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Black gold and blue seas, can they co-exist?

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"BLACK GOLD" AND BLUE SEAS,
CAN THEY CO-EXIST?

THE IMPACT OF OIL
ON THE MARINE ENVIRONMENT OF
TRINIDAD AND TOBAGO

YOLANDE GOODING
GMA '86

THE WORLD MARITIME UNIVERSITY
"BLACK GOLD" AND BLUE SEAS,
CAN THEY CO-EXIST?

THE IMPACT OF OIL ON THE MARINE
ENVIRONMENT OF TRINIDAD AND TOBAGO

by

YOLANDE GOODING
REPUBLIC OF TRINIDAD AND TOBAGO

A work submitted to the Faculty of the World Maritime University in partial satisfaction for the award of a

MASTER OF SCIENCE DEGREE
in
GENERAL MARITIME ADMINISTRATION

The contents of this work reflect my views and are not necessarily endorsed by the University.

Supervised and assessed by: Dr. Edgar Gold
Co-assessed by: Mr. Aage Os
"Man has the fundamental right to freedom, equality and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being, and he bears a solemn responsibility to protect and improve the environment for present and future generations."

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Within the last thirty years or so, international concern over the increasing pollution of the marine environment has grown rapidly. More and more, the sea has been treated as the ultimate sewer, without the benefit of a treatment plant. Until recently, it had been thought that the marine environment could cope with the waste products which were dumped into it, without the problem of contamination or excess. Consequently, those products which could not be properly disposed of on land and even some of those which could have been, were indiscriminately dumped into the sea.

It has been estimated that land generated sources account for approximately 95% of marine pollution. Land generated pollution is, however, a national problem and is not easily dealt with at the international level. The other 5% is divided between marine and maritime activities and atmospheric fallout. Marine pollution which is ship generated is, however, an international problem by virtue of the fact that the ship sails the seven seas.

Ship generated pollution has many forms, the most obvious being:

(i) garbage and sewage  
(ii) bilge and oily wastes from engine rooms  
(iii) oily ballast from tankers

Though all represent a threat to the environment, the last two are considered to be more damaging.
The threat posed by oil to the marine environment has been the subject of many international symposia, since the evolution of the super tanker and the development of off-shore oil production. The full potential of the threat has been realised in such spectacular, well documented disasters as the TORREY CANYON and the AMOCO CADIZ groundings and the IXTOC I well blowout in Mexico.

Trinidad and Tobago has had its own "near-miss" experience with the collision in 1979, of the AEGEAN CAPTAIN and the ATLANTIC EMPRESS, in the Atlantic Ocean off the coast of Tobago. Although due to various reasons, this incident had none of the effects on the country which the TORREY CANYON or the AMOCO CADIZ had on the United Kingdom and France respectively, it emphasized quite clearly, the threat which is posed by these oil tankers on their journeys to and from the markets and refineries of the USA and the Wider Caribbean.

Apart from this, Trinidad and Tobago has its own potential for disastrous oil pollution of its marine environment by its oil industry and its off-shore fields which surround the island of Trinidad. The oil industry has been an important contributor to the Gross National Product of Trinidad and Tobago. With the recent sharp decline in oil revenues, however, the State has had to do some stock taking of its other income earning resources, principally the development of the tourism and fishing sectors. Uncontrolled pollution of the marine environment of Trinidad and Tobago, would impact adversely on developments in these areas. The
State must ensure, therefore, that as far as possible, the full potential for pollution of its marine environment, whether by oil or other substances, is not realised.

This study acknowledges that there are other types of pollution - chemicals, sewage or garbage, for example - which may be more unsightly or dangerous to the environment. However, because of the prominence of the oil industry in Trinidad and Tobago, and the growing importance of the competing industries of tourism and fishing, it is limited to an examination of the threat of pollution to the marine environment which is posed by oil.

It will consider and make recommendations with respect to:

(i) the vulnerability of Trinidad and Tobago to marine pollution by oil;
(ii) resources available and preparedness for dealing with emergencies;
(iii) measures needed to prevent or minimise the likelihood of pollution.

The information used in the preparation of the study comes from three main sources:

- lectures and discussions at the World Maritime University;
- books, magazine articles and other reading material;
- interviews.

(x)
As far as possible, I have attempted to obtain up-to-date information. However, the difficulties experienced in obtaining concrete data on the oil industry, have severely limited my ability to obtain relevant information on this industry in Trinidad and Tobago. The information contained herein is, consequently, based on personal observations and subject to correction.

Because of the difficulties involved in writing a paper of this nature so far away from the source of information, the topic has not been given the in-depth treatment it deserves. Moreover, there are several areas which, on their own, can form independent subjects of research. The most significant of these is the need for Coastal Zone management in Trinidad and Tobago.

For several reasons, this study cannot and does not attempt to deal exhaustively with the topic. It does attempt, however, to focus attention on a situation which, at this time, needs to be drawn from its present marginal position into the full spotlight of today's realities.
ACKNOWLEDGEMENTS

I wish to acknowledge with grateful thanks, the many people who have aided me in the preparation of this work - friends, colleagues, lecturers, and in particular, the staff of the Institute of Marine Affairs, in Trinidad and Tobago. To those knowledgeable people whom I met on my field training, who helped clarify my ideas on various aspects of this subject, I am forever indebted. Most of all, my deepest appreciation to Dr. Edgar Gold for his guidance and stimulating criticism; to Mr. Atle Fretheim, who despite his busy schedule took time to discuss and advise; to Ms. Joyce Alcantara, Ms. Ina Nicholson and Ms. Dwynette Eversley for their unfailing support; and to Mr. Richard Poisson, who was never too busy to go the extra mile.
chapter 1

environmental protection
the global viewpoint
CHAPTER I.

1.1 THE NATURE OF THE PROBLEM

International concern about environmental protection, though a twentieth century phenomenon, became truly widespread only in the latter half of the twentieth century. During the last century massive industrialisation took place in Europe and the so-called developed countries of the world, with little thought given to the cleanliness and health of the environment. Perhaps, the growing concern for the environment began with the technological advances of this century, which changed industrial development from a vehicle of progress to a threat to life itself. Whatever the reason, early international intimations of this concern surfaced in the 1920s and 30s, when attempts were made through the League of Nations to conclude an International Convention for the control of pollution from ships. These attempts were unsuccessful and it was left until the 1950s before any progress in this field of international cooperation was made.

In the introduction to the Norwegian Nature Conservation Act the point is made that Nature is a national asset which must be protected, hence the need for environmental protection. Environmental Protection as a term, is very wide and all-inclusive covering not only pollution prevention, but having such objectives as resource conservation and management and the management and the maintenance of the quality and biological production of nature. The conservation and management of natural resources normally fall under national
jurisdiction and to that extent, cannot be regulated through the use of international law. Pollution, however, is no respecter of national boundaries. Marine pollution, in particular, is an international problem which can only be solved through international means, in other words, international cooperation. The following quotation perfectly expresses this thought:

"It is, above all, at the edge of the sea that the pretensions of sovereignty cease, and the fact of a shared biosphere begins more strongly with each passing decade to assert its inescapable reality." (1)

The sea itself, is a source of life and covers, it is estimated, approximately 75% of the earth's surface. It is considered to be the main producer of oxygen and is irreplaceable as a source of food. However, because plant and animal life are largely generated only on the continental shelves, where there is an abundance of light and food, it is estimated that the sea is only 10% productive. The continental shelves are also extremely vulnerable to pollution, being the area where most of the mineral resources are located.

1.2. Pollution - Why Oil

What is "marine pollution"? The term has as many varied interpretations as there are spheres of interest. The internationally accepted definition comes from the United Nations Conference on Human Environment held in Stockholm
in June 1972, which states that pollution is:

"the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, resulting in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing, impairment of quality for use of sea water and reduction of amenities." (2)

Thus marine pollution has many forms - visible and invisible - the criterion being the damaging effect of artificially introduced substances or energy on the marine environment. Oil as a pollutant, may be less permanently damaging to the environment than other forms, such as chemicals or hot water discharges. Pollution from oil, however, was chosen as the rallying call for the early environmentalist movement for various reasons.

Oil in the marine environment has many sources. There is land generated oil pollution, in which relatively small amounts of oil find their way continuously into the sea. This creates a state of chronic pollution which is difficult to clean, because of the small amounts. There are also natural seeps which occur in certain areas of the world and are difficult problems to solve by virtue of their naturalness. Other sources of oil include ships and off-shore oil production. These latter two are responsible for the majority of oil entering the marine environment, either from operations or from accidents. Figure 1 gives a comparative idea of
Figure 1 Discharges at sea by sources. (Source: Petroleum in the Marine Environment, National Academy of Sciences)
the sources and their contribution to the pollution of the marine environment.

Oil on the water is highly visible and so are the effects of having it in the marine environment. It is not necessary to draw graphs or quote statistics to convince public opinion, when fishing gear is fouled or beaches made unusable, or even dead sea creatures are washed ashore because of spilt oil in the sea. The evidence is obvious and speaks for itself. It affects a wide cross section of public interests and public sympathies are easily aroused in the fight against oil pollution.

In addition, spilt oil is an international scourge. The TORREY CANYON may have run aground in international waters while carrying a cargo of oil intended for English industry, but it cost both Britain and France many millions of dollars in clean-up costs and lost or damaged amenities. Similarly, IXTOC I was a Mexican well but the oil from the blow-out, the largest ever recorded, fouled about 88 kilometres of the coasts of Texas and cost the United States about 4 million dollars in clean up costs.

Oil represents, or did until the recent crisis, about 60% of the world sea-borne trade - the largest category of commodities carried by ship. The ship itself is one of the most international forms of business ventures existing. It may be financed in one country, owned in another, registered in a third and it traverses the waters of several nations in order to ply its trade. In the circumstances, while oil pollution from land based sources may be ignored on the grounds that it is a
national concern, the threat of pollution from ships and offshore installations is more international in scope, more dramatic, of greater proportions and possibly, more costly to recompense.

1.3 Post World War II Developments

After the Second World War, a vast expansion in world-wide energy consumption was experienced, as the industrialised world set about the task of reconstruction. Oil was the primary source of energy, replacing coal as more efficient, less expensive and more available. However, in most cases, the oil had to be transported by sea to consumers. The major source of fuel for the propulsion of these oil transporting vessels was also oil.

At this time the Middle East was taking over leadership in the production of oil from the United States of America (USA), which had decided to cut back on its production quotas in order to conserve its reserves. Trade was mainly in refined products requiring small tankers. This situation was radically altered in the 1950s when three events occurred, leading eventually to the evolution of the super tanker.

First, there was the Abadan crisis of 1951, which was sparked off when the oil wells of Iran were nationalised by Prime Minister Musadak. Vital supplies of oil to the West were cut off by this action, which revealed to the West the frailty of its control over these resources, in the face of the growing nationalist movements.
The second event, coming hard upon the heels of the first, served to convince the West that their fears regarding the nationalist movements were well founded. In 1956, President Nasser of Egypt nationalised and closed the Suez Canal. This had immediate repercussions in increased time and costs for the voyage from the oil fields of the Middle East, to the oil consuming capitals of the world, because ships now had to travel around the Cape of Good Hope.

These two events occurred almost simultaneously with a veritable explosion in the world demand for oil, which was needed for industry, for heating and the fast growing vehicle population. The net effect was the evolution of a trend towards the building of market-located refineries and a resultant demand for greatly increased quantities of oil to be transported. It was at this point that the distinction between the crude oil carrier and the product carrier began to develop - the crude oil carrier very quickly outstripping the product tanker in size. Later, there were the Very Large Crude Carriers (VLCCs) of between 150,000 deadweight tons (dwt) and ultimately, the Ultra Large Crude Carriers (ULCCs) of over 300,000 dwt.

As the size of the crude carrier increased, so did public anxiety over the threat it presented to the marine environment, not only from oily discharges of bilge water but also from the tank cleanings and washings from these mammoth tankers. The concern was great enough to produce, even before the establishment of the International Maritime Organisation (IMO), an International Convention for the Prevention of Pollution of the Marine Environment by Oil in 1954. The Convention is more
widely known as OILPOL, and entered into force in 1958.

This Convention was the first attempt at the international regulation of maritime pollution and, at best, provided modest and very limited solutions to the burgeoning problem. Even though it was amended in 1962, OILPOL was never more than moderately successful. It did provide, however, the base upon which a later and more stringent Convention — the International Convention for the Prevention of Ships (MARPOL) — could have been built.

Nevertheless, before MARPOL could be created, the magnitude of both the threat of pollution and the task of regulation were forcibly and dramatically demonstrated to the world with the "TORREY CANYON" disaster. The TORREY CANYON was one of the first generation super tankers called VLCCs. In 1967, the TORREY CANYON, a vessel of 120,890 tons dwt and fully loaded with 119,328 tons of crude oil ran aground, rupturing all her tanks and spilling the entire cargo onto the shores of Great Britain and France. The worst fears of the environmental protectionists had been realised and had caught the world unprepared to deal with such an emergency — whether technically, administratively or legislatively.
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2 Report of the U.N. Conference on the Human Environment:
Doc. A/CONF. 48/14, July 3, 1972
chapter 2

international regulation of oil pollution
2.1 THE LEGAL FRAMEWORK

The grounding of the TORREY CANYON dramatically highlighted in an inimitable way, grave deficiencies in the legal fabric of international pollution control at the time. International customary law is developed by the practice of states. Thus, if a practice is recognised because of tradition - like the law of General Average, for example - or because the provisions of Convention have been accepted and applied in their national law by a majority of states, that practice can be considered as being part of international customary law which binds all states.

The scale of the TORREY CANYON incident was unprecedented in shipping history and neither international custom nor international law provided a suitable guide for the actions of those involved. One such example was the dilemma of who should take action with respect to the ship. International custom, in such situations, has always dictated that the flag state alone had jurisdiction over the ship, regardless of its location. There was no precedent set on the behaviour of the coastal state i.e. the extent of its authority, if any. On this occasion, after the vessel was deemed to be practically unsalvageable, the British Government undertook to intervene - too late - for the sake of its own marine environment, by bombing the ship.
Another controversial issue raised by this incident, was the question of compensation and the right of the vessel owners to limit their liability as per existing international law.

Thus it was that two diplomatic conferences were subsequently called as a direct consequence of the TORREY CANYON disaster, resulting in the adoption of three International Conventions:

- International Convention relating to Intervention on the High Seas in cases of Oil Pollution Casualties (1969)
- International Convention on Civil Liability for Oil Pollution Damage (1969)
- International Convention for the Establishment of an International Fund for Oil Pollution Damage (1971)

2.1.1 International Convention Relating to Intervention on the High Seas in cases of Oil Pollution Casualties (Intervention Convention) 1969

The problem brought into focus by the TORREY CANYON incident, which this Convention sought to solve was, whether a coastal state had the authority to intervene in a maritime casualty involving a foreign flag, in defence of its own interests and if it did, what were the precise limits of that authority.

In the end, after much debate, the Convention as drawn up related to the high seas only and it was left to the states to make their own regulations.
regarding their territorial waters. The essence of the Convention is expressed in Article 1 which states:

"(1) Parties to the present Convention may take such measures on the high seas as may be necessary to prevent, mitigate or eliminate grave and imminent danger to their coastline or related interests from pollution of the sea by oil, following upon a maritime casualty, which may reasonably be expected to result in major harmful consequences."

In other words, this Convention allows coastal states, in the event of a casualty which threatens their shores, to abrogate the freedom of the high seas, for a specific purpose - to protect its territory from oil pollution - under specific conditions - grave and imminent danger. This makes the Convention of critical importance for those states situated on tanker routes, for whom the spectre of an oil tanker disaster is an ever present nightmare.

The Convention entered into force on May 6, 1975.
2.1.2 International Convention on Civil Liability for Oil Pollution Damage (Civil Liability Convention) 1969

As previously indicated, another of the thorny issues raised by the TORREY CANYON incident was the question of liability and adequate compensation. Up until this time, the rules of limitation applicable to the situation were those set by the 1957 Convention on the Limitation of Liability. Under this Convention, the limitation on liability for property damage was approximately $67 US per ton of the ship's "limitation tonnage".

"Limitation tonnage" is calculated on about 40% of the deadweight tonnage of the vessel and about 10% less than the gross registered tonnage. In the case of the TORREY CANYON, the owner's liability was limited to about $4,746,000 US. This meant that any damage over and above this sum would have to be borne by the victims. Needless to say that the combined claims of both England and France ran into tens of millions of dollars which could not have been compensated.

In addition, the Convention also provides for liability according to fault. This meant that the burden of proof of negligence or fault lies with the victim. The TORREY CANYON issue demonstrated the need for revision of this aspect of the concept of liability and compensation, to bring it more in keeping with the modern day hazard of the oil tanker and its potential for unlimited damage.

Consequently, the issue as considered at the
Diplomatic Conference in 1969, was resolved into three questions:

- who should be made liable for damage done;
- the basis of such liability;
- the limit of the liability.

The result of these deliberations was the International Convention on Civil Liability for Oil Pollution Damage, also called the Civil Liability Convention. Under this Convention, strict liability is placed on the owner of the ship from which oil is discharged. With "strict liability", it is not necessary to prove fault in order to obtain compensation. There are very limited exceptions to this liability and the burden of proof lies with the ship owner, against whom all claims must be made. Although allowed to limit his liability, the amount of the limit was doubled.

