Environmental Protection Report

A COLLATION OF THE ENVIRONMENTAL IMPACT WORK CARRIED OUT FOLLOWING THE ROSEBAY OIL SPILL MAY 1990

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Summary

In May 1990 an accident off the South Devon coast involving the Oil Tanker-Rosebay, resulted in oil deposition onshore between Hope Cove in South Devon and the Lizard in South Eastern Cornwall.

Following the incident a number of organisations were involved in Environmental Impact work. The National Rivers Authority, after consultation with the majority of those concerned, have attempted to collate the work undertaken in this report.

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1. Introduction

Following the curtailed seaborne operation to collect the spilled oil from the Rosebay incident in May 1990, at least 300 tonnes of emulsified oil came ashore on the coast of South Devon and South Eastern Cornwall, between Hope Cove and the Lizard, Appendix 1. The greatest concentration of this oil came ashore in the mouth of the Erme estuary and the surrounding Bigbury Bay area, the remaining small fragmented slicks then tracked westward soiling the coastline patchily to the Lizard.

As with any oil spill, the visual impact of stranded crude and emulsified oil is quite dramatic and frequently evokes an understandable public outcry to remove and clear the contaminant swiftly and completely.

However, the effects on the impacted biological community are rarely as obvious as the layman would expect and need to be studied with care before conclusions can be drawn as to the severity of the effect.

2. Background to the Report

This report aims to collate all the environmental impact work undertaken in the aftermath of the spill and has therefore been produced following consultations with a wide spectrum of bodies. Those organisations other than the NRA, involved in this procedure, are listed below:

Plymouth Marine Laboratories (PML) *	Polytechnic South West (PSW)
Devon Wildlife Trust (DWT) #	Devon County Council (DCC)
Cornwall County Council (CCC)	South Hams District Council (SHDC)
South Devon Heritage Coast	Nature Conservancy Council (Devon)
Nature Conservancy Council (Cornwall)	(NCC)
Ministry of Agriculture Fisheries	Restormel District Council
and Food (MAFF)	Carrick District Council
Caradon District Council	Kerrier District Council
Helford Voluntary Marine Conservation	Royal Society for the Protection
Area (HVMCA)	of Birds (RSPB) *

* indicates organisations who carried out environmental impact work reported here, # indicates those who carried out work to be appended at a later date.

These organisations met at the NRA headquarters on the 26th November to discuss their work. Each contribution is dealt with as a separate section and any conclusions drawn in these sections will be those of the body concerned.

The reader should also treat each section or part section individually with respect to Figures and Tables. However, for ease of reference, the original page numbers have been altered.

3. Environmental Impact Work Undertaken by Plymouth Marine Laboratories

The following section is a contribution from Plymouth Marine Laboratories (PML) which outlines the work they undertook after the spill and includes field observations made at the time of their sampling visits.

Observations of the Impact of the Rosebay Oilspill on Selected Shores in South Devon.

Contributing Scientists; M C Austen, J T Davey, J M Gee, M A Kendall and A A Rowden. Members of this group have attended other oil spills in UK and abroad and have given advice on their effects to the oil industry.

Plymouth Marine Laboratory has no statutory obligation to respond to incidents of this kind but in view of their interests in the detection of the effects of pollutants on marine communities it was decided to set up a sampling programme to monitor the effects of the spill. As all staff taking part had to be re-deployed from other duties and because of the need to take a large number of samples over a wide area they restricted themselves to a study of the meiofauna. These small animals (<0.5mm and >0.064mm) can be sampled adequately by the use of small cores and thus the sampling itself is not labour-intensive.

Meiofauna samples were taken from the upper mid-shore at the following locations; Fort Bovisand (5 sites), Mothecombe (10 sites), Bigbury Bay (15 sites), Thurlestone (5 sites) and Hope Cove (5 sites). The locations of these shores are shown on Appendix 1. With each meiofauna core a sediment sample was taken using a solvent cleaned glass tube. On returning to the lab the meiofauna samples were preserved in formalin and the sediment samples were frozen.

The first samples were taken on the afternoon of May 16 and the remaining sampling dates were May 17, May 21, May 30 and August 6. On each occasion notes were made of any visible effects of oil on the biota of rocks.

PML hoped that funding could be found to extract and analyse the fauna from the existing contract. As matters stand it is improbable that time/money will be available for this. The samples have therefore been archived.

On May 16 only Mothecombe could be said to have been badly oiled. Elsewhere the oil came ashore in patches most of which were of a very watery emulsion. There were rocky areas at Thurlestone and Bigbury Bay which were affected by untreated (or poorly treated) oil. No immediate mortality of the rocky shore fauna was observed although where the oil was thickest there was some smothering of the uppershore barnacles and crack dwelling molluscs. There was no noticeable mortality on the following day although at Mothecombe significant numbers of the large and normally nocturnal isopod Ligia were seen to be active during the daytime.

Table 1. Relative Contamination of the Shores on 16th May 1990.

	Bovisand	Mothecombe	Bigbury	Thurlestone	Hope Cove
Oil/emulsion on sand		+++	+	+	+
Smell of oil in sediment		+++	+++	++	
Oil/emulsion on rock		+++	+	+	
Recent mortality of molluscs					

key

+++ Effect obvious.

++ Effect noticeable.

+ Effect barely noticeable.

No entry indicates no visible impact.

Table 2. Relative Contamination of the Shores on 17th May 1990.

	Bovisand	Mothecombe	Bigbury	Thurlestone	Hope Cove
Oil/emulsion on sand.		+++	+		
Smell of oil in sediment.		+++	++		
Oil/emulsion on rock.		+++	+	+	
Recent mortality of molluscs					

By May 21 there had been some mortality along limpets (Patella vulgata and Patella depressa) and the topshell Monodonta lineata. Moribund and recently dead individuals of both species were found on the strandline at Bigbury and Mothecombe and at both sites other animals were adhering weakly to the rock. No more than about a 10% mortality in these species is estimated to have occurred. On the other hand patches of barnacles which had been seen to have been oiled on the first day now had more or less clear opercular plates and were judged to be capable of normal feeding.

Table 3. Relative Contamination of the Shores on 21st of May 1990.

	Bovisand	Mothecombe	Bigbury	Thurlestone	Hope Cove
Oil/emulsion on sand.					
Smell of oil in sediment.		+	+		
Oil/emulsion on rock.		+	+	+	
Recent mortality of molluscs		+	+		

In early August it was difficult to detect any biological effect on the rock fauna. While asphaltic deposits showed the areas which had been oiled the only evidence of any mortality having occurred was a slightly greater than normal number of one or two year old limpets occupying the home-scars of larger animals.

4. Projects undertaken by or for the National Rivers Authority in Connection with the Rosebay Oil Spill.

This section is a collection of four projects undertaken by or for the NRA following the oil spill. The titles are given below;

(a) An Assessment of the Impact of the Beached "Rosebay Oil" on the Infaunal Communities of the Lower Erme and Avon Estuaries.

(b) Visual Monitoring of the Communities Present in the Mouth of the Erme.

(c) An Investigation of the Toxicity of Beach Sand Contaminated by Spillage of Crude Oil.

(d) An Investigation of the Residual Oil Contamination of the Sediments of the Erme Estuary.

4.(a) An Assessment of the Impact of the Beached "Rosebay Oil" on the Infaunal Communities of the Lower Erme and Avon Estuaries.

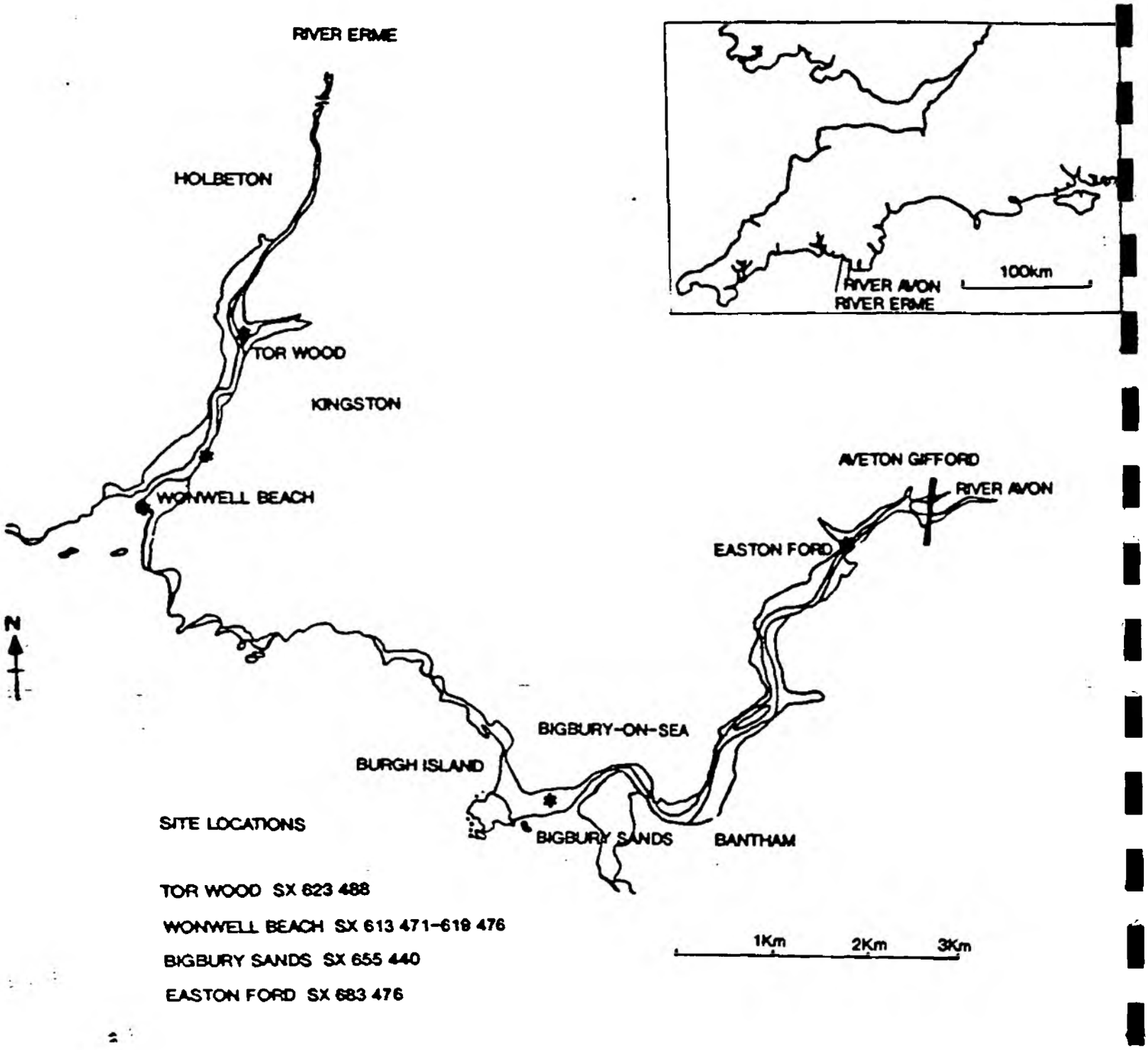
INTRODUCTION

Following the stranding of approximately 100 tonnes of emulsified oil, from the Dionne Marie/Rosebay incident, in the mouth of the Erme on the evening of 15/5/90, and <20 tonnes in the mouth of the Avon, there arose the inevitable question; what has been the ecological effect? The response is that we cannot realistically know, as to answer this would require knowledge of the structure and composition of the communities immediately prior to the pollution event, and no surveys or monitoring have been undertaken recently in the area to be able to comment with any confidence, on the effects on the biota.

