4-1978

Science in the Sea-Can the Scientists Endure 200 Mile Jurisdiction?: A Case Study of the R/V Trident 1973-1975

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SCIENCE IN THE SEA -
CAN THE SCIENTISTS ENDURE 200 MILE JURISDICTION?
A CASE STUDY OF R/V TRIDENT 1973-1975

by

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A paper submitted in partial fulfillment
of the degree of Master of Marine Affairs

April, 1978

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Scientific research at sea is expected to become costlier and access to claimed coastal waters more difficult to obtain. However unfortunate it may be to the world community at large, the era of unrestricted access to areas outside narrow territorial limits is past. Marine scientists need to (and probably will) adjust to the emerging regime of the oceans, or move on to regions where the (sea) grass is greener. According to the theory of evolution species that cannot adapt to a new environment are bound to disappear. The men who have in the past successfully met the challenges of hostile ocean environments, are not likely to become the dinosaurs of the seas.

H.T. Franssen, 1974

INTRODUCTION

Before the 1958 Continental Shelf Convention scientists were free to do their research anywhere in the oceans except within a narrow band of territorial waters. Since that time national jurisdiction has closed off increasing amounts of the sea. Most coastal areas and continental shelf areas now require coastal state consent prior to commencing work. Possible reasons for this closure include 1) fear of natural resource exploitation, 2) fear of military exploitation, or 3) growing feelings of nationalism among the developing countries.

The topic is very difficult to define precisely. Some of the following questions are indicative of the dilemma scientists face in trying to maximize the amount of easily accessible ocean.

1) What is pure scientific research? Almost any area of oceanographic research could have military or resource implications even though these implications may have nothing to do with the scientist's reasons for doing the work.

2) What organizations, institutions, or individuals are entitled to do research? Most research is funded by governments or industry. In the U.S. most research is funded by the National Science Foundation (NSF) or the Office of Naval Research (ONR). NSF research is not necessarily any "purer" than that funded by ONR. The data can often be used in various ways.

3) Where is the dividing line between exploration and exploitation? How much fish can you catch while doing research before you become a fisherman? Since it is often difficult to tell a NMFS trawler from a

commercial fishing vessel or the military surveillance vessel PUEBLO from R/V TRIDENT, developing states are often suspicious of foreign vessels off their shores, suspecting military surveillance or resource exploitation.

This paper is divided into two parts. The first deals at length with the development of the issue of freedom of research. The second part utilizes cruise tracks of the URI research vessel TRIDENT for the period 1973-1975 to assess what impact a 200 mile coastal state jurisdiction may have on marine science as it is practiced today.

HISTORICAL DEVELOPMENT OF THE ISSUES INVOLVED WITH MARINE SCIENTIFIC RESEARCH AND THE LAW OF THE SEA

Before the 1958 Law of the Sea Conference scientists were free to conduct their research anywhere they pleased. The number of restrictions has been continually increasing until the marine scientist is becoming as fettered as the scientists who study phenomena which occur on land. As the land geologist cannot go to a foreign land and perform research, collect rocks, and bring specimens home without a permit from the foreign government, so the marine geologist may not be able to perform seismic studies or take core samples in coastal areas without permission from the foreign coastal State which claims jurisdiction in the marine area of interest.

The restrictions began in the 1958 Geneva Convention on the Continental Shelf which came into force on June 10, 1964. The conditions governing research were included in Article 5.

> 5(1) The exploration of the continental shelf and the exploitation of its natural resources must not result in any unjustifiable interference with navigation, fishing, or the conservation of the living resources of the sea, nor result in any interference with fundamental oceanographic or other scientific research carried out with the intention of open publication.
>
> 5(8) The consent of the coastal State shall be obtained in respect of any research concerning the continental shelf and undertaken there. Nevertheless the coastal State shall 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, subject to the proviso that the coastal State shall have the right, if it so desires, to participate or to be represented in the research, and that in any event the results shall be published.

The United States has taken a position which maximizes the interpretation of freedom of research. When deciding whether or not to apply

for permission for work on the continental shelf, the government has taken the strict interpretation that only instruments actually contacting the shelf are doing research on the shelf. This is a somewhat illogical position since you can study the shelf from seismic and magnetic surveys conducted at the surface or you can be studying the water column above the shelf from an instrument package located on the shelf which has nothing at all to do with research on the shelf itself. This interpretation has been a convenient device, however, for limiting the number of cases where permission has been sought. It is also a controversial point.

The 1958 Geneva Convention on Fishing and Conservation of the Living Resources of the High Seas which came into force on March 20, 1966 had one provision in Article 6 dealing with fisheries research.

> 6(2) A coastal State is entitled to take part on an equal footing in any system of research and regulation for purposes of conservation of the living resources of the high seas in that area (of the high seas adjacent to its territorial sea), even though its nationals do not carry on fishing there.

The 1958 Convention on the Territorial Sea and the Contiguous Zone did not mention scientific research. It was generally assumed that no marine scientific research could be conducted in either internal waters or the waters of the territorial sea without the express consent of the coastal State. Two areas of disagreement sprang up. The first deals with the width of the territorial sea -- widths of 3-200 nautical miles have been claimed. The second point of controversy was whether research ships could conduct research while underway in the territorial sea. The newest draft of the Law of the Sea Treaty, the Informal Composite Negotiating Text (ICNT) has set the width of the territorial sea at 12 miles

and declared that ships conducting research while underway are not undergoing innocent passage, thus, permission is required for this type of research.

Unfortunately, no mention of freedom of research was included in the 1958 Convention on the High Seas. Four freedoms were expressly included in that Convention. These include the freedom of navigation, the freedom of fishing, the freedom to lay submarine cables and pipelines and the freedom to fly over the high seas. These were not meant to be an exclusive list. The International Law Commission stated the following in the 1956 commentary on the draft articles for the 1958 Law of the Sea Conference:

> The list of freedoms of the high seas contained in this article is not restrictive. The Commission has merely specified four of the main freedoms, but it is aware that there are other freedoms, such as freedom to undertake scientific research on the high seas.

For additional information on the issues of the 1958 Law of the Sea Conference see Knight (1975). There was considerable ill will generated by the use of the oceans for nuclear testing purposes (Kolodkin, 1973). This was probably a contributory factor in not specifically including marine scientific research in the 1958 Convention on the High Seas. It is also very difficult to define precisely what is meant by the term marine scientific research. This point will be expanded later in this paper.

Kildow (1973) has discussed the restrictions on research which have been documented by the U.S. State Department due to the 1958 Convention on the Continental Shelf. All U.S. public vessels are required to seek permission for foreign continental shelf research through the State

Department and private vessels are encouraged to do so. It has been State Department policy to apply for clearance 90 days before the proposed cruise in order to avoid a precedent of long advance notice. Many of the developing countries think this is inadequate notice to allow adequat participation in the planning parts of the cruise and are demanding 180 day notice in the proposed Law of the Sea treaty. In some cases the U.S. State Department has vetoed the requests of U.S. ships to work in foreign waters. Some of the reasons for State Department refusal to allow U.S. research in foreign waters are given below.

1. Clearance reqeusts will be refused if there is perceived danger to the ship.

2. Refusal will be made if the request is inconsistent with some aspect of U.S. foreign policy as indicated below:

   a. The request involves a country which the U.S. does not recognize or where it has no embassy - for example, Cuba, North Korea, East Germany and Syria.

   b. The request is to a nation with which there are political difficulties, anti-American sentiments or sensitive conditions - for example, South Africa, South West Africa, Somalia, Congo.

   c. The request is for work in areas where nations have made jurisdictional claims not recognized by the U.S. - for example in areas where nations have claimed a 200 mile territorial sea, the State department would require work within 3 miles; the territorial sea limit recognized by the U.S. Sometimes a port call would be requested and a station would

be occupied on the way into port to meet this requirement of working within the territorial sea limits established by the U.S. State Department.

d. The foreign government requires a longer period of notice than 90 days (Brazil 180 days).

Kildow reports there were 32 reported cases of refusal between 1967 and 1973. It is unknown how many research plans were aborted or changed because of anticipated difficulties in gaining clearance. An analysis of the reasons given by foreign governments appear to all be political. They are summarized below.

1. Military security - In some cases concern was expressed that the research vessels would be gathering data for military intelligence such as harbor details, types of vessels, size of the fleet, or bathymetric data.

2. Bureaucratic delays - In some cases misunderstandings, clumsy bureaucracy, poor communications, or requirements for too many observers prevented research clearances from being granted on time.

3. Environmental concerns - Work involving explosives for seismic studies are often refused in areas where fishing is important due to anticipated fish kills. In some cases there are fears of pollution or depletion of rare species.

4. Fear of resource exploitation - Fisheries collections by research vessels that look like fishing vessels or shelf research which looks like mineral assessment is usually not allowed.

5. Political reasons - see above - Burma allows no foreign vessels to do research off its coast. The U.S.S.R. has also been reluctant to

grant clearance for shelf research. Cheek (1973) also reports on reasons for restrictions. Table I shows the reasons for 28 refusals reported to him in his survey.

Restrictions on research appear to be increasing in number. The Ocean Policy Committee of the National Academy of Sciences (1977a) reported that the UNOLS (U.S. National University Oceanographic Laboratory System) records for 1976 indicated that about half of the scheduled cruises for work in waters over which other nationas claim control have been cancelled because requests were denied or have been hindered sufficiently to prevent the cruise from taking place. At least 18 nations have prohibited research in their waters. Other oceanographic states as well as the U.S. have been rejected clearance to do research off coastal states.

It is ironic that the United States, whose scientists are now so strongly pushing for freedom of research, is at least indirectly responsible for the increased coastal water jurisdiction exhibited by the nations of the world. In 1945 the Truman Proclamation proclaimed jurisdiction over the continental shelf and in 1966 the United States unilaterally established an exclusive fishing zone (Knight, 1975). Other nations quickly followed suit.

The Stratton Commission (1969) recommended that the U.S. should propose a new treaty to replace the continental shelf proposal. They proposed the following provisions:

1. Scientific research in the territorial waters or on and concerning the continental shelf of a coastal nation may be conducted without its prior consent, provided it is notified of the objectives and methods of

TABLE 1

Reasons for Foreign Rejection of Research Clearance Requests*

Region	Type of Clearance Requested				Rejected By			Reason for Rejection							Total
	1) Territorial Sea	2) Fisheries	3) Continental Shelf	4) Port Call	1) Own Institution	2) U.S. Agency	3) Foreign Government	1) Coastal State Policy	2) Political Differences	3) Work Unacceptable to Coastal State	4) Safety	5) Unacceptable Conditions Imposed on Research	6) Inadequate Notice	7) None Given	
Canada	0	0	1	0	0	1	0	0	0	0	0	0	1	0	1
Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carib., Bah., C. Am.	0	0	2	0	0	1	1	0	0	1	0	0	0	1	2
South America	2	0	2	0	0	3	1	0	1	0	0	1	0	2	4
West Europe	0	0	1	0	0	0	1	0	1	0	0	0	0	0	1
East Europe	0	0	1	1	0	0	1	0	0	0	0	0	0	1	1
North Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
West Africa	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1
East Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southwest Asia	0	0	1	0	0	0	1	0	0	0	0	0	0	1	1
South Asia	0	0	0	4	0	1	3	3	0	0	0	1	0	0	4
Southeast Asia	1	0	0	0	0	0	1	0	0	0	0	0	0	1	1
East Asia	3	0	4	0	0	2	5	0	2	2	0	0	0	3	7
Australia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hawaii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Ocean.	1	0	1	3	0	0	5	0	0	0	2	0	0	3	5
Antarctica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

* After Cheek, 1973a.

the research and the period or periods of time during which it will be conducted, in sufficient time to enable the coastal nation to decide whether it wishes to participate or be represented in all or part of the research, and provided that the investigators agree to publish the results of the research;

2. Fisheries research including the limited taking of fish specimens may be conducted in the exclusive fisheries zone of any coastal nation under the same conditions. The U.S.S.R. did not agree to the U.S. suggestion of a notice regime for the territorial sea or the continental shelf (Kolodkin, 1973). Only the coastal state could explore or exploit for minerals on its own continental shelf. This quickly led to the problem of distinguishing between research on the continental shelf and exploration for mineral resources. More will be discussed concerning this point later in the paper.

The U.S. does receive some requests to do research in waters under its jurisdiction. Several governments including Japan, Poland, U.S.S.R. work with the National Marine Fisheries Service (NMFS) on fishery research in U.S. waters as a partial condition of receiving a Governing International Fishery Agreement (G.I.F.A.). In fact it is interesting to note that after the Argo Merchant oil spill some work was done by Polish, East German and Russian vessels as the U.S. did not have sufficient vessels available in the area at that time (Sherman and Busch, 1978). Kildow says as of 1973 about 10 requests per year for port calls were received for work off the U.S. Through a bilateral agreement Canada gets permission to do research in U.S. waters with only 24 hours notice. The requests for U.S. port calls take about a week to process and must be

approved by the Department of State, Navy, Army, Coast Guard, Treasury (Customs), Justice, Interior and Agriculture. Soviet Bloc countries require 14 days notice before making a port call unless they are participating in a NMFS program which takes less time. Generally requests for U.S. port calls are refused when the government cannot guarantee the safety of the vessel and crew. The U.S. has made it a uniform policy applying to all countries that no scientific research will be allowed in the territorial sea (3 miles) nor the fishery zone (12 miles) and no port calls will be allowed in the Pacific waters near the U.S. Trust Territories. Presumably this is for military security reasons.

Initially the U.S. position was that simply providing the coastal State with prior notice of the intent to do research and including a list of objectives, locations and dates of research coupled with the opportunity to participate and receive any published results was all that was required to do research in the territorial waters off coastal nations. This was the so-called notice regime. Later the scientists began to realize that notice should be accompanied by certain obligations to the coastal State. A recent National Academy of Sciences report (1977a) details these responsibilities:

1. To keep the coastal State fully informed concerning the nature, objective, schedule and participants of the proposed research project;

2. To ensure the rights of the coastal State to be represented in the program;

3. To provide the coastal State with preliminary and final reports;

4. To share the data and samples;

5. To seek to provide the coastal State with assistance in inter-

preting the results and their relevance to coastal State interests. Osgood et al. (1975) have added three others to the list of obligations:

6. Open publication as soon as possible of significant research results;

7. Compliance with all applicable international environmental standards;

8. Flag state certification that the research will be conducted in accordance with the treaty by a qualified institution with a view to purely scientific research.

