



CRUISE REPORT ON RESEARCH ACTIVITY

M.V.SEAFDEC 2 Cruise No. 31-1/2009

6 March – 11 April 2009

**National Research Survey by Department of Fisheries,
Brunei Darussalam**

TD/RP/166

This report is base on preliminary data

For readers who may need data in the report, please contact to:

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Survey Cruise Report



Cruise no.: MV.SEAFDEC2 No.31-1/2009

Period: 6 March – 11 April 2009 (37 days)

Area: Waters of Brunei Darussalam

Port of call: Maura port, Brunei Darussalam

Objective: **Main Activity for Research Survey are as follows:**

1. Oceanographic survey: ICTD, IKMT, Bongo net, Neuston net, Temperature-Depth Sensor (TD), Current indicator, and other weather information.
2. Demersal resources survey in Zone 3 will be carried out by using the Bottom beam trawl and Otter-board trawl.
3. Acoustic survey by FQ 80.
4. Large Pelagic fish sampling from Pelagic Longline in Zone 4
5. Whale sighting

Numbers of stations are as follows:

1. Trawl : Otter board 9 operations and Beam trawl 11 operations
2. Acoustic survey : 32 stations
3. Oceanographic survey: 34 stations
4. Pelagic longline: 5 stations (Location according to the result of Acoustic survey)

I. List of personal on board:

Ship personals

No.	Name	Position
1	Mr. Tossaporn Sukhapindha	Captain
2	Mr. Veerachai Chettasumon	Chief engineer
3	Mr. Suren Pruksarat	Second officer
4	Mr. Aussawin Buachuay	Apprentice Navigator
5	Mr. Kittinai Sukdit	Second engineer
6	Mr. Nuttapon Chaitanavisut	Third Engineer
7	Mr. Somyos pornprasert	Fishing Assistant
8	Mr. Vudthirat Vudthipanyo	Boatswain
9	Mr. Pradit Kui-prasert	Steerman
10	Mr. Tana Rungjoy	"
11	Mr. Jaron Po-U	Able Seaman
12	Mr. Plew Shodok	Oiler
13	Mr. Boontarin Wara-in	"
14	Mr. Watchara Panasri	"
15	Mr. Veerapon	Cook
16	Mr. Marut Sangphuek	Ship's boy

Researchers from SEAFDEC/TD

No.	Name	Responsibility	Contact address	Period of duty
1	Mr. Sayan Promjinda ¹	Chief scientist	sayan@seafdec.org	10 Mar-7 Apr
2	Mr. Narong Ruangsivakul ¹	Fishing gear Technologist	narong@seafdec.org	10 – 30 Mar
3	Mr. Nakaret Yasook ¹	Fishing gear Technologist	nakaret@seafdec.org	31 Mar-7 Apr
5	Dr. Natinee Sukramongkol ¹	Fisheries Oceanographer	nattinee@seafdec.org	10 Mar-7 Apr

Researchers from Brunei Darussalam

No.	Name	Activity	Position and contacted	Contact address
1	Mr. MATZAINI HAJI JUNA	Hydroacoustic survey/searching	Fisheries officer	11 Mar – 4 Apr
2	Mr. ELVIRO CINCO	Oceanographic survey/searching	Marine ecologist	11-15 Mar, 23Mar-4 Apr.
3	Mr. HAJI AJI HAJI SAFAR	Oceanography survey/searching	Senior fisheries assistant	11 Mar – 4 Apr
4	Mr. HAJI CHUCHU HAJI KASSIM	Oceanography survey	Senior fisheries assistant	11 -21 Mar.
5	Mr. ABD JAMID HAJI ZAININ	Fishing trial	Head of fisherman	17-21 Mar, 30 – 4 Apr.
6	Mr. MATSALEH HAJI TAHIR	Plankton survey	Senior fisheries assistant	11 -28 Mar
7	Ms. DESIMAWATI HAJI METALI	Oceanographic survey	Fisheries officer	17-21 Mar

No.	Name	Activity	Position and contacted	Contact address
8	Mr. HAJI RAMLEE HAJI AHMAD	Oceanographic survey	Junior fisheries assistant	23-28 Mar
9	Mr. SYAH HAJI IBRAHIM	Hydro-acoustic survey/searching	Coral expert	23-28 Mar
10	Mr. AHMAD PUTIH	Plankton survey	Fishermen	11 Mar – 4 Apr
11	Mr. BIDIN SURU	Fishing	Vessel senior officer	11 – 21 Mar, 30 Mar- 4 Apr.
12	Capt. MOHAMMAD MAIL	Deck operation	Captain	11-15, 23-28 Mar
13	Mr. TALIP HJ OMAR	Fishing	Fishermen	11 Mar – 4 Apr
14	Mr. HARUN HAJI PUTIH	Deck operation	Assistant Vessel officer	11 Mar – 4 Apr
15	Mr. ROSLAN HAJI LAMIT	Engine room operation	Engineer	11-15, 23 Mar – 4 Apr.
16	Mr. AHMAD JAIR	Engine room operation	Engineer	17-21 Mar
17	Mr. AMIRUL HAPIZUDIN NAIM	Engine room operation	Licensing officer	11-15 Mar
18	Mr. RAIHAN MURSIDI	Engine room operation	Licensing officer	17-21 Mar
19	Mr. ADI SHAH ABD HAMID	Engine room operation	Licensing officer	23-28 Mar
20	Mr. MAZALI HAJI AHMAD	Fishing	Fishermen	30 Mar-4 Apr
21	Mr. MOHD HATRAL KAMAL ABD HAMID	Fishing	Fishermen	30 Mar-4 Apr
22	Mr. NORAZMI HAJI BAGOL	Fishing	Fishermen	30 Mar-4 Apr

II. Research Activities

Session I: 11 to 12 March 2009

Date	Time	Activities	Remark
10 Mar 09	1315	Alongside M.V.Tenggiri, Fish Landing Complex, Maura port, Brunei Darussalam	
	1330-1530	Transfer some of fishing gear to M.V. Tenggiri And prepared the Bottom otter trawl	
11 Mar 09	0800	All researcher DOF/Brunei (12 persons) embarked on board	
	0830	Leave Maura fishing port to survey station	
	1000-1130	FQ 80 Calibration , sea depth 50 m	
	1200-2400	Start Topographic survey from St. no.A1- A18	
12 Mar 09	0614-0740	Oceanographic survey op.1 at station A1 - CTD , sea depth 109 m - Bongo net, sea 109 m. - Neuston net, sea depth 104 m.	L05°35'.00N λ114°29'.20E L05°36'.30N λ114°29'.50E L05°36'.20N λ114°30'.30E
	0755-1002	Bottom trawl fishing operation 1 At station A1(A1-A2), sea depth 109 m.	L05°36'.70N λ114°29'.40E – L05°35'.80N λ114°28'.60E
	1030-1137	Bottom trawl fishing operation 2 At station A2(A2-A3), sea depth 109 m.	L05°32'.10N λ114°26'.10E – L05°29'.80N λ114°24'.50E
	1215-1325	Oceanographic survey op.2 at station A3 - Bongo net, sea 123 m. - Neuston net, sea depth 122 m. - CTD , sea depth 108 m	L05°26'.20N λ114°20'.70E L05°26'.30N λ114°21'.30E L05°26'.80N λ114°22'.00E
	1342-1457	Bottom trawl fishing operation 3 At station A3(A3-A4), sea depth 126 m.	L05°25'.80N λ114°20'.20E – L05°23'.80N λ114°20'.20E
	1532-1640	Bottom trawl fishing operation 4. At station A4(A4-A5), sea depth 111 m.	L05°19'.50N λ114°16'.30E – L05°17'.60N λ114°16'.10E
	1716-1817	Oceanographic survey op.3 at station A5 - Bongo net, sea 102 m. - Neuston net, sea depth 97 m. - CTD , sea depth 95 m	L05°13'.90N λ114°13'.30E L05°13'.00N λ114°13'.70E L05°13'.00N λ114°14'.00E
	1955	Proceeded to Muara Fishing port	
13 Mar 09- 21 Mar 09		- Hands employed in routine work - To arrange and preparation of fishing gear equipments	
		- Fish photography and post capture image training for DOF/Brunei at Muara Fishing station	17 – 18 March 2009

Session II: 22 to 25 March 2009

Date	Time	Activities	Remark
22 Mar 09	1700	All researcher DOF/Brunei (10 persons) embarked on board	
	2150	Leave Muara fishing port to survey station	
23 Mar 09	0618-0740	Bottom trawl fishing operation 5. At station A5(A5-A6), sea depth 132 m.	L05°12'.80N λ114°11'.80E – L05°11'.00N λ114°10'.00E
	0847-0945	Bottom trawl fishing operation 6. At station A6(A6-A7), sea depth 100 m.	L05°08'.70N λ114°06'.90E – L05°08'.00N λ114°07'.20E
23 Mar 09	1010-1125	Bottom trawl fishing operation 7. At station A7(A6-A7), sea depth 100 m.	L05°06'.50N λ114°04'.80E – L05°05'.40N λ114°03'.10E
	1155-1326	Oceanographic survey op.4 at station A7 - Bongo net, sea 99 m. - Neuston net, sea depth 97 m. - CTD , sea depth 95 m	L05°04'.01N λ114°02'.50E L05°04'.10N λ114°02'.80E L05°03'.90N λ114°02'.20E
	1347-1505	Bottom trawl fishing operation 8. At station A7(A7-A8), sea depth 101 m.	L05°03'.90N λ114°01'.50E – L05°03'.80N λ113°59'.50E
	1552-1715	Bottom trawl fishing operation 9. At station A8(A8-A9), sea depth 119 m.	L05°01'.20N λ113°52'.50E – L04°59'.40N λ113°51'.20E
	1735-1840	Oceanographic survey op.5 at station A9 - Bongo net, sea 99 m.	L04°57'.80N λ113°49'.90E

