Marine Biology Research

ISSN: 1745-1000 (Print) 1745-1019 (Online) Journal homepage: https://www.tandfonline.com/loi/smar20

Approach and methods for sampling of benthic fauna on the 2004 MAR-ECO expedition to the Mid-Atlantic Ridge

Odd Aksel Bergstad & Andrey V. Gebruk

To cite this article: Odd Aksel Bergstad & Andrey V. Gebruk (2008) Approach and methods for sampling of benthic fauna on the 2004 MAR-ECO expedition to the Mid-Atlantic Ridge, Marine Biology Research, 4:1-2, 160-163, DOI: 10.1080/17451000701851477

To link to this article: https://doi.org/10.1080/17451000701851477

Published online: 26 Feb 2008.

Marine Biology Research, 2008; 4: 160–163

SHORT REPORT

Approach and methods for sampling of benthic fauna on the 2004 MAR-ECO expedition to the Mid-Atlantic Ridge

ODD AKSEL BERGSTAD[1] & ANDREY V. GEBRUK[2]

[1]*Institute of Marine Research, Flødevigen, His, Norway, and* [2]*P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow, Russia*

Abstract
During June and July 2004 the project MAR-ECO conducted a multidisciplinary expedition to the Mid-Atlantic Ridge between the Reykjanes Ridge and the Azores. Benthic macro invertebrates were collected by otter trawl at 22 locations. This report describes sampling approach, technology and sample-processing procedures.

Key words: *benthos, MAR-ECO, Mid-Atlantic Ridge, sampling, technologies*

Background

The North Atlantic is believed to be the most studied part of the world ocean, however, the knowledge of benthic fauna of the Mid-Atlantic Ridge remains very poor. The ridge is a chain of seamounts, but the ridge fauna is much less known than that of numerous seamounts in the open North Atlantic where several comprehensive research programmes have been carried out by different nations (Hempel & Nellen 1972; Mironov 1994; Rogers 1994; Pfannkuche et al. 2000; Mironov et al. 2006). Limited earlier works of the Mid-Atlantic Ridge benthic fauna were restricted to the Reykjanes Ridge (Kuznetsov 1985; Tendal 1998; for a review see Mironov & Gebruk 2006) and an area north of the Azores (Koehler 1909). Some observations of the Mid-Atlantic Ridge benthic fauna were made parallel to studies of hydrothermal activities on the ridge (Copley et al. 1996; Young 1998).

The MAR-ECO project aims to gather information on mid-ocean ridge macro- and megafaunal assemblages and their distribution patterns in relation to abiotic parameters. The target area extends from Iceland to the Azores, in waters associated with the Mid-Atlantic Ridge (Bergstad & Godø 2003). Early in the planning phase of the project, it was decided to focus on pelagic and benthopelagic fauna. With the limited ship-time available, targeting both pelagic and benthic fauna adequately would be difficult. Thus sampling of epibenthos was restricted to catches from bottom trawls and other gear targeting demersal nekton, e.g. longlines, and whatever observations could be made from unmanned and manned submersibles operating in the relevant area.

Research reports in the present issue represent diverse and extensive new taxonomic information on benthos. All reports are based on samples and data from the MAR-ECO expedition on the Norwegian research vessel *G.O. Sars* in June and July 2004. A full account of the strategies, methods and technology applied on the MAR-ECO expedition is given by Wenneck et al. (2008) in the MAR-ECO thematic issue of *Deep-Sea Research II*. In the present report only parts relevant to epibenthos sampling and processing are included.

