1991

Maritime environment protection: its influence on maritime operations and maritime education and training

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MARITIME ENVIRONMENT PROTECTION; ITS INFLUENCE ON MARITIME OPERATIONS AND MARITIME EDUCATION AND TRAINING

by

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India

A dissertation submitted to the World Maritime University in partial fulfilment of the requirements for the award of the

Degree of Master of Science

in

Maritime Education and Training (Nautical)

Year of Graduation

1991

I certify that all material in this dissertation which is not my own work has been identified and that no material is included for which a degree has been previously conferred upon me.

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

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MARINE ENVIRONMENT PROTECTION; ITS INFLUENCE ON MARITIME OPERATIONS AND MARITIME EDUCATION AND TRAINING

DEDICATED
TO
MY PARENTS
MY WIFE ESTHER
AND DAUGHTERS
VINESSA AND NERISSA

ACKNOWLEDGMENT

In the preparation of this paper, I am deeply indebted to all those who provided me with their guidance, information and above all the encouragement, which made it possible for me to write this paper. I would like to express my profound gratitude in particular to:

Professor J. H. Mulders, my course Professor, Mr Van Walen my lecturer, and Professor A. D. Couper my co-assessor for providing information and guidance whilst directing and assessing this paper.

Other Professors, Lecturers and staff of the WMU for their co-operation and goodwill.

The Shipping Corporation of India and the Maritime Training Institute for nominating me for this course and to the Swedish International Development Authority (SIDA) for sponsoring me for the two years fellowship in Maritime Education and Training (Nautical) at the World Maritime University, at Malmö in Sweden.

My senior colleagues at the Maritime Training Institute, Capt R. D. Kohli and Capt V. Subramanian for their encouragement and to Capt T. D. Hazari who provided me valuable guidance.

My colleagues at the WMU, for their friendly ideas and discussions.

Last, but certainly not the least my wife Esther and daughters Vinessa and Nerissa who have had to put up with the hardships of a prolonged separation and for their support and encouragement that has made it possible for me to pursue my studies at the World Maritime University.

CONTENTS

PREFACE

Most of my childhood days and a better part of my adult life was spent living near the coast of Bombay on the Arabian sea. In the good old days there used to be a beach that was our frequent haunt as kids. I have seen the condition of this beach slowly deteriorate, and to-day there is nothing left of the beach. The beach is lined with garbage of all sorts, and most of it is washed ashore from the sea. This is not only an unpleasant view, but is detrimental to the health of those who use the beach.

Later on, when I went out to sea, the same problems began to develop, the amount of ships garbage began to increase and new types of packaging replaced the conventional reusable containers like bottles, causing more garbage to be dumped into the sea.

The deterioration of environment quality which began when man first collected into villages and utilized fire, has existed as a serious problem under the ever-increasing impacts of an exponentially increasing industrialized society. This has also left its impact on the types of hazardous cargoes that are being carried in sea transportation. These cargoes have come to be classed and known as "marine pollutants"

During the first year of our training at the World Maritime University we were introduced to many new areas of learning by way of seminars on various topics. Of these, there were two seminars that made a real impression on me, and it made me really think. One was " Marine Affairs - part 1 ", and the other one was " Marine Environment Protection ". These two seminars opened our eyes to the ever increasing threat that the oceans are facing.

later on, we went on to study the different types of legislations that were introduced by IMO to control marine pollution. These legislations as we understood it, were far too complicated for an average seafarer. Because of this, there is a tendency for ship's personal to ignore some of the rules and get away with it if it were possible. It was also easy to understand, that in most cases it was almost impossible to apprehend the culprits, and so the vicious circle continues.

It didn't take me long to realize that the problem of marine environment protection could be solved by making the laws simpler. If this was done, then one might find improvements in their compliance. But this may not always be possible for some reason or the other.

The other way that this problem can be solved is by making the professional seafarer himself understand the problem that the whole world is facing, and this will automatically built up a sense of responsibility in him. It is with this goal in mind, that this paper has been written. The paper takes the reader step by step to the understanding of the subject. From the weather that shapes the earth, to the ecological systems that confront us, and finally the problems that man has to face today.

In the paper " Marine Environment Protection, its influence on maritime operations and maritime education and training" I have sought to bring about the fact that man's fingerprint is found every where in the oceans. Chemical contamination and litter can be observed from the poles to the tropics and from beaches to the abyssal depths. This is because of mans ever increasing industrial activity. This has been contrasted with the earlier ages when mans activity didn't harm the marine environment.

The paper also analyses the steps taken by IMO and the effects that these steps are having on the preservation of the marine environment. The results show us that legisla--tions in themselves will not serve the purpose of prevent--ing pollution of the oceans. The answer to this lies in educating our seafarers about the problems of polluting the oceans. It is only when they realize that the destruction of the environment will eventually mean their own destruction, that they will become responsible people and in this way they could become guardians of the marine environment.

In chapter 5, this paper aims at making an attempt to develop an advanced training course on marine pollution prevention. It also gives the learning objectives for all the subjects that are expected to be covered, and it also outlines a basic course on marine environment protection.

This paper is only a beginning and provides an approach to the development of marine environment protection courses. When I resume my duties in the next year, I hope to further develop the details on the actual development of the course itself.

Finally, if this paper is well accepted by the WMU faculty and if some day this training programme is implemented, it would give me the greatest satisfaction that my time and efforts have been well spent.

CHAPTER -1

THE MARINE ENVIRONMENT

1.0.0 A THREATENED OASIS

In our solar system the earth is the only planet with an appreciable supply of liquid water. This rare gift is essential for life and consequently, as the only intelligent and conscious species, mankind should consider the protection of this water system - Rivers, Lakes, Seas, and oceans alike-as the first condition for survival.

1.1.0 THE OCEAN ATMOSPHERE SYSTEM.

The earths surface has three primary components, The Hydrosphere, the Lithosphere, and the surface outer shell of rock. The total surface water covers an area of about 361 million square Km, as compared with the total surface area of the earth of 509 million square Km. It thus covers 71 % of the earths surface. In terms of volume the oceans and seas cover 1370 million cubic Km, and the atmosphere (vapour) approximately 140000 cubic Km.

The atmosphere which is constantly in motion, shapes the complex patterns of weather and climate of the globe and in doing so it agitates the ocean surface. The atmosphere due to its different pressure systems andK temperature systems give way to events such as rain, hail, snow, fog, rough sea and to violent revolving storms. As a result of this, the atmosphere agitates the ocean surface to create tides and currents and many other phenomena that we encounter.

The atmosphere and the oceans systems therefore do not play isolated roles. In fact, and in a sense the atmosphere and the oceans constitute a single system of two fluids interacting with each other. It is not until recent years that meteorologists and oceanographers have realized this dependance, and which have come to be known as the " OCEAN-ATMOSPHERE SYSTEM ". The effects of this system range from local disturbances like eddies to effecting global climatic fluctuations, not only for short durations, but may extend for decades and even centuries. These disturbances are therefore going to have an affect on maritime activities such as fishing, merchant shipping, off- shore drilling and diving.

It is not the intention here to go into every detail pertaining to global winds and weather - rather it will suffice to recall that as a result of our earths inclination of about 66.5% to the orbital plane, we experience various seasons, and these together with the prevailing dominant world winds, we get different types of weather condition around the globe. Thus; these are seasonal rhythms in global patterns of wind, pressure and precipitation. We can thus say that <u>our planets inclination together with the ocean atmosphere system is solely responsible for life as it exists today.</u>

The meteorological conditions, or weather systems not only have a very large influence on the movement of the surface layer, but also the whole water columns beneath it. The unequal heating of the land and sea masses causes the well known land breezes to blow during the night and the sea breezes to blow towards land by day. Then there are the local weather conditions such as the Foehns, Bora, or Mistral which produce intense wind condition which have pronounced effects on the coastal regions. Tropical revolving storms : often referred to as Hurricanes, Cyclones , and Willie -Willies, are centers of low pressure that form in localised areas of the world, and they can be most devastating, causing much loss to human life and property. These can cause disturbances over hundreds of miles. In the Indian ocean, we have the semi-annular Monsoons circulating system between June and September as a result of the low pressure built up due to the over heating of the west Asian land mass.

Even so, with all the vagaries that these ocean -atmosphere system bring to us, they also bring with it the wonderful bounties of nature. In the monsoon phenomena just mentioned about; the monsoon clouds bring in much moisture from the Indian ocean and virtually unload its contents in the form of heavy rain, which in turn nourishes the paddy and bring food and fruit to the land and also replenishes the lakes and rivers and its ground water which is much needed for survival.

1.2.0 THE OCEAN AND LIFE.

The largest biological environment on our planet is found in our oceans. The oceans two-dimensional surface area are twice as much as the land and fresh water areas combined, but the true greatness of the oceans is only realized if we also take the depths of the ocean into consideration. Although life in the oceans floor region may be less than that of land and in the skies; there is a vast mid - water environment with an enormous volume of some 1370 million cubic Km. which is abundant in living organisms.

In spite of the size of the ocean environment, the oceans have a small variety of species of animal life. Off over a million different animal species in this world, only about 160,000 live in the seas. Off these only 2% live in the mid water and the remaining being the benthic or the ocean floor community, and this is not surprising as this is where there is abundance of microscopic phytoplankton upon which they live.

In the seas, there is a good deal of environmental variation in shallow seas near warm coastal shores, temperate shores and ice covered polar regions. However the variation in this area is negligible compared to the vastness of the oceans. The rest of the oceans however have a remarkably stable and uniform environmental conditions. Temperatures in excess of +5 degrees Celsius are restricted to a narrow near surface layer. Similarly the sea water salinity never varies by more than a small percentage. As a result of these conditions the ocean environment does not change from place to place as it happens on land. But it is possible to distinguish general marine biological zones and provinces depending upon their distance from land and their depth beneath the surface. There are mainly four marine biological zones: (see fig 1, profile of continental margins and fig 2, divisions of the marine environment on pg 6).

1.2.1 The epipelagic or euphotic zones:

This zone extends to a depth of about 100 meters which is a very thin layer, but it is important as its lower boundaries limit the penetration of sufficient sunlight which helps in supporting photo-synthesis. Photo-synthesis is the essential process by which sunlight converts nutrients into living cells which are the building blocks of life. Most of the marine resources live in this region.

1.2.2. Mesopelagic zone:

This extends down to about 1000 meters and to the very limit of sunlight penetration. Species in this zone either come up for food, or rely on scavenging or on other migrating animals. Most species have adapted to the hazardous conditions by camouflage.

1.2.3. Bathypelagic zone:

Between 1000 m. to 2000 meters living material and number of species are relatively small compared to the mesopelagic zone. Few animals migrate or are active at this depth because they have to conserve energy.

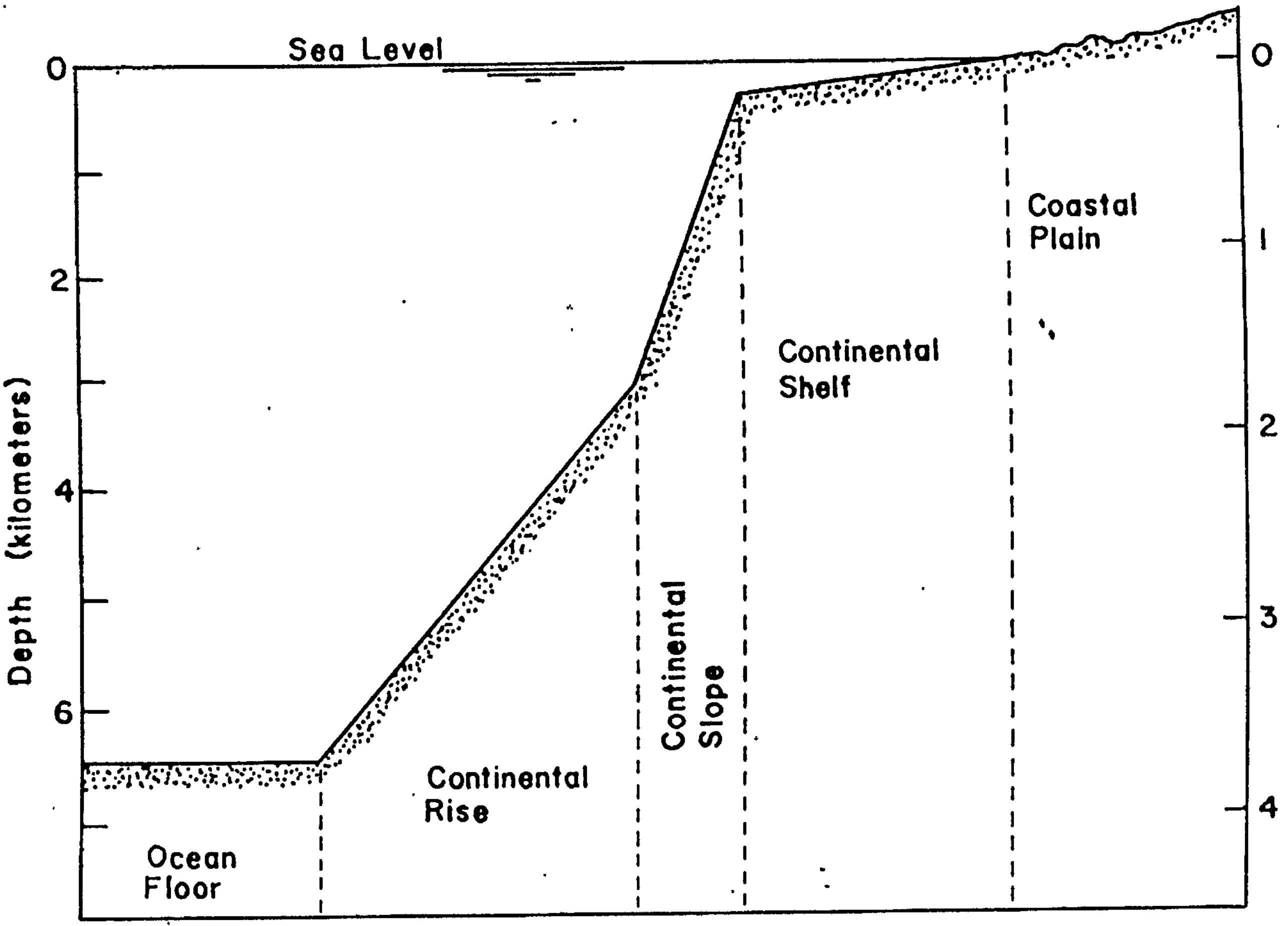

Figure 1 Schematic profile of continental margins.

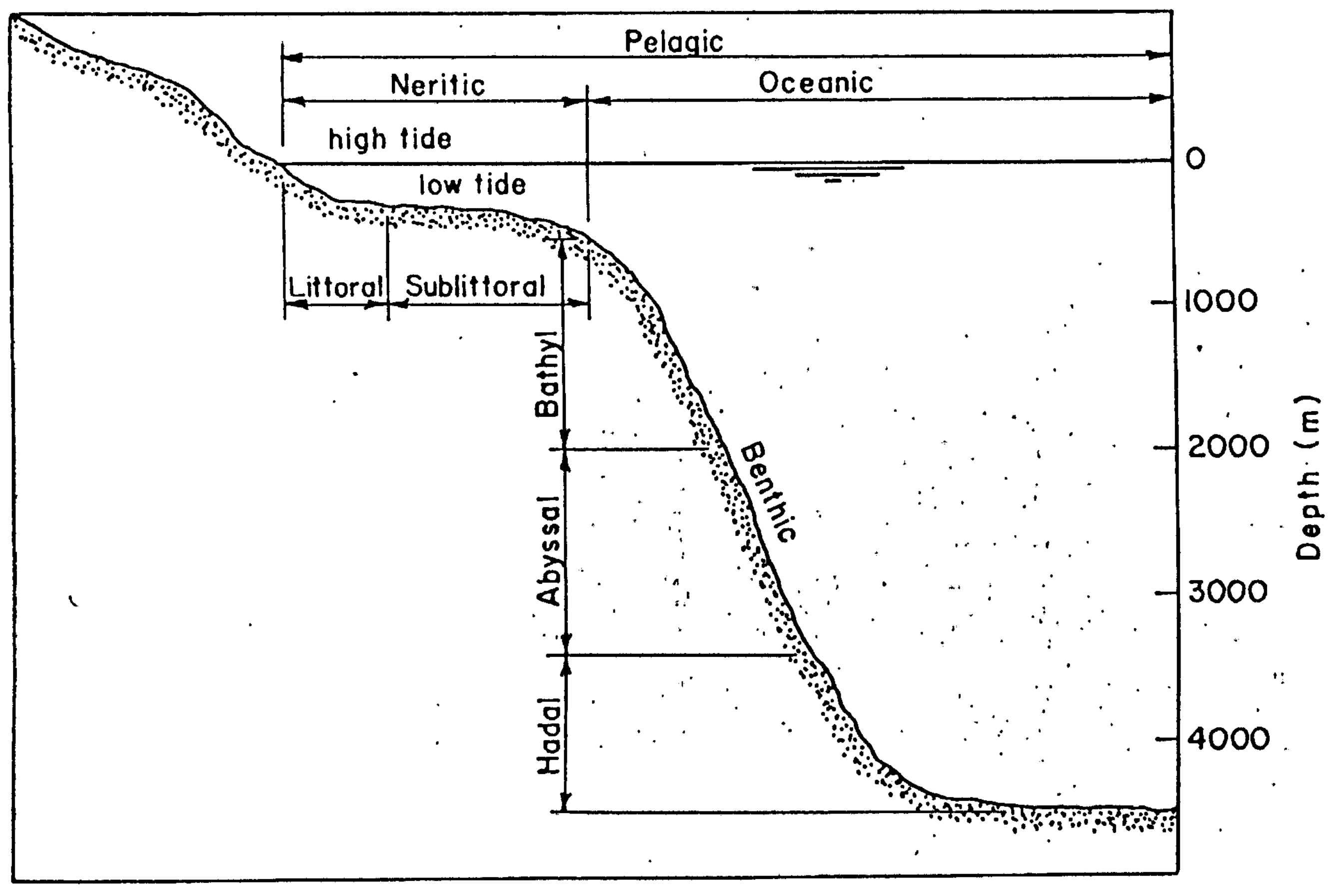

Figure 2 The divisions of the marine environment.

