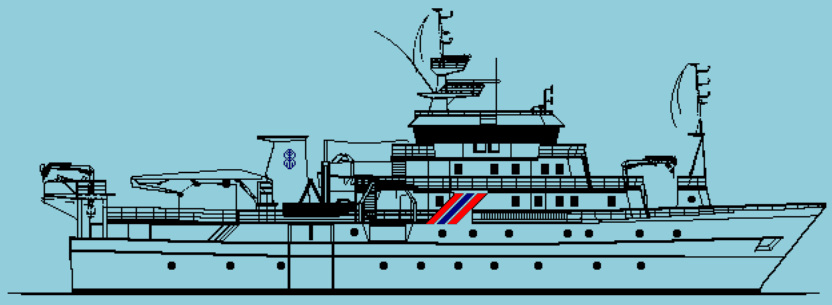
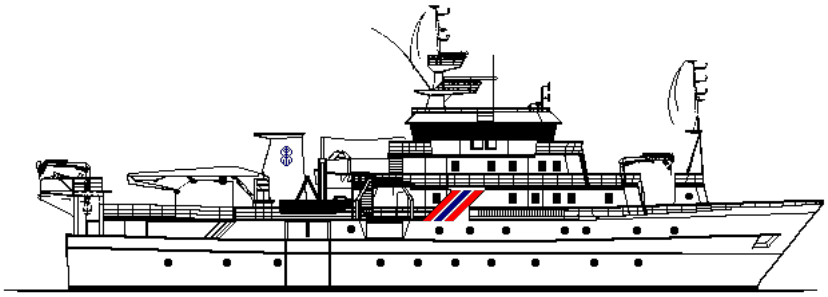


MYANMAR

Habitat mapping on the Myeik Archipelago

June 4th –June 18th 2015

Bergen, May 2016



MYANMAR
Habitat mapping on the Myeik Archipelago

June 4th –June 18th 2015

By

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THE EAF-NANSEN PROJECT

FAO started the implementation of the project “Strengthening the Knowledge Base for and Implementing an Ecosystem Approach to Marine Fisheries in Developing Countries (EAF-Nansen GCP/INT/003/NOR)” in December 2006 with funding from the Norwegian Agency for Development Cooperation (Norad). The EAF-Nansen project is a follow-up to earlier projects/programmes in a partnership involving FAO, Norad and the Institute of Marine Research (IMR), Bergen, Norway on assessment and management of marine fishery resources in developing countries. The project works in partnership with governments and also GEF-supported Large Marine Ecosystem (LME) projects and other projects that have the potential to contribute to some components of the EAF-Nansen project.

The EAF-Nansen project offers an opportunity to coastal countries in sub-Saharan Africa, working in partnership with the project, to receive technical support from FAO for the development of national and regional frameworks for the implementation of Ecosystem Approach to Fisheries management and to acquire additional knowledge on their marine ecosystems for their use in planning and monitoring. The project contributes to building the capacity of national fisheries management administrations in ecological risk assessment methods to identify critical management issues and in the preparation, operationalization and tracking the progress of implementation of fisheries management plans consistent with the ecosystem approach to fisheries.

LE PROJET EAF-NANSEN

La FAO a initié la mise en oeuvre du projet "Renforcement de la base des connaissances pour mettre en œuvre une approche écosystémique des pêcheries marines dans les pays en développement (EAF-Nansen GCP/INT/003/NOR)" en décembre 2006. Le projet est financé par de l'Agence norvégienne de coopération pour le développement (Norad). Le projet EAF-Nansen fait suite aux précédents projets/ programmes dans le cadre du partenariat entre la FAO, Norad et l'Institut de recherche marine (IMR) de Bergen en Norvège, sur l'évaluation et l’aménagement des ressources halieutiques dans les pays en développement. Le projet est mis en oeuvre en partenariat avec les gouvernements et en collaboration avec les projets grands écosystèmes marins (GEM) soutenus par le Fonds pour l’Environnement Mondial (FEM) et d'autres projets régionaux qui ont le potentiel de contribuer à certains éléments du projet EAF-Nansen.

Le projet EAF-Nansen offre l’opportunité aux pays côtiers de l'Afrique subsaharienne partenaires de recevoir un appui technique de la FAO pour le développement de cadres nationaux et régionaux visant une approche écosystémique de l’aménagement des pêches et la possibilité d'acquérir des connaissances complémentaires sur leurs écosystèmes marins. Ces éléments seront utilisés pour la planification et le suivi des pêcheries et de leurs écosystèmes. Le projet contribue à renforcer les capacités des administrations nationales responsables de l’aménagement des pêches en introduisant des méthodes d'évaluation des risques écologiques pour identifier les questions d’aménagement d’importance majeure ainsi que la préparation, la mise en œuvre et le suivi des progrès de la mise en œuvre de plans d’aménagement des ressources marines conformes à l'approche écosystémique des pêches.

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FOREWORD

This survey report describes the Habitat mapping survey conducted by R/V Dr, Fridtjof Nansen in the Myeik archipelago in Myanmar waters from June 4th to June 18th 2015. It contains information about the sailing tracks, recordings from ship mounted instruments and samples collected. It also contains the results from analysis of hydrocarbons and heavy metals in the sediments samples collected by the VAMS (Video Assisted Multi sampler). Sediment samples for biological analysis are being processed by students at Myeik University and Mawlamyin University in Myanmar. These sediment samples are used as a basis for several masters' thesis at the two universities. Two parallel sets of sediment samples for biological studies are stored at IMR in Bergen for further analysis. One set of samples area preserved in formaldehyde and one set in alcohol for possible bar-coding. The underwater videos are stored at IMR in Norway with a copy at the Fisheries Department in Myanmar. We aim to arrange a workshop on the benthic samples in Myanmar to secure that as much information as possible can be extracted from the collected material to contribute to the baseline information about the environmental status and the biodiversity of the seafloor in the surveyed area. The work onboard the vessel information collected onboard and the analysis of samples and videos is a good basis for transfer of competence and it can and should be worked up to a level that can be published in international scientific papers.
Comments from the Myanmar partners are incorporated in the report

1. INTRODUCTION

Myanmar has a long coastline with many small islands along the coast with relatively high biological production in the sea. This area has a very high biodiversity both of fishes and invertebrates, but it is not very well described or studied. Myanmar is the largest fishing nation in the Bay of Bengal region. Total marine catches are uncertain but estimates ranges as high as 1, 3 - 1, 8 million tons on annual basis. The fisheries sector contributes around 10% of the GDP in Myanmar and a part of the population find their livelihood in this sector. Little is known about the seabed and the environmental status of the sediments along the coast of Myanmar.

Myanmar undergoes rapid changes with industrialization and high activity in many sectors; the tourism along the coast and industrialization in many sectors. The offshore oil activities including land bases and increased shipping activities is something that need special attention. The 50 years experience from Norway and experiences from many other places around the world shows that the basis for a good development in sectors with potential conflicting interests is knowledge and communication. The environmental monitoring system developed to watch the offshore petroleum industry in Norway and to avoid any harm to living marine resources and coastal areas has proved that it is possible to have a good development both in fisheries and offshore petroleum industry in the same area. However this requires a good monitoring and control system in both sectors and good communication between the different users of the sea.

The R/V Dr Fridtjof Nansen Benthic habitat survey in Myanmar June 2015 was a complementary survey to the MPA mapping and the 2013 and 2015 fisheries surveys with

main focus on fisheries impact on benthic communities. But it is also an example of how an environmental Baseline study cam be organized in Myanmar to secure a sound development both in the fisheries sector and in the offshore petroleum industry to secure a development with maximum outcome from the two sectors with as little impact on the natural environment as possible.

Stakeholders: The Norwegian Ministry of Foreign Affairs(MFA), The Food and Agriculture Organization of the United Nations (FAO), Institute of Marine Research (IMR), Bay of Bengal Large Marine Ecosystems (BOBLME), and Directorate of Fisheries (DOF) Myanmar.

Reference is made to consultations between officials of the Royal Embassy of Norway in Myanmar and the Food and Agriculture Organization of the United Nations (FAO) in the context of the EAF- Nansen Project, implemented by FAO, for the execution of the 2015 Marine Ecosystem Assessment Survey Myanmar through the Bay of Bengal Large Marine Ecosystem-BoBLME project (GCP/RAS/246/NOR) also executed by FAO. The objective of the BoBLME project is to assist Maldives, India, Sri Lanka, Bangladesh, Myanmar, Thailand, Indonesia and Malaysia to improve the lives of the coastal populations through improved regional management of the Bay of Bengal environment and its fisheries.

The research vessel Dr. Fridtjof Nansen visited some preselected vulnerable areas on the Myeik archipelago for benthic habitat mapping; one area with high fishing pressure and one area partly within a Marine Protected Area. The video assisted sampling device (VAMS) was used for identification of benthic communities and for sediment sampling. Sediment composition, biodiversity and levels of pollution by heavy metals and hydrocarbons according to OSPAR guideline for environmental monitoring offshore will be analysed after the survey. A mulitbeam echo sounder was used for mapping of the bathymetry and to create detailed bathymetry profiles. In addition, meteorological and hydrographic sampling was conducted in order to monitor the environmental conditions in the area

1.1 The Survey area

The survey area was located in the Myeik region.

It extends from 13° in the north of Myeik stretching to around 10° in the south and 99° minutes east to 97° minutes in the western part of the survey area. Inside the Myanmar economic zone towards the Thailand border in the south and the Andaman Islands (India) to the East. The overall size of the surveyed area is approximately 60 000 km^2. In addition the vessel was recording hydrographic data on the way from Phuket to the survey area (a distance of approximately 200 nautical miles).

The main activity took place along two transects from approximately 25 meters depth to 1500 meters depth in the working area. The Northern transect is called A and the Southern transect is called B. The major part of the work was concentrated in 4 smaller areas around the two transects. Two shallow areas 25-50 meters depth called a1 and B1 and two deeper areas 100-250 meters depth around the shelf break called areas A2 and B2

The Myeik Archipelago is a shallow water area with hundreds of island scattered all over. The Northern area is said to be a high pressure area with regards to fisheries, while the Southern area around Lampi Island is a protected area with restrictions to fisheries.

Eastward towards the Andaman Islands we have the shelf break with ravines sea mounts and banks.

Previously unfamiliar with the area we notice that names vary in different versions of the maps used. We also see some deviations between map data and data from the echo-sounder regarding depths. A map of the survey area showing sailing tracks transects and stations are given below in fig 1.1.

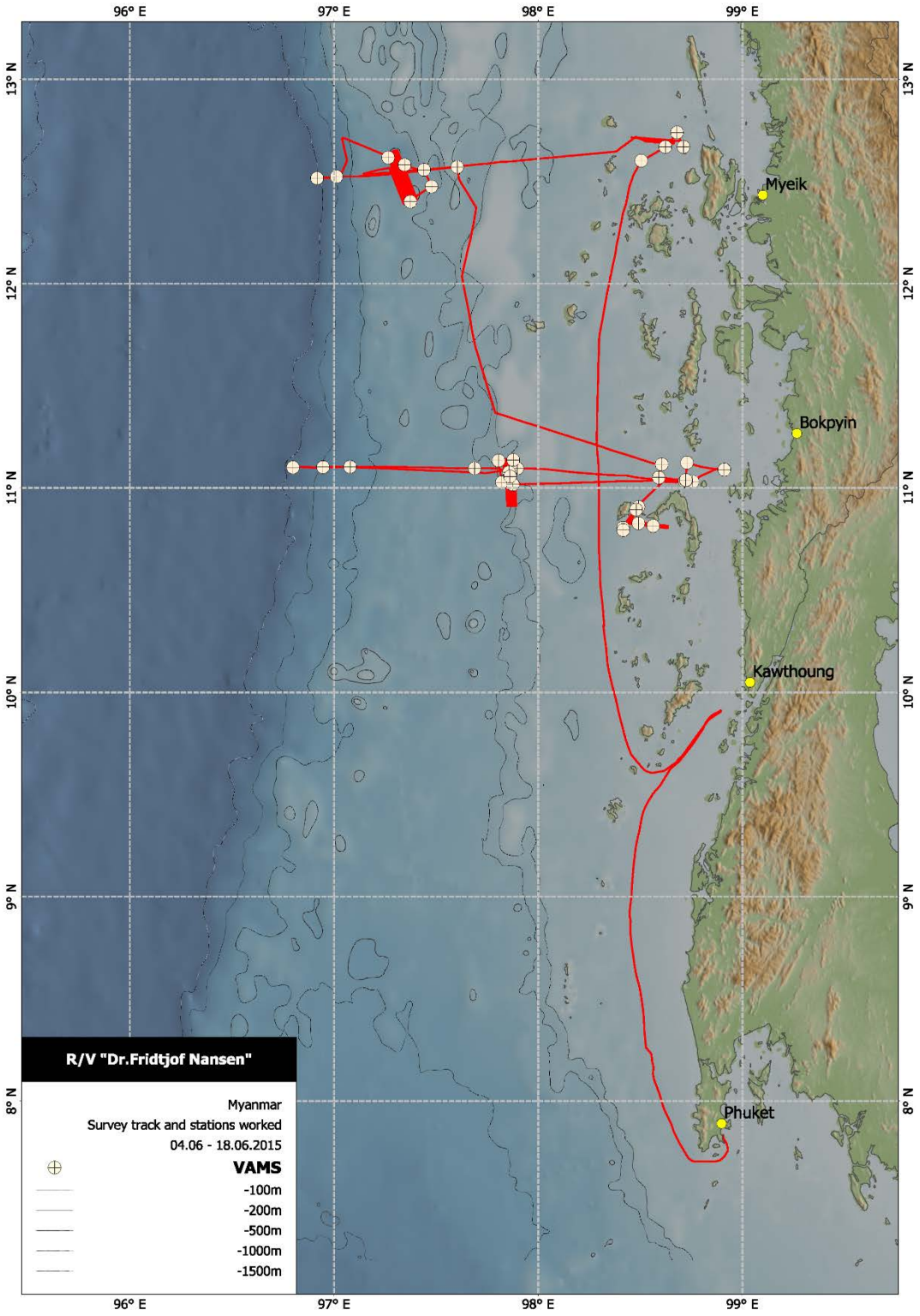

Fig 1.1 Sailing track and survey area

1.2 Aims and objectives

The aim of the survey was to start habitat mapping in the deeper parts of the Myeik and Merguri Archipelago stretching from outside the existing marine protected areas in shallow waters and out to 1500 m outside the shelf described by video footage and grab samples for biological and chemical parameters in the sediment related to selected organic and inorganic sources of pollution.
The CTD was used to collect data regarding the physical environment to add to the information from the observation and sampling. Information about the benthic habitats will be related to fish abundance and diversity in the survey area. Bathymetric mapping was conducted in preselected parts of the survey area.

The survey was designed for training and capacity building regarding benthic sampling routines and sampling of environmental parameters according to international standards. Decisions regarding the survey area and the scope of work were made in cooperation between the Myanmar and the Norwegian scientists prior to the survey.

1.3 List of participants

Participants:	*Period:*	*E-mail address*	*Gender*	*Institution*:	*Country*
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List of abbreviations:
IMR - Institute of Marine Research
DoF - Department of fisheries, Ministry of Livestock, Fisheries and Rural Development
MLMU- Mawlamyine University, Mon State
MU- Myeik University
NAVY - Myanmar Navy Hydrographic office
Univ. Lodz- University of Lodz, Poland.
C.L- Cruise leader
L.C.L- Local cruise leader

1.4 Narrative

Table 1.1: Overview of survey plan with ports of call and time estimated between each port.

Day /Date	Activity	For Scientists	For Crew
June2nd	Arrival of vessel in Phuket Customs clearance of container and on loading equipment to Nansen.	Norwegian scientist arrival to Phuket. Lifting and on loading VAMS	Crew Change
June 3rd	Rigging of equipment	Rigging	Rigging
June 4th	Departure from Phuket 17:30 to Kawthoung port.		
June 5th	Embarkment local scientists outside Kaw Thaung port 11:00. Steaming towards Area A1. 1 test dive, VAMS.	Embarkment local scientists, cruise meeting and planning.	Operations
June 6th	Area A1 shallow waters, 4 WAMS stations : A1/4, 3, 2 and TA25 Multibeam on the night shift.	Day shift	Operations
June 7th	VAMS Transect A1, 4 grab stations 25-500m. (A1/1, TA 100, 250, 500) Multibeam on the night shift.	Day shift	Operations
June 8th	VAMS area A2, 5 stations 230-350m depth .Multibeam 100 km^2 covered in area A2 at 200-300 meters at night.	Day shift	Operations
June 9th	3 VAMS stations on transect A 100-1500 m depth. 130km^2 covered by Multibeam in A2.	Day shift	Operations
June10th	The CTD station from transect A and transit to area B.	Day shift	Operations
June11th	Transect B and area B2, 4 stations 100-250 m depth. Multibeam 15 km^2 in area B1.	Day shift	Operations
June12th	VAMS TB/500, 1000, 1500. Multibeam 130 km^2 in B2	Day shift	Operations
June 13th	Transit TB to B2. VAMS 4 stations in B2: B2/6, 7, 8, 9.	Day shift	Operations
June14th	VAMS 4 stations in B1: B1/5-8. More multibeam in B1.	Day shift	Operations
June15th	VAMS 3 stations in B1: B1/9-11. Multibeam south side Lampi Island.	Day shift	Operations
June16th	VAMS 2 stations in B1: B1/12, 13. Transit Kawthuong		Operations
June17th	Transit Phuket	disembarkment local scientists	Operations
June18th	Port call Phuket	Disembarkment Norwegian scientists	Operations

In the morning at 0900 Tuesday June 2th RV Dr. Fridtjof Nansen arrived at the harbour in Phuket for crew change.

- 1100 the vessel was ready for rigging equipment for benthos studies:
- 1200 the VAMS arrived at the harbour packed on 2 trucks.
- 14:00, Mobile Crane for lifting equipment onboard arrived in the port.
- 15:15, The vessel started loading the equipment.
- 16:00 Winch was mounted on socket.
- 17:00 All equipment lifted onboard.
- 20:00 The scientific crew from Norway and Poland arrived in Phuket.

The next day fibre optics, power and mechanical equipment were connected to the VAMS. Video logging software for analysis of Video transects was installed on the computer.

On Thursday June 4th function tests on the VAMS took place. The system was working and we had pictures on the monitors. We had meetings with Thai scientists from Phuket and acquired some literature on corals in Andaman Sea.
Nansen left Phuket harbour at 17:30 for Kaw Thoung.

05/06-15. 11:00, The Scientists from Myanmar arrived on Nansen by boat from Kaw Thoung. The survey plan was discussed with the local scientists and adjusted according to new information about the fishing activity. The northern transect off Myeik was kept as in the sailing order but sampling area A2 was moved to 250 meters dept to cover what is thought to be a coral ridge that follows the southern part of the coast of Myanmar at approximately 250 meters. Transect B was moved south to Lampi island.

06/06-15. Started sampling the shallow waters on the northern transect off Myeik in area A1. The sampling was successful and the local scientists were eager to learn the procedures for preparation and preservation of sediment samples. They were also contributing well while logging the video transects.

07/06-15. Multibeam survey during night covered an area of 30 km^2 in area A1 in shallow waters.
Service on VAMS: Re-termination the umbilical from the cage to the ROV. The cable was damaged when the cage was dragged along the bottom on a shallow water station with strong currents. It was difficult to keep ship in position in strong tidal currents without DP. Four stations were sampled with the Van Veen grab while servicing the VAMS.

Fig. 1.2 Working in an area with high fishing activity.

08/06-15. Multibeam survey during night, an area of approximately 100 km^2 was covered in area A2 at 200-300 meters depth. VAMS in operation again, now with 55 meters new ROV cable. Video-transects and sediment sampling at 5 stations in Area A2. High density of shrimps and small fishes.

09/06-15. An additional area of 130km^2 was covered by Multibeam during the night. A total of 230 km^2 has been covered in area A2. Sediment sampling and video transects on three stations in deep water at 100, 1000 and 1500 meters' depth. Low densities of fish and shrimps were found, generally smaller animals at the deep stations.

10/06-15. The transit from Area A to area B followed a line at approximately 200 meters depth. At this depth we had indications from the previous fisheries surveys that there was hard bottom and maybe corals. By running the multibeam ecosounder we tried to get more information about the bottom hardness and location of coral reefs.
Five sampling locations; One as start of transect B and four in the B1 area were sampled today. We found lots of corals in the south western part of area B. In the north west we had soft sediments and generally lower biodiversity.

11/06-15. Multibeam mapping in area B1 covered an area of approximately 15 km^2 (Fig. 1.3). The mapping in shallow water was very time consuming since each line only had a width of approximately 4 times the water depth. At 25 meters' depth we covered a line that was 100-meter-wide on the bottom. Many small structures protruding from the bottom was shown in

the mapped area. Some of them were covered with corals. Given time and consensus we will go back to verify this and get video/photo documentation.
Four stations were sampled today, one at 100 meters' depth and 3 locations in area B2. We visited 2 locations with coarse sand and relatively high density of juvenile fish and one area with dead coral fragments rather large in size. There was high diversity of small corals, sponges and other benthic fauna.

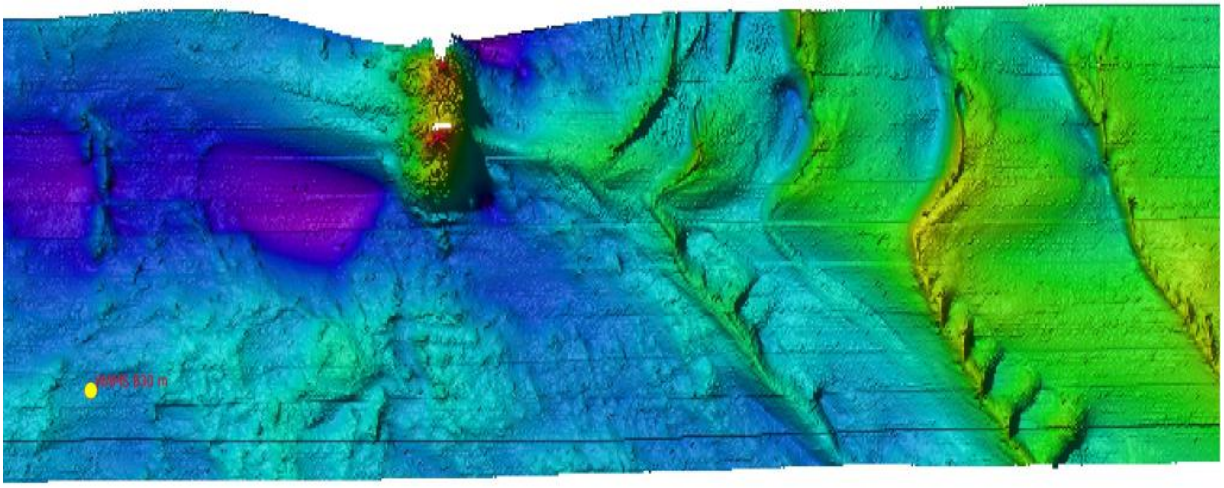


Fig. 1.3 June 11th Bathymetric map from area B1 based on data from multi beam survey in shallow water. Sampling station TB 30 meter is shown as yellow dot.

12/06-15. Multibeam survey in area B2 covered an area of approximately 130 km^2 in a hard bottom area. One location in area B2 and the deep stations on TB/500, 1000 and 1500 meters were sampled today.

13/06-15. Transit from deep stations on transects B to area B2 and continued multibeam survey covering the hard bottom area at night. Studies of a large area containing various corals have taken place today. The corals were located on the shallow side of the fault observed on the multibeam maps. Video transects with VAMS was performed successfully along a 300 meter long transect crossing the ridge on 3 locations at B2.

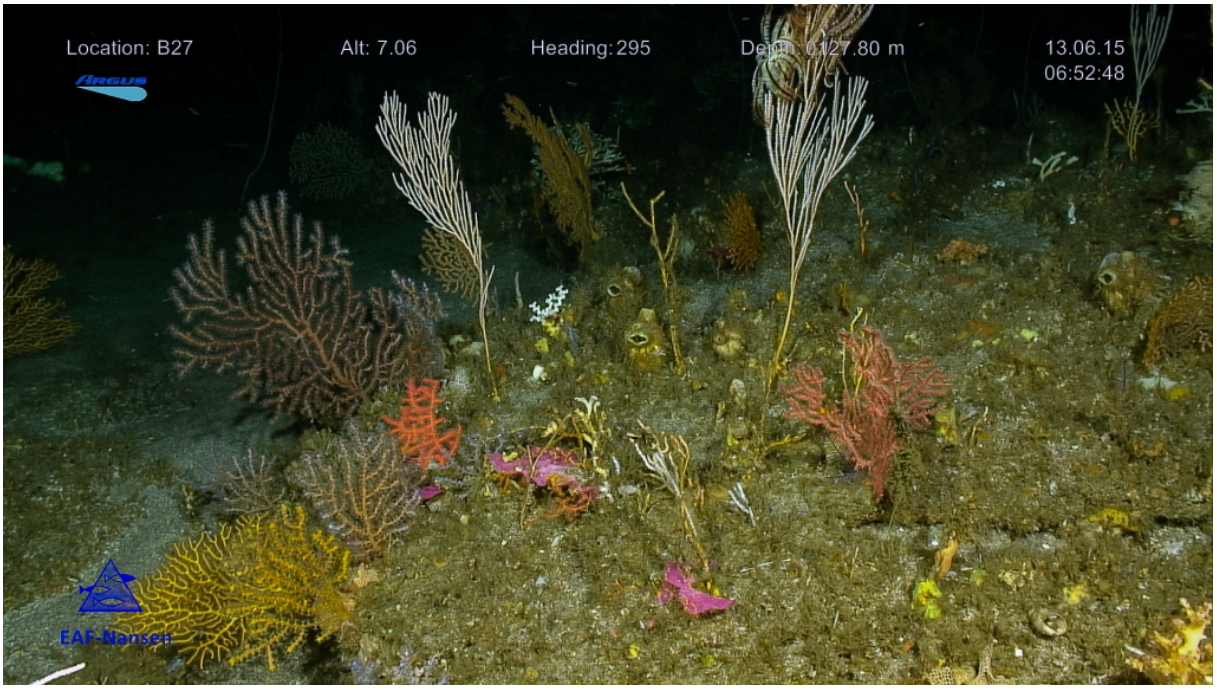


Fig: 1.4 Corals from 127 meters on transect B

Fig: 1.5 Grouper and Moray eel, hunting buddies?

14/06-15. Transit to area B1 to follow up and extend the area where multibeam survey started last week. Sampling and video transects on special structures shown on the multibeam map. The visibility was low and there were strong currents in the area north of Lampi Island. The vessel was anchored on two of the locations, one area with corals. Better visibility on the west side. Large coral area with high abundance and diversity of fish was discovered on the western side of Lampi Island.

15/06-15. Sampling and video transects on special structures shown on the multibeam map in the area west of Lampi Island One large and 3 smaller areas with corals were verified and high abundance and diversity of fish was discovered on these locations. Observed many old gillnets fastened on the corals. There was low visibility on some locations.

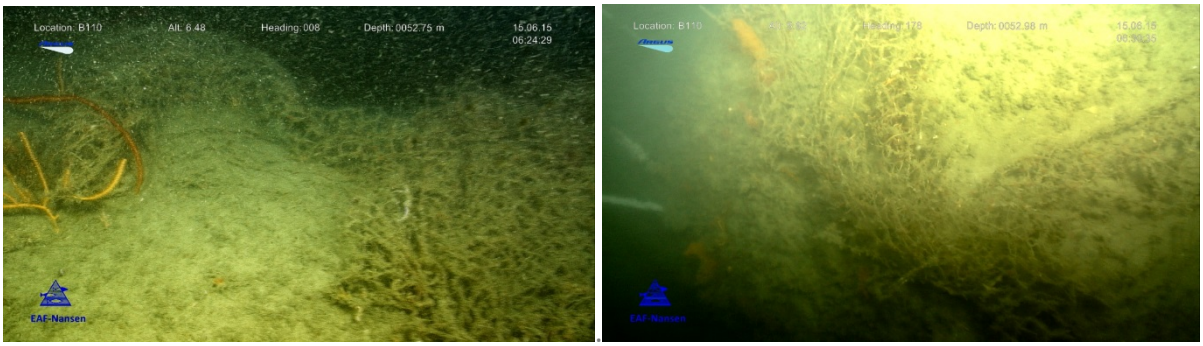


Fig 1.6 Old fishing nets from transect B

16/06-15. Sampling and video transects on special structures that appeared on the multibeam map in the area south of Lampi Island. Verified two areas with corals at 40-50 meters depth and observed high abundance and diversity of fish. Old gillnets fastened in corals were observed on the locations studied today too. Multibeam mapping was done at night to extend the mapped area on the south side of Lampi Island.

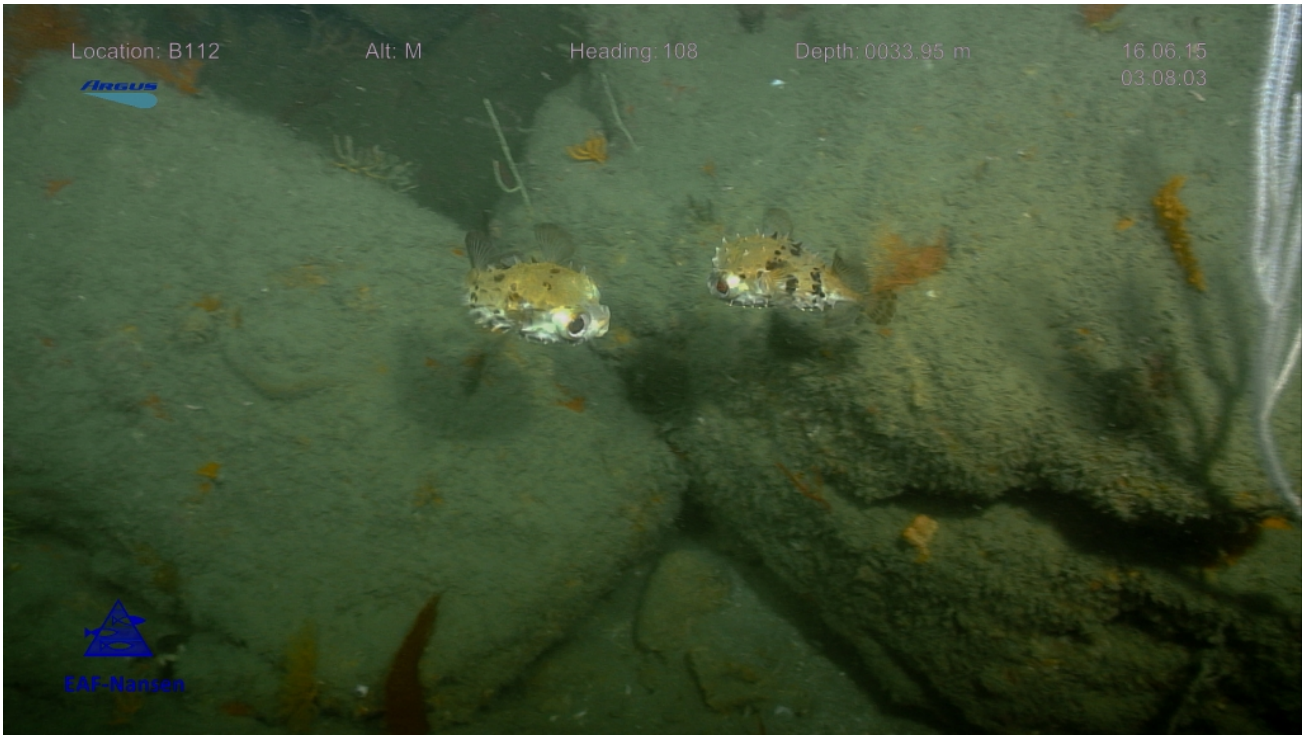


Fig: 1.7 Two juvenile Puffers marking territory.

