GULF OF SUEZ REEF SURVEY 1989

Patron : The Lord Adrian MD, FRS, FRCP.
Master of Pembroke College, Cambridge.

EXPEDITION REPORT

August 1990

Registered Charity No. 311460

Approved by : Royal Geographical Society,
The Explorers' Club of America,
Scientific Exploration Society,
Cambridge Expeditions Committee.

خليج السويس منطقة مهمة جدًا بالنسبة إلى مصر و صناعتها في ميدان النفط. في شمال الخليج تشكل قناة السويس طريقًا دوليًا لشحن ، وتتطوّر المنطقة الجنوبية لسياحة وإجانب بالاضافة إلى صيد السمك الموجود والامكنية لتطوّر المدن والصنائع.

خلال الصيف الماضي شرعت فرقة من جامعة كمبردج لتفحص تأثير التلوّث النفطي على الشعاب المرجانية في الخليج.

يحتوي هذا التقرير نتائج البحث وتفاصيل الإعداد قبل المغادرة إلى مصر. قدّمت هذه النتائج إلى مؤتمر علمي دولي في القاهرة، كانون الأول ،١٩٨٩.

نرسل هذا التقرير إلى كفلاءنا ، حكومة مصر، شركات البترول و منظمات بيئية أخرى.

أملنا وهدفنا هي زيادة معرفة في العالم حول دمار التراث البحري المصري و منع هذا الدمار.

Action must be taken immediately to reverse the impact of man's activities on the coral reefs and marine environment of the Gulf of Suez. This action has to be seen as an international responsibility, addressing the causes and not the symptoms, and looking to the area's long term survival - not just its short term exploitation.

1. ABSTRACT

The Gulf of Suez is an area of great importance to Egypt, supporting an expanding oil industry with large proven reserves, currently producing 750,000 barrels per day (September 1989). The Suez Canal in the north forms an international shipping route, whilst tourism is developing in the south. Additionally, the region hosts a small commercial fishery and its shores offer potential for both urban and commercial development.

In July and August 1989 a team of six divers, based at Cambridge University, set out to investigate the effects of oil pollution on the coral reefs of the Gulf of Suez.

This report details the findings of the team, and outlines the preparations that were needed for such an expedition. The results were presented to an International Forum of Exploration and Production Oil Companies investigating safety and environmental issues within the industry, held in Cairo in December 1989,

This report is being sent to sponsors, the Egyptian government, oil companies and to other interested and ecological organisations. It is the hope and aim of the members of the expedition to increase awareness of the destruction of Egypt's marine heritage, and ultimately to prevent it.

Ras Mohammed is a most breathtaking drop-off. Dropping to over 500 metres, it is one of the most spectacular dives in the world.

2. CONTENTS

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09278 3851

The Expedition Team
From the left: Rob Cooper, Karen Wild, Jonathan Cheal, Emmeline Rogers, Peter Ireland, Adrian Surtees and Perky.

The Expedition would not have been possible without the most generous help and advice of our sponsors and friends (see appendices)

Bertha - the Orange Beastie.
Generously loaned to us by Bapetco.

3. EXPEDITION MEMBERS

Leader - Peter Ireland, BSAC Sports Diver, reading Engineering at Pembroke College, Cambridge.

Scientific Officer - Karen Wild, BSAC Dive Leader, reading Marine Biology and Oceanography at University College of North Wales, Bangor. Member of 1988 Operation Raleigh expedition to Chile.

Diving Officer - Rob Cooper, BSAC Advanced Diver, reading Engineering at St. Catharine's College, Cambridge. Member of Grenadine Marine Conservation Diving Expedition 1987 and The Great Barrier Reef Conservation Study Group 1988.

Mechanic - Adrian Surtees, BSAC Sports Diver, Graduate Mechanical Engineer from Oxford Polytechnic.

Food and Medical Officer - Emmeline Rogers, BSAC Sports Diver, reading Arabic at Selwyn College, Cambridge.

Equipment Officer - Jonathan Cheal, BSAC Dive Leader, reading Modern Languages at Pembroke College, Cambridge. Member of 1986 expedition to Malawi, retracing Livingstone's footsteps.

Perky - Diving Support Vehicle, incorporating a Dunlop compressor into a Land Rover. Developed by Adrian Surtees, with much assistance from Hypresair Ltd.

Bertha - A Chevrolet Suburban generously loaned to the expedition by Bapetco - the production company for Shell in Egypt.

4. DIARY OF EVENTS

October	12	1988 -	Emme, Jon, and Pete decide to organise an expedition to Egypt. Gulf of Suez decided as expedition area since chronic oil pollution was thought to be affecting the coral reefs. General expedition planning begins.
November	10	-	Rob Cooper invited to join the expedition.
December	3	-	Expedition approved by Cambridge Expeditions Committee and gains charitable status.
December	28	-	Karen Wild invited to join expedition.
February	10	1989 -	Adrian Surtees invited to join expedition. Work on diving support vehicle commences.
July	4	-	Emme and Jon fly to Cairo for preparations in Egypt.
	6	-	Land Rover with Adrian, Karen, and Pete leaves the Yokohama stand at the Royal Show. Destination Venice for ferry to Alexandria.
	14	-	Arrive Alexandria. Adrian and Karen go to Sharm el Sheikh with Land Rover to investigate possible sites. Pete joins Emme and Jon in Cairo to assist with Customs clearances.
	21	-	Emme, Jon and Pete join Adrian and Karen in Sharm el Sheikh.
	22	-	Diving acclimatisation and species recognition begin on reefs surrounding Sharm el Sheikh. Rob arrives in Egypt and joins team.
	27	-	Move to El Tur. Start of scientific project.
August	1	-	Second vehicle arrives. Move to The Quay, Ras Mohammed.
	8	-	Survey coast from Ras Mohammed to El Tur by snorkelling at several sites. Camp remains at Ras Mohammed.
	10	-	Leave Ras Mohammed for West side of Gulf, travelling via Suez.
	12	-	Arrive Ras Shukheir.
	16	-	After lengthy interrogation with Police and Army, move to Hurghada.
	18	-	Hire boat and survey offshore reefs.
	22	-	Project work finished.
	23	-	Spare time spent either diving or visiting Luxor.
	26	-	Return to Cairo.
	30	-	Emme, Jon and Rob fly back to Britain. Adrian, Karen and Pete return to Sinai.
September	10	-	Depart Alexandria in the Land Rover.
	16	-	Arrive U.K.
December	18	-	Results presented to a Forum of International Oil Companies, held in Cairo.

5. INTRODUCTION

This project developed from the desires of a group of students, interested in diving, to use their summer vacation in a constructive manner. Language students Emme and Jon, and Engineering students Pete and Rob initiated the expedition at Cambridge University, but had to search elsewhere for a Marine Biologist and a Mechanic. Advertisements at the Royal Geographical Society and in 'Diver' magazine attracted many applicants, and the expedition was fortunate to find Karen, a Marine Biologist from University College of North Wales (UCNW), Bangor, and Adrian, a Mechanical Engineer from Oxford Polytechnic.

Adrian became committed to supplying the expedition with compressed air and transport whenever it was needed. He had much diving experience in varying conditions, and this was invaluable. With Rob's experiences from two previous diving expeditions, and with Emme as an Arabic speaker, the team was well set up to overcome most foreseeable problems.

Mike Ledzion, leader of the Sinai Coastal Reef Survey in 1988, suggested a diving survey of the Egyptian Gulf of Suez to follow up work completed in the Gulf of Aqaba, a popular tourist region. Severe oil pollution was believed to affect the Gulf of Suez, resulting from the off-shore oil industry and heavy shipping. Little work had been done in the Gulf of Suez and the expedition aimed to survey a previously unstudied region in the southern part of the Gulf.

The expedition set out with 3 initial aims :-

1. To undertake a comprehensive survey of four representative dive sites in the region, ascertaining the nature of the marine life and recording the topographical features of the reefs.

2. To evaluate and record the effect of oil pollution on the reefs.

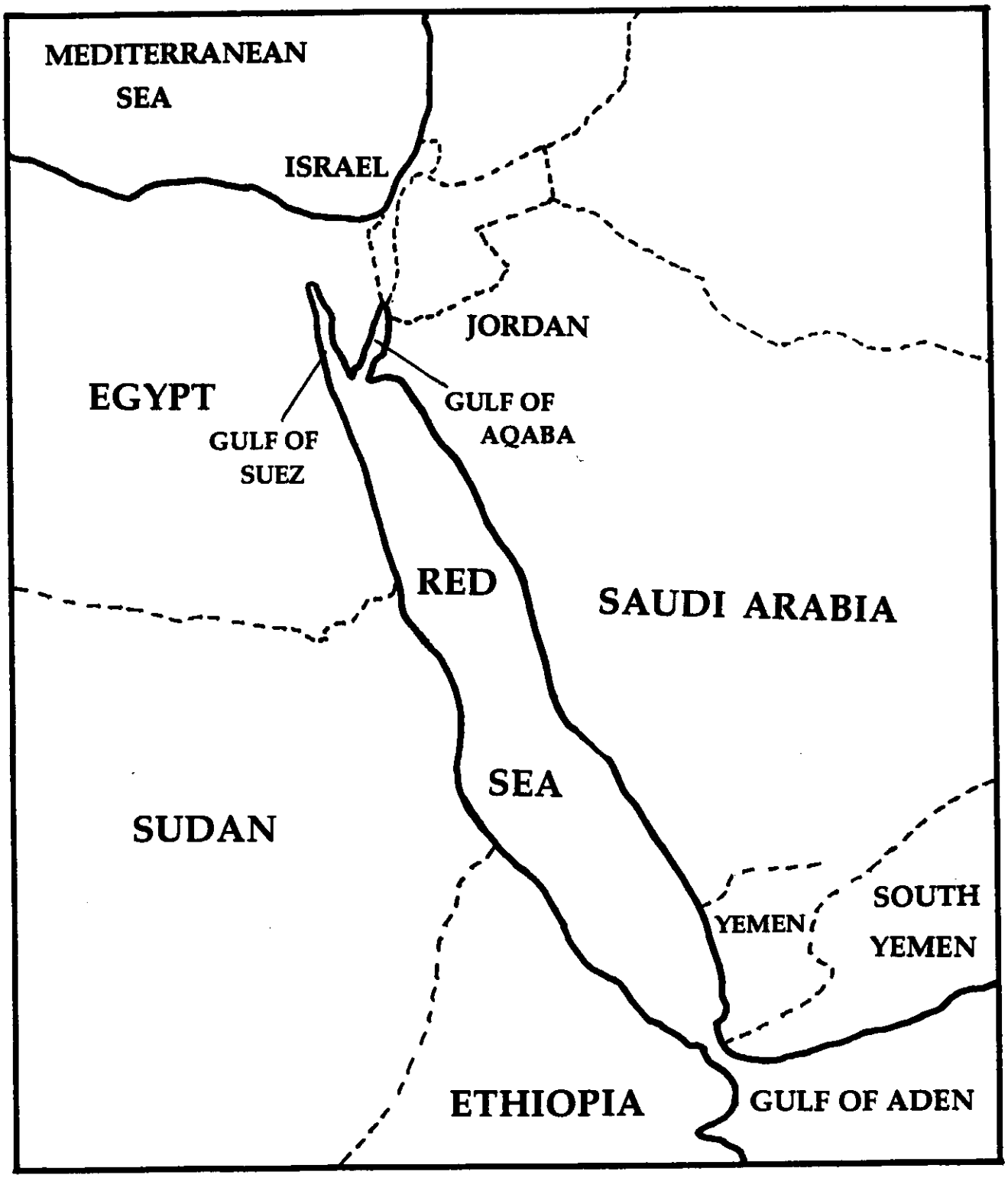
3. To submit our results and conclusions to the Egyptian Government and to oil companies in the Gulf of Suez with a view to securing the future conservation of this remarkable area.

With no major sponsor for the expedition, a large number of financial supporters were found, and much equipment was donated. Without this help, the project would not have been possible, and the expedition is indebted to all supporters for their help and generosity. (c.f. Appendices)

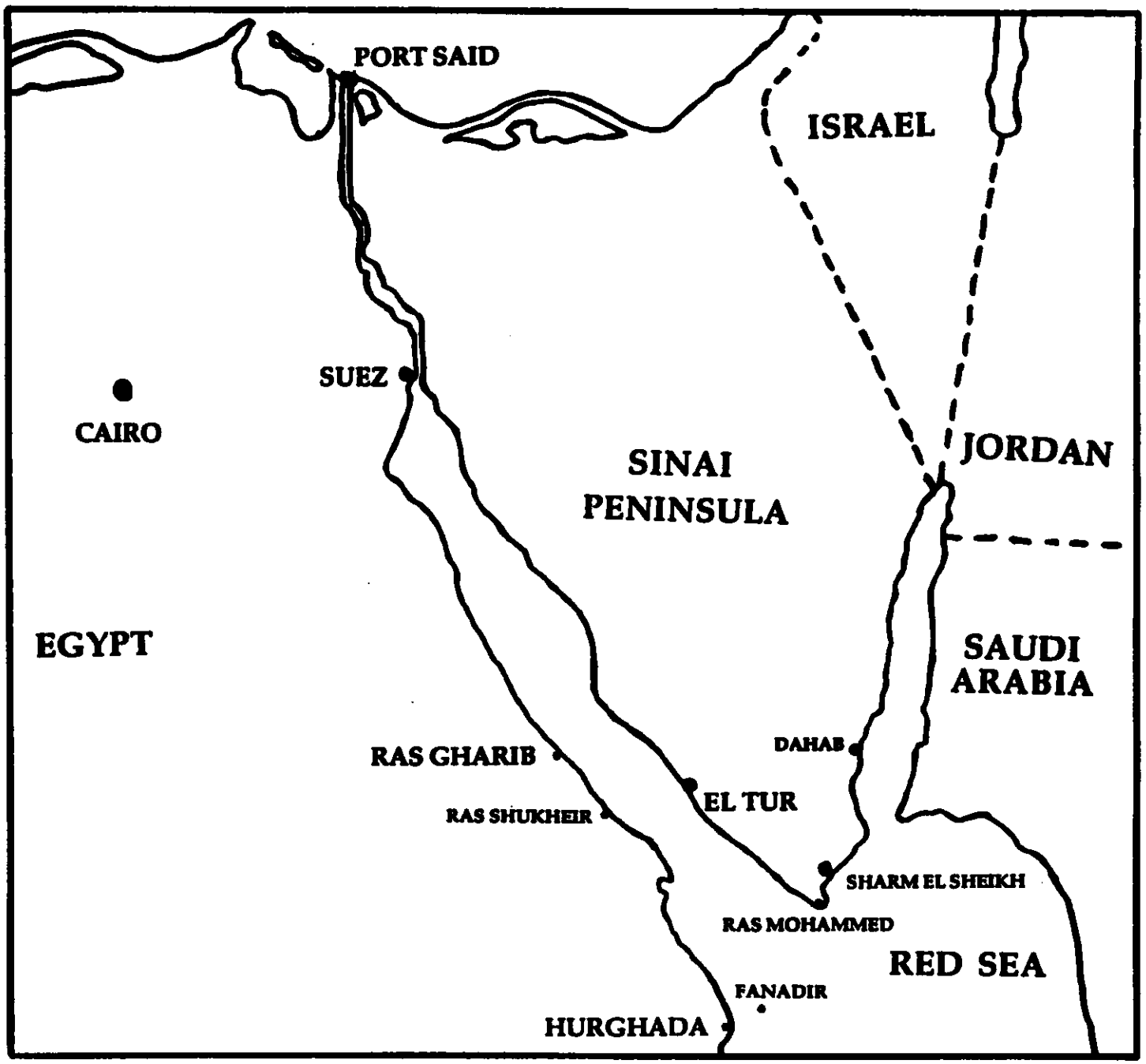
This report explains the work completed in the field by the expedition, and describes the importance of the Gulf of Suez to Egypt. It is hoped that it will persuade the reader that action must be taken immediately to save the Gulf's coral reefs, and indeed the marine life in the whole Red Sea, or this valuable resource will be lost for ever.

6. Maps

6.1 Map of general region of Red Sea.



6.2 Map of the Gulf of Suez.

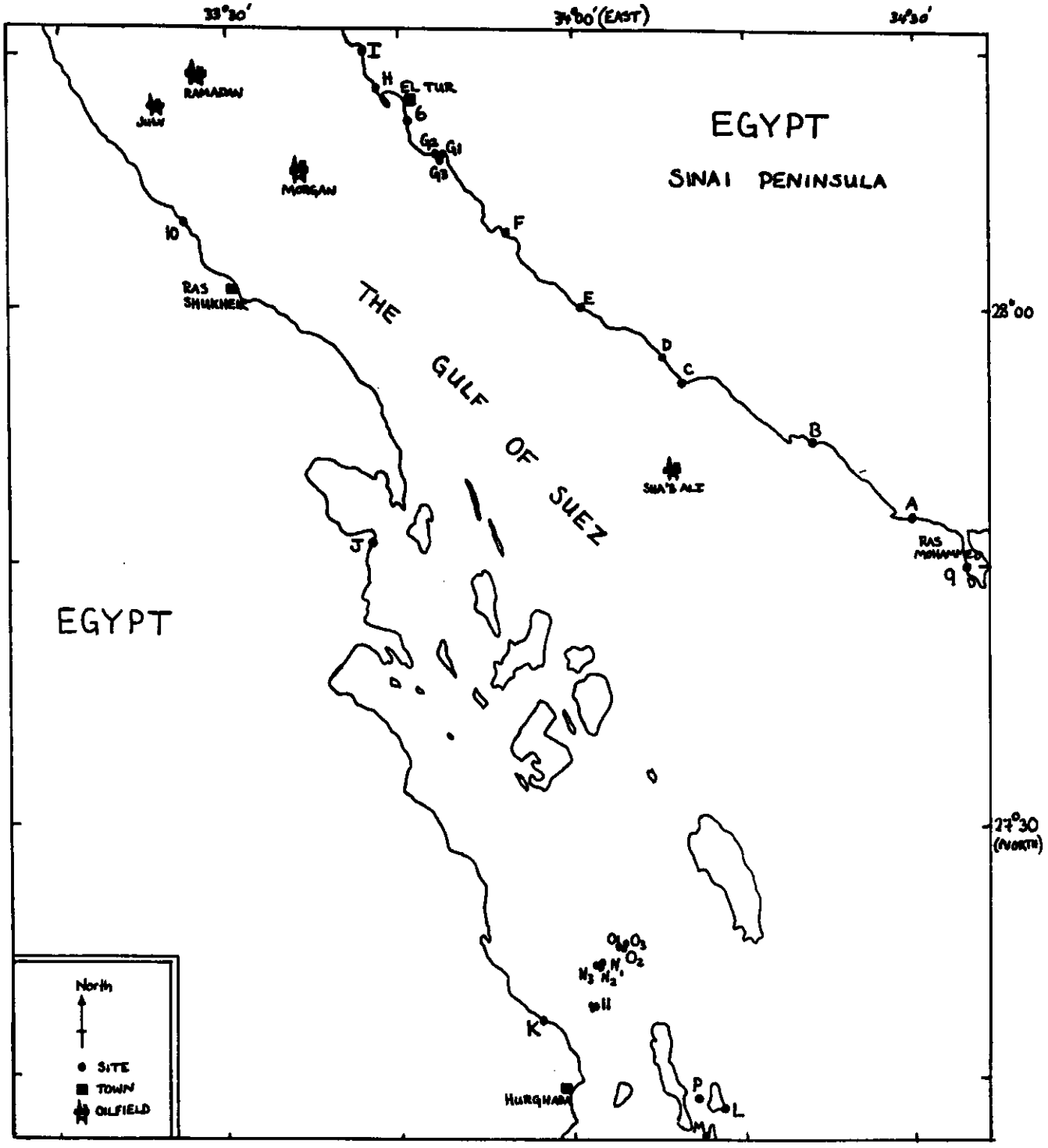


6.3 Details of Sites Surveyed.

Site	Name	Latitude (north)	Longitude (east)	Beach Faces	Beach Shape
	East Coast				
9	Ras Mohammed (The Quay)	27.733	34.240	SW	Bay
A	Qad Ibn Hadden	27.800	34.117	S	Flat
B	Ras el-Millan	27.892	33.975	S	Headland
C	Ras Kenisa	27.933	33.883	SW	Headland
D	Ras Kenisa (north)	27.958	33.867	SW	Flat
E	Ras Garra (south)	27.990	33.814	SW	Flat
F	Ras el-Sebil	28.067	33.733	SW	Bay
G1	Sheikh Riyad Harbour	28.167	33.650	E	Headland
G2	Sheikh Riyad Harbour	28.167	33.650	S	Headland
G3	Sheikh Riyad Harbour	28.167	33.650	W	Headland
6	El Tur (south)	28.213	33.627	W	Flat
H	El Tur (north)	28.243	33.592	W	Headland
I	Hamma Musa	28.267	33.586	W	Bay
	West Coast				
M	Abu Rimathi (island)	27.167	33.981	SW	Headland
L	Giftun el-Saghir (island)	27.171	33.983	SE	Headland
P	Gifatin islands (channel)	27.206	33.958	E + W	Channel
K	Abu Sha	27.283	33.773	NE	Flat
11	El Fanadir (islands)	27.300	33.837	E	Rocks
N3	Sha'b Abu Nigara (south)	27.357	33.819	SE	Submerged Reef
N2	Sha'b Abu Nigara (south)	27.357	33.819	SW	Submerged Reef
N1	Sha'b Abu Nigara (south)	27.357	33.819	N	Submerged Reef
O1	Sha'b Abu Nigara (north)	27.357	33.819	E	Submerged Reef
O2	Sha'b Abu Nigara (north)	27.357	33.819	S	Submerged Reef
O3	Sha'b Abu Nigara (north)	27.357	33.819	SE	Submerged Reef
J	Ras el-Bahar	27.747	33.554	SE	Flat
10	Ras Shukheir	28.183	33.228	NE	Flat

The numbered sites (9, 6, 11, & 10) refer to those sites studied in greater detail. Some numbers were allocated to practice sites in the Gulf of Aqaba and were not part of the survey.