The Civil Liability Convention covers pollution damage stemming from the escape or discharge of oil from laden tankers. Tankers sailing in ballast are not covered. It is restricted to damage caused by persistent oil and applies only to damage occurring in, or threatening the territory or territorial seas of a contracting state. Pure threat situations are not covered.

The Convention entered into force in June 1975, and a subsequent Protocol, which amended the unit of account in which the limits of liability are expressed, became effective in 1981. This amendment was as a direct result of another super-tanker disaster, the grounding of the AMOCO CADIZ. (1) A further amendment to the Convention was made in 1984, but is not expected to take
effect until the late 1980s.

In becoming party to this Convention, a state has the right to demand that all tankers, wherever registered, entering its own ports, are insured against the limit of their liability under the Convention, for pollution damages. By the same token, the tanker owners of member states must also be insured.

An important new innovation which is noteworthy here, is the right of direct action against the insurer, in the event that the ship owner reneges on payment of compensation.

2.1.3 International Convention for the Establishment of an International Fund for Oil Pollution Damage (Fund Convention) 1971

The Liability Convention had found widespread acceptance among states participating in the Conference, only after it was agreed that the creation of an international fund - a proposal put forward at the 1969 Conference - be tabled for discussion at a Diplomatic Conference to be called in the near future. The idea was that a Fund, which was supplementary to the Liability Convention, should be set up with a two-fold purpose:

- to provide compensation additional to that provided under the Liability Convention
- to "indemnify" the ship owner for part of the increased burden placed on him thereby.

The Conference took place in Brussels - the
proposer of the idea — and the resultant International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (Fund Convention) reflected these two principles. Subsequently, the International Oil Pollution Compensation Fund (IOPC) was created to fulfil the principles expressed.

Basically, the IOPC Fund's liability begins where the Liability Convention ends. Its liability is strict and subject to very few defences, and both the victims of pollution damage and the owner of the ship causing it, may be claimants against the Fund.

It is financed from the contributions levied on the importers of crude oil and heavy fuel oil in the territories of contracting states. It is interesting to note that under both the Civil Liability and the Fund Conventions, financial responsibility lies with industry while the benefits accrue to the State.

The Fund Convention entered into force in October 1978. Participation is only open to those states which are members of the Liability Convention.

2.2 VOLUNTARY COMPENSATION SCHEMES

In the meantime, both the tanker and the oil industries had been following very closely, developments at the public international level and began to feel the need for involvement themselves. They realised that the TORREY CANYON incident had provided them with very bad publicity, the result of which could have been
unilateral action in the regulation of shipping by coastal states. This would have been catastrophic for the industries. In a show of good faith, therefore, two voluntary compensation schemes were set up - TOVALOP and CRISTAL - to correspond with the Liability and Fund Conventions.

2.2.1 TOVALOP

TOVALOP is the acronym for Tanker Owners Voluntary Agreement concerning Liability for Oil Pollution, which was established, in January 1969, by seven of the world’s leading oil companies. It became operative in October of the same year, after 50% of the world tanker tonnage became subject to it. Today, every sea-going vessel transporting oil is entered in the TOVALOP scheme, the purpose of which is the reimbursement of national governments for their expenses reasonably incurred, in prevention or clean-up of polluted coast lines caused by the negligent discharge of oil from a member tanker.

TOVALOP follows the form and substance of the Civil Liability Convention very closely and the liability coverage is almost precisely the same. However, whereas the Civil Liability Convention applies only to actual costs incurred in mitigation and removal, and costs related to the threat of damage, TOVALOP applies to all tankers, whether loaded or in ballast.

TOVALOP was conceived as an alternative to the Civil Liability Convention and comes into operation only when the Liability Convention does not apply. Thus countries which have not become party to the Liability
Convention can have recourse to TOVALOP.

2.2.2 CRISTAL

As with TOVALOP, CRISTAL - the Contract Regarding an Interim Supplement to Tanker Liability for Oil Pollution, was drafted as a voluntary interim scheme for the provision of additional compensation to victims of oil pollution, who had been insufficiently recompensed under existing laws or TOVALOP. It is subscribed to by over 90% of the oil companies receiving crude and heavy fuel oil.

CRISTAL does not apply to incidents covered by the Fund. It is strictly supplementary and is designed to compensate those who have suffered pollution damage ONLY in so far as they have been unable to obtain adequate compensation from other specified sources. Thus, it can be considered to provide cover for those countries which are not parties to the Fund Convention. However, it should be noted that to obtain compensation under CRISTAL, the oil must be owned by an oil company which is party to CRISTAL and carried in a tanker which is a member of TOVALOP.

An interesting point of difference between TOVALOP and CRISTAL can be seen in the way in which they compare with their international counterparts, the Liability and Fund Conventions.

As previously stated, TOVALOP follows very closely, the form and purpose of the Liability Convention with certain differences which make the choice
Table 1: Significant differences between TOVALOP and the Civil Liability Convention


<table>
<thead>
<tr>
<th></th>
<th>TOVALOP</th>
<th>Civil Liability Convention</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Application</strong></td>
<td>Vessel specific i.e. a voluntary regime covering only those tankers owned by members</td>
<td>Territory specific - a legal regime applying to vessels within the scope of its provisions, but limited to the territory or the territorial sea</td>
</tr>
<tr>
<td><strong>Coverage</strong></td>
<td>a) Includes pure threat situations</td>
<td>a) Actual pollution damage only. However, 1984 amendments cover pure threat.</td>
</tr>
<tr>
<td></td>
<td>b) Tankers in ballast as well as laden tankers</td>
<td>b) Only laden tankers. Will extend to tankers in ballast when the 1984 amendments come into force</td>
</tr>
<tr>
<td></td>
<td>c) Includes bareboat charterer by providing that he be deemed owner</td>
<td>c) Registered owner(s) only</td>
</tr>
<tr>
<td><strong>Liability</strong></td>
<td>Limited in all cases</td>
<td>Limited only where there is no actual fault or privity</td>
</tr>
</tbody>
</table>
Table 2: Significant differences between CRISTAL and the Fund Convention

<table>
<thead>
<tr>
<th></th>
<th>CRISTAL</th>
<th>Fund Convention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit of Compensation</td>
<td>At US $36 million per incident, it is considerably lower than the Fund</td>
<td>US $50 million per incident, but may be increased by the Assembly to US $66 million should the need arise</td>
</tr>
<tr>
<td>Coverage</td>
<td>a) Includes pure threat situations</td>
<td>a) Only actual pollution damage</td>
</tr>
<tr>
<td></td>
<td>b) Does not cover incidents of natural phenomena or intentional acts of third parties</td>
<td>b) Coverage provided for incidents of natural phenomena or intentional acts of third parties</td>
</tr>
<tr>
<td></td>
<td>c) Includes tankers in ballast</td>
<td>c) Does not cover tankers in ballast</td>
</tr>
<tr>
<td>Applicability</td>
<td>Scheme of last resort. Applies only when every other source is exhausted</td>
<td>Complements the Civil Liability Convention</td>
</tr>
</tbody>
</table>
between the two, more or less equal. The major
differences are summarised in Table 1. In the words of
Abecassis and Jarashow "a government not yet party to
the 1969 Liability Convention is, at the moment, faced
with a choice of schemes. The purely voluntary TOVALOP
scheme does not cover every tanker but provides very
wide protection in respect of those vessels it does
cover - all laden tankers - but does not offer such wide
protection in respect of them."

The same relationship cannot be said to exist
in quite the same way between CRISTAL and the Fund Con­
vention, even though it appears to. It is true that
CRISTAL will supplement compensatory payments for oil
pollution damage, where other payments are insufficient.
However, CRISTAL is both vessel specific and cargo
specific, in that compensation will only be considered
if the oil is owned by a member company of CRISTAL and
carried in a TOVALOP tanker. It may be concluded,
therefore, that CRISTAL cannot really be regarded as an
alternative to the Fund Convention, since it does not
compensate in respect of damages compensable under the
Fund.

The continued existence of these two Agreements
- TOVALOP and CRISTAL - is at present called into
question by two proposed schemes - PLATO and CRISTAL
(revised) 1985 - which are meant to replace TOVALOP and
CRISTAL respectively.

PLATO - Pollution Liability Agreement among
Tanker Owners - is the creation of the oil industry and
its intent appears to be the reduction of the liability
of the oil sector, at the expense of the ship owner.
PLATO had been given a deadline of March 31, 1986, by which it must have had at least 50 million gross registered tons (grt) in tanker tonnage in order to become effective by June 1, 1986. Failure to achieve the March target would have meant the termination of the CRISTAL agreement by June 1, 1986. This is the stand taken by the oil industry. On the other hand, there has been strong resistance to the revised agreements from both the independent tanker owners, whose support is necessary if they are to come into force, and the Protection and Indemnity (P&I) Clubs.

As at October 1986, the date of the preparation of this document, PLATO has not received the required tonnage to come into force, but the oil companies have decided to retain the status quo temporarily until discussions are held in November 1986.

2.3 THE TECHNICAL ASPECT

After the negotiations resulting from the TORREY CANYON incident had been concluded, the attention of the maritime community was turned to solving the ever-present problem of operational pollution from ships.

In 1954, the International Convention for the Prevention of Pollution by Oil (OILPOL) was adopted at a Conference called by the United Kingdom. The Convention was amended subsequently in 1962, 1969 and 1971, each time under the auspices of the International Maritime Organisation (IMO). However, by 1973, it was generally
felt to need substantial improvement and extension. The problem with OILPOL was mainly, no mechanism for proper enforcement of its provisions. Too much was left to the discretion of the flag state. Thus in 1973, a new Conference was convened by the IMO, at the end of which a new Convention was adopted - the International Convention for the Prevention of Pollution from Ships (MARPOL '73). The Convention itself, was amended by a Protocol in 1978 and is now known as MARPOL '73/78.

2.3.1 MARPOL '73/78

This Convention covers all the technical aspects of all kinds of pollution from ships and applies to all ships of all types, including fixed or floating platforms. It does not extend, however, to pollution resulting from drilling activities.

While it retains much of the specifications carried in OILPOL, it goes further in demanding stricter regimes in operational discharges from ships. It designates "special areas" where discharges of oil are completely prohibited except under minor, well-defined conditions. The definition of oil has been broadened to include petroleum in any form, including crude oil, fuel oil, sludge, oil refuse and refined products.

The Convention has 5 Annexes which attempt to regulate different forms of pollution:

Annex 1 - Oil
Annex 2 - Noxious liquids carried in bulk
Annex 3 - Harmful substances carried in packages, portable tanks, freight containers, road or rail tank wagons

Annex 4 - Sewage from ships
Annex 5 - Garbage from ships

Annex 1 is compulsory and must be ratified at the same time as the main Convention. Accidental pollution is also covered in the Protocol and limited as far as possible, through requirements for protectively located segregated ballast tanks.

MARPOL '73/78 is widely regarded as the most important instrument of its type so far adopted. Not only does it specify improved ship and shore techniques and technology in the loading, unloading and transport of oil, but it also provides strict mechanisms for monitoring and control of these specifications. It has effectively shared jurisdiction and enforcement between the flag state and the coastal state, thereby ensuring that the provisions of the Convention are met. Ratification of MARPOL is, therefore, important not only for shipowning countries, but for port states as well.

2.4 THE ADMINISTRATIVE FRAMEWORK

The main administrative organisations in the international regulation of marine pollution are:
- the International Maritime Organisation
- the United Nations Environment Programme

These organisations perform their regulatory roles through the administration of various Conventions dealing with the subject. Each has a unique role to
play. UNCLOS III is an umbrella organisation which oversees the use of the marine environment by all competing interests. The IMO's portfolio is to ensure "clean seas and safe ships" while UNEP is principally interested in the implementation of programmes on a regional basis, which would achieve both interests—a balanced use of marine resources in an environment of clean seas and safe shipping. There are other bodies involved in the work of pollution prevention and regulation but they are more regional in scope and, therefore, will not be dealt with in the context of this chapter.

2.4.1 UNITED NATIONS CONFERENCE ON THE LAW OF THE SEA

The Law of the Sea Conferences are temporary United Nations bodies convened under the authority of the General Assembly, to redraft as necessary, the basic "constitutional" law of the oceans. At these conferences the multiple uses of the sea are considered, and attempts made to regulate them in an internationally accepted manner to establish some sort of order and an awareness of their responsibilities among the users.

The last Law of the Sea Conference was held over the period 1973 to 1982. The treaty instrument resulting from these conferences is called the United Nations Convention on the Law of the Sea. It has not yet come into force. However, because it incorporates many older Conventions e.g. pertaining to the Continental Shelf or to the High Seas, many aspects of it are already incorporated into international maritime law and practice.
When it comes into force, this treaty will be the single most important treaty in the administration of the marine environment. It is important because it is by far the most comprehensive Convention on the regulation and coordination of the uses of the sea by all the interested parties. Though it recognises and supports the work done by antecedent Conventions, it goes beyond their combined efforts and attempts to strike a balance among the varied interests of all users of the oceans.

It deals with the allocation of jurisdictional rights and duties among states and not with the specifics of implementation. Consequently, the Law of the Sea may be termed an "umbrella" Convention, with all other Conventions concerning the marine environment being subordinate to it. The Convention was adopted in 1982.

Section XII of the Law of the Sea Convention deals specifically with the protection and preservation of the marine environment. The section begins with Article 192 which sums up the general obligation of parties to this Convention in the following way:

"States have the obligation to protect and preserve the marine environment."

It thus makes the protection and preservation of the marine environment no longer a matter of choice, but a legal obligation. In addition, Articles 193 and 194 go on to recognise the sovereign right of states to exploit their natural resources but always subject to their duty to protect and preserve the marine environment, and to
ensure that activities under their jurisdiction do not cause pollution damage to other states or otherwise spread beyond the marine areas under their jurisdiction.

Under the Law of the Sea, parties to the Convention are expected to issue regulations and standards for equipment and installations used in exploration or exploitation of the natural resources of the sea bed and subsoil, to ensure the safety of both the users and the environment. Article 194 (5) also requires that measures taken shall also include those to "protect and preserve rare and fragile ecosystems, as well as the habitat of depleted, threatened or endangered species and other forms of marine life."

Of particular interest to this subject, is the balance achieved in the Convention, in the distribution of rights and obligations in Articles 217 to 220, among the coastal, port and flag states, to ensure the enforcement of international as well as national laws and regulations concerning the protection and preservation of the marine environment.

All in all, Part XII represents a general framework for a legal regime which establishes on a global, conventional basis, the obligations, responsibilities and most important, powers of states, in all matters of marine environment protection. Under this regime, states no longer have a freedom to pollute - not even their own waters. Even though the Convention is not yet in force, a state, on becoming party to the Law of the Sea immediately undertakes two specific tasks. First, there is the undertaking to fulfil its obligations assumed under the Convention, by ensuring that its
national laws and regulations reflect such obligations. Secondly, there is a need to ensure that the state is also party to all the relevant International Conventions to which the Law of the Sea Convention makes indirect reference, since these provide the standards for its implementation.

2.4.2 INTERNATIONAL MARITIME ORGANISATION

The International Maritime Organisation (IMO) represents the most important regulatory organisation in the international regulation of marine pollution. The Convention establishing IMO was concluded in 1948 and came into force 10 years later. The principal objectives of the Organisation are safety and pollution prevention, as stated, interalia, in Article 1 of its Convention:

- "to provide machinery for cooperation among governments in the field of governmental regulations and practices relating to technical matters of all kinds affecting shipping engaged in international trade.
- to encourage the general adoption of the highest practicable standards in matters concerning maritime safety and efficiency of navigation and the prevention and control of marine pollution from ships.
- to deal with legal matters related thereto."

There are four Committees through which IMO gets most of its work done - Maritime Safety Committee, Legal Committee, Marine Environment Protection Committee and Technical Cooperation Committee. The names of the committees describe quite accurately, their spheres of
activity. The two which are of greatest interest to this topic are the Marine Environment Protection Committee and the Technical Cooperation Committee.

A) MARINE ENVIRONMENT PROTECTION COMMITTEE

This committee evolved out of a sub-committee on marine pollution which was once subordinate to the Maritime Safety Committee. It was made a full Committee of the IMO in 1973 more or less as a result of all the work generated in IMO by the TORREY CANYON incident. The Committee is directly responsible to the Assembly and is open to all members of the Organisation.

The Marine Environment Protection Committee (MEPC) is concerned with the environmental aspects of shipping and all facets of MARPOL implementation. It also coordinates pollution control activities between IMO and other agencies.

B) TECHNICAL COOPERATION COMMITTEE

This committee was created in 1969, in response to the growing desire of the developing countries for technical assistance for their shipping industries. The main thrust of projects funded under the sponsorship of this Committee, is the improvement of safety standards, pollution prevention and increased awareness in the maritime administrations. The work of the Committee is funded by the United Nations Development Program (UNDP), the United Nations Environment Programme (UNEP), and a system of "funds-in-trust".