Data on benthic fauna were also obtained from video records made during remote operating vehicle (ROV) dives (ROV *Aglantha* and *Bathysaurus*, Argus Remote Systems AS, Norway) on the MAR-ECO cruise of *G.O. Sars* and submersibles *Mir-1* and *Mir-2* dives on the 49th cruise of the RV *Akademik Mstislav Keldysh* (in 2003) as a part of the MAR-ECO project. These data are being analysed

Correspondence: A. V. Gebruk, P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences, Nakhimovsky Pr. 36, Moscow, 117997, Russia. E-mail: agebruk@sio.rssi.ru
Published in collaboration with the University of Bergen and the Institute of Marine Research, Norway, and the Marine Biological Laboratory, University of Copenhagen, Denmark

(Accepted 3 November 2007; Printed 18 February 2008)

ISSN 1745-1000 print/ISSN 1745-1019 online
DOI: 10.1080/17451000701851477

separately. Observations on occurrence of deep-water corals on the Mid-Atlantic Ridge were submitted to *Deep-Sea Research II* for its MAR-ECO thematic issue (Mortensen et al. 2008); observations on soft sediment fauna will be presented later.

Sampling strategy, methods and technology

The primary objectives of investigations on the south-bound Leg 1 of the 2004 expedition were to sample pelagic nekton and zooplankton communities throughout the MAR-ECO area from south of Iceland to the Azores, and the primary objective on Leg 2 (4 July to 5 August) was to collect data and biological samples on demersal animals in specific limited sub-areas (Bergstad & Godø 2003). Early in the planning phase it was realized that there was insufficient time during Leg 2 to sample all three MAR-ECO sub-areas. The northern waters of the Reykjanes Ridge had been sampled extensively during earlier cruises (e.g. Magnusson & Magnusson 1995; Copley et al. 1996; Mironov & Gebruk 2006), hence it was decided to focus effort in the middle and southern sub-areas (Figure 1).

Most activities were concentrated at pre-determined locations: seven in the southern and 13 in the middle sub-area. These had been selected to sample different depths on either side of the ridge axis. On an ad hoc basis, two trawls were made on the Faraday (SS 53) and one on the Hecate seamount (SS 65) to collect additional material from relatively shallow grounds. Prior to the cruise composite charts had been generated from available public charts and unpublished bathymetry datasets (see report by B. Murton on www.mar-eco.no/sci for more information). These were used to locate suitable sites, but in many cases the charts were inaccurate or imprecise at the horizontal scale of 100 to 1000 m required to deploy trawls and benthic landers. A multibeam echosounder (SIMRAD EM 300) and associated charting software (Olex AS, Trondheim, Norway) was used to map the locations selected for detailed study.

A 'superstation' was defined as a 2.5 by 2.5 nautical mile (1852 m) square within which a series of operations were carried out. However, this area was sometimes expanded, primarily due to discovery through use of multibeam mapping of unsuitable ground for trawling. Within the area, one or more

