E	2.6	4702	0.2	749.3		141.8	31/07/2021 18:05
406	Muirfield	MB	13° 22.5 S	96° 21.3 E	6.4	4709.6	0.6	750		141.8	31/07/2021 18:40
407	Muirfield	MB	13° 19 S	96° 10.56 E	5.1	4720.7	0.5	751		141.8	31/07/2021 19:07
408	Muirfield	MB	13° 17.8 S	96° 0.84 E	2.1	4730.2	0.2	751.9		141.8	31/07/2021 19:19
409	Muirfield	MB	13° 5.9 S	96° 6.24 E	3	4743.2	0.3	753.1		141.8	31/07/2021 19:36
410	Muirfield	MB	13° 6.3 S	96° 14.46 E	13.6	4751.2	1.2	753.8		141.8	31/07/2021 20:50
411	Muirfield	MB	13° 9.3 S	96° 23.7 E	0.8	4760.7	0.1	754.7		141.8	31/07/2021 20:54
412	Muirfield	MB	13° 15.3 S	96° 24.18 E	12.8	4766.7	1.2	755.2		141.8	31/07/2021 22:04
413	Muirfield	MB	13° 18.5 S	96° 21.84 E	0.9	4770.7	0.1	755.6		141.8	31/07/2021 22:09
414	Muirfield	MB	13° 15.7 S	96° 13.5 E	13.3	4779.3	1.2	756.3		141.8	31/07/2021 23:21
415	Muirfield	MB	13° 14.2 S	96° 5.76 E	1	4786.9	0.1	757		141.8	31/07/2021 23:27
416	Muirfield	MB	13° 7.9 S	96° 8.76 E	12.7	4793.9	1.2	757.7		141.8	01/08/2021 0:36
417	Muirfield	Position	13° 11.6 S	96° 22.26 E	2.7	4807.6	0.3	758.9		141.8	01/08/2021 0:52
418	Muirfield	DTV	13° 15.4 S	96° 21.9 E	4.4	4811.5	3.2	759.3	0.4	142.2	01/08/2021 4:27
419	Muirfield	Position	13° 16.6 S	96° 19.5 E	4.7	4814.1	0.5	759.5		142.2	01/08/2021 4:55
420	Muirfield	DTV	13° 14 S	96° 13.46 E	5.7	4820.5	4.1	760.1	0.4	142.6	01/08/2021 9:24
421	Muirfield	Position	13° 13 S	96° 8.34 E	5	4825.6	0.5	760.6		142.6	01/08/2021 9:54
422	Muirfield	DTV	13° 11.5 S	96° 6.78 E	4	4827.8	2.9	760.7	0.4	143	01/08/2021 13:10
423	Muirfield	Position	13° 8.6 S	96° 7.68 E	22.8	4830.8	2.3	761		143	01/08/2021 15:27
424	Muirfield	CTD	13° 12.1 S	96° 21.18 E	0	4844.4	0	762.3	2	145	01/08/2021 17:27
425	Muirfield	Beam trawl	13° 12.9 S	96° 21 E	6.2	4845.2	3.1	762.3	0.4	145.4	01/08/2021 20:58
426	Muirfield	Position	13° 9.7 S	96° 8.34 E	5.3	4857.9	0.5	763.5		145.4	01/08/2021 21:30
427	Muirfield	CTD	13° 10.6 S	96° 8.04 E	0	4858.9	0	763.6	1	146.4	01/08/2021 22:30
428	Muirfield	Beam trawl	13° 13.9 S	96° 21.24 E	3.5	4872.2	1.8	764.8	0.4	146.8	02/08/2021 0:40
429	Muirfield	Position	13° 14.6 S	96° 20.46 E	2.8	4873.2	0.3	764.9		146.8	02/08/2021 0:57
430	Muirfield	CTD	13° 11.5 S	96° 7.86 E	0	4885.9	0	766	1	147.8	02/08/2021 1:57
431	Muirfield	Beam trawl	13° 7.3 S	96° 14.83 E	2.8	4893.9	1.4	766.8	0.4	148.2	02/08/2021 3:46