6.4 Detailed Map of the Southern Part of the Gulf of Suez, Illustrating sites studied and the position of major oil fields.



7. LOGISTICS

a) PREPARATION

When preparing an expedition, there are many sources of assistance, with the Expedition Advisory Centre at the Royal Geographical Society in London being most helpful. Their book 'The Expedition Planning Handbook' is superb and essential reading. We would also recommend potential expeditioners that other people are the greatest sources of information - from past expeditioners who have been through it all before, to a friend who suggests that you will need good sunglasses in the desert (something we had overlooked!). As you will find out, most people are very helpful. Try to ask them specific questions such as 'Is there drinking water available in Sharm el Sheikh' rather than 'How do I organise an expedition to Egypt'. Many of the people will know a lot about where you are going, and others will think they do when they don't. Many people's opinions disagree, and as expeditions tend to undertake projects that have not specifically been done before, no one knows exactly what conditions will be like, so it is up to you to take everyone's advice with a pinch of salt, and make your own informed judgement. The best advice is to talk to lots of people about all aspects of what you are attempting to do, and start planning early, as everything takes longer than expected.

i) The plan

With the Gulf of Suez in mind for our project, we approached Dr. Lynne Barratt at the Tropical Marine Research Unit at York University. She coordinates a programme called Reefwatch which gathers information on coral reefs from all over the world to establish an international database, and monitor. Little was known about coral reefs within the Gulf of Suez, which strengthened our resolve to work in this remote and polluted region. Dr. Callum Roberts, based at the Marine Biology station at Sharm el Sheikh in the Sinai, gave further assistance. We received much helpful advice from him both before we left England, and whilst we were in Egypt.

The initial plan was to survey four sites between El Tur and Ras Mohammed. We were warned of many hazards there, such as the army and oil slicks, which could prevent us from diving. However much of the information we received contradicted other sources. This initial plan would therefore be kept until we could find out for ourselves what it was really like - after all, no one had tried to do this before! Contingencies were always kept in mind, and there were two alternatives if El Tur to Ras Mohammed was not possible. One was to carry out some survey work on the western side of the Gulf of Suez, where it was rumoured that military activity was less of a problem. The other was an extension of the survey of the Gulf of Aqaba to the north, complementing the previous year's expedition. In this way, we were sure that some useful work could be achieved, once we had arrived in the region.

ii) Permission

As in any venture of this kind, permission from the host country is essential

and we managed to obtain this from the Egyptian Embassy in London, written in Arabic. A Carnet de Passage was also obtained to allow the Land Rover and compressors an easy passage through Europe and into Egypt. When dealing with Egypt, it is very important to take into account the considerable delays in communication due to inefficient postage, difficult telephone connections, religious holidays and general bureaucracy.

iii) Fund-raising

Using the expenditure of the expedition the year before as a guide, an accurate budget could be made, and it soon became apparent that £13,500 was needed. With resale of equipment on our return, and personal contributions from the expedition members, about £8000 needed to be raised. This was a daunting task, but there was much advice available from the Expedition Advisory Centre, and from the recommendations of previous expeditions.

Lord Adrian, Master of Pembroke College, very kindly consented to become the expedition's patron, and with Cambridge University's approval, a prospectus was produced (800 copies in all). This was sent to companies, trust funds and scientific organisations in order to attract financial and material sponsorship, the latter in the form of food and equipment. We sought to give publicity in return for this assistance, and managed to get several articles about the project into the press. The response was very encouraging, and after a lot of hard work by the whole team, including organising a profitable disco and raffle, the necessary finance was raised. Most of the money was donated by charitable trusts who support the useful work that expeditions like this carry out. (c.f. Appendices)

iv) Equipment

As we soon found out, it is relatively simple to buy basic camping equipment in Egypt, but the quality is not good, and cannot be relied upon. Fortunately, most of the equipment needed to keep six team members in the desert for six weeks was loaned to the expedition by the members themselves. The rest was very kindly donated, or provided at a discount by manufacturers and suppliers.

Our camping equipment was kept to the very basics: large canopies to provide shade, good cooking pots, cool boxes and portable showers proved essential. Tents were used for storing equipment in the field, protecting it from wind and sand, and our ubiquitous plastic bags were a lifesaver.

Diving gear was loaned from our respective dive clubs, as well as belonging to the team. Silicone grease, spare o-rings and high pressure hoses were also taken, as it can be difficult and expensive to locate spares in the local dive shops, which are geared up solely to hire equipment to tourists.

We realised that the Land Rover would not be able to carry everything to Egypt, and were concerned about freighting the gear due to problems with Customs, which could delay the project. Fortunately, Ruston Gas Turbines Ltd. kindly offered to air-freight the equipment free of charge, and Customs difficulties were partially overcome through the help of their own agent in Cairo.

became paramount.

A capacity of 3.5 Cubic Feet per Minute (CFM) was considered an absolute minimum requirement to keep all six divers working and it was recommended that we also take a spare as one was bound to break down. Financial constraints meant we had to look at the secondhand market. After weeks spent scouring the ads in everything from 'Diver' to 'Exchange and Mart' two used Dunlop compressors of 5 CFM each were located. They had previously been fitted aboard the Antarctic survey ship HMS Endurance and as such had already proved their reliability during years of service in the sub-zero temperatures of the South Atlantic.

Having obtained two compressors, the problem of providing a reliable form of drive and location for them in the Land Rover came to the fore. This proved to be far more difficult than first envisaged, and would have been impossible but for the help and generosity of manufacturers and suppliers of both Land Rover and Dunlop compressor equipment.

The solution to the problem of how to provide air and transport was to have one unit :-

a vehicle with an integral compressor powered by the vehicle's engine and mounted in the back of the vehicle.

b) Air and Transport

Objectives:

1. Provide transport for expedition diving gear and three of the expedition members.

2. Provide enough compressed air to keep all expedition members diving.

By studying previous diving expedition reports it was found that these two objectives had been treated as separate issues: having a vehicle to provide transportation and a separate, portable compressor, complete with its own engine to provide compressed air. It became apparent that expeditions have had serious compressor problems either restricting expedition work or in a few cases preventing the expedition proceeding any further.

All the people approached agreed that this, the problem of providing a reliable air supply in the field, was one of the biggest faced by a diving expedition: especially one operating in such harsh conditions.

The main problem area associated with compressors, small enough to be portable, is that due to their small size they have to work at full load for sustained periods to deliver sufficient air. This places very high demands upon both the compressor and the engine driving it, with failure of either or both being the usual result. To have depended upon such a unit to operate constantly for the whole summer would have been like guaranteeing to get to Australia on a moped.

To meet the challenge of these problems it was decided to look at the solution of providing transport and air as one integrated task. Designing and building a vehicle with an integral compressor capable of carrying all our diving equipment onto any site and then when there, filling the diving tanks.

This approach immediately solved the first problem as the power for the compressor would now be supplied by the vehicle engine. It also made the solution of the second problem easier in that compressor size and weight was now no longer so critical due to the fact that the compressor was to be mounted within the vehicle and did not have to be handled manually.

By the end of March two Land Rovers had been acquired, neither roadworthy. The first was incomplete but had a rebuilt chassis along with brand new heavy duty suspension and steering parts already fitted plus numerous other new parts not yet fitted. The second vehicle was only suitable for parts but had a good set of body panels and a hardtop in good condition. The task was then started of transforming these two incomplete heaps of parts into one vehicle. A vehicle that would get us out to Egypt, keep us diving in remote areas and bring us safely home again.

Soon every weekend and evening was being spent covered in oil surrounded by mountains of bits which showed a definite reluctance to fit together. As this work progressed on the Land Rover the problems of integrating a compressor

became paramount.

A capacity of 3.5 Cubic Feet per Minute (CFM) was considered an absolute minimum requirement to keep all six divers working and it was recommended that we also take a spare as one was bound to break down. Financial constraints meant we had to look at the secondhand market. After weeks spent scouring the ads in everything from 'Diver' to 'Exchange and Mart' two used Dunlop compressors of 5 CFM each were located. They had previously been fitted aboard the Antarctic survey ship HMS Endurance and as such had already proved their reliability during years of service in the sub-zero temperatures of the South Atlantic.

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a vehicle with an integral compressor powered by the vehicle's engine and mounted in the back of the vehicle.

A Land Rover Parts Power Take Off system (PTO) was used to drive the compressor, taking its power from the main gearbox and transmitting it to the rear of the vehicle via propshaft. The solution to the location of the compressor itself was provided by Hypresair, manufacturers of the Dunlop range of compressors. After giving the two compressors a complete overhaul, they designed and built a purpose-made frame which fits into the inside of the Land Rover. This slides in and out to allow the drive belts to the rear gearbox to be fitted and, if necessary, tensioned.

The high pressure pipework and air filtration system were fitted onto the inside panels of the Land Rover hardtop and the system pressure gauge mounted so it was visible from outside. The outlet valve and manifold were mounted on the outside of the rear panel allowing one, two or three diving cylinders to be filled simultaneously. Having got a system that worked, attention could be turned to the additional equipment required to ensure that the vehicle could be relied upon to overcome all obstacles.

The fact that we would be driving all the way to Egypt via Europe and then travelling extensively within Egypt meant that we would be likely to encounter every type of driving condition from motorways to desert sands. This called for a very versatile set of tyres, one that would provide good handling to control a heavily-laden vehicle on the road, enable us to cross large areas of open sand and stand up to the extreme wear inflicted by the sharp rocks and fossilised corals of the shoreline. To this end, a set of Yokohama Super Digger tyres were donated. They were ideal, having already proved themselves as one of the market leaders in this area of the world.

To safeguard against the danger of getting completely stuck, particularly vital when working close to a rugged shoreline, a Ramsey winch was fitted which provided more than enough power to haul the vehicle out of the most awkward predicaments. This was backed up with a versatile selection of ropes, chains, shackles and a hi-lift jack, versatile enough to be used as anything from a jack to a winch.

A roofrack, supplied by Land Rover Parts, was essential to cope with the mountains of gear we were taking and was supplemented by three large metal trunks to protect our diving and scientific gear. To counter the threat of fire, particularly serious when handling petrol in hot conditions, two Halon fire extinguishers were mounted within easy reach inside the cab. A Powerbank unit was taken to provide a mobile electrical power source, along with a complete toolkit and set of spares. Also petrol jerrycans and water containers were taken, giving a total capacity of 40 gallons of fuel and 25 gallons of water.

For further in formation about the Land Rover and its conversion, please contact:

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Landsdown,
Bourton-on-the-Water,
Glos. GL54 2AB
0451 21259.

A second four wheel drive vehicle was obtained from Bapetco in Cairo, which was a necessity due to lack of space in the Land Rover. This Chevrolet Suburban acted as a people and equipment transporter and as an emergency back-up.

Cheap flights to Egypt were provided by Kuoni Travel and enabled three team members to fly, leaving the others to drive the Land Rover across Europe.

c) IN THE FIELD

Emme and Jon had flown out to Cairo in advance of the others to collect the second vehicle, recover the freight, and to make preliminary preparations. The expedition is most grateful to Alex Vanderlip for the use of his rented apartment in Cairo as a base, invaluable as we attempted to sort out the freight and vehicle.

In the meantime, Adrian, Karen and Pete were working around the clock to prepare the Land Rover for departure. After having appeared on the Yokohama stand at the royal Show, we just made the Ramsgate-Dunkerque ferry and then drove almost continuously to Venice through France and Italy, arriving at our destination with a few hours to spare. The ferry from Venice to Alexandria aboard Adriatica's 'Espresso Egitto' was a welcome four day rest, and we made new friends as we cooked our stew on the afterdeck every evening.

i) Egypt

'Hours, if not days' we had been warned it would take us to get through Customs at Alexandria. Customs clearance involved shuttling back and forth between about five different booths, getting number plates and insurance. We made friends with a couple of Customs officers, and no 'Baksheesh' or bribery for which we had been prepared was needed. After less than 3 hours, we were through and into Alexandria. The traffic took a while to get used to, with the incessant use of car-horns, but Perky rose to the situation and jammed her horn on! Having met up with Emme and Jon at the Hotel Cecil in the middle of Alexandria, the news was not promising. The air freight needed Pete's passport to clear Cairo Customs, as Ruston Gas Turbines Ltd. had sent the freight in his name and it couldn't be changed. Mr. Havik of Bapetco, who was generously lending us a second four-wheel drive vehicle, was having great problems with the paperwork, as it was part of a large duty free consignment, the rest of which was about to be re-exported. Adrian and Karen went south to Sinai to meet Dr. Callum Roberts and to learn a little more about the area, whilst Emme, Jon and Pete headed for Cairo.

In Cairo, we were able to stock up with provisions and equipment and to establish contact with those interested in our work and keen to help. It was necessary to register ourselves with the Tourist Police and with the British Embassy consular section, in case of an emergancy. It took a great deal of effort to retrieve our freight from the airport, with the situation was not being helped by the fact that we were bringing diving cylinders into the country which caused particular problems with Customs.

ii) Sinai

The freight was cleared within a few days, but the vehicle was still delayed. Emme, Jon and Pete took essentials from the freight and joined Adrian and Karen in Sharm el Sheikh by bus; the relief of leaving Cairo's heat and noise behind us was overwhelming. Rob joined us soon afterwards, returning from a course project in Japan. A week was spent learning about the fish and coral on the reefs in the vicinity of Sharm el Sheikh. Friends Peter Wild and Dr. Sarah Wright visited the team and helped to develop our survey method and

patch up several coral wounds.

With the full team together, we refined our survey techniques in the excellent conditions at Sharm. With a growing tourist industry based on spectacular diving and beautiful beaches, the area has suitable facilities to accommodate foreign visitors. Sharm was to become our main base in the Sinai, with communications by phone and post (to the Poste Restante at the Post Office), shops and dive centres. After a week, we set off to investigate our first site at El Tur.

iii) El Tur

After a preliminary snorkel, we set up camp just south of the town. Conditions were very different to Sharm, with 300m reef flats and 2m of swell.

Before night fell on that first day, the army expressed their disapproval of us camping by the sea, moving us over the main road away from the shore. After supper, the Police came and expressed their disapproval, and Adrian and Pete were taken off to see the chief Policeman. They were able to negotiate a camp site next to the Police Station so that they could keep an eye on what we were doing. The following day, the army tried to move us on again, so we tried to explain the situation, refusing to move, and finally, we were allowed to stay. Whilst at the dive site, the Secret Police arrived with a French interpreter. Alex, who had come down from Cairo for a peaceful few days in the sun, went with Pete to their headquarters for further questioning and an explanation of what we were trying to do. Our letter of permission didn't carry a lot of weight, as we should have had an Egyptian accompanying us. They didn't seem too happy with our diving, but with Alex's rapidly improving Arabic, and Pete's broken French, they were persuaded to allow us to complete our first site. The second vehicle arrived on our last day here, and was quickly named Bertha, the orange beastie. She had brought the remainder of the expedition stores from the air freight, so we were now complete and fully mobile, and could move on. Having the extra vehicle relieved the great burden on the Land Rover, and proved to be a morale boost after the difficult conditions at El Tur.

iv) Ras Mohammed

Ras Mohammed was the next site, and we were able to camp within the National Marine Nature Reserve. Often described as the best diving in the world for its spectacular underwater drop-offs and quantity of marine life, many people travel to Egypt solely to dive here. The threat of an oil spill destroying the habitat is ever present, and it would be a huge loss, discouraging many tourists. The government is planning to develop the peninsula and we were interviewed by a national newspaper who were doing an article on Ras Mohammed. Our project work was concentrated at a site on the West side, known as The Quay.

Regular trips were made into Sharm for fuel, water and food (and to collect Emme's letters!) and Karen was able to discuss our progress with Dr. Callum Roberts. Once the project work was finished we were able to dive the peninsular's famous tourist sites with Anthony Gaffney and Robert Havik, two friends who came to join us for a few days.

Access to the stretch of the coastline between Ras Mohammed and El Tur proved to be more difficult, with no camping allowed and routes to the shore restricted by suspected mine-fields. To combat this, we continued to stay at Ras Mohammed, and when looking for new sites, kept strictly to already beaten tracks. The army, a little bemused, was most hospitable in giving us tea and food, and took particular delight in examining our passports and documents, although it seemed that they did not understand Arabic, let alone English! We would try and give them some of our rations in return - corned beef for instance - but their rations were usually better. We met Captain Tawfik, the Captain in charge of the region, who, having fed us with fish and bread with tea, swam with us on his old windsurfer board. He explained that camping was only possible at Ras Mohammed or Sharm el Sheikh, and diving between Ras Mohammed and El Tur was out of the question. When we mentioned the possibility of borrowing a boat, he looked very angry, his friendliness quickly disappearing, so we moved on hastily. Snorkelling was permitted, so we spent 3 days shuttling from Ras Mohammed to snorkel at many sites up the coast, completing more general surveys of the beach and reef conditions.

v) Ras Shukheir and Hurghada

Having surveyed as many sites as possible between Ras Mohammed and El Tur, one of our contingency plans came into operation. After a two day drive around to the other side of the Gulf, via Suez, we found much of the coastline was either mined or owned by the oil companies, which made access to the shore difficult. One site was found just north of Ras Shukheir, with the local army once again being very friendly, swimming and playing football with us. After 3 days, with the site nearly completed, some soldiers who we didn't recognise woke us up in the middle of the night wanting us to pack up and go with them to their headquarters. Emme persuaded them to wait until morning, when we went with them to Ras Gharib for 5 hours of questioning with various people. Luck was with us, and Emme managed to explain we had now finished at Shukheir, which unfortunately was a forbidden zone, and that we were moving to Hurghada, and we avoided being sent to Suez, and probably Cairo, for further questioning.