1.2.4. Abyssopelagic zone:

Extends from 2000 meters downwards. There is a decrease in water fauna, and on the ocean floor there is an increase in bio mass. There is a pelagic community associated with the ocean floor. Here live strange rat-tail fishes, which are still being explored.

1.3.0 THE PLANKTON: (Which means wanderers or drifters)

1.3.1 PYHYTOPLANKTON:

Unlike on land, where you have large plants and trees; in the oceans the main plant producers are tiny microscopic plants called phytoplankton. Just like on land where plants use sunlight together with carbon-dioxide and water to produce carbohydrates; so also do the plants in the shallow seas where sunlight can penetrate (ie; to approx 100 meters in some regions to about 40 meters in some other). This depth would depend on weather conditions, temperature, latitude, seasons and suspended matter in the water. In these regions different types of plants (or sea weeds or algae as they are known) also grow. The region where these algae are found account for less than 1% of the sea vegetation, and from this it is very clear that the bulk of marine plant life is in the form of tiny microscopic plants called phytoplankton.

For phytoplankton to flourish, there must be sunlight, temperature and nutrients like nitrogen, phosphores, calcium etc. Higher the temperature, higher is the rate of production. So also production is higher in coastal regions because of the shallow depths and the availability of sunlight. Nutrients may come from rivers mouths and generally these areas also have high concentrations of phytoplankton. Then there are areas which have strong vertical water currents, these areas are called upwelling areas. These currents pick up nutrients from the sea bottom and bring them up to the surface where there is sufficient sunlight and consequently such areas have the highest concentration of phytoplankton production.

In colder near polar regions, the water column rarely develops a significant thermocline and therefore the water column is unstable and this to-gether with currents bring nutrients to the surface from very great depths. Hence you find that some polar and sub- polar regions are among the most productive regions of the world.

The sub-tropical and tropical regions have the right temperature and light for the production of phytoplankton throughout the year, but this area also has a strong thermocline ie; very stable water columns and therefore nutrients come up only in specific regions. In the tropical regions, such areas of high productivity would occur between the westward flowing equatorial currents driven by the trade winds and the adjacent eastward flowing equatorial countercurrents.

1.3.2 ZOOPLANKTON:

The zooplankton or animal plankton, contains representatives of all the main animal groups from the protozoans to larval fishes, and they come in all different forms; from microscopic forms to jelly fishes with disc a meter wide and with tentacles many meters long. The zooplankton are ultimately dependant upon the phytoplankton which is the primary source of food, even if they have other sources of food. Because of the above, zooplankton are almost found equally distributed as that of the phytoplankton. They naturally have to follow their food source, and therefore unlike phytoplankton they are not restricted to only sunlit areas of the ocean and they can be found at all depths. Many of there species move towards the surface during the night and descend to several hundred meters during the day. As far as we are concerned the zooplanton are particularly important, as they form the first link between the primary production of vegetation and the animal life.

It is estimated that the world annual phytoplankton production to be around 15 to 30 billion tonnes of carbon, against this the annual fish production is a meager 2 to 30 million tonnes of carbon. One important cause of this difference must be the nature of the trophic relationships in the marine environment (that is the number of links in a food chain). Four or five trophic levels are common between phytoplankton and the higher carnivores. The feeding chain of this environment is so complex that it would be rather more like a web than a chain.

1.3.3 THE PLANT LIFE

Plants support the entire biological community through their production of food. They are confined to the upper 100 m. or so of water by the availability of sunlight and the food produced here nearly supports the whole animal population. Algae has the overwhelming majority of marine plants. Some remain anchored to the sea bed and others are planktonic, There are many varieties and they are given names resembling their colour and they range from blue, green, brown, and red.

1.4.0 THE BENTHOS:

This is a term user for all marine life living off the ocean floor. They come in a wider variety of form, and amount to about 98 % of all marine species. The largest variety live in the shallow water and others may be found as deep as in the abyssal plains. In the shallow waters these species have an abundant supply of phytoplankton. In the deep reaches of the ocean, they remain mostly anchored to the ground and seldom move or they move very slowly in order to conserve energy. They live of the nourishment of the floor or from the excreta that fall to the ocean floor. Benthic animals are found throughout the ocean floor, even in the deep sea trenches at depths in excess of 10,000 m. Just a few years ago it was believed that life could not exist at depths of greater than a few hundred meters.

Benthic fishes display three different feeding habits.

Some, such as star-fish, crabs, snails etc. move about in search of their sustenance. Others, such as corals, sponges, bivalves such as clams, mollusks, oysters, and barnacles, tube worms, etc. filter their sustenance from the water. Still others, such as some segmented worms, ingest the sediments for the nutrients they contain.

1.4.1 THE PELAGIC ENVIRONMENTS:

The pelagic environment is conveniently divided into the upper sunlit photic zone and the deeper dark aphotic zone. Different types of organisms tend to be found in these two regions, and various forms of animal life can be found at all depths. In clear ocean water the photic zone extends to a depth of roughly 100 m. which can be reduced in turbid coastal waters. The pelagic environment can also be subdivided into the waters over the continental shelves, and the waters of the deep ocean floor.

Fishes are but one of many groups of organisms which live in the above environment. A few of these are exploited by man for food, but the vast majority of them are not commercially important. Fishes live at nearly all levels of the ocean, from the air-water interface down to the water-land boundary, to depths at least as great as 8300 m. Around 58 % of fish species are marine and of these only about 13 % occupy the deep ocean. Little more than 250 species are permanent residents in the epipelagic zone, yet there are approximately 1000 meso-and bathypelagic species and nearly 1300 benthic forms dwelling on the ocean floor.

Most fishes are nekton, or free- swimmers, they have the ability to move with controlled locomotion over considerable distance. This ability has apparently developed to allow escape from enemies, to pursue its prey, and to negotiate necessary migratory travel. Study and observation have conclusively shown that the nekton is unalterably dependent on other life for its existence; it is assumed, therefore, that plankton and benthos were fairly well established in the evolutionary chain before the nekton developed ecologically.

Nekton is primarily composed of fish, both demersal and pelagic; invertebrates such as octopus and squid, and marine mammals. The demersal fish are those which spend their adult life swimming very close to the bottom, usually in the continental shelve, and have adapted their physical characteristics accordingly. Some primary examples of the demersals are flounder, cod, haddock, sole, and halibut, all of which have commercial importance.

The pelagic fish generally live near the surface in both the continental and oceanic provinces wherever there is a sufficient planktonic food supply. The sharks and true fish (water-breathing through mouth and gills and having bony skeleton) are both travelers of the open sea. Each species has adapted itself to the primary environment of preference, but does, in many cases, migrate great distances for spawning. The eel and salmon are examples. The squid has a water jet propulsion mechanism making it unique in the marine environment, and it operates in a large depth range. The marine mammals are thought to have moved from the dry land since their original development. The whale is joined by the porpoise and dolphin in the nektonic realm. The seal, otter and polar bear are also properly considered as nekton, but must live near the shore to care for their young.

1.5.0 THE OCEAN BIRD LIFE.

Here are approximately about 8600 species of birds in this world and out of these about 300 are really marine, that is they actually live off the sea. Seabirds are numerous in regions where there is turbulence and upwelling which cause the surface to be rich in nutrients because this supports an abundant supply of invertebrates and fish. It is for this reason that you find fewer seabirds in tropical and subtropical zones and in this region marine birds are normally found around islands or shallow water areas. The annual changes in the atmosphere and the ocean circulation causes food supply to vary and this also changes the breeding cycle and other habits of the sea birds.

Seabirds can be classed into three broad categories; distinguished by their habitat. Those which dive near the coast line like the Pelican, Cormorants, sea gulls and coastal terns. Those which dive for fish in offshore waters like Penguins, diving petrels and gannets, and finally those which frequent the open oceans and spend much of their lives on it, like the Albatrosses, Shearwaters and Petrels.

All seabirds nest on land and their choices differ widely. They range from coastal cliffs, niches, grassy slopes, bushes trees and mangroves along the coast. A few of the seabirds breed in small colonies, but a vast majority of them breed in congested colonies, for example : Penguins rookeries are so congested that they may have a few million pairs. All seabirds collectively exploit all the resources of the upper oceans, like small and large fishes, flying fish, squid, krill, crustacea and they all have various techniques and habits. The sea gulls with which we are most familiar are notorious scavengers.

1.6.0 LARGE ANIMALS OF THE SEA.

The sea is also the home of a number of large animals many of them being mammals. They are the seals found in the colder waters in the northern and southern oceans. Their, very near relative the Walruses are also found near much colder or icey waters. There are many different types of species of seals and Walruses that are found and they spend much of their time along the shore as they spend in the water hunting for small fishes like herrings. These animals also live in colonies along the coast. Last, but definitely not the least are the largest animals of the oceans, the Whales. In the last few years they have been hunted indiscriminately and a few species have reached extinction. They are however now protected by a ban on hunting. The whales are divided into two main groups, the baleen whales which have enormous mouths which they use to feed on small fishes like krill which they filter through their baleen. The toothed whales on the other hand do not live on krill but live on larger prey, from large fishes to a giant squid. The largest animal that has ever existed on the surface of the earth is the blue whale. During the feeding period an adult may consume as much as 3 tons of krill per day, and their calves are about 7 meters at birth. The second largest in size is the Fin whale, and the Sperm whale is the deepest diving of the whales and can descend to 1000 m. for an hour.

1.7.0 MARINE FOOD CYCLE (CHAIN OR WEB)

EQUATION OF LIFE.

We can summarize the description of the production and use of food on earth by the equation of life. In photo--synthesis, the energy that is used is sunlight. When plants and animals respire, the energy that is generated is used in its own body processes, such as for locomotion, digestion, body heat etc. Respiration is very similar to the way in which we produce energy by fire or by using petrol in our cars. In the following paragraphs we will see that the equation of life follows a cycle, and that it is within this cycle that the food web is spun.

The synthesis of organic compounds from the inorganic constitute of sea-water is carried out almost entirely by photosynthetic activity of marine plants. In the oceans, the dominant of plant life or primary producers is the phytoplankton, which are microscopic plants that drift along with the currents.

Due to their requirement for light, phytoplankton are restricted to the upper layers of the water and up to a depth where sunlight penetrates. This can vary from tens, to hundreds of feet. Because of seasonal, annual, and geographical variations in light, temperature, nutrients, and grazing by zooplanktons, the distribution and species of phytoplanktons vary from ocean to ocean and from place to place.

There are many functional interrelationships among marine organisms, for example: bacteria, in addition to decaying organic matter, they also produce vitamins and other trace nutrients. Some algae, sponges and coral produce antibiotics that are needed by other organisms. Some fishes clean parasites from some others in return for protection. Some algae, snails and other small creatures depend on eelgrass for support. In short, in stable marine communities, their interdependences become quite extensive and complex.

So also, the most important interdependences involves the supply of food. Food is repeatedly passed from prey to predator in ways that leads to talk about a link in a food chain, -- much like a ladder. However, if you have a closer look at it; it will reveal that it is much more of a very complex and delicate WEB. This is because, each of the nutrients may follow diverse routes through the living organisms in the oceans.

Less than 2% of the ocean is sufficiently shallow and has sufficiently firm substrata to accommodate large attached plants. Consequently, sea weeds, that we find washed ashore, do not represent a very large component of the plant population. Most of the oceans primary productivity is carried out by microscopic single celled plants, such as the phytoplankton. The sustenance of the oceans living organisms ultimately come from these primary producers.

1.7.1 HIGHER TROPHIC LEVELS.

Most of the organic matter produced by these plants is stored and subsequently oxidized by the plants themselves, but some is passed on to animals feeding on these plants, and some to animals feeding on the animals that feed on these plants. Each step along the way is called a trophic level. For example, plants make up the zero trophic level, and animals that feed directly on the plants are the first trophic level. In general, the individuals at each trophic level tend to be larger and more complex than those at the lower trophic levels on which they feed. But this isn't always true. For instance, simple microscopic parasites may feed on large fish or mammals. Often the trophic level is a matter of maturity rather than breed. The larvae or juveniles of large carnivores may be microscopic and feed directly on the plants.

A general rule of thumb is that each trophic level uses up about 90 % of the food it consumes and stores only about 10 % for passage on up to higher trophic levels. That is, most of the food materials consumed by any organism stops there and do not get passed on further. After these materials have been metabolized, the organism returns the waste products back into the marine environment where they can be reused by plants to start the cycle all over again.

Bacteria play a very important part in the process of the food web. They act on the waste products and other organic materials and convert them into forms that are useful to the plant life in the process of photosynthesis. Bacteria get their energy through the oxidation of organic

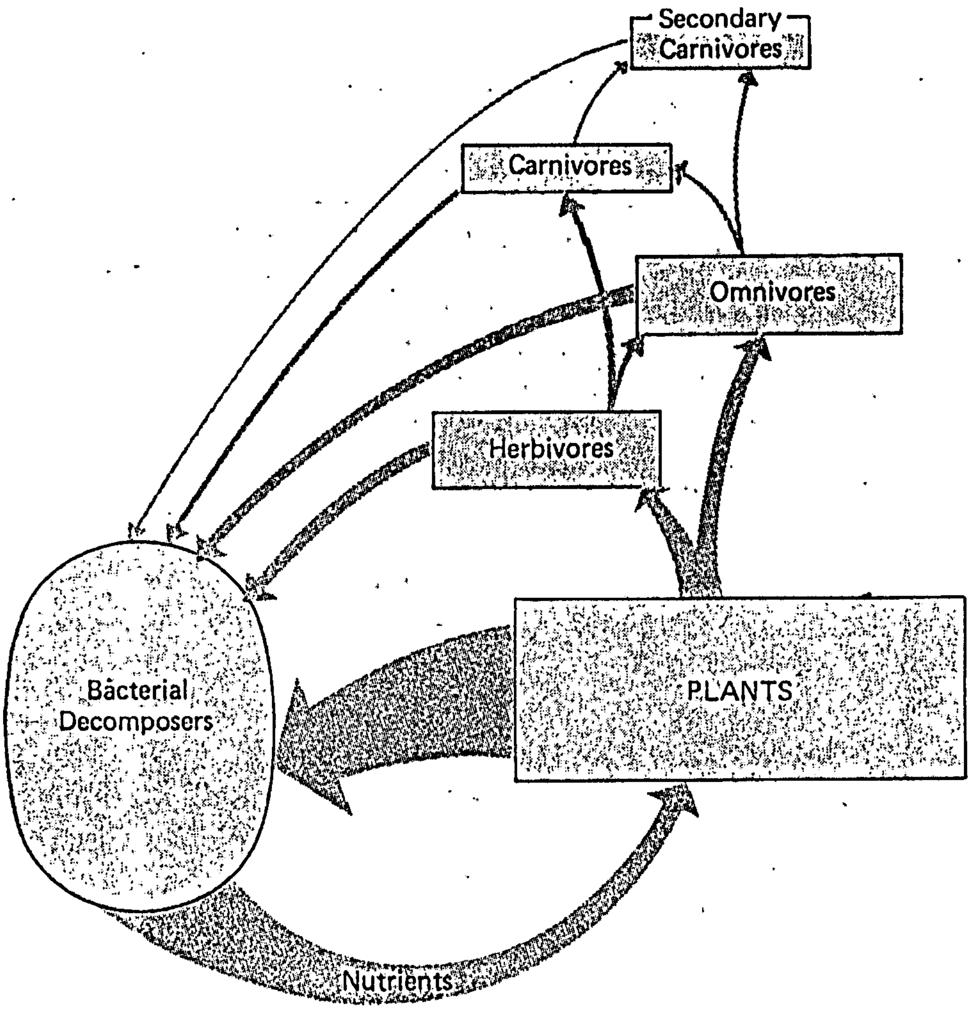

FIGURE 3.
Passage of food through the food web. On the average, only about 10% of the food consumed by an organism gets passed on to the next higher trophic level. The remaining 90% is eventually returned to the bacterial decomposers.

materials. Therefore in areas where there is less amount of oxygen the process of decaying is rather slow, and in the area where it is high the process is faster. Bacteria in themselves are not a major source of food in the food web. (see fig 3, on pg 18).

