

ORV SAGAR KANYA
CRUISE 289
(21 September - 25 October 2011)

NATIONAL INSTITUTE OF
OCEANOGRAPHY
(Council of Scientific and Industrial Research)
Dona Paula, Goa 403004

REPORT ON CRUISE 267 OF ORV SAGAR KANYA

CONTENTS

1. Summary
2. Cruise track
3. Introduction
4. Itinerary
5. Cruise participants
 - 5.1. Scientific component
 - 5.2. Ship's complement
6. Objectives
7. Work accomplished
 - 7.1. Parameters measured
 - 7.2. Instrument and machinery used onboard
 - 7.3. NIO Equipment used onboard
 - 7.4. ADCP operations
 - 7.5. Surface met observation
 - 7.6. CTD operations
 - 7.7. MPN operations
 - 7.8. Deck incubation
 - 7.9. *In situ* primary production measurements
 - 7.10. Grazing experiment
 - 7.11. Vaisala Sonde operations
 - 7.12. Aerosol measurements
8. Performance of the equipment used
9. Performance of the ship
10. Loss Report
11. Conclusions
12. Recommendations
13. Acknowledgements

Appendix - I. Table 1

Appendix – II Table 2

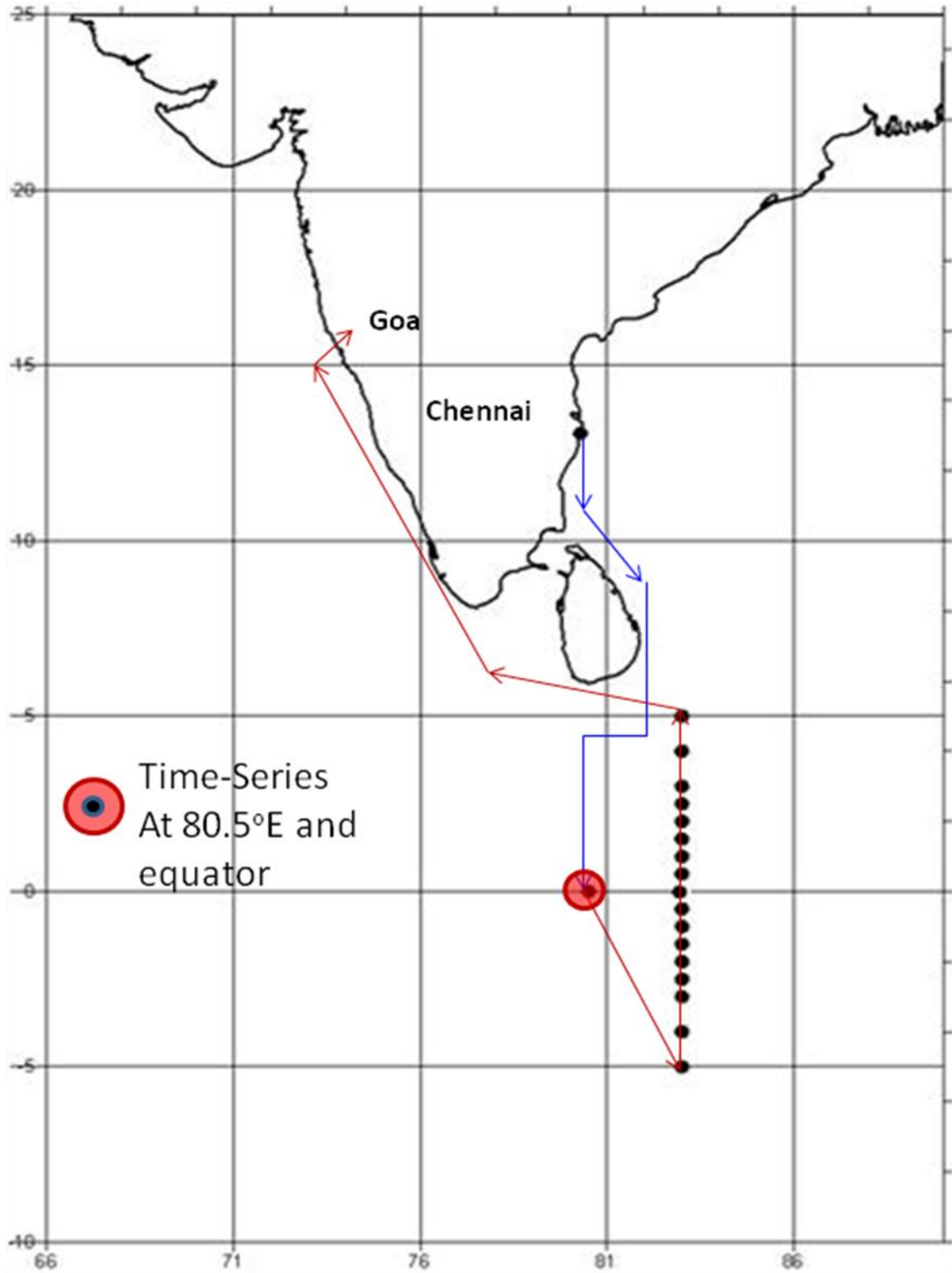
1. SUMMARY

The 289th cruise of ORV *Sagar Kanya* forms a part of the water column measurement planned under the national programme “Equatorial Indian Ocean Process Studies – Dynamics and biogeochemistry (EIOPS)” funded by Ministry of Earth Sciences (MoES) and also forms a part of the National Institute of Oceanography’s supra Institutional programme SIP-1306. The objective of the programme is to address the seasonal variability of the upper ocean in response to atmospheric forcing and its implication to overall biogeochemistry. The present cruise forms the last measurement under this programme. For the present cruise, the *in situ* measurements consisted of two parts – (1) a time-series measurement at two locations [equator and 80.5°E from 25th September to 3rd October 2011; and equator and 83°E from 4th October to 12th October 2011], and (2) a cross-equatorial transect along 83°E from 5°S to 5°N from 12th to 20th October 2011. The measurements were designed to capture the signature of fall intermonsoon. For the time-series measurements the CTD was operated at 3-hourly intervals up to 500m and during noon up to 1000m for the time-series duration. For the cross-equatorial transect CTD was operated up to 1000m at half-a-degree interval from 3°N to 3°S and at one-degree-interval in the rest of the stations (See Fig.1) along 83°E from 5°N to 5°S with 5L Niskin bottles. In all 17 CTD stations were occupied along the trans-equatorial section. Water samples were collected for the analysis of chemical (surface, 10m, 20m, 40m, 60m, 80m, 100m, 120m, 150m, 200m, 300m, 400m, 600m, 800m and 1000m) and biological parameters (surface, 10m, 20m, 40m, 60m, 80m, 100m and 120m) by operating the CTD twice (usually Deep Cast from 1000 - 60 m and Shallow cast from 40 - 1 m). Similarly there was separate cast for Primary Productivity (PP, up to 120 m). Multiple plankton net (MPN) was operated at mid-day and mid-night at time-series as well as PP stations to get the stratified biomass in the depth range 1000-500, 500-300, 300-base of the mixed layer, and from base of the mixed layer to surface. In addition, in the time-series locations a 6-hourly MPN was operated for 24-hours during the beginning and end of the time-series. Similarly at the time-series location PP experiment (12-hours) as well as Grazing experiments (48-hours) were carried out at the beginning and end of the time-series. In addition, *in situ* PP measurements were carried out at 5°N, equator and 5°S along 83°E. To achieve *in situ* conditions for PP measurements, the PP mooring assembly with samples from 8 different depths (surface, 10m, 20m, 40m, 60m, 80m, 100m and 120m) after adding tracer substrates was deployed before day-break and recovered after sun set. In these locations (5°S, equator and 5°N)

MPN was operated up to 2800m. Surface meteorological parameters were collected at CTD locations while ADCP data were collected along the track. Vaisala sounding was carried out at 6-hourly interval at the time-series stations, while along the 83°E Vaisala sounding was done at CTD stations.

In addition to the above waters samples were collected from the surface en-route in the Arabian Sea for isotope analysis under IWIN programme.

2. CRUISE TRACK



3. INTRODUCTION

The 289th cruise of ORV *Sagar Kanya* forms a part of the water column measurement planned under the national programme “Equatorial Indian Ocean Process Studies – Dynamics and biogeochemistry (EIOPS)” funded by Ministry of Earth Sciences (MoES) and also forms a part of the National Institute of Oceanography’s (NIO) supra Institutional programme SIP-1306. The objective of the programme is to address the seasonal variability of the upper ocean in response to atmospheric forcing and its implication to overall biogeochemistry. The present cruise forms the last measurement under this programme. For the present cruise, the *in situ* measurements consisted of two parts – (1) a time-series measurement at two locations [equator and 80.5°E from 25th September to 3rd October 2011; and equator and 83°E from 4th October to 12th October 2011], and (2) a cross-equatorial transect along 83°E from 5°S to 5°N (12th October 2011 from 1030 hrs to 20th October 2011). The measurements were designed to capture the signature of fall intermonsoon.

For *in situ* measurements, the CTD was operated at 3-hourly interval at the time-series locations, while along the 83°E trans-equatorial section from 5°N to 5°S CTD was operated at half-a-degree interval from 3°N to 3°S and at one-degree-interval in the rest of the stations (See Fig.1) with 5L Niskin bottles. In all 134 CTD stations were occupied. Water samples were collected for the analysis of chemical (surface, 10m, 20m, 40m, 60m, 80m, 100m, 120m, 150m, 200m, 300m, 400m, 500m, 600m, 800m and 1000m) and biological parameters (surface, 10m, 20m, 40m, 60m, 80m, 100m and 120m) by operating the CTD twice (usually 1000 - 60 m and 40 - 1 m). Similarly there was separate cast for Primary Productivity (PP, up to 120 m) and Grazing Experiment (60L from SCM). Multiple plankton net (MPN) was operated at each of the stations to get the stratified biomass in the depth range 1000-500, 500-300, 300-base of the mixed layer, and from base of the mixed layer to surface. At 3 locations along 83°E (equator, 5°S and 5°N) MPN was lowered up to 2800m to collect samples from 2800-2000m, 2000-1000m, 1000-500m, 500-300m, 300-0m in the deep cast and from 300-base of thermocline, base of thermocline to base of the mixed layer, and from base of the mixed layer to surface. To achieve *in situ* conditions for PP measurements, the PP mooring assembly with samples from 8 different depths (surface, 10m, 20m, 40m, 60m, 80m, 100m and 120m) after adding tracer substrates was deployed before day-break and recovered after sun set at 3

stations (along 83°E), while PP and grazing experiments were carried out by deck incubation, twice at each of the time-series stations at the beginning and towards the end of the time-series.

