offshore biological monitoring (Dicks, 1982) is the point at which damage to a marine ecosystem becomes significant. A related question is that of the relevance of biological surveys after an accident. Answers depend on the point of view from which one wants to tackle the problem.

There have been several 'Viewpoint' articles on ecological monitoring (Gray, 1980; Dicks, 1982; Hartley, 1982) in this journal. They have indicated that many long-term studies on offshore oil fields are conducted on behalf of the oil companies. The aim of the studies was to pinpoint changes in the environment as a result of their operations. Results available to date indicate that biological effects of offshore oilfields are relatively small and it is tempting to suggest that monitoring offshore may be unnecessary in the future (Dicks, 1982). But the function of monitoring goes further than gathering data about changes under normal conditions. Closed bag experiments to monitor changes on the population and ecosystem level (Davies *et al.*, 1981) do help to predict in a more realistic way the possible effects of an actual pollution accident. However, as long as the scientific knowledge of the marine environment is generally thought to be restricted, it would be worthwhile taking the results of present ecosystem research as a starting point, rather than a substitute for ecological survey after an environmental accident, regardless of the expected consequences for the environment.

It is important for both the oil industry and the government to agree that the impact assessment of an accident is in principle a worthwhile activity. Only then will it be possible to organize appropriate surveys at the right moment in a more or less standardized way. The results may then contribute to the knowledge of pollution effects. The environment itself, the kind of the accident, the knowledge of comparable problems, the existing directives and sometimes the political situation, will be taken into account to determine whether a biological survey of the accident is thought to be useful and whether it should indeed be carried out.

The cooperation of the Netherlands Institute for Sea Research (NIOZ), Texel, is acknowledged.

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BASELINE

Heavy Metals in Recent Sediments from the Bay of Cadiz, Spain

The results obtained in the study of the degree of accumulation of organic matter and heavy metals in the sediments of the Bay of Cadiz (Spain) are shown in this paper. More specifically, the solid content, organic carbon, PO_4^{3-}, Fe, Mn, Zn, Cu, Pb and Cd in the superficial sediments (3 cm) of 20 sampling stations distributed throughout the bay and some channels flowing from it were determined (Fig. 1). The establishment of the contamination levels is of great interest because they are related to the utilization of the salt-ponds as marine piscifactories. Our work is part of a long-term research programme concerning the exploitation of biological resources in this area (Establier, 1975).

The samples were frozen awaiting analysis. Later, they were dried at 105°C for 20 h and all solids foreign to the sediment were eliminated, ground and strained at 200 μm. The solid content was determined as the weight loss at 110°C of a 5 g aliquot of original wet sample. Organic carbon was determined using the technique of Gaudette *et al.* (1974). The sediments were calcinated at 450°C and the acid extract

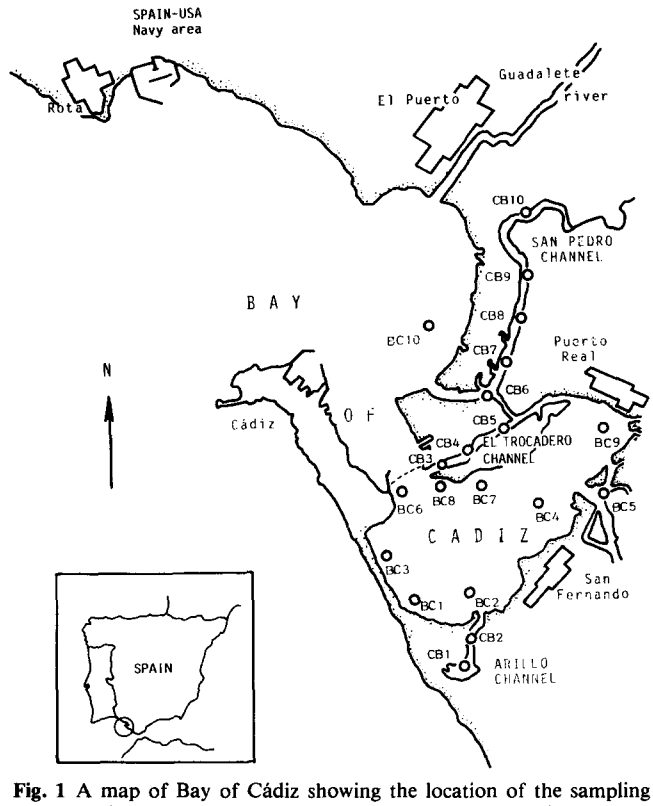

Fig. 1 A map of Bay of Cádiz showing the location of the sampling stations in March 1982. All of them are situated within the intertidal region.