To sum up; the animals that live on the tiny plant life and other suspended materials are the microscopic and multicellular organisms such as the copepods, arrow worms and young ones of larger organisms. These organisms have the capability of filtering the water and collecting their food. They in turn serve as food for the smaller fish, which in turn help to concentrate the food in their bodies for transfer up to higher levels of the food web. For example; a large fish such as Tuna or even we for example could not be able to feed on microscopic organisms, but we could feed on smaller fishes such as Anchovies that live off these smaller organisms which in turn live on the microscopic life. We can see from this that the main function at each tropic level is to concentrate the food and pass it on to the next higher level, and also to complete the network of the complicated food web. (see fig 4, on pg 20).

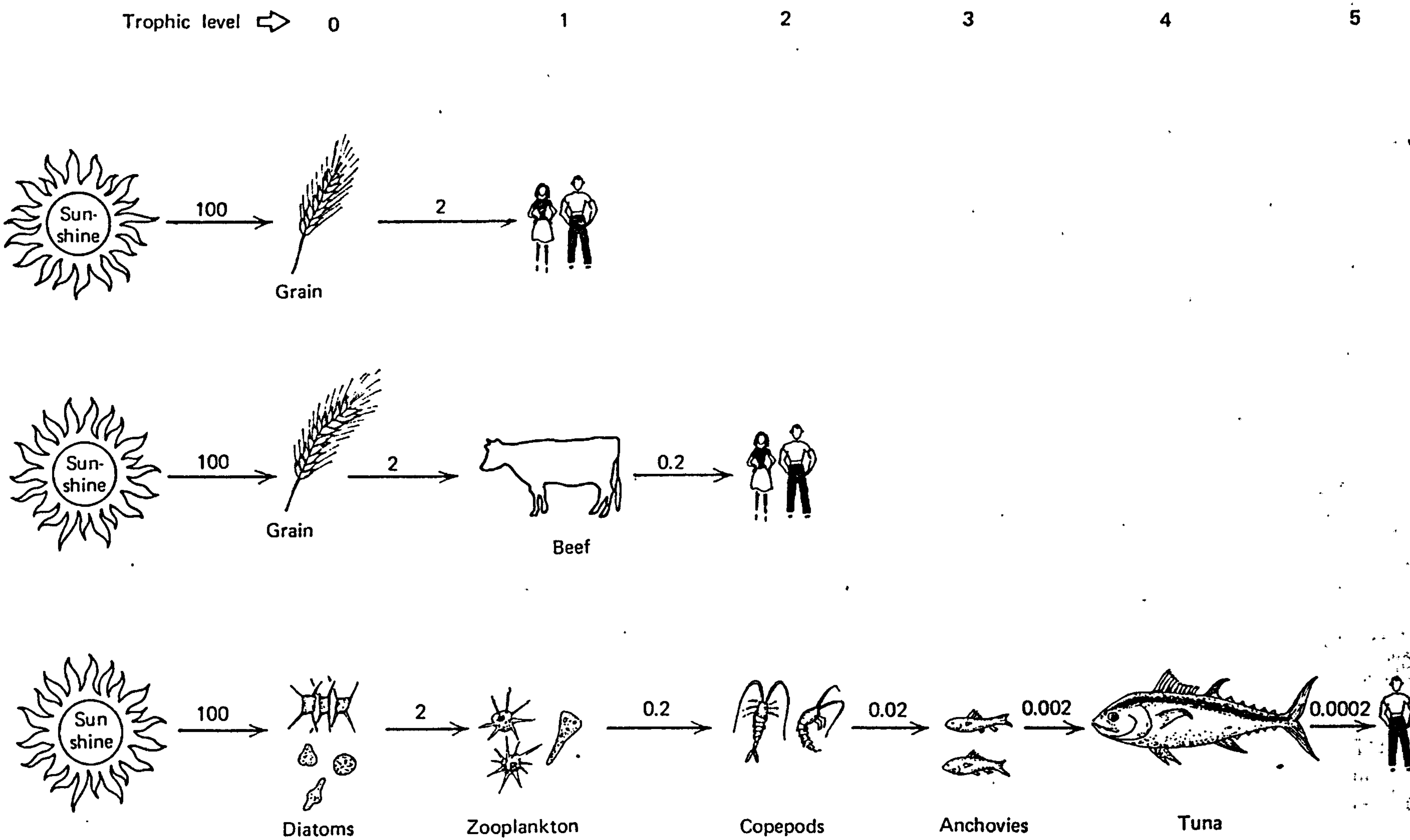

FIGURE 4.
Illustration of the amount of energy being passed on to successive trophic levels from the original 100 calories of solar energy incident on the primary producers. Clearly, it is most efficient to harvest the lowest trophic levels possible.

CHAPTER - 2

MARITIME OPERATIONS AND THE OCEANS

2.0.0 INTRODUCTION

In chapter 1, we were introduced to the Marine Environment, so that we could appreciate the performance of nature in the marine world. This nature in the marine world or ecology as it is called, is extremely delicate, and it can be very easily destroyed or disturbed by any activity which alters or interferes with the sensitivities of the ocean life. In this chapter we will see how this is systemati--cally being done, and how, advertantly or inadvertantly mans activities are damaging the oceans.

2.1.0 HISTORY AND DEVELOPMENT OF TRADITIONAL MARINE OPERATIONS

Man has exploited the sea for his food and for other resources from his earliest days. In fact there is evidence that suggest that the early man's diet consisted of bivalves in the same way as much of the animals that lived along the shore. In fact there is also evidence of " Man as a fisherman " which dates back to 8 to 10,000 years ago. During this period man used harpoons, nets, traps and hooks.

Ever since then; man learned the principle of flotation and also the principle of transportation on water, using small boats carved out of the bark of trees, e.g. as the Red Indians of North America. But the earliest sailors who crossed the high seas were known to be the Phoenicians in their papyrus boats, and later the Chinese and the Indians. Much later c.2000 the Romans in their galleon conquered territories and built a huge empire, which in years to come soon disappeared.

Then came the age of exploration. With much larger sailing ships in their fleet, the Portuguese and the Spaniards started exploring distant lands. Here came the great explorers like Columbus who sought a west passage to India and accidently discovered America. Vasco da Gama found the west passage to India for trading in spices, muslin cloth and gold, and then finally Ferdinand Magellan circum--navigated the world in quest for adventure.

If we stop for a moment and try to visualize the type of marine activities that man indulged in about this period of time, we will realise that his basic needs were the same. In fact; ever since man first set his foot upon the seas, till this time, and in fact even to our modern times, mans activities on the oceans consisted of four basic needs.

a) To fish for his food.
b) To travel for trading.
c) To travel for adventure.
d) To travel in conquest.

2.1.1 EFFECT OF SUCH ACTIVITIES IN THE OCEANS

Fishing as it existed in those days was very primitive in nature as compared to todays standards. It was done physically by using harpoons, traps and hooks from shore or from small wooden boats. This type of traditional fishing or ARTISANAL fishing as it is often called, is still being practiced to this day--in some regions of the world. This activity had practically no adverse effect on the marine environment; as every thing that was used in those days was made of natural materials. For example, the boats were made of wood and their nets were made of natural fibers. Even the fishing activity was limited in scale due to the primitive nature and also because of the small population it was required to feed. It didn't even pose problems of depletion of fish stocks.

Sailing merchant ships travelled around most of the known sea lanes in search of trade (mostly barter trade) and the commodities they looked for, was to import necessities in exchange for the needs of the trading country. Therefore, you will find that in those early days the items traded were mostly basic necessities of life, like food-stuffs such as grains, spices, tea, coffee, and clothings. Surely none of these items had any danger attached to their transportation.

Besides the above two types of ocean activities, only naval ships might have posed a problem as far as any danger was concerned, and that is, with the carriage of explosive material used in their cannons and fire arms. This would also be negligible in terms of its size or magnitude. To sum up it may be concluded that in the early days most of mans activities were limited to using the oceans in moderation and that too by using materials that were basically natural; for example all the ships were made of wood and they all tapped wind power by their sails, all sails and cordage were made of natural fibers, all cargoes were carried in wooden boxes, casks, or bags. All cargoes consisted of basic necessities and were natural consumer products. It would also be proper to say that up to this time man lived with nature and they got on pretty well.

2.1.2 THE COURSE CHANGES.

Except for the fishing industry, marine activities remained by and large the same. The fishing industry expanded to the deeper ocean regions and larger scale fishing for larger species like the whales proliferated. Fishermen started using more sophisticated techniques to haul in larger catches. At around the same time, the world experienced the Industrial revolution in Europe. This was the time when the course changed and the chain of events that followed it never stopped. Ships grew bigger, steel replaced the wooden hulls. Ships no longer used the inexhaustible wind energy, but were propelled by steam. The paddle boats, and ships using reci-procating steam engines, using coal as fuel replaced all sailing boats, and were the pioneers of the now familiar " Air pollution "

2.1.3 DEPLETION OF FISHING STOCKS:

With the rapid mechanization of the fishing fleets, the fishing industry developed factory ships for processing fish catches and large scale fishing began to deplete many stocks of fishes. The most noticed, and well known case was that of the whaling industry.

Large scale whaling developed in the North Atlantic in the 17th century by the British, Dutch, French and the German fleets. This was carried out in open boats with hand harpoons, in boats under sails or by oars from a mother ship. By the 18th and 19th century open boat whaling for sperm whale grew world wide. The discovery of oil in the late 1860's contributed further to its decline . By this time (19th century) the grey whale along the North American coast and the Bowheads in the Arctic waters were seriously reduced. The third phase of whaling began with the use of explosive harpoons from steam ships. The Norwegians pioneered this technology and soon depleted the north Atlantic stocks, before developing the Antarctic whale fishery in the 20th century. This was followed by the expansion of this industry quickly through the British territories, on the high seas and the use of factory ships in 1925. In the first half of the 20th century, coastal whaling flourished in many parts of the world, and by about this time, there was growing concern world wide for the conservation of whales because by then, some species were on the point of extinction. Iceland, Japan, Norway and the Soviet union, were the last major whaling nations before all stocks were protected from commercial catching in the late 1980's by the International Whaling Commission.

God tucked this oil in the bowels of the earth,
and out of reach of man - Yet they found it.

2.2.0 MODERN MARINE ACTIVITIES

2.2.1 THE DEVELOPMENT OF TANKERS

Oil was first discovered accidently in 1850 by colonel Edwin Drake in Pennsylvania in the U.S.A. and commercial production began around 1862. At first oil production was very limited and initially this oil was transported in barrels in the holds of sailing ships. As the demand for crude oil increased, the oil was carried in the deep tanks built into the holds of general cargo ships. During this same era; the concept of bulk carriage of coal and other cargoes originated, and finally this concept was applied to the carriage of liquid bulk cargo or crude oil carrier. In 1886 a British firm built the ss "GLUCKAUF" for German - American owners, thus creating the prototype of the first liquid bulk carrier, or TANKER.

As the demand for oil increased further, the tankers grew in size in the early 20th century. The demand for oil increased because the number of products of crude oil increased from just kerosene to a wide range of petroleum and others. The first world war and the second world war gave an impetus to the oil industry because it had to keep the war machine running. Together with the world war destruction, there was also a rapid industrialization in Europe and in America. During this time the size of tankers increased to a maximum of 50,000 DWT so as to be able to cross the Suez canal.

In 1967 after the six day war between Israel and Egypt, the Suez canal remained closed and it was anticipated that it would not reopen soon. This fuelled the cost per ton mile for crude to be carried around the cape of Good Hope. Shipowners were quick to exploit the economies of scale, and the tankers virtually grew in size overnight to very large crude carriers (VLCC's of over 200,000 dwt) and ultra large crude carriers (ULCC's of over 300,000 dwt) and over. These VLCC,s and ULCC,s appeared in the early 1970's.

So long as tankers remained small in size and in numbers, no one realized what potential threat these ships posed. It was only when tankers grew in size to about 50,000 dwt and over, oil and sludge began depositing on the beaches of Europe, so that these beaches could not be used for recreation. This was perhaps a minor problem compared to what was to come. The oil pollution in these cases stemmed from operations such as tank cleaning, stripping, tank washing and deballasting, and is known as operational pollution.

The more serious problems are those that followed. On 18th march 1967, the 119,000 dwt Liberian tanker, M.V. TORREY CANYON with a draught of 16m. ran aground on Pollard rock near Bishop's rock light house on the U.K. coast. The result was an open gash of about 200m. The rough seas pounded the ship; there was an explosion and finally the ship sank. The R.A.F. bombed the sea surface in order to set the oil on fire, but this had little effect, and the oil spill damage was massive along the British and French coasts. This problem arose out of error in navigation and for the first time the International community was worried about accidental pollution.

On 15th December 1976, another disaster was caused due to an error in navigation. This time it was the M.V. ARGO MERCHANT, a Liberian tanker carrying 28,000 tonnes of heavy fuel oil. She ran aground on Nantucket shoals not far from the entrance to New York harbor.

On 16th March 1978 the M.V. AMOCO CADIZ, once again a Liberian tanker of 232,182 dwt, experienced steering gear failure, which could not be repaired. She was assisted by one tug, but due to heavy weather, she ran aground off the Brittany coast of France. The damaging consequences were far more serious than the Torrey Canyon disaster. This pollution was due to engine failure. There were also pollution cases arising as a result of collisions between tankers and another vessels.

On 23rd March 1989 the M.V. EXXON VALDEZ, ran aground in Prince William Sound in Akaska spilling huge amounts of crude oil. The main reason was an error in navigation, which originated from the Captains inability due to abundant use of alcohol.

2.2.2 OFFSHORE DRILLING

It was realized quite early that oil remained in reservoirs that extended far into the sea. The search began and the first offshore wooden jetty platform was drilled in 1896 off the coast of California. Gradually, the offshore drilling progressed into much deeper water, and out of sight of land. The first such well was spudded in 1947 in the Gulf of Mexico. Such drilling activities grew dramatically in many parts of the world, particularly the Iranian gulf region. From 1960 onwards, offshore drilling, with its superior technology, ventured into deeper waters of the continental shelves, and by now, virtually all developed and developing countries with access to oil began to develop their resources.

Drilling by itself does not cause a major pollution problem, as the seepage is not too much, but there are other problems. The gas that comes out of the drilling process is invariably let out into the atmosphere or they are flared, both of these cause pollution problems particularly when there are a number of wells. These offshore structures also pose a threat or interfere with fishing and surface navigation. Also with sophisticated offshore operations, there are other servicing operations that take place, like sub- sea pipeline laying, storage tank facilities, under water repairs and maintenance to structures, and use of divers and submarines. All these will contribute to the disturbances to the local marine eco -system.