17/06-15. The scientists from Myanmar were picked up by a local boat for transportation to Kaw Thoung. Nansen proceeded to Phuket harbour in for demobilisation. ETA 08:00 June 18th.

1.5 Scope of work

During the cruise period 42 benthic stations were sampled, leaving us with 121 samples (mostly 3 replicates pr. Station) for benthic fauna, 81 sample sets for chemical analysis (mostly 2 replicates pr. Station), 42 samples for grain size distribution (1 replicate), 40 stations with video footage, CTD's were taken from 39 of the stations and 500 km^2 of multibeam coverage.

40 samples for benthic fauna analysis was following the crew back to Myanmar and is currently being processed by students as part of a master's program.

The rest of the samples were sent to Norway for storage and analysis. Currently 38 samples (1 replicate pr. Station) for metal analyses,16 samples (1 replicate pr. Station) for hydrocarbons and 41 samples for grain size has been analysed.

Table 1.2 gives an overview of sampling stations, collected samples, data and related CTD stations.

Table 1.2. Information about the sampling stations. The mulitibeam entry is designated an Id number referring to the area (ch. 3.

Station	DATE	TIME	LON	LAT	DEEP	CTD st.	Diary ref.	Dive time	Notes	Bio Samples	Ch. samples	Video	Multi beam	Remark
Test	5/ 6/15	13:05:17	97.8215	10.3254	66		VA test dive	Na		3	2			Test dive, no record.
A1/4	6/ 6/15	03:24:03	98.005	12.6014	58	HD460	VAMS A1-4	Na	2	3	2	X		
A1/3	6/ 6/15	06:29:41	98.1227	12.6687	46	HD461	Vams A1_3	Na	2	3	2	X		
A1/2	6/ 6/15	10:23:43	98.1797	12.7392	44	HD462	VAMS A1-2	Na		3	2			No record
TA/25	6/ 6/15	11:57:10	98.2115	12.6685	26		Vams 25 M	Na	2	3	2	X		
A1/1	7/ 6/15	03:44:15	97.9778	12.7182	54	HD463	GR 1-3 Duo	-		3	2	X		
TA 100	7/ 6/15	09:37:07	97.2501	12.5859	99	HD464	GR 4-6 duo	-		3	2	X		
TA 250	7/ 6/15	11:59:29	96.9413	12.5568	254	HD465	GR 7-9 duo	-		3	2	X		
TA/500	7/ 6/15	15:53:04	96.6447	12.5352	512	HD466	GR 10-12 duo	-		3	2	X		
A2/1	8/ 6/15	02:30:09	96.8462	12.5807	297	HD467	Vams A2-1	42	2	3	2	X	3	(Id number for multibeam see ch. 3.4)
A2/2	8/ 6/15	04:27:30	96.9413	12.5564	256		VAMS A2-2	47	2	1	1	X	3	
A2/3	8/ 6/15	06:44:34	96.9776	12.4747	223	HD468	VAMS A2-3	67	2	3	2	X		
A2/4	8/ 6/15	08:52:37	96.8741	12.401	252	HD469	Vams A2-4	53	2	3	2	X	3	
A2/5	8/ 6/15	12:15:30	96.7655	12.6166	347	HD470	VAMS 347 M	62	2	3	2	X	3	
TA/1000	9/6/15	01:56:58	96.5123	12.5232	1026	HD471	VAMS 1000 M	96	2	3	2	X		998,1000, 1026m
TA/1500	9/ 6/15	05:36:50	96.4173	12.5156	1502	HD472	VAMS 1500m A	60	2	3	2	X		
TA 100/2	9/ 6/15	11:52:30	97.104	12.5703	104	HD473	VAMS 100 M A	102	3	3	2	X		
B1/1	10/6/15	01:39:46	98.1056	11.1157	52	HD474	VAMS B1-1	62	2	3	2	X		
B1/2	10/6/15	03:47:03	98.0909	11.051	47	HD475	VAMS B1-2	55	2	3	2	X		
B1/3	10/6/15	06:28:52	98.2184	11.032	40	HD476	VAMS B1_3	54	7	3	2	X	1	
B1/4	10/6/15	09:00:56	98.2288	11.1239	54	HD477	VAMS B1-4	53	4	2	1	X		
TB/30	10/6/15	11:25:58	98.4117	11.0894	31	HD478	Vams B 30m	56	2	3	2	X	1	
TB/100	11/6/15	04:17:23	97.3977	11.0956	101	HD479	Vams B 100m	50	1	3	2	X		
B2/1	11/6/15	06:39:40	97.3061	11.1342	213	HD480	Vams B2_1	57	2	3	2	X		
B2/2	11/6/15	08:55:51	97.3225	11.0282	245	HD481	VAMS B2-2	33	3	3	2	X		

Table 1.2 continued. Information about the sampling stations. Continued.

Station	DATE	TIME	LON	LAT	DEPTH	CTD st.	Diary	Dive min.	Dive notes	Bio samples	Ch. Samples	Video	Multi Beam	Remark
B2/3	11/6/15	11:02:19	97.3618	11.0698	146	HD482	VAMS B2-3	116	5	3	2	X	4	150 m
TB/500	12/6/15	05:47:20	96.5789	11.103	501	HD486	Vams B 500m	72	3	3	2	X		
TB/1000	12/6/15	09:28:16	96.4464	11.1019	981	HD485	VAMS B 1000m	45	2	3	2	X		
TB/1500	12/6/15	12:28:05	96.2995	11.1004	1534	HD484	VAMS B 1500m	84	2	3	2	X		
B2/5	13/6/15	01:49:07	97.3783	11.1371	107	HD487	VAMS B2-5	50	3	3	2	X	4	
B2/6	13/6/15	03:56:09	97.3573	11.0772	149	HD488	VAMS snitt	77	3	3	2	X	4	
B2/7	13/6/15	06:24:39	97.3624	11.0564	124	HD489	Vams snitt_2	65	2	1	1	X	4	1 bio sample
B2/8	13/6/15	08:57:43	97.3764	11.0175	132	HD490	Vams B2-8	66	3	3	2	X	4	
B1/5	14/6/15	01:21:31	98.2563	11.0306	27	HD491	VAMS 25m	105	3	3	2	X	1	
B1/6	14/6/15	05:01:46	98.2238	11.0357	38	HD492	VAMS Anchor	46	5	3	2	X	1	
B1/7	14/6/15	07:43:06	98.2236	11.039	37	HD493	VAMS Anchor_2	14	1	3	2	X	1	
B1/8	14/6/15	11:59:44	97.9799	10.894	57	HD494	VAMS 56 m	78	4	3	2	X	1	
B1/9	15/6/15	03:25:38	97.9162	10.8051	50	HD495	VAMS 49M	67	2	3	2	X	5	
B1/10	15/6/15	06:02:29	97.9169	10.7939	50	HD496	VAMS 51M	90	3	3	2	X	5	
B1/11	15/6/15	09:09:44	97.9916	10.907	42	HD497	VAMS 41 m	67	3	3	2	X	5	
B1/12	16/6/15	02:47:56	98.0633	10.8144	31	HD498	VAMS 31 M	63	4	3	2	X	5	
B1/13	16/6/15	06:00:12	97.9914	10.8271	44	HD499	Vams 45 M	44	2	3	2	X	5	

2. METHODS

- Provides an overview of the methods used on board, all listings are conditionally that the equipments is available.

2.1 Meteorological and hydrographical sampling

Meteorological data including wind direction and speed, air temperature and sea surface temperature (SST) was logged automatically into the system using a WIMDA meteorological station and averaged by every nautical mile distance sailed.

CTD profiles were be deployed at selected sediment sampling stations. A Seabird 911 CTD Plus is used to obtain vertical profiles of temperature, salinity and oxygen. Real time plotting and logging was done using the Seabird Seasave software installed on a computer. The profiles were taken from the surface down to a few meters above the sea floor. The CTD data can be post processed in the Quick cast database and displayed with the software package Ocean Data Viewer. The CTD is currently also equipped with a light meter to determinate the extent of the phobic zone.
The SBE 21 Seacat thermosalinograph was running continuously during the survey, collecting data for salinity and relative temperature at 5 m depth every 10 seconds. An attached in-line Turner Design SCUFA Fluorometer was used to supplement these data with the underway measurements of Chlorophyll-a levels [RFU].

2.2 Sediment sampling and Identification of benthic communities using video.

The sampling was conducted according to the area and the number of stations indicated in Table 1.1 and Figure 1. The exact locations, suitable notations and the number of replicates to be sampled will be discussed and decided upon prior to the survey based on the objectives, available time, budgets and capacity for analysis.

Table 2 contains an overview of the different gear types onboard that can be used for sampling and identification of benthic organisms /communities.

Table 2. Overview of the available gear for benthic sampling. Short descriptions, sampling area, utility area and type of data collected are given.

Gear	Description	Sampling area	utility area	type
Video grab (VAMS)	4 duo grabs, 1 standard 0,1 m^2 grab and a small ROV	0,1 m^2 + 0,05	Soft and semisoft bottom 100-2500m (3000)	Quantitative
Grab type 1	Short arm	0,1 m^2	Soft bottom shallow water 10-200m	Quantitative
Grab type 2	Long arm	0,1 m^2	Harder bottom in shallow water, soft and harder bottom in deep water. 10-3500 m	Quantitative
Grab type 3	Double Chamber	0,1 m^2 + 0,05	Soft bottom 100-3500 m	Quantitative
Sneli sledge	Benthic sledge		30-100 m soft/semi soft bottom	Qualitative

2.2.1 VAMS (Video Assisted Multi sampler)

Video Assisted Multi Sampler (VAMS) was developed to improve the sampling technique in terms of visual inspections, reliability, speed, accuracy and the ability to carry an array of relevant sensors. The current version of the VAMS can operate to 2500 meters depth and collect 8 parallel sediment samples on one dive, in addition to various sensor outputs, high resolution video and still pictures from the Seabed.

The VAMS consist of a sampling platform with hydraulic operated grabs, current meter, CTD and sonar. An ROV with a 30 meters umbilical is integrated in the sampling platform. The ROV is equipped with a HD camera for documentation, guidance and visual inspection of the sampling. It has also been used for habitat characterization in the vicinity of the sampling platform.

In rough conditions the ROV will be operated after the VAMS has landed on the sea bed. The VAMS will then serve as a stable base point for the ROV to prevent drag from the surface waves. This feature enables the ROV to be maneuvered with high precision to deliver high quality video and images.

The VAMS was operated after a pattern based on the European standard ES 16260 (Water quality-Visual seabed surveys using ROV's and /or towed observation gear for collection of environmental data) and software developed by Pål Buhl Mortensen for the MAREANO project for video analysis. Buhl Mortensen is also the developer of the 16260 standard. The standard is being adjusted to the VAMS who is a recent development in terms of equipment. The ES 16260 and the sampling scheme are attached to the sailing order (Annex 1 and 4).
The video transect will be run with the ROV from the center platform out to 15 meters in four directions N,S,E and W, in addition a line of 15 meters will be filmed between the first four lines creating a square. A total of 224m^2 for each station.

The whole system including the winch has been sent by air freight and will be installed on the vessel in Phuket.

All information about the sampling and the samples are recorded in a sampling journal recording all relevant information about the process.

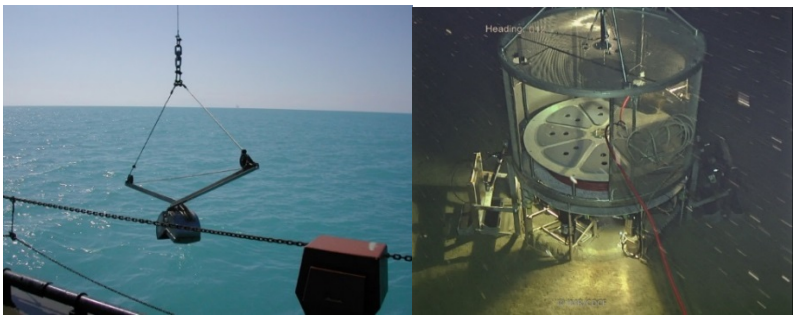
2.2.2 Van Veen Grab

The Van Veen grab is a quantitative tool also suited for sampling chemical parameters. The grabs can be operated at any depth as described in table 2. The grab samples can be sub sampled or treated as quantitative samples, this is mostly determined by the purpose of the investigation, budgets and the capacity for post survey analysis.
When landed the samples are validated in terms of sampling success based on the working standard implied for the particular survey. If no particular standards are implied the following general considerations applies: For qualitative sampling everything can be used, if there is only small amounts of sediments in the sample and there are reasons to believe that there has been problems during the sampling a new sample should be considered. For a quantitative sample to be valid the grab needs to be properly closed and the surface of the sample undisturbed, or at least not washed out. Samples taken on muddy bottom will often fill the grab to the lid and disturb the surface for retrieval of samples for chemical analysis. Quantitative grab samples shall be measured in terms of volume and samples below minimum volume should be discarded. The volume is noted in the sampling journal. For practical reasons the volume is measured with a ruler from bottom of the lid to the sediment surface. Once the sampling equipment is landed and secured the surface water is drained the volume measured and the sample validated. Drained water might contain animals and shall therefore be drained into the fine mesh sieve. The material for biological samples is washed and sieved carefully through a descending set of sieves usually the 5 mm sieve in

combination with one or two finer sieves placed in the drawers under the washing table. The time aspect is important, especially for samples collected from deep water locations due to differences in temperature. If there is more than 10°C in difference between bottom temperature and the temperature of the flushing water, the RSW (refrigerated sea water) plant can be started to provide an ideal temperature for sample treatment. The choice of the sieve's mesh size should be decided prior to the survey. There are four mesh sizes available onboard 5mm, 1mm, 0,5 mm and 0,3mm. The 0,3mm is mostly used for deep water benthos > 250meters.

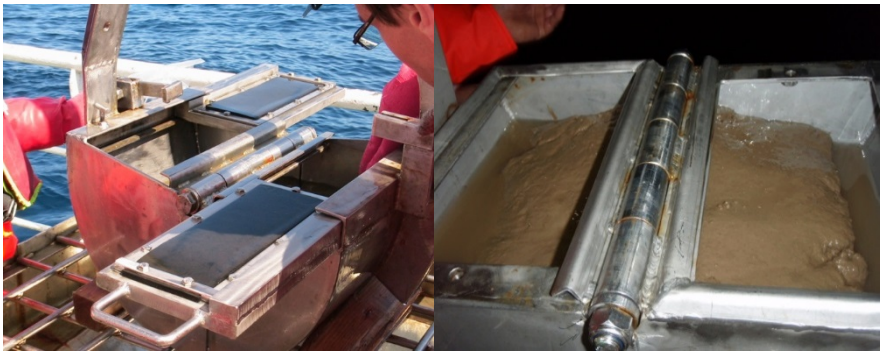
Since most of the animals are found in the upper 5 centimeters of the sediment it is often practical to take off this surface layer and wash it separately. This is often done when working with mud or clay samples. These samples often have a soft surface that is easily dissolved and a denser sub layer that requires a tougher treatment. This procedure is especially important when working on deep water samples because the specimens found there are generally smaller and more fragile. Visible specimens can be picked from the sieves and isolated in smaller containers to avoid unnecessary wear and tear.

After sieving, the material left in the sieves are carefully transferred to containers and fixed as soon as possible in either pre-buffered[1] formaldehyde solution at 4%-8%[2] (Diluted in sea water) or preserved in (70) 96% ethanol. Samples preserved in ethanol can be used for genetic analysis (bar coding). (70 % ethanol should be used on Sipuncula and Priapulida if used for traditional taxonomy because the osmotic pressure will cause shrinkage when using 96% ethanol.) Make sure that nothing is left in the sieves and that the sieves are washed carefully between each sample to avoid contamination. The containers should have a maximum of 2/3 sediment filling to ensure adequate formaldehyde concentration for results. Small animals and low water content = 4% solution, larger animals and or higher water content = 8% solution (SR 802.01 IMR-eng Formaldehyde). When preserved in ethanol, the ethanol should be changed within a 24 hours' period especially if the sample is intended for DNA analysis.



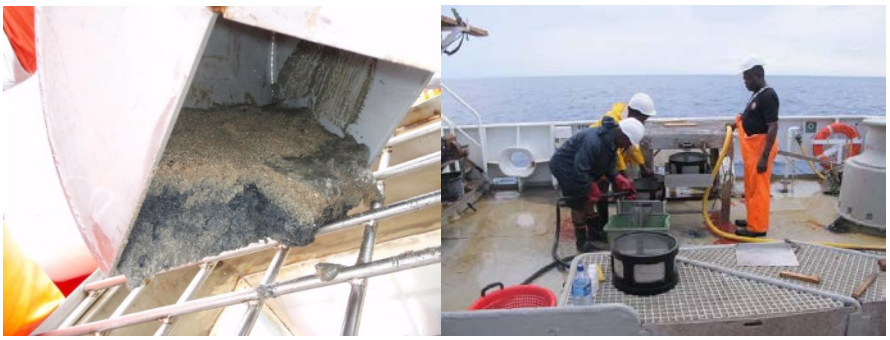
Left: launching the long armed Van Veen grab.
Right: Sampling with the video grab.

[1] Borax is added to formaldehyde to raise the pH of the sample, preventing the dissolution of calcified structure or other tissues. Approximately, 1 ss (soup spoon) is added for each liter of 4 % formaldehyde.
[2] To ensure the sample final concentration is 4 % might be useful to make the formaldehyde solution at 8 %. As such, you can fill the container up to half and fill the other half with the formaldehyde at 8 %. This will reduce the fixation to 4 %.



Left: The washing table with the grab landed on top.
Right: sediment surface

Left: measuring the sediment volume.
Right: opening the grab to wash the sample.



Left: polluted sediments under the surface layer.
Right: washing samples.

Left: setup of chemicals for fixation and packing of samples
Right: Munsell solil chart for determination of sediment color.

Figure 2. Pictures illustrating the process of sampling with the Video grab (VAMS).

The samples are then labeled with the station notation, date, depth, sample number and number of containers (1/X-X/X), and stored in boxes labeled with the contents. The container is then placed in a transparent plastic bag with the label inside facing out for easy identification; an additional label can be placed in the inner cap of the container or inside the container. A sample inventory record is useful if the amount of samples is extensive.

Samples for chemical analysis were collected with a special spate from the upper centimeter of the sediment surface. Plexi glass tubes can also be inserted if deeper sections are to be sampled. The samples are bagged in Rilsan bags and labeled with station notation, date, depth and sample number.

The sampling regime was based on international standards. This is done to have a uniform way of environmental assessment for comparison and standardization. OSPAR guidelines, which is used in European waters for environmental assessment, is the basis for collection, handling and analysis of sediment samples. This standard is designed for shelf depths and some adoptions may be useful when planning sampling in deep water habitats.

For a detailed sampling procedure see float diagrams for sampling of benthic animals (Annex 2), chemical parameters (Annex 3) and the sampling journal (Annex 4).

2.3 Multibeam echo sounder for 3D bottom mapping

The R/V Dr. Fridtjof Nansen is equipped with the Kongsberg Maritime EM710 multibeam echosounder with positioning and motion data from Seapath 200. The positioning system mounted is Fugro SeaStar. Seabed Information System (SIS) software will be used for online logging and echosounder control. Post-processing of data will be performed using Neptune, which is also used for the calibration of the EM710.

The multibeam survey will cover patches of an area around the sampling locations on the Myeik Archipelago between depths from 50m to 1500m. During the survey, local scientists will get a brief description of the sampling methodology and equipment operation.

2.3.1 Seabed Information System (SIS)

SIS is used for the online operation of Kongsberg Maritime multibeam echosounder systems. The application is used by the operator to control all settings and logging during the survey.

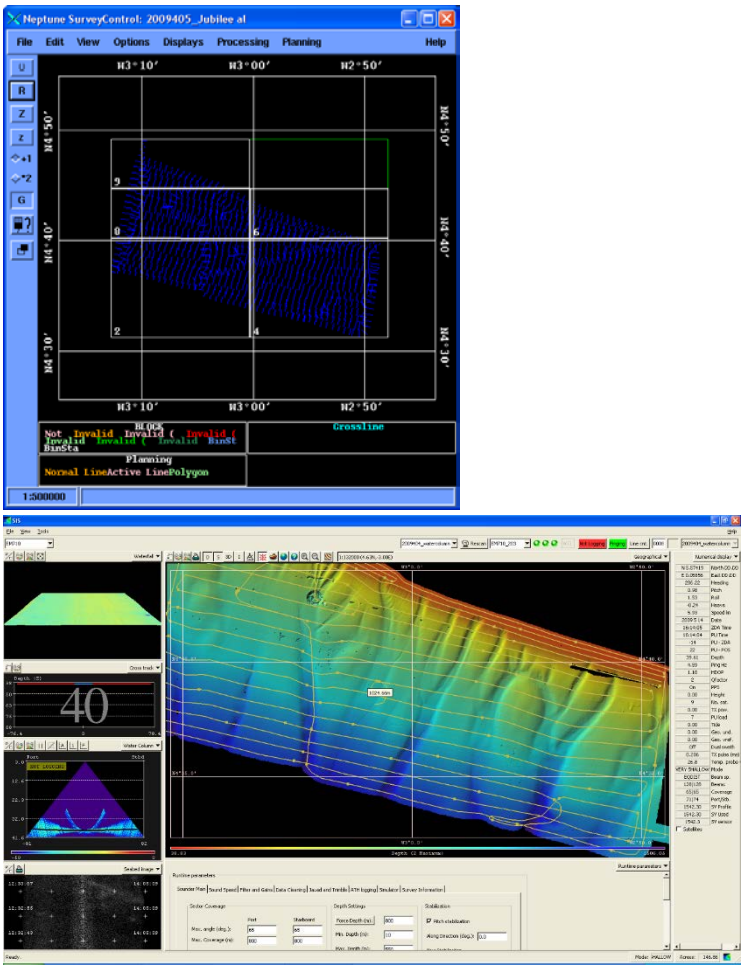


Figure 3. Screenshot from the Seabed information system.

2.3.2 NEPTUNE – Post Processing

Prepared raw data from SIS are processed using Neptune post-processing software. All depths are corrected for tidal influence using post-processed GPS data and reduced to mean sea level.

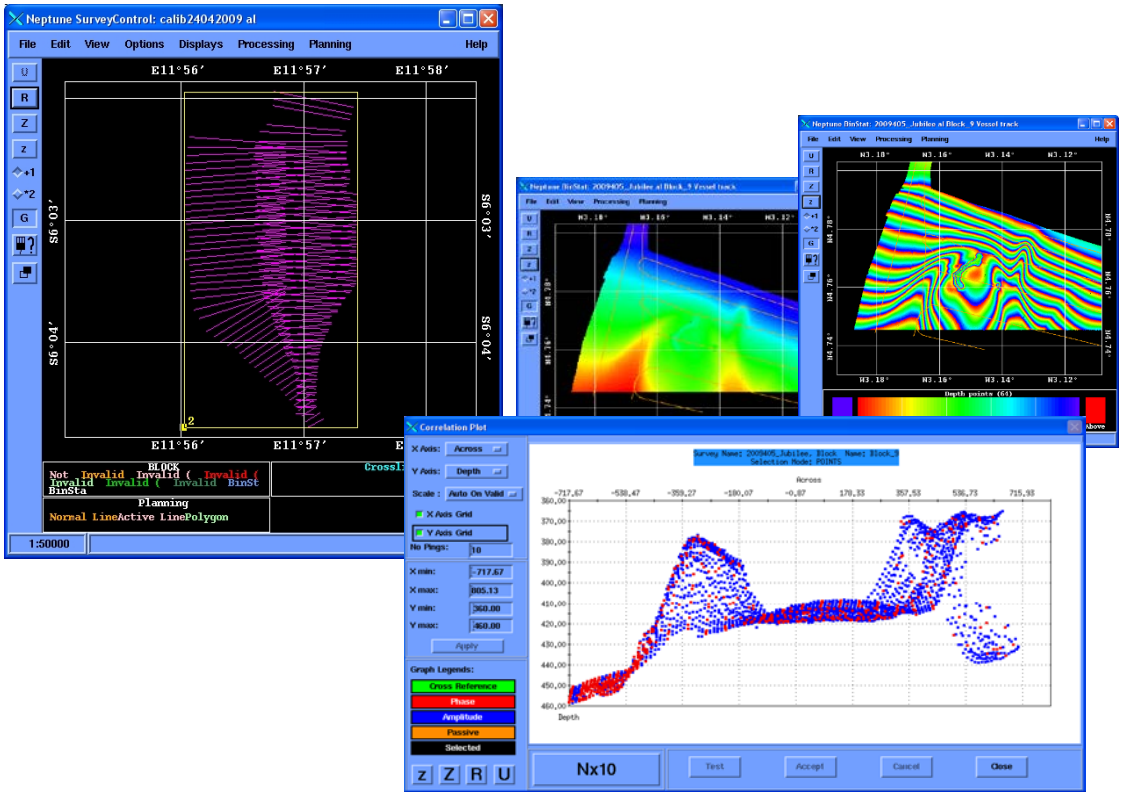


Figure 4. Screen shots from Neptune Post-processing software

After tide correction, spurious soundings were removed/flagged invalid using the BinStat module. Cleaned accepted data are exported to ASCII files as formatted as latitude, longitude and depth. In addition, mean depths are exported for each processing cell (30x30m).

Fledermaus – Visualization. Exported ASCII data can be imported into Fledermaus visualization and DTM software.

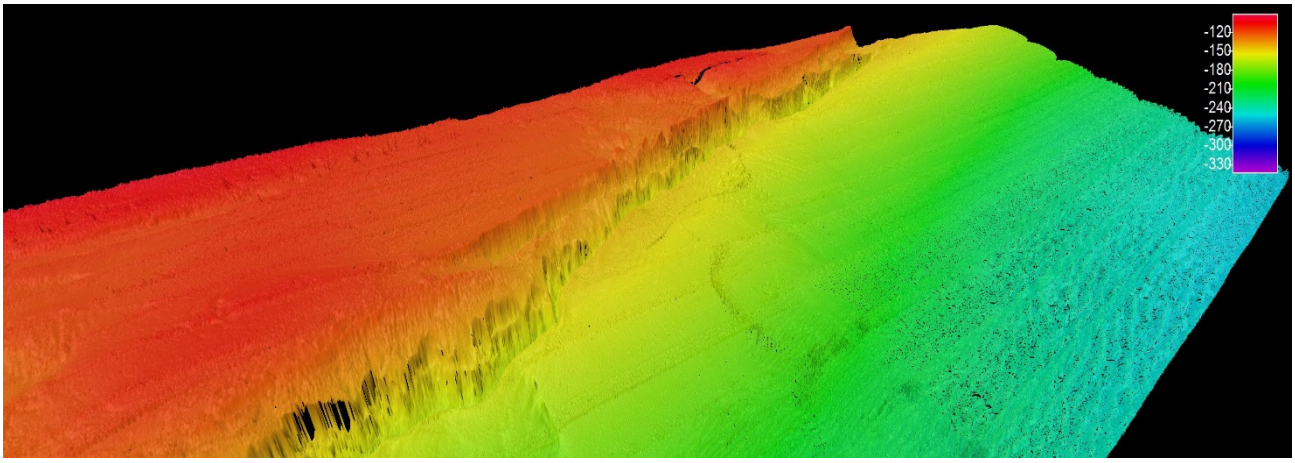


Figure 5.
Interesting topography in area B2, seen from North, corals in the slope and on the top, soft bottom in the deeper area. Visualization of details in benthic structure by use of the software Fledermaus.

The vessel is not equipped with a functional, transceiver, hi Pap system to receive navigation signals from the VAMS for underwater positioning. She also lacks dynamic positioning. This will limit the accuracy of positioning of the vessel and make operations in rough weather and strong currents challenging.

3 RESULTS

42 benthic stations were sampled in the period from June 5th to June 16th. Sediment samples for grain size/sediment characterisation, chemical analysis and fauna analysis were collected from each station. In addition, CTD data was recorded on 39 of the stations and video footage from 36 of the stations for habitat mapping purposes. In addition to this 498,57 km^2 was covered by the multibeam echo-sounder to provide data for bathymetric maps. 40 of the collected fauna samples have already been processed in Myanmar. Table 3.1 gives an overview of the sampling stations, collected samples and data and table 3.0.1 gives an overview of the benthos stations.

Table 3.1 sampling stations.