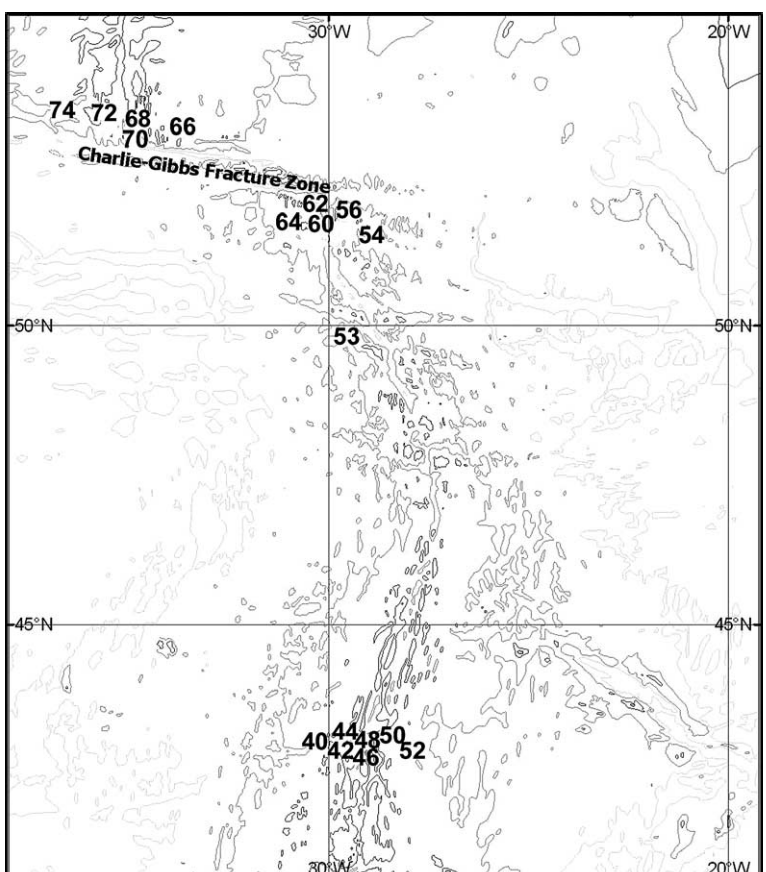

Figure 1. Locations of stations on the RV *G.O. Sars* MAR-ECO cruise, Leg 2.

Table I. Locations sampled by bottom trawl during Leg 2 of the 2004 MAR-ECO expedition. Environmental data included are near-bottom measurements with a CTD sensor (Søiland et al. 2008).

				Sampling location		Trawling depth (m)			Environmental data		
Sub-areas sampled	Super station	Trawl station	Date	Latitude	Longitude	Mean	Max.	Min.	Temp. (°C)	Salinity (psu)	Oxygen (ml l^{-1})
Southern MAR-ECO box	40	367	7 July 2004	42°55′N	30°20′W	2961	2968	2954	3.16	34.92	5.94
	42	368	8 July 2004	42°48′N	29°38′W	2078	2107	2063	3.93	34.97	5.78
	44	369	9 July 2004	42°55′N	29°32′W	1742	1767	1702	5.01	35.06	5.38
	46	370[a]	10 July 2004	42°45′N	29°16′W	3046	3068	3024			
	48	371[a]	11 July 2004	42°52′N	29°06′W	1072	–	–			
	46	372	11 July 2004	42°46′N	29°16′W	3031	3050	3005	3.48	34.93	5.89
	50	373	12 July 2004	43°01′N	28°33′W	2600	2607	2593	3.79	34.95	5.82
	52	374	13 July 2004	42°55′N	28°08′W	2977	2979	2973	3.18	34.93	5.86
Faraday seamount	53	375	15 July 2004	49°51′N	29°37′W	990	1003	981	3.82	34.90	6.08
	53	376	15 July 2004	49°51′N	29°37′W	985	1019	966	3.82	34.90	6.08
Middle MAR-ECO box, south	54	377	16 July 2004	51°19′N	28°52′W	3512	3527	3505	2.83	34.94	5.83
	56	378	17 July 2004	51°45′N	29°33′W	1916	1950	1872	3.43	34.90	6.13
	60	379	19 July 2004	51°33′N	30°18′W	1263	1296	1237	3.91	34.90	6.01
	62	380	20 July 2004	51°55′N	30°25′W	1910	1959	1872	3.42	34.90	6.14
	64	381	21 July 2004	51°32′N	30°58′W	3461	3465	3452	2.90	34.93	6.04
Hecate seamount	65	382[a]	23 July 2004	52°16′N	31°00′W	753	979	607			
Middle MAR-ECO box, north	66	383	24 July 2004	53°01′N	33°36′W	3030	3071	2995	2.91	34.98	5.98
	68	384	25 July 2004	53°08′N	34°46′W	2350	2374	2306	2.99	34.98	6.02
	70	385	26 July 2004	52°58′N	34°52′W	1650	1670	1630	3.13	34.94	6.10
	72	386	27 July 2004	53°16′N	35°31′W	2548	2567	2522	3.08	34.97	6.01
	74	387[a]	28 July 2004	53°17′N	36°46′W	3055	3063	3048			
	74	388[a]	28 July 2004	53°17′N	36°47′W	3058	3065	3047			

