UNITED NATIONS

ECONOMIC AND SOCIAL COUNCIL

Distr.
GENERAL

E/4487
24 April 1968

ORIGINAL:

Forty-fifth session
Agenda item 12

MARINE SCIENCE AND TECHNOLOGY: SURVEY AND PROPOSALS

Report of the Secretary-General

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INTRODUCTION

The present report is submitted through the Economic and Social Council to the General Assembly pursuant to General Assembly resolution 2172 (XXI) of 6 December 1966.

It may be recalled that, since resolution 2172 (XXI) was approved, another resolution (2340 (XXII)) was adopted by the General Assembly during its second session on 28 December 1967, which established an ad hoc committee to study the peaceful uses of the sea bed and the ocean floor beyond the limits of national jurisdiction. Resolution 2340 (XXII) stipulated, inter alia, that the results of the studies being undertaken in pursuance of resolution 2172 (XXI) should be submitted to the above-mentioned committee. Due account of this fact has been taken in preparing the present report.

In its operative paragraphs 2 and 3, resolution 2172 (XXI) requested the Secretary-General, inter alia, (1) to undertake a comprehensive survey of activities in marine science and technology and, (2) in the light of this comprehensive survey, to formulate proposals:

> "(a) Ensuring the most effective arrangements for an expanded programme of international co-operation to assist in a better understanding of the marine environment through science and the exploitation and development of marine resources, with due regard to the conservation of fish stocks;
>
> "(b) Initiating and strengthening marine education and training programmes, bearing in mind the close interrelationship between marine other sciences."

In the same operative paragraphs, resolution 2172 (XXI) requested the Secretary-General to undertake the above-mentioned survey and to formulate his proposals in co-operation with the intergovernmental organizations concerned and the Governments of interested Member States. The Secretary-General was requested to set up a group of experts to assist him in the preparation of his survey and proposals.

In order to discharge the responsibilities entrusted to him, the Secretary-General engaged the services of a well-known oceanographer, Dr. John Lyman of Washington, D.C., who was appointed as his special consultant. Moreover, an ad hoc Unit on Marine Science and Technology was established within the

[illegible] under the direct supervision of the Under-Secretary-General for [illegible] Social Affairs, to co-ordinate the work of all organizations [illegible] to the preparation of the present report.

The Group of Experts mentioned above was composed of specialists nominated by the organizations concerned and others acting in their private capacity to [illegible] fields of expertise which were outside the competence of the aforementioned [illegible].[1] The Group of Experts met twice, in June 1967 and in March 1968.

During the first meeting the scope of the survey and its outline were agreed upon, as well as the ways and means of obtaining required information. Subsequently, the Secretary-General sent a note verbale with an accompanying questionnaire[2] to all Governments of States Members of the United Nations [illegible] organizations.[3] In addition, the United Nations organizations concerned were requested to provide the ad hoc Unit on Marine Science and Technology with all pertinent information in their possession.

On the basis of the responses received, the ad hoc Unit prepared a first draft outlining activities in the field of marine science and technology and circulated it to all members of the Group of Experts and interested organizations for their comments.

During the second meeting of the Group of Experts, the draft was reviewed and, in addition, a set of proposals was established for consideration by the Secretary-General.

In the meanwhile, the various organizations of the United Nations system had [illegible] or collectively taken steps to ensure that General Assembly resolution [illegible] would receive adequate attention. By February 1967, the seventh [illegible] of the ACC Sub-Committee for Marine Science and its Applications had [illegible] the problems involved in the preparation of the report of the Secretary-General. Again, progress in this respect was reviewed by the Sub-Committee at

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1/ See annex I, Specialists participating in the work of the Group of Experts on Marine Science and Technology set up by the Secretary-General.

2/ See annex II, Note verbale and questionnaire dated 6 July 1967 from the Secretary-General.

3/ See annex III, List of countries which have replied to the note verbale.

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its eighth session in February 1968. In July 1967 a joint working group appointed by the Advisory Committee on Marine Resources Research of the FAO, the Scientific Committee on Oceanic Research of the International Council of Scientific Unions and the Advisory Committee of WMO was convened at Helio Cabala, Italy, to study the implementation of the resolution; this group issued a special report on International Ocean Affairs. Later, in October 1967, the Intergovernmental Oceanographic Commission devoted several meetings of its fifth session to the same subject.

The Secretary-General wishes to express his appreciation for the co-operation he has thus received from a wide variety of sources. It is his belief that the report now being presented to the General Assembly is a faithful consensus of the opinions he has been able to gather from those sources.

The report comprises three parts. In the first, some introductory observations are presented on the importance of marine science and technology. The second reviews the activities of Member States, the mechanism for co-operation at the international level and questions related to education and training in marine science. The third part examines briefly the need to maximize international co-operation, and sets forth the proposals which the Secretary-General, in accord with the executive heads of the organizations of the United Nations system, considers necessary to present to the General Assembly regarding an expanded programme to assist in a better understanding of the marine environment through science, international co-operation for development and exploitation of marine resources (living and mineral), international action relating to the prevention of pollution of the sea, and an expanded programme of co-operation in the field of education and training in marine science.

A number of annexes illustrating and expanding on the main body of the report provide in particular complementary details on the activities of Member States and the various organizations concerned.

I. INTRODUCTORY OBSERVATIONS ON THE IMPORTANCE OF MARINE SCIENCE AND TECHNOLOGY

1. The objective of oceanography is to increase, in collaboration with other scientific disciplines, human understanding of all aspects of the oceans - the properties and behaviour of the ocean waters; the nature of living creatures in the sea; the interactions between the waters, the air above them and the solid earth beneath; the shape and structure of the ocean basins, and the interrelationships of all these topics. Because the seas cover 71 per cent of the globe, oceanography is a science concerned in many ways with the earth as a whole, in which physics, chemistry, biology and mathematics are applied to the study of the oceans of our planet.[1/] In this sense, it is closely related to meteorology, the study of the earth's gaseous envelope and its relation and effects on the underlying surface; to geology, whose object of study is chiefly the solid outer part of the earth, and more distantly to astronomy, the study of bodies outside the earth. In common with these other sciences, the present state of the object of study has largely been determined by events in the distant past. Thus, oceanography is concerned not only with things as they are but also with what they were in past times.

A. Understanding the ocean

2. A science must do more than merely describe its object of study; a primary aim must be understanding - the finding of underlying relationships between phenomena. It is not enough, for example, to map the position and measure the speed of the Gulf Stream; we want to know what driving forces move the water, and what forces resist the motion. Even if we had an accurate and detailed map of the ocean floor, we would still need to know the processes, deep within the earth, which have deformed our planet's surface to produce the ocean basins and the continental masses.

1/ For a more detailed treatment of the subject, the reader is referred to "General scientific framework for world ocean studies", prepared by the Scientific Committee on Oceanic Research of the International Council of Scientific Unions for the Intergovernmental Oceanographic Commission. In the preparation of this part, pertinent material has been extracted from that publication to serve as a background for understanding the activities dealt with in the following part.

The motions of the waters

3. The oceans are restless - every drop of sea water in the world is constantly in motion. There is a great variety of motions, from the ever-changing waves on the surface to the sluggish currents deep within the sea; from the majestic flow of great ocean rivers, such as the Gulf Stream in the Western Atlantic and the Black Current (Kuroshio) off Japan, to the swift tidal races of harbour Much of the movement is swirling and irregular, but in almost all cases the water particles follow nearly horizontal paths, this because, on a planetary scale, the oceans are only a relatively thin film, which itself consists of thinner films of water of different densities.

4. Rather than the continual motion of the waters resulting in a thorough mixing, other processes bring about differences between water masses, and these differences are maintained by the layering, or stratification of the sea. A sounding off Hawaii will reveal, a mile beneath the tropical surface, water with a temperature close to freezing. This water sank from the surface near Antarctica thousands of years ago, since when it has retained its Antarctic temperature as it slowly travelled to the North Pacific.

Air-sea interaction

5. Recent meteorological studies show that large-scale weather patterns over periods of weeks to many years are closely related to the temperature distribution of the water layers near the surface of the sea. Improvements in the present low accuracy of long-range weather forecasting can therefore be made through studies of the large-scale interactions between the oceans and the atmosphere, which are interlocked components of a great heat engine, transporting heat energy from low latitudes to high latitudes, where is is radiated into space. About one third of the energy of the air enters it through the condensation of water vapo from the sea surface. A large part of the remainder is transferred as heat from the warm sea to cooler air. Evaporation and heating do not uniformly over the ocean nor are they uniform at any given latitude. They are high where the cloud cover is small and in these regions where the dif temperature between the sea and the air is greatest. Areas of maximum difference shift their location, and their intensities vary. Regions where storms

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are born and the paths of storm travel also appear to change with variations in water temperature near the sea surface. Because of its high heat capacity and massive inertia, the ocean can change only slowly with time; which may explain, at least in part, the persistence of weather patterns over periods of weeks to years.

6. Forecasting is not the only economic objective of modern atmospheric research. There is reason to hope that some aspects of our planet's weather can be controlled. Tropical storms may be aborted in their early oceanic stages if a means can be found to prevent anomalously large transfers of heat energy and water vapour from the sea to the air in the regions of hurricane or typhoon formation.

7. Recent work has shown that anomalies in atmospheric circulation result in anomalies of ocean surface temperature. For example, with increasing winds of cold origin, there is an increased transfer of sensible and latent heat from the ocean to the atmosphere and an increased stirring of the upper layers of the stratified sea. Both processes result in a lowering of the sea surface temperature. Restoration of sea surface temperatures to their "average value" comes from a slow strengthening of the poleward-moving ocean currents near the sea surface. Still unsolved is the character and rate of the changes in the ocean density distribution that cause these poleward currents.

8. The large-scale interactions between the sea and the air need to be studied co-operatively by oceanographers and meteorologists through data recording at many points in the upper water layers combined with continuous mapping of cloud cover, winds and atmospheric temperature distributions over the oceans. Many of these atmospheric measurements will come from weather satellites but the measurement of the ocean parameters will probably require establishment of a network of anchored buoys.

The ways of life in the sea

9. The differences in the properties of the waters are reflected in variations of fertility between different parts of the sea. Off Peru, in a strip of ocean a hundred miles wide and a thousand miles long, the water near the surface forms a permanent green pasture, as productive for animal life as the blackest soil of the Ukraine. In the central regions of the North Atlantic and the North Pacific, the purplish blue colour and the clarity of the waters show that they are an oceanic

10. The oceans are a gentle physical environment for living things. There are hundreds of thousands of different kinds of sea creatures, ranging from the microscopic plants of the open sea and the grasses and algae of shallow waters, which are the basic food supply for all marine animals, to the giant whales. Between these extremes is a web of life in which most animals are both predator and prey, and the final fate of all is to be food for bacteria. Research on the physiology, life histories, distribution, behaviour and evolution of marine organisms forms one of the classical fields of biology. The need for biological knowledge is greater today than ever before, because of the rapid expansion of fisheries throughout the world ocean.

The earth beneath the sea

11. From the geological viewpoint, our knowledge of the nature and origin of the oceans and their bounding continents, while still scant, has increased greatly over the past two decades, as a result of increased scientific investigations in the ocean environment. It is now realized that the topography of the ocean floors is highly complex and that this complexity reflects a long and varied history. We now believe that the existence of the ocean basins and of the waters which fill them is intimately related to the structure of the outer layers of the earth; the history of the oceans cannot be separated from the history of the earth as a whole.

12. Studies of the sediments and rocks beneath the deep sea have yielded revolutionary insights into this history. The earth's crust is thin under the oceans, and the great underlying mass of rock called the mantle, which makes up most of the body of our planet and encloses its molten core, is therefore easier to study at sea than on land. By mapping the shape of the sea floor and the thickness of its sediments, measuring variations in the force of gravity, the earth's magnetic field, heat coming from the interior, and the acoustical properties of the rocks, a picture is beginning to emerge of the processes that have shifted the continents and shaped the ocean basins. Some geologists now believe that the mantle rocks beneath the ocean are slowly turning over in great convection cells thousands of miles in diameter. The driving mechanism for the motion is thought to be convection, resulting from the radioactive production of heat deep within the earth. Recent investigations of the Mid-Oceanic Ridges have led to the hypothesis of sea floor spreading, which propounds that new crustal material is

continually forced up to the surface along the axes of the great central ridges of the oceans and is slowly dragged outward by the convective motion of the mantle to the edges of the ocean basins, where it is again carried downward into the earth's interior underneath the continental margins. Many workers relate this hypothesis to the long-debated theory of continental drift, with a gradual widening of the Atlantic, Indian and South Pacific Oceans as the continents move apart.

13. Much of the evidence for these theories is indirect and uncertain. However, technological developments now permit deep holes to be drilled through the thin layers of oceanic sediments into the underlying rocks, and core samples to be collected for direct study. Such operations are naturally expensive but the cores obtained will give a new level of insight into the nature of the earth beneath the sea.

Incompleteness of present knowledge

14. Even the task of describing its field of endeavour is far from complete in oceanography. Our maps of the ocean floor are at about the stage of land surface maps published 250 years ago. We may know in general the average direction and volume of the major currents near the sea surface, but we are unable to describe the changes of these currents from season to season or from year to year. In this respect, meteorology is far ahead, for the meteorologist plots every day the direction and speed of the winds over the entire northern hemisphere.

15. We have only fragmentary knowledge of the currents beneath the sea surface. For example, direct measurements with current meters and buoys show, 200 feet beneath the surface along the equator in the Pacific Ocean, a broad thin ribbon of water flowing steadily eastward at a speed of two to three miles an hour, under the westward-moving surface current. Waters elsewhere in the depths sometimes move equally rapidly, but virtually nothing is known of the duration of the motions, nor of their magnitude, direction and variation with time.

16. During the past hundred years, thousands of different kinds of fishes and other marine animals have been collected, described and classified; yet new species are found nearly every time a research ship visits the poorly explored waters of the southern hemisphere, or lowers a trawl 2,000 metres beneath the surface in the

North Pacific. It is practically certain that many deep-sea creatures cannot be caught with present collecting gear. Fishermen have been harvesting the sea for thousands of years, but even today no one can estimate within a factor of ten how many fish live in the ocean.

Observations and measurement

17. Observation and measurement in the ocean environment is difficult because of light scattering and attenuation. Sound is the only kind of man-generated energy that is propagated for longer distances in sea water than in air, but sound waves are usually badly bent and distorted as they move through the water. Men can enter the depths of the sea only with elaborate oxygen-carrying and pressure-protective devices. The invention during the Second World War of self-contained underwater breathing apparatus has permitted short visits to be made to the upper layers of the underwater world. A very few explorers have gone down to great abyssal depths in bathyscapes and somewhat lesser depths are accessible in small submarines. At present, however, most measurements below the sea surface still depend on remote self-operating instruments controlled from surface ships. Consequently, our picture of what the ocean is like is analogous to that which could be obtained on land by travelling in a balloon above a continuous deck of clouds.

18. Oceanographic instruments have been greatly improved during the past [illegible] years, through advances in electronic and related engineering. The rate at which some types of data can be collected has increased to the point where computer techniques are required for processing and study.

Why study the ocean?

19. One of the most important uses of the ocean may be as a source of human protein food. Hundreds of millions of the earth's people suffer in greater or less degree from deficiency diseases caused by a lack of the right kinds of protein in their diets. In 1964 about a quarter of the world supply of high-quality (animal) protein came from some 40 million tons of fish. Unless non-animal sources of [illegible] quality protein can be provided on a large scale, this proportion will need to be raised in the future. As human populations grow, their requirements for cereals and other energy-providing foods for human consumption will increase so rapidly

that it may be difficult to divert sufficient crops for animal feed to maintain even the present low level of meat and milk production. If means can be found to preserve and distribute fish protein in an acceptable and inexpensive form, an additional quantity of marine fish equal to the present catch could be entirely utilized in the less developed countries twenty years from now, just to provide for the high-quality protein needs of the added numbers of people in their populations.

20. Such a doubling or even quadrupling of the present marine harvest would be possible, but difficult to sustain until we obtain far more knowledge of the ocean waters and the plants and animals they contain. A doubling of the world fish catch would be worth many thousands of millions of dollars each year. The annual cost of the necessary research could be several hundred millions of US dollars.

21. Besides their protein component, marine animals contain a number of other important chemical constituents. Marine oils, glycerides containing highly unsaturated fatty acids, are obtained in large quantities from fish, whales, seals and even seabirds. They are valuable in the formulation of paint, or are hydrogenated as a source of margarine, thus forming an important addition to diets in countries deficient in edible oils.

22. Numerous useful chemicals are already being recovered from processing several hundred thousand tons of marine plants annually, and the possibility of extending the list to pharmaceuticals, including even antibiotics, is under intensive study.

23. Exploration of the mineral resources of the ocean floor is only in the earliest stages. Metal such as manganese, copper, cobalt and nickel, found in concretions in various areas of the sea floor, await the technological advances permitting economic development. Metal-rich brines in the Red Sea are another potential resource. Phosphate deposits on the sea floor may also alleviate fertilizer shortages in many countries. A number of minerals, of which petroleum and gas are the most notable, are already exploited in many offshore areas; such operations will be extended further from land as technology and economic considerations permit.

24. Phase I of the Mohole operation in 1961 has shown that drilling in very deep water is within the state of the art, though naturally very expensive. The sea also possesses vast resources of wave, tidal current and thermal energy, the utilization of which deserves further study.

25. Food requirements and national security are among the reasons for the increase in government support to the marine sciences in recent years, and meteorology has, for many decades, attached prime importance to the oceans. Man's unending quest for knowledge - the advancement of science - has also been a motivation in oceanographic study.

B. The ocean as highway

26. The sea is the major highway for the international transportation of heavy or bulky materials; it will undoubtedly remain so for many generations to come, with steadily increasing shipments of many commodities. Freight costs for ocean cargoes vary widely but could total $15,000 million per year on a world basis by 1975. A reduction in the cost of ocean shipping would serve the interests of both the advanced and less developed countries. Oceanographic and meteorological research can reduce significantly losses at sea and ocean shipping costs, as many aspects have a direct bearing on the ocean's use as the major intercontinental highway. For example, better knowledge of wave characteristics should permit improved design, increase safety, and lower operating costs. Better forecasting of waves, winds and currents would facilitate improved routing, lower fuel consumption, lessen time at sea and lower storm losses. Greater knowledge of near-shore wave, current and sea floor characteristics is needed for harbour construction and improvement, and may be helpful for the development of new methods of loading and unloading. Increased knowledge of the life histories, behaviour and physiology of fouling and boring organisms could help to lower the losses caused by these pests.

Safety of ships

27. Each year the oceans take thousands of human lives owing to casualties to ships, such as collision, stranding, capsizing, foundering, fire, etc. In 1966, for example, 112 ships larger than 1,000 gross tons were lost - more than 700,000 tons. The safety of ships and human life at sea are ensured by adequate ship design and construction, proper installation and handling of equipment and accurate navigation. Extensive investigations being carried out on an international and national basis into these problems require a good knowledge of the behaviour of the oceans.

28. Wind-generated ocean waves produce the major stresses suffered by a ship. Vessels on the crest and trough of a wave suffer longitudinal stresses, and racking stresses in a transverse sea. Heavy slamming of waves introduces severe stresses in the local structure of the forepart of the ship's bottom while pitching, which causes the emergence of the propeller, may produce dangerous vibrations.

29. Stability is critical in ship design; evaluation of the elements of stability and development of suitable stability criteria depend greatly upon knowledge of the characteristics of the ocean and behaviour of ships under high waves and winds, especially in following or quartering seas.

30. Before maximum loading regulations were introduced, overloading often caused ships to founder. An international convention on load lines was first established in 1930 and improved in 1966 on the basis of better oceanographic knowledge of zones of ocean storms. If more were known about these storms, it might be possible to allow greater loads at certain times and thus lower shipping costs without reduction of safety.

31. The recent rapid expansion in world shipping affects safe navigation. There is an urgent need to improve position fixing so as to avoid collisions and strandings. Better surveys of navigable waters and fuller information about navigational hazards in nautical publications and charts would reduce the chances of stranding.

32. There are additional potential savings in human life and property from reduced storm damage to ships and cargo as well as losses due to icing of fishing trawlers and other smaller vessels in black ice-fogs and cold, stormy seas.

Ship design

33. Loss of speed in heavy weather affects both fuel consumption and power requirements. Wave characteristics affect the behaviour of a ship and its response to the sea. Statistical information on wave properties such as height, length, power spectrum, coherence and distribution over large areas of the oceans is essential if ships are to be designed with higher payload/weight ratios. Designing ships specifically for certain limited trade routes, taking into account the specific characteristics of the waves in relation to local seasonal conditions, also offers possibilities for economic gain.

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34. Radical developments such as hovercraft, hydrofoils or cargo-carrying submarines must also be based on a better knowledge of the oceans and lower atmosphere. The availability of shorter routes under the polar ice contri[illegible] to the attractiveness of the commercial submarine. The polar route betwee[illegible] and Tokyo is only 6,300 miles against 11,200 by the conventional surface route. Similarly, the under-ice polar route would save nearly 3,000 miles between Honolulu and London.

Ship operation

35. A full understanding of waves, their distribution in space and tim[illegible] the world oceans, and the effects of waves and winds on ships would make it possible to predict what would happen to a ship along any given route. Ships could then be routed for maximum comfort, economy and safety. This is already being done in some countries on the basis of the rather limited available knowledge and ship operators have utilized the Least Time Track principle to reduce the time of vessels at sea. Savings in steaming time of eight hours for a 3,000-mile trip, and thirteen to fifteen hours for a 5,000-mile voyage have been recorded. The technique is still in its infancy but will develop with increasing knowledge.

36. More reliable prediction of tidal currents in narrow channels and constricted harbours, better nautical charting techniques, incorporation of radar "pictures" in harbour chart atlases, improved harbour construction based on more accur[illegible] predictions of the changes in bottom silting conditions, and development of[illegible] for preventing or dissipating such natural hazards as fog and ice could also result from an increased effort in marine research.

37. The fouling of ship hulls and the ravages of boring animals have been a problem since man first took to the sea. In earlier times, it was not unusual for a ship to have its bottom encrusted completely with a thickness of eight to nine inches, adding 300 tons or more to the original weight of the ship. Fouling results in a rough hull, more frictional resistance, higher power requirements and hence increased fuel consumption and higher costs. Fouling can so increase resistance that fuel consumption must be increased by 50 per cent to maintain shipping schedules. Frequent dry-docking and anti-fouling paints can control this problem but may cost more than operators care to spend. Growths two to three inches thick and weighing upwards of 100 tons may therefore still be seen, particularly on ships that have spent some time in tropical ports.

C. Harvesting the ocean

38. The total annual production of the world's marine fisheries doubled between 1955 and 1967 - an increase of 6 per cent each year which promises to be maintained in the near future. Use of fish as fish meal is increasing more rapidly than that of fish as direct food for humans. The latter, however, still shows an average growth nearly twice the rate of growth of the world's population.

39. Of the present total catch of 50 million tons, more than one third goes to the production of fish meal (used in feed-stuffs for poultry and livestock, and thus providing human food indirectly) and oil. This compares with about 4 million tons in 1955, and represents a very large increase in the indirect contribution of fisheries products to human diet. Most of the fish protein eaten by a growing chicken is retained as protein in the body of the animal and thus passed on for human consumption.

40. These growth rates in fish catching can be maintained with the aid of oceanic investigations conducted on a world-wide basis to locate and assess fish populations see how these vary with changing conditions in the sea and determine those aspects of behaviour that can be exploited in harvesting them.

41. The value of the world ocean harvest to the fishermen, now several thousand million dollars a year, can be multiplied by at least three in computing the contribution to the gross world economic product, since the catch about trebles in value between the producers and the final consumers. Within fifteen to twenty years, this contribution could more than double. Part of this growth will occur only if there is an increase in fisheries-oriented research. The necessary marine research and development could cost several hundred million dollars a year and yet be economically very beneficial.

Benefits to fisheries from marine research

42. Research on the ecology and biology of the organisms supporting the marine fisheries is of direct economic value in two ways. First, for those fish populations being substantially exploited, it can provide the basis for both more efficient catching operations and "conservation" (maintaining the populations at levels which will produce maximum yields year after year). Such fish populations are now in the minority, but they include the most valuable species in the

near-shore waters of the northern hemisphere and some of the more valuable species supporting high-seas fishing operations. With expanding operations, additional fish populations are being exploited to the point where conservation measures are urgently required. Secondly, for the populations that are little used, or not used at all, research on their habits and reactions can provide the basis for developing means of catching them cheaply, so that they can be exploited economically in large volume. Such little-used fish stocks occur not only in distant waters but also near the coasts of major fishing nations.

Unexploited stocks

43. Fishery investigations have revealed the existence of very many large unused resources. Only a few illustrative examples are given here. A large population of anchovies off the coast of California appears to be capable of sustaining a fishery of at least a million tons a year. Taking this catch should assist in rebuilding the stock of sardines with which they compete. A very large stock of hake exists in the same region. Both species are used primarily for fish meal. The population of jack mackerel off the Pacific coast, now yielding a catch of about 45,000 tons a year, could support greatly increased catches. The catch of mackerel in the North Sea has increased several times in the past three years through the introduction of efficient fishing gear. Large stocks of demersal fish exist in the Bering Sea and the Gulf of Alaska, as well as large stocks of ocean perch (redfish) in the latter. Catches of over a million tons are already being made by Russian and Japanese fishermen from these stocks. Research work in the Indian Ocean has revealed very high productivity in the Arabian Sea which indicates the presence of large potential resources. Continuing research will undoubtedly uncover many new possibilities.

44. The greatest potential resources of animal protein in the ocean are in the form of small organisms, particularly zooplankton.[2/] Some nations have been exploring the possibility of utilizing the stocks of krills, particularly Euphausia superba, in the Antarctic Ocean. The potential yield might be of the order of 50 million to 100 million tons a year. The utilization of enormous stocks of

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2/ For further information, see "Resources of the sea (beyond the shelf)" (E/4449/Add.2).

lantern fishes and other organisms scattered in the subsurface layers of wide ocean areas is another possibility. The large-scale exploitation of these potential resources would, however, require new technological developments.

Lower harvest costs

45. Better understanding of the behaviour of marine animals will lead to improved catching methods, lower costs and growing markets for the increased ocean harvest. Improvements in fishing gears, the invention of new ones and more extensive use and further development of electronic aids to fish location, navigation and under water telemetry will also play a part.

46. Development of high-seas fisheries seems to tend towards world-wide operations supplying a world market, employing large, long-range vessels operating from "overseas" bases. The trend is well developed by the Japanese and is a significant element of the Russian and Polish fisheries. French, German, American, Scandinavian and Spanish operators are also entering the picture. In these new ocean-ranging fisheries, oceanographic research can be an important aid to development.

Effect of physical conditions in the sea

47. The yields of many of the major sea fisheries are widely variable from season to season, year to year and even decade to decade. In some cases, these fluctuations are known to be related to large-scale changes of the physical conditions in the sea. A few examples follow.

48. Off the north-west coast of South America (Peru-Ecuador), the pulsation of warming and cooling in the eastern Pacific reaches an apogee every five to eight years in a phenomenon so sharply evident in the whole area as to have earned a distinctive name, "El Niño". The cause of this phenomenon is still uncertain, but its effect is a spilling of a thin skin of warm tropical water over the normally cold upwelled water for a variable distance down the Peruvian coast. In this area lies the largest single species fishery in the world (for anchovy, Engraulis) as well as large fisheries for yellowfin, skipjack tuna and bonito, and a very numerous oceanic bird population producing guano (fertilizer). The effect of "El Niño" on the production of the fisheries and guano is harsh. It often brings

about a mass mortality of the guanay birds; sometimes there is such mortality of aquatic life as to render the inshore water putrid; torrential and damaging rains in adjacent Ecuador and Peru are a regular accompanying feature.

49. In the regions of eastern boundary currents in the tropics, a shallow thermocline directly overlies a layer of water that is almos... When this oxygen-poor layer rises and invades the continental shelf, ... life is rudely affected. Some sections of the broad continental shelf off the Malabar coast of India are flushed partially clean of life each year as the monsoon and the current turn, the thermocline rises toward the surface and the cool water under it creeps in over the continental shelf. Swimming animals are forced to the surface and towards the beach. Adult shrimp school in the upper water layers and sole by the tens of tons surface and come into the beach seines. Similar, but not so striking, phenomena occur annually on the north shore of Gulf of Guinea.

50. Large populations of fish and invertebrates are very often associated ... regions of upwelling. The enormous population of anchovies off Peru is substantially confined to the upwelled waters there; off Dahomey, where the water upwells behind a cape, 5,000 canoes may take 10,000 tons of sardinella during a two-months' season. The pink shrimp of the Gulf of Panama come in with cool, upwelling water; the king mackerel (Scomberomorus) schools at the surface in the Gulf of Aden when the surface waters are cooled by upwelling. Along the Sarashtra coast of India, cool subsurface water creeps up over the continental shelf as the monsoon and the surface current change. It is then that the great Indian salmon or Dara (Polydactylus) swarms into the stake nets.

51. About 80 per cent of the marine fish catch of India is taken on the west coast. The prime components of the catch by volume are the oil sardine (Sardinella longiceps) and the Indian mackerel (Rastrelliger canagurta). Both are subject to very wide fluctuations in yield. The sardine catch peaks sharply during the transition period between monsoons, when the cool, low-salinity coastal waters characteristic of the south-west monsoon are replaced by the warm saline waters of the north-east monsoon. In the past ten years the mackerel catch has ... very variable, although not so widely as that for sardine. Generally ... when the sardine catch is up, the mackerel catch is down, and vice versa.

Some catch fluctuations are not understood

52. For the above examples, the relation between physical changes in the sea and large fluctuations in the yield of the fisheries is fairly clear. In other cases, the reasons for wide annual swings in the size of the catch are not well understood.

53. The winter herring fishery of Norway, for instance, goes through time changes in productivity that have been traced back to medieval times. In the most recent swing, the annual catch declined from 1,146,000 tons in 1956 to 69,000 tons in 1961 - the smallest catch in fifty years. The relation of these broad swings to climatic and sea conditions has been the subject of intensive research throughout this century, and now it is possible to make at least short-term predictions.

54. In the 1930's, the catches of bluefin tuna (Thunnus) and of sardine (Sardinops) were large in Japan. During the 1940's and into the 1950's, the catches of both species shrank continuously until their importance became nominal. In the late 1950's, the catches of these species began to increase; but whereas the bluefin tuna again supports an important fishery, the sardine has disappeared for a second time. There is no demonstrable relation between these events and the degree of fishing effort.

55. From the standpoint of volume of production, the Atlantic menhaden (Brevoortia tyrannus) is overwhelmingly the most important single species in the North American fisheries. The annual catch, which used to average 600,000 tons, has in recent years dropped to about 200,000 tons. The wide swings are apparently related in part to changes in water temperatures on the eastern coast of the United States, on which depend spawning success and survival of young fish.

56. The effect of variations in oceanic conditions on the availability of mackerel (Scomber) to the New England fishery has been the subject of a classic study.

Needs of information on ocean conditions

57. On a world-wide basis, the great fisheries are affected in a major way by changes in ocean currents, temperatures and other physical and chemical conditions. The fisherman needs to anticipate these to improve his efficiency and lower his cost of production. He can however do this only to a very limited degree on the basis of his own local observations, because oceanic events in the local area are partly the result of atmospheric and oceanic processes acting at a distance.

58. No phenomenon of the open ocean is so eagerly sought out by the pelagic fishermen as the interfaces between water masses, whether these be measured by current at the surface, or by sharp thermoclines on the bathythermograph trace. Concomitantly, no feature of the ocean is so changeable as to location and persistence as these interfaces.

59. Fisheries development requires the mapping of the world ocean as a unit at periodic intervals - monthly, seasonally or annually - by presently available parameters, and others that can be introduced. These maps should show the existing conditions, together with anomalous conditions over a suitable base say fifteen years. Particular sectors of the maps, such as areas of upwelling areas occupied by important fisheries, areas of current interfaces etc., should enlarged for more detailed examination and means should be developed for speedy transmittal to ships at sea and workers ashore. The compilation and transmittal of such synoptic maps would be an appropriate function for national and international data centres, for which adequate finances should be furnished to provide this service on a timely basis.

60. Time series of observations are also needed at relatively fixed locations. An ever-increasing number of continuously recording devices should be installed on weather ships, moored buoys and oceanic islands. Much development remains to be done on these devices, but this should not prevent widespread distribution in their simpler forms to important localities in the world ocean.

Exploration of fish distribution

61. Frequently, the location and depth of fish stocks are known only where they are exploited by some established fishery. At other times, they may be in some entirely different geographical location, or in a deeper water layer.

62. Exploration for both exploited and unexploited stocks by conventional gear or exploratory gear is essential to understanding and appraisal of th and world fishery potential. However, both adults and juveniles may at times be virtually unavailable to this equipment. Exploration with conventional not only slow, expensive and frequently inadequate but it may result in conclusions - gross underestimation of stocks, for example. There are several approaches to the problem of augmenting fisheries exploration data: among these are underwater sound and television, surveys of fish eggs and larvae and the

collection of fish scales in stratified bottom sediments. The value of electronic methods (echo-sounding, sonar etc.) for locating fish is well established, but of equal importance is their potential for estimating, by automatic "counting" techniques, the actual quantities of fish present in a region. Further research and technology in this field is vital to fish stock assessment.

63. Collection of pelagic fish eggs and larvae requires simple ships and simple plankton nets. It can yield a wealth of information on the fishes at two very important stages - spawning and hatching - and it can reveal much information on the planktonic associates of the species. Pelagic eggs and larvae of abundant fish are numerous and widespread. Thus even a sparse coverage will be adequate for many exploratory purposes.

64. Initial identification of previously undescribed eggs and larvae requires collections of larval and post-larval series. To obtain more than a very rough estimate of the abundance of the spawning stock also requires further studies, as for example, on the fecundity of the adult fish.

65. One underlying uncertainty of all fish surveys is that of the persistence of the species within a given region. In a few cases, extensive historical records permit an estimate of persistence. In most cases, however, there is no assurance that the species does not fluctuate widely in distribution and abundance over the time scale of a few decades.

66. Fish scales, earbones (otoliths) and other remains are preserved in some ocean-bottom sediments. Where deposition is rapid and the bottom water conditions are sufficiently reducing, as in some inshore basins, the sediments may be virtually undisturbed. The deposits of a decade or even a single year may be distinguishable and may contain sufficient identifiable fish remains to give insight into the persistence of fish species, interrelations of abundance of different species and gross changes in the composition of the fauna. This information can be processed on a time scale that is useful for the appraisal or management of fisheries stocks (for example, 200 years by decades). Studies of associated organic remains, such as diatom tests, will give insight into past oceanic conditions.

67. Larval and sediment surveys can be carried out with simple equipment, but they require both competent laboratory investigators who can identify, classify

and interrelate the materials from different species, and numbers of trained technicians to help in handling large collections. Descriptive keys to eggs and larvae of different species are valuable training tools.

Grazing the sea

68. It is often said that fishing techniques have not advanced much beyond mankind's hunting stage, and that what is needed is to farm the ocean. In fact the problems of fisheries are more properly compared to cattle grazing on an open range than to farming. A balance between catches of different kinds of must be maintained, or else the kinds that are least useful will take over from the most wanted varieties. We need to learn how to breed better varieties of fishes, like salmon, that fatten themselves in the distant seas and return to the rivers to spawn, and how to control the predators and pests that compete with us for harvest of the sea. The addition of small quantities of vitally needed substances may increase the fertility of the ocean pastures, in the way that the Australians have been able to improve their sheep range by adding small quantities of cobalt.

69. At least in some cases, the principal effect of selectively fishing a particular species is to alter its competitive relationship with its associates. Off California, the apparent effect of taking the Pacific sardine almost exclusively was to stimulate the competing anchovy stocks.

70. To date, much fishery research has been devoted to individual species, almost in an ecological vacuum. Increased attention needs now to be devoted to the trophic-level competitors and prey species of exploited fish stocks in order to understand the existing degree of competition and the potential of these species to replace the exploited stock. This may result in utilization of the competing species and thus possibly in a more stable "trophic-level" fishery.

Mariculture

71. While the problems of open-ocean fisheries resemble those of open-range management on land, there are many promising possibilities for development of a genuine marine agriculture, or "mariculture", in shallow near-shore and enclosed waters. In recent years, Japan has been the world leader in culturing seaweeds, particularly "laver", oysters and other mollusks,

shrimps etc. In oyster culture, the Japanese have succeeded in increasing the productivity of a hectare of sea area from 700 kilogrammes to as much as 35,000 kilogrammes, a fiftyfold increase, by attaching the seed oysters to long ropes hanging from rafts. In this way, bottom-living predators can be avoided, and the entire volume of the sea in the area of cultivation can be utilized.

72. In agriculture on land, plant nutrients are added in the form of chemical fertilizers. In Japanese aquaculture, marine plankton are the "fertilizers" that nourish the crop of shellfish. The areas most useful for aquaculture are not those that can be enclosed or fenced in, but rather those in which there is a continual through-put of plankton carried by currents past the location where the crop is being grown. Substantial production of aquatic animals through mariculture is still in a primitive stage requiring much research of many kinds.

D. Marine minerals[3/]

73. Marine mineral deposits may be considered in three fundamental categories:

(a) Deposits associated with pre-existing geological formations (bedrock) of various ages now buried under the sea, which are especially important on the continental shelves;

(b) Surficial deposits lying upon or immediately under the sea floor, particularly the chemical precipitates in process of formation in the ocean environment;

(c) "Deposits" in the form of minerals contained in solution in sea waters.

Mineral deposits within bedrock

74. This category may include any or all of those types of mineral deposits found in a similar geological setting on land - petroleum, gas, sulphur, salt and potash, coal, iron as well as base, precious and rare metals, industrial minerals etc. There is, however, one important proviso - a majority of these are unique to the

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3/ The material presented in this part, is largely taken from the Introduction and Summary of "Resources of the sea (beyond the continental shelf)". For further details, see document E/4449/Add.1.

continental environment and are therefore not likely to occur in significant amounts in bedrock underlying the abyssal ocean floor, where only those metals associated with basic and ultrabasic igneous rocks, such as chrome, nickel, cobalt and platinum, are to be expected.

75. In this category, the spectacular success of petroleum and gas development in many offshore areas throughout the world needs little elaboration; 16 per cent of the world's total oil production and 6 per cent of its natural gas come from offshore wells. With the list of new offshore petroleum discoveries growing yearly - United States of America, Mexico, Venezuela, Peru, Chile, Trinidad, Brazil, Nigeria, Gabon, Angola (Cabinda), United Arab Republic, Libya, Iran, Saudi Arabia, United Kingdom, Italy, Japan, Brunei, Australia are recent examples - continuous expansion is assured and possibly by 1980, 25 to 30 per cent of production may come from beneath the sea. Production to date has been mostly from near-shore areas of the inner continental shelf, which are still inadequately explored. Although the petroleum potential of the deeper water regions of the outer continental shelf and continental slope can only be evaluated tentatively, because of our meagre knowledge, there can be little question that they also contain substantial reserves of petroleum and related products which will come in for attention when technological development allows economic exploitation.

Surficial deposits

76. The surficial deposits include all the unconsolidated sediments lying on the ocean floor. Offshore placer deposits being exploited for tin, gold, diamonds, industrial minerals etc. in various parts of the world may conveniently be grouped in this category; they are likely to be restricted to the continental shelf, with little importance in the slope and abyssal depths beyond.

77. Potentially the most important deposits in the group are the phosphorite being deposited on the shelf, slope and ocean floor and the manganese nodules found mainly on the abyssal sea floor; both of these are being increasingly investigated by State organizations and commercial interests.

78. Phosphorite occurs on the sea floor in the form of blankets of nodules, flat slabs, pellets and rock-coatings, mostly confined to water depths of 20 to 200 fathoms in the outer continental shelf, upper continental slope and submarine

banks. It has been recorded in dredged samples from many parts of the world and commonly forms in regions where deep cold waters rich in dissolved phosphate - from the decay of animal and plant remains, brought by rivers from land sources or from phosphatic sediments on the sea floor - are brought in large volumes to shallow depth by vigorous upwelling of ocean currents. As phosphate deposition also depends on a slow rate of offshore sedimentation, those areas of upwelling off desert coasts, with low rainfall and absence of large rivers, are particularly favourable, as for example along the Pacific coast of South America.