2.2.3 SEA BED MINERAL MINING

Although many people may consider offshore mining to be a new frontier for mineral development; the recovery of sand, gravel and tin from relatively shallow water has been going on for decades. The only difference now, is the fact that as mineral resources on land becomes scarcer and costlier, man has turned to the sea which is even richer in minerals. Today a wide range of minerals are mined offshore and in the continental shelf, and they include gold, tin, silica and carbonated sands. In recent years there has been an interest in deposits in the deeper oceans. These deposits contain rich metals and are called polymetallic sulfides and manganese nodules. Manganese nodules contain concentrations of iron and manganese oxides which also have nickel, cobalt and copper. Although commercial mining in this sphere has yet to start; it is bound to take off in the very near future. The influence this industry will have on the environment will be very similar in nature to that caused by offshore drilling, and perhaps slightly greater, as in the mining process damage will also be done to a greater sea bed area.

2.2.4 CHEMICAL CARRIERS

Chemicals represent about 10% of the total world trade in terms of value. Some 70,000 to 80,000 chemicals are now on the market; and hence in the environment. These figures are only informed estimates and no complete inventory has been made. Some 1000 to 2000 new chemicals enter the commercial market each year, many without adequate prior testing or evaluation of effects. Chemical carriers and other ships that carry chemicals in parcels are carrying out the hazardous task of transporting such chemicals.

Such chemicals may very easily enter the marine environment, by accidents, such as loss of cargo overboard, jettisoning of cargo, and total loss of an entire ship carrying such dangerous cargoes. This pollution adds to the normal pollution as a result of run offs from land; which incidentally form the major part of marine pollution. The damage that dangerous chemicals such as DDT and PCB's are capable of doing are well known and will be dealt with in the next chapter. It is needless to say, that chemicals cause the most disastrous form of marine pollution.

2.2.5 DREDGING

Although dredging in ports, harbours and waterways may be essential for marine commerce, and the economies of the countries involved; adverse impacts from dredging operations may occur at two separate locations. The dredging site and the dumping grounds. The immediate effect is the destruction of benthic organisms and obliteration of a potential spawning ground.

2.2.6 OCEAN DUMPING OF SHIPBOARD, AND OTHER WASTES.

All shipboard wastes like sewage and garbage when dumped near the coast, adds to the problem of pollution. It may not be such a problem, when dumped into the open sea, as the effect becomes diluted. However when this discharge is done close to the shore, it is another matter. Unsightly floating matter and pathogenic organisms are generally objectionable aspects of these discharges.

Large quantities of city or municipal solid waste materials, such as sewage sludge and solid wastes such as garbage are dumped into the oceans daily by many countries, these wastes also include waste chemicals, rubble from building construction work and demolition. This is the major factor that goes into making the oceans the ultimate sink.

Industrial wastes are also being dumped into the oceans by barges or from outfalls from the factories into the sea or into rivers, which ultimately find their way into the oceans. Most of these discharges are highly toxic and damaging to the marine environment.

Burning has been the best way of wastes disposal ever since man came into existence, and one of the modern ways of disposing land based wastes was to incinerate the wastes at sea. This was found attractive as remote sites could be designated with negligible effects to the marine environment. The optimal procedure for incineration at sea is to conduct it whilst steaming clear of shipping routes in the open sea.

The arguments against incineration at sea are chiefly that there may be some reformation of toxic materials in the flue gases, that emissions may damage sensitive species in the sea-surface micro-layer, and that the continued availability of this technology may act as a disincentive to reducing wastes at source. One of the fears expressed was that an accident may occur during transport to the burn site.

In 1988, all countries party to the convention for the prevention of marine pollution by dumping from ships and aircrafts, 1972 (Oslo Convention) agreed to phase out incineration at sea by 1994. Contracting parties to the LDC have also agreed in principle to discourage incineration at sea.

Pesticides like DDT and PCB's that are used on land for farming finally find their way into the oceans, either from the atmosphere after aerial spraying, or from overland runoff of sprayed areas or from intentional dumping in the sea.

Anti-fouling paints are used on all vessels ranging from ocean going to small boats. These paints that are used, contain heavy metal poisons that kill living organisms and thus prevent the hull from being fouled with marine growth. Unfortunately these metals continually build up in the water and in the sediments near the vicinity of docks and dry docks.

Then, we have radioactive nuclear wastes, and the list, just doesn't seem to end. If one recalls the marine activities of man in his traditional ways, which existed barely a century back, one can very plainly see the destruction that man is causing to his very origins.

CHAPTER- 3

NEED FOR MARINE ENVIRONMENT PROTECTION

3.0.0 INTRODUCTION

"Like human beings, the oceans require a regular check - up." Professor Alastair McIntyre.

The first survey or check - up was done by the group of experts on the scientific aspects of marine pollution (GESAMP) in 1982. The second GESAMP study of the state of the health of the marine environment has just been published in 1990. There are many other individual studies that have been made, by environmental groups and flag states. This chapter will help to bring out the crying need of the hour and that is, the need for marine environment protection (MEP):

3.1.0 THE BALANCE UNDER THREAT

Late in 1983 the Secretary General of the United Nations asked Norways Mrs Gro Hardlem Brundtland - the only politician in the world to proceed from the post of environment Minister to Prime Minister- to put together an independent commission to look at this grim syndrome and suggest ways into the next century which would allow the planets rapidly growing population to meets its basic needs. In April 1987 it published its findings. The world commission on environment and development in its report "Our Common Future", talks of the balance under threat.

Quote " Today, the living resources of the sea are under threat from over-exploitation, pollution, and land-based development. Most major familiar fish stocks throughout the waters over the continental shelves, which provide 95 % of the world's fish catch, are now threatened by overfishing.

Other threats are more concentrated. The effects of pollution and land development are most severe in coastal waters and semi-enclosed seas along the world's shore-lines. The use of coastal areas for settlement, industry, energy facilities, and recreation will accelerate, as will the upstream manipulation of estuarine river systems through dams or diversion for agriculture and municipal water systems. These pressures have destroyed estuarine habitats as irrevocably as direct dredging, filling, or paving. Shore-lines and their resources will suffer ever increasing damage if current, business-as-usual approaches to policy, management, and institutions continue.

Certain coastal and offshore waters are especially vulnerable to ecologically insensitive onshore development, to competitive over-fishing, and to pollution. The trends are of special concern in coastal areas where pollution by domestic sewage, industrial wastes, and pesticide and fertilizer run-off may threaten not only human health but also the development of fisheries.

Even the high seas are beginning to show some signs of stress from the billions of tons of contaminants added each year. Sediments brought to the oceans by great rivers such as the Amazon can be traced for as much as 2000 kilometers out to sea. Heavy metals from coal-burning plants and some industrial processes also reach the oceans via the atmosphere. The amount of oil spilled annually from tankers now approaches 1.5 million tons. The marine environment, exposed to nuclear radiation from past nuclear weapons tests, is receiving more exposure from the continuing disposal of low-level radioactive wastes.

New evidence of a possible rapid depletion of the ozone layer and a consequent increase in ultraviolet radiation poses a threat not only to human health but to ocean life. Some scientists believe that this radiation could kill sensitive phytoplankton and fish larvae floating near the ocean's surface, damaging ocean food chains and possibly disrupting planetary support systems.

High concentrations of substances such as heavy metals, organochlorines, and petroleum have been found on the ocean's surface. With continued accumulation, these could have complex physical, chemical, and biological activity where microbial processes play a major role, but as yet serious damage is known to have occurred only in very localized regions. Although these findings are encouraging, given acceleration pressures and the inadequacy of present data they provide no grounds for complacency." Unquote.

3.2.0 BIOLOGICAL EFFECTS

GESAMP in its report on " The state of the marine environment" No 115 in 1990, has made a number of observations about the biological effects on the marine environment. In chapter 3, the report discusses some of the most critical topics for the assessment of the state of marine ecosystem and of human health in relation to the marine environment.

3.3.0 HUMAN HEALTH EFFECTS

Rapidly expanding and increased coastal communities and rivers draining agricultural and industrial areas are the prime sources of contaminants along the coastline. The principal health problem worldwide is the existence of pathogenic organisms discharged with domestic sewage into coastal waters, or rivers which eventually drain into the sea.

Bathing in such waters and consuming contaminated fish and shellfish are the causes of a variety of infections. Chemicals contamination of sea water is also a potential threat to human health, however the problems are not entirely man-made, as aquatic biotoxins occur naturally and they are also a health hazard.

3.3.1 MICROBIAL AGENTS

These can affect human health as a consequence of bathing in the sea, or consuming seafood. The impact on health arises as a result of contact with microbially polluted sea water which causes ear, eye and skin infections or respiratory diseases. Most of the diseases associated with the ingestion of enteric pathogens affect the gastro - intestinal tract. Seasonal population influx at tourist resorts adds considerably to the problem, and visitors with low levels of immunity are specially susceptible. Skin diseases affect the bathers particularly children under five.

The same urban sewage also contaminates seafood. Molluscs and other seafoods are susceptible to contamination by pathogens carried to sea in wastewater flow. Bivalves, filter large volumes of sea water and retain pathogenic bacteria and viruses. This is responsible for gastro - intestinal disorders such as diarrhoea, cholera and infectious viral hepatitis. These diseases are mostly associated with the consumption of seafoods, such as bivalves.

3.3.2 CHEMICAL CONTAMINANTS

Chemicals with a potential to cause harm to human health if ingested with seafood are present naturally in sea water and their concentrations can be increased by man's activities. Natural levels in sea water are usually low., but the relatively elevated concentrations of mercury in predatory fish in the Mediterranean and in the Seychelles Islands, and of cadmium in crabs from the Orkney Islands off Scotland and copper in the estuarine fauna of Cornwall are striking examples of geologically associated contamination. Studies in these regions, show that although exposure levels are much higher than elsewhere, no clinical effects have been detected among consumers.

Anthropogenic inputs of chemical contaminants, mainly originating from industrial discharges to estuaries or coastal waters, can result in locally much higher concentrations and correspondingly more severe potential and actual health effects. The case of mercury-polluted effluents from an industrial plant at Minamata Bay, where contaminated seafood was a major component of the local diet from the opening of the plant in the 1930's until 1986, is an alarming example of such health risks. Medium or long-term exposure to chemicals in seafood may cause a variety of health effects, depending on the chemical agent, the amounts ingested, and the total body burden resulting from all routes of intake.

A variety of chemicals is involved. (see table 1, on pg 40) Synthetic organic compounds or mixtures, such as PCBs, accumulate in sediments or are associated with detritus and can be taken up into the food chain and recycled years after the input has ceased. In some areas, such as parts of the middle Atlantic Bight of the U.S.A., fish consumption has been restricted because of the high levels of PCBs in the flesh (e.g. up to 84 ppm in lobsters and 730 ppm in fin fish). Petroleum is a widespread potential contaminant, and fortunately oil tainted seafood is a deterrent to consumption and thus a protection of public health. Heavy metals are widely perceived as being of concern, and seafood are regularly monitored by many countries.

Table Harmful substances in the sea

Acetone	Herbicides
Acids and alkalies	Lead
Acrylonitrite	Mercurial compounds
Arsenic	Mercury
Benzene	Military wastes
Cadmium	Naphthentic acid
Carbonate compounds	Nutrients and ammonia
Carbon disulfide	Oil
Chlorobenzene	Organophosphorus compounds
Chloroform	Phenol
Chromium	Phthalate esters
Cresol	Polychlorinated biphenyl compounds
Crotonaldehyde	Pulp and paper wastes
Cumene	Radioactive materials
Cyanide	Solid objects
Detergents	Styrene monomer
o-dichlorobenzene	Sulfite
p-dichlorobenzene	Titanium dioxide wastes
Domestic sewage	Toluene
Dredging spoils and inert wastes	Toluene diisocyanate
Epichlorohydrin	Trichlorobenzenes
Ethyl alcohol	Vinyl acetate
Ethyl benzene	Vinyl chloride
Ethylene chloride	Xylene
Heat	Zinc

3.3.3 AQUATIC BIOTOXINS

Various toxic substances are produced by many phytoplankton species. Until about a decade ago the organisms known to be implicated were mainly pelagic dinoflagellates, both paralytic and diarrhoeic shellfish poisoning (PSP & DSP) being caused by consumption of bivalve molluscs that have accumulated toxins from these dinoflagellates.

Saxitoxin and related toxins which cause PSP usually have little effect on shellfish but are potent neurotoxins to man causing respiratory paralysis and death by asphyxia. PSP was recorded in Canada as long ago as 1793 and over the past 20 years has spread throughout the world. Between 1969 and 1983, 905 cases were documented, with 24 deaths. PSP is now being reported much more widely. In 1983, for example, PSP was reported in the Philippines, which resulted in 21 deaths, and 300 cases of illness, and this resulted in a ban on sale of shellfish for 18 months.

DSP has been recognized only more recently, but it also affects both cultivated and wild shellfish in many countries. The contamination of shellfish with diarrhoeic toxins causes severe gastro- intestinal disturbances but no fatalities have been reported. The dinoflagellates responsible can contaminate shellfish at low cell densities, well below those which alter the color of the water, so phytoplankton monitoring is necessary.

Dinoflagellates that produce ciguatoxins contaminate a variety of tropical and sub-tropical grazing fish, and human exposure occurs through eating predator fish that feed on the grazers. As many as 50,000 individuals may be poisoned annually, with fatality rates from 0.1 to 4.5 %. Temperate countries may also be affected through import of tropical fish, and no effective monitoring programme has yet been developed.

3.3.4 CONCLUSIONS

Cases and outbreaks of gastro-enteric diseases occur in Europe and America, but the tropical and subtropical waters are the main foci of these public health hazards. The other beach-linked diseases, however, are common to crowded beaches, especially those exposed to sewage discharges. Successful breaking of the faecal-oral transmission route must include the control of sewage and pathogen discharges to coastal waters or, in other words, restrict use of polluted beaches and consumption of contaminated seafood.

3.4.0 BIOLOGICAL SIGNIFICANCE OF ENVIRONMENTAL CONCENTRATIONS

In this section the significance of these concentrations for marine species and communities is discussed. The effects of present concentrations of contaminants can be considered in terms of exposure to materials dissolved in the water column or deposited in sediments, or as tissue concentrations.

3.4.1 TRACE ELEMENTS

Among metal contaminants, mercury presents a special case because of the conversion of inorganic forms of mercury to persistent organic forms and their subsequent concentration through food chain transfers to top predators, with accumulation in fatty tissues over their longer life span.

It has been reported that zooplankton and benthic molluscs can accumulate inorganic mercury at a more rapid rate than organic mercury, and that they take up mercury from sea water rather than sediments and at rates that are proportional to their concentration. Concentrations below ng(1)^-1; do not appear to have any effects on algae or zooplankton. The biggest problem is the effect on long lived ocean fish, they have the ability to accumulate high levels of mercury over a long period of time, and such fishes in enclosed seas had accumulation of upto a thousand times higher. These concentrations do not appear to have any effect on the fishes themselves.

At Minamata, Japan, mercury poisoning from the consumption of locally contaminated seafood caused 2000 cases of intoxication between 1930 and 1968, with 43 deaths recorded from 1953. This disaster led to the awareness of the problem and to the recommendation of monitoring the levels of mercury concentration in seafood.

Cadmium and lead concentrations are of lesser concern and the only effect that it is known to produce is to enhance the growth of some phytoplankton species. These elements as well as Arsenic, Selenium and Mercury were highlighted in the 1982 GESAMP study, but they are now regarded as being of lesser concern.

3.4.2 HALOGENATED HYDROCARBONS.

Toxic effects of halogenated hydrocarbons have been reported at almost all levels in the food chain. Primary productivity is reduced to 50% at the lowest levels of concentration. Some shrimps show a 50 % mortality and other fishes have reduced egg hatches. Seals and seabirds in some areas of the Baltic have been reported to be harmed as a consequence of organochlorine compounds in their body tissue. There has also been a sharp decline in birds of prey and fish eating birds have reduced egg hatch. Many seals in the Baltic sea have been found dead and investi--gations have shown they had PCB levels of up to 110 ppm. In some cases they had levels of PCB and DDT of up to 190 ppm.

3.4.3 PETROLEUM HYDROCARBONS.

It is known that hydrocarbons from oil exploration are found near oil platforms and near estuaries with major shipping and tanker operations and refining activities. The level of concentration in sediments in these places may be between 5 to 160 ppm and in very polluted places it may go upto 1000 ppm. Effects reported on living organisms near oil rigs or accident sites, include high tissue levels of induced enzyme activity in molluscs, reduced growth in sea grass, behavioral change in crabs, and successional changes in small benthic crustacean. Higher oil residues have also been reported in the livers of fish.

3.5.0 EUTROPHICATION.

Eutrophication is the process that takes place when the nutrients in the water increases. This is well known when we see any fresh water lakes with large additions of nutrients. This generates bad effects, because the excessive nutrients, changes the primary production and species composition, increases algae blooms and generally bring deleterious effects, such as oxygen depletion, with consequent effects on water quality and living resources.