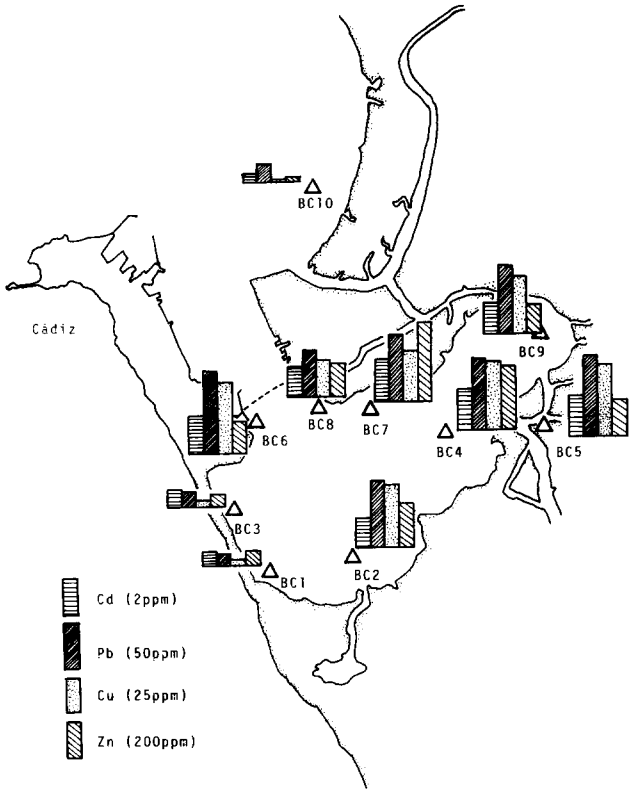

Fig. 2 Cd, Pb, Cu and Zn values obtained from the Bay of Cádiz sediments.

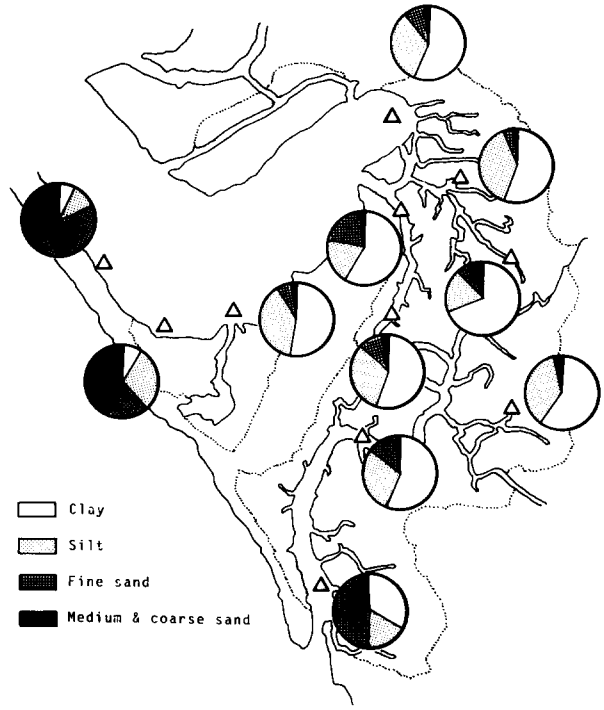

Fig. 4 Clay, silt, fine sand and medium and coarse sand abundance in the sediments of studied area.

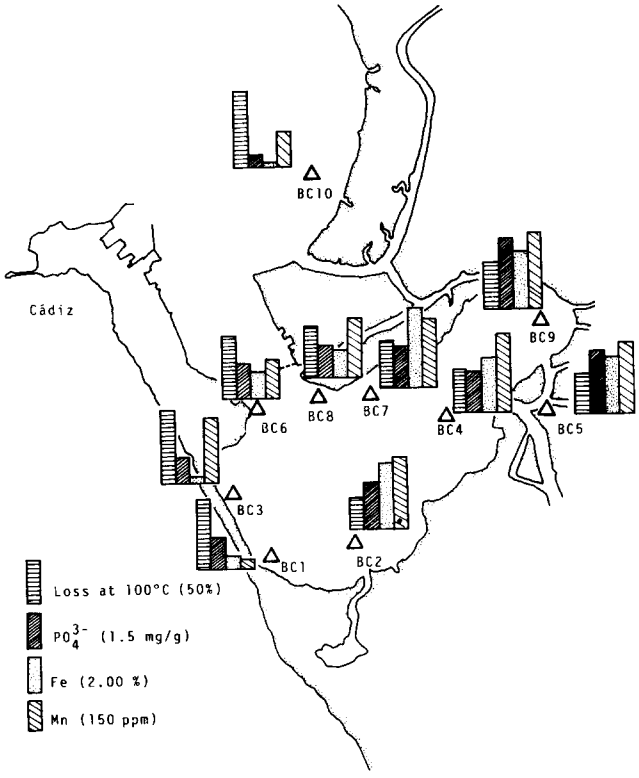

Fig. 3 Loss of weight at 110°C (total solids), PO_4^{3-}, Fe and Mn values obtained from the Bay of Cádiz sediments.

was analysed by atomic absorption; the method of Katz *et al.* (1977) was modified (Gómez Parra, 1983) according to Smith & Milne (1979).