[a]Trawls with problems, excluded from analyses.

bottom tows were conducted as part of the more comprehensive sampling programme that included the following gear and actions (referred to by 'local station' number in Table I):

- Deployment of a free-fall baited photographic lander (ROBIO, see King et al. 2006).
- A CTD sensor (Seabird, SBE 911plus), water sample, and vertical ADCP profile (Teledyne RDI 300 kHz Monitor WorkHorse), including also on many stations an ISIT camera system (Oceanlab, University of Aberdeen) to record vertical distribution of bioluminescence.
- Mapping of the entire area by SIMRAD EM 300 multibeam echosounder (see below).
- An ROV dive (ROVs *Aglantha* and *Bathysaurus*, Argus Remote Systems AS, Bergen, Norway), either only pelagic or both pelagic and demersal. Demersal dives included two perpendicular 400 m long transects, and additional exploratory excursions.
- A bottom trawl tow of duration depending on bottom conditions determined from the bathymetry survey.

The bottom trawl used was a Campelen 1800 shrimp trawl as described in Wenneck et al. (2008). Horizontal opening between the upper bridles at the wing tips was 17 m at 50 m doorspread, while the distance between Danlenos at the tips of the ground gear was 12 m. Vertical opening was 4.5 m at 50 m doorspread. The trawl was equipped with a 22 mm mesh size cod-end liner. The groundgear (rock-hopper type, with discs of 35 cm diameter) travelled 3.5 m behind the headrope in the centre of the trawl. There was 10 m of chain as a first part of the lower bridles in front of the Danlenos. According to video recordings made using camcorders and lamps in deep-water housings attached to the headrope, the rockhoppers travelled within the normally soft substrate, more than halfway submerged, so that most fish and epifauna on the bottom was caught. The winch drums held 5000 m of 24 mm wire and this permitted trawling to 3500 m at a towing speed of 1.5 knots. To monitor trawl configuration and performance a full suite of newly developed wireless SCANMAR deep-water sensors (Scanmar AS, Norway) with reserves was applied.

Since charts proved imprecise or inaccurate, real-time bathymetry mapping using a multibeam sounder was used to locate a suitable trawling path within the pre-determined superstations. A Kongsberg SIMRAD EM 300 30 kHz $1^\circ \times 2^\circ$ multi-beam bottom profiling sounder provided data for a detailed 3-D mapping of each superstation, normally with a swath width of around 2800–4600 m. In good weather these data could be collected at a vessel speed of 5 knots. Raw data were transferred to and presented in real time by the Olex navigational plotting system, and 3-D maps of the superstations at user-selected perspective angles and orientations.

Using this two-stage process, 22 locations were mapped and trawled. Of the 22 tows, 17 were considered technically satisfactory (Table I) and valid for use in studies of demersal fishes and epibenthic/benthopelagic invertebrate megafaunal taxa.

Processing of benthos samples and collections

Benthic fauna was sorted on board by higher taxonomical groups. Samples were preserved in 80° alcohol, or 4% buffered formaldehyde depending on taxonomic affiliations. Specimens in the best condition of most taxa were photographed prior to preservation.

All samples have been deposited at the Museum of Zoology, University of Bergen (ZMBN). Species identification was provided by taxonomic experts invited to Bergen to work with the collection, and in some cases material has been sent out to specialists for identification.

Acknowledgements

The authors thank the officers and the crews of the RV *G.O. Sars* and the RV *Akademik Mstislav Keldysh* for their help at sea. We are also grateful to the pilots of ROVs *Bathysaurus* and *Aglantha* and submersibles *Mir-1* and *Mir-2*. Special thanks are due to the staff of the Museum of Zoology, University of Bergen for curating the MAR-ECO collections. Two anonymous referees helped us to improve the manuscript. This publication and all papers in the present issue of *Marine Biology Research* are elements of MAR-ECO, a field project under the Census of Marine Life programme.

