

Survey Cruise Report



- Cruise no.:** MV.SEAFDEC2 No.23-1/2007
- Period:** 1 February – 15 March 2007 (43 days)
- Area:** Myanmar waters (09°30 N - 16°15 N and 094°30 E - 098°00 E)
- Port of call:**
- | | | |
|-------|---------------|-------------------------------|
| 7-8 | February 2007 | Phuket, Thailand |
| 10-12 | February 2007 | Myiek, Myanmar |
| 13-14 | February 2007 | Myiek, Myanmar (off schedule) |
| 20-22 | February 2007 | Myiek, Myanmar |
| 2-3 | March 2007 | Myiek, Myanmar |
| 11-13 | March 2007 | Myiek, Myanmar |
- Objective:**
- 1) To investigate the status of demersal resources in the depth of water from 30m to 200m by bottom trawl
 - 2) To investigate the status of large pelagic resources on the continental slope to the deep sea area using drifting long line
 - 3) To collect the oceanographic parameters and planktons for further analysis in relationship to the fisheries resources
- Main activity:**
1. Fisheries resource survey by bottom trawl and Pelagic longline
 2. Oceanographic survey using Integrated Conductivity Temperature and Depth measuring instrument (ICTD), Thermosalinograph-fluorometer (TSG), Vandorn water sampler and Bongo net

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. Somphote Vudthipanyo	Third officer
5	Mr. Komson Sangphuek	Second engineer
6	Mr. Aussawin Buachuay	Fishing Assistant
7	Mr. Vudthirat Vudthipanyo	Boatswain
8	Mr. Pradit Kui-prasert	Steerman
9	Mr. Tana Rungjoy	"
10	Mr. Somkiat Phetrasatien	Able seaman
11	Mr. Nattapong Chaitanavisud	Fitter
12	Mr. Plew Shodok	Oiler
13	Mr. Boontarin Wara-in	"
14	Mr. Watchara Panasri	"
15	Mr. Saichol Kornnoom	Cook
16	Mr. Phaithoon Sriratanaphon	Ship's boy

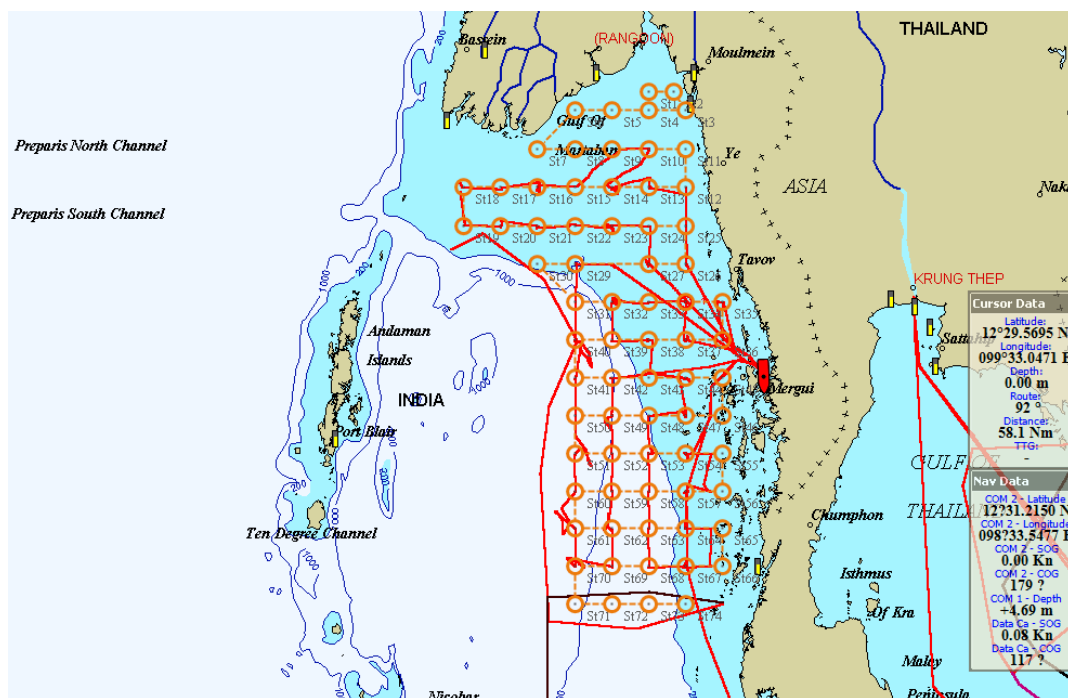
Researchers

No.	Name	Responsibility	Contact address	Period of duty
1	Mr. Isara Chanrachkij ¹	Chief Scientist	isara@seafdec.org	7 Feb – 15 Mar
2	Mr. Sayan Promjinda ¹	Fishing gear Technologist	sayan@seafdec.org	7 Feb – 15 Mar
3	Ms. Penchan Laongmanee ¹	Oceanography	penchan@seafdec.org	7 Feb – 2 Mar
4	Ms. Nawinee Khumthong ¹	Oceanography	nawinee@seafdec.org	7 Feb – 15 Mar
5	Mr. Suthipong Thanasansakorn ¹	Fish handing technician	suthipong@seafdec.org	7 – 21 Feb
6	Mr. Thaweesak Thimkrap ¹	Fish handing technician	thaweesak@seafdec.org	7- 21 Feb
7	Mr. Myint Pe ²	Fishery biology &Myanmar chief scientist	myintpe@myanmar.com. mm	12 Feb –12 Mar
8	Mr. Khin Maung Aye	Fishing head & Navigation	myintzu@myanmar.com. mm Institute of Fisheries Technology, Department of Fisheries, Yangon	12 – 20 Feb
9	Mr. Win Ko Ko ²	Fish Taxonomy		12 Feb –13 Mar
10	Mr. Saw Aung Htut ²	Taxonomy &Oceanography		12 Feb –13 Mar
11	Mr. Tiat Wai ²	Taxonomy & Oceanography		12 Feb –13 Mar
12	Dr. Hla Phone	Taxonomy & Oceanography	Department of Fisheries, Sinn Min Road, Ahlone Township, Yangon	12 Feb – 3 Mar

3) The deep sea zone of Central and Southern of Myanmar waters (Upper part of Andaman Sea) 16 Survey stations are planned to conduct the oceanographic survey and 6 stations of pelagic resources survey by operating pelagic longline during the third session. Sea depth is different from 400 m to 2000 m, Period of the third session is carried out from 3 to 11 March 2007.

Survey summary:

The mission of Cruise No. 23-1/2007, **The National Research Survey in the EEZ of Myanmar Waters**, has been accomplished with 60 survey stations. The stations are divided into 60 Oceanographic survey, 17 operations for Fishing survey by Bottom Trawl and 6 operations for Pelagic Longline. The area of survey is covered both offshore and coastal area. 9 survey stations, on the inner of Gulf of Martaban area, have been cancelled because depth is too shallow to safety navigation and plenty of stationary gears. 4 stations, in the southern of survey area, have been cancelled as well according that these 4 stations are fixed into the overlap zone between Myanmar Waters and Thai Waters.



The survey has been split into 3 sessions. On the first and second session oceanographic survey and bottom trawl fishing has been carried out. Oceanographic survey and pelagic longline has been conducted on 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 activities.

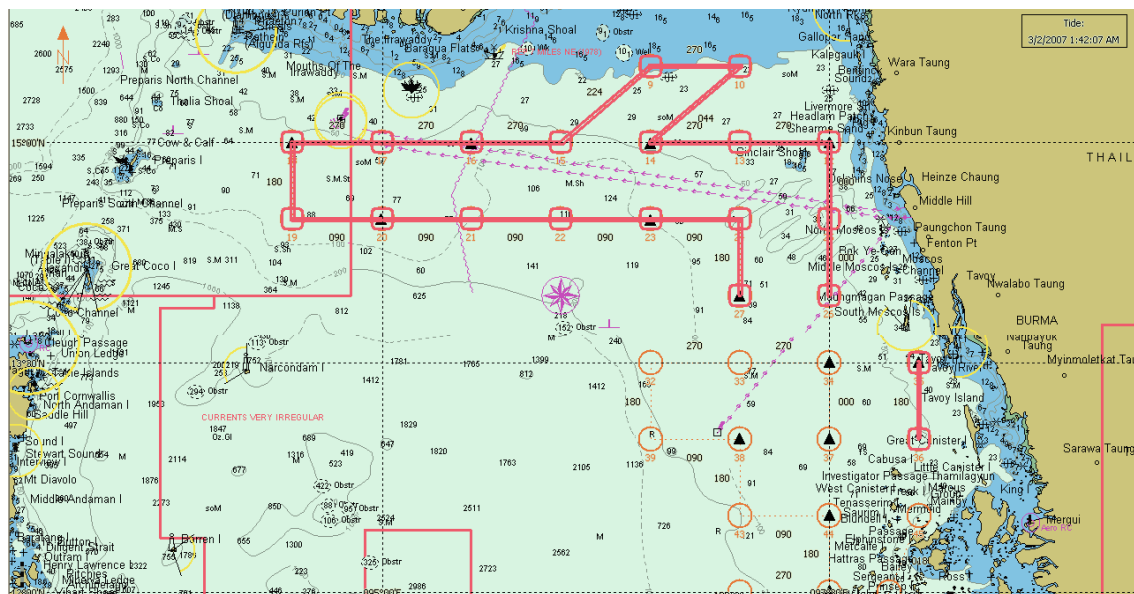
The first session (13-20 February 2007)

There are 20 oceanographic survey stations and 8 bottom trawl fishing operations have been conducted on the first session from 13 to 20 February 2007. There were 2 serious trouble of bottom trawl survey at first operation at station No.36, i.e. the right part of head rope of bottom trawl net was broken and made the net panel attached with the head rope is also damage. The other trouble is chain for driven wire

arranger of the towing winch had broken and towing wire would not be proper arranged in to the drum both during setting and hauling. In order to play safety for crew and fishing equipment, captain and both chief scientist of Myanmar and SEAFDEC agreed to return to port of Myeik and purchase for spare part of ground rope and chain for driven wire arranger of towing warp winch. So that M.V.SEAFFDEC returned and arrived at Port of Myeik in the evening of 13 February 2007. After finish the repairing of trawl net and towing warp winch, M.V. SEAFFDEC return to survey station No. 26 on 14 February 2007.

The survey on the upper part of Gulf of Martaban, Irrawadi river-mouth, on station No.1, 2, 3, 4, 5, 6, 7, 8 and 11 has been cancelled. Most of stations are fixed in the shallow water zone (sea depth less than 20 m.) and these stations has been widely obstructed by enormous stationary fishing gear such giant fyke net, bamboo streak trap, and etc. As well as the information from Myanmar Scientists that drifting or survey operation in the nighttime unsafe of the hijack by the rebellion groups.