4. ITINERARY

Departure: Chennai, 21 September 2011

Arrival: Marmugoa, 25 October 2011

5. CRUISE PARTICIPANTS

5.1 Scientific component

1. Dr. S. Prasanna Kumar, Chief Scientist	National Inst. of Oceanography
2. Dr. Jayu Narvekar, Dy. Chief Scientist	-do-
3. Ms. T. Divya David	-do-
4. Mr. P. Byju	-do-
5. Mr. Joshua D' Mello	-do-
6. Ms. Priyanka Banerjee	-do-
7. Ms. Aarti Verenkar	-do-
8. Ms. Shweta Halarnekar	-do-
9. Ms. Valeta Rebello	-do-
10. Ms. Raisa Carvalho	-do-
11. Ms. Surekha Gauns	-do-
12. Ms. Manisha Coelho	-do-
13. Ms. Reshma Virnodkar	-do-
14. Mr. K. Shivkumar	-do-
15. Mr. H. Shrivardhan	Goa University
16. Mr. K. Kaleshkumar	Bharathidasan University
17. Mr. S. Parthasarathi	-do-
18. Mr. D. Prasath	-do-
19. Mr. A. Ramesh Kumar	-do-
20. Mr. K. Madhusudan	NORINCO
21. Mr. P. Boopathy	-do-
22. Mr. T. Ramesh	-do-
23. Mr. F.B. Leo	-do-
24. Mr. Parshuram Durgappa Madar	-do-
25. Mr. Amey Hazare	NCAOR

5.2 Ship's complement

1. CAPT. S. R. Lokhande	Master
2. Mr. Aggarwal Rajat Umesh	Chief Officer
3. Mr. Raibhole Sandeep Shamraj	2 nd Officer
4. Mr. Pereira Shelton Anthony	3 rd Officer
5. Dr. Kamal K. Gupta	Medical Officer
6. Mr. R.J. Carrasco	RO
7. Mr. Swaroop Shekhar Jee	CEO
8. Mr. Debasis Sikdar	2 nd EO
9. Mr. Ritwick Singh	3 rd EO
10. Mr. M.B. Thimmanna	4 th EO
11. Mr. Vaidya Timmy	EL/O
12. Mr. A. A. D'Silva	Catg. Officer
13. Mr. John N. Joseph	POM

6. OBJECTIVES

1. To obtain a high-resolution time-series data on physical and biogeochemical parameters at two locations (i) equator, 80.5°E and (ii) equator, 83°E to decipher the short-term (intra-seasonal time scale) physical and biogeochemical coupling in the equatorial Indian Ocean.

2. To obtain trans-equatorial sections along 83°E from 5°N to 5°S to decipher spatial variations in physical, chemical and biological properties as a part of the seasonal cycle and the various forcing that are responsible for such variability in the equatorial Indian Ocean.
3. Atmospheric sounding (6-hourly) using Vaisala Sonde as a part of IWIN Project.
4. Collect water samples for IWIN project for isotope analysis.
5. Collection of data on Aerosol.

7. WORK ACCOMPLISHED

7.1 Parameters measured

- | | |
|--|--|
| 1. Temperature profile | 8. Chlorophyll <i>a</i> |
| 2. Salinity profile | 9. ¹⁴ C based Primary production rate |
| 3. Sea surface temperature (SST) | 10. Phytoplankton |
| 4. Wind speed and direction | 11. Zooplankton |
| 5. Air temperature and wet bulb temperature | 12. TBC |
| 6. Atmospheric pressure | 13. Grazing Experiment |
| 7. Vertical profiles of atmospheric parameters (temperature, humidity, pressure, wind speed and direction) | 14. TCO ₂ |
| | 15. pH |
| | 16. Alkalinity |
| | 17. Nutrients (Nitrate, Phosphate, Silicate) |

7.2 Instrument and machinery used onboard

- | | |
|--------------------------------------|---|
| 1. CTD with Rosette (Sea-Bird) | 7. Jib boom |
| 2. 5L Niskin samplers | 8. Atlas crane |
| 3. ADCP | 9. CTD winch |
| 4. Sub-bottom profiler for Depth | 10. Deep sea winch |
| 5. Milli Q water purification system | 11. pH meter |
| 6. MPN | 12. Deep-freezer in the wet starboard lab |

7.3 NIO equipment used onboard

- | | |
|-------------------------------|-----------------------------------|
| 1. Coulometer | 5. Bucket thermometer |
| 2. Spectrophotometer | 6. PP Mooring system |
| 3. Dosimat | 7. Dynalab met kit |
| 4. Filtration units and pumps | 8. Vaisala Sonde launching System |

7.4 ADCP operation

Ship-borne ADCP was used to collect current data en-route along the track as well as at stations.

7.5 Surface met observations

Surface met observations were carried out at each of the CTD stations using hand-held met kit.

7.6 CTD operations

Sea-Bird CTD was operated at 3-hourly interval at two stationary time-series locations (1) equator, 80.5°E and (2) equator, 83°E, for eight-days each. In addition CTD was also operated along a trans-equatorial section from 5°N to 5°S along 83°E; at half-a-degree interval from 3°N to 3°S and at one-degree-interval from north and south of 3° and up to 5°. At time-series locations CTD was operated up to 1000m depth once-a-day and up to 500m every 3-hourly to collect temperature and salinity profiles along 83°E (see cruise track at Fig.1). In addition to the above, data on oxygen, fluorescence and photosynthetically available radiation (PAR) were also collected. Data was collected during down cast while water samples were collected during up cast. At each of the CTD stations water samples were collected using CTD Rosette.

At stationary time-series locations water sampling was carried out in 3 different cycles for chemical and biological analysis – (1) At 3-hourly interval CTD was lowered to 500m and water samples were collected from subsurface surface chlorophyll maxima (SCM) and surface, (2) At 6-hourly interval water samples were collected from 150m depth to surface, and (3) daily water samples were collected from 1000m depth to surface in two casts: deep and shallow. During the deep cast CTD was lowered up to 1000m and water samples were collected from 1000m up to 60m, and in the shallow cast water samples were collected from 40m to surface.

Along 83°E the trans-equatorial section 17 CTD stations were occupied up to 1000m.

The water samples thus collected were used for the analysis of nutrients, TCO₂, alkalinity, oxygen (surface, 10m, 20m, 40m, 60m, 80m, 100m, 120m, 150m, 200m, 300m, 400m, 600m, 800m and 1000m) and chlorophyll (surface, 10m, 20m, 40m, 60m, 80m, 100m and 120m). In addition, a total of 3 PP stations, 5°N, equator and 5°S, along 83°E were also occupied where PP mooring was deployed for *in situ* incubation experiment from before sunrise to after sunset.

7.7 Multiple Plankton Net operations

Multiple plankton net (MPN) was operated to make stratified collection up to 1000m during mid-day and mid-night at stationary time-series locations. In addition, at these locations, MPN was operated at 6-hourly interval for 24-hour period during the beginning and end of the time series. Along the 83°E transect MPN was operated at each of the 17 stations and at PP stations it was operated during mid-day and mid-night. For making the stratified sampling, MPN was hauled up using the following depth intervals: from 1000-500, 500-300, 300-bottom of the mixed layer and from bottom of the mixed layer to surface. At 3 locations along 83°E (equator, 5°S and 5°N) MPN was lowered up to 2800m to collect samples from 2800-2000m, 2000-1000m, 1000-500m, 500-300m, 300-0m in the deep cast and from 300-base of thermocline, base of thermocline to base of the mixed layer, and from base of the mixed layer to surface.

7.8 Deck incubation

At the time-series locations deck incubation was carried out for estimating the PP by inoculating the samples drawn using CTD rosette from 8 depths (surface, 10m, 20m, 40m, 60m, 80m, 100m, 120m) by ¹⁴C. Based on the Par just below the sea surface the percentage light cutoff were determined at standard depths at which the water samples were drawn and accordingly the light filters were prepared. The bottles from each depth were appropriately covered with light cutoff and immersed in sea water in a tank where

running sea water supply was attached to the tank. Dec incubation was carried out from dawn to dusk. This was carried out 3 times during the beginning and end of the time-series location (1) equator, 80.5°E and once at the time-series location (2) equator, 83°E. At equator and 83°E at the end of the time-series both deck as well as *in situ* incubation was carried out to quantify the error/bias in estimating PP associated with the deck incubation.

7.9 *In situ* primary production measurements

In situ primary production measurements were carried out by inoculating the samples drawn from CTD rosette from 8 depths (surface, 10m, 20m, 40m, 60m, 80m, 100m, 120m) by ¹⁴C and deploying it *in situ* with the help of PP mooring. In all 3 PP stations were occupied at 5°N, equator and 5°S along 83°E.

7.10 Grazing experiment

Grazing experiment is carried out to estimate microzooplankton grazing impact on natural marine phytoplankton communities. During Sagar Kanya cruise (SK 289) this Experiment was carried out along 83° E transect at equator, 5° N and 5° S, and was repeated twice at equator (80.5° E). Water sample for this experiment was collected using 200um mesh so as to avoid interference of Mesozooplankton grazers. Dilutions were prepared by adding fractions of whole sea water to different fractions of filtered sea water. As Equatorial Indian Ocean is known to be an oligotrophic system, nutrients were added to avoid phytoplankton growth from being Nutrient limited. Samples at time zero (T0) were collected and dilutions were incubated for 48 hrs using Deck Incubation where in the samples were incubated in running sea water. At the end of Incubation, T48 samples were collected. These samples need to be analyzed further to determine grazing rate and growth rate of phytoplankton in this system.

7.11 Vaisala Sonde operations

Vaisala Sondes were released at 6-hourly intervals at 05:30 hrs, 11:30 hrs, 17:30 hrs and 23:30 hrs at both time –series locations. Later this has been changed to 05:00 hrs, 11:00 hrs, 17:00 hrs and 23:00 hrs so as to meet the requirement of meeting 3 hours deadline which is cutoff for submitting delayed mode data to weather centers. In addition, Vaisala Sondes were released at each of the one-degree stations along the 83oE cross-equatorial transect. Details of the Vaisala ascent are given in Table 1 to 3.