79. Of the known and potentially favourable areas - off southern California (United States of America), Baja California (Mexico), eastern United States of America, western South America, Australia, north-west Africa, Japan etc. - only the first three are being investigated in any systematic manner. It appears, however, that the best submarine nodular phosphate, even after conventional processing, will only approximate to a low-grade land product; further upgrading by chemical means may be necessary to produce a competitive product.

80. Manganese nodules have been reported from many locations on the ocean floor, generally at depths from 400 to 3,400 fathoms. The nodules grow slowly on the abyssal ocean floor, the original sources of the manganese contained in the water probably being surface run-off in rivers from the continents and submarine volcanism. Chemical composition of nodules varies considerably with characteristic differences noted in Pacific, Atlantic and Indian Ocean occurrences. The maximum manganese content recorded, over 40 per cent in the Pacific, is still less than ferro-grade and battery-grade manganese ores from land sources. However, the significant quantities of other metals contained in the nodules - copper, cobalt, nickel etc. - have resulted in their receiving considerable attention during recent years from the viewpoint of low-grade ores of copper, cobalt, nickel and manganese, rather than for manganese alone.

81. Although regional distribution is yet very imperfectly known, there is no doubt that the potential gross amounts of manganese and associated metals in ocean-floor nodules are enormous. Numerous practical problems must however be solved before the vast economic potential can even be assessed, far less the nodules commercially harvested and processed. For one, new extraction methods will be required to beneficiate the complex and metallurgically unfamiliar matrix of the nodules.

Minerals contained in solution in sea waters

82. The third category of deposit, that contained in solution within sea waters, has come in for renewed attention by the recent discovery of hot high-gravity brine pools in the middle of the Red Sea due west of Mecca, where stagnant or semi-stagnant bottom waters show greatly abnormal concentrations of base metals and other mineral constituents. Bottom sediment sampling within the "Atlantis Deep", one of the three located within an area of approximately 10 miles square, indicates the possibility of $1.5 thousand million gross value of gold, copper, zinc and silver to a depth of 10 metres below the seafloor; these metals have been precipitated from the brine, analyses of which show metals such as iron, manganese, zinc, lead, copper, silver and gold in concentrations from 1,000 to 50,000 times the amounts present in normal sea water.

83. Apparently a method of extracting uranium from sea water has been developed which could be competitive with low-grade uranium ores, while gold concentrations in sea water have been analysed as high as almost 60 mg per ton, which would constitute a relatively high-grade gold prospect if contained in a sufficient body of water. All these may have future economic importance.

84. The exploitation from sea water of salt, bromine, magnesium and fresh water is well established in certain parts of the world and will increase as needs arise and technology develops. Such exploitation has, however, no cause to extend far offshore.

Ocean mining methods

85. Ocean mining operations today are limited to near-shore areas, mainly in protected calm waters and almost entirely for placer or other surficial deposits. As in the petroleum industry, exploitation capability will largely develop by progressing seaward from shallow waters to the outer shelf, slope and beyond, as economic justification allows. While awaiting technological advances and breakthroughs in ocean engineering, being pursued by some government agencies, the mining corporations have been interested but not notably active in deep-sea mineral development. The picture could, however, quickly change by interlock of ocean mining technology, offshore petroleum technology and other branches of ocean engineering.

86. Design studies are being carried out by a number of governmental and industrial organizations to devise systems in accordance with the rather limited knowledge of the characteristics of marine mineral deposits and marine environmental elements, and the capability of the various components from existing technology. Possible systems take in several concepts - dredge vehicles towed along the ocean floor, self-propelled bottom crawlers or wheeled vehicles and submersible hydraulic dredge vehicles with submersible ore hoppers to transport ore to the surface, to mention but a few.

87. It is clear that marine mineral ventures will require very substantial capital investment for engineering development and procurement of equipment. Thus, only a portion of the benefits to be gained can be attributed to ocean research and surveys.

Products of marine organisms

88. Although drugs, by and large, cannot be classified as minerals, the sea has been a useful source of drugs including alginates, agar, cod liver and other fish oils, chondrus extract, spermaceti, ichthyol and various chemical combinations of iodine, magnesium and bromine. Lack of medical utilization of more substances from the sea is perhaps due to lack of knowledge about the compounds which may be available. The presence of antibiotics in marine organisms has been demonstrated, and several workers have been active over the past decade. The pace of their discoveries indicates that our present knowledge is small compared with what remains yet to be discovered about the pharmacology of marine organisms. Other biochemical substances have been isolated that show cancer-inhibiting, nerve-blocking or heart-stimulating properties in the laboratory. Some biotoxins from poisonous invertebrates and fish are 200,000 times more powerful in blocking nervous activity than are drugs at present used for this purpose. Sponges produce at least fifteen types of sterols not found in higher animals, and they contain an arabinosyl nucleoside which is apparently highly effective against certain viruses and leukemia in laboratory animals. Some sea cucumbers and starfish contain mixtures of steroid glucosides, a group of chemicals that contains the powerful cardiac drug, digitalis, and has been shown to suppress several kinds of tumours in laboratory animals.

E. Pollution prevention in coastal waters and ocean recreation

89. The inshore marine environment must be protected against deterioration resulting from the discharge of municipal and industrial wastes. This environment has the capacity to receive a certain amount of waste discharge without damage to its other uses and in fact a valuable and legitimate use of the near-shore marine environment is as a diluting and assimilating medium for waste materials, provided that these are introduced within the capacity of the environment. By capacity is meant a rate of introduction which will not result in degradation from the standpoint of other uses, such as fishing and recreation. All shellfish grown in water polluted by sewage is to be considered as contaminated; they present an important health risk because of their ability to concentrate micro-organisms. Many epidemiological studies have confirmed that consumption of uncooked shellfish can cause epidemics of gastro-intestinal diseases such as typhoid, paratyphoid, dysenteries, cholera and viral infections.

90. Ideally, the engineer designing a sewage treatment plant should have complete information on the effect of the treated effluent on the marine environment. This information would include the physical movement and [illegible] of the wastes, and the biochemical and geochemical interactions of the waste components with the environment, including, for instance, the survival of pathogenic micro-organisms and the effects of waste components on the [illegible]. With this information, the engineer could design the optimum treatment required to protect fisheries and the recreational uses of the environment. Over-design (involving a waste of funds) or under-design (involving risk to other valuable uses of the marine environment) could thus be avoided.

91. The application of conventional sanitary engineering waste disposal methods in the case of discharges into open coastal waters and tidal estuaries requires additional background knowledge of basic physical, chemical and biological processes occurring in this type of environment. Much of this requirement falls within the realm of oceanography.

92. Oceanographic research in the near-shore marine environment can provide the information required to determine the best outfall location for sewage effluents and the type and degree of treatment needed for this location. In some [illegible] the added cost of locating the outfall in a region of greater receiving [illegible] may be less than the added cost of more complete waste treatment.

93. The capacity of the inshore marine environment to receive industrial waste discharges at a level which does not restrict other uses is in itself one of the natural resources of the sea. The research required is the same as that for domestic sewage effluent. Industrial waste discharges into some estuarine and coastal waters have had a more serious effect on recreation and fisheries than have domestic sewage discharges.

94. In several countries, nuclear power plants are under construction on estuaries and coastal embayments. The future development of nuclear power will require increased use of inshore marine waters as a source of condenser coolant for the power plants. Release of some radioactive nuclides to the marine environment may result from this use. Research on physical dispersion required for other waste discharge problems will be equally useful in understanding the possible effects of radioactive discharges from nuclear plants. Research on the various chemical forms of radioactive nuclides in the sea, their effects on the marine biota, and their binding by the sea sediments either in suspension or on the bottom, is also required. There are parallel requirements for research on the effects of waste heat from coastal steam power generators and of brine effluents from desalination plants.

95. The development of effective methods for treating oil spillages is of increasing importance, following the rapid expansion of sea traffic in this commodity and the startling increase in the size of ships employed in its transport. Pollution from agents other than oil, which may result from accidents to bulk carriers transporting large quantities of toxic or other dangerous chemicals, is also an avenue in which there is a growing need for research. The problems involved are basically the same whether the pollution occurs in coastal waters or on the high seas.

96. In many countries, a large and growing demand for marine recreational facilities requires careful planning in order to develop to the fullest the potentials for small-boat harbours, improved inshore fishing and suitable public beaches for sunning, swimming and surfing. The demand is so great in many places that ways must be found in effect to "stretch" the natural shore lines.

97. Beside pollution from waste discharges, several other factors influence the recreational uses of the shore line. Even the control of fresh-water runoff from

the land may have profound effects. On the beaches of Southern California, for example, the sand supplied by rivers is transported along the beach by wave-generated currents, and is lost to the deep sea at submarine canyons. Runoff control has cut the supply of sand to nearly zero, and, without some the beaches may seriously deteriorate within the next two decades.

98. On the other hand, desirable sandy swimming areas along some estuaries have been ruined by the deposition of fine sediments in the form of muds high in organic content, as a result of upland erosion followed by stream transport into the estuary. In other instances, spoil from the dredging of navigation channels may, because of improper disposal, contribute to the deterioration of the swimming areas.

99. The development of new beach areas, the protection of beaches against erosional or depositional damage, the extension of coastlines, the construction of new boat harbours, the development of improved sport fishing through the building of artificial reefs are all matters which are subject to the natural, physical, chemical, biological and geological processes of the sea. Improved oceanographic knowledge of these processes can materially influence the effectiveness with which plans for such developments are brought to fruition, and hence can materially reduce the costs of successful development.

100. In addition, the efficiency and safety of management and use of marine recreational facilities can be improved through adequate forecasts of wind, wave and surf conditions, and of storm tides. These are also important areas of oceanographic research. It is difficult to place a monetary value on having sufficient and adequate recreational facilities available to man.

II. SURVEY OF ACTIVITIES IN MARINE SCIENCE AND TECHNOLOGY

101. In the preceding part, the importance of research and development in marine science and technology has been underscored. Some examples of areas have been cited where modest investments in scientific activity might well lead to results of considerable practical importance.

102. This part of the report offers pertinent details of current world-wide activity in marine science and technology. Included is consideration of scientific and engineering investigations of the sea and its contents; of exploration, development and exploitation of marine resources together with their management and conservation; of the provision of appropriate technical services, and of the education and training of professional and technical personnel in this field.

103. Activities of this nature are carried out chiefly by governmental institutions and by private groups. The international and interconnecting nature of the oceans makes it highly appropriate for such activities to be co-ordinated by international organizations, regional or global, and in some cases such organizations are themselves directly involved in these activities.

104. After reviewing the activities pursued by Member States in various fields of scientific endeavour involving the ocean, in the exploitation of marine resources, in co-ordination of their national marine science programmes, and in international co-operation in marine research, the existing mechanisms for the promotion and co-ordination of marine activities at the international level are described. Matters relating to education and training at both national and international levels are dealt with separately.

A. Activities of Member States in marine science and technology

105. This section analyses national activity in marine science and technology. It considers Member States involvement in the conduct of basic and applied research relating to marine science and technology, in the provision of public services concerned with ocean use, in the exploitation of ocean resources and in international co-operation in marine science affairs.

1. Research

Indices of Member States commitment to marine research

106. Three indices have been selected as indicative of the magnitude of national activity in marine research. These indices are number of research and survey vessels, annual national expenditures for research and number of professional scientists involved.[1/]

107. Research vessels over 15 metres in length are operated by forty of the fifty-eight States reporting. Of these, nineteen States possess fleets of five or more such craft, as detailed in table 1.

Table 1. Distribution of oceanographic research vessels

Member State reporting	Number of research vessels (15 m. and larger)
United States	188
USSR	110
Japan	42
United Kingdom	28
Canada	22
France	18
Federal Republic of Germany	17
South Africa	12
Denmark	11
Argentina	10
Portugal	10
Norway	9
Poland	9
Sweden	9
Australia	8
Netherlands	8
Venezuela	6
New Zealand	5
Thailand	5

1/ Complete details are given in annex V, "Countries' commitment to marine research (selected indices)".

108. Of the fifty-eight States reporting, fifty-three are engaged in basic or applied research in ocean science.[2/] States reporting annual total expenditures in support of marine research exceeding $500,000 are listed in table 2.

Table 2. Countries reporting annual research support exceeding $500,000

Country	Annual budget (dollars)
United States	438,000,000
Canada	38,550,000
United Kingdom	25,000,000
France	24,000,000
USSR	18,000,000
Japan	10,000,000
Federal Republic of Germany	8,000,000
Netherlands	3,780,000
Australia	2,200,000
South Africa	2,100,000
Thailand	2,090,000
Norway	2,003,000
New Zealand	1,793,300
Portugal	1,330,000
Mexico	1,304,000
Venezuela	1,060,000
Sweden	872,000
Monaco	816,000
Iceland	776,326

109. Because of the relative price levels in different countries, the number of professional scientists employed in oceanographic studies is in some respects a better index of the magnitude of national oceanographic efforts than the total monetary support figures.

2/ Their programmes are described qualitatively in annex VI, "Summary of national activities in marine science and technology", and pertinent statistics are tabulated in annex V.

110. Table 3 lists Member States reporting fifty or more professiona engaged in ocean science activity.

Table 3. States reporting fifty or more marine scientists engaged in research

State	Number of scientists
United States	2,000
Japan	1,000
USSR	1,000
United Kingdom	650
Canada	509
France	475
Federal Republic of Germany	300
Chile	113
Netherlands	95
Norway	95
Australia	85
China	81
South Africa	73
New Zealand	71
Argentina	70
Peru	70
Mexico	67
Monaco	50
Sweden	50
Austria	45 to 65

Fields of research

111. Another index of effort in marine science is the number of different disciplines in which marine research is carried on. To achieve some the extent of their programmes, Member States were asked specifically their activity in the following areas: marine biology; physical oceanography;

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air-sea interaction; chemical oceanography; marine geology; and ocean engineering. Argentina, Australia, Chile, Federal Republic of Germany, Finland, France, Japan, Monaco, Norway, Netherlands, Poland, South Africa, USSR, United Kingdom and United States all reported activity in each of these disciplines.

Marine biology and fisheries

112. As the responses tabulated in annex V clearly show, most commonly the initial efforts in marine science undertaken in less developed countries are concerned with marine biology and fisheries research. Of the fifty-eight Member States replying, only Cambodia, Cameroon, Ceylon, Guatemala, Honduras and the United Republic of Tanzania reported no activity in basic or applied research related to fisheries or marine biology.

Physical oceanography

113. A frequent pattern of development, after initiation of studies of marine organisms themselves, is for countries to expand their interest to studies of the environment in which the organisms live, thus undertaking research in physical and chemical oceanography, marine geology and air-sea interaction. Physical oceanography includes study of the physical properties of sea water and the geographical distribution of density, temperature and viscosity; the hydrodynamics of waves, tides and currents; the acoustical and optical properties of the marine environment, and the formation, mixing and diffusing of water masses.

114. Of the fifty-eight Member States responding, thirty-six reported programmes in physical oceanography. Although in some countries these studies are limited to the coastal waters where local fisheries are carried on, many countries engage in such studies on the high seas.

115. It may be noted that meteorology and physical oceanography are intimately related.

Air-sea interaction

116. The energy that maintains the atmospheric circulation is to a great extent supplied by the oceans. Owing to the characteristic patterns of ocean currents, this energy supply is extremely localized. In turn, the circulation of the

atmosphere, which depends on where the energy is supplied, must be influenced by the oceanic circulation. Vice versa, anomalies in atmospheric circulation result in changes in heating and evaporation that lead to anomalies of ocean surface temperature and salinity, and these in turn must affect the dynamics of the ocean. In fact, the atmosphere and the ocean are interlocked components of a great heat engine. Realization of this fact has led a number of countries to undertake studies on a co-operative basis between meteorologists and oceanographers, within the framework of either national or international projects.

117. Aspects of air-sea interaction studied in the ocean include observation of the generation, propagation and decay of wind-driven surface waves; the formation and drift of sea ice; the transfer of air-borne dust to the sea floor and of salt particles to the atmosphere; the exchange of dissolved gases, particularly carbon dioxide, between the sea surface and the atmosphere; the generation of wind-driven currents, and the evaporation and precipitation of water. Of the fifty-eight member countries listed in annex V, eighteen report programmes of research in air-sea interaction.

Chemical oceanography

118. In its earliest stages, chemical oceanography has been concerned with the determination of salinity to assist in the understanding of physical [illegible] and with the measurement of the quantities of plant nutrients (nitrogen, phosphorous and silicon compounds), which are of importance in determining [illegible] production, the ultimate basis of fisheries. Of the responding Member [illegible] listed in annex V, twenty-four report activity in chemical oceanography [illegible] Federal Republic of Germany, Finland, France, Monaco, Norway, USSR, Uni[illegible] and United States report also geochemical studies involving other trace [illegible]

Marine geology and geophysics

119. Fisheries aspects of marine geology are concerned with the discovery of fishing banks, characterization of the bottom from the standpoint of trawling, and study of the suitability of the bottom to support populations of clams, oysters and other benthic animals. Geophysical studies, including both refraction and reflection seismology, observations of gravity and magnetic field recording are of

major value in determining the submerged structures of the sea floor. Many countries have carried out investigations over their continental shelves to assist in locating possible economic mineral deposits. Of the fifty-eight Member States whose responses are tabulated in annex V, twenty report programmes in marine geology and eighteen in marine geophysics.

Ocean engineering

120. Most engineering problems dealt with on land will eventually be encountered in the oceans, while others, involving corrosion, biological activity and hydrostatic pressure, are unique to the sea. Ocean engineering is concerned with the design and construction of underwater structures, habitats and submersible vehicles; with the design of instruments, tools and fishing gear, and with the development of data-collection systems. Such activity is reported by Australia, Canada, Chile, Finland, France, Japan,Monaco, Norway, South Africa, USSR, United Kingdom and United States.

2. Surveying and provision of public services

121. The public services enumerated include nautical charting, providing navigational services, forecasting sea conditions, monitoring and forecasting pollution, exploratory fishing and charting of fish stocks, geological and geophysical surveying and maintaining coasts and channels. Canada, Chile, Federal Republic of Germany, Finland, France, Japan, Norway, South Africa, Sweden, United Kingdom and United States each reported activity in all these fields. Only seven countries reported no activity in any of these fields.

122. The numbers of professional personnel engaged in these activities are tabulated in annex VI. The United States reported 1,500; Canada, 383; France, 126; Thailand, 118; Pakistan, 100; Federal Republic of Germany, 80; Australia, 51; China (Taiwan), 41; Netherlands, 40, and Argentina, 36. Sixteen countries reported between one and twenty-seven professional scientists engaged in this work. It should be noted that in many countries some of these services are routinely provided by naval personnel and national meteorological services. Consequently, a number of countries did not report a definite number of individuals engaged in such services. In other cases, the number of professional scientists engaged in provision of public services could not be separated from the number engaged in research.

Nautical charting

123. Surveying and charting territorial waters is a function of national hydrographic offices, which in most countries are part of the naval forces. Forty-two of the reporting States indicate activity in this field. [illegible] States are members of the International Hydrographic Bureau, whose [illegible] are in Monaco, and which serves as a clearing-house for exchange of information and standardization of charts and publications. It also sponsors publication of the General Bathymetric Chart of the Oceans, a world-wide series of charts to the scale 1:10,000,000.

124. The International Hydrographic Bureau has undertaken to determine the coastal areas and the portions of the continental shelves that have not been thoroughly surveyed of adequate hydrographic surveys. The results of this determination, which are still incomplete, show that for no single continent are the coastal areas and continental shelves yet adequately known for exploitation of marine resources.

Position-fixing systems and related navigation services

125. Responses from twenty-two countries indicate activity in this field. Many countries operate electronic position-fixing systems, such as radio beacons, Decca, Loran, Omega and the like, for use by ships or aircraft crossing the sea or approaching the coast. Although the northern hemisphere is better provided with such aids to navigation, none of the systems mentioned is world wide in coverage. The availability of a navigation system using satellites, capable of fixing positions of vessels, aircraft or research units at any time over the entire [illegible] under any weather and sea-state conditions with a high degree of accu[illegible] no doubt facilitate the safety and efficiency of navigation and ocean[illegible] and exploitation.

Monitoring and forecasting of physical conditions of the ocean

126. Twenty countries report involvement in observing and forecasting physical conditions over the ocean. In many cases, this function is carried out by the marine section of the national meteorological office. Iceland maintains watch over nearby waters; Finland, Poland and Sweden report operation of forecasting services. Norway forecasts hydrographic conditions, in particular, those related to the cod fishery in the Lofoten Islands area. China (Taiwan) has developed a typhoon and flood-warning service.

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Monitoring and forecasting of pollutants

127. Twelve of the responding countries, Australia, Canada, Chile, Federal Republic of Germany, Finland, France, Japan, Norway, South Africa, Sweden, United Kingdom and United States, reported activity in monitoring and forecasting marine pollution. Radioactive pollutants, sewage, industrial wastes and petroleum all received attention.

128. The International Convention for the Prevention of Pollution of the Sea by Oil, 1954, amended in 1962, is the only existing international instrument for prevention and control of pollution of the sea. Thirty-five countries, including the major maritime States, are parties to the Convention. The prevention and control of pollution under this Convention are exercised only in relation to ships.

Exploration, monitoring and forecasting of fish stocks

129. Thirty-seven countries report activity in exploratory fishing and similar assistance to their commercial fisheries. Eight of these countries, namely, China (Taiwan), Cyprus, Federal Republic of Germany, Finland, Iceland, Norway, United Kingdom and United States, regularly assess the stocks and issue forecasts of fish abundance.

Submarine geological and geophysical survey

130. Such surveys are usually exploratory for oil, gas and mineral resources of the continental shelf areas. Geophysical techniques using seismology and gravity and magnetic measurements penetrate the overlying loose sediments to reveal the geological structure of the sea floor. Twenty-one countries report geological surveys of their territorial waters. Australia, Finland, Federal Republic of Germany, Japan, Malaysia, Mexico, Norway, Poland, Republic of Viet-Nam, South Africa, Thailand, USSR, United Kingdom and United States are conducting geophysical surveys in addition to their geological surveys.

Maintenance and modification of coasts and channels

131. Channels and harbours require deepening, and beaches and headlands require protection in many parts of the world. Nineteen States reported activity in this area. Sierra Leone is improving its harbours and estuaries. Pakistan reported the establishment of new fish harbours to promote the fishing industry.

3. Uses of the sea and its resources

132. Non-military uses of the sea and its resources include husbanding and harvesting of biological resources; extraction of minerals; derivation of power harnessing current, tidal, thermal or wave energy; waste disposal; transport and communication, and recreation.[3/]

Harvesting of biological resources

133. Food and Agriculture Organization data show fifty-five of the fifty-eight Member States responding report significant catches of marine fish. These also reveal that there is great variation in the degree to which different countries make use of the biological resources of the sea. Table 4 summarizes 1966 fish production by the world's fourteen leading fishing countries, which together accounted for almost exactly three quarters of the total world catch in that year. The wide fluctuation in value per unit weight that is apparent in table is chiefly a result of the use to which the catch is devoted. Fish for human consumption, fresh or frozen, bring a higher price than fish to be canned or preserved, and fish used as raw material for processing to meal and are least valuable.

134. The living resources of the high seas, other than fish, have already been subject of a detailed report prepared pursuant to Economic and Social Council resolution 1112 (XL).[4/]

135. Of the 1965 total world catch (52.4 million metric tons), 68.9 per cent or 36.1 million metric tons, was used for human consumption. Fish meal (animal food-stuffs) and oils were produced from 29.2 per cent, or 16.3 million metric. The remaining 1.9 per cent was used for other purposes such as bait or pet food. World trade in fishery products in 1965 amounted to 6,175,000 tons, valued at $2,183 million.

3/ Responses of Member States to the questions concerning the degree and magnitude to which they use ocean resources are tabulated in annex VI, "Summary of national activities in marine science and technology", and annex VII, "Exploitation by countries of marine biological and mineral resources".

4/ E/4449/Add.2.

Table 4. Leading fishing nations, 1966

(Catch in millions of metric tons, live weight)

Country	Catch	Value to fishermen (dollars)
Peru	8.79	113,649,000
Japan	7.08	1,500,000,000[a/]
China (mainland)	6.00[a/]	-
USSR	5.35	-
Norway	2.85	183,293,000
United States	2.52	454,000,000
Chile	1.38	128,803,000
India	1.37	-
Spain	1.36	282,757,000
Canada	1.35	160,197,000
Iceland	1.24	65,000,000[a/]
South and South West Africa	1.18	34,000,000[a/]
United Kingdom	1.07	177,511,000
Denmark, including Faroes and Greenland	1.06	117,000,000[a/]

Source: Food and Agriculture Organization, Yearbook of Fishery Statistics (Rome), vol. 22, 1966.

a/ Estimated.

136. A few countries report substantial activity in husbandry of marine biological resources. Although research and development on aquaculture of both vertebrate and invertebrate marine organisms are proceeding in many countries, practical results are confined for the most part to the culture of those sessile pelycypod molluscs that require a hard substrate, such as oysters and mussels. Large tonnages of black mussels are raised through aquaculture in Denmark, the Federal Republic of Germany, France, Italy, Netherlands and Spain. Oysters are cultured both for food and for pearls. Japan, Republic of Korea, United States and France are the leading countries engaged in oyster culture. Certain marine fish and

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crustacea that command an exceedingly high retail price are artificially cultured in Japan; elsewhere in the world such activity is primarily devoted to fresh-water species.

137. Fourteen countries report significant harvests of marine algae. The 1966 world production reported to the Food and Agriculture Organization was 710,000 metric tons in live weight, although there is reason to believe that this total does not reflect total production figures for certain countries, such as the United States and the Philippines. In Japan and the Republic of Korea, where the bulk of the landings are processed for direct human consumption, an important part of seaweed production results from aquaculture. In other countries, particularly Canada, Norway and the United States, marine algae are used mainly as industrial raw material. Once potash, iodine and acetone were the end products sought, but in recent years alginates and other vegetable gums important in the pharmaceutical and cosmetic industries have become the chief products.

138. Marine mammals are hunted by relatively few countries. Only Japan, Norway and the USSR still engage in pelagic whaling in the Antarctic. The United Kingdom operates an Antarctic whaling station in South Georgia. Others whaling in the southern hemisphere are Australia, Brazil, Chile and the Republic of South Africa; in the northern hemisphere, Canada, Denmark, Iceland, Japan, Norway, Portugal, Spain, the United States and USSR.

139. Fisheries for porpoises are reported in Canada, China (Taiwan), Denmark, Norway and Turkey. Seals are harvested for fur in Argentina, South Africa and the United States, and for skins and oil in Canada, Denmark, Finland, Norway and USSR. Walrus are exploited for meat, ivory and hides by Arctic aborigines in all countries bordering the Arctic Ocean. Sea otters from Alaskan waters are hunted to a limited extent for fur by the United States.

Extraction of mineral resources

140. Hydrocarbons, either oil or gas, are exploited from offshore wells by countries. Saudi Arabia has the largest offshore oil fields in the world. Malaysia, Iran, Indonesia and Japan are other Asian nations with offshore oil. The Netherlands in Europe, the United Arab Republic, Nigeria and Gabon in Africa, Brazil and Venezuela in South America, and Mexico, Trinidad and Tobago and United

States in North America, all have offshore oil wells in production. Mexico's offshore oil fields supply 30 per cent of her oil production. The United Kingdom is developing North Sea gas fields expected to supply 2,000 million cubic feet of natural gas a day by 1970. This gas will account for about 10 per cent of the total United Kingdom energy requirements at that time. Australia, Italy, Libya and United States also have offshore gas fields in production.

141. Sulphur deposits have also been discovered in the cap rock of offshore salt domes. Sulphur is recoverable through the Frasch process, which involves melting the elemental sulphur through injection of superheated water and then transporting it to the surface through air-lift. The United States is the only country to report recovery of sulphur from offshore deposits.

142. Continental shelves, which are geologically part of the continents they abut, may contain coal or ore deposits which can be exploited by mineshafts extending seaward. Japan reports annual production of 1,300,000 tons of coal in this manner, and similar coal mines are operated in Chile and China. Finland reports annual production of 300,000 tons of iron ore and 50,000 tons of limestone from undersea mines.

143. Surficial deposits of the continental shelves often contain economically exploitable minerals, which can be recovered by dredging. Large tonnages of sand, gravel and aggregates are reported by Argentina, Denmark and Sweden, United Kingdom, United States and Yugoslavia. Limestone production, either from coral rock or seashells, is reported by Argentina, Indonesia and United States, and Iceland recovers annually 135,000 cubic metres of shell sand that serves as the basis of a cement industry. Australia recovers rutile, zircon, ilmenite and monazite from beach sands. Thailand and Indonesia report tin production from offshore dredging. Diamonds are similarly recovered off the coast of South West Africa. Japan reports recovery of iron ore from offshore sand deposits at the rate of 40,000 tons yearly.

144. A detailed report on mineral resources of the sea, beyond the continental shelf, has already been prepared in response to Economic and Social Council resolution 1112 (XL).[5/]

145. Several countries report activity in processing sea water for chemical recovery. Bromine is produced in Japan, United Kingdom and United States and

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5/ E/4449/Add.1.

magnesia in Japan, Norway, United Kingdom and United States. Sea water is also used as feedstock for desalinating plants in some arid countries. The United States reported an installed desalination capacity of 189,516,000 gallons per day in 1966. Actual production figures, although not available, were considerably less. Japan reported annual production of desalinated water of 1,500,000 tons.

146. Salt is produced from solar evaporation of sea water in a number of countries having a suitable warm, dry season. Besides sodium chloride, gypsum, magnesia and potash are possible by-products. Australia, Chile, Colombia, Cyprus, Japan, Mexico, New Zealand, Thailand, United States and Yugoslavia all report solar salt production.

Derivation of power

147. The only installation for large-scale harnessing of power from the sea is the French tidal barrier on the River Rance. In this estuary the tidal range is nearly 14 metres. The Rance barrier, which also serves as a highway bridge across the estuary, has an installed power capacity capable of producing 500,000 million kilowatt-hours of electricity annually.

Waste disposal

148. All coastal nations utilize the sea to at least a limited extent for waste disposal. Most seaside communities with centralized facilities for collection of sewage make use of the sea for disposal of either raw or treated effluent. Garbage and trash are dumped at sea from barges. Low-level radioactive wastes are disposed of into the sea through pipelines or in sealed containers. Surplus explosives are dumped or detonated in deep water.

149. It is common practice to locate power plants in harbours where seaborne fossil fuels are available at minimum transportation cost. The waters of the harbour or estuary are used in cooling turbines and are returned to the sea after appreciable warming. The resulting thermal enhancement is sometimes referred to as "heat pollution", although there is a possibility of utilizing it for industrial processes or aquaculture.

Transport and communication

150. Canada, France, Japan, Switzerland, USSR, United Kingdom and United States, are developing submersibles for recreational, commercial and scientific purposes. The Swiss-designed, Italian-built submersible Trieste, equipped with a pressure hull fabricated in the Federal Republic of Germany, operating for the United States Navy, attained a depth of 10,740 metres off Guam in January 1960.

151. Telegraph cables spanned the Atlantic in 1859. Since that time the principal world capitals have been linked with a network of telegraph cables. Trans-oceanic telephone cables proved feasible in 1950, when the first coaxial voice cable was laid between Newfoundland and Ireland.

152. Transport of power by undersea cables over moderate distances is also feasible. Table 5 lists present underwater power cables.

Table 5. Underwater power cables

Location of cable	Distance (miles)	Voltage (kilowatts)	Power
Sweden to Gotland	44	100	40 MW DC
England to France	30	100	160 MW DC
British Columbia to Vancouver Island.	14.7 and 2.9	138	120 MVA AC
British Columbia to Texada Island	4	15	4.5 MW AC
Saudi Arabia to Texas Tower . . .	25	40	...
North Island to South Island, New Zealand	...	250	600 MW
Denmark to Sweden	...	...	...

Source: Data compiled from records of the Resources and Transport Division of the United Nations Secretariat.

153. Undersea pipelines link many of the offshore oil and gas fields with distribution systems ashore. The feasibility of a pipeline from North Africa across the Mediterranean to Europe is currently under study.

154. Many harbours have pedestrian or vehicular tunnels carrying passengers, road transport and trains beneath navigable channels. The possibility of constructing such a tunnel beneath the English Channel is now under investigation.

Recreation

155. Member States reporting use of the sea for recreation include Australia, Cambodia, Chile, Cyprus, Norway, Poland, Republic of Viet-Nam, Sierra Leone, Singapore, South Africa, Sweden, Syria, United States and Yugoslavia. Ocean bathing has been a favourite holiday recreation for generations. The warm, clear waters of tropical and subtropical seas are being increasingly used for yachting, Scuba-diving, amateur archaeology and related activities. The variety and voracity of the fishes in these waters have increased sport fishing to such an extent that occasional competition with commercial fishermen for certain species has resulted.

4. Co-ordination of national activity in marine science and technology

156. Annex VIII summarizes Member States responses to the question concerning their mechanism for co-ordination of national activities in marine science and technology, including their international aspects. Few countries lack an effective mechanism for such co-ordination, although, as study of annex VIII will reveal, many different solutions have been devised for this common problem.

5. Participation in international co-operation in marine science and technology

157. Member States were asked to indicate their participation in the work of international governmental and non-governmental organizations concerned with marine science and in co-operative marine investigations. Their replies are tabulated in annex IX. The mission and function of most of the organizations referred to in this tabulation are described more fully in the following section.

B. Existing mechanisms for the promotion and co-ordination of marine activities at the international level

158. Internationally, co-ordination and promotion of marine activities are functions of two types of organizations, non-governmental and inter-governmental. At the present time, the principal non-governmental oceanographic organizations are contained within the framework of the International Council of Scientific Unions (ICSU). Although many important inter-governmental bodies are part of the United Nations system, other such bodies lead an independent existence. There also exist some mechanisms for co-ordinating the work of international organizations, both within each of the two classes and between them.

1. Non-governmental organizations

159. The International Council of Scientific Unions[6/] consists of a number of unions classified according to scientific disciplines, and of several special and scientific committees concerned with interdisciplinary problems. Membership of ICSU and its unions and their constituent associations is held by appropriate national scientific bodies. Funds are obtained from national contributions and from international organizations (principally UNESCO). Membership of special and scientific committees is held by individuals nominated by their national academies or by interested unions; funds are obtained from national contributions, from ICSU itself, or from contracts with organizations such as UNESCO.

160. Within ICSU the following organizations have an important interest in marine problems:

International Union of Geological Sciences (IUGS)
International Union of Geodesy and Geophysics (IUGG)
International Association for the Physical Sciences of the Ocean (IAPSO)
International Union of Biological Sciences (IUBS)
International Association of Biological Oceanography (IABO)
Commission on Marine Geology
Scientific Committee on Oceanic Research (SCOR)
Scientific Committee on Antarctic Research (SCAR)
Special Committee for the International Biological Program (SCIBP).

6/ For a detailed account of relevant activities of non-governmental organizations, see annex X.

161. In addition, within the Federation of Astronomical and Geophysical Services, there is a Permanent Service for Mean Sea Level.

162. Of the sub-union organizations listed, IAPSO (formerly the International Association of Physical Oceanography) has been most active. Its principal functions have been the organization of scientific meetings, the publication of [illegible] of such meetings, and the organization of committees on scientific pr[illegible] recent years, its effectiveness as an action body has been limited be[illegible] small financial resources and infrequent meetings. The biological and [illegible] groups (IABO and the IUGS Commission on Marine Geology) are relatively [illegible] done little as yet.

163. The Scientific Committee on Oceanic Research during the ten years of its existence has proved a useful mechanism for stimulating international scientific activity. Among SCOR's best-known accomplishments are the initiation of the International Indian Ocean Expedition and the organization of the first International Oceanographic Congress. A number of small working groups, often in co-operation with other appropriate international organizations, have [illegible] to the study of significant methodological problems. Since 1961, SCO[illegible] as a scientific advisory body to the UNESCO programme in oceanography [illegible] Intergovernmental Oceanographic Commission (see below). In the latter capacity and jointly with the ACMRR (see below), it took the lead in examining the scientific aspects of General Assembly resolution 2172 (XXI) on resources of the sea, which resulted in the publication of the report International Ocean Affairs. The factors for SCOR's success include its small professional membership, its adequate financial resources, the frequent meetings of its Executive Committee and its scientific advisory responsibilities to intergovernmental organizations.

164. Of the other ICSU interdisciplinary committees, SCAR co-operates with SCOR through its working group on Antarctic oceanography, and SCIBP has a section on marine productivity.

165. A proposal has been made for a simplification of the ICSU structure related to the marine field through the organization of a new union of marine sciences. This union would bring together IAPSO, IABO, the IUGS Commission on Marine Geology and SCOR in a single coherent organization.

166. It should be noted that the existing ICSU structure is not designed to give adequate consideration to problems of marine resources utilization, nor is there adequate provision for a meaningful input from non-academic scientists or engineers such as those associated with industry and with fishery research which is largely undertaken through government agencies.

167. Certain international non-governmental organizations concerned with some aspects of marine science and technology, as, for example, the International Association of Water Pollution Research (IAWPR), are not within the ICSU framework. Several other associations concerned primarily with economic and institutional problems of marine resources utilization (e.g., fish processing), or with technical matters such as shipbuilding and navigation, often have subsidiary bodies concerned with scientific problems. Most of the ICSU affiliates, as well as the unaffiliated associations, have advisory or consultative relations with the intergovernmental bodies described below.

2. Intergovernmental organizations of the United Nations system

168. Within the United Nations system,[7] in addition to the United Nations itself, certain organizations have a very broad interest in marine problems. These include, especially:

United Nations Educational, Scientific and Cultural Organization (UNESCO)
Food and Agriculture Organization of the United Nations (FAO)
World Meteorological Organization (WMO)

Organizations with a more specialized interest in important marine questions include:

International Atomic Energy Agency (IAEA)
Inter-Governmental Maritime Consultative Organization (IMCO)
World Health Organization (WHO)

169. The United Nations itself is directly concerned with marine affairs in several ways. The General Assembly, as a political body, has shown considerable interest in legal and jurisdictional problems, particularly in connexion with marine resources. General Assembly resolution 2172 (XXI) is largely responsible for the present reappraisal of organizational arrangements, and subsequent resolutions of that body may result in modifications of these arrangements. The United Nations also performs a function comparable to those of specialized agencies through its

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7/ For a detailed account of relevant activities of the international organizations of the United Nations system, see annex XI.

Resources and Transport Division, which is concerned with mineral resources, including those of the continental shelf and deep ocean.

170. ECAFE, a regional economic commission of the United Nations, has been particularly active in the survey and prospecting of mineral resources in offshore areas. Under its sponsorship, an intergovernmental operative body, the Committee for Co-ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas (CCOP), has been in existence for two years.

171. Technical assistance and Special Fund programmes are administered under the United Nations Development Programme (UNDP). From this source large sums of money are provided for development projects related to the marine field, particularly in the marine fisheries. Expenditure on existing UNDP fishery projects probably exceeds the total of all other "international" funds spent on marine problems (other than those related to defence or to the actual exploitation of marine resources).

172. The UNESCO programme in marine science is conducted by the Office of Oceanography which also serves as secretariat for the Intergovernmental Oceanographic Commission (IOC). The UNESCO programme proper is concerned with stimulating and co-ordinating basic oceanic research and associated scientific work throughout the world and with providing technical assistance in oceanography to the developing countries. The former part of the programme includes provision of financial support and other assistance to exchange of information and work on modern oceanographic methodology and instrumentation. The work is carried out through the setting up of groups of experts, organization of scientific meetings and publication of technical reports and other documents. The latter part of the programme involves provision of fellowships, organization of training courses, provision of scientific equipment and scientific advice through expert services, and administration of UNDP projects. The UNESCO programme in marine science covers such fields of research as physical and chemical oceanography, marine biology (including taxonomy and ecology), marine geology, geomorphology and geophysics.

173. The Intergovernmental Oceanographic Commission was established [illegible] in 1960 as a result of the stimulation and experience provided by the [illegible] Geophysical Year. The major motivation behind the Commission's establishment was the desire of the oceanographic community to involve the governmental support of

international oceanographic co-operation on a world-wide basis. The Commission at present has fifty-nine members, and its membership is open to all States Members of the United Nations family willing to participate in oceanographic programmes that require concerted action by them. The Commission's purpose is "to promote scientific investigation with a view to learning more about the nature and resources of the oceans, through the concerted action of its members". The Commission has responsibility for organizing through World Data Centres the international exchange of oceanographic data. It has organized large co-operative investigations in the Indian Ocean, tropical Atlantic and western North Pacific, and it is now organizing such work in the Caribbean and Mediterranean. The Commission sponsored the second International Oceanographic Congress organized in 1966 with the support of UNESCO, FAO, IAEA and SCOR. The Commission's working groups are studying problems of data exchange, radio frequencies for oceanographic purposes and mutual assistance among Member States; a new programme concerns the development of an integrated global ocean station system for monitoring the ocean environment, and a study of legal aspects of scientific investigations of the ocean and of its resources.