Date	Time	Activities	Remark
		- Neuston net, sea depth 97 m. - CTD , sea depth 97 m	L04°57'.90N λ113°50'.20E L04°58'.10N λ113°50'.70E
24 Mar 09	0656-0805	Oceanographic survey op.6 at station A11 - CTD , sea depth 332 m - Bongo net, sea 301 m. - Neuston net, sea depth 274 m.	L05°06'.80N λ113°50'.30E L05°06'.70N λ113°50'.70E L05°06'.50N λ113°50'.70E
	0918-1027	Oceanographic survey op.7 at station A13 - Neuston net, sea depth 280 m. - Bongo net, sea 244 m. - CTD , sea depth 167 m	L05°13'.00N λ114°03'.30E L05°12'.80N λ114°03'.90E L05°12'.20N λ114°04'.80E
	1132-1244	Oceanographic survey op.8 at station A15 - Bongo net, sea 369 m. - Neuston net, sea depth 286 m. - CTD , sea depth 340 m	L05°22'.00N λ114°11'.60E L05°21'.70N λ114°12'.70E L05°21'.50N λ114°13'.50E
	1410-1523	Oceanographic survey op.9 at station A17 - CTD , sea depth 515 m - Bongo net, sea 414 m. - Neuston net, sea depth 264 m.	L05°36'.10N λ114°19'.40E L05°36'.10N λ114°19'.80E L05°35'.50N λ114°20'.90E
	1600-1708	Oceanographic survey op.10 at station A18 - Neuston net, sea depth 300 m. - Bongo net, sea 286 m. - CTD , sea depth 255 m	L05°41'.00N λ114°24'.20E L05°40'.80N λ114°24'.30E L05°40'.80N λ114°24'.50E
			Proceed to zone 3 for Bottom trawl fishing trial at fishing ground
25 Mar 09	0650-0824	Bottom trawl fishing trial operation 1. At Zone 3, sea depth 40.5 m.	L04°52'.70N λ114°15'.60E – L04°57'.50N λ114°18'.30E
	0858-1039	Bottom trawl fishing trial operation 2. At Zone 3, sea depth 43 m.	L04°53'.00N λ114°15'.10E – L04°56'.70N λ114°18'.50E
		Proceed to Muara fishing port	

Session III: 26 to 30 March 2009

Date	Time	Activities	Remark
26 Mar 09	1700	All researcher DOF/Brunei (10 persons) embarked on board	
	2150	Leave Muara fishing port to survey station	
27 Mar 09	0630-0747	Bottom beam trawl fishing operation 1 At station A1(A1-A2), sea depth 110 m.	L05°33'.80N λ114°27'.40E – L05°30'.80N λ114°25'.00E
	0752-0904	Oceanographic survey op.11 at station A2 - Bongo net, sea 108 m. - Neuston net, sea depth 108 m. - CTD , sea depth 108 m	L05°30'.80N λ114°25'.10E L05°30'.90N λ114°25'.60E L05°31'.20N λ114°25'.60E
	0918-1037	Bottom beam trawl fishing operation 2 At station A2(A2-A3), sea depth 109 m.	L05°30'.80N λ114°25'.00E – L05°28'.50N λ114°22'.70E
	1057-1213	Bottom beam trawl fishing operation 3 At station A3(A3-A4), sea depth 126 m.	L05°26'.00N λ114°20'.20E – L05°22'.60N λ114°18'.50E
	1236-1335	Oceanographic survey op.12 at station A4 - CTD , sea depth 112 m - Bongo net, sea 111 m. - Neuston net, sea depth 111 m.	L05°19'.80N λ114°17'.20E L05°19'.80N λ114°17'.20E L05°20'.00N λ114°17'.70E

Date	Time	Activities	Remark
27 Mar 09	1345-1536	Bottom beam trawl fishing operation 4 At station A4(A4-A5), sea depth 112 m.	L05°19'.30N λ114°16'.60E – L05°17'.50N λ114°15'.00E
	1619-1736	Bottom beam trawl fishing operation 5 At station A5(A5-A6), sea depth 118 m.	L05°12'.50N λ114°11'.40E – L05°10'.10N λ114°08'.50E
	1757-1850	Oceanographic survey op.13 at station A6 - Bongo net, sea 101 m. - Neuston net, sea depth 101 m. - CTD , sea depth 114 m	L05°09'.00N λ114°07'.40E L05°09'.20N λ114°07'.80E L05°09'.40N λ114°07'.60E
28 Mar 09	0615-0741	Bottom beam trawl fishing operation 6 At station A6(A6-A7), sea depth 100 m.	L05°07'.10N λ114°05'.30E – L05°04'.60N λ114°02'.70E
	0840-0958	Bottom beam trawl fishing operation 7 At station A7(A7-A8), sea depth 105 m.	L05°03'.40N λ113°58'.60E – L05°02'.30N λ113°54'.60E
	1010-1123	Oceanographic survey op.14 at station A8 - Bongo net, sea 125 m. - Neuston net, sea depth 137 m. - CTD , sea depth 145 m	L05°01'.90N λ113°53'.00E L05°02'.30N λ113°52'.90E L05°02'.60N λ113°52'.90E
	1145-1312	Bottom beam trawl fishing operation 8 At station A8(A8-A9), sea depth 116 m.	L05°00'.60N λ113°51'.70E – L04°57'.90N λ113°49'.20E
	1345-1505	Oceanographic survey op.15 at station A 10 - Bongo net, sea 330 m. - Neuston net, sea depth 498 m. - CTD , sea depth 598 m	L05°02'.10N λ113°45'.00E L05°02'.30N λ113°45'.50E L05°02'.60N λ113°45'.30E
	1601-1752	Bottom beam trawl fishing operation 9 At station A11(A11-A12), sea depth 213 m.	L05°06'.80N λ113°54'.30E – L05°06'.90N λ113°58'.00E
	1735-1843	Oceanographic survey op.16 at station A 12 - Bongo net, sea 195 m. - Neuston net, sea depth 196 m. - CTD , sea depth 197 m	L05°06'.09N λ113°57'.00E L05°06'.09N λ113°56'.90E L05°06'.09N λ113°56'.80E
29 Mar 09	0615-0750	Bottom beam trawl fishing operation 10 At station A12(A12-A13), sea depth 214 m.	L05°07'.04N λ113°57'.40E – L05°10'.30N λ113°59'.30E
	0846-1018	Bottom beam trawl fishing operation 11 At station A13(A13-A14), sea depth 260-317 m.	L05°14'.20N λ114°04'.70E – L05°16'.30N λ114°08'.20E
	1035-1106	Oceanographic survey op.17 at station A 14 - Bongo net, sea 255 m. - Neuston net, sea depth. - CTD , sea depth 314 m	L05°18'.00N λ114°10'.10E L05°17'.90N λ114°09'.80E L05°17'.90N λ114°09'.60E
29 Mar 09	1302-1420	Oceanographic survey op.18 at station A 16 - Bongo net, sea 459 m. - Neuston net, sea depth.480 m. - CTD , sea depth 526 m	L05°28'.70N λ114°15'.90E L05°29'.20N λ114°15'.40E L05°28'.50N λ114°15'.00E
	1830-1955	Bottom beam trawl fishing Trial operation 1 At Zone 2, sea depth 26 m.	L04°53'.40N λ114°33'.30E – L04°56'.30N λ114°33'.80E
	2135-2253	Bottom beam trawl fishing Trial operation 2 At Zone 2, sea depth 22 m.	L05°03'.70N λ114°47'.60E – L05°07'.00N λ114°48'.00E
		Proceeded to Muara Fishing port	

Session IV: 31 March to 2 April 2009

Date	Time	Activities	Remark
31 Mar 09	1030-1200	Load fuel 15 tons at BSM's Jetty	
	1730	All researcher DOF/Brunei (12 persons) embarked on board	
	1800	Leave Muara fishing port to survey station	
1 Apr 09	0606-0725	Oceanographic survey op.19 at station B 12 - CTD , sea depth 2,248 m - Neuston net, - Bongo net,	L05°36'.80N λ113°19'.50E L05°37'.60N λ113°19'.10E L05°38'.50N λ113°18'.90E
	0749-0845	IKMT operation 1. At station B12-B11, sea depth 2500 m	L05°03'.70N λ114°47'.60E – L05°07'.00N λ114°48'.00E
	0845-1030	Acoustic survey by FQ-80 to station B11	

Date	Time	Activities	Remark
1 Apr 09	1034-1157	Oceanographic survey op.20 at station B 11 - Bongo net, sea depth 2,368 m - Neuston net, - CTD	L05°43'.60N λ113°35'.90E L05°44'.90N λ113°36'.20E L05°45'.30N λ113°36'.00E
	1218-1324	IKMT operation 2. At station B11-B10,	L05°43'.60N λ113°35'.60E – L05°46'.40N λ113°38'.80E
	1324-1515	Acoustic survey by FQ-80 to station B10	
	1517-1637	Oceanographic survey op.21 at station B 10 - Bongo net, sea depth 2,400 m - Neuston net, sea depth 2,400 m - CTD sea depth 2,400 m	L05°56'.60N λ113°50'.10E L05°57'.80N λ113°50'.10E L05°58'.20N λ113°50'.10E
	1652-1750	IKMT operation 3. At station B10-B 9,	L05°56'.90N λ113°50'.00E – L06°00'.00N λ113°52'.20E
	1750-1947	Acoustic survey by FQ-80 to station B9	
2 Apr 09	0615-0630	Oceanographic survey op.22 at station B 9 - Neuston net, sea depth 2,494 m	L06°13'.20N λ114°01'.40E
		Proceed to station B8, B1 and proceed back to Muara fishing port.	
3 Apr 09	0800-1200	To arrangement and all of equipment were clearaged	
6 Apr 09	0900	Ship leave Muara fishing port to SEAFDEC/TD, Thailand	
	1000-1200	Cruise discussion with DOF/Brunei at Muara fishing station.	

