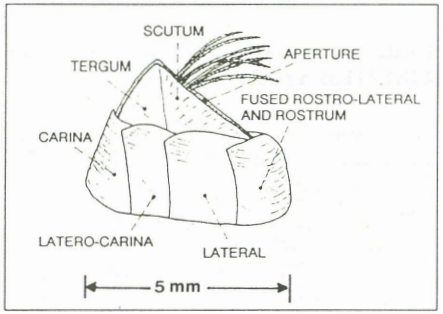
cemented to the bottom (fig. 3).

FIG. 3 AN ADULT BARNACLE.



If the barnacles are not quickly rejected by the coral they will take over much of the coral surface and kill it. If the coral is already stressed, perhaps because the background environment is unhealthy, the coral may die.

Hopefully this **'Adopted'** coral will recover. If so it may be that barnacle settlement is part of the normal reef cycle. We will only eventually learn this by keeping an eye on the **'Adopted'** coral.

AVALANCHE!

Much of the reef-top on Vilingili house reef is severely degraded and consists of sand and coral rubble. On a healthy reef there would be less coral rubble and the rubble would be contained between living coral areas. This is not the case on Vilingili house reef near the old boatyard. There is an almost constant rain of rubble and sand down the reef face. Where the rubble and sand collects on living coral the coral may die. The deterioration feeds on itself releasing more sand and rubble that in turn kills more living reef.

We are seeing this happen to one of the table corals we adopted on Vilingili house reef. We cleared it of one large piece of rubble in May. There were at least five small pieces of rubble on the table coral in late September and the coral was dying under this rubble.

Most Resorts will also have seen the same thing happening near their access channels. This **'circle of destruction'** is only made clear because we have been monitoring this **'Adopted'** coral.

GETTING IT TOGETHER

Either we sit back and let this **'circle of destruction'** continue or we try to do something about it. Remove your COT. Buoy your anchoring sites. Restrict your boat and snorkeling access points through the house-reef. Clear rubbish and debris from the reef. Act responsibly... get it together!

The evidence is growing that some reefs simply cannot sustain present levels of use without positive action. Perhaps your reefs are dying. If so they will surely continue to die unless they are looked after! **'Adopt a coral'** and celebrate a birthday... not an anonymous deathday!

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SPECIAL OIL ISSUE

COT

NEWS LETTER

MARINE RESEARCH SECTION
MINISTRY OF FISHERIES AND AGRICULTURE
The Republic of Maldives

EDITORIAL

OIL

A necessary evil?

The world runs on oil. This is as true for the Maldives as it is for other countries. The planes that bring the tourists run on oil. The desalinated water that is used by the people of Male' is produced using oil. Even the medicines and plastics needed to improve the quality of life of Maldivians require oil in their manufacture.

There are problems with using oil. There is pollution of the land, sea, and air. There is the greenhouse effect and there are all the difficulties generated by the 'better' lifestyle of a world dependent on oil. So why not stop using oil? Perhaps one day we will. The oil companies probably wouldn't mind that much. They would be far more concerned about the effects of any associated political instability on their business. They would just deal in another energy commodity.

The people would probably mind a great deal. In the short-term they would have to pay more for energy. During this time it is more than likely that every tree from Alabama to Zurich would end up on the cooking fire and that every wild animal from an Antelope to a Zebra would end up in the cooking pot. So much for conservation!

So oil is a necessary evil to be used in the best way and in the full expectation that there will be other sources of energy to take-over, in a controlled fashion, when the time is right.

THE BENEFITS

A large multinational company is presently exploring for oil in the territorial waters of the Maldives. The Maldives needs to expand and diversify sources of foreign exchange. Present revenues from sources such as tourism and fisheries are simply not enough to meet the developmental wishes of the Government. This is particularly so with the present rate of population increase. Any discovery of commercial quantities of oil will help.

THE COSTS

Of course there is a problem to be faced in discovering and exporting oil from the Maldives. The Maldives is the country most at risk from the projected sea-level rise associated with the greenhouse effect. The very use of this oil would, in theory, speed-up the covering of the Maldives by the sea (so-called inundation). What a gloriously unrealistic gesture it would be for the Government not to exploit any proven reserves. It would be utterly selfless, since, if all the "hot-air" talked about the greenhouse effect is to be taken seriously it is already too late to save the Maldives from inundation in the next century.

Of course it would gain the respect of the whole world and perhaps even a little of its money. And what if it wasn't enough money and there was a collapse in tourism, or the tuna fishery failed? Would the oil stay in the ground in the face of true economic hardship?

So we accept the realities of life and make the best of the situation.