However an infaunal survey of these areas was carried out by the Oil Pollution Research Unit (OPRU) for the Nature Conservancy Council on the 14/5/87. This information can possibly be compared, purely as a yardstick, with results from an identical repeat survey carried out following the oil spill, as the dates are highly compatible.

Consequently a repeat survey was carried out on the 29/5/90 and was designed so that the methodology mirrored exactly those adopted by OPRU on the 1987 survey. The positions of the sites sampled on these surveys are shown in Figure 1.

Figure 1. Location of sites surveyed in 1987 and 1990.



METHODS

Four $0.01m^2$ cores were collected from each of the four sites shown and seived over a 0.5mm mesh in situ. The seived samples were then transfered to 2l screw topped pots and fixed by the addition of 10% saline formalin solution containing the vital stain eosin. The samples were then returned to the lab and stored for a period of two weeks to allow the process of fixation to be completed.

The fixed samples were then further washed and seived in the laboratory fume cupboard over a 0.5mm mesh to remove the formalin and the remaining fine sediment. The samples were then spread out in a white tray, and sorted under water, removing the stained macrofaunal oganisms with fine forceps. Following removal, the specimens were then placed in a solution of 95% alcohol: 5% glycerol prior to identification. At a later date the biological specimens were then identified to the lowest practicable taxon (where possible) and counted.

NOTE As can be seen from Figure 1. the Wonwell Beach site is composed of four cores, taken from a transect approximately 1km long and cannot be represented by a single location.

RESULTS

The results of the intertidal cores are presented in Table 1. and a comparison between 1987 and the 1990 post oil spill results are presented in Table 2.

It can be seen that the results from the surveys show in all cases, communities marginally more diverse and more densely populated in 1990 than those of 1987. Also illustrated is a low degree of similarity between the years at all sites, with the exception of Easton Ford.

Table 1. Taxa recorded from the intertidal cores taken from the Erme and Avon Estuaries on 29/5/90.

SPECIES RECORDED	SITE AND CORE NUMBER															
	Avon Bigbury Sands				Erme Wonwell Beach				Avon Easton Ford				Erme Tor Wood			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Eurydice pulchra			1													
Cyathura carinata									4	5	4		1		1	
Bathyporeia pilosa													1	1		
Corophium volutator									2		21	14				
Megalopa larva				4												
Paraonis fulgens					4	6										
Tharyx marioni						2										
Cirriformia tentaculata						2										
Neanthes diversicola							48	54	32	24	7	34	8	4	5	26
Malacoceros fulginosus							7	2						4		23
Streblospio shrubsolii							1		34	39	1		19	4	4	20
Prionospio malmgreni										1						
Spio martinensis																3
Pygospio elegans															3	
Scolelepis squamata	2	3			10	14	3								1	
Capitella capitata							6									
Capitomastus medius							2	21								5
Ophryotrocha hartmanni ?							1									
Arenicola marina													1			1
Ophelia bicornis						2										
Tubificoides benedini						1	1									
Enchytraidae indet							17	4						5		
Tubificidae indet							5	5	99	17	7	139	19	16	4	6
Tubifex pseudogaster											1		102	61	25	5
Nematoda indet							3									
Nemertean indet												1				

Table 2. Taxa recorded from the intertidal cores taken from the Er
on the 29/5/90, compared with those taken on the 14/5/87
combined totals from four 0.01m cores.

	SITE AND CORE NUMBER					
	Avon Bigbury Sands		Erme Wonwell Beach		Avon Easton Ford	
SPECIES RECORDED	1990	1987	1990	1987	1990	1987
CRUSTACEA						
Eurydice pulchra	1			10		
Cyathura carinata					13	2
Bathyporeia pilosa				6		
Haustorius arenarius				1		
Corophium volutator					37	3
Pontophilus norvegicus		1				
Megalopa larva	4					
ANNELIDA						
Paraonis fulgens			10			
Tharyx marioni			2			
Cirriformia tentaculata			2			
Ampharete grubei						1
Neanthes diversicola			102	1	97	41
Streblospio shrubsolii			1		74	4
Prionospio malmgreni					1	
Spio martinensis						
Pygospio elegans						
Malaccoceros fulginosus			9			
Scolelepis squamata	5		27	1		
Capitella capitata			6			
Capitomastus medius			23			
Ophryotrocha hartmanni?			1			
Arenicola marina						
Ophelia bicornis			2			
Tubificoides benedini			2			
Enchytraidae indet			21			
Tubificidae indet			10	1	262	24
Tubifex pseudogaster					1	
MOLLUSCA						
Scrobicularia plana						1
NEMATODA						
Nematoda indet			3			
NEMERTEA						
Nemertean indet				1	1	
No of Species	3	1	14	7	8	7
No of individuals	10	1	221	21	486	76
Percentage similarity	0%		10.5%		50%	

me and Avon Estuaries
. Scores represent

	Erme Tor Wood
1990	1987
2	
2	
	1
43	7
47	
3	
3	
27	
1	
5	
2	
5	
45	69
193	
13	3
378	77
14.2%	

DISCUSSION

The low percentage similarity results shown in Table 2. illustrate how variable the communities inhabiting the sediments of these two estuaries are from year to year, especially near their mouths, where the high substratum mobility and coarse grain size does not allow for a diverse, stable community to become established.

However the major point to be brought out of the survey, is that on the results presented in Table 2. the Rosebay oil spill is unlikely to have had a major impact on the infaunal communities of the Avon and the Erme estuaries, as species and individual numbers were consistently higher in May 1990, at the sites surveyed. However this statement is based on the assumption that the extent of the greater diversity and population density exhibited in the 1990 samples was not of a significantly larger magnitude prior to the oil spill. Also it must be stated that where localised acute contamination occurred, such as in a few locations on both Wonwell beach and higher up the Erme estuary, mortalities will have occurred and the communities will be presently in a state of recovery.

In view of the marked difference in the communities between the years, in terms of both numbers and species, and that generally both of these parameters were increased in 1990, above 1987 levels, it would appear that other factors such as recent climatic history for example, have had a greater effect in shaping the present infaunal communities at these sites than the recent oil spill.

Finally it must also be mentioned that the method, one of dispersed cores, which is ideal for picking up a representation of the suite of species present at each location, does have failings with respect to robust quantitative comparisons between surveys. This is most noticeable in the case of the Wonwell beach site where the results shown in Table 1. indicate clearly that the site straddles (at least in part) an environmental gradient, as the first three cores give the

distinct appearance of a classical zonation pattern. In the absence of comprehensive abiotic analyses no firm hypothesis as to the nature of the gradient can be made, though increasing substrate stability i.e. decreasing wave action, must be a probable causative factor.

Hence the methodology used is not one to be recommended for pollution studies, although it possibly does a reasonable job for the level of comparison required here.

NOTE

The occurrence of the two individuals of Ophelia at the Wonwell beach site is interesting from a marine ecolgical/conservation point of view, being an arctic species it has rarely been recorded in this country.

4.(b) Visual Monitoring of the Communities Present in the Mouth of the Erme.

4.(b) Visual Monitoring of the Communities Present in the Mouth of the Erme.

The mouth of the Erme undoubtedly received the heaviest oiling when the remains of the Rosebay oil came ashore on the 15th May and although a boom was in place across the mouth of the estuary, some oil spilled over and under it during peak tidal flows. Most of this oil then became trapped on the shingle spit but some was deposited at the edge of the saltmarshes, Figure 1. The fate of this oil and that which impacted the sediments and rocky shores at the mouth on the Wonwell side of the bay was then monitored at various times during the following months.

Set out below are the observations made during those visits.

29th May

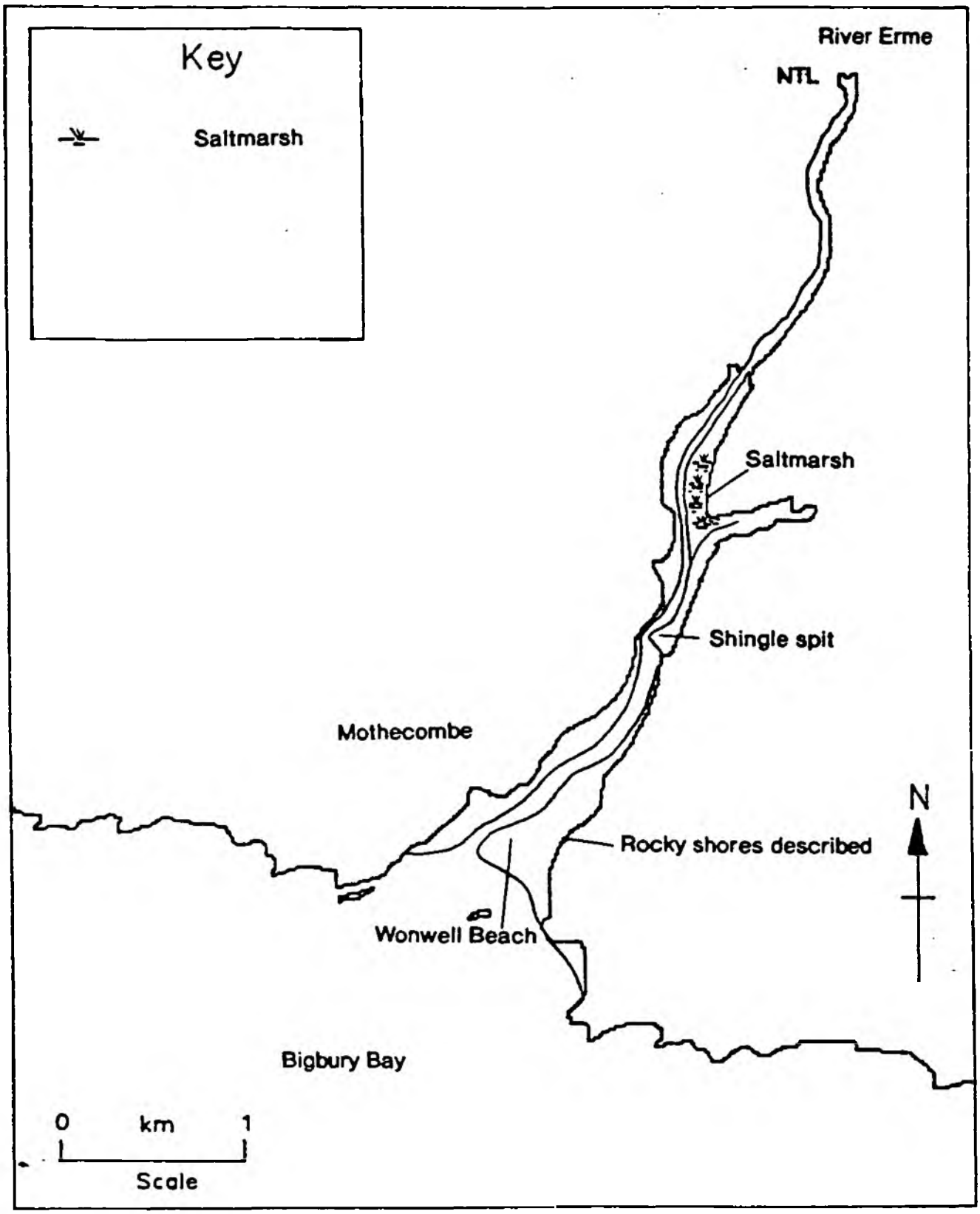
Core samples were taken for the macrobenthic study; some mortality of infauna was observed (several Echinocardium caudatum specimens were found dead and heavily oiled at the mouth of the Erme) and an oily sheen could be seen on the areas of standing water all over the sand flats. The rocky shores were marked by a vertical band of "tacky" oil generally about 30cm high in the region of Mean High Water Neaps (MHWN). Some mortality was observed in the Limpet (Patella species) populations at this height, and this was manifested by a number of recently vacated home scars. Mortality was also observed in the barnacle population though the proportion was probably low and obscured by the existence of previously dead specimens on the rocks.