III. Area of Survey

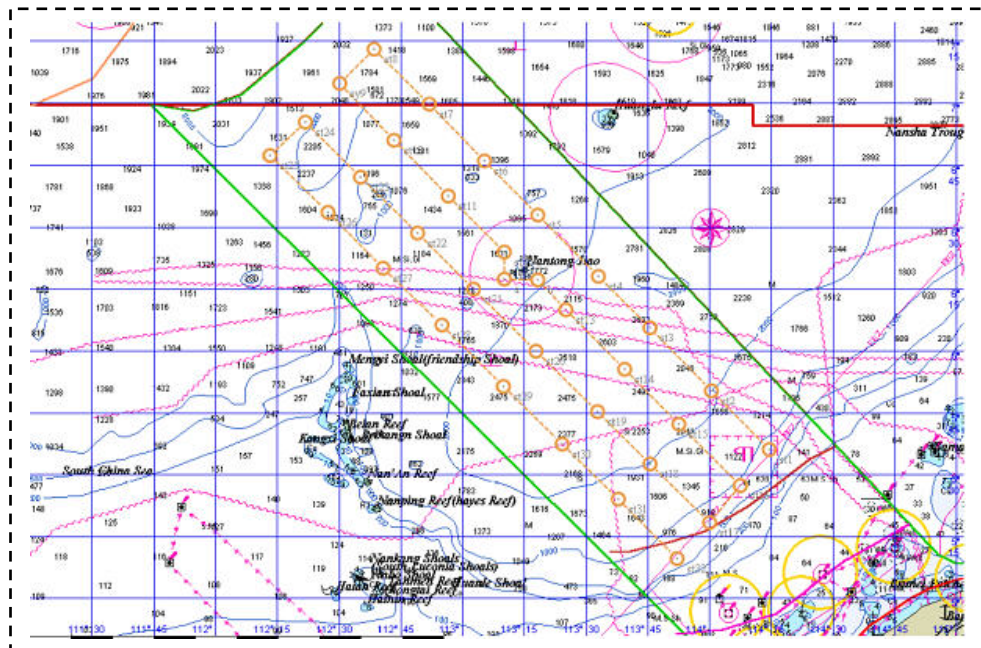


Figure 1. Map of the survey area and survey stations.

The survey has been conducted within the EEZ of Brunei (Figure 1). Numbers of planned survey station are 50 stations cover with continental slope (Zone 3) and deep sea (Zone 4). The area has been parted into 2 main areas, i.e.

1) Continental slope in Zone 3. Sea depth is different from 100 – 550 m. 18 survey stations (A1-A18) are planned to conduct oceanographic survey 18 stations, 18 bottom trawl operation for demersal resources survey on the first session and 18 bottom beam trawl operations on the second session. Period of the first session is carried out from 11 to 15 March 2009 and in the second session on 17-21 March 2009.

2) The deep sea zone (Zone 4) 32 Survey stations are planned to conduct the oceanographic and Hydroacoustic survey, IKMT were conducted during the third session. Sea depth is different from 800 m to 2,600 m, Period of the third session is carried out from 23 to 28 March 2009. Large pelagic fisheries resource by Pelagic longline in Zone 4 will be carried out 5 operations on last session, the location according to the result of acoustic survey.

IV. Survey summary

The mission of Cruise No.31-1/2009, The National Research Survey in the EEZ of Brunei, FQ-80 calibration was carried out on first day of the survey and topographic survey was conducted between stations A1 to A 18 before the fishing operation for checked the sea bottom on 11 March 2009. The cruise survey have to reschedule because of vessel was waiting for work permission in Brunei Darussalam from 13 to 22 March. To continue the survey on 23 March, so cruise survey plan had to arrange and the fourth session for pelagic longling was cancel. So the new schedule of the resource survey has been accomplished with 22 survey stations. The stations are divided into 21 Oceanographic survey, 9 operations and 2 fishing trial in trawl fishing ground of zone 3 area by Bottom Trawl, 11 operations and 2 fishing trial in fishing ground for shrimp of zone 2 area by Beam trawl operations. Hydroacoustic survey by FQ80 was conducted in

the third session for 4 operations (planned to 32 stations) due to the rough sea condition in the third session. Detail of activities is appeared into each part of activities, i.e. oceanographic survey and fisheries resources survey. Daily activity of survey is appeared into the table of research activities.

The first session (11-12 / 22-25 March 2009)

There are 10 oceanographic surveys at the odd number stations and stations no.18. Nine bottom trawl fishing operations and two fishing trials have been conducted on the first session from 11 to 25 March 2009 (Figure 2).

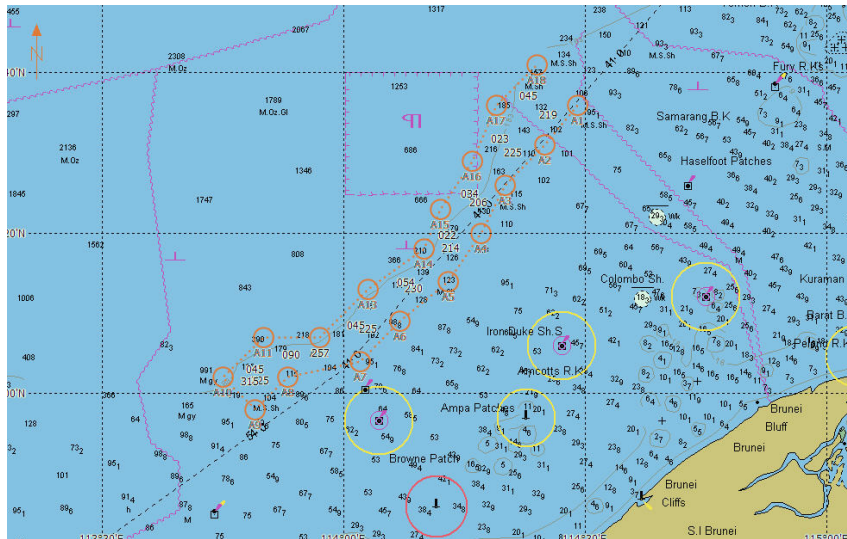


Figure 2. Map of the survey stations in Zone 3.

The second session (26 – 30 March 2009)

The second survey is started from 26 to 30 March 2009 in zone 3, which same station in first session (Figure 2). Oceanographic survey was conducted in an even number stations, but some stations had been operated in first session. There are 8 oceanographic survey stations, 11 bottom beam trawl fishing operations and 2 beam trawl fishing trial in zone 2 have been carried out in the second session.



Figure 3. Map of the survey stations in Zone 4.

The Third session (31 March – 2 April 2009)

This session is conducted from 31 March 2 April 2008 in the deep sea zone of Brunei water (Zone 4), the survey station had been to 12 station for Hydroacoustic survey, oceanographic survey and IKMT operation. The affected from the rough sea condition on 2 April, the survey had been cancelled and finished the cruise survey, then proceed back to Maura fishing port. Three stations of oceanographic survey, Hydroacoustic survey by FQ-80 from station B12-B9 and IKMTs operation were conducted. Depth of the survey area is from 2,000 m to ~2,600 m.

V. Fishery resources survey

Two categories of fishing gear, i.e. Bottom otter board and beam trawl, which were demersal resource survey in deep sea have been surveyed during survey. On the first, M.V. SEAFDEC 2 has operated the bottom trawl for investigate the resource abundant, species composition of demersal resources in continental slope in the deep sea of zone 3 of Brunei Waters, depth from 100-130 m and at the fishing ground of bottom trawl, depth 40 m. The second session, M.V. SEAFDEC 2 has operated the bottom beam trawl for investigation the demersal resource in target species on shrimp in the same area with first session, the rage of sea depth more deeper than bottom trawl. The range the sea depth from 100- 350 m for beam trawl fishing.

5.1 Bottom Trawl

5.1.1 Demersal resource survey

Nine bottom trawl fishing operations were carried out during the first of this cruise. Two out of nine at station No.A1 (A1-A2) and No.A6 (A6-A7) trawled less than 30 minutes. Due to the otter board was stuck at bottom ground because of the bottom ground was muddy.

5.1.2 Material and method

Demersal resources survey is sampled by using bottom trawl (Figure 4 - 5). M.V. SEAFDEC 2 bottom trawl is 2 seams trawl. Ground rope is 40.12 m. length and head rope is 32.56 m length. Net body is 66.37 m length. Ground rope is suitable for soft bottom. Cod end part is 40 mm double mesh size and make by polyethylene PE 700d/30. Net opening is about 4-10 m height and 10-17 m wing spread. Net spread by rectangular iron otter board 1400 mm length and 2,200 mm height. Sweep line is 30 m length with upper and lower net pendant 50 m

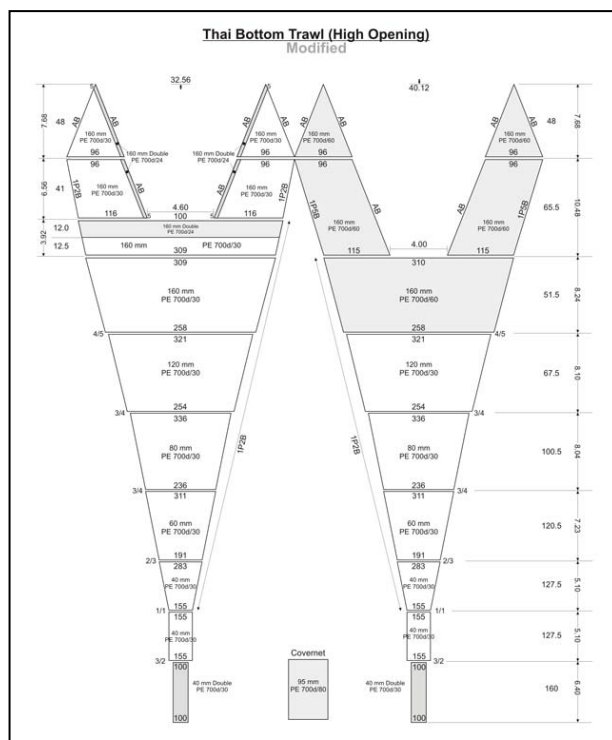


Figure 4. The monograph of the bottom trawl.

Trawling speed is 2.5-3.5 knot and trawling time is 30 minute per operation.