Table 1. Details of Vaisala Sonde launch at Time-series location 0, 80.5°E

SI No.	Date	Time (GMT)	Remarks
1	25/09/11	06:00	Max. Height is 14208 m
2	25/09/11	12:00	Max. Height is 20673 m
3	25/09/11	18:00	Max. Height is 20689 m
4	26/09/11	00:00	Max. Height is 7570 m
5	26/09/11	06:00	Max. Height is 20013 m
6	26/09/11	12:00	Max. Height is 18657 m
7	26/09/11	18:00	Max. Height is 10817 m
8	27/09/11	00:00	Max. Height is 12951 m
9	27/09/11	06:00	Max. Height is 17126 m
10	27/09/11	12:00	Max. Height is 16540 m

11	27/09/11	18:00	Max. Height is 16615 m
12	28/09/11	00:00	Max. Height is 18525 m
13	28/09/11	06:00	Max. Height is 17111 m
14	28/09/11	12:00	Max. Height is 15565 m
15	28/09/11	18:00	Max. Height is 15916 m
16	29/09/11	00:00	Max. Height is 11349 m
17	29/09/11	06:00	Max. Height is 16704 m
18	29/09/11	12:00	Max. Height is 17149 m
19	29/09/11	17:30	Max. Height is 10036 m , changed the launching time
20	29/09/11	23:30	Max. Height is 16192 m
21	30/09/11	05:30	Max. Height is 16199 m
22	30/09/11	11:30	Max. Height is 8987 m
23	30/09/11	17:30	Max. Height is 10483 m
24	30/09/11	23:30	Max. Height is 8533 m
25	01/10/11	05:30	Max. Height is 20154 m
26	01/10/11	11:30	Max. Height is 20115 m
27	01/10/11	17:30	Max. Height is 19707 m
28	01/10/11	23:30	Max. Height is 20065 m, first launch failed due to error in the data reception (Second Launching Time 01:30 GMT)
29	02/10/11	05:30	Max. Height is 8573 m
30	02/10/11	11:30	Max. Height is 8994 m
31	02/10/11	17:30	Max. Height is 10432 m
32	02/10/11	23:30	Max. Height is 18656 m
33	03/10/11	05:30	Max. Height is 19562 m

Table 2. Details of Vaisala Sonde launch at Time-series location 0, 83°E

SI No.	Date	Time (GMT)	Remarks
34	04/10/11	05:30	Max. Height is 20889 m
35	04/10/11	11:30	Max. Height is 16203 m
36	04/10/11	17:30	Max. Height is 17709 m
37	04/10/11	23:30	Max. Height is 20901 m
38	05/10/11	05:30	Max. Height is 21680 m
40	05/10/11	11:30	Max. Height is 18383 m
41	05/10/11	17:30	Max. Height is 17840 m
42	05/10/11	23:30	Max. Height is 20292 m
43	06/10/11	05:30	Max. Height is 16774 m
44	06/10/11	11:30	Max. Height is 15387 m
45	06/10/11	17:30	Max. Height is 10365 m
46	06/10/11	23:30	Max. Height is 15683 m
47	07/10/11	05:30	Max. Height is 12350 m
48	07/10/11	11:30	Max. Height is 12203 m
49	07/10/11	17:30	Max. Height is 11374 m
50	07/10/11	23:30	Max. Height is 12147 m

51	08/10/11	05:30	Max. Height is 15077 m
52	08/10/11	11:30	Max. Height is 13414 m
53	08/10/11	17:30	Max. Height is 20377 m
54	08/10/11	23:30	Max. Height is 17248 m
55	09/10/11	05:30	Max. Height is 12671 m
56	09/10/11	11:30	Max. Height is 10708 m
57	09/10/11	17:30	Max. Height is 14820 m
58	09/10/11	23:30	Max. Height is 14213 m
59	10/10/11	05:30	Max. Height is 14621 m
60	10/10/11	11:30	Max. Height is 17113 m
61	10/10/11	17:30	Max. Height is 16914 m, first launch failed due to error in the data reception(Second Launching Time 18:50 GMT)
62	10/10/11	23:30	Max. Height is 15448 m

Table 3. Details of Vaisala Sonde launch at CTD stations along 83°E

Sl No	Date	Latitude	Longitude	Time (GMT)	Remarks
63	12/10/11	1 S	83 E	11:21	Max. Height is 20052 m
64	12/10/11	2 S	83 E	23:33	Max. Height is 18629 m
65	13/10/11	3 S	83 E	11:30	Max. Height is 19347 m
66	13/10/11	4 S	83 E	21:10	Max. Height is 20095 m
67	14/10/11	5 S	83 E	12:33	Max. Height is 19188 m
68	17/10/11	1 N	83 E	09:32	Max. Height is 21251 m
69	17/10/11	2 N	83 E	20:31	Max. Height is 19509 m
70	18/10/11	3 N	83 E	09:10	Max. Height is 20653 m
71	18/10/11	4 N	83 E	18:33	Max. Height is 19868 m
72	19/10/11	5 N	83 E	05:46	Max. Height is 16151 m

7.12 Aerosol measurements

Aerosol optical depth was measured (Goa University) using Microtops II Sunphotometer at 5 channels (380nm, 440nm, 500nm, 675nm and 870nm) every 30 minutes interval. The data is geo-tagged using Garmin GPS-12 connected to the Sunphotometer. The ambient black carbon was measured using Magee Scientific® Aethalometer model AE-42. The ejected aerosol samples were carefully recovered from the instrument in order to avoid contamination and stored in labeled Petri dishes.

8. PERFORMANCE OF THE EQUIPMENT USED

Sea-Bird CTD

The CTD worked very well and collected 178 profiles.

On 2nd October 2011 at 0310 hrs the deck unit transformer burned while the CTD was heaving at station CTD053 (0° 0.196'N, 80° 29.974'E). The CTD went up to 500m and while coming up stopped and a sound came out from the deck unit with the message of time out communication. There was fume from the deck unit and CTD operation was abandoned and the CTD underwater unit was brought to deck. The data retrieval failed and data was not saved. It appeared that the fault was due to seepage of seawater into the underwater cable through the slicing which caused the burning of transformer in the deck unit. Surprisingly, the fuse of the cable did not blow.

CTD Rosette

The CTD Rosette was used with 12 numbers of 5L Niskin bottles for water sampling purposes. Rosette and Niskin sampling bottles worked well in all operations without any problems. For PP sampling 4 numbers of 10L bottles and 8 numbers of 5L bottles were used in combination.

CTD winch

CTD winch was used for lowering the CTD as well as Plankton Net. Winch worked well with out any problem while all the operation, except in the first operation when the limit switch of the level winder did not work. Hence leveling was done manually. After first operation NORINCO personnel (Mr. Madhu) serviced it and then on it worked till the completion of the cruise without any problem.

CTD boom had oil leak from the hydraulic pipes dirtying the deck. Later the Engineers of the ship made some arrangements to collect the leaking oil in cans via pipes, as the oil seal cannot be repaired onboard as it needs workshop help.

Multiple Plankton Net

Multiple plankton net worked well. It was operated up to 1000m at all the trans-equatorial stations. In addition it was operated at mid-day and mid-night at time-series as well as PP stations to get the stratified biomass in the depth range 1000-500, 500-300, 300-base of the mixed layer, and from base of the mixed layer to surface. In addition, in the time-series locations a 6-hourly MPN was operated for 24-hours during the beginning, middle and end of the time-series. At 3 locations along 83°E (equator, 5°S and 5°N) MPN were lowered up to 2800m to collect samples 2800-2000m, 2000-1000m, 1000-500m, 500-300m, 300-0m in the deep cast and from 300-base of thermocline, base of thermocline to base of the mixed layer, and from base of the mixed layer to surface.

MilliQ water for Chemical Analysis

High quality MilliQ water is essential for quality chemical analysis of sea water. Presently the Elix is not functional (lack of filter cartridge) and hence the condensed water from AC unit is fed to MilliQ. Very often due to lack of adequate quality of MilliQ water for chemical analysis the blank values were high which affects the data quality.

9. PERFORMANCE OF THE SHIP

In general, the shipboard machinery and equipment worked satisfactorily.

In adequacy in living standards and health concerns:

- (1) The rooms and beds should be free from insects and bugs. **Proper linens (clean without stain marks), bed covers and pillows must be provided.** In the present cruise the Chief Scientist have to bring this to the notice of the Captain as well as the Chief Catering Officer to get clean linens and pillows in several rooms. Standing instruction should be given to Catering Officer, who is responsible for the cleanliness of the rooms, that he should personally ensure the hygiene of the rooms.

Presently majority of the living quarters of Scientists are infected with bed bugs. During the cruise many scientific personnel were sleeping in the recreation room, winch control room and in the lab. There is an urgent need to fumigate the ship to get rid of the bugs and cockroaches.

- (2) **Many rooms do not have chairs, thermo flask, glasses, curtains, clock** etc. In some of the bath rooms the soap dish holders are either rusted or broken. There are no shower curtains in some rooms.
- (3) **Clean drinking water** – Presently the water from RO plant is stored in tanks and very often the tanks and pipes are dirty due to sedimentation, rust etc. which contaminates the drinking water. Either Aqua Guards need to be installed at every floor wherever there is cooler and also in Galley.

In the absence of the Aqua guard, bottled water should be supplied to all the personnel's as this directly affect the health of the people living in the ship.

- (4) **Scientist's recreation room must have separate plug points** for microwave, toaster and coffee kettle. Presently extension boards are used which are not safe when several people handle them.

In adequacy in the scientific machinery/equipments:

- (1) Proper and adequate furnishing necessary for laboratory. For example proper sitting arrangement in the lab in terms of chairs (adjustable in height for use in chemical and biological labs).
- (2) Clock in some laboratory is not working and needs replacement.
- (3) Phone connection is not there in the Wet Port lab. The phone of the dry port lab is not function well. This has been brought to the notice of the Ship's officer. Though it was replaced twice the result was poor. Lot of interference due to which vital communication to Bridge and back during operation was not smooth.
- (4) Presently the MilliQ water is not of quality as the Elix is not functional (lack of filter cartridge). Therefore the condensed water from AC unit is fed to

MilliQ. A proper MilliQ system with quality water out out is essential for the generation of quality chemical data.

10. LOSS REPORT

No loss occurred during the cruise.