Hurghada is a large tourist resort, and we looked into hiring a fishing boat for a few days to do some work on offshore reefs. Shore diving is difficult in this area, and we didn't want to antagonise the army any more. Fortunately, extra money had been coming in whilst we were in the field, so we had the finance to hire a boat and do a detailed survey of Fanadir Reef and 1/2 day surveys of several other sites. This completed the project work, and with 3 spare days, Adrian, Karen and Jon took Perky to Luxor to visit the Valley of the Kings, while Emme, Rob, Pete, and Hilary Glover (who had joined us for a couple of weeks) remained at Hurghada with Bertha and did some fun diving off a larger dive boat from the Magawish Resort Village.

The trip back to Cairo was long and arduous, with both vehicles experiencing overheating problems, and Bertha a bad oil leak. Adrian had kept both vehicles working tremendously well, with compressed air and transport always available when the expedition needed it. The long trip to Cairo tested the vehicles and Adrian to the limit, and Alex's flat was a very welcome destination. Bertha was returned to Bapetco, and excess equipment was given to friends in Cairo, or donated to local Egyptians. We were treated to a farewell

meal by Peter Llewelyn at the British Council, who put us in contact with Moustafa Fouda, a marine biologist at the University of Cairo, who had also worked in the Gulf of Suez. Emme, Jon and Rob flew back to Britain, and Perky drove the remaining three back to Sinai to pick up the spare compressor, which had been left at Sharm El Sheikh. Here we met Dr. Rupert Ormond, a leading authority on coral reefs, working with students from York University. His interest in coral reefs was first kindled on a Cambridge expedition to Sudan!

After some more fun diving at sites like the Blue Hole, the Canyon and Jackson Reef, the Land Rover crew returned to Alexandria to catch the boat home. This time, a more picturesque route was taken from Venice - going over the Alps and through Austria. The contrast between struggling through a pass at 2509m whilst getting snowed on, and camping in the dusty dry heat of the desert was overwhelming. The scenery was incredible, and it was a pity that we could not stay a little longer, but everyone was so tired. A minor road accident in France was a bit of a damper, but no one was hurt and no serious damage was done. Back in Britain, nothing seemed to have changed a great deal, but we had only been away eleven weeks - what an eleven weeks though!

vi) Exploration and Production Forum, Cairo December 1989

In November the expedition was invited to present its findings to a seminar of international oil companies, in conjunction with the Exploration and Production (E & P) Forum, under the title :

'The promotion of safety standards in the Petroleum Industry Operations and the safeguarding of the Red Sea from pollution.'

The invitation was from Shell Egypt, and who were very generous to allow Karen, Adrian and Pete to travel to Cairo for this seminar. With over 100 managers from the oil industry in Egypt, and many from elsewhere, it was a little awe-inspiring at first, but with three expedition members present, our confidence was boosted, and we talked to many interested oilmen about our work, using a visual display of pictures and a chart on pinboards. Karen presented the results to the seminar, and provoked many questions and much discussion.

The living style could not have contrasted greater with four months earlier - staying in luxury at the Heliopolis Sheraton after a British Airways Club World flight, compared with camping in the desert or sleeping in ditches, while living out of a Land Rover. Very many thanks to Eoin Mackenzie and Shell Egypt for making this most productive trip possible.

Excerpt from the introductory word of Mr. Tarek Heggy (The Chairman of Shell companies in Egypt) in the inauguration of the E & P Forum seminar:-

"I would like to thank the overseas participants, Mr. P.J. Ireland, Miss K.A. Wild and Mr. J.A. Surtees for giving us the pleasure and the benefit of their participation in this seminar today."

d) Diving

Our work constituted visual coral surveys (with use of quadrats), fish counts (with use of transacts), and beach surveys. For this work to be consistent, familiarisation and practice counts were carried out. Thus, a total number of 145 dives were completed, with 111 hours spent submerged for an average dive time of 45 minutes. A total number of 75 project dives were completed at depths of 1,6,9,and 18m. The familiarisation dives were done in the Gulf of Aqaba (Ras umm Sid, Na'ama Bay) whereas we travelled to the Gulf of Suez for the actual project dives.

i) The sites

The four sites chosen were at El Tur, Ras Mohammed 'The Quay', Ras Shukheir and Sha'b el Fanadir, and each provided us with extremely different diving conditions.

The site on the beach at El Tur comprised of a shallow reef crest (uncovered at low tide), a 1m drop and then a shallow slope to 9m. The wind direction at this site produced a swell at the reef edge of over 2m, thus making it extremely hazardous to enter and exit the water. To reduce this danger, we placed a shore watch (ready with snorkel gear) at the edge of the reef flat, occasionally standing in up to 1m of water, and getting very sunburnt. This provided immediate assistance or even rescue if needed and also acted as a beacon for direction to the submerged transects. The visibility at this site was often poor, so diving practices were restricted to account for this deterioration.

The site at Ras Mohammed was completely different: a short reef crest, a 10m vertical cliff followed by a steep slope to 30m +. The visibility, coral and fish life were excellent at this site and greatly improved the diving morale of the team. Deeper transects (18m) were possible and therefore our diving arrangements (to stay within tables) had to change to cope with this greater depth. This site proved to be an excellent area for night dives, with, again, complete surface cover using strong lights as orientation. Egyptian batteries did not last very long in the underwater torches, so a buddy pair would have to take at least two torches each.

The site at Ras Shukheir on the other side of the Gulf of Suez was heavily polluted and provided fairly uninteresting diving. The reef was shallow, with a maximum depth of about 4m with poor visibility and small coral forms.

The final site was at Sha'b el Fanadir off Hurghada and was carried out from a small fishing boat. This site was almost as spectacular as the Quay at Ras Mohammed, with a coral wall to 14m, a shallow slope to 25m and then a steep drop off to 40m +. By this time, all the survey work was carried out much more efficiently.

ii) Logistics and equipment

The organisation of the diving and recording of survey data with a team of 6 people becomes straightforward once all the members are confident of the tasks. Therefore practice was needed to optimise the divers' performance and

to ensure a constant surface watch.

The only incident underwater caused by equipment was due to mask failure. Fortunately this was only at a shallow depth and was easily dealt with. However, due to the sandy environment, great care must be taken with diving equipment on a continuous basis to prevent serious accidents.

iii) Safety

The only decompression chambers in Egypt are to be found in Cairo and Hurghada. These medical facilities are run by two brothers; Dr. Wahil and Dr. Hassan Nasser, who are both extremely knowledgeable in diving medicine and are also diving instructors. They alternate in 2 week cycles from their Cairo medical centre to the Magawish Tourist Village in Hurghada, where they run the dive school and act as resident doctors. The full address is:

Magawish Resort Village,
Hurghada,
Red Sea,
Egypt. Tel. 062 440255.

They provided us with great confidence and also gave valuable advice concerning our dive sites. I recommend that anyone contemplating expedition diving in the Red Sea should consult these doctors at an early stage.

Although most of our diving was carried out in shallow waters, a general plan had to be constructed in case of emergency. The MFO (Multi-National Force of Observers) do have a helicopter service, but it seems that this cannot always be relied upon. BSAC Cairo recommend that any decompression casualty should be driven straight back to Cairo. With this in mind, we managed to get hold of an emergency Oxygen set, kindly loaned to us by pneuPAC Ltd., so that Oxygen could be administered to the casualty on the way to a decompression chamber. Oxygen refills are available in Cairo.

Even though we were warned against diving in July and August due to the heat, we did not experience much discomfort. We wore wetsuit longjohns to provide basic warmth but, more importantly, to protect ourselves from the razor-sharp coral. A constant sea breeze and canopy-cover kept us fairly cool, so that we could dive throughout the day.

iv) Final remarks

The diving that we carried out during this expedition was diverse, but extremely enjoyable, with the best dives being off the Shark Reef at Ras Mohammed. However, great care must always be taken to maintain safe diving practices in these idyllic, but often remote areas.

8. Scientific Report

This expedition and subsequent work has resulted in a broad survey of the Egyptian Gulf of Suez coastline, a quantitative assessment of beach pollution, more detailed studies of the abundance and distribution of corals, reef fish and invertebrates and a refined investigation into the influence of oil pollution on Coelenterates.

i) Reefwatch Programme

The Reefwatch study (see Appendix D for more details) gave a general overview of coastal conditions and environmental impacts at 26 sites in the Gulf of Suez (see figure 6.1). Coral reefs are found in the southern part of the Gulf and broadly fall into two categories. Fringing reef formations are associated with offshore islands and unprotected stretches of coastline, whilst patch reef have developed within large lagoon systems. Fringing reefs generally feature more abundant coral, greater numbers of fish and a wide diversity of species, in comparison with patch reefs.

Within the lagoon systems reduced water movement enhances sedimentation, which may foul coral colonies. Active removal of settling sediment requires additional energy expenditure and restricts normal particulate feeding. Increased turbidity of the water reduces light penetration and limits photosynthetic nutrition of the coral by symbiotic algae. The net effect of increased sedimentation is reduced coral growth rates in a limited range of more tolerant species.

Smaller fish populations are associated with patch reefs, as the reduced reef area and impoverished coral community provides more limited food resources.

Accumulations of soft sediment within a lagoon provides suitable substrate for seagrass communities, which are not found on fringing reefs. Seagrasses stabilise the sea bed and encourage sedimentation by restriciting near bed water movements with their leaves. This results in the lagoon becoming shallower with time and eventual land reclamation.

However there was no correlation between any of the environmental impacts assessed solely on the Reefwatch data sheets and the abundance of dead and damaged corals. This highlighted the subjective nature of the Reefwatch program and stimulated the more quantitative work.

ii) Beach Pollution Study

A quantitative assessment of beach pollution was made in a 100m x 10m strip of beach adjacent to the water's edge. This showed that the southern part of the Gulf of Suez is very severely polluted with oil and rubbish. The most polluted beaches were situated close to offshore oil production platforms at El Tur and Ras el-Millan, and Ras Shukheir which was also close to an oil terminal (see figs 8.1 and 8.2).

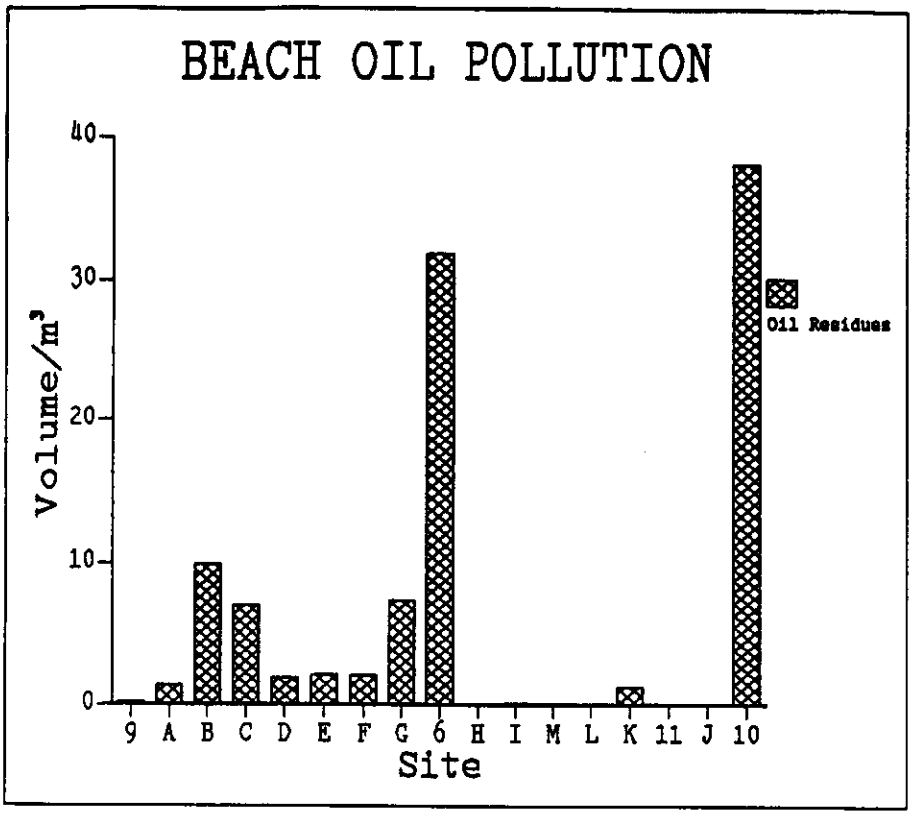


Fig. 8.1 **Volume of oil residues estimated in a 100mx10m strip of beach immediately adjacent to the high-water mark, at sites on the east and west coasts of the Gulf.**

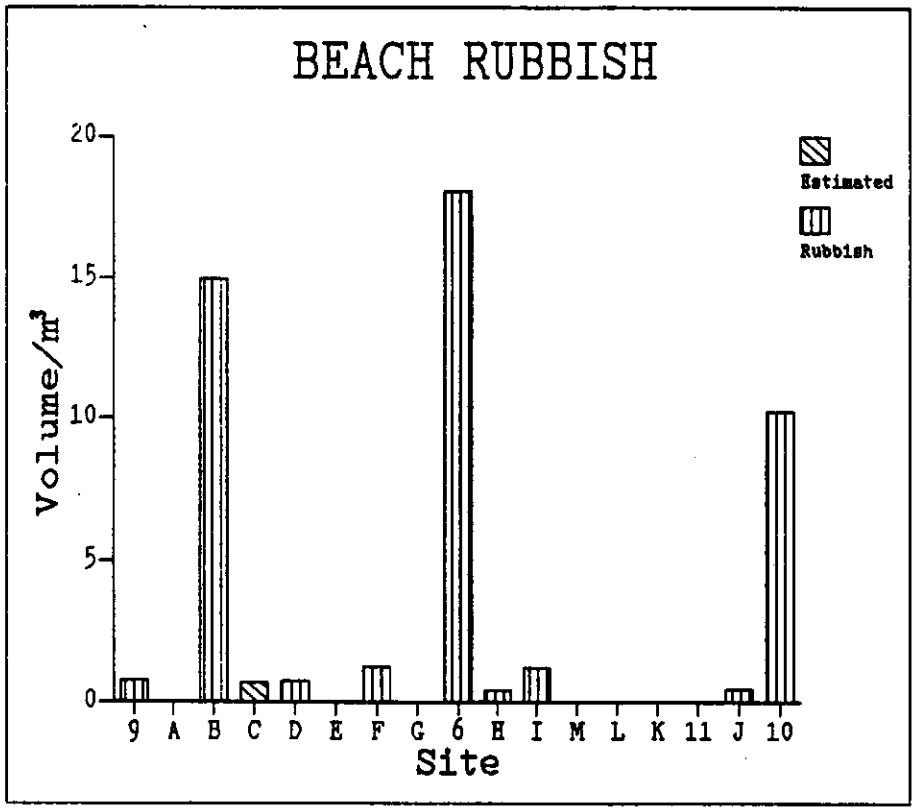


Fig. 8.2 **Volume of beach rubbish estimated in a 100mx10m strip of beach immediately adjacent to the high-water mark, at sites on the east and west coasts of the Gulf.**

Oil pollution and buoyant rubbish items naturally drift towards the coast, driven by the prevailing northerly winds which are deflected onshore by rising desert thermals. The narrow nature of the Gulf means that any accidental oil spill is quickly swept towards the beach before clean-up operations can be mobilised. Previous reports have indicated that contingency plans and equipment are inadequate and unsuitable for typical Suez conditions (Wennink & Nelson-Smith 1979, Dicks 1987).

Laboratory analysis of oil samples allowed estimates of oil mass to be made and subsequent comparison of this data with other world regions. The most polluted site listed by Coles and Gunay (1989) was in the Saudi Arabian Gulf; values calculated for the Gulf of Suez exceed 6 times this amount indicating the chronic nature of current oil pollution levels.

Collecting oil samples at El Tur for laboratory analysis in England.

The presence of weathered oil confirms previous reports of severe oil pollution in the region, whilst observations of fresh fluid oil suggest that this pollution is continuing. Legislation prohibiting oil tankers from flushing their tanks within the Red Sea cannot yet be enforced, owing to inadequate land-based

waste disposal facilities. However the dumping of rubbish into the sea is subject to strict laws. The abundance of beach rubbish in the Gulf of Suez, indicates that these laws are seldom enforced.

Over 75% of beach pollution in the Gulf consists of oil residues and plastic materials (fig. 6.3), both of which are very slow to degrade. The most effective way to reduce such pollution is to physically remove the fouling items, whilst restricting further inputs to the marine environment.

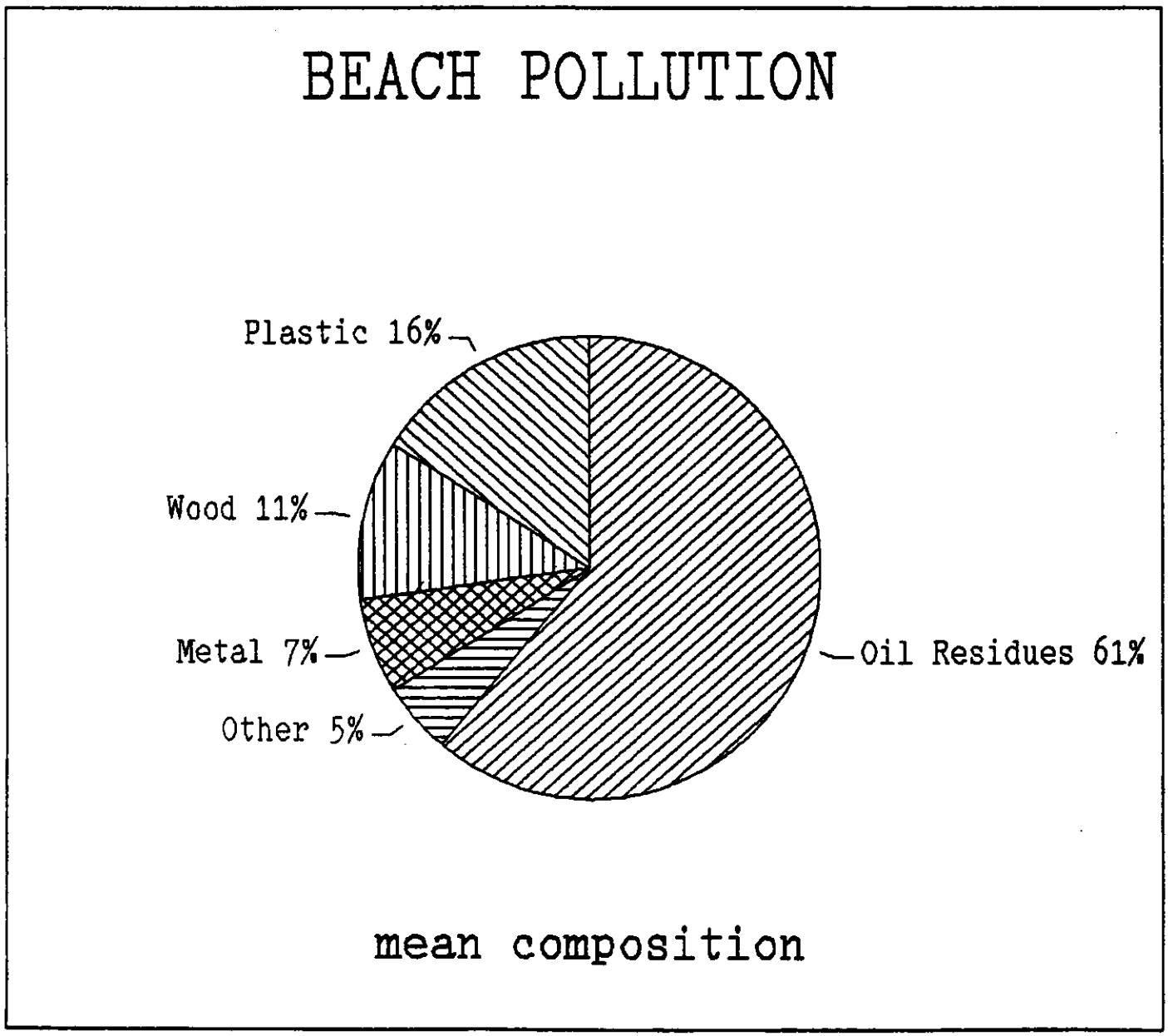
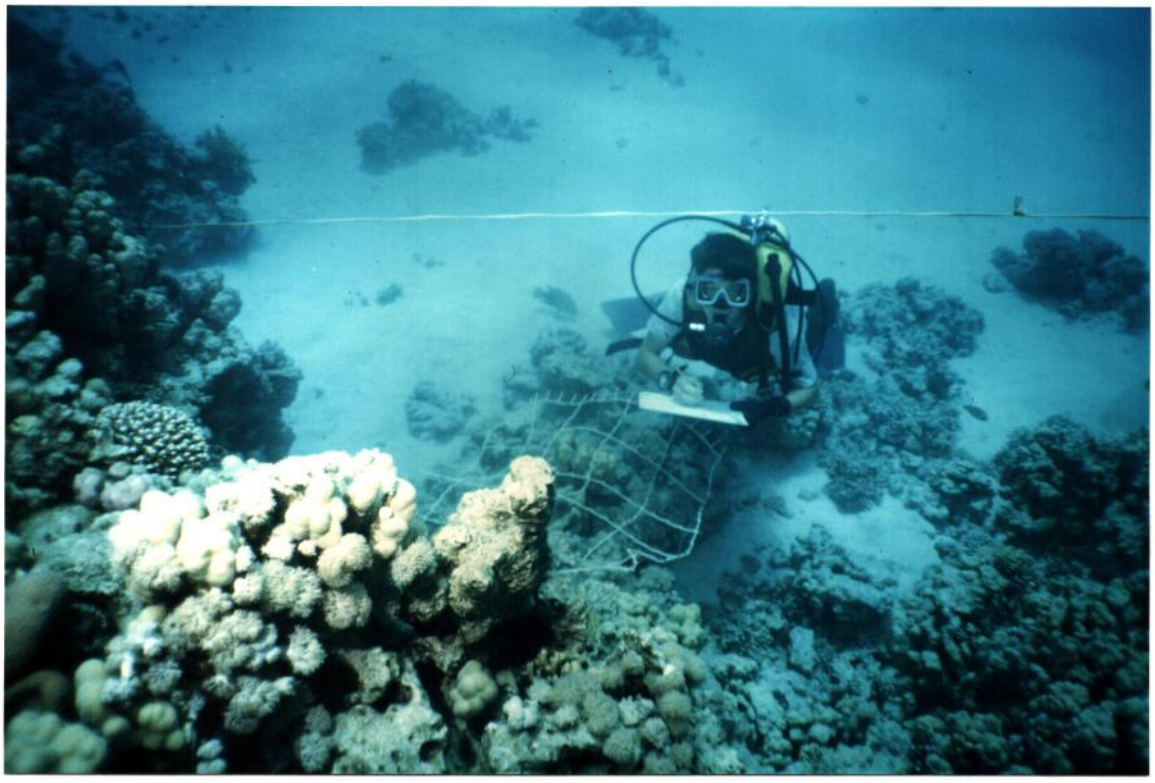