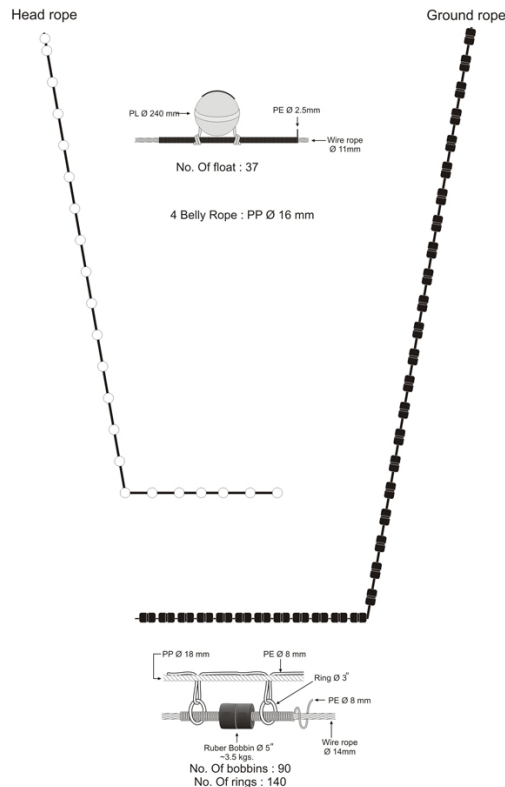


Figure 5. The construction of the head rope and ground rope of the bottom trawl.

5.1.3 Area of fishing operation

Bottom trawl were carried out in the continental slope of zone 3 (Figure 6). Sea depth was from 100 m to 132 m. To operated at the smooth of sea bottom station as A1, A2, A3, A4, A5, A6, A7, A8 and A9. In the outer line from station A 10 to A 18, sea depth was from 200 to 500 m. The fishing operation was not operated due to length of warp wire on MV SEAFDEC 2 not enough. 2 bottom trawl fishing operation were conduct at the fishing ground of zone 3 and 1 hours for towing time.

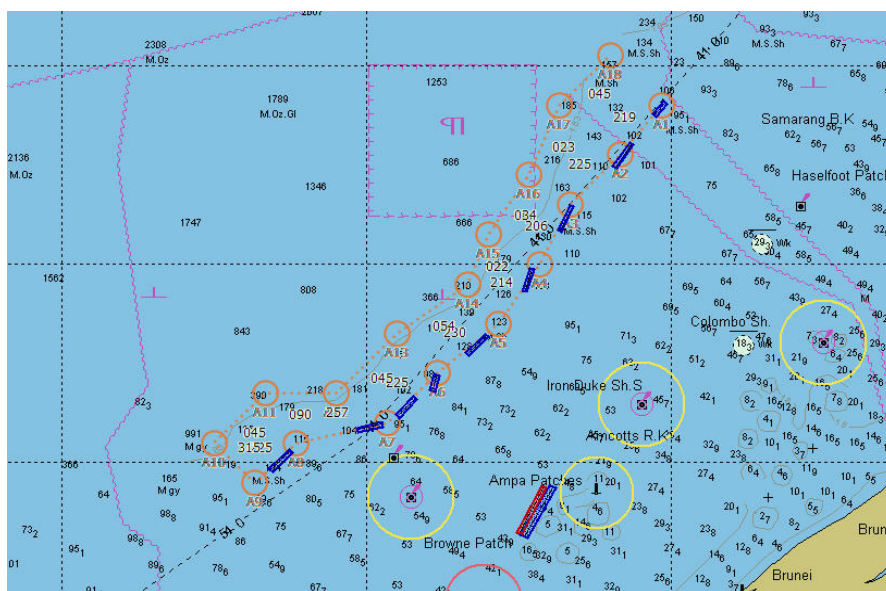


Figure 6. The survey tracks of the bottom trawl.

5.1.4 Result of resources survey

Total catch from 9 trawl fishing operations, 210 towing minutes, was 334.8 kilograms and CPUE was 95.65 kilogram. In Operation 1 and 6 the otter board were stuck with muddy bottom and trawling time less than 30 minute, so the data were not include in total catch. Operation 7 at station No.A6 is the highest catch with 102.15 kg and CPUE was 204.3 kg/hrs followed by operation5 of station A5 with the total catches of 60.74 kg and CPUE 121.48 kg/hrs (Table 1). The details of species composition, size composition and distribution of catches will be report by DOF/Brunei.

Table 1. Bottom trawl fishing data summary

Op. No	Ship speed (kt)	Towing time	Sea depth (m)	Warp length (m)	Net Opening (m)	Wing Spread (m)	Total catch Weight (kg)	CPUE (Kg/hr)
1	2.5	17	105-115	400	6-8	7.9	4.85	17.12
2	3.2	30	110	400	4.4	14.1	24.63	49.26
3	3.1	30	122-126	400	4.4	14.1	55.23	110.46
4	3.1	30	111	450	3.7	15.7	18.68	37.36
5	3.0	30	118-132	450	4.1	16.1	60.74	121.48
6	3.2	13	100	400	6.5	8	-	-
7	3.4	30	100	400	4	16	102.15	204.3
8	3.1	30	100	400	3.9	16	48.92	97.84
9	3.1	30	115-119	450	3.7	15	24.45	48.9

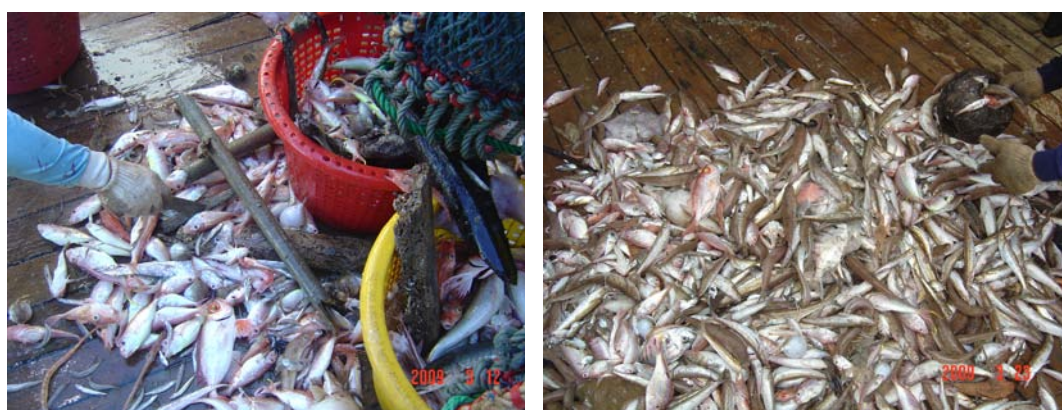


Figure 7. Catches from the bottom trawl.

5.2 Beam trawl

SEAFDEC design of deep sea beam trawl gear and its net were developed and modified and developed from the old ones of SEAFED beam trawl that we used in the year 2008 to gain more 100 kg in weight of iron beam and to change wider and longer of net (Figure 8).

Head rope and ground ropes are made from Z-twist Polypropylene rope, diameter 12 mm. Length of head rope is 4 m. and ground rope length is 8.70 m. The wing parts and square part are made from polyethylene net, twine size 700d/18 and mesh size is 38 mm.

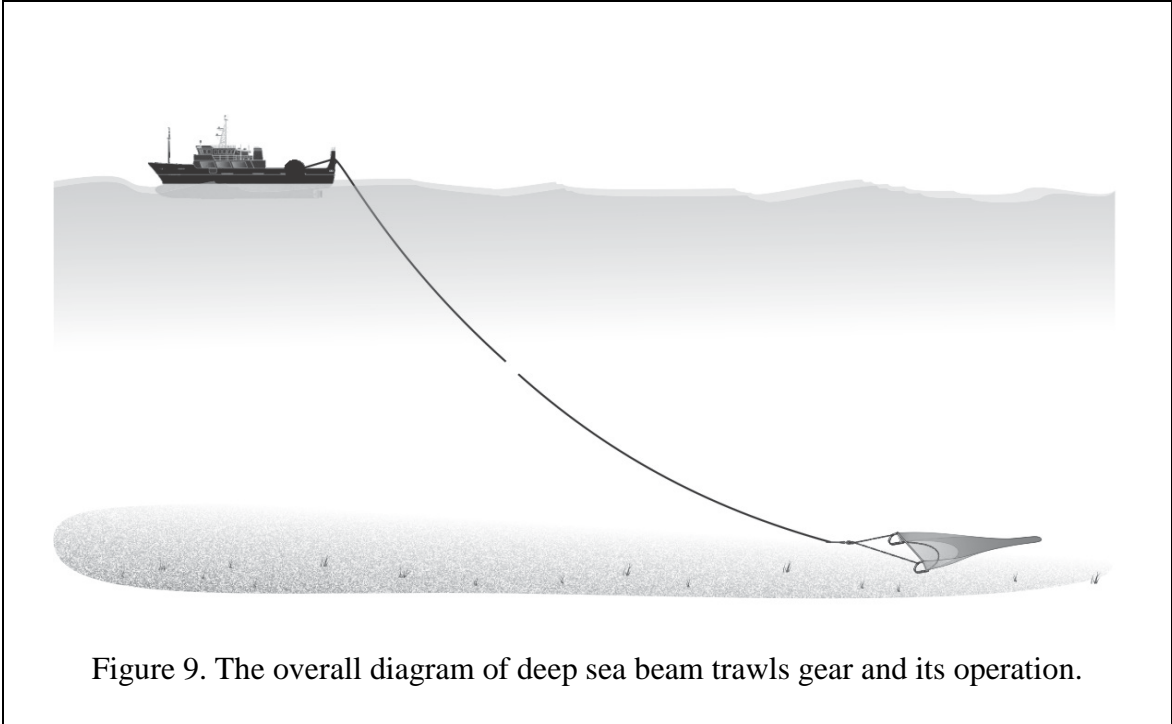


Figure 10. Beam trawl preparation.