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
432	Muirfield	Position	13° 12.7 S	96° 16.57 E	1.6	4899.6	0.2	770.3		148.2	02/08/2021 3:56
433	Muirfield	CTD	13° 14.6 S	96° 19.55 E	0	4903.1	0	770.6	1	149.2	02/08/2021 4:56
434	Muirfield	Beam trawl	13° 14.6 S	96° 19.55 E	1.5	4903.1	0.7	771.6	0.4	149.6	02/08/2021 6:04
435	Muirfield	Net	13° 15 S	96° 20.28 E	2.5	4903.9	1.2	772.5		149.6	02/08/2021 7:19
436	Muirfield	CTD	13° 12.9 S	96° 20.96 E	0	4906.1	0	772.7	1	150.6	02/08/2021 8:19
437	Muirfield	Beam trawl	13° 13.4 S	96° 21.6 E	1.7	4906.9	0.9	773.7	0.4	151	02/08/2021 9:34
438	Muirfield	MB	13° 13.4 S	96° 21.6 E	10	4906.9	0.9	774.2		151	02/08/2021 10:29
439	Muirfield	Position	13° 12.4 S	96° 22.63 E	6.7	4908.3	0.7	774.3		151	02/08/2021 11:09
440	Muirfield	CTD	13° 12.4 S	96° 22.63 E	0	4908.3	0	775.3	1	152	02/08/2021 12:09
441	Muirfield	Beam trawl	13° 13.9 S	96° 23.47 E	1.3	4910.1	0.7	776.7	0.4	152.4	02/08/2021 13:13
442	Muirfield	Position	13° 10 S	96° 19.39 E	0.8	4915.6	0.1	777.2		152.4	02/08/2021 13:18
443	Muirfield	CTD	13° 10 S	96° 19.39 E	0	4915.6	0	778.2	1	153.4	02/08/2021 14:18
444	Muirfield	Beam trawl	13° 10.8 S	96° 20.63 E	1.1	4917.1	0.6	779.4	0.4	153.8	02/08/2021 15:15
445	Muirfield	Position	13° 7.6 S	96° 16.94 E	3.5	4921.9	0.4	779.8		153.8	02/08/2021 15:36
446	Muirfield	CTD	13° 7.6 S	96° 16.94 E	0	4921.9	0	780.8	1	154.8	02/08/2021 16:36
447	Muirfield	Beam trawl	13° 8.4 S	96° 19.74 E	1.4	4924.8	0.7	782.7	0.4	155.2	02/08/2021 17:41
448	Muirfield	Net	13° 11.3 S	96° 16.68 E	2.5	4928.9	1.2	783.1		155.2	02/08/2021 18:56
449	Muirfield	CTD	13° 11.3 S	96° 16.68 E	0	4928.9	0	784.1	1	156.2	02/08/2021 19:56
450	Muirfield	Beam trawl	13° 11.7 S	96° 17.3 E	1	4929.7	0.5	784.9	0.4	156.6	02/08/2021 20:50
451	Muirfield	Position	13° 12.5 S	96° 14.82 E	1.8	4932.2	0.2	785.2		156.6	02/08/2021 21:01
452	Muirfield	CTD	13° 12.5 S	96° 14.82 E	0	4932.2	0	786.2	1	157.6	02/08/2021 22:01
453	Muirfield	Beam trawl	13° 13.1 S	96° 15.48 E	1	4933.1	0.5	787.1	0.4	158	02/08/2021 22:54
454	Muirfield	Position	13° 15.3 S	96° 12.64 E	2.6	4936.6	0.3	787.4		158	02/08/2021 23:10
455	Muirfield	CTD	13° 15.3 S	96° 12.64 E	0	4936.6	0	788.4	1	159	03/08/2021 0:10
456	Muirfield	Beam trawl	13° 16.1 S	96° 14.99 E	1.2	4939.1	0.6	790.1	0.4	159.4	03/08/2021 1:10
457	Muirfield	Position	13° 15.7 S	96° 9.58 E	3	4944.4	0.3	790.6		159.4	03/08/2021 1:29
458	Muirfield	CTD	13° 15.7 S	96° 9.58 E	0	4944.4	0	791.6	1	160.4	03/08/2021 2:29
459	Muirfield	Beam trawl	13° 16.4 S	96° 13.09 E	0.9	4947.9	0.4	793.8	0.4	160.8	03/08/2021 3:19
460	Muirfield	Position	13° 13.6 S	96° 4.45 E	2.1	4956.7	0.2	794.6		160.8	03/08/2021 3:32
461	Muirfield	CTD	13° 13.6 S	96° 4.45 E	0	4956.7	0	795.6	1	161.8	03/08/2021 4:32
462	Muirfield	Beam trawl	13° 15.1 S	96° 6.83 E	0.7	4959.5	0.4	797.4	0.4	162.2	03/08/2021 5:18