- Damage:**
1. On 2nd October 2011 at 0310 hrs the deck unit transformer burned while the CTD was heaving at station CTD053 (0° 0.196'N, 80° 29.974'E). The CTD went up to 500m and while coming up stopped and a sound came out from the deck unit with the message of time out communication. There was fume from the deck unit and CTD operation was abandoned and the CTD underwater unit was brought to deck. The data retrieval failed and data was not saved. It appeared that the fault was due to seepage of seawater into the underwater cable through the slicing which caused the burning of transformer in the deck unit. Surprisingly, the fuse of the cable did not blow.
 2. On 2nd October 200One 5L Niskin sampler was broken while heaving the Rosette after sample collection at CTD 055 (0° 0.008'N, 80° 30.025'E) station.
 3. On 14th October one of the net in the MPN was torn slightly at two places, which was mended by stitching.

- Cutting of CTD Cable:**
1. On 2nd October 2011, about **5m** of CTD cable was cut for re-splicing the cable to eliminate the water seepage portion of the cable which caused the blowing of transformer in the deck unit.
 2. On 7th October, about **100m** cable was cut because of the vertical spike in the pressure data while heaving up. Since this was noticed several times earlier it was decided to cut the cable to avoid problem during data collection.
 3. On 17th October 2011 about **25 m** CTD cable was cut to prevent seepage of sea water as the cable developed kinks at 3 places.

11. CONCLUSIONS

Data was collected at all the planned stations.

1. All 134 stations were covered (62 stations at equator and 80.5°E & 56 stations at equator and 83°E) for various observations and data collection.
2. Along the trans-equatorial section 17 CTD profiles and water samples were collected up to 1000 m depth along 83°E.
3. Nutrients and chlorophyll a measurements were carried out at both time-series stations and along the trans-equatorial transect along 88°E.
4. ¹⁴C based primary production measurement were carried in-situ at 3 stations, along 88°E.
5. Deck incubation of PP as well as Grazing experiments was carried out at both the time-series locations.

12. RECOMMENDATIONS

- (1) Deep sea echo sounder is not available onboard. It is an urgent requirement for any scientific operation as well as navigational requirement.
- (2) It is absolutely essential to have AUTOSAL (Guildline) for calibration of salinity from sea water sample.
- (3) A set of at least 5 spare nets to be procured for MPN as the present net has been used extensively and few nets have either torn or stitched or it will soon be torn due to wear and tear.
- (4) The titration unit available at Chemistry lab is the instrument is very old (came along with ship). It is good to procure one new unit as the present one may stop functioning at any time.
- (5) pH meter is needed in the chemistry lab which is a common facility needed by all groups.
- (6) There is a need to procure spare 5L and 10L samplers for Rosette, there are not enough bottles in case of breakage or damage which will hamper the operations.

13. ACKNOWLEDGEMENTS

Master, Chief Engineer, Chief Officer, all other Officers as well as the entire shipboard personnel from deck, engine and catering departments cooperated very well to make this cruise a great success. The Chief Scientist and the entire team record their appreciation for this co-operation.

Similarly, the NORINCO engineers extended their technical support whenever required.

The constant encouragement by the Director, NIO and the excellent logistical support extended by Mr. Subramanian and NCAOR team is greatly acknowledged. Dr. Rasik Ravindra, Director NCAOR was instrumental in getting this cruise allotted for equatorial measurements.

Equatorial project team acknowledges the funding support by the Ministry of Earth Sciences, Government of India through INCOIS, Hyderabad for carrying out this measurement programme.

A Special word of appreciation to NORINCO Personnel

Each and every NORINCO personnel onboard, Madu, Bhupati, Ramesh and Leo, rendered full support during SK-289 operations.

1. **Mr. Madhu** was instrumental in not only scientific operations but also setting the Propulsion Motor (PM) operational. The PM stopped working suddenly, and onboard engineers tried to get it working. But it was Madhu who could trouble-shoot it and make it operational. Without the PM we would have lost the operational efficiency and it would have compromised our cruise objectives.
2. **Mr. Bhupati** was instrumental in the successful completion the PP mooring. In addition, he made operational the suction pump in the Coulometer when it stopped functioning. He also devised a way to supply uninterrupted flow of sea water for Deck incubation of PP and Grazing Experiment from the Fire Hydrant. He also repaired the zip of one of the net which came out of and mended the net which was torn slightly at its side during operation by stitching it.
3. **Mr. Parashuram** rendered support for all the operations. He repaired the 1 ml Auto pipette used by the chemistry group for adding reagents. The auto pipette was unusable after several operations as the spring got stuck. Mr. Parashuram serviced it and made it operational.
4. **Mr. Ramesh and Leo** rendered software support for CTD and also for ADCP and thermosalinometer PCs. In addition, when the software for Spectrophotometer was corrupted, both of them worked hard and set up the software with appropriate drivers so that we could carry out the nutrient measurements. At one stage it appeared that we will not be able to accomplish the determination of nutrients onboard when the Spectrophotometer software got corrupted.

Appendix I

Table 1 - Station locations and operations

Time-Series Location-1 0°, 80.5°E						
Beginning of 3-hourly CTD profiling with water sampling at SCM and surface for chemical and biological analysis, 6-hourly water sampling up to 150m at standard depths, once-a-day (mid-day) CTD profiling up to 1000m with water sampling at standard depths (deep cast and shallow cast) and mid-day and mid-night MPN up to 1000m and						
Sl. No	Station number	Latitude	Longitude	Date	Time IST	Operations
1	CTD_001	0° 0.161'N	80° 30.036'E	25-09-11	0915 1130	CTD up to 500m. Water samples at SCM (70m) and surface. Vaisala Sonde operation. Frequency 403.1 MHz
2	CTD_002	0° 0.122'S	80° 30.152'E	25-09-11	1135 1245	CTD up to 1000 m. Mid-day Deep cast Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, 60m, and 55m (SCM) for biological and chemical analysis. MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-250m, 250-30m and 30-0m
3	CTD_003	0° 0.318'N	80° 29.934'E	25-09-11	1447 1730	CTD up to 500m. 3-hourly cast combined with Shallow cast . Water samples were collected at 40m, 20m, 10m, surface (~2m) (shallow cast), SCM (50m) and surface (3-hourly cast). Vaisala Sonde operation.
4	CTD_004	0° 0.468'N	80° 30.172'E	25-09-11	1754	CTD up to 500 m. Water sampling up to 150m. Water samples collected at 150m, 120m, 100m, 80m, 60m, 57 (SCM) 40m, 20m, 10m, surface.
5	CTD_005	0° 0.048'N	80° 30.029'E	25-09-11	2105 2130	CTD up to 500 m. Water samples at SCM (70m) and surface. Vaisala Sonde operation.
6	CTD_006	0° 0.054'N	80° 29.953'E	25-09-11	0000 0100	CTD up to 500 m. Water sampling up to 150m at standard depths and SCM (68). MPN up to 1000m. Start of 6-hourly cycle . Nets closed 1000-

						500m, 500-300m, 300-240m, 240-46m and 46-0m.
7	CTD_007	0° 0.151'N	80° 29.917'E	26-09-11	0315 0530	CTD up to 500 m. Water sampling at SCM (60m) and surface. Vaisala Sonde operation
8	CTD_008	0° 0.055'N	80° 29.940'E	26-09-11	0635 0710	CTD up to 500m. Water sampling up to 150m at standard depths and SCM (58m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-230m, 230-42m and 42-0m.
9	CTD_009	0° 0.126'N	80° 30.066'E	26-09-11	0929	CTD up to 500 m. Water sampling at SCM (55m) and surface.
10	CTD_010	0° 0.111'N	80° 30.079'E	26-09-11	1220	CTD up to 1000m. Mid-day Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, 60m, and 55m (SCM).
11	CTD_010S	0° 0.286'N	80° 30.262'E	26-09-11	1405 1445	CTD up to 50 m. Water samples were collected at 40m, 20m, 10m and surface. MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-250m, 250-45m and 45-0m.
12	CTD_011	0° 0.020'N	80° 29.860'E	26-09-11	1620 1730	CTD up to 500 m. Water sampling SCM (61m) and surface. Vaisala Sonde operation.
13	CTD_012	0° 0.029'N	80° 29.988'E	26-09-11	1805 1850	CTD up to 500 m. Water sampling up to 150m. MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-250m, 250-45m and 45-0m.
14	CTD_013	0° 0.104'N	80° 30.037'E	26-09-11	2106 2330	CTD up to 500 m. Water sampling SCM (52m) and surface. Vaisala Sonde operation.
15	CTD_014	0° 0.026'N	80° 30.050'E	27-09-11	0010 0130	CTD up to 500 m. Water sampling up to 150m and SCM (58m) MPN up to 1000m. End of 6-hourly cycle Nets closed 1000-500m, 500-300m, 300-240m, 240-41m and 41-0m.
16	CTD_015PP	0° 0.101'N	80° 29.950'E	27-09-11	0315	CTD up to 500 m. Water sampling up to 120m for PP (deck incubation) and for chemical and biological analysis and SCM (57m).
17	CTD_015T BC	0° 0.065'S	80° 30.068'E	27-09-11	0435	CTD up to 120 m. Water sampling for TBC at standard depths and SCM (53).