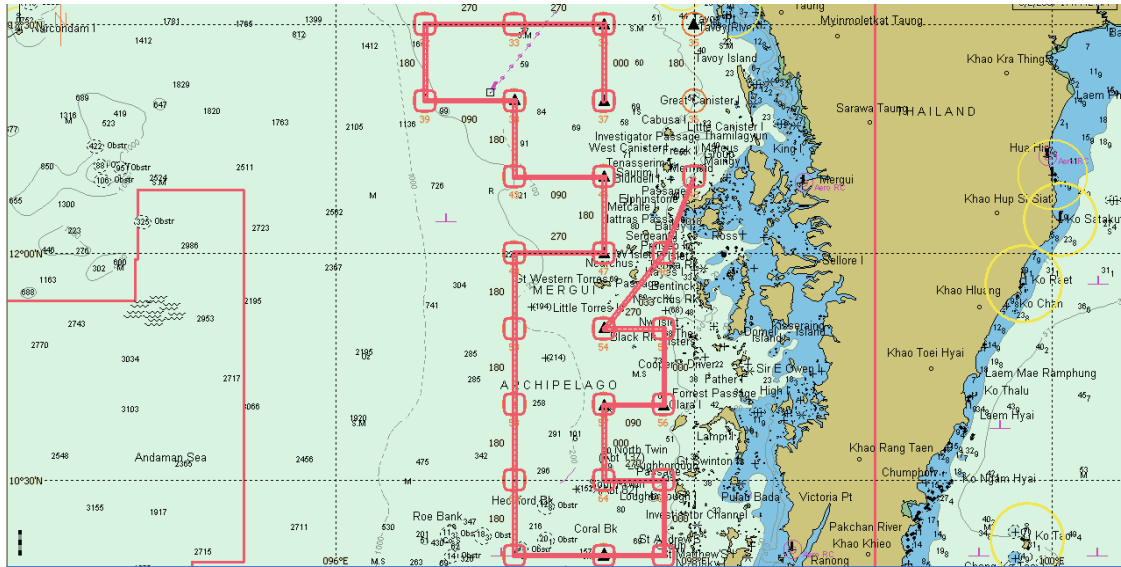
The survey in the first session had been stopped before schedule because the desalinometer (Freshwater filtering machine) was broken. Although the spare part had store on the vessel but the fixing need the calm sea condition. By this reason M.V.SEAFFDEC returned to Myeik after finish the station No.27 on 19 February 2007 and arrived at Myeik on 20 February 2007. Chart of survey on the first session is appeared below;



The second session (22 February – 1 March 2007)

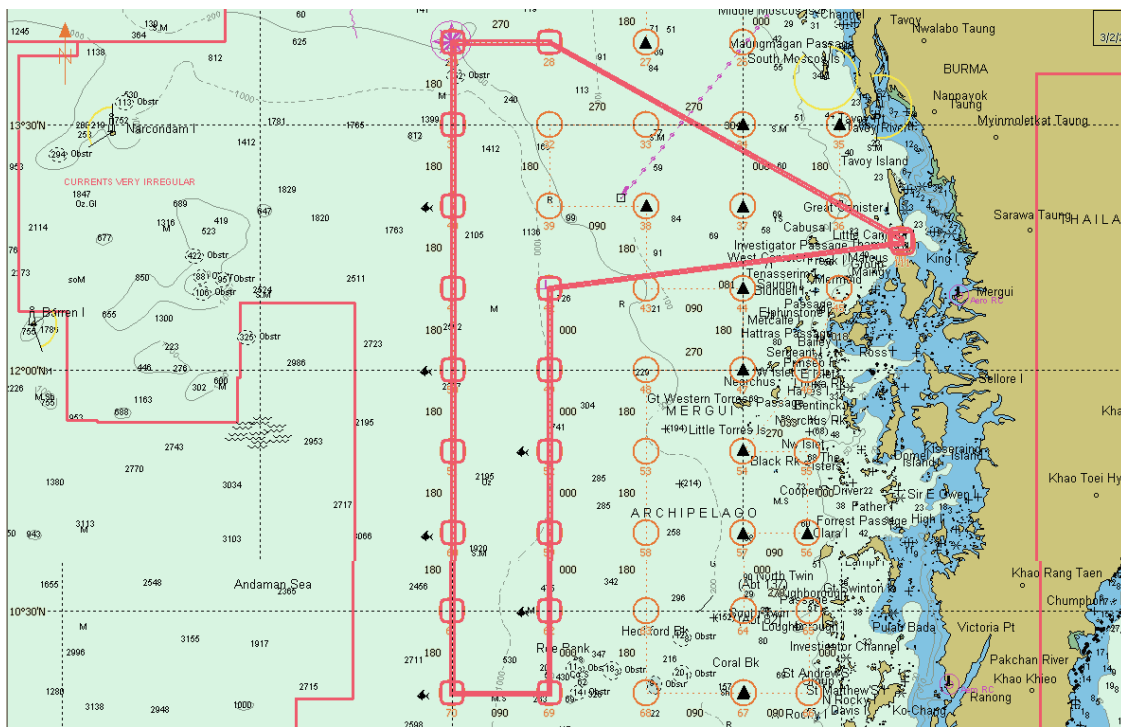
. The second survey is started from 22 February to 1 March 2007 in the upper part of Andaman Sea, Myanmar Waters. There are 24 oceanographic survey stations and 9 bottom trawl fishing operations have been carried out in the second session.

During the survey at station No.67, bottom trawl is struggled with the underwater obstacles and ground rope of bottom trawl was broken because bottom type was coral and reef. Crew members spent 7 hours for replacing the new ground rope and fixing the tear net. The bottom trawl was operated in the next survey days.



The Third session (2 February – 11 March 2007)

Affected from the trouble of the first session, 2 stations, No.28, 29 and 31 are added into the third session. This session is conducted from 2 to 11 March 2007 in the deep sea zone of Andaman sea, Myanmar EEZ, beyond the trawlable area. The third session is started at station No.28 and finished at station No. 42. The target resources survey is focused on the mega-pelagic resources collectable by pelagic longline. Depth of the survey area is from 400 m to 2700 m divided into 2 parts i.e., Continental slope from 400-1000 m and Abyssal plain more than 1000 m.



There are 16 oceanographic survey stations and 6 pelagic longline fishing operations have been completely conducted on the third session.

The survey was carried out by cooperation among researcher from SEAFDEC, Myanmar and Thailand. During discussion of all researchers on 12 Feb 07, the meeting agrees that draft report will send to Myanmar chief scientist for three copy (Department of Fisheries, Myiek University and Myanmar Fisheries Federation) on 13 Mar 07. The final survey cruise report shall send to Myanmar chief scientist by the end of May. And research papers from the survey should also send to Myanmar chief scientist 6 month after the survey period (by September)

List of research paper from SEAFDEC and Thai researcher

1. Distribution and abundance of Zooplankton in Myanmar water by Ms. Sunun Pattarajinda, Kasetsart University, Thailand
2. Distribution and abundance of Fish Larvae in Myanmar water by Mr. Teerapong Doungee, Kasetsart University, Thailand
3. Distribution and abundance of Phytoplankton in Myanmar water by Ms. Sopana Boonyapiwat, Department of Fishery, Thailand
4. Total alkalinity and TNTP (total nitrate and total phosphate) by Dr. Penjai Sompongchaikul, Prince Songkranakarin University, Thailand
5. Physical and chemical characteristic of Myanmar water by Penchan Laongmanee , SEAFDEC/TD
6. Heavy metal in fish caught from MV.SEAFDEC2 in Myanmar water by Dr. Penjai Sompongchaikul, Prince Songkranakarin University, Thailand
7. Catch composition by Dr. Thanittha, Kasetsart University, SEAFDEC/TD and Myanmar researcher
8. Catch efficiency of bottom trawl by single and multi-species by Dr. Thanittha, Kasetsart University, SEAFDEC/TD and Myanmar researcher
9. Stomach content of scombridae from Pelagic longline by Ms. Sampan Panjarat, Department of Fisheries, Thailand
10. Otolit and DNA study of scombridae from Pelagic longline, Sayan Promjinda, SEAFDEC/TD

Oceanographic survey

There are 60 oceanographic stations was conduct during the survey (Fig 1). Partial detail and environmental condition of each station are in table 1 and 2 respectively. The following are material and method of oceanographic survey.

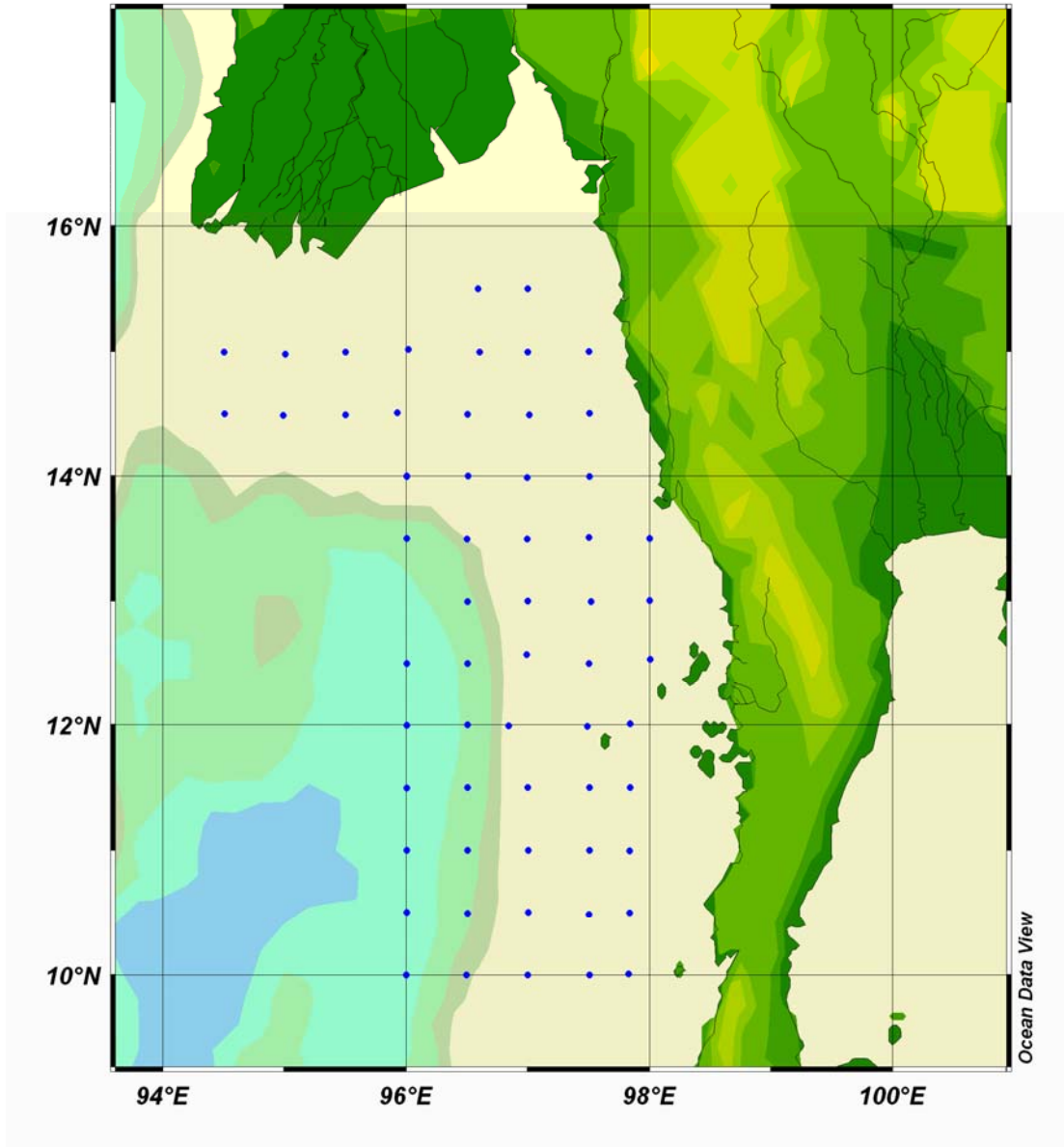


Fig. 1 Map of oceanographic survey stations



Physical and chemical character of water

Physical and chemical character of water including conductivity, temperature,

Fig. 2 Operating CTD in laboratory

depth, dissolved oxygen, pH, Chlorophyll fluorescence and PAR was measuring using SeaBird 911 CTD and Thermosalinograph with Fluorometer (TSG-Fluorometer)

M.V.SEAFFDEC 2, iCTD systems equipped with three main sensors for conductivity, temperature and depth and four auxiliary sensors for dissolved oxygen, pH, chlorophyll fluorometer and PAR. The iCTD was deployed from the sea surface to approximately 5 m. above sea bottom with constant velocity 0.5 m/s and retrieved to the surface at a similar speed (1 m/s was applied for station deeper than 200 meter depth).



