SESAME

Southern European Seas: Assessing and Modelling Ecosystem changes

SESAME SP APRIL Cruise

Brief report

Chief scientist: Gabriel Navarro

CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

SESAME SP Cruise
R/V REGINA MARIS
6 - 14 April 2008

Figure 1: Regina Maris: Oceanographic research vessel

Vessel: Regina Maris (Junta de Andalucia)

Embarkation: Cadiz, 06 April 2008

Disembarkation: Cadiz, 14 April 2008

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INSTITUTION INVOLVED

ICMAN – CSIC, Instituto de Ciencias Marinas de Andalucia (Cadiz)

IMEDEA – CSIC, Instituto Mediterraneo de Estudios Avanzados (Mallorca)

Participant List		
Name and Surname	**Organization**	**Activity on board**
Gabriel Navarro	ICMAN-CSIC	Chief scientist
Itziar Alvarez	IMEDEA-CSIC	Mesozooplankton
Pedro Echeveste	IMEDEA-CSIC	Bacterial/Phytoplanckton abundance and biomass
Susana Flecha	ICMAN-CSIC	Biogeochemistry
Sebastien Lasternas	IMEDEA-CSIC	Bacterial/Phytoplanckton abundance and biomass
Antonio Moreno	ICMAN-CSIC	Mesozooplankton
David Roque	ICMAN-CSIC	Physical Oceanography
Simone Taglialatela	ICMAN-CSIC	Biogeochemistry

PARAMETER LIST	**Responsible**	**Institute**
First priority		
Pres, Temp, Sal, Ox, Fluo (CTD)	Roque	ICMAN-CSIC
Beam attenuation (CTD)	Roque	ICMAN-CSIC
O_2 (Winkler on board)	Flecha	ICMAN-CSIC
Nutrients (NO_2, NO_3, PO_4, $Si(OH)_4$)	Flecha	ICMAN-CSIC
Second priority		
DOC & DON	Flecha	ICMAN-CSIC
Phytoplankton abundance & composition	Echeveste	IMEDEA-CSIC
Mesozooplankton abundance	Taglialatela	ICMAN-CSIC
Mesozooplankton biomass	Álvarez	ICMAN-CSIC
Bacterial abundance	Lasternas	IMEDEA-CSIC
Under way measurements		
Thermosalinograph	Roque	ICMAN-CSIC

OBJECTIVES

The SESAME SP1 cruise goal was that of covering 33 stations in two transects requested by the Project. Twenty three (23) stations were sampled along a west-east transect plus 10 additional stations along a north - south transect at 4°W. The duration of the cruise was about nine days. Water sampling were from the surface down to a maximum depth of 500 m. At some selected stations, the sampling will be done down to the bottom.

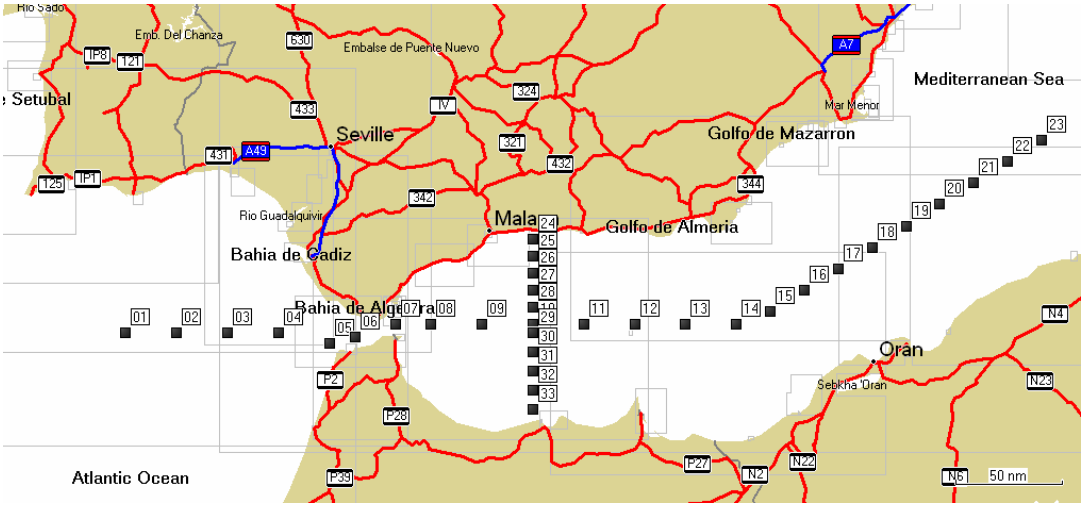

Figure 2: Study area and sampling stations (CTD, biogechemical, bacterial and phytoplankton)