Station	CTD st.	DATE	TIME	LON	LAT	DEEP	Remark	Dive time	Note sheets
Test		5/ 6/15	13:05:17	97.8215	10.3254	66	Test dive, no record.		
A1/4	HD460	6/ 6/15	03:24:03	98.005	12.6014	58			2
A1/3	HD461	6/ 6/15	06:29:41	98.1227	12.6687	46			2
A1/2	HD462	6/ 6/15	10:23:43	98.1797	12.7392	44	No record		
TA/25		6/ 6/15	11:57:10	98.2115	12.6685	26			2
A1/1	HD463	7/ 6/15	03:44:15	97.9778	12.7182	54		-	
TA 100	HD464	7/ 6/15	09:37:07	97.2501	12.5859	99		-	
TA 250	HD465	7/ 6/15	11:59:29	96.9413	12.5568	254		-	
TA/500	HD466	7/ 6/15	15:53:04	96.6447	12.5352	512		-	
A2/1	HD467	8/ 6/15	02:30:09	96.8462	12.5807	297		42	2
A2/2		8/ 6/15	04:27:30	96.9413	12.5564	256		47	2
A2/3	HD468	8/ 6/15	06:44:34	96.9776	12.4747	223		67	2
A2/4	HD469	8/ 6/15	08:52:37	96.8741	12.401	252		53	2
A2/5	HD470	8/ 6/15	12:15:30	96.7655	12.6166	347		62	2
TA/1000	HD471	9/6/15	01:56:58	96.5123	12.5232	1026	998,1000, 1026m	96	2
TA/1500	HD472	9/ 6/15	05:36:50	96.4173	12.5156	1502		60	2
TA 100/2	HD473	9/ 6/15	11:52:30	97.104	12.5703	104		102	3
B1/1	HD474	10/6/15	01:39:46	98.1056	11.1157	52		62	2
B1/2	HD475	10/6/15	03:47:03	98.0909	11.051	47		55	2
B1/3	HD476	10/6/15	06:28:52	98.2184	11.032	40		54	7
B1/4	HD477	10/6/15	09:00:56	98.2288	11.1239	54		53	4
TB/30	HD478	10/6/15	11:25:58	98.4117	11.0894	31		56	2
TB/100	HD479	11/6/15	04:17:23	97.3977	11.0956	101		50	1
B2/1	HD480	11/6/15	06:39:40	97.3061	11.1342	213		57	2
B2/2	HD481	11/6/15	08:55:51	97.3225	11.0282	245		33	3

Table 3.1 sampling stations continued.

Station	CTD st.	DATE	TIME	LON	LAT	DEPTH	Remark	Dive min.	Note sheets
B2/3	HD482	11/6/15	11:02:19	97.3618	11.0698	146	150 m	116	5
TB/500	HD486	12/6/15	05:47:20	96.5789	11.103	501		72	3
TB/1000	HD485	12/6/15	09:28:16	96.4464	11.1019	981		45	2
TB/1500	HD484	12/6/15	12:28:05	96.2995	11.1004	1534		84	2
B2/5	HD487	13/6/15	01:49:07	97.3783	11.1371	107		50	3
B2/6	HD488	13/6/15	03:56:09	97.3573	11.0772	149		77	3
B2/7	HD489	13/6/15	06:24:39	97.3624	11.0564	124	1 bio sample	65	2
B2/8	HD490	13/6/15	08:57:43	97.3764	11.0175	132		66	3
B1/5	HD491	14/6/15	01:21:31	98.2563	11.0306	27		105	3
B1/6	HD492	14/6/15	05:01:46	98.2238	11.0357	38		46	5
B1/7	HD493	14/6/15	07:43:06	98.2236	11.039	37		14	1
B1/8	HD494	14/6/15	11:59:44	97.9799	10.894	57		78	4
B1/9	HD495	15/6/15	03:25:38	97.9162	10.8051	50		67	2
B1/10	HD496	15/6/15	06:02:29	97.9169	10.7939	50		90	3
B1/11	HD497	15/6/15	09:09:44	97.9916	10.907	42		67	3
B1/12	HD498	16/6/15	02:47:56	98.0633	10.8144	31		63	4
B1/13	HD499	16/6/15	06:00:12	97.9914	10.8271	44		44	2

3.1 Sediment characteristics.

The sediment ranged from Sandy Medium Gravel on B1/13 to Fine Silt on TA/1500.
The median distribution D50 of the sediment samples ranged from -0.671 to 7,372 with the coarsest sediments taken from around 50 meters on transect B (B1/10, -0,671) and the finest sediment coming from the deep end of transect A (TA/1500, 7,372).
The general trend was finer sediments with increasing depth. The shallow stations on transect A seems to be more fine graded than the ones on the B transect. This could be due to the influence from the river outlets in the northern part of the area. The coarsest sediments are highlighted in blue in table 3.1.2.
The finest graded sediments were found at TA/1500 named fine silt and the second finest TB/1500 named medium silt; these two are highlighted in yellow in table 3.1.2. Table 3.1.1 shows the relation between the Phi scale and the mesh size.

Table 3.1.1 Phi scale to explain the Median diameter (MD Φ) distribution.

Mesh size of the sieve (mm)	Phi class Φ	Rough description	Description
16	-4	Gravel	Coarse gravel
>16-8	-3		Medium gravel
>8-4	-2		Fine gravel
>4-2	-1		Very fine gravel
>2-1	0	Sand	Very coarse sand
>1-0,5	1		Coarse sand
>0,5-0,25	2		Medium sand
>0,25-0,0125	3		Fine sand
>0,0126-0,063	4		Very fine sand
>0.062-0.031	5	Silt	Very coarse silt
>0,030-0.016	6		Coarse silt
>0.015-0.008	7		Medium silt
>0.007-0.004	8		Fine silt
>0.003-0.002	9		Very fine silt
>0.002		Clay	Clay

Table 3.1.2. Grain size distribution.

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	Depth	SEDIMENT NAME:	FOLK AND MEAN	WARD METHOD SORTING	(f) SKEWNESS	KURTOSIS	D10 (f):	D50 (f):	D90 (f):	% GRAVEL:	% SAND:	% MUD:
Test St. 66	66	Slightly Fine Gravelly Very Fine Sand	3.146	0.989	-0.212	1.659	2.006	3.303	3.938	0.009	0.924	0.068
TA25	25	Sandy Fine Gravel	-0.612	1.796	0.078	0.694	-2.820	-0.749	1.754	0.467	0.532	0.001
A1/1	53m	Slightly Very Fine Gravelly Fine Sand	1.803	1.362	-0.121	1.135	0.028	1.896	3.530	0.035	0.924	0.041
A1/2	44m											
A1/3	46m	Slightly Very Fine Gravelly Fine Sand	1.748	1.344	-0.348	1.110	-0.285	2.090	3.060	0.042	0.931	0.027
A1/4	60	Slightly Very Fine Gravelly Medium Sand	1.365	1.454	0.063	1.097	-0.522	1.329	3.326	0.043	0.906	0.050
TA/100	100											
TA/100.2	105	Very Fine Gravelly Fine Sand	1.545	1.485	-0.275	1.027	-0.632	1.853	3.136	0.060	0.911	0.029
A2/1	295	Slightly Fine Gravelly Very Fine Sand	2.671	0.942	-0.145	0.846	1.319	2.750	3.804	0.003	0.969	0.028
A2/2	252											
A2/3	220	Slightly Very Fine Gravelly Fine Sand	2.870	0.712	0.031	0.907	2.063	2.813	3.777	0.004	0.978	0.018
A2/4	249	Moderately Sorted Fine Sand	3.014	0.725	0.080	0.872	2.140	3.013	3.890	0.000	0.945	0.055
A2/5	341	Slightly Fine Gravelly Fine Sand	2.676	1.186	0.098	1.218	1.311	2.708	3.916	0.002	0.922	0.076
TA/500	500	Very Coarse Silty Very Fine Sand	3.130	1.058	-0.150	1.180	1.665	3.266	4.541	0.000	0.838	0.162
TA/1000	1000	Very Fine Sandy Coarse Silt	4.348	1.337	0.049	0.885	2.656	4.345	5.843	0.000	0.445	0.555
TA/1500	1500	Fine Silt	7.270	0.724	-0.195	1.282	6.217	7.372	8.806	0.000	0.020	0.980
B30	30	Slightly Very Fine Gravelly Fine Sand	1.909	0.938	-0.297	1.058	0.342	2.011	2.862	0.013	0.972	0.015
B1/1	53	Very Fine Gravelly Medium Sand	0.965	1.251	-0.372	1.186	-0.908	1.275	2.363	0.090	0.909	0.002
B1/2	48	Very Fine Gravelly Fine Sand	0.928	1.592	-0.280	0.760	-1.465	1.220	2.715	0.152	0.846	0.002
B1/3	41	Sandy Very Fine Gravel	0.087	2.085	0.112	0.914	-2.539	-0.086	2.857	0.328	0.640	0.032
B1/4	55	Very Fine Gravelly Medium Sand	1.265	1.273	-0.360	2.000	-0.970	1.470	2.552	0.098	0.901	0.000
B1/5	30	Very Fine Gravelly Medium Sand	0.902	1.596	-0.168	1.105	-1.327	1.140	2.784	0.133	0.835	0.032
B1/6	44	Sandy Very Fine Gravel	0.014	1.858	0.038	0.775	-2.415	-0.061	2.489	0.336	0.645	0.019
B1/7	38	Sandy Very Fine Gravel	-0.515	1.162	0.110	1.061	-1.854	-0.580	1.037	0.340	0.659	0.001
B1/8	57	Very Fine Gravelly Medium Sand	0.385	1.577	-0.211	0.884	-1.748	0.644	2.193	0.214	0.775	0.011
B1/9	50	Very Fine Gravelly Coarse Sand	0.533	1.775	0.045	1.010	-1.664	0.567	2.943	0.195	0.761	0.043
B1/10	51	Sandy Very Fine Gravel	-0.579	1.905	0.114	1.248	-2.834	-0.671	1.890	0.427	0.545	0.028
B1/11	43	Very Fine Gravelly Medium Sand	0.281	1.721	-0.253	1.104	-2.237	0.545	2.024	0.206	0.779	0.016
B1/12	32	Very Fine Gravelly Medium Sand	0.858	1.505	-0.022	1.226	-0.978	0.923	2.775	0.097	0.867	0.036
B1/13	45	Sandy Medium Gravel	-0.350	1.899	0.138	0.664	-4.334	-0.077	2.344	0.354	0.605	0.040

Table 3.1.2. Grain size distribution, continued

	Depth	SEDIMENT NAME:	FOLK AND MEAN	WARD METHOD SORTING	(f) SKEWNESS	KURTOSIS	D10 (f):	D50 (f):	D90 (f):	% GRAVEL:	% SAND:	% MUD:
B1/100	103	Very Fine Gravelly Fine Sand	1.384	1.391	-0.417	1.284	-0.866	1.719	2.778	0.088	0.911	0.001
B/500	500	Poorly Sorted Very Fine Sand	2.974	1.040	-0.073	1.167	1.567	3.075	3.979	0.000	0.905	0.095
B/1000	1000	Slightly Very Fine Gravelly Very Coarse Silty Fine Sand	2.871	1.188	0.163	1.128	1.468	2.801	4.629	0.004	0.834	0.162
TB/1500	1500	Medium Silt	6.886	0.906	0.217	1.041	5.980	6.685	8.679	0.000	0.014	0.986
B2/1	215	Very Fine Gravelly Medium Sand	0.419	1.209	-0.162	0.877	-1.329	0.496	1.821	0.130	0.870	0.000
B2/2	245	Very Fine Gravelly Coarse Sand	0.370	1.087	-0.093	0.904	-1.025	0.403	1.702	0.102	0.897	0.001
B2/3	149	Slightly Very Fine Gravelly Fine Sand	2.468	1.356	-0.002	1.113	0.912	2.459	3.981	0.018	0.885	0.097
B2/4	281	Slightly Very Fine Gravelly Medium Sand	1.437	0.744	-0.098	1.421	0.342	1.482	2.428	0.018	0.981	0.001
B2/5	110	Slightly Very Fine Gravelly Medium Sand	1.850	0.835	-0.144	1.038	0.607	1.849	2.773	0.016	0.984	0.000
B2/6	136	Slightly Very Fine Gravelly Medium Sand	1.527	0.568	-0.016	1.445	1.007	1.527	2.265	0.010	0.990	0.000
B/8	110	Slightly Very Fine Gravelly Medium Sand	1.189	0.972	-0.320	1.562	-0.342	1.392	2.274	0.040	0.960	0.000

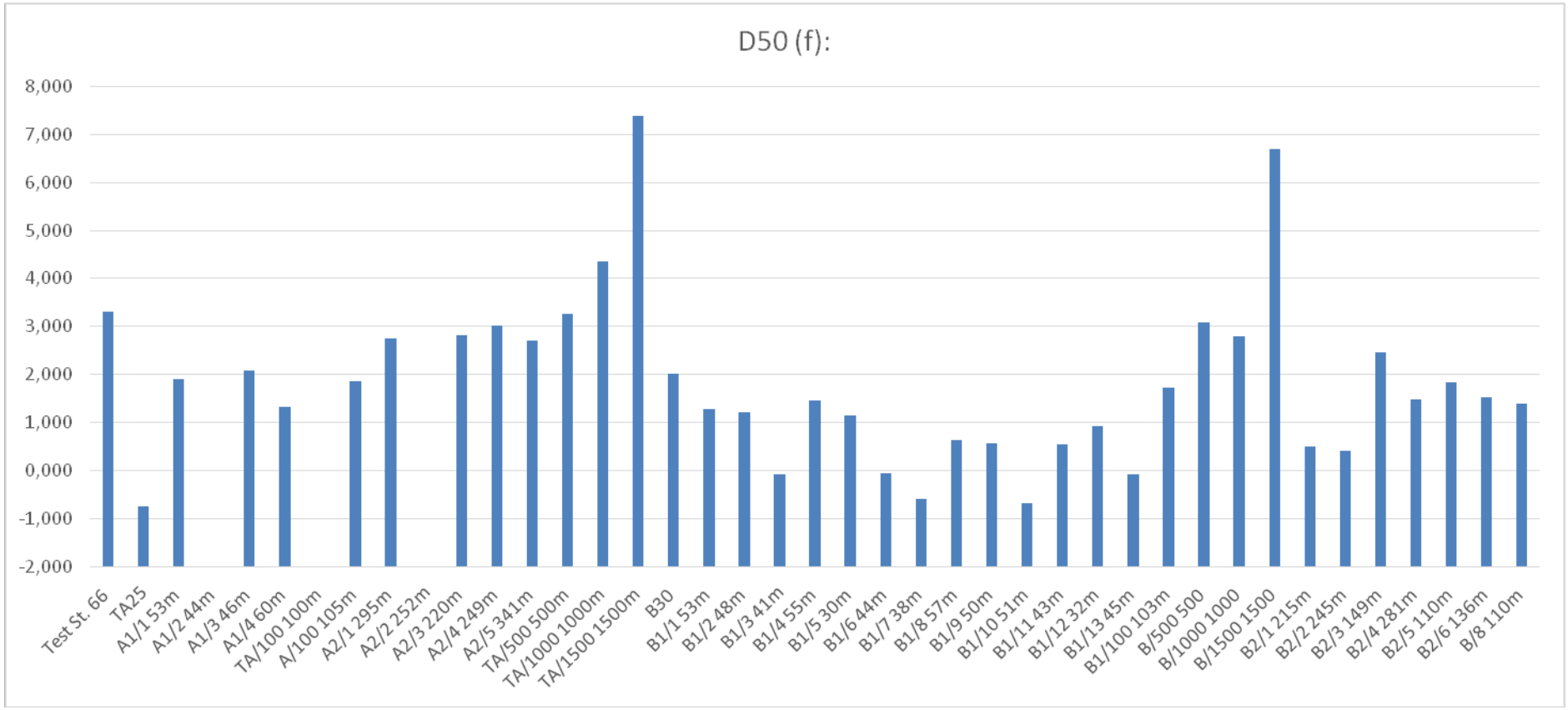

Figure 3.1.1 Median diameter Myeik archipelago.

3.2 Chemical compounds.

3.2.1 Metals.

42 stations each consisting of 2 replicates were sampled for chemical analysis.
The sampling was conducted according to the OSPAR guidelines for monitoring of offshore oil activities and analyzed in accredited laboratories. The sampled parameters were metals (Ba, As, Pb, Cu, Cr, Hg, Ni, Zn and Cd), THC,PAH's and NPD's.Because of budgets only one replicate was analysed. The numbers are presented in table 3.2.2
Since our search for local standards on pollutants and metals in marine sediments came up short, the data set was compared to OSPAR and Klif (Norwegian Pollution Authority) standards for coastal waters. The background levels for the natural occurring substances however, might differ considerably from one area to another depending on geological conditions, the listed background levels should therefore be regarded as guidance levels rather than strict limits (NGU Rapport 2011.035 TA-2683/2011 p: 6).
The comparison to these standards might therefore not be relevant for the natural occurring substances, nevertheless:
The results of the analysis were compared to the Background concentrations found in the OSPAR guidelines and KLIF's (The Directorate of climate and pollution, Norway) TA 2229-2007, Classification of metals and organic poisons in water and sediments. These two standards are developed for use in the North West Atlantic region and are based on measurements mainly from upon the shelf. The measurements vere taken in what is regarded as, prestine areas, and from sedment layers thought to be formed prior to industrialisation.
Because of the depth gradient with gradually finer sediments, and from that higher affinity to chemical compounds and metals, espesically the metals are expected to show higher levels in deeper waters than upon the shelf (NGU Rapport 2011.035 TA-2683/2011). The general pattern of sedimentation also contributes to this.
The Ospar background concentrations (Bc) are marked with a green line when measurments are approaching this limit, the KLIF classes are also marked where appropiate concerning levels of contaminents. (The KLIF classification system is based on risk assesment regarding ecological effects.)

Arsene: Generally lower on transect A than B. highest value on TB/1000 and lowest on TB/1500, low on the other deep stations. Elevated levels around 300 m depth on transect A and some on around 50 meters on transect B. Fig 3.2.1

Cadmium: Generally lower values on transect A compared to transect B. Increase with depth on transect A, elevated values on someshallow stations on transect B. Fig 3.2.2

Crome: Higher values on transect A than B. tendency to increase with depth on A more variation on transect B. Fig 3.2.3

Copper: Higher values on A than B, increase with depth on both. Fig 3.2.4

Mercury: Higher values on A than B, increase with depth on both. Fig 3.2.5

Nickel: Higher values on A than B, increase with depth on both. Fig 3.2.6

Lead: Higher values on A than B, tendency to increase with depth on A. Fig 3.2.7

Zink: Higher values on A than B, increase with depth on both. Fig 3.2.8

Barium: Generally low values in shallow waters marked increase from 500 meters and deeper on both stations. Fig 3.2.9

Table 3.2.1. klif classification of metals

Classification of state from content of metals (KLIF)					
	I Background	II Good	III Moderate	IV Bad	V Extremely bad
As (Arsene)	<20	20-52	52-76	76-580	>580
Pb (Lead)	<30	30-83	83-100	100-720	>720
Cd (Cadmium)	<0.25	0.25-2.6	2.6-15	15-140	>140
Cu (Copper)	<35	35-51	51-55	55-220	>220
Cr (Chromium)	<70	70-560	560-5900	5900-59000	>59000
Hg (Mercury)	<0.15	0.15-0.63	0.63-0.86	0.86-1.6	>1.6
Ni (Nickel)	<30	30-46	46-120	120-840	>840
Zn (Zink)	<150	150-360	360-590	590-4500	>4500
Ba (Barium)					

Table 3.2.2 content of selected metals. Red= half LOD (Level of Detection) bold = highest value.

ELEMENT SAMPLE	Dry matter %	As Arsene mg/kg DM	Cd Cadmium mg/kg DM	Cr Chromium mg/kg DM	Cu Copper mg/kg DM	Hg Mercury mg/kg DM	Ni Nickel mg/kg DM	Pb Lead mg/kg DM	Zn Zink mg/kg DM	Ba Barium mg/kg DM
Test St. 66	57.8	6	0.025	23	6	0.03	10	7	25	6
A1/1 53m	51.9	6	0.025	21	7.3	0.03	13	11	27	15
A1/2 44m	40.7	5	0.06	44	18	0.05	24	27	76	28
A1/3 46m	39.4	16	0.025	30	7.8	0.03	15	14	36	19
A1/4 60m	57.3	6	0.025	19	6.7	0.02	12	10	26	14
TA/100 100m	57.3	17	0.08	26	6.1	0.01	15	9	31	8
A2/3 220m	59.5	6	0.12	14	6.4	0.02	11	12	34	7
A2/4 249m	48.6	9	0.025	24	5.3	0.02	12	14	39	11
A2/1 295m	54.9	39	0.14	**86**	10	0.03	29	39	88	16
A2/5 341m	64.8	30	0.43	53	14	0.03	23	33	63	18
TA/500 500m	36.7	19	**0.84**	50	34	0.005	43	31	93	62
TA/1000 1000m	45.9	8	0.025	40	39	0.07	43	14	72	150
TA/1500 1500m	21	3	0.86	56	**67**	0.21	**84**	26	**122**	**408**
B/500 500	41.7	17	0.19	30	21	0.07	23	8	41	60
B/1000 1000	36.4	**77**	1	82	55	**0.28**	63	**45**	78	158
B/1500 1500	32.6	0.25	0.68	4.6	16	0.08	37	8	39	80
A 100/2 105m	77.4	6	0.025	9.8	2.7	0.005	7	5	16	5
B30	76.4	5	0.025	14	2.8	0.01	6	8	15	10
B1/1 53m	37.9	26	0.17	25	5	0.02	12	12	23	18
B1/2 48m	68.4	30	0.23	30	4	0.005	9.4	9	13	10
B1/4 55m	68.8	18	0.14	20	2.3	0.005	7.6	11	12	6
B1/5 30m	57.7	9	0.11	21	5.3	0.02	8.7	9	20	14
B1/6 44m	87.9	19	0.025	31	4	0.01	7.7	8	14	12
B1/7 38m	56.1	31	0.54	16	5.2	0.01	5.6	2	7.3	21
B1/8 57m	63.4	26	0.63	18	5.2	0.02	6.5	5	12	13
B1/9 50m	63.6	18	0.27	16	4.3	0.02	8.7	1	14	15
B1/10 51m	63.6	16	0.22	8.5	4.8	0.02	3.8	0.5	9.2	7
B1/11 43m	67.5	22	0.46	15	4.5	0.01	4.1	1	7.7	6
B1/12 32m	68.3	18	0.2	19	5.3	0.01	6.3	6	11	7
B1/13 45m	68.1	13	0.05	15	6.1	0.02	7.8	5	14	13
B2/1 215m	75.2	4	0.025	12	1.6	0.005	4.5	3	11	6
B1/100 103m	80.8	8	0.11	4.8	1.3	0.005	2.2	3	6.4	2
B2/2 245m	83.1	9	0.07	24	3.3	0.005	7.8	6	19	14
B2/3 149m	76.5	6	0.025	13	2	0.005	5.7	5	19	3
B2/4 281m	73.5	7	0.025	72	2.9	0.005	13	4	46	4
B2/5 110m	45.1	6	0.09	8.4	1.8	0.005	3.6	4	12	3
B2/6 136m	42.2	9	0.1	21	3.1	0.005	8.7	8	27	4
B/8 110m	43.8	10	0.05	18	2.7	0.005	7	7	22	4

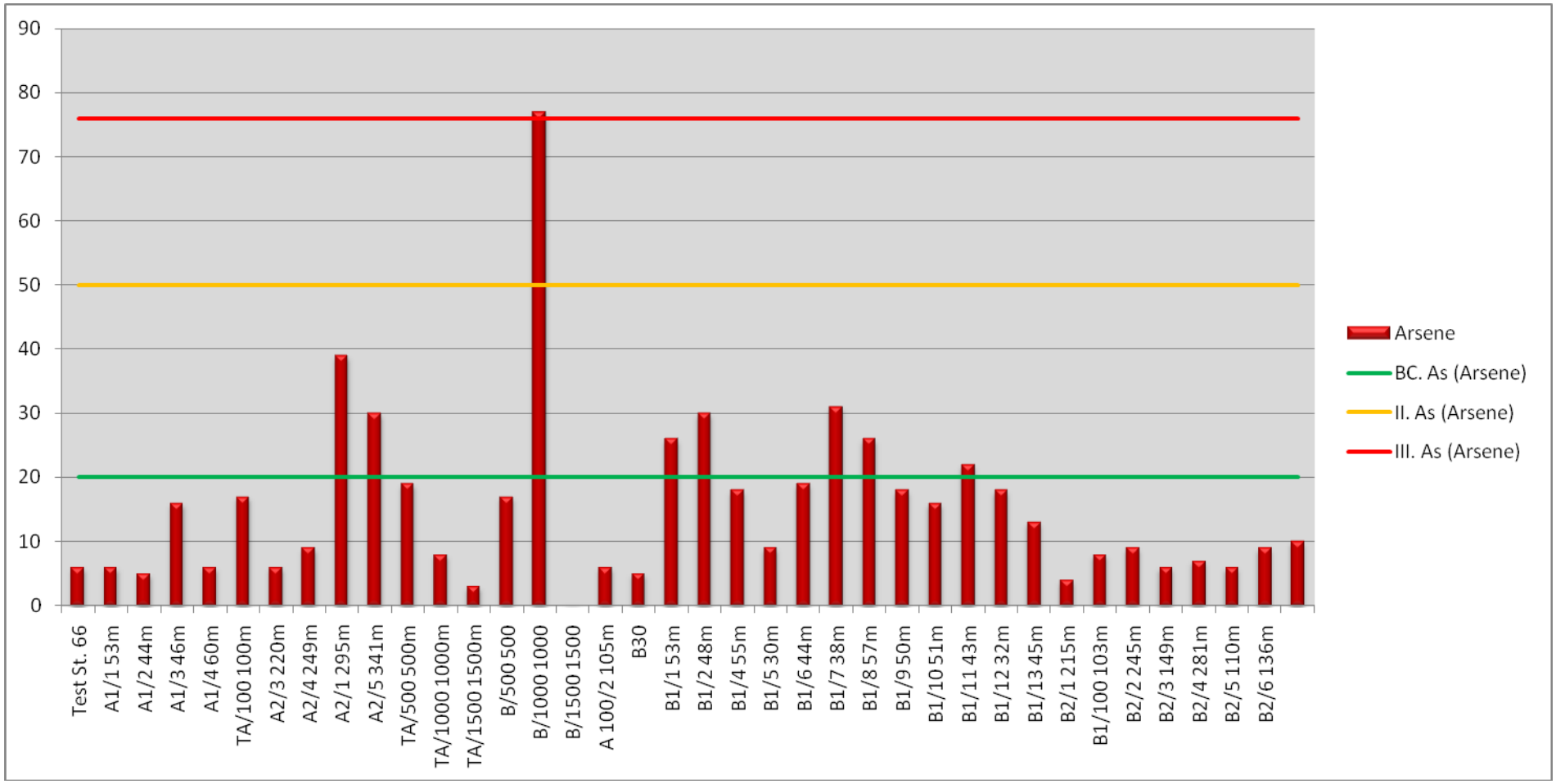

Fig. 3.2.1 Arsene with the classification from Table 3.2.1. marked where appropriate.

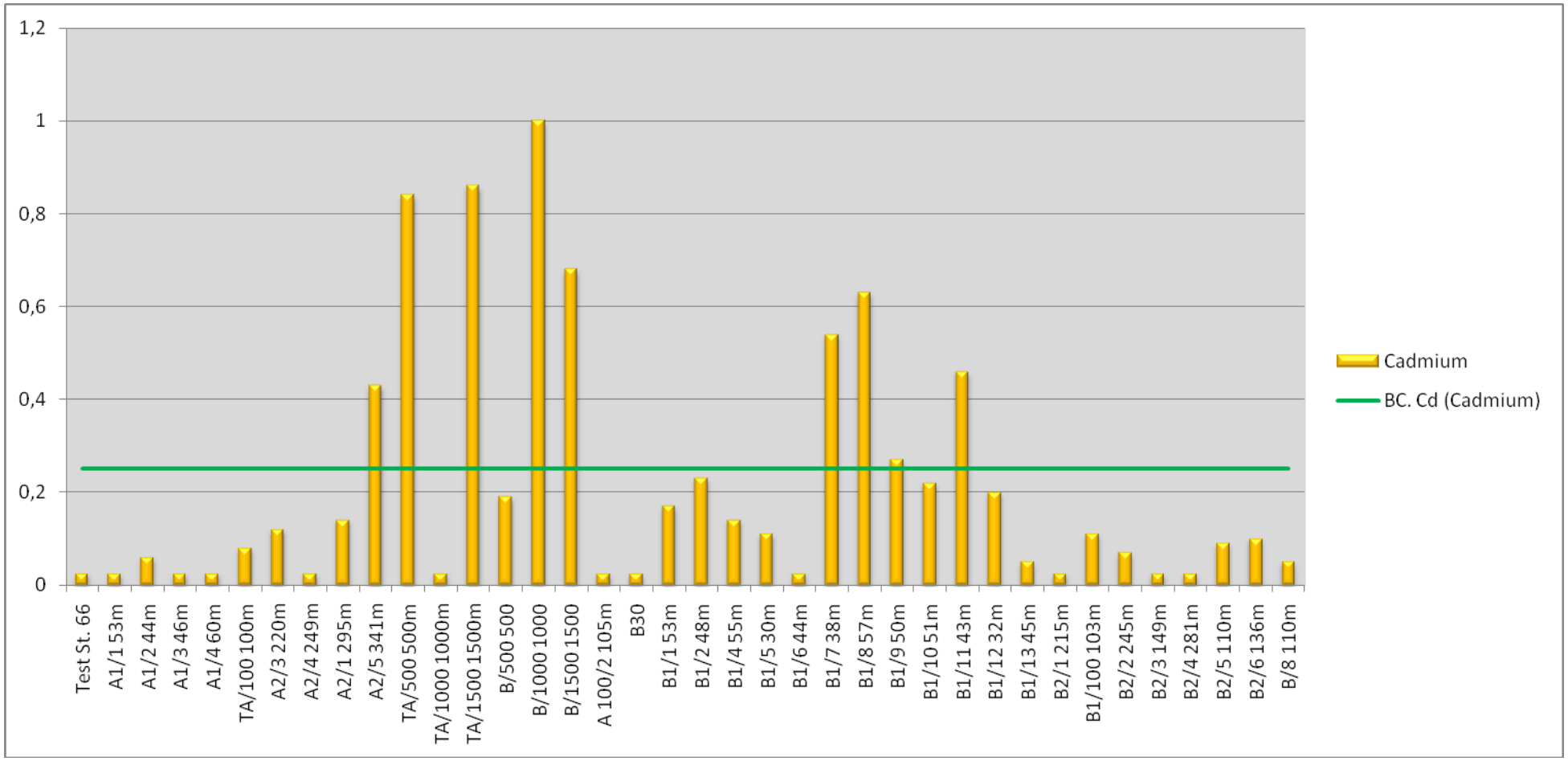

Fig. 3.2.2 Cadmium with the classification from Table 3.2.1. marked where appropriate.