If oil is discovered there will be risks in exploiting it. The risks can be minimised but they are always there. One day, despite all precautions taken by the industry, there could be a spill. The environmental impact of a spill cannot be predicted as it depends on a great number of factors, including the size of the spill, the type of oil spilled, where it goes and what it comes into contact with, the weather conditions at the time, and the measures taken by the industry to contain it and reduce its effect.

THE POLLUTER PAYS

The only effective way of minimising the frequency of oil spills, and the impact of any oil once spilled is to hold the polluter responsible. This is the **'polluter pays'** principle. The only way to make sure that the potential polluter is aware that he is responsible is to make sure that the industry is open to inspection by the public. Without this inspection the people who benefit from the oil will not be able to determine whether the risks associated with extracting and exporting it are acceptable.

The company that is exploring for oil in Maldives has one of the best environmental reputations in the Industry. The parent company is also registered in Holland which is one of the 'greenest' countries in Europe. This is not to say that the company is perfect but it does mean that they are prepared to go to almost any lengths to maintain their good image.

Quite clearly there are questions to be asked, and answered, concerning their operations. We have started to ask them and they have started to answer.

QUESTIONS AND ANSWERS

1 **Q** Are you looking for oil/gas?

A Yes.

2 **Q** Have you found oil/gas?

A No. Exploration is a risk business. We would not be looking if we didn't think there would be a good chance of finding it. In the Maldives we are still in an early phase of exploration; to find oil or gas we have to drill a well.

3 **Q** Does the license issued to you to survey for oil/gas give any commitment to provide you with a license to extract?

A Yes. The investment in exploration is significant and would not be justifiable if we had not obtained this commitment.

4 **Q** Will it be economically viable to extract oil/gas from the survey area at current prices if oil/gas fields are found?

A It could be economically viable, but that depends on many factors, such as the size of a find, the quality of the oil and the reservoir, and the costs of production etc.

5 **Q** If extraction is, or does become viable, will you be responsible for funding, and carrying-out, clean-up and compensation in the event of an oil-spill.

A The operator would fund, and carry-out, clean-up in the event of an oil spill resulting from any of their operations. I cannot tell you what the arrangements for compensation would be at this time for a spill arising from our operations. We will prepare, and fund, a full oil-spill contingency plan with Government for our operations before any extraction commences.

6 **Q** What mutually agreed adjudicator will be designated to set levels of compensation?

A No adjudicator is designated in advance. Claimants would have recourse to the legal system to make claims which would very likely be settled at levels similar to such current settlements worldwide.

7 **Q** What precautions do you take to ensure that your normal operations minimise damage to the environment?

A We are the subsidiary of an International Oil Company with a good environmental reputation to preserve. We undertake an environmental impact asessment* for all our operations and ensure that any impacts are minimised according to internationally set standards. We will obviously meet any standards set by Government though we will be concerned if the standards do not allow us to extract oil!

** An environmental impact assessment looks at all potential impacts on the environment from an operation like oil extraction. The assessment determines whether any impacts are likely to be significant. Ways of minimising any significant impacts are recommended. It is usual to incorporate all realistic recommendations in operating procedures - Ed.*

OIL-POLLUTION AND CORAL REEFS

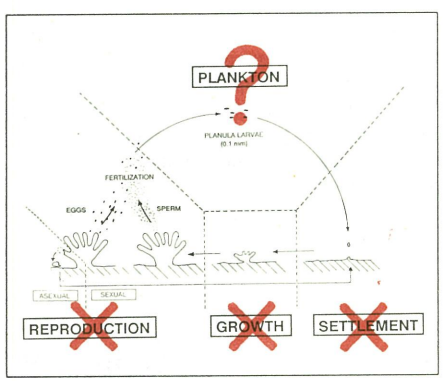
Coral reefs form one of the most sensitive and complex ecosystems on earth. They are sensitive because they have evolved in a stable, almost womb-like, salt-water medium, and have few defences to changes in its composition. Oxygen, nutrients, and chemicals easily cross from the sea into the plants and animals that form the coral reef. So do pollutants.

This sensitivity is increased because the system is complex. Animals and plants are dependent on each other. Stress on one leads to stress on another. This is particularly so for the relationship between corals and the algae that live in their tissues. The algae provide photosynthetic products to the coral that enable the coral to lay down a coral skeleton - the building block of the reef. The corals provide protection and nutrients for the algae. When the coral is stressed the algae may be expelled and the coral may not survive this.

PUTTING THE PROBLEM IN CONTEXT

We must treat seriously the effects of oil on coral reefs. Fig 1. shows stages of a coral's life cycle that may be sensitive to oil polution

FIG 1. OIL-SENSITIVE STAGES IN THE CORAL LIFE CYCLE.