As long as the research was not related to resource exploitation U.S. scientists felt that coastal State permission was not required for research in the territorial sea. They felt no control of research should apply outside the territorial sea (Knauss, 1973). Developing countries countered by agreeing that all the provisions of notice and obligations should apply, but in addition permission to do research in all areas of coastal jurisdiction including the exclusive economic zone and the continental shelf required the absolute consent of the coastal State - the consent regime. For many new nations the ability to control research was a test of their sovereignty. Bookman (1975) has compared some aspects of notice and consent regimes.

Ross and Smith (1974) and Franssen (1973b) have evaluated the oceanographic capabilities of different countries by comparing the number of scientists, number of vessels, number of research laboratories and annual expenditures for research. Although the data is old (1968) the rankings are probably still relatively correct. (See Table II for these comparisons). Winner (1976) lists the 10 states with the largest

TABLE II

Number of Scientists, Vessels, Laboratories and Research Expenditures as Indicators of Capability to do Marine Scientific Research

Country	# Marine Scientists[a]	# Marine Scientists[b]	# Scientists[c]	# Research & Univ. Labs[a]	# Vessels > 15 m[b]	# Vessels[c]	Annual Research Expenditure[b]
U.S.A.	2000	1350	--	250	118	-	438,000,000
U.K.	650	680	--	116	28	-	25,000,000
Japan	1600	550	--	164	42	-	10,000,000
U.S.S.R.	1600	500	--	53	110	-	18,000,000
Canada	509	360	--	17	22	-	38,550,000
West Germany	300	224	--	34	17	-	8,000,000
Australia	85	181	--	37	8	-	2,300,000
India	--	168	161	25	-	19	---
Brazil	--	140	137	18	-	12	---
France	475	120	--	43	18	-	24,000,000
Norway	95	94	--	21	9	-	2,003,000
Netherlands	95	77	--	21	8	-	3,780,000
Yugoslavia	--	74	--	20	-	-	---
Mexico	67	74	67	35	-	1	1,304,000
South Africa	78	59	--	12	12	-	2,100,000
Philippines	--	55	36	21	-	5	---
Korea	--	51	50	15	-	9	---
Peru	70	50	70	7	-	2	---
Argentina	70	41	70	17	10	11	---
Portugal	--	--	--	-	10	-	1,330,000
Poland	--	--	--	-	9	-	---
Sweden	50	--	--	-	9	-	872,000
Denmark	--	--	--	-	11	-	---
New Zealand	71	--	--	-	5	-	1,793,300
Thailand	--	--	26	-	5	11	2,090,000
Venezuela	--	--	24	-	-	10	1,060,000
Monaco	50	--	--	-	-	-	816,000
Iceland	--	--	--	-	-	-	776,326
Chile	113	--	113	-	-	4	---
China	81	--	28	-	-	2	---
Austria	45-65	--	--	-	-	-	---

Egypt	--	--	33	-	-	-	---
Indonesia	--	--	40	-	-	4	---
Israel	--	--	20	-	-	2	---
Pakistan	--	--	46	-	-	9	---
Sri Lanka	--	--	14	-	-	-	---
Turkey	--	--	23	-	-	5	---
Vietnam	--	--	30	-	-	2	---

a S.Z. Quasim, "Development of Marine Science Capabilities in Different Regions of the World" in Bologna Conference Report (1973) cited by D. Ross and L. Smith (1974).

b United Nations, ECOSOC, Marine Science and Technology: Survey and Proposals, Report to the Secretary-General, New York 24, 1968, pp. 35-36, cited in H.T. Franssen, "Criteria for Successful Implementation of Technical Assistance in the Marine Sciences, p. 425-261 in U.S. Marine Scientific Research Assistance to Foreign States, National Academy of Sciences, 1975.

c F.A.O., doc. FRV/T93, Rome, 1969; F.A.O., doc. FR:FRC/68/WP-GEW, Rome, 1970; F.A.O., International Directory of Marine Scientists Rome, 1970, cited in Franssen (1975).

number of marine scientists as including the United States, the United Kingdom, Japan, U.S.S.R., Canada, West Germany, Australia, India, Brazil and France. Osgood et al. (1975) point out the U.S. is unique in having a major ocean-going academic research fleet. Knauss (1973) points out that the United Kingdom, France, Canada, Australia, the U.S.S.R. and Japan have not spoken in favor of the U.S. position in favor of a notice and obligation regime but prefer the coastal State consent regime for research in coastal waters. Winner (1976) points out that Brazil, India and Canada have not generally aligned themselves with the other developed research states on research issues at the Law of the Sea Conference. Thus, it is seen that the U.S., the nation with the large commitment of personnel and expenditures to oceanography, stands virtually alone on the issue of freedom of research in coastal waters. Most of the rest of the world prefers to allow access to coastal areas only with the express consent of the coastal state.

Burke (1975) has also discussed the concept of the scientists' obligations to the coastal State. He suggests that the obligations should be formulated to satisfy coastal State interests such as 1) knowing about projects in areas of particular interest; 2) participating in the research directly or by representatives; 3) obtaining an interpretation of the economic significance of the research results; 4) securing the data and information produced by the project; and 5) gaining time to assimilate the data before it is made available by publication in scientific journals. Point 5 is particularly troublesome to the scientists and they are fearful of any repression of the data. The 1976 Revised Single Negotiating Text (RSNT) contained a provision that would have allowed the

coastal state to restrict the publication of the scientific data after the fact and without the consent of the scientists. This provision was eliminated in the 1977 version of the proposed treaty, the Informal Composite Negotiating Text, (ICNT), the coastal State must now indicate in advance while granting consent if it wishes to impose restrictions on publication of results, (1977) Richardson. Burke concludes that the consent of the coastal state ought not be required as a condition precedent to research in the economic zone or on the shelf, but that a mechanism should be established to assure that the research state does in fact observe the obligations to the coastal state. He suggested that sanctions should be applied in cases where the obligations are not discharged.

Details of the provisions of the Informal Composite Negotiating Text are provided in Appendix A and summarized later in this paper. At this point it appears that coastal State jurisdiction of all areas within 200 miles of the coast will prevail closing off 37% of the ocean to free research. Only the waters of the high seas will remain without consent requirements as the sea-bed will fall under the jurisdiction of the International Sea-bed Authority.

WHAT IS MEANT BY FREEDOM OF RESEARCH?

Wooster and Bradley (1973) have defined in an operational sense what is meant by the freedom of research. The scientists wish to be able to travel to any part of the ocean to study phenomena of interest. They need to be able to allocate resources including personnel, vessels, capital and equipment from 1-3 years in advance of a project for planning purposes and attainment of funding. The inability to receive prior assurance of clearance permission may well deter some important projects from ever being done. The scientists need flexibility to change methods, personnel and cruise tracks at any time, right up to and including the actual cruise itself. Events occurring during the cruise may entirely alter the work which is to be done. In addition the scientists need access to coastal waters off foreign shores. The coastal zone is the location of most of man's maritime activities. The area of the land-sea boundary is one of upwelling, rich biota including fisheries stocks, accessible minerals, and coastal boundary currents. It is a pollution zone for dumping and is often the region of highest population density. For all of these reasons and others the coastal zone is an important area to study. In addition to studies of the ocean as a whole it is often important to look at the boundary conditions -- in this case the land/sea interface. The scientist also needs easy access to coastal waters for ship and equipment repairs as well as changes of personnel and equipment for subsequent experiments.

The IOC (Intergovernmental Oceanographic Commission) compiled a comprehensive listing of the types of oceanographic research which should be

done during its preparation of the Long-Term and Expanded Program of Oceanic Exploration and Research (LEPOR). Wooster and Bradley (1973) have examined the listing and sorted the projects according to their dependence on access to coastal waters. Their data is summarized in Table III. The numbers refer to those in the LEPOR list and are classifications by type of oceanography; numbers 1.1 - 1.17 refer to physical and chemical oceanography, 2.1 - 2.13 to marine biology, 3.1 - 3.11 to marine pollution, and 4.1 - 4.12 to marine geology. They conclude that three-quarters of the projects in the LEPOR list depend to some significant extent on access to the coastal region and at least one-third appear to be geography-specific and involve some substantial element of research in distant coastal waters. Their analysis helps substantiate the widely held belief that not only could "the solution of major scientific problems be seriously hampered, but that investigation most closely related to man's rational use of the ocean and its resources would suffer the most" if proposed restrictions on research in coastal waters are implemented.

TABLE III

Classification of Oceanographic Research Projects According to their Requirements for Coastal Access*

I. Projects Independent of coastal access

A. Regions remote from land

1.1 Small-scale ocean-atmosphere interaction
1.2 Medium-scale ocean-atmosphere interaction
1.6 Zonal flows in mid and low latitudes
4.5 Crests of ridge-rift systems
4.7 Anomalous deep-ocean crustal areas
4.11 Deep-ocean sediments

B. Theoretical and Experimental Studies (done ashore)

1.14 Hydrodynamic numerical methods
3.4 Analytical methods for pollution studies
3.6 Methods and instrumentation

II. Projects most dependent on coastal access

1.9 Coastal and oceanic upwelling
1.13 Coastlines and estuaries
2.7 Biotic exchanges between sea areas
2.8 Biological production of coastal waters
3.10 Methods of removing marine pollutants
3.11 Effects of thermal pollution
4.2 Geological and geophysical surveys of continental margins
4.6 Ocean and land aspects of trench-arc systems
4.8 Mediterranean and marginal seas
4.10 River mouth monitoring

III. Projects partially dependent on coastal access

A. Research projects which can mostly be done in one's own coastal waters*

1.3 Large-scale ocean-atmosphere interaction
1.4 Scales and frequencies
1.5 Mixing and diffusion
1.12 Chemical composition of sea water
1.16 Tsunami
1.17 Expansion of tide station network
2.1 Distribution of primary and secondary carnivores
2.3 Primary and secondary production
2.4 Effect of fishing and environment on recruitment
2.5 Effect of environment on behavior of fish
2.6 Organisms of Southern oceans
2.9 Establishment of marine reserves
2.10 Taxonomy
2.11 Aggregation of plants and animals

2.12 Dissolved organic matter and detritus
2.13 Methods in marine biology
3.2 Effects of environmental changes on marine life
3.3 Sub-lethal effects of pollutants
3.5 Pollution indicator organisms
3.8 Sources and distributions of marine pollutants
3.9 Fate of pollutants in marine environment
4.12 Mineral resource assays

B. Partially dependent projects requiring access to foreign coasts

1.7 Formation and transformation of subsurface waters
1.8 Water, heat and salt budgets in ocean basins
1.10 Frontal systems and convergence zones
1.11 Vertical structure of currents
2.2 Dynamics of ecosystems
3.1 Base line variations
3.7 World wide pollution monitoring
4.1 Morphological charting of sea floor
4.3 Magnetic survey of world ocean
4.4 Deep drilling
4.9 Geo traverses and land-sea geological transects

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* After Wooster and Bradley (1973).
\+ It is considered that each nation will do its own resource survey; thus excludes global surveys.

PRECEDENTS FOR FREEDOM OF RESEARCH IN THE OCEAN

The concept of freedom of research in the ocean derived from a tradition of mare liberum. Before the oceans were considered to be a source of new resources, which could and should be used to bring new revenues to developing countries, scientists were free to go anywhere to do their work. The ocean was considered to be valuable primarily for commerce and naval uses. Neither the technology nor the data base existed to indicate where to explore the oceans for resources. It could, perhaps, have been considered as being, therefore, not economically important whether scientists were studying the oceans or not. After World War II as navies and governments began to probe the oceans' secrets, lack of knowledge began to become a threat to those lacking the capability to do exploration or to understand the phenomena discovered by others. In 1967 a declaration was made by the U.N. Ambassador from Malta proclaiming the oceans as the common heritage of mankind. This declaration coupled with the 1958 Convention on the Continental Shelf has resulted in a pressure by developing countries to control and regulate scientific research in the oceans.

There are few precedents for freedom of research. It is mentioned only in the treaties on research in the Antarctic (1959) and in Space (1967) (Ringeard, 1973). In 1961, twelve nations (Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, U.S., U.S.S.R., and South Africa) put aside their claims of sovereignty in Antarctica and became signatories to the Antarctic Treaty. In 1959 Antarctica was perceived to be of little value and so an entire continent was allowed to become available for the sole purpose of scientific study. Now Antarc-

tica is perceived to be a vast reservoir of resources - gold, iron, offshore oil and gas, and krill. Technology to harvest krill (Euphasia superba), a tiny shrimp-like creature, is now being developed. Some estimate its potential protein harvest as equal to that of the presently caught commercial fish (about 70 million tons/year). The Antarctic Treaty obligated its signers to conserve the continents' resources and protect its environment. It was silent on the issue of resource exploitation. To preserve the continent for science the signatory nations are now attempting to assess krill stocks and prepare management plans to control catch as part of a proposed treaty dealing with future exploitation of the living and non-living resources in the waters off Antarctica.

As Shapley 1977(a) points out, it is interesting to note that diligent behind the scenes efforts by the 12 signatories of the Antarctic Treaty have, to date, excluded the issue of Antarctica and its resources from the proposed Law of the Sea Treaty. It is also interesting to note that Poland has recently spent $3 million to open a 20-man station in the Antarctic in order to qualify for admission to the Treaty which states that a nation qualifies for admission by conducting substantial research activity there. Shapley implies Polands' main interest in the Antarctic is krill fishing and not science, as recent 200 mile fishing zones have shut off its traditional fishing grounds.

Ringeard (1973) points out that no proposed Law of the Sea text mentions purely and simply the freedom of research as was done in the treaties governing research in Antarctica and in space. Research in space is currently free but only a very few highly developed nations -- primarily the United States and Russia -- have the resources to do research in

space or the capability to prevent it from being done by others. Initially few benefits were seen from space research and developing a capability to do research in space was not a priority item for developing countries. The spin-off from space research has, however, already been enormous. For example, the current boom in microprocessors can be traced to developments in space-age electronics. As resources of value were found in the oceans and in Antarctica, pressure mounted for control of research. Will research in space suffer the same fate?

Ringeard also points out the differences in perception of the freedome of research issue at the Law of the Sea Conference. There are at least three different points of view:

1. The researchers are demanding an abstract freedom in the name of intellectual curiosity, with an apparent innocence which is perhaps only a naive and ill-disguised ruse.

2. Powerful States are demanding free competition in scientific research (i.e., the ability to go anywhere and study anything of interest).

3. The developing countries are demanding controlled scientific research in order to moderate the negative effects of free competition (i.e., by preventing developed countries from gaining more knowledge developing countries hope they can prevent the technology gap from increasing).