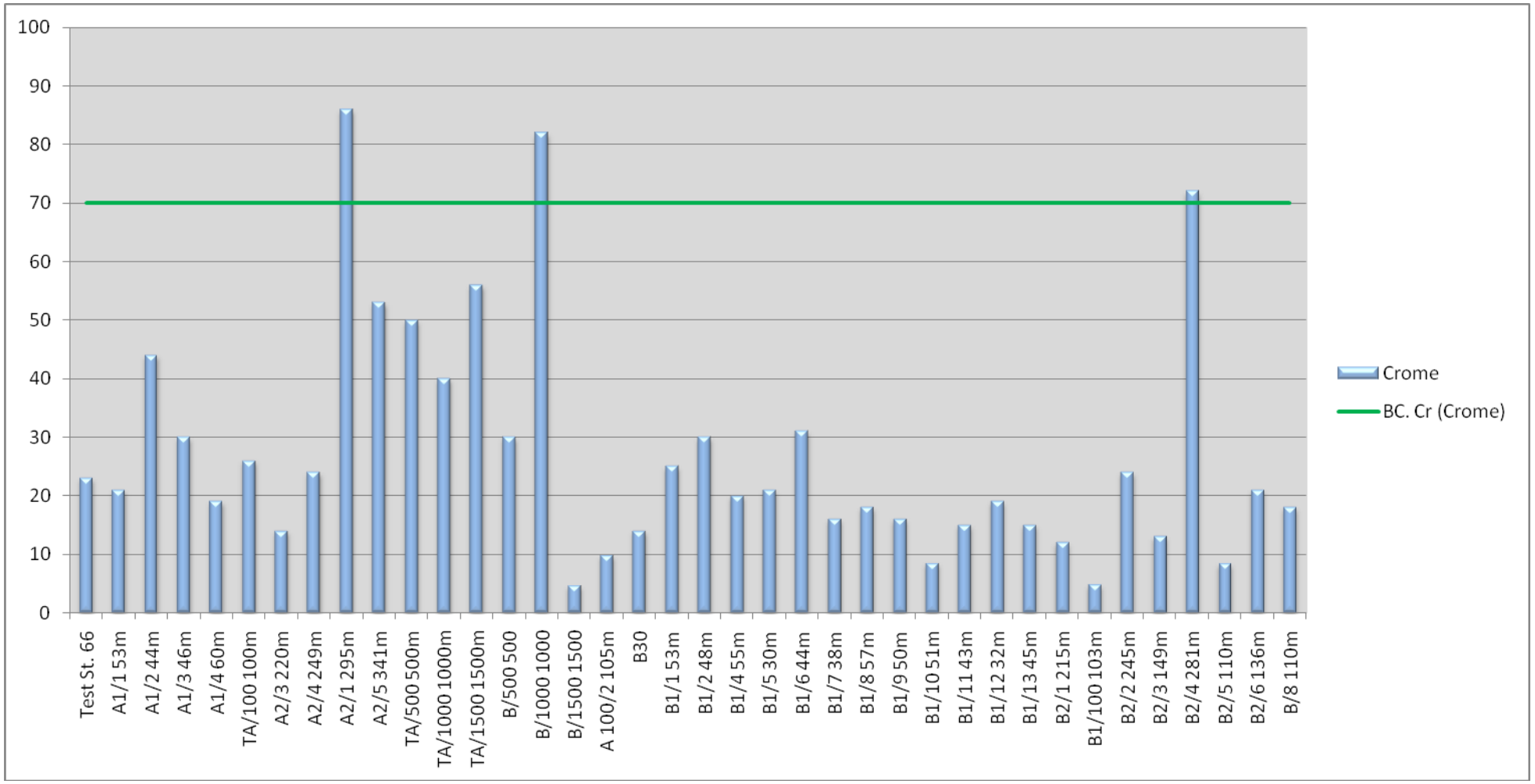

Fig. 3.2.3 Chrome with the classification from Table 3.2.1. marked where appropriate.

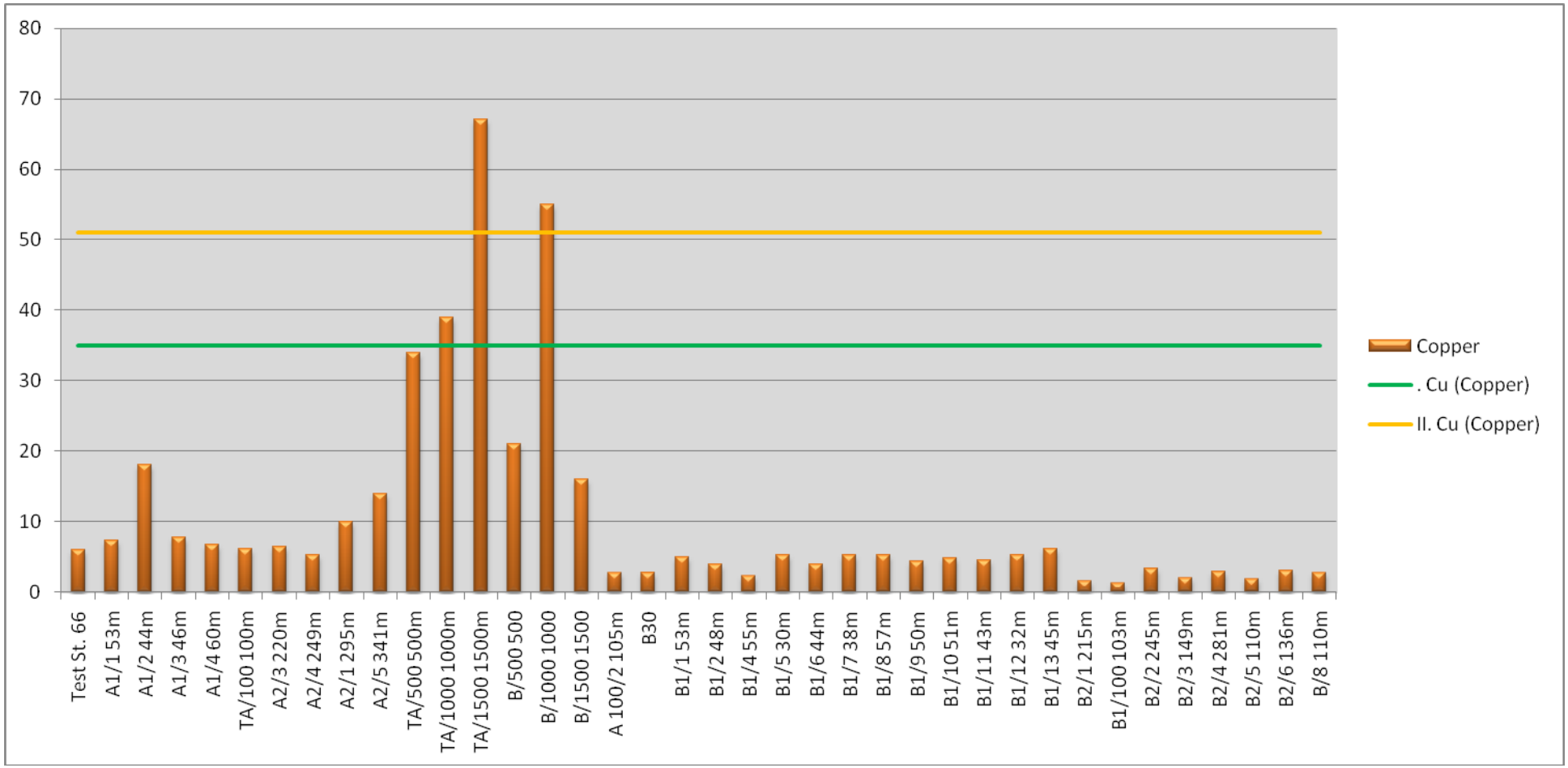

Fig. 3.2.4 Copper with the classification from Table 3.2.1. marked where appropriate.

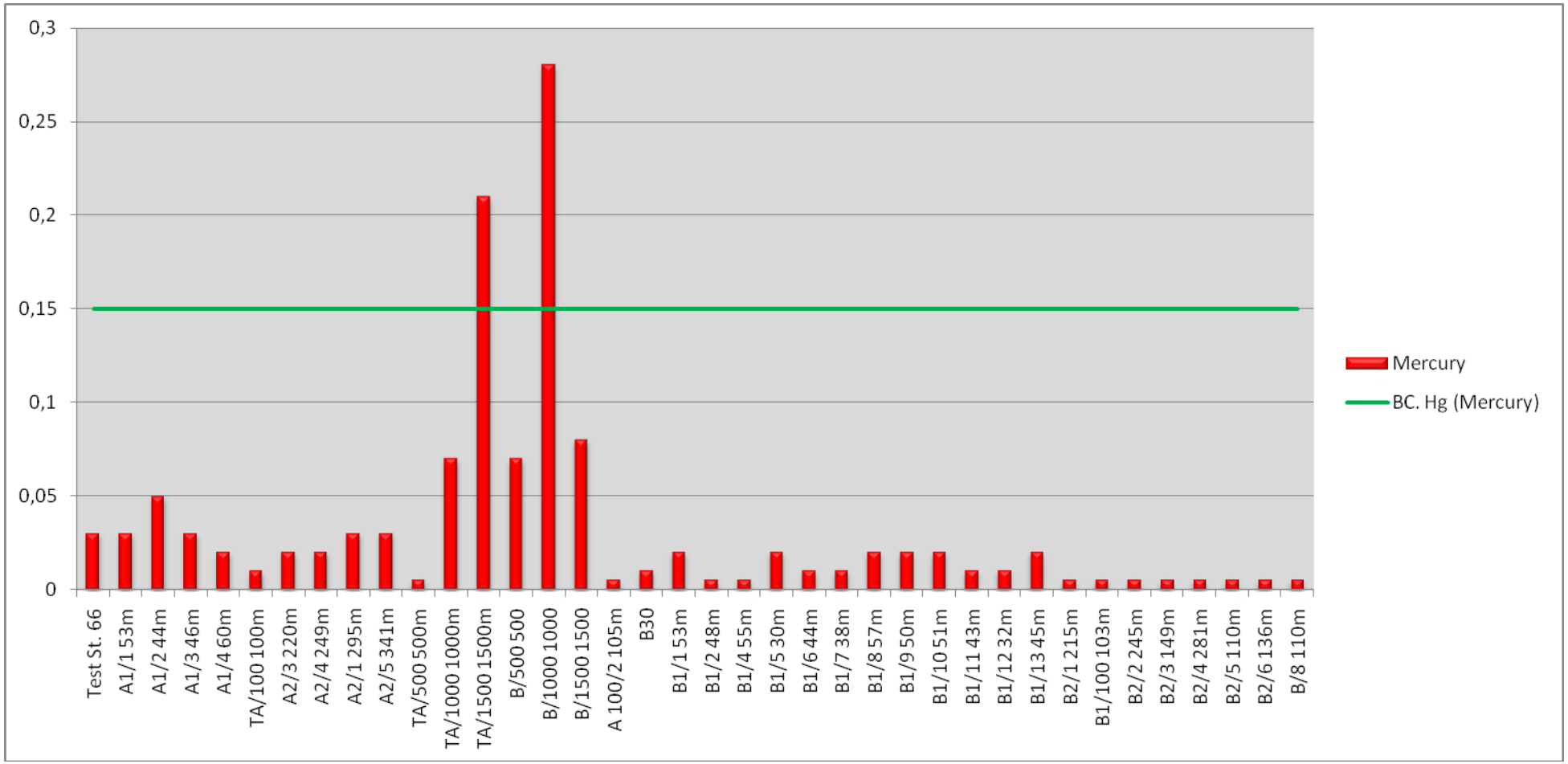

Fig. 3.2.5 Mercury with the classification from Table 3.2.1. marked where appropriate.

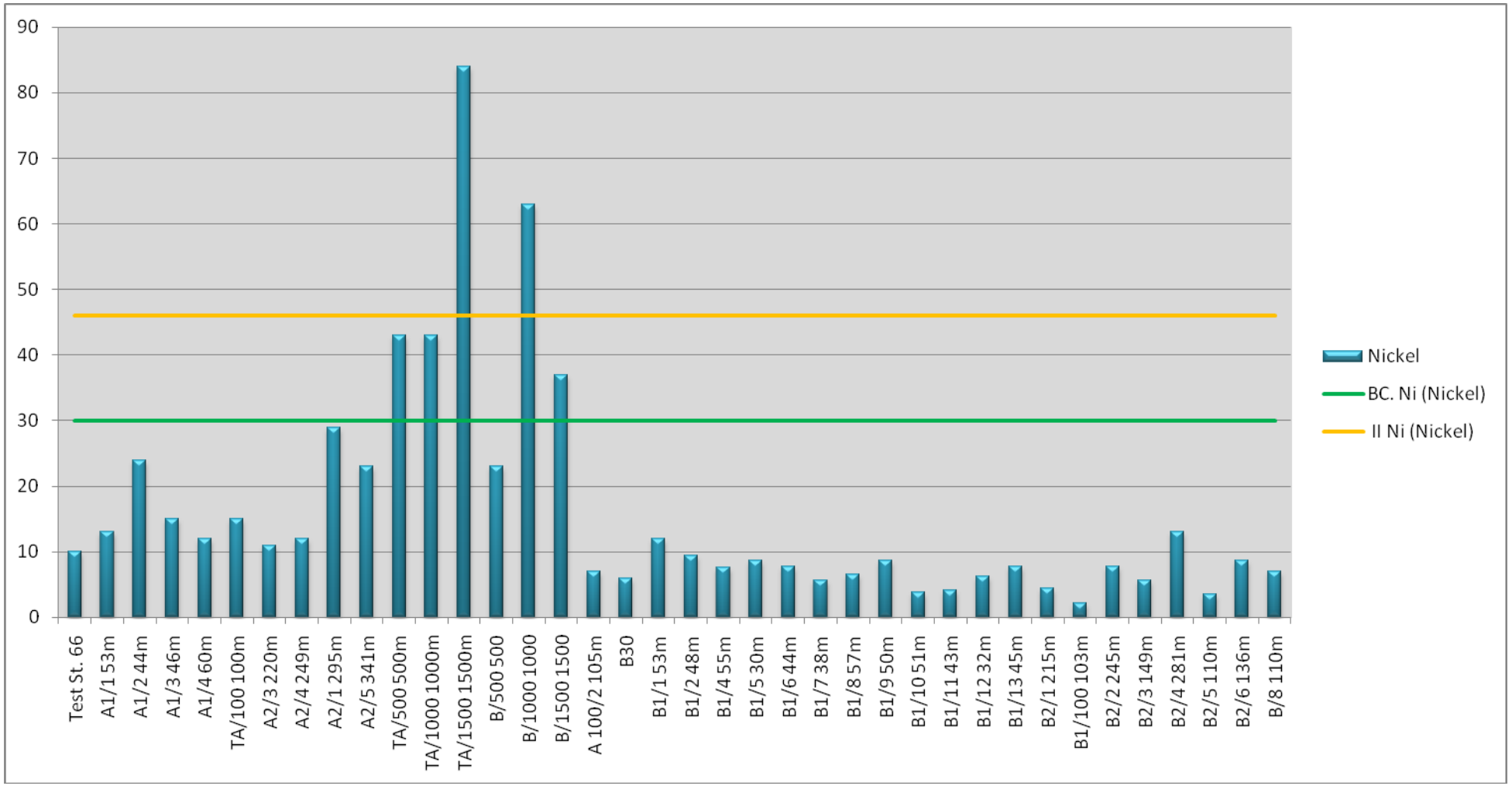

Fig. 3.2.6 Nickel with the classification from Table 3.2.1. marked where appropriate.

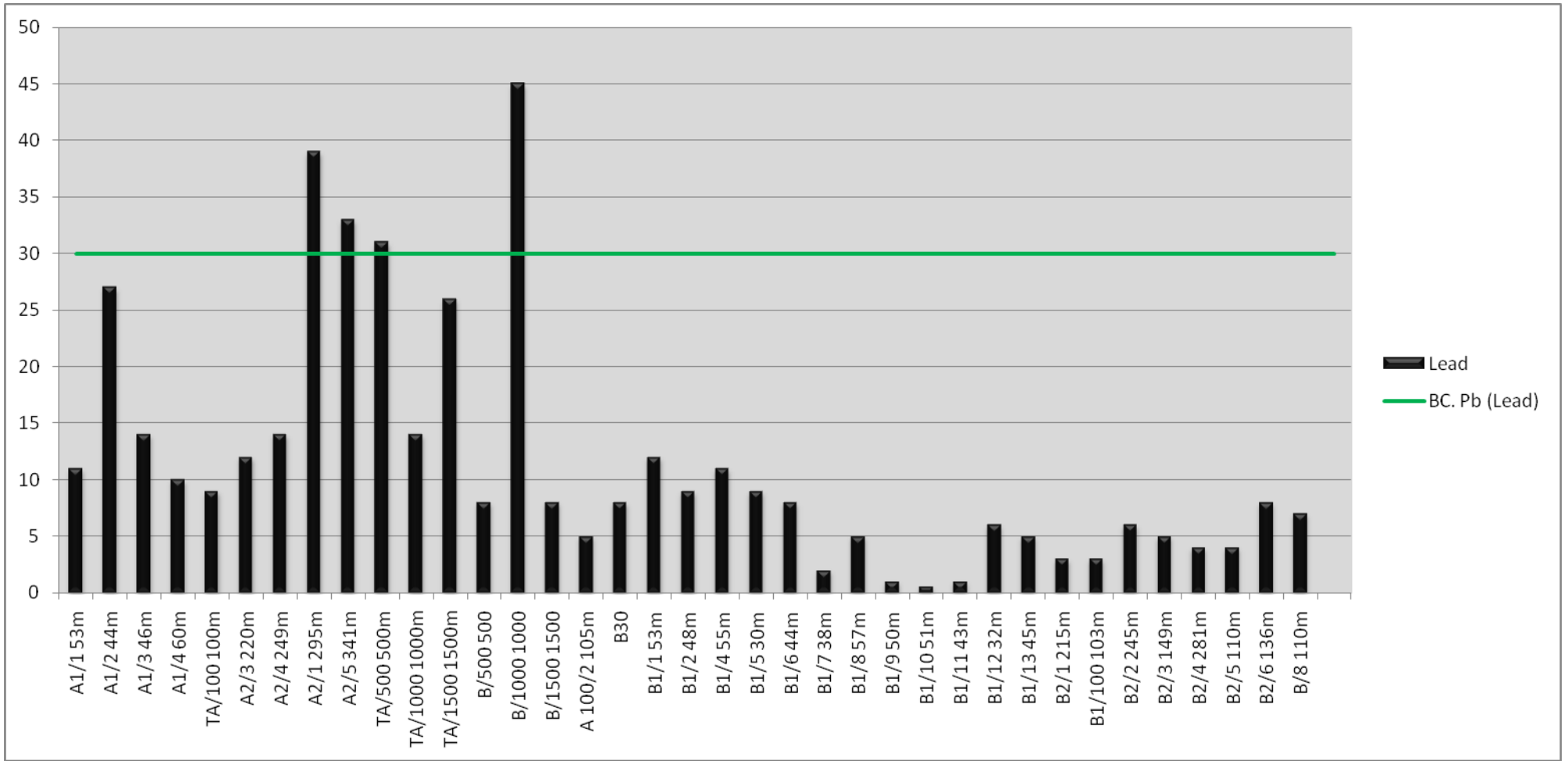

Fig. 3.2.7 lead with the classification from Table 3.2.1. marked where appropriate.

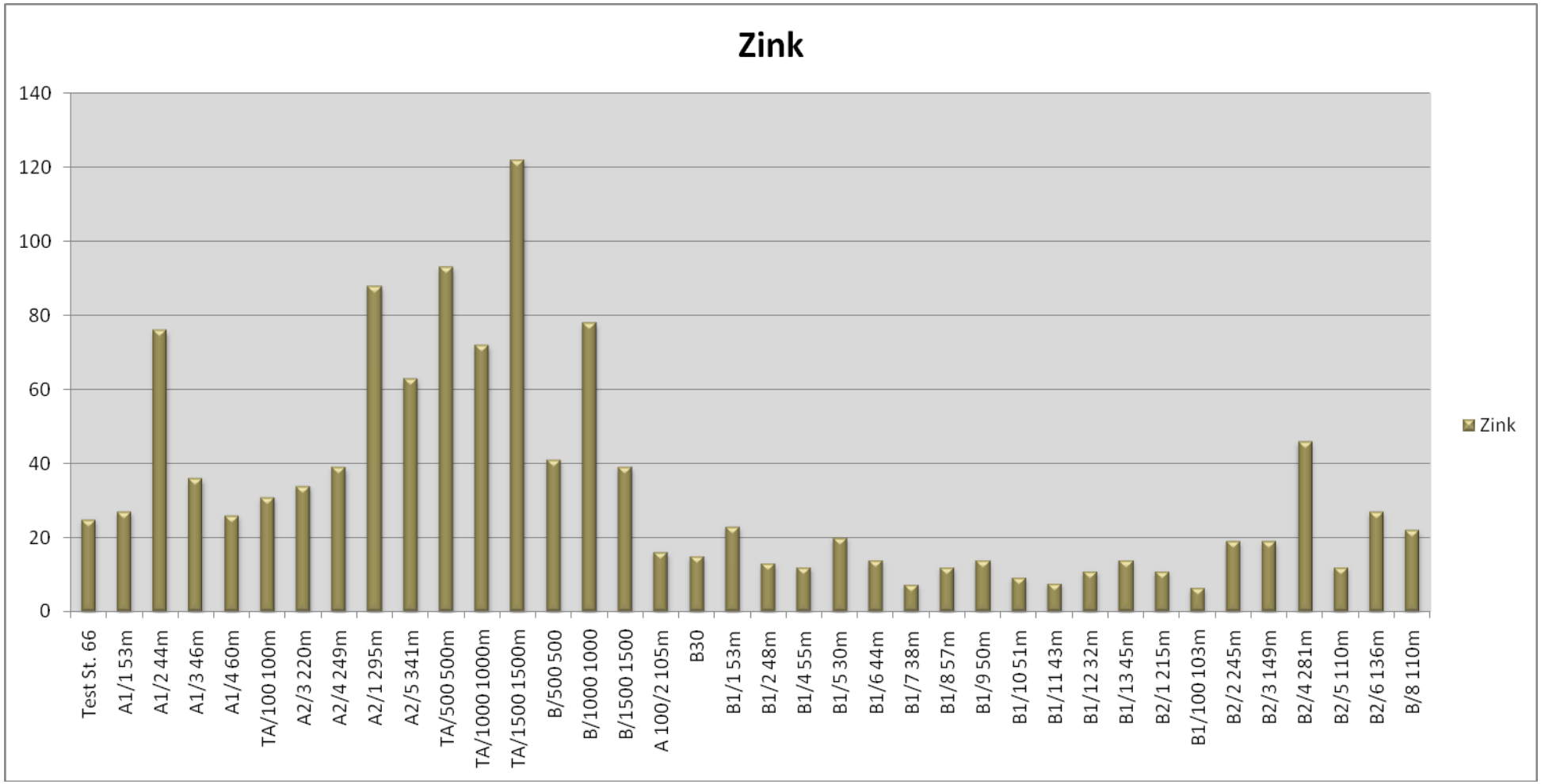

Fig. 3.2.8 Zink with the classification from Table 3.2.1. marked where appropriate.

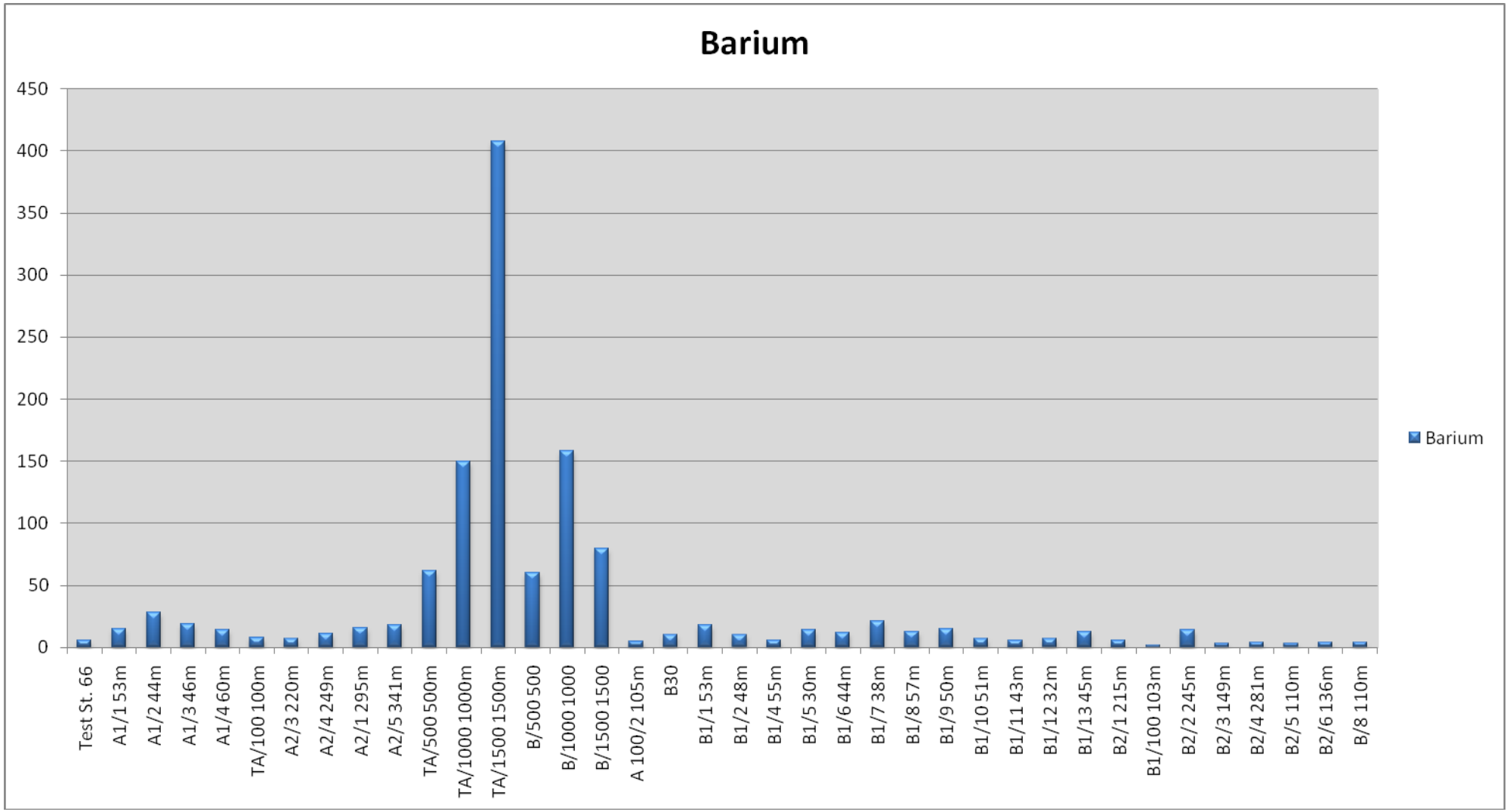

Fig. 3.2.9 Barium

3.2.2 Hydrocarbons.

Due to the budget only one replicate from 16 stations were analysed.
THC: The results for THC (total hydrocarbons) are within the low end of the scale. The values go from >2 mg/kg (detection limit) to 8,7 mg/kg.
The threshold for potentially harmful values is 50mg/kg.
There is a slight increase in most of the PAH's at TA/1500 compared to background levels. All except Perylene ends up in class II, good conditions according to the Klif manual.
Perylene shows high levels on 5 stations. TA/500, 1000 and 1500 TB/1500 and B2/3. The value on TA/1500 was very high. At this time, we do not know if this compound is part of any industrial processes but it seems to be independent of the other parameters. The measurement data presented in table 3.2.2 are marked with colour codes like in table 3.2.1 from TA 2229-2007 (KLIF).
The TA/1500 has the highest values for many of the targeted chemicals but it also has the finest sediments and the affinity to chemical compounds that goes with it.
The TA/1500 is also located within seeing range of oil drilling activities.

table 3.2.1 colour Codes and some threshold values from TA 2229-2007

Parameter	Perylene	Benzo(a) pyrene
Background conc.	< 18	<6
II Good	18 -21	6-240
Moderate	21-31	
IV Bad	31-310	
V Extremely bad	>310	

Table: 3.2.2 THC and selected PAH's.