EXPECTED RESULTS

- Physical, chemical and biological data acquisition and realization of a common data set
- Analysis of physical (temperature, salinity and density), chemical (oxygen, nutrients, dissolved organic carbon an nitrogen, alkalinity) and biological (bacteria, phytoplankton, mesozooplankton) parameters
- Combined interpretation of the data to investigate possible links among physical, chemical and biological processes
- Contribution to the characterization of the trophic regimes of Mediterranean Sea
- Realization of an homogeneous data set on sub-regional scale for the ecosystem analysis and for the comparison between experimental data and model simulation for their calibration.

DESCRIPTION OF ACTIVITIES

SESAME SP-I cruise foresaw 33 stations. Samples were collected at the following depths: 5, 20, 50, 75, 100, 150, 200, 500, in the stations reported in the map (fig.2). In some station, WP2 and bongo hauls were performed (fig. 3). CTD cast was deployed till 500 meters depth due to maximum depth for several external sensors.

Date	Time (UTC)	Station Name	Bottom depth (m, aprox.)	Lat - N	Lon
04/07/2008	18:21	S-SP1-008	780	N 36º 00.0'	W 5º 00.0'
04/07/2008	21:57	S-SP1-009	> 1000	N 36º 00.0'	W 4º 30.0'
04/08/2008	01:27	S-SP1-010	> 1000	N 36º 00.0'	W 4º 00.0'
04/08/2008	04:44	S-SP1-011	1000	N 36º 00.0'	W 3º 30.0'
04/08/2008	8:20	S-SP1-012	200	N 36º 00.0'	W 3º 00.0'
04/08/2008	12:23	S-SP1-013	>1000	N 36º 00.0'	W 2º 30.0'
04/08/2008	16:00	S-SP1-014	>1000	N 36º 00.0'	W 2º 00.0'
04/08/2008	19:40	S-SP1-015	>2000	N 36º 06.0'	W 1º 40.0'
04/08/2008	22:42	S-SP1-016	>2000	N 36º 16.0'	W 1º 20.0'
04/09/2008	02:02	S-SP1-017	>2000	N 36º 26.0'	W 1º 00.0'
04/09/2008	05:03	S-SP1-018	>2000	N 36º 36.0'	W 0º 40.0'
04/09/2008	08:40	S-SP1-019	>2000	N 36º 46.0'	W 0º 20.0
04/09/2008	12:19	S-SP1-020	>2000	N 36º 56.0'	W 0º 00.0'
04/09/2008	15:24	S-SP1-021	>2000	N 37º 06.0'	E 0º 20.0'
04/09/2008	19:00	S-SP1-022	>2000	N 37º 16.0'	E 0º 40.0'
04/09/2008	22:05	S-SP1-023	>2000	N 37º 26.0'	E 1º 00.0'
04/11/2008	5:35	S-SP1-024	250	N 36º 40.0'	W 4º 00.0'
04/11/2008	7:52	S-SP1-025	560	N 36º 32.0'	W 4º 00.0'
04/11/2008	9:55	S-SP1-026	500	N 36º 24.0'	W 4º 00.0'
04/12/2008	9:32	S-SP1-027	900	N 36º 16.0'	W 4º 00.0'
04/12/2008	11:57	S-SP1-028	>1000	N 36º 08.0'	W 4º 00.0'
04/12/2008	14:07	S-SP1-029	>1000	N 35º 56.0'	W 4º 00.0'
04/12/2008	16:59	S-SP1-030	800	N 35º 47.0'	W 4º 00.0'
04/12/2008	19:00	S-SP1-031	>1000	N 35º 38.0'	W 4º 00.0'
04/12/2008	21:00	S-SP1-032	393	N 35º 29.0'	W 4º 00.0'
04/12/2008	22:50	S-SP1-033	396	N 35º 20.0'	W 4º 00.0'
04/13/2008	7:20	S-SP1-007	> 800	N 35º 56.0'	W 8º 00.0'
04/13/2008	11:54	S-SP1-006	260	N 35º 56.0'	W 7º 30.0'
04/13/2008	15:03	S-SP1-005	355	N 35º 56.0'	W 7º 00.0'
04/13/2008	16:10	S-SP1-004	450	N 35º 56.0'	W 6º 30.0'
04/13/2008	22:40	S-SP1-003	850	N 35º 51.0'	W 6º 00.0'
04/14/2008	02:21	S-SP1-002	>1000	N 35º 54.0'	W 5º 45.0'
04/14/2008	05:54	S-SP1-001	>1000	N 36º 00.0'	W 5º 21.0'