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
463	Muirfield	MB	13° 13.6 S	95° 58.39 E	2.4	4967.9	0.2	798.2		162.2	03/08/2021 5:31
464	Muirfield	Position	13° 13.6 S	95° 58.39 E	2	4967.9	0.2	800.2		162.2	03/08/2021 5:43
465	Muirfield	CTD	13° 17.3 S	96° 2.66 E	0	4973.4	0	803.5	1	163.2	03/08/2021 6:43
466	Muirfield	Beam trawl	13° 6.3 S	96° 1.84 E	0.8	4984.5	0.4	804.5	0.4	163.6	03/08/2021 7:31
467	Muirfield	Position	13° 6.3 S	96° 1.84 E	2.2	4984.5	0.2	806.5		163.6	03/08/2021 7:44
468	Muirfield	CTD	13° 2.3 S	96° 6.67 E	0	4990.7	0	810	1	164.6	03/08/2021 8:44
469	Muirfield	Beam trawl	13° 5.4 S	96° 11.08 E	0.8	4996	0.4	810.5	0.4	165	03/08/2021 9:33
470	Muirfield	Position	13° 5.4 S	96° 11.08 E	22.6	4996	2.3	811.5		165	03/08/2021 11:48
471	Muirfield	CTD	13° 5.8 S	96° 14.69 E	0	4999.6	0	813.8	2	167	03/08/2021 13:48
472	Muirfield	Beam trawl	13° 7.6 S	96° 8.17 E	5.6	5006.2	2.8	814.4	0.4	167.4	03/08/2021 17:00
473	Muirfield	Net	13° 7.6 S	96° 8.17 E	4.1	5006.2	2.1	815.4		167.4	03/08/2021 19:03
474	Muirfield	CTD	13° 8.1 S	96° 9.42 E	0	5007.5	0	816.5	1	168.4	03/08/2021 20:03
475	Muirfield	Beam trawl	13° 8.5 S	96° 8.76 E	2.8	5008.3	1.4	816.6	0.4	168.8	03/08/2021 21:50
476	Muirfield	Position	13° 8.5 S	96° 8.76 E	2.8	5008.3	0.3	817.6		168.8	03/08/2021 22:06
477	Muirfield	CTD	13° 9.1 S	96° 9.72 E	0	5009.4	0	818.6	1	169.8	03/08/2021 23:06
478	Muirfield	Beam trawl	13° 9.7 S	96° 11.76 E	3.5	5011.5	1.7	818.8	0.4	170.2	04/08/2021 1:15
479	Muirfield	Position	13° 9.7 S	96° 11.76 E	1.3	5011.5	0.1	819.8		170.2	04/08/2021 1:22
480	Muirfield	CTD	13° 10.3 S	96° 12.54 E	0	5012.4	0	820.7	1	171.2	04/08/2021 2:22
481	Muirfield	Beam trawl	13° 10.2 S	96° 9.66 E	2.5	5015.3	1.2	821	0.4	171.6	04/08/2021 4:00
482	Muirfield	Position	13° 10.2 S	96° 9.66 E	5.9	5015.3	0.6	822		171.6	04/08/2021 4:35
483	Muirfield	CTD	13° 10.9 S	96° 10.38 E	0	5016.3	0	823	1	172.6	04/08/2021 5:35
484	Muirfield	Beam trawl	13° 12.1 S	96° 10.62 E	3.6	5017.4	1.8	823.1	0.4	173	04/08/2021 7:48
485	Muirfield	Position	13° 12.1 S	96° 10.62 E	2.3	5017.4	0.2	824.1		173	04/08/2021 8:02
486	Muirfield	CTD	13° 12.7 S	96° 11.72 E	0	5018.7	0	825.2	2	175	04/08/2021 10:02
487	Muirfield	Beam trawl	13° 10.3 S	96° 6.33 E	5	5024.4	2.5	825.7	0.4	175.4	04/08/2021 12:57
488	Muirfield	MB	13° 10.3 S	96° 6.33 E	4.2	5024.4	0.4	826.7		175.4	04/08/2021 13:20
489	Santa Ridge	Transit	13° 11.2 S	96° 7.34 E	15.8	5025.8	1.4	827.8		175.4	04/08/2021 14:46
490	Santa Ridge	MB	13° 19.2 S	96° 20.12 E	18.4	5040.6	1.7	829.2		175.4	04/08/2021 16:26
491	Santa Ridge	MB	13° 19.2 S	96° 20.12 E	20.6	5040.6	1.9	830.2		175.4	04/08/2021 18:19
492	Santa Ridge	MB	13° 18.4 S	96° 23.74 E	5.8	5044.2	0.5	832.5		175.4	04/08/2021 18:50
493	S Cocos	Transit	13° 20.5 S	96° 22.58 E	27.9	5046.6	2.5	832.7		175.4	04/08/2021 21:23