					0530	Vaisala Sonde operation.
18	CTD_015G Z	0° 0.010'N	80° 30.082'E	27-09-11	0541 0600	CTD up to 100 m. Water samples were collected at SCM (54m) (60 litre) for grazing experiment. PP Deck incubation starts.
19	CTD_016 CTD_016T	0° 0.053'N	80° 30.089'E	27-09-11	0705 0815	CTD up to 500 m. Water sampling up to 150m for biological and chemical parameters. SCM (53m). CTD up to 120 m. Since the sampling bottle at 120m depth did not close, the CTD was lowered again up to 120m
20	CTD_017	0° 0.022'N	80° 30.032'E	27-09-11	0925 1130	CTD up to 500 m. Water sampling SCM (50m) and surface. Vaisala Sonde operation.
21	CTD_018	0° 0.066'S	80° 30.059'E	27-09-11	1203	CTD up to 1000m. Mid-day Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, 60m, and 56m (SCM).
22	CTD_018S	0° 0.059'S	80° 30.066'E	27-09-11	1359 1425	CTD up to 40 m. Shallow cast. Water samples were collected at 40m, 20m, 10m, surface(~2m) MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-260m, 260-40m and 40-0m.
23	CTD_019	0° 0.044'S	80° 30.151'E	27-09-11	1622 1739	CTD up to 500 m. Water sampling SCM (52m) and surface. Vaisala Sonde operation.
24	CTD_020	0° 0.070'N	80° 30.076'E	27-09-11	1829	CTD up to 500 m. Water sampling up to 150m at standard depths and SCM (55m).
25	CTD_021	0° 0.006'N	80° 29.995'E	27-09-11	2107 2330	CTD up to 500m. Water sampling SCM (49m) and surface. Vaisala Sonde operation.
26	CTD_022	0° 0.017'N	80° 30.090'E	28-09-11	0015 0125	CTD up to 500 m. Water sampling up to 150m at standard depths and SCM (56m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-270m, 270-35m and 35-0m.
27	CTD_023	0° 0.073'N	80° 29.813'E	28-09-11	0306 0539	CTD up to 500 m. Water sampling at SCM (65m) and surface. Vaisala Sonde operation.
28	CTD_024	0° 0.200'N	80° 30.070'E	28-09-11	0620	CTD up to 500 m. Water sampling up to 150m at standard depths and at SCM (55m).
29	CTD_025	0° 0.010'N	80° 30.012'E	28-09-11	0905 1130	CTD up to 500 m. Water sampling at SCM (57m) and surface. Vaisala Sonde operation.

30	CTD_026	0° 0.037'N	80° 30.095'E	28-09-11	1210	CTD up to 1000 m. Mid-day Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, 60m, and 55m (SCM) for biological and chemical analysis.
31	CTD_026S	0° 0.030'N	80° 29.923'E	28-09-11	1359 1417	CTD up to 60 m. Water samples were collected at 40m, 20m, 10m, surface (~2m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-260m, 260-40m and 40-0m.
32	CTD_027	0° 0.259'N	80° 30.096'E	28-09-11	1607	CTD up to 500 m. Water sampling at SCM (56m) and surface.
33	CTD_028 CTD_028T	0° 0.242'N	80° 30.116'E	28-09-11	1730 1730 1821	CTD up to 5000 m. Water sampling up to 150m at standard depths and at SCM (57m). Vaisala Sonde operation. CTD up to 2m for surface sampling only.
34	CTD_029	0° 0.084'N	80° 30.160'E	28-09-11	2101 2330	CTD up to 500m. Water sampling at SCM (60m) and surface. Vaisala Sonde operation
35	CTD_030	0° 0.037'N	80° 29.983'E	29-09-11	0040 0148	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (63m). MPN up to 1000m. Start of MPN 6-hourly cycle. MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-270m, 270-45m and 45-0m.
36	CTD_031	0° 0.078'N	80° 30.343'E	29-09-11	0437	CTD up to 500m. Water sampling at 150m (the missed sample at CTD 030), SCM (72m) and surface.
37	CTD_032	0° 0.161'N	80° 30.348'E	29-09-11	0610 0615 0714 1141 1200	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (65m). Vaisala Sonde operation. Delayed the usual 05:30 ascend by 45 minutes due to large ship drift. MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-270m, 270-45m and 45-0m. Vaisala Sonde operation. Delayed the usual 11:30 ascend by 11 minutes due to large ship drift. End of Grazing Experiment.
38	CTD_033	0° 0.012'N	80° 30.307'E	29-09-11	1158	CTD up to 1000m. Mid-day Deep cast. Water samples were collected

						at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, 60m, and 55m (SCM) for biological and chemical analysis.
39	CTD_033S	0° 0.116'N	80° 30.578'E	29-09-11	1640	CTD up to 500m. Shallow cast. Water samples were collected at SCM (59m) 40m, 20m, 10m, surface (~2m). This is combined Shallow cast of 12:00hrs with 15:00hrs.
40	CTD_034	0° 0.168'N	80° 30.247'E	29-09-11	1806 1850	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (58m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-270m, 270-45m and 45-0m.
41	CTD_035	0° 0.038'S	80° 30.072'E	29-09-11	2110 2300	CTD up to 500m. Water sampling at SCM (65m) and surface. Vaisala Sonde operation.
42	CTD_036 CTD_036S	0° 0.067'N	80° 30.168'E	30-09-11	0010 0142 0200	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (73m). Water sample at 20m was not collected as the bottle opening mechanism got stuck. CTD up to 20m. Water sampling at 20m. MPN up to 1000m. End of 6-hourly cycle Nets closed 1000-500m, 500-300m, 300-270m, 270-55m and 55-0m.
43	CTD_037	0° 0.024'N	80° 30.103'E	30-09-11	0355 0530	CTD up to 500m. Water sampling at SCM (70m) and surface. Vaisala Sonde operation.
44	CTD_038	0° 0.010'S	80° 30.356'E	30-09-11	0616	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (65m).
45	CTD_039	0° 0.013'S	80° 30.010'E	30-09-11	0908 1100	CTD up to 500m. Water sampling at SCM (68m) and surface. Vaisala Sonde operation.
46	CTD_040	0° 0.008'N	80° 29.999'E	30-09-11	1209	CTD040 up to 1000m. Mid-day Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, 60m (SCM) for biological and chemical analysis.
47	CTD_040S	0° 0.062'N	80° 30.053'E	30-09-11	1347 1410	CTD up to 50m. Shallow cast. Water samples were collected at 40m, 20m, 10m, surface (~2m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-270m,

						270-45m and 45-0m.
48	CTD_041	0° 0.101'N	80° 30.053'E	30-09-11	1535 1730	CTD up to 500m. Water sampling at SCM (60m) and surface. Vaisala Sonde operation.
49	CTD_042	0° 0.085'N	80° 30.072'E	30-09-11	1755	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (67m).
50	CTD_043	0° 0.071'N	80° 30.059'E	30-09-11	2112 2330	CTD up to 500m. Water sampling at SCM (60m) and surface. Vaisala Sonde operation.
51	CTD_044	0° 0.035'N	80° 29.995'E	01-10-11	0020 0110	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (67m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-265m, 265-50m and 50-0m.
52	CTD_045	0° 0.197'N	80° 29.971'E	01-10-11	0255	CTD up to 500m. Water sampling for PP up to 120m and regular SCM (76m) and surface.
53	CTD_045G Z	0° 0.026'N	80° 30.014'E	01-10-11	0407 0515 0530	CTD up to 100m. Water sampling from SCM (73m) 60 litres. PP deck incubation. Vaisala Sonde operation.
54	CTD_046	0° 0.198'N	80° 30.200'E	01-10-11	0605	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (70m).
55	CTD_047	0° 0.084'N	80° 30.050'E	01-10-11	0905 0940 1100	CTD up to 500m. Water sampling at SCM (74m) and surface. Time of operation 09:05 to 09: 38 hrs. Grazing deck incubation. Vaisala Sonde operation.
56	CTD_048	0° 0.014'N	80° 30.077'E	01-10-11	1210	CTD up to 1000m. Mid-day Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, 69m (SCM), 60m for biological and chemical analysis.
57	CTD_048S	0° 0.014'N	80° 30.077'E	01-10-11	1339 1356	CTD048S up to 50m. Shallow cast. Water samples were collected at 40m, 20m, 10m, surface (~2m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-270m, 270-60m and 60-0m.
58	CTD_049	0° 0.024'S	80° 30.053'E	01-10-11	1523 1700	CTD up to 500m. Water sampling at SCM (73m) and surface. Vaisala Sonde operation.
59	CTD_050	0° 0.090'N	80° 30.013'E	01-10-11	1802	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (69m).
60	CTD_051	0° 0.019'N	80° 30.072'E	01-10-11	2104	CTD up to 500m. Water sampling

					2330	at SCM (70m) and surface. Vaisala Sonde operation.
61	CTD_052	0° 0.048'N	80° 30.010'E	02-10-11	0020 0103	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (76m). MPN up to 1000m. Start of 6-hourly cycle. Nets closed 1000-500m, 500-300m, 300-260m, 260-60m and 60-0m.
62	CTD_053	0° 0.196'N	80° 29.974'E	02-10-11	0315 0500 0650 0700	CTD up to 500m. Water sampling was for SCM (68m) and surface. CTD went up to 500m and while coming up it stopped, a sound came from deck unit and showed a "timeout communication" at 0335 hrs. Data acquisition was terminated and restarted. There was fume from the deck unit and hence CTD operation was abandoned and underwater unit was brought to deck at 03:57 hrs without collecting water samples. Vaisala Sonde operation. Data retrieval failed and data not saved. CTD was rectified. Vaisala Sonde re-sent
63	CTD_054	0° 0.122'N	80° 29.801'E	02-10-11	0749 0835 1100	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (73m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-250m, 250-62m and 62-0m. Vaisala Sonde operation.
64	CTD_055	0° 0.008'N	80° 30.025'E	02-10-11	1207	CTD up to 1000m. Mid-day Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, 65m (SCM), 60m for biological and chemical analysis.
65	CTD_055S	0° 0.342'N	80° 30.383'E	02-10-11	1420 1435	CTD up to 50m. Shallow cast. Water samples were collected at 40m, 20m, 10m, surface (~2m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-250m, 250-55m and 55-0m.
66	CTD_056	0° 0.252'N	80° 30.653'E	02-10-11	1643	CTD up to 500m. Water sampling at SCM (64m) and surface.
67	CTD_057	0° 0.012'N	80° 30.053'E	02-10-11	1806	CTD up to 500m. Water sampling up to 150m at standard depths and