Fig 8.3 Mean composition of beach pollution, by volume, in the Gulf of Suez



Diver recording reef substrate information using a 1mx1m quadrat and submersible slate.

iii) Detailed Site Investigations

Detailed sublittoral surveys of fringing coral reefs were completed at 2 sites suffering from heavy pollution within the Gulf and 2 relatively pollution-free sites at the mouth of the Gulf. Water temperature and salinity were similar throughout the region with the northern pair of sites featuring greater exposure, turbidity and a shallower profile in comparison with the southern pair of sites. Corals were found to grow most prolifically at depths of 1-12m and were investigated further.

The abundance of coral cover was found to vary with depth, such that hard corals were generally most abundant at the reef crest, whilst soft coral increased with depth (fig. 8.4). Sand and rubbish accumulated, by gravity, with depth and provided substrate and shelter for numerous invertebrates and reef fish.

The distribution of coral colonies was found to relate to the intensity of water movements, turbidity, sediment content of the water and spatial competition for solid substrate. At the reef crest hard corals adopted branching and streamlined forms which were resistant to turbulent wave generated currents (fig. 8.5). Soft corals could not survive these mechanical stresses. In deeper water, accumulating sediment favoured massive and large polyped corals which could efficiently clean themselves and so avoid fouling. Plate forming colonies were less common and restricted to shallower depths. The natural attenuation of light with depth, which is greater in turbid waters, eventually limits photosynthetic nutrition of reef-building corals from their intracellular symbiotic algae. Reduced nutrition results in slower growth and reduced coral cover with depth.

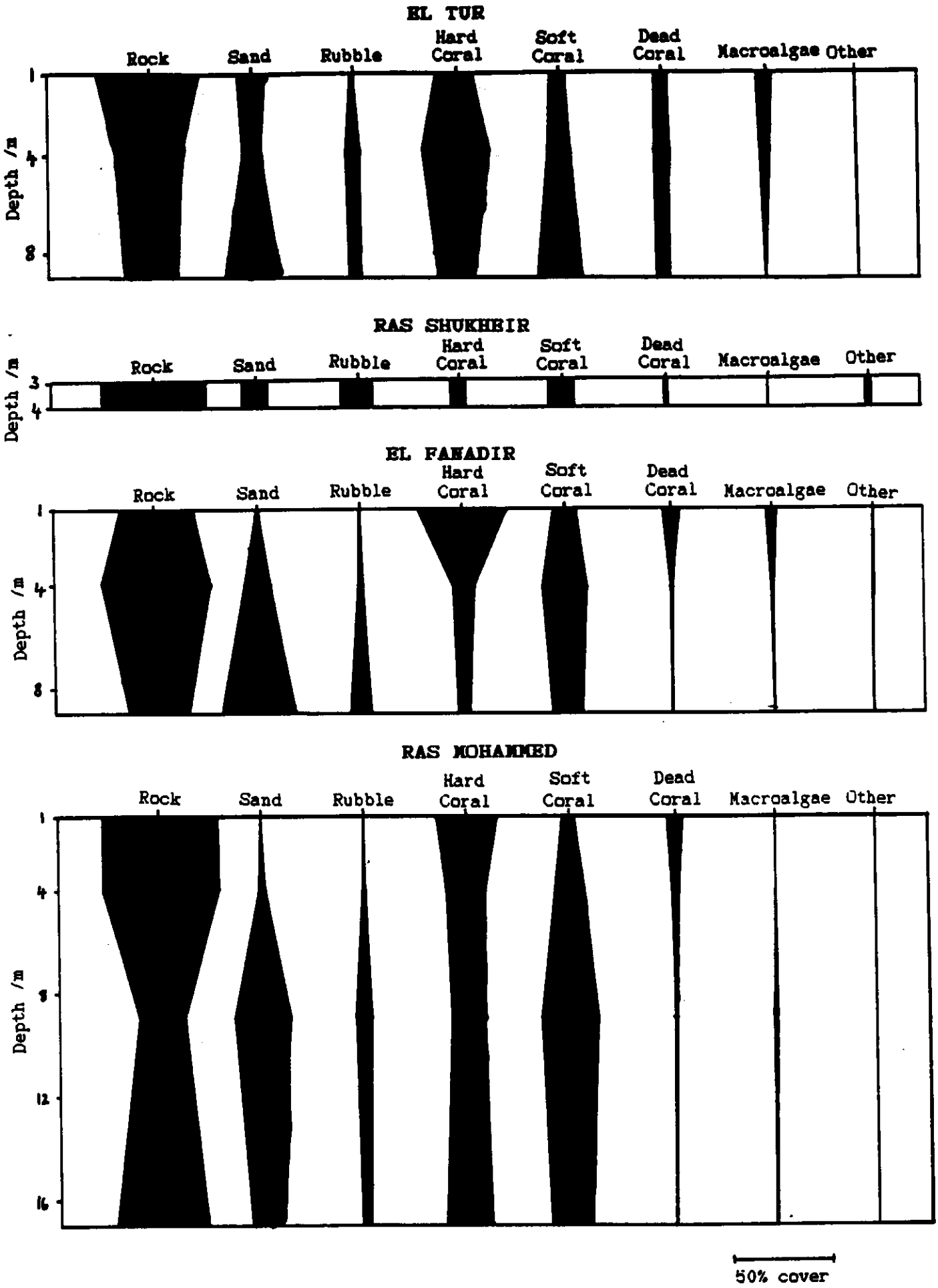


Fig 8.4 **Distribution of reef substrate with depth at El Tur, Ras Shukheir, El Fanadir and Ras Mohammed.**

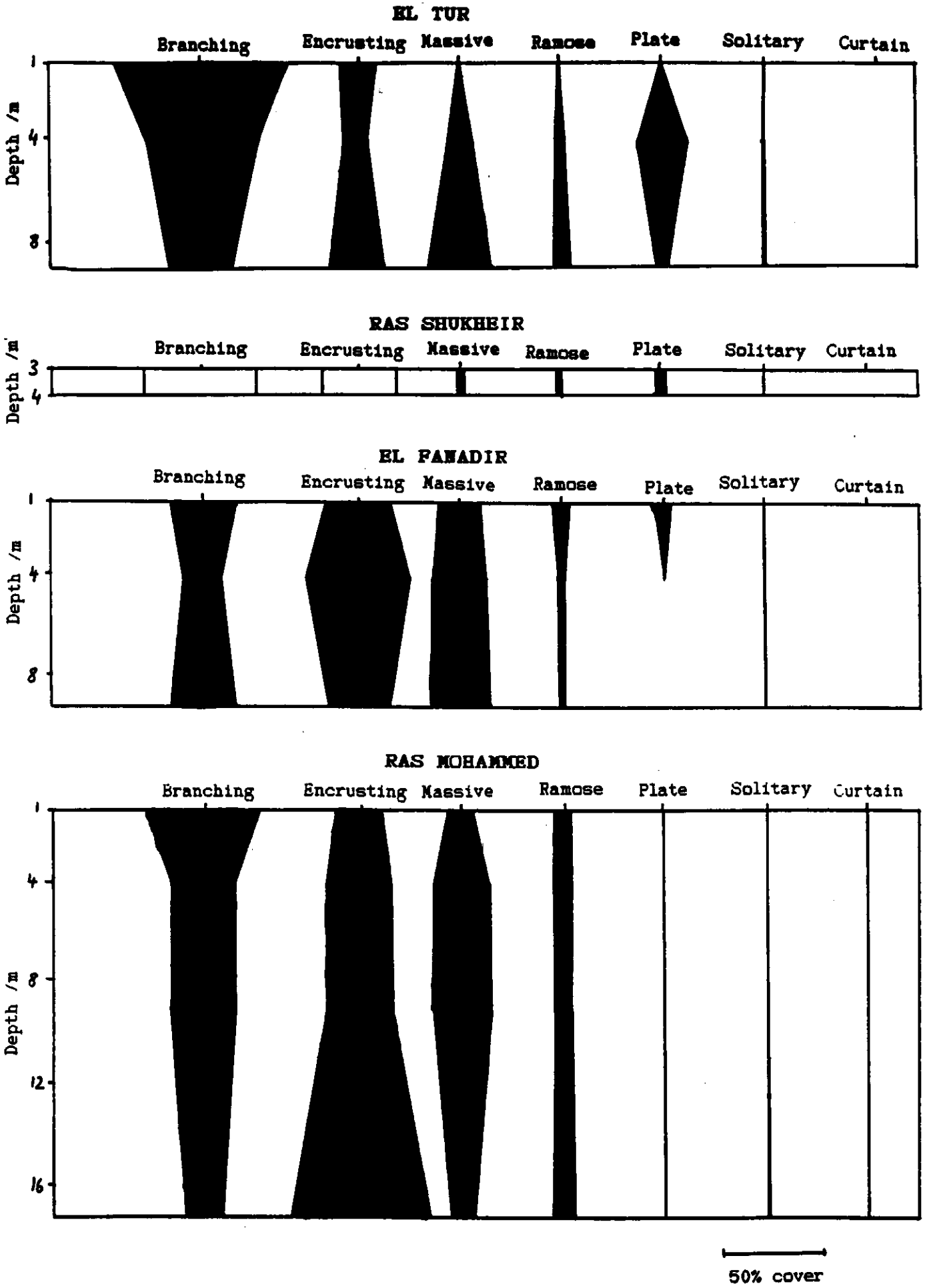


Fig 8.5 **Distribution of coral form with depth at El Tur, Ras Shukheir, El Fanadir and Ras Mohammed.**

Inter- and intra-specific competition for space on the crowded reef slope was often intense. Fast growing fine algaes compete with settling coral spat for solid substrate. Grazing fish and urchins play an important role in creating free substrate for larval settlement, but may destroy spat and limit coral recruitment by excessive grazing. Established coral colonies may demonstrate aggressive behaviour to neighbouring species, killing or restricting their further growth. Branching *Acropora* species are recognised as particularly aggressive (Sheppard 1979), and were found to dominate the hard coral cover in shallow waters.

Coral cover at 4m was similar at 3 sites, though at the most heavily oil polluted site (Ras Shukheir), there was significantly less coral (tested at the 5% level). Of the corals found, the opportunistic species *Stylophora pistillata* was particularly common. The abundance of dead coral and coral rubble was higher at Ras Shukheir, which suggests some environmental disturbance has influenced the site.

Reef fish are sensitive to changes in water quality, whilst some urchins are opportunistic and benefit from perturbations in the environment. To cross-examine the oil polluted sites, a fish and invertebrate survey was completed. Significantly larger populations of a range of predetermined fish were found at Ras Mohammed, where fishing is restricted within a National Marine Park. Similar numbers of fish were present at El Tur and El Fanadir where local fishing activities are thought to have reduced the populations. However very few reef fish of any description were seen at Ras Shukheir (fig. 8.6a). The absence of fish at Ras Shukheir was accompanied by an apparent population explosion of the sea urchin *Tripneustes gratilla* (fig. 8.6b), which has been recorded in similar numbers in polluted waters in the Gulf of Aqaba (Ormond 1987).

These findings suggest that the long history and very high levels of oil pollution at Ras Shukheir have upset the natural ecosystem stability, by limiting recruitment to one or more stages in the community food web. This has resulted in reduced coral cover, reduced reef fish populations, general reduction in species diversity at the site and a population explosion of the urchin *Tripneustes gratilla.* The abundance of grazing echinoderms may now be limiting the recovery of the reef by disturbing settling coral spat and so restricting recolonisation by corals.

iv) Symbiotic Algae and Coral Stress

These studies have suggested that oil pollution is having a detrimental effect on reef-building corals, but they have not demonstrated the mechanism by which oil pollution is thought to harm them. To investigate this, studies of the symbiotic algae contained within reef-building corals, which are vital to their nutritional requirements, were completed.

In the field, tissue samples from pieces of coloured coral were found to be packed with pigmented symbiotic algae (*Symbiodinium* sp.), whereas pale bleached samples contained far fewer algal cells. Bleached corals are associated with stressful environments which include fluctuations from optimal temperature and salinity regimes, excessive irradiance or sedimentation and pollution (Brown and Harvard 1985). Since bleached corals

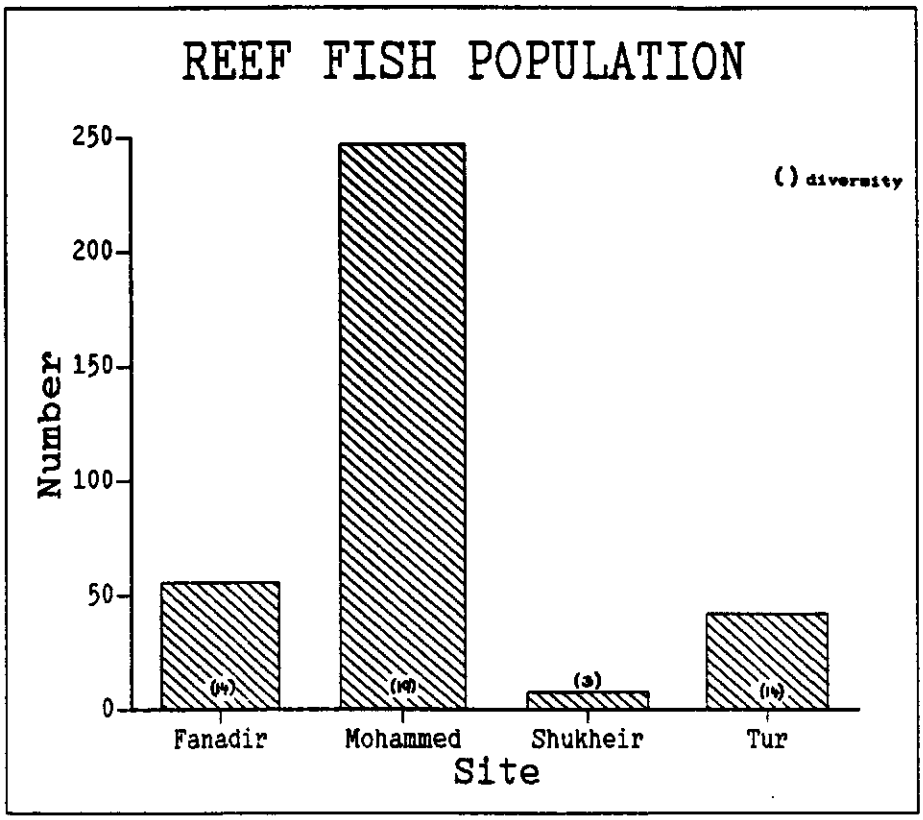


Fig 8.6a **Total number of reef fish seen in 4x200m surveys*, with diversity of species recorded in brackets. (* only 3x200m surveys were completed at Ras Shukheir)**