Station	Depth	Result THC µg/g dry weight	Perylene ng/g	Naphthalene	Acenaphthylene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a) anthracene	Chrysene	Benzo(b) fluoranthene	Benzo(a) pyrene
Test st A1/1, TA-25	66	**4.1**	1.82	0.88	0,25	0.63	0,25	0.57	0,25	0,25	0,25	0.56	0,25
	25	**1.0**	1.39	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25
A1/1	53	**1.0**	2.13	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25
TA100/2	106	**1.0**	1.88	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25
TA 250	252	**1.0**	4.62	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25
TA 500	500	**5.9**	35.31	4.34	0.64	3.27	0.81	3.79	4.39	1.20	1.57	2.64	1.13
TA 1000	1000	**5.8**	52.30	5.02	0.51	3.25	0.84	3.62	5.29	1.35	1.50	3.19	0.93
TA 1500	1500	**8.7**	613.61	**15.42**	**1.91**	**15.34**	**2.20**	11.31	10.30	3.66	5.27	98.44	33.78
A2/1	295	**1.0**	16.39	1.42	0,25	1.09	0,25	1.32	1.45	0.51	0.56	1.04	0,25
B30	31	**3.0**	2.07	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25
B1/1	53	**1.0**	1.38	4.63	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25
TB/100	103	**1.0**	0.74	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,25
B500	500	**6.0**	8.92	2.09	0,25	1.57	0,25	1.75	1.87	0.65	0.86	1.62	0.65
B1000	1000	**2.5**	8.89	1.68	0,25	1.28	0,25	1.09	1.03	0,25	0.73	1.97	0.55
B1500	1500	**4.7**	309.71	7.04	0.80	7.15	0.78	5.19	4.29	1.88	3.08	90.65	23.66
B2/3	149	**2.0**	43.53	1.48	0,25	0.83	0,25	1.41	1.08	0.62	0,25	1.15	0,25

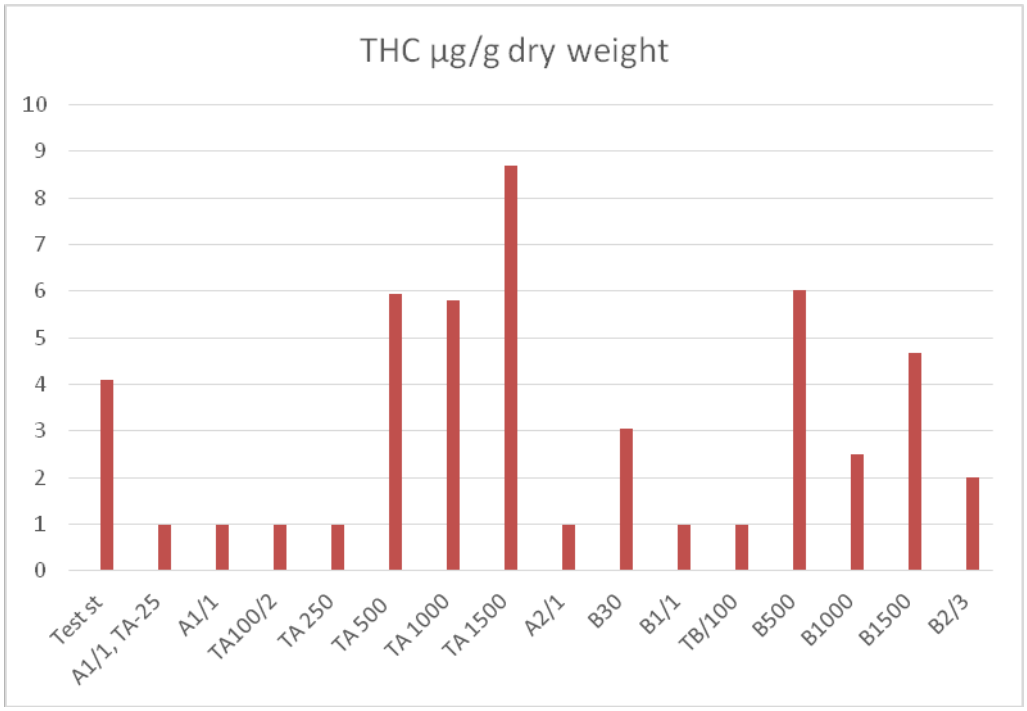

Fig. 3.2.1 THC

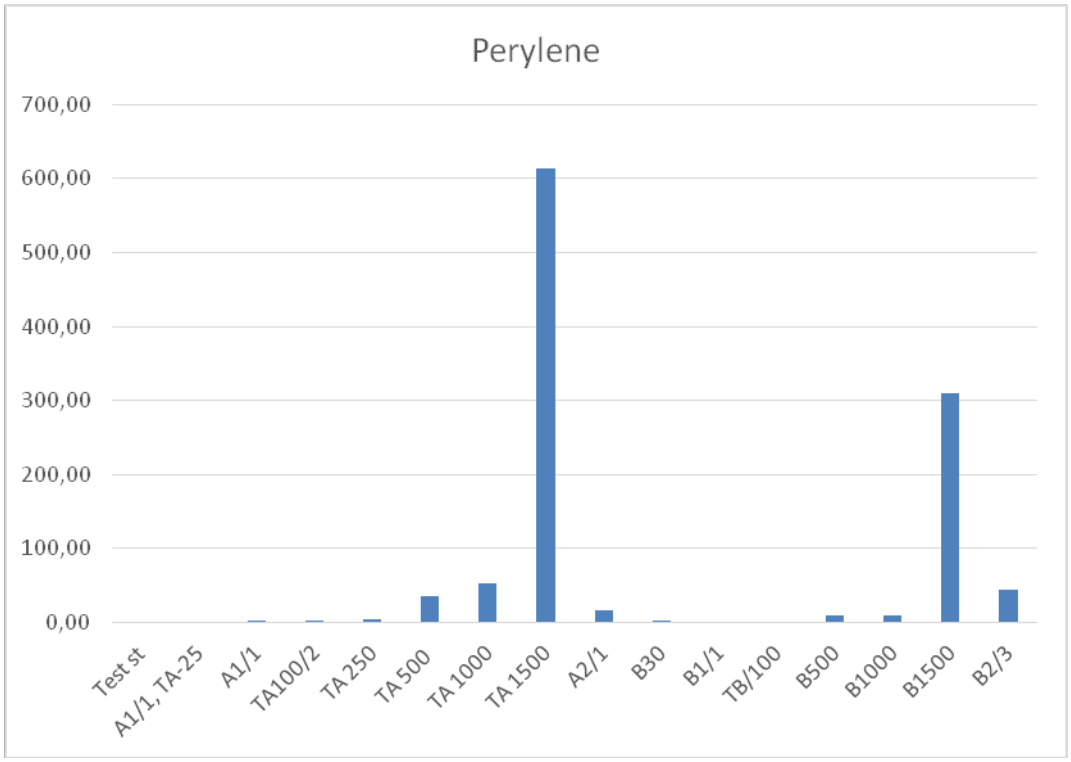

Fig. 3.2.2. Perylene

3.3 Sediment samples for fauna analysis and video footage.

During the cruise period 121 samples (mostly 3 replicates pr. Station) were collected from 42 stations for benthic fauna analysis, 40 samples for benthic fauna analysis was following the crew back to Myanmar. These samples have been processed by students as part of a master's program.

37 stations with video footage were recorded during the survey and the observations were logged. The video log is delivered as an extra word document and. It is to be regarded as a raw data document taken down as we went along as an aid to find sequences in the recordings. We have also made an excel file containing an overview of the animal groups that were encountered during the video transects. This information is presented in annex VII for each of the four survey areas. There is also a description of the landscape and some of the physical parameters from the CTD's. This overview is also submitted in an excel file.

The rest of the samples were sent to Norway for storage and analysis if the budget allows for it at a later stage.

3.4 Multibeam echo sounder for bottom mapping

5 major areas were with a surface of 498.57 km^2 were scanned using the mulitibeam echosounder the table underneath (Tab. 3.4.1) the map was generated in fledermaus software package.

id	Name	PERIMETER	Area km^2	Stations in mapped area
1	Area_B1	33386.1962	15.05	B1/5, B1/7, B1/16,B1/3,TB30
2	Area_A1	37182.8205	28.83	
3	Area_A2	74432.9121	231.27	A2/5,A2/1,A2/4,A2/2
4	Area_B2	65601.4457	161.90	B2/5,B2/6,B2/3,B2/7,B2/8,
5	Area_C1	80438.2009	61.52	B1/11,B1/8,B1/13,B1/12,B1/9,B1/10
	Sum		498.57	

Table 3.4.1 Mulitibeam areas.

Seabed Information System (SIS) was used for the online operation of Kongsberg Maritime multibeam echosounder systems. The application was used by the operator to control all settings and logging during the survey.
Prepared raw data from SIS aware processed using Neptune post-processing software. All depths are corrected for tidal influence using post-processed GPS data and reduced to mean sea level. After tide correction, spurious soundings were removed/flagged invalid using the BinStat module. Cleaned accepted data were exported to ASCII files as formatted as latitude, longitude and depth. In addition, mean depths are exported for each processing cell (30x30m).
Some of the Exported ASCII data were then imported into Fledermaus visualization and DTM software to generate bathymetric maps.

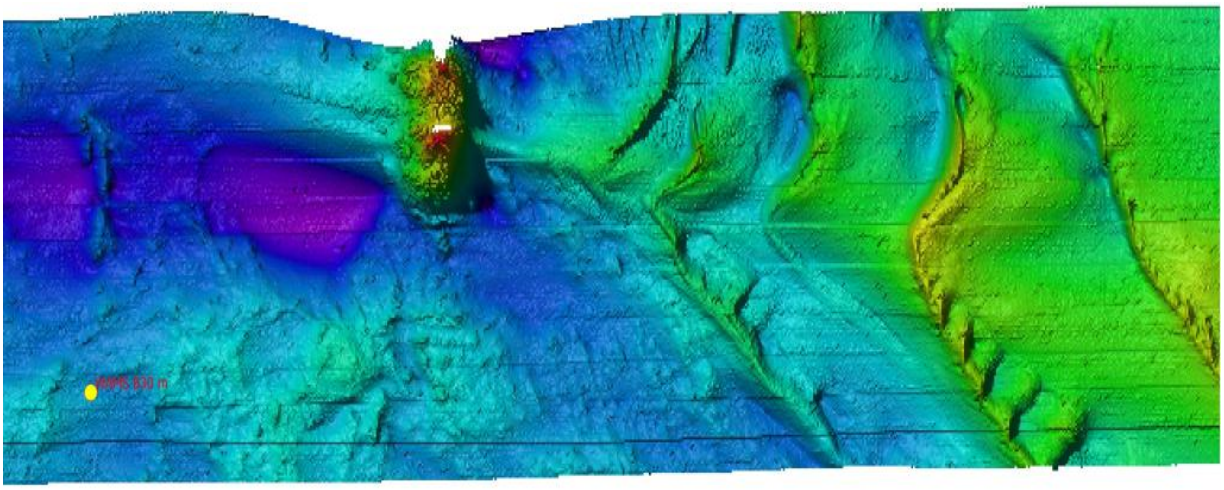

Fig. 3.4.1 June 11th Bathymetric map from area B1 based on data from multi beam survey in shallow water. Sampling station TB 30 meter is shown as yellow dot.

3.5 Hydrography and Fluorescence

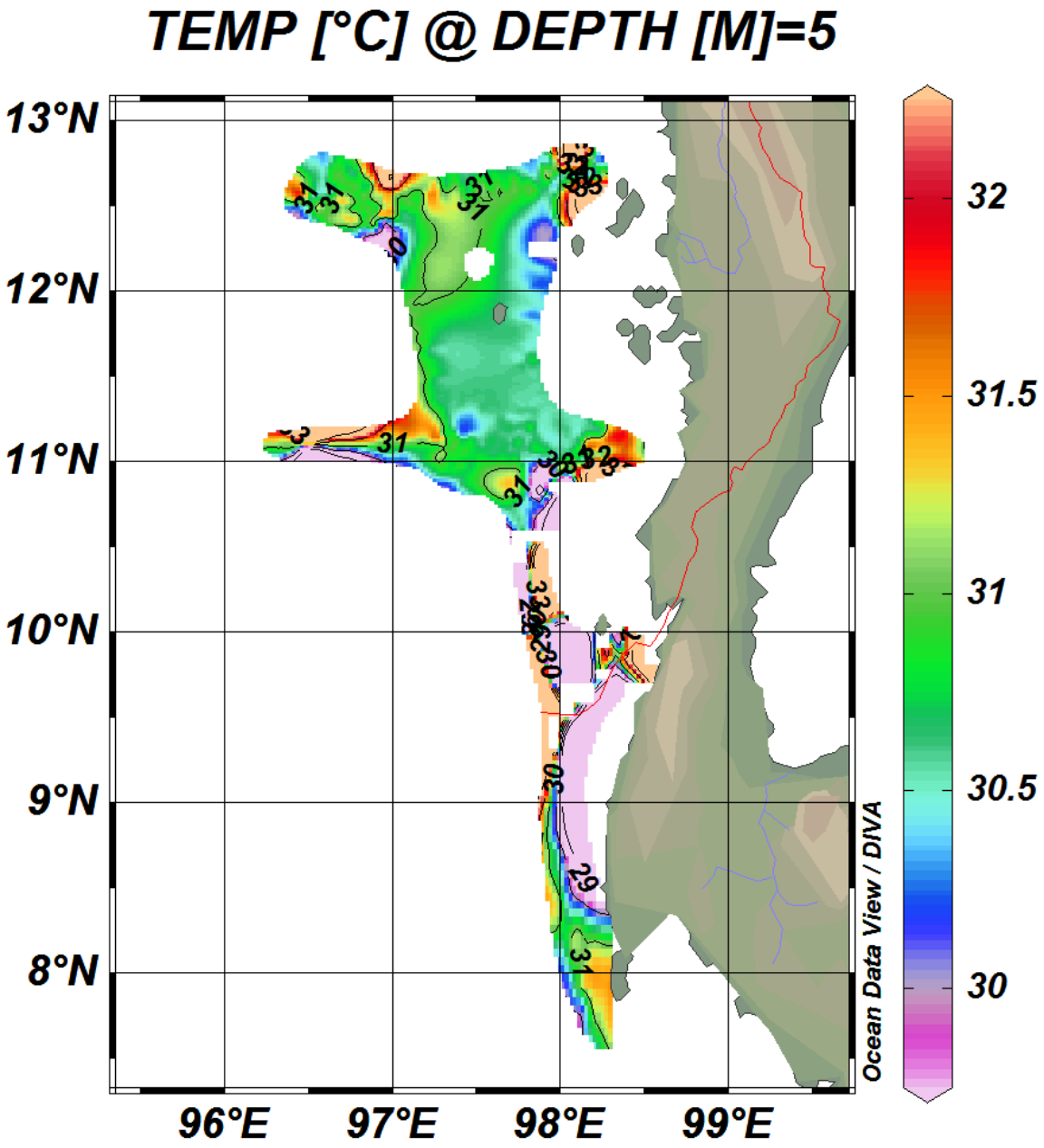

Fig. 3.5.1 Temperature data from the thermosalinograph showing the stretch from Phuket to the survey area and the survey area itself.

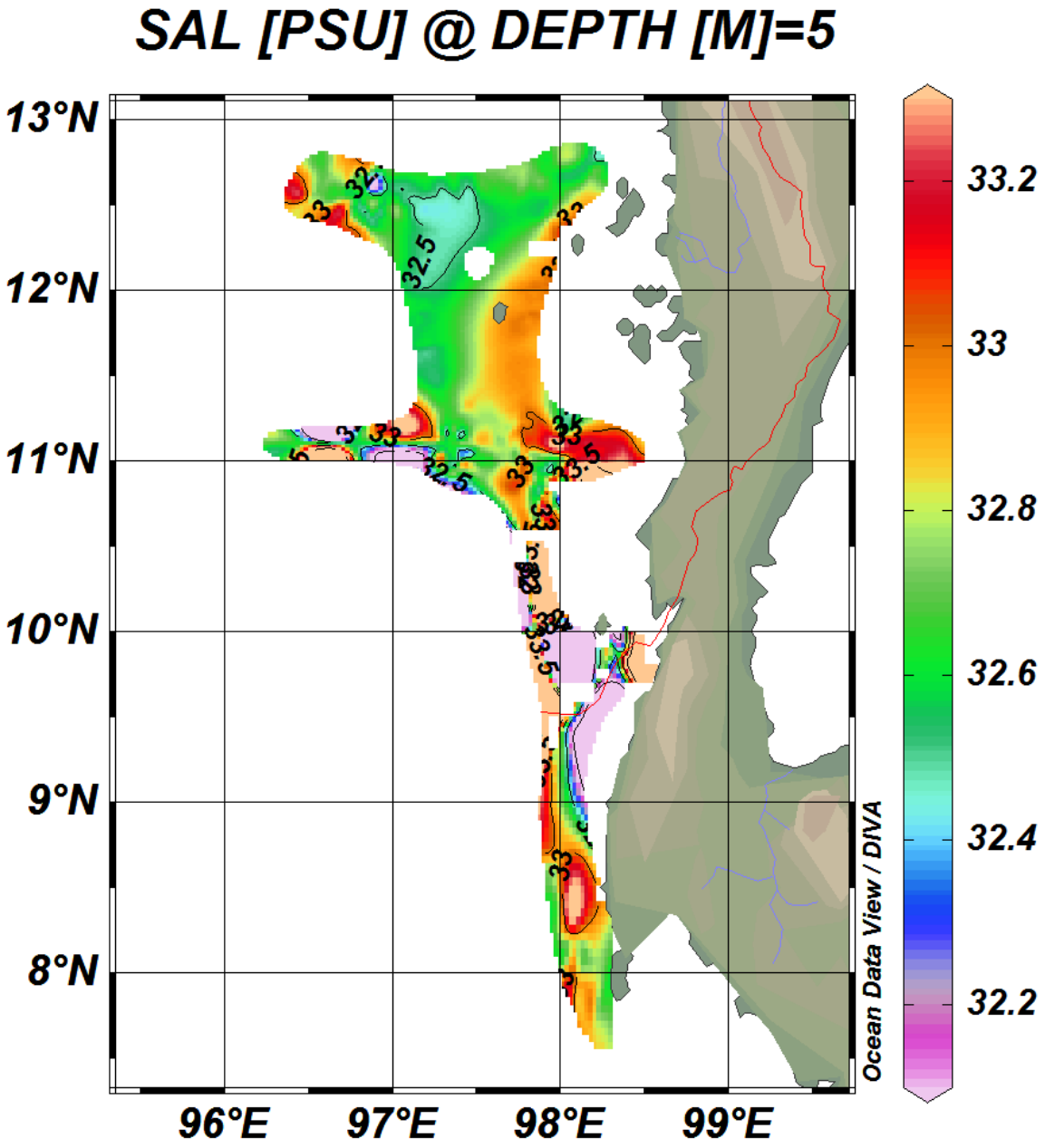

Fig. 3.5.2 Salinity data from the thermosalinograph showing the stretch from Phuket to the survey area and the survey area itself.

North

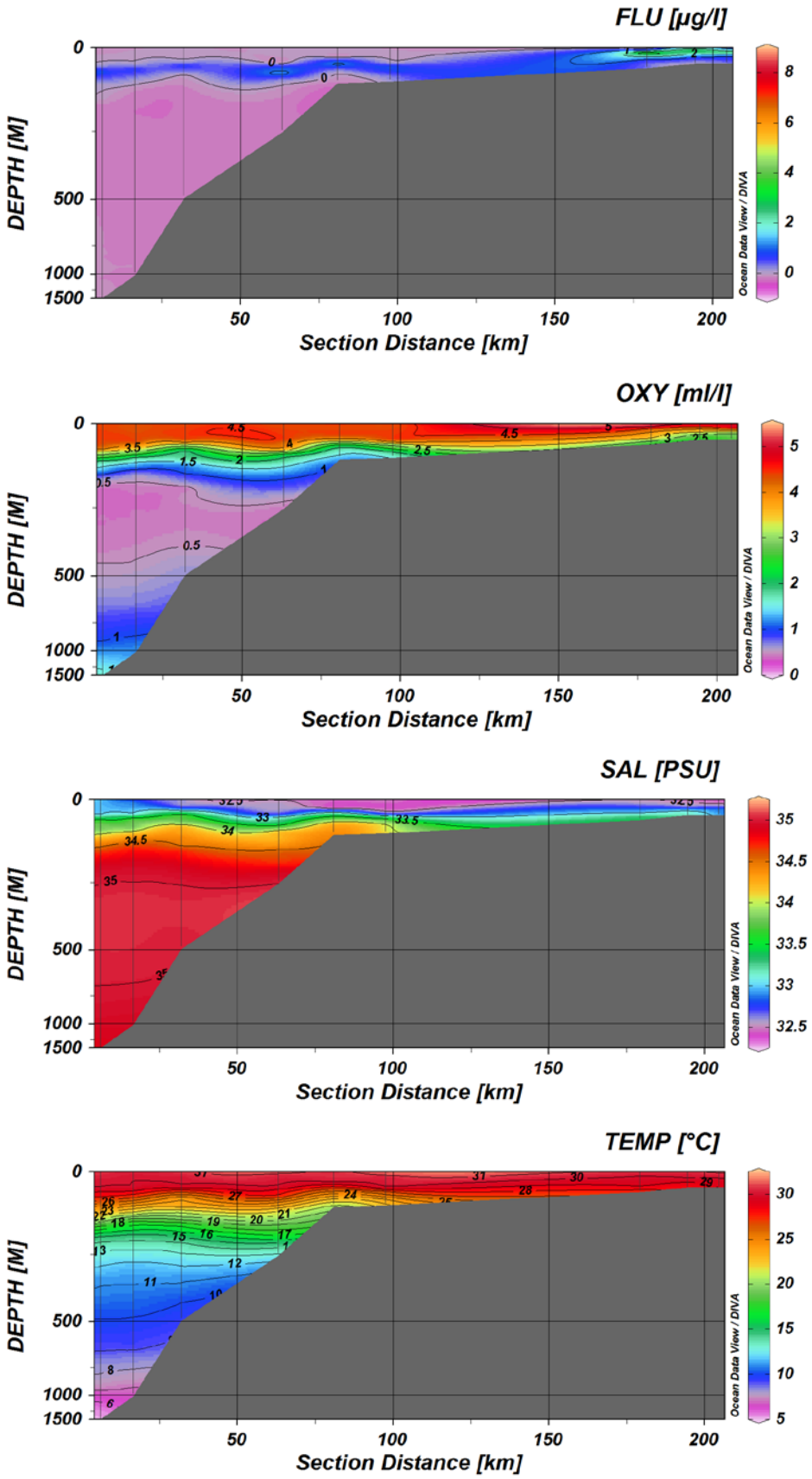

Fig. 3.5.3 Hydrographic profiles from the Northern transect Fluorescence, oxygen, salinity and temperature.

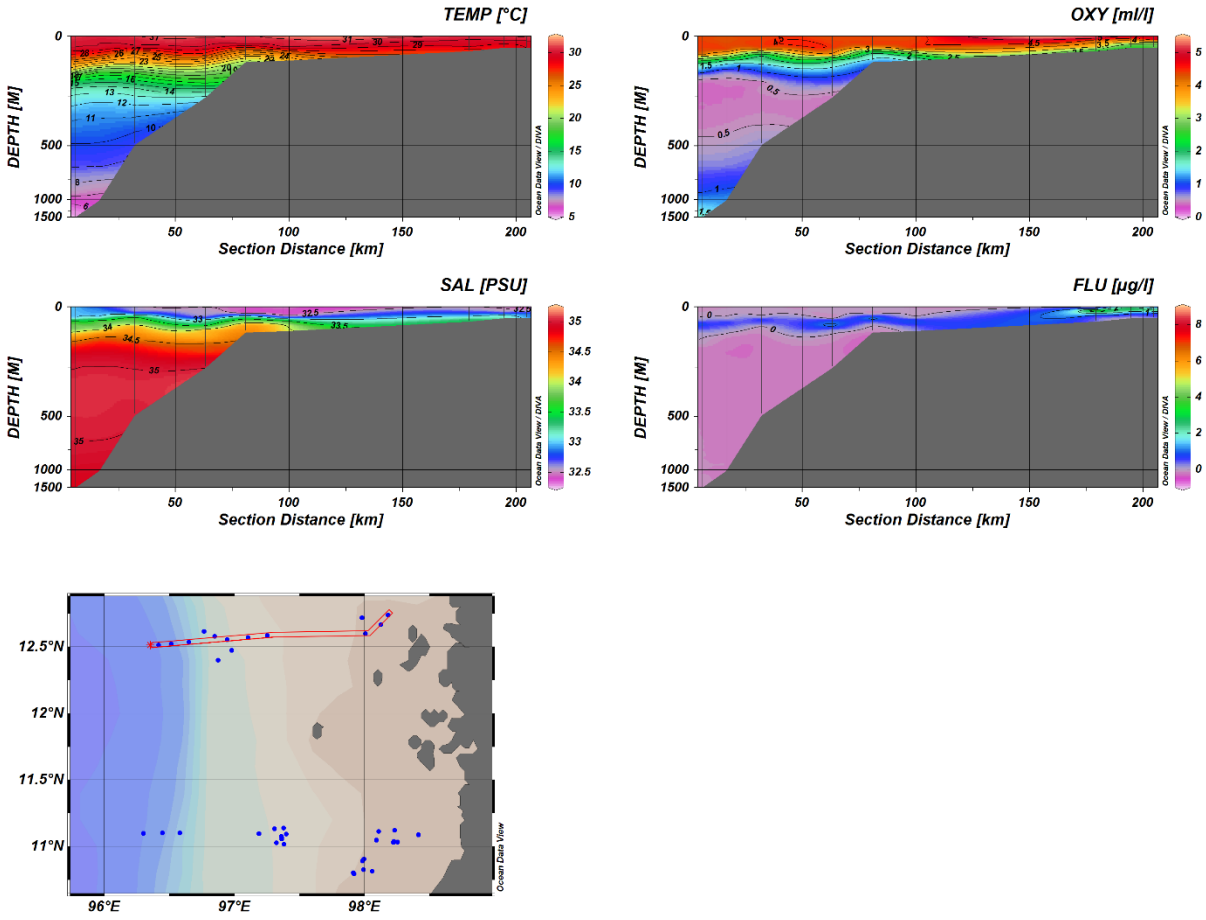

Fig. 3.5.4 Hydrographic profiles from the Northern transect (A) including the station map.

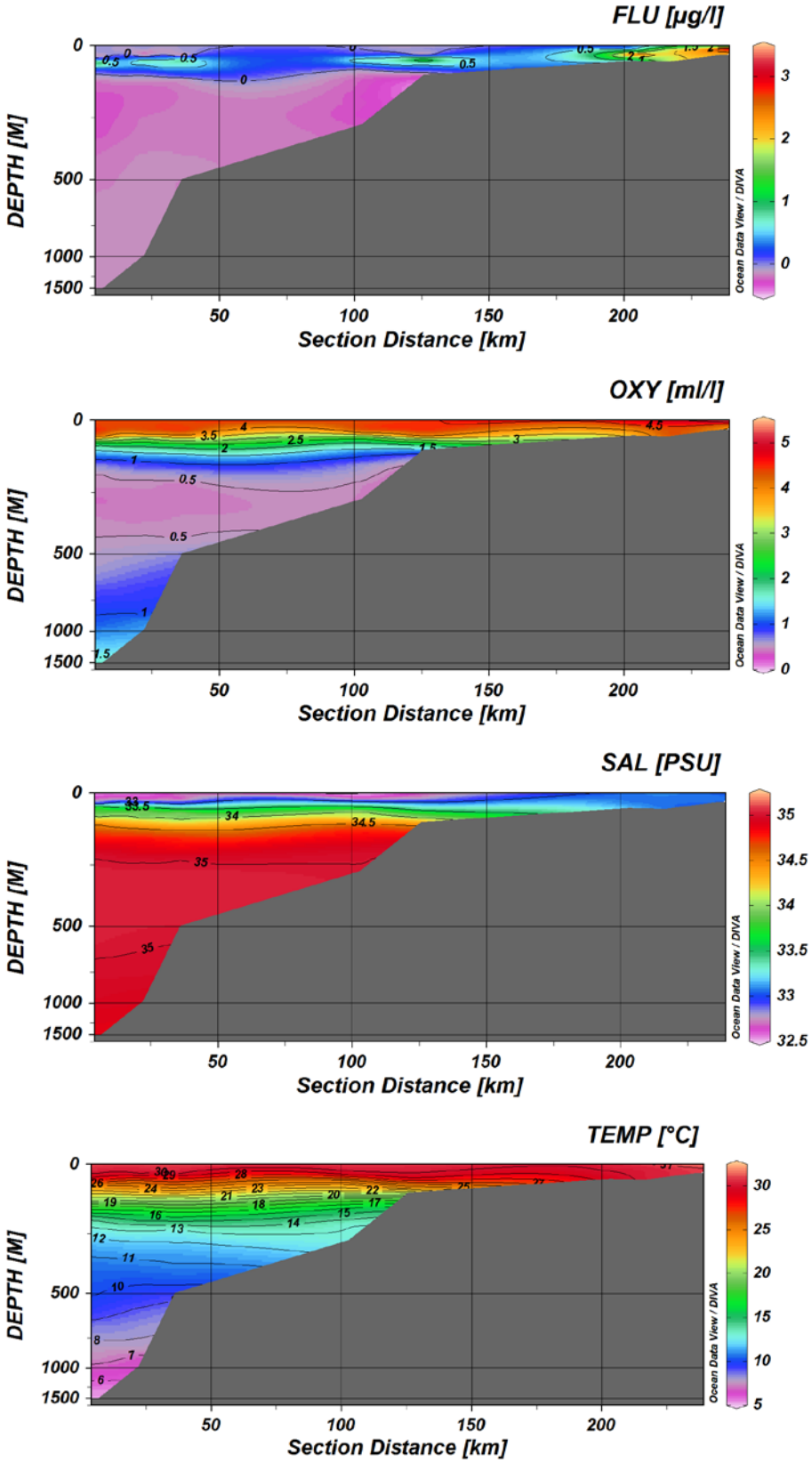

Fig. 3.5.5 Hydrographic profiles from the southern transect Fluorescence, oxygen, salinity and temperature.

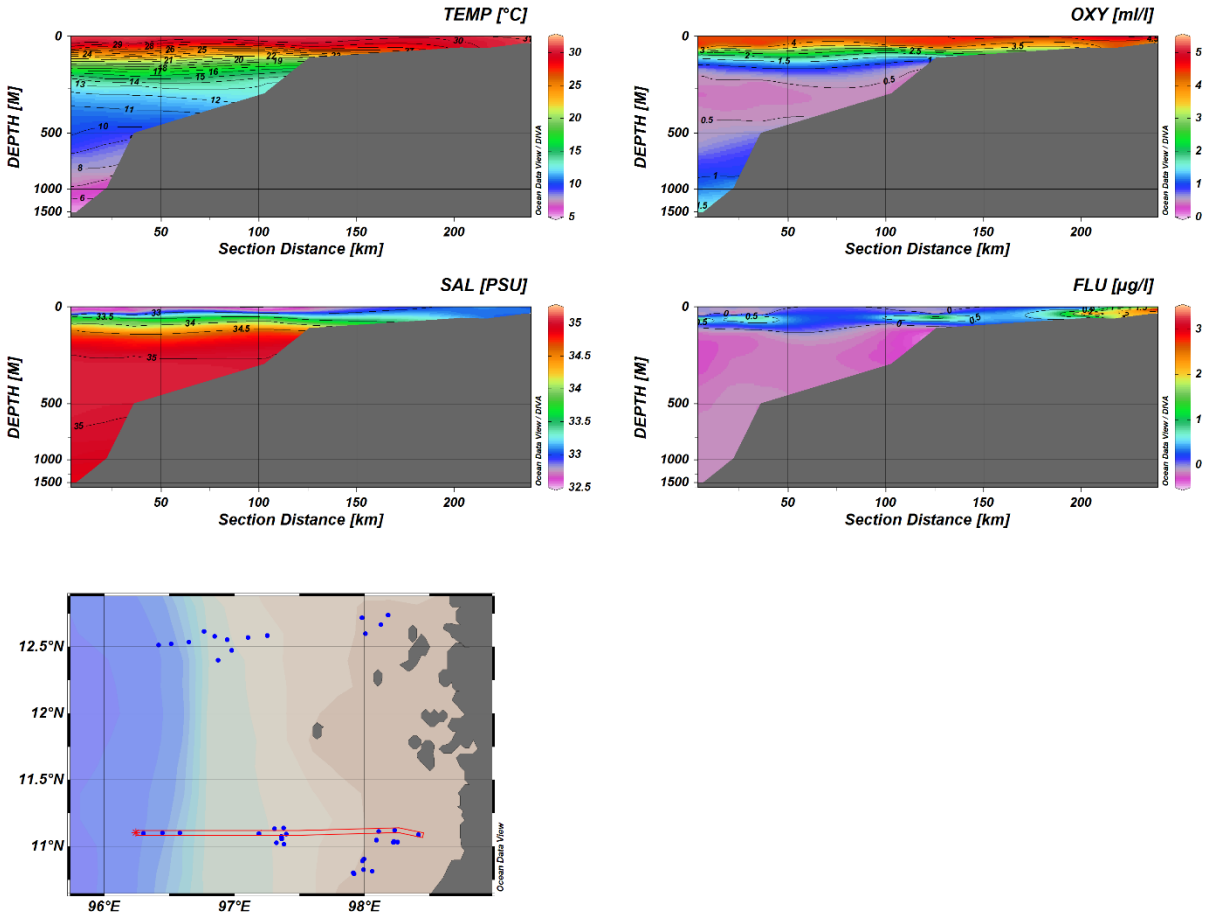

Fig. 3.5.6 Hydrographic profiles from the Northern transect (A) including the station map.