					1900	at SCM (65m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-260m, 260-55m and 55-0m.
68	CTD_058	0° 0.036'N	80° 30.157'E	02-10-11	2125 2300	CTD up to 500m. Water sampling at SCM (66m) and surface. Vaisala Sonde operation.
69	CTD_059	0° 0.106'N	80° 30.114'E	03-10-11	0018 0111	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (62m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-260m, 260-54m and 54-0m. Time of operation 01:11 to 02:05 hrs. End of 6-hourly cycle.
70	CTD_060	0° 0.185'N	80° 30.151'E	03-10-11	0319 0530	CTD up to 500m. Water sampling at SCM (63m) and surface. Vaisala Sonde operation.
71	CTD_061	0° 0.068'N	80° 30.337'E	03-10-11	0623	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (65m).
72	CTD_062	0° 0.323'N	80° 30.226'E	03-10-11	0910 1130	CTD up to 500m. Water sampling at SCM (63m) and surface. Time of operation 09:10 to 10:10 hrs. Down cast SCM (63m), Up cast SCM (60m). Vaisala Sonde operation.
End of Time-series at 0, 80.5°E. Started moving to next time-series station 0, 83°E at 11:45 hrs.						
Time-Series Location-2 0°, 83°E						
Sl. No	Station number	Latitude	Longitude	Date	Time IST	Operations
73	CTD_063	0° 0.173'N	83° 0.059'E	04-10-11	0905 1100	CTD up to 500m. Water sampling at SCM (68m) and surface. Vaisala Sonde operation.
74	CTD_064	0° 0.019'N	83° 0.077'E	04-10-11	1212	CTD up to 1000m. Mid-day Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, 76m (SCM) for biological and chemical analysis. By mistake bottle no.8 was fired at 410m depth; hence bottle no.10 was fired at 400m to get the sample.
75	CTD_064S	0° 0.203'N	83° 0.048'E	04-10-11	1412	CTD up to 80m. Shallow cast. Water samples were collected at

					1430	60m, 40m, 20m, 10m, surface (~2m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-270m, 270-62m and 62-0m.
76	CTD_065	0° 0.203'N	83° 0.145'E	04-10-11	1637 1700	CTD up to 500m. Water sampling at SCM (76m) and surface. Vaisala Sonde operation.
77	CTD_066	0° 0.114'N	83° 0.140'E	04-10-11	1805	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (77m). After stabilization at 10m when CTD was brought to surface it came out of the water. Hence it was sent to 10m again for stabilization.
78	CTD_067	0° 0.001'N	83° 0.031'E	04-10-11	2107 2300	CTD up to 500m. Water sampling at SCM (76m) and surface. Down cast SCM at 76m and Up cast SCM at 70m. Water samples for biology and chemistry was collected. SCM samples were collected from the location of SCM obtained from both down and up cast. Vaisala Sonde operation.
79	CTD_068	0° 0.068'N	83° 0.005'E	05-10-11	0010	CTD068 up to 500m. Water sampling up to 150m at standard depths and at SCM (81m). Down cast SCM at 81m and up cast SCM at 76m. Water samples for biology and chemistry was collected at 76m. Vertical spike in the pressure sensor at nearly 70m while heaving. MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-285m, 285-70m and 70-0m.
80	CTD_069	0° 0.041'N	82° 59.998'E	05-10-11	0312 0500	CTD up to 500m. Water sampling at SCM (80m) and surface. Down cast SCM at 80m and Up cast SCM at 71m. Samples were collected for biology and chemistry at 71m. Vaisala Sonde operation.
81	CTD_070	0° 0.197'N	83° 0.017'E	05-10-11	0605	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (75m).
82	CTD_071	0° 0.010'S	83° 0.065'E	05-10-11	0905	CTD up to 500m. Water sampling at SCM (72m) and surface. Down cast SCM at 72m and Up cast

					1100	SCM at 71m. Samples were collected for biology and chemistry at 71m. During up cast position was 0° 0.660'N, 83° 2.018'E. Vaisala Sonde operation.
83	CTD_072	0° 0.037'N	83° 0.012'E	05-10-11	1205	CTD up to 1000m. Mid-day Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, SCM (72m) for biological and chemical analysis. SCM was at 81m during down cast and 72m during up cast.
84	CTD_072S	0° 0.294'N	83° 0.079'E	05-10-11	1440 1506 1700	CTD up to 100m. Shallow cast. Water samples were collected at 60m, 40m, 20m, 10m, surface (~2m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-290m, 290-74m and 74-0m. Vaisala Sonde operation.
84	CTD_073	0° 0.294'N	83° 0.079'E	05-10-11	1708	CTD up to 500m. Water sampling at SCM (64m) and surface. Down cast SCM at 68m and Up cast SCM at 64m.
85	CTD_074	0° 0.089'S	83° 0.074'E	05-10-11	1825	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (67m). Downcast SCM was at 70m and up cast SCM was at 67m. Time of operation 18:25 to 19:05 hrs.
86	CTD_075	0° 0.041'S	83° 0.023'E	05-10-11	2057 2300	CTD up to 500m. Water sampling at SCM (60m) and surface. Down cast SCM at 67m and Up cast SCM at 60m. Vaisala Sonde operation.
87	CTD_076	0° 0.059'S	83° 0.054'E	06-10-11	0007 0107	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (69m). Down cast SCM was and up cast SCM was at 69m. There was problem of large wire angle throughout the operation. CTD was stopped at ~ 350m and then it came up to ~250m. It was again lowered up to 500m. MPN up to 1000m. 6-hourly cycle starts. Nets closed 1000-500m, 500-300m, 300-280m, 280-58m and 58-0m.

88	CTD_077	0° 0.043'N	83° 0.079'E	06-10-11	0320 0500	CTD up to 500m. Water sampling at SCM (64m) and surface. Both down cast as well as up cast SCM was at 64m. Vaisala Sonde operation.
89	CTD_078	0° 0.077'N	83° 0.124'E	06-10-11	0604 0653	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (64m). Down cast SCM was at 68m and up cast SCM was at 64m. MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-280m, 280-60m and 60-0m.
90	CTD_079	0° 0.059'N	83° 0.102'E	06-10-11	0904 1100	CTD up to 500m. Water sampling at SCM (66m) and surface. SCM down cast at 69m and up cast SCM at 66m. Vaisala Sonde operation.
91	CTD_080	0° 0.022'N	83° 0.069'E	06-10-11	1210	CTD up to 1000m. Mid-day Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, SCM (67m) for biological and chemical analysis. SCM was at 80m during down cast and 67m during up cast.
92	CTD_080S	0° 0.024'S	83° 0.076'E	06-10-11	1340 1358	CTD up to 100m. Shallow cast. Water samples were collected at 40m, 20m, 10m, surface (~2m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-64m, and 64-0m.
93	CTD_081	0° 0.001'S	82° 59.992'E	06-10-11	1521 1700	CTD up to 500m. Water sampling at SCM (65m) and surface. SCM down cast at 70m and up cast SCM at 65m. Vaisala Sonde operation.
94	CTD_082	0° 0.022'N	83° 0.056'E	06-10-11	1757 1841	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (68m). Down cast SCM was at 74m and up cast SCM was at 68m. MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-270m, 270-65 and 65-0m.
95	CTD_083	0° 0.078'N	83° 0.052'E	06-10-11	2105	CTD up to 500m. Water sampling at SCM (74m, 71m) and surface. SCM down cast at 74m and up

						cast SCM at 71m.
96	CTD_084	0° 0.023'N	83° 0.014'E	07-10-11	0011 0059	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (72m & 68m). Down cast SCM was at 72m and up cast SCM was at 68m. MPN up to 1000m. Nets closed 1000-500m, 500-320m, 320-67m and 67-0m.
97	CTD_085	0° 0.198'N	83° 0.067'E	07-10-11	0307	CTD up to 500m. Water sampling at SCM (68m) and surface. SCM both down cast and up cast SCM at 68m.
98	CTD_086	0° 0.029'N	83° 0.136'E	07-10-11	0605	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (72m & 68m). Down cast SCM was at 72m and up cast SCM was at 68m.
99	CTD_087	0° 0.012'N	83° 0.096'E	07-10-11	0900 1100	CTD up to 500m. Water sampling at SCM (77 & 68m) and surface. Down cast SCM was at 77m and up cast SCM was at 68m. Vaisala Sonde operation.
100	CTD_088	0° 0.052'N	83° 0.224'E	07-10-11	1233	CTD up to 1000m. Mid-day Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, SCM (83m & 80m) for biological and chemical analysis. SCM was at 83m during down cast and 80m during up cast. Deep cast was delayed because of chopping of sea cable and re-splicing due to suspected water seepage.
101	CTD_088S	0° 0.038'N	83° 0.023'E	07-10-11	1409 1424	CTD up to 50m. Shallow cast. Water samples were collected at 40m, 20m, 10m, surface (~2m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-270, 270-75m and 75-0m.
102	CTD_089	0° 0.031'N	83° 0.077'E	07-10-11	1606 1700	CTD up to 500m. Water sampling at SCM (84 & 77m) and surface. Down cast SCM was at 84m and up cast SCM was at 77m. Vaisala Sonde operation.
103	CTD_090	0° 0.031'N	83° 0.114'E	07-10-11	1802	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (83m & 75m). Down cast SCM was at 83m and up cast SCM

						was at 75m.
104	CTD_091	0° 0.070'N	83° 0.092'E	07-10-11	2119 2300	CTD up to 500m. Water sampling at SCM (84 & 78m) and surface. Down cast SCM was at 84m and up cast SCM was at 78m. Vaisala Sonde operation.
105	CTD_092	0° 0.085'N	83° 0.064'E	08-10-11	0005 0046	CTD092 up to 500m. Water sampling up to 150m at standard depths and at SCM (86m & 76m). Down cast SCM was at 86m and up cast SCM was at 76m. Time of operation 00:05 to 00:35hrs. A spike at 60m in the pressure while heaving up. MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-260, 260-68m and 68-0m.
106	CTD_093	0° 0.006'S	83° 0.035'E	08-10-11	0310 0500	CTD up to 500m. Water sampling at SCM (75) and surface. Down cast and up cast SCM was at 75m. Vaisala Sonde operation.
107	CTD_094	0° 0.029'S	83° 0.025'E	08-10-11	0553	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (79m & 77m). Down cast SCM was at 79m and up cast SCM was at 77m.
108	CTD_095	0° 0.100'N	83° 0.050'E	08-10-11	0906 1100	CTD up to 500m. Water sampling at SCM (78) and surface. Down cast and up cast SCM was at 78m. Vaisala Sonde operation.
109	CTD_096	0° 0.022'S	83° 0.035'E	08-10-11	1210	CTD up to 1000m. Mid-day Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, SCM (80m & 76m) for biological and chemical analysis. SCM was at 80m during down cast and 76m during up cast.
110	CTD_096S	0° 0.078'N	82° 59.980'E	08-10-11	1410 1437	CTD up to 50m. Shallow cast. Water samples were collected at 40m, 20m, 10m, surface (~2m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-270, 270-72m and 72-0m.
111	CTD_097	0° 0.125'N	83° 0.007'E	08-10-11	1558	CTD up to 500m. Water sampling at SCM (76m & 71m) and surface. Down cast 76m and up cast SCM