Table I. Information about date, time, depth and position of the stations.

DATE	STATION NAME	CTD	BIOGEO-CHEMICAL	BACT. PHYTO	MESOZOO
04/07/2008	S-SP1-008	X	X	X	
04/07/2008	S-SP1-009	X	X	X	
04/08/2008	S-SP1-010	X	X	X	
04/08/2008	S-SP1-011	X	X	X	
04/08/2008	S-SP1-012	X	X	X	X
04/08/2008	S-SP1-013	X	X	X	X
04/08/2008	S-SP1-014	X	X	X	X
04/08/2008	S-SP1-015	X	X	X	
04/08/2008	S-SP1-016	X	X	X	
04/09/2008	S-SP1-017	X	X	X	
04/09/2008	S-SP1-018	X	X	X	
04/09/2008	S-SP1-019	X	X	X	X
04/09/2008	S-SP1-020	X	X	X	X
04/09/2008	S-SP1-021	X	X	X	X
04/09/2008	S-SP1-022	X	X	X	X
04/09/2008	S-SP1-023	X	X	X	
04/11/2008	S-SP1-024	X	X	X	X
04/11/2008	S-SP1-025	X	X	X	X
04/11/2008	S-SP1-026	X	X	X	X
04/12/2008	S-SP1-027	X	X	X	X
04/12/2008	S-SP1-028	X	X	X	X
04/12/2008	S-SP1-029	X	X	X	X
04/12/2008	S-SP1-030	X	X	X	X
04/12/2008	S-SP1-031	X	X	X	
04/12/2008	S-SP1-032	X	X	X	
04/12/2008	S-SP1-033	X	X	X	
04/13/2008	S-SP1-007	X	X	X	X
04/13/2008	S-SP1-006	X	X	X	X
04/13/2008	S-SP1-005	X	X	X	X
04/13/2008	S-SP1-004	X	X	X	
04/13/2008	S-SP1-003	X	X	X	
04/14/2008	S-SP1-002	X	X	X	
04/14/2008	S-SP1-001	X	X	X	X

Table I. Information about the sampling in each station.

Measured parameters.

CTD cast: CTD SBE25+: pressure, temperature, conductivity, dissolved oxygen, transmisometer and fluorescence. Till 500 meter depth.

Thermosalinograph

Biogeochemical. (Water samples were taken with rosette – 12 bottles/5 liters).

- Dissolved Oxygen
- Chlorophyll
- Nutrients (NO_2, NO_3, PO_4, $Si(OH)_4$).
- pH
- Total alkalinity
- Dissoved organic carbon (COD) and Dissolved organic nitrogen (DON).

Biology:

- Bacterial abundance (IMEDEA-CSIC): 4 depth were sampled at the 33 stations in order to appreciate the bacterial abundance distribution in the study area.