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
494	S Cocos	MB	13° 20.5 S	96° 22.58 E	22.5	5046.6	2	834.7		175.4	04/08/2021 23:25
495	S Cocos	Position	13° 16.8 S	96° 26.15 E	11.6	5051.6	1.2	837.7		175.4	05/08/2021 0:34
496	S Cocos	CTD	13° 30.7 S	96° 16.14 E	0	5068.5	0	839.2	2	177.4	05/08/2021 2:34
497	S Cocos	Beam trawl	13° 44 S	96° 29.22 E	5.6	5086.9	2.8	840.9	0.4	177.8	05/08/2021 5:45
498	S Cocos	Position	13° 37.3 S	96° 49.2 E	9.7	5107.5	1	842.7		177.8	05/08/2021 6:44
499	S Cocos	CTD	13° 39.1 S	96° 54.9 E	0	5113.3	0	843.3	2	179.8	05/08/2021 8:44
500	S Cocos	Beam trawl	13° 57 S	97° 16.87 E	5.8	5141.2	2.9	845.8	0.4	180.2	05/08/2021 12:03
501	S Cocos	MB	14° 15.2 S	97° 3.29 E	19.9	5163.7	1.8	847.8		180.2	05/08/2021 13:51
502	S Cocos	MB	14° 3.8 S	97° 5.25 E	6.6	5175.3	0.6	848.9		180.2	05/08/2021 14:27
503	S Cocos	Position	14° 3.8 S	97° 5.25 E	12.6	5175.3	1.3	850.9		180.2	05/08/2021 15:43
504	S Cocos	CTD	14° 7.9 S	97° 9.07 E	0	5180.8	0	854.2	2	182.2	05/08/2021 17:43
505	S Cocos	Beam trawl	13° 58.4 S	97° 7.31 E	7.4	5190.5	3.7	855	0.4	182.6	05/08/2021 21:48
506	SW Cocos	Transit	13° 58.4 S	97° 7.31 E	123.4	5190.5	11.2	857		182.6	06/08/2021 9:01
507	SW Cocos	MB	14° 2.5 S	97° 11.53 E	6.8	5196.4	0.6	860.4		182.6	06/08/2021 9:39
508	SW Cocos	MB	14° 14.7 S	97° 27.72 E	6.5	5216.3	0.6	862.2		182.6	06/08/2021 10:14
509	SW Cocos	MB	14° 8.6 S	97° 30.4 E	10.4	5222.9	0.9	862.8		182.6	06/08/2021 11:11
510	SW Cocos	Position	14° 9.6 S	97° 17.41 E	6.6	5235.5	0.7	864		182.6	06/08/2021 11:50
511	SW Cocos	CTD	14° 9.6 S	97° 17.41 E	0	5235.5	0	866	2	184.6	06/08/2021 13:50
512	SW Cocos	Beam trawl	14° 14.6 S	97° 22.94 E	7.2	5242.9	3.6	870.1	0.4	185	06/08/2021 17:49
513	SW Cocos	Position	14° 43.7 S	95° 19.26 E	1.5	5366.2	0.2	881.4		185	06/08/2021 17:58
514	SW Cocos	CTD	14° 48.5 S	95° 24.34 E	0	5373.1	0	882	1.5	186.5	06/08/2021 19:28
515	SW Cocos	Beam trawl	14° 45.8 S	95° 30.49 E	4.4	5379.6	2.2	882.6	0.4	186.9	06/08/2021 22:04
516	SW Cocos	Position	14° 36.7 S	95° 25.44 E	6	5390	0.6	883.5		186.9	06/08/2021 22:39
517	SW Cocos	CTD	14° 39.4 S	95° 19.26 E	0	5396.5	0	884.1	2	188.9	07/08/2021 0:39
518	SW Cocos	Beam trawl	14° 39.4 S	95° 19.26 E	7.4	5396.5	3.7	886.1	0.4	189.3	07/08/2021 4:46
519	SW Cocos	Transit	14° 44 S	95° 24.84 E	14.3	5403.7	1.3	890.2		189.3	07/08/2021 6:05
520	SW Cocos	MB	14° 42.7 S	95° 25.56 E	6.9	5405.2	0.6	890.3		189.3	07/08/2021 6:42
521	SW Cocos	MB	14° 42.7 S	95° 25.56 E	3	5405.2	0.3	892.3		189.3	07/08/2021 6:58
522	SW Cocos	Position	14° 45.8 S	95° 28.8 E	2.9	5409.6	0.3	895		189.3	07/08/2021 7:15
523	SW Cocos	CTD	14° 46.3 S	95° 22.66 E	0	5415.6	0	895.5	2	191.3	07/08/2021 9:15
524	SW Cocos	Beam trawl	14° 46.3 S	95° 22.66 E	7	5415.6	3.5	897.5	0.4	191.7	07/08/2021 13:09