ISSUES OF IMPORTANCE TO U.S. SCIENTISTS AND DEVELOPING COUNTRIES

In 1972 the Committee on International Ocean Affairs (CIOA) of the Department of State conducted a survey of the U.S. ocean science community on marine scientific research under the direction of Dr. Conrad Cheek (Cheek, 1973a, 1973b). Of 1450 survey forms distributed, 399 were returned in usable condition. He found that 50% of the research was conducted on and above the continental shelf; 30% beyond the continental shelf but landward of 200 nautical miles; and 20% beyond 200 nautical miles. (As I read this, it is not necessarily distribution off foreign shores but all research conducted by respondees). Research efforts in waters close to the U.S. in the Caribbean, Mexican and Canadian water reflected declining research interests probably due to past intensive study, while increasing interest was noted in more remote waters, particularly off the southern continents. These remote waters of increasing research interest are precisely those which are becoming increasingly inaccessible as developing countries extend their jurisdiction seaward.

In general, prior to 1973 very few conditions were imposed by coastal states as a condition for doing research other than participation by coastal state representatives. There were relatively few requirements for substantial changes in research plans, cruise tracks (except off Russia), or deletion of projects. In 375 granted clearance requests which were reported, there were 275 coastal state scientists whose participation was invited in advance of clearance requests, 80 scientists whose uninvited participation was required by coastal states, and 33 non-participating observers, whose presence was mandatory. A total of 388

coastal state representatives participated in the 375 reported cruises. About 87% of the clearance requests had been negotiated through the State Department. In the past oceanographic institutions have made requests for research directly to the coastal State. Increasing claims of sovereignty in coastal waters however have necessitated the processing of claims through the State Department. For 28 denails of permission to do research the reasons were generally diplomatic, if expressed at all. Twenty-two other projects were abandoned due to long delays in obtaining clearance. Considering the limited number of responses the actual number of denials and abandoned projects is probably considerably higher.

One goal of the State Department survey was to find out what restrictions on research the U.S. scientific community found acceptable in order that a U.S. position favorable to the scientists could be formulated for the Law of the Sea Conference. A summary is shown in Table IV of the responses of the U.S. marine scientists to the potential restrictions which may be imposed on researchers hoping to work off foreign shores. Cheek's assessment of the data is summarized below. In theory the U.S. scientists did not object to explaining the goals of the project and the intended use of the data, explaining the use of equipment and techniques used on board the ship, having a coastal State representative participate in the cruise (the participant being either a coastal State scientist, an international organization scientist or a 3rd party scientist), providing duplicate samples where possible as well as providing a copy of the results including an interpretation of the results for the coastal State. There was considerable concern over coastal State jurisdiction over raw data and samples, publication rights and items requiring additional expense. Since a period of time is usually required

TABLE IV

Viewpoints of U.S. Marine Scientists on Proposed Coastal State Restrictions on Research*

Rank	Generally Acceptable Proposals	% Acceptance
1.	At his request, explain to the coastal state representative the nature and intended use of any data collected while in waters under coastal state jurisdiction.	97
2.	Provide the coastal state a cruise report within a few months after completion of the cruise.	92
3.	Provide the coastal state representatives access to all research areas on the vessel.	87
4.	Provide the coastal state with a tentative interpretation of results after preliminary data treatment.	86
5.	Acknowledge the right of the coastal state to be represented aboard ship by a scientist designated by an international oceanographic organization (such as IOC).	
6.	Conduct seminars or give instructions to coastal state personnel during port calls.	81
7.	Have at least one coastal state representative aboard at the expense of the expedition, but not involving travel cost or steaming time.	79
8.	Acknowledge the right of the coastal state to have its interests represented by a scientist from a third state to be designated by the coastal state.	71
9.	Train coastal state participants during the cruise.	68
10.	Agree to meaningful participation by a scientist designated by the coastal state in planning, execution, and follow-up of your project.	63
11.	Add to your itinery a port call to the coastal state.	57
12.	Provide the coastal state with duplicate or split samples that it requests.	53

Rank	Generally Unacceptable Proposals	% Acceptance
13.	Immediately after completion of the cruise provide any raw data specifically requested by the coastal state for given reasons.	46
14	Have at least one coastal state representative aboard at the expense of the expedition, including travel cost and steaming time.	41
15.	Agree in advance to a specified time frame for publication.	38
16.	Publish the results in a journal agreed upon by the principal investigator and the coastal state.	38
17.	Add projects and/or ship time in order more nearly to accomodate the stated needs of the coastal state.	17
18.	Agree to coauthorship by a coastal state scientist, however minimal his contribition may be.	35
19.	Conduct part of the sample and data treatment in the coastal state's land-based facilities if requested to do so.	23
20.	Delete from or otherwise modify your planned cruise track or stations to accomodate the stated needs of the coastal state.	13
21.	Immediately after completion of the cruise, provide all new data to the coastal state.	26
22.	Modify your project according to the determination of a qualified scientist designated by the coastal state.	13
23.	Acknowledge the right of the coastal state to restrict the distribution of data.	8
24.	Permit custody and control of non-duplicable data or samples by the coastal state.	4

* (After Cheek, 1973a) In some cases rank does not exactly correspond with % acceptance since rank was calculated using an "average" of acceptance, rated on a scale of 1 (highly acceptable) to 6 (totally unacceptable).

to verify data the scientists were reluctant to allow release of preliminary data fearing damage to their reputations or loss of publication rights if someone else appropriates the results. Some were especially concerned about handing over non-duplicable data and samples to the coastal State. The imposition of publication deadlines was also considered a problem. Scientists felt that some results may not be significant enough for publication or may require additional data from subsequent cruises before the results can be clearly interpreted. Scientists also fear giving the coastal State the right to place restrictions on the distribution of data (for example, a coastal State may not wish to have the details of its resource locations made public for fear of development pressure and exploration from multinational corporations or neighboring states - Knauss, 1973) invites denial of permission to publish. In addition, many scientists consider it unethical to enhance the stature of a coastal state scientist by agreeing to his undeserved co-authorship.

Proposals requiring additional shiptime (typically $3000/day), paying travel expenses of coastal state scientists, and requiring extra port calls were not happily received. Current modes of oceanographic funding do not make provision for these sorts of expenses. In the future if these requirements are imposed additional sources of funding may be required.

The Ocean Policy Committee of the National Academy of Sciences (1977) has summarized the objectives of the (U.S.) oceanographic community.

1. To establish the right to conduct all research beyond the territorial sea (except for carefully specified and limited types).

2. To provide predictability in the response of the coastal state so that the planning and conduct of research are facilitated. Predicta-

bility must be assured in determining (i) whether a particular project needs consent, and (ii) whether consent will be granted. Criteria for these decisions must be specific, objective and timely.

3. To secure protection for the researching state of organization against arbitrary or unreasonable restrictions resulting from differences in interpretation of conditions and obligations.

4. To ensure that the procedural provisions of the treaty provide predictability in the planning and in the conduct of research.

5. To maintain the traditional practice to publish and disseminate research results.

There seems to be little acknowledgement among the U.S. scientific community that coastal nations are insulted by both the quality and quantity of the results that are returned to them after many research cruises. Those scientists who are able to repeatedly gain access to supposedly closed areas (for example, Dr. K.O. Emery has had many opportunities to work off Brazil) are the ones who carefully log all their cruise experiences for the coastal nations and work with them on interpretation of the data (see Ross, 1974). In many cases the only participation has been in the cruise itself. Several writers in the National Academy of Sciences Study of U.S. Scientific Assistance to Foreign States (1974) emphasize that the best way to ensure successful participation by coastal nations is to take the trouble to locate a trained colleague from the nation or if necessary the region of the study so that true participation is possible in all phases of the work. An untrained observer or a political bureaucrat sent along for the ride is unlikely to contribute much to a scientific cruise and may even hinder its progress.

Coastal nations are beginning to request more advance notice of the cruise, as well as the opportunity to participate more actively in the research itself including all aspects of the cruise as well as the laboratory analyses of the samples and data.

Redfield (1973) points out that the 1958 Shelf Convention provisions on publication of results have not been enforced. Institutions in this country typically have no organized procedure for ensuring that results of the work done on the continental shelf, or any other work, are published. He adds that cruise summaries consisting primarily of information about what measurements and observations were made, where, when and by whom and perhaps preliminary results may be required by the institutions within a short period of time after the cruise. The cruise reports are not particularly useful to coastal States. Vargas (1974) states that Mexico received 54 applications for research between January 1, 1972 to December 31, 1973. Of this number 49 were approved. Of the 49 cruises 19 cruise notices and 7 cruise reports were provided, but these "did not produce any scientific information". It is usually dependent on the chief scientist of the cruise whether the cruise report or any other results are returned to the coastal State. The State Department which processes clearance requests does not have a procedure for ensuring that data or results are published or communicated to appropriate foreign states. Neither do the funding agencies for oceanographic research require distribution of data and results to foreign states.

Bernard and Killworth (1977) point out that many oceanographers favored "educating the less developed nations so they can understand the benefits of ocean research for all mankind". They point out that

> Even scientists who favored this approach did not want to do the educating, except in the most passive ways. They were in favor of giving scholarships to foreign students to study in the United States, but they did not feel responsible for seeing to it that students returned to work in their home countries. They agreed that host-country scholars should participate in cruises; but they were against publication of results in host-country journals (even in English), or joint planning of expeditions with host-country colleagues. Practically without exception, the oceanographers interviewed rejected the idea of personally devoting time to teaching in countries whose waters they wished to study.

One problem has been that most scientists are essentially apolitical (Winner, 1976). Their prime concern has been the particular study at hand. They have not in general been conscious of the fact that their data may have considerable commercial or military application. They have been even less aware that developing countries would like to know what they have been studying and what implications the research has for resource development or potential economic benefit to the less developed coastal nation in whose waters the research project has been carried out.

Kildow (1973) also expresses the opinion that marine scientists have to become more involved in seeing that data is turned over to developing countries. She states

> It may help to offset a deteriorating trend if marine scientists reexamine their position in the matter. For example, they must recognize that conduct of science for individual or nationalistic purposes alone may no longer be acceptable; that it is necessary to recognize the needs and aspirations and capabilities of the countries off which they intend to do their research.
>
> Scientists themselves admit that scientific results are not always fully shared with nations in whose waters the information was gathered. More scientists will find they must process and disseminate their data if they are to continue to work in their favorite locations.

Clearly the time when the scientists could ignore the demands of coastal States is nearly over. The proposed treaty requires compliance with regulations giving access to data samples to the coastal States as

well as copies of the results and interpretations of those results. Failure to comply will jeopardize future research efforts - even failure to comply by one institution may cause all institutions of a particular nation to be denied access to a region. Institutions will hopefully become self-policing with regard to distributing the results of their work in coastal waters.

As Vargas (1974) points out:

> Up to now none of the highly developed countries, which are interested in marine investigation, have a mechanism-official or private-which will ensure that the information produced by a scientific expedition authorized by a given coastal state will eventually be made available to the proper offices of that State - whether governmental, scientific, or academic. The importance of fulfilling this requirement - or, if it is not, the notoriety of its nonfulfillment - is governed by the fact that the great majority of the worlds' coastal States (if not all of them) requires the acquisition of information as a sine qua non condition in order to extend to a foreign oceanogrpahic vessel the legal authorization to conduct the investigation.

The Latin Americans have the potential to develop their own capability to do marine scientific research. They are definitely aware of their rights to participate and be represented in research. Vargas (1974) and Ferrero (1973) have pointed out the Latin American viewpoint. They point out that the Latin Americans do not want to shut off research in their coastal waters but they wish to genuinely collaborate and reap the benefits of the research. Their view-points on coastal State sovereignty over research in coastal waters were expressed in the Lima Declaration of 1970 and reaffirmed in the 1972 Caribbean Countries Specialized Conference on Problems of the Law of the Sea held in Santo Domingo.

WHAT ARE THE BENEFITS OF OCEANOGRAPHIC RESEARCH?

Developing countries appear to be most concerned with using the Law of the Sea Conference as a means of legitimatizing their unilateral extension of jurisdiction over broad areas of the ocean and sea floor--an action which they hope will provide increased revenues from exploitation of the living and non-living resources of the continental shelf and the exclusive economic zone for their development. Many of the nations of the world are politically new and many are underdeveloped. They feel no benefits will be available to them from the doctrine of freedom of the seas, a doctrine which the developed maritime nations adopted to promote their exploitation of resources from their colonial empires. Many of the developing countries remember colonial exploitation and fear exploitation by the technologically advanced nations (M. Franssen, 1973). Besides worries that scientific research will lead to resource exploitation by foreign companies, some nations worry that their military security will be threatened. In addition it may be resented that foreigners know more information about the nearshore ocean than do the nationals of the adjacent coastal state -- thus intensifying their feelings of nationalism (Friedheim and Kadane, 1972). In addition, developing countries fear that new knowledge from research which they cannot use or understand will expand the technology gap between the developed and developing nations (Burger, 1973).

The scientists who wish to work in foreign coastal waters have attempted to convince the developing countries that there is nothing to fear and indeed something to gain from allowing research in the coastal

waters. They have attempted to do this in 3 ways: 1) by defining scientific research so that it is no longer associated with commercial or military interests; 2) by listing positive benefits of research which will accrue to all mankind; and 3) by providing technical assistance to developing countries so they may develop their own expertise in marine science. To date none of these has been very successful in promoting research in coastal areas.

The following discussion will center on some of the benefits of marine scientific research. A discussion of a definition for research and technical assistance will follow later in the paper.

Nations seem to have two points of view concerning research -- one point of view for waters under their own jurisdiction and a second for those areas under another nation's or international jurisdiction. Burger (1973) classifies these as inclusive and exclusive interests. In the area of inclusive interests many nations share an interest in the improvement in basic knowledge and understanding of the ocean environment, effective pollution control, weather prediction and modification, improved and new ocean uses, as well as enhanced resource development, assessment and prediction. Exclusive interests in research are those directly pertaining to resources subject to coastal authority, promotion and enhancement of national scientific and technical capability in relation to the ocean, its understanding, development and security.

Several resolutions have been passed at the United Nations promoting international cooperation in marine science. In 1966 Resolution 2172 called for a comprehensive survey of the activities in marine science and technology carried out by various international organizations,

member states, universities, scientific and technological institutions, etc. It also requested that the Secretary General formulate proposals for ensuring the most effective arrangements for expanded international cooperative activities directed towards better understanding of the marine environment through science and in the exploitation and development of marine resources, together with strengthening marine education and training programs.