- Phytoplankton (abundance, composition) (IMEDEA-CSIC)

  The abundance of both, microphytoplankton and picophytoplankton was followed during this cruise. Water for nano-microphytoplankton abundance was sample at the 33 stations, at 1 or 2 depths. Phytoplankton cells will be counted and classified into the 3 major microphytoplankton groups that are: Diatoms, Dinoflagelates and Flagelates. Picophytoplankton abundance was examined from 4 depths at the 33 stations.

- Mesozooplankton (abundance, biomass) (IMEDEA-CSIC).

  Two mesozooplankton fractions will be sampled:

  Priority 1: Mesozooplankton were sampled in the upper 200 m of the water column. Parameters will include relative abundance (ind/m3), biovolume, carbon content (mgC/m3) and functional groups quantification using image-analysis techniques.

  Priority 2: Ichthyoplankton. Fish eggs and larvae were sampled at several stations down to 200 m. They will be identified to species level when possible and the relative abundance (ind/m3) will be calculated.

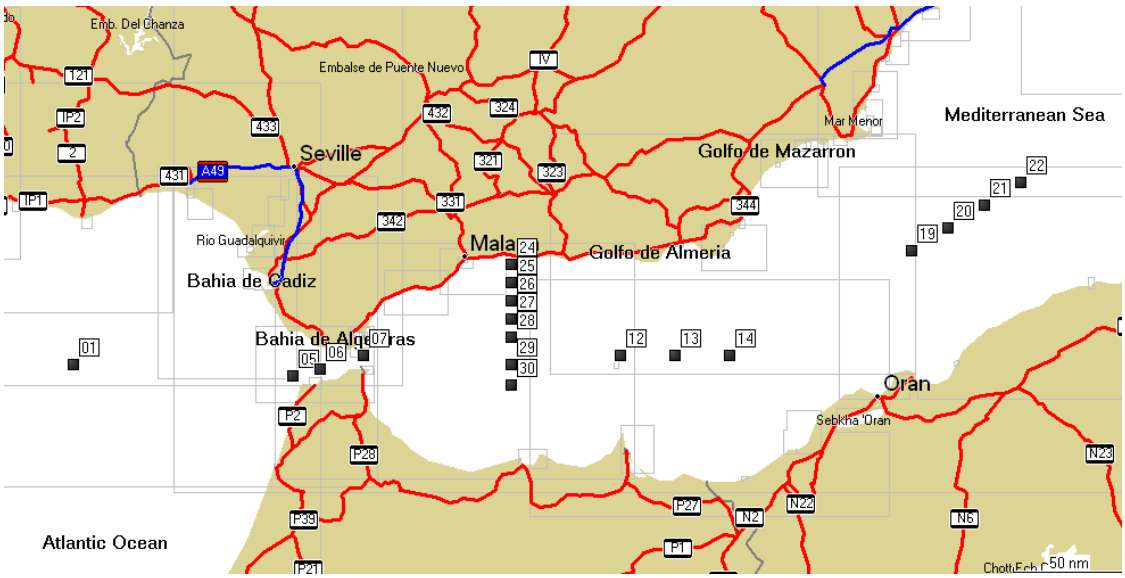

Figure 3: Study area and sampling stations (Mesozooplancton)

Outline of the method used (Actually, analysis of these varaibles are in progress).

Dissolved oxygen

Samples for dissolved oxygen (DO) measurements were withdrawn directly from the Nisking bottles in seal flasks and stored in darkness for at least 24 hours, as described by the Winkler method. Analysis was performed by potentiometric titration using a Metrohm 794 Titoprocessor, with an estimated error of ± 1 μmol kg^{-1}.

Chlorophyll

Samples for chlorophyll measurements were filtered through Whatman GF/F filters, which were frozen at –20 °C until analysis in the laboratory. Chlorophyll was extracted from the filters with 90% acetone and measured by fluorescence with a Turner design 10-AU fluorometer according to Yentsch and Menzel (1963).