Earlier it was thought that eutrophication could not take place in the open oceans, but that is not the case, as globally, the inputs of nutrients from rivers due to man's activities are at least as great as those from natural processes. These effects are generally more along the coastal regions. The areas thus affected are numerous and geographically widespread but all have the common feature of limited water exchange with the open sea.

In the Baltic sea, systematic monitoring since 1980 has produced evidence of eutrophication, as seen in progressively decreasing oxygen and increasing levels of nutrients. This resulted in unwelcome blooms of plankton algae and this was a matter of concern.

In 1988, there was also an unusual bloom along the coasts of Denmark, Norway, and Sweden. The algae responsible reached concentrations of 50 - 100 million cells per litre. The bloom did great damage to seaweeds, invertebrates and fish in the coastal waters, costing the Norwegian fishing industry over $ 10 million..

Off the Dutch coast nitrogen and phosphorous increased by a factor of four and two respectively between 1930 and 1980. The inland sea and other sea areas of Japan have serious problems with excess nutrients, mariculture being particularly affected through the impact of phytoplankton blooms. These examples indicate widespread adverse effects of high levels of nutrient addition, although toxic blooms occur without obvious eutrophication.

It is now possible to recognize the sequence of changes that characterizes progressive stages of eutrophication in the sea. It is also possible to monitor these stages and to take action to control and even to reverse this process.

3.6.0 ECOLOGICAL EFFECTS.

In this area, GESAMP has come to the conclusion that it is very difficult to come to any definite conclusions. Long term effects of contaminant exposure of a population are difficult to distinguish from natural changes. The establishment of a relationship between a toxic agent and a target requires a defined exposure limit and this varies from pollutant to pollutant and from species to species and to the stages in the life history of a species. Some substances may be instantly lethal in trace quantities, but such substances are uncommon and their dangers soon recognized. Response of the targets commonly varies between individuals depending on age, sex, size, physical and genetic make-up. Further, for highly mobile organisms such as fish or marine mammals, the past history of exposure is usually not known, and reliance can only be placed on the accumulated residues of a suspected toxic agent.

3.6.1 SPECIES EXTINCTION

However the Brundland report in "Our common future" referring to the species and ecosystems says " There is a growing scientific consensus that species are disappearing at rates never witnessed on this planet before. But there is also controversy over those rates and the risks they entail. The world is losing precisely those species about which it knows nothing or little; they are being lost in the remotest habitats. The growing scientific concern is relatively new and the data base to support it fragile. But it firms yearly with each new field report and satellite study.

Many ecosystems that are rich biologically and promising in material benefits are severely threatened. Vast stocks of biological diversity are in danger of disappearing just as science is learning how to exploit genetic variability through the advances of genetic engineering. Numerous studies document this crisis with examples from tropical forests, temperate forests, mangrove forests, coral reefs,

Box 6-1. Some Examples of Species Extinction

- In Madagascar, until about mid-century, there were 12,000 plant species and probably around 190,000 animal species, with at least 60 per cent of them endemic to the island's eastern strip of forest (that is, found nowhere else on Earth). At least 93 per cent of the original primary forest has been eliminated. Using these figures, scientists estimate that at least half the original species have already disappeared, or are on the point of doing so.
- Lake Malawi in Central Africa holds over 500 cichlid fish species, 99 per cent of them endemic. The lake is only one-eighth the size of North America's Great Lakes, which feature just 173 species, fewer than 10 per cent of which are endemic. Yet Lake Malawi is threatened through pollution from industrial installations and the proposed introduction of alien species.
- Western Ecuador is reputed to have once contained between 8,000 and 10,000 plant species, some 40 and 60 per cent of them endemic. Given that there are between 10 and 30 animal species for every one plant species in similar areas, western Ecuador must have contained about 200,000 species. Since 1960, almost all the forests of western Ecuador have been destroyed to make way for banana plantations, oil wells, and human settlements. The number of species thus eliminated is difficult to judge, but the total could well number 50,000 or more—all in just 25 years.

The Pantanal area of Brazil contains 110,000 square kilometres of wetlands, probably the most extensive and richest in the world. They support the largest and most diversified populations of waterfowl in South America. The area has been classified by UNESCO as 'of international importance'. Yet it suffers increasingly from agricultural expansion, dam construction, and other forms of disruptive development.

Sources: W. Rauh, 'Problems of Biological Conservation in Madagascar', in D. Bramwell (ed.), *Plants and Islands* (London: Academic Press, 1979); D.C.N. Barel et al., 'Destruction of Fisheries in Africa's Lakes', *Nature*, Vol. 315, pp.19–20, 1985; A.H. Gentry, 'Patterns of Neotropical Plant Species Diversity', *Evolutionary Biology*, Vol. 15, pp. 1–84, 1982; D.A. Scott and M. Carbonell, 'A Directory of Neotropical Wetlands', IUCN, Gland, Switzerland, 1985.

savannas, grasslands, and arid zones. Although most of these studies are generalized in their documentation and few offer lists of individual species at risk or recently extinct, some present species-by- species details. (See examples on page 48).

Habitat alteration and species extinction are not the only threat. The planet is also being impoverished by the loss of races and varieties within species. The variety of genetic riches inherent in one single species can be seen in the variability manifested in the many races of dogs, or the many specialized types of maize developed by breeders.

Many species are losing whole populations at a rate that quickly reduces their genetic variability and thus their ability to adapt to climatic change and other forms of environmental adversity. For example, the remaining gene pools of major crop plants such as maize and rice amount to only a fraction of the genetic diversity they harboured only a few decades ago, even though the species themselves are anything but threatened. Thus there can be an important difference between loss of species and loss of gene reservoirs."

3.7.0 NEED FOR MARINE ENVIRONMENT PROTECTION AND RECOVERY OF DAMAGED ECOSYSTEMS AND SPECIES.

The slow but continuous alteration of the open-ocean waters can offer future generations the legacy of a poisonous ocean. It is most unreasonable to titrate the seas with man's wastes to the endpoint of a world-wide mass mortality of organisms. Yet, such an event is today not incon--ceivable. The time might be a century or longer. If these substances follow the water in mixing with the deep ocean, they will be transferred within a decade to zones below the mixed layer, where they may remain for thousands of years, the residence time of the persistent naturally occurring organic molecules. At what level might they irreversibly damage the ecosystem? (Edward Goldber)

It is concerns of this type that have been orchestrated from time to time and that is now making people aware of the magnitude of the problem we are being faced with. The magnitude of the problem itself transcends all international boundaries, and are not the concerns of any individual state. It is therefore important that international organizations pool in their economic and scientific resources to engage in appropriate and adequate surveillance activities to monitor the health of the oceans.

3.7.1 THE MUSSEL/BARNACLE WATCH -A FIRST STEP

The many proposed global marine monitoring programmes are characterized by their vastness and complexity which lead to their doom as fantasies on paper. This is because the pollutants of the marine system are extremely difficult to measure.

Mussels and barnacles are especially attractive as sentinel organisms for the purpose of measuring the exposure levels of these pollutants. The mussel has been extensively studied both experimentally and ecologically with respect to its ability to record pollutant levels. Molluscs are well-known concentrators of heavy metals, and have been used already in a regional monitoring programme of halogenated hydrocarbons and mercury. The mussels appear valuable as sentinels for hydrocarbon pollution. A second group of organisms which appears worthy as sentinel organisms are the goose barnacles. Unlike the mussel it is an oceanic species and quite cosmopolitan, i.e. found in nearly all coastal waters of the world.

3.7.2 DYING CORAL REEFS AND GREENHOUSE EFFECT

Coral reefs around the world, which biologists say may serve as an early warning system for environmental degradation, are suddenly starving and in many cases dying because of abnormally warm seas according to leading marine scientists.

Most researchers suspect that the current crisis was caused by higher sea temperatures. As the water heats up, the coral polyps that build the reef with their skeletal remains spit out the microscopic algae that help feed the coral and give the reef its golden, red and yellow hues. The phenomenon is called "bleaching" because it leaves the coral with white blotches. In the past, the corals would often return to health. But there is preliminary evidence that repeated stress may make recovery more difficult. Marine biologists are unsure whether the higher sea temperature are caused naturally or whether the planet is warming because of an enhanced greenhouse effect caused by a buildup of pollutants. (Herald Tribune 14-10-90)

3.7.3 RECOVERY OF DAMAGED ECOSYSTEMS

It is pertinent to consider the extent to which damaged habitats and species are able to recover once polluting inputs have ceased. An ecosystem damaged by oil, nutrients or sewage will typically have lower species diversity, shorter food chains and less efficient energy transfer between trophic levels than an unaffected ecosystem. The simplest expectation is that the pre-impact system will eventually be re-established. However, since ecosystems are highly dynamic, often with several possible stable states, recovery need not follow the same sequence or time scale as loss, and the system will not necessarily revert to its previous structure.

CHAPTER - 4

MARINE OPERATIONS AND MARINE ENVIRONMENT PROTECTION

4.0.0 INTRODUCTION

This chapter begins with a history of the making of the marine pollution prevention controls. The text of this chapter will bring out the various international conventions that are dealing with this subject that are currently in force, and their applications on board the ships. It will also make a critical analysis of the effectiveness of these operations in practice and conclude with some suggestions for the future. By the end of this chapter we will come to realise that rules and regulations or controls in themselves do not bring about the desired results in marine environment protection, rather, it is proper education in the subject that leads to an understanding of the problem and thereby enhances the responsibility of an individual to do his or her part in protecting the environment.

4.1.0 HISTORY OF MARINE POLLUTION CONTROL

After oil was discovered, towards the end of the 19th century, the first tanker, the "Gluckauf" that was built in 1885 commenced its operation and the idea caught on rapidily. In 1897 Dr Rudolf Diesel built the first diesel engine and by 1927 approx, 28% of the world fleet used oil for power.

In the first two decades of the 20th century, signs of pollution started showing up along the coasts of the British Isles. This was caused by the discharge of oil from the ships. Oil used as fuel produced engine room waste oils which had to be disposed of. Oil tankers produced wastes associated with the cargo. When the cargo was unloaded, sediments were left on the tank walls which had to be cleaned off. This resulted in an oil/water mixture that had to be disposed of, which was invariably pumped into the sea.

In 1922, the United Kingdom - then the leading sea power - introduced an act in parliament called "The oil in navigable waters act". This act prohibited British ships from discharging oil along the coast and within port limits. This law was ineffective because the seaways are international. Realizing this the U.K. and the U.S.A. convened an international conference in 1926, which was attended by 13 countries. They favored combating pollution by establishing a system of zones where the discharge of oil was banned. But the draft prepared by the convention was never adopted. In the meantime pollution continued to cause concern, and by 1928 according to the Financial Times of London, 500,000 barrels of waste oil a year were being tipped into the sea.

The establishment of the United Nations in 1945 was followed by the creation of a series of specialized agencies. One of these agencies was the International Maritime Organization (IMO), which was created (under the former title of IMCO) in 1948 and came into existence in 1958. During the next few years things became worse still. By 1953 more than 250 million tons of oil were being transported annually. The IMO was unable to ratify any convention, mainly due to hostility from member states who would not favor an international body regulating shipping.

4.1.1. THE 1954 OIL POLLUTION CONVENTION (OILPOL-54)

In the absence of IMO, the United Kingdom took the initiative and in 1954 convened an international conference on oil pollution. This conference dealt with operational pollution and did not consider accidental pollution, or pollution by other substances. The main weapon of this convention was the establishment of zones where the discharge of oily wastes was prohibited. It also required ports to have reception facilities for slops from non-tankers. The 1954 convention was therefore limited in its achievements, but none the less it was still the first international treaty concerned with oil pollution. In March 1958, the responsibility of this convention was taken over by IMO, and the convention came into force in July of the same year.

The most urgent task of IMO at the time of its creation was to update the "Safety of life at sea - 1948" (SOLAS-48). This was done in 1960, and IMO was then able to turn its attention to oil pollution. By the mid 1970's the oil boom was well underway and it became increasingly clear that

OILPOL -54 was inadequate, and that slop reception facilities were inadequate due to financial and other problems. It was also impossible to detect violations in prohibited areas and to prosecute offenders. It was in 1962 that IMO convened a conference to consider amendments to the convention. This amendment extended the limits of the areas and included new tankers of 20,000 dwt and above. The amendments entered into force in May 1967.

About this time two developments took place. The first was the new method of restricting discharges from tankers that was known as "load on top" and the second was the "Torrey Canyon" disaster in 1967.

4.1.2. LOAD ON TOP (LOT) SYSTEM

The " load on top " (LOT) system was developed in the early 1960's. It was a way of drastically reducing the amount of oil discharged into the seas as a result of routine operations such as ballasting and line/tank cleaning. Under this system, all oil-water mixtures that were obtained during any routine operations, such as water washing of tanks, dirty water ballast floating on the surface, tank stripping etc., were pumped into a separate tank called the slop tank (instead of pumping it over the side). In the slop tank the oil and water separates after some time, and the bottom water which is clean can be pumped out, in a sort of decanting process. What is left behind is an emulsion and floating on top of it is the residue oil. At the loading port fresh oil is loaded on top of the oil remaining in the slop tank.

Although the oil that is left in the slop tank is not so pure, as fresh crude oil, this was acceptable to the industry as a whole. This was because the oil industry found that their oil losses came down as a result of this operation. Also both the shipowners and the oil industry realized that this oil would have otherwise been wasted and that in the bargain they were preventing pollution. By the end of the 1960's it was claimed that some 1.6 million tons of waste oil that would have been discharged into the sea each year was being saved by using LOT.

4.1.3 TORREY CANYON AFTERMATH

The grounding of the " Torrey Canyon " was the biggest pollution disaster in history at that time, and it had far reaching consequences. This disaster caused damage to the beaches along the coast, seabirds and fishes began to die slowly, and this also threatened the livelihood of the fishermen in the area. The biggest problem after that was the cleaning up process that was proving to be futile. All this brought about bad publicity in the media and a lot of embarrassment to the Governments concerned. It also brought a lot of awareness to the public about the damage to the environment and in the process a lot of pressure was brought upon the Governments to do something about this problem. Upto now the only concern was that of operational pollution and no one could foresee a problem arising out of accidental pollution.

The fact remained that there were about thirteen ships like the Torrey Canyon in operation around the world, and further disasters were a distinct possibility. This problem of accidental pollution had to be tackled at an inter-national level and that was through the IMO. Some of the issues that arose out of this disaster were of a legal nature, rather than of a technical nature. For this purpose IMO institutionalized the legal committee which began its work in 1969. Their work resulted in the adoption of two new conventions, one of them relating to Intervention on the high seas in cases of oil pollution, and the other was the International Convention on Civil Liability for Oil Pollution Damage (CLC convention). The former gave nations the right to intervene and take action to prevent or to mitigate the dangers of pollution by oil from ships outside territorial waters. The CLC convention was designed to see that adequate compensation was made available to victims of oil pollution by the owners of ships that were involved. This convention was backed by the establishment of an International Fund for Compensation for Oil Pollution Damage (Referred to as the Fund Convention).

4.2.0 THE AWARENESS GROWS

In 1969 the load on top (LOT) procedures were adopted in the 1954 oilpol convention to pave the way for the wider implementation of the load on top method, but the amendments did nothing about accidental pollution. By the early 1970's the world had at last come to realize that it was facing an immense problem. These problems were brought to light by books such as " Silent Springs " by Rachel Carson and by reports such as the club of Rome's report on " The limits of growth ". There were doubts created about the limitless sources of energy, metals and other substances and the limits of nature to cope with pollution.

IMO was until this time exclusively involved with the problem of oil pollution. However as a result of world wide concern it was soon realized that there were other substances which could be even more dangerous if disposed into the marine environment. In 1969 the IMO Assembly adopted a resolution referring to the Stockholm conference and called for a conference exclusively on marine pollution in 1973. At the same time preparations were being made for a conference on the dumping of land based wastes to be held in London in 1972.

4.2.1 THE LONDON DUMPING CONVENTION

The London dumping convention (or LDC for short) was the first international attempt to regulate the deliberate dumping of land - generated wastes. These wastes consisted of dredged materials (upto 90% of the total), industrial wastes and sewage sludge. In particular the concern focused on the unrestricted dumping, which put human health at risk, arising from pathogens, increased eutrophication from nutrients and toxic effects of some waters on marine life. The damaging influence was also felt in other activities such as fishing and recreational activities.