174. As noted above, the secretariat for the Commission is provided by UNESCO; SCOR and FAO's Advisory Committee on Marine Resources Research serve as scientific advisory bodies. All co-operative programmes of the ICC are organized through concerted action of its Member States which pay for their own participation in such programmes, while UNESCO provides support for IOC secretariat, general administration, co-ordination, meetings and publications. A small sum is allocated by FAO within its own budget towards support of fishery-related aspects of ICC projects.

175. The Food and Agriculture Organization has always included as an important component the Fisheries Division, which was in 1966 raised to the status of a Department having two subunits, the Fishery Resources and Exploitation Division and the Fishery Economics and Products Division. The former of these Divisions is particularly concerned with scientific problems related to evaluation of living resources, with the relation between these resources and their environment and the effect of fishing upon them, and with the scientific and technical problems of their harvesting and management. It maintains the Fishery Data Centre as an element of the World Data Centre system referred to above. The other Division's

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responsibilities include technical aspects of fishery resource utilization, development of statistical systems needed for the resource assessment, economic research related to fishery management and institutional arrangements for training. The Department carries out its functions by providing services, including bibliographic and documentation services, for marine scientists, publishing manuals, convening conferences and symposia and conducting specialized training programmes. Many of these activities are carried out in co-operation with other bodies, especially UNESCO. The Department also administers a large number of field projects for the development of fisheries, which include components of ocean research as well as technical studies.

176. A Committee on Fisheries (COFI) was established recently (1966) in response to the demand by member States for expansion and strengthening of FAO's fishery activities. The Committee consists of thirty-four member States selected biennially by the FAO Council and represented by their senior fishery officers. It reviews the work programme of the FAO Department of Fisheries, considers fishery of international character and promotes international co-operation in

177. In 1961 FAO established an Advisory Committee on Marine Resources (ACMRR). This Committee is a group of experts, appointed in their individual capacity and with a responsibility to advise FAO on research on marine fishery resources and the dissemination, interpretation and application of the results of such research, with special attention to the fishery aspects of oceanographic research, for which ACMRR also serves as the advisory body to ICC.

178. Regional fishery bodies under FAO are the Regional Fisheries Advisory Commission for the South-West Atlantic (CARPAS), the Indo-Pacific Fisheries Council (IPFC), the General Fisheries Council for the Mediterranean (GFCM), the Indian Ocean Fishery Commission (IOFC) and the Fishery Committee for the Eastern Central Atlantic. FAO is also a focal point for negotiation of certain new regional fishery conventions, notably the International Convention for the Conservation of Atlantic Tunas and a Draft Convention concerning the Living Resources of the South-East Atlantic.

179. The World Meteorological Organization, in connexion with the provision of meteorological services by its members, co-ordinates the collection, processing and dissemination of meteorological observations and information from the oceans.

The system for handling and processing such observations is being greatly expanded in the framework of the World Weather Watch. Development of this programme and promotion of air-sea interaction studies through the associated Global Atmospheric Research Programme (GARP) have led to enhanced co-operation with oceanographic institutions, through ICC on the intergovernmental side and through ICSU on the non-governmental side. The WMO structure includes a Commission on Maritime Meteorology which is concerned, inter alia, with the standardization of observations of surface meteorological and oceanographic parameters at sea, the provision of meteorological forecast and climatological information over the oceanic areas. At the present time, WMO co-operates with IOC on the preparation of a co-ordinated plan for use of radio frequencies in oceanic data transmission and examines its contribution to the development of an Integrated Global System of Ocean Station Systems.

180. The International Atomic Energy Agency has an acknowledged competence in the field related to discharge or release of radioactive materials in the sea. It organizes panels and symposia on problems of marine radioactivity, grants a small number of research contracts and research grants and operates the International Laboratory of Marine Radioactivity at Monaco, with scientific research related to waste-disposal problems and training facilities. The Agency participates in various international programmes related to marine pollution.

181. The Inter-Governmental Maritime Consultative Organization has an international responsibility with regard to prevention and control of oil pollution in the sea through the International Convention for the Prevention of Pollution of the Sea by Oil. It is also dealing with problems of pollution by agents other than oil when originating from ships. In addition, IMCO is concerned with the safety aspects of design and operation of ships, drilling rigs, buoys and other platforms used at sea.

182. The World Health Organization, being concerned with the promotion and improvement of sanitation, recreation and other aspects of environmental hygiene, is interested in scientific and technical questions of waste-disposal problems in estuaries and coastal areas. It conducts studies for the determination of health effects of bathing in polluted coastal waters, guides of water quality, studies of efficiency of methods for treatment and disposal of sewage and industrial wastes. It assists member countries by providing advisory services, educating scientific and professional personnel and organizing conferences, seminars and other meetings on waste disposal and pollution control.

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183. Co-ordination of programmes and work of the organizations of the United Nations family is effected through the Subcommittee on Marine Science and its Applications of the Administrative Committee on Co-ordination (ACC), which reports to the Economic and Social Council.

3. Other intergovernmental organizations

184. The only non-United Nations intergovernmental organization[8/] with a world-wide interest in marine problems is the International Hydrographic Bureau (soon to become the International Hydrographic Organization under a new convention). The IHB's interest is, however, limited to hydrography and associated problems of tides and sea level. The Bureau, with forty-one member countries, facilitates co-operation among hydrographic offices in order to render navigation safer and easier; it encourages uniformity in charts and hydrographic documents, the adoption of reliable and efficient methods of carrying out hydrographic surveys, and the development of theory and improvement in the practice of hydrography. In recent years, IHB has become interested in co-ordination of hydrographic surveys with relevant oceanographic activities and in the application of oceanographic knowledge for the benefit of navigators.

185. To some extent IHB is concerned with research on the sea floor, principally with respect to bathymetry. In many aspects the interests of IHB are related to those of IMCO. From an oceanographic point of view, hydrography is important both because of the scientific need for detailed and accurate charts and because in many countries oceanographic surveys and research are conducted by hydrographic offices.

186. Nearly all other non-United Nations intergovernmental organizations with marine interests are restricted in geographical coverage to more or less well-defined regions. The oldest and most important of these organizations is the International Council for the Exploration of the Sea (ICES) which is concerned with the North Atlantic Ocean and adjacent seas. The purpose of ICES is to promote and encourage research and investigations for the study of the sea, particularly those

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8/ For a detailed account of relevant activities of non-United Nations intergovernmental organizations, see annex XII.

related to the living resources thereof. Member Governments each appoint their national representatives on the Council as well as the national members of a number of standing committees dealing with scientific matters and with regional fish stocks. ICES serves as a regional data centre, through its Service hydrographique, and compiles and distributes fishery statistics through its Statistical Service.

187. Although an intergovernmental organization, ICES has been able to combine scientific and applied studies and actions in a uniquely successful manner, so that it demonstrates many of the characteristics of a scientific advisory body as well as being a means for co-ordinating governmental action. Thus ICES serves as the scientific adviser to a regional fisheries regulatory body, the North East Atlantic Fisheries Commission (NEAFC), and maintains close relations with FAO (ACMRR), ICNAF, IOC, SCOR and other international organizations.

188. The International Commission for the Scientific Exploration of the Mediterranean Sea (ICSEM) is a regional organization established fifty years ago with a purpose and structure analogous to those of ICES. It has been lacking the impetus provided to ICES by industrial fisheries which practically do not exist in the Mediterranean. However, the ICSEM opened its membership to all other countries of the world interested in scientific studies of the Mediterranean, and co-operates with IOC and GFCM in co-ordinating research programmes in this area.

189. There also exist a number of intergovernmental fisheries commissions other than those linked with FAO, all except the IWC being regional in nature. They include:

International Commission for the Northwest Atlantic Fisheries (ICNAF)
North East Atlantic Fisheries Commission (NEAFC)
Inter-American Tropical Tuna Commission (IATTC)
International Whaling Commission (IWC)
International North Pacific Fisheries Commission (INPFC)
International Pacific Halibut Commission (IPHC)
International Pacific Salmon Fisheries Commission (IPSFC)
Black Sea Fisheries Commission (BSFC)

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190. These organizations provide mechanisms for regulation of specific fisheries. In some cases (as IATTC) they have their own research staffs; in other cases, research is carried on by member countries and co-ordinated, compiled and [illegible] within the Commission. Those few which are not directly concerned with research, such as NEAFC, have arrangements for drawing scientific advice from other competent international bodies.

C. Education and training in marine science

191. It should be noted at the outset that educational systems vary from country to country, a fact reflected in marine science education and training. Well-established categories of "graduate" and "undergraduate" studies which have a very definite meaning in the United Kingdom, United States or Canada, cannot be applied in the USSR nor in a number of other countries in Europe. Only a very general parallel may be established between the universities of the two groups of countries, neither are technical colleges of western countries fully analogous to the institutes of higher technical education of the USSR. Arrangements for post-graduate training also differ from country to country and the resulting scientific degrees are not fully equivalent.

192. In these circumstances the expressions "undergraduate", "graduate" and "post-graduate" studies, when used in this section refer respectively to introductory studies in basic scientific disciplines, to specialized studies leading to a diploma, and to specialized studies leading to a higher scientific degree. One should keep in mind that practising oceanographers may be recruited either from those who graduated in some of the oceanographic disciplines or from those who make their graduate studies in such sciences as biology, chemistry, geology, geophysics, theoretical mechanics etc. In the latter case, additional specific training in marine disciplines can be given either during post-graduate studies or in the course of research activities.

193. Keeping in mind this diverse situation, the ensuing text first outlines the chief aspects of student training in marine science, takes an over-all view of the world-wide status of trained personnel, and then analyses briefly the education and training programmes of the main agencies of the United Nations family concerned with this problem.

1. Framework of student training in marine science

194. The diversity of the problems in oceanography provides an appeal to practically every kind of scientific interest. The student beginner can rarely evaluate the direction in which his abilities may effectively be applied until he has assessed his aptitude and the opportunities which the subjects have to offer.

195. Broad study of the relevant complex of basic sciences should be the prime objective of the undergraduate years. There is a definite advantage in having these studies started as early as possible so that the student may arrive early at the stage where the several disciplines interact and provide the unified background for the interpretation of the natural phenomena of the sea.

196. The undergraduate will naturally elect one of the basic sciences as his major interest. This interest should be developed fully into the graduate years, to provide the definite professional orientation and competence necessary for research work on a chosen aspect of oceanography. At this point planning and guidance of his training should be in the hands of an experienced oceanographer. In some countries the choice of a narrow specialization is required during the undergraduate years. In such cases, undergraduate study should be arranged to accommodate the student's intended specialization in marine science.

197. Since the graduate student will need to draw on the technical literature of his subject with ease and will require to demonstrate his ability to do so before embarking on a scientific degree course, it is very desirable that language study be sufficiently advanced prior to graduate work. German, English, French and Russian appear to be the languages most useful to the ocean scientist at present. Because of the increasing international contacts among oceanographers and their employment in foreign service, the ability to speak one or more foreign languages has become a great asset.

198. While the scientific basis of education for oceanography exists in many universities and there are in some countries departments of oceanography within universities or institutes of higher education with specialization in oceanography, students will not be attracted to the subject unless its nature is presented to them explicitly, some formal recognition given to its value, and leadership provided by the faculty. An introductory course in oceanography at the undergraduate level is needed to acquaint the student with its subject matter and to give concrete meaning and purpose to the more general subject [illegible] his curriculum. Such a course would not only orient the prospective [illegible] but would have general educational value in demonstrating the application of the basic sciences to the complex situations encountered in nature. It would be useful in broadening the outlook of students in the physical sciences, geology and

biology. Such a course should be available at the junior or senior level, after the student has had some introduction to the sciences. It may be supplemented by a summer of practical work at sea aboard a research ship. Institutions undertaking graduate instruction will naturally provide advanced courses in special aspects of oceanography in accordance with the interests of their faculties.

199. Undergraduates preparing for careers in oceanography should establish some first-hand contact with the ocean, and graduate students beginning research require facilities for obtaining data at sea. Provision for such experience cannot ordinarily be provided directly by universities except those which maintain their own marine research facilities, or have permanent contacts with marine research institutions.

200. The importance of field experience has been recognized for many years by biologists, and seaside laboratories under university operation exist in practically every seaboard State. Summer courses in marine biology given at such laboratories have made an invaluable contribution to education, not only by presenting subject matter in the field but also by enabling the student to profit from experiences and contacts which his home institution does not provide.

201. Technicians for oceanography may be drawn from among those who graduate in general biology, chemistry or physics and do not develop sufficient abilities for research work. There is, however, an increasing need to organize the specialized training of such technicians and laboratory assistants on a permanent basis. Training should comprise such subjects as electronics, modern calculation techniques, programming for computers, instrument maintenance and repairs etc. As the maintenance and use of shipborne instruments and equipment differ somewhat from that of equipment ashore, training should include adequate shipboard practice.

202. There are a number of international programmes of marine education and training; among them are programmes which are integral parts of regular activities of such organizations of the United Nations family as FAO, UNESCO, WMO etc. Such a diversity of responsibilities for what may be regarded as one subject is however natural, considering both the inseparable ties between training and research and the multidisciplinary character of marine science. Thus the programme of each organization reflects, as far as training and education are concerned, the scope of scientific disciplines and activities covered in the

corresponding programme for promotion of marine science and technology. The orientation of the training provided - towards fundamental research or towards applied tasks - also depends upon the types of programmes and activities of the organization concerned. Nevertheless, since a sharp and rigid separation of "fundamental" and "applied" training is neither desirable nor practicable, the need for appropriate co-operation among the agencies has been recognized and implemented as far as operating procedures permit, especially by UNESCO and FAO in their programmes of fellowships and regional training courses.

2. World-wide status of trained personnel

203. One of the questions addressed to States Members of the United Nations, the specialized agencies and the IAEA was "Is the development of the activities of your country in marine science and technology limited by the shortage of trained personnel?" The question went further and asked "What educational institutions or other arrangements do you have for instruction in marine science and technology?" The answers received at the United Nations give a good world-wide picture of the trained personnel.

204. Thirty-one countries (Argentina, Cambodia, Cameroon, China (Taiwan), Dahomey, Ecuador, Finland, Guatemala, Honduras, Indonesia, Ivory Coast, Netherlands, Pakistan, Peru, Poland, Portugal, Republic of Viet-Nam, Saudi Arabia, Sierra Leone, Singapore, Sudan, Syria, Thailand, Tunisia, United Kingdom, United Republic of Tanzania, Uruguay, Venezuela and Yugoslavia) answered affirmatively the first part of the question. Eight others (Canada, Chile, Cuba, Denmark, Greece, New Zealand, Norway and United States) reported temporary shortages only in a few specialized areas, such as taxonomy. Peru reported no surplus of specialized personnel, and Monaco responded that lack of funds rather than personnel was the limiting factor in development of marine science activities. Only Australia, Austria, Federal Republic of Germany, Iceland, Ireland, Japan, Monaco, South Africa, Sweden and Union of Soviet Socialist Republics reported adequate numbers of personnel trained in marine science.

205. Fourteen member countries (Cambodia, Cameroon, Ceylon, Cyprus, Dahomey, Guatemala, Honduras, Iceland, Ivory Coast, Kuwait, Madagascar, Malaysia, Republic of Viet-Nam and Saudi Arabia) reported an entire lack of local institutions for

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instruction in marine science and technology. Portugal offers training only for technicians. Other Member countries replying stated that their training activity ranges from a single national laboratory or fishery training centre to numerous university departments and training facilities in government laboratories.

206. Suggested improvements for educational and training programmes include: strengthening the existing United Nations-sponsored programmes; formation of "sister-university" programmes between developed and developing nations, and the establishment of regional centres for research, education and training (ICES and FAO could implement these in the field of fishery science and marine biology, and IOC in the field of general oceanography).

207. A world-wide survey of senior professional oceanographers made in 1964 by the National Academy of Sciences of Washington, D.C., identified 2,563 oceanographers in ninety-three countries. However, the great majority of these individuals were concentrated in a few highly developed countries, as the following tabulation (adjusted to reflect the 1967 status of countries) will indicate:

Number of oceanographers credited to country	Number of countries	Number of oceanographers credited to country	Number of countries
0	59	41-80	8
1-5	26	81-160	2
6-10	10	161-320	3
11-20	12	554	1
21-40	10		

208. In summary, well over half of the total senior professional oceanographic manpower in 1964 was concentrated in six countries, namely, Canada, Federal Republic of Germany, Japan, USSR, UK and United States, whereas eighty-five countries numbered only 134 senior professional oceanographers among them. Although no more recent statistics are available, there is no reason to believe that there has been any significant change since 1964 in this distribution of oceanographic manpower.

3. UNESCO programme of training and education in marine science

209. Training and education occupy a particularly important place in UNESCO's programme of oceanography. Each biennium, under the Regular Programme, ten to fifteen young scientists are awarded a UNESCO fellowship offering them from six to nine months in well-established oceanographic institutions of advanced countries, working under the guidance of eminent specialists.

210. Shipboard fellowships, allowing participation in oceanographic expeditions aboard ships of other nations, are also included in the Regular Programme. This is particularly important since it is not every nation that can afford its own research vessel.

211. Under the Technical Assistance Programme, regional and national institutions and laboratories receive assistance in developing their own oceanographic programmes. To stimulate national interest as well as between the countries, regional training courses form an important part of UNESCO's programme.

212. Training students of developing countries in their own country or region is further assisted by visiting professors or experts from advanced countries. It is a basic requirement that all UNESCO experts in oceanography be selected from among the most competent specialists and be prepared to give lectures and hold seminars in the country of assignment. This programme is further strengthened by travel grants given to visiting lecturers.

213. The budgetary provisions for training in oceanography are given in biennial "Approved programme and budget of UNESCO" which specifies broad of the programmes in various areas of the world. It is of interest to note that the allocations for fellowships in marine science showed a considerable increase over the past budgetary periods, being $50,000 in 1965/66, $74,000 in 1967/68 rising to $85,000 in 1969/70, as far as the Regular Programme is concerned. To these figures a number of fellowships under the Technical Assistance component of the UNDP should be added.

214. The following table summarizes the total amount of funds spent on training in marine science within the framework of UNESCO's programme since 1961.

Budgeted UNESCO assistance expenditure, 1961-1968
(dollars)

	1961/62	1963/64	1965/66	1967/68	Project 1969/70
Fellowships	90,500	85,000	110,000	134,000	205,000
Training courses. .	16,000	174,000	130,000	109,700	136,000
Total . .	106,500	259,000	240,000	243,700	341,000
Experts and consultants	64,700	279,800	298,620	307,300	400,000
Total . .	209,200	538,800	538,620	551,000	741,000

215. Since the activities of the Intergovernmental Oceanographic Commission complement the UNESCO programme in marine science, proper evaluation of the effectiveness of this assistance is considerably facilitated. The example of the Indian Ocean Expedition has shown that the programme of assistance associated with it was particularly profitable for the countries involved. This is largely because the expedition provided an immediate field of application to young scientists whom UNESCO helped to train, to the equipment supplied and other facilities provided. The impact of this and all other co-operative activities on national development was in fact so great that in 1966 UNESCO received fifty applications for a mere ten fellowships available in oceanography. It is doubtful that the limited assistance provided by UNESCO could have been so successful without the Commission's work of co-ordination and encouragement. The establishment by the Commission during its fifth session of a Working Group on Education and Training in Marine Science will undoubtedly have a great effect on further development of marine research in the world, as well as on international co-operation in marine research.

Fellowships

216. The UNESCO Office of Oceanography assists candidates in choosing the most appropriate laboratories or universities for their training. Fellowship applications are channelled through the National Commission for UNESCO in the candidate's own country where a standard form may be obtained in which he indicates his particular interests and the place of study he considers appropriate.

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217. The maximum duration of a UNESCO fellowship is nine months in the first instance. There have been cases of fellowships being extended for up to two years. Only under the Technical Assistance programmes may fellowships be awarded initially for twelve months.

218. Shipboard fellowships are usually from one week's to several weeks' duration, depending on the programme of work, the ships' area of operations and approval [illegible] the host country.

219. Training courses last from one to three months. However, at the end of these courses, several candidates are usually granted an extension, either in the same country or to visit other countries for additional training in their specialized field of study.

220. Beneficiary Governments have inter alia the following obligations towards the holder of a UNESCO fellowship:

(a) Ensuring the continuation of salary or such other arrangements as may be appropriate to maintain the fellow's dependants, or other obligations while he is abroad;

(b) Assurance that the fellow will be employed upon his return home from study abroad in work related to the studies for which the fellowship was awarded.

221. From 1955 to 1967, long-term fellowships in oceanography awarded under the Regular Programme or under Technical Assistance totalled 132. During 1968 another nine fellowships will be available under Regular Programmes, bringing the total to 141. This number excludes the Danish Special Contribution, whereby about eighty-five marine scientists (including the fifth course in 1968) will have received two months' training. Many of the fellows on the Danish course have been granted extensions to visit specialized institutes or universities in their own field of study. Other short-term fellowships, such as shipboard fellows[illegible] travel grants are not included above. In all, forty-four countries have [illegible] from fellowships.

Training courses

222. An important part of teaching in marine science is given through training courses held in different countries. Such courses not only provide training for students but are also directed towards stimulating national interest in

oceanography. In addition to training courses directly organized by UNESCO, several training courses by other organizations have also been supported, either by travel grants for students and instructors, or supply of equipment. During 1961-1968, courses have been organized by UNESCO in the following countries: Algeria, Argentina, Brazil, Chile, Denmark, India, Ivory Coast, Japan, Morocco, Pakistan, Tunisia, Turkey and Venezuela.

The role of consultants and experts

223. UNESCO's policy has always been to recruit, both under Regular and Technical Assistance Programmes, highly qualified experts and consultants who have experience in teaching as well as in research. The experts have usually started their assignments at the beginning of university academic years, thus being able to give full courses incorporated into the universities' curricula.

224. During 1961-1967, the following countries received UNESCO experts (or consultants) in marine science: Argentina, Brazil, Cuba, Ecuador, Indonesia, Mexico, Panama, Pakistan, Republic of Korea, Sierra Leone (post to be filled in 1968), Thailand and United Arab Republic. The experts were assigned to the country either as short-term consultants (three to four months) or for a longer duration of three to four years. At the end of their assignments, the lectures and courses given by the experts have in several cases been printed by the universities - sometimes with UNESCO support - thus providing suitable textbooks for the students after the termination of the experts' assignments.

4. FAO programme in education and training

225. Specialized training is an integral part of the programmes of FAO in the field of marine resource investigation, exploitation and management. A wide variety of activities is conducted under the organization's Regular Programme as well as in the country and regional technical assistance projects, especially those funded by the UNDP, but also under the Freedom from Hunger Campaign and various Trust Funds.

Fellowships

226. Each year ten or more fellowships are awarded under UNDP (TA) and (SF) projects. The fellows selected are often the counterparts of international [illegible] working in their countries. Study programmes are worked out for each to spend six to twelve months at one or more leading research institutions, including work at sea. In addition, one or two "Andre Meyer" fellowships of up to two years' duration are awarded under FAO's Regular Programme; these are for advanced research training in fundamental subjects in which the organization has an interest through the need to strengthen the scientific basis of its development activities.

Training courses

227. Every biennium one or two regional or interregional training centres are conducted under the UNDP (TA) programme. Each centre usually lasts from six weeks to two months, attended by fifteen to thirty participants from developing countries. The instructors are FAO headquarters and field staff, and [illegible]. In some cases a general elementary introduction to fishery science is given, but most successful have been the centres giving intensive instruction in particular subjects or techniques to supplement fuller training obtained in other ways. Recent examples have been a Centre on Marine Resources Appraisal in Latin [illegible] (1966, Chile, thirty-two participants from fourteen countries), at which the subject of fish population dynamics has been taught; and a Mediterranean [illegible] fish-tagging methods (1965, Yugoslavia, sixteen participants, seven countries). Other centres are being organized under the Danish Special Contribution.

228. Many centres are directly related to the needs of FAO's regional fishery councils and commissions. Thus the Mediterranean Centre mentioned above was an element in the GFCM sardine research project, and the IPFC has stimulated a series of stock assessment centres in its region, oriented to tuna and ma[illegible] research. Several centres involved co-operation with other agencies; thus [illegible] has arranged for some instruction in general marine science at a specialized centre, and vice versa.

229. Centres of a similar nature are being organized as co-operative projects between a group of FAO/UNDP (SF) fishery projects. Thus a sardine researc[illegible]

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is planned to be held in Ghana in 1968 for West African scientists and technicians associated with the projects in that area.

230. Regional training courses are organized and supported jointly with other international organizations, for example, with the ICES (particularly on fish resource assessment methods including acoustic techniques) and the Mediterranean Association for Marine Biology and Oceanology (MAMBO). Joint training activities are programmed where possible with certain interested national institutions, an example being the Smithsonian Institution (United States of America).

231. Some courses held in non-scientific fields such as fishermen's training, include some instruction in oceanography, meteorology and fishery science. This applies also to the curricula of permanent national training institutions being supported as UNDP (SF) projects, in, for example, India (Bombay) for fishery officers, and the Republic of Korea (Pusan) for fishermen and instructors.

232. One or two Group Fellowship Study Tours and Seminars under UNDP (TA) have been held in the USSR annually. In each up to twenty marine research workers from developing countries attend lectures and seminars by Soviet scientists, and by other scientists brought there by FAO, and visit laboratories etc. for a total of about six weeks. Earlier projects of this kind covered marine fishery investigations generally, but recently attention has been given to more specialized subjects, for example, in 1967, the study of fish behaviour in relation to fishing gear. The lectures given in connexion with these are published and form useful reference books for future training programmes.

233. In 1967 a sea-going group fellowship was held on a Soviet research vessel in the Black Sea. Twenty students from countries in the Mediterranean area, after introductory lectures in Moscow, spent a month at sea learning techniques, carrying through a cruise programme, having lectures and seminars aboard and at foreign ports (Istanbul, Varna) which were visited and near which are located marine research institutions. Similar cruises in the Mediterranean and elsewhere are planned for 1968 and following years.

234. FAO places high value on scientific training at sea and, as opportunities arise, is placing fellows on board vessels of various countries to participate in normal research cruises. Such opportunities are now multiplied as a result of the acquisition of many research vessels for FAO/UNDP (SF) fishery projects.

235. It has been found useful on occasions to associate training courses with important international conferences and symposia. For example, arrangements were made for participants in the Group Fellowship Study Tour on Fish Behaviour in 1967 to attend an FAO Conference on the same subject which was held in Bergen, Norway, immediately after. In this case the Norwegian bilateral aid programme supported the FAO fellows during this part of their trip abroad. Similarly, participation at a study tour in 1966 was arranged to coincide with the Second International Oceanographic Congress in Moscow.

236. Some training courses are organized at the national level in connexion with FAO/UNDP projects. In addition, FAO field staff sometimes arrange to give courses at local universities and other institutions in the country of their assignment. An important part of research training is "on job", for the national counterpart staff of field projects. The Associate Expert Scheme has also provided opportunities for advancing the professional development of young scientists who are assigned to work with FAO staff in the field and also for periods at the agency's headquarters.

Teaching aids

237. Fishery science continues to suffer from a lack of adequate textbooks, training manuals etc., in a variety of languages. For many years FAO has been working to arrange for preparation and publication of such texts, and has now issued a series of manuals of various aspects of fishery research. Most of these have been developed in connexion with the regional training centres where they have been tried and subsequently modified. In this work FAO co-operates actively with other organizations, as for example, the ICSU Special Committee for the International Biological Programme, which is also issuing a series of method handbooks. Through its extensive work in providing scientific bibliographic documentation services, FAO has been assisting libraries of training and research institutes to obtain the materials they need for training purposes.

238. Ad hoc advice is given to Governments and individuals on curricula, study programmes, existence of training facilities in various countries and related matters. An indexed directory of Hydrobiological and Fisheries Institutions

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Training Programmes and Facilities has been published and up-to-date files of such information are maintained.

Evaluation of needs and means for training

239. The FAO Advisory Committee on Marine Resources Research has studied several aspects of training problems in fishery science and related fields, and has considered and reported on, for example, the desirability of establishing regional research and training institutions in certain areas. Detailed consideration has also been given to these problems at the regional level. Thus the IPFC in 1966 held (at Hawaii) a Symposium on Fisheries Education and Training and is publishing the proceedings and a manual on the subject. Training problems in specialized fields have been considered as an important item in sessions of other regional fishery bodies and at various technical conferences on particular subjects. The FAO Committee on Fisheries has now taken up the broad problem of fisheries training at all levels as a major item for study.

240. Under FAO's Special Programme of Education and Training in Africa studies have been made of over-all regional and country needs and institutional problems in East Africa and in West Africa; proposals have been developed for regional training projects that might be submitted to the UNDP for funding.

241. Mutual assistance between countries in the same region is being encouraged, so that for example, where one country has developed a special training facility, attendance of nationals from a neighbouring country is facilitated. Consideration is being given to the possibility of supporting the growth of closer relations between institutions in a developing country and corresponding ones in more developed countries.

242. The need to encourage young people to interest themselves in marine science has been recognized, and to this end FAO is collaborating with several institutions, especially CSIRO Australia, to develop a pamphlet and other descriptive material on marine science as a career, including of course fishery aspects.

5. WMO education and training programme in marine science

243. Port meteorological personnel are employed in many countries to provide instruction to ship's officers concerning weather-observing techniques and procedures which include certain sea parameters (waves, sea-surface [illegible]. Instructive treatises have also been prepared and distributed. Other training has been done on a more informal basis and includes lectures to yachtsmen, fishermen etc. With regard to their own personnel, many services conduct formal courses on maritime observational procedures and include information on oceanography. Air-sea interactions are a basic consideration in the training of scientific meteorological staff.

244. The functions of the world and regional meteorological centres include the provision of facilities for training. This training will normally involve all aspects of the work in the centres and will encompass endeavours relating to the analysis and forecast of ocean parameters such as waves, sea temperature, ice etc. Besides this, special WMO training centres have been in operation for quite some time in certain countries, and WMO experts are training personnel in others. This training includes, in some cases, the techniques and procedures for [illegible] sea and swell in off-shore areas where drilling and other marine activities are in progress. Seminars and symposia are sponsored by WMO (one to four per year) and fellowships are awarded. In this regard, the WMO Executive Committee Panel of Experts on Meteorological Education and Training has recently prepared the outline of a WMO Comprehensive Guide to Meteorological Education and Training. On the advice of the WMO Advisory Committee, this outline includes physical [illegible] as a subject which should be part of the fundamental meteorological education necessary for all meteorologists, irrespective of their field of [illegible]

6. ECAFE training in offshore geophysical prospecting

245. A Regional Training Centre for Offshore Geophysical Prospecting was [illegible] by Japan in May 1967, through the recommendation of the ECAFE Co-ordinating Committee on Offshore Prospecting. This Centre has been taking in trainees from the Asian countries.

III. THE NEED TC MAXIMIZE INTERNATIONAL CO-OPERATION EFFORTS AND RELATED PROPCSALS

246. The reasons and needs for international co-operation in the domain of marine science and technology have been stated appropriately as follows:

> "The world ocean covers 71 per cent of the earth's surface. Most countries have sea coasts and make some use of the sea, although national jurisdiction extends over only a small fraction of the ocean's area; the remainder is common property. The waters of the world ocean and their contents intermingle without serious restraint. Many oceanic processes are of large scale and are driven by forces of planetary dimension. The organisms inhabiting the sea are influenced by these processes and forces, and their distribution, abundance and behaviour are often influenced by events occurring far beyond the territorial limits recognized by man." 1/

247. Rapid expansion of marine research and oceanic service activities throughout the world during the past decades has caused the creation of a variety of international organizations dealing with international co-operation within this context. Some of these attend to specific problems of only a few countries; others are regional; a number carry responsibilities that are world-wide but not comprehensive as to subject matter. Co-ordination among these organizations is considerable and continues to develop in relation to many problems, but it is neither complete nor easy and needs to be improved. A certain consolidation in the programming of intergovernmental co-operation in marine affairs is needed to facilitate proper assignment or division of responsibilities among the various organizations and bodies involved, and prevent duplication or dissipation of effort and expenditure. While planning of ocean activities is largely initiated on a national basis, and some is carried out at a regional level, an increasing amount of such planning requires a global approach because of the nature of the ocean, of its interrelation with the atmosphere and of the exploiting industries. Aside from such planning there is need for broadly based co-ordination of the activities in this field through national and international efforts, and collaboration in the interpretation and analyses of the results.

1/ International Ocean Affairs, a special report prepared by a joint working group appointed by ACMRR of FAO, SCOR of ICSU and AC of WMO, preface. See also annex XIII to the present report.

248. A better understanding of the marine environment and an increase on the exploitation and development of marine resources requre that international co-operation be given more support at all levels. Particularly with scientific and applied research, one or more of the following reasons apply: the scale of research is often greater than can be serviced by any one country alone; the research required involves a greater diversity of scientific competence or facilities than any one country possesses; solution of a problem by one country requires access to data and experience possessed by other countries; the cost effectiveness of research for each country can be increased substantially by joining forces in an international operation; the subject of research is affected by the activities or laws of another country; there is a special need to reach agreement on the employment methods of research; there is need to establish mutual confidence in experiments or analyses bearing on particular problems requiring international action.

249. It is in this context that the Secretary-General presents to the General Assembly a series of considerations and specific proposals relative to a better understanding of the marine environment through science, development and exploitation of marine resources (living and mineral), prevention of pollution and education and training in marine science.

250. The questions of international concern which arise in the development and exploitation of marine resources (including questions of conservation) and in the use of the ocean generally for economic purposes are specialized and largely technical in nature, as are the related problems, such as control of marine pollution, safety of human life and property at sea and provision of technical ocean services. All are therefore best considered within the framework of the appropriate specialized organizations concerned, wherein lies the necessary technical and where Governments can most easily contribute effectively to international co-ordination through their appropriate national bodies. Such established international agreements which, of course, also have legal and even political aspects. The co-ordinating arrangements in this field appear generally to be satisfactory and the Secretary-General accordingly proposes that the General Assembly recognize and encourage the role of the specialized agencies and other organizations concerned.

251. Problems of a general legal nature relating to the development and exploitation of marine resources and to other uses of the ocean are the subject

of special United Nations conferences based on extensive preparatory work by the International Law Commission. Special problems of a predominantly political nature have been taken up in the General Assembly which, for instance, in the case of the sea bed beyond the continental shelf, has appointed an ad hoc committee to study the subject. The Secretary-General therefore has no proposal to offer in those domains for the time being. He is glad to note, however, that provisions have been made enabling the bodies dealing with these questions to receive technical information as appropriate from the specialized organizations concerned.

252. In the field of science and the related field of education and training the Secretary-General sees the need for greatly strengthened arrangements and for an expanded programme of international collaboration. While responsibility for ensuring adequate co-ordination and collaboration in specialized scientific work is best entrusted to the specialized organizations concerned, an expanded programme of international co-operation to assist in a better understanding of the marine environment through science would involve several specialized agencies and other international organizations and the Secretary-General therefore makes positive proposals in this regard.

A. An expanded programme of international co-operation to assist in a better understanding of the marine environment through science

253. The expanded programme should synthesize national and international plans in this field and might serve a dual purpose. It would enable Governments and international bodies to take cognizance of each other's plans, to adapt them as necessary, to avoid unnecessary duplication, to ensure that gaps are filled and, co-operatively or jointly, to undertake large-scale activities in research and related services which are not feasible for a single country or for a single organization. Co-operative scientific investigations of the ocean, such as those organized by the IOC, contribute greatly to the scientific foundation necessary for the development and exploitation of marine resources, both living and non-living. The expanded programme would also provide a basis for making timely and adequate provisions for finance and facilities to support the activities included in it.

254. The expanded programme would need to be formulated by a suitable, an existing, inter-governmental body occupying a focal position and re... the international organizations concerned. It should include in its membership all or most of the countries interested in a better understanding of the marine environment through science and should be so constituted as to ensure that its work is also responsive to needs with regard to the exploitation and development of marine resources, and in keeping with the over-all plans of Governments.

255. The terms of reference of the IOC established by UNESCO in 1960 already come close to those required for such an inter-governmental body. The Commission... the most important role at present in co-ordinating national and international oceanographic programmes.

256. The Secretary-General therefore proposes that the General Assembly recommend to Member Governments, UNESCO, FAO, WMO and such other organizations of the United Nations family as may be concerned that they agree as a matter of urgency to broaden the base of IOC so as to enable it to formulate and co-ordinate the expanded programme. This agreement should provide, through appropriate modification of the IOC statutes among other things, for adequate joint... support by the agencies concerned for such a broadened ICC, for a secretariat organized jointly and for an equitable participation of the agencies concerned organizing the Commission's work. Another necessary step will be that Member Governments concerned provide appropriate direct financial support to the Commission. The modified statutes should permit the use of directly contributed funds for all aspects of the Commission's work.

257. Support of the expanded programme and the activities of a broadened ICC by the organizations of the United Nations family can be co-ordinated adequately through the ACC and its Sub-Committee on Marine Science and its Applications; no other special co-ordinating machinery is required. To avoid unnecessary duplication of effort and proliferation of machinery, the ACC should ensure advance consultations between the secretariats of the organizations concerned regarding proposals which fall within the terms of reference of more than one of them, and ensure that any temporary arrangements made for the implementation of such proposals by one or several organizations are discontinued after completion of the tasks involved.

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258. The expanded programme will, of course, require additional expenditure at various levels. Governments will have to provide directly for concerted national activities under the programme. It must be recognized that developing countries will need assistance from developed countries and from international bodies if they are to play their part in making the programme truly global and derive full benefit from it. A substantially larger budget for marine expenditures by the organizations sponsoring the broadened IOC will be essential for the joint conduct of certain projects, organization of meetings, provision of secretariat services, arrangements for data exchange, documentation etc. In addition, the fullest collaboration of other international organizations and bodies must be sought.

259. The increased international expenditures required by the expanded programme may be financed through increased regular governmental contributions to the international organizations and bodies concerned (including non-United Nations bodies), and may have to be supplemented by direct financing and by funds from other appropriate sources.

260. The Secretary-General therefore proposes that the General Assembly call upon States Members of the United Nations family of organizations to provide direct financing to the broadened ICC, to give urgent consideration to increasing their national allocations for marine research activities, and to strengthen their support of international co-operation in these activities through their contributions to the organizations concerned and through their direct participation in the expanded programme.

261. The co-ordinated implementation of the expanded programme by international organizations requires improved co-ordination at the national level, in order that each Member State's position should be consistent as regards the expanded programme through all the international organizations concerned.

262. The Secretary-General proposes that the General Assembly call upon States Members of the United Nations family of organizations to make suitable arrangements to co-ordinate their relevant national activities in such a way as to enable their national co-ordinating mechanisms to provide adequate support for the proposed expanded programme of inter-governmental co-operation.

263. For the success of the expanded programme it is essential to ensure such a division of responsibilities and functions among the existing international

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organizations so as to achieve maximum efficiency in the implementation of the programme throughout the whole system.

264. The Secretary-General proposes that the General Assembly recommend that the expanded programme be so developed as to provide for the proper interrelation between the work of the broadened IOC and that of other inter-governmental bodies, in particular, regional organizations, as well as international non-governmental bodies whose participation in the activities of the broadened IOC should be ensured by all appropriate means.

265. The IOC and the United Nations organizations and bodies concerned have received valuable and necessary scientific advice through committees and other bodies of scientists acting with a maximum of independence in their private capacities as individual experts.

266. The Secretary-General proposes that the General Assembly recommend to the IOC and the United Nations organizations concerned the preservation and strengthening of this principle of seeking independent expert advice and to arrange, in particular, for a continuation of the work started by the Joint ACMRR/SCOR/WMO (AC) Working Group in the identification of specific scientific problems which require expanded international co-operation.[2/] The IOC, as well as the United Nations organizations concerned, would then be better able, in developing the expanded programme, to assign priorities and propose means of attacking the problems so identified.

267. The Secretary-General further proposes that the General Assembly recommend to the IOC and the United Nations organizations concerned that, in keeping with the recommended evolution of the IOC, they hold under review the mechanisms for obtaining independent scientific advice, paying due regard to trends in organization of non-governmental bodies such as, for example, the suggested of several ocean-related bodies of the ICSU family into an international u marine science.