The following list of man's uses of the sea was drawn up in response to that resolution:

1. Use of living resources;
2. Use of mineral resources including fresh water;
3. Use for shipping and navigation;
4. Coastal works -- protection and modification;
5. Siting and maintenance of cables, pipelines, tunnels;
6. Use for effluent and waste disposal;
7. Understanding air/sea interaction as one basis for forecasting and modification of weather and climate;
8. Extraction of energy from the sea;
9. Coastal resorts and recreation;
10. National and collective security;
11. Use as an environment for research and habitat.

The working committee concluded "all marine uses of the sea can benefit from research. Indeed few of these can be expected to develop further without it " (International Ocean Affairs, 1967). The committee also provided a list of reasons why internation cooperation was required. In 1970 the General Assembly passed resolution 2749 promoting interna-

tional cooperation in scientific research exclusively for peaceful purposes.

The U.S. National Academy of Sciences (1964) has drawn up an extensive list of the benefits to the United States of marine research. These benefits are potentially available to all nations. Unfortunately, not many of the nations of the world have advanced far enough to truly benefit from sophisticated marine research. The NAS report also identified the need for international cooperation in several areas. This is certainly not a complete list but does suggest some areas where cooperative studies would be advantageous. An annotated list is given below. This list is almost 14 years old but more work is required in all the areas listed below.

1. Increased cooperation will speed up research. At present there is only limited knowledge about the biota and topography of the oceans and the processes that are occurring there.

2. Intercalibration of standards and methods is required to provide consistency and quality control in the data obtained from research.

3. The monitoring of air/sea interactions required for successful weather and climate forecasts requires the use of many ships for a long period of time in widespread areas. No one nation could provide all the ships, personnel or laboratory facilities which are required for these studies.

4. Measurements of tidal fluctuations should be studied world-wide.

5. Deep sea sediment thicknesses should be studied by seismic techniques in all the ocean basins.

6. A determination of the size and distribution of vertebrates and invertebrates is required for the development and conservation of fishery stocks. Gulland (1977) has recently reemphasized the need worldwide for better scientific data for use in fisheries management.

7. Additional surveys for deep sea mapping are required. Cooperative studies would spread the costs among several users.

8. Special phenomena such as atolls, trenches, island arcs, boundary currents, tsunamis and monsoons should be studied cooperatively. A coordinated study of all the continental shelves is not yet available.

9. Additional effort is required to promote data exchange between developed countries but particularly between developed and developing nations. The U.S.S.R. and the U.S. through their national data centers store and access a great deal of the world's oceanographic data. Additional expansion and services are required in the areas of data storage, retrieval and dissemination. An area that is definitely in need of attention is an interpretation of the existing data for the benefit of developing countries.

10. A continuing need exists for the exchange of ideas, techniques, and equipment. This can best be done by visits between scientists, technical meetings and symposia, exchange of data and results and joint research projects.

11. An area not mentioned in the 1964 study but in urgent need of study is that of man's effect on the ocean due to pollution. The inputs of industrial wastes, pesticides and petroleum via intentional dumping, river runoff, tanker accidents and the atmosphere are having unknown long term effects on the marine ecosystem. Some even believe our very

survival may depend on protection of the ocean environment (Knauss, 1974).

Schaefer (1968) has expressed the view that the world urgently needs to acquire new resources to support its ever increasing population. He states:

> In the race between population growth and the development of resources, especially food, development is losing to population growth. Even if population is controlled there will be required the discovery, exploration and development of vast new resources, if the presently less privileged majority of the population of this planet is to attain standards of living approximating those of the advanced countries.

Wooster (1977) has used the example of upwelling research to demonstrate that identifiable benefits could result to society as a whole from marine scientific research. He identifies the areas of environmental forecasting and protection, energy development and resources as important areas of societal concern that could benefit from more research. He suggests that a better mechanism needs to be developed to identify applied benefits of research. For this purpose he suggests that oceanographers join with engineers, economists and other social scientists to periodically assess the results of research and relate them to these societal problems. He suggests this is necessary on both a national and international level.

It is somewhat difficult to reconcile the needs of the international community for more knowledge of the oceans with the need of the coastal states to protect their resources for their economic development. No arguments seem successful in alleviating their fears of commercial or military exploitation. Only the developed countries have the capacity at present to provide vessels, expensive equipment and large numbers of trained personnel. These facilities are available now and should be put

to use. The developing countries want to have an opportunity to participate and decide what is studied, as well as when it is studied. In addition they wish to control who has access to the knowledge derived. Participation by personnel of developing countries in coastal research is one thing -- dictation of what should be studied by those who lack the ability to study the oceans is quite another. Mothballing the current capability of the developed states to do research until the developing states catch up does not seem to be a very economical or practical way to enhance understanding of the global environment or the global resources.

THE DEFINITION OF RESEARCH

One problem that has complicated the issue of freedom of research is the problem of defining what research should be free. The 1958 Convention on the Continental Shelf did not provide any adequate guidelines for defining research. It implies, perhaps, a distinction between fundamental and applied research. It states only that the coastal state shall not normally withold consent if the research request is submitted by a qualified institution with a view to purely scientific research into the physical or biological characteristics of the shelf, subject to the right of the coastal state to participation or representation in the research and that the results shall be published. 'Pure' research, is evidently that which is openly published, thus secret military or proprietary commercial studies would seem to be precluded.

In terms of justifying the benefits of marine research the oceanographer is in a difficult position. "At home he has to justify his research to an increasingly skeptical public in terms of its potential economic or military value. Abroad, he has to convince policy makers that his research has no immediate impact on resources and national security, that his findings will not be contrary to the coastal State's interests, and indeed, may benfit the individual state and the world community at large" (Franssen, 1973b). A recent article entitled "Plate Tectonics, Energy and Mineral Resources: Basic Research Leading to Payoff" (Rona, 1977) is illustrative of the point that perhaps marine science research is beginning to have substantial economic impact with less time occurring between the period of research and the period of

application. Earlier statements by oceanographers often expressed the view that while a clear cut separation between fundamental research and research having commercial and military applications was difficult, if not impossible to make, their research seldom if ever, was sufficiently detailed for immediate exploitation by industry (Franssen, 1973b). The distinction between "fundamental"("basic", "pure") research and "applied" research is so difficult to determine that oceanographers prefer to use the terms "open research" meaning research for the benefit of all mankind and characterized by prompt availability and full publication of results and "limited exploration" meaning research which is intended for the economic benefit of a limited group as evidenced by restrictions on publication and on availability of data and samples instead (Knauss, 1973).

As (Knauss, 1969) points out

> The line between pure and fundamental research (i.e. research for scientific truth) and applied research (i.e. research for scientific knowledge applicable to national security or resource exploitation) is not an easy one to define. The scientific skills and techniques are often identical; at times judgment must be made on the basis of explicit or implied intent of the group doing research. A government or corporate expedition is usually thought to be doing applied research while university groups are thought to be doing pure research. The matter is further blurred when the same vessel may do pure research one month and classified military research the next month. Where university professors serve as consultants to oil companies and where ONR (Office of Naval Research) supports research, pure research often becomes applied.

Knauss (1971a) points out that a distinction based on intent is difficult to enforce objectively. Wooster (1971) states

> The need to distinguish 'fundamental' scientific research from other kinds is largely tactical. Scientists recognize that such a distinction has little real meaning and is extremely difficult to make in practice. At the same time they sense a practical need to dissociate science from its military and commercial applications.

Burke (1969) points out that with regard to mineral exploration and marine scientific research "It is already painfully clear that no objective distinction can be discerned between these activities on the shelf."

Although it is difficult to distinguish vessels, equipment or personnel in trying to make a distinction between applied and fundamental research, a distinction can sometimes be made on the intensity of research. In many cases the scientists' study will cover a broad area in a rather general survey while a resource study will be focused intensively on a small area. Although Knauss (1973) points out that "To scientists the difference is obvious between bona fide scientific research programs and those directed (for example) toward oil exploration" no objective criteria have yet been drawn up for making the distinction between applied and basic research.

In 1969 the Working Group on Legal Questions Related to Scientific Investigation of the Intergovernmental Oceanographic Commission (IOC) drew up a resolution promoting fundamental scientific research (IUC resolution VI-13). They were unable to define fundamental research. "It was agreed that the term 'fundamental research' could include 'research having practical application' but should not include 'research with a view to exploration and exploitation' " (Groustra, 1970).

The Law of the Sea Conference is still struggling to define exactly what is meant by 'research', 'exploitation and exploration of resources', and 'prospecting'. Winner (1977) has described the confusion over these terms.

Although many delegations submitted draft proposals to the Law of the Sea Conference which contained a definition of marine scientific

research (see Knight, 1975) no consensus on a definition was reached. Winner (1977) has noted there were slight differences between the ISNT and the RSNT (the 1975 and 1976 draft treaties of the Law of the Sea Conference) versions of the definition of marine scientific research. In the ISNT marine scientific research is "work designed to increase man's knowledge of the marine environment. In the RSNT it is "work designed to increase mankind's knowledge of the marine environment." He believes this may indicate a trend toward discouraging classified military research.

The ICNT, the 1977 version of the proposed treaty, has apparently abandoned the quest for a definition of marine scientific research. The ICNT notes however that marine scientific research is to be conducted exclusively for peaceful purposes and shall not form a legal basis for any claim to the marine environment or its resources.

The trend is now to try to define resource-related versus non-resource-related research. It is believed that coastal States will be more interested in strictly controlling the former than the latter in the exclusive economic zone and on the continental shelf. Since almost all research could have resource implications it has become necessary to determine how close the link is between the proposed research and the resource of interest. Article 247 of the ICNT states in part

> The coastal States may in their discretion withold their consent to the conduct of a marine scientific research project of another state or competent international organization in the exclusive economic zone or on the continental shelf of the coastal State if that project is of direct significance for the exploration and exploitation of natural resources, whether living or non-living.

The ICNT seems to express great concern over environmental pollution.

Presumably all studies involved in acquiring an assessment of the nature and extent of pollution and the pathways and risks of exposures to, and the remedies for pollution will be expedited if Article 201 is carried out. Perhaps other areas of research besides pollution assessment can be identified and eliminated from the resource-related category. This could perhaps be done under Article 252 which reads

> States shall seek to promote through competent international organizations the establishment of general criteria and guidelines to assist States in ascertaining the nature and implication of marine scientific research.

Knauss (1975) compiled some examples of what activities might or might not be considered resource-related research for some valuable economic zone resources including petroleum, fisheries, manganese nodules, and placer deposits but was unable to derive a comprehensive set of criteria for evaluating them.

Perhaps a list of questions about the resources to be found in the economic zone would be helpful. Unfortunately insufficient research has been done off coastal nations to provide specific answers about what will be found in any area. A National Academy of Sciences' study on technical assistance to developing countries (1974) identified obtaining an adequate resources survey as a pressing need for developing countries if they hope to use resource exploitation as a means of gaining revenue for development. The lack of this information has had a great deal to do with creating the suspicion of research that exists today. It is ironic that the developing countries are having to pay for resource surveys that they could obtain for free by easing their restrictions on research. Maureen Franssen (1973) cites a case where Petrobas (the Brazilian government oil

company) gave Dr. K.O. Emery of the Woods Hole Oceanographic Institution a $129,000 contract in 1972 to do a detailed geological survey of the Brazilian continental shelf. It really would not seem to be in the best interests of coastal States to suppress research which would provide preliminary resource assessments for them which would be useful for planning purposes.

The following information will be required before a coastal State can make rational decisions about what research should be controlled in areas of coastal State jurisdiction:

1) What resources are available in offshore areas?

2) Where are they located?

3) What quantities of resources are available?

4) What resources are available in sufficient quantities and qualities to be valuable for commercial exploitation using existing technology?

5) For a particular type of resource what types of research and technology are required to bring it into commercial production?

6) What is a commercially valuable quantity of this material?

7) Do the individual resources have important non-commercial uses for which they should be studied, harvested etc.? For example, is the resource formed through an interesting geological, chemical, physical, or biological process which should be studied or is it an important source material for a non-resource related study.

Answers to #7 could perhaps assist in resolving use conflicts that may arise with regard to a particular resource. It is foolish for a coastal State to commit personnel and funding to marine resource development if it has no resources worth exploiting. Without preliminary re-

source surveys planning projections may be grossly inaccurate.

The United States has attempted to provide a definition of fisheries research in connection with the 12 mile contiguous zone and with regard to the 200 mile limit bill. Schaeffer (1967) cites a State Department source and provides a definition of fisheries research:

> Fishery research in the contiguous zone. Fishery research is the study of the biology, environment, abundance, availability, and exploitation of fish or other aquatic organisms for the purpose of facilitating the utilization of those organisms for sport or commercial purposes. Such research in the contiguous fishery zone requires clearance. Research in the contiguous zone for other purposes, even if it involves marine organisms does not require clearance; this is true even if the research in question might be valuable to fisheries research, although done for other purposes.

The 200 mile limit bill (FCMA)[a] states that foreign fishing will not be allowed in the 200 mile fishery conservation zone without a permit, a governing international fishery agreement (G.I.F.A.), between the foreign nation and the United States. The term "fishing" does not include any scientific research activity which is conducted by a scientific research vessel and thus scientific research is exempt from the permit requirement. Winner (1977) states that section 204(B) (7) (D) which allows the Secretary of Commerce to establish any conditions and restrictions for each foreign permit deemed necessary and appropriate could be used to protect the fisheries by requiring consent for foreign fisheries related research. No guidelines for what constituted research were included in the FCMA.

In January 1977 the State Department attempted to draw up guidelines

[a] The 200 mile limit bill is formally known as Public Law 94-265, "The Fishery Conservation and Management Act of 1976."

for fishery research. The first draft was rather lengthy. It is included below.

Fisheries Research in the Fishery Conservation Zone

A. Scientific research, excluded from the provisions of P.L.94-265, includes fisheries research. For purposes of implementing the FCM Act, scientific research is deemed to include activities conducted from a scientific research vessel by a government entity or bona fide scientific research institution such as:

1) collection of data concerning population dynamics or the the state of a stock or species;

2) surveys of the abundance or distribution of larvae, young of the year, or a stock or species generally;

3) the physical and chemical properties of the marine environment, including the availability of nutrients;

4) the collection of samples of plankton, larvae or immature fish with no commercial value;

5) the collection of samples of mature fish, but only in such small quantities as to be of value only in a laboratory or museum, and in any event which are not sold; and

6) all other types of scientific research which does not bear on fisheries. (Note: this is not intended to exclude coastal state control of research concerning the continental shelf and undertaken there.)