The convention tackles this problem by dividing substances into three categories. The dumping of the most dangerous substances which are included in Annex 1 ("The black list") is completely prohibited: they include organo halogen compounds; mercury; cadmium; persistent plastics; crude oils; high-level radioactive wastes; and materials produced for biological or chemical warfare. Other substances are included in Annex 2 and may only be dumped after a special permit has been issued, while less dangerous substances can be dumped after a general permit has been issued.

4.2.2 MARPOL 73/78.

In 1973 IMO met to consider other aspects of marine pollution from ships (MARPOL 73). This was an ambitious programme, as it sought to eliminate operational pollution and at the same time reduce accidental pollution. It not only dealt with oil, but also with chemicals in bulk, noxious goods carried in packaged form, sewage and garbage. The MARPOL convention was not implemented quickly due to technical difficulties and also due to the fact that most nations felt that this convention could not be effectively implemented. Then, in 1976 and 1977, a series of tanker tragedies took place around the U.S. coast, which prompted public opinion to raise the problem of pollution, and the then U.S. President Jimmy Carter gave an assurance that something would be done to control this problem. As a result IMO convened another conference in February 1978 to consider new measures for tanker safety and pollution prevention, and the outcome was the adoption of a protocol to the MARPOL convention. This combined convention came to be known as MARPOL 73/78. It included a major change in tank cleaning operations, known as Crude Oil Washing (COW) and also made provisions for Segregated Ballast Tanks (SBT). As with the 1971 amendments to OILPOL, this convention sought to reduce accidental pollution by limiting the size of tanks, and to have them protectively located. The convention also introduced design criteria for safety of the tanker, by adequate sub-division of the tank spaces and by maintaining stability standards. Safety was further improved by making necessary changes to SOLAS and by introducing Inert Gas Systems (IGS).

4.2.3 TRAINING

The 1978 conference was a success and both the MARPOL and SOLAS protocols were accepted and entered into force in 1981. The marpol protocol merged with marpol 73, annex 1 and they jointly entered into force in October 1983. In 1978, another major development was the adoption of the International Convention on Standards of Training, Certification and Watchkeeping for seafarers (known as the STCW convention). This convention ensured that proper training is given to seafarers at all levels.

Emphasis was given to training, and the technical assistance programme, which was operating since the late 1960's was given a boost. The aim was to help developing countries to build up their maritime industries and also to train their own personnel and to ensure that IMO standards were being maintained.

In 1983 the World Maritime University was opened in Malmo, Sweden, to serve as an international training centre for men and women who were expected to play important roles in administration, maritime training, shipping and other maritime sectors. In 1988 the IMO International Maritime Academy was opened at Trieste, Italy, followed one year later by the opening of the IMO International Maritime Law Institute in Malta. All of these institutes are designed to provide training for an elite group - the people that are responsible for ensuring that things get done. IMO also started providing assistance to training institutions around the world, so as to ensure that ships' personnel receives proper training and that they were fully conversant with internationally agreed measures and standards. IMO also accorded a few training institutions around the world, the status of "Branches of the World Maritime University" to cater for various regions of the globe. These branches hold regular training programmes and seminars on a number of important topics and keep the personnel of the maritime industry well informed of the latest developments in each field.

4.2.4 LEGISLATIVE DEVELOPEMENTS IN POLLUTION CONTROL.

The entry into force of SOLAS; the 1978 SOLAS protocol and MARPOL 73/78, brought about important changes that were crucial to the industry, the most important being the carriage of chemicals. Annex 2 of MARPOL and the 1971 Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk also made contribution towards protecting the environment. Even so, by the 1980's there was need for change. In 1983 the International Bulk

Chemical Code (IBC) was adopted, and this was made mandatory under chapter 7 of SOLAS. In 1985 MARPOL 73/78 was also amended to make it easier to implement Annex 2 and the IBC code (modified for Pollution aspects).

The Contracting Parties to the London Dumping Convention also took measures to tighten controls. In 1983 the 7th Consultative Meeting agreed on a moratorium on the dumping of low-level radioactive wastes. In 1988 a resolution was adopted calling for a phasing out of marine incineration by 31st December 1994.

On 31st December 1988 Annex 5 of MARPOL 73/78 entered into force. One of the most important features of the Annex is the complete ban on the discharge of plastics into the sea. Annex 3, which deals with pollution by harmful substances in packaged forms, is also nearing entry into force. In April 1989 the MSC adopted amendments to the International Maritime Dangerous Goods (IMDG) Code which are intended to help implementation of this Annex. For the first time this code has been extended to cover marine pollutants. These amendments came into force from 1st January 1991.

4.3.0 UNRESOLVED AREAS OF CONCERN.

Although IMO has been up-to-date at resolving matters of serious concern to the environment, there are many areas which still require attention and there are also other matters that are still being debated on. A few of these topics are being listed and discussed.

4.3.1 OIL TANKER DESIGN: (USE OF DOUBLE HULL).

In the years leading to MARPOL 73/78 a lot of measures were taken towards tanker safety and pollution control. However the grounding of the EXXON VALDEZ reopened this debate amidst strident calls for the introduction of new structural requirements applicable to oil tankers. The Exxon Valdez was a virtually new ship, constructed to the latest standards, and yet this disaster was six times worse than the Amoco Cadiz from the ecological point of view. This incident therefore raised a demand for new measures to prevent any repetition. There is a widespread belief that a double hull construction will provide the needed protection, but many ship operators believe there are significant limitations to the design. In minor casualties, double sides or double bottoms might minimize pollution, but in all other cases it is doubtful. Ships are operated by people, and so long as this is the case tanker casualties involving oil spillage will inevitably continue and double hull construction alone will not eliminate them.

4.3.2 BALLAST WATER CONTROLS.

Investigations undertaken in a number of countries have led to the discovery of exotic marine organisms which are believed to have been introduced via the ballast water and sediments discharged by visiting ships. The Australian quarantine authorities have shown particular concern about the existence of Toxic dinoflagellates in Tasmanian waters, which have entered the food chain and caused shellfish poisoning. A similar problem has been noticed by the Canadian authorities in the Great Lake area. Consequently both these governments have introduced voluntary control measures that require ships to provide samples of their ballast tank to show that it is free from any marine organisms and that the ship has exchanged water ballast on the high seas, in water depths exceeding 200 meters.

4.3.3 ATMOSPHERE POLLUTION.

Control of gaseous emissions from ships is also another matter under IMOs considerations, and the areas that are under focus are: exhaust gases from propulsion machinery, cargo vapors from oil and chemical tankers, and finally the ozone depletion threats that are caused from escaping gases from refrigerants and halon gases from fire-fighting systems.

According to one of many reports that have been published, it is estimated that international shipping contributes 7% of the total world emissions of nitrogen oxides (NOX) and 4% of sulphur dioxide (SO2). At present there are technical solutions to these problems, but they may be installed at substantial expense. Reduction of sulphur, content in marine fuel oil may be considered, but this will raise the prices of marine fuel oil. Fitting equipment to remove SO2 from exhaust gas would have to be paid for in terms of equipment and maintenance. No matter what the costs are, it seems certain that some form of control is bound to be introduced and that the shipping industry will be willing to accept the proposals for the protection of the environment. This effort will however be futile, if it is not matched by a similar determination to reduce atmospheric pollution from other sources - particularly land-based industrial source.

National and regional initiatives continue to be developed to limit emissions of cargo vapors from oil tankers and chemical carriers, notably in the United States, where the subject of air quality remains high on the agenda. However, standards for cargo vapor emission control systems under development by the Coast Guard have still to be published and progress in IMO on such matters is not expected to accelerate until the U.S. rules are finalized.

4.3.4 OZONE DEPLETION.

Ozone depletion is now a matter of serious concern to governments and society alike, and IMO is studying the potential threats associated with halon fire extinguishing gases, and the refrigerants which are used in ship's systems and for refrigerated containers. It is understood that over 80% of refrigerated cargo ships and container ships use refrigerant gases that are not currently the subject of control. R-22 seems likely to continue to be acceptable, at least for the moment, but particular problems are expected from refrigerated containers, which in almost all cases use the more damaging R-12. At present machinery and refrigerant manufacturers are unable to offer alternative means. There is also pressure to do away with halon fire-extinguishers. No doubt that concern for ozone depletion has priority, but even so, this question must be weighed very carefully, as halon is the most effective means of controlling, disastrous ship-board fire. It would be better to search for a good alternative to Halon before it is banned.

4.3.5 SOME CONSIDERATIONS FOR THE FUTURE.

The question of limiting pollution from tankers has brought about a number of proposals as was already discussed in paragraph 4. relating to double bottom, double hulls. There are also other proposals that have also surfaced and one of them is limiting the size of tankers.

4.3.6 LIMITING THE SIZE OF TANKERS.

It has probably now come to be accepted that no matter what type of sophisticated technology we have at our disposal to prevent accidental pollution - accidents will always happen. The problem is the magnitude of the pollution problem that we would have to face. The answer is simple and clear, and that is, that the problem would be directly related to the size of the tanker. Therefore the tanker should be limited in size. It has always been argued that it is a matter of stratistics; meaning that if there were more number of smaller ships, then there would be more number of accidents. While this may have some truth in the statistical sense, it can still be said that for each accident, the magnitude of the problem would be such that it would be manageable and therefore cause much less damage to the environment.

It is very difficult here to arrive at a figure limiting the size of tankers. Much would depend on the economics of the industry and also the facilities available. It would also depend on the impact a total loss would have on a sensitive environment. If we are to hazard a guess, a tanker should be limited to between 70,000 to 100,000 dwt.

4.3.7 "NO-GO" LIMITS FOR SENSITIVE AREAS.

As has already been said discharge of hazardous materials due to accidents or even operational discharge cannot be avoided. Yet it is important that we protect the most sensitive area from even the remotest chances of pollution. The only way this can be done is by prohibiting ships to pass through these sensitive areas. IMO has already promulgated some instruments designating sensitive areas as "Areas to be Avoided" in accordances with the General provisions on ship's Routeing. It has already been used in practice for several sensitive areas and to mention a few such as:

1) In the region of Nantucket shoals (USA)
2) In the region of Northwest Hawaiian Islands (USA)
3) In the region of the Great Barrier Reef (Australia)
4) In the region of Aldabra and Mahe Islands (Seychelles)

In the future more areas will eventually be designated as "Areas to be avoided". This will be expected as more and more nations are becoming aware of the condition of their environment. In the not to distant future, The author foresees " highways " on the high seas. Which is to say, that the traffic separation schemes will take the shape of traffic routeing schemes and these will steer traffic clear of sensitive areas.

4.3.8 BALLAST WATER POLLUTION CONTROL

Taking water ballast is an operational necessity and cannot be avoided, and it is also very difficult to monitor the discharge of water ballast. The only solution that one can visualize at the moment is to install a device similar to the water purifier that is available in the market for purifying drinking water. The device uses ultra-violet rays that destroy all living organisms in the water, there by making it fit for human consumption. A similar device, but of a more powerful capacity may be fitted at the sea-chest of intakes and discharges of water ballast lines and this will destroy the sea water organisms and make the water ballast pure enough for discharge in all waters of the globe.

4.3.9 USE OF BIO-DEGRADABLE PACKAGING

To-day, plastics are used in all forms of packaging, from beer can binders to plastic bags, cups, and containers for preserved foods. Yet it is plastics that pose the biggest problem as far as the marine environment is concerned, this is because plastics are not degradable and may last for centuries. The problem is even greater when we see that this form of waste is surely but steadily increasing in the oceans.

The packaging industry has already started to pay atten--tion, and some of them are already producing bio-degradable products such as cups, bags, and even some forms of packaging. This industry and its products must be encouraged and one of the ways in which the marine industry can contribute is to make legislation to ban the use of plastics and to substitute their requirements with bio-degradable products.

Even in the field of ropes and fishing nets, we should not loose sight of the fact that nylon had replaced bio-degradable materials such as cotton and manilla, and it is high time that we use our sensibilities and revert to using the materials that our fore fathers used. This once again can only be done by making a law and enforcing a ban on materials such as nylon, polypropelene, in the fishing industry.

4.3.10 RECYCLING SHIPBOARD DRY WASTES

Shipboard dry wastes such as bottles, aluminium cans, and cardboard boxes etc. should be segregated on the ship and where possible these wastes can be compressed into small bales and collected. These items may be stored in separate containers on the ship, and the same may be emptied at the next suitable port of call, where such items are collected for recycling.

This will not only prevent pollution of the oceans and the coastal regions, but it will also be very productive because these same waste products will be recycled and it will conserve scarce raw materials.

4.3.11 MONITORING SHIPBOARD WASTE MANAGEMENT

Finally it must be said that implementing and monitoring proper waste disposal must be left to each and every individual ship. It can only be done in a conscious way if everyone accepts his own responsibility, and this can only be achieved if all seafarers are well educated on environmental problems, and hence the urgent need for developing such a course. It would be a good idea if one of the members of the ships staff is deputed to be in charge of supervising and monitoring the shipboard waste disposal system. His duty is to ensure that all measures statutory and non statutary are being followed by the ships personnel. He could also involve himself by educating the crew by means of video films and shipboard posters. If this is done with a proper will and spirit it can achieve great things, and if this is done by all ships it can appreciably reduce the litter of the seas.

CHAPTER – 5

MARINE ENVIRONMENT PROTECTION IN MARITIME EDUCATION AND TRAINING

5.0.0 INTRODUCTION

This chapter will seek to impress upon those involved in the process of training shipping personal – the importance of including Maritime Environment Protection as an important subject of study. This study will inculcate and develop a strong sense to preserve the environment in which they live. Increasingly we live in a world of rules and regulations and there is no dirth of it in the shipping world. These rules are made to regulate the activities. In the context of Marine Environment Protection, they are meant to control pollution. However with the ever increasing rules and regulations, it becomes more and more difficult, if not impossible to comply with, and even more difficult to monitor. This is the reason why it is felt that proper education in the subject will help the marine industry to preserve the environment in which they live.

5.1.0 REGULATIONS AND EDUCATION

It might seem to be out of place to take an example out of a street junction, but that is what really happens in reality. Let us imagine four different situations at a street junction.

5.1.1 A junction without signals (no regulations).

There would be a free for all, and as a result, the junction would have a chaotic situation with frequent traffic jams. It would also be vulnerable to accidents and cause much loss of life and property. This is what would happen if we had no regulations in marine environment protection.

5.1.2 A traffic light without a policeman (no monitoring).

Making rules and regulations in themselves has no meaning if there is no effective and practical way of policing or monitoring these regulations. This junction would be still vulnerable due to unscrupulous drivers, who would jump signals because they were not being watched.

5.1.3 A traffic light with a policeman (regulations and monitoring).

This would probably be the best alternative and would be the most effective way of enforcing MEP programmes. But unfortunately; it is not practicable, to monitor and punish violators, particularly in a vast marine environment.

5.1.4 A traffic signal and well educated motorists (regulations and education).

A well educated motorist would be well informed of what is good for him. He would be aware of the dangers involved in rash driving and of jumping signal lights. He would follow the rules even if the policeman was not around to keep an eye on him. Even if the traffic lights are not working, he would still know how to conduct himself under the circumstances. This is the difference that education brings to an individual where ever there are rules and regulations to be followed.

5.2.0 WHY LEGISLATIONS DO NOT WORK

To introduce a law banning pollution is one thing, and enforcing the law is something else, and it is just as difficult to-day as it was when the problem first emerged. In 1961 for example an IMO survey showed that although there were 92 violations of prohibited zones that had been detected, there had been no successful flag state pro-secutions. Within territorial waters there were 577 cases reported and only 294 successful prosecutions. The situation to-day has not changed very much. This is because it is very difficult in the first place to detect violations. The expense to patrol vast stretches of sea space is very prohibitive. Even if it were possible to detect violations, it becomes even difficult to collect sufficient evidence to prove the case in court. This is the reason why policing the seas and prosecuting offenders, very often becomes a futile exercise.

5.2.1 A 1989 study by a Dutch group called Werkgroep Noordzee, containing 300 reports by states bordering the North Sea of violations of Marpol 73/78 discharge rules showed that only 51 (17.9%) of these reports were followed up by the flag states of the ship involved. In 64 cases there were no prosecution because the proof given was considered to be insufficient. Only 18 of the 300 cases were finally prosecuted and in those cases too, the fine imposed was very small and could not perhaps deter them from being careless in the future. (See Table 1. pg. 6).