					1730	71m. Vaisala Sonde operation.
112	CTD_098	0° 0.019'N	83° 0.044'E	08-10-11	1759	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (75m). Down cast SCM was at 75m.
113	CTD_099	0° 0.012'N	83° 0.053'E	08-10-11	2104 2300	CTD up to 500m. Water sampling at SCM (82m & 80m) and surface. Vaisala Sonde operation.
114	CTD_100	0° 0.017'N	83° 0.034'E	09-10-11	0004 0043	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (80m & 73m). Down cast SCM was at 80m and up cast SCM at 73m. MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-255, 255-68m and 68-0m.
115	CTD_101	0° 0.032'S	83° 0.023'E	09-10-11	0300 0530	CTD up to 500m. Water sampling at SCM (77m & 74m) and surface. Vaisala Sonde operation.
116	CTD_102	0° 0.034'S	83° 0.014'E	09-10-11	0600	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (83m & 79m). Down cast SCM was at 83m and up cast SCM at 79m.
117	CTD_103	0° 0.119'S	83° 0.077'E	09-10-11	0914 1100	CTD up to 500m. Water sampling at SCM (84m & 81m) and surface. Vaisala Sonde operation.
118	CTD_104	0° 0.001'S	83° 0.037'E	09-10-11	1214	CTD up to 1000m. Mid-day Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, SCM (82m & 74m) for biological and chemical analysis. SCM was at 82m during down cast and 74m during up cast.
119	CTD_104S	0° 0.150'N	83° 0.222'E	09-10-11	1342 1356	CTD up to 50m. Shallow cast. Water samples were collected at 40m, 20m, 10m, surface (~2m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-250, 250-70m and 70-0m.
120	CTD_105	0° 0.082'N	82° 59.994'E	09-10-11	1509 1700	CTD up to 500m. Water sampling at SCM (77m & 76m) and surface. Vaisala Sonde operation.
121	CTD_106	0° 0.016'S	83° 0.074'E	09-10-11	1755	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (77m). Down cast and up cast SCM was at 77m.
122	CTD_107	0° 0.029'N	83° 0.025'E	09-10-11	2102	CTD up to 500m. Water sampling

					2300	at SCM (76m & 70m) and surface. SCM Samples were collected for both down cast (76m) and up cast (70m). Vaisala Sonde operation.
123	CTD_108	0° 0. 082'N	83° 0.025'E	10-10-11	0100 0044	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (72m). Down cast and up cast SCM was at 72m. MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-260, 260-64m and 64-0m.
124	CTD_109	0° 0. 132'N	83° 0.106'E	10-10-11	0307 0530	CTD up to 500m. Water sampling at SCM (70m & 62m) and surface. SCM Samples were collected for both down cast (70m) and up cast (62m). Vaisala Sonde operation.
125	CTD_110	0° 0. 046'N	83° 0.037'E	10-10-11	0559	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (68m & 59m). Down cast SCM was at 68m and up cast SCM was at 59m.
126	CTD_111	0° 0. 016'S	83° 0.044'E	10-10-11	0909 1100	CTD up to 500m. Water sampling at SCM (75m & 71m) and surface. SCM Samples were collected for both down cast (75m) and up cast (71m). Time of operation 09:09 to 09:40 hrs. Vaisala Sonde operation.
127	CTD_112	0° 0. 012'S	83° 0.034'E	10-10-11	1204	CTD up to 1000m. Mid-day Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, SCM (3m) for biological and chemical analysis. SCM was at 73m during both down cast and up cast.
128	CTD_112S	0° 0. 042'N	83° 0.005'E	10-10-11	1340 1357	CTD up to 50m. Shallow cast. Water samples were collected at 40m, 20m, 10m, surface (~2m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-260, 260-66m and 66-0m. Time of operation 13:57 to 14:45 hrs.

129	CTD_113	0° 0.001'N	83° 0.000'E	10-10-11	1446 1700	CTD up to 500m. Water sampling at SCM (73m & 69m) and surface. SCM Samples were collected for both down cast (73m) and up cast (69m). Time of operation 14:46 to 16:02 hrs. Vaisala Sonde operation.
130	CTD_114	0° 0.031'N	83° 0.041'E	10-10-11	1758	CTD up to 500m. Water sampling up to 150m at standard depths and at SCM (67m & 62m). Down cast SCM was at 67m and up cast SCM was at 62m.
131	CTD_115	0° 0.001'N	83° 0.012'E	10-10-11	2102 2300 2315	CTD up to 500m. Water sampling at SCM (76m & 78m) and surface. SCM Samples were collected for both down cast (76m) and up cast (78m). Vaisala Sonde. No response from Radiosonde. Hence another Vaisala Sonde was released.
132	CTD_116	0° 0.132'N	83° 0.162'E	11-10-11	0007 0045 0210	CTD115 up to 500m. Water sampling up to 150m at standard depths and at SCM (82m & 77m). Down cast SCM was at 82m and up cast SCM was at 77m. MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-250, 250-75m and 75-0m. Since the zip of the net was broken, the thermocline sample from 250-75m was not collected. Hence MPN was lowered again up to 250m to collect the sample.
133	CTD_117P P	0° 0.082'N	82° 59.977'E	11-10-11	0342	CTD up to 500m. Water sampling up to 120m for PP at standard depths and at SCM (81m & 75m). Down cast SCM was at 81m and up cast SCM was at 75m.
134	CTD_117G Z	0° 0.174'N	83° 0.163'E	11-10-11	0455 0500 0540 0705 1045	CTD up to 100m. Water sampling at SCM (76m) for Grazing 60Litre. Vaisala Sonde operation. PP Mooring. Deployment starts at 0540 hrs and ends at 0635 hrs. PP Deck incubation starts at 0705 hrs and ends at 1815 hrs. Grazing deck incubation starts at 1045 hrs and ends on 13-10-2011 at 1045hrs.

					1745	PP Mooring retrieval starts at 1745 hrs and retrieval ends at 1825 hrs.
135	CTD_118	0° 0. 044'N	83° 0.112'E	11-10-11	2322	CTD up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, SCM (71m) for biological and chemical analysis. SCM was at 67m during both down cast and 71m during up cast.
136	CTD_118S	0° 0. 005'N	83° 0.068'E	12-10-11	0115	CTD up to 50m. Shallow cast. Water samples were collected at 40m, 20m, 10m, surface (~2m).
		0° 0. 372'N	83° 0.544'E	12-10-11	0131	MPN up to 2800m. Deep cast. Nets closed 2800-2000m, 2000-1000m, 1000-500, 500-300m and 300-0m.
		0° 0. 078'N	83° 0.110'E	12-10-11	0545	MPN up to 300m. Shallow cast. Nets closed 300-255m, 255-56m, 56-0m and 500-300m. End of 2nd Time Series
Beginning of Trans-Equatorial Section Profiling and Sampling						
137	CTD_119	0° 29. 995'S	83° 0.064'E	12-10-11	1030	CTD up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, SCM (60m), and 40m for biological and chemical analysis. SCM was at 66m during down cast and 60m during up cast.
					1214	CTD up to 50m. Shallow cast. Water samples were collected at 20m, 10m, surface (~2m).
138	CTD_120	1° 0. 059'S	83° 0.109'E	12-10-11	1619	CTD up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, and 60m (SCM) for biological and chemical analysis. SCM was at 84m during down cast and 80-60m during up cast.
		1° 0. 018'S	82° 59.972'E		1655	Vaisala Sonde operation.
		0° 59. 942'S	83° 0.086'E		1731	CTD up to 50m. Shallow cast. Water samples were collected at 40, 20m, 10m, surface (~2m).
					1745	MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-250, 250-55m and 55-0m.

139	CTD_121	1° 29. 922'S	83° 0.068'E	12-10-11	2225 2358	CTD up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, 68 (SCM) and 60m for biological and chemical analysis. SCM was at 80m during down cast and 68m during up cast. Bottle at position 24 (60m) was leaking due to breakage of bottle while heaving up. CTD up to 70m. Shallow cast. Water samples were collected at 60, 40, 20m, 10m, surface (~2m).
140	CTD_122	2° 0. 150'S 1° 59. 968'S 1° 59. 712'S	82° 59.869'E 83° 0.012'E 83° 0.404'E	13-10-11	0409 0503 0536 0600 1045	CTD up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, and 77 (SCM) for biological and chemical analysis. SCM was at 90m during down cast and 77m during up cast. Vaisala Sonde Operation at 0503 hrs. CTD up to 70m. Shallow cast. Water samples were collected at 60, 40, 20m, 10m, surface (~2m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-250, 250-56m and 56-0m. Terminated the Deck incubation of Grazing Experiment.
141	CTD_123	2° 30. 024'S 2° 29. 948'S	83° 0.001'E 82° 59.918'E	13-10-11	1115 1234	CTD123 up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, and 63 (SCM) for biological and chemical analysis. SCM was at 71m during down cast and 63m during up cast. CTD123S up to 80m. Shallow cast. Water samples were collected at 60, 40, 20m, 10m, surface (~2m).
142	CTD_124	2° 59. 953'S	82° 59.898'E	13-10-11	1627	CTD up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, and 54 (SCM) for biological and chemical analysis. SCM was

		3° 0. 068'S 3° 0. 126'S	83° 0.056'E 82° 59.946'E		1700 1748 1804	at 67m during down cast and 54m during up cast. Vaisala Sonde Operation. CTD up to 70m. Shallow cast. Water samples were collected at 60, 40, 20m, 10m, surface (~2m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-250, 250-52m and 52-0m.
143	CTD_125	4° 0. 151'S 4° 0. 080'S	83° 0.000'E 83° 0.109'E	14-10-11	0158 0240 0329 0353	CTD up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, 60m, and 53 (SCM) for biological and chemical analysis. SCM was at 65m during down cast and 53m during up cast. Vaisala Sonde Operation. CTD up to 100m. Shallow cast. Water samples were collected at 40m, 20m, 10m, surface (~2m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-210, 210-48m and 48-0m.
144	CTD_126 MPN	5° 0. 186'S 5° 0. 502'S 5° 1. 495'S 5° 0. 226'S 5° 0. 058'S	82° 59.794'E 82° 58.957'E 82° 57.204'E 82° 59.891'E 82° 59.861'E	14-10-11	1237 1304 1552 1726 1805 1852	CTD MPN up to 300m. CTD cast to identify sampling depths for MPN. Isothermal depth 69m & Bottom of Thermocline 220m. MPN up to 2800m. Deep cast. Nets closed 2800-2000m, 2000-1000m, 1000-500, 500-300m and 300-0m. The net of bucket 500-300m sample was torn and hence the sample was discarded. MPN up to 300m. Shallow cast. Nets closed 300-220m, 220-69m, 69-0m and 500-300m. CTD up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, and 71 (SCM) for biological and chemical analysis. SCM was at 70m during down cast and 71m during up cast. Vaisala Sonde Operation. CTD up to 70m. Shallow cast. Water samples were collected at 60m, 40m, 20m, 10m, surface (~2m). Bottle at 60m did not close.