Fig. 3 Lowering CTD

All iCTD data were average into every 1 meter interval. Data in each station were divided into down cast and upper cast.

During retrieving iCTD, Carousel water sample (Niskin Bottles) which is a part of CTD system were used for collecting water samples from standard depth (table 3 for several study).

TSG – Fluorometer were operated during MV.SEAFFDEC2 along the cruise track. The system was designed to pump water from approximately 5 meter below the sea surface continuously for measuring temperature, salinity and fluorescence chlorophyll-a. The data were average every 6 second. Operating summary is shown in table 1.

Nutrient
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 SEAFFDEC/ Training Department laboratory.



Fig. 4 Water Filtering before freeze

Total Nitrate and Total Phosphate (TNTP)

30 ml of water sample were freeze at -45 °C immediately after collecting for TNTP study which will be conducted at Faculty of Environment management, Price Songkranakarin University.

Total Alkalinity (TA)

125 ml of water sample were collected then store in room temperature for TA study at Faculty of Environment management, Price Songkranakarin University.



Fig. 5 Water filtering for TSS

Total Suspended Solid (TSS)

Water sample from surface and fishing depth were filter through the know weight GFC filter paper then freeze for further process at SEAFFDEC/TD laboratory. In some station water from standard depth were also using for TSS study (table 3)

Heavy Metal in flesh of marine fish

In every fishing operation three sample of each commercial fish species were collected then freeze in -15 °C for further analysis at Faculty of Environment management, Price Songkranakarin University.



Fig. 6 Towing Bongo net

Zooplankton and Fish larvae

The 60 cm. diameter bongo frames were attached with zooplankton and larvae net with mesh size of 330 μm and 500 μm , respectively. A flow meter was attached at the aperture of net to measure the water volume passing through the net. Zooplankton net and fish larvae net was attached with Hydro bios flow meter and TSK flow meter no. 7035 respectively.

The TSK flow meter was calibrated before the survey period which was 6.59 revolutions per meter. The hydro bios will be calibrated soonest after MV.SEAFFDEC2 arrive SEAFFDEC/TD.

Bongo net was oblique tow with 1-2 knots approximately ship speed. Angle of towing cable was maintained at 45 °. Towing depth was observed using Net SONDE (depth meter). The operations depth of Bongo in shallow water depth station was from surface to 10-15 m above the sea bottom while the deep water station, maximum depth of Bongo was limit with length of wire (140 m).



Fig. 7 Fish larvae sample

Towing time for downward and upward was 15 minute each. The samples were preserved in 5% buffered formalin and seawater immediately. Partial details of Bongo net operation are in table 3.

Another zooplankton study was conducted by Prof Dr. Htay Aung. Zooplankton was collected using 30 cm diameter, 110 cm length of 100 μm mesh size net. The net was set at 30 meter depth then slowly pull to surface. Sample then was preserved in 5% buffered formalin.



Fig. 8 Filtering for Phytoplankton

Prof Dr. Htay Aung also conducted another phytoplankton study. Six vertical manual tows by hand from 6 meter to surface were conducted in every survey stations. The net is 25 cm diameter and 60 cm length with 25 μm mesh size. Sample was also preserved in 2% formaldehyde.

Phytoplankton

In coastal area, phytoplankton was collected from three layer of water: at surface, 25 m and 50 m while in off shore station, only surface layer was collected (table 3).

At surface layer, 50 liter of water was collected using a simple bucket. 20 lit of water at 25 and 50 meter depth was collected by Van Dorn water sampler. Sample then was filtered through 20 μm mesh size net and was preserved in 2% formaldehyde.



Fig. 9 Vertical towing phytoplankton net

Preliminary analysis of oceanographic parameter

Figure 10 show data from each particular area. Data from station 18 represent general pattern of coastal water that surface water is low in salinity and pH. Station no. 12 represents irregular characteristic of coastal water with high salinity and oxygen but low in pH. Station 39, 58 and 66 represent offshore water with high in salinity and pH.

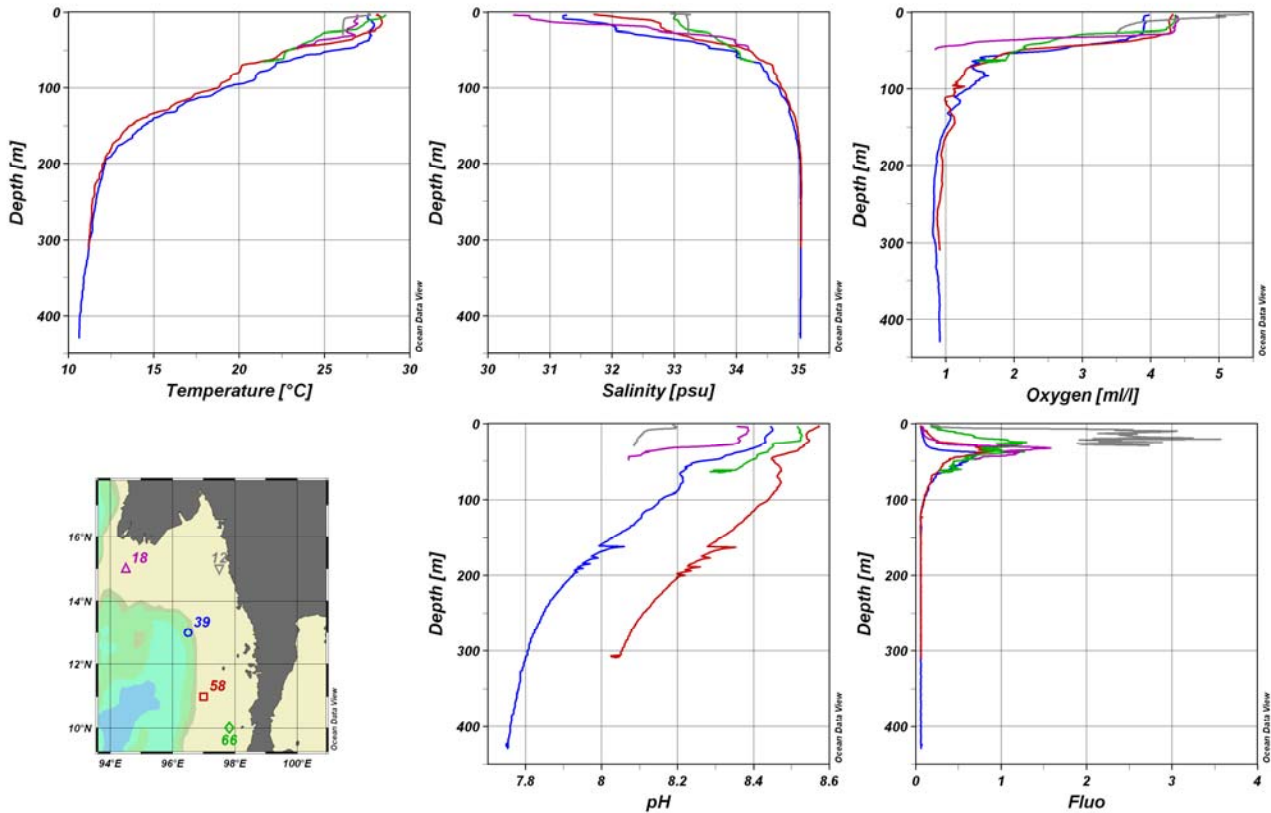


Fig. 10 Profile of temperature ($^{\circ}$ C), salinity (psu), oxygen (ml/l), pH and fluorescence of station no. 18, 39, 58, 66 and 12

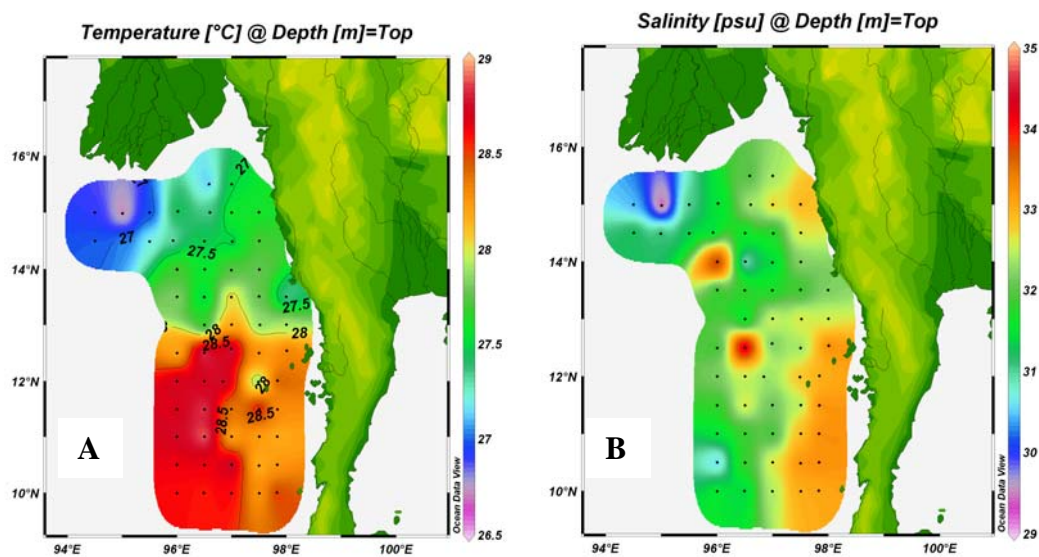


Fig. 11 Horizontal plot of A: Surface temperature ($^{\circ}$ C) and B: Surface salinity (psu)

Another prominent characteristic of this area is lower salinity and temperature in the northern of survey area which was effected from Ayeyarwadi river (Fig 11 and 12).

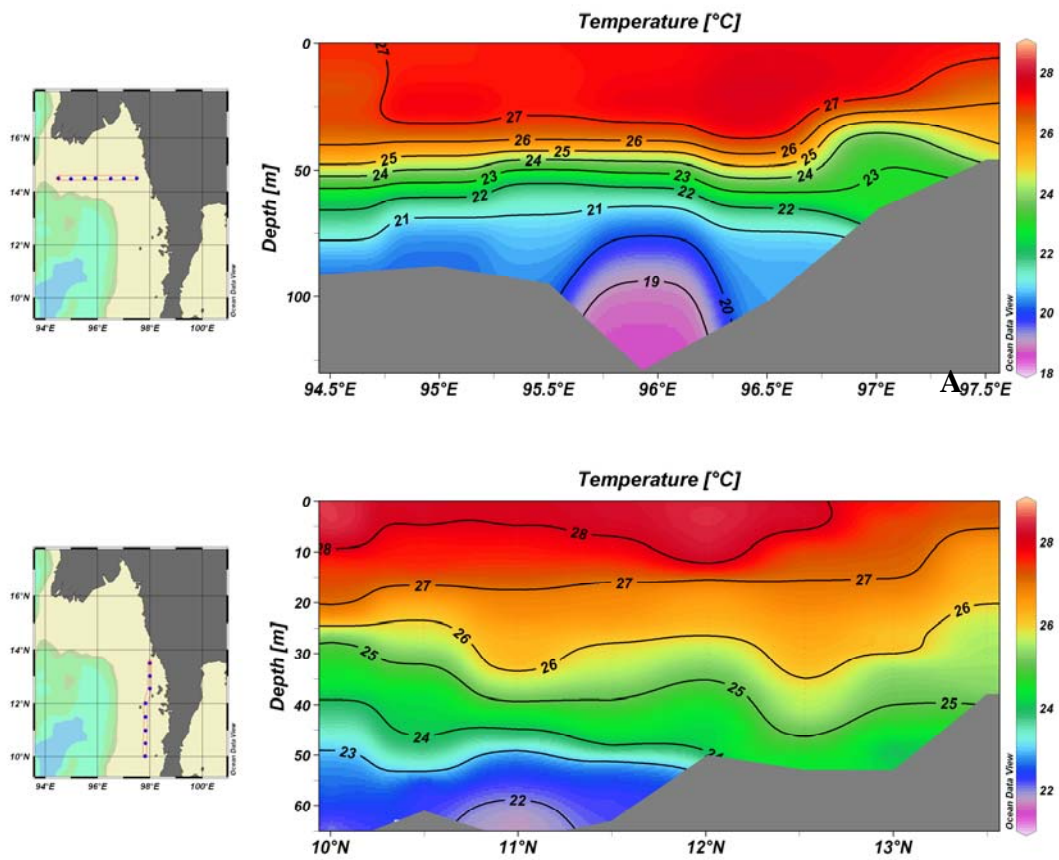


Fig. 12 Vertical plot of temperature ($^{\circ}\text{C}$)
 A: Along station no. 35,36,45,46,55,56,65 and 66
 B: Along station no. 19 - 25