The environment group Friends of the Earth reported the results of this survey to the Marine Environment Protection Committee (MEPC) in March 1989, stating:

" The results of this survey are not encouraging. First of all, there is a very small chance that vessels involved in illegal discharges will be detected or caught. Secondly, if a vessel is detected there is an extremely small chance that this detection will be followed by prosecution. Thirdly, if a vessel is prosecuted there is a small chance that this will meet with success since the burden of proof is on the prosecuting authorities and in many cases proof is considered insufficient. Finally, when a judge does impose a fine, these fines generally appear to be very low in comparison to the price the vessel would have to pay for using port reception facilities."

The enforcement of the Marpol convention therefore is a serious problem. But there are other problems as well. Before coastal and flag states enforce MARPOL they must also be signatories to the convention, and there are many nations that have not yet ratified the convention. In August 1990 only 60 states had ratified MARPOL and this leaves some 80 states which have not yet ratified the convention. Most of these states are developing countries and the reason for this may be attributed to the lack of legal and technical expertise and financial considerations.

Therefore the main crux of the problem as to why these conventions do not work, is the fact that there is a traffic light without a policeman, or a traffic light with a police-man who has no prosecuting powers. Both situations are bad from the point of view of enforcing any regulations.

TABLE : 1

Number of cases of discharges in the North Sea reported by North Sea coastal states to flag states and number of fines subsequently imposed by flag states, - 1982-1987

FLAG STATES	NUMBER OF CASES	NUMBER OF FINES
PANAMA	36	5
LIBERIA	23	2
U.K.	21	0
NORWAY	20	1
CYPRUS	17	2
PHILIPINES	14	0
SWEDEN	12	0
DENMARK	12	0
GREECE	12	6
FEDERAL REP OF GERMANY	9	1
THE NETHERLANDS	8	0
YUGOSLAVIA	3	1

5.2.2 There are many problems that come up with regard to the implementation of these regulations and also its enforcement. Even with the advent of sophisticated electronic surveillance equipment like satellite remote sensing it may not be possible to effectively keep track of offenders and to even prosecute them in a court of law. Even if it were possible to catch offenders, it would be very difficult to prove that they are really guilty of negligence. There is also the problem of extent of liability. Here again it is very difficult to access the extent of damage to the environment and the cost involved in its restoration. This is the reason why most of the offenders get the benefit of doubt and are let off with minor fines.

5.3.0 WELL TRAINED CREWS

Just as a well trained motorist knows his responsibility and knows how to respect the law of the road, so also in the long run, it is only a good and sound education system on the subject that will help. To-day, more than ever before, the question of protecting the environment has taken center stage. This is not only true for Marine Environment Protection, but also for protecting the environment on land. In fact to-day, there are many schools around the world that have started including this subject in their curriculum. This is done with the sole purpose of influencing young minds at a very early stage so that they may care for the world in which they live.

The only answer to solving the vexed problem of marine environment protection, is to educate all seafarers and that would include all those even remotely connected with shipping. They should be taught the effects of pollution on the environment and how eventually these effects have their toll on marine life and finally to that of man himself.

5.3.1 The MEPC in its 30th session, agenda No 19, referring to the International Seminar on the Protection of Sensitive Sea Areas recommends in Annex 2 Para 10.5 Quote " The education and training should be designed to MOTIVATE the crew to act in an environmentally correct manner". It also goes further to encourage IMO in its efforts to promote MEP curriculum at the WMU and at all other nautical training institutions world wide. Such recommendations also appear from time to time in many papers presented on this subject.

It is with this purpose in view that this course is being designed. It will seek to take the student to the very basics of MEP and to build up his concern for nature. It will inculcate in his mind that he has a responsibility to himself and to his children who will eventually inherit the seas.

5.4.0 EDUCATIONAL PERSPECTIVE

The final section of this study deals with the teaching of Marine Environmental studies to professional seafarers. It is not possible here to do more than outline a general coverage of topics. What needs to be done in future studies is to break down the syallabus into parts suitable for each grade of seafarers, and to consider ways of intergrating these in maritime education and training in a meaningful way.

5.5.0 COURSE FRAMEWORK

SCOPE: This course will provide training to all categories of seafarers and will include all officers and crew sailing aboard ocean going and coastal ships. It will include personnel manning, ferries, pleasure craft, offshore rigs and platforms, and craft such as hydrofoils, hovercrafts, seaplanes, and any other craft used at sea.

Since all shipping activities in to-day's world are controlled by shore based administrative staff, they are equally involved with the activities of those who man these ships at sea. It is therefore equally important that they also understand the problems involved in Marine Environment Protection and with this knowledge they could also help and co-operate with the ships staff in maintaining a healthy environment at sea.

The course may be divided into two levels, namely;- level 1, a basic course of three days duration; and- level 2, an advanced course of five days duration.

The basic course could be offered to ratings, petty-officers, junior officers and shore-based staff in shipping and related organizations.

The advanced course could be offered to senior ship Officers (Masters, Chief Engineers, Chief Officers and Second Engineer) and shore based Technical Superintendents.

5.5.1 STAFF REQUIREMENTS

All training and instruction should be given by suitably qualified personnel. It is preferable that those giving lectures in Marine Environment Aspects should have had experience in this field, and be educated at least to a degree - level in one of the following fields.

1. Oceanography
2. Marine Biology
3. Environmental studies

Alternatively these lectures may be taken by personnel having had training in Marine Environment Protection which will include ex-students of the WMU.

5.6.0 ADVANCED TRAINING PROGRAMME ON MARINE ENVIRONMENT PROTECTION

COURSE OUTLINE

SUBJECT AREA		HOURS
1.0	**INTRODUCTION**	
1.1	An introduction to marine environment protection	1.0

2.0	**THE MARINE ENVIRONMENT**	
2.1	Origins of Sea Water and its Chemistry	1.0
2.2	The Ocean Atmosphere System	1.0
2.3	The Ocean and Life	2.5
2.4	Marine Food Web	1.0
	Objective Test / Self Evaluation	0.5

		6.0

3.0	**DEGRADATION OF THE MARINE ENVIRONMENT**	
3.1	Effects of Traditional Marine Activities on the Environment	1.5
3.2	Effects of Modern Marine Activities on the Environment	1.5
3.3	Dangerous Goods and Marine Pollutants	1.5
3.4	Biological Effects on Environment	1.5

3.5	Ecological Effects on Environment	1.5
	Objective Test / Self Evaluation	0.5

		8.0

4.0 OCEAN MANAGEMENT

4.1	Control Strategies for Protecting the Marine Environment	1.0
4.2	Pre-operational Procedures for Hazard Assessment and Marine Pollution Control	1.5
4.3	Post-operational Procedures for Hazard Assessment and Pollution Control	0.5
4.4	Computer Aided Hazard Identification and Response : eg; " SEABEL "	1.0
4.5	Case Study / Group Discussion	1.5

		5.5

5.0 IMO CONVENTIONS ON MEP

5.1	London Dumping Convention (LDC 72)	0.5
5.2	Intervention Convention (69/73)	0.25
5.3	Marpol 73/78	
	- Annex 1	1.25
	- Annex 2	1.0
	- Film : "Chemical Tanker Operations - Part 2"	0.5
	- Annexes 3, 4, 5.	1.0
	- Unclos 82	

SUBJECT AREA	HOURS
- New Salvage Convention 89	
- New Convention on Oil Pollution preparedness and Response	1.0
- Films: "Fighting Pollution"	0.5
- Film : "Response to Marine Oil Spills"	1.0
	7.0

6.0 CONCLUSION

6.1	Future Developments in MEP	1.0
6.2	Objective Test and Course Evaluation	1.0
6.3	Recommendations and Conclusion	0.5
		2.5
	TOTAL	30.0

5.7.0 LEARNING OBJECTIVES

1.0 INTRODUCTION (1 HOUR)

1.1 An introduction to Marine Environment Protection — 1Hr

- .1 Explains the objectives of the course
- .2 States briefly the course plan
- .3 States briefly the contents of the course
- .4 Explains briefly the purpose and need for MEP

2.0 THE MARINE ENVIRONMENT (6 HOURS)

2.1 The Natural Chemical Characteristics of sea water. — 1Hr

- .1 Traces the historical study of sea water
- .2 Explains the major constituents of sea water and the concept of salinity
- .3 Defines
  - Minor elements
  - Nutrient elements
  - CO2
  - Dissolved organic gases

2.2 The Ocean Atmosphere System — 1Hr

- .1 Explains the three primary components of the earths surface; The Hydrosphere, The Lithosphere and the outer shell of rock.
- .2 Explains that the Atmosphere is constantly in motion.

.3 Explains briefly the predominant global wind patterns, and local and seasonal winds.

.4 Explains how the Atmosphere shapes complex weather patterns.

.5 Explains how winds agitate the ocean surface to create tide and currents.

.6 Explains how the ocean and atmosphere constitute a single system of two fluids interacting with each other (The Ocean Atmosphere System).

.7 Explains how the vagaries of this system also bring with it the bounties of nature (eg; The Monsoons).

2.3 The Oceans and Life. **2.5Hrs**

.1 Compares the marine and land based biological environment-Its size, numbers of species etc.

.2 Explains the four main biological zones

.3 Explains the Plankton-Phytoplankton.

.4 Explains the Zooplankton.

.5 Explains the Benthos.

.6 Describes the ocean bird life.

.7 Describes the other marine animal life-mammals etc.

2.4 Marine Food Web **1Hr**

.1 Explains the synthesis of organic compounds.

.2 Explains the meaning of primary producers

.3 Describe the functional interrelationships among marine organisms.

.4 Describe how food is passed on from prey to predator in a form of a food chain.

.5 Explains that in fact it is a food web.

.6 Explains each step along the food web is called a Trophic level.

.7 Explains the role of bacteria in the food web.

3.0 DEGRADATION OF THE MARINE ENVIRONMENT (8 HOURS)

3.1 Effects of Traditional Marine Activities on the Marine Environment **1.5Hrs**

.1 Explains mans four basic needs

- to fish for his food
- to travel for adventure
- to travel in conquest
- to travel for trade

.2 Describe how these traditional activities were carried out from ancient times up to the advent of powered ships.

.3 Explains how these activities had minimal effect on the environment.

3.2 Effects of Modern Marine Activities on the Marine Environment **1.5Hrs**

.1 Explains the development of powered vessels and their use in fishing and whaling and the depletion of fishing stocks.

.2 Traces the history and development of shipping after the discovery of oil.

.3 States the effect on the marine environment due to oil spills.

.4 States the effect on the marine environment due to offshore drilling and sea bed mining.

.5 Explains the effect on the marine environment due to pollution from chemical tankers.

.6 Explains briefly the effects of dredging, ocean dumping of wastes, and the use of anti-fouling paints.

3.3 Dangerous Goods and Marine Pollutants. **1.5Hrs**

.1 Defines the meaning of dangerous goods.

.2 Explains the classification of dangerous goods.

.3 Describes briefly the IMDG code, U.N. No, EmS No and MFAG No.

.4 Exhibits the labels used in this system.

.5 Explains what are marine pollutants and how they are classed.

.6 Identifies label for marine pollutant and actions in emergency.

3.4 Biological Effects on the Environment. **1.5Hrs**

.1 States the findings of the "Brundtland report".

.2 States the GESAMP report on "The State of the Marine Environment No 115 of 1990 and its observations".

.3 Explains the effects on human health as a result of different types of pollution.

.4 Explains the effects of Microbial agents and their consequence on bathing in the sea and seafood contamination.

.5 Explains about seafood contamination by sewage and associated diseases like diarrhoea, cholera and viral hepatitis.

.6 Explains the effects of chemical contaminants and Eutrophication.

3.5 Ecological Effects on the Environment. 1.5Hrs

.1 Explains difficulty in coming to definite conclusions on the ecological effects because of variations in exposure, species age etc.

.2 Explains how some substances can be lethal in trace quantities, while others are not.

.3 Describes with case histories how population of species changes as a result of pollution

.4 Explains the effects on sensitive areas, eg. coral reefs.

.5 Explains the reasons for the decline in marine mammals.

.6 Explains the effects of fish diseases and the problem of beached sea birds.

4.0 OCEAN MANAGEMENT (5.5 HOURS)

4.1 Control Strategies for Protecting the Marine Environment. 0.5Hrs

.1 Explains the reasons for evaluation the potential for Marine pollution.

.2 Explains the measurement of toxicity.

.3 Explains the measurement of bioaccumulation potential.

.4 Explains briefly: Persistence, bioavailability and Tainting.

.5 Explains the selection and monitoring of dredged material dumpsites.

.6 Compares the assessment of waste disposal on land and at sea.

4.2 Pre-operational Procedures for Hazard assessment and marine pollution control. **1.5Hrs**

.1 Explains the importance of scientific basis for national and international frameworks for managing anthropogenic inputs into the marine environment.

.2 Explains the strategies to match technical, economic, social and institutional implications.

.3 Explains the importance of integrating pollution control with an active waste management program.

.4 Explains the selection of specific dumping requirements.

.5 Describes briefly, laboratory based testing procedures: acute and chronic toxicity, bioaccumulation, degrading and tainting.

4.3 Post Operation Procedures for Hazard Assessment and Pollution Control. **0.5Hrs**

.1 Explains the monitoring network strategy.

.2 Describes the function of control stations and parameters to analyze.

.3 Explains the strategy to find effectiveness of control measures.

.4 Explains the importance of data quality assurance and control.

4.4 Computer Aided Hazard Identification and Response "**SEABEL**" or similar version. **1.Hrs**

OR

"**SEABEL**" hand book or similar printed version

.1 Explains the aim of the exercise.

.2 Describes the process of accident diagnosis, and explains the importance of structured information gathering by means of a check-list.

.3 Describes the process of effect diagnosis and the prediction of the behavior of chemicals.

.4 Describes the process of hazard identifi--cation to people, property and environment.

.5 Describes the process of emergency response decision support.

5.0 IMO CONVENTIONS ON MEP (7.0 HOURS)

5.1 THE LONDON DUMPING CONVENTION (LDC-72) **0.5Hrs**

.1 States the purpose of LDC-72

.2 States and explains briefly the salient articles.

.3 Explains briefly the "Black and grey" lists

5.2 INTERVENTION CONVENTION (69/73 **0.25Hrs**

.1 States the purpose of intervention 69/73 in the aftermath of Torrey Canyon disaster.

.2 States and explains briefly the salient articles.

5.3 MARPOL.73/78

- Annex 1 **1.25Hrs**

.1 States the effects of oil on the marine environment.

.2 Explains briefly the definitions given in regulation 1.

.3 Explains briefly the application, surveys, inspections and certification.

.4 States the conditions under which oil-
-water mixtures can be discharged into
the sea from cargo and machinery spaces.

.5 Explains briefly the concept of "Special
areas and permissible discharges into the
sea in such areas.

.6 Explains briefly the requirements of shore
reception facilities.

.7 Explains briefly the concepts of SBT, CBT,
and PL.

.8 Explains briefly the equipment requirements
for oil pollution control, i.e. Oil
discharge monitoring and control systems,
Oil/Water separators, slop tanks, sludge
tanks, standard discharge connection and
oil/water interface detectors.

.9 Explains briefly the requirements of an oil
record book.

.10 Explains briefly the requirements of the
accidental aspects of control of pollution.

- Summarizes Annex 1 and shows a film,
"Fighting Pollution". **0.5Hrs**

- Annex 2. **1.Hrs**

.1 Defines noxious liquid substances (NLS)

.2 Explains briefly the categorization of
NLS into categories A,B,C and D.

.3 States the effects of NLS on the marine
environment.

.4 Explains briefly the IBC code and chemical
tankers types 1, 2, and 3.

.5 Explains briefly the application, surveys, inspections and certification.

.6 Explains briefly the list of substances covered by Annex 2 and list of substances not covered by Annex 2.

.7 Explains briefly the concept of prewash, efficient stripping, solidifying and and viscous substances.

.8 States the control and discharge requirements for each of the categories of NLS, within and outside special areas.

.9 Explains briefly the concept of commercial tank cleaning, slop disposal, inspection by cargo surveyors and discharge to shore reception facilities.

.10 Explains briefly the requirements of a cargo record book and procedures and arrangement manual.

.11 Explains briefly the use of flow diagram as an aid to comply with the operational requirements of Annex 2.

- Summarizes Annex 2, and shows a film, "Chemical Tanker Operations - Part 2. **0.5Hrs**

- Annex 3, 4, and 5. **1.Hrs**

.1 Explains briefly the salient features of Annex 3.