The edge of the saltmarsh at SX 623 488 was slightly oiled; a band of oil about 2m wide was visible in places, though no chemical burning of the vegetation had occurred. Also present at the edge of the marsh were some tyre tracks where a vehicle had attempted to clear the oil away, but fortunately had not completed the task. These tracks were approximately 10cm deep.

Figure 1.

The Erme Estuary

Impacted habitats mentioned in the text



6th September

Oily sheen could still be seen emanating from an exposed deposit of oil which must have become trapped earlier in the summer at SX 619 477. Slight oily sheen was also seen in a few locations on the sand flats of Wonwell beach.

The rocky shores at the mouth of the Erme were marked by the same size oil band as in May though the oil had lost all tackyness and was the consistency of dry black paint. Many of the previously vacated home scars now possessed small immigrant limpets. Additionally, many of the barnacles in the oiled band had obviously survived the ordeal.

The oiled area in the saltmarsh was still very visible and although firm to the touch, it could be cut away with a knife to reveal a less weathered under layer which still possessed a strong oily smell. The previously mentioned tyre tracks were still very prominent and had not appreciably decreased in depth over the 3 months.

November 6th

No change was noted in the condition of the sediments at SX 619 477 so arrangements were made to have the trapped oil removed. The rest of the beach appeared to be clear of obvious contamination and healthy lugworm beds were found at the southern end of the beach.

No change was observed in the rocky shore community and the situation in the saltmarsh was similarly unchanged, with the tyre tracks and oil pavement still obvious.

Photographs documenting these observations are held at the NRA and are available for inspection.

4.(c) An Investigation of the Toxicity of Beach Sand Contaminated by Spillage of Crude Oil.

In tandem with the work carried out by the NRA, the Water Research Centre (WRC) volunteered to undertake a programme of toxicity work on the sediments of the Erme and lower Avon estuaries. This work was carried out partly to attempt to assess the toxicity of the contaminated sediments to the infaunal communities present, and partly to assess the applicability of the method which is presently under development at the WRC.

AN INVESTIGATION OF THE TOXICITY OF BEACH SAND CONTAMINATED BY SPILLAGE OF CRUDE OIL

Report No: NR 2649

December 1990

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Contract No: 4056

Client's Reference No: <>

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AN INVESTIGATION OF THE TOXICITY OF BEACH SAND CONTAMINATED BY SPILLAGE OF CRUDE OIL

B D Roddie, T J Kedvards and R E Davis

SUMMARY

The beaching of oil from a spillage off the coast of Cornvall raised some concern about the possible biological impact. To help to address this concern, toxicity tests vere conducted on samples of beach sand collected from several sites on vhich oil had landed. Local unimpacted sites and standard positive and negative control sites vere incorporated in the study.

The tests demonstrated that two of the impacted sites vere measurably contaminated with crude oil, but that at only one of these sites vas mortality of the test organisms (Corophium volutator) significantly elevated with respect to controls. Narcotisation vas evident in test animals exposed to sediments from 7 of the eight sites studied, most notably the 'clean' site, vhich vas measurably contaminated vith oil presumed to originate from a nearby harbour.

Mortality and narcotisation vere significantly correlated vith oil concentration in the sediment.

Report No NR 2649, December 1990
◇ Pages, ◇ Tables, ◇ Figures etc
Project Reference No.

CONTENTS

SECTION 1 - INTRODUCTION

This study was undertaken due to the concern that had been expressed over the beaching of a light crude oil spilled from the 274 000 tonne tanker Rose Bay on 12.5.90. It was estimated (pers comm Mercer T, 1990) that 1000 tonnes of crude was released of which 500 tonnes were sunk at sea and 100 tonnes actually beached in the vicinity of the R. Erme, only to be mostly washed back out to sea. The sickle-shaped slick of oily 'mousse' first came ashore at Stoke Point, approximately 10 km south west of the River Erme (Figure 1), on 15.5.90 between the hours of 1800 and 2000. The slick travelled eastward along the coast to the mouth of the River Avon.

WRc undertook to conduct tests on contaminated beach material with the aim of assessing the biological impact of the spill at selected sites. Specimens of the marine amphipod Corophium volutator were exposed for ten days to samples of beach sediment from a number of sites. Response was assessed in terms of mortality at the end of this period. The exposure of an infaunal organism to the solid phase provides results which are readily interpretable in terms of possible effects of contamination on benthic communities.

SECTION 2 - MATERIALS AND METHODS

Sediment toxicity was assessed in samples removed to the laboratory, by exposing groups of Corophium directly to settled material.

2.1 SEDIMENT SAMPLE COLLECTION

Control sediment was collected from Nevton Bay, Poole using a stainless steel scoop to remove the top 4-5 cm of sediment. The sediment was transported back to the laboratory in 25 litre sealed plastic plastic buckets with minimum delay and kept at 13 $\pm$1 °C until initiation of the test. Positive control sediment was collected from Devonport, Plymouth in the same manner as described above. Upon return to the laboratory a

2 litre sample of each of the control sediments was vet-sieve fractionated, the resulting fractions being dried at 80 °C for 24 hours and weighed to an accuracy of ± 0.01 mg. Earlier samples of these control sediments were chemically characterised; a 10 g subsample of each fraction was analysed for metals (Cd, Pb, Hg, Ni, Cr, Cu, Zn) by atomic absorption spectrophotometry following digestion in aqua regia.

Test samples were taken from five sites (Figure 2) where the sediment was most obviously contaminated with oil and for which previous biological data were available. Sites 1 to 4 lay along a transect up the River Erme from its mouth. Site 5 was situated at the mouth of the River Avon, and the control site (CS) at North Sands Salcombe was chosen because grain size was similar to other sites but oil contamination was not believed to have occurred. All sites were chosen in consultation with NRA South-West Region biologists. The grid references for the five sites were:

Site 1	SX 61454725
Site 2	61654735
Site 3	61884763
Site 4	62254875
Site 5	65254410

North Sands
Salcombe SX73103813

Samples were collected at low tide on 6.6.90, approximately three weeks after the oil had first beached. Each sample was collected by removing the top 2-5 cm of sediment from a 0.2 m^2 area with a stainless steel scoop. The sample was then sealed in a labelled polythene bag which was placed in a second sealed bag. Five replicates for each of the 5 sites were taken at random within a 4 m^2 area. Samples were transported back to the laboratory at approximately 3 °C with minimum delay. The test was initiated immediately upon return to the laboratory.

2.2 SEDIMENT CHARACTERISATION

All sediment samples were size-fractionated into sand and silt/clay components, and the relative contribution of each component by weight calculated on a dry-weight basis. Subsamples of dried (60 °C) material were ashed at 450 °C for 24 h, and the mass loss calculated in percentage weight terms as an indication of organic content.

Subsamples of each sediment were dried at 60 °C for petroleum hydrocarbon residue analysis. A sample of crude oil from Challaborough Head (collected at 16.45 on 18.5.90) was used as a reference standard.

Samples were diluted with glacial acetic acid, water and 2-propanol and ultrasonicated for 45 minutes. They were then shaken for two 5-minute periods with pentane. The pentane was dried with anhydrous sodium sulphate and the sample volume reduced to approximately 4 ml. All samples were subjected to a double sulphur removal procedure, and were then passed through a double NH_2 cartridge before being further eluted with pentane to a total volume of 10 ml. The extracts were analysed by GC-FID.

2.3 SEDIMENT TOXICITY TEST

The test was conducted in a temperature-controlled room at 13 °C and under a 16:8 L:D light regime. The test vessels consisted of standard 1 litre glass beakers of 10 cm internal diameter. Vessels were arranged in rows of 9 and covered with thin sheets of perspex to minimise evaporation losses. Aeration was provided by an oil-free low pressure, high volume pump to air tubes where rows of 9 chambers received air at a constant rate through plastic 1 ml pipettes. Air was bubbled into the beakers at a rate that did not disturb the sediment.

All control and test sediment samples were homogenised immediately prior to addition to the test vessels. Approximately 150 ml of test sediment were placed in the bottom of each beaker and smoothed with a polythene spatula to create an even, 2 cm deep layer. A disc of plastic attached

to a nylon cable tie was placed on the sediment surface ,to minimise sediment resuspension as bioassay seavater (33°/$_{oo}$, pH 8.0 ± 0.1, temperature 13 ± 1 °C) was added to the 750 ml mark. The disc was removed and rinsed in clean seavater between beakers and changed between treatments. Two replicate test vessels were prepared for each of the 30 site replicates, and five replicates each for the positive and negative control sediment samples (Plymouth and Poole).

Mature Corophium were collected from Nevton Bay, Poole Harbour. Animals were sieved from their native sediment on-site, and transported in seavater to the laboratory. On arrival at the laboratory, they were transferred to fresh seavater at the same salinity and gradually acclimated to 33°/$_{oo}$ stock seavater at a rate of 3°/$_{oo}$ per day; this was achieved by maintaining a constant flov of stock seavater through the holding tank.

Corophium of greater than 5 mm length (not including rostrum; Kemp et al 1985) vere randomly added in groups of 10 to each of the test vessels.

All vessels vere observed daily to ensure that the aeration rate vas uniform. Any vater lost due to evaporation vas replaced with deionised vater to the required level. Each beaker vas carefully examined, but not disturbed except for the temporary removal of the aeration pipe, once every two days. Notes vere made on sediment appearance, number of amphipods visible upon the sediment either alive, dead or narcotised.

The test vas terminated after 10 days exposure. Test and control sediments vere gently sieved through a 0.5 mm screen and the number of live and dead animals counted. Animals exhibiting narcosis vere placed in beakers of uncontaminated seavater and the number of animals recovering within 1 hour recorded. Missing animals vere assumed dead and decomposed (Svartz et al 1985).

SECTION 3 - RESULTS

3.1 SEDIMENT CHARACTERISATION

3.1.1 Chemical characteristics

Samples of control sediments had previously been analysed for trace heavy metal content, and the results of this analysis are presented here for comparative purposes. For all seven metals analysed, the concentrations in the positive control (Plymouth Docks) sediment always exceeded those in the Poole site (Table 1, Figures 2a and 2b). Levels of Zn, Cu, Hg and Pb in the positive control were 6, 7.5, 9 and 15 times higher respectively than in the Poole sediment. Cd was also found at more than twice the concentration in Plymouth compared with the Poole sediment (Table 1). Only the levels of Ni and Cr were comparable at both sites.