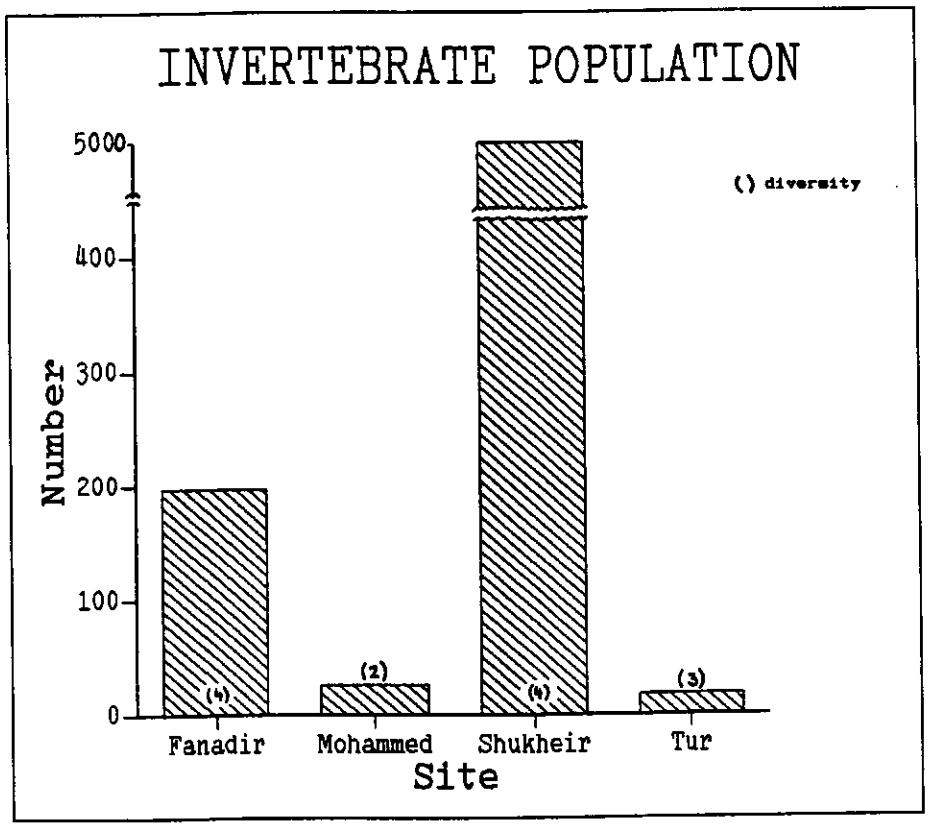
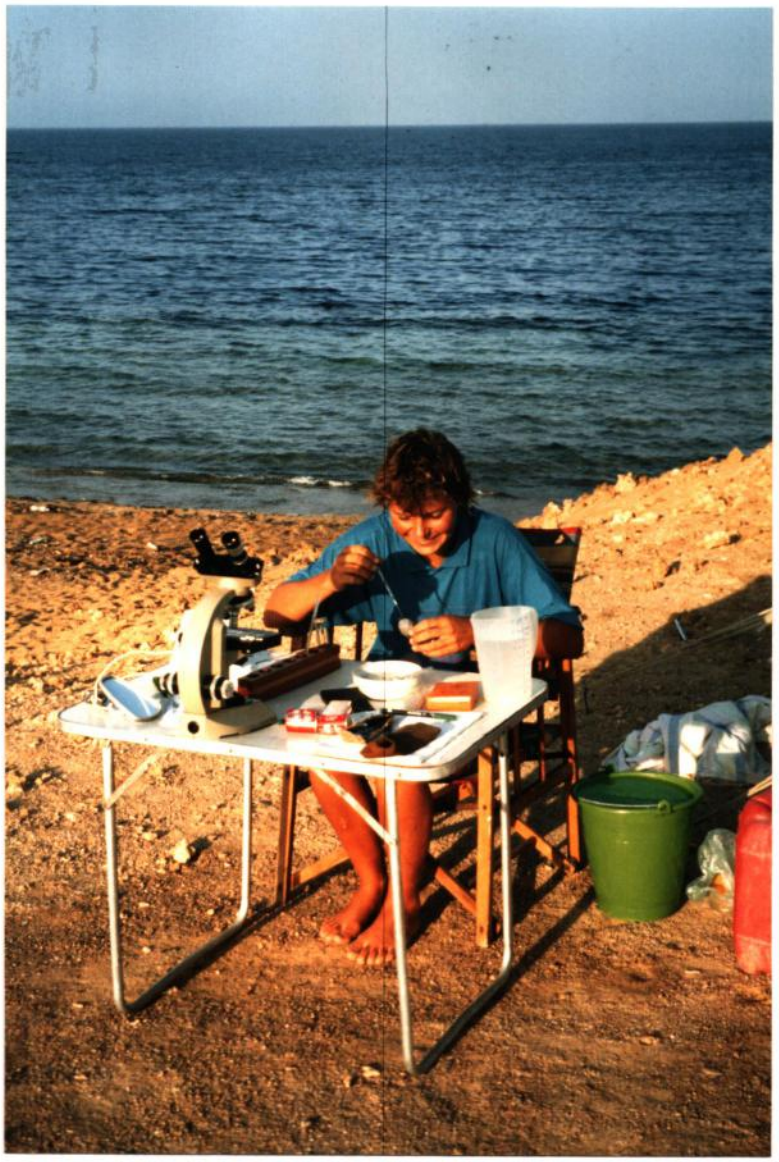


Fig 8.6b **Total number of reef invertebrates seen in 4x100m surveys*, with diversity of species recorded in brackets. (* only 3x100m surveys were completed at Ras Shukheir)**

were found at several sites it is not possible to isolate the particular stress factor disrupting the reefs at Ras Shukheir from these observations.



Determining the concentration of symbiotic algae in reef-building corals, in the field.

In the laboratory it was possible to investigate the impact of oil pollution on the same symbiotic algae (*Symbiodinium* sp.) living in the temperate sea anemone *Anemonia viridis*. This anemone is closely related to tropical corals within the phylum Coelenterata and permitted work to continue in British laboratories after the expedition had been completed.

Controlled experiments showed that exposure of the anemone to sea water contaminated with oil caused expulsion of more debris and symbiotic algae than similar anemones in clean sea water. Fluctuations in algal cell division were also investigated, but the algae and/or host were found to be very sensitive to temperature change which masked any effects the oil pollution might have induced.

This study indicates that oil pollution induces expulsion of symbiotic algae in the temperate anemone *Anemonia viridis*. Loss of symbiotic algae in tropical corals is a reponse to stress which suggests that the temperate anemone *Anemone viridis* has been stressed in the laboratory by oil. From this research and relevant literature it is possible to hypothesise that oil pollution induces stress in all Coelenterates.

v) Conclusions

Coral reefs in the Gulf of Suez are at the northern limit of their natural global distribution. Exceptionally high salinities and sub-optimal sea water temperatures for 6 months of the year place corals under extreme physiological stress. Since corals in the Gulf are already at the limits of their temperature and salinity tolerance, the additional impact of oil pollution poses a serious threat to their survival. With offshore oil production set to expand in the near future, it is vital that effective oil spill contingency plans are implemented to minimise the damage due to accidental losses and protect the coral reef communities.

For full details and results of the scientific work undertaken by this expedition (see Wild 1990)

vi) References:

Brown, B.E. & Howard, L.S. 1985. Assessing the effects of 'stress' on reef corals. *Advances in Marine Biology* 22, 1-63.

Coles, S.L. & Gunay, N. 1989. Tar pollution on Saudi Arabian Gulf beaches. *Marine Pollution Bulletin* 20, 214-218

Dicks, B. 1987. Pollution. In A.J. Edwards & S.M. Head (eds), Key Environments Red Sea. Pergamon Press, Oxford pp128-151.

Ormond, R.F.G. 1987. Conservation and management. In A. J. Edwards & S.M. Head (eds.), Key Environments Red Sea. Pergamon Press, Oxford pp128-151

Sheppard, C.R.C. 1979. Interspecific aggression between reef corals with reference to their distribution. *Marine Ecology Progress Series* 1, 237-247

Wennink, C.J. & Nelson-Smith, A. 1979. Coastal oil pollution evalution study for the Gulf of Suez and the Red Sea coast of the Republic of Egypt. Inter-Governmental Maritime Consultative Organisation, London 135pp

Wild, K.A. 1990. Oil pollution in the Gulf of Suez, Egypt and a related study on coral reef communities and algal symbiosis. c/o UCNW Bangor, Marine Science Library, 180pp.

9. Pollution and the Gulf of Suez: A Personal View

i) Pollution
ii) Egypt and pollution
iii) Problems facing the introduction of legislation in the Gulf of Suez
iv) Impact of legislation on pollution
v) Oil spill contingency
vi) Measures to minimise spillage
vii) Coping with other forms of pollution
viii) The future
ix) Sources

The fact that the ecology of both the Gulf of Suez and the Red Sea as a whole is facing disaster, threatened from all directions by man's actions is beyond dispute. The question is, what can be done about it? Before this question can be addressed, however, it is important to examine the causes of this problem, before looking to the future. As this report shows, the problem is not merely national, but an international concern.

i) Pollution

Pollution of the sea, particularly by oil, was first recognised as a problem before the First World War. As a result various countries introduced measures in the 1920's and 1930's to control the discharge of oil within their territorial waters in the form of fines for illegal discharges. It was not until 1954, however, that international action was taken.

In 1954, the United Kingdom organised a conference on the subject which resulted in the adoption of the International Convention for the Prevention of Pollution of the sea by oil (OILPOL 1954). OILPOL 1954 attempted to tackle the problem of oil pollution of the seas in two main ways:

1 It established 'prohibited zones' extending at least 50 miles from the nearest land in which the discharge of oil or of mixtures containing more than 100 parts of oil per million was forbidden.

2 It required Contracting Parties to take all appropriate steps to promote the provision of facilities for the reception of oily water and residues.

Several amendments were adopted to this convention but in 1969, the IMO Assembly (International Maritime Organisation), partly inspired by the Torrey Canyon disaster of 1967, decided to convene an international conference to adopt a completely new convention. A conference met in 1973 in London and adopted the Convention. A protocol to the Convention was adopted in 1978 which introduced more stringent requirements dealing with the prevention of oil pollution. The 1978 Protocol and the 1973 Convention are read as one instrument:

International Convention for the Prevention of Pollution from Ships (1973) as modified by its Protocol of 1978 (MARPOL 73/78)

As compared with the OILPOL Convention, one of the most significant innovations of MARPOL is the designation of certain enclosed or semi-enclosed sea areas as 'special areas'; areas in which discharges of oil or oily mixtures are totally prohibited. In order to achieve this objective there is a requirement that oil loading terminals and repair ports within special areas should be provided with reception facilities to receive all oil and oily wastes.

Regulations for three special areas (the Black, Baltic and Mediterranean seas) took effect immediately the Convention entered into force. However in the remaining areas, the Red Sea and the Gulf, sufficient measures have yet to be taken to provide adequate facilities to meet the requirements of the Convention.

ii) Egypt and pollution

Being an International Convention, MARPOL 73/78 is very important to marine protection as it applies to all contracting parties in all areas, not just their own territorial waters. Egypt has already shown its commitment to the objectives of MARPOL 73/78 being, along with Israel, the only Red Sea States to ratify the convention so far, a commitment that enabled, with financial assistance from the EEC, reception facilities to be built at Port Said on the Mediterranean coast.

The same commitment has not yet been seen for the Red Sea, Egypt not yet having informed the IMO as to whether these facilities exist in the Egyptian Red Sea area. As in Port Said, Egypt may need financial help to provide these facilities. Until all the countries bordering the Red Sea adopt the Convention and its principles and back it up with adequate facilities to enable its implementation, the Red Sea will be unable to benefit fully from its protection.

Apart from MARPOL 73/78, to which Egypt has already shown its commitment, little positive action has been taken to tackle the threat presented to the marine environment by pollution.

In 1972 a republican decree was issued to set up the 'Permanent Committee for the Prevention of Marine Pollution by Oil' (the oil industry is represented in this committee by the Egyptian General Petroleum Company - EGPC). In 1982 another decree was issued to establish 'The Egyptian Environmental Affairs Agency (EEAA)'. Also a National Oil Spill Contingency Plan has been developed, and Egypt is now taking the official and legal procedures to ratify:

1 The International Liability Convention

2 The International Fund Convention.

To date these measures have had little impact upon the problems. However, positive steps are being taken. From the 22nd to the 24th November 1989, Egypt hosted a meeting in Alexandria as part of the Red Sea and Gulf of Aden Environment Programme. In this 'Expert Meeting on Combating Marine Pollution in the Red Sea and Gulf of Aden', Egypt reaffirmed its commitment to MARPOL 73/78 and importantly, so did most of the other nations which enclose the Red Sea. All except North Yemen and Israel were represented.

This meeting was followed on the 18th December 1989 by a Seminar, organised

by Shell Egypt for the Exploration and Production (E & P) Forum under the title:

> The promotion of safety standards in the Petroleum Industry operations and the safeguarding of the Red Sea from pollution.'

At this meeting, which was attended by members of our expedition to present our findings, it was acknowledged by representatives of the oil industry that the requirements of both safety and environmental protection are essential objectives which must be met. These targets must be seen as one of the functions of management.

It is essential for the future of the marine environment as a whole that effective legislation is introduced internationally to address the problems presented by all forms of pollution. However, any legislation can only be effective if it is actively enforced, with offenders being held responsible for the damage and pollution they cause. Such legislation requires a massive commitment and a high level of international co-operation. Not surprisingly this presents numerous problems.

iii) Problems facing introduction of legislation in the Gulf of Suez

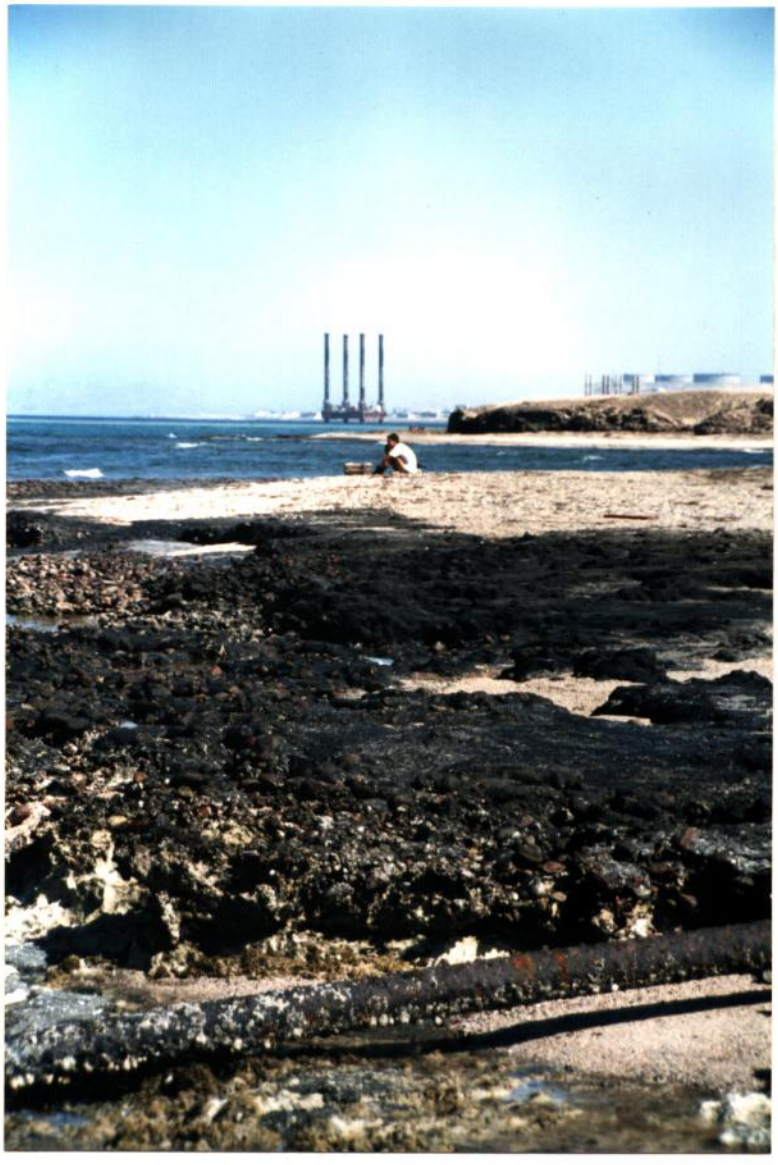
The Gulf of Suez presents a number of problems to the effective implementation of measures which could protect its ecology due to the diversity of activity it supports. Individual causes and effects of pollution cannot be considered in isolation. A policy must be adopted which takes account of all factors affecting the area. The formulation of such a policy requires a general assessment of the following activities:

a) Oil industry exploration and production
b) Shipping
c) Tourism
d) Industrialism and urbanisation
e) Military presence and restrictions

a) Oil industry exploration and production

Although small by Middle Eastern standards, the Gulf of Suez is one of the fastest developing oil production areas, with enormous production potential. The recognition of the high levels of oil pollution afflicting this area is not recent. In 1979 a study commissioned by the IMO into the degree of oil pollution in the Red Sea concluded that:

> 'Coastal pollution by oil was found to be a very serious problem along major sections of the Gulf of Suez and Red Sea coast', and continues 'a number of areas must rank with some of the worst polluted coastlines in the world, with the areas worst affected being the Gulf of Suez, to the point where we think that very long term coastal damage is inevitable and with almost irreversible conditions in some of the worst afflicted locations.'



Oil pollution, looking south, at Ras Shukheir.

All subsequent research in the Gulf of Suez has confirmed these findings right up to our survey, where we found one area at Ras Shukheir to be six times more polluted with oil than any other area in the world, for which figures are available: a level of pollution that is not isolated to this one area but afflicts much of the Gulf's coastline.

Measures to combat these levels of contamination are hindered by the fact that there is considerable dissent as to the source of this pollution. There is a large number of separate companies operating independently (the EGPC has a controlling stake in all these companies, however) who are unprepared to take collective responsibility for the problem. Also there is disagreement as to whether the main cause is due to exploration and production, or to shipping.

b) Shipping

Since the Suez canal reopened in 1975 it has again become an important international shipping route with 17,541 transits being made in 1987 (Suez Canal Authority). Also large tankers use the Gulf of Suez to access the oil terminals at Ras Shukheir and Ain Sukhna. This level of traffic poses a severe threat to the enclosed environment of the Gulf of Suez and Red Sea as a

whole. Apart from operational discharges and dumping (illegal under MARPOL 73/78) which takes place, the main threat from shipping is that posed by a serious accident. Accidental loss can occur through grounding, collision or negligence.

In respect to navigation problems in the Gulf of Suez the Admiralty chart (No 2375) makes a specific warning to shipping about rigs which may be operating within the main shipping lanes. This warning did not prevent an accident occurring in December 1989 when a Philippine ship struck an offshore rig resulting in a large escape of gas which took three days to contain.

c) Tourism

Ras Mohammed is a most breathtaking coral drop-off. Dropping to over 500 metres it is one of the most spectacular dives in the world. You have not lived until you have dived it! The currents bring in big fish, shark, barracuda, turtles and take you past luxuriant corals. The Red Sea turns your diving fantasies into reality.

Footprints in the Beach oil.

For how long will tourists be interested in this area?

This image is portrayed to the tourist: unrivalled marine life, clear waters and fantastic climate. These factors along with the growth in 'activity and adventure' holidays have created a thriving and rapidly expanding industry. An industry which is being strongly encouraged by the Egyptian Government, due to its input of foreign revenue and to attract visitors away from the traditional, historical treasures of the Nile.

The demands of tourism have resulted in rapid and uncontrolled development, particularly at the tip of the Sinai peninsula. Development which has taken place with little environmental consideration or concern as to its sustainability and long term effects on the reef. In fact the Marine Research Station, at Na'ama Bay, an expanding tourist resort near Sharm el Sheikh, is being demolished to make way for an hotel. Research and monitoring is essential to the conservation of the reefs, even more so with the additional stresses the growing number of visitors are placing on them.

A representative of the Egyptian Ministry of Tourism present at the E & P Seminar in Cairo acknowledged that development, particularly at Sharm el Sheikh, was not under control and stressed that measures were being implemented to rectify this.

There is considerable evidence of widespread devastation caused by the curio trade. Extensive physical damage is also apparent resulting from the activities of divers and their support boats. The increased number of people which this development brings into the area in turn increases the pollution and effluent being created, which further depletes the quality of the very amenities which attract tourism in the first place.

d) Industrialisation and urbanisation

In the Gulf of Suez the only heavy industry, besides the oil industry, is situated at the top of the Gulf around the city of Suez, which also forms the main urban area. As well as industrial pollution urban areas generate large amounts of sewage and garbage, much of which gets disposed of directly into the sea. At present, the coastline of the Gulf of Suez remains largely undeveloped, however, apart from the tourist industry there are a number of other initiatives which aim to change that.

Following Egypt's repossession of the Sinai in 1982 its first Governor General Youssef Sabri Abu-Taleb (who is now Minister of Defence) predicted that, with the existence of underground water in the area, development would rapidly follow.

With the majority of Egypt being made up of arid desert, less than 5% of its territory is inhabited or cultivated. With over 98% of the population living along the banks of the river Nile, the opportunity to utilise and develop other areas is of great importance. (source, population and area: Central Agency for Statistics)

Desert reclamation schemes are already being implemented within Sinai and in conjunction with greenhouse agriculture produce a wide range of vegetables. Such increases in production are not only important to a country which imports one half of its food requirements, but help to draw some of the

expanding population away from the already crowded Nile.

e) Military presence and restrictions

In spite of Israel's withdrawal from the Sinai in 1982 following the Camp David agreement, there still remains a large military presence in the area. The UN maintains a 1500 strong force, the Military Force of Observers at Sharm el Sheikh with Egypt's forces concentrated along the Western coastline of the Sinai.