Loya and Rinkevich (1987) *state that *"evidence has been accumulating which indicates numerous detrimental effects of Petroleum HydroCarbons (PHC) on coral reproduction, growth rate, photosynthesis, cell structure, colonization capacities, feeding and behavioural responses, in addition to various harmful effects of oil dispersants and drilling muds".*

Loya and Rinkevich come-up with six recommendations for managing oil pollution. They are listed in table 1.

Table 1. RECOMMENDATIONS FOR MANAGING OIL POLLUTION.*

1 Complete prohibition of well-drilling in the vicinity of coral reefs (minimum 2km from reefs).

2 New oil terminals or other oil installations must be developed far from coral reefs (at least 5-10km away) and be constructed in areas in which the currents and/or winds will remove any spilled oil from the reef.

3 In case of oil pollution, the use of mechanical removal of the oil is recommended rather than emulsifiers or dispersents.

4 Day to day monitoring (of tar balls and carbohydrates in sea-water) in chronically polluted areas.

5 Identification and standardisation of maximum PHC levels in sea-water above which remedial action should be taken.

6 Initiation of base line biological studies in reef areas with a high probability of future subjection to oil pollution.

7 Public education and enforcement of environmental laws.

Loya, Y., and Rinkevich, B., (1987). Effects of petroleum hydrocarbons on corals. In "Human impacts on coral reefs:Facts and Recommendations", B. Salvat ed., Antenne Museum E.P.H.E., French Polynesia: 91-102.

CATASTROPHIC OIL POLLUTION

A major 'catastrophic' oil spill can be terribly destructive. However, it should be noted that there have been major oil spills in coral reef areas that have had no appreciable impact. The tide has been up (fig. 2, see page 5) and the oil has floated over the top of the reef or the wind has blown the spill away from the reef. However, there have also been oil spills that have killed reefs!

CHRONIC OIL POLLUTION

Less obvious but more widespread and potentially as damaging is the chronic pollution caused by continuous minor discharge of oil such as occurs at a refuelling point in a harbour. Eventually this pollution can kill the reef locally.

A HEALTHY ENVIRONMENT

When either catastrophic or chronic oil pollution occurs, the ability of the reef to cope depends not only on the level of oil pollution but also the degree to which the corals are subject to other forms of stress. A reef that is in an otherwise healthy environment is much more likely to survive, and recover from, oil pollution than one that also has to cope with sewage or other forms of pollution.

There are a number of points to bear in mind when considering how serious oil pollution is likely to be.

DIFFERENT KINDS OF OIL

There are many different kinds of oil. Crude oil can vary quite substantially in chemical composition and this crude can be refined to produce a range of products from sticky tars through to highly volatile fuels and chemicals. Nobody can guess what kind of crude oil may be found in the Maldives but if oil is found it will contain a mixture of tars, fuels and chemicals. The tars are relatively inert but physically cover the corals making it difficult for the corals to breath and feed and requiring the coral to expend a lot of energy to produce the mucus needed to shed the oil. The volatile fractions, and chemicals, can be toxic and actually poison the coral.

CLIMATIC EFFECTS

The climate of the Maldives is warm and sunny. Volatile substances will evaporate from an oil spill relatively quickly. This situation is very different from that found in colder climates.

MANAGEMENT

CHRONIC OIL POLLUTION

Chronic oil pollution is a small day-to-day problem that adds-up and gets more serious the longer it is ignored. Usually it is ignored. In the meantime there is **every** excuse to avoid the problem. No system for collection and disposal of waste oil is available in Maldives. No advice about reducing the amount of oil discharged with bilge-water or from refuelling operations is available in Maldives.

It is no good complaining if somebody tips waste oil into the sea or, worse still, buries it in the sand, unless an alternative means of disposal is available. It is no good complaining about discharge of oil-contaminated bilge-water and leaks from refuelling operations unless alternatives are available. These alternatives exist. They need to be introduced to Maldives and the people persuaded to use them.

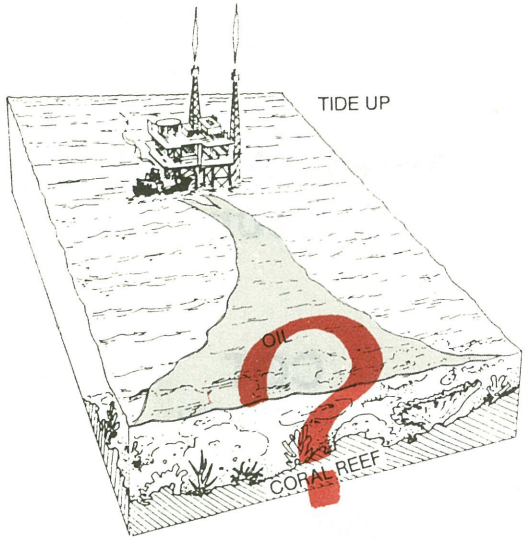
(We will discuss the problems of managing chronic oil pollution in a later issue - Ed).