The moisture content, amount extracted, and hydrocarbon content of each of the sediment samples is given in Table 5. Hydrocarbon content is reported as µg/g reference crude. Hydrocarbons were below the detection limit of 5 µg/g in samples from sites 1,2, and 5. Detectable amounts were present in samples from sites 3 and 4, and in the sample from the presumptively clean reference site. The residue at site 4 was low, at only 39 µg/g, but was appreciably higher at site 3 and at the clean site (356 and 153 µg/g respectively).

3.1.2 Physical characteristics

The percentage of sand, silt and clay composing the two control sediments was also determined (Table 2). The Plymouth sediment consisted of 78% sand and 22% silt and clay, while the Poole sediment consisted of 42% sand and 58% silt and clay. These control sediments contained 2.8% and 4.4% organic matter (as measured by loss on ignition at 450 °C, Table 2) respectively. The test sediments consisted of between 94.4% and 97.7% sand, with organic contents of between 0.21% and 0.42%.

3.2 TOXICITY TEST

3.2.1 Water Quality

Maximum, minimum and mean values of pH and dissolved oxygen (DO) are summarised in Table 3. DO ranged from a minimum of 90% saturation to a maximum of 100% saturation during the course the test. The pH varied between 7.93 and 8.28. The ranges observed on any one day were considerably less than the overall variation indicated above.

3.2.2 Biological effects

Highest mortality was observed in animals exposed to sediments from site 3 (Table 4). The samples from this site were visibly contaminated with oil. The mortality data were analysed by single-factor analysis of variance, and treatment means compared using a Tukey test. Mortality in animals exposed to sediments from site 3 was significantly higher ($p<0.05$) than mortality in any other treatment group (Figure 3). Mortality in treatment groups excluding site 3 ranged from 10% (Plymouth control sediment) to 19% ('clean site' and site 2), but this difference was not significant ($p>0.05$).

There was evidence of some sublethal effect in response to the sediments from the reference site at Salcombe (Figure 3, immobilisation).

Analysis of variance of regression of mortality on sediment oil content yielded a correlation coefficient of 0.973 (94.6% of variance explained)and an F-ratio of 70.4 (significant at $p<0.001$). Analysis of variance of regression was also carried out for immobilisation against sediment oil content for those sites where mortality was not significantly different from that observed in the negative control sediments (ie excluding site 3). This analysis yielded a correlation coefficient of 0.967, with an F-ratio of 88.17 (96.7% of variance explained, significant at $p<0.001$).

SECTION 4 - DISCUSSION

The mortality observed in the negative control sediment was comparable to results obtained in previous tests (6.5-10%) using sediment from the same source. However, mortality of Corophium in sediments from Plymouth was markedly lower than in previous tests (35-42%). This may be attributable either to a reduction in toxicity of the batch of sediment used, or to a decrease in sensitivity in the batch of test animals used compared to previous batches.

Evidence from the present study, and from previous studies on marine sediments, indicates that Corophium is tolerant (in terms of 10-day survival) of a wide range of particle sizes, and that coarse sediments with low organic content are not in themselves a cause of undue stress or mortality. Thus, although the species generally inhabits relatively fine sediments, it lends itself to employment in toxicity testing in many sediment types.

A significant ($p<0.05$) lethal effect was observed in animals exposed to sediments from site 3, and immobilisation was most marked in animals exposed to sediment from the reference site at Salcombe. Chemical analysis showed these two sites to be the most contaminated by crude oil residues. Some slight increases in mortality above control values were observed in animals exposed to sediments from the other sites, but these were not statistically significant ($p>0.05$) and only one of these sites was measurably contaminated with oil.

The levels of hydrocarbon residue found in samples from site 4, the reference site, and site 3 (39, 153 and 356 µg/g respectively) were similar to concentrations reported for sites located within 500 m of an oil-drilling rig (Groenewoud 1990, 30 µg/g at 500 m increasing to 300-400 µg/g at 100 m). Tests conducted subsequently on the same gradient using Corophium produced significantly elevated mortality (30-55%) with respect to controls. The crude oil involved in the present investigation is unlikely to be as toxic as mixed oil and drilling mud, and this may explain the occurrence of a sublethal

response rather than elevated mortality on exposure to sediment from the reference site containing 153 µg/g crude. The levels of response observed in the present study are, however, broadly similar to those arising from exposure to comparable levels of contamination in drilling area sediments.

SECTION 5 - CONCLUSION

Three sites (3,4 and the reference site) were measurably contaminated with petroleum hydrocarbons. At a concentration of 39 µg/g crude (site 4), no adverse biological effects were detected. At 153 µg/g (North Sands, Salcombe), marked sublethal effects were observed in the form of narcotisation of Corophium, while at 356 µg/g crude (Erme estuary, site 3), severe lethal effects occurred. Comparison of these results with previous studies on oil-contaminated sediments suggests that the observed responses can realistically be attributed to the direct effects of crude oil.

The particle-size distribution of the sediments investigated was dominated by coarse sand and organic content was low. Such sediments do not readily sorb significant amounts of organic contaminants or trace heavy metals, and it would be surprising if there were already present toxicants which might have contributed to the observed effects. Toxic effects in such sediments are most likely to arise from gross contamination incidents. If the presence of crude oil in the sediments studied can reasonably be attributed to a specific incident, then the biological effects reported can with equal confidence be attributed to that incident.

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KEMP P F, COLE C A and SWARTZ R C (1985) Life history and productivity of the phoxocephalid amphipod Rhepoxynius abronius (Barnard). J Crustacean Biology 5, 449-464.

SWARTZ R C, DEBEN W A, JONES J K P, LAMBERSON J O and COLE F A (1985) Phoxocephalid amphipod bioassay for marine sediment toxicity. Aquatic Toxicology and Hazard Assessment:Seventh Symposium, ASTM STP 854, edited by R D Cardwell, R Purdy and R C Bahner. 284-307, American Society for Testing and Materials: Philadeliphia.

METAL	SITE	
	Poole mg/kg	Plymouth mg/kg
Ni	25.65	34.64
Cu	50.89	614.53
Zn	154.29	904.28
Cd	0.57	1.21
Pb	61.69	909.31
Cr	47.16	49.75
Hg	0.51	4.61

Table 1 - Analyses of control site sediments

SITE	PERCENT		
	Sand	Silt & Clay	LOI
1	97.1	2.9	0.28
2	97.7	2.3	0.32
3	94.4	5.6	0.42
4	95.7	4.3	0.21
5	97.1	2.9	0.34
CS	94.4	5.6	0.40
Poole	42.0	58.0	4.40
Plym	78.0	22.0	2.80

Table 2 - Particle size distribution of impacted beach sediment and controls

	pH			D.O.		
Sediment	Avg	Max	Min	Avg	Max	Min
Site 1	8.10	8.25	8.00	96	100	91
Site 2	8.11	8.25	7.96	96	99	90
Site 3	8.15	8.28	7.96	96	99	90
Site 4	8.11	8.26	7.95	96	98	92
Site 5	8.09	8.24	7.93	97	99	93
'Clean'	8.13	8.28	7.97	96	99	92
Plymouth	8.15	8.27	7.99	96	99	92
Poole	8.18	8.33	8.00	96	99	91

Table 3 - Water Quality Data For Impacted Beach Sediments.

Station	Sample	% Mortality
1	1	25
	2	0
	3	15
	4	10
	5	10
2	1	10
	2	25
	3	25
	4	30
	5	5
3	1	55
	2	44
	3	50
	4	30
	5	75
4	1	20
	2	5
	3	15
	4	15
	5	5
5	1	10
	2	15
	3	25
	4	5
	5	20
'Clean'	1	15
	2	20
	3	10
	4	30
	5	20
Poole	-VE	12
Plym	+VE	10

Table 4 - Mortality data from oil impacted sediments

Table 5 - Moisture content, sample size, and hydrocarbon residue in sediments from six locations

Sample	Percent moisture	Sample mass (g)	Hydrocarbon residue (µg/g)
Clean site	32.74	7.46	153
Site 1	20.28	8.51	<5
Site 2	23.84	8.77	<5
Site 3	27.22	7.41	356
Site 4	19.66	8.03	39
Site 5	7.46	9.44	<5

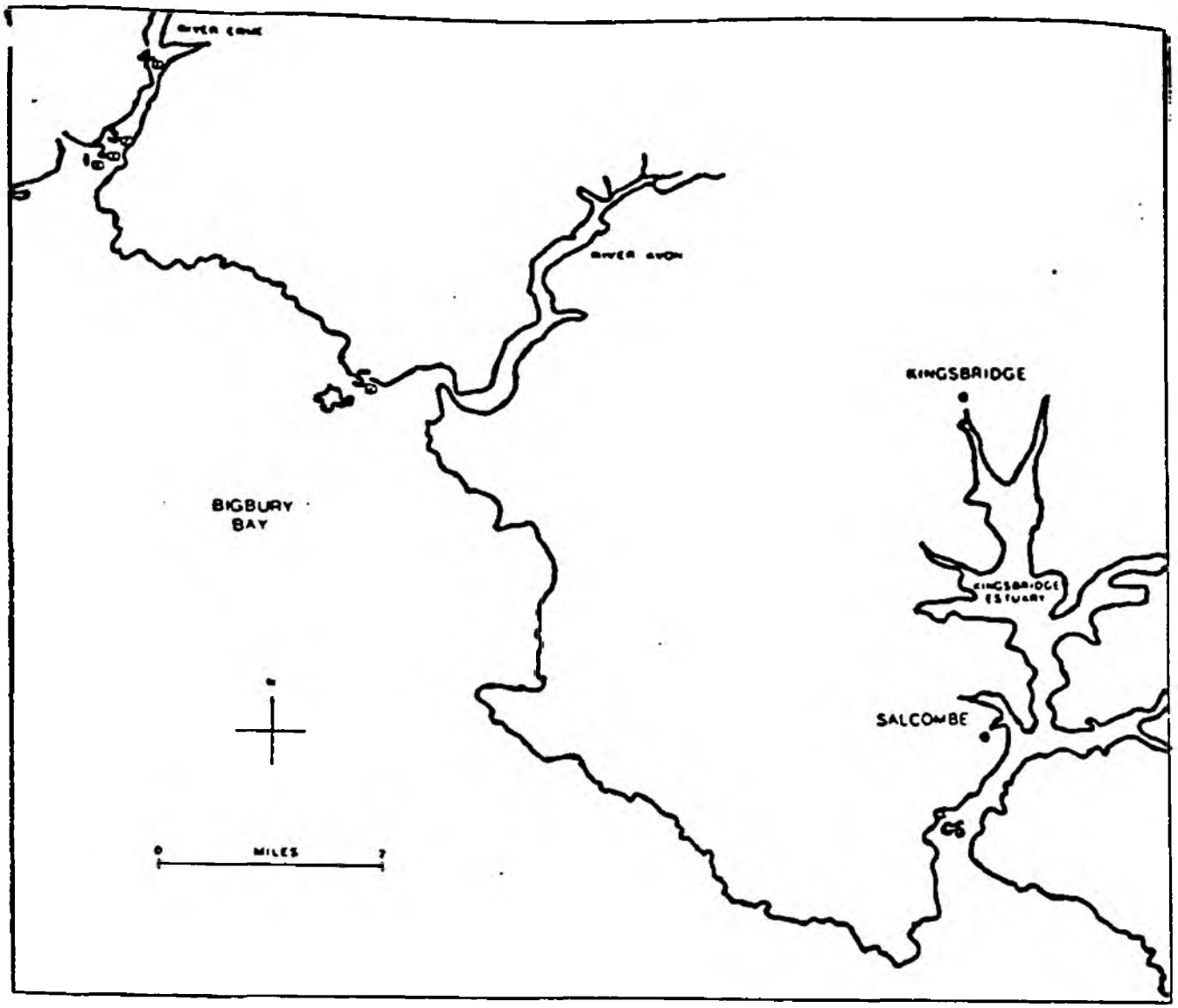


Figure 1 - Location of sampling sites

Metal Analysis Of Control Site Sediment For Poole & Plymouth.