.2 States the co-relation between Annex 3 and Marine Pollutant category of IMDG code.

.3 Defines "sewage" and the division of waste water from accommodation spaces into "black and grey" categories.

.4 States the effects of sewage on the marine environment.

.5 States the conditions under which sewage can be discharged into the sea and the effluent standards.

.6 States the requirements of control, inspection, survey and certification vide Annex 4.

.7 Defines "garbage" and its effects on the marine environment.

.8 States the conditions under which garbage can be discharged into the sea within special areas and outside special areas vide Annex 5.

.9 States that disposal of all kinds of plastics and synthetics into the sea is prohibited as they are not bio-degradable.

.10 Summarizes the salient features of Annex 3, 4, and 5.

5.4 UNCLOS 82. 0.5Hrs

.1 Explains briefly the background of UNCLOS 82 and the concepts : "common heritage of mankind" and "towards a new economic international order".

.2 Explains briefly the provisions of territorial seas, straits, archi-pelagic waters, exclusive economic zone and the right of innocent passage.

.3 Explains briefly the provisions regarding protection and preservation of the marine environment.

.4 Summarizes the salient features of UNCLOS 82.

5.5 New SALVAGE CONVENTION 89 and New CONVENTION ON OIL POLLUTION PREPAREDNESS RESPONSE

AND CO-OPERATION 90. (OPRC 90). **0.5Hrs**

.1 Explains briefly the salient features of the International Convention on salvage, 1989.

.2 States that the New Salvage Convention -89 is intended to replace the Brussels Convention 1910 which incorporates the principle, "no cure, no pay".

.3 States that the new convention would remedy this deficiency by providing a 'special compensation' to be paid to salvors when there is a threat of damage to the environment.

.4 States that the International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990, would be a major step forward to provide a global framework for international co-operation in combating major incidents or threats of marine pollution.

.5 States that the Convention stipulates that ships must carry a shipboard oil pollution emergency plan.

.6 Summarizes the salient features of OPSC-90.

6.0 CONCLUSION (2.5 HOURS)

6.1 Future Developments in MEP. **1.Hrs**

.1 Explains briefly the developments in air pollution control.

.2 Explains briefly the developments in tanker double bottom and double hull construction.

.3 Explains briefly the developments regarding water ballast pollution and possible steps to control same.

.4 Explains briefly the developments to control emission of halogenated hydrocarbons for the protection of the ozone layers.

.5 Suggests some possible thinking on subjects such as:

a) Limiting the maximum size of tankers.

b) Banning the use of plastics at sea.

c) Creation of a waste disposal system and a waste free ship.

d) Tin - free anti-fouling paints.

5.8.0 DEVELOPMENT OF A BASIC COURSE ON MARINE ENVIRONMENT PROTECTION

A detailed outline and the learning objective of an advanced training course on marine environment protection has been outlined in item: 5.7.0. This coures has a duration of five days. In outlining the course on basic training in marine environment protection, the topics relevant to the needs of Junior Officers and crew have been taken into account. It incorporates the knowledge that is required by them in the day to day running of the ship. The course duration has been restricted to three days.

In item: 5.9.0. the course outline for a basic course on marine environment protection has been defined, for a course duration of three days. The detailed learning objectives for the same has not been defined, as the same may be developed from the learning objectives of the advanced training course. When developing the learning objectives of the basic course, care should be taken that the subject matter is suited for the level of the participants.

5.9.0 BASIC TRAINING PROGRAMME ON MARINE ENVIRONMENT PROTECTION

SUBJECT AREA		HOURS
1.0	INTRODUCTION	
1.1	An Introduction to Marine Environment protection.	1.0
2.0	THE MARINE ENVIRONMENT	
2.1	Chemistry of Sea Water	0.5
2.2	The Ocean Atmosphere System	0.5
2.3	The Ocean and Life	1.5
2.4	Marine Food Web	1.0
		3.5
3.0	DEGRADATION OF THE MARINE ENVIRONMENT	
3.1	Effects of Traditional Marine activities on the environment	1.0
3.2	Effects of Modern Marine activities on the environment	1.0
3.3	Dangerous Goods and the Marine environment	1.0
3.4	Biological Effects on the Environment	1.0
3.5	Ecological Effects on the Environment	1.5
		5.5

SUBJECT AREA		HOURS
4.0	**OCEAN MANAGEMENT**	
4.1	Control Strategies for Protecting the Marine Environment	1.0
4.2	Hazard Assessment and Response	1.0
		2.0
5.0	MARPOL 73/78	
5.1	Annex 1	1.0
	Film: "Fighting Pollution"	0.5
5.2	Annex 2	0.5
	Film: "An Introduction to Chemical Tankers"	0.5
5.3	Annex 3, 4, 5.	1.0
		3.5
6.0	**CONCLUSION**	
6.1	Future Developments in MEP	1.0
6.2	Objective Test and Course evaluation	1.0
6.3	Recommendations and Conclusion	0.5
		2.5
	TOTAL	18.0

CHAPTER – 6

CONCLUSION

6.0.0 IMPLEMENTATION

Perhaps the most difficult part of implementing courses on marine environment protection is the will to conduct such courses. This is because there is always the feeling -- Is this course really required? -- It is going to cost a fortune!-- But it is not mandatory. Questions like these were also asked when the problem of tanker oil pollution first came up and it was found necessary to train personnel in tanker safety. To-day tanker safety training has been accepted and pollution by oil has drastically come down.

The only way to ensure that Marine Environment Protection is made part of the marine education system is to make such courses compulsory. For without such a mandatory requirement, nobody would at his own option ever conduct such a course.

The purpose, or the objective of proposing such a course is to instill a sense of awareness in the minds of all those connected with shipping activities. It is not only the Master of a ship, or for that matter, it is not only the officers who are responsible for ensuring pollution prevention. It is the rank and file on the ship that form a majority and who would act according to the training that has been imparted to them. Is it possible to keep a check on everybody on the ship? Who could prevent them from dumping plastics into the sea? Who could prevent the deck boy from dumping the ships garbage overboard? or an unscrupulous engine hand from pumping bilges into the sea.

The problem is that even if there are regulations that have to be complied with, there is no way in which the same can be monitored. For example, when there is an incinerator and a sewage treatment plant on board, who could be sure that all are following the rules and that nobody is taking short cuts for their convenience. There are many questions such as these that will bring us to the realization that training in Marine Environment Protection is a must for everybody. It is only when seafarers are trained in this subject, that they will have a sense of awareness and responsibility, and this in turn will bring about a total revolution in preserving the environment. There is no doubt that the road is long and sometimes frustrating. Sometimes it would appear that it will never work, and that it is a waste of time and money. But in the long run, this education process will make an impact in the psyche of the minds of all future generations of seafarers. They will be aware of the dangers of destroying nature and of the consequences of polluting the marine environment. Finally, it is these seafarers themselves that will be instrumental in bringing about this awareness to future generations as well.

6.1.0 REFRESHER COURSES

It is said that the process of education never ends. It never ends because of two reasons. Firstly because technology is changing rapidly and we must keep abreast of the latest developments. Secondly, because nature has endowed our memories with a built-in erasure, and that is why after some time we forget the lessons that we have been taught.

It is therefore strongly recommended that refresher courses be conducted after a period of about five years. The objective of these refresher courses should be to familiarize the participants about what they had learned in the earlier course and also to up-date ones knowledge with the latest developments in Marine Environment Protection.

6.2.0 VISUAL AIDS AND PUBLICITY POSTERS

Visual aids have long been known for their power in influencing the minds of people. We see this happening daily on our T.V. screens. It has such a powerful influence, that it has earned the reputation of being called "An idiot box". Yet, this idiot box can be used as a powerful tool in influencing the minds of the people in the right direction. For example, T.V. and Video can be used as a teaching aid in schools and colleges. It can also be used for educating people on the marvels of nature, like the "Discovery" T.V. channel etc.

In the same manner, it would be a good idea if films based on Marine Environment Protection, such as Marpol 73/78 regulations; Carriage of dangerous goods by sea; Chemical carriers; Gas carriers; Contingency planning and Fighting pollution etc, are made available to all ships. In fact any films connected with environment protection in general, and marine environment in particular would be very interesting and may be shown.

Posters, containing marine environment themes could also be made available to ships by International organizations like IMO, Friends of the Earth, Green Peace or any other environmental groups. These posters must be printed in the local languages of the crew members and should be exhibited at conspicuous places on the ship.

These are some of the steps that may have to be taken in order to educate the shipping community and to spread the message of Marine Environment Protection to every corner of the globe. If such measures are taken with dedication, there is no doubt that there will be a day when we would see the fruits of our efforts. This will be seen in the very behavior and attitude of our seafarers to-wards the marine environment.

In conclusion, it must be said that the author of this paper would have the satisfaction that his time has been well spent, if this paper is well accepted and that sometime in the future there would be such courses conducted in all maritime training establishments around the world.

ADVANCED TRAINING PROGRAMME ON MARINE ENVIRONMENT PROTECTION

COURSE TIME-TABLE

PERIOD/DAY	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
I PERIOD (1.5 hrs.)	**1.0 INTRODUCTION** 1.1 An Introduction to MEP **2.0 THE MARINE ENVIRONMENT** 2.1 Natural Chemical Characteristics of Sea Water	2.4 Marine Food Web (Contd.) OBJECTIVE TEST/ SELF-EVALUATION **3.0 DEGRADATION OF THE MARINE ENVIRON.** 3.1 Effects of Traditional Marine Activities	3.4 Biological Effects (Contd.) 3.5 Ecological Effects	4.4 Computer Aided Hazard Identification & Response, "SEABEL" CASE STUDY/ GROUP DISCUSSION	FILM: "Chemical Tanker Operations-Part II" MARPOL 73/78, Annexes III,IV & V
II PERIOD (1.5 hrs.)	2.1 Natural Chemical Characteristics of Sea Water (Contd.) 2.2 The Ocean Atmosphere System	3.1 Effects of Traditional Marine Activities (Contd.) 3.2 Effects of Modern Marine Activities	3.5 Ecological Effects (Contd.) OBJECTIVE TEST/ SELF EVALUATION	CASE STUDY/ GROUP DISCUSSION (CONTD.) **5.0 IMO CONVENTIONS ON MEP** 5.1 LDC 72	5.4 UNCLOS 82 5.5 New SALVAGE CONVENTION 89 and OPRC 90 FILM: "Response to Marine Oil Spills"
III PERIOD (1.5 hrs.)	2.3 The Ocean and Life	3.2 Effects of Modern Marine Activities(Contd) 3.3 Dangerous Goods and Marine Pollutants	**4.0 OCEAN MANAGEMENT** 4.1 Control Strategies 4.2 Pre-operational Procedures	5.2 INTERVENTION 69/73 5.3 MARPOL 73/78 ANNEX I.	FILM: "Response to Marine Oil Spills"(Contd) **6.0 CONCLUSION** 6.1 Future Developments in MEP.
IV PERIOD (1.5 hrs.)	2.3 The Ocean and Life (Contd.) 2.4 Marine Food Web	3.3 Dangerous Goods and Marine Pollutants (Contd.) 3.4 Biological Effects	4.2 Pre-operational Procedures(Contd.) 4.3 Post-operational Procedures	FILM: "Fighting Pollution" MARPOL 73/78, Annex II.	6.2 Objective Test and Course Evaluation 6.3 Recommendations and Conclusion

BASIC TRAINING PROGRAMME ON MARINE ENVIRONMENT PROTECTION

COURSE TIME-TABLE

PERIOD / DAY	DAY 1	DAY 2	DAY 3
1ST PERIOD (1.5 hrs)	**1.0 INTRODUCTION** 1.1 An introduction to Marine Environment Protection **2.0 THE MARINE ENVIRONMENT** 2.1 Chemistry of Sea Water	3.2 Effects of Modern Marine Activities on Environment (Contd.) 3.3 Dangerous Goods and Marine Pollutants	Film:"Fighting Pollution" 5.2 Annex II Film:"An Introduction to Chemical Tankers"
2ND PERIOD (1.5 hrs)	2.2 The Ocean Atmosphere System 2.3 The Ocean and Life	3.4 Biological Effects On Environment 3.5 Ecological Effects on Environment	5.3 Annexes III, IV & V **6.0 CONCLUSION** 6.1 Future Developments in MEP
3RD PERIOD (1.5 hrs)	2.3 The Ocean and Life (Continued) 2.4 Marine Food Web	3.5 Ecological Effects on Environment(Contd.) **4.0 OCEAN MANAGEMENT** 4.1 Control Strategies for Protecting the Marine Environment	6.1 Future Developments in MEP(Contd.) 6.2 Objective Test and Course Evaluation
4TH PERIOD (1.5 hrs)	**3.0 DEGRADATION OF THE MARINE ENVIRONMENT** 3.1 Effects of Traditional Marine Activities on Environment 3.2 Effects of Modern Marine Activities on Environment	4.2 Hazard Assessment and Response **5.0 MARPOL 73/78** 5.1 Annex I	6.3 Recommendations and Conclusion.

GLOSSARY AND ABBREVIATIONS

1. Algae: one celled aquatic organisms with chlorophyll that grows in the presence of light, CO_2 and nutrients and release oxygen.

2. Anthropogenic: toxins produced by man in industry.

3. Ballast: Weight taken on board the ship in the form of sea water for seaworthyness.

4. Bentic region: the bottom of a body of water.

5. Biodegradable: having the capacity of decomposing quickly as a result of the action of micro-organisms.

6. Brackish water: a mixture of fresh and salt water.

7. Carcinogens: cancer producing substances.

8. Coliforms: group of bacteria that produce gas and ferment lactose some of which are found in the intestinal tracts of warm blooded animals.

9. DDT: A non-systemic and persistent insecticide bioaccumulated by marine organisms.

10. Dinoflagellates: bacteria.

11. DSP: Diarrhoeic shellfish poisoning.

12. Ecology: the inter-relationships of living things to one another and to their environment or the study of such inter-relationships.

13. Effluent: liquid flowing out.

14. Eutrophication: process of aging of lakes and other still water bodies, characterized by excessive aquatic growth.

15. FAO: Food and Agricultural Organisation.

16. GESAMP: Group of experts on the scientific aspects of marine pollution.

17. Heavy metals: metallic elements with high molecular weights, generally toxic to plants and animal life in low concentrations. eg. mercury, chromium, cadmium, arcenic and lead.

18. IMDG: International Maritime Dangerous Goods Code.

19. IMO: International Maritime Organisation.

20. IOC: International Oceanografic Commission.

21. LDC: London Dumping Convention.

22. MEP: Marine Environment Protection

23. MEPC: Marine Environmental Protection Committee.

24. MET: Maritime Education and Training.

25. Pathogens: microorganisms that causes diseases.

26. PCB: Polychlorinated biphenyls

27. PSP: Paralytic shellfish poisoning.

28. Saxitoxins: a type of toxin.

29. SOLAS: Satety Of Life At Sea.

30. Thermocline: inflection point in a lake/sea, temperature profile.

31. WHO: World Health Organisation.

32. Zooplankton: tiny aquatic animals.

BIBLIOGRAPHY

1. Atlas and Encyclopaedia of the sea, (1989) -
   The Times publications-
   edited by Alastair Couper.

2. Health of the oceans, - by Edward D Goldber.

3. Herald Tribune, - article dated 13/14 October 1990.

4. GESAMP:, - The state of the marine environment
   studies, No 115 of 1990.

5. Marine pollution and its control, - Mc Graw - Hill
   series.

6. Cleaner oceans, - IMO News No: 3 of 1990.

7. Silent springs, - by Rachel Carson.

8. Our common future, - "Brundtland report" -
   A Norvegian commission report.

9. The fishing industry, - Paper by Kenneth C Lucas.

10. Sea and Air, - by William / Higginson / Bohrbourn.

11. Tanker practice: The construction, operation and
    maintenance of tankers, 1956.
    by King George Alfred Brown.

12. GESAMP report highlights threat to the oceans, - IMO News No:2 of 1990.

13. International chamber of shipping, - Annual report 1989/1990.

14. " SEABEL " - TNO Division of Technology for society 1988.

15. Hanover Express, - Hapag Lloyd report 1991.

16. Marine Environment Protection Committee, - 30th Session, agenda No:19 of 1990.

17. Essentials of ocean science, - by Keith Stowe.

18. Why do Int. conventions not work? - by Gerard Peet.

19. Parts of Syllabus selected from IOC seminar papers, - by Kauke / karau.
R.G.V. Boelens.
M. Preston.
O. Linden.