Nutrients

Two replicates of filtered seawater (12 mL, Whatman GF/F filters) were taken at each sampling station and stored at -20 ºC for inorganic nutrient concentration determination. Concentrations of nitrate, nitrite, phosphate and silicate were measured in the laboratory using a Skalar San^{++}System autoanalyser following the techniques of Strickland and Parson (1972).

pH

The pH was measured following the spectrophotometric method of Clayton and Byrne (1993) using m-cresol purple as indicator, and consequently, the scale used was total. Samples were collected directly from the rosette in 10cm path-length optical glass cells and measurements were carried out on board with a Shimadzu UV-2401PC

spectrophotometer containing a 25ºC-thermostated cells holder. Seawater, also previously thermostated to 25ºC, was analyzed for a blank determination at 730, 578 and 434 nm and 50 μl of the dye was subsequently injected and the measurements repeated. Three photometric replicates were carried out for each injection in order to remove any dye effect. The pH values were then calculated according to:

$$pH = pK + \log(R - 0.0069)/(2.222 - 0.133R)$$

where K_{ind} was the dissociation constant for the indicator and R was the ratio of indicator absorbances at molar absorptivity maxima (R=A578/A434) that was corrected for base line absorbance at 730 nm. The method has a precision of ± 0.003 pH units and measurements were shown to be internally consistent with other carbon dioxide measurements by using the above mentioned certified reference materials.

Total alkalinity

Total alkalinity (A_T) was determined by titration of seawater using a potentiometric system as described in Pérez et al., (2000) with a Metrohm 794 Titoprocessor. Water samples were taken from the Niskin bottles in 500 mL borosilicate bottles and poisoned with 100 μL of a saturated aqueous solution of mercuric chloride for later shore-based analysis. The accuracy of the A_T determination was assessed by regular measurements of Certified Reference Material (CRM, supplied by Prof. Andrew Dickson, Scripps Institution of Oceanography, La Jolla, CA, USA).

Dissolved organic matter (DOC, DON)

For the analysis of dissolved organic carbon (DOC) and dissolved organic nitrogen, samples of 20 mL were filtered through precombusted 47-mm Whatman GF/F filters and collected in acid-cleaned precombusted 15-mL vials. After acidification with H_3PO_4 to pH <2, they were sealed with Teflon-lined caps and stored in the dark at 4 °C until analyzed in the laboratory. DOC and TDN (total dissolved nitrogen) content in samples is measured with a commercial Shimadzu TOC-V_{CPH} analyzer working under the principle of high-temperature catalytic oxidation according to the protocol described by Alvarez-Salgado and Miller (1998) and equipped with a chemiluminescence detector. DON is estimated after subtracting inorganic nitrogen measured as described above to the TDN concentration provided by the analyzer.

Calculation of inorganic carbon concentration

From pH data and A_T values, the concentration of inorganic carbon (C_T) is calculated using the dissociation constants from Mehrbach et al. (1973) refitted by Dickson and Millero (1987).

Phytoplankton/Bacterial abundance

Microphytoplankton: 250ml of seawater from surface and deep chlorophyll maximum (DCM) will be fixed in lugol (2% v/v). The sample are being processed in IMEDEA by inverted light transmitted microscopy.

Pico - nanophytoplankton: At each station, for each depth, 1ml sample were fixed with 1% glutaraldehyde, then deep frozen in liquid nitrogen after 10min. Samples were thereafter unfrozen and ran through flow cytometry to estimate total abundance.
Moreover, cells viability has been estimated by using the cell digestion assay (CDA, Agusti and Sanchez, 2002), samples were also be freezed in liquid nitrogen until processed in IMEDEA laboratory by using flow citometry.

Bacterioplankton total abundance
1ml samples were fixed with 1% glutaraldehyde (final), after 10 minutes in the dark, deep frozen in liquid nitrogen.
The samples were then unfrozen, 400µl samples stained with 4µl SyBR Green (Molecular Probes), let 10 minutes to stain in the dark and were ran through a flow cytometer.