2.4.3 UNITED NATIONS ENVIRONMENT PROGRAMME

The United Nations Environment Programme (UNEP)
was created out of the United Nations Conference on the Human Environment which was held in Stockholm in 1972. All forms of pollution including marine pollution were discussed and it was agreed that due to the lack of effective coordination at both national and international levels, not much headway was being made in the field of pollution prevention. It was therefore decided that a new intergovernmental body should be created for the purpose of coordinating the actions of existing United Nations agencies. This was called the United Nations Environment Programme (UNEP).

The Regional Seas Programme of UNEP was initiated in 1974. Subsequently, the Governing Council of UNEP has endorsed the regional approach to the control of marine pollution and coastal ecosystem management. The Regional Seas Programme is an action oriented programme, comprising a comprehensive transectoral approach to marine and coastal areas and to environmental problems, concerning the causes and consequences of environmental degradation. Each programme is specially designed for the specific region to which it refers. The governments of the relevant regions are involved in the programmes, beginning with the formation of the Action Plan and continuing throughout all aspects of its implementation. UNEP usually fulfils the role of coordinator.

For purposes of the Regional Seas Programme, the world has been divided into 10 regions, of which one covers the Wider Caribbean Region. The Action Plan for the Caribbean Region was adopted in 1981, but is not yet fully operational. The coordinating centre is sited in Jamaica.
2.4.3.1 The Caribbean Action Plan

The Caribbean Action Plan has been formulated to suit the requirements of the Wider Caribbean, which it defines as "the insular and coastal states and territories of the Caribbean states and territories of the Caribbean Sea and the Gulf of Mexico, including the Bahamas, Guyana, Suriname and the French Department of Guiana, as well as the waters of the Atlantic Ocean adjacent to these states and territories."

The principal objective of the Plan is to assist Governments in minimising environmental problems through assessment of the state of the environment and development activities in environmental management. Activities under the Plan usually concentrate on the coastal areas with special reference to interaction among terrestrial, coastal and marine ecosystems. Components of the Action Plan may be listed as:

- Environmental Assessment, which would assist national policy-makers to manage their natural resources in a more effective and sustainable manner.
- Environmental Management, to be undertaken along with the assessment programme by designated national institutions.
- Environmental Legislation, by which the commitment of Governments to manage their common environmental problems, individually and jointly, will be expressed and measured.
- Institutional Arrangements, which are decided upon by the regional Governments and are necessary for the planning and
monitoring of activities.

- Financial Arrangements, although the initial funds for establishment of the Plan may be provided from the UN to its agencies, regional governments are expected to gradually assume full financial responsibility.

With respect to the problem of pollution of the region by oil, the Action Plan includes specific projects for assessment of the origin and magnitude of existing hydrocarbon pollution and the potential effects of future exploration and exploitation. The effect of oil on coastal ecosystems and fisheries will also be examined, as well as the ability of national and regional institutions to deal with spills of oil and other hazardous substances. The accent is on prevention, rather than cure.

Two regional agreements for the protection and development of the marine environment of the Wider Caribbean region have also been adopted under the auspices of UNEP in 1983. They are the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region also known as the Cartagena Convention and the Protocol concerning Cooperation in combating Oil Spills in the Wider Caribbean Region. The Convention is a comprehensive umbrella agreement for the protection and development of the environment. It lists the sources of pollution which require control and also identifies environmental management issues for which cooperative efforts are to be made. Apart from the Protocol on Oil Spills, there is scope for additional Protocols to be developed in the future. Under the Convention, no state may become a
contracting party without also ratifying at least one Protocol. It should be noted that, to date, Trinidad and Tobago has neither signed nor ratified the Convention.

2.5 SUMMARY

It would be true to say that the subject of pollution and in particular, oil pollution has been occupying the full attention of international environmental fora over the last few decades. Oil has been singled out, because it was the risk represented by the transportation of oil, in hitherto unimaginable quantities, in supertankers at the beginning of the 1950s which ushered in the age of marine environmental concern.

All these Conventions and organisations play an important part in the pollution protection they offer member countries. Some offer compensation regimes for possible damage in an incident; others - MARPOL, for example - provide for acceptable technical operating standards for ships operations; IMO offers a forum for open discussion of international problems and the possibility of a solution acceptable to all.

It is up to countries like Trinidad and Tobago to derive the full benefit which membership in organisations such as IMO and UNEP may bring, through its active and meaningful participation in the work of these organisations.
(1) The AMOCO CADIZ, a super tanker of 232,182 dwt and fully laden with a cargo of crude oil, ran aground off the Brittany Coast of France, in March 1978 spilling her entire cargo. The incident was caused by a failure in the steering gear. The coasts affected were the same which had suffered in the TORREY CANYON incident in 1967.

The pollution damage caused by this incident is unrivalled in the history of ship-generated pollution running into millions of dollars, and the case for compensation is still being heard in the American courts.

The incident has had many implications for international maritime law and practice.
chapter 3

the case of trinidad and tobago
3.1. BRIEF OVERVIEW

The Republic of Trinidad and Tobago is a unitary state composed of two islands which lie at the southern end of the Caribbean chain. Trinidad is situated just about seven miles off the coast of Venezuela, at the mouth of the Orinoco River, while Tobago is approximately twenty-one miles to the North East of Trinidad. The total area of the two islands is 5,128 square kilometres.

Oil was discovered in Trinidad in 1866, but commercial production did not begin until 1908. Following the discovery of oil, several small companies were formed to prospect for the mineral. Oilfields were developed at various locations in the south-western portion of the island and by 1913 - 14 the oil industry was well established.

There was continued growth and expansion of the industry during the war years. After World War II, innovations in the fields of geophysics and other sciences led to the discovery of marine fields. In 1954, the first commercially viable of these fields -the Soldado Marine Field- was located off-shore in the Gulf of Paria. Oil production on the East coast of Trinidad began in 1972. Today, these are the most productive marine fields, having produced so far, over 450 million barrels of oil.

There are six operating companies in Trinidad, producing an average of approximately 164,000 barrels of oil per day. About 80% of the total production comes from the
marine fields - principally those off the East coast. Petroleum activity is centered in two main regions; - land areas in Trinidad - marine areas around Trinidad

As may be seen from figure 2, the oil bearing soil structures of Trinidad are located principally in the southern portion of the island, where the major oil accumulations exist. In the marine areas around Trinidad, both oil and natural gas are mined. The principal oil bearing areas are the Atlantic Province and the East coast in which the largest producing fields are located and the Gulf of Paria on the West coast. (1)

Geologically, Trinidad is part of the South American mainland. The island actually sits on the continental shelf of the mainland and this may account for the fact that oil is found in Trinidad and its surroundings waters, but not in Tobago.

In the early years, the economy of Trinidad and Tobago was based on the production and export of such traditional agricultural crops as sugar cane, cocoa, coffee. Gradually, as the world demand for oil and its products grew, agriculture was superceded by the oil industry as the mainstay of the economy.

Over the last few decades in particular, relatively rapid economic growth has been accompanied by substantial structural change. This has resulted in a modern, diversified, semi-industrial economy supported by a vigorous rapidly expanding petroleum sector. Currently the petroleum industry accounts for approximately 24% of the Gross Domestic Product of Trinidad and Tobago - the most
Figure 2  Source: Ministry of Energy and Natural Resources
Republic of Trinidad & Tobago
significant sectoral contribution. Additionally, this sector accounts for over 60% of visible trade and is the major earner of foreign exchange for the country. (2)

Trinidad, then, faces the direct risk of pollution from oil exploration, refining and exploitation activities, as opposed to Tobago which is not actively involved in the mining of oil and the oil industry. However, the passage of tankers and other types of shipping off the shores of both islands, represent just as great a risk of pollution from oil - both accidental and operational. Figures 3 - 5 indicate the high risk oil spill zones in the Caribbean on the basis of offshore drilling, through shipping and port approaches and is of interest here. It will be noted that in each case, Trinidad and Tobago is included in the areas of greatest risk.

3.2 SOURCES AND RISKS

The main sources of oil pollution in the waters around Trinidad and Tobago may be listed as:
- Offshore operations
- Refinery operations
- Run-off from garages, gas stations and other land-based sources
- Passing tankers and ships
- Natural seeps

Because very little research has been done into the quantifying of these inputs, this list does not indicate any from of ranking.
3.2.1 Offshore Operations

Offshore drilling operations are carried out in the Gulf of Paria, near the south-western peninsula of Trinidad and in the extreme south-eastern corner of the island on the Atlantic coast. By its very nature, offshore drilling will pollute the environment regardless of the precautions taken. These may influence the quantities of oil escaping, but not completely prevent the intrusion of oil into the marine environment. In addition, well blowouts pose a constant occupational hazard, as do the risk of pipeline leaks and ruptures.

In order to measure the full effect of offshore operations in the areas where the wells are situated, it would be necessary to know the conditions which existed before the commencement of the drilling operations. However, some idea may be obtained even today, by comparison of the drilling area with its surroundings.

3.2.2 Refinery Operations

In Trinidad, refinery operations began around 1912, when the first refinery was established at Point Fortin. Today the main refinery operations are at Pointe-a-Pierre, with a rated crude distillation capacity of 350,000 barrels per day and Point Fortin, with a rated crude distillation capacity of 100,000 barrels per day. These refineries are export oriented, with main exports being fuel oil, motor gasolines and napthas. (3)

Both refineries are situated on or near the coast and are presumed to discharge their effluents directly into the water courses and rivers. The reasons for this
presumption are first, because of the unavailability of information on the subject and second, because of the very obvious effect of the Pointe-a-Pierre refinery on the Guaracara River. The river, which runs through the refinery area, is dead—no life exists in the river or on its banks. It is also very susceptible to fire, because of the amount of oil which floats on the water at all times.

The refineries use, as many older refineries, sea water for their cooling process on a once-through basis and then return it to its source. Apart from the use of a gravity separator, very little attention may be paid to the oil content of such water. In addition, open cachment systems for oil spillage from tanks and other operations, which are prone to overflow during flooding and heavy rains, are used. A look at the physical situation of the refineries indicates that they are perfectly sited for the discharge of effluents directly into the Gulf.

Moreover, the tankers calling at these refineries, present another major hazard to marine life in the Gulf, as well as along the North coast of Trinidad and even to Tobago, since there are several opportunities for mishaps or accidental discharges in their journey to and from the refineries.

3.2.3 Run-off from Land-Based Sources

Land based sources include garages, service stations and similar facilities which may be considered the most minimal source of oil into the sea, and therefore, of negligible importance. This is not necessarily the case. In aiming for a clean environment, all sources must be considered and their impact on the environment measured. The
significance of this source is the fact that:
- the oil normally enters the sea through rivers and water courses, thereby affecting the very delicate and important ecological systems found at the estuaries and mouths of the rivers;
- it is generally lubricating and fairly persistent types of oil which because of chemical additives, are difficult to be used or broken down, even by oil consuming bacteria of the benthic communities which form a major part of these systems;
- it is a form of chronic pollution which is even more damaging to the environment than accidental spills, which will occur only occasionally.
- as the vehicular traffic increases in the country, so would the size and influence of this form of marine pollution.

It is therefore necessary to institute research into this area, to investigate and assess the quantities of oil which enter the marine environment and its effect.

3.2.4 Shipping

Shipping in general and tankers in particular, present another major source and risk of oil pollution in the marine environment. Trinidad and Tobago are situated in a region which is heavily trafficked by oil tankers on their way to and from the refineries of the Caribbean region and Gulf of Mexico. Figure 6 shows that some of the most used routes lie between Trinidad and Tobago, in what is known as the Trinidad and Tobago Channel, or pass very near to the islands. There are also those tankers which call regularly at the refineries on the West coast and the production fields off the South East coast of Trinidad, placing almost
Figure 6: Major and minor sea lanes through the Caribbean with prominent ports of entry and airports. Source: Caribbean Data Atlas
the entire coastline of the island at risk. The coastlines of both islands are extremely vulnerable because of the fishing resources, nurseries, coastal wetlands, coral reefs, bathing beaches, wild life sanctuaries and other amenities which are all found along these coasts.

Probability became frightening reality in 1979, when two fully laden supertankers -the AEGEAN CAPTAIN and the ATLANTIC EMPRESS- collided in the Atlantic, off the coast of Tobago. The collision released the biggest oil spill ever recorded and it was simply a combination of fortuitous circumstances, which prevented the oil from being stranded along the coasts of Tobago and/or Grenada.

Apart from the problems posed specifically by tankers, there is the perennial problem of the discharge of dirty ballast and other oily water mixtures arising from ships operations. While these discharges threaten mainly the North and East coast of Trinidad, Tobago is totally exposed on all sides.

Finally, there are the Port activities, such as bunkering, which inevitably allow for additional leakage of oil into the sea.

3.2.5 Natural Seeps

This has been a documented phenomenon occurring on the East coast of Trinidad ever since 1797, the date of the first recorded report. The problem today, is to ascertain to what extent the stranded tar found on the beaches of the East coast, is the result of naturally occurring seepage, or the result of spills - either from passing ships and/or
off-shore operations in this area.

3.3 VULNERABILITY

Having identified the possible sources of oil in the marine environment of Trinidad and Tobago, the two types of pollution represented by these sources may be categorized as:

- operational, i.e. from the operations of the oil industry
- accidental or occasional

The two categories exact a different kind of response from the environment. Operational pollution is constant and insidious and can cause irreparable harm to the living resources of the marine environment. This is the kind of pollution caused by operations in the oil industry, whether offshore or refinery operations, or by deballasting operations from passing ships and tankers.

Accidental pollution on the other hand, caused for example, by tanker collisions or well blowouts, may be dramatic and appear totally devastating at the time of the event, but these incidents are exceptional. In such cases, though the environment suffers in scale with the incident, except for the very fragile ecosystems which may be totally annihilated, there is the possibility of recovery, even if total recovery may take as long as 10 or 15 years.

Trinidad and Tobago's vulnerability to oil pollution is being examined, therefore, from the standpoint of both accidental and operational pollution.
3.3.1 Physical — Trinidad

The Gulf of Paria separates Trinidad from Venezuela. It is a semi-enclosed body of fairly shallow water with two outlets — one to the Caribbean Sea and one to the Atlantic Ocean. The Gulf provides some of the most productive commercial and recreational fishing grounds in the area and is used by fishermen from both countries. Fishing is particularly good all along the central and southern Gulf region, between San Fernando and Icacos.

Because of its fairly protected location, the Gulf lends itself to many varied recreational uses, such as sailing, swimming and wind surfing. The major industries in the country are located along the Gulf coast of Trinidad, as are all the major ports of the island. There are also numerous housing developments either planned for, or in the process of being constructed along the Gulf Coast. Consequently, it may be considered a location of fairly intensive coastal development.

A coastal classification of the area describes the shores stretching from the Caroni Swamp to Pitch Point, La Brea as mud flats, while along the shores can be found coastal wetlands, the most well known of which may be the Caroni, South Oropouche and Roussilliac Swamps.

The susceptibility of these shores to pollution from oil is given in a preliminary study carried out by the Institute of Marine Affairs (IMA) in Trinidad, in 1982. An excerpt of the report is attached as Annex I. It may be observed that the shores of the Gulf can be generally classified as Index 5, i.e. fairly vulnerable, and in some cases Index 9 i.e. extremely vulnerable.
In a paper presented by Mr. John Agard of the IMA, to an Oil Spill Control seminar in 1983, in Trinidad, the sensitivity of the coastline of Trinidad and Tobago to spilled oil was discussed. While this paper was adequate, more detailed, scientific studies need to be undertaken in order to determine precisely, the degree of vulnerability of the coasts. These studies would have to include an assessment of:

1) RISK. Due to the fact that:
   - it is the site of much offshore drilling which takes place in the southern Gulf area
   - it contains the most frequently used shipping routes into the ports of Trinidad, all of which are situated along that coast;
   - the two refineries as well as numerous other industries are situated along the island's West coast.

2) FACILITIES AFFECTED. For example:
   - fishing grounds
   - wild life sanctuaries
   - marine ecosystems
   - recreational usage

3) COST OF CLEAN-UP/RESTORATION OF AFFECTED AREAS. Taking into consideration such special areas as coastal wetlands, the cleaning of which may be quite difficult.

The North Eastern coasts of Trinidad are characterised by exposed steeply dipping or cliffed rocky headlands. They are described as high energy environments with intense wave action. The area is also a high risk zone, because of the Trinidad and Tobago channel situated between the two
islands, which is used as a shipping lane to the Caribbean Sea. However, the physical attributes mentioned above may make it difficult for oil to be stranded on-shore and even if it is, would allow it to be naturally washed away, quite easily.

In any case, there is a cost to the environment, and it will have to be evaluated in reaching an estimate of the area's vulnerability, especially bearing in mind its touristic value.

The East and South coasts have to be similarly assessed, bearing in mind that the most productive oil fields are situated at the south-eastern corner of the island. In addition, the natural seepage of oil occurring off the East coast, must be taken into account since this may encourage greater laxity in anti-pollution supervision, as oil in the environment can be blamed on the seeps.

Other factors which must be considered in this preparation of a vulnerability index include:
- wind speed and direction
- current flows
- tidal patterns
- circulatory patterns of the Gulf of Paria
- renewal time for the water in the Gulf.