Fishery resources survey

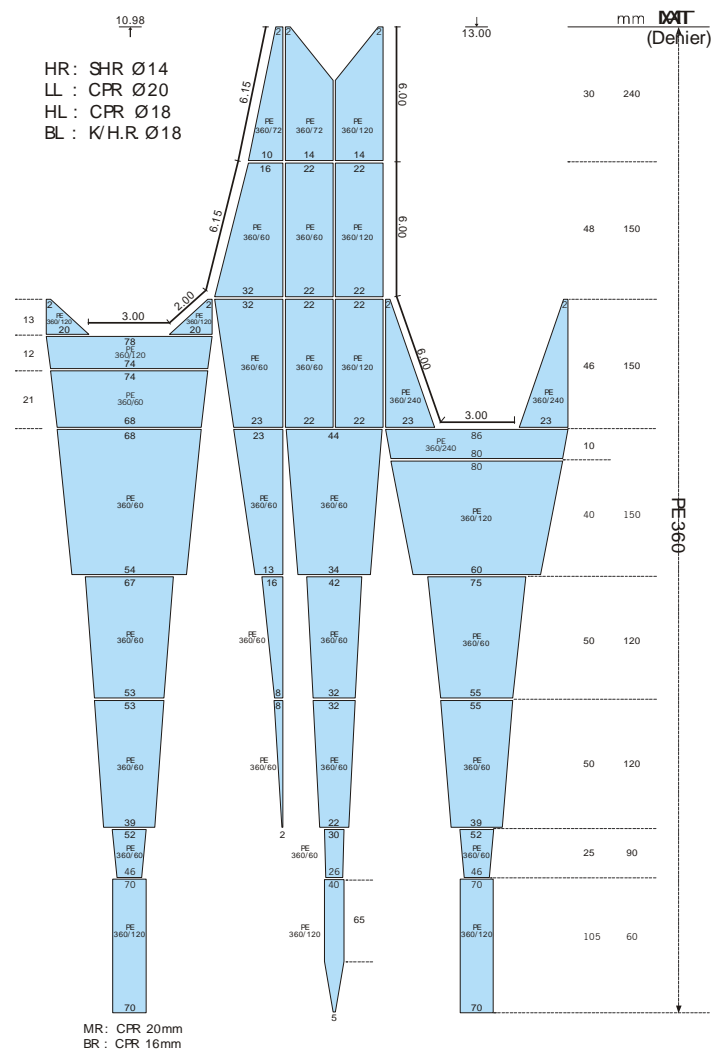
2 categories of fisheries resources, i.e. demersal resource and pelagic resources have been surveyed during survey. On the first and the second, MV SEAFDEC2 has operated the bottom trawl for investigate the resource abundant, species composition of demersal resources in trawlable ground of Myanmar waters, depth from 30-100 m. On the third session, MV SEAFDEC2 has operated the pelagic longline for investigation the pelagic resource abundant, pelagic species composition targeted on tuna, sword and billfish in deep sea zone of Myanmar waters, depth from 400-2500 m.

Demersal resource survey

Seventeen bottom trawl fishing operations were carried out during the first and second session of this cruise. Three out of seventeen at station No.35, 27 and 67 trawled less than 60 minutes. The ground rope of trawl net was broken at station No.35 because of rusty combination rope. Although the net is renewed all ground rope and head rope, the new ground rope is rusty inside and new combination rope was not strong as well as the non-rusty one. At the station No.67 the dangerous sea bottom was appeared in the echo sounder screen captain commanded to urgently hauling but trawl net already struggle with underwater obstacles. After finish hauling, trawl net is found broken at the ground rope however crew spent 8 hour to repair and the survey by bottom trawl was carried out on the next days. After the second session weight 72 kg was added at the ground rope because the net is unstable touch the sea bottom, observed by scanmar trawl eye sensors.

Material and method

Demersal resources survey is sampled by using bottom trawl. M.V.SEAFDEC2 bottom trawl is 4 seams trawl. Ground rope is 37 m. length and head rope is 31.6 m length. Net body is 40.55 m length. Ground rope is suitable for soft bottom. Cod end part is 1 inch mesh size and make by polyethylene knotless net. Net opening is about 2.5-3.0 m height and 20-24 m wing spread. Net is spread by rectangular iron otter board 1400 mm length

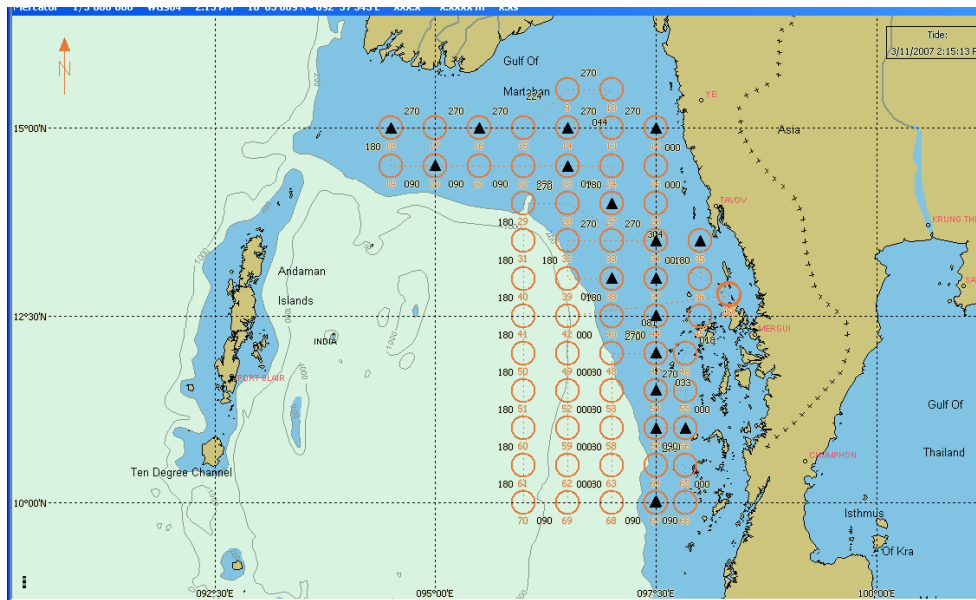


20-24 m wing spread. Net is spread by rectangular iron otter board 1400 mm length

and 2200 mm height. Sweep line is 30 m length with upper and lower net pendant 50 m Trawling speed is 3.0-3.5 knot.

Area of fishing operation

Bottom trawl were carried out in the trawlable area of gulf of Martaban and Andaman Sea, Myanmar waters. Sea depth was from 30 m to 100 m. Bottom trawl operation is carried out in the Gulf of Martaban in the first session and along the coast line of Tanintanyi Region, Andaman Sea in the second sessions



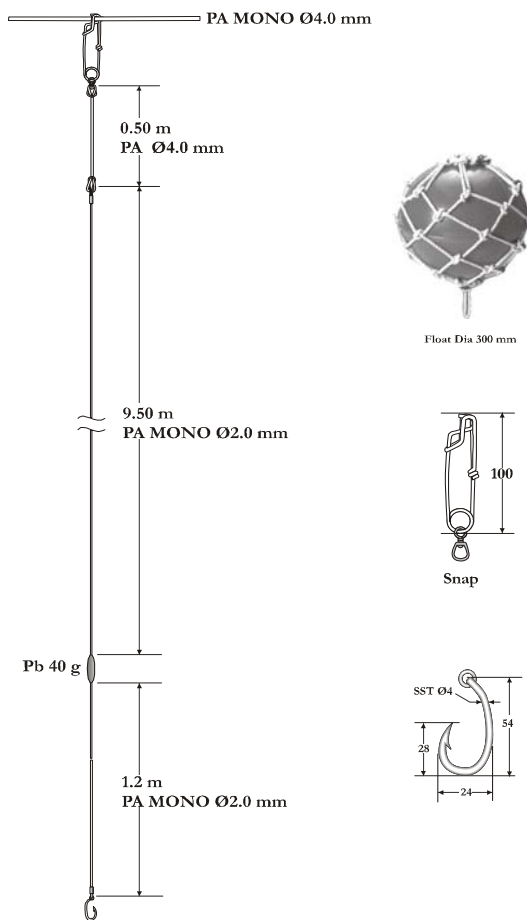
Result of resources survey

Seventeen fishing operation is conducted in 2 survey area, i.e. Northern of Gulf of Martaban and Along the Coast line of Tanintanyi Region in Andaman Sea. Standard trawling time is 60 minutes but three stations were hauling earlier than 60 minutes because the bottom was not suitable. Head rope is broken at Station No.12 because the head rope, made by combination rope and wire is rusty. Eventhough SEAFDC trawl technician has already change the new head rope before started the survey, rusted new combination rope made the head rope weak and broken while strong hydrodynamic force was acted with the net. The Ground rope was broken at Station No.67 because fishing ground is coral reef. Although captain had emergency hauled the net after rough bottom was observed, net is already struggled with underwater obstacles.

Total catch from 17 trawl fishing operations, 966 towing minutes, was 1393.32 kilograms and CPUE was 86.52 kilogram. The CPUE of Gulf of Martaban and Along the Coast line of Tanintanyi Region in Andaman Sea, was not far different, 88.67 kg and 84.30 kg respectively. Station No.12 is the highest catch with 167 kg but the catch was composed by jelly fish 132 kg. the second highest catch is station No.67 with catches 142.4 kg. The detail of species composition, size composition and distribution of catches has been under responsible by Dr. Thanittha Thapanand-Chaidee. Complete report shall be distributed to Department of Fisheries Myanmar within 6 months.

Pelagic resources survey

Six pelagic longline fishing operations were carried out during the third session from 3 to 11 March 2007. Total hook deployed on the pelagic resources survey were 3401 hooks with 39 individual fishes were catches.



Material and method

Pelagic resource samples have been collected by using pelagic longline. M.V. SEAFDEC2 has installed an automatic longline system. The system is composed with mainline spool, automatic line shooting machine and branch line setting beeper. Main line spool is made by aluminum alloy diameter 100 cm and 130 cm length. The spool is able to contain monofilament mainline, diameter 4 mm, more than 30 kilometers. The mainline shooter is made by aluminum alloy. Function of mainline shooter is, to release the mainline from spool with very accurate shooting rate in order to control the depth of branch line in the sea. While the controller wants to emergency stop the mainline shooter, mainline spool must be instantly stopped as well. Setting speed of mainline shooter needs to compatible control with the speed of vessel. M.V. SEAFDEC2 is shooting with speed around 6-8 knots and setting

mainline shooter at speed around 7-8 knots. In order to control speed of mainline shooter SEAFDEC/TD technician develop the computer software to command the shooting of branch line and float, as well as counting length of mainline and number of branch line.