B. However, activities such as the following regardless of who conducted by are not considered to be scientific research, and do not come under the statutory exclusion unless undertaken as part of a joint research project in cooperation with the United States:

1) experimental fishing for the purpose of determining whether fisheries resources might be available for commercial exploitation;

2) scouting to locate schools or stocks of fish for purposes of commercial exploitation;

3) fishing carried out for the purpose of training fishermen;

4) taking commercial quantities of fish, except by agreement;

5) the conducting of tests of fishing gear which may be used in commercial fisheries.

Such activities are considered to be fishing and require a permit.

C. A scientific research vessel is:

1) a vessel which has been built for, modified for use for, or for the time being is used for oceanographic survey or

research (including physical, chemical, geological, and biological research or combinations thereof, and directly related activities) by a governmental entity or bona fide scientific research institution, and is not being used for any of the activities mentioned in paragraph B.

2) A vessel which has been built or modified as a fishery research vessel by a governmental entity or bona fide scientific research institution, is not capable of storing or retaining commercial quantities of fish, and is not being used for any of the activities mentioned in paragraph B or similar activities, or

3) a vessel which has been built, modified, or chartered as a fishery research vessel by a governmental entity or bona fide scientific research institution, is not used for any of the activities mentioned in paragraph B or similar activities, any fish taken and retained are not sold or in any way exchanged for good or services of value.

D. Any vessel which actually takes fish, attempts to take fish, or engages in any activity which can reasonably be expected to result in the taking of fish, regardless of quantity, may be boarded and inspected to verify that it qualifies for the scientific exclusion, provided, however, that prior notice may be given to the coastal state of scientific research activities and the coastal state may concur, either expressly or tacitly.

E. The foregoing applies with respect to the fishery conservation zone, that is, a zone contiguous to the territorial sea of the United States, the inner boundary of which is a line coterminus with the seaward boundary of each of the coastal States, and the outer boundary of which is a line drawn in such a manner than each point on it is 200 nautical miles from the baseline from which the territorial sea is measured.

F. The foregoing shall apply with respect to the fishery conservation zone of the United States effective 1 March 1977.

After a meeting between the Department of State and the Ocean Policy Committee of the National Academy of Sciences the guidelines for distinguishing excludable scientific research including fisheries research, and fishing were substantially changed (National Academy of Sciences, 1977b). The revised guidelines are listed below.

Scientific Research in the Fishery Conservation Zone

Scientific research, including fisheries research, is specifically excluded from the term "fishing" in Section 3(10) of the Fishery Conservation and Management Act of 1976. It should be noted, however,

> that the following specific activities are considered to be fishing within the meaning of the Act, and therefore require a permit issued in accordance with Section 204:
>
> > Any activity involving the catching, taking or harvesting of fish in commercial quantities, or the use of gear capable of catching, taking, or harvesting fish in commercial quantities, including:
> >
> > 1) the conducting of tests of fishing gear; or
> > 2) fishing carried out for the purpose of training fishermen.
>
> Fisheries research which assists in the conservation and management of the stocks, and the identification of the fishery resources of the Fisheries Conservation Zone is encouraged. With this in mind, the specific activities outlined above, when undertaken in full cooperation with the United States, shall not be deemed to be fishing within the meaning of the Act.

It is not known what effect this definition has had, either on foreign research in U.S. waters or on U.S. efforts to do research in foreign fishing zones. One intended use of the definition by the State Department is to try to determine what U.S. research in foreign waters requires permission. It is unknown what regulations, if any, other nations have made with regard to allowing research in fishery zones if the research is not associated with commercial fishing.

It should be possible in a similar manner to provide definitions for differentiating oil and gas exploration and manganese nodule exploration from research. The technologies for these are sufficiently developed to allow a description to be made.

Fishing, oil and gas exploration, and manganese nodule mining seem to be the resources coastal nations are most interested in exploiting for economic gain. The scientists may be able to facilitate access to coastal waters if they can somehow develop workable guidelines to show their work is not related to exploration and exploitation of valuable resources.

IS RESEARCH A RESOURCE WHICH GENERATES WEALTH?

Several of the developing countries appear to view scientific research as a resource capable of generating wealth which they are unable to share (Moore, 1974). Only the wealthy countries can support an oceanographic research fleet and have the capability to interpret and utilize the results of the data. The developing countries view research as a threat that will open up their natural resources to foreign exploitation. Their lack of capability to discover and exploit their own resources is viewed as a threat to their national pride. Franssen (1974) points out that research has become a national resource to be controlled by the State, and wherever possible exclusively conducted by their own nationals for the benefit of the nation. The only foreign research that will be allowed is that which contributes to national goals.

Bernard (1972) has considered the implications of the ownership of data. He points out that data is a commodity subject to ownership. He states

> Data is a resource, subject to legal ownerhsip. Ownership of anything not previously considered ownable is largely a political matter. It depends on the power to stake and maintain a claim. When Peru says it claims 200 miles of maritime sovereignty, it is not just claiming the fish and minerals in those waters. It is saying that the data concerning those resources is also a natural resource. No one may use it to exploit the tangible resources. And no one may use it for personal gain without paying for the privilege.
>
> To protect their interests, oceanographers can recognize that they have a responsibility to a human constituency for how their data is used. They can recognize the fact that data is subject to national ownership until published. And they can recognize their personal debts to foreign states for the development of their scientific careers. Until oceanographers recognize this last point and engage in a collusion (not collision) strategy with coastal states, they will be forced into an increasingly difficult adversary relationship.

> There is a non-quantifiable possibility that such a relationship will be to the detriment of those countries that restrict research. But it is a certainty that it will hurt oceanography. In an adversary relationship then, the odds do not favor oceanography.

Social consciousness has not previously been a concern for field scientists. Numerous programs of technical assistance have, however, been proposed. Technical assistance will be discussed in a later section.

INTERNATIONAL ARRANGEMENTS TO FACILITATE RESEARCH

There have been numerous suggestions over the years involving the use of 3rd party certification of the legitimacy of various research projects. The developing countries evidently feel less likely to be exploited when dealing with an international agency than dealing directly with more powerful developed countries. Schaefer (1968) recommended the development of international arrangements to certify bona fide fundamental scientific research agencies and/or expeditions to which coastal states would automatically grant consent. Brown (1969) has reviewed several such plans which are outlined below.

1. International Council of Scientific Unions (ICSU) Plan.

According to this plan (1967) coastal states should grant permission to any scientific research vessel if the research program had been approved by the ICSU. The ICSU, in turn, guaranteed that the research would lead to results which would be openly published. In addition advance notice would be given to the coastal State so that it could designate a representative to participate. At that point in time the U.S. government did not agree. The U.S. position was strongly shaped by the Navy at that time and it was felt that the U.S. should retain power to permit, prohibit, or regulate activities by foreign nationals in waters under its jurisdiction.

2. Stratton Commission Plan.

The Stratton Commission (The United States Commission on Marine Science, Engineering and Resources) recommended in 1969 that the U.S. should unilaterally announce that upon proper notice it would give consent

for any international cooperative project sponsored or endorsed by the Intergovernmental Oceanographic Commission (IOC) provided that it could participate or be represented. The scientists were to publish the results and make available the basic data. For research on the continental shelf the Stratton Commission recommended that the U.S. grant consent for any investigation certified by the IOC as meeting the requirements of the Continental Shelf Convention. They suggested that research could be conducted in the territorial sea without prior consent if there was prior notification of intent, including the dates of the proposed research, a list of proposed objectives and methods, a provision for the coastal state to participate, and an agreement that the data would be published. They suggested that the coastal state should perhaps retain veto power over research which it considered prejudicial. They also proposed that research on and concerning the continental shelf and in the fishery zone should be permitted without prior consent under the same conditions as listed for the territorial sea. There was no support for this position in the U.S. government.

3. The Intergovernmental Oceanographic Commission Plan.

In 1969 the IOC adopted resolution VI-13 which stated that the IOC should assist in promoting fundamental scientific research that was carried out either in the framework of the U.N. Long Term and Expanded Program of Oceanic Research (LEPOR) or within Declared National Programs. The coastal State would be notified of the intent to do research so that it could participate. A formal description of the nature and the location of the research project were to be submitted to the coastal State and the IOC. The IOC would pass on the description to the coastal State

together with a request for favorable consideration and if possible, a factual description of the international scientific interest in the subject prepared by the requesting State. The coastal State would have access to all data and the results were to be published in an open internationally destributed scientific publication. Many thought that the IOC lacked adequate staff and resources to assess the proposals. Others thought use of the IOC would cause additional bureaucratic delays.

4. The International Council for Exploration of the Sea (I.C.E.S.) Plan.

In 1967 I.C.E.S. proposed that a list of research vessels with specifications for their identification should be drawn up. In addition the annual cruise programs for continental shelf work were to be exchanged between member states. I.C.E.S. suggested that routine permission should be granted for all such research including that using dredges, grabs, etc. on the continental shelf. They recommended that coastal States should still retain the power to grant approval for seismic studies using explosives. The member states of I.C.E.S. did not enthusiastically endorse this plan either.

Thus, all the plans for third party review of research came to naught. Coastal States, including developed States who wanted to do research, refused to grant general approval to all research in their coastal waters without the opportunity to grant express consent on each project.

Cadwalder (1973) has come up with an interesting point concerning the common heritage concept. He states

> Scientific research can be justified on the grounds that, since research does yield knowledge of potential social utility, no state accepting the common heritage principle can properly erect barriers

> that restrict mankind from learning what he must know about the ocean in order to optimize its use for the benefit of all.

Cadwalder also points out that it is illogical for coastal nations to profess belief in the common heritage of the oceans and at the same time press unilateral extensions of their national jurisdiction. He suggests that if the common heritage principle applies to marine scientific research then the test of legitimacy is whether the results of the investigation contribute to the common good or only to the advantage of the sponsor. The problem is who tests. The data may have significance only to those advanced enough to comprehend them. He also proposed verification by an international third party or an arbitration process.

The Intergovernmental Oceanographic Commission (IOC) evolved as an agency under the administration of UNESCO. The IOC initially consisted primarily of developed countries and its function was coordination of scientific activities in the ocean, i.e., scientific activities of a few developed countries having the capability to do oceanographic research. There has been a move to broaden the base and the scope of the IOC, giving it a key role in implementation of the U.S. International Decade (IDOE) and the U.N. sponsored Long range Expanded Program of Oceanographic Research (LEPOR). Although the IOC now includes a large number of developing countries, the developing countries appear to fear that the political issues arising out of the ocean and its multiple uses will in some fashion be removed from the General Assembly and disposed of, or subjected to the jurisdiction of another international agency such as the IOC. The developing countries fear that accelerated oceanographic research will enhance the technology gap between developed and developing

countries, and increase the chances of military and commercial exploitation. They also fear that if the IOC is broadened and strengthened into an international agency to administer the oceans that it may impede the creation of the International Seabed Authority, the agency they hope will administer the sea floor beyond the limits of national jurisdiction and exploit the resources found there for the benefit of their economies (Burke, 1969). They perhaps have a basis for their feeling of exclusion. The U.S. and U.S.S.R. worked hard to keep the issue of disarmament of the sea bed in the Eighteen Nation Committee on Disarmament and out of the General Assembly (Burke, 1969). The developing countries are also not participants in the 12 country administration of Antarctica established by the Antarctic Treaty (Shapley, 1977a).

The IOC has been suggested by several people as a possible reviewer of the intent of proposed research projects. Neither the developing countries nor the developed countries seem to be in favor of IOC verification at this time. The developing countries fear the IOC is too much dominated by developed countries while the developed countries think that the IOC has neither the staff nor the resources to review research proposals and that IOC review would add additional bureaucratic delay to the granting of clearance requests (Cadwalder, 1973).

Holt (1970) has discussed the operation and functions of the IOC. He points out that the developed and developing countries frequently do not have in mind the same goals for the IOC; neither do the diplomats and the scientists.

Langerar (1969) pointed out that the IOC is subject to all sorts of contradictory statements. Some are listed below.

1. The IOC is becoming more bureaucratic and the scientists are in the background.

2. The scientists are too strong.

3. The IOC is a rich man's club.

4. The smaller countries are too influential. Too much of the scientific effort has to go into the training, education and mutual assistance.

Galey (1973) reported that there were 74 nations which were members of the IOC. The funding level seems to be extremely low for the coordination of LEPOR and the national programs. While the U.S. budget for I.D.O.E. was $50 million for a three year period, the budget for IOC during 1971-1972 was only $352,000. Some have considered raising the IOC to an autonomous agency and giving it broader functions and areas of responsibility. There has been neither political support nor funding for this idea.

Even the role of the IOC seems to be in question. After the 11th meeting of the Bureau and Council of the IOC in 1970 the U.S. delegation reported on the differing viewpoints of the developing and developed nations.

> The developed nations favor broadening the scope of the IOC's work along the lines of the proposed Long-Term and Expanded Program of Oceanic Exploration and Research (LEPOR). They believe such exploration and research is not tied to exploitation of resources and can be conducted any time under the existing freedom of scientific research and the existing freedom of the high seas for the benefit of all mankind.
>
> The developing countries also favor strengthening the IOC, but not for LEPOR. Their intent . . . is assisting the developing nations to exploit their offshore resources for the benefit of the developing nations. Thus, the role that the developing nations envision for the IOC is an increasingly restrictive and regulatory role which would carefully direct scientific exploration and research

towards the development of resources, rather than encourage the free development on non-resource-oriented research.

Friedheim and Kadane (1972) have analyzed U.N. speeches to determine what the perception of the role of the IOC is among different nations. They found that the Latin American group wished to see ocean science controlled. The Asian group did not endorse scientific freedom but were less interested in imposing specific restrictions on ocean science. The Africans hovered between encouraging scientific research and strengthening the scientific capabilities of developing countries. Only the Western European, Eastern European and Other groups were favorable on encouraging scientific research, much less guaranteeing its freedom. The landlocked nations generally appeared to be in favor of freedom of research. The Soviet bloc at the U.N. has spoken the strongest in favor of strengthening the IOC.

Although the IOC has been weakened by political controversy and suffers from a lack of personnel and funding, Friedheim and Kadane (1972) suggest that a convention should be negotiated through the IOC on freedom of marine scientific research rather than relying on the Law of the Sea Conference or United Nations resolutions to facilitate freedom of research. They believe that such a convention would be better than regional, bilateral or unilateral actions and would probably be signed by most of the maritime nations of the world. It remains to be seen if this is a viable proposal.