5.2.1 Fishing operations

Eleven fishing operations were conducted during the second session. Beam trawl fishing trials were conducted only in the daytime as the shrimp species always bury themselves under the muddy. Therefore, daytime operations are the most appropriate period for fishing trial. Towing time of operations was 60 minute. Sea depth of those 11 operations was range between 100 and 370 m. The towing line was released 1.5 to 2.5

times of the sea depth. The towing speed was reduced to between 2.5 – 3.3 knots at the rock and/or coral bottom to reduce the damage of the trawl net (Figure 9-10).

5.2.2 Area of beam trawl operation

Bottom beam trawl were carried out on the continental slope of zone 3 (Figure 11). Sea depth was range from 100 m to 1374 m. The survey was carried out on the smooth sea bottom which the sea depth not more than 200 m at station A1, A2, A3, A4, A5, A6, A7, A8, A11, A12, and A13.

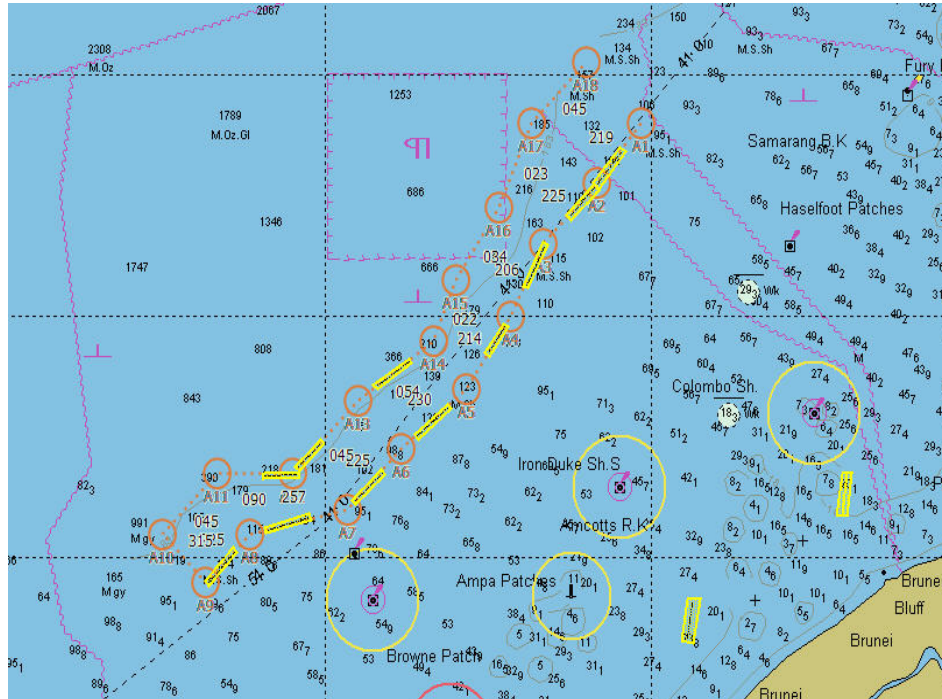


Figure 11. Fishing tracks of bottom beam trawl.

5.2.3 Results of beam trawl survey

Total catches from 11 beam trawl fishing operations of about 660 towing minutes was 40.25 kg and CPUE was 3.65 kg/hrs. Highest catches was found at the operation number 9 of station A11 with the total catches of 5.12 kg followed by station A4 of the 4th operation with the total catches of 4.36 kg (Table 2). Flatfish and shrimp were dominant in the catches from beam trawl. The maximum number of shrimp specimens was found at station A13 (4.18kg). The details of species composition, size composition and distribution of catches will be report by DOF/Brunei.

Table 2. Beam trawl fishing data summary

Op. No	Ship speed (kt)	Towing time	Sea depth(m)	Warp Length (m)	Total catch (kg)	CPUE (Kg/hr)
1	3.3	60	110	250	2.85	2.85
2	2.9	60	109	250	4.7	4.7
3	3	60	127	300	2.38	2.38
4	2.4	60	112	270	4.36	4.36
5	2.9	60	118	270	2.83	2.83
6	2.9	60	100	250	4.8	4.8
7	2.9	60	105	250	3.7	3.7
8	2.5	60	116	270	3.14	3.14
9	2.8	60	213	450	5.12	5.12
10	2.5	60	206-235	500	2.19	2.19
11	3.1	60	270-350	650	4.18	4.18



Figure 12. Catches from the beam trawl.

5.3 Hydroacoustic survey

The acoustic survey in Brunei waters was conducted only one day on 1st April 2009 due to the sea condition. This survey for estimate the pelagic marine resources range from sea surface to 600 meters depth by using scientific echosounder on board M.V.SEAFFDEC2 namely Furuno FQ80. All together 3 survey tracks were done. Data recorded with dB value in “SCSV” output selected. The data file set contains both of low frequency (38 kHz) and high frequency (120 kHz) with the short pulse length. All data were stored in hard drive and gave to researcher of Brunei Darussalam. For more detail and information of each track see in the acoustic observation logsheet.

5.4 Isaacs-Kidd Mid-Water Trawl

Isaacs-Kidd mid-water trawl (IKMT) is oceanography tool used to collect bathypelagic biological specimens larger than those taken by standard plankton nets. The IKMT is a long, round net approximately 6.50 m long, with a series of hoops decreasing in size extending from the mouth of the net to the rear (cod) end, which measures an additional 2 m in length (Figure 13). The hoops maintain the shape of the net during towing. The mouth of the net is 1.75 m wide by 1.30 m high, and is attached to a V-shaped, rigid diving vane

The outer net of IKMT is PA multifilament ϕ 1 mm, mesh side 75 mm and the inner net is PA multifilament (knotless) ϕ 0.5 mm, mesh size 16 mm. Codend part used the plankton net mesh size 600 micron. All bridles are SST wire ϕ 8 mm. The net spreader is iron ϕ 35 mm with approximately 1.50 m length. The depressor made from iron plat and all details of IKMT are shown in figure below.

Three operations of IKMT were conducted for the living organisms collecting at the deep-scattering layer with towing speed between 4 knots and approximated towing time as 30 minute. To make sample collection correct, the target area had detected by the scientific echo-sounder (Furuno FQ80) before and during the operation. All sample that collected by IKMT were preserved with formalin 10% solution. For more details and information of each operation see in the IKMT

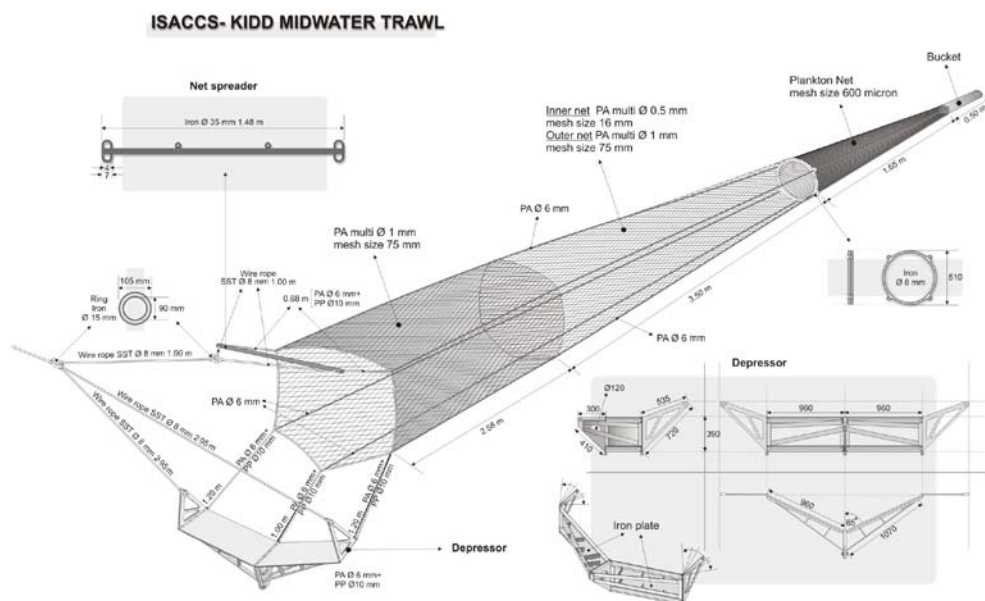


Figure 13. ISACCS-KIDD Midwater trawl construction.

VI. Oceanographic survey

There are 21 oceanographic stations conducted in leg I, II and III, respectively (Figure 14). Partial details of the survey and environmental condition of each station had shown in table 3 and 4, respectively. The materials and methods of the oceanographic survey are described as followed;

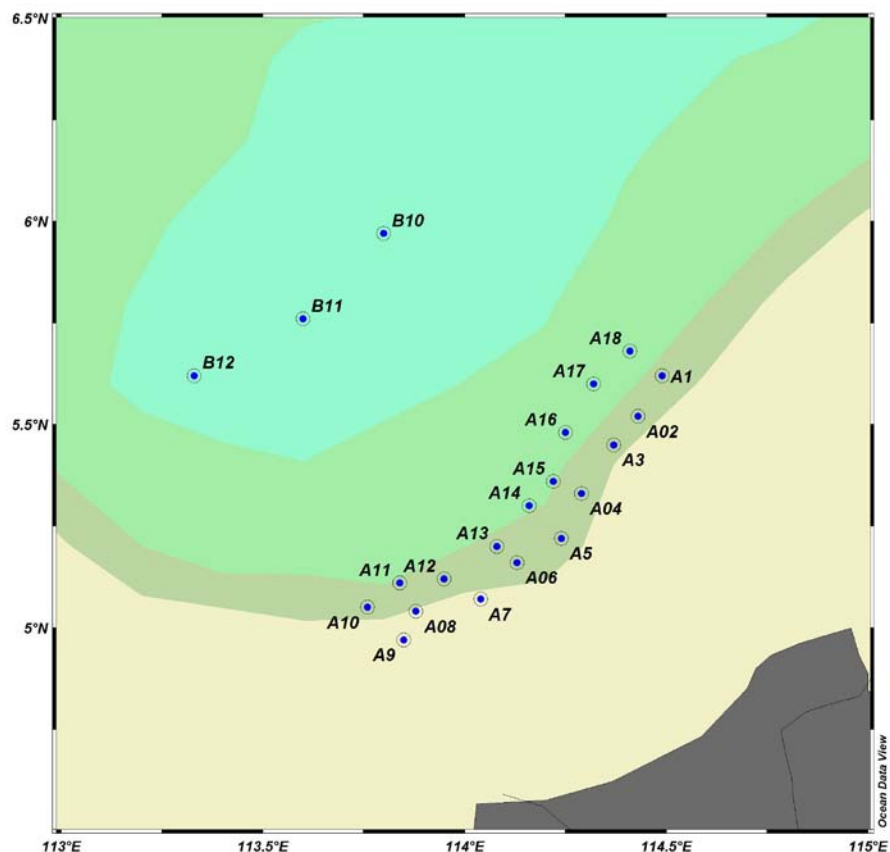


Figure 14. Map of the oceanographic stations at the Brunei Darussalam Waters.