B. International co-operation regarding development and exploitation of living marine resources

268. The need for international co-operation in the development and exploitation of living marine resources, including the rational exploitation and conservation

2/ See annex XIII.

of fish stocks, is very great as most of the resources are not confined within national boundaries and a large part of the fishing operations takes place on the high seas with participation of nationals of different countries. Research relating to fishery resources also assumes in many respects an international character. Its progress, however, depends substantially on the availability of basic knowledge of the marine environment for the provision of which proposals are made in section A above.

269. As a consequence of the wide recognition of this need, a great deal of international machinery has been established which is providing for such co-operation in various ways. With the growth of international fishery problems and of the machinery designed to help in their solution (including more than fifteen international fishery bodies), the need for co-ordination and avoidance of duplication has also grown. This further need was recognized at the twelfth session of the Conference of FAO when Governments resolved to give that organization the status of the leading inter-governmental body in encouraging rational harvesting of food from the oceans and inland waters. The Conference of FAO therefore established an inter-governmental Committee on Fisheries inter alia to conduct periodic general reviews of fishery problems of an international character and to appraise such problems and their possible solutions with a view to concerted action by nations and FAO in co-operation with UNESCO, IMCO, WMO, the ILO and other inter-governmental bodies. The Committee was instructed to conduct its work so as to supplement rather than to supplant other organizations working effectively in the field of fisheries and specifically to take into account the role of commissions.

270. As the survey has shown, the FAO Committee on Fisheries has already stimulated closer co-operation between existing bodies, has identified areas where international action is needed and has been instrumental in obtaining international agreement and in creating international machinery to this end. The effectiveness of its work has been enhanced by some strengthening of the fisheries sector of FAO but has been limited by still inadequate financial support for international fishery activities (such as research, exploration, conservation and technical assistance) including particularly those of regional and specialized bodies in which developing countries should play an important role. There is still

considerable scope for further improvement of international collaboration in relation to fisheries development and conservation, which can be achieved within the existing organizational framework.

271. The Secretary-General, recognizing the importance of international co-operation in fisheries, the important role played by various international organizations in this field, and specifically the leading part of FAO and its COFI, proposes that the General Assembly call upon Member States to increase their support for international co-operation, including particularly the work of regional and other specialized fishery bodies, and draw the attention of international funding organizations to the need for assisting developing countries to participate more fully in such work.

C. International co-operation in the development and exploitation of marine mineral resources

272. The need for international co-operation in the development and exploitation of mineral resources of the ocean in the interest of mankind is rapidly growing as a result of the recent progress in scientific knowledge of the ocean and advances in marine technology. This need is further emphasized by the international character of the high seas. Pre-eminent in consideration of this issue is the necessity for more information about the topography, geology and sedimentary characteristics of the ocean floor, for elucidation of the pertinent ocean processes, for further development of technology and instrumentation and for resolution of associated economic, administrative and legal issues.

273. When dealing with development and exploitation of marine mineral[illegible] one has to consider operations relating to their exploration, evaluation or assessment and production proper. By exploration is meant the geographically broad surveys leading, by progressively narrowing the search, to the location of mineral occurrences of possible economic importance. Evaluation comprises a detailed investigation of mineral occurrences or deposits, in order to discover their nature, to establish the quantity and tenor of the contained economic minerals, to determine how best they may be exploited, and generally to take into account all other factors affecting their economic development. Production includes all the operations relating to extraction, beneficiation and transport

of the minerals discovered. Most of these operations are normally carried out by public or private enterprise.

274. For international co-operation in this domain, it is appropriate to distinguish between resources on the continental shelf where exploitation is taking place today and where the question of jurisdiction is subject to the 1958 Convention on the Continental Shelf, and those of the remainder of the sea bed and ocean floor for which proper technology for recovery has not yet been developed and for which the question of the jurisdiction that could apply still remains unsettled.

275. The role of inter-governmental organizations is normally limited to the gathering and diffusion of information relating to the knowledge of mineral deposits, and technological progress affecting the instrumentation needed for their exploration, evaluation and exploitation; to providing services contributing to the programming and safety of the operations at all stages as well as to fostering the legal and administrative conditions for practical utilization of the resources. To these may be added the technical assistance given in these fields to developing countries which is still rather limited but of great potential importance.

276. As far as international arrangements are concerned, the proposals for dealing with scientific aspects are given in section A above. The technological, economic and some of the related administrative and legal aspects, including technical assistance, are presently dealt with by the United Nations Secretariat (Resources and Transport Division of the Department of Economic and Social Affairs and ECAFE) but only for the resources of the continental shelf. Apart from scientific research and preliminary studies, very little is being done as regards resources beyond the continental shelf.

277. The Secretary-General therefore proposes to the General Assembly that it take steps to expand further the existing activities in the continental shelf area and to ensure that, as far as the whole ocean is concerned, the United Nations is given adequate responsibility for systematic collection and diffusion of information regarding economic marine mineral deposits, techniques appropriate for their development, as well as for resolving related juridical, general administrative and political issues.

D. International action relating to the prevention of the pollution of the sea

278. The investigation and control of marine pollution, which is related to many of the activities discussed in the preceding section, is a matter on which international action on both regional and global scales is now becoming urgent. It involves examination of a wide variety of difficult and highly technical problems to provide a firm basis for enactment of appropriate legislation, establishment of institutional arrangements for continuing studies, and the development of necessary technical services.

279. With respect to these urgent problems of broad concern, a high degree of concerted action is being attained through existing machinery which appears satisfactory for this purpose. In this context, the ACC through its Panel on Marine Science and its Applications has, within the past two years, played a key role in making arrangements for gathering during 1967, from Governments and other sources, information and suggestions on which a realistic expanded and co-ordinated programme can be based. The bodies that have been mainly concerned, in addition to the United Nations itself, are IMCO, WHO, FAO, UNESCO and IAEA. The material thus far received has been analysed and is generally available, and a more intensified programme is being based largely upon it. The action now actively under consideration covers the joint provision of scientific and technical advice, exchange and dissemination of information and future international legislation for the control of pollution.3/

280. The programme evolving covers all aspects of marine pollution: health, fisheries, amenity; oily and radioactive substances as well as other pertinent marine research as well as control and monitoring. In several instances, a particular service function is already the responsibility of one or only a few of the organizations of the United Nations family; in other cases, many organizations may be involved. The provision of such services would therefore require active and co-ordinated contributions from all the organizations concerned. FAO, UNESCO (ICC) and IMCO have agreed to establish a joint group of experts to advise on scientific aspects related to the pollution of the sea within the competence of the sponsoring organizations. The group will re[illegible] agencies should they wish to join it.

3/ See annex XIV.

281. The Secretary-General accordingly proposes that the General Assembly request the organizations of the United Nations family concerned to continue, with urgency, to elaborate and implement their planned joint action with respect to marine pollution.

282. The Secretary-General also proposes that the General Assembly call upon States Members of the United Nations system of organizations to participate actively in the joint undertaking of the organizations concerned and that, in keeping with the progress of scientific research related to marine pollution, they take steps towards adopting, in addition to the international Convention for the Prevention of Pollution of the Sea by Oil, 1954, such effective international agreements on prevention and control of marine pollution as may appear necessary.

V E. An expanded programme of co-operation in the fields of education and training in marine science

283. As shown in the survey above, marine education and training programmes are part of the normal activities of a number of organizations of the United Nations family, which use widely for this purpose existing national training and education facilities. However, the scarcity of competent personnel still remains a limiting factor to the development of national efforts and of international co-operation as regards the study of the ocean and the full and rational use of its resources. This scarcity demonstrates the inadequacy of the existing national and international marine education and training programmes, which therefore need to be strengthened as a prerequisite for the implementation of the expanded programme of co-operation.

284. The necessary strengthening of marine educational and training programmes, particularly of those undertaken by the organizations of the United Nations family, may be achieved through the following means:

(a) Increased allocations for study grants, fellowships and training courses and enlarged assistance to Member States for the development of national and regional marine education and training programmes and facilities, including endowment of teaching posts through both the regular programmes of the United Nations organizations concerned and UNDP funds, as well as through the proposed international oceanographic fund;

(b) Additional contributions by Member States to the international marine education and training programmes by offers of study grants and fellowships through the organizations of the United Nations family and through extended bilateral and multilateral assistance schemes;

(c) Improvement of facilities for marine education and training at the national and regional level, with associated arrangements made for stable professional careers for scientists and technicians in their home countries or regions;

(d) Expanding the coverage, scale and continuity of scientific documentation and related services for marine scientists;

(e) Improved national arrangements to facilitate the participation of their competent personnel in international programmes of training and research.

285. Therefore the Secretary-General proposes that the General Assembly call upon States Members of the United Nations family of organizations and upon the organizations of the United Nations family concerned to make the necessary arrangements for the application of the above-mentioned means to strengthen the existing marine education and training programmes and to initiate new programmes wherever necessary.

Annex I

SPECIALISTS PARTICIPATING IN THE WORK OF THE GROUP OF EXPERTS ON MARINE SCIENCE AND TECHNOLOGY SET UP BY THE SECRETARY-GENERAL

United Nations

John Lyman	-	Special Consultant to the Chairman of the Group of
E.S. de Breuvery	-	Co-ordinator, ad hoc Unit on Marine Science and Technology, ESA
J.P. Lévy	-	Ad hoc Unit on Marine Science an[illegible] ESA; Secretary of the Group of E[illegible]
P. Villat*	-	Consultant
F. Wang*	-	Consultant

Experts nominated by specialized agencies and organizations

G. Chatel**	President, Directing Committee of IHB (since July 1967)
G. Dente	Head, Cargoes and Related Matters Section, IMCO
B. Dieterich*	Sanitary Engineer, Community Water Supply, WHO
K.N. Federov	Director, Office of Oceanography, UNESCO; Secretary, IOC
C. Goad*	Deputy Secretary-General, IMCO
S.J. Holt	Director, Fishery Resources ar[illegible] Division, Department of Fisher[illegible]
J. Joseph	Director, Laboratory of Marine[illegible] IAEA

* Attended first meeting only (15-21 June 1967).

** Attended second meeting only (4-8 March 1968).

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H. Lacombe*	Chairman, IOC, until October 1967; Professor, Musée d'histoire naturelle, Paris
W. Langeraar**	The Hydrographer of the Royal Netherlands Navy; Chairman, IOC since October 1967
K. Langlo	Chief, Technical Division, WMO
A.W.H. Needler	Chairman, COFI; Deputy Minister of Fisheries, Ottawa, Canada
R. Pavanello	Chief, Environmental Pollution, Division of Environmental Health, WHO
F.E. Popper	Director, Programme of Co-ordination and Operations, Department of Fisheries, FAO
R.R. Revelle	Member, Executive Committee, SCOR
N.L. Veranneman	Chief, Section of Applied Meteorology, WMO; Secretary, ACC Sub-Committee on Marine Science and its Applications
A. Viglieri*	President of Directing Committee, IHB (until July 1967)

National experts participating in their private capacity

J. Alinat	(France) Deputy Director, Musée océanographique, Monaco
H.A. Arnold	(USA) Senior Staff Member for Marine Engineering, National Council on Marine Resources and Engineering Development, Washington, D.C.
P.D. Barabolia**	(USSR) International Lawyer, Leningrad
W.M. Chapman**	(USA) Director, Marine Resources, Ralston Purina Co., San Diego, California
J. Jónsson	(Iceland) Director, Marine Research Institute, Reykjavik, Iceland

* Attended first meeting only (15-21 June 1967).

** Attended second meeting only (4-8 March 1968).

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V.G. Kort	(USSR) Institute of Oceanology, Academy of Sciences, Moscow
A.S. Laughton*	(UK) Principal Scientific Officer, National Institute of Oceanography, Surrey, England
C.E. Lucas	(UK) Chairman, Consultative Committee, ICES; Director, Marine Laboratory, Aberdeen, Scotland
S. Oda	(Japan) Professor of International Law, Tohoku University, Sendai, Japan
A.H.J. Sciard**	(France) Chief of International Affairs, Centre national pour l'exploitation des océans
W.S. Wooster*	(USA) Secretary, SCOR; Professor, Scripps Institution of Oceanography, California

Observers

A. Banjo*	Head, Science and Technology Section, ECA
A. Boumendjel*	Officer in Charge, Geneva Office, UNITAR
G.B. Gresford**	Director for Science and Technology, ECA
H. Kasahara**	Project Officer, Research and Training Division, UNDP
C.Y. Li**	Deputy Director, Division of Industry and Natural Resources, ECAFE
O. Schachter**	Deputy Executive Director and Director of Research, UNITAR

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* Attended first meeting only (15-21 June 1967).

** Attended second meeting only (4-8 March 1968).

Annex II

NOTE VERBALE AND QUESTIONNAIRE DATED 6 JULY 1967
FROM THE SECRETARY-GENERAL

The Secretary-General has the honour to refer to resolution 2172 (XXI) by the General Assembly of the United Nations on 6 December 1966, a copy of is enclosed for ease of reference.

As will be seen, the resolution requests the Secretary-General of the United Nations - in co-operation with certain specialized agencies and other inter-governmental organizations concerned and interested Member States - to undertake a comprehensive survey of activities in marine science and in the light of which proposals are to be formulated for:

"(a) Ensuring the most effective arrangements for an expanded programme of international co-operation to assist in a better understanding of the marine environment through science and in the exploitation development of marine resources, with due regard to the conservation of fish stock;

"(b) Initiating and strengthening marine education and training programmes, bearing in mind the close interrelationship between marine and other sciences."

In pursuance of this resolution and as a result of consultations between the organizations concerned, the Secretary-General is addressing Governments in his own name of the United Nations and of the specialized agencies concerned in his own name and on behalf of these organizations with the request that they contribute to the survey by (a) expressing their views on the following general questions, and (b) providing the information requested in the attached questionnaire on activities.

The general questions are:

"1. Indicate the existing international activities relating to the matter of the resolution which in your view require substantially increased efforts together with any other international activities which it may be desirable to initiate, and suggest ways of financing such increased or additional efforts;

"2. Having regard to the international co-operation already established between interested organizations, please indicate whether you consider there is need for improvement of this co-ordination and, if so, in which specific fields, and suggest means by which in your view such improvements could be effected."

Both the general questions and the questionnaire have been framed on the advice of the Group of Experts which is assisting the Secretary-General in accordance with the resolution, and should be considered with reference to the attached list of subjects and activities. Where appropriate and possible, supplementary information should be given in greater detail in accordance with the items in the list. Such supplementary information would also be welcome if supplied later than the reply itself.

The Secretary-General finally draws attention to the fact that the survey and subsequent proposals are to be considered by several bodies before being submitted to the General Assembly in the autumn of 1968. The Secretary-General hopes therefore that Governments will give this important matter their early and serious consideration and will communicate their replies to him (preferably in ten copies) not later than 1 October 1967. After that date work on the report will proceed on the basis of information available at the time to the United Nations and the other organizations concerned.

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LIST OF SUBJECTS AND ACTIVITIES

I. RESEARCH

Physical oceanography - including marine physics

Air-sea interaction

Chemical oceanography - including geochemical and biochemical aspects

Marine geology and geophysics

Marine biology - including fishery biology

Ocean engineering - including research and development relating to the use in the ocean of data systems, materials, instruments and tools (including fishing gears), submersibles and other unconventional ocean vehicles, platforms, buoys, undersea laboratories and habitats etc.

II. SURVEYING AND PROVISION OF PUBLIC SERVICES

Nautical charting - including relevant surveying

Position-fixing systems and related navigation services - excluding coastal buoyage and lighthouses

Monitoring and forecasting of physical conditions of the ocean - including related weather and sea-ice parameters

Monitoring and forecasting of pollutants - including radioactivity

Exploration, monitoring and forecasting of fish stocks - including preparation of fishing charts

Submarine geological and geophysical survey

Maintenance and modification of coasts and channels

III. USES OF THE SEA AND ITS RESOURCES

Harvesting of biological resources - including their husbandry

Extraction of mineral resources - including (a) petroleum and gas, (b) other minerals from the sea-bed and below, and (c) chemical recovery from sea water, including separation of fresh water

Derivation of power - by harnessing of current, tidal thermal or wave energy

Waste disposal - including voluntary and involuntary aspects

Transport and communication - including pipelines, tunnels, cables and submersibles, and excluding surface shipping

Recreation - including sport fishing

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QUESTIONNAIRE

QUESTIONS ON NATIONAL ACTIVITIES, PUBLIC AND PRIVATE

1. Which of the following activities in marine science and technology does your country pursue:

(a) Research, whether basic or applied;

(b) Surveying and provision of public services;

(c) Uses of the sea and its resources.

2. What is the magnitude of the activities of your country in marine science and technology, as measured by:

(a) Annual total expenditure for research whether basic or applied;[a/]

(b) Number of professional scientists and engineers engaged in (i) research, and in (ii) surveying and provision of public services;[b/]

(c) Annual extraction of minerals from the sea, sea bed and below the sea bed.

3. Is the development of the activities of your country in marine science and technology limited by the shortage of trained personnel? What educational institutions or other arrangements do you have for instruction in marine science and technology?

4. What mechanisms do you have for co-ordinating your activities in marine science and technology, including their international aspects?

5. To what extent is your country engaged in international co-operation in marine science and technology, as indicated by participation in:

(a) The work of pertinent inter-governmental organizations;

(b) The work of pertinent non-governmental organizations;

(c) Co-operative marine investigations;

(d) Bilateral or multilateral programmes in education and training.

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a/ If possible please give the figures for each of the last five years of record.

b/ Exclude or list separately those engaged in position fixing and related navigation services, and in maintenance and modification of coasts and channels.

Annex III

LIST OF COUNTRIES WHICH HAVE REPLIED TO THE NOTE VERBALE OF THE SECRETARY-GENERAL

Argentina
Australia
Austria
Belgium
Cambodia
Cameroon
Canada
Ceylon
Chile
China (Taiwan)
Colombia
Cuba
Cyprus
Dahomey
Denmark
Ecuador
Federal Republic of Germany
Finland
France
Ghana
Greece
Guatemala
Honduras
Iceland
Indonesia
Iraq
Ireland
Ivory Coast
Japan
Kuwait
Laos
Lesotho
Luxembourg
Madagascar
Malaysia
Mali
Mexico
Monaco
Netherlands
New Zealand
Norway
Pakistan
Peru
Philippines
Poland
Portugal
Saudi Arabia
Sierra Leone
Singapore
South Africa
Sudan
Sweden
Syria
Thailand
Tunisia
Union of Soviet Socialist Republics
United Kingdom of Great Britain and Northern Ireland
United Republic of Tanzania
United States of America
Uruguay
Venezuela
Republic of Viet-Nam
Yugoslavia

Annex IV

COMMON ACRONYMS AND ABBREVIATIONS OF ORGANIZATIONS MENTIONED IN THE REPORT

Parent organizations of dependent bodies or programmes and status of independent bodies are indicated in parentheses when not given in the title itself. Locations of headquarters or permanent secretariats are also shown in many cases.

AC	Advisory Committee (WMO)
ACC	Administrative Committee on Co-ordination (United Nations)
ACMRR	Advisory Committee on Marine Resources Research (FAO)
AINA	Arctic Institute of North America (NGO), Montreal, Canada
ASEAN	Association of South East Asian Nations (IGO)
CARPAS	Southwest Atlantic Fishery Commission (Comision Asesora Regional de Pesca Para el Atlántico Sud-Occidental) (FAO)
CICAR	Cooperative Investigation of the Caribbean and Adjacent Regions
CIM	Cooperative Investigation of the Mediterranean (IOC/ICSEM/GFCM)
COFI	Committee on Fisheries (FAO)
CPCIP	Comission Permanente de la Convention internationale des peches de 1946, now NEAFC
CPPS	Comision Permanente del Pacifico Sur (IGO)
CSK	Cooperative Study of the Kuroshio (IOC)
CSTR	Commission scientifique technique et de la recherche (OAU), Lagos, Nigeria
ESTROPAC	An oceanographic study of the eastern tropical Pacific (EPOC)
ECA	Economic Commission for Africa (United Nations), Addis Ababa,
ECAFE	Economic Commission for Asia and the Far East (United Nations), Bangkok, Thailand
ECE	Economic Commission for Europe (United Nations), Geneva,
ECOSOC	Economic and Social Council (United Nations)
EPOC	Eastern Pacific Oceanic Conference (NGO)
EURATOM	European Atomic Energy Community (IGO), Brussels, Belgium
FAGS	Federation of Astronomical and Geophysical Services (ICSU)
FAO	Food and Agriculture Organization (United Nations), Rome, Italy

FCECA	Fishery Committee for the Eastern Central Atlantic (FAO)
GARP	Global Atmospheric Research Program (WMO)
GDPS	Global Data Processing System (WMO)
GEBCO	General Bathymetric Chart of the Oceans (IHB)
GFCM	General Fisheries Council for the Mediterranean (FAO)
GOS	Global Observing System (WMO)
GTS	Guinean Trawling Survey
IABO	International Association of Biolcgical Oceanography (IUBS)
IAEA	International Atomic Energy Agency (United Nations), Vienna, Austria
IAPO	Now IAPSO
IAPSO	International Association for the Physical Sciences of the Ocean (IUGG)
IATTC	Inter-American Tropical Tuna Commission (IGO), La Jolla, California
IBP	International Biological Programme (ICSU)
ICES	International Council for the Exploration of the Sea (IGO), Copenhagen, Denmark
ICITA	International Cooperative Investigation of the Tropical Atlantic (IOC)
ICNAF	International Commission for the Northwest Atlantic Fisheries (IGO), Dartmouth, N.S.
ICSEM	International Commission for the Scientific Exploration of the Mediterranean Sea (IGO), Monaco
ICSU	International Council of Scientific Unions (NGO), Rome, Italy
IGO	An intergovernmental organization, other than United Nations family
IGY	International Geophysical Year (ICSU)
IHB	International Hydrographic Bureau (IGO), Monaco
IIOE	International Indian Ocean Expedition (SCOR/IOC)
ILO	International Labour Organisation (United Nations), Geneva, Switzerland
IMCO	Inter-Governmental Maritime Consultative Organization (United Nations), London, England
INPFC	International North Pacific Fisheries Commission (IGO), Vancouver, B.C.
IOC	Intergovernmental Oceanographic Commission (UNESCO)
IOFC	Indian Ocean Fishery Commission (FAO)
IPFC	Indo-Pacific Fisheries Council (FAO)
IPHC	International Pacific Halibut Commission (IGO), Seattle, Washington
IPSFC	International Pacific Salmon Fisheries Commission (IGO), New Westminister, B.C.

ITU	International Telecommunication Union (United Nations), Geneva, Switzerland
IUBS	International Union of Biological Science (ICSU)
IUCN	International Union for the Conservation of Nature and Natural (NGO), Morges, Switzerland
IUGG	International Union of Geodesy and Geophysics (ICSU)
IUGS	International Union of Geological Sciences (ICSU)
IWC	International Whaling Commission (IGO), London, England
IWP	Indicative World Plan for Agricultural Development (FAO)
MAMBO	Mediterranean Association for Marine Biology and Oceanology (NGO)
MILOCS	Multinational Military Oceanographic Work
NATO	North Atlantic Treaty Organization (IGO)
NEAFC	North-east Atlantic Fisheries Commission (IGO), London, England
NGO	A non-governmental organization
NPFSC	North Pacific Fur Seal Commission (IGO), Washington, D.C.
NWPO	Northwest Pacific Oceanographers (NGO)
OAS	Organization of American States (IGO), Washington, D.C.
OAU	Organization of African Unity (IGO), Addis Ababa, Ethiopia
OECD	Organisation for Economic Co-operation and Development (IGO), Paris, France
ORSTOM	Office de la Recherche scientifique et technique d'outre-mer, Paris, France
PAIGH	Pan-American Institute of Geography and History (OAS), Mexico, D.F.
PSA	Pacific Science Association (NGO), Honolulu, Hawaii
SCAR	Scientific Committee for Antarctic Research (ICSU)
SCIBP	Scientific Committee for the IBP (ICSU)
SCOR	Scientific Committee for Oceanic Research (ICSU)
SF	Special Fund (UNDP)
TA	Technical Assistance (UNDP)
UNDP	United Nations Development Programme, United Nations Headquarters
UNESCO	United Nations Educational, Scientific and Cultural Organization, Paris, France
UNIDO	United Nations Industrial Development Organization, Vienna, Austria
UNITAR	United Nations Institute for Training and Research, United Nations Headquarters

WDC	World Data Centre: WDC-A for Oceanography, Washington, D.C.; WDC-B for Oceanography, Moscow, USSR
WHO	World Health Organization (United Nations), Geneva, Switzerland
WMO	World Meteorological Organization (United Nations), Geneva, Switzerland
WWW	World Weather Watch (WMO)

Annex V

COUNTRIES' COMMITMENT TO MARINE RESEARCH
(SELECTED INDICES)

Country	Year	Total expenditure for research (converted to $US at rates in effect 1 October 1967)	Professional scientists engaged in: Research	Professional scientists engaged in: Surveying and provision of public services	Number of research vessels (15 metres and up) a/	Remarks
Argentina	Not stated	285,700	70	36	10	
Australia	1966/67	2,200,000	85	51	8	Not including $10 million for offshore petroleum exploration (1966)
Austria	1967	58,000	45 to 65	-	-	Not a coastal country
Belgium	Not stated	216,000	15	Not stated	2	
Cambodia	Not stated	-	1	1	-	
Cameroon	Not stated	20,400	1	Not stated	-	For Sub-Section of Marine Fisheries
Canada	1967	38,550,000	509	383	22	
Chile	Not stated	67,800	113	...	3	
China (Taiwan)	Not stated	175,000	81	41	3	
Colombia	Not stated	Not stated	4	Not stated	-	
Cuba	Not stated	390,398	—— 13 ——		1	Professionals work in both fields
Cyprus	1967	22,400	3	Not stated	-	
Dahomey	Not stated	20,400	4	Not stated	-	
Denmark	1966/67	348,391	—— 20 ——		11	Professionals work in both fields
Ecuador	1967	200,000	12	2	-	Not including naval hydrography
Federal Republic of Germany	1966	8,000,000	300	80	17	Expenditure includes vessel maintenance
Finland	1966	225,944	6	6	1	Figures are solely for Institute of Marine Research, representing one-half to one-third of the national total
France	1966	24,000,000	475	126	18	Personnel figures for 1964

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Annex V (continued)

Country	Year	Total expenditure for research (converted to $US at rates in effect 1 October 1967)	Professional scientists engaged in: Research	Professional scientists engaged in: Surveying and provision of public services	Number of research vessels (15 metres and up) a/	Remarks
Ghana	1966/67	100,800	5	Not stated	2	Costs are for equipment and running research vessels
Greece	Not stated	100,000	15	Not stated	3	Expenditure for Fishing Service
Guatemala		Not stated	-	1	-	
Honduras		-	-	-	-	No formal activity
Iceland	1967	776,326	14	10	3	Marine Research Institute budget only
Indonesia	1968	26,300	40	None reported	3	Also 394 graduates of academies, fishery high school, and sea fishery school
Ireland	1966/67	145,600	11	2	2	Expenditure for sea fishery research
Ivory Coast	1967	490,000	12	8	1	Also $117,500 for fishery directorate
Japan	1966	10,000,000	—— 1,600 ——		42	Prefectural and private activity included in personnel (800) but not in support
Kuwait	1967/68	200,000	3	...	-	
Madagascar		Not stated	14	None reported	2	
Malaysia	1966	80,000	5	14	-	Figures available only for fisheries
Mexico	Not stated	1,304,000	67	27	-	
Monaco	Not stated	816,000	50	Not stated	1	Excluding IHB
Netherlands	1967	3,780,000	95	40	8	
New Zealand	1967/68	1,793,000	71	11	5	
Norway	1965	2,003,000	95	Not stated	9	
Pakistan			46	100	3	Unable to estimate totals
Peru	1967	499,600	70	3	1	
Philippines	1966/67	96,300	36	Not stated	4	

Country	Year	Total expenditure for research (converted to $US at rates in effect 1 October 1967)	Professional scientists engaged in: Research	Professional scientists engaged in: Surveying and provision of public services	Number of research vessels (15 metres and up)a/	Remarks
Poland	Not stated	Not stated	Not stated	Not stated	9	
Portugal	1966	1,330,000	12		10	Number of surveyors is variable
Republic of Viet-Nam	1967	134,000	30	Not stated	1	
Saudi Arabia	Not stated	6,000	2	3	-	
Sierra Leone	1966	28,000	4	4	-	
Singapore	1967	41,600	6	Not stated	-	
South Africa	1966/67	2,100,000	78	Not stated	12	Figures reported only for Division of Marine Fisheries
Sudan	1966/67	28,700	1	-	-	Including supervision of shell farms
Sweden	1966/67	872,000	50	Not stated	9	Estimated
Syria		Not stated	1	3	-	
Thailand	1967	2,090,000	26	118	5	Totals for hydrography, fisheries and meteorology
Tunisia	Not stated	100,000	7	Not stated	-	
USSR	Not stated	18,000,000	1,600	Not stated	110	
United Kingdom	1967/68	25,000,000	650	...	28	Approximate figures
United Republic of Tanzania		-	None reported	None reported	1	
United States	1967	573,000,000	2,000	1,500	188	Includes $228 million in capital investment in ships and facilities and in operational expenses
Uruguay	1967	23,000	11	Not stated	1	
Venezuela	1967	xxxxxxxxxxxx000	24	13	6	
Yugoslavia	1967	xxxxxxxxxxx000	45	8	2	

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Foot-note to annex V:

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a/ The numbers of research vessels were compiled from the national responses to questionnaires and from the listings in the following sources (after eliminating duplications in the various lists):

World Data Centre A for Oceanography, Oceanographic Vessels of the World (Washington, D.C.), vol. I, 1961; vol. II, 1963; suppl. II, 1966.

N. Fujinami, Research Vessel Data, edition 1 (Food and Agriculture Organization, Rome, September 1961);

Food and Agriculture Organization, 1965 Research Vessel Data, Fisheries Reports (Rome), No. 29, December 1965;

Food and Agriculture Organization, 1968 Research Vessel Data (in press);

National Council on Marine Resources and Engineering Development, Marine Science Affairs - A Year of Transition, (Washington, D.C., 1967), pp. 117-130.

Annex VI

SUMMARY OF NATIONAL ACTIVITIES IN MARINE SCIENCE AND TECHNOLOGY

A. Research, whether basic or applied.

B. Surveying and provision of public services:

(a) Nautical charting;

(b) Position-fixing systems and related navigation services;

(c) Monitoring and forecasting of physical conditions;

(d) Monitoring and forecasting of pollutants;

(e) Exploration, monitoring and forecasting of fish stocks;

(f) Submarine geological and geophysical survey;

(g) Maintenance and modification of coasts and channels.

C. Uses of the sea and its resources.

Country	A	B							C
		a	b	c	d	e	f	g	
Argentina	Fundamental or applied research in hydrobiology, physical oceanography, chemical oceanography, meteorology, geological oceanography, marine geophysics, fisheries	x		x		x	x	x	Fisheries; petroleum exploration; recovery of sand, gravel and limestone
Australia	Basic and applied research in ocean sciences and engineering	x		x	x	x	x	x	Beach mining; recovery of salt, offshore gas and petroleum; fisheries; waste disposal; recreation
Austria	Basic research, chiefly in marine biology								Not reported
Belgium	Fundamental and applied research in chief fields								Not reported

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Country	A	B							C
		a	b	c	d	e	f	g	
Cambodia	Fundamental research is planned	x							Sport fishing
Cameroon	None	x				x	x		Fisheries
Canada	Basic and applied research in all fields	x	x	x	x	x	x	x	Being developed
Ceylon	No response								Fisheries
Chile	Physical and chemical oceanography, air-sea interaction, marine geology and geophysics, marine biology, ocean engineering	x	x	x	x	x	x	x	Fisheries; petroleum exploration; undersea coal mines; solar salt works; recreation and sport fishing
China (Taiwan)	Basic and applied research in physical and chemical oceanography, fishery biology, marine meteorology		x	x		x	x		Undersea coal mines; fisheries
Colombia	Basic research	x							Fisheries
Cuba	Basic and applied research on chemical and biological oceanography	x				x			Fisheries
Cyprus	Applied fisheries	x				x			Fisheries; salt production; sport fishing
Dahomey	Applied research in fisheries					x			Fisheries
Denmark	Basic and applied research in marine hydrography and biology	x				x	x		Fisheries; recovery of sand, gravel, and stone

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Country	A	B							C
		a	b	c	d	e	f	g	
Ecuador	Study of bio-ecology of fishing zone	x				x			Fisheries
Federal Republic of Germany	Physical, chemical and biological oceanography, maritime meteorology, marine geology and geophysics	x	x	x	x	x	x	x	Fisheries
Finland	Physical and chemical oceanography, marine geology and geophysics, air-sea interaction, marine biology, ocean engineering	x	x	x	x	x	x	x	Fisheries; undersea iron and limestone mines
France	Basic and applied research in all fields	x	x	x	x	x	x	x	Fisheries; energy
Ghana	Physical and chemical oceanography and marine biology related to fisheries					x			Fisheries
Greece	Both fundamental and applied fisheries research	x				x			Fisheries
Guatemala	None	x							None reported
Honduras	None								None reported
Iceland	Chemical and physical oceanography; marine biology	x	x	x		x			[illegible]
Indonesia	Basic and applied research on fisheries and marine science	x				x		x	[illegible] rock recovery; tin mining; recreation

Country	A	B							C
		a	b	c	d	e	f	g	
Ireland	Basic and applied research in fisheries	x							Fisheries
Ivory Coast	Physical oceanography, marine geology, biological oceanography								Fisheries
Japan	Basic and applied research in all fields	x	x	x	x	x	x	x	Fisheries; magnesium, bromine and salt; coal; iron ore; petroleum and gas; desalinated water
Kuwait	Fisheries oceanography	x				x			Fisheries
Madagascar	Air-sea interaction, physical oceanography,, chemical oceanography, biological oceanography					x			Fisheries
Malaysia	Applied research in marine biology and fisheries	x		x		x	x		Fisheries; pearl, prawn, and mollusc culture; petroleum production; tin a possibility
Mexico	Basic and applied research in fishery sciences, marine biology, physical oceanography	x							Fisheries; salt production; petroleum production under way
Monaco	Research in all fields	x							Thermal energy utilization
Netherlands	Basic and applied research in all fields	x	x	x		x		x	Fisheries; waste disposal
New Zealand	Basic and applied fisheries research	x						x	Fisheries; salt recovery; undersea power cable

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Country	A	B							C
		a	b	c	d	e	f	g	
Norway	Basic research in physical oceanography, air-sea interaction, chemical oceanography, marine geology and geophysics, marine biology ocean engineering	x	x	x	x	x	x	x	Fisheries; recreation ... covery of ... sium from ... water
Pakistan	Basic and applied research in biological oceanography					x			Fisheries
Peru	Applied research in fisheries oceanography	x							Fisheries
Philippines	Basic research in oceanography and basic and applied fisheries research	x				x			Fisheries; gold-fish culture
Poland	Basic and applied research	x		x		x	x	x	Fisheries; recreation
Portugal	Chemical and physical oceanography, marine geology, marine biology	x							Fisheries
Republic of Viet-Nam	Physical and chemical oceanography, marine geology and geophysics, marine biology. Applied fishing research	x				x			Fisheries; recreation ... including ... fishing
Saudi Arabia	Basic research in fisheries	x							Fisheries
Sierra Leone	Basic research on physical and chemical oceanography							x	Fisheries; recreation

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Country	A	B							C
		a	b	c	d	e	f	g	
Singapore	Research in physical and chemical oceanography and marine biology	x	x						Fisheries; recreation; submarine cables; preliminary study of tidal current energy
South Africa	Basic and applied research in all fields	x	x	x	x	x	x	x	Fisheries; recreation; waste disposal
Sudan	Applied research in marine biology of shell species						x		Shell farms
Sweden	Physical and chemical oceanography, air-sea interaction, geology and geophysics, marine biology	x	x	x	x	x	x	x	Fisheries; waste disposal; recreation; sand recovery
Syria	Marine biology								Fisheries; waste disposal; sport fishing
Thailand	Marine and fishery biology	x		x		x	x		Fisheries; recovery of salt; recovery of tin
Tunisia	Marine and fisheries biology								Fisheries
USSR	All fields of research	x	x			x			Fisheries
United Kingdom	All fields of research	x	x	x	x	x	x	x	Recovery of sand and gravel; bromine; magnesia; gas production (North Sea)
United Republic of Tanzania	None					x			Fisheries

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Country	A	B						C
		a	b	c	d	e	f	g
United States	All areas of research	x	x	x	x	x	x	x	All uses derivati power
Uruguay	Fishery biology					x			Fisheries
Venezuela	Physical, chemical and biological oceanography	x							Fisheries
Yugoslavia	Physical and chemical oceanography, air-sea interaction, marine geology and geophysics, marine biology	x		x		x	x	x	Fisheries; waste disposal; recreation

Annex VII

EXPLOITATION BY COUNTRIES OF BIOLOGICAL AND MINERAL MARINE RESOURCES

Country	Marine fishery production (catch), 1966 (thousands of metric tons) a/		Annual marine mineral production
Argentina	Fish and shellfish . . .	211.2	Sand, gravel, quantities no
	Seaweed.	29.6	
Australia	Fish and shellfish . . .	87.9	Salt, 600,000 tons
	Mother-of-pearl shell. .	0.4	Petroleum and gas, discoveries being developed
			Beach sand minerals (rutile, zircon and monazite) r
Austria	None		None
Belgium	Fish and shellfish . . .	62.7	None reported
Cambodia	Fish and shellfish . . .	39.3	None reported
Cameroon	Fish and shellfish (1965)	8.5	None
Canada	Fish and shellfish . . .	1,290.1	
	Seaweed.	29.9	None
Ceylon	Fish and shellfish . . .	97.1	None reported
Chile	Fish and shellfish . . .	1,383.5	Petroleum, under development
			Coal, 185,000 tons
			Salt, salinas 185,000 tons
			not stated 185,000 tons
China (Taiwan)	Fish and shellfish . . .	410.6	Coal, "insignificant"
	Seaweed.	1.5	
Colombia	Fish and shellfish . . .	29.3	Salt, 40,000 tons
Cuba	Fish and shellfish . . .	43.2	None reported
Cyprus	Fish and shellfish . . .	1.0	Salt, 7,000 tons

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Country	Marine fishery production (catch), 1966 (thousands of metric tons) a/		Annual marine mineral production
Dahomey	Fish and shellfish	3.8	None reported
Denmark	Fish and shellfish	1,046.0	Sand, gravel and stone, 2.5 to 3 million cubic metres
Ecuador	Fish and shellfish	48.2	None reported
Federal Republic of Germany	Fish and shellfish	647.3	None
Finland	Fish and shellfish	53.4	Iron ore, 300,000 tons Limestone, 50,000 tons
France	Fish and shellfish	814.3	Insignificant
Ghana	Fish and shellfish	74.5	None reported
Greece	Fish and shellfish (1965).	111.9	None reported
	Sponges.	0.1	
Guatemala	Fish and shellfish	5.1	None reported
Honduras	Fish and shellfish (1957).	2.5	None reported
Iceland	Fish and shellfish	1,240.3	Limestone (shell sand), 135,000 cubic metres
Indonesia	Fish and shellfish	720.0	Salt, no data Petroleum, no data Tin, no data Coral rock, no data
Ireland	Fish and shellfish	39.7	None reported
Ivory Coast	Fish and shellfish	55.0	None reported
Japan	Fish and shellfish	6,626.1	Desalinated water, 1.5 million tons Magnesia, 347,000 tons Bromine, 5,000 tons Salt, 882,000 tons Coal, 1.3 million tons Iron ore, 40,000 tons Petroleum, 130,000 kilolitres Natural gas, 370 million cubic metres
	Seaweed		

Country	Marine fishery production (catch), 1966 (thousands of metric tons) a/		Annual marine production
Kuwait	Fish and shellfish (1963) . .	6.8	None reported
Madagascar	Fish and shellfish.	11.0	None reported
Malaysia	Fish and shellfish.	269.2	Petroleum, no data
Mexico	Fish and shellfish.	256.0	Salt, 50,000 tons
	Seaweed	23.2	
	Shells, sponges or coral. . .	0.1	
Monaco	No report		None
Netherlands	Fish and shellfish.	339.7	None reported
New Zealand	Fish and shellfish (1965) . .	48.4	Salt,
Norway	Fish and shellfish.	2,806.2	
	Seaweed	43.2	Magnesium,
Pakistan	Fish and shellfish.	175.2	None reported
Peru	Fish and shellfish.	8,709.0	None reported
Philippines	Fish and shellfish.	708.5	None reported
Poland	Fish and shellfish.	314.9	None
Portugal	Fish and shellfish.	770.0	None reported
Republic of Viet-Nam	Fish and shellfish.	315.8	None reported
Saudi Arabia	Fish and shellfish.	23.0	None reported
Sierra Leone	Fish and shellfish.	31.4	None reported
Singapore	Fish and shellfish (1965) . .	10.6	None reported
South Africa	Fish and shellfish (1965) . .	1,182.2	None reported
Sudan	Fish and shellfish (1962) . .	0.7	None
	Seaweed (1962) . .	0.9	
Sweden	Fish and shellfish	313.6	Sand, considerable quantities
Syria	Fishery statistics not available		None reported

Country	Marine fishery production (catch), 1966 (thousands of metric tons) a/		Annual marine mineral production
Thailand	Fish and shellfish	624.6	Tin, 2,406 tons Salt, 200,000 tons Also gypsum and magnesium compounds
Tunisia	Fish and shellfish	25.7	None reported
	Sponges etc.	0.1	
USSR	Fish and shellfish	4,509.4	Not stated
	Seaweed.	64.6	
United Kingdom	Fish and shellfish	1,066.6	Sand and gravel, $14,000,000 Bromine, $ 8,400,000 Magnesia, $25,200,000 Gas "highly significant"
United Republic of Tanzania	Fish and shellfish	19	None
United States	Fish and shellfish	2,455.5	(1966) Salt, bromine, magnesium, $117,000,000 Petroleum, gas and sulphur, $1,117,700,000 Sand, gravel, rock etc., $49,209,000
	Seaweed		
Uruguay	Fish and shellfish (1965). . .	15.8	None reported
Venezuela	Fish and shellfish	98.4	None reported
Yugoslavia	Fish and shellfish	27.3	Salt, 50,000 to 80,000 tons Sand, 200,000 tons

a/ Data from Food and Agriculture Organization, Yearbook of Fishery Statistics (Rome).