MARINE SCIENCE AND TECHNICAL ASSISTANCE TO DEVELOPING NATIONS

A few words must be said about the role of marine science as a vehicle for technical assistance to developing countries. Developing countries have been demanding technical assistance as a quid pro quo for doing research in their coastal waters. Franssen (1973b) has pointed out that while the benefits of scientific research may indirectly benefit all of mankind, the immediate benefits of scientific research will flow to the technologically advanced industrialized countries which can best utilize the information obtained. Developing countries are beginning to demand that they receive an assessment of the research results with a view to how they can apply the basic research to their economic development. They also want participation by their nations in research cruises as well as training of their own personnel.

Most developing countries have not made marine research a priority item. Pontecorvo (1973) points out that most developing countries cannot participate in ocean sciences programs that require they use their own capital. Many government administrations have failed to appreciate the significance of oceanic research and there is a common problem of insufficient funds and equipment. Where there is marine research activity it has been slanted toward fisheries research (Bello, 1974). This is perhaps not unreasonable considering that fishing has traditionally been a resource which it has been possible to exploit with local personnel and relatively simple technology. In addition fishing has been a necessity to provide a significant source of protein in many areas.

As early as 1966 the United States supported the idea of technical assistance and submitted a list of suggested U.S. actions to the IOC Working Group on Mutual Assistance (Maxwell, 1966). This program included seven ideas for action.

1. The U.S. should establish bilateral and multilateral programs by universities, private institutions and government agencies (without IOC assistance).

2. The U.S. should be prepared to respond to requests for mutual assistance. It was suggested that perhaps the IOC could identify countries needing assistance and try to solicit aid from developed countries in the way of cooperative investigations, education, cruises, and equipment.

3. The U.S. could actively recruit professors to teach in developing countries and encourage the initiation of projects by individuals.

4. The U.S. government should educate its own scientists to the scientific and political benefits of cooperation.

5. The U.S. should loan or give equipment to developing nations but also assume the responsibility for maintenance of that equipment.

6. The U.S. should develop funding for personnel and equipment to go abroad.

7. The U.S. should establish a group within the government which has overall authority and responsibility for mutual assistance programs.

Burke (1971) urged that the developed states make a firm commitment of funds for assistance to developing nations. He urged that they not wait for the "nebulous wealth from the sea-bed" to pay for this assistance. (One of the primary reasons the developing nations have so strongly supported the International Sea Bed Authority is that they imagine that

vast wealth will be derived from mining manganese nodules and that this wealth should be used to benefit developing countries.) Wooster and Redfield (1973) have pointed out that while there are contributions that can be made by individual institutions and their personnel, programs of assistance really require a degree of coordination and commitment of resources possible only from the national or international level. Wooster (1971) estimated that about 0.5% of the U.S. oceanographic budget was spent on technical assistance. The decision to provide more funding for technical assistance to developing countries is a political one not a scientific one.

Pontecorvo (1973) has pointed out some of the benefits which developing countries may receive from technical assistance in marine science. These are listed below:

1. Employment by nationals in responsible positions;

2. Participation on equal terms with the world scientific community;

3. Development of an in-house capability which is helpful in dealing with international agencies and businesses.

In 1973 the U.S. offered an ill defined program of technical assistance (Waggener, 1975). She states that the program included "multilateral efforts by all appropriate international agencies to create and enlarge the ability of developing States to interpret and use data for their economic benefit and other purposes; to augment their expertise in the field of research and to obtain scientific research equipment". In introducing the U.S. position at the 1973 session of the Law of the Sea Conference, Ambassador McKernan suggested a two stage process for

technical assistance, 1) that developing countries should receive assistance in interpreting data about marine areas of concern in a manner relevant to their interests and 2) they should be assisted in developing the capability to do research themselves by receiving equipment and personnel training. He suggested that part of the revenues from the I.S.A. should be used for technical assistance. At that time the U.S. also indicated a willingness to commit funds to multilateral efforts to international agencies to help developing states.

In 1973 the John Hopkins School for Advanced International Studies with support from the U.S. State Departments sponsored a symposium which was attended by representatives of twenty two countries to exchange ideas on the needs and techniques for providng assistance in marine science to those countries that desire it. Stewart (1974) summarized this meeting and stated what he felt was the dominant need of developing countries:

> The major marine science need of developing countries appears to be the development of an adequate critical mass of manpower adequately educated and trained in technology to provide the base for intelligent resource management and recovery.

The primary ways U.S. scientists become involved with technical assistance are through educational exchange programs, assistantships for students, and participation in joint research cruises. Ross and Smith (1974) have discussed some aspects of technical assistance via cruises. They find that technical assistance in the form of joint cruises is most effective if the developing country personnel is well-trained and realistically takes part in the research program (i.e. a scientist and not an observer sent by the government). They list the most common

problems to the transfer of technology to scientists from developing countries as 1) lack of funding, 2) langauge barriers, 3) lack of adequate training of foreign scientsits and 4) bureaucratic hangups. Ross (1974) evaluated the amount of participation by foreign scientists in cruises sponsored by the Woods Hole Oceanographic Institution over the period 1967-1973. He found that 69% of the personnel were from WHOI, 25% from other U.S. institutions and 5% were foreign participants. During the period 1969-1973 an average of 39% of the research effort by WHOI ships was within 200 miles of other countries coasts. He concludes "Now it does not follow that the percentage of foreign participation should equal the amount of time we spend in these nearshore waters, but there does seem to be a discrepancy." WHOI took 28% of all foreign scientists taken to sea on UNOLS vessels in 1972.

In 1974 the National Academy of Sciences sponsored a symposium on "U.S. Marine Scientific Assistance to Foreign States". There appears to be quite a considerable amount of assistance from the U.S. by individuals, universities, private institutions and government agencies. Unfortunately, there does not seem to be any coordination of the effort or even a uniform list of goals on the national level. Neither does there seem to be a very effective mechanism for transferring technology on the international level. Apparently it is difficult to design technology assistance programs that work. Although lack of funding is one problem, a much larger problem exists in trying to cope with the socio-economic problems of technology transfer. It does no good to transfer high level science and technology to a country unprepared for it. Culture shock is probably responsible for a great many failures in the technical assistance program.

Basalla (1967) has developed an interesting model for the development of sciences in developing countries. It is summarized in detail in Appendix C.

Although technical assistance in marine science has been politically linked with freedom of research at the Law of the Sea Conference, the link is somewhat tenuous. Weiss (1973) points out that what developing countries really want is marine technology.

> But a developing country needs not only marine scientists and economists. It needs plant managers, fishing boat masters, experienced exploration geologists and petroleum economists. It also needs access to proprietary technologies available only through the international private sector. Some of these skills and technologies are available through the hiring of experienced people as expatriate employees or as consultants, or of developing country nationals who have worked in multinational corporations or in other companies involved in these fields. Others are available by purchase or through participation in joint ventures.

In a commentary to Weiss' paper Franssen points out that what makes technology transfer so difficult is the lack of a scientific infrastructure which includes public and private institutions as well as science policy organizations such as the National Academy of Sciences. He sees the necessity for such an organization within the government to develop goals, to coordinate, promote and finance scientific research at the national level, to assist in bringing in science and technology from other countries, to assess future needs, and to promote higher education.

Waggener (1975) has considered in detail whether the transfer of marine science technology is really a workable quid pro quo for freedom of scientific research. She found at least seven problems that are unresolved .

1. Most existing international organizations are inefficient.

2. There is a lack of funding.

3. A strong national commitment by coastal states to the development of a national marine industry plan is mandatory for the successful transfer of marine technology.

4. The educating of students from developing countries poses the "brain drain" problem.

5. Marine science is often given a low priority by developing countries.

6. Much of the transfer of marine technology is on a government to government basis and not on a commercial basis. Much of the modern technology for the exploitation of marine resources belongs to the multinational corporations of developed countries. The technology is usually patented and available only by foreign investment.

7. Modern science cannot exist in a country whose economy is not based on modern technology.

Waggener concludes that the transfer of technology is not a feasible quid pro quo for the freedom of research for three reasons.

1. The transfer of technology implies a phase out of activities by the developed country as the developing country becomes autonomous. There is no guarantee that prior consent requirements would be revoked.

2. Developed nations may be reluctant to transfer marine technology in order to protect their own interests.

3. The issues of technology transfer and freedom of scientific research are really separate and distinct issues. While the developing countries are generally unwilling to relinquish the consent requirement, they nevertheless want marine technology from advanced nations. They

assume they are entitled to marine technology as a matter of right, of "common heritage".

The outlook for the use of marine science transfer to facilitate access to coastal waters does not appear very promising. Unfortunately the scientists appear to be totally at the mercy of the politicians both in the developed and developing countries.

OPPORTUNITIES FOR UNILATERAL U.S. ACTION

In 1970 the National Academy of Sciences proposed that the United States should make a unilateral declaration allowing scientific research in areas outside internal waters but subject to jurisdiction provided certain conditions were met: 1) at least 60 days prior notice; 2) the opportunity to participate in research and exploration with access to all equipment, compartments, and instruments on the vessel; 3) copies of all data on request and the right of access for study for all unique samples; 4) open publication of results; and 5) guarantees of no hazard to resources or uses of the sea or sea-bed. The Academy forwarded its recommendations to the Department of State but they were never implemented. It was felt that a demonstration by the United States of its support of freedom of research without regard to any advance commitment of reciprocal action was the best approach. It was anticipated that this unilateral action would demonstrate the advantages of free research and exploration. Burke (1970a) noted that there were several potential advantages to be gained by unilateral action: 1) demonstrate that there are advantages to the U.S. and other coastal nations of allowing free research in waters under national jurisdiction; 2) dissipate suspicion of U.S. research expeditions in areas subject to the jurisdiction of other states; 3) encourage other states to take similar action and open areas that are currently closed or under heavy restrictions; 4) provide arguments to foreign scientists who may wish to persuade their governments to reduce national obstructions to foreign research; 5) encourage bilateral agreements between the U.S. and other states; 6) contribute to the U.S.

position in promoting freedom of the seas; and 7) provide flexibility in the U.S. position. Since a unilateral declaration is a national matter it could be readily modified to adapt to changing situations.

Burke also noted there were several potential disadvantages: 1) a unilateral declaration might forfeit the bargaining position of the U.S. in bilateral negotiations if the U.S. has already conceded free entry to foreign scientists to areas of U.S. jurisdiction; 2) a unilateral declaration might also constrain foreign scientists who would prefer bilateral agreements as devices to pressure their own governments to adopt more liberal policies with regard to foreign scientists; 3) it might actually generate suspicion of U.S. motives since very few nations have the capability to do research in U.S. waters.

It is highly ironic that the U.S. scientists are the most vocal in demanding freedom of research but they are unable to persuade their own government to make a unilateral declaration in this regard. Knauss (1971b) has pointed out that the interests of the international marine science community rank low in the priorities of every coastal nation and that there is little advocacy even in the U.S. and the U.S.S.R. for freedom of research. The U.S. position has been dominated by military security and the Navy and freedom of scientific research has been a negotiable point.

Knauss has ranked the priorities of the United States in order of importance at the U.N. Law of the Sea Conference. The list is instructive.

U.S. Priorities at the Law of the Sea Conference in order of importance:

1. Freedom of transit through international straits.
2. The development of stable agreements.
3. A narrow territorial sea.
4. Access to ocean resources, petroleum, fish, minerals.
5. Needs of special interests groups.
    a. Petroleum
    b. Fisheries
    c. Offshore minerals (manganese nodules).
    d. Marine science

Even in the U.S. the scientists cannot organize an effective lobby for their position.

Osgood et al. (1975) also recommend that the U.S. take national action to establish an institution or mechanism to coordinate, certify, and police academic research programs in waters of other nations or in international waters. They suggest that UNOLS (the University National Oceanographic Laboratory System which currently coordinates university research ships) could adopt this function. If international guidelines are agreed upon with regard to notification, participation, and publication of research results, UNOLS could interact directly with the U.S. and foreign governments and with U.S. ship operators to ensure compliance of its vessels. If an international agreement does not occur UNOLS could nonetheless establish appropriate standards for its own vessels which, if regularly adhered to, would develop a measure of acceptability for UNOLS approved vessels. The organization could control the behavior of its ships through moral persuasion and attendant implications for receiving future government funds.

The U.S. also has an opportunity to facilitate research by promoting technical assistance to developing countries both on a national and an international level. Technical assistance is discussed in another section of this paper.

A SUMMARY OF THE PROPOSED RESTRICTIONS ON MARINE SCIENTIFIC RESEARCH IN THE ICNT

Marine scientific research is mentioned in several areas of the Informal Composite Negotiating Text (ICNT). In some cases the texts prepared by the three committees of the Law of the Sea Conference overlap and are even contradictory. Committee I and III texts differ in several areas. A detailed summary listing of provisions dealing with marine research in the ICNT is given in Appendix A. A detailed comparison of this draft of the Law of the Sea Treaty with the Informal Single Negotiating Text (ISNT) and the Revised Single Negotiating Text (RSNT) is beyond the scope of this paper. Burke (1975) gives an assessment of the ISNT as does the U.S. National Academy of Sciences (1976) while Winner (1976, 1977) presents a comparison of the ISNT and the RSNT. The Ocean Policy Committee of the National Academy of Sciences (1977a) and Hedberg (1976) have also assessed the RSNT. In addition to the official texts produced at the U.N. Conference on the Law of the Sea, several writers have presented draft treaties suggesting various compromise positions on some aspects of the proposed treaty. Examples of these "unoffical" texts are O'Connor (1975) and Burger (1973).

Under the terms of the ICNT scientists are no longer allowed free research rights in internal waters, territorial seas, on the continental shelf (defined in the ICNT as the sea-bed and subsoil of the submarine areas that extend beyond its territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin, or to a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured where the outer

edges of the continental margin does not extend up to that distance), in the waters of the exclusive economic zone out to 200 miles, in archepelagic waters, in enclosed or semi-enclosed seas, or in straits used for international navigation nor on the international sea-bed beyond national jurisdictions. All the above will require consent from the coastal State(s) or the International Sea-bed Authority. Thus, the only area remaining free is the high seas in areas more than 200 miles from any coastline. About 37% of the ocean is cut off due to the 200 mile economic zone restrictions on research. Unmanned data buoys will be subject to the same restrictions as manned vessels.

The consensus on restriction of research is strong. At the 1974 Caracas session of the Law of the Sea Conference 83 out of 104 countries voted, for example, for restriction of freedom of scientific research in the exclusive economic zone. The countries listed below voted in favor of free research (Alexander and Hodgson, 1975).