3.3.2. Physical - Tobago

The island of Tobago does not face exactly the same risks as Trinidad, with respect to pollution of its marine environment. As stated before, Tobago does not participate actively in the production or refining of oil.
Consequently, the main sources of oil in Tobago's waters would come from:

- the bilges of passing ships and tankers
- run-off from land based sources such as garages, gas stations etc.
- collision between tankers
- a well blowout of great magnitude in the fields off the South East coast of Trinidad

It may be concluded therefore, that there is very little, if any, chronic pollution in the waters around Tobago. The biggest threat of oil pollution to the island will come from single incidents occurring off its coasts. The coastal classification map at figure 7 gives an idea of the island's vulnerability to oil spills. It can be noted that the coastline of the island is quite mixed and, in most cases, draws a protection priority of 1 or 2, where 1 is equal to high priority and 3, low priority.

As with Trinidad, there are the other factors of wind speed and direction, current flows, tidal patterns, etc., which are important in the preparation of a proper vulnerability index. It may even be said that for Tobago, these factors are more important, since they represent the only means by which oil may reach the shores of the island.

3.4 LIVING RESOURCES

Yet another important aspect of vulnerability to oil pollution which has to be taken into account, is the biological aspect i.e. the impact of oil on the living
resources in the marine environment.

The Norwegian Nature Conservation Act defines the basic goal for a pollution control policy as the maintenance of quality and biological productivity of nature. This is particularly applicable to the marine environment, where life generally depends on the maintenance of ecosystems in balance.

Some of the most important ecosystems in the tropical region may be found in mangrove swamps. The importance to the marine environment of the mangrove swamp, cannot be overemphasized. They provide nurseries and feeding grounds for commercially important species of fish and crustaceans. Their roots and lower trunks support a variety of crabs, oysters, barnacles and other invertebrates. Mangroves protect shorelines and river banks from erosion and generally assist in land reclamation. They offer protection from siltation to coral reefs, which may be generally found growing beyond the mangroves. The area of the mangrove swamp is richer in nutrients than the land or sea around them and this contributes to their fertility.

To date, very little scientific research has been conducted to assess the effects of oil on mangroves. It has been observed, however, that in the short term there is likely to be high mortalities of turtles, invertebrates and fish in the event of a spill. In the longer term i.e. over 5 years, the oil may weather comparatively quickly and recolonisation of both mangrove and invertebrates has been observed. (4) In cases of chronic pollution, it has been found that mangroves are irreparably destroyed.
The treatment of oil in mangrove swamps is also difficult due to the type of soil found there. The nature of the mangroves automatically rules out the use of dispersants and/or manual methods of collection. The use of dispersants, even those which are very slightly toxic, may cause great harm to the communities of marine life within the swamp. It can also smother the breathing pores of the mangroves themselves, causing widespread death among trees. Manual collection, because of the tangle of roots, the mud, etc. may cause more destruction than solve the problem. In other words, with these systems prevention is better than cure.

Both Trinidad and Tobago possess extensive areas of mangroves. In Trinidad, the Caroni Swamp has the biggest acreage, but there are also important areas in the Oropouche and Nariva/Mayaro Swamps. During the last decade or so, the productivity of the Caroni Swamp has been affected by certain practices which have led to increased pollution, often by oil. The effect of continuous spillage in these areas, as well as preventive measures which may be employed, need to be investigated and utilised.

In Tobago, the mangrove complex at the south western point of the island, provides protection for the Buccoo Reef - the island's most extensive reef system. The Bon Accord lagoon, as it is known, is representative of an oceanic mangrove community with predominant vegetation being the red mangrove. The roots act as suitable substrate for oysters, sponges, algae and corals. Among the roots are found conch, crabs, shrimps, snails and other microorganisms. The aerial parts of the mangrove provide good roosting for sea and land birds. The entire lagoon serves as
a nursery for several species of commercial and sport fish, by providing the juveniles with food, cover and protection. The lagoon is crucial to the maintenance of the physical stability and productivity of the land/sea interface, inclusive of the reef.

Other resources which are also at risk, if the marine environment becomes polluted by oil include the wildlife sanctuaries situated on offshore islands, such as Soldado Rock, St. Giles Islands and Little Tobago. The St. Giles Islands supports one of the most important sea bird breeding colonies in the southern Caribbean, especially with reference to the larger species of birds, such as the Magnificent Frigate bird and the Red-footed Booby. Except for Soldado Rock, which lies almost in the middle of the offshore marine fields in the Gulf of Paria, the greatest threat to these sanctuaries would be from an incident of accidental pollution – either a tanker collision or a well blowout. In the case of the Soldado Rock sanctuary, the effect, if any, of chronic pollution on the inhabitants of the Rock would have to be evaluated, in any calculations of the island’s vulnerability.

3.5 ECONOMIC RESOURCES

The economic resources which may experience detrimental effects as a result of marine oil pollution are chiefly fishing and tourism. In neither case can it be said that the industry is flourishing, yet, properly rationalised and exploited, they both have the potential to become important earners of foreign exchange, as well as important employment generators.
3.5.1 Fishing

Fisheries may be considered as one of the primary economic resources of Trinidad and Tobago, although as an industry, it is yet to receive the benefit of proper rationalisation. By rationalisation, I mean that such areas as:

- size of fish stocks
- recruitment rate of stocks
- spawning grounds
- reasons for seasonal fluctuations (if any)
- optimum fishing rate to avoid depletion of stocks

need to be thoroughly researched in order to provide a basis for the careful regulation of the industry.

In his 1985 Budget Speech, with reference to Agriculture and Fisheries, the Prime Minister of Trinidad and Tobago made the following statement:

"The process of adjustment necessarily involves removing bottlenecks in the production of those goods and services where as a nation we have basic resources which can be utilised effectively"

In the "Review of the Economy" for 1985, there is also the statement made that commercial development of an island fisheries industry based of aquaculture, is being actively pursued. It could be argued that, directly related to these two comments, is the question of the environmental conditions under which these activities will be conducted. It is necessary at this time of review and revitalisation of the fishing industry, to examine its relationship vis-a-vis the oil industry and to determine their competing demands for use of the marine environment.
The Gulf of Paria is utilised in its entirety by both local fishermen and their counterparts from neighbouring Venezuela. Based on information received from the Ministry of Agriculture on landings, the Gulf is a very productive area, with catches including the following species:

- Shrimp (Penacus and Xiphopenaeus)
- Sea trout (Cynoscion)
- Croaker (Micropogon)
- Snappers, Groupers (Charcarinidae)
- Carite (Scomberomorus Brasiliensis)

Fishing also takes place along the North and East coasts of Trinidad, up to about 10 nautical miles from the shore. Methods employed are beach seining, bottom lining, fish traps and gill netting, most of which are susceptible to fouling by oil.

In Tobago, because of its lower risk exposure to operational pollution, the problem is not as acute as it may be in Trinidad.

3.5.2 Tourism

The tourist industry is another under exploited, potential earner of foreign exchange, which in these days of the declining role of the oil industry, must begin to assume greater importance. Apparently, in recognition of this fact, the Government of Trinidad and Tobago has undertaken several projects with the intention of improving infrastructure in the industry. To quote again from the 1985 "Review of the Economy":

"To this end, a number of projects were pursued among which were the development of beach facilities at Manzanilla and
Vessigny and the continuing improvement of facilities at Maracas Bay for which an expenditure of $618,000 is estimated for 1985."

It also mentions that other facilities, such as the Gasparee Caves were reopened in March 1985, presumably after refurbishing.

While not all tourists may be interested only in sun, sea and sand, the vast majority visiting the islands is. Moreover, enjoyment of the sea and sea sports, such as surfing and pleasure boating, has in the last few years blossomed very widely among the residents of Trinidad and Tobago. The Five Islands off the north western peninsula of Trinidad, accommodate holiday homes, as well as island homes and provide many aquatic attractions for the numerous holiday makers, both local and foreign, who visit them. The Soldado Rock, also in the Gulf of Paria near the south western peninsula, is a declared wild life sanctuary, of interest to nature lovers and conservators.

All around the island of Trinidad, are bays and coves which are used as beaches and swimming resorts. The two mentioned above in the excerpt from the "Review of the Economy" - Manzanilla on the East coast and Vessigny, on the West - are both near enough to oil field operations to be influenced by them.

These are all facilities and amenities which are extremely susceptible to oil pollution. If the thrust into developing the tourism industry and the potential of the country is to continue, a careful examination of this industry and the potential hazards to it, which the oil
industry represents, must be initiated. It is not only recommended for the protection of Government investment, nor only for the attraction of foreign exchange, though both these reasons are of utmost importance. Consideration should also be given to the fact that, in making investments which encourage local tourism, the outflow of foreign exchange to other holiday resorts in the region, will be somewhat reduced.

3.6 SUMMARY

It may be concluded that Trinidad and Tobago is extremely vulnerable to the risk of oil pollution, whether it is chronic, operational pollution or the less frequent, but quite possible incidents of accidental pollution. Trinidad, because of its participatory role in the industry, is more vulnerable than Tobago. How vulnerable, should not be a guessing game. It is necessary to calculate the risks, in order to be prepared for any eventuality. Thus far, Trinidad and Tobago has been unbelievably lucky in not having to cope with disasters such as a major well blowout on the scale of IXTOC I, for example, or the results of a tanker accident. The collision of 1978 gave only a preview of what can happen. It would therefore be advisable to heed the old axiom that forewarned is forearmed.

The information collected in the preparation of a vulnerability index may be used in two ways. It can provide part of the background information necessary for the preparation of a national contingency plan. It can also provide an idea of the effect of chronic pollution on the environment. The problem of chronic pollution must be addressed in
the final reckoning, if the marine environment is to be improved.

Trinidad and Tobago can no longer afford to ignore the effect of oil in its environment. At a time when oil is slipping from its once indisputable position as major income earner of the economy, there is need to find either substitutes or equal partners. Tourism and fishing can fill the role, if certain basic conditions are met. Chief among these must be a clean environment free from pollution, not only by oil but all other types as well.

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Chapter 4

The impact of oil in the marine environment
CHAPTER 4

4.1 FATE AND EFFECTS OF OIL IN THE MARINE ENVIRONMENT

Having identified the probable sources of oil in the marine environment and the resources which may be affected by it, an examination of the fate and effects of oil in the marine environment is necessary for an illustration of its possible impact. This chapter gives a brief overview of the general characteristics of oil in the marine environment, before discussing the probable effects of oil in the waters of Trinidad and Tobago.

4.2 CHARACTERISTICS OF SPILLED OIL (1)

Oil which is spilled at sea undergoes different processes from that which enters the marine environment through run-offs and effluent discharges. In the latter case the oil is dissolved or dispersed in relatively small amounts in the water and its appearance is rarely more obvious than a thin oily sheen, even though it may be more damaging. For this reason, chronic pollution is often ignored in favour of more dramatic incidents. The term "spillage", however, refers to quantities which are much greater - assessed generally in terms of barrels and/or tons. In spillage incidents, the oil is transformed through a series of processes collectively known as "weathering".
4.2.1 Weathering

The weathering of oil occurs at the air/water interface and in the water column, causing changes in the physical and chemical properties and falling into two successive steps - primary and secondary weathering.

Primary weathering predominates in the first days after the spill, due to the spreading of the slick and evaporation of light fractions under the action of the wind. Dissolution of the most soluble compounds, as well as the formation of reverse emulsions - water in oil - also occur. Some sedimentation takes place when the oil adheres to suspended particles. Primary weathering affects mainly the physical characteristics of the oil e.g. density, viscosity, without altering the chemical nature of the components.

Secondary weathering may last for several years on the already weathered oil. It involves the transformation of molecules by chemical or photochemical oxidation and microbial biodegradation.

4.2.1.1 Evaporation

This occurs within the first few hours of the spill and is a process whereby the most volatile fractions of the hydrocarbon compound are lost to the atmosphere. The rate of loss is determined by the meteorological conditions as well as the type of oil. This process can create a fire hazard in confined areas such as ports and harbours.

4.2.1.2 Dissolution and Natural Dispersion

These are two distinct processes leading to the
introduction of oil or some of its constituents into the water column. Dissolution involves mainly the light fractions, which are the most volatile, whereas dispersion may involve the whole product, which is distributed in the shallow water. The dissolved fractions are responsible for the major part of the impact on marine flora and fauna because of their inherent toxicity.

4.2.1.3 Emulsification

Reverse emulsions are formed by the incorporation of water droplets into the oil. The emulsion can contain up to 80% water and resembles a sticky, viscous, dark brown mass which is termed "chocolate mousse". The formation and stabilisation of reverse emulsions depend more on the chemical composition of the oil, than on environmental conditions. The formation of these reverse emulsions together with evaporation of the light fractions have a great effect on the viscosity of the spilt oil during weathering at sea.

4.2.1.4 Photochemical Oxidation (2)

This is a rather complicated process. For the purposes of this study, it is only necessary to indicate that it is the process whereby, in the presence of oxygen, oil subjected to the rays of the sun on the surface of the sea, undergoes certain changes. These changes degrade certain components of oil and render them more water soluble and subject to dissipation by solution and dilution.

4.2.1.5 Sedimentation

Sedimentation may take place in two ways:
Fig. 8 — Natural Forces Which Disperse and Modify Oil Slicks on Water (Garrett, 1972)

Source: "Oil Spills - their Fate and Impact on the Marine Environment" © Almqvist & Wiksell, Stockholm 1972.
by actual sinking, because of the increased density of the oil through the combined effect of evaporation and dissolution of the light fractions, photochemical oxidation and incorporation of water droplets and solid particles.

- by adsorption on suspended particulate matter and then depositing and accumulating in calm subtidal zones. This occurs mainly in coastal areas and estuaries where there is a high suspended matter content and affects finely dispersed and even dissolved hydrocarbons, rather than thick slicks or pellets.

In areas subjected to chronic pollution, hydrocarbon distribution has been observed in proportions of 1 in the water column, 10 at the surface and 1,000 in the sediments. Oil saturated sediments present two main risks. Affected sediments can gradually release the substances adsorbed, resulting in chronic pollution. Compounds directly associated with the sediments are more available for ingestion by benthic organisms. (3)

4.3 EFFECTS OF OIL POLLUTION

It appears that very little research has been done on tropical ecosystems and their response to oil pollution. In many cases, the data in this field has been acquired through observations on a "one-off" basis and through the drawing of parallels with temperate climate systems. There is, therefore, a pressing need for research to be done in this area.

The effects of oil pollution may be broadly categorised as:
- damage to marine life, mainly through the
toxic, noxious or tainting properties of oil
- damage to non-living resources.

In most cases, the effects of oil pollution can be assessed in economic terms - as a measure of revenues lost. There are, however, some areas e.g. lost recreational facilities, which cannot be costed monetarily, but which may carry social and other costs. The task of evaluating such amenities makes the exercise of preparing and rating a vulnerability index, a difficult proposition.

4.3.1 Damage to marine life

It should be noted that oil spilled in the open sea has a different effect on the environment from that spilled in coastal zones and estuarine areas. Except for areas of up-welling, the biological productivity of the open sea is very low. Moreover, adult fish have often shown the tendency to avoid polluted waters. Consequently, except for the threat to sea birds, oil on the open sea is only of danger to plankton.

Near-shore areas - coastal zones, estuaries - present a different problem. Generally, oil is most damaging to marine life in the coastal areas where the depths are shallower and water exchange is fairly restricted. These coastal areas are some of the most productive, because of the abundance of nutrients and penetration of light. The organisms which form the basis of the food chain - phytoplankton and zooplankton - bloom in the coastal zones, which serve as hatching, nursery and feeding grounds for many species of fish and shell fish.

It is in these areas that the effect of oil on
marine life can be lethal. The degree of damage depends on several factors:

- the type of oil i.e. crude, fuel, refined products
- degree of weathering
- species affected
- duration of exposure and quantities exposed to
- time of year i.e. spawning season, dormant state
- methods of clean-up used

Consequently, oil which is discharged in the coastal or estuarine environments, or which enters these environments before the volatile fractions are lost, can damage entire populations of marine life which inhabit these zones, either through toxicity or smothering.

Apart from the possible mortalities brought about by the toxicity in oil, another form of damage to marine life - fish specifically - is tainting. Oil ingested by the fish can accumulate in the flesh and oil-tainted fish is generally unmarketable. Moreover, the debate as to whether tainted fish is likely to be carcinogenic has not yet been resolved.

A) Trinidad and Tobago

In Trinidad and Tobago, as throughout the entire Caribbean area, coastal zone fisheries are particularly important. In the Caribbean area, upwelling - which is a process whereby the subsurface nutrient rich waters interchange with surface waters in the ocean - does not occur. Consequently, the open waters of the Caribbean Sea are quite nutrient poor, and the development of fisheries is
dependent, to a large extent, on the coastal zone. It is therefore important that these areas be constantly monitored with regards to pollution levels.

4.3.1.1 Coastal Wetlands and Coral Reefs

Scientific evidence for the effect of oil on these tropical ecosystems is practically non-existent, as most of the experimentation and research concerning the effects of oil pollution have been done in colder climates. Conclusions about these systems have, therefore, been based on observations and occasional experiments and extrapolations of information for somewhat similar temperate climate systems, such as salt marshes.

As emphasized earlier, coastal wetlands and in particular, mangrove swamps, as well as coral reefs are both environmentally and ecologically, very important ecosystems. They are generally found growing in association, and major damage from oil can be caused either from the effects on the inhabitants of these systems, or by smothering of the systems themselves.