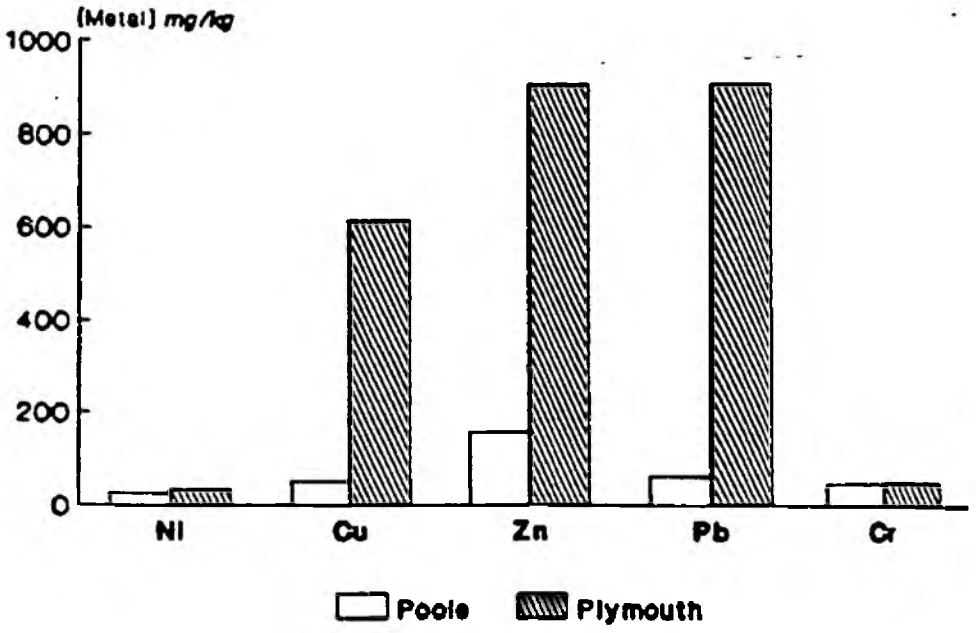


Figure 2a

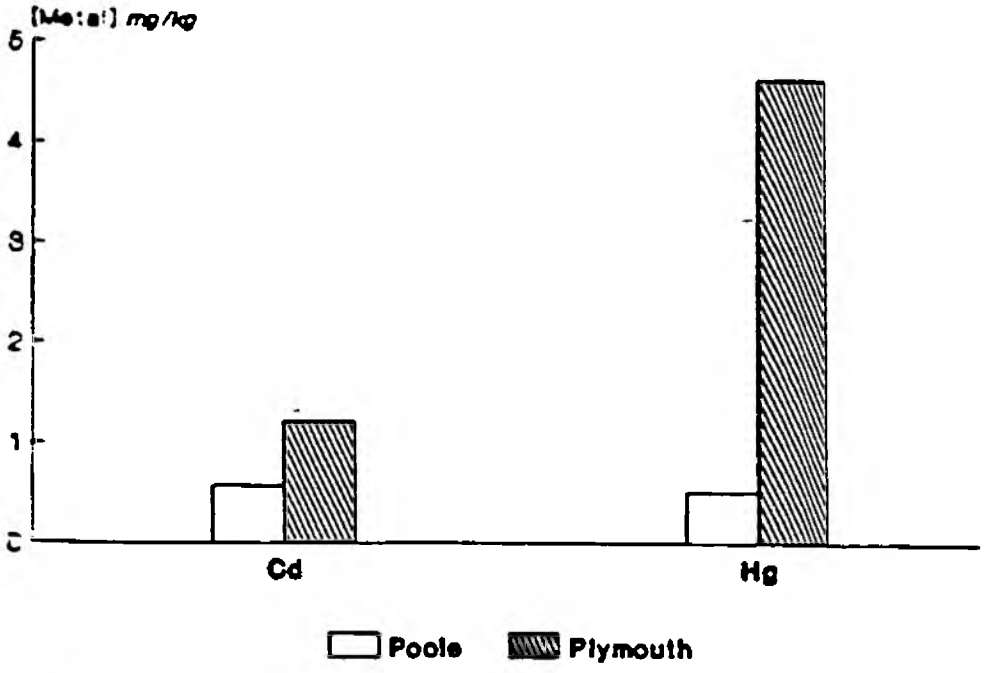


Figure 2b

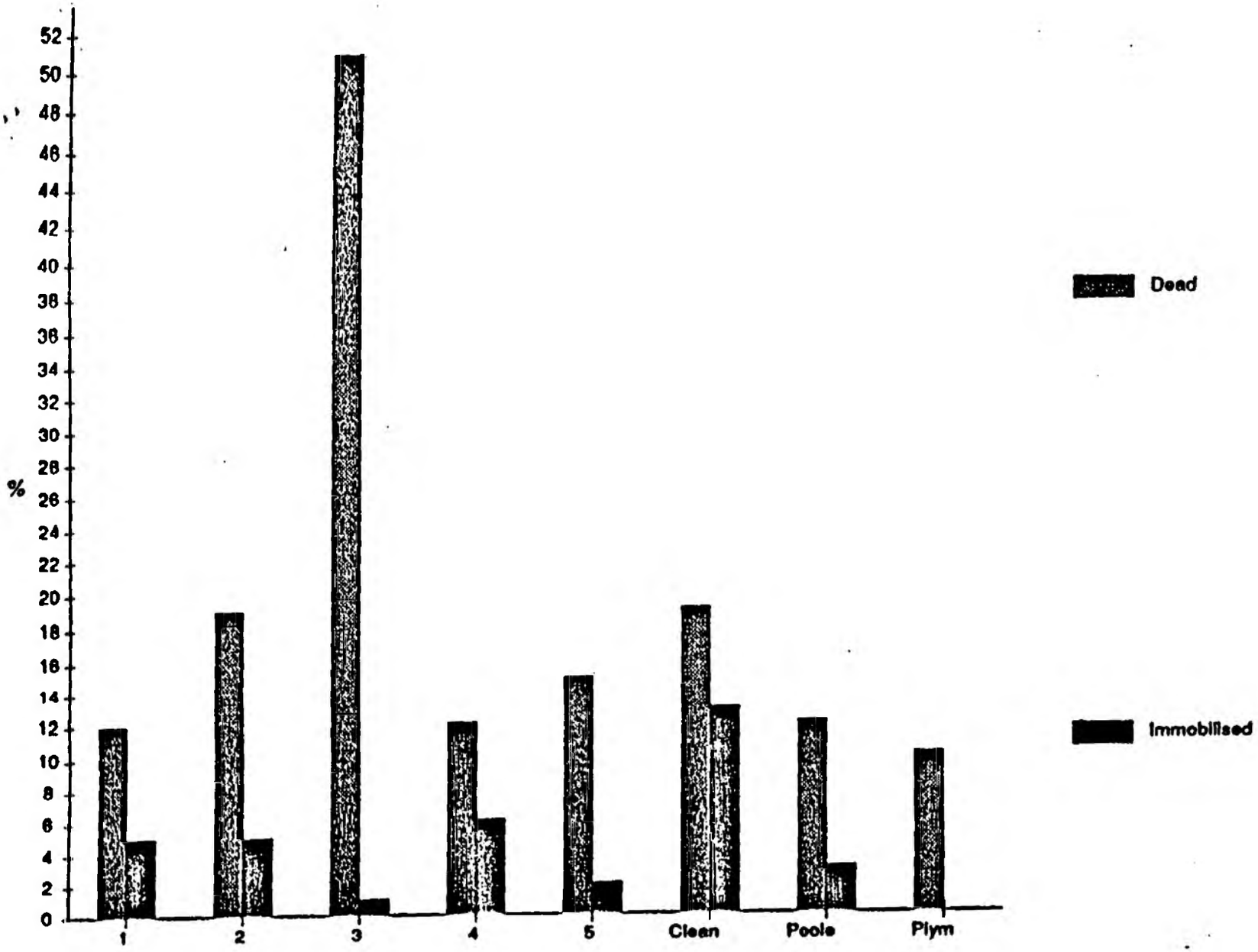


Fig. 3 Effect of oiled sand on Corophium

4.(d) An Investigation of the Residual Oil Contamination of the Sediments of the Erme Estuary.

4.(d) An Investigation of the Residual Oil Contamination of the Sediments of the Erme Estuary.

As a follow up to the sediment toxicity work undertaken by WRC, and on their advice, a set of sediment samples were taken on November 6th to observe the remaining levels of oil contamination in the sediments of Wonwell beach. This study was undertaken as WRC's ecotoxicology department are at the time of writing, of the opinion that below a level of 50ppm of oil, beach sediment is not unduly toxic to the infaunal communities.

Three sites were then sampled, as shown in Table 1. The locations of these sites are also shown on Figure 1.

Methods

At each site approximately 100g of sediment was collected with a previously detergent washed stainless steel spoon. The samples were then stored in a fridge, prior to analysis.

Results

The results are shown in Table 1.

Table 1.