Annex VIII

NATIONAL CO-ORDINATION MECHANISMS

Argentina — Comité nacional de oceanográfia (sixteen... created in 1964 under Consejo Nacional... Investigaciones Cientificas y Technicas. Serves as national committee of SCOR.

Australia —
(1) Australian National Committee for Oceanic Research (national committee of SCOR).
(2) Technical Committee on Oceanography (CSIRO, Navy, National Development).
(3) Australian Marine Science Association.
(4) Australian National Committee for Geology and Geophysics (national committee of IUGG).

Austria — No special mechanism.

Belgium — None mentioned.

Cambodia — None.

Cameroon — Sous-secteur des pêches maritimes.

Canada — Canadian Committee on Oceanography (a... federal government agencies and sc... institutes).

Ceylon — No information.

Chile —
(1) Comision de Investigacion de Recursos del Mar y Aguas Continentales del Consejo de Rectores de las Universidades Chilenas (est. 1965).
(2) Comision para la Investigacion, Fomento y Aprovechamiento de los Recursos del Mar (est...
(3) Centro Nacional de Datos Oceanográficos de Chile (Instituto Hidrográfico de la Armada).

China (Taiwan) — Chinese National Committee on Oceanic Research (est...

Colombia — None exists at present.

Cuba — Joint planning between the Centro de Investigaciones Pesqueras and Instituto de Oceanología.

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Cyprus	All work is done within the Fisheries Department.
Dahomey	(1) Service national des pêches, in marine science and technology. (2) Service des mines et de la géologie, in hydrographic and undersea research.
Denmark	Commission for Marine and Fisheries Research, incorporating marine and fishery research institution, fishermen's unions, and Greenland and Faroe interests.
Ecuador	Junta Directiva of Instituto Nacional de Pesca, incorporating representatives from Navy, Foreign Ministry, National Planning Commission and private fishery interests.
Federal Republic of Germany	(1) German IOC section (interministerial). (2) Senate Commission of Oceanography of the German Research Association. (3) German Scientific Committee on Marine Research. (4) German National Committee of SCOR. (5) German Oceanographic Commission (fund-raising).
Finland	(1) Supervisory Commission of State Institute of Marine Research, representing Ministry of Trade and Industry, fisheries research, Board of Navigation, and meteorological research. (2) SCOR National Committee.
France	Centre national pour l'exploitation des océans (CNEXO) established 1967 under the authority of the Prime Minister.
Ghana	Participation in conferences, symposia and international expeditions.
Greece	Participation in seminars, oceanographic missions, visits of representatives, correspondence.
Guatemala	Hydrography is co-ordinated to the specifications of IHB and PAIGH.
Honduras	Government Fisheries Department.
Iceland	Marine Research Institute (Ministry of Fisheries) with governing body and industrial advisory body.
Indonesia	National Committee on Marine Research.

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Ireland	Frequent consultations between the organizations concerned.
Ivory Coast	Close liaison between Centre de recherches océanographiques and Direction des pêches maritimes et lagunaires.
Japan	(1) Science and Technology Agency, Office of the Prime Minister. (2) Japanese National Commission for UNESCO. (3) Council for Ocean Science and Technology, advisory to Prime Minister. (4) Japan Science Council Special Committee on Oceanography.
Kuwait	(1) A planned fisheries advisory committee between government and private sectors. (2) Co-ordinating committee between Fisheries Division and Kuwait Institute for Scientific Research.
Madagascar	Commission de recherches océaniques et études des côtes and five other marine-related commissions of the Comité de coordination.
Malaysia	National Special Committee on Oceanographic Research.
Mexico	Collaboration between government departments and institutions.
Monaco	Four-member committee of co-ordination.
Netherlands	(1) Netherlands Commission for Sea Research (National Committee for SCOR). (2) Consultative Board for Physical Oceanographic Research in the North Sea. (3) Interdepartmental Co-ordinating Commission for Problems concerning the Discharge of Waste Water into the Sea.
New Zealand	(1) Committee of the Royal Society of New Zealand. (2) New Zealand National Committee for SCOR.

Norway	(1) Association of Norwegian Oceanographers. (2) Norwegian Geophysical Society. (3) National Contact Committee for the IOC. (4) Norwegian SCOR and SCAR Committees.
Pakistan	National Committee for Oceanographic Research.
Peru	(1) Consejo Interuniversitario. (2) Ministry of External Relations (for international matters).
Philippines	National Committee on Marine Sciences, under National Science Development Board.
Poland	(1) Comité national polonais du SCOR (Comité des recherches de la mer de l'Académie polonais des sciences) for science. (2) Comité de la science et de la technique, for technology.
Portugal	Exchange of observers and data.
Republic of Viet-Nam	Conferences, meetings, expeditions, etc.
Saudi Arabia	Fisheries Section, Ministry of Agriculture.
Sierra Leone	No national co-ordinating body. At international level, OAU Scientific, Technical and Research Committee.
Singapore	(1) National Science Council of Singapore Government. (2) Standing Committee on Marine Science and Technology of Singapore National Academy of Sciences.
South Africa	(1) South African National Committee for Oceanographic Research (national). (2) Correspondence (international).
Sudan	Contact between Port Sudan Harbour Administration, University of Khartoum and local government.

Sweden	No national body. The Research Council allocates appropriations. Royal Board of Fisheries carries out most activities in fisheries and fishery hydrography. Nature Management Board co-ordinates sewage disposal problems.
Syria	No response.
Thailand	National Marine Science Committee of the National Research Council (est. 1962).
Tunisia	Exchange of publications; participation in seminars.
USSR	(1) Oceanographic Committee of the USSR. (2) Oceanographic Commission of the Academy of Science of the USSR.
United Kingdom of Great Britain and Northern Ireland	(1) Natural Environment Research Council (for marine research). (2) Department of Education and Science (for inter-governmental affairs). (3) British National Committee for Oceanography of the Royal Society (for non-governmental international affairs). (4) Advisory Council on Science and Technology, and interdepartmental liaison (for science and technology).
United Republic of Tanzania	East African Common Services Organization.
United States of America	(1) National Council on Marine Resources and Engineering Development (inter-governmental), national and international. (2) National Academy of Sciences, in non-governmental international affairs.
Uruguay	CARPAS of FAO.
Venezuela	No report.
Yugoslavia	Various committees, including National Committee for the Scientific Exploration of the Mediterranean.

Annex IX

COUNTRIES' PARTICIPATION IN INTERNATIONAL CO-OPERATION IN MARINE SCIENCE AND TECHNOLOGY

This annex sets forth to what extent the countries are engaged in international co-operation in marine science and technology, as indicated by their participation in:

A. The work of pertinent intergovernmental organizations;

B. The work of pertinent non-governmental organizations;

C. Co-operative marine investigations;

D. Bilateral or multilateral programmes in education and training.

Country	A	B	C	D
Argentina	IHB, IOC, WMO, FAO, PAIGH, CARPAS, UNESCO	SCAR, SCOR, IAPSO, ICSU	ICITA, Tridente cruises, Drake Passage and Weddell sea studies	Curso Latino-americano de Planctonologia, November 1965
Australia	IPFC, FAO, WMO, UNESCO, IOC	IUCN, SCOR	IIOE; liaison with Lamont Geological Observatory, Scripps Institution, National Science Foundation	Australia and UNESCO aid programmes
Austria	-	-	IIOE	

Country	A	B	C	D
Belgium	ICES	No report	Financial contribution to stations at Roscoff, Naples, Villefranche, Wimereux	No report
Cambodia	IPFC	-	-	-
Cameroon	FAO	No report	ORSTOM	No report
Canada	UNESCO, IOC, IMCO, WMO (CMM), FAO (COFI), IAEA, ICNAF, ICES, IATTC, INPFC, IPSFC, IHB, IPHC, IWC, NATO, NPFSC, OECD	ICSU, PSA, IAPSQ, PAIGH, EPOC, NWPO, AINA	As required by organizations under A	Colombo Plan; Commonwealth and Fellowship Plan; Special Commonwealth Africa Assistance Programme; Commonwealth Caribbean Assistance Programme; French-speaking African States Programmes; fellowships granted in Canada by UNESCO, FAO etc.
Ceylon	None mentioned			
Chile	CPPS, FAO, UNESCO	ICSU, SCAR, SCOR	Anton Brunn cruises, 1966; EASTROPAC; joint studies with Peru, 1966	Agreement with University of California, Curso Latinoamericano de Planctonología, 1965; FAO Centro Latinoamericano de Capacitación Pesquera, 1952; Centro de Capacitación Pesquera, 1966

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Country	A	B	C	D
China (Taiwan)	IOC	ICSU	IIOE, CSK, ECAFE, offshore mineral prospecting	Students in 1964, 1966; Denmark (planned), Japan,
Colombia	None exists	-	-	-
Cuba	Answered affirmatively without degree or details	-	-	-
Cyprus	GFCM	-	-	-
Dahomey	All pertinent organizations	-	GTS, ICITA	-
Denmark	FAO, IOC, ICNAF, NEAF	ICES, IAPSO, SCOR	Ad hoc Committee for Inter-Scandinavian Co-operation; NATO 1966 Sargasso Sea expedition; Nordic Marine Geology Commission	Trains foreign studen... UNESCO... Danish... Technical Co-operation
Ecuador	IATTC	-	EASTROPAC, El Niño programme	-
Federal Republic of Germany	UNESCO, IOC, FAO, IAEA, IHB, WMO, IMCO, ICES, ICNAF, WHO, EURATOM, OECD, NATO, ECAFE, ECA	SCOR, SCAR, IAPSO, IABO, ICSU, IUGS	IGY, ICITA, Norwestlant, Overflow Expedition; IIOE, Herring Survey, Skaggerak expedition, MILOCS	Trains foreign students; participation in FAO programmes; makes facilities available for foreign scientists
Finland	IOC, WMO, FAO, IHB, IMCO, IAEA, ICES	SCOR, IAPSO, IABO, IUGS, Commission on Marine Geology	Baltic investigations; chemical intercalibration; pollution	Nordic Commissions for Marine Biology, Physical Oceanography, and Marine Geology

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Country	A	B	C	D
France	UNESCO (IOC), FAO (ACMRR), IMCO, WMO, IHB, IWC, CPCIP, ICNAF, ICSEM, GFCM, ICES, NATO	IAPSO, SCOR	IIOE, ICITA	Foreign students universities; supply of researchers to foreign Governm
Ghana	FAO	-	Ghana/UNDP marine fishery project	-
Greece	GFCM, ICSEM	Various non-governmental organizations	Visits by foreign investigators	Bilateral and multilateral programmes not specifically described
Guatemala	IHB, PAIGH	-	-	-
Honduras	-	-	-	Proyecto Centro-americano de Desarrollo Pesqu (United Nations Special Fund and FAO)
Iceland	ICES, IOC, NEAFC, ICNAF, FAO, IWC, NATO Science Committee	IAPSO	Joint Norwegian-Icelandic investigations in Irminger Sea	-
Indonesia	-	-	1963 Baruna expedition with Japan, IIOE, CSK	Students trained abroad under Colombo Plan, Japanese War Reparations, UNE East-West Centre
Ireland	ICES, FAO, NEAFC	-	ICES projects	-
Ivory Coast	IOC, FAO, WDC-A CSTR (OUA)	-	-	-

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Country	A	B	C	D
Japan	All United Nations specialized agencies, IPFC	SCOR, IUGG, IUBS, SCAR	IIOE, CSK, ECAFE, joint prospecting	UNESCO regional shiptour regional courses, regional 1966
Kuwait	FAO, UNESCO, WMO, UNITAR	-	FAO Conference, Kuwait, 1966	Technical co-operation with UAR and USSR
Madagascar	IOC membership under study	SCOR	IIOE	-
Malaysia	FAO, IOC	SCOR	-	Possibility ASEAN
Monaco	IOC, ICSEM, IHB, IAEA	ICSU; 1966 hosted first International Congress of the History of Oceanography	Joint Mediterranean cruise with Tunisia, 1967	Nothing organized
Netherlands	IOC, FAO, IAEA, IMCO, IHB, ICES	Oceanography IUGG	CICAR (proposed)	Limit tion UNESC
New Zealand	IMCO, FAO, IPFC, IWC, IHB, IOC	IAPSO, SCOR SCAR	University of California swell recording etc.	Gives under
Norway	IOC, ICES, ICNAF, NEAFC, IWC, IMCO, IHB, NATO Sub-Committee	SCOR, SCAR, IAPSO, IABO	Numerous projects	and Physical Oceanography, UNESCO, Fulbright bilatera developme programmes with India Kenya vesse

Country	A	B	C	D
Pakistan	IOC	-	-	-
Peru	IOC	Pacific Science Association	Eastropac, El Niño survey; Duke University, Yale; Scripps Institution	None mentioned
Philippines	IOC, FAO, IPFC	Rockefeller Foundation	CSK	Bilateral programmes with Federal Republic of Germany, France, Japan, Norway, Sweden and United States; multilateral programmes under Colombo Plan
Poland	ICES, IOC	SCOR, ICSU	Co-operation with Baltic countries	Bilateral training programmes with USSR, East Germany and Yugoslavia
Portugal	ICNAF, NEAFC	SCOR	Planned co-operation with Federal Republic of Germany and Spain	Reciprocal exchanges
Republic of Viet-Nam	UNESCO, IOC IPFC	None mentioned	CSK	Various bilateral programmes
Saudi Arabia	-	-	-	Training centre under construction with FAO technical assistance
Sierra Leone	None mentioned	None mentioned	West African Regional Fisheries Survey	Frequent participation in multilateral aid and training programmes
Singapore	IMCO, IOC	None mentioned	CSK	None mentioned

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Country	A	B	C	D
South Africa	IHB, WMO	SCOR, IAPSO, SCAR	IIOE, data exchange with WDC-A	Ad hoc [illegible] with [illegible] countries
Sudan	None mentioned	None mentioned	Bilateral agreements	None mentioned
Sweden	ICES, IHB, IOC, IAEA	IAPSO, SCOR, IUBS	Data exchange with WDC-A and B	Limited exchange in Nordic countries
Syria	IMCO	-	Bilateral agreement with Japan	None mentioned
Thailand	IOC, IPFC, FAO (COFI), WMO	SCOR	CSK - Joint Programme with Malaysia, 1967; ECAFE offshore prospecting	Co-operation with Federal Republic of Germany [illegible] established [illegible] South-east [illegible] Fisheries [illegible] Development Centre
Tunisia	FAO	None mentioned	Joint programme with Monaco	None mentioned
USSR	IOC, WMO, IPFC, GFCM, ICES, ICNAF, ECAFE, ECOSOC	SCOR, SCAR, PSA	None mentioned	None mentioned
United Kingdom	IOC, ICES, ICNAF, IWC	SCOR, IAPSO	IIOE, Norwestlant, Iceland-Faroe Ridge Project, Young Herring Survey	Through NATO Science Committee and FAO
United Republic of Tanzania	FAO	Not applicable	IIOE	[illegible]

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Country	A	B	C	D
United States of America	IOC, WMO, IAEA, FAO, WHO, IMCO, OAS, IHB, ICES, PAIGH, ICNAF, NPFSC, IPSFC, INPFC, IPHC, IATTC, IWC, IPFC etc.	IUBS, IAPSO, SCOR, SCAR, PSA, Association of Island Marine Laboratories of the Caribbean etc.	ICTA, Georges Bank survey; Eastropac etc.; bilateral programmes with 75 countries	Bilateral programmes with 30 countries
Uruguay	CARPAS	None mentioned	None mentioned	None mentioned
Venezuela	None mentioned	None mentioned	Co-operation with investigators from Argentina, Japan, Norway, Spain, United States etc.	None mentioned
Yugoslavia	ICSEM, GCFM-FAO UNESCO, IHB	MAMBO	Bilateral co-operation with Naples, Italy, and Göttingen and München, Federal Republic of Germany	Trains Yugoslav students in Poland; trains Indonesian, Indian, Icelandic, Syrian and Soviet students in Yugoslavia

Annex X

NON-GOVERNMENTAL ORGANIZATIONS

Contents

1. There exist a large number of international bodies concerned with the study of the sea and its resources which operate through the adherence of scientific societies or of individual scientists. Prominent among these is a group of organizations belonging to or created by the International Council of Scientific Unions.

I. The International Council of Scientific Unions (ICSU)

2. Created in 1919 as the International Research Council, ICSU, according to its 1957 Yearbook is now a federation of sixteen international scientific unions. A total of eighty-five countries belong to one or more of these sixteen unions, of which fifty-nine have officially been admitted to ICSU. The two principal objects of ICSU are to facilitate and co-ordinate the activities of the international scientific unions in the fields of the exact and the natural sciences and to act as the co-ordinating centre for the national organizations adhering to the Council. These latter are either the principal scientific academy, the national research council, any other institution or association of institutions, or failing these, the Government. Further objects of ICSU are to encourage international scientific activity; to enter through the intermediary of the national adhering organizations into relations with the Governments of their respective countries in order to promote scientific research in these countries; to maintain relations with the United Nations and its specialized and related agencies, and to make such contacts and mutual arrangements as are deemed necessary with other international councils, other unions, or other organizations, where common interest exists.

A. ICSU unions having a major interest in ocean science

3. Three ICSU unions have a major interest in ocean science, namely, the International Union of Geodesy and Geophysics, the International Union of Biological Sciences and the International Union of Geological Sciences.

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The International Union of Geodesy and Geophysics (IUGG)

4. The IUGG federates seven autonomous international associations, one of which is the International Association of Physical Sciences of the Ocean (IAPSO), which changed its name in 1967 from the International Association of Physical Oceanography (IAPO).

5. The outgoing President of IAPSO in a letter dated 5 October 1967 reported to the Secretary-General on pertinent action taken by the Association at its XIV General Assembly. In addition to the change of name, the Association authorized its Executive Committee to enter into joint arrangements with other appropriate organizations to form and support joint working groups on specific scientific problems as required, and it reaffirmed its intention to collaborate with the UNESCO, WMO, SCOR, IUGS, the other IUGG associations such as IAMAP, IAG, IASH, and others, and with other international organizations concerned.

6. It also requested its Executive Committee to study, in collaboration with other international organizations interested in oceanography, the desirability and feasibility of establishing an International Union of Marine Sciences which would embrace marine geophysics and geology, marine chemistry, physical and meteorological oceanography, and marine biology and to report to the XV General Assembly. The XV General Assembly, if practicable, will be held jointly with SCOR, IABO, the Commission on Marine Geology of IUGS, and with IAMAP with those sections interested in air-sea interaction problems.

The International Union of Biological Sciences (IUBS)

7. A component of ICSU since 1923, the IUBS, according to the 1967 ICSU, included in its Division of General Biology a Section of Oceanography. However, it appears that action has been taken to reconstitute this Section as the International Association of Biological Oceanography (IABO).

8. The IABO was formed only recently to act as a scientific society providing a forum for discussion of the problem concerning the biology of the sea. It is the intention that the Association will be concerned primarily with the biology of the sea as a living system rather than with the biology of marine animals as biological units, although clearly there must be a certain amount of overlap.

The field of the Association's work embraces an understanding of the biological processes of the sea. In spite of the large amount of work done on fisheries, this is a surprisingly neglected field, and yet only by a thorough understanding of these processes can we define the potential which the sea has for utilization by man as a source of food and concentration of chemical elements.

9. The Association is managed by a committee consisting of the President, Secretary, Treasurer and two committee members, one of whom represents the International Biological Programme. The first General Assembly of the Associati was held in June 1966 in Moscow on the occasion of the Second International Congress of Oceanography. The first scientific meeting of the Association is scheduled to take place at Woods Hole Oceanographic Institution in May 1968 when the topic for discussion will be "Design and analysis in zoo-plankton sampling".

The International Union of Geological Sciences (IUGS)

10. The IUGS affiliated itself as a union with the ICSU in 1961. It comprises eight associations and eight commissions, one of these being the Commission on Marine Geology.

B. Committees of the ICSU concerned with marine science and marine resources

11. Under its statutes, ICSU may create special or scientific committees and inter-union commissions, but only if no other means exist for achieving the specific objective of the committee or commission. Under this provision, the following groups concerned with marine science and marine resources have been established.

Scientific Committee on Oceanic Research (SCOR)

12. Established in 1957, SCOR is charged with furthering international scientific activity in all branches of oceanic research. In discharging its functions, SCOR may:

(a) Arrange to discuss and consider problems of contemporary oceanography, especially those of an interdisciplinary character requiring international co-operation and to prepare plans for international oceanic research programmes;

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(b) Co-operate with other international organizations which deal with scientific aspects of oceanic research (e.g., at the present time SCOR advises UNESCO and the Intergovernmental Oceanographic Commission on marine sciences);

(c) Study, by appointing working groups or by appropriate commissions, scientific problems arising from international oceanic research programmes, including, among others, the development of new methods and the standardization and intercalibration of existing ones.

13. Membership consists of twenty-eight members nominated by national scientific institutions in as many countries, and ten members nominated by ICSU and by interested international scientific unions. Officers form an Executive Committee consisting of an elected President, two Vice-Presidents, Secretary, retiring President and three ex officio members.

14. One of SCOR's principal responsibilities is to serve as a scientific advisory body to the marine science programme of UNESCO and to the Intergovernmental Oceanographic Commission. In discharging this responsibility, the SCOR Executive Committee normally meets twice a year near the time of pertinent meetings of the Commission or of its Bureau and Consultative Council. When advice is requested on specific matters, special working groups may be established or questions may be referred to national committees for oceanic research.

15. General scientific meetings of SCOR are normally held at two-year intervals and feature scientific symposia on scientific questions of general and interdisciplinary interest.

16. Most of the work of SCOR is carried on by working groups composed of specialists selected from countries represented on SCOR. Often these working groups are jointly sponsored by other international organizations such as UNESCO, the International Council for the Exploration of the Sea, FAO's Advisory Committee on Marine Resources Research and the International Association of Physical Sciences of the Ocean. At the present time, working groups on the following subjects are active:

Oceanographical tables and standards;

Photosynthetic radiant energy;

Micropaleontology of marine bottom sediments;

Continuous velocity measurements;

Zooplankton laboratory measurements;

Primary production under special conditions;

Nutrient chemistry.

17. The budget of SCOR comes above all from UNESCO, either directly through a contract or indirectly through ICSU and the rest from national contributions.

Scientific Committee on Antarctic Research (SCAR)

18. Established in 1958, SCAR is charged with furthering the co-ordination of scientific activity in Antarctic, with a view to framing a scientific programme of circumpolar scope and significance. Membership under its Constitution consists of one delegate from each country actively engaged in Antarctic research, scientists nominated by ICSU and each union desiring to participate.

Special Committee for the International Biological Programme (SCIBP)

19. Established in 1963, the SCIBP is charged with planning and ensuring the execution of an International Biological Programme (IBP), a world-wide study of (a) organic production on the land, in fresh waters and in the seas, and the potentialities and uses of new as well as existing natural waters, and (b) human adaptability to changing conditions. It includes a sectional committee on marine productivity (PM).

Federation of Astronomical and Geophysical Services (FAGS)

20. Established in 1956, FAGS is a federation of permanent services in the astronomical and geophysical fields. These services are entrusted with the tasks of collecting, as a continuous activity, observations, information and data in their sciences; of analysing and synthesizing them; of drawing conclusions from them; distributing data on request and publishing the results obtained.

21. The twelve permanent services currently under FAGS includes the Permanent Service on Mean Sea Level of the IUGG.

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Comité international de géophysique (CIG)

22. The CIG is an interunion Committee of the ICSU, formed in 1959 and administered by the IUGG. It has as its objectives to ensure the fullest possible exploitation of the International Geophysical Year (IGY) and International Geophysical Co-operation (IGC) 1959 data, including maintaining the efficient functioning of the World Data Centres (WDC's) and encouraging the discussion and utilization of IGY and IGC 1959 results, and publishing the IGY and IGC 1959 results and bibliographies. It is also charged with planning further international co-operation in geophysics and related sciences.

II. Other non-governmental international organizations

International Union for Conservation of Nature and Natural Resources (IUCN)

23. The IUCN, which has its seat in Morges, Switzerland, has expressed a concern over conservation of whales, of marine environments, of marine turtles and seals, of the Peruvian anchoveta and of fish in general.

Nordic Council for Marine Biology

24. Established in 1956, the Council is described in the publication Nordic Collaboration in Marine Biology, issued in 1964. It is a joint training enterprise involving Denmark, Finland, Norway and Sweden, under the Nordic Culture Commission.

Congress of Baltic Oceanographers

25. This Congress is essentially an informal group from the member countries in the International Council for the Exploration of the Sea that have Baltic coastlines, operating as a sub-committee on the co-ordination of hydrographic investigations in the Baltic. According to a report tabled at the meeting of the ICES Hydrography Committee in October 1967, the 6th Conference of Baltic Oceanographers will meet at Gdynia in May 1968 to plan a multiship programme to be known as "Baltic Year, 1969".

Pacific Science Association (PSA)

96. Founded in 1920, with permanent secretariat located in Honolulu, the Pacific Science Association sponsors the Pacific Science Congresses, held at four-year intervals in countries around the Pacific basin. The Association has a standing committee on marine sciences.

Mediterranean Association for Marine Biology and Oceanology (MAMBO)

97. According to International Marine Science for June 1966, MAMBO held its first general assembly in Malta in November 1965. Participants numbered twenty individuals from Denmark, France, Greece, Israel, Italy, Malta, Tunisia and Yugoslavia.

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Annex XI

ACTIVITIES OF THE ORGANIZATIONS OF THE UNITED NATIONS SYSTEM

Contents

Contents (continued)

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1. This annex reviews the main activities of the organizations of the United Nations system concerned with problems related to marine science and technology. It will be recalled, in this respect, that these organizations are represented in a sub-committee of the ACC dealing with marine science and its applications. This sub-committee was created in the light of the provisions of Economic and Social Council resolution 792 III (XXX) of 3 August 1960 and has met regularly since 1961. During its sessions, the activities of all the organizations concerned are reviewed in detail in order to obtain the fullest possible co-ordination among the various relevant programmes of the United Nations system of organizations.

A. The United Nations

2. Two departments of the United Nations have major interest in fields related to marine science and technology, namely, the Department of Economic and Social Affairs through its Resources and Transport Division and the Office of Legal Affairs in respect of the international law of the sea

Resources and Transport Division

3. The Division, which comprises five operational sections - Surveying and Mapping, Geology and Mining, Energy and Electricity, Water Resources (both surface and underground) and Transport and Tourism - deals with problems arising and development schemes in developing countries. In addition to specialized economists, the Division employs on a continuing basis a number of technical advisers in those fields. It serves as executing agency for related UNDP projects.

4. Hydrographic charting is included in the work programme related to cartography and a Special Fund project covering the hydrographic mapping of the coastal waters of the Central American States is under preparation. In co-operation with the International Hydrographic Bureau in Monaco, the Cartography Section is endeavouring to obtain a broad picture of the future hydrographic needs of developing countries. By means of the establishment of Special Fund projects, designed to strengthen the cartographic institutes and capabilities of several countries, such as India, Pakistan and Jamaica, the Cartography Section is helping to create a professional capability and the proper equipment to undertake full-scale modern mapping, including offshore hydrographic mapping.

6. A number of developing countries have requested United Nations assistance for surveying of their offshore mineral potential and in determining the means of exploiting such resources. The Division supports offshore exploration in the Far East which is carried out by ECAFE partly through Technical Assistance. Belonging to the energy field is a Special Fund project which is now being carried out, involving seismic surveying in the offshore area between Trinidad and Tobago. This project is the follow-up of earlier Technical Assistance financing of an aeromagnetic survey over this water body. In a related field, a Special Fund project, which includes a study of the export of natural gas from Algeria to Europe, involves the problems raised by pipelines under the Mediterranean and it is hoped that interesting and comprehensive studies will be duly released for publication.

7. In addition to its activities in Technical Assistance and Special Fund projects related to those fields, the Resources and Transport Division is responsible for the implementation of Economic and Social Council resolution 1112 (XL) adopted on 7 March 1976. The resolution requested the Secretary-General:

(a) To make a survey of the present state of knowledge of these resources of the sea (mineral and food, excluding fish) beyond the continental shelf, and of the techniques for exploiting these resources;

(b) As part of that survey, to attempt to identify those resources now considered to be capable of economic exploitation, especially for the benefit of developing countries;

(c) To identify any gaps in available knowledge which merit early attention by virtue of their importance to the development of ocean resources, and of the practicability of their early exploitation;

(d) To report on the progress of the survey at an early session of the Council.

8. It should be noted in respect of (c) that among the gaps which may delay progress in this field are the ones constituted by the absence of resources assessment, of adequate maps and of administrative machinery as well as of legal status of the deep sea. It may be noted in this connexion that the economic exploitation of the resources under question "especially for the benefit of developing countries" is closely related to the solution of filling the latter gap.

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Accordingly, the Resources and Transport Division, in preparing the report, intends, in addition to examining systematically the technological aspects relating to the exploration and exploitation of resources, to identify the legal gaps as well as to chart survey shortcomings which would deserve early attention. It is intended to submit the Secretary-General's report to the Economic and Social Council at its spring 1968 session.

8. Furthermore, following the adoption by the General Assembly on 18 December 1967 of resolution 2340 (XXII) concerning the examination of the question of the reservation exclusively for peaceful purposes of the sea-bed and the ocean floor, and the subsoil thereof, underlying the high seas beyond the limits of present national jurisdiction, and the use of their resources in the interests of mankind, the Division co-operates in the work of the ad hoc Committee set up by this resolution, especially in so far as economic, technical and related problems are considered.

9. A report on new sources of energy,[a/] in which particular emphasis is placed on tidal energy and thermal energy of the sea, was published a few years ago and a study is now being undertaken which will examine the possibilities of harnessing tidal power for multipurpose applications, including improvement in navigational facilities.

10. A variety of water problems related to the oceans are studied in the Division. There is first the considerable work programme in the field of desalination, including Special Fund projects in Israel and Kuwait. There are also studies relating to the combined use of sea water for the production of fresh water through desalination and production of minerals from the concentrated sea brines.

11. Under Technical Assistance, beach erosion and beach protection, as well as the reclaiming of land from the sea, have been studied in a number of countries.

12. The origin and courses of ground-water springs in the ocean are being studied and a Special Fund project is being prepared in order to find ways of making economic use of the fresh-water springs occurring in the ocean.

13. Sea currents, coastal sedimentation as it affects marine structures and port construction, including dredging, are undertaken by the Transport Section which

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a/ New Sources of Energy and Economic Development (United Nations publication, Sales No.: 57.II.B.1).

has a broad programme in port development, port efficiency and related questions. This also includes the site selection and construction of lighthouses as well as under-water and diving operations connected with marine salvage. Technical assistance is provided to a number of countries and there are several Special Fund projects which are concerned with marine transportation and port development. Coastal shipping is studied on a continuing basis and research is under way concerning the use of unconventional means of transportation, such as hydrofoil and hover-craft in coastal waters. Seminars are regularly held on ports and port management and a seminar on coastal shipping is now being organized.

14. The Division, through its tourist programme, also deals with beach resort development and recreation.

15. A number of activities concerned with the oceans are also carried out in the regional economic commissions, such as the control of typhoons (by ECAFE) and, as mentioned earlier, offshore exploration.

Economic Commission for Asia and the Far East (ECAFE)

16. As already mentioned, the work of the Economic Commission for Asia and the Far East is closely connected to the work pursued by the Resources and Transport Division. Under ECAFE sponsorship, an intergovernmental body called the Committee for Co-ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas has been established and actual operation has already begun. This intergovernmental body, at present consisting of six member countries, namely, China, Japan, Republic of Korea, Republic of Viet-Nam and Thailand, is devoting its attention to the western Pacific where these countries are located. It has an advisory body which includes experts contributed by the Federal Republic of Germany, France, Japan, United Kingdom, United States and UNESCO. The Committee is undertaking nine major projects. The first of these, concerning the co-ordinated programme of offshore surveys, contains nineteen subprojects relating to prospecting for mineral resources in the offshore areas of the member countries; of these four are currently under way, three will commence in early 1968, another three are scheduled to commence later in 1968 and the remaining nine are already planned for 1969 or will be undertaken when resources permit.

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17. Other projects in the work programme of the Committee relate to advisory services, training in offshore prospecting, establishment of an equipment pool, investigation of detrital heavy mineral deposits, technical publications, library and documentation centre, co-operation with related organizations and strengthening of the Committee's technical secretariat.

18. Arising from the Committee's recommendations, a Regional Advisory Group on Offshore Prospecting has been established in the ECAFE secretariat; a regional training centre for offshore geophysical prospecting, operated by the Japanese Government at its own expense, commenced its first training course in May 1967; technical reports have been published in printed form by member countries of the Committee; a sonic and magnetic survey has been completed along the east coast of the Republic of Korea; and studies have been made of detrital heavy minerals.

19. The Committee has been operating largely through the contributions of member countries as well as by developed countries both in and outside the ECAFE region. Australia has provided expert services to survey the heavy detrital minerals. The United States is to undertake, beginning in March 1968, a total of 20,000 nautical miles of aeromagnetic traverses each year for the next five years in the offshore areas of the member countries of the Committee. Japan has established a regional training centre, as mentioned above, provided a geophysicist to the Committee's secretariat, and undertaken geophysical surveys in the offshore areas of other member countries. The Federal Republic of Germany is expected to provide assistance in various ways for aeromagnetic and seismic surveys in 1968.

20. In addition to the above, the secretariat has provided advisory services on offshore survey and prospecting to Burma, Cambodia, Ceylon, China (Taiwan), India, Malaysia, Pakistan, Philippines, Republic of Viet-Nam and Thailand.

Office of Legal Affairs

21. The codification of the law of the sea by the United Nations has represented one of the most significant successes of the Organization in the legal field. In fact, questions relating to the law of the sea were taken up by the International Law Commission at its first session in 1949. At its thirty-eighth meeting, the Commission approved the report to the General Assembly of the work of its first session containing, among fourteen topics selected for codification, the régime of

the high seas and the régime of territorial waters. From 1950 to 1955, the Commission examined various aspects of the law of the sea and submitted a number of articles covering different topics of that branch of international law.

22. The United Nations Conference on the Law of the Sea, which was held from 24 February to 27 April 1958, made a most important contribution to the codification of the law of the sea. The work of this Conference was based on seventy-three draft articles prepared by the International Law Commission as well as on relevant debates of the General Assembly during its eleventh session. The Conference adopted four Conventions, an optional Protocol and nine resolutions.

23. The four Conventions may be described as follows:

(a) The Convention on the Territorial Sea and the Contiguous Zone, adopted on 27 April 1958, consists of thirty-two articles dealing, among others, with the base lines from which the territorial sea of the coastal State is measured, both in normal cases and in special cases, and the delineation between the territorial seas of adjacent or opposite States;

(b) The Convention on the High Seas, consisting of thirty-seven articles, was adopted on 27 April 1958 and upholds freedom of access to the high seas of all States, whether coastal or land-locked, and regulates the responsibility of a State towards a ship flying its flag;

(c) The Convention on Fishing and Conservation of the Living Resources of the High Seas, adopted on 26 April 1958, consists of twenty-two articles and a preamble stressing the need for international co-operation in preventing over-exploitation of the living resources of the high seas;

(d) The Convention on the Continental Shelf, consisting of fifteen articles, was adopted on 26 April 1958. The continental shelf, in accordance with the Convention, is the extension into the high sea of the sea bed and subsoil of the territorial sea and is defined as extending to a depth of 200 metres or, beyond that limit to where the depth of the superjacent waters admits of the exploitation of resources. Similar criteria are applied to the continental shelves of islands.

24. The Optional Protocol of Signature concerning the Compulsory Settlement of Disputes was adopted on 26 April 1958. Any country ratifying it accepts the compulsory jurisdiction of the International Court of Justice in disputes arising out of the four Conventions on the law of the sea.

25. The nine following resolutions on various maritime questions were adopted [illegible] 27 April 1958:

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(a) Nuclear tests on the high seas;

(b) Pollution of the high seas by radioactive materials;

(c) International fishery conservation conventions;

(d) Co-operation in conservation measures;

(e) Humane killing of marine life;

(f) Special situations relating to coastal fisheries;

(g) The régime of historic waters;

(h) Convening of a second United Nations Conference on the Law of the Sea;

(i) Tribute to the International Law Commission for its preparatory work for the Conference.

26. On 10 December 1958 the General Assembly decided "that a second international conference of plenipotentiaries on the law of the sea should be called for the purpose of considering further the questions of the breadth of the territorial sea and fishery limits", and requested the Secretary-General to convoke the Conference early in 1960. The Second Conference on the Law of the Sea was held at Geneva from 16 March to 26 April 1960. The Conference failed to adopt any substantive proposal on the two questions before it.

27. In the meantime the General Assembly adopted resolution 1453 (XIV) in order to study the juridical régime of historic waters, including historic bays. The Secretariat prepared a study (A/CN.4/143) to that effect which was published in 1962.[b/]

28. On 11 June 1964, the United Nations Conference on Trade and Development which met in Geneva from 23 March to 16 June 1964 approved a set of eight principles on the transit trade of land-locked countries, together with an interpretative note. The Conference also adopted a resolution by which it recommended that a Committee should be established and entrusted with the preparation of a new draft convention to be submitted to a United Nations Conference of Plenipotentiaries in 1965. The Conference, held at United Nations Headquarters from 7 June to 8 July 1965, adopted a Convention on Transit Trade of Land-locked States. It also adopted two resolutions: one related to facilitation of maritime trade of land-locked countries

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b/ Yearbook of the International Law Commission, 1962, vol. II (United Nations publication, Sales No.: 62.V.5), p. 1.

through application of the relevant terms of the Convention on Facilitation of Maritime Travel Transport by States and by IMCO; the other concerned the provision of assistance by the United Nations technical co-operation organs and regional economic commissions in furthering transit trade. The Convention entered into force on 9 June 1967.

19. The Office of Legal Affairs maintains the publication of the United Nations Legislative Series. These series reproduce a systematic collection of those national legislative texts which deal with matters of international concern and constitute practice of States in the field of international law. As far as the law of the sea is concerned, the following volumes of the United Nations Legislative Series are relevant:

(a) Laws and Regulations on the Régime of the High Seas, vol. 1 (United Nations publication, Sales No.: 51.V.2);

(b) Laws concerning the Nationality of Ships (United Nations publication, Sales No.: 56.V.1);

(c) Laws and Regulations on the Régime of the Territorial Sea (United Nations publication, Sales No.: 57.V.2);

(d) Supplement to Laws and Regulations on the Régime of the High Seas, vols. 1 and 2, and Laws concerning the Nationality of Ships (United Nations publication, Sales No.: 59.V.2).