Mesozooplankton – Ichthyoplankton

Mesozooplankton: samples were taken using a standard (57 cm) WP2 net equipped with 200 µm mesh and a mechanical flowmeter (Mod. General Oceanics 2030) attached 2/3 of the mouth. Vertical tows will be performed down to a maximum of 200 m at each station at standard velocities. Angles over 15 degrees will be rejected. Only stations that fall within the daylight hours will be sampled (between 8:00 – 20:00 local time). The samples will be divided in two using the beakers technique. One part will be fixed in borax-buffered 4% formalin for taxonomic identification. The other half will be stored at -20C for biomass determination, and will be treated fresh back in the lab. The filtered volume will be obtained both by flowmeter conversions and by using geometric approximations. Taxonomic identification will be only conducted to the level of functional group and main size classes using a calibrated image-analysis system. Biomass will be calculated following the protocol adopted by the most recent protocol agreed by the WP2 participants, which basically obtains the dry weight after “cleaning”, fractionating and dessicating the sample, which is then converted to carbon units by analysing a subsample through a CHN analyser.

Ichthyoplankton: Samples will be collected using oblique standard bongo 60 hauls, using 335 µm meshes and mechanical flowmeters. Hauls were down to 200 m and samples were fixed using 4% borax-buffered formalin at a pH over 8.2. Relative abundance (ind/m3) will be calculated for each identified group, and selected species of relevance to SESAME will be further analysed for developmental traits. Hauls will be performed only when WP2 hauls were conducted to have simultaneous meso and Ichthyoplankton data.

DETAILED PLAN OF THE ACTIVITIES

6 April 2008

18:00 Sunday afternoon, we were ready to leave Cádiz. First, we wanted to go to Station 1, but the weather in the gulf of Cadiz was very bad, so we decided navigate to Station 8, in the Mediterranean Sea.

7 April 2008

18:20 **Station 8.** CTD cast (400 m), biogeochemical sampling and Bacterial Phytoplancton sampling.

21:57 **Station 9.** CTD cast (400 m), biogeochemical sampling and Bacterial /Phytoplancton sampling.

8 April 2008

01:27 **Station 10.** CTD cast (400 m), biogeochemical sampling and Bacterial /Phytoplancton sampling.

04:44 **Station 11.** CTD cast (450 m), biogeochemical sampling and Bacterial/Phytoplancton sampling.

08:20 **Station 12.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2).

12:23 **Station 13.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2).

16:00 **Station 14.** CTD cast (500 m), biogeochemical sampling and Bacterial/Phytoplancton sampling. Mesozooplancton sampling (WP2, bongo).

19:40 **Station 15.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling.

22:42 **Station 16.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling.

9 April 2008

02:02 **Station 17.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling.

05:03 **Station 18.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling.

08:40 **Station 19.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2, bongo).

12:19 **Station 20.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2).

15:24 **Station 21.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2).

19:00 **Station 22.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2).

22:05 **Station 23.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling.

10 April 2008

We navigated to station 24 during 250 miles with rough sea.

11 April 2008

5:35 **Station 24.** CTD cast (225 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2, bongo).

07:52 **Station 25.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2).

09:55 **Station 26.** CTD cast (450 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2).

The weather was very bad and we navigated to Malaga port. We were in Malaga during one night.

12 April 2008

09:32 **Station 27.** CTD cast (300 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2).

11:57 **Station 28.** CTD cast (400 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2).

14:07 **Station 29.** CTD cast (450 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2, bongo).

16:59 **Station 30.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2).

19:00 **Station 31.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling.

21:00 **Station 32.** CTD cast (400 m), biogeochemical sampling and Bacterial /Phytoplancton sampling.

22:50 **Station 33.** CTD cast (350 m), biogeochemical sampling and Bacterial /Phytoplancton sampling.

13 April 2008

07:20 **Station 7.** CTD cast (225 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2).

11:54 **Station 6.** CTD cast (200 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2).

15:03 **Station 5.** CTD cast (300 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2, bongo).

16:10 **Station 4.** CTD cast (400 m), biogeochemical sampling and Bacterial /Phytoplancton sampling.

22:40 **Station 3.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling.

14 April 2008

02:21 **Station 2.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling.

05:54 **Station 1.** CTD cast (500 m), biogeochemical sampling and Bacterial /Phytoplancton sampling. Mesozooplancton sampling (WP2, bongo).

We arrived to Cadiz about 16:00 hours.