no	Location	Activity	Latitude	Longitude	Distance (nm)	Total distance	Steaming time (hr)	Total steam	Activity (hr)	Total activity	Date/Time
525		Waypoint	18° 38.8 S	99° 13.44 E	300.7	5423.0	27.3	901.7	0.5	192.2	08/08/2021 16:59
526		Waypoint	19° 57.7 S	99° 35.88 E	81.7	5437.3	7.4	903.0		192.2	09/08/2021 0:25
527		Waypoint	21° 9.4 S	100° 31.68 E	88.8	5444.2	8.1	903.6		192.2	09/08/2021 8:29
528		Waypoint	22° 13.9 S	102° 6.54 E	109.3	5447.1	9.9	903.9		192.2	09/08/2021 18:25
529		Waypoint	24° 33.2 S	106° 43.92 E	290.4	5450.0	26.4	904.1		192.2	10/08/2021 20:49
530	Perth Canyon	Waypoint	32° 0 S	115° 10.8 E	631.4	5450.0	57.4	906.1	0.5	192.7	13/08/2021 6:43
531	Fremantle	Port	32° 3 S	115° 45.3 E	29.4	5457.0	2.7	910.1		192.7	13/08/2021 9:24

CTD configuration

	Please select:
Fundamentals:	
• Which CTD rosette to be used for this voyage (24 Niskin bottles or 36):	36
• Likely total number of casts:	95
• Likely maximum depth of deepest cast:	5500
• Lowered ADCP required:	X
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):	X
• PAR Sensor (Biospherical QCP-2300):	
• Transmissometer (Wetlabs C-Star 25cm):	X
• Fluorometer – Chlorophyll-a (Chelsea Aquatracka III – 430/685nm):	X
• Fluorometer – CDOM (Wetlabs FLCDOM – 370/460nm)	X
• Nephelometer (Seapoint Turbidity Meter)	X
• ECO-Triplet (Chlorophyll-a, CDOM and backscatter – maximum depth 2000m)	X
Hydrochemistry Analyses:	
• Salinity	X
• Dissolved Oxygen	X
• Nutrients: Nitrate	X
• Nutrients: Phosphate	X
• Nutrients: Silicate	X
• Nutrients: Nitrite	X
• Nutrients: Ammonia (special request after discussion with hydrochemistry)	