The survey was conducted during the rainy season. The shallow stations closest to shore was influenced by runoffs and algal blooms settling on the seabed causing low visibility and high turbidity on some stations.

The fluorescence showed relatively high values close to the shore. Note that the scale on two sets of plots may differ. Fig 3.5.1-6.

4 SUMMARY

The limited data from the chemical analysis shows a trend of increasing values with depth and finer sediments. Many of the parameters show a peak on station TA/1500 which also has the finest sediments. The limited data available makes it impossible to say anything more about this with any certainty. It is however worth mentioning that this particular station is within visual range of drilling activities.
Considering the measurement results and the cost of conducting surveys we suggest that a budget for analysis of both biological (sediment samples and video) and chemical parameters are considered.

5 LITERATURE

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EUROPÄISCHE NORM EN 16260 October 2012 ICS 13.060.45 Supersedes for EN 16260:2011 English Version Water quality - Visual seabed surveys using remotely operated and/or towed observation gear for collection of environmental data.
Corals of the world.

6 ANNEX

I. Sampling journal
II. Grab profiles.
III. Samples and responsibilities after the survey
IV. Benthos samples flow chart macro fauna.
V. Benthos samples flow chart Samples for chemical analysis.
VI. Matrise based on video observation sceme
VII. EUROPEEN STANDARD 16260

ANNEX I SAMPLING JOURNAL **Sign. in:** **Page nr: 1 of**

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 5/6-2015	Position		Depth 66 m
		Latitude N/S	Longitude E/W	
Test		10.3254	97.8215	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 13:05	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0,1m^2 Van Veen Grab and 0.5 mm sieve (round holes)		

Type of bottom sediment: Sand, shellsand and some silt and clay.			
Color: 10Y 3/2 – 4/2 Dark-very dark grayish olive	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
1	VA test	10	1	1	1					1	II VA		
2	VA test	9	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
4	VA test	F					1		Form.	I VA	
5	VA test	10					1		Form.	II VA	
6	VA test	9					1 and 2		Form.	III VA	
						23 bottles					

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 6/6-2015	Position		Depth 60 m
		Longitude E/W	Latitude N/S	
A1/4		98.005	12.6014	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start:	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand, shell sand and some silt and clay.			
Color: 10Y 3/2 – 4/2 Dark-very dark grayish olive	Odor: None		
Observation of animals: Polychaetae (Owenidae) Isopoda, amphipoda.	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2	VA 1_4	8	1	1	1					1	II VA		
3	VA 1_4	6	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1	VA 1_4	F	1-13	13			2		Form.	I VA	
2	VA 1_4	8	14-28	14			2 and 3		Form.	II VA	
3	VA 1_4	6	29-46	18			3 and 4		Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 6/6-2015	Position		Depth 46 m
		Longitude E/W	Latitude N/S	
A1/3		98.1227	12.6687	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start:	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand, shell sand and some silt and clay.			
Color: 10Y 4/2 Dark grayish olive	Odor: None		
Observation of animals: Crabs, polychaetae, Ophiuroidea.	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		12	1	1	1					1	II VA		
3		11	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1		F	47-63	17			4 and 5		Form.	I VA	
2		12	64-76	12		1 from surface on ethanol 2or 3?	5		Eth.form	II VA	
3		11	77-87	10			6 and 7		Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 6/6-2015	Position		Depth 44 m
		Longitude E/W	Latitude N/S	
A1/2		98.1797	12.7392	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start:	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand, shell sand and some silt and clay.			
Color: 10Y 4/2-3/2 Dark- very dark grayish olive	Odor: None		
Observation of animals: Manthis, polychaetae	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2	VA 1_2	full	1	1	1					1	II VA		
3	VA 1_2	full	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1	VA 1_2	F	88-93	6			6		Form.	I VA	
2	VA 1_2	F	94-98	5			6		Form	II VA	
3	VA 1_2	F	99-103	5			6 and 7		Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 6/6-2015	Position		Depth 26 m
		Longitude E/W	Latitude N/S	
TA 25		98.2115	12.6685	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start:	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Shell sand, sand, coarse, coral sand. Harder sediment			
Colour: 5Y 6/3-5/3 pale olive	Odor: None		
Observation of animals: polychaetae sedentary, soft corals, Ophichtidae, crabs.	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2	VA 25 m	full	1	1	1					1	II VA		
3	VA 25 m	full	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1	VA 25 m	F	104-109	6			7		Form.	I VA	
2	VA 25 m	F	110-123	5			7-8		Form	II VA	
3	VA 25 m	F	124-137	5			8		Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 7/6-2015	Position		Depth 53 m
		Longitude E/W	Latitude N/S	
A1/1		97.9778	12.7182	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start:	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand, shell, silt and clay.			
Color: 10Y 5/2-4/2 dark grayish and grayish olive	Odour: None		
Observation of animals: polychaetae, mortia	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2	GR 2	12	1	1	1						II VA		
3	GR 3	8	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1	GR 1	F	137-142	6			8-9		Form.	I VA	
2	GR 2	12	143-153	11			9		Form/eth.	II VA	
3	GR 3	8	154-162	9			9-10		Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 7/6-2015	Position		Depth 100 m
		Longitude E/W	Latitude N/S	
TA / 100		97.2501	12.5859	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start:	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) Duo		

Type of bottom sediment: Sand, silt and shell.			
Color: 5Y 5/1-4/1 grey and dark grey	Odour: None		
Observation of animals: polychaetae	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2	GR 5	15.5	1	1	1		*Part of ch. for gr.			*	Duo		
3	GR 6	15	1	1	1		size				Duo		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1	GR 4	F	163-168	6			10	1	Form.	Duo	
2	GR 5	15.5	169-174	6			10	1	Form	Duo	
3	GR 6	15	175-180	6			10	1	Form.	Duo	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 7/6-2015	Position		Depth 252 m
		Longitude E/W	Latitude N/S	
TA / 250		96.9413	12.5568	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start:	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) Duo		

Type of bottom sediment: Sand, silt and shell.			
Color: 5Y 4/1-31 Dark grey and very dark grey	Odour: None		
Observation of animals: polychaetae	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2	GR 5	15.5	1	1	1		*Part of ch. for gr.			*	Duo		
3	GR 6	16.5	1	1	1		size				Duo		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1	GR 4	15	181	1			10	1	Form.	Duo	
2	GR 5	15.5	182	1			10	1	Form/eth	Duo	
3	GR 6	16.5	183	1			11	1	Form.	Duo	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 7/6-2015	Position		Depth 512 m
		Longitude E/W	Latitude N/S	
TA / 500		96.6447	12.5352	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 08:53:04	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) Duo		

Type of bottom sediment: Sand, silt, mud and clay.			
Color: 5Y 4/1-31 Dark grey and very dark grey	Odour: None		
Observation of animals: polychaetae	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2	GR 11	7	1	1	1					1	Duo		
3	GR 12	5	1	1	1						Duo		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1	GR 10		184-186	3			11	1	Form.	Duo	
2	GR 11	7	187-190	4			11	1	Form/eth	Duo	
3	GR 12	5	191-193	3			11	1	Form.	Duo	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 7/6-2015	Position		Depth 512 m
		Longitude E/W	Latitude N/S	
A2/1		96.6447	12.5352	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 08:53:04	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) Duo		

Type of bottom sediment: Sand, silt, mud and clay.			
Color: 5Y 4/1-3/1 Dark grey and very dark grey	Odour: None		
Observation of animals: polychaetae	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2	VA2-1	10	1	1	1					1	II VA		
3	VA2-1	10	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1	VA2-1		194-198	5			11		Form.	I VA	
2	VA2-1	10	199-202	4			11		Form/eth	II VA	
3	VA2-1	10	203-208	6			11		Form.	III VA	

Sign. out:

SAMPLING JOURNAL **Sign. in:** **Page nr: 11 of**

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 8/6-2015	Position		Depth 252 m
		Longitude E/W	Latitude N/S	
A2/2		96.9413	12.5564	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 04:27:30	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment:			
Colour:	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2	VA A2-3		1	1	1					1	II VA		
3													

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1											
2	VA A2-3		209	1			11		Form/eth	II VA	
3											

Sign. out:

SAMPLING JOURNAL **Sign. in:** **Page nr: 12 of**

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 8/6-2015	Position		Depth 220 m
		Longitude E/W	Latitude N/S	
A2/3		96.9776	12.4747	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 08:53:04	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand coarse, mud and shells.			
Color: 5Y 3/1-2,5/1 Very dark grey and black	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2	VA A2/3	13	1	1	1					1	II VA		
3	VA A2/3	6	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1	VA A2/3		210-221	12			11		Form.	I VA	
2	VA A2/3	13	222-228	7			12		Form/eth	II VA	
3	VA A2/3	6	229-256	28			12		Form.	III VA	

Sign. out:

SAMPLING JOURNAL **Sign. in:** **Page nr: 13 of**

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 8/6-2015	Position		Depth 252 m
		Longitude E/W	Latitude N/S	
A2/4		96.9776	12.4747	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 08:53:04	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand, clay, silt and shells.			
Color: 5Y 5/1-4/1 Grey and dark grey.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2	VA A2/4	13	1	1	1					1	II VA		
3	VA A2/4	12	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1	VA A2/4	F	257	1			12		Form.	I VA	
2	VA A2/4	13	258-259	2			13		Form/eth	II VA	
3	VA A2/4	12	260	1			13		Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 8/6-2015	Position		Depth 341 m 347 log
		Longitude E/W	Latitude N/S	
A2/5		96.7655	12.6166	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 12:15:30	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: shell sand			
Color: 5Y 4/2-3/2 Olive grey and dark olive grey	Odour: None		
Observation of animals: shrimp	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	Misc.		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		8	1	1	1					1	II VA		
3		5	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			261-266	6			13		Form.	I VA	
2		8	267-214	8			13		Form/eth	II VA	
3		5	275-280	6			13		Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 9/6-2015	Position		Depth 1000 m
		Longitude E/W	Latitude N/S	
TA/1000		96.5123	12.5232	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 01:56:58	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Shell sand and shell.			
Color: 5Y 5/1-4/1 dark grey and grey.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2	VA A2/3	full	1	1	1					1	II VA		
3	VA A2/3	full	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			281	1			13		Form.	I VA	
2		full	282-283	1	1		13		Form/eth	II VA	
3		full	284-285	1	1		13		Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 9/6-2015	Position		Depth 1500 m
		Longitude E/W	Latitude N/S	
TA/1500		96.4173	12.5156	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 05:36:50	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Mud and clay.			
Color: 5/1-4/1 dark grey and grey.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		full	1	1	1					1	II VA		
3		full	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1		full	286	1			13		Form.	I VA	
2		full	287-288	2			13		Form/eth	II VA	
3		full	289-290	1	1		13		Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 9/6-2015	Position		Depth 106 m
		Longitude E/W	Latitude N/S	
A100/2		97.104	12.5703	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 11:52:30	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand coarse, mud and shells.			
Color: 5Y 4/2-3/2 Olive grey and dark olive grey	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		9,5	1	1	1					1	II VA		
3		6,5	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1		full	293-303	11			13-14		Form.	I VA	
2		9,5	304-313	10	2	291-292 bottles for ethanol	14		Form/eth	II VA	
3		6,5	314-329	16			14		Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 10/6-2015	Position		Depth 53 m
		Longitude E/W	Latitude N/S	
B1/1		98.1056	11.1157	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 01:39:46	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: clay and some shells.			
Color: 5Y 5/1-4/1 dark grey -grey (2) 5Y 4/2-3/2 Olive grey and dark olive grey	Odour: H_2S smell		
Observation of animals: Polychaetae	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2			1	1	1					1	II VA		
3			1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			330-341	12			15		Form.	I VA	
2			342-354	12			15		Form/eth	II VA	
3			355-368	19			15-16		Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 8/6-2015	Position		Depth 48 m 47 log
		Longitude E/W	Latitude N/S	
B1/2		98.0909	11.051	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 03:47:03	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand coarse, fine sand and shells.			
Colour: 5Y 6/1-5/1 grey	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		7	1	1	1					1	II VA		
3		12	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1		F	369-379	12			11		Form.	I VA	
2		7	380-392	7			13		Form/eth	II VA	
3		12	393-413	21			12		Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 10/6-2015	Position		Depth 41 m 40 log
		Longitude E/W	Latitude N/S	
B1/3		98.2184	11.032	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 06:28:52	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand coarse, stone, clay and shells.			
Color: 5Y 4/1-3/1 Dark and very dark grey.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		-	1	1	1					1	II VA		
3		17	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3 mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1		F	414-422	9			17		Form.	I VA	
2		-	423-426	4			17		Form/eth	II VA	
3		17	427-436	10	3		18		Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 10/6-2015	Position		Depth 55 m 54 log
		Longitude E/W	Latitude N/S	
B1/4		98.2288	11.1239	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 09:00:56	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand coarse, mud and shells.			
Colour: 2,5Y 6/1-5/1 grey.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		16	1	1	1					1	II VA		
3			1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 1mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			437-446	10			18		Form.	I VA	
2		16	447-459	13			18		Form/eth	II VA	
3		Empty		0					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 10/6-2015	Position		Depth 31 m
		Longitude E/W	Latitude N/S	
B30		98.4117	11.0894	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 11:25:58	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand coarse, and shells.			
Color: 10Y 4/1-3/1 Very dark grayish and dark grayish olive	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		13	1	1	1					1	II VA		
3		6	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			460-471	12			19		Form.	I VA	
2		13	472-489	17	1		19		Form/eth	II VA	
3		6	490-502	13			19+20		Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 11/6-2015	Position		Depth 103 m
		Longitude E/W	Latitude N/S	
TB/100		97.3977	11.0956	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 04:17:23	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Coarse sand, small stones and shells.			
Color: 5Y 7/1-6/1 gray and light gray	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		11	1	1	1					1	II VA		
3		13	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1		F	506-516	11					Form.	I VA	
2		11	517-527	11					Form/eth	II VA	
3		13	528-537	12					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 11/6-2015	Position		Depth 215 m
		Longitude E/W	Latitude N/S	
B2/1		97.3061	11.1342	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 06:39:40	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand coarse, and shells.			
Color: 10Y 4/1-3/1 Very dark grayish and dark grayish olive	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		8	1	1	1					1	II VA		
3		5	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1		F	538-556	19					Form.	I VA	
2		8	557-578	21	1				Form/eth	II VA	
3		5	579-616	38					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 11/6-2015	Position		Depth 245 m
		Longitude E/W	Latitude N/S	
B2/2		97.3225	11.0282	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 08:55:51	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand coarse, stones and shells.			
Colour: 5Y 6/1-5/1 gray	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		6	1	1	1					1	II VA		
3		6	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1		F	617-637	21					Form.	I VA	
2		6	638-661	34	1				Form/eth	II VA	
3		6	662-687	25					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 11/6-2015	Position		Depth 149 m
		Longitude E/W	Latitude N/S	
B2/3		97.3618	11.0698	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 11:02:19	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Shell, sand, stones clay some silt, and dead corals.			
Color: 5Y 5/1-4/1 5Y 4/1-3/1 Grey, dark gray and very dark gray.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		17	1	1	1					1	II VA		
3		open	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			683-685	3					Form.	I VA	
2		17	686-687	2	1				Form/eth	II VA	
3		open	688-691	4					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 12/6-2015	Position		Depth 281 m
		Longitude E/W	Latitude N/S	
B2/4		97.1889	11.096	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 01:26:23	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand and shell sand.			
Color: 5Y 3/1-2,5/1 Very dark gray and black	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		6,5	1	1	1					1	II VA		
3		7	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1		F	692-708	17					Form.	I VA	
2		6,5	709-730	22					Form/eth	II VA	
3		7	731-750	20					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 12/6-2015	Position		Depth 500 m (501d)
		Longitude E/W	Latitude N/S	
TB500		96.5789	11.103	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 05:47:20	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand, silt, clay and shells.			
Color: 5Y 51-4/1 Dark gray and gray.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		6	1	1	1					1	II VA		
3		6,5	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			751-753	3					Form.	I VA	
2		6	754-758	5					Form/eth	II VA	
3		6,5	759-762	4					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 12/6-2015	Position		Depth 1000 m (981d.)
		Longitude E/W	Latitude N/S	
TB1000		96.4464	11.1019	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 09:28:16	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand, silt, and clay.			
Color: 5Y 4/1-5/1 Dark gray and gray.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		6,5	1	1	1					1	II VA		
3		11	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			763-767	5					Form.	I VA	
2		6,5	768-771	4					Form/eth	II VA	
3		11	772-775	4					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 12/6-2015	Position		Depth m (1534 d.)
		Longitude E/W	Latitude N/S	
TB/1500		96.2995	11.1004	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 12:28:05	**Time Finish:**	**Duration:**
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Mud and clay.			
Color: 5Y 3/1-2,5/1 Very dark gray and black.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		6	1	1	1					1	II VA		
3		6	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1		F	776	1					Form.	I VA	
2		6	777-778	2					Form/eth	II VA	
3		6	779	1					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 13/6-2015	Position		Depth 110 m (107d.)
		Longitude E/W	Latitude N/S	
B2/5		97.3783	11.1371	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 01:49:07	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand fine, coarse, and shell sand.			
Color: 5Y 7/1-6/1 Light grey and grey.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		16	1	1	1					1	II VA		
3		21	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1		F	780-781	2					Form.	I VA	
2		16	782-784	3					Form/eth	II VA	
3		21	785-787	3					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 13/6-2015	Position		Depth 136 m (149 d.)
		Longitude E/W	Latitude N/S	
B2/6		97.3573	11.0772	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 03:56:09	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand and shells.			
Colour: 5Y 6/1-5/1 Grey	Odour: None		
Observation of animals: crab and fish	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		10,5	1	1	1					1	II VA		
3		7	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			788-802	15					Form.	I VA	
2		10,5	803-817	15					Form/eth	II VA	
3		7	818-836	19					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 13/6-2015	Position		Depth 124 m
		Longitude E/W	Latitude N/S	
B2/7		97.3624	11.0564	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 06:24:39	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment:			
Colour:	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2											II VA		
3											III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1									Form.	I VA	
2			837	1					Form/eth	II VA	
3									Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 13/6-2015	Position		Depth 110 m (132 d.)
		Longitude E/W	Latitude N/S	
B2/8		97.3764	11.0175	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 08:57:43	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand and shell sand.			
Colour: 5Y 6/1-5/1 Grey	Odour: None		
Observation of animals: crab and fish	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2			1	1	1					1	II VA		
3			1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			838-844	7					Form.	I VA	
2			845-859	15					Form/eth	II VA	
3			860-875	16					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 14/6-2015	Position		Depth 30 m (27 d.)
		Longitude E/W	Latitude N/S	
B1/5		98.2563	11.0306	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 01:21:31	**Time Finish:**	**Duration:**
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand mud,clay, and shells.			
Color: 5Y 4/1-3/1 Very dark gray and dark gray.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	Misc.		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		10	1	1	1					1	II VA		
3		14	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1		F	876-884	9					Form.	I VA	
2		10	885-892	8					Form/eth	II VA	
3		14	893-898	6					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 14/6-2015	Position		Depth 44 m (38d.)
		Longitude E/W	Latitude N/S	
B1/6		98.2238	11.0357	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 05:01:46	**Time Finish:**	**Duration:**
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS anchored_2		

Type of bottom sediment: Sand, clay and shells.			
Color: 5Y 5/1-4/1 gray-dark grey + grayish to dark grayish olive.	Odour: None		
Observation of animals: Ophiuriodea, Capitellidae	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		11,7	1	1	1					1	II VA		
3		19,5	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			899-900	2					Form.	I VA	
2		11,7	901-912	12					Form/eth	II VA	
3		19,5	913-914	2					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 14/6-2015	Position		Depth 38 m (37 d.)
		Longitude E/W	Latitude N/S	
B1/7		98.2236	11.039	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 07:43:06	**Time Finish:**	**Duration:**
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand coarse, and shells.			
Color: 10Y 4/1-3/1 Very dark grayish and dark grayish olive	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		5,5	1	1	1					1	II VA		
3		10	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			915-933	19					Form.	I VA	
2		5,5	934-950	17					Form/eth	II VA	
3		10	951-959	9					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 14/6-2015	Position		Depth 57 m
		Longitude E/W	Latitude N/S	
B1/8		97.9799	10.894	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 11:59:44	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand,silt, clay and shells.			
Color: 2 5Y 5/1-2/1 Dark grayish brown and grayish brown.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		18	1	1	1					1	II VA		
3		E	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			960	1					Form.	I VA	
2		18	961-965	5					Form/eth	II VA	
3		E	966	1		1 single Coral			Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 15/6-2015	Position		Depth 50 m
		Longitude E/W	Latitude N/S	
B1/9		97.9162	10.8051	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 03:25:38	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand fine and coarse, clay and shells.			
Color: 5Y 5/1-4/1 and 10Y 5/2-4/2 grey and dark grey, grayish and dark grayish olive.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		10	1	1	1					1	II VA		
3		10	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			967-968	2					Form.	I VA	
2		10	969-983	15					Form/eth	II VA	
3		10	984-1002	19					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 15/6-2015	Position		Depth 50 m
		Longitude E/W	Latitude N/S	
B1/10		97.9169	10.7939	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 06:02:29	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand, some silt, clay and shells.			
Color: 10Y 5/2-4/2 Grayish and dark grayish olive.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		13	1	1	1					1	II VA		
3		19	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			1003-1012	10					Form.	I VA	
2		13	1013-1026	14					Form/eth	II VA	
3		19	1027-1029	3					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 15/6-2015	Position		Depth 43 m (42 d.)
		Longitude E/W	Latitude N/S	
B1/11		97.9916	10.907	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 03:25:38	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand, empty shells, dead coral sand stones.			
Color: 10Y 5/2-4/2 Grayish and dark grayish olive.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		19	1	1	1					1	II VA		
3		17	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			1030-1034	5					Form.	I VA	
2		19	1035-1039	5		No subsample for DNA alm. empty			Form	II VA	
3		17	1040-1047	8		Small amount of sediment.			Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 16/6-2015	Position		Depth 32 m (31 d.)
		Longitude E/W	Latitude N/S	
B1/12		98.0633	10.8144	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 02:47:56	**Time Finish:**	**Duration:**
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand fine and coarse, clay and shells.			
Color: 5Y 5/1-4/1 and 10Y 5/2-4/2 grey and dark grey, grayish and dark grayish olive.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		15	1	1	1					1	II VA		
3		16	1	1	1						III VA		

Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			1048-1060	13					Form.	I VA	
2		15	1061-1066	6					Form/eth	II VA	
3		16	1067-1072	6					Form.	III VA	

Sign. out:

Vessel: Nansen	Area: Myanmar	Project code:	Survey nr: 2015405 Myanmar Habitat

Grab station nr.:	Date: 16/6-2015	Position		Depth 45 m (44 d.)
		Longitude E/W	Latitude N/S	
B1/13		97.9914	10.8271	Positioning control:

Weather:	Wind:	Wave height (m):
Time Start: 06:00:12	Time Finish:	Duration:
Sample equipment used (name, bite area, weight): 0.1 m^2 Van Veen Grab and 0.5 mm sieve (round holes) VAMS		

Type of bottom sediment: Sand fine and coarse, clay, some silt stones and shells.			
Color: 5GY 5/2-4/2 Grayish green and dark grayish green.	Odour: None		
Observation of animals:	No. rejected samples:		
Observation of oil, waste etc: None	Empty:	Stone:	Open:

Sample nr.	Diary nr.	Volume (cm)	Metals:	THC:	box		Remarks : chemical	Toc:	Granulometry geo.		G. nr	Ex. w	Br. Surf
									Sec.	0-5			
2		17	1	1	1					1	II VA		
3		16	1	1	1						III VA		

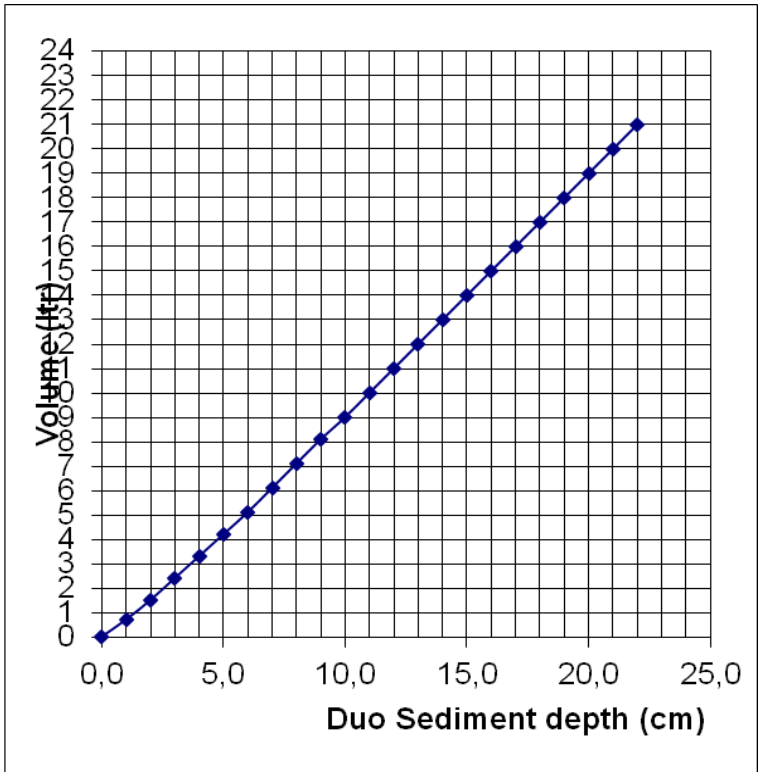
Sample nr.	Diary nr.	Vol. (cm)	Bottle number	bottles 0,5mm	Bottles 0,3mm	Remarks: Bio sample	Box nr.	Pallet nr.	fixation	Grab nr.	Extra weights
1			1073-1076	3					Form.	I VA	
2		17	1077-1080	4					Form/eth	II VA	
3		16	1081-1083	3					Form.	III VA	

Sign. out:

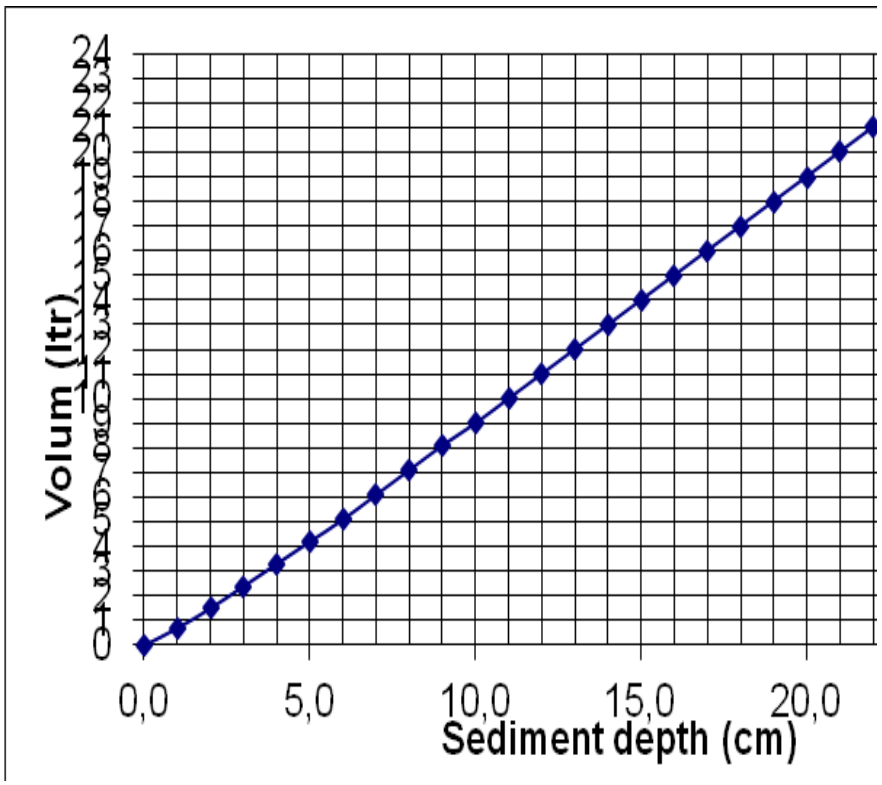
ANNEX II: Instruments and sampling gear; Grab profiles.

Three main types of grabs were used during the survey: long arm, the Danish grab and the duo Grab.