Date	Location	Grid Ref.	Tot. extractable hydrocarbons.	Comparable WRc site.
6/11/90	Lower Wonwell	SX 6160 4735	60 mg/kg	2
6/11/90	Lime Kiln	SX 6185 4760	580 mg/kg	3
6/11/90	Tor Wood	SX 6225 4875	190 mg/kg	4

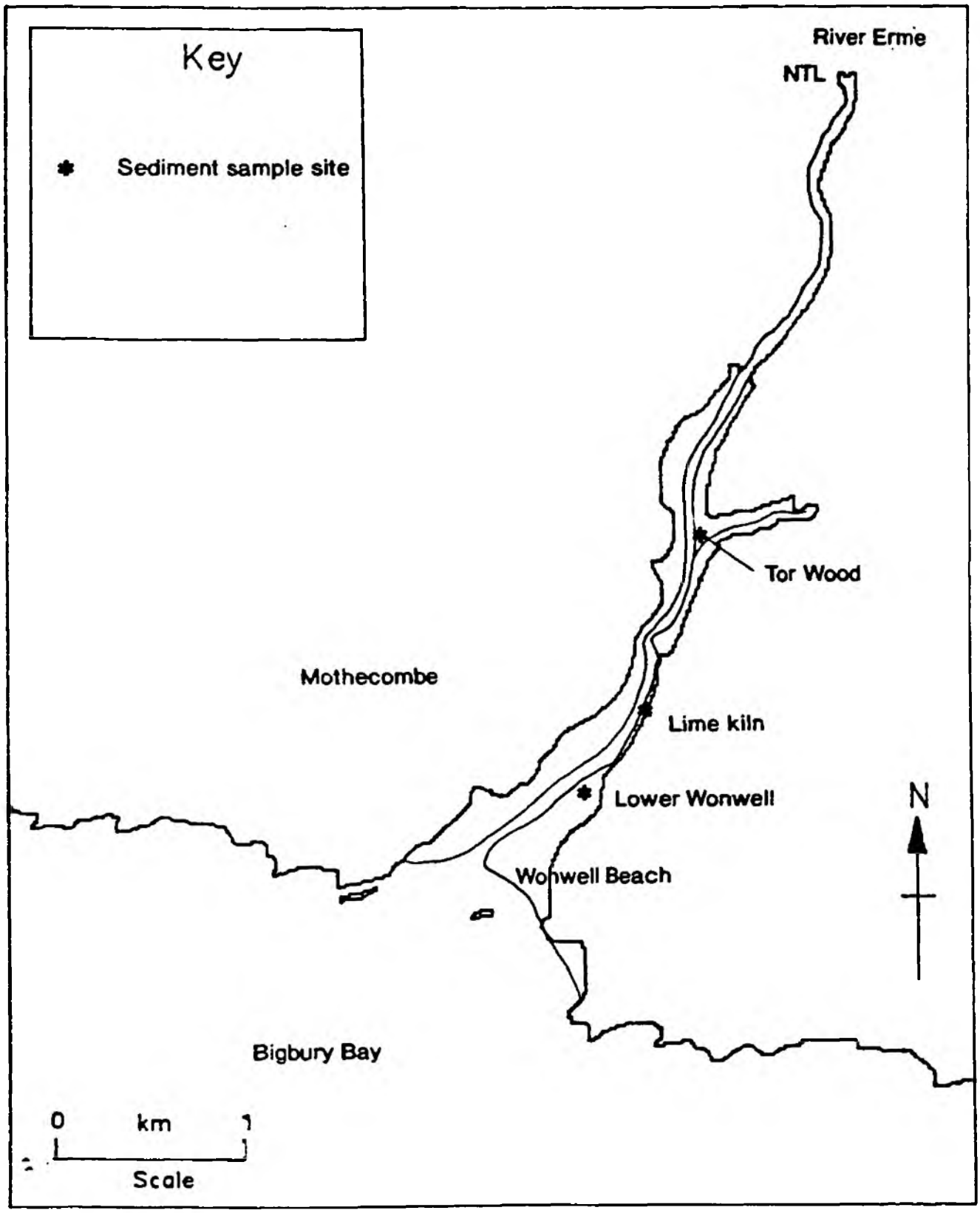
Discussion

The results are interesting in that all the levels of oil contamination are considerably higher in the November samples than the May samples (see Table 5. of the WRC report for a comparison).

Figure 1.

The Erme Estuary

Sediment sample sites in the lower Erme estuary.



Several possible scenarios could account for the results, these being:-

1. The deposition of considerable quantities of sediment in the bay,

   which obviously occurred in May, (as buried oil deposits have already been discussed in this report), resulted in the sediment that was utilised in the toxicity study, [see report (a)], being at a considerably lower level of contamination than the sediment collected in November. This sediment having been at the surface at the time of the oil spill and then been re-exposed by the Autumn gales.

2. The relative contamination of the sediments was at the outset a very patchy affair and the levels of oil in the sediments varied greatly from place to place on the beach. Hence subsequent samples of the sediment, taken throughout the year, have shown varying results in terms of level of oil contamination.

It is not possible to comment further on the scenarios presented above, though a combination of the two postulations would appear to supply a probable explanation.

On the basis of the results of this section the NRA is undertaking a further programme of survey work on the sediments in the mouth of the Erme to follow the fate of the oil contamination, post spill.

The results of this further study will be appended to this report when they become available.

5. The Impact of the Rosebay Oil on the Local Seabird Populations.

This section outlines the work carried out by the Royal Society for the Protection of Birds (RSPB) following the oil spill and comprises a comprehensive survey of the coastline between Bovisand in Plymouth Sound and Bolt Head, at the mouth of the Kingsbridge estuary. The extent of this coastline can be seen in Appendix 1.

SX612743 - SX615450 Wonwell Beach - Beacon Point 06.00 - 09.00hrs

SX612472 - SX617472 Erme Estuary 14.30 - 18.00 hrs

Morning Survey:

2 Oiled birds observed - neither obtainable

6 Cormorants/Shags - 1 oiled immature Cormorant

4 Oystercatchers - 1 oiled

4 Shelduck

2 Greater Black-headed Gulls and 50 Herring Gulls.

All appeared normal with the 2 oiled individuals being the exception.

Afternoon Survey:

No oiled birds

No Cormorants/Shags

No Oystercatchers

Gull activity minimal

Birds in fields N.B High tide. 1500 hrs.

SX647448 - SX650445 Challaborough Beach 10.30 - 15.00 hrs

No oiled birds

Gull activity minimal - but late in survey period 6 seen flying together.

Nesting birds on cliff ledges (11 young).

SX653443 - SX663445 Bigbury Beach towards Cockleridge 15.30 - 18.00 hrs

No oiled birds

5 Cormorants/Shags on rock looking towards Bantham

1 Shag flying and 1 Cormorant diving off beach

10 Adult Herring Gulls preening on various areas of sand - 2 above beach

1 Male Mallard

All appeared normal

SX663442 - SX669421 Bantham to Warren Point (Thurlestone) 09.30 - 13.45 hrs

1 oiled bird observed. Not obtainable

During survey:
15 (approx) individual Cormorants/Shags
2 Oystercatchers
1 Herring Gull with oiled breast band
5 Terns and 2 Gannets plunge diving off-shore
Gull activity minor, Fulmars on cliffs.
All appeared normal except for the 1 Herring Gull.

SX669421 - SX675396 Warren Point (Thurlestone) to Hope Cove 11.30 - 16.45 hrs

No oiled birds.
Report; 2 dead Cormorants recovered in last 2 days.
During survey:
Unlisted numbers of Cormorant/Shags
Arctic Terns off beach/Fulmars on cliffs
Few Dunlin and Oystercatcher
Gull activity minor.

SX674390 - SX689383 Bolt Tail - Bolberry Down 14.00 - 16.00 hrs

No oiled birds.

During survey:
14.00 - 15.00 hrs;
4 Cormorants/Shags on rocks. 1 excessively preening
2 Greater Black-backed and 12 Herring Gulls mainly juveniles flying
1 Gannet around the Ham Stone

15.00 - 16.00 hrs;
2 Greater Black-backed and 4 Herring Gulls
1 Gannet offshore (not one seen before)
8 Herring Gulls following boat
Above Whitechurch Cove 2 Black-backed Gull and 6 Herring Gulls bathing in rock pool well above high tide mark.

SX706369 - SX727361 Soar to Bolt Head 14.30 - 18.00 hrs
No oiled birds
During survey:
From Bolt Head 11 Cormorants on a stack
2 Gannets offshore
1 Oystercatcher

Gull activity included Greater and Lesser Black-backed gulls with Herring Gulls.

Summary
This survey was undertaken to ascertain the number of corpses due to oil pollution on beaches throughout the affected area, Bovisand to Bolt Head, none were found. Information gained by several participants during their survey indicated that 2 Cormorants are known to have been recovered dead in the Thurlestone area in the two days prior to this survey.

Three oiled birds were observed, none of these obtainable. All seemed not to be distressed by their condition. 1 Cormorant* excessively preening appeared to be distressed and has not been included in the previous total of 3.

Opinion among beached bird surveyors who have undertaken numerous surveys and some local persons residing in the vicinity of beaches was unanimous- during previous winters the number of corpses and oiled birds coming ashore had been many times greater on several occasions.

Of the approx. 37 hours of survey time spent at 14 sites there were:-

Corpses	Nil
Unobtainable Oiled Birds	4 *

These figures cannot be considered in any way definitive relative to final casualty figures; they do confirm on 20 May 1990 there was no widespread evidence of beached birds dead or oiled the 8th day after spillage 12 May 1990.

6. The Impact of the Rosebay Oil Spill on Selected Rocky Shores Within the Affected Area.

This final section will contain notes compiled by the Devon Wildlife Trust, on the effect of the oil spill on a selection of rocky shore locations from the Wembury Marine Conservation Area, and the Mouth of the Erme.

The notes will become available in April and will be appended to this report when appropriate.

7. Report Conclusions

A relatively small amount of environmental impact work has been undertaken on the effects of the Rosebay Oilspill. The impact of this oil was spread along the coast of South Devon and South East Cornwall, between Hope Cove and The Lizard but the major strandings occurred within Bigbury Bay on the Devon coast.

The studies undertaken have indicated that apparently limited damage occurred to impacted communities, though ecological conclusions are highly tentative.
Additionally, the studies have indicated the difficulty encountered in defining precisely the impact of an oilspill of this magnitude without the benefit of biological data collected immediately before the event. Data available from 3 years before allows only limited assessments to be made.

The NRA are still continuing to monitor the levels of oil contaminating the sediments of the Erme Estuary and results will be appended to this report, as will the results of the Devon Wildlife Trust's shore surveys when they become available.