6.1 Physical and chemical oceanography

The iCTD was deployed from the sea surface to approximately 5 meter above the sea bottom and the maximum depth of 350 meter at the station deeper than 400 meter. Physical and chemical characteristic of water including conductivity, temperature, depth, dissolved oxygen, and PAR was measuring using SeaBird 911 CTD and Thermosalinograph with Fluorometer (TSG-Fluorometer). All iCTD data were average into every 1 meter interval. Data in each station were divided into down cast and up cast.

TSG – Fluorometer were operated along the cruise track of M.V. SEAFDEC 2 to measure the temperature and chlorophyll a. The system was designed to pump water from approximately 5 meter below the sea surface continuously. The data were average every 6 second. Operating summary had shown in table 3.

During retrieving the iCTD, Carousel Water Sample comprised with the Niskin Bottles which is a part of CTD system were used for collecting water samples from standard depth (Table 3). About 60 ml of water sample from Niskin bottles was

filter through Whatman GFC filter paper and stored in the freezer at -45 °C for nutrient analysis (nitrite, nitrate, phosphate and silicate) at SEAFDEC/TD laboratory.

Water sample of 125 ml were collected and using the handheld digital pH meter to measure the sea water pH from standard depth.

6.2 Biological oceanography

Marine biology was conducted on the fish larvae, fish juvenile, and zooplankton. The 45 cm diameter bongo frames were attached with the net mesh size of 500 μm and 330 μm , respectively. A flow meter was attached at the aperture of net to measure the water volume passing through the net. Bongo net was oblique tow with ship speed approximately 1-2 knots. Angle of towing cable was maintained at 45°. Towing depth was observed using Net SONDE (depth meter). Towing time for downward and upward was 30 minute each. The samples were preserved in 5% buffered formalin and seawater immediately. Partial details of Bongo net operation are in table 3.

Fish larvae and juvenile was also collected using the Neuston net. The 75 cm long, square shape frame with net mesh size 1000 μm . The operation was conducted after the bongo net operation with the towing time approximately 15 minute at the sea surface. The details of the Neuston net operation are in table 3.

Heavy Metal in flesh of marine fish were collected every fishing operations, three samples of three commercial fish species (*Saurida* sp., *Nemipterus* sp., *Upeneus* sp. were collected and freeze in -15 °C for further analysis at Faculty of Environment Management, Prince Songklanakarin University.

6.3 Preliminary analysis of oceanographic parameters

The vertical profiles of temperature, salinity, conductivity, dissolved oxygen and pH from the oceanographic stations A1 to A9, A10 to A18, and B10 to B12 were plotted and shown in figure 15, 16, and 17, respectively.

All the survey stations conducted during the day time (air temperature recorded between 27-32 °C). Sea depth varies between 80 m (station A08) and 2,494m (station B09). Water transparency measured from 8 m to 23m. Sea surface temperature was between 28-32 °C. Rapid changes of salinity, dissolved oxygen, and pH with increasing depth also found at the thermocline layer. At depth greater than 150 m, salinity are nearly stable (Figure 15-17). The subsurface salinity varied between 30 to 33 PSU and low salinity was observed in the southwestern area of station A07 to A09 (Figure 17-18).

The spatial and temporal patterns of inter-monsoon temperature variability along the continental shelf edge (station A1 to A9) off Brunei Coast. The seasonal thermocline layer was observed at the depth between 10 and 60 m at sea temperature range from 29 °C to 24 °C (Figure 15-16). While the permanent thermocline could observed at the greater depth from 60 to 100 meter (Figure 15-16). The mechanism to role the seasonal thermocline incident in those areas may the linkage between the low salinity at the subsurface layer and the wind stress affects thermocline depth. The low salinity at subsurface layer (Figure 15-16) as a consequence of the large-scale of the rain during the survey period. The weaken wind prevailed during the transitional period between Northeast and Southwest monsoon in April affect to the water circulation in those areas. The unwell-mixing of the subsurface layer with the deeper layer driven the subsurface seasonal thermocline layer (10 – 60 meter) and the deep mixed layer in the permanent thermocline (60 – 100 meter) (Figure 15-16).

The spatial patterns of the temperature variability along the continental slope (station A10 to A18) and off Brunei Waters (station B10 to B12) were corresponding to the observational datasets of station A1 to A8 (Figure 20).

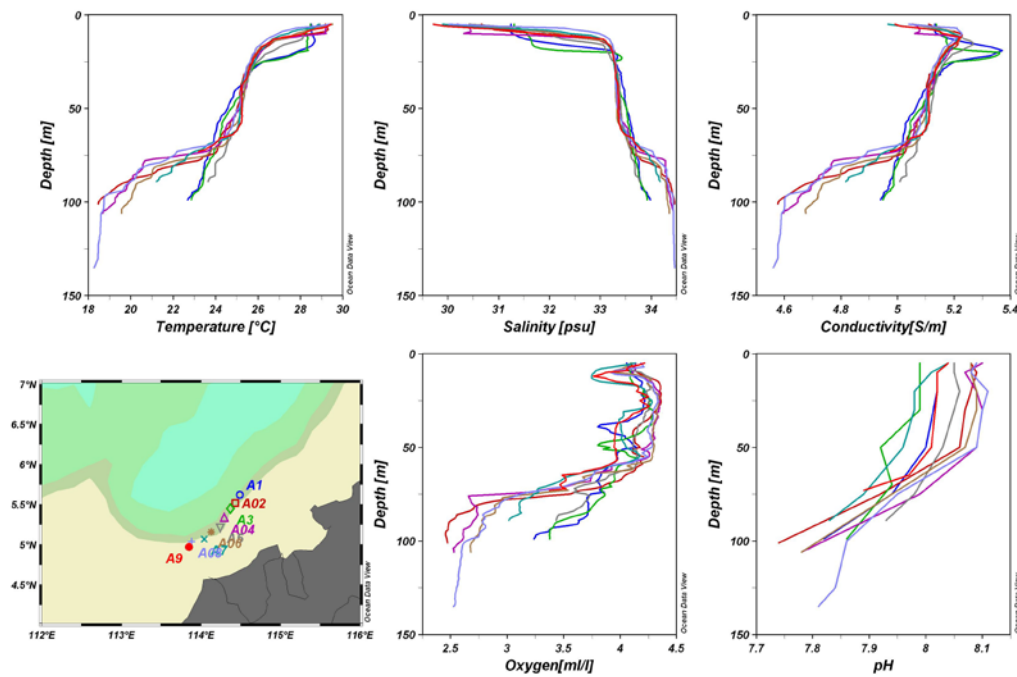


Figure 15. Profile of temperature ($^{\circ}\text{C}$), salinity (psu), conductivity (S/m), dissolved oxygen (ml/l), and pH of oceanographic stations A1 to A9.

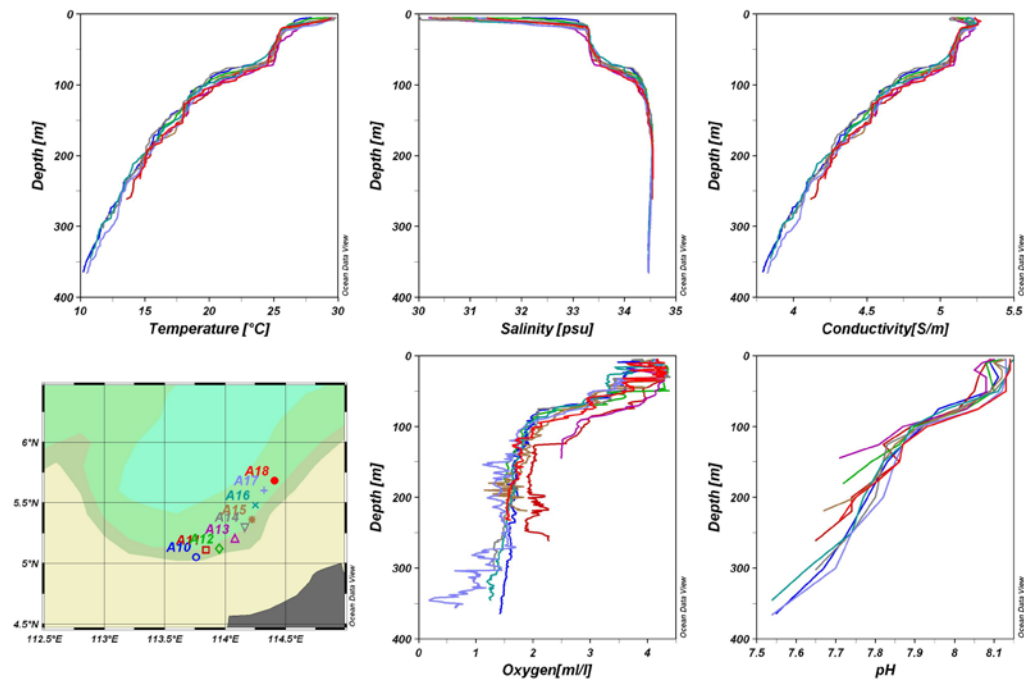


Figure 16. Profile of temperature ($^{\circ}\text{C}$), salinity (psu), conductivity (S/m), dissolved oxygen (ml/l), and pH of oceanographic stations A10 to A18.