20. More recently it has been decided to publish in 1968 a further volume of the United Nations Legislative Series, bringing up to date:

(a) Laws and Regulations on the Régime of the High Seas, vol. 1;

(b) Supplement to the foregoing volume (ST/LEG/SER.B/8);

(c) Laws and Regulations on the Régime of the Territorial Sea.

21. For that purpose, the Secretary-General of the United Nations, by a note of 31 March 1967, requested Governments to transmit to him, not later than 31 December 1967, the texts of the laws, regulations, treaties and other sources of evidence of international law, from the period between 1958 and the present time, and which relate to the delimitation and control of the territorial sea, of contiguous zones and of the continental shelf, and to the exploitation of the resources of the sea, sea-bed and subsoil outside internal waters.

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B. FAO and related organizations[c/]

32. Following resolution 8/63 of the twelfth session of the FAO Conference and the decision of the thirteenth session, the Department of Fisheries, headed by an Assistant Director-General, came into being on 1 January 1966, with two Divisions, the Fishery Resources and Exploitation Division and the Fishery Economic and Products Division. The Fishery Resources and Exploitation Division (FR) consists of three branches and two sections which cover fish stock evaluation, inland fisheries, marine biology and environment, fishing vessels and engineering, and fishing operations, respectively.

33. During the thirteenth session of the Conference, approval was also given for the establishment of a Committee on Fisheries under article V of the FAO Constitution. The Committee consists of thirty member nations, elected during the forty-sixth session of the FAO Council immediately after the thirteenth Conference.

34. The Committee on Fisheries (COFI) held its first session at FAO headquarters, Rome, in June 1966 and was attended by representatives of twenty-nine member countries, fourteen observer countries and six international organizations.

35. The Committee, in addition to its principal tasks of reviewing the work programme of the FAO Department of Fisheries and promoting international co-operation in fisheries, considered fishery problems of an international character. These included rational utilization of the pelagic fishery resources of the Indian Ocean, fishery problems of the Middle and South Atlantic and marine pollution.

36. The Sub-Committee on the Development of Co-operation with International Organizations concerned with Fisheries and the Working Party on the Rational Utilization of the Fishery Resources of the Indian Ocean were also established. The Committee recognized that the terms of reference and work of the Advisory Committee on Marine Resources Research (ACMRR) were complementary to its own and anticipated that there would be many occasions in the future when it might

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c/ Summarized from the report submitted to the 1967 meeting of the ACC Sub-Committee on Marine Science and its Application.

recommend that the Director-General seek scientific and technical advice from the ACMRR on matters with which COFI was concerned. Conversely, the ACMRR might, through the Director-General, indicate problems which could be examined by COFI.

37. At the end of 1966 the FAO Department of Fisheries had sixty-five fisheries experts under the Technical Assistance component of the United Nations Development Programme working in all parts of the world. Ten of these experts were marine fisheries biologists or fisheries oceanographers.

38. Under the UNDP (Special Fund) scheme, the Department of Fisheries is at present responsible for the planning and execution of twenty-eight projects (eleven in Africa, ten in Central and Latin America, seven in Asia). The total cost for these projects amounts to about $52 million, of which about $24 million are provided by the Special Fund, the rest under government counterpart contributions.

Research methodology and techniques

Fish tagging

39. Following the recommendations of the FAO/GFCM Seminar on Sardine Tagging (November 1964) approved during the eighth session of the General Fisheries Council for the Mediterranean (May 1965), standard tag releasing and reporting forms as well as data log sheets were printed and distributed to those laboratories engaged in marking experiments in the Mediterranean area. A Guide to Marks used for Tunas, an Inventory of Tuna Marking Projects and a Manual of Methods for Fish Stock Assessment, Part 4 - Marking have been published and distributed.

Acoustic fish detection methods

40. The ACMRR Working Party on Direct and Speedier Estimation of Fish Abundance is preparing a training manual on acoustic fish detection methods, and this will be used for courses to be held on this subject. Intercalibration tests will be carried out as part of the research programmes of the UNDP (SF) projects covering the survey and development of pelagic fish resources in West Africa. FAO is the executing agency for these projects.

Evaluation of marine fisheries resources

41. The new Fish Stock Assessment Section has begun to promote and, where appropriate, participate in the assessment of fisheries resources and the effects of fishing, with the aim of obtaining estimates of size of stocks, sustainable yields and the effects of fishery regulation measures. Reports have been published on the status of Antarctic whale stocks and the effects of fishing on the Peruvian anchovy.

42. Work to establish the FAO Fisheries Data Centre has begun, initially to deal with fisheries data of the International Indian Ocean Expedition (IIOE) but also eventually to include data coming from fisheries projects under UNDAP executed by FAO and from other sources. FAO has agreed to act as the depository agency for data from the Guinean Trawling Survey. Some fisheries data from IIOE and all data from the Global Telecommunication System (GTS) have already been submitted. FAO is also acting as the centre of submission on sperm whale stocks outside the areas of the North Pacific.

43. Discussions have begun with NODC, Washington on the storage and retrieval of biological data. FAO has contributed to the work of the Joint SCOR/ACMRR Working Group on Biological Data.

44. The Department of Fisheries prepared the background analysis of the status of Antarctic whale stocks, and the 1965 special meeting of the IWC, called to discuss this question, based its recommendation on a three-year pattern of over-all quotas. FAO has now accepted the responsibility for continuing assessments on behalf of the IWC and to this end an expert working group, convened by the newly formed FR Division, met in Seattle in January 1966 to review the data. Members of the group met again in Rome in April 1966 to analyse the results of the 1965/66 season and reported to the 1966 annual meeting of the International Whaling Commission (IWC). Nevertheless, a serious situation is developing in the North Pacific where stocks of several species of whales have been seriously depleted. Two IWC Working Groups are studying the problems connected with all species of whales in the North Pacific, and of sperm whales generally. FAO is following their activities closely and will be taking an active part in the sperm whale analysis.

Indicative World Plan

45. A major project in the current FAO programme of work is the preparation of an Indicative World Plan for Agricultural Development (IWP) under which an attempt will be made to predict and set targets for food production by the years 1975 and 1985. The Department of Fisheries has the responsibility within this project of providing material on potential production of food from the oceans and inland waters, taking into account economic and technological factors, as well as the knowledge of the yielding capacity of the resources. Within the Department, the FR Division is expected to advise on the resources aspects of these problems which in many instances are of primary importance to fishery development.

46. Existing information about the living marine resources of all types will be summarized for this purpose. To assist the Division in this task, a small informal working group of experts was established. These experts were selected for their knowledge of resource information about various ocean regions and for their interest in this type of methodology of appraisal. The group has also been selected in such a way that its members, some of whom have detailed knowledge of certain areas and types of resources, supplement FAO staff. The first meeting of the group took place in Rome from 5 to 17 December 1966.

Recent activities of sub-bodies of FAO

Indo-Pacific Fisheries Council (IPFC)

47. The IPFC held its twelfth session at Honolulu, Hawaii, from 3 to 17 October 1966. The major highlights of this session were the Joint IPFC/IOC Meeting on the Fishery Aspects of CSK (7 to 10 October) and the Symposium on Fisheries Education (5 to 6 October).

48. The former meeting decided on the nature of the work to be carried out in respect of the species of fishes selected for study at the third meeting of the CSK International Co-ordinating Group (Tokyo, August 1966) and agreed to provide to the FAO Fishery Data Centre the required time series data on catch, effort and age composition on a resource basis, thus obtaining a "readout" service. Various measures were recommended to make the best use of CSK oceanographic observations

for fishery studies. The Council decided to establish a Working Party on CSK Fishery Aspects with the main task of reviewing the progress of the CSK fisheries studies and maintaining liaison among national institutions engaged in CSK studies and the UNESCO/IOC/CSK.

49. The Symposium on Fisheries Education laid considerable stress on the training of operatives and personnel required to increase fish production, and also to increase the utilization of fish and fishery products. The Symposium recommended that one or more educational centres be established in the Indo-Pacific region for the training of extension officers and teaching staff.

50. The Council devoted considerable attention to the question of the rational utilization of fishery resources in the Indian Ocean. It was recognized that a major sector of the Indian Ocean fishery resources consists of tunas, marlin, sharks and other pelagic fishes of the high seas and that international action is required immediately for the assessment of these resources and the possible management of their fisheries. Different means of devising and co-ordinating such a programme were discussed and the action necessary, if the Council were to undertake this responsibility, was formulated. A group of experts was nominated to assist the working party of the COFI which will be studying this problem.

51. The host country problem discussed at the session related to the introduction of exotic species in Hawaii. The Council supported the proposal to expand and internationalize the Tropical Fish Culture Research Institute at Malacca, Malaysia, and passed a resolution requesting FAO to appoint a consultant group for the study of the potentialities of the Institute, to recommend a programme of work and to present a formula for its continuity, even if the Malaysian Government does not apply for UNDP (SF) assistance for the project.

52. The Council recommended that FAO convene a sub-committee of IPFC member Governments to review the structure and function of the Regional Fisheries Office. A Working Party on the Economics of Fish Culture and another Working Party on Rastrelliger were also appointed.

General Fisheries Council for the Mediterranean (GFCM)

53. The eighth session of the GFCM was held in Rome from 10 to 15 May 1965. At that session the Council considered resources, production and utilization problems

of marine and inland waters of the area. The possibilities of launching Technical Assistance and Special Fund projects to promote marine resources appraisal and fisheries development in the area was discussed at some length. Various countries showed interest in such international co-operation and endorsed the value of the proposed project. It was commonly agreed that clupeoid and scombroid species are those of the most economic value, and the project should probably concentrate on development of these particular fisheries. Early in 1967, the secretariat of the GFCM was reorganized and an Assistant Secretary temporarily appointed to help with the preparation of the forthcoming session of the Council. Possibilities of getting additional financial help and of increasing FAO assistance to working groups are being considered.

Southwest Atlantic Fisheries Advisory Commission (CARPAS)

54. The Commission held its third session at Montevideo, Uruguay, from 25 to 29 April 1966. It approved a report submitted by the Working Group on Fisheries a few days before the third session of CARPAS and recommended that this Working Group be enlarged and strengthened. Many noteworthy recommendations were made by the Commission on the following subjects: standardization of biological sampling in the CARPAS area; planning of CARPAS activities; co-ordination of Technical Assistance and Special Fund projects, environment research (oceanography and plankton related to studies on marine fisheries resources) and the training of experts and personnel.

55. It was also recommended that CARPAS organize in conjunction with its fourth session (1968) a Seminar on the Resources and Exploitation of Shrimp and Related Species in the Southwest Atlantic Area, and that the exploitation of fisheries on a rational basis be promoted by CARPAS member countries.

56. A further important recommendation of the Commission was made in regard to the revision of the CARPAS statutes, and it was decided to request the Director-General of FAO to initiate consultations on the question. This revision would allow Bolivia and Paraguay to become member countries and would also permit other countries (whose fleets operate or carry out fisheries research in the CARPAS area) to participate in the activities of the Commission.

57. It was agreed that the fourth session of CARPAS would be held within the next two years in Rio de Janeiro, Brazil acting as host Government. The proceedings of the session and some related papers presented during the meetings will be published by FAO.

Atlantic Tuna Convention

58. The FAO convened a Conference of Plenipotentiaries on the Conservation of Atlantic Tunas in Rio de Janeiro, Brazil, in May 1966. The Conference prepared a Convention, which was open for signature by any State Member of the United Nations or of any specialized agency at Reio de Janeiro until 31 May 1966, and which now remains open for signature at FAO headquarters. On deposit of the instruments of ratification, approval or adherence by seven Governments, this Convention will come into force and an International Commission for the Conservation of Atlantic Tunas will then be established. The Brazilian Government has offered Santos as the site for the headquarters of the new organization.

Advisory Committee on Marine Resources Research (ACMRR)

59. The fourth session of ACMRR took place at FAO headquarters, Rome, from 16 to 21 January 1967. The Committee devoted particular attention to the discussion of guidelines for the development of FAO activities in the field of marine resources.

60. In considering the relations between ACMRR and COFI, the Committee expressed agreement with the view that many mutual benefits could arise from close collaboration between the two FAO bodies and confirmed that it would assist in any way possible with COFI work.

61. The Committee discussed the report of its Working Party on FAO Regional Fisheries Council and Commissions which met at FAO headquarters from 9 to 13 January 1967, under the chairmanship of Dr. G.L. Kesteven. The Working Party analysed the reasons for international action and the principles governing it, and reviewed the existing fishery bodies from the point of view of structure, staff, procedures and relations with FAO and other international and national bodies. Based on an assessment of the activities of IPFC, GFCM and CARPAS, steps required -

to make the work of these bodies more effective and better adjusted to the present world fisheries situation were proposed.

62. The Committee had a preliminary discussion on the advantages for fisheries research of the kind of co-operative surveys organized under IOC and other international bodies, or conducted under FAO/UNDP (SF) projects.

63. The report of the Joint SCOR/ACMRR Working Group established to advise the Intergovernmental Oceanographic Commission (IOC) on action required by the Commission on the oceanographic aspects of pollution was approved, with certain drafting amendments. ACMRR expressed its willingness to continue, if required, to assist IOC activities in this field. The Committee decided to establish an ACMRR Working Group on Marine Pollution and its effects on Fisheries Resources to assist FAO in its activities in this field, and in preparing the plans and arrangements for the World Scientific and Technical Conference which the organization intends to organize in 1969 on this important subject. Other agencies (especially UNESCO, IMCO, IAEA, WHO) and international bodies (especially IAWPR and SCIBP) should be invited to participate in the activities of the Working Group.

64. Various matters concerning co-operation with other organizations were discussed. In relation to the WMO/World Weather Watch, the Committee advised on action by the secretariat and by the ACMRR Working Group on Fishermen's Charts and the use of Synoptic Data, particularly in relation to meteorological problems which required further research from the point of view of fisheries. Co-operation between operators of fishing fleets and WMO, for the purpose of securing upper-air meteorological observations was encouraged.

65. Collaboration and co-ordination of action with the IBP-PM Sectional Committee should be continued, particularly on the organization of meetings of common interest. Plans for the development of research in benthos communities and on the productivity of coral reef areas were welcomed. FAO was advised to offer support to the proposed Symposium on the Biological Results of the IIOE.

66. Particular attention was devoted to matters concerning IOC. The Committee noted with satisfaction the close co-operation and collaboration developed between UNESCO/IOC and FAO, the joint action in cases of mutual interest being one of the better means of serving member countries and science.

67. The status of the fishery aspects of the Co-operative Study of the Kuroshio (CSK) was reviewed and the successful collaboration established with IPFC encouraged. Organizational arrangements and plans for further action were considered. The Department of Fisheries was requested to give every possible support to these fishery studies, particularly to the activities of the CSK Associate International Co-ordinator for Fisheries.

68. The recommendations of the UNESCO/FAO/OAU Symposium on Oceanography and Fisheries Resources of the Tropical Atlantic (Abidjan, October 1966), which deals with the follow-up of ICITA, were endorsed.

69. Preliminary discussion took place on the scientific aspects of the proposed plan for the Co-operative Study of the South Mediterranean (CSSM) and for an International Project of Studying the North Atlantic Dynamics and Hydrology.

70. The secretariat was requested to follow up and keep the Committee informed of discussions at the next session of plans for the suggested Third International Oceanographic Congress. The Committee will meet again at FAO headquarters early in 1968.

C. UNESCO and the Intergovernmental Oceanographic Commission (IOC)[d/]

71. UNESCO considers that "application of knowledge presupposes the existence of such knowledge" and feels that one of its major responsibilities, as far as marine science is concerned, is to make such knowledge available through international co-operation. The statutes of the Intergovernmental Oceanographic Commission (IOC), as approved by the eleventh General Conference of UNESCO, reflect the same preoccupation in specifying the purpose of the Commission as being "to promote scientific investigations with a view to learning more about the nature and resources of the oceans, through the concerted action of its members".

72. The Oceanographic Programme of UNESCO and the activities of the Intergovernmental Oceanographic Commission in their present form take their origin

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d/ The description of UNESCO and IOC activities was prepared on the basis of the last (1967) report of UNESCO to the ACC Sub-Committee on Marine Science and its Applications and the IOC brochure, Intergovernmental Oceanographic Commission - Five Years of Work (1966).

from the eleventh session of the General Conference of UNESCO (1960) and they received further strong impetus for development during the fourteenth General Conference of UNESCO in November 1966, when more than twenty delegations requested that increased support be provided by UNESCO to its whole oceanographic programme. Subsequently the General Conference adopted resolution 2.2522 "Intergovernmental Oceanographic Commission and UNESCO's Programme in Oceanography". One particularly important feature of this resolution is the due recognition by UNESCO's member States of the importance of IOC's major function, which is to lay the scientific foundation for exploitation of the ocean's resources. The resolution also stresses the continuing rapid expansion of the Commission's work and calls upon the United Nations and its specialized agencies to use to the fullest possible extent the results of this work. Also, the advisory role of the Commission to the United Nations and its specialized agencies was reiterated by this resolution.

73. UNESCO's activities in oceanography may be subdivided into the following general categories:

(a) Providing secretarial services to the IOC and support to the international expeditions co-ordinated by the IOC;

(b) Exchange of information and promotion of development of modern oceanographic methodology and instrumentation;

(c) Assistance to national and regional institutions and laboratories;

(d) Training and education in marine sciences.

There is also a programme of publications associated with all the above activities.

Providing secretarial services to the IOC and support to international expeditions

74. This programme started in 1960 from a modest allocation of $40,000 for 1961/62 to reach the level of $150,000 in 1967/68. It is proposed to allocate $225,000 for these services and support in 1969/70. With these means at its disposal, the IOC secretariat annually co-ordinates national activities to the value of $15 million to $20 million.

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Exchange of information and promotion of modern oceanographic methodology and instrumentation

75. This programme has also proved very dynamic, and in the course of its development it enlisted active participation of the most competent scientists from the world oceanographic community, and the collaboration of such bodies as SCOR, ACMRR, ICES, IAPSO and IABO. The programme has grown, starting from $18,000 budgeted for it in 1963/64, to $80,000 in 1967/68 with a good prospect of further growth.

76. The largest number of publications of UNESCO in oceanography is associated with this particular programme. The examples comprise in the first volume the series, Monographs on Oceanographic Methodology, "Determination of photosynthetic pigments in sea water", which was sent free to marine laboratories and is also on sale to individuals and commercial firms. The second volume, "Zooplankton sampling methods" is being printed. The quarterly newsletter International Marine Science continues to be prepared jointly by UNESCO and FAO and published by the former; a special issue on oceanographic equipment was published in October 1966. A series of the UNESCO Technical Papers in Marine Science (seven issues available) is being published and distributed free of charge to laboratories. The International Oceanographic Tables, prepared by the Joint Panel on Oceanographic Tables and Standards of UNESCO/SCOR/IAPO/ICES, were published jointly by the United Kingdom National Institute of Oceanography and UNESCO and widely distributed. A new instalment of these tables (relating refractive index to salinity) is now being printed by UNESCO. Approximately thirty other important publications in oceanography were issued by UNESCO during 1966/67.

Assistance of UNESCO to regional and national institutions and laboratories

77. Under this programme, which has now reached the level of $500,000 per budgetary period, UNESCO provides assistance in the form of expert advice, equipment, organization of meetings and various grants from both regular programme and UNDP (TA) funds. This programme has also grown continuously in measure of the development of co-operation within the IOC framework, as the programme is designed specifically to help countries to participate in this co-operation. Examples of such assistance are given below.

78. UNESCO continues to provide assistance to the Indian Ocean Biological Centre, established through co-operation between UNESCO and Indian Council for Scientific and Industrial Research (CSIR), by appointing the Curator of the International Collection as it has done since 1963. This collection was established through voluntary donations of countries which participated in the International Indian Ocean Expedition. Equipment and other kinds of help are also given by UNESCO to this Centre. UNESCO regional taxonomic expert, Dr. R. Serene has continued his activities in South-East Asia since 1962. With his assistance some very useful taxonomic publications were made available to scientists of the region and collections of museums were considerably improved. The liaison officer in marine science is working in Latin America from the UNESCO Centre in Montevideo, helping to implement the assistance programme in the region.

79. Oceanographic equipment was provided upon request to the following countries: Algeria, Brazil, Hong Kong, India, Sierra Leone, Mexico, Panama, Tunisia, United Arab Republic, United Republic of Tanzania and a number of other countries. UNESCO is at present studying the possibilities of administering a certain number of Special Fund projects in the fields of marine science.

80. A considerable number of young scientists and lecturers were given UNESCO support to attend the Second International Oceanographic Congress held in Moscow from 30 May to 9 June 1966 following the recommendation of the IOC. The Congress was attended by about 1,850 scientists from fifty-seven countries. During the Congress 550 scientific papers were presented. FAO, WMO, IAEA and SCOR joined UNESCO in supporting the Congress. UNESCO is now publishing a volume of morning review lectures of this Congress.

81. Seventy scientists and fisheries officers from West African countries, Argentina, Federal Republic of Germany, France, Spain, USSR and the United States participated in the Symposium on Oceanography and Fisheries Resources of the Tropical Atlantic (a follow-up of the ICITA and the Guinean Trawling Survey) organized jointly by UNESCO and FAO in co-operation with the Scientific and Technical Research Commission of the Organization of African Unity, and held in Abidjan, Ivory Coast, in October 1966. Surveys of the distribution of tuna, sardinella and shrimps, sponsored in part by the UNDP, were also discussed. The importance of ICITA for the exploration of the equatorial undercurrent and various

biological aspects of the tropical Atlantic was evident. In contrast to earlier large expeditions, most of the data collected during the ICITA and GTS were already processed and analysed two years after the close of the expedition and the data reports published and distributed.

Training and education programme of UNESCO in marine science

82. This programme is described in detail in section C.3 of part II of this report.

Advisory bodies to UNESCO and IOC in the field of marine science

83. SCOR of ICSU continues to provide UNESCO with scientific advice on oceanographic programmes. SCOR and ACMRR (of FAO) are also official advisory bodies to the Intergovernmental Oceanographic Commission.

The Intergovernmental Oceanographic Commission (IOC)

84. The Commission takes its origin from a modest proposition to engage in "the joint operation by interested Member States of international research and training vessels for exploring the oceans more systematically than hitherto, for stimulating efforts in this direction, and for training specialized research personnel", which was advanced in 1958 by the tenth General Conference of UNESCO.

85. The eleventh General Conference established under the aegis of UNESCO the Intergovernmental Oceanographic Commission whose statutes state, inter alia, "the purpose of the... Commission shall be to promote scientific investigation with a view to learning more about the nature and resources of the oceans through the concerted action of its members".

86. At present there are fifty-nine Member States in the Commission, with the accession during the part two years of Peru, Singapore, Madagascar and South Africa. The fifth session of the Commission was held from 19 to 28 October 1967. About fifteen meetings of IOC working groups and other subsidiary bodies were held during 1966/67 (Data Exchange, Ocean Data Stations, Mutual Assistance, ad hoc Group on Standard Format for Data Exchange, Marine Pollution etc.). The secretariat took steps to intensify the work of various groups through correspondence.

International expeditions being co-ordinated by the IOC

87. So far three large-scale international expeditions have been co-ordinated by the IOC:

88. International Indian Ocean Expedition (IIOE). This expedition comprised twenty-three participating countries (fourteen of which were ship-operating), forty research vessels, 180 research cruises of varying duration and complexity. As a follow-up of the International Indian Ocean Expedition (IIOE) five volumes of the Collected Reprints of the Expedition were published and are being widely distributed. Preparation of the atlases resulting from the International Indian Ocean Expedition is under way in various participating countries. Their publication is expected in 1968-1969.

89. International Co-operative Investigations of the Tropical Atlantic, 1963-1964. This expedition comprised three stages ("EQUALANT I, II and III"), eight countries, thirteen ships, thirty-six research cruises. Preparation of the Atlas of the Tropical Atlantic is terminated and that Atlas will soon be published.

90. Co-operative Study of the Kuroshio and Adjacent Regions of the Pacific, 1965-19... . This expedition started in 1965 and passed through a number of phases. Participation in it comprised eleven countries, thirty-six research vessels and approximately 250 scientific cruises with a very wide geographical coverage. The International Co-ordination Group for the Co-operative Study of the Kuroshio met four times and is planning to organize a Symposium on the Kuroshio in May 1968 in Honolulu. The Group studied the operational plans for the second stage of the Study which will continue for two years, having started in July 1967. The Group plans to put more emphasis on the study of variability of the Kuroshio and fisheries aspects, as well as geological and geophysical studies of the Kuroshio region. It was also agreed by the Group's members to conduct synoptic surveys four times a year, extending the area to the South China Sea. Scientific data obtained by the CSK ships are regularly published and available to all interested countries or institutions. An Atlas based on 1965 data was recently prepared by the Kuroshio Data Centre and made available to participating countries. Negotiations are under way in connexion with the establishment of a regional biological centre for the CSK. Fisheries aspects of the Co-operative Study of the Kuroshio are being

successfully developed through co-operation with FAO which ensures the active efforts of Dr. J. Marr, Assistant International Co-ordinator for Fisheries, and channels relevant activities through the IPFC.

New expeditions approved by IOC

91. Two new co-operative expeditions were approved for execution by IOC during its last (fifth) session. The Co-operative Studies in the Mediterranean (CSM) will be conducted as from 1969 jointly by IOC, ICSEM and GFCM. The Co-operative Investigations of the Caribbean and Adjacent Regions (CICAR) will start in 1970. A symposium on the Caribbean Sea and its resources will be organized jointly by UNESCO and FAO in 1968, to prepare ground for this co-operation.

Data exchange

92. Efficient organization of data exchange was particularly important for the success of the co-operative expeditions. But the Commission went further in requesting member Governments to consider whether they could make available to the oceanographic community the data resulting from their national research activities not related to the co-operative programmes. Governments were called on to declare open certain parts or the whole of their national programmes for free use of results by scientists of other countries. This decision called for revision of the rules governing international exchange of oceanographic data as established at the time of the International Geophysical Year. So a new set of rules reflecting the new situation was prepared. This also prompted publishing by UNESCO of the quarterly newsletter International Marine Science (prepared jointly with FAO). In accordance with the above set of rules, "declared" national programmes consist of lists of research cruises, either planned for a certain period of time ahead or already implemented in the past, and/or lists of other national oceanographic activities resulting or expected to result in oceanographic data specified in the agreed list. Such "declared" national programmes are communicated to the IOC secretariat with a statement of declaration in the format employed by the International Marine Science. Data resulting from such "declared" programmes are then exchanged in accordance with provisions of the

guide established by the IOC. Agreement to exchange information and data on the national programmes so declared is an entirely new form of co-operation between the Commission's member Governments. The rules for international exchange of oceanographic data are given in the Manual on International Oceanographic Data Exchange of which the second edition has just been prepared by IOC and published by UNESCO (see also paragraph 108 below).

Co-operation between members of the IOC

93. Direct co-operation between members of the Commission and the organization of concerted actions by member States are the basic principles under which the Commission works. It is only through efficient co-operation and large-scale voluntary contributions from member States in kind that the Commission has been able to accomplish what it has, with only modest means at the disposal of its secretariat.

94. Organization of co-operative expeditions is, technically, not an easy task. This was abundantly demonstrated by the experience gained from the International Indian Ocean Expedition, which has shown that unless an international expedition is planned as a co-operative venture from the very beginning its further co-ordination may not be very efficient. The Bureau of the Commission together with the secretariat intend to summarize this experience in a Manual on Co-operative Expeditions, which is now under preparation. There are other aspects of work where smooth and efficient international co-operation is more easily arranged. Building up of the Indian Ocean Biological Centre plankton collection is one example. It has also become current procedure with international expeditions that the Governments of participating and bordering countries grant to the research vessels engaged in such operations special port and customs facilities, e.g., exemption of taxes, reduction of charges and provision of free services where possible. This alone tends to reduce the usually high cost of oceanographic work, not counting the much greater profit from the pooling of efforts in purusit of a common goal.

95. This pooling of efforts is profitable for other reasons besides a simply arithmetic one. It goes without saying that ten ships in a given area can accomplish ten times more work in a given period of time, or can accomplish a

particular scientific task ten times quicker than one ship. But some scientific investigations cannot be accomplished successfully other than in a very short time and it follows that if their geographic scale is large they are then outside the possibilities of a country having only one or two research ships. A co-operative effort by a number of countries is the only way to accomplish such investigations. Thus the effect of pooling of efforts is not simply arithmetical but also scientific in that it permits study of such scientific problems as can be studied only through a multiship synoptic approach.

96. The significance of this co-operation does not stop with sharing among participating countries the information and data obtained. As soon as knowledge is accumulated, various areas of application of this knowledge become evident and also become objects of national attention.

97. One of the major preoccupations of the Commission is to make all its activities interesting and useful to its members so as to provide as much help as possible in the development of their national oceanographic programmes. In this the Commission's work has already been of value to a number of countries which have seized the numerous opportunities offered to build up the national element in their oceanographic research. For example, the national oceanographic programmes of both the United States and the USSR were considerably strengthened to meet the demands of the new large-scale co-operative expeditions of the IOC. The Government of India is developing, on the basis of its participation in the International Indian Ocean Expedition, its own National Oceanographic Institute. The Federal Republic of Germany acquired for the International Indian Ocean Expedition a new modern research vessel "Meteor". Numerous countries have established a national oceanographic data centre.

98. These are, of course, merely a few examples of the "by-products" of international co-operation. Their scale and impact depend very much on the degree of voluntary involvement of each member. The Commission therefore is constantly seeking ways and means by which this involvement may be further increased. To conduct this search, the Commission created its Working Group on Mutual Assistance. Planning of this Group's work was facilitated by the fact that, on the initiative of IOC members, numerous examples of mutual assistance had already taken place

during recent years. The Government of Canada, for example, offered a number of tide gauges for installation by interested member countries. Applications for these tide gauges were collected by the secretariat and examined by the Permanent Service for Mean Sea Level. Tide gauges were then shipped to those countries whose requests were approved and subsequently installed. Brazil, Japan, United States, USSR, and other countries offered places aboard their research vessels participating in co-operative expeditions to scientists and students of other countries.

99. However, the Commission went further and collected national reports on the actual status and needs for development of oceanography in every country. These reports were analysed by an expert invited by the Commission. The IOC Working Group on Mutual Assistance studied this analysis and associated proposals and came up with a number of specific suggestions in the domain of mutual assistance. It is natural that this search brings IOC's activities into close relation with the oceanographic programme of UNESCO and related programmes of other international agencies more specifically devoted to various aspects of technical assistance.

Co-operation with other international bodies

100. From the outset, the Intergovernmental Oceanographic Commission established close working relations with such United Nations agencies as FAO, whose primary interest lies in fishery resources of the ocean, with WMO, whose emphasis is on weather forecasts, data acquisition systems, environmental research and marine climatology, with IMCO, whose competence lies in the field of navigation and maritime safety and with IAEA and WHO, whose responsibilities embrace various aspects of marine pollution etc.

101. Co-operation with regional oceanographic organizations is one of the important elements of the Commission's work. Only by correlation of IOC's responsibilities with regional initiatives and activities of such organizations as the International Council for the Exploration of the Sea, the International Commission for the Scientific Exploration of the Mediterranean, the International Commission for the Northwest Atlantic Fisheries etc. can adequate coverage of the world ocean be ensured, both geographically and as to subject.

102. Through its close work with other agencies of the United Nations system and other international organizations, the Commission became a useful mechanism for

solving, at inter-governmental level, such problems of scientific development as were too complicated to hope to resolve previously for any one scientific institution or any one Government acting independently.

103. One of the problems of international character successfully resolved through co-operation between international agencies was the reaching of agreement on the marking of oceanographic buoy stations in the ocean for easy identification and safety purposes. Similarly successful co-operation is now developing in the field of co-ordinated sea level observations in the open ocean, in seeking radio frequencies for oceanographers' use in studying air-sea interaction, and in countering the menace of marine pollution. To co-ordinate application of the increasing abundance of knowledge of the ocean and its further international exploration, a sensible division of responsibility among existing international organizations is a most essential prerequisite. For this purpose, the ACC Sub-Committee on Marine Science and its Applications was created within the United Nations system and has been functioning now for four years.

104. The Commission is also aware of the great complexity of the existing system of international organizations dealing with marine sciences. It is natural that because of this complexity quite a number of oceanographers have to serve in several capacities in a number of different international organizations, which leads both to overburden of work and very often duplication of effort. On the one hand this situation occurs because oceanographers are in general not numerous in the world, but on the other hand because, so far, no steps have been undertaken to rationalize the existing system of international bodies. It is appropriate that the IOC, jointly with other organizations, should look into the matter.

105. The Commission enjoys the closest and most fruitful collaboration with the Scientific Committee on Oceanic Research (SCOR) of ICSU and the Advisory Committee on Marine Resources Research (ACMRR) of FAO. The Commission designated these bodies as its official scientific advisers.

106. One particularly important product of IOC's co-operation with its advisory bodies, SCOR and ACMRR, was the preparation and publishing of the Draft of a General Scientific Framework for World Ocean Study. This document was conceived as a basis for developing various national, regional and world-wide international programmes for ocean investigations. The draft was prepared through collaboration

of several groups of authors associated with both SCOR and ACMRR and, after being published in all four official languages of the IOC, was discussed and revised by the joint working group composed of all interested organizations. Finally, the document developed into a very broad survey of the actual state and perspectives of future development of marine science. It was found to be of use to the research worker, the teacher of post-graduate students and, of course, to students themselves.

107. A booklet entitled Intergovernmental Oceanographic Commission - Five Years of Work, IOC Technical Series No. 2, as well as two other issues (Nos. 3 and 4) of the same series, were published. Three issues (Nos. 16, 17 and 18) of the IIOE Information Paper and eight issues of the CSK Newsletter (Nos. 5 to 12) were published during 1966/67.

Perspectives of further development of the IOC

108. At its last meeting the IOC Bureau established a new Working Group on the Commission which, in September 1967, looked into the inter-governmental aspects of the implementation of General Assembly resolution 2172 (XXI) as well as into further development of the IOC activities. It was suggested that, inter alia, the following aspects of further development be studied by the Commission:

(a) Relationship and co-operation of the IOC with other international bodies and the United Nations specialized agencies;

(b) Role of the IOC in providing environmental information for various applied activities in the field of marine science;

(c) Broad legal framework of oceanographic research on the high seas;

(d) Role of the IOC Bureau and the Consultative Council in the financial aspects of the IOC activities;

(e) Role of the IOC Bureau and the Consultative Council as regards personnel in the IOC secretariat;

(f) Juridical aspects of the IOC activities;

(g) IOC policy with regard to marine mineral resources.

109. The Commission, at its fifth session, studied most of these problems and its decisions are reflected in a number of resolutions adopted at this session,

particularly resolutions V-1, V-3, V-6 and V-20. The Commission established a Working Group on Legal Questions related to scientific investigations of the ocean (including scientific investigations of resources of the ocean) which will meet for the first time in September 1968.

110. During the last session, the Commission accepted, on the recommendation of one of its working groups, the following point of view:

> "By statute the purpose of the Commission is 'to promote scientific investigation with a view to learning more about the nature and resources of the oceans, through the concerted action of its members'. An important part of oceanographic research deals with the history, shape, structure and composition of the sea floor. Such research contributes to the scientific basis for the extraction of mineral resources from the sea floor. Governments may wish to collaborate in programmes of geological and geophysical research within the framework of the Commission, and thus the Commission could not accept any exclusion from this field of investigation. At the same time, the Commission recognizes the interests of other international organizations in various aspects of the marine mineral resource problem, including the technological aspects of prospecting and exploitation of these resources, scientific investigations and economic aspects, and welcomes the opportunity to co-operate with such organizations towards the goal of utilizing these resources for the benefit of man."

111. An important stimulus for the intensification of IOC activities is in the fact that with the increased development of oceanographic research, resources exploitation and ocean engineering by member countries, these countries will need more and more fundamental oceanographic data (physical, chemical, biological, geological, geophysical). Until recently, oceanographic data were not considered as an item of technical assistance. International data exchange under the IOC is organized on an equivalent basis and the amount of data involved still permits the World Data Centres to supply data at cost of reproduction. With the introduction of new methods of automatic data collection and the foreseen enormous increase of digitized oceanographic information, World Data Centres will one day need a stronger financial foundation for their work, while the cost of the retrieval of data will also increase because of the increased complexity of operations. UNESCO, jointly with IOC, is now facing the necessity to readjust the international system of oceanographic data exchange in order to enable it to meet the growing national needs in oceanographic data. It will bring a new item of

expenses on the oceanographic budget of UNESCO, and the oceanographic data will then certainly be regarded as an item of technical assistance. Developments in the field of oceanographic data exchange are so rapid that UNESCO and IOC will already have to meet some extremely valid financial contingencies in 1968 or 1969, although it is very difficult to predict now what specific form they may take.

112. A further important step forward was the establishment by the IOC at the fifth session of the Working Committee on an Integrated Global Ocean Station System (IGOSS) which will co-ordinate the Commission's work on data exchange, communications, variability and ocean-atmosphere interaction.

113. The Working Committee, for which very close co-operation with WMO is sought, should enable oceanographic systems not only to benefit from existing meteorological synoptic ocean data systems and telecommunication system but also to contribute to the development of the meteorological systems which would thus, to the extent compatible with respective requirements, serve both oceanography and meteorology. In particular, IOC, in co-operation with WMO and in consultation with IFRB, will develop a co-ordinated plan for the use of new radio frequences recently designated for oceanographer's use by the ITU's World Administrative Radio Conference. Other IOC working groups whose work is partly co-ordinated by the IGOSS Working Committee should enable IOC to take part in such WMO projects as the World Weather Watch (WWW) and the Global Atmospheric Research Project (GARP).

D. Activities of WHO related to marine science and its application

114. The World Health Organization initiated over two years ago a study on public health aspects of coastal pollution[e/] with the objective of determining as far as possible existing and potential hazards to the public health associated with the discharge into estuaries and along the sea coast of municipal sewage and industrial and other kinds of waste.

115. With the increased use by large groups of people of beaches for recreational purposes and because of the consumption of sea food often grown in polluted coastal

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e/ World Health Organization, Bulletin (Geneva) (in press).

waters, it is easy to explain the concern expressed in many countries regarding the possible repercussions that coastal pollution might have on human health and the public well-being. It is also possible that it may affect the tourist industry that is considered in many countries as an important source of revenue.

116. The micro-biological quality of sea water intended for recreational and bathing purposes is still the object of controversy. This is clearly reflected in the results of efforts made by various public health authorities in several countries to establish sanitary standards.

117. The first part of the study undertaken by WHO consists of a review of up-to-date knowledge of the presence, behaviour and fate of a number of organisms (bacteria, viruses and parasites) commonly found in coastal waters polluted by domestic sewage. A number of experts all over the world have been consulted and a synthesis of preliminary conclusions drawn up. There seems to be little doubt that the marine environment has generally an unfavourable influence on survival of most pathogenic micro-organisms. Many factors, such as dilution, temperature, absorption, sedimentation, nutrient deficiencies and others, are on the whole unfavourable to the growth of the pathogenic organisms considered. However, special circumstances do exist, especially in temperate and warm coastal water near large cities, for which these conclusions are not applicable.

118. This study also includes a review of some epidemiological findings; however, no definite conclusion has emerged so far in this regard. Further epidemiological research is needed. Another part of the study is concerned with the special health hazards associated with the consumption of sea food grown in the polluted areas.

119. The study is to continue so as to establish a scientific basis for guidance on the quality of water required to safeguard the health of users of coastal water and to recommend adequate methods and practices to prevent coastal pollution.

120. WHO has recently published, in its quarterly International Digest of Health Legislation[f/] a comparative study conducted on water pollution control legislation in thirteen countries. This quarterly reviews periodically new legislation passed in member countries in this field.

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f/ World Health Organization, International Digest of Health Legislation, 1966, No. 17, pp. 645-854.