Belgium	Costa Rica	France	Hungary
Bulgaria	Denmark	West Germany	Iceland
Byelorussian S.S.R.	Finland	East Germany	Netherlands
Poland	U.S.S.R.	Ukranian S.S.R.	
Switzerland	United Kingdom	Uganda	
South Africa	United States	Upper Volta	

This is a curious alliance of the well-developed sea-going nations with the geographically disadvantaged ones.

One of the main areas of dispute at the Law of the Sea Conference has been the International Sea-bed Authority (ISA). In the current draft treaty the ISA can control all research on the sea-bed beyond national jurisdiction. The developing countries have felt that by having the ISA control all activities on the sea-bed including research they would

be able to obtain the results of work which they are unable to do themselves and they would also prevent developed countries from locating and obtaining mineral resources from the sea-bed without giving the derived revenue to the developing countries. The common heritage of mankind doctrine is based on the concept of using wealth derived from the ocean and sea-bed beyond national jurisdiction for the economic development of developing countries. It will be extremely ironic if the amount of wealth to be derived from the sea-bed may have been seriously overestimated. Menard and Frazer (1978) have reviewed all the IDOE data plus additional data from Scripps Institution of Oceanography on manganese nodules which gives both chemical analyses and abundance for various locations and concluded that the grade of copper and nickel in manganese nodules is negatively correlated with their abundance on the sea floor even in the region of greatest commercial interest. They conclude

> The data do not in any way suggest that mining the sea floor for copper and nickel is not feasible or that commercially exploitable mine sites do not exist. The data do warrant the larger conclusion that some aspects of the debate on the law of the sea have been based on an optimistic misconception.

One particularly devastating feature of the ICNT is that the new text has no effective provision by which researchers could appeal arbitrary or capricious behavior by chauvinistic coastal states (Knauss, cited in Shapley, 1977(b)). Article 247 of the ICNT essentially gives the coastal State pocket veto power over choosing which research projects it will allow in the exclusive economic zone and on the continental shelf. Article 254 allows the coastal State to stop research activities in progress under certain conditions. Article 265 states that the coastal State cannot be obliged to submit to settlement any dispute arising out of its

actions relative to denying access under Article 247 or its cessation of research projects under Article 265. No state will be able to do research if the coastal State does not give its explicit consent. Alexander (1974) had suggested that one way to facillitate research in coastal waters would be to create an arbitration tribunal to which the flag state may appeal what it considers unwarranted witholding of consent. The coastal States appear unwilling to relinquish any of their control in these areas. Ross (1978) has also expressed doubts about the ICNT.

Shapley (1977b) suggests that the ICNT is not good for the U.S. interests in several areas including deep-sea mining and scientific research and suggests that the U.S. might pull out of the Law of the Sea Conference -- an action which would doom the conference and any chance for a treaty in the near future. She states that

> The deeper issue is how much the United States should subject itself to demands or harassment by the Third World radicals who have come to dominate the meeting.

The ICNT even if it is not ratified will probably shape the course of future customary law. Hull (1976) has summarized the likely outcome of the scientific research issue:

> The best that can probably be expected in any LOS agreement is a statement of principles in support of freedom of research, but only with the permission and participation of the contiguous state -- a codification, in effect, of what is becoming customary practice.

WHAT HAPPENS AFTER THE LAW OF THE SEA CONFERENCE?

There seems to be substantial areas of disagreement remaining at the Law of the Sea Conference. Even if a majority of nations comes to consensus there is no guarantee that it would be in the U.S. interest to sign such a treaty. With or without a treaty it is clear that there will continue to be more restrictions on research than there have been in the past.

Winner (1977) feels that once developing states become politically mature and secure in their sovereignty they will ease the restrictions on research. He feels the emphasis will definitely be toward applied research and the coastal states may even pay for research concerning coastal resources. Franssen (1974) predicts that once the developing countries have developed a mature scientific and technological capability they will welcome collaboration with scientists in other countries. The marine scientists, however, are extremely pessimistic and fear much essential work will remain undone due to coastal state restrictions (Shapley, 1977(b)).

Knauss (1971b) has summarized some of the options that are available to the marine scientists to cope with the restrictions on research. The first option is that of special agreements. It may be possible for the scientists to buy rights of access or pay fees as commercial oil companies do. It might also be possible to make special arrangements as individual oceanographic institutions or as a nation. These could be bilateral, regional or multilateral agreements. It may be possible to use the International Seabed Authority to promote the special interests of the

international science community in such areas as 1) conservation 2) pollution and 3) environmental forecasting.

Although there has not been much agreement at the Law of the Sea Conference there has been a lot of discussion and rhetoric. Some differing viewpoints on marine science and the Law of the Sea are presented in Appendix B.

PART II

AN ANALYSIS OF THE RESEARCH ACTIVITIES OF R/V TRIDENT 1973-1975 FOR THE POTENTIAL IMPACT OF 200 MILE COASTAL STATE JURISDICTION

In Part I the issues related to marine scientific research and the law of sea have been examined from an essentially political point of view. In this section actual cruise records from R/V TRIDENT for the period 1973-1975 are examined to see what work was carried out in the area of the proposed 200 mile zone. Figure 1 shows the area of the oceans encompassed by a 200 nautical mile economic zone (after Knauss, 1974). Figure 2 shows the location of all the research cruises conducted by the University of Rhode Island in the 13 years it was used as an oceanographic vessel.

The R/V TRIDENT was acquired from federal surplus in 1962 and converted to an oceanographic vessel with a $300,000 grant from the Office of Naval Research (ONR). It was perhaps typical of the type of vessel used for oceanographic research in the 1960's and early 1970's, i.e., it was a converted military vessel. The fact that TRIDENT was the sister ship of the PUEBLO probably did not help in gaining access to coastal waters of foreign nations. In 1976 TRIDENT was sold to Alaskan fishing interests and a new vessel, R/V ENDEAVOR, was obtained under a grant from the National Science Foundation (NSF). Table V shows a summary of all R/V TRIDENT research operations.

Between 1963-1975 about 65% of her time was spent at sea averaging 239 days/year. A total of 281 days was spent in foreign ports during this time period (Annual Report, Graduate School of Oceanography, 1976). Port calls in coastal areas of foreign nations are often essential for logistical support. The vessel must obtain food, water, fuel, and often a change of scientists and equipment at least every 30 days. Ship time is

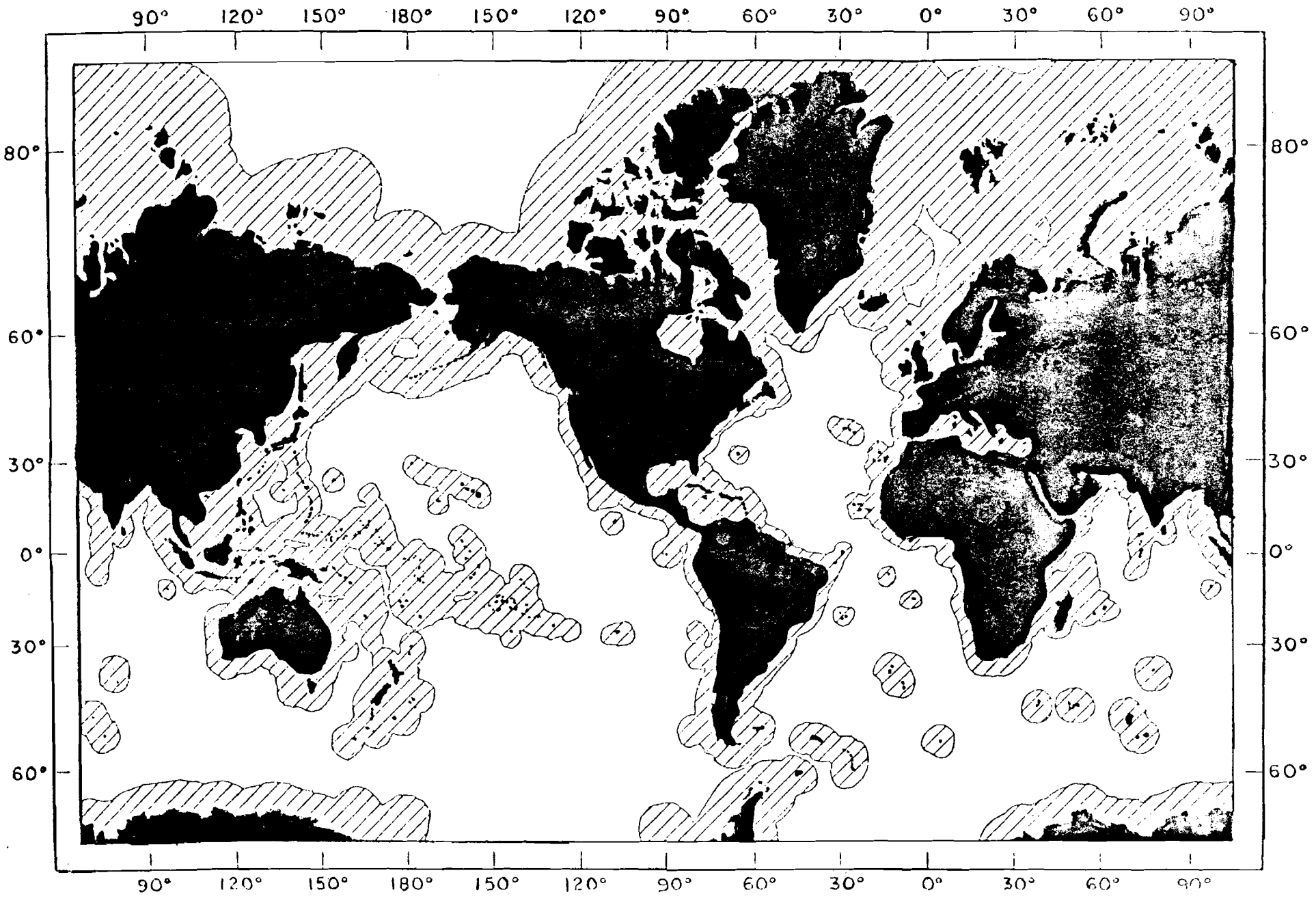

Figure 1. The area of the oceans encompassed by a 200-nautical-mile economic zone.

After Knauss, 1974.

Figure 2. University of Rhode Island Expeditions of R/V TRIDENT 1962-1975.

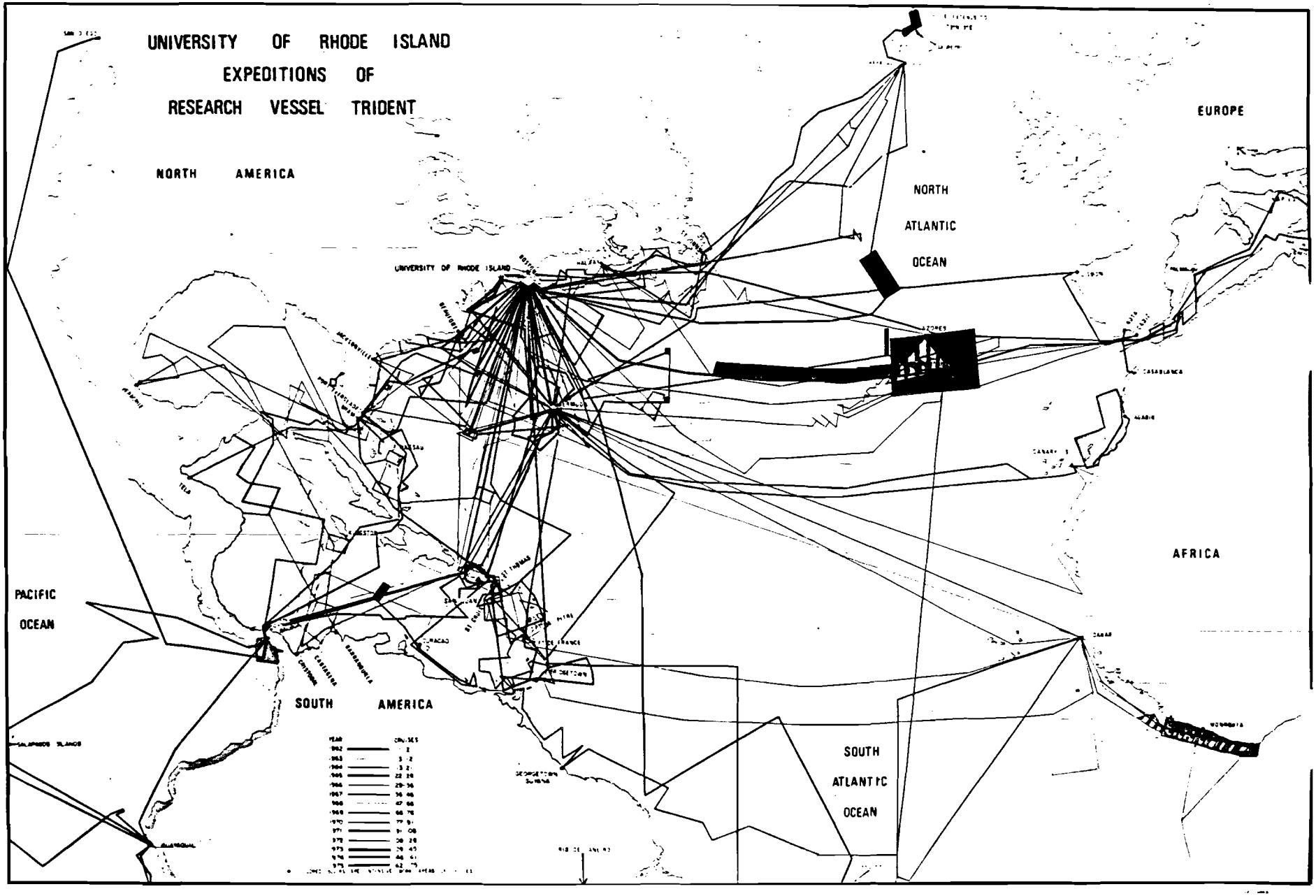

TABLE V

Summary of R/V TRIDENT Research Operations

1962-1975

Year	Days	Home Port	At Sea	Outlying Ports U.S.	Outlying Ports Foreign	Out of Service
1962	108	41	36	28	3	
1963	365	152	198	8	7	(48)
1964	366	82	190	84	10	(132)
1965	365	56	224	75	10	(87
1966 (partial)	297	47	223	17	10	(15)
1967	365	28	217	107	13	(106)
1968	366	53	230	69	14	(71)
1969	365	109	223	19	14	(84)
1970	365	62	269	0	34	(68)
1971	365	38	265	44	18	(52)
1972	366	26	276	24	40	(47)
1973	365	104	235	7	19	(61)
1974	365	35	256	24	50	(49)
1975	365	44	250	32	39	(52)

From Annual Report, Graduate School of Oceanography, University of Rhode Island, 1976.

expensive, it is not feasible to return to home port after every cruise.