The restrictions this military presence imposes present considerable obstacles to most of the activities and initiatives being undertaken in the Gulf of Suez and Sinai area.

Research and monitoring is particularly difficult, if at all posssible, due to the lengthy permission required to access the shoreline of the Gulf of Suez. Also it is very difficult to operate a private boat in the area (there is considerable concern over the operations of drug smugglers) and even the oil companies are unable to operate their own helicopters and aircraft. This obviously makes the implementation of legislation and the subsequent monitoring of that legislation more complicated.

iv) The Impact of legislation on pollution

To be effective in combating pollution legislation has to tackle the problems in a number of ways.

1. Sources of pollution. Pollution results from most of man's activities and its disposal must be controlled. As well as large 'news hitting' incidents action must be taken against the small but almost continuous incidences of pollution. It is these small discharges that add up to create the major source of total pollution.

2. Operational pollution. Generally, this is the major cause of marine pollution. It has to be reduced by introducing anti-pollution measures into the design and operation of all industrial, oil handling and processing equipment.

3. Accidents. Reducing accidents, and limiting their effects, is essential both for safety and the environment.

4. Compensation. The cost of pollution can be enormous and requires compensation for the victim to cope with its consequences.

5. Implementation. Effective legislation is very expensive in both introduction and operation and requires a high degree of international co-operation.

Worldwide, legislation has made a significant impact in reducing marine pollution but it is still a massive problem. Ignoring other pollutants the National Academy of Sciences of the United States estimated in 1980 that as much as 3.54 Million tons of oil entered the world's seas annually.

v) Oil spill contingency

In coping with oil, the major source of pollution, the main problem is that due to the narrow, enclosed nature of the Gulf of Suez any spill will rapidly come ashore; often within a matter of hours. Also poor sea conditions for much of the year render the use of booms and skimmers inappropriate (Dicks 1983) and the use of dispersants on inshore waters could possibly cause more environmental damage than the oil itself.

The Torrey Canyon disaster of 1967 caught the UK government with no effective means of dealing with a large oil spill. Desperate attempts to deal with the problem resulted in indiscriminate use of detergents and the bombing to the wreck itself. Neither method was successful and a massive coastal area was devastated. Twenty years later in Alaska, attempts to contain the Exxon Valdez spill were no more successful.

In a report on the Exxon Valdez spill to President George Bush, the US Environmental Protection Agency and the Department of Transportation concluded that plans by the government and Exxon for cleaning up a spill of this size were 'wholly insufficient'.

The report also says that tools used by Exxon to clear up the mess were primitive or simply unavailable. Eye-witness accounts described the situation as chaos as six separate contingency plans failed to cross-refer and co-ordinate their actions.

An Egyptian national oil spill contingency plan has been developed and approved by the Minister of Maritime Transport with three aircraft for aerial observation reportedly soon to be entering service. However, details of these contingencies are unknown, but Ras Gharib, where the oil companies' equipment to combat the effect of oil spillage is based, was observed to have some of the worst pollution of the Gulf on its own beaches.

Considering the problems facing a team aiming to deal with a spill, and the fact that usually less than 20% of the oil is recovered, it is obvious that contingency plans must be considered the last line of defence.

To combat oil spillage, the most effective measure is to prevent the oil escaping in the first place. Accidents will always happen so emphasis must be placed on minimising their effects. This means designing tankers, rigs, pipelines and oil processing and handling equipment with this requirement in mind. Such a requirement will prove expensive.

Although expensive in the short term such expenditure could prove beneficial to the long term operation of the oil industry. Measures to reduce the number and minimise the effects of accidents, however and wherever they occur, are not only beneficial to the environment but essential to help increase safety.

In just two accidents, which rocked the entire oil industry in 1988 and 1989, 167 men died in the North Sea and a huge area of Alaska's biologically rich coastline was devastated. In human and ecological terms the costs are incalculable but in purely financial terms the Exxon Valdez disaster alone has cost Exxon over $1 billion. (Exxon estimate) In 1986/7 Egypt's net revenue from

petroleum was $1.061 billion. (IMF estimate)

vi) Measures to minimise spillage

Two possible measures aimed at limiting the release of oil pollution from offshore rigs were highlighted at the E & P Seminar in Cairo. The first involved the use of booms around the rig and the second, the use of a gravity sump on the rig to separate waste oil and water. Both these initiatives have been utilised in the Gulf of Suez but it is unknown how effective they are and whether they will be taken up by the industry as a whole.

Of all the safety measures being considered, however, none has inspired more heated debate than that of double hulls on tankers. The US coastguard has estimated that a double bottom on the Exxon Valdez could have prevented as much as 2/3 of the oil escaping. Hardly an untried idea, double skins of one type or another are present on virtually all of the 60,000 merchant ships afloat; except for tankers.

Double hulls are already required on tankers carrying hazardous cargoes such as liquefied natural gas (LNG), and have more than once been credited with preventing disaster. In 1979 the LNG tanker El Paso Paul Keyser hit a rock ledge at a speed of 17 to 18 knots in the Straits of Gibraltar. Although the outer hull was torn open under four of the six cargo tanks, the inner hull suffered only minor damage and none of the 95 000 cubic meters of highly volatile cargo escaped.

The oil industry cites two objections to the introduction of twin skins. Firstly that oil vapours could form an explosive gas within the void between the twin skins and that a breached twin-skinned tanker would be harder to salvage. But according to Mr. A. Mackenzie of the Tanker Advisory Centre there has not been one explosion directly attributed to a double hull in the past 25 years, although some 230 tankers have them fitted. Also the risk could be virtually eliminated with the use of an inert gas in the voids. An inert gas system is already required on all tankers over 20 000 Dwt. to counter the risk of explosion in empty cargo and ballast holds. (International Convention for the Safety of Life at Sea: SOLAS)

With reference to the second objection, Capt. Warren Lebeck, a member of the Marine Board of the National Academy of Engineering stated that 'with double bottoms and wing ballast tanks, you're actually in a better position to start a salvage operation'. Capt. J.H.Boyd, US Navy Supervisor of salvage from 1973 to 1976 puts it more succinctly. 'I view the probability of a major salvage or pollution incident growing out of the grounding of a large single-bottom tanker an order of magnitude greater than that for a double-bottom tanker.'

The only other objection to the introduction of double-skinned hulls would appear to be cost.

To cope with the consequences of the escape of any pollution, and particularly oil, more emphasis must be placed on effectively containing it in the first place. If this objective cannot, or will not be met, then the operational methods and practices of these polluters must be called into question.

vii) Coping with other forms of pollution

Besides oil, little attention has been focused on the threat posed by other forms of pollution, and the cargoes travelling via the canal, which may possibly effect the Gulf of Suez and Red Sea as a whole.

Large amounts of garbage were encountered throughout the areas surveyed and are probably generated by a combination of shipping, urban settlements and industry, offshore rigs and tourism. Sewage, apparently untreated,was seen being discharged directly into the sea at Ras Gharib but it is unknown what measures are taken to treat and dispose of sewage in other urban areas and from offshore rigs.

Under MARPOL 73/78, the discharge of both garbage and sewage from shipping is controlled. Ships are not permitted to discharge untreated sewage within 4 miles of land and within 12 miles sewage must be comminuted and disinfected before discharge. Different minimum distances have been set for the principle types of garbage but a most important feature is the complete prohibition placed on the disposal of plastics and synthetic materials into the sea.

Details of what range of cargoes are transported through the Suez Canal are unavailable but in 1987 alone 17 541 transits were made carrying a total of 347 million tons of goods (Suez Canal Authority); a figure that must include a number of potentially hazardous cargoes. One initiative that was proposed at the meeting in Alexandria on the 22nd to the 24th November 1989 was aimed at this potential problem. It calls for co-operation between all Red Sea States in notifying one another about the transit of potentially harmful cargoes, particularly hazardous or toxic chemicals.

It is unknown what pollution results from industrial processes bordering the Gulf of Suez and what measures, if any, are taken to control any resulting contamination and pollution.

Problems caused by tourism generally involve either the physical damage of the reefs, or removal of a wide range of marine life. This directly affects specific species of corals, invertebrates and fish and may indirectly affect many others. Also, the developments taking place to cater for the needs of the tourist, appear to be taking place with little consideration of their environmental impact.

Addressing this problem at the E & P Seminar, a representative of the Egyptian Ministry of Tourism outlined a number of measures aimed at controlling the expanding tourist industry and to try and clean the coastline at the mouth of the Gulf of Aqaba. Unfortunately though, the proposed actions looked at the Gulf of Aqaba in isolation. To assume that the other areas of the Red Sea can be protected without addressing the problems of the Gulf of Suez must be considered a dangerously short-sighted one.

Ultimately if the future of the Gulf of Suez and Red Sea as a whole is to be secured then a plan has to be implemented which takes account of all the factors involved. This needs to look not only at the direct causes and effects of marine pollution but at the overall management and operation of the coastal

zone.

viii) The Future

The Gulf of Suez suffers from some of the worst pollution in the world and much of its coastline is considered to be almost irreversibly damaged; a situation that has not only devastated the Gulf of Suez but also threatens the Red Sea as a whole. Initiatives have been taken but as yet have failed to improve significantly the future outlook of the marine environment.

The last few years, however have seen nothing short of a revolution occurring in man's appreciation of the importance that the natural environment has for our quality of life. This places an enormous value on the world environment and balance of nature; for this reason alone, the coral reefs and marine environment of the Gulf of Suez and Red Sea must be protected.

As well as these abstract and subjective values the marine environment has a considerable financial value, in the forms of tourism, fisheries and recreation for urban areas. Its destruction not only jeopardises these but also any other future developments which are as yet unknown, as tourism was in the Red Sea only 20 years ago.

Is there a future for the Gulf of Suez?

Ultimately many of the obstacles to marine protection are financial, with most activities which exploit the areas riches only concerned with the short term profits to be gained rather than the long term sustainability of their actions. Consequently any measures aimed at marine protection are going to prove expensive, either in direct financial terms or in more stringent operating restrictions, which may reduce production and/or increase costs.
To implement effectively a scheme incorporating marine and environmental protection, which looks at the long term future of the Gulf of Suez as a renewable resource, is a formidable task, a task which must be considered a function of government. This still leaves the question, who is going to pay for it?

Egypt is a developing country, which like many others shoulders the burden of a considerable foreign debt, the repayment of which consumes a massive amount of resources. In 1985/86 the servicing of foreign debt cost Egypt $3400m; in the same period Egypt's total net revenue from petroleum, Suez Canal tolls and tourism amounted to just under $4000m. (IMF estimates. source: International Financial Statistics)

Not only are many of the resources of the Gulf of Suez exported to the developed nations, but much of the revenue is as well. Adopting the adage 'the polluter pays' leaves us with just one question. **If we in the developed world value the natural environment, when are we going to stop exploiting it and start paying for it?**

ix) Sources

Coastal Oil Pollution Evaluation Study for the Gulf of Suez and the Red Sea Coast of the Republic of Egypt. - Capt. C J Wennink & Dr. A Nelson-Smith Commissioned by IMO (was IMCO inter-governmental maritime consultative organisation)

10. CONCLUSION

The expedition successfully completed all its initial aims and objectives:

1. To undertake a comprehensive survey of four representative dive sites in the region, ascertaining the nature of the marine life and recording the topographical features of the reefs.

2. To evaluate and record the effect of oil pollution on the reefs.

3. To submit our results and conclusions to the Egyptian Government and to oil companies in the Gulf of Suez with a view to securing the future conservation of this remarkable area.

Some areas studied in the Gulf of Suez suffer from extreme levels of oil pollution. It is evident that the long term contamination of these areas is continuing.

Since coral reefs in the Gulf of Suez are already at the limits of their temperature and salinity tolerance, the additional impact of oil pollution poses a serious threat to their survival.

The E & P Forum (Cairo, December 1989) showed that senior management from the international companies within the oil industry are concerned about the pollution problem. It is vital that these concerns are backed up by positive steps: not just looking at the Gulf of Suez in isolation but at the Red Sea as a whole.

Action must be taken immediately to reverse the impact of man's activities on the coral reefs and marine environment. This action has to be seen as an international responsibility, addressing the causes and not the symptoms, and looking to the area's long term survival - not just its short term exploitation.

APPENDIX A -

EXPEDITION FINANCES

A.1 Income

	£	
Merchant Taylors' Company	1,000.00	
Westbrooke Developments	625.00	
Whitbread Take Home	500.00	
Marlborough College - Daubney Fund	500.00	
Conder Conservation Trust	500.00	
Esso Suez Inc.	500.00	
Albert Reckitt Trust	500.00	
Explorers' Club of America Youth activity fund ($750)	453.72	
B.P. Educational Committee	300.00	
Cambridge Expeditions Fund	300.00	
Selwyn College	300.00	
Pembroke College	300.00	
Buckinghamshire County Council - Frogmore Foundation	300.00	
University College of North Wales	300.00	
Mobil Oil	250.00	
St. Jude's Trust	250.00	
Cambridge University Engineering Association	200.00	
Laing Charitable Trust	150.00	
Royal Geographical Trust	150.00	
International Paint	125.00	
Wallace O'Connor, Egypt (500 LE[1])	125.00	
Worthing Rotary	100.00	
Skinners' Company	100.00	
Lancing College	50.00	
Whitley Animal Protection Trust	50.00	
Fareham Council	50.00	
Ricardo Consulting Engineers	25.00	
Hertfordshire Education Foundation	20.00	
Others - personal donations	266.00	
		8,289.72
Raffle Profit (Costs = £269.00)	512.71	
Disco Profit (Costs = 254.57)	282.34	
Printing Service	11.00	
		806.05
Personal Contributions[2]		1,138.33
Interest		18.44
Total Income		**10,252.54**

[1] LE = Egyptian Pound; 4 Egyptian pounds = 1 British pound, September 1989.

[2] This amount is less than initially budgeted for, as the expedition members purchased most of their own diving equipment so that the expedition did not need to hire it.

A.2 Statement of Finances

Expenditure

Administration		
Photocopying - including production of prospectus	206.92	
Telephone calls	277.46	
Postage and stamps	201.45	
Stationary	28.32	
Fax and Telex	21.52	
Petrol - meetings, delivery and collection of gear	308.60	
Cambridge University Explorers' and Travellers' Club	36.00	
Royal Geographical Society Expedition Planning Seminar	40.00	
Books	72.00	
Food	4.50	
Travellers' Cheques and bank charges	28.91	
Interest on £1000 loan - contingency in the field	40.00	
Miscellaneous	23.20	
		1,288.88
Insurance		803.75
Medical		
Medical kit and sun protection creams etc.	105.46	
Hospital in Cairo	6.00	
		111.46
Equipment		
Tank hire	156.00	
Diving equipment	17.00	
General equipment	115.12	
Equipment bought in Egypt[3]	91.53	
		379.65
Photographic		
Underwater camera and lenses[4]	574.95	
Slide and print film	173.80	
Processing in U.K.	55.78	
Film and processing in Egypt	8.73	
Slide copier	40.00	
		853.26
Air fares and ferries		
Flights	555.00	
Mediterranean Ferry	1,323.80	
Channel Ferry	134.25	
		2,013.05
Petrol		
In transit across Europe and back again	189.03	
Egypt	187.49	
		376.52
Carried forward		**5,826.57**

[3] Most of the equipment that was purchased in Egypt did not fulfil its requirement. It is recommended to take everything that you need with you, especially torch batteries.

[4] Donated to the Tropical Marine Research Unit, for use on future, similar expeditions.

Brought forward		**5,826.57**
Vehicle Costs[5]		
Compressors[6]	466.25	
Tools replaced	28.66	
Equipment replaced	17.00	
Spares needed in the field	102.74	
Repairs/service on return	219.61	
Insurance	57.00	
Carnet de passage	421.50	
Vehicle Documentation	84.77	
Administration costs (telephone, stamps etc.)	54.72	
Tolls, repairs, insurance, taxes, and tows in transit	18.68	
Tolls etc. in Egypt	37.69	
Additional costs for the use of the vehicle, and to cover the loss of no claims bonus	709.48	
		2,218.10
Field Expenses		
Food bought in U.K. (Much was also donated)	138.01	
Food in transit.	166.63	
Food in Egypt.	588.87	
Cigarettes.[7]	22.90	
Taxis[8] and buses	184.48	
Boat hire from Hurghada.	205.25	
Hotels and camping fees.	65.03	
Equipment lost or damaged.	171.51	
Telephone and Fax.	90.13	
Visas.	10.50	
Port taxes.	15.06	
Commission on changing money.	3.94	
Tips.	45.56	
		1,707.87
Report - Estimate		500.00
Total Expenditure		**10,252.54**
Total Income (Section A.1)		**10,252.54**

The accounts are available for inspection on request.

[5] See Diving Support Vehicle Finances for further details.

[6] The compressors cost £1466.25 to buy, but the expedition only covered £466.25 as the compressors will remain as an integral part of the Diving Support Vehicle.

[7] Often a useful present to make new friends!

[8] Taxis are the only realistic way to travel around Cairo, though the journeys can be hair-raising, with much arguing over the cost of the journey at the destination.

APPENDIX B -

DIVING SUPPORT VEHICLE FINANCES

	£
1.0 Land Rover - Parts and Assembly	
Rolling Chassis	1,600.00
Land Rover for spares	400.00
1.1 Engine	
Engine Block	120.00
Bearings, rings, seals, gaskets	107.21
Ancillaries	
Water Pump	23.00
Oil Filter	4.96
Cylinder head	55.00
Conversion to unleaded (Shire 4X4)	115.00
Inlet manifold	15.00
1.2 Cooling	
Radiator hoses and fan belt	10.68
1.3 Fuel and Exhaust system	
Weber Carburettor	Sponsor
Exhaust pipe and silencer	43.59
Carburettor adaptor plate	8.50
Fuel pumps - mechanical	14.00
electrical	5.00
Exhaust manifold	20.00
Petrol pipe	8.40
1.4 Ignition System	
Contact set	1.32
Condenser	1.39
Spark plugs	3.59
Coil	11.72
Rotor arm	0.61
Lead set	6.13
Lumenition rev limiter and breakerless ignition	Sponsor
1.5 Clutch	
Clutch plate	28.75
Release bearing	15.72
Hydraulic fluid	2.23
Carried forward	**2,621.80**

Brought forward	**2,621.80**
1.6 Transmission	
Gearbox	650.00
EP90 oil	15.43
1.7 Prop Shafts	
No significant costs	
1.8 Fron and Rear Axles	
EP90 oil	7.72
1.9 Breaking System	
Wheel cylinders (2 rear)	22.70
Brake shoes (front)	18.50
Brake pipe and unions	28.79
Brake flexible hoses (3 off)	18.57
Master cylinder	32.20
Wheel cylinder seals	15.59
Hydraulic fluid	8.92
1.10 Electrical System	
Alternator	5.00
Battery	5.00
Assorted switches, connections, wire, terminals, fuses, bulbs etc. (to make new loom)	40.00
Starter motor	10.00
Side lamps	8.05
Battery clamp	1.32
Battery leads	2.30
1.11 Suspension and Steering	
Wheels and tyres	Sponsor
1.12 Bodywork and Chassis	
Headlamp cowls	15.00
Mudshields	42.71
Hinge pin kit	2.86
Chassis bracket for 2nd fuel tank	3.00
Paint, brushes etc.	55.00
Carried forward	**3,630.46**

Brought forward	**3630.46**

1.13 Compressor Drive

Centre Power Take Off unit	Sponsor
Rear P.T.O.	Sponsor
Centre bearing and propshaft	30.00
	3.660.46

2.0 Compressor - Parts and costs

2.1 Compressors

Two Dunlop HP air compressors	1035.00
Set of HP air filters	201.25
Assorted spares	230.00
	1466.25

2.2 Compressor Rebuild and Fitting

Rebuild and test both compressors	Sponsor
Design and construct a mounting frame to fit into the Land Rover	Sponsor
Adapt compressor and filter set to fit	Sponsor
All pipework, hoses, valves, gauges etc.	Sponsor

2.3 Compressor Repairs/Problems

2.31 Repairs/Problems in the Field

Fault.	Solution.
Leaking pipe union	Replace O-ring
Leaking filter	Negligible leak so was left until our return

2.32 Repairs on Return

Leaking filter	Seals replaced

The compressor gave no problems at all during the trip and apart from changing the oil and filter medium at service intervals, the only attention it required was to observe the start up and run down procedure which gave it a chance to warm and cool down gently and to top up the oil reservoir when required.