Complete set of pelagic longline is composed by mainline, branch line and buoy line. Mainline is made from Nylon monofilament diameter 4 mm. Breaking strength of mainline is more than 0.5 metric ton. The standard operational of pelagic longline carried out onboard M.V. SEAFDEC2 is setting more than 25 kilometer in an operation. Branch line is made by Nylon monofilament diameter 2.0 mm length 11 m. there are 2 designs of hook, Circle shape and J-shape, setting with branch line in order to investigate and compare the efficiency of hook designs. M.V. SEAFDEC2 has standard operational of pelagic longline to deploy 600 hooks per one operation. 20 hooks are set between float intervals. 2 set of Temperature and Depth sensors (TD sensors) were attach at the branch line No.1 and 10 in order to check the actual depth of hook. TD sensors have shown that the shallowest branch line was 34-70 m and deepest branch line No.10 and 11 was 150-250 m.

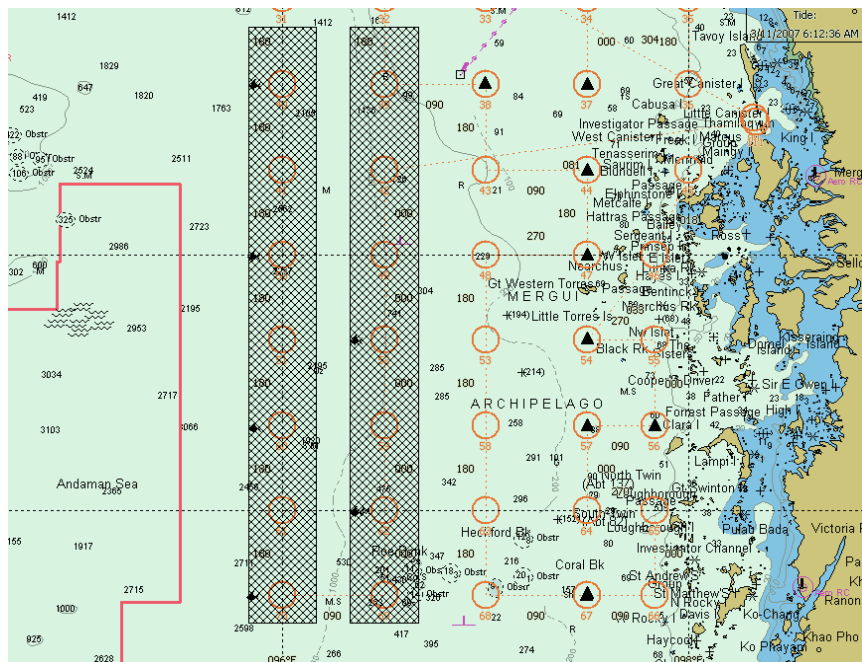
On this cruise, the baits, Indo-Pacific Mackerel, were not enough to set 600 hooks within an operation because bait size is bigger than expectation. Normal size of bait is 8 to 10 fishes per kilogram but the baits that prepared from Bangkok, Thailand were as big as 6-8 fishes per kilogram. Total branch line setting on 6 fishing

operations are 3,401 branch lines. 50 Luminescence light sticks for attracting sword fish were attach at branch line on station No.2, 3, 4 and 5

6 Fishing operations were conducted in the deep sea area of Andaman Sea. Shooting operations had been operated in the evening and hauling had been done in the early morning time. 600 hooks were spent 1:45 to 2 hours for setting and 3:30 to 4 hours to hauling. During setting operation the line shooting machine was well function without any serious trouble. Drifting of longline at Station No.1, 2 and 3 was south west,

Area of fishing operation

The pelagic longline fishing operations were carried out in the deep sea area of Andaman Sea, Myanmar waters. Sea depth is from 700 m to 2700 m. According to the underwater topography, fishing ground can be separated into two main areas, i.e. Continental slope from 400 to 1500 m (Sea Chart: Left shadow zone) and abyssal plain of the depth between 2000 to 2700 m (Sea chart: Right shadow zone)



Result of operation

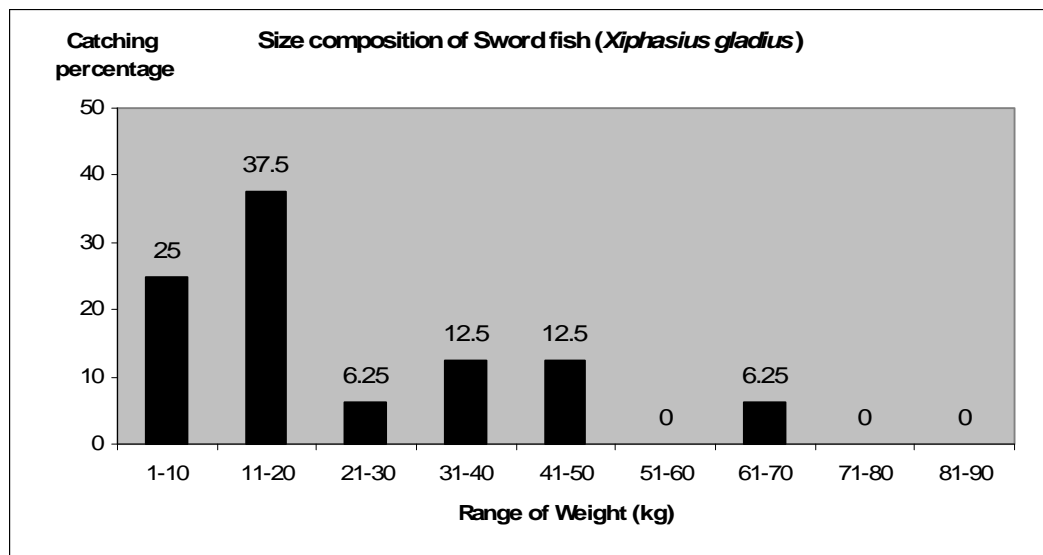
39 individual fishes, 6 fish species, were catches from 6 pelagic longline fishing operations. Total weight is 1266.7 kilograms. Total numbers of hook deployed were 3,401 hooks. Catch per unit effort (CPUE) of pelagic longline survey in Myanmar Waters is 11.47 individual fishes per 1000 hooks. Sword fish is found the highest CPUE, 4.7 individual fishes/1000 hooks follow by Thresher shark 3.82 individual shark/1000 hooks. Ray is the third catches rate with 1.47 individual Rays/1000 hooks.

Station No.3 is found highest catch 13 fishes with CPUE 21.85 individual fishes/1000 hooks. Station No.2 caught 9 fish and become the second highest CPUE, 14.68 individual fishes/1000 hooks. The third highest CPUE is station No.5 with 12.61 individual fishes/1000 hooks

Operation No.	Hook No.	Catch						Total
		Thresher shark	Sword fish	Sail fish	Ray	lancet	Other	
1	598	0	1	0	0	0	1	2
2	613	2	5	0	1	1	0	9
3	595	4	6	0	2	1	0	13
4	604	2	1	1	0	0	0	4
5	555	4	0	1	2	0	0	7
6	436	1	3	0	0	0	0	4
Total catch		13	16	2	5	2	1	39
CPUE (1000 hook)		3.82	4.70	0.59	1.47	0.59	0.29	11.47

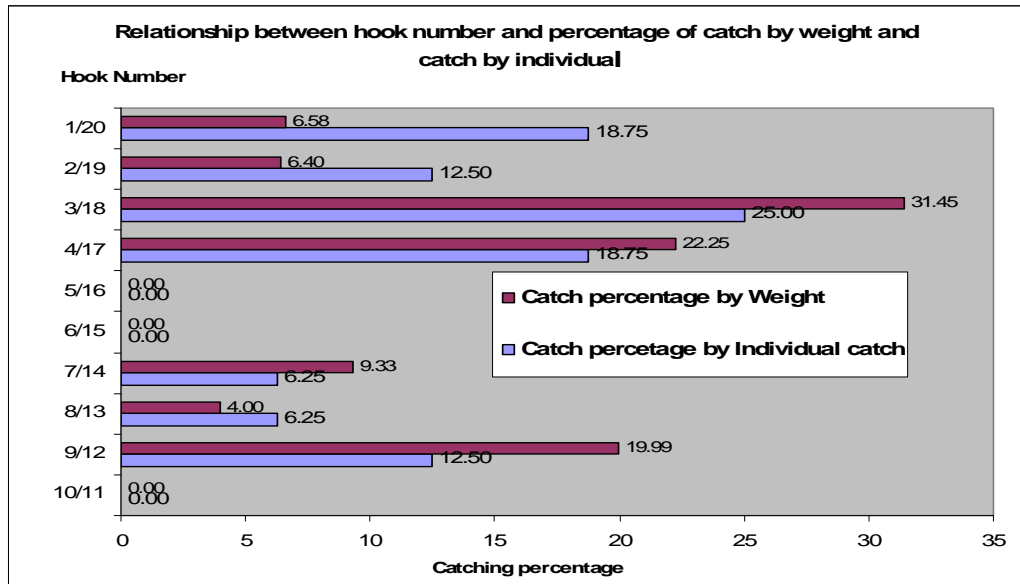
The main target catch of this pelagic resource survey is sword fish (*Xiphasius gladius*). Number of individual Sword fish caught during the survey is 16 fishes, 382.2 kilograms. Catch per unit effort of sword fish during the survey by pelagic longline is 4.7 individual fishes/1000 hooks. The biggest sword fish is 65 kilograms and smallest sword fish is 2.2 kilograms. Sword fish is caught at Station No.3 with the highest catches, 5 individual sword fishes (CPUE of sword fish at station No.5 was 10 Individual fishes/1000 hooks) and station No.5 has no any sword fish caught. The comparison between fishing area Continental slope from 400 to 1500 m and abyssal plain of the depth between 2000 to 2700 m has shown significant different catches of sword fish. Fishing ground in the distant water depth between 2000-2700 m. has caught 12 individual sword fish and catch in continental slope from 700-1000 m. has caught 4 fishes. Station No.5, depth 875 m has not caught any sword fishes.

Size Variation of sword fish is from 2.2 kilogram to 65 kilogram. Majority size of sword fish caught by pelagic longline is in the range of weight 11-20 kg, 37.5 % followed by juvenile range of weight is 1-10 kg, 25% Most of juvenile sword fish is catch from station No.6 in continental slope from 700-1000 m. and Station No.1 depth 1900 m.

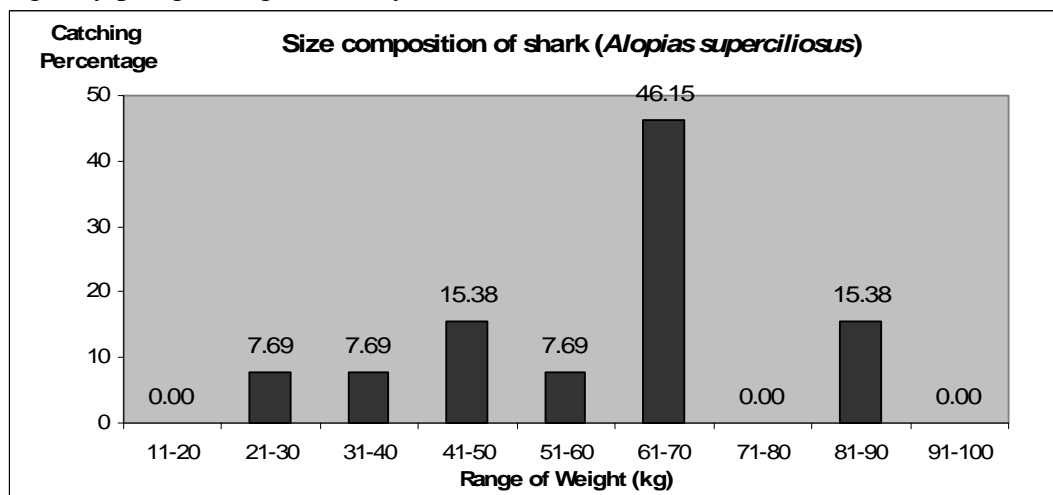


Efficiency of hook is investigated in term of depth of individual hook. Hooks No.1 and 20 are assumed in the same shallowest depth level. As well as hook No.10 and 11 are assumed in the same deepest depth level. From the graph, catch at the shallow hooks No.1-4 and 17-20 are shown higher than deeper hook No.7-10 and 11-14. Hook level is show not significant different between deep and shallow hook level

however setting on the shallow from 35-120 m. show little better than from 150-200 m. But the actual depth of capture is strongly affected by the current condition. We could not clearly specify the swimming layer of sword fish in Myanmar Waters because they are swim from sea surface to depth 250 m.