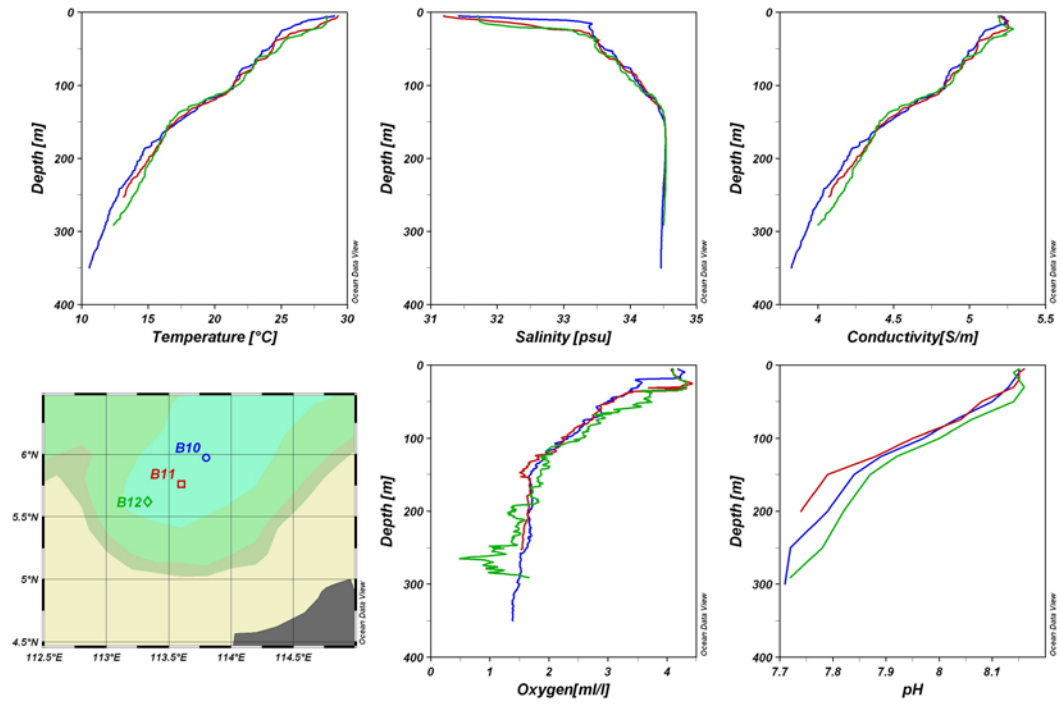


Figure 17. Profile of temperature ($^{\circ}\text{C}$), salinity (psu), dissolved oxygen (ml/l), and pH of oceanographic stations B10 to B12.

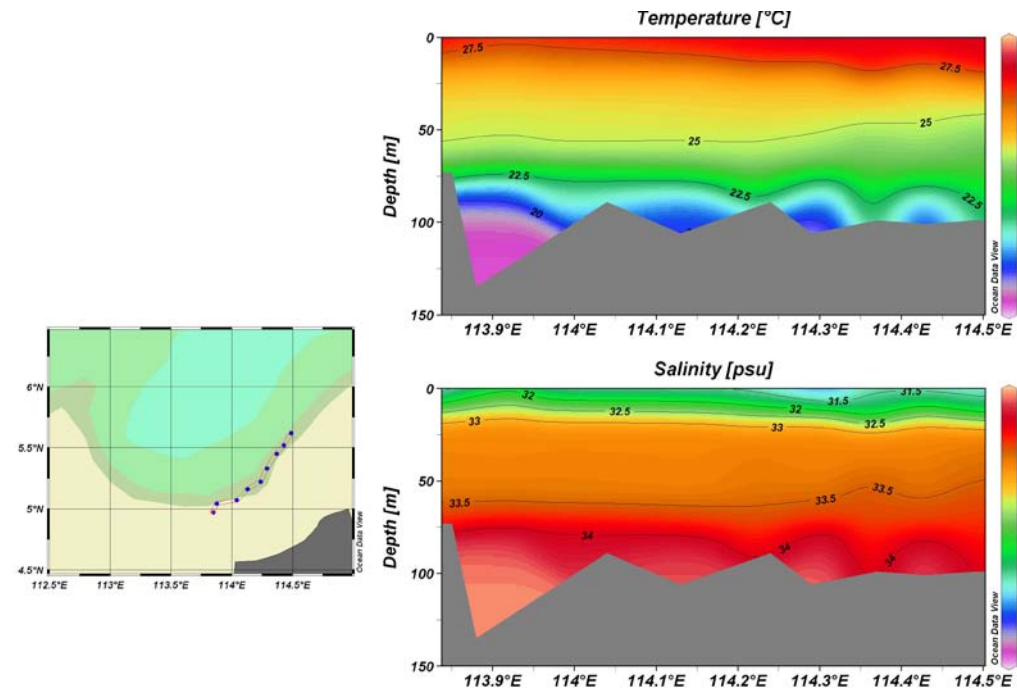


Figure 18. Vertical plot along the survey track at station A1 to A9 of temperature ($^{\circ}\text{C}$) and salinity.

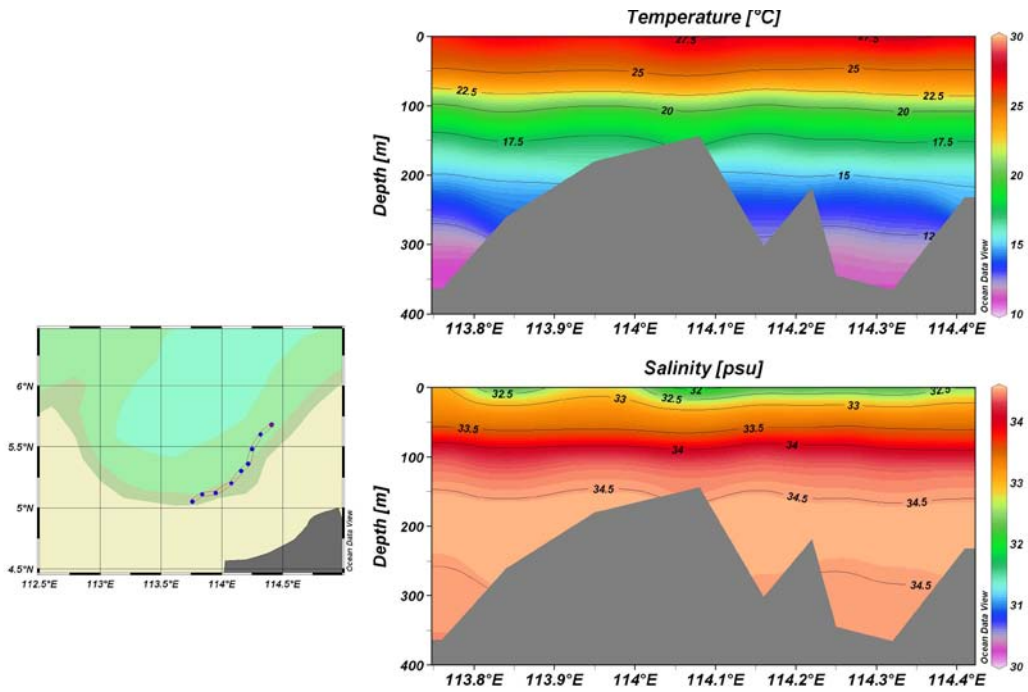


Figure 19. Vertical plot along the survey track at station A10 to A18 of temperature (°c) and salinity.

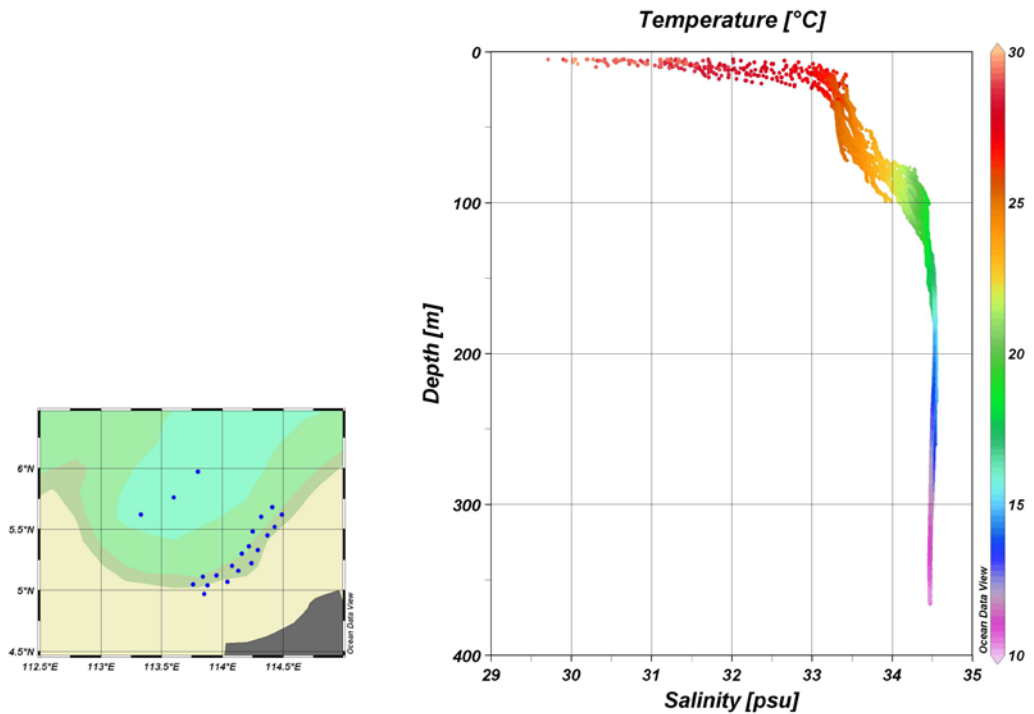


Figure 20. Vertical profiles of temperature-salinity by sea depth along the survey tracks of station A1 to A18, B10 to B12.