3.0 Vehicle Equipment and Tools

3.1 Tools

3.1.1 Basic Toolkit

Item.	Damage.	Value - £	Expedition paid.
40 piece socket set	Normal wear	40.00	
Torque wrench	Normal wear	25.00	
Set AF spanners	Normal wear	14.27	
Set AF combination spanners	9/16 lost	14.50	3.15
Set metric spanners	Normal wear	9.49	
Small adjustable spanner	Lost	5.64	5.64
Large adjustable spanner	Normal wear	12.79	
Set feeler gauges	Ruined	1.89	1.89
Screwdrivers (flat head)	Normal wear	9.99	
(screw head)	Two lost, one replaced in the field	3.98	1.99
Pliers	Normal wear	6.99	
Junior hacksaw	Lost	1.99	1.99
Tyre pressure gauge	Normal wear	0.80	
Grease gun	Normal wear	8.99	
Mole grips	Normal wear	5.99	
Lump hammer	Normal wear	8.99	
Needle nosed pliers	Normal wear	4.99	
Cold chisel (2 off)	Both lost	5.60	5.60
Allen keys	Normal use	2.99	
Set files	Round file lost	9.27	4.30

3.1.2 Supplementary Tools

Hand drill and 6 twist drills	Normal wear	15.10	
Impact driver and bits	Normal wear	13.20	
Timing strobe	Normal wear	7.99	
Compression gauge	Unused	4.99	
Crow bar	Lost	4.10	4.10
		239.53	28.66

This basic toolkit was found sufficient for all the problems we encountered, but would have to be considered a minimum. Also, problems were encountered when the two vehicles split up as there were insufficient tools to provide the second vehicle with anything but the most basic toolset.

3.2 Vehicle Equipment

		Value - £	Expedition paid.
Electric winch	Normal wear	Sponsor	
Hi-lift jack	Normal wear	54.75	
90' chain	Cut into lengths for securing gear	5.00	5.00
Nylon rope	Broken winching	12.00	12.00
Tow rope	Normal wear	12.50	
Fire extinguishers	Unused	Sponsor	
Powerbank	Will no longer charge from mains	Sponsor	
Roofrack	Welded up in the field	Sponsor	
Tyre inflator (runs off diving cylinders)	Normal use	25.00	
Metal boxes (3 off)	Normal use	15.00	
4 petrol jerrycans	Normal use	20.00	
		144.25	**17.00**

All these items proved their worth on many occasions during the expedition except, thankfully, the two fire extinguishers. Although both vehicles had problems with burnt wiring, they were both caught when the wiring was smoking and before it burst into flames. Sand ladders would have been useful, especially for the Chevrolet which due to its weight struggled in soft sand. One effective way to gain flotation on soft sand proved to be letting air out of the tyres after which compressed air was used to re-inflate them (another advantage of having a compressor).

More effective ground-anchors than the stakes we had would have been useful when using the winch for self-recovery. However, most occasions when the winch was called into action was to haul other vehicles out of holes. The main advantage of having the winch was that it enabled us to attempt exceptionally difficult terrain, confident in the knowledge that if we got stuck, the winch was there to take over.

4.0 Vehicle Spares and Repairs

4.1 Vehicle Spares

4.1.1 Spares used in the field

Alternator	Used	43.25	43.25
Spark plugs	Used	3.59	3.59
Contact set (2 off)	Used	1.86	1.86
Condenser (2 off)	Used	1.91	1.91
Distributor cover	Used	1.92	1.92
Rotor arm	Used	0.61	0.61
Lead set	Used	6.13	6.13
Fan belt	Used	4.95	4.95
Oil filter	Used	2.27	2.27
Carried forward		**66.49**	**66.49**

Brought forward		**66.49**	**66.49**
Assorted electrical wire	Most used (rest on return)	16.00	16.00
Range of nuts, bolts, unions, jubilees, connections etc.	about 1/3 used	32.00	12.00
Radweld (2 off)	Used	?	
Araldite	Used	?	
Exhaust putty	1/2 used	?	
Hylomar	1/3 used	?	
Insulation tape (6 off)	All used (+ loads more)	?	
Cost of the above (approximately)		12.00	12.00
		126.49	106.49

4.1.2 Spares taken but not used

Spare wheel and two tyres	Sponsor	
Gasket set	17.99	
Coil	11.72	
Brake master cylinder seals	5.78	
Brake wheel cylinder seals (front)	9.98	
Brake wheel cylinder seals (rear)	5.60	
Clutch master cylinder seals	4.03	
Slave cylinder seals	3.06	
Assorted hoses	12.28	
Clutch plate	28.75	
U bolt	2.68	
Tappet screw and nut	1.76	
	103.63	
	230.12	106.49

These spares enabled us to solve most of the problems we encountered in the field with the selection of 'bodge it bits' such as Araldite and insulation tape proving particularly valuable. A number of spares which could have been taken, such as suspension parts etc. were considered unnecessary due to the fact that during the rebuild of the vehicle, all servicable parts were overhauled and, if necessary, replaced.

4.2 Vehicle Repairs

Key to solutions : 1 Satisfactorily repaired
2 Repaired, but needed further work on return
3 Patched up in the field but needs replacing
4 Failed to repair

4.2.1 Land Rover repairs in the field

Fault	Solution	Cost
Broken rear PTO	1	nil
Radiator leak	3	nil
Front axle oil leak	3	nil
Steering arm to swivel oil leak	2	nil
Fuel vaporisation	1	nil

Fault	Solution	Cost	Expedition paid.
Rear wiring loom burnt out	2	nil	
General tuning (regular ign, carb checks)	2	nil	
Roofrack welds broken	2	LE 15	3.75
Handbrake failed (loss of pin)	1	nil	
Exhaust stud stripped	1	nil	
Several blown bulbs	1	nil	
Battery failing to hold charge	3	nil	
Broken oil hose to pressure gauge	1	nil	
Broken windscreen mounts	3	nil	
Rear propshaft UJ worn	3	nil	

4.2.2 Land Rover repairs/service on return

Fault		
Replacement radiator	74.36	74.36
Damaged rear wing	79.24	79.24
Damaged wiring replaced (expedition spares used)	nil	
Replacement battery	30.48	30.48
Roofrack : welds tidied before painting	nil	
Front axle oil seals replaced	1.20	1.20
All oil reservoirs changed and new filter	13.00	13.00
Propshaft UJ replaced	8.05	8.05
Ignition system overhauled and adjusted	nil	
Weeping petrol tank repaired	6.75	6.75
Replacement windscreen mounts	2.78	2.78
	219.61	**219.61**

The repairs necessary on the Land Rover, both in the field and upon its return were all fairly minor with no problems occurring that limited its performance. After what amounted to little more than a routine service on its return, it was perfectly ready to turn around and repeat the performance.

5.0 Documentation

5.1 Insurance

	Cost - £		Expedition paid.
Twelve month premium	128.00		24.62
Additional drivers cost	57.00		57.00
Third party insurance in Egypt	4.40	(LE 18.50)	4.40

5.2 Tax

UK road tax	21.15		21.15
Egypt road tax	1.20	(LE 5.00)	1.20
Carried forward	**211.75**		**108.37**

Brought forward	**211.75**		**108.37**
5.3 Carnet de Passage			
Carnet de passage (not including insurance)	39.50		39.50
Insurance etc. (deposit needed also of £250)	382.00		382.00
EEC Carnet de passage (probably not necessary, but a good precaution)	free		
AA membership	34.00		34.00
5.4 Documents			
Driving licence	free		
Vehicle registration document	free		
International driving permits - four drivers	10.00		10.00
International certificate for motor vehicles	2.50		2.50
	679.95		**576.37**

6.0 Total Diving Support Vehicle Costs

	Total Costs £		Expedition paid.
Vehicle preparation			
Land Rover	3,660.46		
Petrol (major journeys and deliveries)	220.00	(Approx.)	58.60
Miscellaneous	280.00	(Approx.)	54.72
Compressor preparation			
Compressors	1,466.25		466.25
Rebuild	Sponsor		
Petrol costs	132.00		132.00
Vehicle tools	239.53		28.66
Vehicle equipment	144.25 Sponsor		17.00
Vehicle spares	230.12		106.49
Vehicle repairs	219.61		219.61
Vehicle documentation	679.95	(+ £250 deposit)	576.37
Total Cost of Construction and Repair.	**7,272.17**		
Costs Directly Attributable to This Expedition			**1,659.70**

7.1 Comments

1. The cost for the vehicle may seem high but involved a full overhaul of all servicable parts.

2. The project took about one month's full time effort spread over about three months and would probably have taken twice as long had it not been for the considerable help received from both friends and relations in providing everything from transport and muscle-power to expertise and advice.

3. Considerably more time should have been allowed to prepare and test the Land Rover and all the equipment.

APPENDIX C -

NON-FINANCIAL CONTRIBUTIONS

Diving Support Vehicle

Hypresair	- Complete compressor overhaul.
Yokohama Tyres	- Wheels and tyres.
Land Rover Parts Ltd.	- Roofrack and Power Take Off unit.
	- Gearbox at cost.
Bushey Hall Winches	- Ramsey winch.
Lumenition	- Rev. limiter and breakerless ignition.
Powerbank	- Battery pack.
Weber Concessionaries	- Carburettor.
Sire four by four	- Unleaded cylinder head at cost.
A+E Flamefighters	- Fire Extinguishers.

Expedition in General

Ruston Gas Turbines Ltd.	- Air freight of equipment to Egypt.
Bapetco.	- Loan of second vehicle - Bertha.

Equipment

Immel Publications Ltd.	- 35% discount on books.
William Sindall plc	- String, Tarpaulins, Plastic Containers.
Wallace O'Connor, Egypt	- Tent Poles.
Royal Navy	- Charts.
Hydrographic Department, MOD.	- Charts.
Curver	- Coolboxes and Coolbags.
Hills Industries Ltd.	- Portable Showers.
Swiss Cutlery (London) Ltd.	- Swiss Army Penknives.
Ever Ready	- Torches.
London Rubber Company	- Marigold gloves - for diving.
Lancing College	- Loan of Water Purifiers.
Chorleywood Scouts	- Water Containers.
Supreme	- Plastic Bags.
Walter Coles and Co. Ltd.	- Plastic Bags.
Ryman	- Envelopes.
Heffers	- Envelopes.

Diving Equipment

U.W.I. Ltd.	- Reduced price Poseidon regulators.
Collins and Chambers Ltd.	- Reduced price regulators.

Transport

Kuoni	- Reduced price flights.
Sally Line	- Reduced price ferries.
Overland Ltd.	- Arranged documentation for Egypt.

Food

S. Daniels	- Danoxa Corned Beef.
Plumrose	- Luncheon Meat.
Weetabix	- Alpen.
Mornflake	- Oats and Hawaiian Crunch.
Benskins, Ind Coope	- Beer.
J.A.Sharwood and Co. Ltd.	- Soy Sauce and Curry Powder.
Lea and Perrins	- Worcester Sauce.
Schwartz	- Packets of Authentic Mixes.
British Vinegars	- Worcester Sauce and Soy Sauce.

Health, Safety and Hygiene

pneuPAC Ltd.	- Loan of emergency Oxygen set.
Kirby Warwick	- Puritabs.
Young Optical	- Polaroid Sunglasses.
Bausch and Lomb	- Reduced price Ray-Ban Sunglasses.
ABCD Advertising	- Piz Buin Suncreams.
Scholl Consumer Products Ltd.	- Coppertone Sunshade.
Smith + Nephew	- Nivea Sun Products.
Garnier Laboratories	- Ambre Solaire Cream.
Bayer	- Autan insect repellant.
Jungle Formula	- Reduced price insect repellant.
Sterling Health	- Panadol, Milk of Magnesia and Actal.
Fisons	- Sanatogen Vitamin Pills.
Superdrug	- Easywash.
Dylon	- Travel Wash.

Raffle

Whitbread	- Beer.
Beach Villas of Cambridge	- Holiday Voucher.
Lloyds Bank	- Clock Radios.

The expedition would have been impossible without the invaluable help of the following people:

Dr. Callum Roberts.
Drs. Lynne Barratt, Rupert Ormond and Sarah Bury.
Mr. and Mrs. Ireland and Mr. and Mrs. Berry.
Mike Ledzion, Alex Vanderlip, Lord Adrian and Dr. J.C.D.Hickson.
Mr. Peter Llewelyn, Mr. Amgad Abdel Ghaffar, and Mr. Mike Davies.
Mr. Kees Havik, Mr. Neil White, and Mr. Eoin Mackenzie.
Dr .Chris Girton and Mr. Roger Anstey of BP Exploration.
The Pembroke College Porters.
Pete Wild, Dr. Sarah Wright, Hilary Glover, Anthony Gaffney, Robert Havik.
The residents of 1, Grantchester Street and 42, Wilkins Road.
The Scientific Exploration Society.
Cambridge University Underwater Exploration Group.
Cambridge University Explorers' and Travellers' Club.
Cambridge Expeditions Medical Scheme.
Royal Geographical Society Expedition Advisory Centre.
All friends who helped raise the funds with the disco and raffle.

Special thanks to Ruston Gas Turbines Ltd., Bapetco and Shell Egypt.

APPENDIX D -

DESCRIPTION OF REEFWATCH

Typical Reefwatch form.

Description of how Reefwatch works.

Examples of sheets used in fish surveys.

REEFWATCH

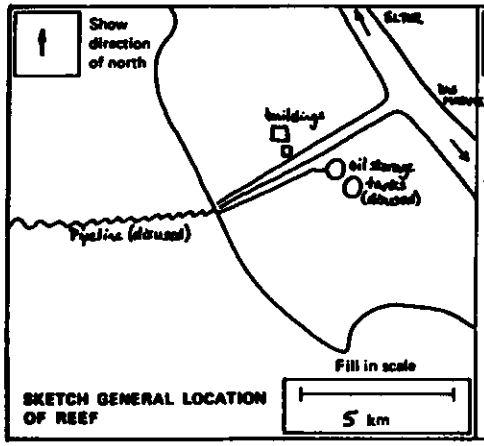
E — Your Ref. No.

EGYPT	SINAI	RAS GAERA	—
COUNTRY	REGION	LOCALITY	REEF NAME

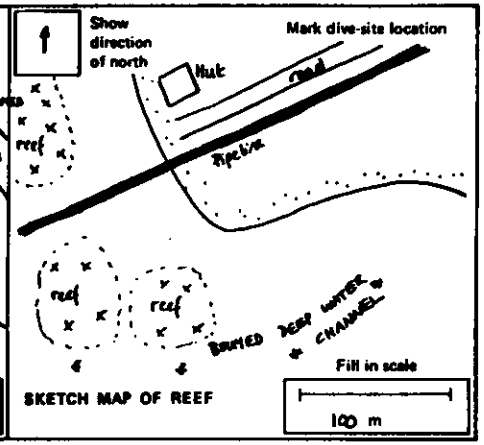
LATITUDE (deg. / min. / sec.)	LONGITUDE (deg. / min. / sec.)	CHART TYPE & NO.	PUBLISHER/SOURCE
29 / 59 / 25	33 / 48 / 50	ADMIRALTY 2375	ROYAL NAVY

POSITION ACCURACY	Completely certain	Fairly certain ✓	Slightly uncertain	Very uncertain

DATE: 9 / 8 / 89

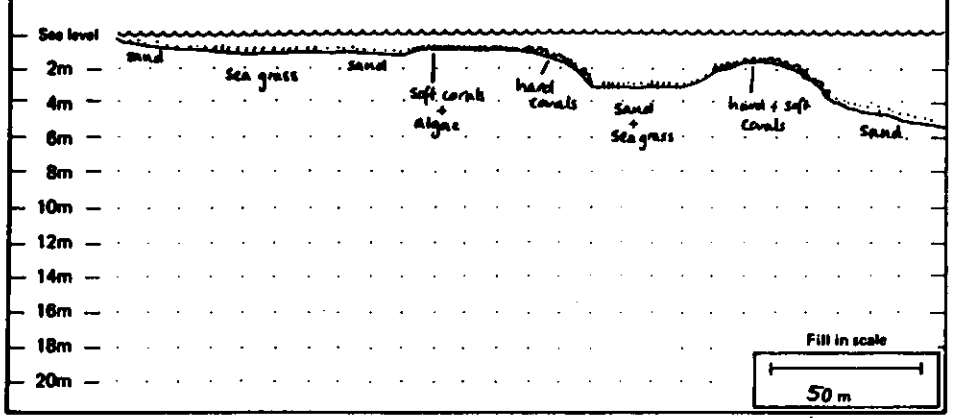


SKETCH GENERAL LOCATION OF REEF



SKETCH MAP OF REEF

SKETCH PROFILE (SIDE VIEW) OF REEF OR SHORE (show significant coral and fish locations)



Estimate bottom depth 100 metres from reef	1–4	(4–8)	8–15	15–30	30–50	50–80	>80 m

	Among best in area	Rather better	Typical ✓	Rather worse	Can't tell
Is Reef Typical					
Attractiveness	Exceptional	Pretty good ✓	Moderately good	Limited	Poor
Dive Site Rating	Exceptional	Pretty good	O.K.	Not very good	No good ✓
Coral Cover (Hard and soft)	Almost complete	High ✓	Moderate	Fairly low	Very low
Coral Cover (Soft)	Almost all	Most	About half ✓	Not much	Almost none
Coral Variety	Exceptional >30 types	Good 20–30 types	Moderate 10–20 types ✓	Limited 5–10 types	Poor <5 types
Algal growth	Extensive long growth >3cm	Extensive thick lawn >1-5cm ✓	Extensive thin lawn >3mm	Extensive algal film <3mm	Little or no algal film
Reef Fish Nos.	Superabundant	Abundant	Numerous	A bit limited ✓	Noticeably few
Reef Fish Variety	Incredibly varied varied >60	Pretty varied 45–60	Moderate variety 30–44	A bit limited 15–29 ✓	Noticeably few <15
Pelagic Fish Nos.	Superabundant	Abundant	Numerous	A bit limited	Noticeably few ✓

ENVIRONMENTAL IMPACTS	Fishing	Spear-fishing	Diving	Shell collecting	Broken coral	Dead coral	Oil slick	Beach oil	Sediment	Sewage or waste	Other *
None		✓	✓				✓			✓	
Possible/little				✓		✓			✓		
Definite/some	✓				✓			✓			
Considerable											
Extensive/severe											✓

ADDITIONAL COMMENTS (Attach supplementary notes, with ref. no., if necessary)

* Dredged channel destroyed reef around pipeline. Pipeline carried oil but presently disused. Large areas of sand and seagrass. Saw 'spanish dancer' swimming nudibranch. Variety of corals some smashed – storm / anchor damage? Army chief has personal curios collection, including branched Acropora sps. and digitate plates.

KEYWORDS:

impact details	reef mining	land reclamation	port	factory	tourism	Park Reserve	legislation	curios	fish farming	site access	currents	unusual species	interesting features

NAME(S)	ADDRESS
Ade. Pete. Emme.	GULF OF SUEZ EXPEDITION 1989.
	COUNTRY / TELEPHONE

Approximate no. of previous diving visits (or months) in coral reef areas.	Extensive >6	Moderate 3–6	Few ✓ 1–2	None

Please return to: Reefwatch Coordinator, Tropical Marine Research Unit, Department of Biology, University of York, York, YO1 5DD, England, U.K.