One of the important bycatch from pelagic longline is shark. Only specie of Thresher shark (*Alopius superciliosus*) was caught during pelagic resources survey. 13 individual sharks were catch with total weight 804 kilograms. The CPUE of shark caught by pelagic longline in Myanmar Waters is 3.82 individual sharks/1000 hooks.



The comparison between fishing area Continental slope from 400 to 1500 m and abyssal plain of the depth between 2000 to 2700 m has not shown any significant different catches of thresher shark. Fishing ground in the distant water depth between 2000-2700 m. has caught 6 individual sword fish and catch in continental slope from 700-1000 m. has caught 7 fishes. Station No.1, depth 1900 m has not caught any Thresher sharks.

Size variation of Thresher shark is appeared from 24 kilogram to 90 kilogram. Majority size of Thresher shark caught by pelagic longline is in the range of weight

60-70 kilograms, 46.15 % followed by range of weight is 41-50 kilograms and 81-90 kilograms as 15.38% Most of thresher shark is maturity size.

Conclusion

Result of the catch has shown that the good fishing ground of sword fish is in the deep sea from Latitude 10°30' N to Latitude 12°30' N and Longitude from 096°15' to the rim of EEZ of Myanmar Waters. According to the Taiwanese fishing vessel operated in the Myanmar waters have base at port of Myeik, M.V.SEAFFDEC detected few targets of vessel by radar at station No.2 and 3. That is confirmed the existed mega pelagic resources target of pelagic longline in the area between Thailand, Myanmar and India. Thresher shark is widely spread in the distant zone of EEZ of Myanmar Waters. However Myanmar government has already announced to the fisheries industries that the shark fishing is illegal fishing. Other catch species are Sting ray, lancet and barracuda. They are not target species for pelagic longline. It should be notified that in Myanmar Waters has not widely spread of lancet fish and snake like mackerel. Myanmar Waters is one of the suitable for pelagic longline fishing ground because both lancet fish and snake like mackerel always made branch line damage. However no any tunas have been caught during this resources survey.

Chart of number of catches: Sword fish (fish symbol) and Thresher shark (shark fin symbol)

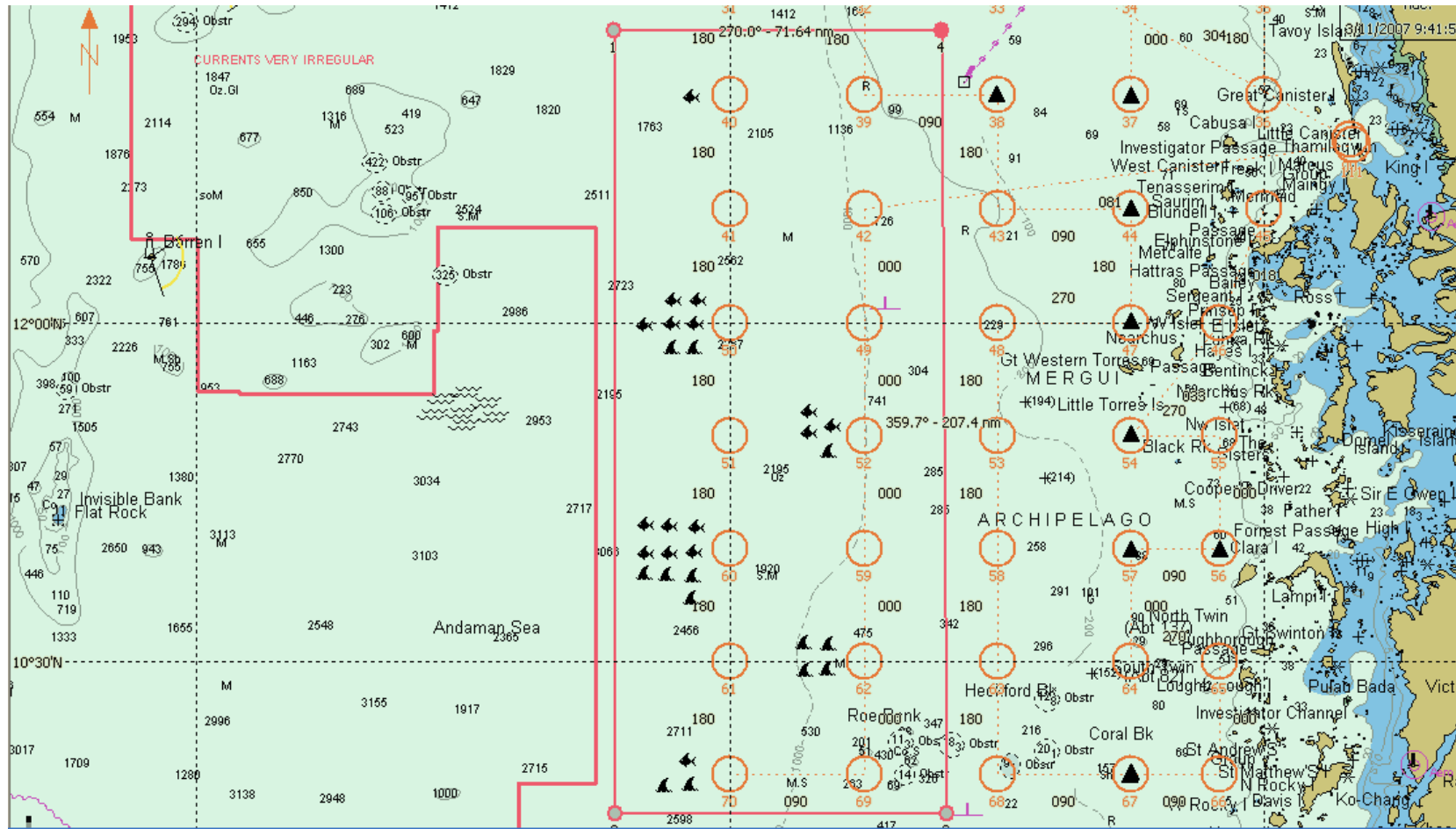


Table 1 Partial detail of oceanographic stations

St.no.	Date	Start	Finish	Lat	Long	Bot. (m)	SBECID	TSG	TD	Bongo net(m)	Phyto, Vandorn (m)	Zoo (vertical, m)	Phyto fromnet (m)	Sechi disc (m)	Foral scale
35	13-Feb-07	05:45	07:25	13_29.8 N	98_00.0 E	38.0	S2D23035	20070213_st35	TDcr23st35	30	0,25	30	surface	-	-
36	13-Feb-07	12:00	13:44	13_00.1 N	98_00.2 E	53.0	S2D23036	20070213_st36	-	45	0,25,50	30	surface	18.5	4
26	15-Feb-07	05:54	07:09	13_59.8 N	97_30.3 E	58.0	S2D23026	20070215_st26	-	40	0,25,50	30	6mX 5time	-	-
25	15-Feb-07	09:52	11:00	14_30.3 N	97_30.3 E	46.0	S2D23025	20070215_st25	-	35	0,25,40	30	6mX 5time	18.1	4
12	15-Feb-07	13:42	14:37	15_00.0 N	97_30.2 E	34.0	S2D23012	20070215_st12	-	20	0,25	30	6mX 5time	8	4
13	15-Feb-07	18:45	19:44	14_59.9 N	97_00.0 E	31.0	S2D23013	20070215_st13	-	15	0,25	30	6mX 5time	-	-
14	16-Feb-07	05:44	06:40	14_59.9 N	96_36.3 E	35.0	S2D23014	20070216_st14	-	25	0,25	30	6mX 5time	-	-
10	16-Feb-07	12:35	13:10	15_29.9 N	97_00.0 E	23.0	S2D23010	20070216_st10	-	15	0,20	20	6mX 5time	1	10
9	16-Feb-07	15:29	16:12	15_29.9 N	96_35.4 E	21.0	S2D23009	20070216_st09	-	15	0,15	20	6mX 5time	1.5	7
15	16-Feb-07	19:45	20:41	15_01.1 N	96_01.1 E	65.0	S2D23015	20070216_st15	-	32	0,25,50	30	6mX 5time	-	-
16	17-Feb-07	05:41	06:57	14_59.8 N	95_30.2 E	75.0	S2D23016	20070217_st16	-	75	0,25,50	30	6mX 5time	-	-
17	17-Feb-07	11:50	13:05	14_58.8 N	95_00.5 E	49.0	S2D23017	20070217_st17	-	49	0,25,48	30	6mX 5time	14	4
18	17-Feb-07	15:41	16:46	14_59.9 N	94_30.2 E	53.0	S2D23018	20070217_st18	-	35	0,25	30	6mX 5time	-	-
19	18-Feb-07	05:48	07:03	14_30.2 N	94_30.5 E	91.0	S2D23019	20070218_st19	-	69	0,25,50	30	6mX 5time	-	-
20	18-Feb-07	09:55	10:50	14_29.4 N	94_59.5 E	88.0	S2D23020	20070218_st20	-	43	0,25,50	30	6mX 5time	15.4	4
21	18-Feb-07	15:37	16:55	14_29.7 N	95_30.1 E	95.0	S2D23021	20070218_st21	-	55	0,25,50	30	6mX 5time	-	-
22	18-Feb-07	19:40	20:48	14_30.6 N	95_55.7 E	129.0	S2D23022	20070218_st22	-	90	0	30	6mX 5time	-	-
23	19-Feb-07	05:45	07:55	14_29.8 N	96_30.3 E	102.0	S2D23023	20070219_st23	-	70	0,25,50	30	6mX 5time	-	-
24	19-Feb-07	11:46	12:46	14_29.6 N	97_00.8 E	65.0	S2D23024	20070219_st24	-	40	0,25,50	30	6mX 5time	18.8	4
27	19-Feb-07	15:26	16:29	13_59.2 N	96_59.6 E	79.0	S2D23027	20070219_st27	-	37	0,25,50	30	6mX 5time	19.2	4
37	23-Feb-07	05:41	06:52	12_59.7 N	97_31.1 E	83.0	S2D23037	20070223_st37	-	60	0,25,50	30	6mX 5time	-	-
34	23-Feb-07	11:07	12:10	13_30.3 N	97_30.1 E	73.0	S2D23034	20070223_st34	-	47	0,25,50	30	6mX 5time	23.9	3
33	23-Feb-07	16:05	17:08	13_29.4 N	96_59.6 E	90.0	S2D23033	20070223_st33	-	64	0,25,50	30	6mX 5time	-	-
32	24-Feb-07	05:43	06:40	13_29.5 N	96_30.1 E	144.0	S2D23032	20070224_st32	-	126	0	30	6mX 5time	-	-

Table 1 Partial detail of oceanographic stations (cont')