Permits

1. Access to Biological Resources in a Commonwealth Area for Non-Commercial Purposes
2. Approval for Activity in a Commonwealth Marine Reserve (for Palau Keeling)
3. Australian Fisheries Management Authority Scientific Permit (outside 12 nm)
4. WA Government General Fisheries Permit (within 12 nm)
5. Museums Victoria Animal Ethics Committee approval

Signature

Your name	Dr Tim O'Hara, Museums Victoria
Title	Chief Scientist
Signature	
Date:	16 November 2020

List of additional figures and documents

- Appendix A - MNF Equipment
- Appendix B - Equipment Manifest
- Appendix C - Hazardous Materials Manifest
- IN2021_V04 site descriptions.pdf

Appendix A

Scientific equipment and facilities provided by the CSIRO 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 CSIRO Marine National Facility by placing an **X** in the relevant box.

(i) Standard laboratories and facilities		
Name	Required	Notes/Comments
Aerosol Sampling Lab		
Air Chemistry Lab		
Preservation Lab	X	Preserving benthic samples
Constant Temperature Lab	X	Bioluminescence experiments/live animal aquaria, 4 degrees C
Underway Seawater Analysis Laboratory	X	Niskin sample retrieval?
GP Wet Lab (Dirty)	X	Beam trawl/dredge sample sorting and identification
GP Wet Lab (Clean)	X	Fish identification and preparation
GP Dry Lab (Clean)	X	Invertebrate microscope identification
Sheltered Science Area	X	Preparation for sample recovery
Observation Deck 07 Level	X	Bird/cetacean observations
Walk in Freezer	X	Preservation of frozen samples
Blast Freezer	X	
Ultra-Low Temperature Freezer (-80°C) X2	X	Preservation of tissue samples and Niskin samples
Walk in Cool Room	X	Temporary storage of catch

(ii) Mobile laboratory and facilities <i>(may require additional support)</i>			
Name	Essential	Desirable	Notes/Comments
Modular Radiation Laboratory (Isotope lab)			
Trace Metal Niskin Sampling Container (TM1-blue)			
Trace Metal Seawater Analysis Laboratory (TM2-white)			
Trace Metal Rosette and Niskin Storage Container			
Modular Hazchem Locker	X		
Stabilised Platform Container			
Clothing Container			

(iii) Standard sampling equipment			
Name	Essential	Desirable	Notes/Comments
CTD - Seabird 911 with 36 Bottle Rosette	X		Temp, salinity, O2, turbidity, Fluorometer
CTD - Seabird 911 with 24 Bottle Rosette			
Lowered ADCP	X		Fine scale current measurements over seamounts
Continuous Plankton Recorder (CPR)			

(iv) Specialised sampling equipment			
Name	Essential	Desirable	Notes/Comments <i>(these items may require additional MNF support staff)</i>
TRIAXUS – Underway Profiling CTD			
Desired towing profile:			
Additional instrumentation: (please supply, make and model and datasheets and a contact person for discussion on integration)			

(iv) Specialised sampling equipment			
Name	Essential	Desirable	Notes/Comments <i>(these items may require additional MNF support staff)</i>
Piston Coring System			
Gravity Coring System			
Multi Corer			
Kasten Corer			
Smith Mac Grab		X	Backup
Rock Dredges		X	In case very rocky seafloors are found
Rock Saw		X	
Seaspy Magnetometer	X		
Portable Pot Hauler			
Equipment to measure seawater sound velocity/CTD:			
• XBT System	X		• 2 per day provided
• Valeport Rapid SV			
• Valeport Rapid CTD			
• Valeport SVX2			
Trace Metal Rosette and Bottles			
Trace Metal In-situ Pumps (x6)			
Deep Towed Camera	X		
Drop Camera			
Sherman Epibenthic Sled	X		
Brenke Sled			
EZ Net (Multiple net system, 1m x 1m)			
Hydro-Bios MultiNet (1m x 1m)			