According to Baker,(4) "an overall impression from the limited literature is, that acute short term effects of petroleum hydrocarbons are likely to be high mortalities of invertebrates, defoliation of mangroves and death of seedlings. In the longer term, oil is likely to weather comparatively quickly and both mangrove and invertebrate recolonisation have been observed." However, as she implies further on in the article, the study of the effects of oil pollution on mangroves is still too arbitrary for its conclusions to be unquestioningly accepted.
Information about the coral reefs is no more satisfying. A.H.Knap et al (5) indicate that field reports on the biological impact of oil pollution in reef areas range from the mass mortality of fishes and various invertebrates, to no apparent effect. They claim that the few reports which specifically refer to corals are also inconsistent, and that it may be misleading to draw conclusions from other studies based on short term or qualitative observations.

That having been said, it would appear that the short term effects include mortality in some species at very high concentrations of oil, while stress behaviour and reduced viability of larvae have been demonstrated at lower concentrations. Responses appear to vary with the species and type of oil. Little is known of the long term effects of oil on corals.

A) TRINIDAD AND TOBAGO

In Trinidad, there are extensive stretches of mangroves on both the East and West coasts which are placed at risk because of their juxtaposition to the offshore oil fields. Moreover, the Caroni Swamp which is the most well known and popular of the mangrove communities, is further threatened by its use as a route for the transportation of oil by barge, from the oil fields in the south of the island, to the storage tanks in Port-of-Spain. Already, the Swamp has begun to show signs of undue stress, through accelerated defoliation and the departure of some of the birds for healthier environments. In addition, very little if any work has been done with respect to the effect of the Amoco oil fields off the West coast on the Nariva Swamp. These are areas which need immediate attention in the very short term, since the ecological importance of these systems cannot be over emphasized.
In Tobago, while there is no direct risk from the oil industry, per se, oil is transported by barge to the island and then piped ashore by lines at the south-western tip of the island. This raises the question of possible barge accidents or pipeline leaks being disastrous to the Buccoo Reef, Bon Accord Lagoon, bathing beaches and hotel sites at Milford, Crown Point and Pigeon Point, the most high-priced tourist area in the island.

4.3.2 Damage to Non-Living Resources

The fouling of amenities and installations is another outcome of having oil at large in the marine environment. The effect may not be as lethal as the damage to living resources, but it can be just as painful for the economy, as well as social and recreational activities.

Fouling of amenities such as beaches and marinas, can mean an immediate reduction in revenues obtained from their use. This is in addition to the costs which will be incurred in the cleaning and refurbishing of such amenities for re-use. With regard to industrial installations, included in their clean-up costs must be the cost of shutting down machinery while filters and uptake devices are cleaned.

Even where it may be decided that no clean-up should take place, there may be costs incurred by the need to have the movements of the oil monitored to ensure that it did not affect other more sensitive areas.

In other words, even though it is not lethal, the effect of the fouling of amenities and installations is visibly unpleasant and may prove more costly to alleviate,
than damage done to living resources.

TRINIDAD AND TOBAGO

In Trinidad, there are several industries situated along the coast of the Gulf of Paria, which may use a salt water intake for their cooling systems. In addition, the city of Port-of-Spain has installed a very expensive salt water system for use by the Fire Department. In both Trinidad and Tobago, large sums of money will be spent on improving the infrastructure for the benefit of the tourist industry. Damage to these costly amenities must not be allowed to erode these investments.

4.3.3 Damage to the Economy

From the foregoing brief discussion, it may be concluded that the uncontrolled discharge of oil, from whatever source, is very costly. In the end, the sum total of all the costs adds up to damage to the economy of the affected country. The damage to the economy comes about from:

- lost revenues
- clean-up costs
- compensation payments - to those who suffer loss of income as a result of the incident as well as to those countries whose coastlines are affected
- indirect effects on other sectors of the economy e.g. the possible need to re-direct available resources to assist the clean-up programme.

In Trinidad and Tobago, where local tourism has begun to flourish somewhat, there may be the additional cost of currency outflows created by holiday makers going abroad
because of unavailable holiday facilities.

To fully appreciate the impact of oil in the environment, a complete assessment of costs must be undertaken. There are costs to the environment in the stress that it experiences; costs to the economy in resources lost, diverted, or suspended; costs to the society affecting the quality of life. In other words, pollution is costly and the prevention of pollution is costly. Ultimately, the Government and the society, together, must decide which costs represent the better investment.
REFERENCES

1. Most of the information used in this section has been adapted from "The Fate of Spilled Hydrocarbons at Sea" a paper written by Jean Pierre DESMARQUEST and delivered to students at the World Maritime University by Mr.G. Peigne in December, 1985.

2. "Oil Spills: their fate and impact in the Marine Environment" - a publication by the American Petroleum Institute for the OCIMF and the IPIECA.

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chapter 5

national regulation of oil pollution
5.1 THE LEGAL FRAMEWORK

Usually, one of the most important weapons in the fight against pollution is the law. To be effective, any measures taken must have the full support of national legislation.

As stated in Chapter 3, commercial production of oil first began in Trinidad in 1908. In the ensuing years since that date, many developments have taken place in the industry, including the discovery and exploitation of marine oilfields in 1954.

Before that date, however, the Government of Trinidad and Tobago had recognised the need to regulate the industry and had enacted the OIL POLLUTION OF THE TERRITORIAL WATERS ACT in 1951. Subsequently, the PETROLEUM ACT also made its appearance in 1969. These Acts deal with operational pollution and along with the National Oil Spill Clean-up Plan, which deals with accidental pollution, form the present framework within which the regulation and administration of anti-pollution measures in the oil industry take place.

5.1.1 Oil Pollution of the Territorial Waters Act (1951)

This Act was created in 1951 with the intention of making "provision against the discharge or escape of oil into the waters of Trinidad and Tobago". (1)
It allows the Harbour Master to appoint AT HIS DISCRETION, (my emphasis) a place where ballast water may be discharged. It establishes a penalty of $10,000 TT and imprisonment for 12 months for any act which allows the discharge or escape of oil into the territorial waters of Trinidad and Tobago. However, it also provides that reasonable forms of defence against the charges may be:
- collision
- damage or accident
- inevitability after all reasonable means of prevention have been taken.

This Act was drafted in recognition of the need to regulate ship generated pollution. This was three years before the discovery of commercially viable fields in Trinidad and Tobago, and long before the evolution of the super tankers. Consequently, pollution of the type experienced in the IXTOC I blowout in Mexico, or in the AMOCO CADIZ incident was neither dreamt of nor anticipated when this Act was drafted.

The Act, therefore, deals only with the discharge of oil due to accidents in ship operations, or collisions. To all intents and purposes, collision here did not even envision the release of several thousands tons of oil, but may have referred to mainly bunker fuel. This can be induced from Section 3 (1) which states:

"3 (1) If any oil is discharged, or allowed to escape into any waters to which this Act applies from any vessel, the owner or master of the vessel from which the oil is discharged or allowed to escape is liable................."
This obviously does not refer to spills of the size of AMOCO CADIZ and IXTOC I.

Section 3 is inadequate because it allows the Harbour Master the option of providing reception/discharge facilities for ballast water, but it does not deal with oily waste from engines. This creates two problems. First, no provision is made, as already stated, for oily waste which may be as harmful to the environment as dirty ballast. Second, even though it is only optional for the Harbour Master to provide a place of discharge for the ballast water, no alternative arrangements are mentioned for those cases where the option is not exercised. In such instances, ships calling at ports in Trinidad and Tobago, can be expected to dump their ballast and oily wastes, if not within the twelve mile territorial limit, near enough to influence it.

Moreover, Trinidad and Tobago are small islands with no traffic regulating systems. Unless a ship is calling at one of the country’s ports, there is no way of knowing which ship has released oil into the environment. In most cases, the ship may be long gone by the time the oil reaches ashore, and with no regulating system, it is practically impossible to obtain a list of the possible suspects.

Section 4 allows court proceedings to be instituted against the Master of the offending vessel, should it leave the country before the expiry of proceedings "at any time within two months next after the date on which he first returns to Trinidad and Tobago." If the MASTER never returns but the vessel does, what happens to the proceedings? More to the point is the fact that no fines can be levied, or costs recovered in such instances.

The whole intention of the Act is aimed at the
owner or master, instead of at the vessel as is customary in maritime law. If the vessel were made the offender, then it could be arrested and costs recovered. In fact, if Trinidad and Tobago became party to the CMI Convention on the Arrest of Sea-going Vessels, it could use the full power of the Convention more easily, to resolve problems of this nature.

An obvious omission in the Act, is the failure to deal with oil pollution of the territorial waters caused by refinery operations and other land based sources. In addition, no amendments appear to have been made to include pollution from off-shore installations. Both of these sources may cause more pollution and more harm to the environment than an occasional single incident from a passing ship.

5.1.2 Petroleum Act and Regulations (1969)

The Petroleum Act and Regulations are even less satisfactory. The expressed intention of the Act was the consolidation and amendment of the law relating to petroleum, so as to make better provision for the exploration, development and production of petroleum, and for matters consequential thereto. It focuses, therefore, on the application for and grant of licences, rights and duties and obligations of the Licensees. It does concede the need for the regulation of pollution in Section 29 - Miscellaneous and General - by stating:

"29 (1) The President may make such Regulations as he considers necessary or expedient for carrying out the purposes of this Act and in particular (j) for the prevention of pollution of land, water or air and for compensation therefor;"
The regulation of pollution must have been deemed to be not quite necessary nor expedient as, on the basis of these instructions, there is inserted in the Regulations created under the Act, in the section entitled "General Obligations":

"(A licensee shall) ensure that operations do not unreasonably interfere with other activities in the area and, in the case of operations in submarine areas, care shall be taken to avoid pollution of the seas, beaches or tidal rivers to ensure that navigation, agriculture, fishing, authorised scientific researches and conservation of the living resources of the sea are not unjustifiably hindered, and likewise that no damage is caused to submarine cables and pipelines."

It is my opinion that though the Act itself is quite imprecise, the Regulations do not follow the intention of the Act, which states that regulations may be made to provide for "the prevention of pollution of land, water or air and for compensation therefor". The Regulations simply request licencees in submarine areas to take care to avoid pollution of the seas, rivers etc. and to ensure that there is no "unjustifiable hindrance" to other users of the marine environment. There is no doubt as to which activity is given unquestionable priority.

In the Regulations, the term pollution is not defined and it is not clear whether it simply refers to oil, or includes such things as drillings, abandoned equipment etc. What is the criteria to be used in measuring pollution levels? Whose perception of what constitutes "unjustifiable hindrance" will be used as a measure of such hindrance?
These are all questions which may be raised on reading the Regulations. No mention is made of compensation for pollution damage. No safeguards or precautions are even mentioned with respect to the other users of the marine environment. There are no penalties mentioned as deterrents to polluting the environment. Worst of all, no mechanism for arbitration and settlement of any disputes which may arise between users has been outlined. In other words, except for a paragraph which pays lip service to the avoidance of pollution, the Petroleum Act and Regulations do not really pay much attention to the maintenance of an unpolluted environment. It is left up to the oil industry to interpret what is "unreasonable interference with other activities in the area".

In both Acts, the law appears merely to provide an outline for the further development of legal structures which would aid in the protection of the marine environment. However, in neither case does the law go far enough, and the oil industry has been left with the upper hand. Although this situation should never have been acceptable, in the heyday of the oil industry in Trinidad, it might have been understandable. Today, however, the position held by that industry has been slowly eroded and oil must now make room for others with potential for being equally important foreign exchange earners. These industries - Agriculture, Fishing and Tourism - are dependent upon a clean, unpolluted environment. It is therefore, time to bring these laws once more under the spotlight of adjustment and amendment.
5.2 THE EMERGENCY ASPECT

Although it appears that the legal aspect of pollution regulation has been more or less neglected over the years, some consideration has, at least, been given to the provision of emergency measures to cater for incidents of accidental pollution. In August 1977, a National Oil Spill Clean-up Plan was published.

5.2.1 National Oil Spill Clean-Up Plan

The stated objectives of this Plan are:
"to provide for a coordinated and integrated response to pollution incidents by:
(i) developing a cadre of locally trained personnel for cleaning up oil spills
(ii) stocking supplies of equipment and chemicals for this purpose
(iii) setting up reporting and communication systems" (2)

The Plan was designed to deal with spills of up to 20,000 barrels of oil, since this was assessed as the upper limit of risk. For spills of greater magnitude, external aid would be enlisted.

As a clean-up plan, it is adequate as far as it goes. As a contingency plan, however, it is extremely deficient. Its weakness lies in the narrowness of its conceptualisation, which may be a factor of insufficient background information. To be effective, a contingency plan must be based on, interalia:

1. An assessment of the spill risk probability which would give an idea of the level of risk coverage
necessary.

2. Knowledge of the resources at risk from oil spills. These would include amenity areas, ecologically sensitive areas, fisheries, wild life sanctuaries, marine mammals etc. The identification of resources which are most susceptible to the danger of pollution, backed up with the relevant maps and details and ranked in order of priorities for protection, is probably the key aspect in the adoption of a policy for spill response. Priority ranking can only be done after the assessment of the social economic and environmental value of these resources to the community has been undertaken.

3. Information with respect to normal environmental conditions - weather patterns, sea temperatures, tidal patterns, current flows etc.

4. Knowledge of the types of oil which are likely to be spilled and their behaviour under different environmental conditions. This is necessary because both Trinidad and Tobago are exposed to tankers transporting different kinds of oil, which traverse the Caribbean. In the case of Trinidad, different kinds of crude are actually imported for refining.

The Plan is also deficient in its lack of detail. This is evident, for example, in its treatment of Section 3 which is entitled "Marine Pollution". Section 3(a) lists the category of expected spills as ranging from 1M, which is equivalent of up to 500 barrels, to 4M which refers to spills of more than 20,000 barrels. It then goes on to say who will deal with which size of spill, as follows:

"Categories 1M and 2M should normally be handled by the organisation responsible
for the spill.
Category 3M will require the cooperation of other local agencies and oil companies
Category 4M will require external assistance, the Clean Caribbean Cooperative being the primary agency from which aid will be enlisted."

It is only for category 4M that an expanded explanation is given. It is absolutely necessary in a Plan like this, that participants know who they are, and what are their responsibilities, and this information should be clearly indicated to avoid misunderstandings at crucial moments. Thus, the "other local agencies and oil companies" which will cooperate in this venture, should be identified clearly. Other relevant questions which arise are – will all the listed agencies be expected to assist at the same time; by what means will all the listed agencies be notified that their assistance is required?

Similarly, with respect to categories 1M and 2M, spills of this size occur quite often in ports and bunkering areas, but may not be either the fault or responsibility of those organisations. In those cases, what will be the procedure? This also raises questions as to why organisations such as ports, companies providing dry-docking facilities and such other organisations are not included as members of this Plan.

Section 3(b), Methods of Treatment" reads:
"ALL SPILLS should be handled by the following steps:
(1) Locate and control the source of the spill
(2) Contain the spill if practicable
(3) Collect the major part of the spill

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(4) *Disperse the remaining oil* " (emphasis theirs)"

The Plan does not recognise that there are many different kinds of crudes and that each has different properties which would sometimes entail the need for different handling methods. Crude oils may roughly be divided into two groups—dispersible and non-dispersible. While Trinidad's crude may be categorised as dispersible, the treatment of non-dispersible oils must, nevertheless, be given consideration in a national contingency plan.

There is a modification allowed in the Plan for treatment of spills in "harsher environments" as follows:

1. Locate and control the source of the spill
2. Contain, if possible, the spill
3. Otherwise monitor and/or disperse the spill

There is no recommendation to collect the spill, but there is the possibility of dispersal. This is questionable, for if the environment is so harsh that collection is impossible, the likelihood is that the oil will disperse naturally under the prevailing conditions—i.e. through the action of wind and waves. On the subject of collection of oil, there is need to be familiar with what is available today. Ongoing research in this field, develops new methods of collection constantly, and it is not always necessary to spend large sums of money on equipment which may, hopefully, never be used.

Regarding Tobago, the Plan acknowledges that:

"Tobago, however, is an internationally famous holiday resort island with an ecologically highly sensitive coral reef which serves as a spawning bed for exotic tropical fishes."

Yet, the combat plan for Tobago is "the storage of chemicals at Crown Point Airport (which) will facilitate action to
ensure the rapid protection of the island's coastline."

Overall, the Plan does not reflect present day world wide opinion concerning clean-up methods for oil spills. Too much emphasis is placed on the use of chemicals in combatting spills - evidence of the over-riding importance which has been, and still is given to the oil industry. Over the years, experimentation and practice have led to international acceptance of the view that, more often than not, greater damage is done to the environment by the chemicals used to disperse oil, than by the oil itself. It happens sometimes, that the oil may float above a coral reef, or, even if stranded on-shore at low tide, may be washed away and disappear at high tide, with little or no visible damage to the plant or animal life in the marine environment. This is, of course, dependent on various factors such as type of coastline, wave height, type of oil etc. Dispersants if used, however, because of their toxicity may destroy the very life they are used to protect. There are other ways in which dispersants may fail to achieve the purpose for which they are used.