121. Discharge of sewage and other wastes by ships in habours is referred to in the International Sanitary Regulations[g/] and in the WHO publication Guide to Ship Sanitation.[h/]

122. WHO is assisting many member countries in the execution of field projects on water supply, waste disposal and water pollution control, often using UNDP funds. A number of these projects are concerned with coastal areas (such as UNDP/WHO projects in China (Taiwan), Ghana, India, Malta, Morocco, Nigeria, Philippines, Senegal and Turkey) and are closely related to coastal pollution control. Oceanographic reports on the capacity of the marine environment to receive domestic or industrial effluents are being prepared for these projects by studying hydrometeorological, hydrogeological, hydrodynamical and marine biological characteristics of coastal waters.

123. WHO has a broad training programme in sanitary engineering, waste treatment and disposal into fresh water and marine environment. The programme includes various forms of training and exchange of information (individual fellowships, training courses, seminars) and is carried out either by the WHO headquarters or regional offices in collaboration with the Governments of member States. A special international training course on coastal pollution control is being planned in collaboration with other United Nations agencies.

124. The World Health Organization is establishing a WHO International Reference Centre on Waste Disposal to develop a long-term research and development programme related to storage, collection, treatment re-use and/or ultimate disposal of liquid and solid wastes. The Reference Centre also assists in training of personnel, particularly in developing countries, and in preparation of manuals for training courses, seminars and field developmental investigations.

125. A number of applied research institutes (such as SURSAN Institute of Sanitary Engineering, Guanabara, Brazil) have been set up with UNDP/WHO assistance to improve research and training facilities in environmental sanitation of member countries. A part of the WHO training and research programme in waste treatment and disposal into fresh water and marine environment is carried out through these institutes.

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g/ World Health Organization, International Sanitary Regulations, 3rd ed. (Geneva, 1966).

h/ Vincent B. Lamoureux, Guide to Ship Sanitation (WHO, Geneva, 1967).

E. WMO systems of meteorological services to shipping and other marine activities

126. The present WMO systems of meteorological services to shipping and other marine activities are provided by various countries of the world which, on a voluntary basis, have undertaken to meet allocated responsibilities within a universally co-ordinated scheme. It includes the making and exchange of observations, the processing of the data both in real time and for statistical purposes, the dissemination of the processed information in many forms, including forecast, both written and pictorial, and the archiving of data. The system is now being transformed as a result of modern developments in meteorological science and technology. The more important new meteorological developments, including those affecting marine science and the resources of the sea, are now being synthesized into an over-all world plan to form a new system as the World Weather Watch (WWW).

127. A brief description of those aspects of this world plan that are germane to the oceans is presented in the following paragraphs. Included are explanations of the changes which will take place as a result of the WWW and indications of the interests of other international organizations in the co-ordination and co-operation which are being pursued. The world plan for meteorology (World Weather Watch) as sponsored by WMO may be visualized as consisting of a global observing system, a global telecommunication system, processing and forecasting facilities which are being organized into a global data-processing system, and supporting programmes in climatology, research, education and training.

The Global Observing System (GOS)

128. The GOS consists of a world-wide network of observational facilities. Over the oceans, this network is primarily made up of merchant ships (other types of ships in the programme are fishing vessels, research vessels, etc.) recruited on a voluntary basis by national meteorological services. In addition, a limited number of ocean station vessels are making observations at fixed locations. At the present time, thirty-six maritime nations (members of WMO) are taking part in the voluntary observing ship programme and as of 1 January 1966 had recruited 4,684 ships. This

system of voluntary observing ships is maintained under the auspices of WMO, and each year this organization publishes a detailed list of all the ships participating in the programme.

129. An important shortcoming of this type of programme is that an adequate observational coverage is possible only along the main shipping lanes. Through WWW planning, an attempt will be made to remedy the deficiencies in other areas by expanding the present system of observations made by various types of ships and by the introduction of new observing tools. Of particular interest in this regard is the potential use, for combined meteorological oceanographic purposes, of fixed ocean stations, isolated island stations, mobile ship stations with special observers embarked, coastal stations, unmanned floating or moored buoys, and meteorological satellites.

130. In addition to atmospheric parameters, environmental elements which are observed within this network are sea surface temperature; wave height, period and direction; sea ice; and special phenomena such as ice accretion on the ship superstructure. International codes for the transmission of all of these data are developed, regulated, and co-ordinated by WMO.[1/]

131. The very high cost and very considerable difficulties that must be overcome to reduce the deficiencies in ocean data make it clearly advantageous to both meteorology and oceanography to co-ordinate their needs, their efforts and their resources. For this purpose a joint IOC/WMO group of experts has been established for co-ordinating meteorological and oceanographic requirements as well as to consider questions concerning codes and communications. Further, WMO is co-operating with IOC in other marine activities as well as with ICES regarding the problems associated with a synoptic ocean-observing and forecasting programme.

The Global Telecommunication System (GTS)

132. The GTS is the system of telecommunication facilities and arrangements necessary for rapid world-wide collection and dissemination of meteorological observations and for the rapid exchange of processed data. Here also is a system which has been in existence for many decades and requires expanding and improving.

1/ These codes and the procedures for their use are contained in volume B of WMO publication No. 9 TP 4.

Through WWW planning under the direction of WMO, implementation of programmes is being urged which will provide for the introduction of modern techniques including computers. These techniques will provide high-speed reliable exchanges, quality control through automatic programmed error detection and correction procedures, the elimination of superfluous information and priority handling of urgent messages.

133. With regard to communications from ship to shore, three problems, one real and the others potential, are requiring special attention and consideration. The first concerns the difficulty being experienced by ships in relaying their weather reports ashore. Another is the anticipated increase in the number of voluntary merchant ships and ships reporting oceanographic data which will overload the currently available communications facilities. And, lastly, there is the need for the allocation of special radio frequencies for the relay of new types of data and for monitoring unmanned platforms. Those problems are under continuing review by WMO in collaboration with other international bodies concerned with these problems, such as ITU, IMCO, IOC, UNESCO and IFRB.

Ocean Meteorological Services and the Global Data-Processing System (GDPS)

134. An international programme of marine weather services has been provided for many years under the general guidance and co-ordinating facilities of WMO. This service has been used mainly for the safety of shipping and fishing vessels from hazardous weather but to an increasing extent in recent years greater emphasis is being placed on factors relative to economy and efficiency of operations and the preparation of forecasts tailored for specific needs. A standard form of service covering meteorological information for ocean areas is established and described in the Technical Regulations of WMO. The oceans have been divided into areas for which certain members of WMO are responsible for providing meteorological information at fixed times. Information on the radio stations broadcasting this information is tabulated and kept up to date by WMO[i/] so that all concerned may know the radio frequencies, contents and times of transmission, languages used and

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i/ Publication No. 9, volume D, part F.

other pertinent details. Facsimile radio broadcasts of weather charts, information on sea ice, patterns of sea surface temperature, and sea and swell conditions, both current and forecast, are available for some ocean areas. Details of all facsimile broadcasts are also given in the WMO publication referred to in foot-note 1/.

135. The provision of satisfactory meteorological services to shipping has been hampered by deficiencies in data-processing facilities available to many maritime nations, and the WWW now offers an opportunity to remove some of these deficiencies and to provide improved support to marine activities. Superior data-processing facilities are being planned through a system of world, regional and national meteorological centres. The coverage of the charts will range from global to territorial, through hemispheric and oceanic or continental. These centres will be equipped to the maximum extent possible with modern facilities, including high-speed computers. World meteorological centres and regional meteorological centres will produce analyses and prognoses directly supporting national meteorological centres. Meteorological and related environmental support to shipping and other marine activities will be carried out primarily by the individual national meteorological centres within the existing WMO maritime scheme as described above. However, as a result of this increased support, the specialized needs of a greater variety of marine users can be accommodated. In this regard, and in order to determine the requirements of various potential users, WMO has been seeking advice from various international organizations and, in particular FAO.

Marine climatology

136. Climatological information for ocean areas is available covering past years and is presented in standard form in charts and tabulations. These data are obtained from the log books of all recruited ships and are usually transferred first to maritime meteorological punched cards and are then available for preparation of statistical tabulations, routine summaries or charts or to meet specialized needs as these arise.

137. Standards and specifications for the maritime meteorological punched cards are prescribed through WMO, and general information regarding the meteorological

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section of ship's log books is being provided by this organization. Also plans have been formulated under the WWW scheme for the GDPS (world meteorological centres and regional meteorological centres) to archive all meteorological data, including marine data. Data to be stored will include all of the parameters in the meteorological codes as well as meteorological satellite data.

138. With regard to tabulations and presentations of climatological information, two programmes are at present being undertaken or planned by WMO. These are a project for the preparation of marine climatological summaries and a project for the publication of historical sea surface temperature data. The first-mentioned project was undertaken after consultation with IUGG and has the object of providing research workers in various fields with marine meteorological and oceanographic data systematically collected and summarized on a world-wide basis. It is now being actively pursued and the first series of publications should be available in the near future. The second-mentioned project will involve the preparation of historical records for the period from 1860 to 1960 of sea surface temperature, humidity and wind speed and direction. Preliminary technical and financial arrangements are now being finalized.

Research programme

139. The fifth World Meteorological Congress endorsed the concept of a Global Atmospheric Research Programme (GARP) as a framework within which all research activities relating to the WWW would be planned and implemented in a co-ordinated and effective fashion. This project originated with the ICSU/IUGG Committee on Atmospheric Sciences and was subsequently endorsed by the WMO Advisory Committee. It will be carried out as a joint ICSU/WMO project. The results of a recent Study Conference on GARP have under several headings highlighted the importance of the boundary-layer problems and the need for a better understanding of the energy transfer between the air and its underlying surface.

140. The importance of this problem is further illustrated by the fact that three separate international groups, established by IUGG, IOC and WMO, are also dealing with the interaction between the sea and the air. WMO, as well as IUGG and IOC, has recognized the need for closer collaboration between these bodies, and positive

steps in this direction are being taken by them. In this regard, the IOC Working Group on Ocean-Atmosphere Interaction at its first meeting held at Lucerne, Switzerland, on 27-28 September 1967, recommended that it be dissolved, that only one group (intergovernmental) deal with the problems of ocean-atmosphere interaction, and that it be established as a joint working group between IOC and WMO.

141. Other examples involving research related to the ocean in which WMO is or has recently been participating are briefly enumerated below.

(a) IMCO Sub-Committee on Sub-Division and Stability. WMO has for some time provided a rapporteur to assist this body in its studies regarding external forces affecting ships' stability, and by this means information on wave conditions and wind gustiness was furnished. At its last session in May-June 1967, the Sub-Committee requested the IMCO secretariat to take steps to arrange a meeting of an ad hoc working group on the same subject to be composed of experts to be nominated by UNESCO, WMO, IAFO, ISSC and ITTC. WMO is making arrangements to participate.

(b) International Indian Ocean Expedition (IIOE) of IOC/SCOR.

(c) The Co-operative Study of the Kuroshio (CSK).

(d) The Mediterranean Synopsis of FAO - a survey of climatological information presented in chart form.

(e) FAO's handbook, Fishermen and the Weather.

(f) ACMRR Working Party on Fishermen's Charts and Utilization of Synoptic Data.

F. Activities of IMCO connected with the uses of the sea and its resources

142. The activities of the Inter-Governmental Maritime Consultative Organization cover the following broad spheres:

(a) Preserving the freedom of maritime navigation as an efficient means of transportation and communication and ensuring the highest practicable standards of maritime safety, including the safety of life and property at sea;

(b) Promoting and safeguarding productive uses of the sea and its resources.

143. The organization's activity in these areas results primarily from the international Conventions administered through its co-operative machinery. These include the International Convention for the Safety of Life at Sea, 1960, and the associated Regulations for Preventing Collisions at Sea, the Load Line Convention and the International Convention for the Prevention of Pollution of the Sea by Oil, 1954, as amended. The latter is the only existing international instrument exclusively addressed to the prevention and control of pollution of the sea. At present, thirty-seven countries, including the major maritime nations, are parties to that Convention. Considerable progress has already been made with the legal, navigational and technical aspects and with the organization of regional co-operation, so that rapid and effective measures can be taken as soon as a major spillage occurs following accidents at sea or for other causes. Intensified research and study are envisaged on several subjects.

144. On the technical and navigational side studies are proceeding on the following subjects:

(a) New means of construction and equipment of ships with a view to limiting the risk of collision or stranding and to avoiding or minimizing the escape of oil, or hazardous or noxious cargoes from ships into the sea as a result of such accidents;

(b) The possibility of routing merchant ships and providing for traffic separation in certain areas;

(c) Establishing of prohibited areas or areas to be avoided by ships of certain classes and sizes to reduce the risk of oil pollution or dangerous cargoes in case of accidents;

(d) Approved training and certification of masters and officers;

(e) New methods for removal of oil from the sea;

(f) New agents for absorbing or precipitating the oil;

(g) New chemical and mechanical agencies for protecting coastal areas from pollutions, including construction and use of booms, emulsifiers, etc.;

(h) How deliberate marine pollution can be detected in order that it may be penalized.

145. Legal questions under urgent study, as a result of the "Torrey Canyon" incident include:

(a) The extent to which States may take measures of self-protection when threatened or affected by casualties beyond their territorial seas;

(b) Liabilities arising from casualties involving discharge of oil or other substances;

(c) Measures of international co-operation relating to official inquiries and to ship casualties;

(d) The access and use of sea-borne salvage equipment of other flags within the territorial waters of States;

(e) Powers of surveillance and control by coastal States to implement measures for strengthening the safety of navigation and obviating maritime pollution.

146. Following a resolution of the fourteenth Assembly of IMCO (resolution A. 85 (IV)) drawing attention to the problem of pollution of the sea by agents other than oil, the organization is keeping in touch with other interested international bodies, particularly FAO and IOC, with respect to the investigation, prevention and control of pollution of the sea by those agents, in particular when they are discharged from ships.

147. IMCO is co-operating with the World Meteorological Organization in all matters connected with weather watch which provides for volumary participation of merchant vessels in obtaining and reporting weather data, and which is aimed at improvement of general weather forecasting. The fifth IMCO Assembly, in October 1967, adopted a resolution (A. 139 (V)) inviting member States to give the maximum encouragement to owners, masters and officers of the ships under their flag to participate in this voluntary observing-ship scheme.

148. IMCO is working on improvement of the Maritime Distress System, with a view to improving the safety of all those who are taking part in sea transportation and research, as well as of property at sea.

149. In connexion with the studies on stability and subdivision of ships, IMCO is investigating external forces affecting ships and collecting data on ocean wind and waves. In order to obtain wave and wind data needed in further development of stability requirements, IMCO established, in co-operation with UNESCO/IOC,

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World Meteorological Organization, International Association of the Physical Sciences of the Ocean (IAPSO) and International Ship Structural Congress (ISSC); the latter two bodies being non-governmental international organizations, the Joint ad hoc Group for the Study of External Forces Affecting Ships.

150. The organization is at present considering particular aspects of the construction and operation of drilling rigs used for the exploitation of the subsoil for the safety of such constructions, which may progress to other aspects of the exploitation of the sea bed, the ocean floor and subsoil thereof.

Safety of human life and property at sea

151. Research relating to marine environment and marine resources and the exploitation and transportation of mineral and living marine resources require a wide use, in addition to conventional ships, of special types of craft, such as drilling rigs, production platforms and other similar devices. In future, submersibles might also be used for these purposes.

152. The use of special craft raises certain problems. It is necessary to ensure the safety of these craft and of the people working on them. Special craft may cause a danger to ships navigating in the same areas. Construction, equipment and operation of special craft should prevent spillage of oil and other noxious or hazardous substances into the sea. IMCO, the agency responsible for the safety of life and property at sea, is already dealing with these problems.

G. Activities of IAEA in the field of marine science and its applications

153. IAEA is actively concerned with all problems relating to the activity of the marine environment, especially those arising from peaceful uses of atomic energy. IAEA participates in various programmes of international co-operation dealing with these problems and has special responsibilities relating to radioactive pollution.

Radioactive pollution

154. At the United Nations Conference on the Law of the Sea (1958), concern was expressed at the possibility of pollution of the sea by radioactive materials. As a result, at its tenth plenary meeting, the Conference adopted a resolution which reads in part:

> "... the International Atomic Energy Agency, in consultation with existing groups and established organs having acknowledged competence in the field of radiological protection, should pursue whatever action is necessary to assist States in controlling the discharge or release of radioactive materials in the sea, in promulgating standards and in drawing up internationally acceptable regulations to prevent pollution of the sea by radioactive materials in amounts which would adversely affect man and his marine resources".

155. In 1958 the Agency, in keeping with its mandate, convened its first Panel on Radioactive Waste Disposal into the Sea, composed of eleven scientific experts and presided over by Mr. H. Brynielsson of Sweden. In the following year, the Agency co-sponsored with UNESCO and FAO a conference in Monaco, dealing with all methods of disposal and treatment of radioactive wastes.

156. The Brynielsson Panel held four meeting during 1958 and 1959 and its findings were published as IAEA document Safety Series No. 5, "Radioactive waste disposal in the sea". The document reviews in a general way the desirable limitations and constraints on marine disposal and still provides a sense of direction to the Agency's activities in the field. One of the recommendations of that Panel was that IAEA establish an adequate register of disposal of radioactive waste into the sea. In compliance with this recommendation, a questionnaire was sent to Member States in August 1961 asking for information on the nature and amount of radioactive waste that was being released into the sea. The response at that time was not

sufficient to permit the setting up of a meaningrul register. There is some evidence, however, that the attitude of a number of countries that release significant amounts of waste has now changed to such an extent that it may be possible to set up a reasonably comprehensive register of sea disposals. A revised questionnaire has recently been prepared, but it has not yet been decided whether it should be sent to Member States at this time.

157. To implement the Brynielsson Panel recommendations on establishment of standards and to consider the legal and organizational measures for international control of radioactive marine disposal, the Agency in 1961 convened a Panel on the Legal Implications of Disposal of Radicactive Wastes into the Sea. The Legal Panel met four times over the period 1961-1963 and produced two different drafts of a report (published as DG/WDS/19) reflecting the two diverging views on the fundamental question of the permissibility of disposing radioactive wastes into the sea under international law.

158. An effective control of the radioactive pollution of the sea depends in part on the availability of adequate technical methods for surveying and monitoring the sea and marine products with regard to the presence of radioactive substances. To indicate or devise suitable techniques for such a purpose, an ad hoc panel was convened in 1961 and met again in 1962. This panel produced the document Safety Series No. 11, "Methods of surveying and monitoring marine radioactivity". This document suggests standard methods of assessing radioactive contamination levels in order that measurements in all parts of the world's oceans may be readily comparable.

159. The Agency in 1966 held a symposium that dealt with disposal into both the sea and fresh surface waters. This symposium attracted widespread participation, and papers were presented both from nations which oppose disposal and from those which advocate the practice on a controlled basis. The symposium revealed that the present limits of knowledge have been delineated and the outstanding problems have been narrowed considerably since the previous meeting seven years earlier. In particular, the effects of radioactivity on the resources of the oceans have not been intensively studied but the few genetic studies on the effect of chronic low-level radiation on aquatic organisms leave open the question of its significance.

160. The Agency's Division of Health, Safety and Waste Disposal, through its semi-annual collection and publication of information on research in Member States by means of Waste Management Research Abstracts, keeps abreast of research on the effects of radioactivity on marine resources. In addition, a panel of experts was convened in January 1967 to review the programme of this Division. The panel discussed the document Safety Series No. 5, "Radioactive waste disposal into the sea" and found that it did not appear to be outdated but recommended that the Secretariat examine carefully the manual to determine if it needs revision. The panel suggested that the Agency should keep records of all radionuclides released from peaceful uses into surface waters and coastal discharges and that a centre of reference information on the subject should be maintained. This suggestion is at present under discussion by the secretariat.

161. Over the past eight years the Agency has held twelve panel meetings and two symposia on the subject of marine disposal. Twelve staff members have been assigned to the programme over this period. Two manuals (Safety Series Nos. 5 and 11) have been produced on the subject. Approximately $150,000 has been spent on the programme over this period.

162. In an effort to promote actively the scientific side of the question of radioactive waste disposal into the sea the Agency in 1961 entered into an agreement with the Principality of Monaco and the Oceanographic Institute of Monaco to set up an International Laboratory for Marine Radioactivity. This Laboratory is concerned with the following problems:

(a) The problem of distribution of radionuclides in the sea as a function of time and space;

(b) The chemical behaviour of radionuclides of various chemical states in the sea water;

(c) The distribution and accumulation of radionuclides by the various components of the marine biota;

(d) The interchange of radioisotopes between the sea bottom and the bottom water.

Apart from the close collaboration with the Centre scientifique de Monaco and the Institut océanographique de Monaco, the Monaco Laboratory has an exchange of

experience with other laboratories, institutes and scientists engaged in research related to radioactivity in the sea.

163. Part of the work of the Monaco Laboratory contributes considerably to the solution of the general pollution problem and the IAEA works in this connexion in close collaboration with the ACC Sub-Committee on Marine Science and its Applications which is also concerned with the co-ordination of investigations on the subject of pollution in order to avoid overlapping of programmes.

164. It is planned for the next two years to expand the activities to special problems of waste disposal into the sea, especially on the standardization and intercalibration of analysing methods.

Research contracts and research agreements

165. So far the Agency has granted eighteen research contracts on marine science to nine countries. The Agency has to date awarded a total of thirteen research contracts and six research agreements on work related to the study of radionuclides in the marine environment. A total amount of $350,000 has been spent to date on these studies. No funds have been awarded as yet for this purpose in 1968 and some $10,000 was awarded from the 1967 budget; the current level of expenditure is therefore not large.

166. It should be noted, however, that the Agency is currently developing a sizable co-ordinated programme in this field through a series of "cost-free" research agreements. Under this programme, a number of researchers in different countries will be brought into closer contact with one another so that their efforts may be better co-ordinated. In so doing, it is expected that research efforts will be concentrated on studies of particular relevance to the Agency's programme.

167. By reason of the international character of the sea, the co-ordination of research contracts or agreements would be essential. A co-ordinated programme of research agreements in the field of marine radioactivity is now under preparation by initiative of the IAEA. This co-ordination programme may contribute not only to a rational solution of the problems concerning radioactive waste management but also to the understanding of chemical and biological processes which have a close bearing on marine resources. In connexion with the view stated above, it should be emphasized that the research agreement co-ordination programme in the field of

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marine radioactivity studies will be expanded in the near future on a cost-free basis to an increasing number of Member States.

Desalination programme

168. Nuclear energy can play an important role in augmenting the water supply in water-short areas. Because of the interest in desalting and the assessment of the favourable role of nuclear energy in this application, the Agency has a continuing programme in this field. The Agency works with its Member States, international organizations and others with an interest in this subject to further the practical application of nuclear energy for all people.

169. The programme involves the Agency serving as a focal point for matters relating to the use of nuclear energy for desalination and the allied applications of chemical and fertilizer manufacture; in providing assistance and advice to Member States when requested, by undertaking comprehensive case studies; by sending missions to the countries and by standing ready to perform pre-investment studies; in co-ordinating joint studies for two or more Member States and in stimulating practical considerations of nuclear energy applications. In recent years the Agency's annual expenses, including staff, panel meetings, missions to Member States, fellowships and research contracts, have totalled about $100,000.

170. At the present there are no special problems of co-ordination or overlapping since there are no actual nuclear desalting plants in operation. Close co-operation and co-ordination is, however, necessary in studies that may involve the interests of FAO, UNIDO or the United Nations. It is anticipated that when the time for practical application of nuclear desalting complexes arrives, closer co-operation will be needed.

171. A dramatic rise in the installed desalting capacity primarily from the use of nuclear energy can be anticipated for the mid-1970's. Some such plans may be regional involving two or more countries. Some may involve chemical recovery from the brine discharged from the desalting plant. The desalted water will in part be used for agricultural purposes. The trend is towards energy centres where industrial and agricultural complexes will utilize common reactor facilities. These more complex facilities will require greater co-ordination and longer-range planning.

172. Most of the heat generated by these nuclear energy centres must be carried off by the sea water and the brine. Enormous quantities of sea water are used for cooling. The warmed sea water and brine are discharged back into the ocean. By proper management of the warmed sea water at some coastal sites it may be possible to develop coastal areas of warmer water, possibly in man-made lagoons, offering not only vastly improved recreational opportunities but drastically changed, for the the better, fish populations and fields of giant kelp.

173. Much of the required development to bring all this to fruition is beyond the scope of IAEA. It will therefore take a co-ordinated effort of many organizations of the United Nations family as well as other organizations.

Annex XII

NON-UNITED NATIONS INTERGOVERNMENTAL ORGANIZATIONS

Contents

The International Council for the Exploration of the Sea (ICES)

1. The ICES was officially inaugurated on 22 July 1902. The Council's headquarters since its foundation has been in Copenhagen. The present members of the Council are: Belgium, Canada, Denmark, Federal Republic of Germany, Finland, France, Iceland, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, United Kingdom and USSR.

2. The Council's statutes have been changed from time to time; its main functions throughout the period have, however, been to encourage investigations into the study of the sea, and to co-ordinate the operations of the participating Governments to this end. Its area of operation has been roughly defined as the North Atlantic Ocean and contiguous or adjacent seas, including Greenlandic and Icelandic waters.

3. A new Convention for the International Council for the Exploration of the Sea was signed in 1964 and has now been ratified by the sixteen signatory Governments and has been accepted by Canada, which joined the Council after the Convention was signed. The Convention will enter into force on 22 July 1968.

4. According to this Convention, it shall be the duty of the Council:

(a) To promote and encourage research and investigations for the study of the sea, particularly those related to the living resources thereof;

(b) To draw up programmes required for this purpose, and to organize, in agreement with the contracting parties, such research and investigations as may appear necessary, and

(c) To publish or otherwise disseminate the results of research and investigations carried out under its auspices or to encourage the publication thereof.

5. According to article 2 of the Convention, "The Council shall be concerned with the Atlantic Ocean and its adjacent seas and primarily concerned with the North Atlantic".

6. The secretariat of the Council now includes a General Secretary, a Hydrographer, ten other full-time officers, and four part-time assistants. The Council has recently decided to establish a post of statistician as soon as its finances permit.

Organization of the Council

7. When the Council was established, it became a duty of the member Governments to set up laboratories, as well as co-ordinating national commissions, to take care of each country's responsibilities in accordance with the co-operation initiated by the Council. The chief national representatives in the Council are the two delegates from each member country. These delegates are not only heads of delegations at annual or other meetings; they are also the Council's permanent contacts in their country, and they constantly take part in the preparations of current, as well as special, activities.

8. At present the Council has the following standing (area and subject) committees:

Gear and Behaviour Committee
Hydrography Committee
Statistics Committee
Fisheries Improvement Committee
Demersal Fish (Northern) Committee
Demersal Fish (Southern) Committee
Pelagic Fish (Northern) Committee
Pelagic Fish (Southern) Committee
Shellfish and Benthos Committee
Plankton Committee
Anadromous and Catadromous Fish Committee
Marine Mammals Committee.

9. Each member country is entitled to appoint two members to each of the Committees in which they are interested, and those members function between meetings and until they are replaced. They are, therefore, the permanent contacts in all matters concerning the Committee's field of reference and their work between meetings (especially that of the Chairman) is quite considerable.

10. This structure gives the Council the possibility to mobilize for joint operations or investigations the scientific community of the member countries, and at the same time it gives a large number of scientists in the national laboratories a training in international collaboration, which has proved to be of very great importance.

11. There is also a Finance Committee (six delegates), and an Editorial Committee (three ex officio and two co-opted members). A Liaison Committee provides for the necessary co-operation with the Northeast Atlantic Fisheries Commission.

12. The meetings of the Council's area and subject Committees are open to all "experts" who are included in the member delegations as well as to observers from collaborating organizations. Meetings are also regularly attended by workers in the more basic aspects of marine research as well as by those whose work is more directly related to practical fishery problems. A number of academic marine workers are thereby drawn into ICES' programmes and activities. It is largely thanks to this contact between basic and applied science that ICES has been able to contribute to the foundations of marine science as well as to the understanding of the effects of fisheries on the stocks of commercial fish. Recent examples of more basic work are the Council's participation in the International Geophysical Year and the special survey of the Iceland-Faroe Ridge (the "Overflow" Expedition).

Hydrographical Service

13. Since its foundation the secretariat has included a Hydrographical Service which has assembled, published and distributed conventional data from cruises by member countries in the Northern and Middle Atlantic. Some data from areas south of the Equator are also available.

14. Up to the First World War data were mainly collected from three-monthly cruises undertaken under the auspices of the Council; later on, more frequent cruises were undertaken at irregular intervals, including a large number of more or less extensive joint undertakings. In this way the Hydrographical Service has served as a regional data centre. Throughout the sixty-five years of the Council's existence hydrographical data were published annually up to 1956. For the years 1957 to 1962 they will be published completely (in about sixty-seventy volumes) in the ICES Oceanographic Data Lists. For later periods only data from joint expeditions will be published by the Council, while the Hydrographical Service will continue to collect information from national cruises on punched cards and use them for the publication of atlases, tables and charts, as agreed upon by the member countries. The Hydrographical Service of ICES was the first International Data Centre to establish punched-card holdings of oceanographic data, and these holdings now comprise about 2 million cards.

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15. It should be mentioned that as late as in 1965 the member countries considered whether the establishment of the two World Data Centres A and B would make the Regional ICES Centre superfluous. All member countries found, however, that the ICES Centre with its detailed information and the two World Data Centres supplemented each other and that both were necessary from the point of view of the national offices and laboratories. There is full and effective collaboration between the ICES Centre and the two World Data Centres, and it is believed that the existence of the ICES Centre has in fact in the past been useful also to the World Data Centres.

International standardization

16. It should also be mentioned that the first international standardization (Standard Sea-Water Service, "Knudsen's Tables", standardization of instruments) took place under the auspices of the International Council. Although such activities are now the concern of world-wide organizations, the Council is still participating in them through joint working groups or otherwise. In the same way as for hydrography, the Council maintained during the first twenty years of its existence a planktological service, mainly concerned with identification of planktonic organisms, as well as types of plankton "associations" occurring in the Council's area. This service had fulfilled its original purpose by the 1920's. However, questions concerning standardization of nets and other gear as well as standardization of methods have remained on the Council's agenda, and this is another field where co-operation with other world-wide organizations continues.

Statistical Service

17. One of the first tasks for the Council to take up, when it was established, was the collection, standardization and publication of as detailed and complete statistics as possible from the areas where member countries were fishing. The Bulletin statistique, which is the chief source of statistical information from the Council's area now covers in its fifty volumes information for sixty-three years, and (together with the later supplementary Statistical News Letters) it represents the most detailed and complete statistics available from any of the large areas of the ocean.

18. There are two aspects of the Statistical Service which should be mentioned especially. When the principles of population dynamics were sufficiently elaborated (for a great part through discussions taking place in the Council's Committee, and based upon its early statistical series), the Council started the collection and publication of very detailed catch and effort information as well as biological data records of important species. These are published annually in the Statistical News Letters, of which about 350 pages are now being published each year. The other aspect is the introduction of the STANA being published each year. Through collaboration between FAO, ICES and ICNAF through a joint working party, and largely based upon the Council's early experience, a joint statistical reporting system has been introduced, whereby the Governments concerned report annually on a common format and with copies to each of the collaborating organizations. This arrangement automatically ensures that there will be no overlapping and that there are no gaps in the statistics.

19. The increasing need for current assessments of the strengths of each important stock of commercially exploited species results in ever-increasing demands on an international Statistical Service. Not only will even more detailed information be required but it is also essential to ensure that the right sort of information is collected. A very close operational liaison is, therefore, needed between the Statistical Service and the working groups, which are in charge of stock assessments, and this is one of the main reasons why the Council has recently decided to strengthen its Statistical Service by the appointment of a statistical officer.

Publications

20. Most of the Council's publications are concerned with what may be termed the "Council's area", but they also reflect the fact that for nearly half the period of its existence the Council was the only international organization of importance in its field, and for an even longer period it was the leading scientific body. It still maintains part of this role, because of its traditions, because its membership with few exceptions comprises the leading nations in its field and because of its organizational set-up. This is reflected in its publications.

21. The Journal du Conseil, printed three times a year, publishes relatively short research contributions, often, but not always, arising from communications to the Council meetings, and related to its main area of interest. "Area" in this

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connexion is not meant in its geographical sense, but refers to the subject-matter. The Journal du Conseil therefore publishes investigations of relevant general interest from contributors all over the world, and it has maintained a position as one of the leading international journals in its field.

22. The Rapports et procès-verbaux series is now issued irregularly, with reports on Joint Expeditions (such as, for instance, the Overflow Expedition (1960)), Joint Experiments (for instance, tagging experiments) or reports of symposia. The latter are frequently concerned with matters of very wide interest, so that they have drawn participatns, and also contributions, from a very wide - sometimes world-wide - international field. Examples are the Symposium on Measurement of Primary Production (1957), Zooplankton Production (1961), Exploitation and Regulation of Fisheries for Crustacea (1962) and the Measurements of Abundance of Fish Stocks (1965). In recent years such symposia have sometimes been co-sponsored by other international organizations.

23. The Co-operative Research Reports is a comparatively new series (since 1962). It contains mainly reports of working group activities, which are of general interest, some of them as much outside as inside the Council's geographical area. This is the case with a report of a Mesh Selection Working Group (Co-op. Res. Rep., Series A, No. 2). Other reports in this series have proved to be of interest to fishery research workers in other areas, as they demonstrate the application of modern methods to the solution of fishery problems.

Collaboration with other organizations

24. At present the Council is collaborating with many other intergovernmental as well as non-governmental international organizations. One of these collaboration arrangements especially deserves to be mentioned, namely the relationship between the Council and the Northeast Atlantic Fisheries Commission (NEAFC). The Commission is a regulatory body, and, from the beginning, a special relationship has existed between the Commission and the Council. The Commission submits questions to the Council for advice and it is believed that the dialogue between the regulatory body on one side and an independent, international body with the possibility of mobilizing the recognized scientific community in the member countries on the other side is of great value for the common purpose of both.

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25. Collaboration with other international organizations is largely on a more informal basis. This has not, however, been any obstacle to its development. As an example may be mentioned the very close relationship with FAO, which has grown out of the two organizations' activities and their mutual interests. One such collaboration of a permanent character concerns the collection and publication of statistics through the STANA system.

26. Other activities include at present:

(a) Current Bibliography for Marine Science and Fisheries which has replaced an earlier activity of the Council. The compilation of the Bibliography is now largely undertaken by the FAO staff, but the former editor of the ICES Bibliography, paid by ICES, is also connected with it;

(b) Together with the American Geographical Society, the publication of a North Sea Synopsis in the Society's Serial Atlas of the Marine Environment. The Synopsis is based on the work performed by an ICES working group, which drew upon the large scientific community available through the Council's committees;

(c) Production of a handbook, consisting of Leaflets of Fishery Statistics. The authors were largely sought through ICES, which also paid their fees, while the publication is undertaken by FAO;

(d) A North Atlantic Bibliography based upon the ICES and ICNAF series of publications. Most of the compilation was done by the FAO staff, but partly paid for by ICES. The printing will be undertaken by FAO, while the three organizations will distribute it jointly;

(e) A Working Group on Direct and Speedier Measurements of Fish Abundance (FAO, through ACMRR). Largely the same members constitute an ICES working group to run a Ccurse in the use of Hydro-acoustics for Measurement of Fish Abundance, to be held under the auspices of ICES with FAO support during 1968;

(f) The two organizations have agreed to establish a Joint Working Group for Assessment of Important Stocks of Commercially Exploited Fishes in West African Waters;

(g) The Council will, with the support of FAO, hold a Symposium in 1968 on the living resources of the African Atlantic Continental Shelf, the stocks of such resources, and their fisheries between the Straits of Gibraltar and Cape Verde,

at Santa Cruz de Teneriffe. Collaboration will in this case enable contact to be established between the coastal States (through FAO) and other nations (members of ICES) fishing in the area, for discussion of scientific matters and possibly also future scientific collaboration;

(h) The two organizations (together with ICNAF, IOC and IBP) will arrange in 1968 a world-wide Symposium on food chains in the sea, when ICES will act as host and provide secretarial assistance during the Symposium;

(i) The two organizations - in collaboration with the Danish Government - will jointly run a Course in Stock Assessment Methods in Copenhagen in 1968. This Course is a link in a series of such courses, started by the Council in Lowestoft in 1957 and by FAO in non-European countries.

27. Collaboration between ICES and IOC/UNESCO is developing along similar lines, and the fact that only a short time has been available is the reason why the list of joint activities is shorter. However, it includes such important fields as:

(a) Intercalibration and intercomparison of hydrographical methods (with SCOR and IBP). It has again been possible through the Committee contacts of ICES, which also comprise the academic workers in the field, so far to arrange three regional intercalibration tests, the results of which have been, or will be, published by UNESCO;

(b) The publication of oceanographic data from joint expeditions, such as the Baltic investigation of 1964; the working-up of the material and the publications were undertaken by the Hydrographical Service of ICES, with financial support of UNESCO;

(c) Joint meetings and working groups and also participation in joint working groups (together with other organizations) for new oceanographic standards and tables, as well as for standardization of plankton gear and planktonological methods;

(d) Co-operation in several ways in the collection of oceanographic data, whereby the ICES secretariat in some cases accepts a responsibility as a regional centre;

(e) Co-operation with IOC and the World Data Centres A and B in order to facilitate the exchange of oceanographic data. This co-operation takes place both in the planning and on the operational level.

28. Collaboration with other organizations, most particularly with ICNAF, mainly takes place by exchange of observers at meetings, constant contact between the secretariats and exchange of meeting documents, such as committee and working group reports. Sometimes the collaboration takes place through joint symposia (for example on Redfish Biology) or working groups (such as the Joint ICES/ICNAF Working Group on Atlantic Salmon) or joint meetings, such as the Meeting on Standardization of Methods for Measurements of Fishes (Rome, 1965).

The International Hydrographic Bureau (IHB)

29. The International Hydrographic Bureau had its inception in the International Hydrographic Conference, convened in London in June 1919, with delegations from twenty-four nations. They agreed unanimously to recommend to their Governments the establishment of an International Hydrographic Bureau. Statutes were drafted and approved in 1921, when the IHB began its activities with nineteen member countries. At the invitation of Prince Albert I of Monaco, who offered to provide the necessary accommodations for the new agency, it established its seat at Monaco, where it maintains a small permanent staff.

30. The IHB is financed by contributions from its forty-one member countries, levied annually according to the tonnage of ships in the combined national navy and merchant marine. Every five years an International Hydrographic Conference is convened at Monaco to elect the Directing Committee and to decide on policy matters. Between Conferences the IHB is administered by the three-man Directing Committee of broadly experienced hydrographers, who reside at Monaco.

31. The objects of the IHB, according to the most recent revision of its statutes, are the following:

(a) To establish a close and permanent association between the hydrographic offices of its members;

(b) To encourage co-ordination of the hydrographic work of these offices with a view to rendering navigation easier and safer throughout the world;

(c) To endeavour to obtain uniformity as far as is possible in charts and hydrographic documents;

(d) To encourage the adoption of reliable and efficient methods of carrying out hydrographic surveys;

(e) To encourage development of theory and improvement in the practice of the science of hydrography;

(f) To encourage co-ordination of hydrographic surveys with relevant oceanographic activities and to provide for close co-operation between the IHB and existing international organizations in the field of oceanography, particularly the IOC.

(g) To extend and facilitate the application of oceanographic knowledge for the benefit of navigators.

The new Convention

32. The ninth International Hydrographic Conference, held in April and May 1967, agreed on the text of a new Convention, which will establish an International Hydrographic Organization. The Convention was signed, subject to ratification, by the representatives of seventeen countries, on 5 May 1967 and will be open for signature until 31 December 1967. It has been deposited with the Government of the Principality of Monaco and will enter into force with the ratification of twenty-eight Governments.

33. The new International Hydrographic Organization will be composed of the permanent Bureau and the periodic Conference. Provision has been made for registering the Convention, after it has entered into force, with the Secretariat of the United Nations in accordance with Article 102 of the United Nations Charter.

Publications of the IHB

34. Besides numerous technical publications dealing with hydrography, the IHB publishes the semi-annual International Hydrographic Review and the monthly International Hydrographic Bulletin. It also published the General Bathymetric Chart of the Oceans (GEBCO), a series of charts of the deep oceans at the scale of 1:10,000,000, in co-operation with the hydrographic offices of seventeen countries, which divide responsibility for assembling sounding data and compiling individual sheets.

Co-operation of the United Nations and of various institutions in IHB activities

35. International co-operation, as provided for in the statutes of the IHB, is very satisfactory.

36. The Bureau intends, however, to strengthen or to develop its existing relations with the United Nations and with various specialized organizations. The IHB has had profitable contacts with the Cartography Section of the United Nations Secretariat, with IOC, FAO, PAIGH, etc. Co-operation with these institutions has proved most useful, for example, with regard to the elimination of doubtful bathymetric data.