8. Acknowledgements

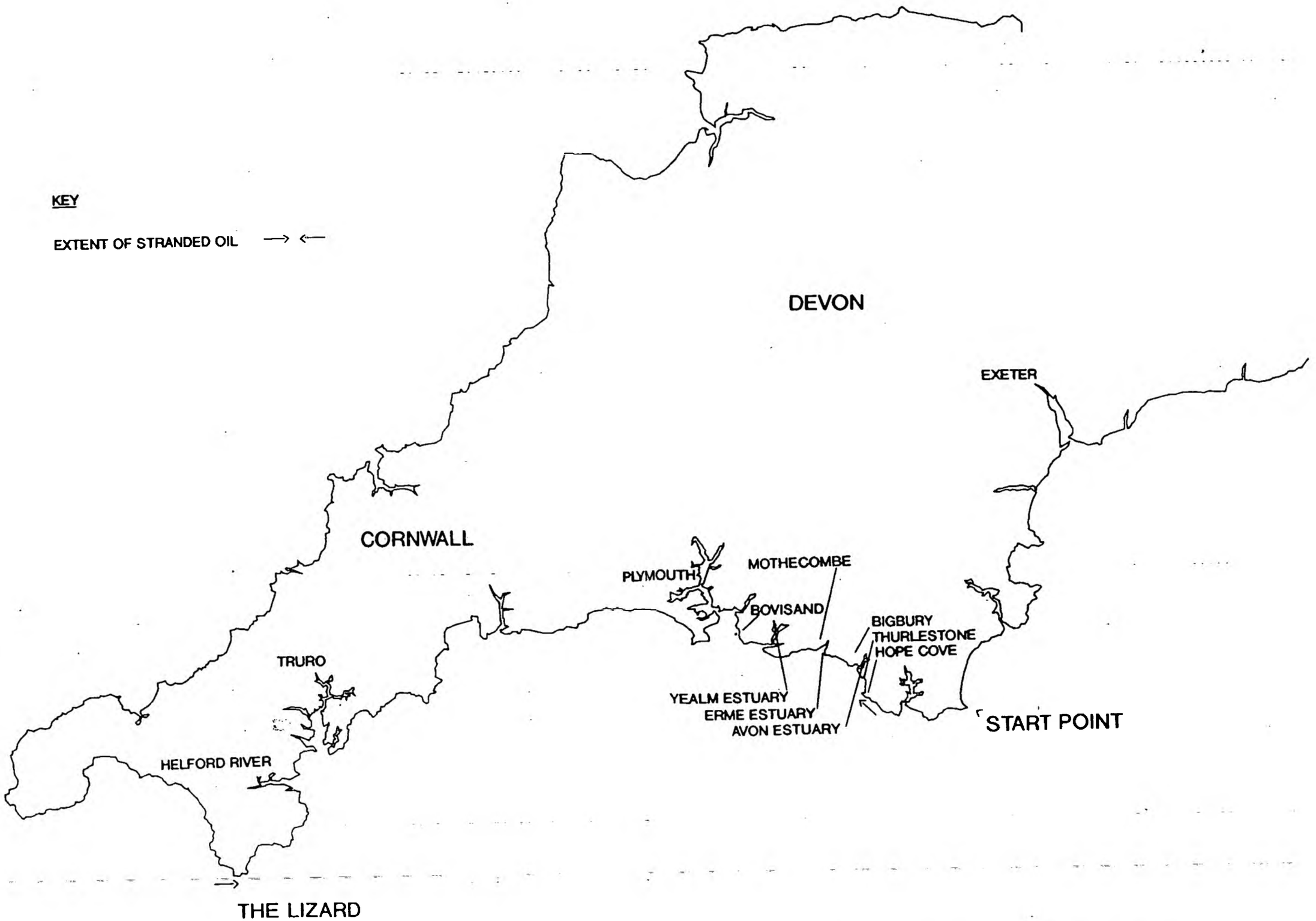
The NRA are grateful to all who helped on the project, especially those who contributed to this report. Additionally, the NRA wish to thank those individuals and representatives of organisations listed in the introduction, that attended the meeting at NRA headquarters on 26th November 1990.

T. Mercer, December 1990. TWIU/TM/17/90

APPENDIX 1.

Geographical Extent of Stranded Oil and Location of Places Mentioned in the Text.

FIGURE A1. GEOGRAPHICAL EXTENT OF STRANDED OIL AND LOCATION OF PLACES MENTIONED IN THE TEXT.



APPENDIX II

Oil Pollution Log Sheets from Members of the Royal Society for the Protection of Birds

OIL POLLUTION REPORT FORM-1

1. FROM:- JIM GRICE

2. (a) DATE:- 20th May 1990. TIME:- 14.00hrs - 16.15hrs.

3. (a) Location Name:- BOYISAND TO HEYBROOK BAY

(b) OS Map Reference :- SX 492505 - SX 497486

4. Visual Appearance of Oil:-

(a) Black (b) Brown ✓

5. Physical State of Oil:-

(a) Liquid (b) Viscous/Semi-Solid ✓ (c) Solid

6. Composition of Polluted Area:

(a) Mud
(b) Sand
(c) Shingle ✓
(d) Pebbles
(e) Rocks ✓
(f) Cliffs
(g) Concrete and metal/wooden structures
(h) Water

7. Extent of Pollution:

(a) Continuous ✓
(b) Intermittent
(c) Scattered

8. Location on Shoreline:

(a) High tide line ✓
(b) Over intertidal zone

9. Location Afloat Nil.

(a) Barbour/Dock area
(b) Marina
(c) Estuary
(d) River
(e) Near water intake pipes
(f) Offshore at sea

10. Quantity of Oil:

(a) Length in Metres . . 70 metres. . . . } End of
(b) Average width in Metres . 4 metres. . . . } slick.
(c) Average thickness in Centimetres Thin film.

11. Additional Information:-

No. oil afloat.
No. oiled birds.

OIL POLLUTION REPORT - FORM 1

1. FROM:- PETER STANFORD

2. (a) DATE:- 20/5/90 TIME:- 15.00 hrs

3. (a) Location Name:- WEMBURY PT. - MOUTH OF YEALM

(b) OS Map Reference :- SX503482 — 527479

4. Visual Appearance of Oil:- NIL

(a) Black (b) Brown

5. Physical State of Oil:- NIL

(a) Liquid (b) Viscous/Semi-Solid (c) Solid

6. Composition of Polluted Area:

(a) Mud
(b) Sand
(c) Shingle
(d) Pebbles
(e) Rocks
(f) Cliffs
(g) Concrete and metal/wooden structures
(h) Water

7. Extent of Pollution:

(a) Continuous
(b) Intermittent
(c) Scattered

8. Location on Shoreline:

(a) High tide line - mousse above
(b) Over intertidal zone

9. Location Afloat

(a) Harbour/Dock area
(b) Marina
(c) Estuary
(d) River
(e) Near water intake pipes
(f) Offshore at sea

10. Quantity of Oil:

(a) Length in Metres . . . . . .

(b) Average width in Metres . . . . . .

(c) Average thickness in Centimetres . . . . . .

11. Additional Information:-

Signs of mousse scattered throughout on rock pools above highwater line. Pools below cleansed by tide. No oiled birds

1. FROM:- ALAN WOODS

2. (a) DATE:- 20th May 1990. TIME:- 14.15 hrs - 15.30 hrs

3. (a) Location Name:- Gara Point - Warren Car Park (Blackstone Pt.

(b) OS Map Reference :- SX 522468 - SX 535461

4. Visual Appearance of Oil:- NIL

(a) Black (b) Brown

5. Physical State of Oil:- NIL

(a) Liquid (b) Viscous/Semi-Solid (c) Solid

6. Composition of Polluted Area:

(a) Mud
(b) Sand
(c) Shingle
(d) Pebbles
(e) Rocks
(f) Cliffs
(g) Concrete and metal/wooden structures
(h) Water

Mousse boulders

7. Extent of Pollution:

(a) Continuous
(b) Intermittent
(c) Scattered ✓

8. Location on Shoreline:

(a) High tide line
(b) Over intertidal zone

9. Location Afloat

(a) Harbour/Dock area
(b) Marina
(c) Estuary
(d) River
(e) Near water intake pipes
(f) Offshore at sea

10. Quantity of Oil:

(a) Length in Metres . . . . . .

(b) Average width in Metres . . . . . .

(c) Average thickness in Centimetres . . . . . .

11. Additional Information:-

1 OILED BIRDS.

OIL POLLUTION REPORT - FORM I

1. FROM:- JOHN LOCKSTONE
2. (a) DATE:- 20/5/90 TIME:- 9.45 - 16.30 HRS
3. (a) Location Name:- Warren Car Park - Stoke Point (Lackstone Point)
   (b) OS Map Reference :- SX 533461 - 560457
4. Visual Appearance of Oil:-
   (a) Black (b) Brown ✓
5. Physical State of Oil:-
   (a) Liquid ✓ (b) Viscous/Semi-Solid (c) Solid
6. Composition of Polluted Area:
   (a) Mud
   (b) Sand
   (c) Shingle
   (d) Pebbles
   (e) Rocks ✓
   (f) Cliffs ✓ - E to W gullies at base.
   (g) Concrete and metal/wooden structures
   (h) Water
7. Extent of Pollution:
   (a) Continuous
   (b) Intermittent E of Stoke Point.
   (c) Scattered N of Stoke Point
8. Location on Shoreline:
   (a) High tide line
   (b) Over intertidal zone
9. Location Afloat
   (a) Harbour/Dock area
   (b) Marina
   (c) Estuary
   (d) River
   (e) Near water intake pipes
   (f) Offshore at sea
10. Quantity of Oil:
   (a) Length in Metres . . . . . .
   (b) Average width in Metres . . . . . .
   (c) Average thickness in Centimetres . . . . . .
11. Additional Information:-
East side of Stoke Point gullies, intermittently filled with brown liquid oil, at base of cliffs. West side gullies in a few places. Ribbons of floating mousse scattered throughout and on rocks.
No oiled birds.

1. FROM:- FRANK & CAROL BARTLETT

2. (a) DATE:- 20/5/90 TIME:- 16.00 hrs - 17.45 hrs

3. (a) Location Name:- Stoke Point - Blackaterry

(b) OS Map Reference :- SX560457 - SX551469

4. Visual Appearance of Oil:-

(a) Black ✓ (b) Brown

5. Physical State of Oil:-

(a) Liquid ✓ (b) Viscous/Semi-Solid (c) Solid

6. Composition of Polluted Area:

(a) Mud
(b) Sand
(c) Shingle
(d) Pebbles
(e) Rocks ✓
(f) Cliffs - Gullies at base ✓
(g) Concrete and metal/wooden structures
(h) Water

7. Extent of Pollution:

(a) Continuous
(b) Intermittent ✓
(c) Scattered

8. Location on Shoreline:

(a) High tide line
(b) Over intertidal zone

9. Location Offshore

(a) Harbour Dock area
(b) Marina
(c) Estuary
(d) River
(e) Near water intake pipes
(f) Offshore at sea ✓

Mousse

10. Quantity of Oil:

(a) Length in Metres
(b) Average width in Metres
(c) Average thickness in Centimetres

11. Additional Information:-

One or two coves thick with black oil, with - mousse scattered throughout with - one offshore.
IVY main and and cove clear of oil.
No oiled birds.

1. FROM:- . . . POLLY SCHLAEFLI . . . . . .

2. (a) DATE:- 20/5/90 . . . . TIME:- 10.00hrs - 13.00hrs.

3. (a) Location Name:- . Blackaterry to Mothecombe Private Beach

(b) OS Map Reference :- . SX581469 - SX612473. . .

4. Visual Appearance of Oil:- . . . . . .

(a) Black (b) Brown ✓

5. Physical State of Oil:- . . . . . .

(a) Liquid (b) Viscous/Semi-Solid ✓ (c) Solid

6. Composition of Polluted Area:

(a) Mud

(b) Sand ✓

(c) Shingle

(d) Pebbles ✓

(e) Rocks ✓

(f) Cliffs 6 feet from base.

(g) Concrete and metal/wooden structures

(h) Water

7. Extent of Pollution:

(a) Continuous

(b) Intermittent ✓

(c) Scattered

8. Location on Shoreline:

(a) High tide line ✓ — approx 6 feet up cliff face

(b) Over intertidal zone ✓

9. Location Afloat

(a) Harbour/Dock area

(b) Marina

(c) Estuary

(d) River

(e) Near water intake pipes

(f) Offshore at sea

10. Quantity of Oil:

(a) Length in Metres . . . . . .

(b) Average width in Metres . . . . . .

(c) Average thickness in Centimetres . . . . . .

11. Additional Information:-

. . Intermittent. thick & globular throughout

. . No. oiled birds. . . . . .

. . . . . .