The results obtained in the bay are shown in Table 1 and Figs 2, 3 and 4. The stations to the west of the area studied are characterized by compact sediments with very low levels of organic matter and heavy metals. An exception is the high Mn content of station BC3, which may be due to the proximity of an important effluent from Cádiz city. The zone located to the east of the bay is characterized by high levels of organic matter, phosphates and heavy metals. Station BC5, located near a shipyard, has an increase in Pb concentration (90 ppm) which may be due to naval activities, as has been described by Bellinger & Benham (1978) in the Port of Liverpool. The central area of the bay presents a transition from the values found in the west to those in the east of the bay: one exception is the high level of Pb registered in station BC5, possibly due to atmospheric car pollution. Although this station was located near the toll booth of the bridge which crosses the bay, it has only been in operation for the last 15 years and the tide currents in the vicinity are strong.

The results obtained in the channels are shown in Table 2 and Figs 5 and 6. In general, compared with the values in the bay, these channels show an increase in the concentration of metals and phosphates and a decrease in the solid content of the wet samples. This is due to the greater stagnancy of the water, which also produces greater uniformity in the physical characteristics of the bottoms and greater homogeneity in the chemical composition of the sediments of the 10 sampling stations. In each channel the highest organic matter, phosphate and metal contents coincided with finer sediment granulometry. Stations CB2 and CB10 show higher values of Pb because they are located near roads.

TABLE 1

Values of the different parameters analysed in the sediments from the Bay of Cádiz

Sampling station	T.S. (%)	O.C. (%)	PO_4^{3-} (mg g^{-1})	Fe (%)	Mn (ppm)	Zn (ppm)	Cu (ppm)	Pb (ppm)	Cd (ppm)
BC1	76.01	0.21	1.27	0.60	53	82	5	14	0.80
BC2	34.23	2.71	1.95	3.72	335	251	45	68	1.69
BC3	81.31	0.45	1.06	0.38	310	73	5	17	1.00
BC4	49.18	1.76	1.76	3.14	376	354	47	73	2.29
BC5	46.67	2.19	2.60	3.17	374	213	57	90	2.37
BC6	70.43	0.98	1.43	1.55	182	172	50	86	2.11
BC7	53.58	1.57	1.80	4.54	329	440	35	70	2.28
BC8	58.08	1.09	1.32	1.43	281	183	24	48	1.68
BC9	51.17	2.73	2.95	3.31	356	166	40	71	1.55
BC10	86.43	0.06	0.55	0.30	169	32	4	19	1.10
Mean	60.71	1.38	1.67	2.21	227	197	31	56	1.69
S.D.*	16.1	0.93	0.68	1.46	101	120	19.3	27.6	0.55
C.V. (%)†	26.5	67	40	66	37	61	62	49	32

*Standard deviation.
†Coefficient of variation.

TABLE 2

Values of the different parameters analysed in the sediments of channels flowing from Bay of Cádiz

Sampling station	T.S. (%)	O.C. (%)	PO_4^{3-} (mg g^{-1})	Fe (%)	Mn (ppm)	Zn (ppm)	Cu (ppm)	Pb (ppm)	Cd (ppm)
CB1	63.89	0.54	2.93	3.60	560	126	20	77	1.40
CB2	47.76	1.49	3.43	4.04	356	261	29	62	1.53
CB3	64.12	1.43	2.04	3.40	460	400	44	66	1.76
CB4	43.75	1.83	2.32	3.50	466	295	43	68	1.96
CB5	40.11	1.97	2.20	3.35	444	315	48	66	1.63
CB6	58.94	0.92	1.19	1.70	413	133	15	42	1.86
CB7	52.01	1.20	1.74	2.52	405	210	25	46	1.77
CB8	36.14	1.90	2.07	3.72	440	225	36	61	1.89
CB9	55.31	1.20	1.67	2.77	416	354	64	47	1.81
CB10	52.87	1.29	2.27	3.02	376	201	32	76	1.48
Mean	51.49	1.38	2.19	3.16	434	252	36	61	1.71
S.D.*	9.1	0.43	0.60	0.65	56.5	85.6	13.9	11.7	0.28
C.V. (%)†	17.6	31	27.5	20.5	13.0	34	39	19.1	10.5

*Standard deviation.
†Coefficient of variation.