Radius (cm)	22.0	Duo
Sediment depth	**X- value (cm)**	**vol in ltr.**
22.0	0	21.00
21.0	1	20.00
20.0	2	19.00
19.0	3	18.00
18.0	4	17.00
17.0	5	16.00
16.0	6	15.00
15.0	7	14.00
14.0	8	13.00
13.0	9	12.00
12.0	10	11.00
11.0	11	10.00
10.0	12	9.00
9.0	13	8.10
8.0	14	7.10
7.0	15	6.10
6.0	16	5.10
5.0	17	4.20
4.0	18	3.30
3.0	19	2.40
2.0	20	1.50
1.0	21	0.70
0	22	0.00

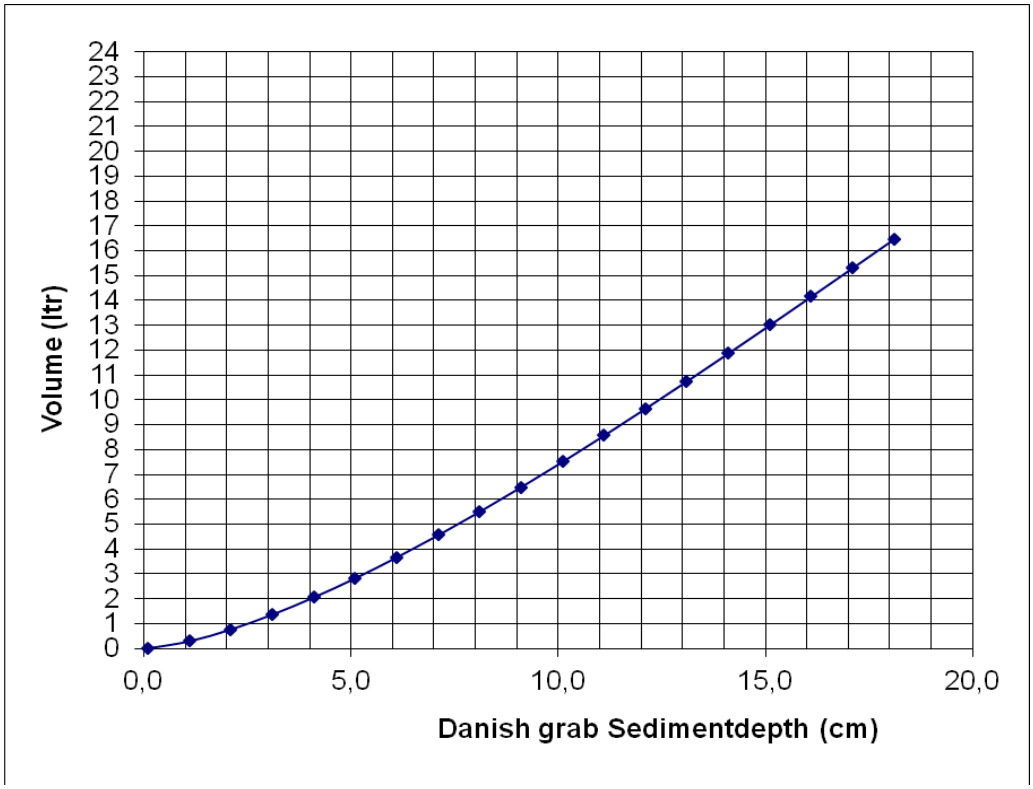


X is the depth measured from the lid to the sediment surface.			Long arm
Sediment depth	**X- value (cm)**	**Volum**	**vol in ltr.**
22.0	0	22808.0	22.81
21.0	1	21488.4	21.49
20.0	2	20171.6	20.17
19.0	3	18860.3	18.86
18.0	4	17557.2	17.56
17.0	5	16265.2	16.27
16.0	6	14987.3	14.99
15.0	7	13726.3	13.73
14.0	8	12485.5	12.49
13.0	9	11268.2	11.27
12.0	10	10077.8	10.08
11.0	11	8918.0	8.92
10.0	12	7792.8	7.79
9.0	13	6706.8	6.71
8.0	14	5664.8	5.66
7.0	15	4672.3	4.67
6.0	16	3735.9	3.74
5.0	17	2863.2	2.86
4.0	18	2063.8	2.06
3.0	19	1350.1	1.35
2.0	20	740.1	0.74



X is the depth measured from the lid to the sediment surface.

Sediment depth	X-value (cm)	vol in ltr.
18.1	0	16.47
17.1	1	15.31
16.1	2	14.16
15.1	3	13.01
14.1	4	11.87
13.1	5	10.75
12.1	6	9.65
11.1	7	8.57
10.1	8	7.51
9.1	9	6.49
8.1	10	5.50
7.1	11	4.56
6.1	12	3.67
5.1	13	2.83
4.1	14	2.06
3.1	15	1.36
2.1	16	0.77
1.1	17	0.29
0.1	18	0.01



Acoustic instruments

The Simrad ER-60/18, 38, 120 and 200 kHz scientific sounder was run during the survey only for observation of fish and bottom conditions. No scrutinizing of the recordings was done. Last standard sphere calibrations were checked on the 07.07.2013 in Baía dos Elefantes using Cu-64, Cu-60, WC-38.1 add WC-38.1 spheres for 18, 38, 120 and 200 kHz, respectively. The details of the settings for the 38 kHz echo sounder were as follows:

Transceiver-2 menu (38 kHz)

Transducer depth	6.50 m
Absorption coeff.	9.6 dB/km
Pulse duration	medium (1,024ms)
Bandwidth	2.43 kHz
Max power	2000 Watt
2-way beam angle	-20,6dB
gain	25,11 dB
SA correction	-0.60 dB
Angle sensitivity	21.9
3 dB beam width	7.43º along ship
7.38º athwardship	
Alongship offset	0.06º
Athwardship offset	0.04º

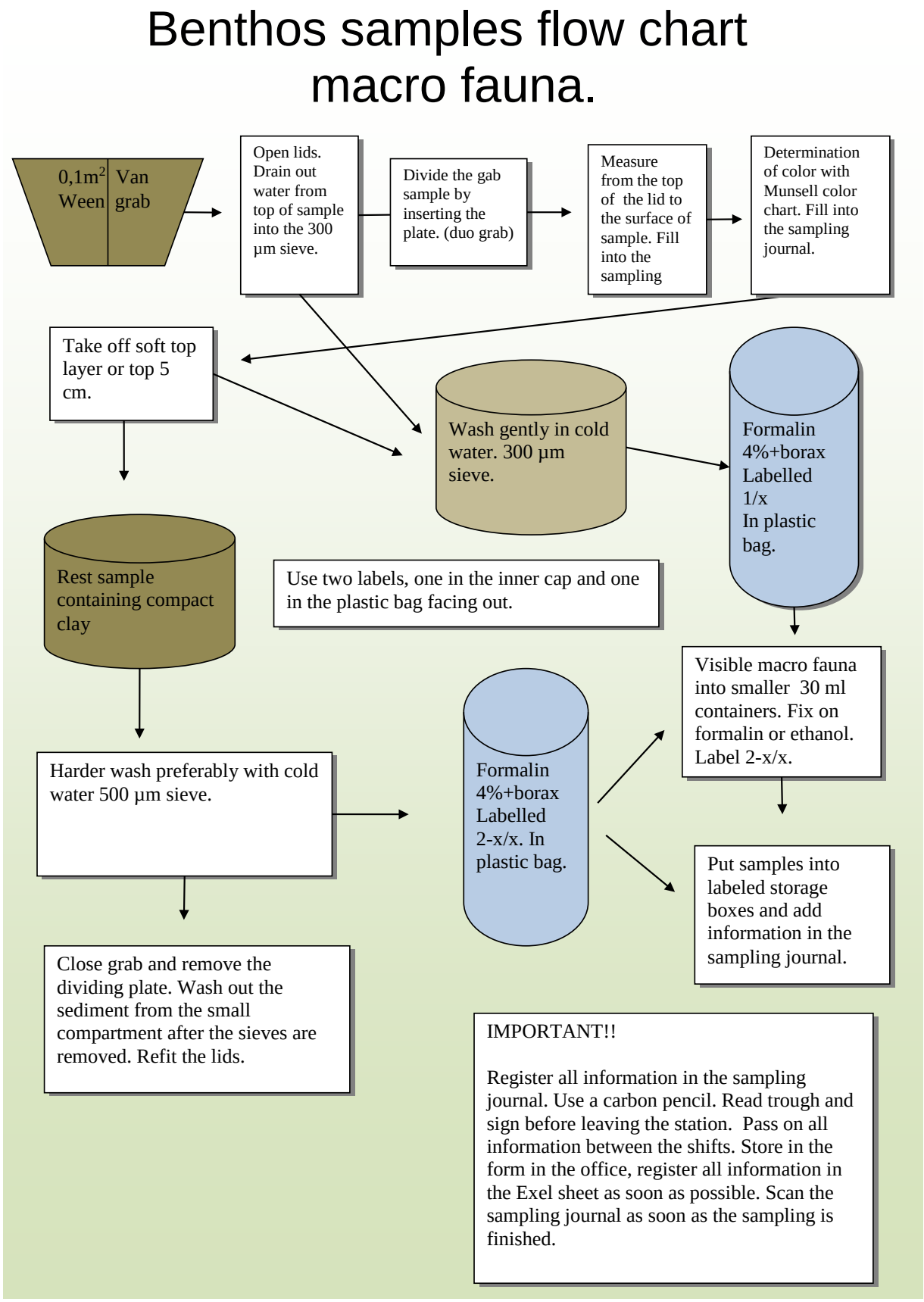
Bottom detection menu Minimum level -40 dB

Annex III Samples and responsibilities after the survey

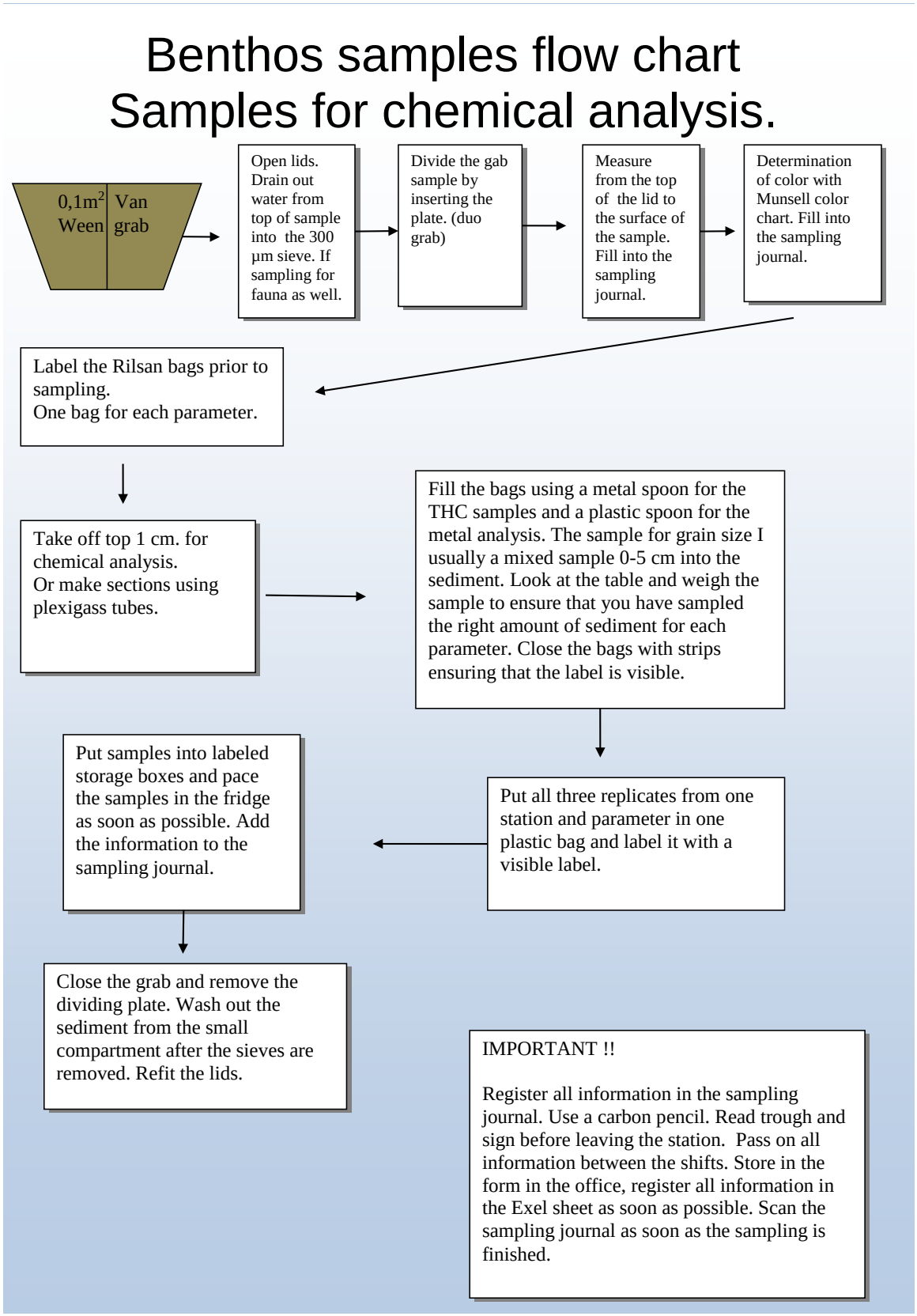
List of Samples:

Type	Number/Type	Responsible
Benthos samples	Samples for macro fauna: 121+3(test station) samples from 42+1(test) stations.	40 number 1 samples DOF Myanmar 84 samples 2,3 samples IMR Norway
	Samples for chemical analysis: 81 samples from 42+1 stations. 43 samples for grain size.	IMR Norway
	Video for habitat and macro fauna: from 39 stations.	**IMR Norway**
Acoustic multibeam samples	Several areas from both transects	**IMR Norway**

Annex IV: Chart 1. Benthos samples flow chart macro fauna.



Annex V: Chart 2. Benthos samples flow chart chemical analysis



Annex VI: Matrise based on video observation scheme

Area A1. Physical parameters and observed taxonomic groups.

Station	TA 25	A1/4	A1/3	A1/1	A1
Depth (start/min)	25	60	46	53	25-60m
Mud		90/80			X
Sand			80	x	X
Shell sand		10/20	20	x	X
Coral sand				x	X
Hardness 1-4		1	3		1-3
Variance					
Ox		2.790	2.630	2.750	2.63-2.79
Sal		33.280	33.099	32.920	33.099-33.920
Temp		27.980	28.580	29.110	27.98-29.11
Flu		0.460	0.270	0.310	0,27-0.46
Turbidity					
Secci depth					
AREA COVERED		120	120	….	120*3
Corals coverage (1-5)		1	1	1	1
Taxon					
Actinaria (Sea anemones, 5 suborders)		x			X
Alcyoniina (dead mans fingers.				x	X
Holaxonia (sea whips, fans, blades and rods)		x	x	x	XXX
bony fish		x	x	x	XXX
polychaetae		x	x		XX
sedentary polychaetae (in tube)		x	x		XX
Crabs		x	x	x	XXX
Shrimps			x		X
swim crabs		x			
hermit crabs		x			X
Ophiuroidea			x		X
Mollusca			x		X
Gastropoda		x			X
Cephalopoda (Squid)		x	x		X
Porifera		x	x		X

Area A2. Physical parameters.

Station	A2/1	TA/100	TA/250	A2/3	A2/4	A2/5	TA/1000	TA/1500	A100/2	**A2**
Depth (start/min)	293	106	252	223	249	341	998	1500	106	106-1500
Mud	40						100	100		X
Sand	50	x	90	90	90	100			x	X
Bedrock		x							x	X
Shell sand	10	x	10		10				x	X
Coral sand										X
Hardness 1-4	2.5	4	3	2.5	2.5	2	1	1	4	1-4
Ox	0.420	1.430	….	0.560	0.460	0.430	1.160	1.570	1.430	0.43-1.570
Sal	35.020	34.361	….	34.860	34.963	35.029	34.930	34.879	34.360	34.36-35.029
Temp	12.070	21.322	…..	15.000	13.402	11.542	6.790	5.150	21.320	5.15-21.32
Flu	_	…..	….	_	_	_	_	_	_	
AREA COVERED	120	120	120	120	120	120	120	120	120	120*9
Corals coverage (1-5)	1			1	1	1	1	1	1.5	1-1.5

Area A2. Observed taxonomic groups.

Station	A2/1	TA/100	TA/250	A2/3	A2/4	A2/5	TA/1000	TA/1500	A100/2	**A2**
Ascidiacea					x		x			2X
Hydrozoa						x	x			2X
Ctenophora (comb jellies, ribbemaneter)							x	x		2X
jellyfish (Scyphozoa)								x		
Actinaria (Sea anemones, 5 suborders)			x		x					2X
ceriantharia (tube anemonae)							x	x		2X
Alcyonacea (Gorgonian)	x					x				2X
Holaxonia (sea whips, fans, blades and rods)				x					x	2X
Pennatulacea (sea pens and sea pansy's)		x	x	x	x	x	x	x	x	8X
bony fish	x	x	x	x	x	x	x		x	8X
sharks (Elasmobranchii)			x							X
Rays			x							X
sedentary polychaetae (in tube)		x	x		x	x	x	x	x	7X
Errantia Polychaetae			x				x		x	3X
crustacea		x								X
Crabs		x	x	x		x	x			5X
Decapoda					x		x			2X
Shrimps	x	x	x	x	x	x	x	x	x	9X
swim crabs								x		X
Amphipoda							x			X
munida	x									X
hermit crabs			x	x		x				3X
isopoda								x		X
Pycnogonidae		x					x			2X
Crinoidea (sea lillies, feather stars)		x							x	2X
Sea cucumbers (holothuroidea)								x		X
Scotoplanes (sea pig)							x	x		2X
Asteroida (sea stars)		x			x				x	3X
Ophiuroidea	x					x	x		x	4X
Mollusca	x									X
Gastropoda			x			x	x	x		4X
Bivalvia					x					X
Cephalopoda (Squid)			x							X
Scaphopoda (SEA TOOTH)							x		x	2X
Placozoa (1)								x ?		X
Porifera		x				x	x	x	x	5X

Area B1. Physical parameters.

Station	B1/1	B1/2	B1/3	B1/4	B1/5	B1/6	B1/7	B1/8	B1/9	B1/10	B1/11	B1/12	B1/13	B30	TB/100	**B1**
Depth (start/min)	53	48	41	55	27	37	38	58	50	51	43	32	45	31	103	27-103
Mud	10															
Sand	80	80		x	x	x	x	x	x	x	x	x	x	90	100	14X
Gravel				x							x					2X
Cobble						x				x		x	x			4X
Boulder						x			x	x		x				4X
Bedrock				x		x							x			3X
Shell sand	10	20		x	x	x	x	x	x	x	x	x	x	10		13X
Coral sand				x		x				x		x				4X
Hardness 1-4	3.5	3	3.5	3.5	3	4	2-4	3	4	3	4	4		2.5	3	2,5-4
Ox	3.664	3.796	4.180	4.330	4.066	4.064	4.073	3.820	2.490	2.520	3.710	4.010	……	4.250	1.639	
Sal	33.141	33.143	33.080	33.060	33.086	33.075	33.050	33.131	33.266	33.232	33.130	33.044	…….	33.056	34.184	
Temp	29.510	29.460	30.160	30.230	30.499	30.845	31.076	30.209	29.131	29.413	29.822	30.378	…….	30.901	22.177	
Flu	1.410	1.860	2.280	2.380			1.705	0.640	0.230	0.471	0.519			2.526	_	
Turbidity								HIGH	HIGH				High		Low	L-H
Secci depth										5 m	5 m		5			5m
Antrpogenic disturbance									Y							X
AREA COVERED	120	120	120	120					120?		120			120	120	120
Corals coverage (1-5)	1.5	1.5	2	2.5					3		3			1		1.5-3

Area B1. Observed taxonomic groups.

Station	B1/1	B1/2	B1/3	B1/4	B1/5	B1/6	B1/7	B1/8	B1/9	B1/10	B1/11	B1/12	B1/13	B30	TB/100	**B1**
Bryozoa			x	x		x		x								4X
Ascidiacea	x		x	x		x		x								5X
Hydrozoa			x			x				x					x	4X
jellyfish (Scyphozoa)					x											X
Anthozoa		x														X
Actinaria (Sea anemones)	x	x	x	x		x			x	x						7X
anthipatharia (black Coral)			x						x							2X
Zoantharia (stalked small corals)				x												X
Scleractinia (stony Corals)	x		x	x		x			x	x	x	x		x		9X
Corallimropharia (Disc Coral)						x										X
Alcyonacea (Gorgonian)	x	x	x	x		x		x		x				x		8X
Alcyoniina (dead mans fingers. .....)	x		x	x		x		x		x		x	x			8X
Holaxonia (sea whips, fans, blades and rods)		x	x	x	x	x		x	x	x	x	x	x			11X
Stolonifera (polypps on stalks on encrusting base, some flower like)			x													X
Pennatulacea (sea pens and pansy's)	x	x	x	x	x	x		x	x	x	x	x	x	x	x	14X
bony fish	x	x	x	x	x			x	x	x	x		x	x	x	12X
Hippocampus (Sea horse, Needle fish)		x														X
Rays					x											X
sedentary polychaetae (in tube)	x				x	x				x		x	x	x		7X
crustacea														x		X
Crabs	x	x									x			x	x	5X
Decapoda														x		X
Shrimps	x	x	x								x					4X
isopoda	x															X
Crinoidea (sea lillies, feather stars)	x		x	x	x	x		x			x	x				8X
Echinoidea, Sea urchin						x					x					2X
Asteroida (sea stars)					x								x			2X
Ophiuroidea		x			x	x		x		x				x	x	7X
Mollusca		x														X
Gastropoda	x	x			x	x									x	5X
Nudibrachia			x	x								x				3X
Bivalvia	x				x	x		x						x	x	6X
Cephalopoda (Squid)					x			x		x						3X
octopus														x		X
Scaphopoda (SEA TOOTH)														x		X

Area B2. Physical parameters.

Station	B2/1	B2/2	B2/3	B2/4	TB500	TB1000	TB/1500	B2/5	B2/6	B2/7	B2/8	**B2**
Depth (start/min)	217	249	150	275	502	985	1532	110	150	127	147	110-1532
Depth (stop/max)										158	(151)	
Mud							60					x
Sand	80	x	x	x	100	100	40	80	x	20	x	11X
Cobble									20			X
Boulder								20	20	30		3X
Bedrock										30	x	2X
Shell sand	20	x	x	x						10	x	6X
Coral sand										10		X
Hardness 1-4	3	3.5	3.5	3	3	3	2	3.5	3.5	3.75	3	2-3.75
Ox	0.491	0.468	0.770	0.451	0.640	1.220	1.590	1.710	0.990	0.733	1.230	0.451-1.71
Sal	34.972	34.991	34.755	35.003	35.022	34.929	34.883	34.085	34.599	34.608	34.433	34.085-35.022
Temp	13.518	13.141	16.960	12.830	9.471	6.521	5.216	22.920	18.444	18.097	19.960	5.216-22.920
Flu	_	_	_	_	_	_	_	0.024				
Turbidity									Low	Low		Low
AREA COVERED	120	120	120	120	120	120	120	120	120	270	Line	120-540
Corals coverage (1-5)	0	0	3.5	0	0	1	1	2	3.5	2-3.5		0-3.5

Area B2. Observed taxonomic groups.

Station	B2/1	B2/2	B2/3	B2/4	TB500	TB1000	TB/1500	B2/5	B2/6	B2/7	B2/8	**B2**
Bryozoa	x		x		x							3X
Lace coral (Bryozoa)										x		X
Ascidiacea			x		x							2X
Hydrozoa			x			x			x			3X
jellyfish (Scyphozoa)							x				x	2X
Actinaria (Sea anemones, 5 suborders)			x		x	x	x	x	x		x	7X
Hexacorallia									x	x		2X
Zoantharia (dragoneyes, stalked small corals)					?							X
Scleractinia (stony Corals)									x	x		2X
Caryophyllidae, Hard Coral polyps			x		x			x			x	4X
Acroporidae (staghorn corals)									x		x	2X
Corallimropharia (Disc Coral)			x						x			2X
Alcyonacea (Gorgonian)								x	x	x		3X
Alcyoniina (dead mans fingers.mm.)			x									X
Holaxonia (sea whips, fans, blades and rods)			x		x	x	x	x	x	x	x	8X
Stolonifera (polypps on stalks on encrusting base)						x						X
Helioporacea (Blue coral)			x						x	x		3X
Pennatulacea (sea pens and sea pansy's)			x		x	x	x	x	x	x	x	8X
bony fish	x	x	x	x	x	x	x	x	x	x	x	11X
anguilliformes		x										X
Rays		x			x				x			3X
polychaetae			x		x							2X
sedentary polychaetae (in tube)			x	x	x	x	x					5X
Errantia Polychaetae						x						X
crustacea			x		x	x						3X
Crabs						x		x				2X
Shrimps	x	x		x	x	x	x	x				7X
munida	x		x	x	x	x						4X
hermit crabs	x	x	x			x	x	x				6X
Crinoidea (sea lillies, feather stars)			x			x			x	x	x	5X
Echinoidea, Sea urchin									x	x	x	3X
Sea cucumbers (holothuroidea)			x		x		x	x	x		x	6X
Scotoplanes (sea pig)					x		x					2X
Asteroida (sea stars)			x				x		x	x	x	5X
Ophiuroidea					x	x	x					3X
Gastropoda			x						x			2X
Nudibrachia			x			x						2X
Bivalvia	x				x							2X
Cephalopoda (Squid)				x								X
Scaphopoda (SEA TOOTH)					x	x	x					3X
Porifera			x		x	x	x	x	x	x	x	8X

APPENDIX VII: EUROPEEN STANDARD 16260

EUROPEAN STANDARD **EN 16260**

NORME EUROPÉENNE

EUROPÄISCHE NORM October 2012

ICS 13.060.45

English Version

Water quality - Visual seabed surveys using remotely operated and/or towed observation gear for collection of environmental data

Qualité de l'eau - Études visuelles des fonds marins utilisant un matériel d'observation commandé à distance et/ou tracté pour la collecte de données environnementales

Wasserbeschaffenheit - Visuelle Meeresbodenuntersuchungen mittels ferngesteuerter Geräte und/oder Schleppgeräten zur Erhebung von Umweltdaten

This European Standard was approved by CEN on 15 September 2012.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 16260:2012: E

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Foreword

This document (EN 16260:2012) has been prepared by Technical Committee CEN/TC 230 "Water analysis", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2013, and conflicting national standards shall be withdrawn at the latest by April 2013.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

Information on the habitats, biotopes, substrates and species diversity on the seabed is an important part of ecosystem-based environmental management, and necessary in order to evaluate the consequences of various anthropogenic activities. Implementing European Directives and required monitoring of substrates and species diversity will require documentation and monitoring of different types of seabed types using inter-comparable and generally non-destructive methods. Many seabed areas are difficult, if not impossible to investigate using traditional sampling such as grabs and dredges or may host fragile communities such as cold-water coral reefs. Visual surveillance using geo-referenced positions is essential to allow revisiting of locations, documentation of environmental conditions and detection of changes in species composition which otherwise would be difficult to achieve. The equipment and methods described here may also be used in combination with acoustic equipment for seabed characterisation.

The methods presented in this European Standard are particularly suitable for seabed mapping and monitoring at depths below depths achievable using traditional SCUBA diving, and in cases where safety or economical issues limit the use of SCUBA diving. They are also suitable for the description of distribution and occurrence of large and scattered organisms on substrates, where sampling with grabs do not provide representative results. For investigations on soft seabed substrate please refer to EN ISO 16665 [1] and for investigations on shallower hard seabed to EN ISO 19493 [2].

This European Standard is also suitable within the operational depth of SCUBA-diving, e.g. for large scale surveys and mapping of the seabed composition, characteristic plant and animal species occurrence and depth distribution.

Remotely Operated Vehicles (ROVs) and passive tethered observation platforms are used for mapping and environmental surveys of the seabed via video and still photographs. However, the methods used and the results obtained can be rather variable without proposed consideration of geographic positioning, taxonomic precision and quantification. It is therefore important that the methods used are standardised in order to compare results.

WARNING — Persons using this European Standard should be familiar with normal laboratory and fieldwork practice. This European Standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

1 Scope

This European Standard describes methods, requirements and equipment for remote visual surveillance of organisms and the seabed using still photography and video recording to ensure precise and reproducible data. The main aims of the methods are to record or monitor seabed conditions and organisms on and just above the seabed in a reproducible way at a resolution that is appropriate to the aims of the survey.

In caves and overhangs this standard may not be suitable due to technological limitations related to navigation and movement of the observation platform.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 14996, *Water quality — Guidance on assuring the quality of biological and ecological assessments in the aquatic environment*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
sonar altimeter
acoustic instrument measuring the elevation above seabed

3.2
box-in-test
test to determine alignment/attitude errors in the navigational data, involving four different positions of the vessel relative to a fixed transponder

3.3
drop camera
video and/or still camera that is either lowered down to the seabed or suspended just above it, generally used for imaging at a single location, or manoeuvred along a set transect using the ships propulsion system on the surface

3.4
frame grab
still image obtained from video record

3.5
geographic precision
accuracy with which a given point can be relocated within a geodetic reference system

3.6
geographic resolution
lowest unit of measurement at which a geographic distribution can be reproduced

3.7
kalman filtration
sequential smoothing method where the most likely result is achieved through a combination of earlier results using the relevant measuring point

Note 1 to entry: This type of data filter is often integrated in navigation software packages, but can also be applied separately [3].

3.8
locality
geographic description of a place or an area where samples are collected, covered by one or more sampling stations

Note 1 to entry: Description is based on habitat, terrain, depth and name of geographic area.

3.9
macrofauna
animal species ranging from 1 mm to 50 mm

3.10
megafauna
animal species larger than 50 mm

3.11
monitoring
investigation via repeated sampling to record eventual changes in environmental conditions or community composition over time

3.12
morphological species
organism that belong to a unidentified species that clearly can be distinguished from other observed, identified or unidentified species, and that may be described based on shape and colour and size

3.13
observation platform
passive sampling gear comprising a supporting construction onto which a video camera and light and/or a still camera (and environmental sensors if required) can be mounted

Note 1 to entry: An observation platform can be tethered to a fixed point or towed.

3.14
PAL-standard
analogue television colour encoding system used as a standard for video recording

Note 1 to entry: Video format used in most European countries

3.15
reference location
location representing presumed natural environmental conditions

3.16
remotely operated vehicle
ROV
remotely operated motorised underwater vehicle equipped with video and/or still camera and often has the capacity to mount additional equipment such as sonar, environmental probes, manipulator arms and sampling equipment

3.17
sample
single photograph, frame grab or uninterrupted video sequence

3.18
sampling station
geographically defined area where still photographs or video recordings are taken

Note 1 to entry: Still photographs cover a defined area, which for practical purposes can be represented by a point on a map. Video recordings carried out by means of a vehicle in motion cover a larger sampling area and the location of the start and end of the line become more important when repeating or relocating sampling stations. Therefore, for video recordings, the starting point is used as the station position.

Note 2 to entry: A station is defined by its geographic position, together with any additional information on features on the seabed (for example rocky outcrops or large stones) recognisable by either direct observation or by acoustic surveillance (for example multi-beam echo-sounder or side-scan sonar). The station is delimited at the given level of precision.

3.19
still image
single photograph or frame grab

3.20
spin-test
test to identify navigational offset errors, involving rotation of the ship above a fixed transponder

3.21
transect
defined and continuous line or belt of pictures or video sequences across a delimited area

Note 1 to entry: The position of the transect can be random or located to reveal different (various gradients of) environmental conditions (for example gradually increasing depth etc.).