In an unpublished paper presented to a meeting of the Bonn Agreement countries in the summer of 1985, Mr.W. Koops of the Dutch Directorate of Rijkswaterstaat reported on field experiments conducted by his organisation in conjunction with the Delft Hydraulics Laboratory. These experiments aimed at obtaining field data on the dispersion processes in relation to the meteorological and hydrodynamic circumstances. The main conclusions were:

(a) dispersion is not enhanced by spraying of dispersant on an oil slick
(b) fast dispersion as on a laboratory scale did not occur
(c) the ineffectiveness of the dispersants was apparently caused by the poor mixing of the dispersant with the oil layer or by washing away from the oil layer before penetrating into the layer.

A list of conclusions and recommendations presented in the paper is attached as Annex 3.

The membership of the Oil Spill Plan Committee as stated in the Plan is in need of revision. The existing committee seems comprised of the oil interests mainly, and one or two public organisations which will assist with the clean-up process. No consideration appears to have been given to the need for other organisations such as the ports, or for that matter research organisations like the Institute of Marine Affairs, the University of the West Indies or the Caribbean Industrial Research Institute, to participate in the committee.

Section 10 of the Plan deals with principles related to cost allocation. Paragraph 10(2) reads:

"Costs of clean-up resulting from a spill caused by an organisation not operating in the country will be borne by the Government. The Government MAY then seek redress from the external sources AS IT SEES FIT." (emphasis mine)

The clean-up of an oil spill, regardless of how small, is a costly exercise. Those who cause discharges or create environmental risks must be made to bear the entire financial responsibility for the consequences. Thus, the only principle on which cost allocation should be based is the "Polluter Pays" principle. The responsible party must be
made to pay, whether the spill was accidental or deliberate.

It should be mentioned, at this point, that a number of oil companies operating in the Caribbean area, have together created an industry agreement, which has been named "The Clean Caribbean Cooperative" (CCC). The objective of the agreement is "enhancing the capability to promptly and efficiently respond to oil spills which cause, or threaten to cause damage by pollution to beaches, harbours, off-shore islands and waters of the Caribbean". (3)

This arrangement is commendable because it allows member companies to increase their combatting capability while sharing the costs of such preparedness. However, the upper limit of the spill response capability has not been given and it has been stated that use of the equipment and management of the response effort are the responsibility of the company or agency taking action to control the spill. CCC as an organised unit does not become involved in any action involving the transport or operation of the equipment or the management of on-scene activity. These services are provided, at a price, by the contractor, from whom the CCC leases the equipment.

It may be recalled that the CCC is listed as the primary agency from which assistance will be sought, in dealing with category 4M spills. While the physical resources of the CCC may be available to the Government at a reasonable price, the cost of the management necessary to operate the equipment in cases of emergency, should be carefully evaluated against the use of alternate measures. It is necessary for Government to examine whether and to what extent should such an agreement be part of its national contingency plan.
Considerable work is necessary to bring the Plan up to the standard required for a contingency plan. Much more research needs to be done for the preparation of such background information as a coastal classification of both islands, a resource vulnerability index, detailed operational plans giving various scenarios for different sizes of spills and weather conditions, etc. All institutions and bodies which have an interest to protect, should an oil spill occur, should be contributors in the preparation of the Plan. Joint governmental and private participation may save and stretch limited resources, if properly formulated. The Plan itself, needs to be re-examined against the changing perspectives created by on-going research and experimentation in this field.

The planning of pollution protection is difficult and made more so because of the divers considerations to be evaluated. Decisions will include such questions as:

- how can competing interests be best balanced e.g. environmental protection versus the wish to minimise costs
- what is the influence of pollution control costs on organisational efficiency i.e. the ability to respond to pollution
- how to assess results which are not easily comparable e.g. the cost of a clean-up operation is not comparable to the reduction in damage achieved
- the effectiveness of measures to prevent oil spills versus the frequency and extent of pollution
Ultimately, it is reduced to a question of the cost of preparedness versus the cost of inaction. No country, moreso one with limited resources, can afford the burden of high preparedness costs which tie up much needed resources, with very little tangible benefits gained. However, no country, moreso one with limited resources, can afford to be without the insurance which preparedness gives. The decision then, must balance the cost of being prepared against the cost of doing nothing. Can Trinidad and Tobago afford to do nothing?

It can be assumed from the foregoing, that there is need for urgent revision and amendment of the laws dealing with the protection of the Trinidad and Tobago marine environment from pollution. Legal requirements and obligations have not kept pace with developments within the country or the international community. Moreover, having ratified the Law of the Sea Convention, Trinidad and Tobago, is now obliged to improve its environment protection policies.

There is a great deal of technical assistance to be found in this area, from such international organisations as the International Maritime Organisation, the United Nations Environmental Programme, the United Nations Development Programme, the Food and Agriculture Organisation and even on a direct country to country basis. What is required, however, is that Trinidad and Tobago first examines its needs and requirements. In order to benefit fully from this kind of assistance, it is necessary to have a complete picture of what obtains in the country today, as well as future trends. This refers not only to oil, but also includes the requirements of other users of the marine environment, socio-economic trends, industrial development
trends housing developments etc. It is only when this information is available, that the law can be adequately revised.

5.3 THE ADMINISTRATIVE FRAMEWORK

For the effective regulation of pollution, two things are necessary and complementary - appropriate legal and administrative structures. The law usually defines the framework within which the administration will operate and provides the administration with its tools of operation. The administration, on the other hand, interprets and implements the law and ensures its proper enforcement. It is also the duty of Administration to monitor situations with a view to amendment or revision of the law as required.

In Trinidad and Tobago, it is difficult to say where administrative responsibility for pollution prevention should lie, because of the many organisations involved in the issue and the absence of any body with overall responsibility for the environment. Definitely, it should not lie with the Ministry responsible for the oil industry, because of problems arising out of a conflict of interests. Nevertheless, that Ministry does have an important contribution to make, as do other Ministries such as those with responsibility for maritime policy, fishing, national security, and various other organisations as well.

One of the great problems in Trinidad and Tobago - as in many countries, developed and developing - is the lack of communications among organisations. These poor communi-
cations are often the cause of much duplication, resulting in wastage of time, talent and money. It would follow, therefore that one of the first problems to be solved is the appointment of an “appropriate authority” to oversee the administration of pollution prevention, always in consultation with and with the cooperation of the relevant interested parties. The obvious choice for such an appointment would be the Ministry with responsibility for maritime policy.

5.3.1 Ministry of Public Utilities and National Transportation

At this point, it may be instructive to take a look at the Ministry which has responsibility for maritime policy - the Ministry of Public Utilities and National Transportation. The overburdened portfolio of this Ministry can be deduced from its name. The responsibilities include:

- Electricity
- Water
- Postal Services
- Telecommunications
- Government Printing Services
- Civil Aviation and Airports
- Ports and Harbours
- Meteorological Services
- Public Transportation
- Regulatory services for land transportation

From the list it may be understandable why, until now, maritime policy has had to play Cinderella to other more pressing and politically sensitive policy areas such as electrification or the supply of water. Progress in the area of maritime policy development has been at best, unilateral and haphazard and at worst, considerably neglected -
being the result of reactions to situations rather than initiatives taken.

In the Ministry, there is no trained staff to deal with maritime related matters. The only officers available for consultation or advice in some matters, are the Harbour Master, who is not resident in the building and who has his own problems with respect to lack of staff, and the Shipping Adviser. This arrangement is not always satisfactory, as many matters fall completely outside the areas of expertise of these two officers.

Lately, the need for adequate laws, trained personnel and the other inputs required for a viable maritime administration has been recognised, as a result of certain events and the Government is now moving to rectify the situation. Officers are being trained and plans are afoot for the creation of a Division of Maritime Affairs, similar in scope, to a Division of Civil Aviation.

It is in the light of these plans and in the absence of a public organisation with responsibility for the environment, that it is suggested that responsibility for marine pollution prevention be placed with the Ministry of Public Utilities and National Transportation.

5.3.2 Harbour Master Division

Monitoring and enforcing the implementation of legal requirements, are crucial to the success of anti-pollution measures. The machinery required for such implementation and enforcement already exists — though imperfectly, in the form of the Harbour Masters Division. Imperfectly, because the Division lacks the necessary staff,
training or facilities for the performance of the task. However, by law, the Harbour Master's Division is responsible for the safety of shipping within the territorial waters of Trinidad and Tobago, and the enforcement of all maritime regulations and anti-pollution measures within these waters.

To execute these duties, a planned expansion of the Harbour Master's Division, which allows for increased trained staff for the purpose of conducting ship surveys and monitoring exercises around the coasts of Trinidad and Tobago, as well as adequate equipment is necessary. Consideration could be given to planned cooperation between the Coast Guard and the Harbour Master's Division in monitoring the territorial waters to prevent the infringement of laws when updated.

5.4. TECHNICAL INPUT

While information on social, industrial, economic and other related trends is available relatively easily in Trinidad and Tobago, in the field of marine science and technology, there is a dearth of such information at present. There exists, however, at least three institutions in the country which may be able to assist in data collection, interpretation and experimentation in this area. These are:

- the Institute of Marine Affairs (IMA)
- the University of the West Indies (UWI)
- the Caribbean Industrial Research Institute (CARIRI)

These three institutions may, with little additional effort;
be drafted into use on the problem of anti-pollution measures.

5.4.1 Institute of Marine Affairs (IMA)

The Institute of Marine Affairs was created by an Act of Parliament on May 10, 1976, as a result of a joint project between the Government of Trinidad and Tobago and the United Nations Development Programme. The objects of the Institute are:

"(a) to promote and encourage a deeper and broader understanding and appreciation of all aspects of the marine environment;
(b) to make available in the Caribbean knowledge of the various disciplines relevant to marine affairs;
(c) to increase the capabilities of Government in the formulation of consistent and informed policies in marine affairs." (4)

These objects should be achieved through the performance of specific functions i.e.

"(a) to conduct marine research on the condition of the marine environment in the Caribbean and adjacent regions;
(b) to study, and promote through studies, the multiple uses of the sea, its resources and potential in the Caribbean and adjacent regions and to evaluate such studies with a view to minimising possible conflicts which may result from such uses;
(c) to establish in the Institute an information centre for the collection and dissemination of information relating to the economic social, technological, scientific, environ-

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mental and legal developments in the Caribbean and adjacent regions.

(d) to analyse the relevant information for the purpose of identifying policy alternatives for Government policy-making in marine affairs;

(e) to respond to technical enquiries and questions made by policy making organs of Government;

(f) to organise training courses and seminars on the subjects falling within the technical competence of the Institute, depending on the availability and specialisation of consultants attached to other agencies, including the Executing Agency;

(g) to advise on the development and optimum utilisation of the marine resource potential of Trinidad and Tobago;

(h) to take such action as may be necessary or expedient for the proper performance of its functions."

It may be noted that these are very expansive and inclusive terms of reference, which make the Institute a key contributing organisation in any plans concerning things maritime. To date, it can be said that the Institute has been conscientiously attempting to execute its functions to achieve the objectives, albeit in a very ad hoc fashion. The organisation itself has recognised the extent of its deficiencies. To quote from a report based on self analysis performed by the Council of Marine Affairs and the Board, jointly:

"The overriding issue arising from all the discussions seemed to have been the need for
concentration on the strategically planned development of marine research in Trinidad and Tobago, rather than a miscellany of projects of different size and range, a problem which is not confined to marine research alone or to the Institute only. Isolation of the critical issues of the marine environment as candidates for in-depth research appears to be a required policy objective."

The formulation of a clear maritime policy by the Government, should assist the Institute in identifying its priorities in the development of their marine research programme. In any case, the Institute of Marine Affairs is the only public institution with a precise mandate for the conduct of research into marine affairs and greater use must be made of its skills and resources in this field.

5.4.2 University of the West Indies (UWI)

The University of the West Indies is a regional institution which serves the entire English speaking Caribbean area. It is supported by the Governments of the Commonwealth Caribbean and comprises three campuses - one each in Barbados, Jamaica and Trinidad and Tobago.

To date, the aquatic sciences do not appear to be a well developed aspect of the curriculum and research work in this field is done, more or less, on a basis of individual interest. Nevertheless, at the Trinidad and Tobago campus, as with all the others, there are quite a number of well trained scientists who staff the Faculty of Natural Sciences and specifically, the Botany and Zoology depart-
ments. In many cases, these scientists have conducted their own experimentation and research in the marine field, the results of which have been internationally recognised and accepted.

The possibility of collaboration between the Institute of Marine Affairs and the University of the West Indies should be fully explored with a view to capitalising on the use of laboratories and similar facilities. In addition, the University can provide resource personnel and consultants from other disciplines, e.g. economists, sociologists, who can assist in the projection and interpretation of trends and patterns which may influence research in the marine field. Apart from its own resident expertise, the University can, through its associations with other institutions abroad, provide excellent opportunities for wider consultancy, especially in areas which are not fully developed in Trinidad and Tobago. In other words, the University represents another kind of resource which needs to be more fully exploited.

5.4.3 The Caribbean Industrial Research Institute (CARIRI)

CARIRI is a public research institution established by an Act of Parliament in 1971, as part of an agreement between the United Nations Industrial Development Organisation (UNIDO) and the Government of Trinidad and Tobago. The objects of the Institute are many and include interalia, the following:

"(a) to provide technical and industrial services to public and private industrial enterprises;
(b) to collect and disseminate technical information, including applicable standards, specifications and quality control procedures;"
(d) to provide engineering services, including assistance with establishing production lines, prototype designs and maintenance and repair problems;" (6)

The declared intention of the Institute is the provision of an improved technological capability to the industrial community. However, there is no reason why a broad interpretation of the objects mentioned above may not include the testing and adapting of materials, equipment and methods for use in the combat of oil pollution in the Caribbean environment. For example, it may be quite possible to produce adsorbent material from local products rather than import expensive materials from abroad.

There is no doubt either that the products of such research will be marketable throughout the Caribbean and perhaps further afield. Most of the States in the Wider Caribbean are fully aware of the dangers presented to their coast lines by the transportation of oil through the Caribbean Sea. Some have actually suffered the effects of polluting incidents. Equipment and methods which can use or substitute locally obtained materials at, hopefully, reduced costs will surely gain wide acceptance in the region. This can have the added benefit of allowing many more of the States, particularly the islands which have limited resources, to improve their response capability, which can only be of benefit to all.

This is the role envisioned for CARIRI in the development of a research base for pollution prevention - the adaptation, testing and perhaps invention of methods and equipment for specific use in the Caribbean.
It may be concluded then, that Trinidad and Tobago has many improvements to make in its pollution regulatory machinery, before it can begin to protect and preserve its marine environment. The legal provisions, though inadequate, and the National Oil Spill Clean-up Plan together indicate token recognition of the fact that there is need for prescriptive action. An in-depth examination of the administrative framework for the regulation of pollution would reveal that the structures do exist, albeit in skeletal form and, more often than not, scattered across various organisations.

However, in the absence of an adequate legal framework, it is well nigh impossible to pull together a satisfactory administrative structure. While various aspects of administration and regulation may be divided among, and performed by, several different organisations, the net effect is still unsatisfactory, because of lack of co-ordination, synchronisation and any kind of harmonisation of actions.

What is necessary at this time, is the combining of the bits and pieces into one cohesive, modern whole, more in tune with today's requirements. In executing these improvements, an important quality which must be borne in mind is "flexibility. The maritime world is a dynamic world, in which to achieve success, participants must be flexible. This flexibility also needs to be reflected in the regulatory institutions to ensure their ability to respond quickly to changing circumstances.

As indicated in the Preface, this study recognises the existence of other forms of pollution which may be even more hazardous than oil. However, as also indicated in the
Preface, this study is limited to dealing with oil for the reasons stated. The establishment of flexible legal and administrative structures for the regulation of oil pollution would ensure that in time, these other forms of marine pollution can be dealt with, without the problem of further restructuring.

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chapter 6

an environmental policy

for

trinidad and tobago
6.1 THE NEED FOR CONTROL

To recall the Stockholm definition, marine pollution is the deterioration of marine resources which results from the introduction, by man, of substances or energy into the marine environment. This is one aspect, examples of which may be found all along the Gulf coast of Trinidad and to a lesser extent, along the South West coast as well.

The second element of the definition refers to the harm which can be caused to legitimate activities which depend on the marine environment, as a result of man's polluting activities - for example, the siting of an oil well in the middle of a fishing zone. Although no concrete examples of this come to mind at the moment, no doubt they do exist along the Gulf coast of Trinidad.

Marine pollution may therefore be defined as: "the conflicting use of ocean resources which results - deliberately or fortuitously - in the release of contaminating substances into the marine environment, and affects the use or potential use of that environment as a source of food and recreation." (1)

The function of marine pollution control is not to discourage the exploration or exploitation of the marine environment, or for that matter, any other uses of it. Marine pollution control must ensure coordination between the uses of, and activities in the marine environment, in
accordance with prescribed values placed on each activity.

Consequently, an effective pollution control policy must seek to resolve conflicts between the use of ocean resources and land activities, including not only direct discharges to the environment, but indirect as well. It should, therefore be part of an overall environmental protection policy.