REEFWATCH

REEFWATCH is an underwater project which has been developed in order to gather information about the increasing threats to coral reef areas. By participating in this project, both diving expeditions and individual divers and snorkellers can contribute to our knowledge of coral reefs and provide valuable information about the extent of local and global damage to these areas.

The Reefwatch form requests basic information about the type and location of the reef, its degree of coral and algal cover, and the extent of any environmental damage. These categories and the information required are explained more fully in the Explanatory Notes below. For those who are interested in undertaking more detailed studies, and especially for expeditions with extra manpower, there are supplementary study cards available on request which are designed to examine the reef populations more closely.

EXPLANATORY NOTES

to accompany and explain the general Reefwatch (RW) form

(Points about which further notes could be made in the 'comment' section of the form are given in square brackets and smaller type.)

GENERAL REEF INFORMATION

YOUR REFERENCE NUMBER – please use a reference number to distinguish your different sites. The same reference number should be used on any supplementary notes or related RW project cards which are completed. Where there are several workers at one site, please ensure that all notes and project cards relating to this site have the same reference number as the form *irrespective* of investigator or date. If more than 30 days have elapsed a second RW form should be completed and given the *same* reference number.

REGION – the island, province, or nearest large town. This is important because there are often several places with the same name in a country.

LOCALITY – the nearest place name to be found on charts or maps. This may be a village, headland, small island, or complex of reefs.

REEF NAME – the name of the individual reef. If unnamed, please say so and take special care when indicating its position on the sketch maps below.

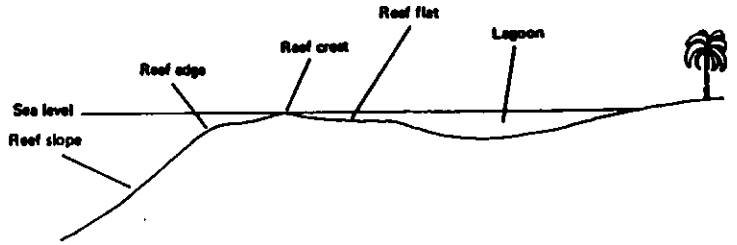
LATITUDE/LONGITUDE, MAP TYPE, NUMBER, PUBLISHER & SOURCE – please give the coordinates as accurately as possible. Admiralty Charts are often the best and most accessible maps of an area for diving purposes showing depths, general reef locations and some reef names. Please give the map details (including number) and your source. *(British Admiralty Charts can be obtained from: J. D. Potter Ltd., 145 The Minories, LONDON, EC3N 1NH, (01-709 9076), or from local ships chandlers – see Yellow Pages.)*

POSITION ACCURACY – even when a large-scale chart is available there may be uncertainty that the reef you are on is the one marked. Often the charts are based on surveys carried out many years ago without modern equipment – some reefs may have been omitted or misplaced, or the reef may have grown, have been eroded, or have changed shape. If you are unsure, please give your most likely position and then indicate how certain you are by circling the most appropriate phrase.

SKETCH GENERAL LOCATION OF REEF – this need not be especially detailed, but should show clearly the position of your reef with reference to one or more places (eg. a village, headland, or reef complex) which *are* marked on the chart. Please remember an approximate scale and mark in the direction of north.

SKETCH MAP OF REEF – this should be a rough sketch map of the actual reef. If it is offshore it will probably be less than one kilometre across and the whole reef can be sketched. If the reef runs along the coast then draw perhaps half a kilometre of coastline. The purpose is to show exactly where on the reef your dive site is (and the points at which you completed any RW study cards) since features such as the amount of coral or the numbers of sea-urchins, can vary greatly within areas of the same reef. Again, please note the approximate scale and the direction of north.

SKETCH PROFILE OF REEF OR SHORE – this is an outline side view (*elevation*) of the reef, going from shallow to deep water. It is usually fairly easy once you are in the water, particularly as there is no need to show great detail. A simplified example is given below and shows the main features of a coastal reef which are mentioned in these notes. (NB. The form of your reef may differ considerably from the diagram so be sure to draw what you see, not what you expect to see.) The reef profile may vary markedly even within a limited area. If this is the case, either draw only the profile from your point of entry into the water, or draw two or three extra profiles using dashed lines. Please mark on the profile any features of particular interest such as the position of major coral outcrops, sea urchin aggregations or extent of seagrass beds, etc. The zonation of dominant corals can also be indicated.



BOTTOM DEPTH – this is the depth at the seabed 100m seawards from the reef edge. It may be a direct observation on a shallow reef, or estimated from the charts if direct observation is impractical.

IS REEF TYPICAL? – indicate, if possible, whether the particular area of reef you have chosen to look at is typical of the surrounding reef or reefs within half a kilometre.

REEF ATTRACTIVENESS – your personal opinion is all that is required. [If the reef is exceptionally attractive, you may like to give reasons.]

DIVE SITE RATING – if you are a diver, please give your opinion here [and make notes on the features of general interest to the diver such as major wrecks and the site's accessibility, known currents, visibility, etc. In some cases, Reef Attractiveness and Dive Site Rating will be the same.]

CORAL COVER – an overall estimate by eye of the amount of *living* hard and soft coral within a 2m band along the reef edge or, where the reef is gently sloping and has no obvious edge, the depth at which coral cover appears to be highest (generally a depth between 1-5m). If possible, swim out from your point of entry until you are able to view a 20m length of reef. Consider first the overall cover of hard *and* soft coral together and then decide how much of this total is soft. Hard corals can be distinguished from soft corals by their stony skeletons and more solid appearance. The soft corals, as their name implies, are soft to the touch, generally flexible – moving to and fro with the waves – and often slimy. Do not be afraid to make very low or very high estimates if this is what you see. *Almost complete* – hard and soft coral covering all or almost all available space; *High* – extensive, but some bare patches; *Moderate* – about half of the reef covered; *Fairly low* – a fair amount of coral but most of the reef bare; *Very low* – only scattered corals.

CORAL VARIETY – a very approximate estimate of the different types of hard and soft corals which are present in the area. Look particularly at one or more points on the reef and, ignoring any differences in colour, pay attention to the detailed arrangement and structure of the polyps (the individual units which make up the coral colony). Coral identification is not easy and the RW form indicates the number of types that a non-specialist might be expected to distinguish for each category (*Exceptional; Good;* etc.). *(If you are interested to pursue this question in more detail see the Generic Guide to Common Corals by Charles Sheppard, available through TMRU (address below) at a cost of approx. £2.50 + p & p.)*

ALGAL GROWTH (between 1–3m depth) – this refers to the green/brown fuzzy lawn or film formed by filamentous algae, and coating rocky surfaces of the reef. Consider *'Extensive'* as more than one third of available rubble or rock surfaces excluding living coral. Thus, *Extensive long growth* – more than one third of rubble/rock surfaces covered with a thick dense lawn >3cm thick. *Extensive thin lawn* – length 3mm–1.5cm. *Extensive algal film* – length <3mm. (Lengths can be estimated with a pencil: the lead is usually about 3mm long, and the length of the whole sharpened end about 1.5cm.)

REEF FISH NUMBERS – these are the fish swimming in and around the coral itself and are usually brightly coloured. Pick a position where you can view a stretch of the reef edge and estimate the numbers of fish close to the coral outcrops. *Superabundant* – huge shoals of fish all around; *Abundant* – many fish and a few shoals; *Fairly numerous* – reasonable numbers but only the occasional shoal; *Limited* – relatively few fish; *Noticeably few* – very scarce.

REEF FISH VARIETY – snorkelling along the reef edge for about 10 minutes, count the different types of reef fish swimming close to the coral. As with corals, some reef fish are difficult to identify at first and the RW form indicates the numbers that a non-specialist might be expected to distinguish for each category.

PELAGIC FISH NUMBERS – these are open-water fish, almost invariably silvery-grey in colour and usually swimming a short distance away from the reef slope. They may be small such as sardines or larger and mackerel-like. (Categories as for reef fish numbers.)

ENVIRONMENTAL IMPACT – Please mark X for personal observation and (X) for estimates known from reports.

For each of the following sections further comment on possible causes, attempts at control, etc., would be very valuable, and points which you might cover are indicated in smaller type. There is no need to spend a great deal of time researching such extra details, but if you are able to pick up the information please note it down.

FISHING – all forms of conventional fishing by commercial or local fishermen on or within 100m of the reef. [What are the main fish species caught?]

SPEARFISHING – by either local fishermen or visitors. [Is the spearfishing carried out with or without SCUBA tanks?]

DIVING – include snorkelling and reef-walking by visitors.

SHELL COLLECTING – [Is this primarily for the curio trade or for food – local or export?]

BROKEN CORAL – this is intended to cover damage where coral has been broken or eroded, either from natural causes such as storms, or from man's use of the reef (ie. coral broken by anchors, combined effects of divers or snorkellers kicking or intentionally breaking off coral, or by the use of explosives by fishermen or other locals). [Where is the damage? What is the apparent cause?]

DEAD CORAL – this refers to coral which appears to have died recently but which is still in position on the reef and not broken off. The skeleton will appear whitish and will not yet have been covered by a mat of alga. It should still show the intricate pattern or latticework and will be sharp to the touch (ie. it should neither have been eroded nor substantially recolonised by other organisms). [Where is the dead coral? What is the apparent cause? eg. sedimentation, sewage or other pollution, the Crown-of-Thorns starfish *Acanthaster*, sea urchins.]

OIL SLICK – ignore any tiny thin spills of only a few square metres (these may simply have come from your own or another small boat). *Some* – one small oil slick; *Considerable* – several small slicks or one large one; *Extensive* – fouling of the whole area with oil such as might occur near an oil terminal or following a major spill. [How big? From where? When?]

BEACH OIL – check for the presence of oil and tar balls on the beach. *Some* – an occasional large tar ball; *Considerable* – numerous tar balls and perhaps a continuous oily mark along the tide line; *Extensive* – signs of a continuous band of tar half a metre wide along the tideline and/or signs of frequent or major oil spills. [From where? When?]

SEDIMENT – an estimate of the amount of sediment in the water column rather than its effect on the coral. Visibility in coral waters often corresponds roughly to the amount of sediment in the water. *Little* – a noticeable haze just above the bottom; *Some* – a noticeable decrease in visibility due to sediment in the water; *Moderate* – a fairly dense suspension of sediment in the water column; *Severe* – a very dense suspension of sediment giving visibility of less than 3m. If convenient, give a more accurate estimate by asking a colleague to hold a black and white object and move away from you along the reef edge. The object will become indistinct and finally disappear at which point the distance in metres between you and your colleague gives a good estimate of visibility which can be recorded in the table. [Please comment on obvious causes such as dredging, soil input from nearby river, etc.]

SEWAGE OR WASTE – indicate here if you can see or know that sewage, rubbish or other pollutants are entering the water within 100m of the site or near enough to be brought into it by the flow of water. [Is this from a town, rubbish dump, factory, etc.?]

OTHER – [Please explain what this is.]

ADDITIONAL COMMENTS – do not feel that you need to spend too much time researching for this section but any further information you gather about the site will be very welcome. In addition to extra notes on the above sections, a few ideas are given below and keywords have been added to the RW form as a reminder.

If the site is already within a Marine Park or Reserve, or in a designated area, it would be invaluable to know what protection this affords, whether specimen collection and spearfishing are banned and whether fishing and tourist activities are limited. To what extent are the restrictions enforced?

Are any of the following animals common in or near the site: sharks, turtles, dolphins, porpoises, dugongs, moray eels, rays, large groupers, etc.? Is the site a turtle nesting area? Are there particularly high numbers of sea birds or waders? Are there surprising numbers of dead (perhaps oiled) birds and marine animals on the shore?

The reef may be in imminent or future danger of complete destruction from reef mining, land reclamation or some other cause. Or it may be the site of fish farming schemes such as oyster culture. Is there a thriving trade in marine curios and, if so, what are the main species sold (corals, shells, pufferfish, etc.).

Any further comments

Your assistance with this project is greatly appreciated. If you have any comments on the project design or if you are in need of further information or advice please contact:

Reefwatch Coordinator,
Tropical Marine Research Unit,
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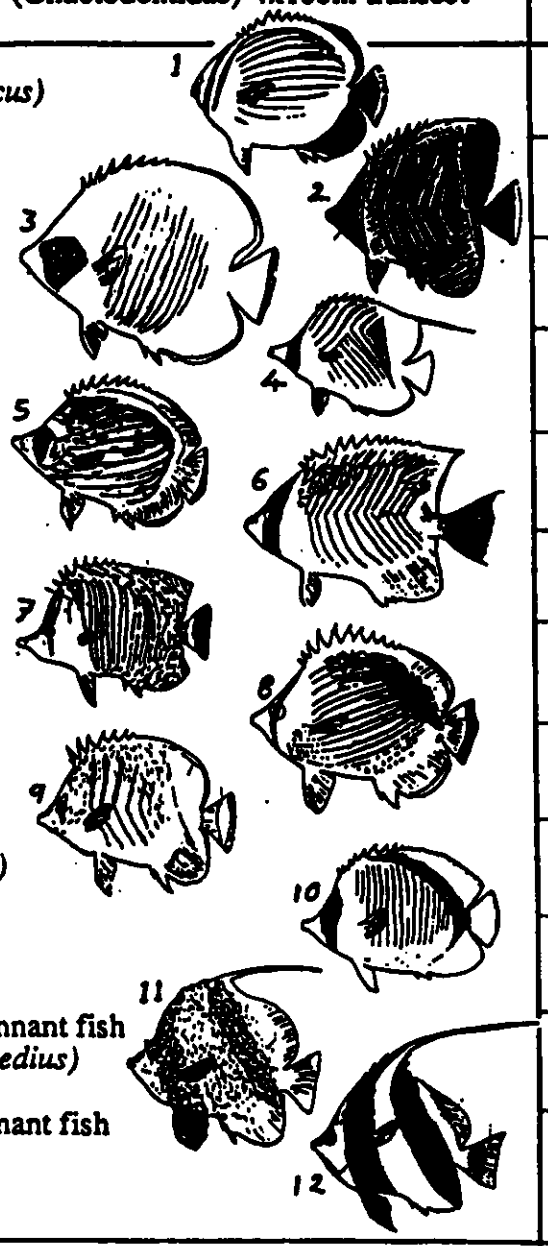
THIS PROJECT HAS FULL RECOGNITION AND SUPPORT OF THE MARINE CONSERVATION SOCIETY
4 GLOUCESTER ROAD, ROSS-ON-WYE
TEL

TMRU

JUNE 1983

Site Ref.	Date	Observer
Depth	Water temp.	Time/last disturbed
Cloud Cover	Sea State	Current

Butterfly fish (Chaetodontidae) 4x100m transect	No. seen	
1. White backed *(Chaetodon austriacus)* 2. Brown faced *(C. Larvatus)* 3. Blue Cheeked *(C. Semi-larvatus)* 4. Threadfin *(C. Auriga)* 5. White Browed *(C. Fascianus)* 6. Chevron *(C. Trifascialis)* 7. White Headed *(C. Mesoleucas)* 8. Yellow finned *(C. Melannotus)* 9. Red Tailed *(C. Paucifascianus)* 10. Black browed *(C. Lineolatus)* 11. B&Yellow Pennant fish *(Heniochus Intermedius)* 12. B&White Pennant fish *(H. Diphreutes)*		
Notes		

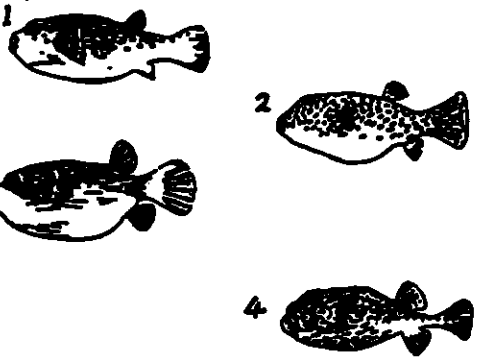


Survey time	Visibility

Site Ref.	Date	Observer
Depth	Water temp.	Time/last disturbed
Cloud Cover	Sea State	Current

Angel fish (Pomacanthidae) 4x100m transect	No. seen	
1. Emperor Angel *(Pomacanthus Imperator)* 2. Dark blue half moon *(P. Asfur)* 3. Light blue half moon *(P. Maculosus)* 4. Royal *(Pygoplites Diacanthus)* 5. Small brown *(Centropyge Multispinnis)* 6. Zebra *(Genicanthus Caudovittatus)* 7. Yellow Ear *(Holacanthus Xanthiotis)*		

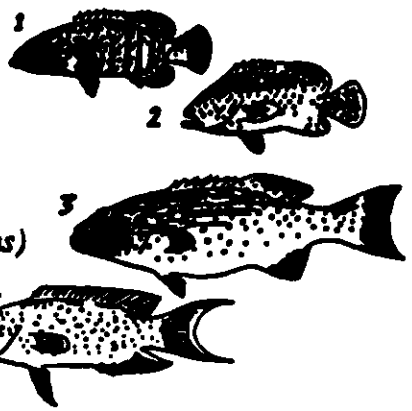
Puffer fish (Tetradontidae) 4x100m transect	No. seen	
1. White spotted *(Arothron Hispidus)* 2. Black spotted *(A. Stellatus)* 3. Masked *(A. Diadematus)* 4. Porcupine fish *(Diodon Histrix)* 5. Blue spotted boxfish. (Ostracion tuberculatus)		



Survey time	Visibility

Site Ref.	Date	Observer
Depth	Water temp.	Time/last disturbed
Cloud Cover	Sea State	Current

Groupers (Serranidae) 4x100m transect	No. seen	
1. Peacock Grouper *(Cephalopholis Argus)*		
2. Coral Grouper *(C. Miniata)*		
3. Roving Grouper *(Plectropomus Maculatus)*		
4. Lunartail Grouper *(Variola Louti)*		
5. Grey Groupers *(Epinephelus Species)*		
6. Red Bond Coral trout (Cephalopholis striatus)		



Invertebrates 4x100m transect	No. seen	
1. Needle Spined Urchin *(Diadema Setosum)*		
2. Slate-pencil Urchin *(Heterocentrotus Mammillatus)*		
3. Crown of Thorns starfish *(Acanthaster Planci)*		
4. Giant Clam *(Tridacna Maxima)*		
5. WHITE RINGED URCHIN (Echinomatia mathaei)		
6. SHORT-SPINED URCHIN (Tripneastes gratilla)		

Survey time	Visibility

APPENDIX E -

PHOTOGRAPHY

The expedition purchased a new Sea and Sea Motormarine SE camera, strobe and wide angle lens outfit for the purpose of recording data and of producing slides for future presentations. This particular camera was chosen as no team member had any experience of underwater photography, and it is very simple to handle. Our results were surprisingly good, with a healthy percentage of shots taken perfectly acceptable for use in presentations.

A good camera-case is essential in the sandy conditions of the Sinai. We took great precautions to look after our cameras, but sand still penetrated them and scratched film, as some of the pictures in this report show. One electronic camera was an insurance write-off due to sand damage. Great care must also be taken to wash the equipment in fresh water after every dive. As we soon discovered, Egyptian batteries are far from reliable and so a good supply of Duracells is important. A spare O-ring is also essential.

We used Fujichrome colour slide film (ASA 100) and were very pleased with its quality, especially in shots with bright colours. If buying in bulk, it is worth using the discount mail-order companies found at the back of camera magazines. We found that it is a good idea to take some print films for quick processing in Cairo, to gauge the standard of camera-handling.

The cost of an underwater camera is a large burden to bear for any expedition like this, as the resale price will often be small. The members of the Gulf of Suez Reef Survey felt that it would be best if the camera could be donated to some organisation which could hire the camera out to future expeditions. The Tropical Marine Research Unit seemed most appropriate, so the camera was donated to them for future expeditions that do similar work to this one.

Some of our slides were copied by the International Maritime Organisation to be held in their library, as a record of the extent of oil pollution in the Gulf of Suez.