OIL POLLUTION REPORT FORM 4

1. FROM:- JOHN BOON
2. (a) DATE:- 20/5/90 TIME:- 06.00 hrs - 09.00 hrs.
3. (a) Location Name:- Wonwell Beach to Beacon Pt
   (b) OS Map Reference :- SX 612743 — SX 615460
4. Visual Appearance of Oil:-
   (a) Black ✓ (b) Brown ✓ (beach)
5. Physical State of Oil:- (beach to Beacon pt)
   (a) Liquid (b) Viscous/Semi-Solid ✓ (c) Solid
6. Composition of Polluted Area:
   (a) Mud
   (b) Sand ✓ beach (minor)
   (c) Shingle ✓
   (d) Pebbles
   (e) Rocks ✓
   (f) Cliffs
   (g) Concrete and metal/wooden structures
   (h) Water
7. Extent of Pollution:
   (a) Continuous over rocks to Beacon Pt (c) Scattered ✓ (beach)
   (b) Intermittent
8. Location on Shoreline:
   (a) High tide line on rocks. (b) Over intertidal zone
9. Location Afloat
   (a) Harbour Dock area (d) River
   (b) Marina (e) Near water intake pipes
   (c) Estuary (f) Offshore at sea
10. Quantity of Oil:
   (a) Length in Metres . . . . . .
   (b) Average width in Metres . . . . . .
   (c) Average thickness in Centimetres . . . . . .
11. Additional Information:-
Beach - clear, minor traces on sand, rocks
oil = High Tide Mark. Estuary to
Beach - Cove. Oil pollution 1 to 2 m wide black
line - right across rocks / gullies and on
shore = Mousse in bays either side of
Beacon Point.
1 Oiled Oystercatcher. } Wonwell
1 Oiled Immature Cormorant. } Beach.
No oil - yond boom at Erme mouth.

1

OIL POLLUTION REPORT - FORM 1

1. COM:- Polly Schlaefli

2. (a) DATE:- 20/5/90 TIME:- 14.30hrs - 18.00hrs

3. (a) Location Name:- Exe Estuary.

   (b) OS Map Reference :- SX 612472 - SX 617472

4. Visual Appearance of Oil:-

   (a) Black (b) Brown ✓

5. Physical State of Oil:-

   (a) Liquid (b) Viscous/Semi-Solid ✓ (c) Solid

6. Composition of Polluted Area:

   (a) Mud
   (b) Sand ✓
   (c) Shingle
   (d) Pebbles
   (e) Rocks ✓
   (f) Cliffs
   (g) Concrete and metal/wooden structures
   (h) Water

7. Extent of Pollution:

   (a) Continuous
   (b) Intermittent
   (c) Scattered ✓ slicks across estuary, together with mousse at sea edge.

8. Location on Shoreline:

   (a) High tide line
   (b) Over intertidal zone ✓

9. Location Afloat

   (a) Harbour/Dock area
   (b) Marina
   (c) Estuary
   (d) River
   (e) Near water intake pipes
   (f) Offshore at sea

10. Quantity of Oil:

   (a) Length in Metres . . 5m long
   (b) Average width in Metres 5m wide
   (c) Average thickness in Centimetres

11. Additional Information:-

Oil Globules on sand and rocks.
No oiled birds.

1. FROM:- MR. W. G. HODGE . . . . . TIME:- 10.30 hrs - 15.00 hrs.
2. (a) DATE:- 20/5/90 . . . . . CHALLABOROUGH . . . . . .
3. (a) Location Name:- . . . . . SX 647448 - SX 650445 . . . .
   (b) OS Map Reference :- . . . . . .
4. Visual Appearance of Oil:- . . . . . .
   (a) Black (b) Brown ✓ . . . . . .
5. Physical State of Oil:- . . . . . .
   (a) Liquid (b) Viscous/Semi-Solid ✓ (c) Solid
6. Composition of Polluted Area:
   (a) Mud
   (b) Sand
   (c) Shingle
   (d) Pebbles
   (e) Rocks ✓
   (f) Cliffs
   (g) Concrete and metal/wooden structures
   (h) Water
7. Extent of Pollution:
   (a) Continuous
   (b) Intermittent
   (c) Scattered ✓
8. Location on Shoreline:
   (a) Close to the line ✓ on Rocks
   (b) Over intertidal zone
9. Location offshore
   (a) Enclosed dock area
   (b) Marina
   (c) Estuary
   (d) River
   (e) Near water intake pipes
   (f) Offshore at sea None ✓
10. Quantity of Oil:
    (a) Length in Metres . . . . . .
    (b) Area Width in Metres . . . . . .
    (c) Area Thickness in Centimetres . . . . . .
11. Additional Information:-
    . . . Generally very clean (Council operation) . . .
    . . . Few dead birds. . . . . .
    . . . Some rock pools . . . . . .

1. FROM:- ROY & MONICA TULLY

2. (a) DATE:- 20/5/90 TIME:- 16.30 hrs - 18.00 hrs.

3. (a) Location Name:- BIGBURY TO COCKLERIDGE

(b) OS Map Reference :- SX653443 to SX663445

4. Visual Appearance of Oil:-

(a) Black ✓ (b) Brown

5. Physical State of Oil:-

(a) Liquid (b) Viscous/Semi-Solid ✓ (c) Solid

6. Composition of Polluted Area:

(a) Mud
(b) Sand
(c) Shingle
(d) Pebbles
(e) Rocks ✓
(f) Cliffs
(g) Concrete and metal/wooden structures
(h) Water

7. Extent of Pollution:

(a) Continuous
(b) Intermittent
(c) Scattered ✓

8. Location on Shoreline:

(a) High tide line ✓ Oiled above
(b) Over intertidal zone ✓ Rocks

9. Location Afloat

(a) Harbour/Dock area
(b) Marina
(c) Estuary
(d) River
(e) Near water intake pipes
(f) Offshore at sea

10. Quantity of Oil:

(a) Length in Metres
(b) Average width in Metres
(c) Average thickness in Centimetres

11. Additional Information:-

Rocks 'freckled' below high tide line with oil, seaweed affected. Minor oil film with dispersant in very minor patches above high tide line.

No oiled birds.

1. FROM:- ROY HEXTER

2. (a) DATE:- TIME:- 09.30 hrs - 13.45 hrs.

3. (a) Location Name:- BANTHAM TO WARREN POINT (THURLESTONE)

(b) OS Map Reference :- SX663442 - SX669421

4. Visual Appearance of Oil:-

(a) Black (b) Brown ✓

5. Physical State of Oil:-

(a) Liquid (b) Viscous/Semi-Solid ✓ (c) Solid

6. Composition of Polluted Area:

(a) Mud
(b) Sand
(c) Shingle
(d) Pebbles
(e) Rocks ✓
(f) Cliffs
(g) Concrete and metal/wooden structures
(h) Water

7. Extent of Pollution:

(a) Continuous
(b) Intermittent
(c) Scattered ✓

8. Location on Shoreline:

(a) High tide line (b) Over intertidal zone

9. Location Afloat

(a) Harbour/Dock area
(b) Marina
(c) Estuary
(d) River
(e) Near water intake pipes
(f) Offshore at sea

10. Quantity of Oil:

(a) Length in Metres . . 100m. . . . . } One Area
(b) Average width in Metres . 2 to 3m. . . . }
(c) Average thickness in Centimetres . 'Thin' . .

11. Additional Information:-

One Herring Gull with oil breast band.

1. FROM:- DAVID HAWKE

2. (a) DATE:- 20/5/90 TIME:- 11.30 hrs - 16.45 hrs.

3. (a) Location Name:- THURLESTONE (WORKEN R.) to HOPE COVE

(b) OS Map Reference :- SX669421 - SX675396

4. Visual Appearance of Oil:-

(a) Black ✓ (b) Brown

5. Physical State of Oil:-

(a) Liquid (b) Viscous/Semi-Solid (c) Solid

6. Composition of Polluted Area:

(a) Mud
(b) Sand ✓
(c) Shingle
(d) Pebbles
(e) Rocks ✓
(f) Cliffs
(g) Concrete and metal/wooden structures
(h) Water

7. Extent of Pollution:

(a) Continuous
(b) Intermittent
(c) Scattered

8. Location on Shoreline:

(a) High tide line
(b) Over intertidal zone

9. Location Afloat

(a) Harbour/Dock area
(b) Marina
(c) Estuary
(d) River
(e) Near water intake pipes
(f) Offshore at sea

10. Quantity of Oil: SX 675419

(a) Length in Metres . . . . 30 m. . . . . } Sand with area of rocks
(b) Average width in Metres . 5 m. . . . . }
(c) Average thickness in Centimetres . . . . . .

11. Additional Information:-

Thurlestone Beach cleaned by Council.
No oil reached Hope Cove.
No oiled birds. At Thurlestone advised last 2 days - 2 Cormorants dead (oiled).

OIL POLLUTION REPORT - FORM 1

1. FROM:- ROY & MONICA TULLY

2. (a) DATE:- 20/5/90 TIME:- 14.00 hrs - 16.00 hrs.

3. (a) Location Name:- SX674390 - SX689383

   (b) OS Map Reference :- Bolt Tail - Bolberry Down

4. Visual Appearance of Oil:- NIL

   (a) Black (b) Brown

5. Physical State of Oil:- NIL

   (a) Liquid (b) Viscous/Semi-Solid (c) Solid

6. Composition of Polluted Area:

   (a) Mud
   (b) Sand
   (c) Shingle
   (d) Pebbles
   (e) Rocks ✓
   (f) Cliffs ✓
   (g) Concrete and metal/wooden structures
   (h) Water

7. Extent of Pollution:

   (a) Continuous
   (b) Intermittent
   (c) Scattered

8. Location on Shoreline:

   (a) High tide line
   (b) Over intertidal zone

9. Location Afloat

   (a) Harbour/Dock area
   (b) Marina
   (c) Estuary
   (d) River
   (e) Near water intake pipes
   (f) Offshore at sea

10. Quantity of Oil:

    (a) Length in Metres . . . . . .

    (b) Average width in Metres . . . . . .

    (c) Average thickness in Centimetres . . . . . .

11. Additional Information:-

MOUSSE / DISPERSANT. up. 1 to 2m. width streaks. Scattered along sea short distance offshore throughout. Whitechurch Cove more extensively affected.

OIL POLLUTION REPORT FORM-1

1. FROM:- RUTH ROBINSON

2. (a) DATE:- 20/5/90 TIME:- 14.30hrs to 18.00hrs.

3. (a) Location Name:- SX706369 - SX727361

(b) OS Map Reference :- SOAR to BOLT HEAD.

4. Visual Appearance of Oil:- NIL

(a) Black (b) Brown

5. Physical State of Oil:- NIL

(a) Liquid (b) Viscous/Semi-Solid (c) Solid

6. Composition of Polluted Area:

(a) Mud
(b) Sand
(c) Shingle
(d) Pebbles
(e) Rocks
(f) Cliffs
(g) Concrete and metal/wooden structures
(h) Water

7. Extent of Pollution:

(a) Continuous
(b) Intermittent
(c) Scattered

8. Location on Shoreline:

(a) High tide line
(b) Over intertidal zone

9. Location Afloat

(a) Harbour/Dock area
(b) Marina
(c) Estuary
(d) River
(e) Near water intake pipes
(f) Offshore at sea

10. Quantity of Oil:

(a) Length in Metres . . . . . .

(b) Average width in Metres . . . . . .

(c) Average thickness in Centimetres . . . . . .

11. Additional Information:-

No oiled birds.