37. Co-operative assistance by United Nations agencies, whatever its nature, is considered in many other instances, in particular for encouraging surveys in coastal areas where bathymetric data are insufficient. This would also apply to aid which could be brought to those States wishing either to establish a hydrographic office or to further develop one already in existence, since the IHB has, under the present conditions, no function other than to tender advice, if required, as it has neither the capability nor the financial means to offer the material help which is so frequently indispensable to effective results.

International Commission for the Northwest Atlantic Fisheries (ICNAF) a/

38. Under the terms of a Convention signed in 1949, the International Commission for the Northwest Atlantic Fisheries is responsible for promoting and co-ordinating scientific studies on the stocks of the species of fish which support international fisheries in the Northwest Atlantic. Based on these researches, the Commission may recommend the application of the following measures to keep these stocks at a level permitting the maximum sustained catch:

(a) Establishing open and closed seasons;

(b) Closing to fishing such portions of a subarea as the panel concerned finds to be a spawning area or to be populated by small or immature fish;

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a/ The following statement was furnished for this report by the Executive Secretary of ICNAF.

(c) Establishing size limits for any species;

(d) Prescribing the fishing gear and appliances the use of which is prohibited;

(e) Prescribing an over-all catch limit for any species of fish.

Membership

39. The countries which share these conservation interests because of their substantial fisheries are Canada, Denmark, Federal Republic of German, France, Iceland, Italy, Norway, Poland, Portugal, Romania, Spain, Union of Soviet Socialist Republics, United Kingdom of Great Britain and Northern Ireland and the United States of America. Offices of the Commission's headquarters are located, by courtesy of the Canadian Government, in the Bedford Institute of Oceanography at Dartmouth, Nova Scotia, Canada.

Committees

40. The Commission has (a) a Standing Committee on Finance and Administration to advise the Commission on matters of finance and administration, (b) a Standing Committee on Research and Statistics to develop and review research programmes and co-ordinate the efforts of the research institutions and scientists of contracting Governments in their implementation, (c) a Standing Committee on Regulatory Measures established in 1967 to give direction to the Commission's programme of work on the problems in connexion with regulatory measures for the fisheries of the Convention area. Ad hoc committees are established as required.

Panels

41. The Commission has six panels, five of which review the status and recommend proposals leading to the wise management of the fisheries in a geographic subarea of the Convention area, while the sixth reviews the status and recommends proposals respecting harp and hood seals in the Convention area. Panel 1 administers the fisheries in the subarea off West Greenland (subarea 1), Panel 2 the subarea off Labrador (subarea 2), Panel 3 off the south and east of Newfoundland and on the Grand Bank (subarea 3), Panel 4 in the Gulf of St. Lawrence and on the Nova Scotia Banks (subarea 4), Panel 5 in the Gulf of Maine and on Georges Bank (subarea 5), and Panel A, the harp and hood seal fisheries in the Convention area.

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Statistical and biological data

42. The Commission early recognized the fundamental need for complete and reliable statistics on the fisheries in the Northwest Atlantic and thus allows its scientists to make the scientific assessments which form the basis for regulating the fisheries in an effort to maintain the maximum sustained catch. Since 1951, ICNAF has concentrated its efforts on collecting, analysing and publishing data on the fish, fish landings and fishing activity (ICNAF Sampling Yearbook and ICNAF Statistical Bulletin). Co-sponsorship with ICES and FAO of the Expert Meeting on Fishery Statistics in the North Atlantic Area in 1959 and of the Continuing Working Party on Fishery Statistics in the North Atlantic Area continues to result in standardized statistical requirements and procedures for the whole of the North Atlantic region.

Research programmes and management techniques

43. The Commission, proceeding on the basis of making sure of the scientific data before embarking on ambitious regulatory measures, drew up an international fisheries research programme and stimulated the development of new ideas and techniques for the solution of international and national fisheries-management problems by organizing scientific symposia on:

(a) Biological fisheries survey problems and techniques for their solution, at Biarritz, France, in 1956;

(b) Fishing effort, effects of fishing and selectivity of fishing gear, at Lisbon, Portugal, with ICES and FAO, in 1957;

(c) Redfish Sebastes in the North Atlantic, at Copenhagen, Denmark, with ICES, in 1959;

(d) Techniques for fish marking and methods of analyses of recovery data, at Woods Hole, Massachusetts, United States of America, in 1961;

(e) Influence of the environment on the distribution and abundance of the major fish stocks of the ICNAF area, at FAO, Rome, in 1964.

44. All symposia were published in the ICNAF Special Publication series and given world-wide distribution.

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Regulation by mesh size

45. Based on the success of an experimental 114 mm mesh-size regulation in 1952 in subarea 5 (Georges Bank), which allowed the small haddock in the declining trawl fishery for haddock to escape in the sizes and quantities recommended by Commission scientists, regulation by mesh size was applied as a conservation measure to other important commercial species in the other subareas. By 1967, ICNAF mesh-size regulations were enforced for cod and haddock in subareas 3 (110 mm), 4 and 5 (114 mm) and were proposed for all groundfish species in subareas 1 (130 mm), 2 and 3 (114 mm), excluding redfish in Div. 3NOP and for cod, haddock and flounders in subarea 4 (114 mm).

Exemptions in non-regulated fisheries

46. In addition to using regulation by mesh size as a conservation measure, the Commission has adopted exemption measures for the protection of the regulated species (cod and haddock) taken in areas where there are substantial fisheries using small-mesh nets for non-regulated species.

Assessment of effect of mesh size

47. Commission scientists pioneered in the development of methods for the assessment of the benefit of saving small fish by regulating mesh size of the nets. In 1962 they reported on the effects of fishing on the stocks of the major commercia species and on assessments of the effect on catches, both immediate and long-term, of changes in the selectivity of gear, in particular, of changes in the mesh size of trawls ("Report of Working Group of Scientists on Fishery Assessment in Relation to Regulation Problems", Supplement to the ICNAF Annual Proceedings, vol. 11, 1962). These assessments of the benefit of mesh regulations are reviewed annually and are the basis for recommendations by the Commission for changes in mesh-size regulation to maintain the fish stocks at a level permitting a maximum continuous catch.

Assessment of effect of fishing

48. In 1964, the Commission, from an assessment of the effect of the increasing fishing activity found (a) that the fishing intensity with which many of the major

stocks of cod and haddock were being fished was at or near that at which they could provide their greatest sustained catches, (b) that mesh-size regulations could not, in themselves, offset the consequences of the continuing build-up in fishing pressure. The Commission, concerned by these findings, asked its scientists to continue studies of effects of fishing and to review possible additional conservation measures which might be used to ensure greatest continuous yield from the fish stocks in the Northwest Atlantic.

49. "A Review of Possible Conservation Actions for the ICNAF Area" (ICNAF Annual Proceedings, vol. 15 1965, pp. 47-56) made it clear that in addition to mesh regulations there must be some direct control of the amount of fishing. The Commission recognized that although catch quotas seemed to be the most feasible system of regulation, it posed scientific and practical difficulties for the ICNAF and also the NEAFC areas of the North Atlantic owing to possible diversions of fishing effort. A decision to obtain more knowledge of the economic implications of possible management practices led in 1966 to the establishment by ICNAF with participation by FAO, NEAFC and OECD of a Working Group on Joint Biological and Economic Assessment of Conservation Actions. The report (ICNAF Comm. Doc. 67/19) led to the setting up in 1967 of a new ICNAF Standing Committee on Regulatory Measures, which will meet early in 1968 to consider its programme of operations and future work on the economic and administrative aspects of the problems of introducing regulatory measures and those of the Commission's Standing Committee on Research and Statistics on the scientific aspects of these problems.

Assessment of effect of environment

50. The Commission developed and adopted an environmental programme to assess the influence of natural causes on the abundance and distribution of fish stocks and on the success of fishing operations. From April to June 1963, a pioneering survey (NORWESTLANT I-III) studied the drift of cod eggs and larvae and redfish larvae in relation to their environment in the northern part of the ICNAF area and in the Irminger Sea. The survey involved the co-ordinated efforts of eight countries using eleven research vessels. Results are being prepared for publication as ICNAF Special Publication No. 7. The Commission also completed an international scientific symposium on the environment in relation to the major fish stocks in the

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North Atlantic, at FAO, Rome, early in 1964 (ICNAF Special Publication No. 6, 1965). Results provided ideas for environmental studies to distinguish between the effects of the environment and effects of fishing on changes in the fish stocks. By 1967, plans were advanced for an international study of fish stocks and recruitment in relation to fishing and the environment in the Gulf of Maine area (subarea 5).

International enforcement

51. The Commission unanimously agreed in 1964 to recommend to contracting Governments that a system of international enforcement of Commission regulations be set up to eliminate the variability of standards possible under a system of national enforcement. While waiting for the Protocol to come into effect, the Commission has encouraged successful bilateral exchanges of national enforcement officers. Such exchanges are providing understanding among the fishing nations of each other's enforcement problems as a background for ensuring an acceptable and effective joint enforcement scheme. Studies are being conducted regarding the applicability of a NEAFC joint enforcement scheme in the Northwest Atlantic under existing ICNAF trawl regulations.

Seal conservation

52. The Commission, in 1966, became responsible for investigation and management of the declining international fishery for harp and hood seals in the Northwest Atlantic. Through the efforts of its scientists and Panel A, conservation measures such as length of hunting season and catch quotas are being assessed. Consideration has been given to the animal welfare agencies who are concerned with the humane killing of seals in the commercial hunt, and mutual understanding of the conservation and humane points of view is proving effective.

Salmon conservation

53. The development, since 1961, of a commercial fishery for Atlantic salmon in waters off Greenland has led to assessment by an ICNAF/ICES Joint Working Party on North Atlantic Salmon of the effects of the fishery on the North American and European stocks of Atlantic salmon which have been found to frequent the Greenland area.

Future activities

54. The outlook for the future is based on the Commission's concern for the rapidly increasing fishing activity in the Convention area by fourteen member countries and at least three non-member countries on present and new stocks and species of fish. Such expansion must now give way to rational and controlled exploitation. Conservation measures to supplement regulation of mesh size will be sought, and problems of early implementation and enforcement will be considered in close co-operation with FAO, ICES, NEAFC and OECD with the aim of establishing common benefits for countries fishing in the whole of the North Atlantic. Commission scientists will continue to improve the kind and collection of data on the fisheries and to develop new ideas and techniques which will allow them to advise the Commission impartially and objectively on the effects of fishing and of proposed regulatory measures on the stocks and catches in the Northwest Atlantic.

Northeast Atlantic Fisheries Commission (NEAFC)

55. As related fully in this chapter under ICES, the Permanent Commission for the Northeast Atlantic Fisheries was created in 1954 as the result of a Convention signed in 1946 and ratified in 1953. It was redesignated NEAFC under a new Convention in 1962. The Commission is a regulatory body, deriving its scientific advice from ICES in the manner already described.

International Commission for the Scientific Exploration of the Mediterranean Sea (ICSEM)

56. This Commission, a Mediterranean counterpart of ICES, was established in November 1919 at Madrid, Spain, by an agreement between the Prince of Monaco and seven member countries. The Commission in plenary assembly determines a programme of scientific work to be carried out by all member States.

Inter-American Tropical Tuna Commission (IATTC)

57. The Inter-American Tropical Tuna Commission is an international fisheries research organization which operates under the authority and direction of a

Convention originally negotiated between the United States of America and the Republic of Costa Rica and entered into force in 1950. The Convention is open to adherence by other Governments whose nationals participate in the fisheries covered by the Convention. Under this provision Panama adhered in 1953, Ecuador in 1961 and Mexico in 1964. Canada applied for membership early in 1967. Other Governments with fishing interests in the area are actively considering the desirability of adhering.

58. Convention waters are described as the "Eastern Pacific Ocean". This has been roughly interpreted to include waters from southern California to northern Chile, a distance of some 4,500 miles. These waters bathe the shores of eleven countries and lie in two hemispheres. Convention waters extend eastward as far as tropical tuna found in coastal waters travel.

59. The principal species studied so far are the commercially important yellowfin and skipjack tunas and the small baitfish used by some vessels to catch the tunas. Researches are carried out by a permanent internationally recruited staff directly under control of the Commission.

60. All member Governments contribute moneys towards the operation of the Commission according to a formula outlined in the Convention based on the amount of catch and utilization of the principal species.

Duties

61. The principal duties of the Commission as detailed in the Convention are (a) to study the biology, ecology and population dynamics of tunas and tuna-bait fishes of the eastern Pacific with a view to establishing the effects that fishing by man has on the stocks and (b) to recommend suitable conservation and management measures designed to maintain the tuna stocks at a level that will afford maximum sustainable catches, when Commission researches demonstrate that such measures are necessary. To carry out these mandates requires a wide variety of researches.

Researches

62. Researches include studies into the life history, biology, population structure and vital statistics of tunas and tuna-bait fishes of the eastern tropical Pacific Ocean, as well as ecology and the oceanography of this general area. Special

effort is made to collect complete location of catch, effort and landing statistics from tuna vessel logbooks and by personal interviews with fishing captains throughout the fishery.

Publications

63. The principal results of the Commission's researches are published in a bulletin series in English and Spanish, the Commission's two official languages. Summaries of research and operational matters are reported on each year in a bilingual annual report. Shorter studies and reports are published in outside journals and periodicals. By the end of 1966, the Commission had published and given world-wide distribution to eighty-five scientific bulletins, more than 100 scientific papers and articles in outside journals, and fifteen annual reports.

Conservation

64. With increased fishing in the Convention area in recent years, owing to fishermen from new countries entering the fishery as well as from the greatly increased efficiency of those that had fished there for some time, Tuna Commission researches have shown that yellowfin tuna stocks have been somewhat overfished for several years, particularly 1960, 1961 and 1962. In keeping with its mandate under the treaty, the Commission has recommended conservation measures to member and other Governments since 1962. It did not prove practical, however, for all Governments fishing substantially in the area to implement suitable regulations until 1966. The Commission's conservation recommendations (a catch quota for yellowfin) has now been in force and observed by all Governments, members or not, during 1966 and 1967. It is the Commission's hope that with continuing attention to good conservation practices, the stocks of yellowfin can be restored and maintained at their maximum sustainable level in a few years, as envisioned in the treaty.

International Whaling Commission (IWC)

65. The International Whaling Commission was established in 1948 upon ratification of the International Whaling Conventions signed at Washington, D.C. in 1946. It has as members most of the principal nations interested in whaling, each of which

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sends one Commissioner to an annual meeting in London. Its object is to encourage or organize studies related to whales and whaling and to consider amendments to the schedule of regulation that formed part of the original Convention.

International North Pacific Fisheries Commission (INPFC)

66. The INPFC was established in 1953 by a Convention between Canada, Japan and the United States, the objective of which is to ensure the maximum sustained productivity of the fishery resources of the North Pacific Ocean. The INPFC promotes and co-ordinates the scientific studies necessary to ascertain the conservation measures required to secure the maximum sustained productivity of fisheries of joint interest to the contracting parties and recommends such measures to such parties. One of the INPFC's major responsibilities is to review annually the status of those stocks listed as being under "abstention", a principle which is unique to the North Pacific Convention. Each contracting party appoints four members to the INPFC and pays an equal share of the cost of doing business and operating its secretariat in Vancouver, British Columbia. Annual meetings are held in the member countries on a rotation basis; interim meetings are held as needed. The INPFC publishes an annual report and a bulletin, each of which is printed in both English and Japanese, its official languages.

International Pacific Halibut Commission (IPHC)

67. This body was originally created in 1923 as the International Fisheries Commission under a Convention between the United States and Canada to investigate the halibut resource of the northern Pacific Ocean including the Bering Sea and to recommend measures for its preservation. The regulatory authority of the Commission was extended under the Conventions of 1930 and 1937. Under a new Convention in 1953 the Commission was renamed the International Pacific Halibut Commission. It is charged with the development of the stocks to levels which will permit the maximum sustainable yield and with maintaining the stocks at those levels. From its headquarters in Seattle, Washington, it conducts scientific investigations upon the resource throughout the range of the fishery extending from northern California to waters off Asia. It develops annual regulations based on the scientific findings and publishes both scientific and annual reports.

International Pacific Salmon Fisheries Commission (IPSFC)

68. The International Pacific Salmon Fisheries Commission was formed in 1937 by ratification of a Convention between the United States and Canada to preserve, protect and extend the sockeye salmon fisheries of the Fraser River. In 1957 the pink salmon of the Fraser River came under its jurisdiction. The Commission's headquarters are at New Westminster, B.C.

Organisation for Economic Co-operation and Development (OECD)

Fisheries Division

69. The twenty-one countries[b/] which make up the Organisation for Economic Co-operation and Development (OECD) are partners in a permanent diplomacy designed to harmonize national economic policies through the regular practice of co-operation, consultation and constructive mutual criticism.

70. OECD serves this common effort as an instrument for making available knowledge relevant to the formulation of rational policy in every major field of economic activity, and as a forum, meeting the year round, in which such policies may be worked out in the light of shared ideas and experiences.

71. The Fisheries Division lies within the Directorate of Agriculture and serves a Committee for Fisheries composed of delegates from OECD member countries, the main concern of which lies in policies, management and trade. Thus, it acts as a forum for discussing national fisheries policies, explores ways and means of improving fisheries management generally and works to develop international trade in fish, the ultimate object being a greater contribution by fisheries to economic growth through betterment of the conditions, particularly those of an international character, under which the national fishing industries operate.

72. It may be helpful for an understanding of the work of the Committee for Fisheries if some samples are given of the projects and studies undertaken in the past decade.

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b/ Austria, Belgium, Canada, Denmark, Federal Republic of Germany, France, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States of America. Special status countries: Yugoslavia, Finland.

Policies

73. There have been two confrontations of the national fisheries policies of member countries, the second laying particular emphasis on the development of fishing power. An investigation into financial assistance given to the industries has been published.

Primary production

74. Studies have been conducted on the economic factors affecting the rational exploitation of certain fish stocks in the North Atlantic, latterly in co-operation with the Commissions concerned in conserving the stocks. Exploratory work is now in progress on the collection, internationally, of statistics on the fishing fleets. Techno-economic studies have been undertaken on the effect of various technical developments on the economics of catching. A comprehensive examination of the price systems employed in OECD countries has been published, as has a review of methods used in assessing costs and earnings.

Trade

75. Particular attention has been paid to impediments to international trade and their influence, taking in customs duties, import restrictions, etc. Surveys have been completed of the markets for various commodities, e.g., canned fish and herring. The international market for frozen fish will be investigated in 1968. A multilingual dictionary of fish and fish products has been compiled.

Annex XIII

SPECIFIC SCIENTIFIC PROBLEMS WHICH REQUIRE EXPANDED INTERNATIONAL CO-OPERATION

1. During discussions among scientists associated with the Advisory Committee on Marine Research of FAO, and the Scientific Committee on Oceanic Research of ICSU, it appeared that, since marine scientists and their laboratories are affected in an important way by international institutional arrangements, scientists must give careful consideration to the issues raised by General Assembly resolution 2172 (XXI). It was decided to establish a joint working group nominated by the two bodies (later joined by WMO Advisory Committee) for this purpose. The Working Group was invited by FAO, IOC and WMO to advise on scientific aspects of implementation of the resolution.

2. The meeting of the Joint Working Group was convened at Helio Cabala (Marino, Italy) on 17 July 1967. On 20 July, the meeting was transferred to Rome, at the FAO Department of Fisheries, where it was concluded on 21 July.

3. A special report on International Ocean Affairs was prepared by the Joint Working Group from which the following section has been extracted as being of interest in relation to the present report.

Examples of specific marine problems requiring international co-operation

Data problems

4. Data exchange is carried on by a variety of informal ad hoc arrangements as well as through more formal channels. In the latter case, the World Data Centres for Oceanography are organized through a non-governmental organization (the International Geophysical Committee of the International Council of Scientific Unions), are operated at national expense (United States of America and USSR), and receive data through inter-governmental agreements made in the Intergovernmental Oceanographic Commission. Other international data exchange systems (for example, bathymetric data through the International Hydrographic Bureau, fishery data through FAO and various regional bodies, regional

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oceanographic data through the International Council for the Exploration of the Sea and the Kuroshio Data Centre etc.) are loosely affiliated through the IOC. Meteorological data, including some oceanographic parameters such as sea surface temperature and sea state, are handled through a separate international system under WMO.

5. Despite the rapid development of international data exchange, particularly during and since the International Geophysical Year, certain inadequacies are becoming apparent. For example, the existing system is unable to cope with the flood of data resulting from expanded programmes in marine science and technology, does not regularly receive important proprietary data, is virtually unable to handle certain types of data (for example, geological and biological data, or data from in situ and other continuously recording instruments), is too poorly co-ordinated internally and with related fields (as meteorology) to permit easy retrieval of all required information, and in general is not organized in accordance with modern concepts of data management.

6. With the development of ocean-wide networks of observing stations, and with the growing importance of synoptic oceanography, there is an increasing urgent requirement for several kinds of data to be exchanged and made available in real time (i.e., at the time of observation). The present oceanographic data system is incapable of meeting this requirement. This state of affairs is in marked contrast with the situation in meteorology where both raw and processed data are exchanged in real time as well as being archived.

7. A modern data exchange or processing system will be complex and expensive, especially because of the wide variety of data and requirements for handling them. To support such a system, a significant increase in national or international funding is required. Existing international organizations in the marine field cannot conceivably operate the necessary data systems. Existing organizations could, however, be used in the development of the desired system. Scientific advisory bodies (SCOR, ACMRR, WMO Advisory Committee) could co-operate in establishing the principles on which the system should be based. Inter-governmental and inter-agency consultations, through IOC and regional channels, could determine the most practicable method to achieve the desired end.

This method may be to expand the functions and capabilities of one or more national centres, with increased international support and responsibility.

Documentation problems

8. Various efforts are being made at the national and international level to provide scientists with listings, indexes and retrieval services for the marine science literature. For example, the Hydrographic Institute of the Federal Republic of Germany provides such services in the non-biological area, while the FAO Fishery Department, in its Current Bibliography for Aquatic Sciences and Fisheries and Current Contents for Marine Sciences attempts to cover a broader field. However, even with the present output of pertinent scientific literature, existing services are far from adequate to meet the wide interests of the scientific community on a global basis.

9. Furthermore, with the expansion of programmes in marine science and its applications, documentation is increasing rapidly. Important advances have been made in the theory and technology of handling information. Demand for adequate information services is growing, particularly in the area of mutual assistance, where field programmes require detailed and extensive background documentation. Present activities in the marine science documentation field are inadequately funded, and are subject to restrictions and inefficiencies that make it difficult to expand them to meet the new needs.

10. If these documentation problems are to be rationalized, they must be discussed at the international level. Any adequate international service would have to be financed by Governments (it was estimated that such a service would cost $500,000-$1 million per year to operate). As in the case of data exchange, an existing national service could be expanded to meet the need, or the service could be provided at an international level.

Exchange of information

11. Important opportunities for collaboration between laboratories in different countries are often missed because information on research plans is not available. Present arrangements for obtaining and disseminating such information are

relatively informal and work well only in limited regions. If fairly complete information on planned programmes were available on a timely basis, useful co-ordination of national programmes could be achieved.

12. The principal difficulty is in obtaining advance information in a systematic manner. This requires an active system of correspondence and laboratory visits. Operation of such an intelligence service to make available information on research programmes, activities of scientists and development of institutions and facilities, is an appropriate function for an international organization. Existing organizations could do this job adequately if they had substantially larger budgets and staffs.

Standardization and intercalibration

13. With the growth of co-operative investigations the need for comparability of data has become more evident. For the most routine sort of observations it is sometimes possible to reach agreement on standard methods which all participants will use. More often, such agreement is not possible and it is necessary to compare the various methods to be employed. Agreed reference methods are useful for these comparisons.

14. Studies of methods and their comparison have been carried out by scientists within the framework of organizations such as ICES and SCOR, often with the encouragement and support of UNESCO, IOC, FAO etc. The work is slow and difficult. The few intercalibration experiments carried out at sea have had limited success. On the other hand, some standards or references are being widely used, such as standard water and carbon-14 solutions, and some standardization of plankton nets is taking place.

15. How can progress towards better and more comparable methods be expedited? Shortage of funds and staff in the various organizations concerned is part of the problem. The basic work is done by scientists in national laboratories with national funds, and increased support at the national level is clearly required. In some cases it may be desirable for a national laboratory with international support to assume an international responsibility for work on a certain method. In some cases, an international standards laboratory may be indicated.

International organizations should co-ordinate and support the work more actively and effectively than in the past. They cannot do so at the present level of funding or with the means presently available for co-ordination among them.

Sea floor charting

16. Through a variety of arrangements, such as the IHB and GEBCO programme, and through the co-operative investigations sponsored by IOC, information is steadily accumulating on the topography of the sea floor. Yet production of an accurate and detailed bathymetric chart of the sort now possible with modern echo-sounding and navigational methods requires a much higher level of co-ordination than is now achieved. A deliberate and systematic effort to survey most of the high seas regions will be necessary, and the scope of this effort clearly demands more sophisticated international co-operation.

17. An adequate map of the sea floor will have many uses in scientific investigation, fisheries, navigation, exploitation of mineral resources etc. The first step in organizing the preparation of such a chart should be to find out what information is most important to potential users, and to determine what scales would be most appropriate. For example, a chart on the scale 1/4,000,000 might be convenient; this would require summary of soundings originally plotted on the scale 1/1,000,000. Once the specifications for the desired chart were established, IOC, in consultation with IHB and other appropriate bodies, could undertake inter-governmental consultations to ascertain how the survey could most effectively be carried out.

Regional and world-wide networks

18. A global network of synoptic meteorological observations has been in existence for many years and is being expanded and perfected by WMO within the framework of the World Weather Watch. The impetus for this activity comes from the synoptic nature of weather analysis and the requirements for weather forecasting on various time and space scales, in support of economic activities. It is clear that oceanographers will very soon require an analogous observation network for monitoring and predicting changes in the ocean. Synoptic oceanography

and ocean forecasting are in their infancy, so that the requirements for an observational network have not yet been established.

19. Since 71 per cent of the earth's surface is covered by oceans, great attention is being given by States members of WMO to expand the meteorological observational system over the high seas. The cost of this part of the meteorological network and its supporting facilities is very high and the incorporation of certain oceanographic observations in this system requires urgent consideration if the cost effectiveness of the programme is to be maximized. Thus, it is urgent that oceanographers and meteorologists meet to co-ordinate the observational programme on moored and drifting automatic stations, on island and coastal stations and on ships of opportunity specially provided with observing personnel. This would permit maximum oceanographic utilization of the meteorological network. Meanwhile, oceanographers must ascertain their own requirements for a monitoring network, so that a scheme can be developed for supplementing the observations derived from the meteorological network where necessary. This supplementary network could be used to some extent both for oceanography and meteorological purposes.

20. It is therefore essential to ensure effective co-ordination of oceanographic and meteorological activities. A first attempt in this direction was made by the establishment of joint WMO/IOC working groups, but there is doubt as to the adequacy of such arrangements in view of the complexity of the problems involved and of the difference in the present international institutional arrangements, including funding. There is as yet no experience in joint action on important matters such as the desirability and design of a joint meteorological-oceanographic network. Because of the extremely close interrelationship of these two disciplines, it is essential and urgent that a mechanism be found for their immediate and effective joint action.

Living resources

21. This is another field in which the need for further international action is urgent. Greater fishing pressure, especially by large fleets of widely ranging vessels, is increasing the demand for adequate management much faster than means

to satisfy this demand are being developed. The present failure to achieve rational expansion and effective management has resulted in a large loss in the harvest of some of these resources (e.g., the nearly complete loss of the Antarctic whales), and increased costs in harvesting others (e.g., an unnecessary extra $50-$100 million per annum in harvesting North Atlantic cod), even to the point of inhibiting the development of new fisheries. It also risks causing a considerable degree of international friction.

22. FAO is at present engaged, under the Indicative World Plan, in a quantitative study of the living resources of the sea, both those exploited and those at present unexploited. The speed, comprehensiveness and accuracy of this survey have been reduced by a shortage both of the right kind of data and of sufficient staff and facilities to analyse them. Such studies are of particular value to international bodies and especially to the UNDP and the international development banks in their programmes for expanding and developing fisheries in many parts of the world. If these studies are to contribute effectively to the future development of world fisheries, much greater resources need to be allocated to providing the necessary scientific material. More work, especially on direct fishery surveys using modern techniques of echo-sounding and sonar, must be carried out on the national level and must be co-ordinated and collated internationally.

23. The achievement of the proper scientific basis for development and management clearly requires a substantial increase of the scientific effort engaged in this research at the national level as well as better international co-ordination and co-operation. It must also be admitted, however, that even within the present total efforts expended in marine research, improved assessments could be achieved in many fisheries by improving the allocation of these scientific efforts between various fields of study. The basis for an improved allocation could best be given by modern analytical techniques such as systems analysis and linear programming. We therefore urge that such studies be arranged, perhaps by ACMRR, on some of the major developed or developing fisheries of the world. These studies should examine: (a) the types of data which are, or could be collected (e.g., physical and biological oceanographic data, taxonomic and physiological

data on fish, catch and fishing effort statistics, biological statistics etc.); (b) the degree to which assessment of the distribution, magnitude, status and interrelations of fish stocks is impeded by shortcomings in particular types of data or is limited by the number of qualified experts in the relevant scientific fields.

24. While the improvement of the basic scientific understanding of the population dynamics of fish resources is essential for better management, there is also an urgent need for better arrangements for management, for dealing with marine pollution and for promoting research directed to the improvement of the living resources. Of special relevance to the present group were better arrangements for providing scientific advice to responsible fishery bodies. In the time available, we were unable to make specific proposals regarding these arrangements, and were also unable to enumerate all of the desirable criteria, especially those concerning the scientific and technological problems. Consideration of these criteria seems particularly important at the present time when several new arrangements are being drawn up for dealing with international fishery problems, and when some existing international bodies are not fully effective within their terms of reference. We therefore urge that ACMRR, COFI and other appropriate bodies give this subject urgent study.

25. In further discussion of management problems, it was noted that certain fishery management bodies, such as the International Whaling Commission and some other multilateral organizations, have been largely unsuccessful in discharging their responsibilities. The North Pacific Fur Seal Commission is a clear exception, as are certain other commissions with their limited responsibilities. It may in any case be difficult to achieve more than a fraction of the potential benefits of management, as determined by scientific research, because of such matters as the imprecision in the definition of the objectives of the regulatory commissions, the varying degree to which their decisions or recommendations are binding on their members, and the effectiveness with which they arrange for provision of advice on economic, technical and other matters relating to the objectives. The greatest difficulties arise, however, from the questions of jurisdiction over living resources (which are largely common property) and the

distribution of the benefits of conservation. For instance, only in the most simple fisheries will the results of conservation action be the same for all groups of fishermen; in most fisheries it is likely that action, which will result in considerable benefit to the fishery as a whole, will cause losses (or at least smaller benefits) to some groups.

26. For the effective application of the results of scientific studies of the living resources of the sea, there is an urgent need for a careful examination by COFI, ACMRR and the regional fishery bodies of the possible effects on the rational exploitation of these resources of changes in the present arrangements for jurisdiction over them.

Non-living resources

27. This category includes the mineral resources of the sea floor (petroleum, phosphate deposits, sulphur, manganese deposits etc.), the extraction of dissolved chemicals and fresh water itself, plus other uses of the sea (waste disposal, transport and communications, recreation etc.). Many of these resources, and in particular mineral resources in or below the floor of the deep ocean, must be considered as "potential" resources, since no one today knows their extent, the technology of their utilization or the cost effectiveness of extraction.

28. It seems likely that the necessary technology will be developed in the near future in several of the highly industrialized nations. Application of this technology will undoubtedly first occur on the continental shelf. The present ambiguity of legal jurisdiction over mineral resources of the continental slope and deep sea should be resolved as soon as possible through inter-governmental action. The scientific aspects of these matters are already being considered by IOC.

29. International co-operative action may be particularly effective in the evaluation of deep-sea mineral resources. The Division of Resources and Transport of the United Nations Secretariat is now making a survey of the present state of knowledge of such resources and of the techniques for exploiting them. To supplement this study, it may be appropriate, through ICC, to stimulate governmental consideration of the desirability of conducting a co-operative field

survey of deep-sea mineral resources. Such surveys would be of even more immediate value if conducted on the continental shelf. This would, of course, require the permission of coastal States, which might grant such permission if survey results were made freely available to them. On an ocean-wide basis, mineral resource surveys could only be prosecuted through international co-operative action. Because of the high cost of such surveys, a careful analysis of the potential benefits is essential.

Freedom of scientific exploration and research

30. There has been a long international tradition of freedom in scientific exploration and research and in the distribution of their results. This tradition is jeopardized by the change in legal position introduced by the ratified Convention on the Continental Shelf (annex IV of the Law of the Sea, and article 5, paragraph 8 in particular).

31. This article makes clear that "consent of the coastal State should be obtained in respect of any research concerning the continental shelf and undertaken there". Although "the coastal State should not normally withhold its consent if the request is submitted by a qualified institution with a view to purely scientific research into the physical or biological characteristics of the continental shelf", planning and execution of research, and especially the modification of research while it is in progress, may be seriously hindered if this provision is strictly interpreted. Quite apart from the right of the coastal State to be represented or to participate in the research if it so desires, the process of submitting proposals, answering supplementary requests for information and obtaining permission or approval from the coastal State through normal government channels may introduce crippling delays or may cause important research ultimately to be abandoned.

32. This is all the more serious because of the further provision that jurisdiction of the coastal State regarding the ocean bottom may be extended beyond the 200-metre depth contour if the necessary technology for exploitation becomes available.

33. Without questioning the proper concern and interest of coastal States in research in adjacent parts of the ocean, it seems essential to maintain the

international freedom to conduct such research freely and without undue restrictions. Attempts are being made by countries members of ICES to maintain the customary freedom of investigation by giving to other member countries advance information on their research cruises for the following year, often followed by more detailed information on individual cruises. Such an arrangement whereby advance research plans and information on proposed research vessel operations can be provided in a convenient manner, through a recognized inter-governmental body, is a useful step towards finding a solution to the problem. If through IOC or some other appropriate body, countries could agree in advance to permit research to proceed, subject to such information being provided, many of the requirements for maintaining the traditional freedom would be met.

Annex XIV

NOTE ON INTERNATIONAL CO-ORDINATION IN THE FIELD OF MARINE POLLUTION PREVENTION

1. While it is for Governments to agree among themselves to take measures against pollution, the role of international organizations is to help Governments to obtain the necessary scientific and technical information and also to provide the necessary legal and political framework for reaching such agreements.

2. In view of the multidisciplinary character of the marine pollution problem, quite a considerable number of international organizations are involved in this work and the most important of them are within the United Nations family. Their work is co-ordinated by the Sub-Committee on Marine Science and its Applications of the Administrative Committee on Co-ordination of the Economic and Social Council.

3. At its thirty-ninth session held in Vienna on 28 and 29 April 1965 the ACC considered and approved a recommendation that more information be asked for from countries with a view to establishing whether any further international action was required in regard to pollution, and, if so, in what manner it should be conducted. An inquiry was made to that effect with States Members of the United Nations system of organizations.

4. The amount and quality of the information received in reply made it indispensable to follow up the first results obtained, and it was decided to send a questionnaire to Governments of 103 countries. By the end of 1966, sixty-six replies had been received. In their replies several countries offered suggestions for further international measures. Some suggestions have already been fulfilled; specifically the 1962 amendments to the 1954 International Convention for the Prevention of Pollution of the Sea by Oil are now in force, and steps have been taken through IMCO to study some aspects of enforcement of existing international instruments and certain problems associated with the carriage of other noxious substances by ships.

5. An analysis of the replies received shows that:

(a) Nineteen countries replied that marine pollution was not a problem in their countries or that it was of negligible proportions at present, although

a few of these expressed certain fears for the future, especially with increasing industrialization and use of advanced agricultural methods involving applications of potentially noxious chemicals;

(b) Twenty-five countries expressed interest in an international solution of the pollution problem in a weaker (co-operation, regulation) or stronger (convention, control) form. Many of these recommended the enforcement of the IMCO Convention;

(c) Twelve countries suggested an exchange of information from the co-ordination of activities between countries and international organizations;

(d) Seven countries emphasized the need for special scientific research;

(e) Seven countries suggested the establishment of an international centre or group of experts to assist for training and the provision of expert assistance;

(f) Five countries emphasized the need to define further and set criteria of pollution.

6. A special session of the ACC Sub-Committee devoted exclusively to marine pollution problems was held at London from 11 to 13 July 1967, during which it was concluded that further co-operation at an international level was necessary on two basic aspects of marine pollution:

(a) Scientific research, and

(b) Monitoring and control.

Scientific research

7. There is an apparent need for much more research relating to pollution problems of all kinds, at the national level, and appropriate international action to promote this research is desirable. Such international action might also be directed to:

(a) Assisting in exchange and dissemination of research results and technical experience, and

(b) Encouraging establishment in countries of national co-ordinating machinery.

Monitoring and control

8. In most cases the pollution reported affects territorial waters, although the sources can be either local (industrial, sewage etc.) or from ships.

With respect to local sources, monitoring and control are possible on a national basis or, in special cases, by way of regional agreements between two or more States concerned. Such regional agreements might be developed in the framework of a broader instrument which defines the responsibilities of countries to take action in their waters so as to avoid the consequent pollution of adjacent high seas and territorial waters of other countries. International control is clearly required with respect to pollution originating on the high seas. This originates mostly from ships. As already mentioned, the International Convention for the Prevention of Pollution of the Sea by Oil, for which IMCO is the responsible agency, already exists and the possibility of adopting similar international instruments or taking international action with respect to other types of pollution occurring in international waters should be considered. In this connexion, it was suggested that a suitable way of preparing for further international instruments of a general character would be through the establishment of an interagency group of experts.

Interagency consultation and co-ordination

9. An ad hoc interagency meeting "to consider the over-all questions of co-ordination in the field of pollution and to advise ACC on this matter" was held at Geneva from 15 to 16 February 1968. The following organizations of the United Nations family were represented: United Nations (including ECE and UNITAR), the ILO, FAO, UNESCO, WHO, WMO, IMCO and IAEA. The meeting recognized the complexity of the question of co-ordination in the field of environmental pollution and, with respect to the specific field of marine pollution, referred to a proposed inter-agency group of experts as a body which could help achieve an effective concerted action by the Governments and agencies concerned.

10. At its fifty-eighth session in Geneva (13-26 March 1968) the Preparatory Committee of the ACC endorsed the proposal of the Sub-Committee on Marine Science and its Applications for a joint group of experts on scientific aspects of marine pollution to advise on scientific aspects related to the pollution of the sea within the competence of the sponsoring organizations (IMCO, FAO and UNESCO). While the details are subject to further discussions among the agencies concerned, the following summarizes the type of mechanism contemplated.

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11. The proposed joint group of experts would advise on scientific aspects related to the pollution of the sea, in particular its effects, methods of study and standards, monitoring and abatement. The joint group will report to the sponsoring agencies, but reports would be made available to other interested agencies. The joint group would therefore not be involved in the implementation of its conclusions and recommendations which would remain the responsibility of the organizations and their member countries.

12. While the joint group may initially be established by IMCO, FAO and UNESCO, provision would be made to ensure that it would be open to the other agencies of the United Nations family interested in pollution problems. The joint group will be composed of scientists acting in their individual capacity and not as representatives of the agencies. Participation in sessions of the joint group should be kept flexible in such a way that it would be for each agency to decide on its participation in the light of the problems to be considered. It is hoped that the establishment of such a joint group will encourage sponsoring agencies to disband their own advisory groups on scientific aspects of pollution problems, if any, in order to avoid duplication of efforts, but it was understood that such a decision is within the competence of the agencies concerned.

13. The agencies sponsoring the joint group would collaborate in providing a technical secretariat and assistance to the group as appropriate. It is also envisaged that one of the agencies, possibly IMCO, will provide an administrative secretary to expedite routine matters and facilitate exchange of information.

14. The co-operation and relations with non-governmental bodies dealing with marine pollution problems were also considered.

15. The above-mentioned plan for a Joint Group of Experts on the Scientific Aspects of Marine Pollution represents a further step in joint action by the organizations of the United Nations family in this field, it being understood that co-ordination of action by agencies will continue to be the responsibility of the ACC and its Sub-Committee.