References

Bergstad OA, Godø OR. 2003. The pilot project 'Patterns and processes of the ecosystems of the northern Mid-Atlantic': aims, strategy and status. Oceanologica Acta 25:219–26.

Copley JTP, Tyler PA, Sheader M, Murton BJ, German CR. 1996. Megafauna from sublittoral to abyssal depths along the Mid-Atlantic Ridge south of Iceland. Oceanologica Acta 19:549–59.

Hempel G, Nellen W. 1972. Bericht über den Verlauf der Roßbreiten-Expedition 1970 (19. Reise von F.S. 'Meteor' vom 11. Januar bis 3. April 1970). 'Meteor' Forschungsergebnisse A 10:51–78.

King N, Bagley PM, Priede IG. 2006. Depth zonation and latitudinal distribution of deep sea scavenging demersal fishes of the Mid-Atlantic Ridge, 42°–53°N. Marine Ecology Progress Series 319:263–74.

Koehler R. 1909. chinodermes provenant des campagnes du yacht Princesse-Alice (Astéries, Ophiures, Échinides et Crinoïdes). Résultats des Campagnes Scientifiques Accomplies sur son Yacht par Albert Ier Prince Souverain de Monaco 34:1–317.

Kuznetsov AP. 1985. Bottom fauna of the Reykjanes Ridge rift zone. Quantitative distribution, trophic structure, communities. Trudy Instituta Okeanologii AN USSR 120:6–20. Russian with English summary.

Magnusson JV, Magnusson J. 1995. The distribution, relative abundance and the biology of the deep-sea fishes of the Icelandic slope and Reykjanes ridge. In: Hopper AG, editor. Deep-water Fisheries of the North-Atlantic Oceanic Slope. London: Kluwer. p 161–200. (NATO ASI Series, Series E, Applied Sciences; 296).

Mironov AN. 1994. Bottom faunistic complexes of oceanic islands and seamounts. Trudy Instituta Okeanologii AN USSR 129:7–16. Russian with English summary.

Mironov AN, Gebruk AV. 2006. Biogeography of the Reykjanes Ridge, the northern Atlantic. In: Mironov AN, Gebruk AV, Southward AJ, editors. Biogeography of the North Atlantic Seamounts. Moscow: KMK Scientific Press. p 6–21.

Mironov AN, Gebruk AV, Southward AJ editors. 2006. Biogeography of the North Atlantic Seamounts. Moscow: KMK Scientific Press. 201 p.

Mortensen PB, Buhl-Mortensen L, Gebruk AV, Krylova EM. 2008. Occurrence of deep-water corals on the Mid-Atlantic Ridge based on MAR-ECO data. Deep-Sea Research II. 55:142–52.

Pfannkuche O, Müller TJ, Nellen W, Weper G, editors. 2000. Meteorberichte Ostatlantic 1998, Cruise 42, 16 June–26 October 1998. Leitstelle Meteor. Hamburg: Institut für Meereskunde der Universität Hamburg. 259 p.

Rogers A. 1994. The biology of seamounts. Advances in Marine Biology 30:306–50.

Søiland H, Budgell WP, Knutsen Ø. 2008. The physical oceanographic conditions along the Mid Atlantic Ridge north of the Azores in June–July 2004. Deep-Sea Research II. 55:29–44.

Tendal OL. 1998. The Viking Sea revisited. Ocean Challenge 8(2):32–36.

Wenneck T de Lange, Falkenhaug T, Bergstad OA. 2008. Strategies, methods, and technologies adopted on the RV G.O. Sars MAR-ECO expedition to the mid-Atlantic Ridge in 2004. Deep-Sea Research II. 55:6–28.

Young PS. 1998. Cirripeds (Crustacea) from the Mid-Atlantic Ridge collected by the submersible Nautile. Cahiers de Biologie Marine 39:109–19.

Editorial responsibility: Franz Uiblein