Table 3. Partial detail of oceanographic stations

St. no.	Date	Start	Finish	Position		Bottom Depth (m)	CTD file name	TSG file name	Bongo net				Neuston net					
				Latitude	Longitude				Towing depth (m)	Start Time	Towing period (min)	Flowmeter rev.		Start Time	Towing period (min)	Flowmeter rev.	Trans- parency (m)	Niskin bottle (depth, m)
												F. Larvae (50µm)	Zoo. (30µm)					
A01	12-Mar-09	06:14	07:40	05° 35.9' N	114° 29.3' E	108	s2d31A01, s2u31A01		70	6:32	32	10050	10865	07:07	33	5132	-	10,20,50,75,100
A02	27-Mar-09	07:52	09:04	05° 31.4' N	114° 25.7' E	108	s2d31A02, s2u31A02		60	07:52	31	10290	10055	08:25	16	3153	22.9	0,10,20,30,50,75,100
A03	12-Mar-09	12:15	13:28	05° 26.2' N	114° 20.7' E	109	s2d31A03, s2u31A03		65	12:15	30	19070	19100	12:50	15	3562	-	0,10,20,30,50,70,102
A04	27-Mar-09	12:34	13:35	05° 19.9' N	114° 17.2' E	112-117	s2d31A04, s2u31A04		75	12:50	27	10975	10805	13:20	15	3630	17.6	0,10,20,30,50,75,106
A05	12-Mar-09	17:16	18:19	05° 13.9' N	114° 13.3' E	96	s2d31A05, s2u31A05		-	17:16	30	12720	12600	17:48	16	3187	-	0,10,20,30,50,75,92
A06	27-Mar-09	17:47	18:50	05° 09.4' N	114° 07.7' E	113-115	s2d31A06, s2u31A06		60	17:47	31	11930	11755	18:20	15	2398	-	0,10,20,30,50,75,106
A07	23-Mar-09	11:55	13:38	05° 04.1' N	114° 02.5' E	99	s2d31A07, s2u31A07		-	11:55	27	10055	10315	12:25	20	3469	9.1	0,10,20,30,50,75,90
A08	28-Mar-09	10:10	11:18	05° 02.7' N	113° 52.9' E	80	s2d31A08, s2u31A08		80	10:10	32	10405	10370	10:44	16	3231	7.5	0,10,20,30,50,75,100,125,135
A09	23-Mar-09	17:35	18:39	04° 57.8' N	113° 49.1' E	96	s2d31A09, s2u31A09	s2cr31A01toA18	-	17:35	30	13470	13465	18:08	17	3080	17.2	0,10,20,30,50,65,79
A10	28-Mar-09	13:45	15:04	05° 02.8' N	113° 45.4' E	598-616	s2d31A10, s2u31A10		85	13:45	31	12770	11670	14:18	15	3789	9.6	10,30,50,75,100,125,150,200,250,300,364
A11	24-Mar-09	06:59	08:05	05° 06.8' N	113° 50.3' E	306-330	s2d31A11, s2u31A11		110	7:18	27	10585	12375	07:49	16	3939	-	0,10,20,30,50,75,100,125,150,200,220,262
A12	28-Mar-09	17:35	18:42	05° 06.9' N	113° 56.8' E	197	s2d31A12, s2u31A12		110	17:35	30	7700	7740	18:07	16	2947	-	0,10,50,75,100,125,150,180
A13	24-Mar-09	08:18	10:28	05° 13.0' N	114° 03.3' E	167	s2d31A13, s2u31A13		-	09:37	30	13215	13165	09:18	16	3287	13.9	0,10,20,30,50,75,100,125,144
A14	29-Mar-09	10:35	11:46	05° 17.9' N	114° 09.7' E	314	s2d31A14, s2u31A14		100	10:35	31	8650	8855	11:08	17	4033	13.2	0,10,20,30,50,75,100,125,200,250,302
A15	24-Mar-09	11:32	12:45	05° 21.5' N	114° 13.3' E	232-239	s2d31A15, s2u31A15		-	11:32	28	12735	11690	12:05	16	2445	13.2	0,10,20,30,50,75,100,125,150,175,200,219
A16	24-Mar-09	13:04	14:19	05° 28.7' N	114° 15.2' E	524-528	s2d31A16, s2u31A16		110	13:04	29	8405	8240	13:37	15	3685	18.4	0,10,30,50,75,100,125,150,200,250,300,350
A17	24-Mar-09	14:10	15:23	05° 36.1' N	114° 19.4' E	515	s2d31A17, s2u31A17		-	14:33	29	13090	14425	15:05	18	3274	15.4	0,10,30,50,75,100,125,150,200,250,300,366
A18	24-Mar-09	16:00	17:09	05° 41.0' N	114° 24.2' E	248-257	s2d31A18, s2u31A18		-	16:16	29	9190	9020	16:00	15	3970	-	0,10,20,30,50,75,100,125,150,175,200,232
B09	2-Apr-09	06:15	06:30	06° 13.2' N	114° 01.4' E	2494	s2d31B09, s2u31B09		-	-	-	-	-	06:15	15	2950	-	-
B10	1-Apr-09	15:17	16:36	05° 58.3' N	113° 50.1' E	2258	s2d31B10, s2u31B10	s2cr31B10toB09	70	15:17	30	12140	12350	15:50	16	3841	15.3	5,10,30,50,75,100,125,150,200,250,300,350
B11	1-Apr-09	10:34	11:57	05° 45.4' N	113° 36.0' E	2368	s2d31B11, s2u31B11	s2cr31B11toB10	70	10:34	31	13150	13950	11:08	17	2816	13.6	5,10,20,30,50,75,100,125,150,200
B12	1-Apr-09	06:06	07:25	05° 36.9' N	113° 19.5' E	2248	s2d31B12, s2u31B12		75	06:53	32	12160	12050	06:35	15	4143	-	5,10,30,50,75,100,125,150,200,250,300

Table 4. Environmental condition during oceanographic survey

Station No.	Position		Wind		Air		Sea Surface Temp (°C)	10 m		25 m		50 m				
	Latitude	Longitude	Spd. (Knt)	Dir.	Temp (°C)	Humidity (%)		Weather	Sea stage	Spd.(Knt)	Dir	Spd.(Knt)	Dir	Spd.(Knt)	Dir	
A01	05° 35.9' N	114° 29.3' E	8.0	240	26.7	1013.5	84	cloudy	calm	28.6	0.6	056	0.5	041	0.6	059
A02	05° 31.4' N	114° 25.7' E	6.0	120	28.7	1014.5	85	cloudy	slight	28.9	0.7	120	0.7	194	0.6	211
A03	05° 26.2' N	114° 20.7' E	12.0	240	29.0	1014.0	78	partly cloudy	slight	28.6	0.9	064	0.7	043	0.5	038
A04	05° 19.9' N	114° 17.2' E	10.0	140	31.1	1015.0	73	cloudy	slight	31.9	0.2	191	0.7	227	0.9	247
A05	05° 13.9' N	114° 13.3' E	8.0	290	29.0	1011.5	85	partly cloudy	calm	29.5	0.4	087	0.6	032	0.7	037
A06	05° 09.4' N	114° 07.7' E	10.0	240	30.1	1012.5	85	partly cloudy	calm	30.4	0.5	184	0.7	207	0.6	227
A07	05° 04.1' N	114° 02.5' E	6.0	180	30.3	1016.5	79	cloudy	slight	30.4	0.1	158	0.4	208	0.6	249
A08	05° 02.7' N	113° 52.9' E	8.0	090	32.0	1015.5	74	cloudy	calm	30.1	0.5	190	0.5	262	0.3	272
A09	04° 57.8' N	113° 49.1' E	6.0	310	30.7	1013.0	78	cloudy	calm	30.4	0.1	006	0.3	215	0.5	270
A10	05° 02.8' N	113° 45.4' E	10.0	000	31.8	1013.0	79	cloudy	calm	30.2	0.0	000	0.1	284	0.4	289
A11	05° 06.8' N	113° 50.3' E	8.0	000	28.1	1014.5	96	cloudy	calm	29.4	0.2	069	0.1	066	0.4	280
A12	05° 06.9' N	113° 56.8' E	10.0	000	30.5	1011.5	85	cloudy	calm	30.6	0.5	226	0.4	235	0.5	252
A13	05° 13.0' N	114° 03.3' E	10.0	310	28.2	1017.0	85	cloudy	calm	29.7	0.2	101	0.1	209	0.3	257
A14	05° 17.9' N	114° 09.7' E	8.0	040	30.8	1014.0	79	cloudy	slight	29.9	0.4	226	0.4	235	0.5	224
A15	05° 21.5' N	114° 13.3' E	6.0	310	28.7	1016.5	92	cloudy	calm	29.8	0.1	262	0.2	243	0.2	257
A16	05° 28.7' N	114° 15.2' E	12.0	040	29.7	1012.0	73	cloudy	slight	29.5	0.0	000	0.1	343	0.2	237
A17	05° 36.1' N	114° 19.4' E	2.0	170	32.4	1013.5	67	cloudy	calm	30.7	0.2	309	0.1	267	0.1	248
A18	05° 41.0' N	114° 24.2' E	2.0	160	32.1	1012.5	63	partly cloudy	calm	31.9	0.1	359	0.1	213	0.1	214
B09	06° 13.2' N	114° 01.4' E	20.0	100	28.4	1010.5	92	cloudy	moderate	29.1	0.0	079	0.1	060	0.3	124
B10	05° 58.3' N	113° 50.1' E	8.0	180	31.2	1010.0	73	cloudy	slight	29.5	0.0	000	0.5	248	0.5	254
B11	05° 45.4' N	113° 36.0' E	10.0	240	29.4	1013.0	85	cloudy	slight	29.3	0.0	000	0.2	252	0.4	238
B12	05° 36.9' N	113° 19.5' E	12.0	100	28.5	1011.0	92	Heavy Rain	moderate	28.4	0.0	000	0.3	052	0.5	273