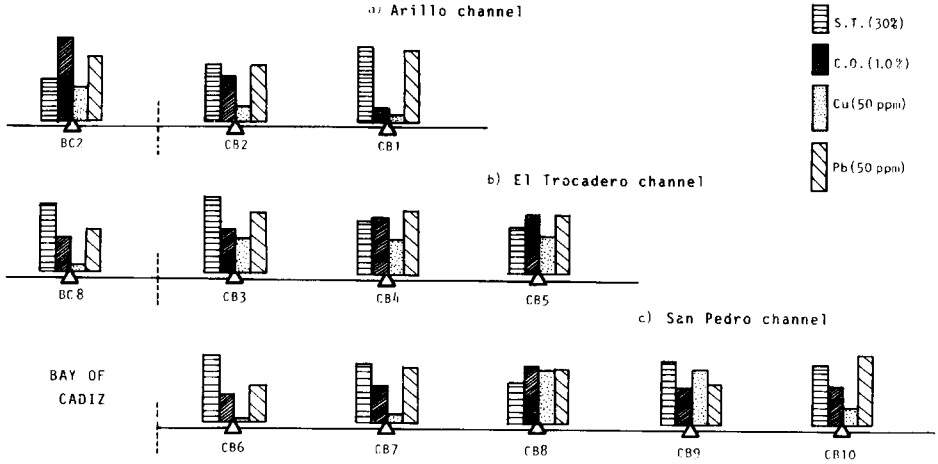

Fig. 5 Loss at 110°C (total solids), organic carbon, Cu and Pb values obtained in the sediments of channels flowing from the Bay of Cádiz. (Sampling stations locations are not shown on scale).

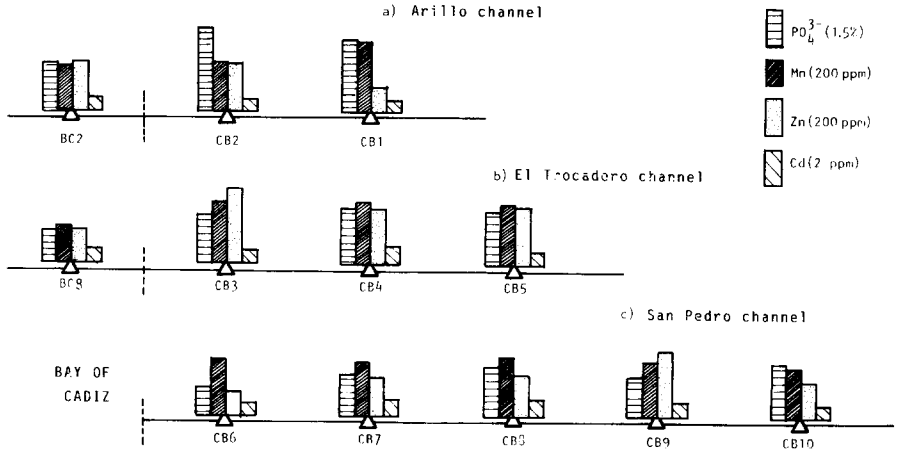

Fig. 6 PO_4^{3-}, Mn, Zn and Cu values obtained in the sediments of channels flowing from the Bay of Cádiz. (Sampling stations locations are not shown on scale).

Notable differences in the organic carbon and heavy metals content have been found in different zones of the bay. The concentration increases in a north–south and west–east direction and depends on the granulometry of the sediment and the speed of tide current, the highest values being reached in the channels flowing from the bay. High values of Pb found in the vicinity of some stations has been attributed to the road traffic or the naval industry.

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CONFERENCES

Rocky Shore Monitoring

Rocky shores are often exceptionally difficult habitats in which to undertake systematic descriptive surveys or to monitor natural and pollution-induced changes. Nevertheless, there are several groups in the British Isles undertaking survey and monitoring for purposes which range from the predominantly academic to those applied directly to answering questions about the effects of industry or the nature conservation importance of sites. In order to review the techniques currently in use and to assess their usefulness and effectiveness for various survey aims on different types of shore, a workshop on rocky shore survey and monitoring was organized jointly by British Petroleum International Ltd and the Field Studies Council Oil Pollution Research Unit. The workshop was held from 1 to 4 May at Orielton Field Centre near Milford Haven. participants were drawn from the following organizations: Aberdeen University Marine Studies Ltd, Bell College of Technology, Brathay Exploration Centre, British Petroleum International Ltd, Britoil plc, Coastal Surveillance Unit (University College of North Wales), Field Studies Council, Heriot-Watt University, Imperial College (University of London), Marine Biological Association of the UK, Marine Conservation Society, Natural Environment Research Council (Rocky Shore Surveillance Group), Nature Conservancy Council, Orkney Marine Biology Unit