		5° 0. 199'S	82° 59.936'E		1931	Water sample could not be collected. CTD has to be deployed once again for sample. CTD up to 60m. Shallow cast Repeat. Water samples were collected at 60m.
		5° 0. 098'S	82° 59.867'E		2128	MPN up to 2800m.Deep cast. Nets closed 2800-2000m, 2000-1000m, 1000-500, 500-300m and 300-0m.
		4° 59. 945'S	82° 59.944'E	15-10-11	0020	CTD up to 300m. CTD cast to identify sampling depths for MPN. Isothermal depth 78m & Bottom of Thermocline 215m.
		5° 0. 228'S	82° 59.201'E		0046	MPN up to 300m.Shallow cast. Nets closed 300-215m, 215-78m and 78-0m.
		5° 0. 120'S	83° 0.029'E		0213	CTD up to 500m. Water sampling up to 120m for PP at standard depths and at SCM (80m & 80m). Down cast SCM and up cast SCM was at 80m.
		5° 0. 048'S	83° 0.042'E		0320	CTD up to 100m. Water sampling at SCM (80-81m) for Grazing 60Litre.
		4° 59.875'S	82° 59.462'E		0449	PP Mooring. Deployment starts at 0449 hrs and ends at 0545 hrs. Sun rise at 0540 hrs.
					0549	PP Deck incubation starts at 0549 hrs and ends at 1815 hrs.
					0755	Grazing deck incubation starts at 0755 hrs and ends on 17-10-2011 at 1045hrs.
					1750	PP Mooring retrieval starts at 1750 hrs and retrieval ends at 1830 hrs.
145	CTD_127	0° 30. 029'N	83° 0.042'E	17-10-11	0912	CTD up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, and 66 (SCM) for biological and chemical analysis. SCM was at 70m during down cast and 66m during up cast. Vertical spike in all parameters at 300m while heaving up. 80m spike in the fluorescence data.
		0° 30. 048'N	83° 0.006'E		1039	CTD up to 80m. Shallow cast. Water samples were collected at 60m, 40m, 20m, 10m, surface

						(~2m).
146	CTD_128	1° 0. 137'N 0° 59. 903'N 1° 0. 240'N	82° 59.904'E 82° 59.894'E 82° 59.789'E	17-10-11	1427 1500 1545 1608	CTD up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, and 61 (SCM) for biological and chemical analysis. SCM was at 65m during down cast and 61m during up cast. Vaisala Sonde Operation. CTD up to 70m. Shallow cast. Water samples were collected at 60m, 40m, 20m, 10m, surface (~2m). MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-275, 275-60m and 60-0m
147	CTD_129	1° 30. 071'N 1° 30. 026'N	82° 59.914'E 82° 59.987'E	17-10-11	2029 2146	CTD up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, and 64 (SCM) for biological and chemical analysis. SCM was at 67m during down cast and 64m during up cast. CTD up to 80m. Shallow cast. Water samples were collected at 60m, 40m, 20m, 10m, surface (~2m).
148	CTD_130	2° 0. 038'N 1° 59. 959'N 2° 0. 887'N	82° 59.993'E 82° 59.963'E 82° 59.773'E	18-10-11	0130 0201 0302 0353	CTD up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, and 62-63 (SCM) for biological and chemical analysis. SCM was at 66m during down cast and 62-63m during up cast. Vaisala Sonde Operation. CTD up to 1000m. Shallow cast. Water samples were collected at 40m, 20m, 10m, surface (~2m) and 800m & 1000m. The shallow cast was extended up to 1000m because while transporting the samples from deck to Chem lab, the person slipped and fell due to which DO sample at 800m and pH at 1000m was lost. MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-260,

						260-58m and 58-0m.
149	CTD_131	2° 30. 246'N 2° 30. 058'N	83° 0.047'E 82° 59.962'E	18-10-11	0854 1037	CTD up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, and 53 (SCM) for biological and chemical analysis. SCM was at 63m during down cast and 53m during up cast. CTD operation was delayed due to cutting of cable. 25m of cable was cut. Two vertical spikes while heaving up in all parameters at 200m and only in fluorescence at 120m. CTD up to 80m. Shallow cast. Water samples were collected at 60m, 40m, 20m, 10m, surface (~2m).
150	CTD_132	3° 0. 194'N 2° 59. 966'N 3° 0. 398'N	83° 0.049'E 83° 0.107'E 83° 0.415'E	18-10-11	1413 1440 1526 1549	CTD up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, and 64 (SCM) for biological and chemical analysis. Double SCM was noticed at 42m and 66m during down cast and 35m and 64m during up cast. Vaisala Sonde Operation. CTD up to 80m. Shallow cast. Water samples were collected at 40m, 20m, 10m, surface (~2m) and at secondary SCM (38-39m).SCM during down cast was 43m and during up cast 38-39m. MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-250, 250-72m and 72-0m.
151	CTD_133	4° 0.058'N	82° 59.987'E	18-10-11	2348 0005	CTD up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, 60 and 55 (SCM) for biological and chemical analysis. Double SCM was noticed at 30m and 57m during down cast and 23m and 55m during up cast. CTD was stopped at 20m during down cast and 104 while up cast as the unit went under the hull. Vaisala Sonde Operation

		4° 0.030'N	83° 0.167'E	19-10-11	0122	CTD up to 80m. Shallow cast. Water samples were collected at 40m, 20m, 10m, surface (~2m). Double SCM during down cast was 29m and 60m and during up cast 26m and 56m.
		4° 0.125'N	82° 59.902'E		0146	MPN up to 1000m. Nets closed 1000-500m, 500-300m, 300-260, 260-24m and 24-0m.
152	CTD_134	5° 0.152'N	82° 59.936'E	19-10-11	0933	CTD up to 1000m. Deep cast. Water samples were collected at 1000m, 800m, 600m, 400m, 300m, 200m, 150m, 120m, 100m, 80m, 60m and 45-46 (SCM) for biological and chemical analysis. SCM was at 50m during down cast and 45-46m during up cast.
		5° 0.047'N	83° 0.085'E		1113	CTD up to 300m. Shallow cast. Cast was extended up to 300m to determine sampling depths for MPN. CTD was lowered up to 20m and was taken back to surface as it was leading into hull. Isothermal layer depth 80m and thermocline depth was 280m. Water samples were collected at 40m, 20m, 10m, surface (~2m). Down cast SCM was at 58m and up cast at 50m.
		5° 0.140'N	82° 59.836'E		1115	Vaisala Sonde Operation at 1115hrs.
		5° 0.104'N	82° 59.998'E		1153	MPN up to 1000m. Shallow cast. Nets closed at 1000-500, 500-300m, 300-285m, 285-80m and 80-0m.
					1309	MPN up to 2800m. Deep cast. Nets closed 2800-2000m, 2000-1000m, 1000-500, 500-0m. MPN was stopped at 2800m and first net was triggered, but the pressure value showed an increasing trend even after heaving up. All the nets were triggered as usual. But the flow (in & out) and volume readings showed abnormally low rates. The MPN unit came up with the bucket and net entangled and bucket on the top of the MPN frame. No samples were collected. MPN was sent back again.
		4° 59.785'N	82° 59.972'E		1525	MPN up to 2800m. Deep cast

		5° 0.068'N	82° 59.780'E		2004	(repeat). Nets closed 2800-2000m, 2000-1000m, 1000-500, 500-300m and 300-0m. Time of operation 15:25 to 17:27 hrs. CTD134MPNBU up to 300m. Shallow cast. To determine the depth of sampling of MPN for Bharatidasan University. Isothermal layer depth was 82m and thermocline depth was 250m. Time of operation 20:04 to 20:18 hrs. While heaving up the CTD, several kinks were noticed on the CTD cable. The most severe one was about 12 to 15m from the underwater unit. It was decided to cut the cable and splice it. Hence the MPN for Bharatidasan University was abandoned. 80m of cable were cut. Cable was spliced and tested ok by 22:10hrs.
		5° 0.022'N	82° 59.923'E		2247	MPN up to 2800m. Deep cast started at 22:47hrs. MPN deck unit shows "under water unit: NO DATA". Hence it was taken back to the deck at 22:52hrs. Sea cable was spliced again and checked the connection with deck unit. The problem was solved at 0024hrs.
		4° 59.963'N	82° 59.965'E	20-10-11	0028	MPN up to 2800m. Deep cast (repeat). Nets closed 2800-2000m, 2000-1000m, 1000-500, 500-300m and 300-0m.
		5° 0.169'N	83° 0.097'E		0223	CTD134PP up to 300m. Water sampling up to 120m for PP at standard depths and at SCM (54m & 53m). Down cast SCM was at 54m and up cast SCM was at 53m. Bottle no: 10 corresponding to depth 60m was not closed as the lid got stuck.
		5° 0.216'N	82° 59.851'E		0259	MPN up to 300m. Shallow cast. Nets closed at 300-276m, 276-96m and 96-0m.
		5° 0.019'N	83° 0.036'E		0342	CTD134GZ up to 80m. Water sampling was done at SCM (46-47m) for Grazing 60Litre and at 60m that was left out in the previous cast (CTD134PP).
		5° 0.222'N	82° 59.932'E		0404	MPN up to 276m (bottom of

		4° 59.970'N	83° 0.018'E		thermocline).Shallow cast (for Bharatidasan University). Nets closed at 276-96mand 96-0m.
				0450	PP Mooring. Deployment starts at 0450hrs and ends at 0550hrs.
				0538	PP Deck incubation starts at 0538hrs and ends at 1832hrs. Sunrise was at 0542hrs.Horizon was cloudy.
				0845	Grazing deck incubation starts at 0845 hrs and ends on 22-10-2011 at 0845hrs.
				1802	PP Mooring retrieval started at 1802hrs and retrieval ends at 1832hrs.