(iv) Specialised sampling equipment			
Name	Essential	Desirable	Notes/Comments <i>(these items may require additional MNF support staff)</i>
Surface Net (1m x 1m)	X		350 micron mesh
Bongo Net 485mm diameter			
Beam Trawl	X		
MIDOC			
Pelagic Trawl System (net, doors)			
Demersal Trawl System (net, doors)			
Trawl Monitoring Instrumentation (ITI) (2,000m depth limit)			
Stern ramp	Exposed		Required for beam trawl, towed camera

(v) Research support infrastructure			
Name	Essential	Desirable	Notes/Comments
Salt Water Ice Machine	X		
Radiosonde Receiver System			
Laboratory Incubators			
Deck Incubators			Temperature controlled deck incubators
Milli-Q System			
Sonardyne USBL System	X		

(vi) Scientific / sample analysis systems				
Name		Essential	Desirable	Notes/Comments
Microscopes:				Refer to the “MNF microscopes procedure” for more information
<i>Brand / model</i>	<i>Type</i>			

(vi) Scientific / sample analysis systems				
Name		Essential	Desirable	Notes/Comments
• Leica / M80	Dissecting	X		
• Leica / M80	Dissecting	X		
• Leica /MZ6	Dissecting	X		
• Olympus / CH	Compound	X		
• Olympus /CH	Compound			
• Leica / MTU282	Camera tube	X		
• Adapters for tube / Nikon	Pentax	X		
• Ring Light *2 / MEB121	LED	X		
Heavy Duty Electronic Balance (80kg)		X		
Medium Duty Electronic Balance (15kg/5g resolution)		X		
Light Duty Electronic Balance (3kg/1g resolution)		X		

(vii) Underway systems			
Acoustic Underway Systems			
Name	Essential	Desirable	Notes/Comments
75kHz ADCP	X		
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	Some mapping of shallow water required (20-100 m)
Sub-Bottom Profiler SBP120			
Scientific Echo Sounders EK60 (6 bands, 18kHz-333kHz)	X		

(vii) Underway systems

Acoustic Underway Systems

Name	Essential	Desirable	Notes/Comments
Multibeam Scientific Echo Sounder ME70 (70-100 kHz)			
Omnidirectional Echo Sounder SH90			
Gravity Meter	X		Towed magnetometer

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 ₂ O)			
Aerodyne Spectrometer (analysis of N ₂ O/CO/H ₂ O)			
Cloud Condensation Nuclei (CCN)			
Polarimetric Weather Radar			

Underway Seawater Systems and Instrumentation

Name	Essential	Desirable	Notes/Comments
Thermosalinograph			
Fluorometer			
Optode			

Underway Seawater Systems and Instrumentation			
Name	Essential	Desirable	Notes/Comments
pCO2			

Seawater systems			
Name	Essential	Desirable	Notes/Comments
Trace metal clean seawater supply			
Scientific clean seawater supplied to laboratories			
Raw seawater available on deck and in laboratories	X		

(viii) Equipment and sampling gear requiring external support (may require additional support from applicants)			
Name	Essential	Desirable	
Seismic Compressors			
Seismic Acquisition System			

(ix) Non-MNF owned equipment which may be accessed

Name	Essential	Desirable	
D and N Francis winch			• 15mm electro-optical cable
Box Corer			
UTAS In-Situ Pumps (x2)			
EM2040			• Shallow water multibeam echosounder system

Appendix B

User Supplied Equipment

Owner	Item name	Location on Vessel
Museums Victoria	Additional microscopes	Dry lab
Museums Victoria	Sorting/preserving equipment, including drums, trays, bottles, bags, forceps etc	Cool room, dry and wet lab
Museums Victoria	Ethanol	Hazchem locker
Museums Victoria	Formaldehyde	Hazchem locker