CATASTROPHIC OIL POLLUTION

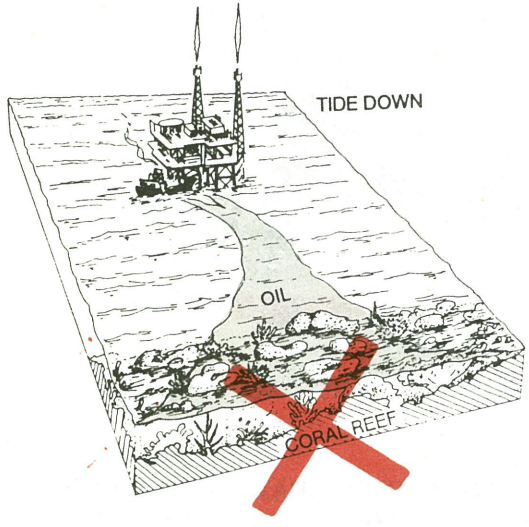
A lot of money is to be made in the oil-spill contingency business (planning what to do if there is an oil spill) and the general opinion about how to deal with an oil spill changes almost yearly. Huge glossy manuals tell you what to do in almost every possible situation. Unfortunately they seldom provide simple guidelines when facing the actual crisis of a real oil spill. Ultimately it is the person at the scene of the spill who has to make a decision about what to do. He/she can do no better than follow four basic guidelines and avoid a fifth option...contd.on page 6.

FIG. 2 EFFECT OF THE STATE OF THE TIDE ON THE AMOUNT OF IMPACT OF AN OIL SPILL ON A SHALLOW WATER CORAL REEF.

OIL FLOATS OVER THE REEF WHEN THE TIDE IS UP



OIL COATS THE REEF WHEN THE TIDE IS DOWN.



SUCK

1 Contain the spill with a boom and pump it into holding tanks.

SINK

2 Sink the spill in deep water by covering it with an inert dense material so it cannot float to a reef.

SCRAPE

3 Scrape as much of the spill from the beach or reef and dispose of it as per 1 or 2.

LEAVE

4 Leave the remains of the spill to the weathering effects of sea, sun, and sand.

and ... 5

NEVER USE CHEMICAL SOLVENTS

ADOPT A CORAL

The following Resorts (Table 2) have adopted corals since the start of the programme.

Table 2. DETAILS OF CORAL'S ADOPTED AT RESORTS

ATOLL	RESORTS	DATE ADOPTED	PORITES CORAL (NAME)	TABLE CORAL (NAME)
S. MALE'	BIYAADHOO	080790	----	RAPHAEL
	EMBUDU VILLAGE	190990	----	----
	DHIGUFINOLHU	----	----	----
N. MALE'	ERIYADU	150990	----	JULIA
	ERIYADU	150990	----	BARBARA
	ERIYADU	150990	----	EVA
	FARUKOLHUFUSHI	310790	----	----
S. MALE'	FIHALHOHI	200890	GREENPEACE	----
	FUN ISLAND	080890	MAMA	ZULU
ARI	GANGEHI	300990	MATTEO	SIMONE
N. MALE'	HELENGELI	210890	MINNA	MAAZ
	KANIFINOLHU	300890	FATIMA	ALI
S. MALE'	RANNALHI	060890	BONZO	GRAZIELLA
	RIHIVELI	140790	VICTOIRE	BASTILLE
	VELIGANDU HURA	----	----	----
	VILLIVARU	080790	ZEENIA	----
VAAV	DIGGIRI	260890	PETA	DISH

---- Still has to be found

We will continue to try to persuade the remainder to take the plunge and the responsibility. We have also adopted pairs of coral's at 19 sites as part of our 'reef environment' surveys. Please let us know if you are a Maldivian and would like one of these corals to be named after a friend or relative.

Several observations are already showing the value of the **'Adopt a coral'** scheme.

ANCHOR DAMAGE

The edge of the only table coral that we found suitable for adoption on Gaaf Alif Hithaadhoo happened to have been knocked off by a boat anchor prior to adoption. The boat anchor was ours! Hopefully the same fate is not in store for adopted corals on your house reef. If you haven't adopted a coral you will never know whether your house reef is deteriorating and, if it is, why it is deteriorating.

BARNACLE SETTLEMENT

One of the Porites corals adopted on Vilingili house reef has recently suffered a settlement of barnacles. Barnacles are related to crabs and spend their early life in the plankton. However, they eventually settle-out just like corals and spend the rest of their life