3.22
video sequence
continuous part of a video film

4 Principle

Remotely operated vehicles (ROVs) and passive tethered observation platforms are used for mapping and for environmental surveys of the seabed. Still photographs and video recordings are used in a variety of ways to obtain visual data for mapping and/or monitoring the seabed and organisms on or near the seabed. This European Standard gives guidance with respect to sampling strategies, geographic positioning, taxonomic identification and quantification and determination of seabed substrates and/or the organisms living on or above the seabed.

5 Equipment

5.1 General

The technical specifications for the equipment used shall be described when reporting the results. The requirements made for the equipment are dependent on the aims of the survey. For mapping and monitoring, a colour camera should be used together with underwater positioning equipment. The positioning equipmen should have an appropriate error margin for the survey objectives with a minimum of ≤ 2 m, with a relative tolerance of + 5 % of the water depth (measured in metres) for depths equal or greater than 20 m and ≤ 3 m, with a relative tolerance of + 3 % of the water depth for depths shallower than 20 m, respectively.

EXAMPLE Water depth: 15 m appropriate error margin: ≤ 3 m + (15 m × 0,03) ≤ 3,45 m
Water depth: 40 m appropriate error margin: ≤ 2 m + (40 m × 0,05) ≤ 4 m

5.2 Cameras and light

Video recordings and still photographs should not contain electric or electronic noise. The minimum requirements of cameras (video recordings and still photographs) differ for the three types of investigations (pilot surveys, mapping and trend monitoring). For pilot surveys (see 7.4) low light, composite video PAL standard should be used. A colour camera is not a requirement for this type of survey. The minimum requirement for mapping (see 7.5) is a high resolution PAL colour camera (e.g. 400 TV lines). The application of a colour HD (high definition), 1080 interlaced is recommended. Still photographs for use in trend monitoring (see 7.6) should document an area of between 0,25 m^2 and 1 m^2 with a good image quality (focus and contrast) with a minimum resolution of 1 080 x 1 560 pixels (HD-format, equivalent to 300 DPI at 9 cm × 13 cm). Lights should be strong enough to provide a fully illuminated surface, at heights ≤ 3 m above seabed surface.

5.3 Sonar altimeter

The elevation above seabed should be measured by a sonar altimeter or by using trigonometry.

NOTE Estimation of height using trigonometry demands that the distance from camera lens to the centre of the image and the camera's inclination angle is known. The distance is from the lens to the centre of the image from the width of the field view (scaled by parallel laser points) and the angle of view.

A simpler method for keeping constant height above the seabed is to use a rope with weight, or a chain suspended from the observation platform. This method is not suitable for sensitive habitats such as coral habitats and sponge communities. Furthermore, it may also represent a safety hazard since the rope may stick to obstacles on the seabed. As far as possible, an even height (1 m to 3 m for mapping) and speed (0,5 kn to 2 kn for pilot surveys and 0,5 kn to 1 kn for mapping) should be maintained. Ideally the lower the speed, the better; but with certain sites it would be impossible to keep speeds consistently down to these levels without resorting to just working at slack water only. An increased video frame capture-rate would allow better slow-motion replay and therefore allow a camera to travel quicker over the seabed. In all cases the camera should travel at an appropriate speed such that images obtained using video or still photograph are not overly blurred.

5.4 Data recording equipment

Video records should be stored in a format (e. g. storage of video files on a hard disc or directly recorded onto a DVD burner or a DV tape recorder), that avoids loss of data quality when copying. For video recordings, the position should be inserted as text on the image, or logged in a data file where the time of the video recording can be used to synchronize the time logged together with the GPS signal, as well as other environmental data (depth, temperature, angle of camera etc.). Alternatively these data can be stored on the audio track of the video. These audio data should always follow the picture and should not be stored on a (or several) separate file(s).

6 Positioning

6.1 General

Geographic references for observations should be accompanied by information on the accuracy obtained using the combination of equipment and method. Positioning should be carried out with reference to a grid net or geodetic reference system.

NOTE 1 Examples on grid-net systems are EUREF89 (European Reference Frame 1989), and UTM coordinate system (Universal Transverse Mercator coordinate system). Examples for geodetic reference systems are ETRS89 (European terrestrial reference system 1989) and WGS-84 (World Geodetic system 1984).

For the purpose of mapping shallow (< 15 m) coastal areas using a drop camera the ship's GPS can be used without hydro acoustic positioning, except for pilot surveys (see 6.3). If using an ROV in open sea areas and in areas with strong currents, the ROV shall be equipped with a sufficiently strong motor or "garage" to avoid drift from the targeted locality (at a fixed position or between two fixed positions). If a towed platform is used in similar areas the observation platform should be heavy enough to prevent too large offset, which will disable reliable hydroacoustic positioning.

Geographic references (beyond general locality: approximately ± 100 m) should be based on hydro-acoustic positioning. When using a towed observation platform or drop camera, its position at the seabed can be estimated from the vessel's position by correcting for deviations in relation to the observation platform (cable length, angle and direction). In all cases, the method used shall be documented.

NOTE 2 There are several sources of errors in the positioning of underwater equipment. The main components in underwater positioning provide transmission of satellite signals to the ship and calculation of the distance and direction to the observation platform. The quality of underwater positioning is mainly depending on how the ship is equipped, but the setting and calibration of this equipment is also very important.

6.2 Calibration of positioning equipment

For mapping and monitoring the hydro-acoustic positioning equipment needs to be calibrated on an annual basis. If a calibration has been performed for instance by comparison with a transponder placed on the seabed, values for the error should be provided in the report. If such a calibration has not been made the errors provided by the producers of the equipment should be used instead.

Filtering of navigational data can significantly reduce noise. The recommended method for this is Kalman filtering [3].

NOTE Many GPS navigation systems on the market already "smoothen" the position, based on previous positions and estimated compass direction, before they are shown in the display. The method used for filtering varies, but most common is the *Kalman filtering*. A simpler method for filtering navigational data is to remove deviant recordings that are obvious outliers from the remainder of the recordings. Deviant values can be replaced by a value derived from the running mean of five records (two before and two after the point of the deviant record) in the series of navigational recordings. If filtering of navigational data is used, the method used should be documented when reporting the results.

The geographic resolution can be obtained by comparing the distances covered by video sequences of similar lengths with the distance as calculated using speed.

6.3 Positioning of the different types of survey

For pilot surveys, positioning may refer to the position of the vessel. The positions of video transects should as a minimum be defined by the vessel's start and end positions. The precision of positional information should fulfil the requirements of Order-2 in S-44 [4] (≤ 20 m, with a relative tolerance of + 5 % of water depth in meter).

Approximate positions along a towed transect may be calculated based on speed of the equipment together with the compass direction.

For a drop camera, a calculated position for where it hit the seabed is satisfactory. This position is estimated based on the offset between the location of the ship positioning system's centre point and the location on the ship where the drop camera is deployed.

For mapping, positions should be recorded at regular intervals (at least one record per 10 s) during the video recordings. The precision of the positional information should as a minimum be ≤ 2 m , with a relative tolerance of + 5 % of water depth in meter for water depth ≥ 20 m and ≤ 3 m , with a relative tolerance of + 3 % for water depth < 20 m.

For trend monitoring using still photography, the positioning shall be accurate enough to allow relocation of the exact location on the seabed in order to be able to follow developments in individuals/populations using positional data for markers and/or photographs/video recordings from previous surveys. See Table 1 for an overview of the recommended minimum quality requirements of the different methods for positioning.

The exact positioning of hanging or towed video with a standard vehicle is almost impossible. Therefore, it is recommended that if an exact position is required, it should be done by placing or choosing a well recognizable obstacle on the sea floor (see 7.6.2). For ROV exact positioning is possible.

For a description and comparison of different crude positioning methods suitable for pilot surveys see Coggan et al 2007 [5].

6.4 Underwater positioning

The degree of accuracy varies depending on the type and aim of the investigation. Where a high accuracy of geographic positions is required, use of the Ultra Short Base Line/Super Short Base Line system (USBL/SSBL-system) should be carried out with reference to appropriate calibration of at least the USBL-system, satellite navigation system and gyro- and navigational software. If this is not available, or changes have been made to the set-up since the last calibration, the system should be re-calibrated. During calibration, a "box-in-test" (see NOTE 1) and a "spin-test" (see NOTE 2) should be carried out in accordance with the manufacturers instructions for the equipment/software.

NOTE 1 During a "box-in-test", all four quadrants of a transponder's position is recorded. The vessel is aligned in four different positions such that by the end of the procedure, recordings are made of where the transponder has been relative to the bow, stern, port- and starboard sides of the vessel.

NOTE 2 In a spin-test, the vessel rotates directly over the transponder whilst the positions are recorded.

The use of an LBL-system (Long Base Line) for positioning during a survey should be carried out with reference to a calibration report.

To provide quantitative or semi-quantitative data, the geographic position of the observation platform on the seabed should be known alongside the error margin (see 6.2).

If using hydro-acoustic positioning equipment, the position should be recorded continuously during the survey. When using a towed observation platform, the vessel's positions may be used, after correction for the known deviation, provided that the vessel's course and speed are stable.

Calculation of the spatial extent of structures should not be based on hydro-acoustic underwater positioning if the error margins of the recordings exceed 10 % of the extent of the structure.

For underwater positioning, the precision of the equipment should be documented.

NOTE 3 Hydroacoustic signals are influenced by the sound velocity of the water (which varies with temperature and salinity). Thus, estimates of sound velocities should be performed at the start of a survey and when moving into areas with different water characteristics. These data should be used for calibration of the positioning equipment as explained by the navigation system's user manuals.

7 Collecting data

7.1 Quality assurance and quality control

Vessels used for the investigations shall be in accordance to the relevant safety standards and manned by crew qualified to carry out their required tasks.

Equipment and methods used shall have documented technical specifications (see 7.3 and Table 1) which allow an assessment of the quality of the results. Quality assurance and quality control measures shall be included in all parts of the investigation.

All procedures shall be described, and all tasks and parts of the work shall be performed in a standardised and reproducible way. The investigation shall be undertaken by qualified personnel with a relevant education. The reader is referred to EN 14996 on the quality assurance of biological and ecological investigations. The overall goal is to ensure documentation and tracking of all fieldwork procedures, samples and equipment from start to end of an investigation.

For quantitative image analysis, the aim should be to take the pictures perpendicular to the surface unless alternative angles provide better quality data to ensure a correct calculation of area and best possible identification of organisms. Alternative angles of alignment may benefit certain surveys design e.g. cameras may be angled forwards where this can improve image ID. Calculation of area may be carried out on sloping surfaces if the image can be scaled (for example by parallel laser points at known distances) and if the angle of the camera relative to the seabed is known.

7.2 Survey plan

A survey programme should be designed in accordance with the aims of the investigation, required precision of results, local topographical and hydrographical conditions in the survey area, information on local sources of pollution, experience from previous investigations and any other factors that can be of significance for the surveys. The survey programme shall be established before commencement of the survey, but appropriate modifications may be made during the fieldwork, as judged necessary.

Visual surveys of the seabed should be carried out by still photography or video, and may be divided into three main types as follows:

— Pilot survey, see 7.4;

— Mapping, see 7.5;

— Trend monitoring, investigations over time, see 7.6.

Table 1 gives an overview of the recommended minimum requirements of the three main survey types.

NOTE Mapping using still photographs and video does not provide complete information about the total species diversity in an area, but provides important additional information about the epi-flora and fauna represented and their local spatial distribution, that traditional sampling gear cannot provide.

7.3 Transect surveys

Except for pilot survey, the camera should be at least 3 m or closer to the seabed in order to identify organisms with a size < 10 cm, or to estimate percentage composition of seabed substrates, but this will depend on video quality. Records from a greater height can only be used for mapping of dominating species > 10 cm or qualitative registration of coarser seabed substrates (cobble, boulder and bed rock).

For quantitative mapping of flora and fauna, the areas covered shall be estimated based on the field of vision and the distance travelled. For calculation of observed area, the photographic field shall be scaled using laser points or calculated using the lens and camera angles together with height above the seabed. Height shall be

recorded to the nearest decimetre. The angle of the lens and the angle of the camera relative to the seabed shall be recorded in degrees.

NOTE On a sloping or uneven seabed calculation of areas based on trigonometry using height above the seabed is complicated and not practical. In such cases laser scaling points are needed.

For mapping where the field of vision is 1,5 m to 3 m, a distance of 10 cm between the laser points is recommended. For pilot surveys conducted at a greater height above the seabed and a wider field of vision, the distance between the laser points can be increased to 20 cm.

The length of transects to be covered in order to ensure comparable results is dependent on the aims of the survey. For mapping of species diversity and abundance distribution, the transect length should as a minimum ensure that a further 10 % increase in transect length would not result in more than a 10 % local (within the transect) increase in recorded taxa. In practice, this is equivalent to approximately 400 m in areas with a uniform habitat. In areas of habitat heterogeneity, this length should be increased to 500 m. It can be difficult to control the distance covered in "real time" and therefore it may be practical to calculate the distance covered based on the speed of the ROV or vessel in the case of towed observation platforms. See Table 1 for recommended transect length for the different types of surveys.

In areas with homogeneous substrate types and evenly distributed flora and fauna shorter transects may be sufficient to represent the diversity of taxa. However, this shall be documented by a graph showing the cumulative numbers of taxa in relation to distance along a video transect from the general survey area.

7.4 Pilot survey

A pilot survey is used as a reconnaissance survey for future more comprehensive recording and surveying of environmental conditions. This type of survey is not suitable for recording changes over time, with the exception of major changes in dominant organisms and seabed conditions (underwater sediment slide, seabed trawl marks etc.). The requirements for methodology and reproducibility are generally relatively simple.

NOTE Side scan sonar is a very helpful tool for the pilot survey and should be used - as far as possible - to identify potential habitats (e.g. mussel banks, boulders/stones, ripple fields, seagrass meadows) for further visual seabed surveys.

No particular requirements are made for identifying the location or number of stations, but the stations should be as far as possible representative for the area under investigation. Precise station positions and water depth shall be recorded.

7.5 Mapping

This is a survey to describe the distribution of seabed types and organisms in a given area. Visible organisms should be identified to lowest possible taxonomic level required by the survey objectives and their abundance should be estimated. Seabed types shall be described in accordance with Table 2, and the relative composition shall be determined.

The survey shall be carried out using semi-quantitative or quantitative methods (see Clause 8). The specified requirements for numbers of stations and station positioning are determined in accordance with the aims of the investigation (requirement of geographical resolution) and size of the mapping area.

Transects for video recording and still photography can be located as single lines in a variety of directions and locations, or in a pattern of parallel lines. The distance between transects and still photographs should be determined by the demand for geographical resolution in accordance with the aims of the survey. Knowledge of the degree of spatial variation of habitat, species and/or biotopes is used to inform the survey design to produce reliable maps. For areal mapping where this variation is not known, transects should be paralleled separated with a distance of maximum 50 m. Information from more widely scattered transects can be used for generating areal maps combined with prediction and verification. Still photographs should be more than 20 m apart, corresponding to one photograph per minute at a stable speed of 0,7 kn. These photographs provide data for statistical analysis and are also helpful in providing a reference photograph for segments of the video. Additional photographs can be taken of particular species or habitats of interest.

The total length of transects should be determined by the aims of the mapping. If the aim is a representative description of species diversity of observed flora and fauna (large macrofauna and flora and megafauna), the total length of transects on a location should be at least 500 m. Minimum transect length should take into account any distances covered during deployment and retrieval time. This will be longer with increasing water depth.

Mapping using video recordings/still photographs is often used to ground-truth/validate acoustic remote sensed data such as multibeam/sidescan data. The minimum number of validation samples needed for that purpose should depend on the number of ground-types that have been provisionally identified from the acoustic data. Positions should be recorded on the images at all times. To avoid loss of data electronic and image figures should be separated.

For mapping of smaller areas or single habitats the length of individual transects should be adjusted to fit the shape of the area or the extent of the habitat. For areas smaller than 500 m in longest direction the required minimum distance of 500 m transect length is not relevant. In addition to positioning of start and end points geographical positions should be recorded continuously along the transects. Start and end point noted on a log sheet for each transect, and continuous recording of positions and time should be logged by a computer with exact reference to starting time of video record. Alternatively, the positions and time should be recorded as a text overlap on the video records and/or on the sound track of the video.

7.6 Trend monitoring

7.6.1 General

The aim of this type of survey is to investigate seabed types and assemblages of organisms, or one or more selected seabed-dwelling taxa over time, in order to document natural variations and any changes over time due to environmental or anthropogenic influences. Changes may be detected in the abundance and distribution of individual species, selected indicators such as individual size, and observed mortality, or the composition of seabed substrates. Monitoring can be carried out at fixed locations by random or random stratified transects or repeated parallel transects. Again, the survey design is dependent on the objectives of the survey and knowledge of variability at the location. Care should be taken when repeating transect in the same location using towed sledges over the bottom, as this in itself can affect the data over time. The survey shall be carried out using semi-quantitative or quantitative methods following a predefined plan. A reference location or reference area should be sampled (see 7.7) to ensure that the data can be used for comparison with the environmental conditions in adjacent areas.

7.6.2 Trend monitoring at fixed stations

Trend monitoring at fixed stations is carried out by collecting still photographs from a unit area that can be identified and relocated by means of markers or naturally occurring points of reference, such as large rocks or bedrock features. The sampling area to be monitored may be marked using positioned air-filled glass buoys anchored to the seabed with lead weights (gas filled objects are clearly detected by sonar, and therefore facilitate relocation). The geographical position of the marker shall be noted in order to revisit the exact area. An area in the immediate vicinity of the marker can be photographed to help relocate the sampling location.

NOTE Gas filled objects reflect strongly on sonar and aids locating the areas.

Trend monitoring at fixed locations requires the use of a stills camera that can be positioned to take still photographs from exactly the same position on the seabed. A video camera may also be used to obtain images from fixed points, but is more suited to trend monitoring along transects. When photographing the fixed locations, the ROV shall be positioned at the same place and in the same direction relative to the marker, for each sampling session. Photographs or video recordings from previous field surveys can be used as references for exact positioning. Information concerning each photograph should be noted in the sampling logbook, as described under the section for recording, see 8.7. A minimum of three fixed locations should be photographed at each station in order to ensure that these are representative of the area at large.

7.6.3 Trend monitoring using video transects

Trend monitoring using transects is suitable for documentation of changes within areas with only slight variations in habitat/seabed type. Parallel transects give representative observations and are also suitable for mapping of local distributions of organisms and seabed types. A minimum of three transects is required. The minimum combined length of the transects is dependent on the aims of the individual survey. If the aim is to detect changes in the diversity of organisms, the combined transect lengths should be at least 500 m. The number and length of transects should be adjusted in accordance with the aim of the investigation and the local conditions. In all other aspects the surveys are carried out as described for transect survey as described in 7.3.

Table 1 — Recommended minimum quality requirements for the parameters included within pilot surveys, mapping and trend monitoring

Method	Parameter	Pilot survey	Mapping	Trend monitoring
Video transects	Number/distribution	No specific requirements	variable[a]	3 transects
	Total length (per location)	No specific requirements	500 m[b]	500 m[b]
	Average speed over seabed	2 kn	1 kn	1 kn
	Height over seabed (max)	No specific requirements	3 m[c]	3 m[c]
	Image quality (size of detectable objects)[d]	4 cm	1 cm	1 cm
	Accuracy of positioning	≤ 20 m, relative tolerance + 5 % of depth Start and end	≤ 2 m, relative tolerance + 5 % of depth[e] Running positions	≤ 2 m, relative tolerance + 5 % of depth[e] Running positions
	Depth recording	Start point, end point max. depth, min. depth	For each position	For each position
Still photo-graphs	Number	1 per 100 m[a]	1 per 30 m[a]	5 per station
	Area	0,25 m^2 to 4 m^2	0,25 m^2 to 2 m^2	0,25 m^2 to 1 m^2
	Image quality (size of detectable objects)[d]	20 mm	5 mm	2 mm
	Accuracy of positioning	≤20 m, relative tolerance + 5 % of depth For each photo	≤ 2 m, relative tolerance + 5 % of depth[e] For each photo	0 (marker on the seabed)
	Depth recording	For each photograph	For each photograph	For each photograph

[a] Depending on required geographical resolution and the size of the mapping area, see 5.3.

[b] Only required for investigation of biological diversity.

[c] For mapping species > 10 cm a greater height from the seabed can be used.

[d] Image quality is here in the sense of identification of objects/organisms (size of object that can be identified, but not necessarily species determined).

[e] For water depth ≤ 20 m: 3 m with a relative tolerance of 3 % of the depth.

Video sequences or still photographs shall be calibrated with regard to field width either by controlling the height over ground or by at least two parallel laser pointers with calibrated distance between them.

NOTE For pilot surveys and mapping in depths less than 15 m it is also possible to give an estimation of the position of the under water system to the measured ship position including the estimated failure. The accuracy of the ship position is necessary.

7.7 Reference location

As part of surveys of areas affected by natural or human caused factors, a reference location outside the impacted area should be selected. Reference locations are decided according to whether a control or other reference needs to be provided. This is not necessarily a different location but can be the same location at a different point in time. Reference locations should to a largest possible degree represent the natural state without influence of any local sources, and should provide a measure of natural temporal and spatial variation in benthic communities. Reference locations should be included in surveys where comparison of the flora and fauna outside the influenced area is needed, or where knowledge about the natural variation is crucial. If reference locations are used these should be comparable with the impact locations, and the investigations should be performed in similar ways under similar conditions.

8 Image analysis

8.1 General

In this European Standard two types of image analyses are described:

— analyses of video sequences;

— analyses of still images (photographs or video "frame grabs").

The analyses should be standardised with respect to distance covered, e. g. by counting the numbers of organisms recorded per unit time. For colonial or encrusting organisms, the most common means of quantification is an estimate of the percent coverage of a specified unit area.

The choice of analytical approach depends on the objective of the survey and the characteristics of the habitat.

8.2 Analyses of video sequences

For quantitative analyses of video, the sequence lengths (sample size) should not be less than four times the error margins of the navigational data. For a navigational uncertainty of > 5 m, the use of video sequences < 20 m will carry an error margin of over 50 % of its actual length, thus the shortest sequence should not exceed 40 m. Solitary taxa should be counted within the video sequences, whereas encrusting and colonial taxa should be estimated as percentage coverage (see Table 3) from a representative subset of frozen video images.

8.3 Analyses of still images

Quantitative data should be presented as numbers of individuals or colonies per unit area, or as percent coverage. The percent coverage should either be measured directly, or by means of a "point count" method with 100 points evenly distributed along parallel lines placed both horizontally and vertically on the picture. The extent of coverage of organisms or habitats is then given as the percent of the points that coincide with organisms or substrate. In cases where the image is not taken perpendicular to the seabed, the network of points should be adjusted such that the distance between the points reflects the perspective of the image. For analysis of flora and macrofauna, the standard unit area is given as a 50 cm × 50 cm frame. This area should be marked as a central field on the images after photographing/recording.

8.4 Seabed substrates

Seabed substrates should be classified in accordance with the EN ISO 14688-1 for granulometric composition, see Table 2.

Table 2 — Particle size fractions and categories of seabed substrate for visual surveys of the seabed

EN ISO 14688-1		Survey type and minimum category	
Grain size	**Seabed substrate**	**Pilot**	**Mapping/Trend**
≤ 0,002 mm	Clay	Mud	Mud
> 0,002 mm to 0,063 mm	Silt		
> 0,063 mm to 2,0 mm	Sand	Coarse sediment	Coarse sediment
> 2 mm to 63 mm	Gravel		
> 63 mm to 200 mm	Cobble	Very coarse sediment	Cobble
> 200 mm to 630 mm	Boulder		Boulder
> 630 mm	Larger boulder/Bedrock[a]	Larger boulder/Bedrock[a]	Larger boulder/Bedrock[a]

[a] The definition of seabed type "bedrock" varies between standards. In EN ISO 14688-1 it is not defined as a particle with a certain minimum size because it is not part of the "soil"

Boulder with an extension larger than the visual field should be interpreted as bedrock as long as there are no clear indications of a separation from likely buried bedrock. For the finer sediment fractions, silt and clay, which are difficult to distinguish on video recordings, the combined term "mud" should be used. In the same way, sand and granule are combined as sand/granule. Recognition of mud and sand is based on structure in the image and not identification of single grains. Identification of grain size can be aided by letting the observation platform/ROV touch the seabed to stir up some sediment. In cases of uncertainty about the seabed substrate category a sediment sample should be taken for ground truthing. This can be made using a grab from the ship or using a small sediment corer mounted on the ROV or the towed observation platform.

If the percent composition of seabed types is to be recorded, this should be estimated as described above for analyses of flora and macrofauna from still images, following the scales given in Table 3.

8.5 Taxonomic identification

Identification of organisms should be carried out by personnel with documented education or experience within relevant areas of marine taxonomy. If the competence is not documented, the identification should be controlled by experts. Where available, identifiers should participate in national/international ring tests and other efforts towards taxonomic standardisation. Responsible institution should establish an image based reference collection from each investigation to document the taxonomical quality.

Images in a reference collection should as a minimum requirement be labelled with reference to the following data:

- Identification to lowest confident taxonomic level. If possible, species level is recommended;
- Geographic spatial location (with clear reference to which geodetic datum was used)/station number and water depth;
- Date and time of observation;
- Scientific name of the observed taxon according to ERMS (European Register of Marine Species);
- Morphological species if relevant;
- Information relating to copyright/freedom of use;
- Name of identifying person.

The nomenclature used should be in accordance with recent editions of general faunal works and an agreed regularly updated literature checklist or relevant catalogues of benthic fauna, such as the European Register of Marine Species (ERMS) [6] and/or World Register of Marine Species (WoRMS) [7]. Where a taxon is not listed in a catalogue, the reference to the original description should be given together with any additional identification literature used. Where a taxon has changed its name since list publication, then the new reference should be cited.

8.6 Identification and quantification of organisms

For mapping and monitoring surveys of biological communities and diversity of flora and megafaunal organisms should be identified to lowest possible taxonomic level.

Abundances should be recorded as numbers per unit area, for example per 10 m^2 for mapping and per m^2 for trend monitoring using still images covering a smaller area. A qualitative abundance scale (Table 3) can be used if quantification is of little relevance, for example for colonial organisms and in areas with mass occurrences of organisms. There are several similar scales that can be used for example the SACFOR scale.

NOTE The SACFOR scale provides intervals for relative abundance, relating to growth form and size of organisms.

Table 3 — Scale for calculation of extent of coverage for qualitative recordings of organisms

Interval-code	Coverage (colonial/encrusting organisms) or substrate %	Mass-occurring organisms (number of individuals or colonies per m^2)
6	100	>100
5	75 > 100	50 > 100
4	50 > 75	25 > 50
3	25 > 50	10 > 25
2	10 > 25	5 > 10
1	0 > 10	1 > 5
0	Not present	Not present

Alternatively, abundance quantification may be carried out on sub-samples ("frozen" video images). It is often not possible to identify specimens with certainty, and also there may be considerable variation between individuals within the same taxon. In such cases 'morphological species' should be used if their form, colour and size is described. For this purpose, a photographic reference collection should be included for all taxa and 'morphological species' in the reporting of results.

8.7 Reporting and archiving

8.7.1 Field report

Before recording, the storage medium (e.g. video cassette, DVD, or data file and hard disk) should be clearly labelled with the project or assignment code, station and sample number. Information on the date, time, geographic position and depth (metadata) should be noted on the form (see Annex A) at the start and end of recording. For mapping and trend monitoring, the same metadata should be logged during the video recording, or for each picture taken. Each still photograph should be given a separate sample number. This information can be stored as text directly on the recording/photograph or as a separate data file. The required frequency of logging of time and geo-references depends on the method and type of survey. If the observations are to be geo-referenced or quantified in relation to area, geographic data should as a minimum be logged at the beginning of each interval that marks a sequence in the video recording. The minimum geographic resolution should not exceed the limits set by the relative accuracy of the logged geographic data set. Additional information that may be useful during interpretation of results, for example weather conditions

or limitations of the vessel shall also be noted on the registration form. Annex A gives an example for a registration form.

Information on geographic position, depth and time, together with height above the seabed and camera angle if appropriate, should be recorded with reference to the image material in the form of time codes. This should be stored either as text on the video recordings or as a separate date file. For stored data files a record of time of sampling, given as GPS-time, for the start of the video recording (see informative Annex A) should be included.

As minimum the following information should be recorded during fieldwork:

— project identifier or contract code;

— institute responsible for the recordings;

— person(s) who carried out the recordings;

— locality identifier (station and sample/image number);

— date and time (start – stop);

— geographic datum and the method used (6.1);

— geographic coordinates (start point – end point);

— geographic coordinates for fixed reference points (for photographing);

— error margins for geographic positioning (specified by the manufacturer);

— type of equipment;

— water depth (start, stop, maximum and minimum for transect; or for each still photograph as appropriate);

— general description of seabed type (for example: mud, sand/granule, cobble, boulder, larger boulder);

— remarks on special observations.

8.7.2 Survey report

After survey, a report should be provided including all information noted in the forms (see Annex A) as well as a description of methods and equipment used and a copy of calibration report for hydroacoustic positioning equipment if such methods have been used.

Annex A
(informative)

Example for a fieldwork registration form for visual seabed surveys

Form 1 – Registration form for visual seabed surveys should be filled out during all types of surveys. This form provides general information about the project and the methods, as well as geographical positions for start and end points for inspection at each location. For trend monitoring using still photography of closely situated areas start and end points will often be identical.

Form 2 – Registration form for still photographs. This form is not relevant for video transects where still photography is not used.

The user of these forms is allowed to copy the present forms given below.

Form 1 – Fieldwork registration form for visual seabed surveys

Project no./name:	**Date:**
Responsible institution:	**Aim:**
Project leader:	
Personnel in field:	

Positions from:		**Geographic datum:**		**Video storage medium:**	
Map	☐	EUREF 89	☐	DV	☐
GPS	☐	WGS 84	☐	VHS	☐
DGPS	☐	ED 50	☐	DVD	☐
		UTM	☐	Hard disc	☐
		Other	☐	Other	☐

Field view calculation using:		**Trigonometric values:**
Laser points:	☐	Angle of view:
Trigonometry:*	☐	Camera angle:
*Demands logging of height above seabed and camera angle if varying		

Surveyed locations and video transects

Date and time:	**Locality no.:**	**Transect no.:**	**Position, start:**	**Position, end:**

Form 2 – Fieldwork registration form for still photography

Project no./name:	Date:
Responsible institution:	Station no.:
Project leader:	Persons in field:
Geographic datum:	

Ref. point no.:	Time:	Latitude:	Longitude:	Depth:	Image no.:

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