Trinidad and Tobago is a small country, dependent for its main economic support on the oil industry. However, it can also be described as a broad-based, developing maritime island state which exploits many of the resources of the sea - from fishing to sand mining. Moreover, notice has been given of the government's intended development of the tourism industry, in which one of the chief attractions will be the offer of the facilities of a clean attractive marine environment. Indeed, much expenditure has already been undertaken for the purpose of improving the infrastructure at certain beaches.

The present stresses on the marine environment of Trinidad and Tobago come not only from oil, but from other sources as well, some more devastating than oil. The coastal ecosystems of the sheltered Gulf of Paria experience undue stress from developments in housing and industry, port activities and a whole range of other developments which go along with the economic and industrial development of the society.

Although the country is dependent for its main economic support on the oil industry, it cannot afford to destroy those marine resources which exist in its coastal zone and territorial sea. Not only are they needed to
supplement the declining oil revenues, but the destruction of these coastal estuarine resources carries with it other costs. It can ruin the livelihood of many subsistence fishermen who depend on these resources, and it also impacts on the future development of these productive but extremely delicately balanced systems.

Some levels of pollution will always be consistent with the exploration and exploitation of the natural resources of the sea. A realistic appraisal of the situation would indicate that there must be some compromises made in the allocation of priorities to activities performed in the marine environment. However, in the final analysis the environment must not be allowed to deteriorate and it is the function of the environmental policy to ensure that permissible levels of pollution do not attain chronic dimensions.

In the circumstances, immediate steps should be taken to rationalise the present uncontrolled situation and to impose some order in the development of the coastal zone, so that the risks which these developments represent will be minimised. In other words, a balance between industrial and economic growth on the one hand, and the desired level of environmental quality on the other, must be struck.

6.2 TOWARDS THE REALISATION OF AN ENVIRONMENTAL POLICY

There are several steps to be taken in the attainment of this goal. Recommended for consideration in this
chapter are what may be considered the main ones.

6.2.1 Creation of a Data Bank on Marine Resources

The formulation of a body of research which can inform on the effect of stresses inflicted on the marine environment by various activities, substances and practices, is one of the first steps to be taken, in the execution of an environmental protection policy. The intention is to discover, first of all, what there is to protect. This data would indicate in categories of priority, the most vulnerable coastal areas and resources, the health of the environment as a whole, the size of allowable catches of fish and similar relevant information. It would assess the overall impact of activities in the coastal zone on the marine environment.

The research necessary to provide this data should form an on-going part of the work of the Institute of Marine Affairs, ably assisted by the Caribbean Industrial Research Institute and the University of the West Indies. Reference should also be made to research institutions abroad - such as the Bedford Institute of the Dalhousie University in Canada - which have done many studies on Caribbean ecological systems and environmental problems.

An important regional institution which can be of great assistance in this field is the Caribbean Conservation Association (CCA). The CCA is a regional non-governmental organisation founded in 1967 for the purpose of conserving and developing the environment and preserving the cultural heritage of the region. It covers the Wider Caribbean and membership comprises individuals, conservation and development organisations and Caribbean Governments.
Trinidad and Tobago is the only Commonwealth Caribbean country which is not a member.

The CCA is a key organisation in the regional approach to environmental protection issues, by virtue of its long experience in the Caribbean and its broadly based membership. It conducts regional inventories, surveys and assessments, formulates and implements plans and strategies of a regional nature. It also undertakes field projects pertaining to the natural environment which aim at strengthening the local capacity to manage the living natural resources (both terrestrial and marine) which are critical to development.

The objects of the CCA include, interalia, the following:

(a) to ascertain and coordinate the needs of the Caribbean area in the fields of conservation.
(b) to coordinate activities designed to satisfy the conservation needs of the Caribbean area.
(d) to encourage the creation of public, private or governmental conservation organisations in the Caribbean area.
(e) to assist in fostering in the people of the area, a greater awareness of the value of their natural and cultural resources.
(g) to establish and maintain conservation projects in the Caribbean area for the preservation or enhancement of the natural resources of the area. (2)

Participation in this organisation will benefit Trinidad and Tobago in several ways. Most important is the reduction in the costs of research which can be achieved through the
execution of joint projects. There is also the benefit of shared information. Moreover, in starting up a data bank at this time, Trinidad and Tobago can avoid duplication of work that has already been done by that organisation. In addition, it is one way of keeping abreast of developments in the environmental field in the Caribbean.

6.2.2 Coastal Zone Management

The implementation of a coastal zone management programme, based on information obtained from the research mentioned above, as well as projected development plans in industry, housing, etc., is the next step. The aim of such a programme is the proper monitoring of growth and development in the coastal zone, which is a band of varying width running along the coast and includes a land component and a sea-ward component. In Trinidad and Tobago, this coastal zone includes a major proportion of the inputs into the economic growth of the country — roads, industrial plant, ports, fisheries and other infrastructure.

A coastal management programme would:
- divide the coastal areas into zones indicating fragile areas, areas of recreational or scientific interest, zones of preservation and zones of development.
- require the submission of coastal development projects at the feasibility stage, to an evaluation which would concentrate on:
  (i) the social profitability of the project
  (ii) its environmental impact
- establish acceptable levels of contamination for all polluting activities
- establish a policy making and management body which would oversee and monitor all developments in the coastal zone.

6.2.3 Raising of Environmental Consciousness

The encouragement of greater public environmental awareness is a very important strategy in pollution regulation. If the population can be made more conscious of the fragility of their environment and the importance of using it correctly, then the ensuing benefits may include:

- reduced violation of pollution control laws;
- increased public monitoring and reporting of pollution violations;
- increased numbers of people wanting to enter this field of employment.

Such programmes should utilise all possible mediums of communication - posters, radio, television, newspapers, public competitions, to name a few. There should also be, in addition to the main campaign, special segments aimed at special groups in the population such as schools or specific industries.

6.2.4 Upgrading the Maritime Administration

Another important component in the establishment of a pollution control policy for the marine environment is the upgrading of the maritime administrative capability of the public sector, by the creation of a Division of Maritime Affairs under the Ministry of Public Utilities and National Transportation. The requirements of this recommendation have been dealt with in Chapter 5. The role envisioned for this Division is different from that which will be performed.
by the coastal zone management body. This Division will implement, enforce and monitor the pollution control laws; liaise with the coastal zone management body where necessary; and is the agency through which affairs directly related to the marine environment, in the absence of a Ministry of the Environment, are taken to the Government.

6.2.5 National Contingency Plan

Trinidad and Tobago, being an oil producing state, must make provision for the probability of a polluting accident - whether by ship or from industry. Such provision will take the form of a national contingency plan, which caters for all emergencies and takes into consideration, the peculiarities of the marine environment of Trinidad and Tobago. The plan should reflect the combined responsibility of the Government and the industry and should include, as far as is necessary, organisations like ports, companies operating dry-docking facilities and others whose operations put the environment at risk. Combat strategies in the plan must be based on research findings and the cost of actual spill combat should be for the polluter's account.

Because of the proximity of Trinidad to Venezuela, cooperation with Venezuela on a bilateral basis, for the protection of the Gulf of Paria from incidents of accidental pollution, should be considered. With respect to the Wider Caribbean - also an area under the constant threat of pollution, from oil in particular and the process of industrial growth, in general - Trinidad and Tobago, as an oil producing country is under a moral obligation to participate in efforts to protect the Caribbean from accidental pollution. The infrastructure for such cooperation already exists in the form of the Cartagena Convention, discussed in
Chapter 2. It is one of the ways in which Trinidad and Tobago can also boost its oil spill response capability and participation in the Convention is highly recommended.

6.2.6 Establishment of an Adequate Regulatory Regime

At the moment, there are no extensive laws on the protection of the environment, and the few specific ones which exist are not adequate. The strength of any law is in its enforcement. To be enforceable, laws must be practical and not overly stringent. They should effectively deter would-be violators but avoid setting impossible standards. In addition, the laws must recognise the accepted relationships between activities and users of the marine environment.

Consequently, the preparation of adequate laws for pollution control based on research data as well as Conventions and regulations promulgated by organisations such as the United Nations Environmental Programme (UNEP), the Economic Commission for Latin American and the Caribbean (ECLAC), the Caribbean Community (CARICOM), on a regional basis and IMO, UNCTAD, FAO and other international organisations, is recommended. Particular attention should be paid to those regulations and Conventions which deal with liability and compensation for pollution damage.

6.2.7 Training

Trained staff will be required at all levels for the implementation of programmes created under this policy. Most, if not all the training required, will be in the technical field and needs should be examined from both long and short term perspectives. Training may take the form of
on-the-job seminars, attachments, workshops, or courses at educational institutions.

In this area it is recommended that the various offers of technical assistance in this field be considered, as there may be benefits available in the form of reduced costs.

6.2.8 Participation in Regional Fora

Trinidad and Tobago is part of a region, all of which is threatened by various forms of pollution. Since the sea has no boundaries, there is nothing to be gained from the improvement of one’s environment in isolation. Marine environmental measures should be taken as part of a regional plan. Such a plan does exist in the form of the UNEP Caribbean Action Plan, which has already been discussed in Chapter 2. The active participation of Trinidad and Tobago in this Plan is strongly recommended.

As stated previously, Trinidad and Tobago is one of the major oil exploiting states in the Caribbean, but it is also quite vulnerable to the effects of pollution. Because of this, Trinidad and Tobago should actively participate in the regional thrust towards healthier environments. It is recommended that the country become a member of, not only the Regional Action Plan, but also the CCA - the Caribbean Conservation Association and participate actively in the regional fora involved in the work of environmental protection and conservation.
6.2.9 Participation in International Fora

Trinidad and Tobago had long been a passive member of many of the international organisations which deal with aspects of maritime affairs. Lately, in keeping with its new interest in the maritime field, it has switched to active participation in some instances and it is recommended that this trend be continued.

To obtain the best out of membership in these organisations, participation has to be not only active, but meaningful, as well. Sending diplomats to technical meetings to save costs is not the ideal solution. While it may not be possible to participate in all meetings, the policy for attendance at these meetings should be proper technical representation at the most important meetings. For the others where diplomats are used, they should be fully briefed beforehand.

6.3 COSTS OF POLICY MAKING AND IMPLEMENTATION

The above recommendations are not considered to be an exhaustive list of goals towards the achievement of environmental protection, but they do represent what are considered the major aims. In attempting to implement a new policy, there will be increased costs. Not all the costs will involve major expenditure. Moreover, some costs reduction may be achieved through joint public/private sector funding; the rationalisation of existing services; and various other schemes. However, although the costs connected with a policy will have a major influence on its feasibility for implementation, these costs must be seen in the
perspective of the benefits to be gained, or in other words, the costs of non-implementation.

Policy making and policy implementation are long term activities. Environmental policy making is, in reality, an attempt to plan prudently for the future. The type of environmental policy which a country adopts, is an indication of the value it places on the future.

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chapter 7

conclusion
CONCLUSION

In conclusion, it would appear that, with adequate controls, "black gold" can co-exist adequately with blue seas. In Trinidad and Tobago, they have done so for many years with only limited negative impact on the marine environment. There are other areas, however, in which the damage done appears irreversible - the Guaracara River is one example. In other locations like the Caroni Swamp for example, the adverse impact of oil on the environment is suspected but needs to be confirmed. In the light of Trinidad and Tobago's recent ratification of the Law of the Sea Convention, it is time to take stock of environmental practices in the country, and to institute some sort of environmental policy in order to fulfil its obligations, voluntarily assumed under the Convention.

The corner stone of the proposed policy would be the implementation of a coastal zone management programme which would monitor and approve developments in the coastal zone - the most delicately balanced ecological zone in the entire environment and, in Trinidad and Tobago, also the most important for productivity. However, the other aspects of the policy cannot be neglected. The legal aspect of policy making is the legitimising force behind whatever actions are taken to ensure a healthy environment; but to be effective, laws must be adequately administered and enforced. Moreover, the creation of environmental awareness in the population...
at large, will ensure that measures taken are not in vain.

One major deterrent to the implementation of these measures will be the cost factor. As previously stated, there are ways of surmounting this problem. The major polluters come from industry. In keeping with the "polluter pays" principle, they should be made to contribute to the clean-up measures necessary, under law. It has been done successfully in other countries - why not in Trinidad and Tobago?

Obviously, there is much to be done, but there are many sources of assistance, both within and outside the country. There are local organisations such as the Field Naturalists, the Wild Life Association, (both private clubs) which are willing to provide their expertise. There is the Institute of Marine Affairs which has the capacity and the capability although it may not be fully utilised, at the present time. Regionally, there is the Caribbean Conservation Association, whose invitation of membership has so far been ignored; and the Caribbean Action Plan which has yet to gain our attention. Further afield, there are many international organisations willing to offer technical assistance in whatever form it may be required.

Trinidad and Tobago has taken a commendable first step through its ratification of the Law of the Sea Convention. The next step is its implementation. Under the Convention there is a distinct obligation - a duty - to conserve resources. As previously stated, this does not mean a complete ban on all activities of the marine environment, especially those critical for the economic
development of the country. It does envisage the setting of operational standards for activities conducted within the marine environment, such as to ensure that conflicting usage of the resources does not result in their deterioration.

In the words of the Barbadian Minister of Health, "we have no right to jeopardize the options of the future. We have to realize that the future of our children will be grim indeed if we do not ensure that development proceeds without devastating the environment, the resource base on which development depends. This goal will be little more than an illusion unless we are willing to take ourselves to task, to ask the difficult questions, to make the hard choices, to take the moral initiatives which our solemn bond of solidarity with the future demands. It will not be an easy undertaking." (1)

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annex I

Possible Application of an Oil Spill Vulnerability Index to the Trinidad Coastline

Source: Institute of Marine Affairs Research Report prepared by Cicely Georges
3. THE OIL SPILL VULNERABILITY INDEX

The oil spill vulnerability index is a physical concept developed by Michel et al (1978) and Gundlach and Hayes (1978) working in Alaska and Spain, and is based on the physical longevity of oil in each coastal environment in the absence of cleanup efforts. The index was first applied while mapping the shoreline of the Lower Cook Inlet, Alaska (Michel et al, 1978) and later extended by Gundlach and Hayes (1978) to include the initial biological impact of spilled oil. This expanded index, called the oil spill vulnerability index, has been applied to other coastal areas, like New Zealand. The index has been further expanded by Hayes et al (1980) to integrate other biological factors into a broader environmental sensitivity index.

The vulnerability of any coastal environment to oil spill damage depends on the following factors (Gundlach and Hayes, 1978 Owens and Robilliard, 1981)

1) Shoreline interaction and physical processes controlling deposition and erosion;
2) Observed persistence of oil in that environment;
3) Extent of biological damage including unique and endangered species;
4) Socio-economic use of area.

The vulnerability index developed by Michel, Gundlach, Hayes and others has been modified slightly to nine indices and applied theoretically to the Trinidad coastline (Table 1). The nine indices outlined below are discussed in more detail in the following section.

The proposed vulnerability index for Trinidad applied to the island's major coastal environments and their potential sensitivity to oil spill damage is described. In environments with indices 1 and 2, the most vulnerable, oil should disperse in a few weeks. In environments with indices of 3 and 4, however, oil might persist for approximately six months. Areas with indices of 5 and 6 may be free of oil in approximately one year, but it might take several years before an environment with a 7 or 8 index is free of oil. Oil would remain for ten years or more in environments with an index of 9.
APPLICATION OF THE OIL SPILL VULNERABILITY INDEX TO THE TRINIDAD COASTLINE (See Table 1 and Fig. 1)

Index 1: Exposed steeply dipping or cliffed rocky headlands characterise Trinidad's North and northern East coast (Plate 1). The prominent rocky and/or cliffed headlands and coastlines, for example, between Corozal and Chupara Points, are high energy environments with intense wave action. In such environments wave impact (Owens and Rashid, 1976) and reflection (Gundlach et al, 1978) can keep oil 5-10 m offshore.

Rocky and cliffed headlands also form the northern East coast (Plate 1) between Guayamara and Matura Points. These coasts are interspersed with embayments and coves in which stranded oil would cover the rocks, killing any attached algae and barnacles (Gundlach et al, 1978).

Index 2: Eroding wavecut platforms are areas of narrow, wave-swept beaches in front of eroding material or cut directly into crystalline rock, which may be covered with sand or gravel (Gundlach and Hayes, 1978).

Wavecut platforms form part of all Trinidad's coasts. On the North coast the La Filette area is a typical example of this category, consisting of low grade metamorphic cliffs fronted by a narrow, medium-grained quartz beach which is covered at tides. On the East coast, narrow wave-swept beaches front the sandstone cliffs of Point Radix. This coastal environment also characterises Trinidad's South coast (Plate 2). The semi-consolidated to consolidated sandstone, mudstone and siltstone cliffs of this coast have narrow sand beaches at their bases, which are covered during high tides. The beaches of Guayaguayare, Caroni and Palo Seco Bays are good examples. The beaches in this category are in high energy environments and would be cleansed of any polluting oil (Gudlach and Hayes, 1978). Some of these areas are important for chip-chip (Coquina Clam, Donax sp.) and stranding oil may wipe out a large section of the population.