St.no.	Date	Start	Finish	Lat	Long	Bot. (m)	SBE CTD	TSG	TD	Bongo net(m)	Phyto, Vandorn (m)	Zoo (vertical, m)	Phyto from net	Secchi disc (m)	Foral scale
39	24-Feb-07	9:14	10:24	12_59.7 N	96_30.2 E	513.0	S2D23039	20070224_st39	-	110	0	30	6m X 5time	30.5	3
38	24-Feb-07	13:26	14:30	12_59.9 N	97_00.0 E	97.0	S2D23038	20070224_st38	-	55	0,25,50	30	6m X 5time	25.8	4
43	24-Feb-07	19:17	20:08	12_34.1 N	96_59.5 E	150.0	S2D23043	20070224_st43	-	110	0	30	6m X 5time	-	-
44	25-Feb-07	5:40	6:51	12_29.6 N	97_30.2 E	80.0	S2D23044	20070225_st44	-	60	0,25,50	30	6m X 5time	-	-
47	25-Feb-07	11:29	12:34	11_59.3 N	97_29.5 E	80.0	S2D23047	20070225_st47	-	58	0,25,50	30	6m X 5time	11.1	5
48	25-Feb-07	16:38	17:57	11_59.6 N	96_50.5 E	236.0	S2D23048	20070225_st48	-	110	0,25,50	30	6m X 5time	15.4	3
53	26-Feb-07	5:45	6:53	11_30.0 N	96_59.9 E	260.0	S2D23053	20070226_st53	-	110	0	30	6m X 5time	-	-
58	26-Feb-07	9:54	10:57	10_59.9 N	97_00.2 E	313.0	S2D23053	-	-	110	0	30	6m X 5time	17.6	4
63	26-Feb-07	13:45	14:46	10_30.0 N	97_00.1 E	335.0	S2D23063	20070226_st63	-	88	0	30	6m X 5time	16.7	4
68	26-Feb-07	17:24	18:29	09_59.8 N	96_59.9 E	328.0	S2D23068	20070226_st68	-	120	0	30	6m X 5time	-	-
67	27-Feb-07	5:40	6:47	09_59.8 N	97_30.3 E	91.6	S2D23067	20070227_st67	-	75	0,25,50	30	6m X 5time	-	-
66	27-Feb-07	11:05	12:10	10_00.5 N	97_49.6 E	68.0	S2D23066	-	-	48	0,25,50	30	6m X 5time	14.7	3
65	27-Feb-07	14:44	15:36	10_29.9 N	97_50.1 E	61.0	S2D23065	20070227_st65	-	45	0,25,50	30	6m X 5time	7.94	6
64	27-Feb-07	17:21	18:30	10_29.0 N	97_30.1E	92.0	S2D23064	20070227_st64	-	50	0,25,50	30	6m X 5time	-	-
57	28-Feb-07	5:40	6:50	11_00.0 N	97_30.3 E	86.4	S2D23057	20070228_st57	-	51	0,25,50	30	6m X 5time	-	-
56	28-Feb-07	10:24	11:26	10_59.7 N	97_50.1 E	67.0	S2D23056	20070228_st56	-	52	0,25,50	30	6m X 5time	10	6
55	28-Feb-07	15:36	16:37	11_29.8 N	97_50.5 E	63.0	S2D23055	20070228_st55	-	54	0,25,50	30	6m X 5time	9	6
54	28-Feb-07	18:30	19:35	11_29.9 N	97_30.5 E	78.0	S2D23054	20070228_st54	-	50	0,25,50	30	6m X 5time	-	-
46	1-Mar-07	10:41	11:50	12_00.6 N	97_50.5 E	50.0	S2D23046	20070301_st46	-	41	0,25,50	30	6m X 5time	17	4
45	1-Mar-07	13:02	16:00	12_32.3 N	98_00.3 E	53.0	S2D23045	20070301_st45	-	50	0,25,50	30	6m X 5time	7.92	6
28	4-Mar-07	5:41	6:38	13_59.9 N	96_30.5 E	117.0	S2D23028	20070304_st28	-	87	-	30	6m X 5time	-	-
29	4-Mar-07	9:34	10:45	14_00.0 N	96_00.2 E	200.0	S2D23029	20070304_st29	-	110	0,25,50	30	6m X 5time	21.12	4

31	4-Mar-07	13:28	14:44	13_29.8 N	96_00.2 E	1400.0	S2D23031	20070304_st31	-	90	-	30	6m X 5time	21.55	5
40	4-Mar-07	17:10	18:17	13_59.8 N	96_00.3 E	NR	S2D23040	20070304_st40	-	82	-	30	6m X 5time	-	-
St.no.	Date	Start	Finish	Lat	Long	Bot. (m)	SBE CTD	TSG	TD	Bongo net(m)	Phyto, Vandorn (m)	Zoo (vertical, m)	Phyto from net (m)	Sec hi disc (m)	For al scale
41	5-Mar-07	11:36	12:45	12_29.6 N	96_00.2 E	2500.0	S2D23041	20070305_st41	-	115	-	30		22.78	4
50	5-Mar-07	15:09	16:22	11_59.8 N	96_00.2 E	2300.0	S2D23050	20070305_st.50	-	87	-	30	6m X 5time	-	-
51	6-Mar-07	10:40	11:56	11_29.6 N	96_00.2E	2100.0	S2D23051	-	-	90	-	30	6m X 5time	20.31	4
60	6-Mar-07	14:10	15:24	10_59.9 N	96_00.2 E	1920.0	S2D23060	20070306_st60	-	113	-	30	6m X 5time	21.61	4
61	7-Mar-07	12:07	13:15	10_30.0 N	96_00.3 E	2500.0	S2D23061	20070307_st61	-	103	-	30	6m X 5time	21.44	4
70	7-Mar-07	15:54	17:00	09_59.9 N	96_00.1 E	2500.0	S2D23070	20070307_st70	-	118	-	30	6m X 5time	-	-
69	8-Mar-07	13:01	14:07	10_00.0 N	96_29.8 E	NR	S2D23069	20070308_st69	-	90	-	30	6m X 5time	16.97	4
62	8-Mar-07	17:07	18:15	10_29.6 N	96_30.2 E	NR	S2D23062	20070308_st62	-	90	-	30	6m X 5time	-	-
52	9-Mar-07	15:16	16:21	11_29.8 N	96_30.2 E	939.0	S2D23052	20070309_st52	-	90	-	30	6m X 5time	21.79	4
59	9-Mar-07	11:28	12:33	11_00.0 N	96_30.2 E	905.0	S2D23059	20070309_st59	-	90	-	30	6m X 5time	21.33	4
49	10-Mar-07	9:28	10:33	12_00.0N	96_30.3E	1000.0	S2D23049	20070310_st49	-	105	-	30	6m X 5time	19.47	5
42	10-Mar-07	13:18	14:25	12_29.8 N	96_30.2 E	1062.0	S2D23042	20070310_st42	-	90	-	30	6m X 5time	16.77	5

** Myanmar local time

Table 2 Environmental condition during oceanographic survey

St. no.	Wind		Air					Bottom		Water	Current					
	Spd. (knt)	Dir.	Temp(c)	Press.	Humidity	Weather	Sea stage	Temp (c)	pH	Temp (c)	Surface		25m.		50m.	
											Spd.(Knt)	Dir	Spd.(Knt)	Dir	Spd.(Knt)	Dir
35	8	170	26.2	1014.0	76	BC	Calm	25.3	7.9	27.3	0.2	287	-	-	-	-
36	4	130	28.9	1015.0	70	BC	Calm	23.8	7.8	27.9	0.3	29	0.3	79	-	-
26	10	020	27.4	1015.0	84	BC	Calm	23.8	7.8	27.8	0.7	97	0.4	80	0.1	48
25	6	030	30.7	1018.0	85	BC	Calm	24.8	7.9	27.7	0.7	333	0.9	24	-	-
12	8	220	28.5	1015.0	57	BC	Calm	26.07	8.09	31.1	0.6	195	-	-	-	-
13	6	250	27.8	1013.5	48	BC	Calm	25.69	8.19	28.1	0.2	174	-	-	-	-
14	12	000	26.4	1013.0	61	BC	Calm	25.17	8.13	27.4	1.3	216	-	-	-	-
10	10	050	30	1014.5	71	BC	Calm	26.82	8.23	29.7	2.3	15	-	-	-	-
9	2	270	27.4	1012.0	57	BC	Calm	26.64	8.23	27.8	1	187	-	-	-	-
15	10	300	27.2	1012.5	69	BC	Calm	22.98	8.07	27.6	0.1	255	0.5	339	-	-
16	14	000	25.4	1012.0	57	BC	moderate	21.25	7.98	27	0.8	232	0.6	252	0.1	225
17	14	010	25	1015.0	76	BC	moderate	23.5	8.08	26.7	0.2	107	0.9	105	-	-
18	12	360	26.3	1012.0	84	BC	moderate	23.42	8.07	26.9	0.8	273	0.5	244	-	-
19	14	050	25.8	1012.5	76	BC	moderate	19.79	8.1	27	0.7	24	0.4	67	0.2	175
20	14	000	27.4	1015.5	84	BC	moderate	20.17	8.04	27.1	0.6	99	0.7	67	0.5	53
21	12	060	28.7	1011.5	76	BC	Slight	20.27	8.12	27.2	1.4	175	1.1	182	0.7	209
22	6	010	27.7	1013.0	66	BC	Slight	18.48	7.98	27.3	1.5	15	1.3	45	0.5	23
23	12	010	26.6	1012.0	75	BC	Slight	27.46	8.45	27.5	1	201	0.9	214	1	198
24	14	350	29.2	1014.0	51	BC	Slight	22.93	8.19	27.8	1.2	68	1.1	40	-	-
27	10	030	28	1011.5	51	BC	Slight	22.01	8.17	29.2	1.1	222	1.1	213	0.1	221
37	12	030	27.7	1015.0	75	BC	Calm	22.01	8.09	27.9	0.9	249	0.7	267	0.6	251
34	6	010	31.5	1013.5	80	BC	Calm	23.22	8.23	28.2	0.3	169	0.5	161	0.4	124
33	2	270	29.3	1010.5	58	BC	Calm	20.88	8.12	29.2	0.4	255	0.2	287	0.4	300
32	10	040	27.1	1012.0	92	BC	Calm	14.15	7.94	27.5	0.5	182	0.5	182	0.6	242
39	6	000	28.7	1014.5	64	BC	Calm	10.65	7.75	27.7	1.2	216	1.1	218	0.7	226
38	10	060	29.7	1010.5	59	BC	Calm	19.4	8.06	28.3	0.9	254	0.4	232	0.6	63
43	6	290	29.3	1011.5	63	BC	Calm	15.15	8.04	29	0.7	285	0.8	281	0.3	293
44	12	020	27.9	1012.0	56	BC	Calm	20.96	8.15	28.3	0.5	242	3	306	0.3	350
47	8	330	29	1013.5	58	BC	Calm	19.16	8.45	28.3	0.5	332	0.5	57	0.3	52
48	6	010	28.4	1010.5	70	BC	Calm	11.94	8.14	28.9	0.1	299	0	350	0.4	343
53	12	020	27.5	1011.0	62	BC	Calm	11.59	7.88	28.4	0.4	308	0.3	91	0.6	80
58	8	010	28.7	1013.5	64	BC	Calm	11.19	8.03	28.6	0.1	65	0.5	92	0.4	32
63	10	090	30.1	1012.0	56	BC	Calm	11.04	8.04	29.9	0.5	215	0.6	168	0.6	102

Table 2 Environmental condition during oceanographic survey (cont')