Index 3: Flat fine to medium-grained sandy beaches have the following characteristics:

a) Grain sizes between two and four phi* (0.0625 mm - 0.25 mm in diameter)
b) Flat profiles
c) Hard packed sands

This type of beach is found on the East, West and South coasts - Cocos Bay and parts of North Mayaro Bay on the East coast (Plate 3), Morne Diable and Quinam Bays on the South coast and Granville and Irois Bays on the West Coast.

Phi = -log₂ (diameter in millimetres)
Stranded oil on flat, fine grained beaches would not penetrate the sediments because of their close packing. The initial biological effects of the oil could include the oiling of bivalves (e.g. Donax sp.) and other molluscs which are common in these environments. The Gulf of Paria beaches would take longer to clean if left alone since they are in lower energy environments when compared with the South and East coast beaches.

Index 4: Steeper medium to coarse-grained beaches with grain sizes of between one and two phi (0.25 mm - 2.0 mm) can be found in both low and high energy environments and are common on all four coasts.

Such larger North coast beaches as Maracas and Grande Riviere fall into this category, as do most of the beaches on the East coast, from Cumana in the north to Mayaro in the south (Plate 4). By contrast, the only beach on the South coast that fits this category is the beach at Icacos. On the West coast, the Cedros and Guapo Bays beaches are included in this category.

Oil could rapidly penetrate the sediment of these beaches up to a depth of 20 cm and could become buried deeper by subsequent sedimentation (Gundlach et al., 1978).

Some of the beaches in this category are important nesting sites for turtles (Leatherback, Green and Hawk's Bill). Stranded oil on these beaches could probably severely damage and perhaps kill the turtle eggs.

Index 5: Exposed compacted tidal flats are typical of the South and West coasts of the island. On the South coast, they are associated with the Moriquite and Erin River mouths and sand bars, at Moruga and San Francique (Erin), respectively. Tidal flats also border the Roussillac Swamps (Plate 5) and the wetlands in the Couva area (Plate 5).

Although these fine-grained sand mudflats are restricted to low energy environments, they are still exposed to the wind, waves and currents. Oil tends not to penetrate or adhere to the sediments, and is often pushed across the flats onto bordering beaches. Tidal flats are usually biologically productive, and any stranded oil would affect the flora and fauna of the intertidal and subtidal zones.

Index 6: Mixed sand and gravel beaches are confined to Trinidad's Gulf coast. The beaches at Bon Accord, Pointe-a-Pierre (Plate 6) and those between Port of Spain and Tetron Bay fit this category.

If oil were to reach these beaches it could penetrate 10-20 cm (Gundlach and Hayes, 1978). However, since sand and gravel
beaches are relatively devoid of biological activity because of their low water content, the biological impact of stranded oil would probably be minimal.

Index 7: Gravel, cobble and boulder beaches are part of Trinidad's North coast, where some beaches are composed entirely of sediments coarser than 2 mm.

The beaches of Bacasa, Cyril's and Damien Bays fit this description, but on other North coast beaches, these larger grain sizes are restricted to the backshores and upper foreshores, e.g. Mal d'Estomac and Matelot Bays (Plate 7). Oil on gravel, cobble and boulder beaches could penetrate the sediment to a depth of 60 cm (Gundlach et al, 1978).

Index 8: Sheltered rocky coasts are restricted to some sections of the southern and western coastlines of the Northwest Peninsula (e.g. Scotland Bay) and the offshore islands of Chacachacare, Huevos, Monos and Caspar Grande. Stranded oil on these coasts could persist for many years killing chitons, crabs, limpets and sea grasses. In storm conditions, however, the wave and wind activity may increase oil dispersal and degradation.

Index 9: Sheltered estuarine marshes and mangrove coasts border the Caroni and parts of the North Oropouche and Nariva Swamps (Plate 8). These wetlands support a great variety of fauna, and serve as a nursery for many species of marine life. Oil in mangrove swamps affects both the flora and fauna, causing defoliation of mangroves and asphyxiation of crabs (Gundlach et al, 1979).

Coral-Algal Reefs - Spooner (1970) reports on the survival of reefs subjected to oil spills, but Johannes (1970) has shown how oil on branching corals led to tissue death. Bak and Elgershuizen (1976) concluded that physical contact with oil sediment particles appears to be less harmful to corals than the toxic effects of oil themselves. Experiments however, have shown that in the case of major oil spills, the reefs are more endangered by the chemical detergents used in the cleanup than by the oil itself (Elgershuizen and de Kruijf, 1976). According to Gundlach and Hayes (1978) the extent of oil spill damage to a coral depends on a) depth of reef; b) toxicity of oil, c) quantity of oil. Coral-algal reefs that are not exposed at low tides have been tentatively given a vulnerability index of eight or nine. Reefs that are exposed at low tide, such as the Salybia Reef, should probably be given the highest rating, i.e. a vulnerability index of nine.
TABLE 1: A SUGGESTED COASTAL CLASSIFICATION SYSTEM FOR THE TRINIDAD COASTLINE
BASED ON ITS VULNERABILITY TO POTENTIAL OIL SPILL DAMAGE

<table>
<thead>
<tr>
<th>Vulnerability Index</th>
<th>Coastal Environment</th>
<th>Comments</th>
<th>Trinidad examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>Exposed, steeply dipping, cliffed rocky headlands</td>
<td>High energy environment, little oil would strand. Little cleanup would be necessary.</td>
<td>North and northern East Coasts</td>
</tr>
<tr>
<td>1</td>
<td>Eroding wave cut platforms</td>
<td>Most of the oil removed by natural processes in a few weeks.</td>
<td>La Fillette, Point Radix, South Coast</td>
</tr>
<tr>
<td>2</td>
<td>Flat, fine to medium grained sandy beaches (0.0625mm - 0.25mm)</td>
<td>The close packed sediments do not allow oil penetration. Oil can persist for many months.</td>
<td>Cocos Bay, Quinam Bay, Irois Bay</td>
</tr>
<tr>
<td>3</td>
<td>Steeper medium to coarse-grained sand beaches (0.25mm - 2.0mm)</td>
<td>Oil can sink some 20mm into the sediment and may subsequently be buried deeper. Cleanup is difficult.</td>
<td>Maracas, Cumana, Icacos and Cedros Bays</td>
</tr>
<tr>
<td>4</td>
<td>Exposed compacted sandy mudflats</td>
<td>Oil does not penetrate but can persist for up to a year.</td>
<td>Erin, Moruga and off Rousilliac Swamp</td>
</tr>
<tr>
<td>5</td>
<td>Mixed sand and gravel beaches</td>
<td>Oil penetration is rapid, cleanup is consequently more difficult and oil can persist for many years.</td>
<td>Chaguaramas Bay, Bon Accord</td>
</tr>
<tr>
<td>6</td>
<td>Gravel, cobble and boulder beaches</td>
<td>The behaviour of oil in this environment is similar to that in the class above.</td>
<td>Cyril, Bacasa &amp; Matelot Bays</td>
</tr>
<tr>
<td>7</td>
<td>Sheltered rocky coasts</td>
<td>In very sheltered areas oil can persist for many years.</td>
<td>Southern shores of offshore islands</td>
</tr>
<tr>
<td>8</td>
<td>Sheltered wetlands</td>
<td>Oil in the environment can last for more than ten years. The biological impact can be devastating. Coral reefs have tentatively been given an index of 9.</td>
<td>Caroni Swamp</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
annex II

Limitations on Dispersant Application

Source: Mr. W. Koops, North Sea Directorate of Rijkswaterstaat
LIMITATIONS ON DISPERSANT APPLICATION

In 1983 field experiments on natural and chemically-induced dispersion of oil were performed in the North Sea by the North Sea Directorate of Rijkswaterstaat and the Delft Hydraulics Laboratory, (ref. 1, 2 and 3). They aimed at the gathering of field data of the dispersion processes in relation to the meteorological and hydrodynamical circumstances.

The main conclusions from these field experiments are:
- the dispersion is not enhanced by spraying of dispersant on the oil slicks
- fast dispersion as on laboratory scale did not occur
- the ineffectiveness of the dispersant was apparently caused by the poor mixing of the sprayed dispersant with the oil layer.

The greater part of the dispersant entered the waterphase due to falling of the dispersant droplets through the oil layer, or by washing-away from the oil layer before penetrating into the layer.

As knowledge in the use of dispersants improves, the validity of decisions using them also is expected to improve. This paper presents an approach to limitations on dispersant application and discusses the criteria for determining the acceptability of chemically treating a specific spill.

The factors mainly included are the dispersibility of the oil and whether chemical dispersion will achieve a reduction in environmental impacts.

An example of a procedure for logically deciding which option to take to mitigate an oil spill is indicated schematically in figure 1 (from IMO/UNEP guidelines (ref. 4)).
Figure 1 Decision tree for the use of chemical dispersants.

The decision to treat or not to treat a spill with dispersants must consider all aspects of the situation: the main questions are as follows - (refer figure 1).

1. Is the oilslick moving towards the shore or a sensitive area?

To answer these question one should also realise that an oil spill could disappear by weathering processes such as evaporation, photo-oxidation and natural dispersion.

The most important process in this respect is the natural dispersion which is shown in figures 2 and 3 (ref. 5).
Small spillages disappear very rapidly from the water surface, as can be seen from figures 2 and 3, while larger spillages at low wave heights have a much longer life time on the water surface.

The natural dispersion of an oil spill roughly can be determined by

\[
V_{\text{disp}} = V_0 \left(1 - e^{-7.6 \times 10^{-5} \frac{Ht}{V_0^{0.62}}} \right) \quad \text{(ref. 5)}
\]

where \( V_{\text{disp}} \) = the volume oil dispersed natural
\( V_0 \) = initial volume
\( H \) = significant wave height
\( t \) = time.

The first question could be improved by asking, will the oil slick reach the coast or a sensitive area or is the drifttime to the coast or sensitive area shorter than the life time of the spill on the water surface.
If the answer is no than continue observing and predicting, but leave spill temporarily alone. If however mechanical recovery is feasible than proceed to action and try to recover as much oil as possible from the marine environment. In case the life time of an oilslick is longer than the drift-time to the coast or a sensitive area combating operations has to be started to prevent pollution risks of these areas. Mechanical recovery methods have priority above the dispersion method, which brings us to the next question of the decision tree of figure 1.

2. **Is recovery feasible?**

The mechanical recovery methods used by the Dutch authorities are feasible and effective up to a significant waveheight of 1.50 m (Beaufort 5 windforce) Swell has no influence on the systems used by the North Sea directorate. As the recovery methods have first priority these will be used up to a wave-height of 1.50 m. Only when dealing with larger slicks it may be necessary to use all available means, mechanical as well as chemical, in combination, if effective response is to be achieved. Above waveheight 1.50 most recovery methods are inadequate and the use of dispersants also may be considered, however the natural dispersion process is much more effective at higher wave heights as can be seen from figure 3. In most cases it has no sense to use dispersant to improve the dispersion process in such highwave situations. Pre-planning to what extent mechanical recovery equipment should be available and at above what spill size the dispersant method should considered is very important. The next question is,
3. Can the oil be normally dispersed?

Not all oils can be effectively dispersed chemically. Obviously there is no point in trying to disperse an oil which cannot be dispersed, or using a dispersant type which is not as effective as another available type. Generally accepted facts (ref. 6) of not dispersable oils are;
- non spreading oils (pourpoint of the oil is higher than the ambient water temperature and or,
- water-in-oil emulsions (mousse) and or,
- high viscous oils (figure 4 shows the effectiveness of dispersant at different viscosities).

![Figure 4 Effectiveness of dispersants at different viscosities.](image-url)
Aging, often referred to as weathering, is the time dependent process which changes the physical properties of the oil which means that also the dispersability of an oilslick is time depending (ref. 7). The evaporation of the volatile fractions of the oil give an increase of pourpoint and viscosity.

Figures 5 and 6 Quoted from Concawe report no 8/83 (ref. 7) show the evaporation percentage for different crude oils as a function of time and the viscosity as a function of evaporation percentage.

**Figure 5** Relationship between time after spillage and percentage of oil evaporated for different crude sources.
Figure 6 Kinematic viscosities of remaining oil, measured at 10°C, versus volume of fractions evaporated.

From the hydrocarbon compendium, table 7 also quoted from the concawe report no 8/83 it can be seen that the pourpoint of some crude oils can easily rise above ambient water temperature.
### Table 7. Hydrocarbons compendium

<table>
<thead>
<tr>
<th>GROUP</th>
<th>Hydrocarbons Compendium</th>
<th>Volume fraction detailed at</th>
<th>Density (kg/l)</th>
<th>Viscosity (cP)</th>
<th>Ash composition</th>
<th>Sounding coefficient (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP 1</td>
<td></td>
<td>32</td>
<td>21</td>
<td>0.115</td>
<td>0.294</td>
<td>0.490</td>
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<td></td>
<td></td>
<td>15</td>
<td>0.190</td>
<td>0.376</td>
<td>0.572</td>
<td>0.778</td>
</tr>
<tr>
<td></td>
<td></td>
<td>23</td>
<td>0.136</td>
<td>0.230</td>
<td>0.387</td>
<td>0.543</td>
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<tr>
<td></td>
<td></td>
<td>33</td>
<td>0.115</td>
<td>0.234</td>
<td>0.381</td>
<td>0.537</td>
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<tr>
<td></td>
<td></td>
<td>35</td>
<td>0.111</td>
<td>0.234</td>
<td>0.381</td>
<td>0.537</td>
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<td></td>
<td></td>
<td>49</td>
<td>0.132</td>
<td>0.230</td>
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<td>0.121</td>
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<td>GROUP 2</td>
<td></td>
<td>32</td>
<td>21</td>
<td>0.021</td>
<td>0.089</td>
<td>0.210</td>
</tr>
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<td></td>
<td></td>
<td>0.015</td>
<td>0.064</td>
<td>0.220</td>
<td>0.368</td>
<td>0.497</td>
</tr>
<tr>
<td>GROUP 3</td>
<td></td>
<td>29</td>
<td>0.010</td>
<td>0.062</td>
<td>0.200</td>
<td>0.360</td>
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<tr>
<td></td>
<td></td>
<td>0.010</td>
<td>0.062</td>
<td>0.200</td>
<td>0.360</td>
<td>0.493</td>
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Note: All values are in scientific notation.
Based on these figures it is clear that the time period in which the dispersion method is effective is limited. The viscosity also increases by the uptake of water by the oil (water-in-oil emulsion) see figure 8.

![Graph showing viscosity of remaining oil as a function of evaporation and water uptake.](image)

**Figure 8** Viscosity of remaining oil as a function of evaporation and water uptake.

The time available for effective chemical dispersion might be as little as a few hours.

As an example: For effective chemical dispersion a limit of 2000 cSt is recommended. From figure 6 the evaporative loss to reach the 2000 cSt value can be found. For kuwait crude for instance 38 percent should be evaporated.
38 percent has been reached within 13 hours after spillage for a 10,000 m³ spill of Kuwait crude, for smaller spillages the time period is much shorter. And if the oil forms a water-in-oil emulsion which occur in most cases in a short time (see figure 9) the 2000 cSt value is reached much faster.

Figure 9 Uptake of water as a function of time.

Another type of non-dispersable oil is an oilslick in the third spreading phase accordingly to Fay where the net surface tension is the driving spreading force. The net surface tension is the sum of the "forces" which act at the circumference of the oilslick and are due to surface interfacial energies.
As a dispersant is a surface active agent it changes the net surface tension. In case of thin oil layers, (oil slicks in the third spreading phase), dispersants even can contract the oil slick like a herder.

Field experiments has demonstrated that dispersant application from aircraft was such that the time spread from first largest drops to final smaller drops was about 15 seconds. This was enough to ensure that the drops arriving early would herd the oil see photo 10 and result in later arrivals falling on clean water surfaces. This will lead to less ideal dispersant oil ratios (ref. 2).

Figure 11 shows the spreading phase as a function of spilled volume. Based on this figure it is clear that the third phase of spreading for small spillages is reached very rapidly and thus the time period in which the dispersion method is effective is limited.

Figure 11 Spreading phase versus volume spilled.
4. Conclusions and recommendations

- There is no point in trying to disperse an oil which cannot be dispersed effectively. Non dispersable oils are:
  - non spreading oils
  - high viscosity oils (＞2000 cSt)
  - water-in-oil emulsions
  - oil slicks in the third phase of spreading.

- Above mentioned stages of non dispersable oils will be reached in short notice due to weathering processes. The time available for effective chemical dispersion might be as little as a few hours.

- The mechanical recovery method has always first priority and could be used up to a significant wave height of 1.50 m. Above these waveheight natural dispersion is the best and effective combating method.

- Only when dealing with larger slicks may it be necessary to consider the chemical dispersion method in addition to the recovery method. But in case of non dispersable oils or marginal effectiveness of the chemical dispersion method it may be wise to accept the unrecovered oil come ashore to be treated there.

- In case dispersants are used the dispersant/oil ratio should be higher than laboratory experiments have shown to achieve an effective dispersion.

- Instead of using dispersants to increase the dispersion process additional energy could be applied on dispersable oils by boats as an alternative.
References


4. 1981 IMO/UNEP: "Guidelines on oil spill chemical application and environmental considerations".


6. 1980 Kuiper, H.D.: "Processes which influence the motions and characteristics of oil at sea".