St. no.	Wind		Air					Bottom		Water	Current					
	Spd. (knt)	Dir.	Temp(c)	Press.	Humidity	Weather	Sea stage	Temp (c)	pH	Temp (c)	Surface		25m.		50m.	
											Spd.(Knt)	Dir	Spd.(Knt)	Dir	Spd.(Knt)	Dir
68	2	040	29	1010.0	46	BC	Calm	10.98	7.99	31.9	0.5	66	0.8	55	0.4	37
67	14	065	27.5	1010.0	58	BC	Calm	11.61	8.3	28.2	0.5	322	0.2	358	0.7	350
66	10	040	28.9	1012.5	70	BC	Calm	21.41	8.31	28.6	0.9	347	0.9	332	-	-
65	10	060	28.7	1009.5	64	BC	Calm	21.7	8.34	28.4	0.6	356	0.5	0	-	-
64	8	340	28.4	1009.5	70	BC	Calm	19.19	8.26	28.2	0.3	312	0.3	0	0.8	15
57	10	120	27.5	1011.0	70	BC	Calm	19.34	8.3	28.3	0.2	16	0.6	11	0.6	7
56	2	040	29.7	1013.5	58	BC	Calm	21.53	8.31	28.4	0.3	350	0.4	353	-	-
55	12	340	30.5	1010.0	73	BC	Calm	22.14	8.34	28.3	0.5	26	0.3	40	-	-
54	4	000	28.5	1010.5	76	BC	Calm	20.91	8.31	28.7	0.7	122	0.3	44	0.7	356
46	6	140	31.8	1014.0	79	BC	Calm	23.95	8.38	29.5	0.6	6	0.7	286	-	-
45	6	250	32.9	1010.5	80	BC	Calm	24.07	8.32	29.9	0.1	251	0.2	317	-	-
28	14	320	26.8	1011.5	69	BC	Calm	16.65	8.1	27.6	0.4	89	0.1	107	0.2	69
29	14	350	28	1014.5	85	BC	Calm	13.01	7.94	27.2	1.3	54	1.2	60	1	40
31	2	000	28.3	1011.0	64	BC	Calm	10.4	7.88	28.1	0.5	104	0.5	252	0.5	262
40	4	330	30.2	1010.5	50	BC	Calm	10.25	7.93	28.5	0.9	225	0.6	241	0.4	247
41	6	320	30.2	1015.0	85	BC	Calm	10.65	7.98	28.6	1	185	1	182	0.8	174
50	8	320	31.7	1012.0	86	BC	Calm	10.56	8.11	29.6	1.6	190	1.6	202	1.1	200
51	8	310	28.5	1014.5	85	BC	Calm	10.66	8.04	29	1.2	201	1	195	0.8	210
60	6	000	31	1011.5	80	BC	Calm	11.02	8.06	28.9	1.1	204	0.9	203	0.7	206
61	6	000	29.7	1012.0	85	BC	Calm	10.49	8.03	29.1	1.5	136	1.7	136	1.7	126
70	8	090	31.3	1009.0	85	BC	Calm	10.56	8.13	28.9	1.9	159	2	155	1.3	152
69	10	350	32.2	1013.0	55	BC	Calm	10.82	8.24	28.6	1	152	0.8	139	0.8	161
62	8	000	28.7	1011.5	70	BC	Calm	10.85	8.29	28.6	0.5	245	0.8	264	0.3	202
52	6	040	28.5	1012.5	58	BC	Calm	10.67	8.114	29.2	0.9	91	0.9	94	0.5	75
59	6	040	30	1015.0	92	BC	Calm	10.53	8.06	28.6	0.3	97	0.7	108	0.5	79
49	8	010	30.3	1016.0	85	BC	Calm	10.59	8.04	28.7	0.7	355	0.7	349	0.6	357

42	10	000	29.5	1015.0	85	BC	Calm	10.65	8.09	28.9	0.3	5	0.2	336	0.5	269
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Table 3 Partial detail of bongo net, total suspended solid and Van Dorn water sampler

St.No.	Bongo net					Total Suspended solid				Niskin bottle (depth, m)	Remarks
	Towing depth (m)	Start Time	Towing period (min)	Flowmeter rev.		Surface		Bottom			
				Fish larvae	Zooplankton	Filter no.	Volume (liter)	Filter no.	Volume (liter)		
35	30	6:55	30	9332	2133	1	5	2	2	0,10,20,30	
36	53	12:02	30	8470	4740	3	5	4	4.77	0,10,20,30,50	
26	40	6:38	30	9902	4029	5	5	6	3.67	0,10,20,30,50	
25	35	9:52	30	9788	3083	7	5	8	4.54	0,10,20,30,40	
12	20	13:42	30	10485	2898	9	5	10	2	0,10,20,28	
13	15	18:45	30	10420	4522	11	5	12	1.91	0,10,20,25	
14	25	6:10	30	5800	1802	13	5	14	0.61	0,10,20,30	Many jelly fish and comb jelly block flow way of water, Profile TSS at 10 m (filter no.15, vol 3 lit) and 20m (filter no. 16, Vol 0.82 lit)
10	15	12:35	10	2055	1328	17	2	18	0.22	0,10,20	
9	15	15:29	20	5380	2995	19	1.5	20	0.5	0,10,16	
15	32	19:45	20	7520	3448	21	5	22	3	0,10,20,30,50,60	
16	45	6:21	30	9400	4356	23	5	24	2	0,10,20,30,50,70	
17	49	11:50	30	10660	5411	25	4	26	2	0,10,20,30,45	
18	35	15:41	30	9080	4388	27	5	28	2	0,10,20,30,48	Profile TSS (Depth, filter no.,volume) 30m,29,3.77 lit - 20m,30,2.6 lit - 10m,31,3.79 lit
19	69	6:31	30	9415	4768	32	5	33	1.3	0,10,20,30,50,75,85	
20	43	9:55	30	10500	5220	34	5	35	2	0,10,20,30,50,75,83	Profile TSS (Depth, filter no.,volume) 75m,36,2lit- 50m,37,2 lit - 20m,38,2 lit
21	55	15:37	30	11290	4253	39	5	40	2	0,10,20,30,50,75,88	
22	90	19:40	30	9235	3755	41	5	42	3.83	0,10,20,30,50,75,100,125	
23	70	6:26	30	8010	1270	43	5	44	1.5	0,10,20,30,50,75,97	Profile TSS (Depth, filter no.,volume) 75m,45,1.68lit- 50m,46,1.54 lit - 30m,47,2.5 lit- 20m,48,2 lit- 10m, 49,1.91 lit)

Table 3 Partial detail of bongo net, total suspended solid and Van Dorn water sampler cont'

St.No .	Bongo net					Total Suspended solid				Niskin bottle (depth, m)	Remarks
	Towing depth (m)	Start Time	Towing period (min)	Flowmeter rev.		Surface		Bottom			
				Fish larvae	Zooplankton	Filter no.	Volume (liter)	Filter no.	Volume (liter)		
24	40	11:43	30	11105	3438	50	5	51	2	0,10,20,30,50,63	
27	37	15:26	30	8420	2280	52	5	53	4.75	0,10,20,30,50,75	
37	60	6:20	30	9475	2909	54	5	55,56	3.94	10,20,30,50,77	Profile TSS (Depth, filter no.,volume) 50m,57,3.42lit- 30m,58,2.25 lit - 20m,59,1.64 lit- 10m,60,2.42lit)
34	47	11:07	30	9805	4432	61+62	5	63	3.62	0,10,20,30,50,67	
33	64	16:05	30	8700	3705	64	5	62	3.7	0,10,20,30,50,75, 85	
32	126	6:10	30	6340	3123	66	5	67	3.88	0,10,20,30,50,75, 100,125,140	
39	110	9:14	30	8445	3685	68+69	5	-	-	0,10,20,30,50,75, 100,150,200,300, 400,420	
38	55	13:26	30	9270	3572	70	5	71	2.53	10,20,30,50,75,92	Profile TSS (Depth, filter no.,volume) 75m,72,2.2lit- 50m,73,2.15 lit - 30m,75+76 ,2.78 lit- 20m,77,2.76 lit, 10m,74,5lit)
43	110	19:17	30	7720	2044	78	5	79	5	0,10,20,30,50,75, 100,125,145	
44	60	6:21	30	8070	1418	80	5	81	5	0,10,20,30,50,75	
47	58	11:29	30	7785	1223	82	5	83	4	10,20,30,50,75	High phytoplankton may block flow way of water in zooplankton net Profile TSS (Depth, filter no.,volume) 50m,84,3.84 lit - 30m,85,1.53 lit- 20m,86,2.23 lit,10m,87,2 lit)
48	110	16.38	30	10055	4179	88	5	89	2	0,10,20,30,50,75, 100,125,150,200, 232	

Table 3 Partial detail of bongo net, total suspended solid and Van Dorn water sampler cont'

St.No.	Bongo net					Total Suspended solid				Niskin bottle (depth, m)	Remarks
	Towing depth (m)	Start Time	Towing period (min)	Flowmeter rev.		Surface		Bottom			
				Fish larvae	Zooplankton	Filter no.	Volume (liter)	Filter no.	Volume (liter)		
63	88	13:45	30	10893	2889	94	5	-	-	0,10,20,30,50,75,100,125,150,200,250,330	
68	120	17:24	30	9957	2965	95	5	-	-	0,10,20,30,50,75,100,125,150,200,250,323	
67	75	6:16	30	7108	1248	97	5	96	1.7	0,10,20,30,50,75,86	Profile TSS (Depth, filter no.,volume) 75m,102,2lit-50m,101,2.58 lit - 30m ,100,1.53 lit-20m,99,2.82 lit,10m,98,2.39lit)
66	48	11:05	30	5545	1226	103	5	104	5	0,10,20,30,50,63	
65	45	14:44	20	5205	554	105	5	106,107	4.67	0,10,20,30,50,55	
64	50	17:21	30	8600	1509	108	5	109	4.8	0,10,20,30,50,75,85	
57	51	6:19	30	6425	1558	110	5	111	5	0,10,20,30,50,75,81	
56	52	10:24	30	7700	1749	112+113	5	114	4.3	0,10,20,30,50,62	Profile TSS (Depth, filter no.,volume) 10m,116+117 ,5lit-20m,118,2.22 lit - 30m ,119,2.6 lit-50m,115,3.96 lit)
55	54	15:36	30	7700	3014	120	5	121	5	0,10,20,30,50,58	All coastal area is high in phytoplankton
54	50	18:30	30	4905	3870	112	5	123	4.32	0,10,20,30,50,73	
46	41	10:41	30	7780	1278	126	5	127	5	0,10,20,30,45	
45	50	15:02	30	5475	3742	128	5	129	5	0,10,20,30,50	
28	87	6:07	30	9025	4815	130	5	131+132	5	0,10,20,30,50,75,100,110	

29	110	9:34	30	8390	4645	134+135	5	136	3.85	0,10,20,30,50,75,100,125,150,200	
31	90	13:28	30	9582	5490	NR				10,20,30,50,75,100,125,150,200,300,400	
St.No.	Bongo net					Total Suspended solid				Niskin bottle (depth, m)	Remarks
	Towing depth (m)	Start Time	Towing period (min)	Flowmeter rev.		Surface		Bottom			
				Fish larvae	Fish larvae	Filter no.	Volume (liter)	Filter no.	Volume (liter)		
40	82	17:10	30	9601	5183	139	5	140	2.3	10,20,30,50,75,100,125,150,200,300,400	
41	115	11:36	30	2497	3812	141	5	142	2.45	10,20,30,50,75,100,125,150,200,300,400	Niskin bottle No.7 (100 m.) cannot collected water
50	87	15:09	30	14827	4039	143	5	144	2.32	10,20,30,50,75,100,125,150,200,300,400	
51	90	10:40	30	10016	4841	145	5	146	1.61	10,20,30,50,75,100,125,150,200,300,400	
60	113	14:10	30	6717	3367	147+148	5	149	2	10,20,30,50,75,100,125,150,200,300,400	
61	103	12:07	30	10332	4005	150	5	151	2.42	10,20,30,50,75,100,125,150,200,300,400	
70	118	15:54	30	9155	3510	NR				10,20,30,50,75,100,125,150,200,300,400	
69	90	13:01	30	3018	5131	154	5	155	2.46	10,20,30,50,75,100,125,150,200,300,400	
62	90	17:07	30	7923	4792	156+157	5	158	2.34	10,20,30,50,75,100,125,150,200,300,400	
52	90	15:16	30	9062	4676	161	5	162	2.47	10,20,30,50,75,100,125,150,200,300,400	
59	90	11:28	30	11855	4387	159	5	160	2.19	10,20,30,50,75,100,125,150,200,300,400	

49	105	9:28	30	5463	3895	163	5	164	2.66	10,20,30,50,75,100,125,150,200,300,400
42	90	13:18	30	5952	3882	165	5	166	2.58	10,20,30,50,75,100,125,150,200,300,400