Figures 3, 4, and 5 show in detail the cruise tracks of 1973, 1974, and 1975, respectively. The area in yellow shows the area of 200 mile jurisdiction, while the red line indicates the boundary of a 200 mile U.S. zone.

For the purpose of this study, the 200 mile zone was considered as any area of the oceans within 200 miles of land, excluding those areas which might be included within a possible 200 mile jurisdiction claimed by the United States. In areas such as the Gulf of Mexico, the Caribbean and the Atlantic Ocean around the southern U.S., Puerto Rico and the U.S. Virgin Islands, a working boundary was determined by using equidistance, i.e., dividing the area between the U.S. and foreign nations in half.

The 200 mile zone was considered to be that shown in Figure 1. The open area includes any area of the ocean not in the 200 mile zone of foreign nations but including areas within the U.S. 200 mile zone.

The data sources used in this study were the R/V TRIDENT's deck logs which are kept as specified by regulatory agencies, and provide a continuous and detailed record of the ship's operations and the cruise reports prepared by the chief scientists subsequent to each cruise. The cruise reports give a brief description of the scientific mission and operations of the ship during each cruise. A cruise is defined as the time, bounded by visits to a port, during which a particular scientific mission or missions is carried out. The cruise summaries prepared by Williams and Ashraf (1976) were also extremely useful.

Ship time is the most convenient parameter by which to make these

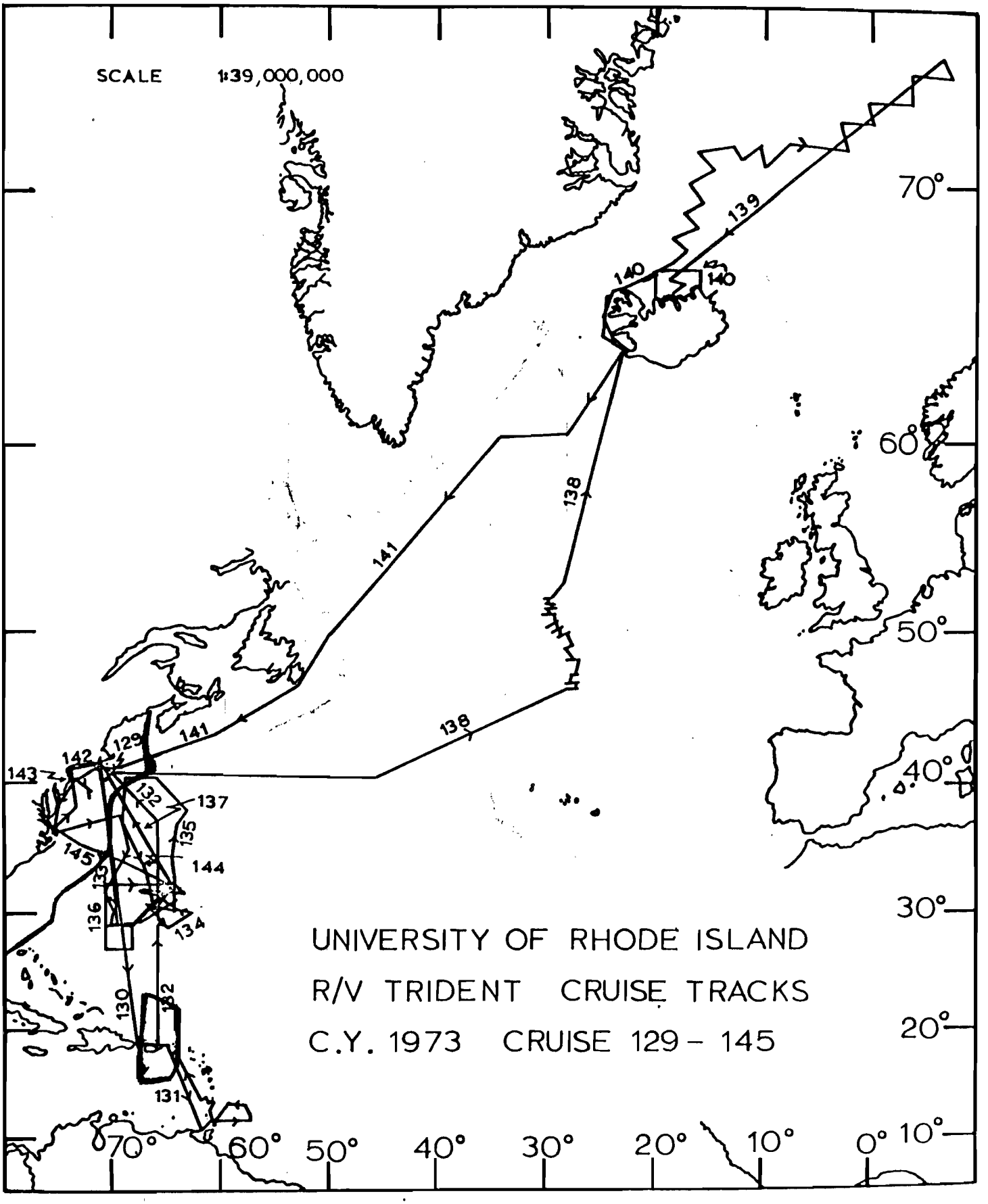

Figure 3. R/V TRIDENT Cruise Tracks 1973.

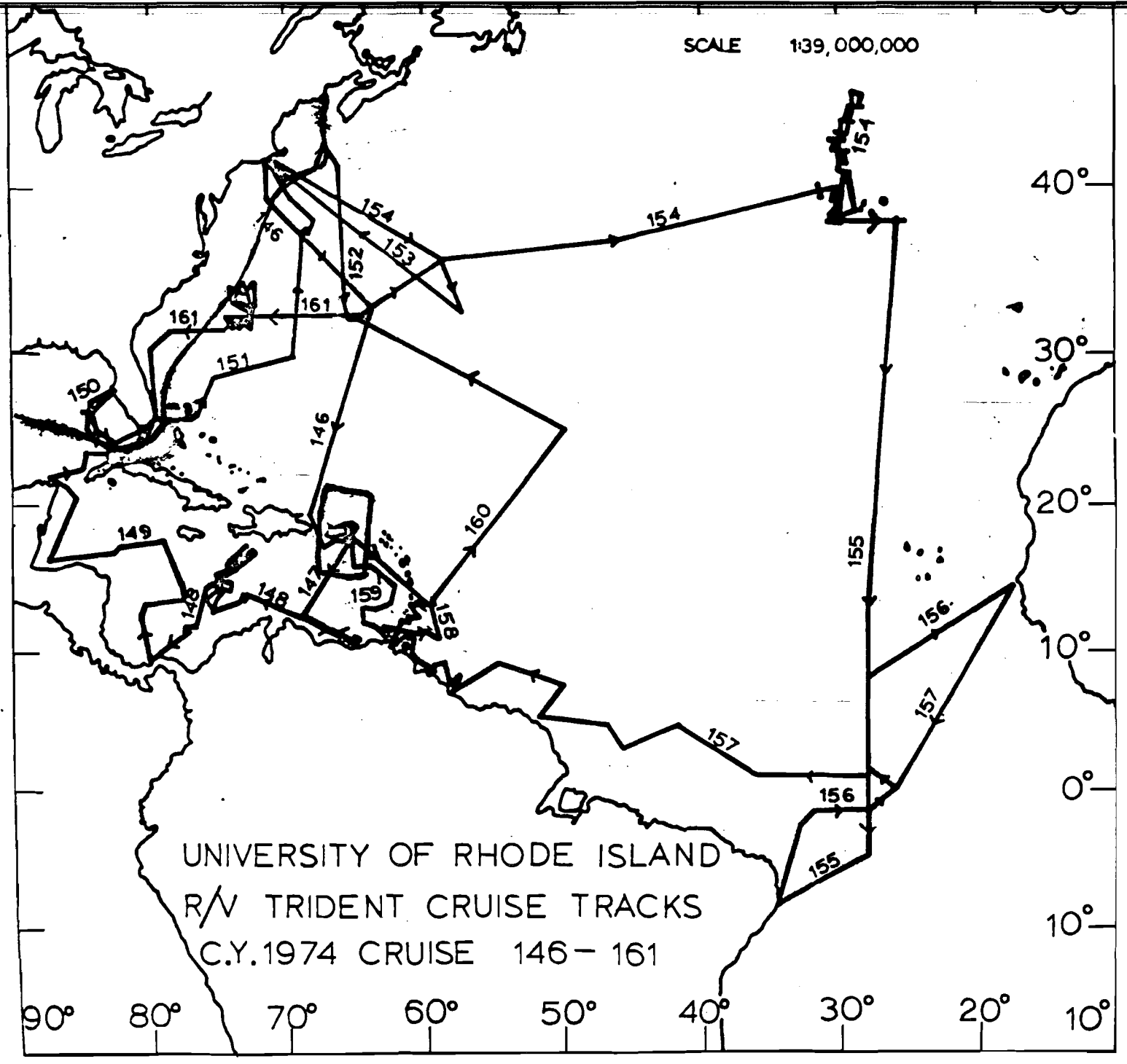

Figure 4. R/V TRIDENT Cruise Tracks 1974.

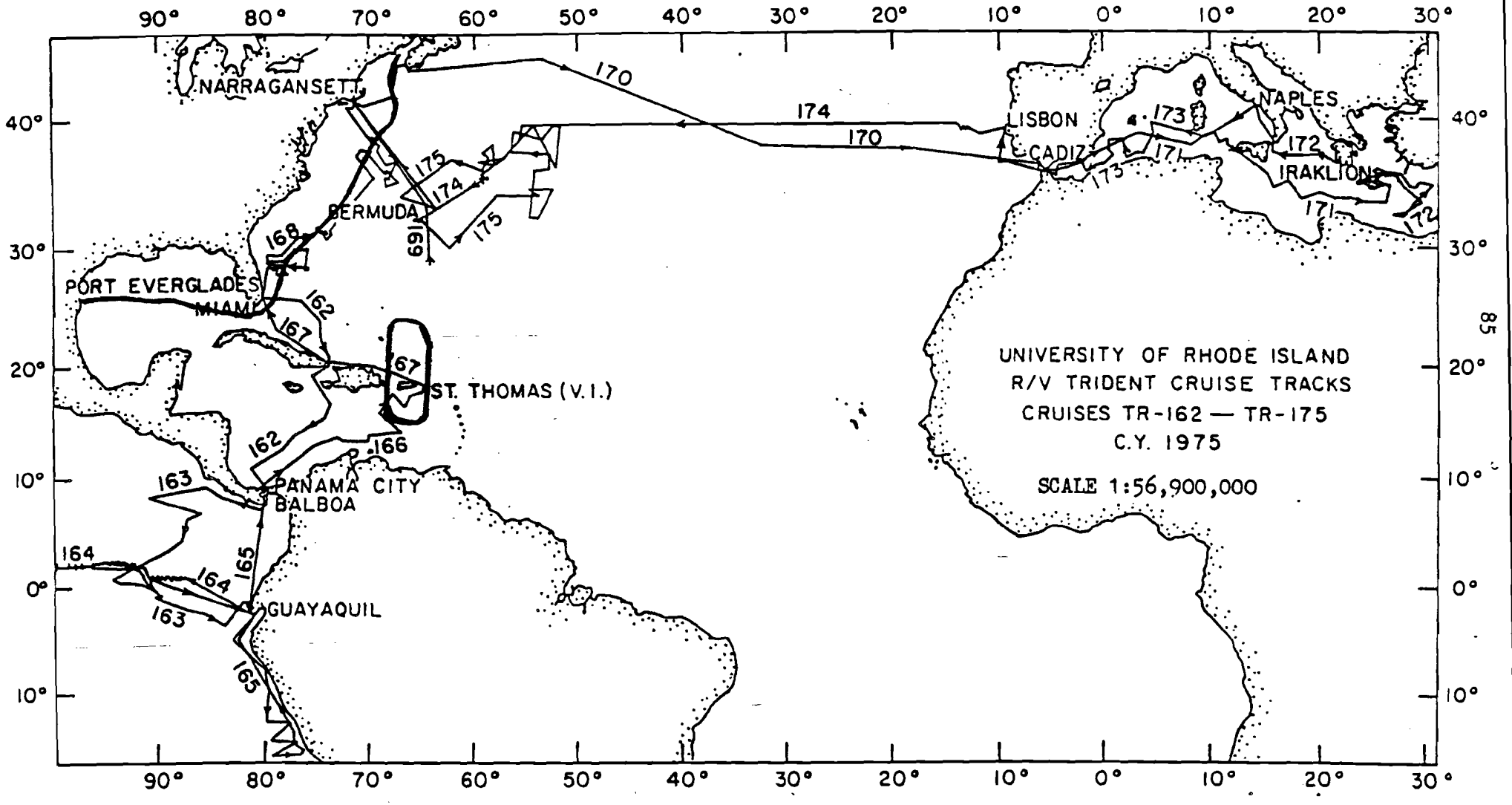

Figure 5. R/V TRIDENT Cruise Tracks 1975.

determinations. Time is readily extractable from the ship's deck logs, as all operations are recorded with reference to the time at which they occurred. Distance travelled was deemed unsuitable as the scientific work of the ship often requires that the ship steam along an intricately convoluted track, stopping frequently for periods of varying duration.

The definition of effort used in these determinations is: the time after the first primary observation and before the last primary observation. In the accompanying tables, this is referred to as working time. The time before the first primary observation and after the last is taken not to represent a direct oceanographic effort and referred to as transit time. A primary observation is an observation taken to further the accomplishment of the immediate scientific mission of the ship. A primary observation may be either a station observation or an underway observation. During transit time ancillary observations may be taken. Ancillary observations are observations taken to gather data considered potentially useful, but not necessary to the immediate scientific mission. Ancillary observations do not interfere with the ship's schedule and are usually underway observations.

The reasoning that led to this defintion was that, between primary observations, the ship's position and operations are determined by the preceeding and succeeding primary observations, and could not be significantly altered without affecting the immediate scientific mission. Thus, specific location or movement along a particular line are necessary to the total oceanographic effort. Furthermore, it is a rare occasion when the ship is not engaged in some sort of continuous underway observation which may or may not be recorded in the deck logs or cruise reports.

Whether or not observations taken between recorded primary observations are themselves primary or ancillary is problematical. Bathymetry and magnetometry are examples of this.

By similar reasoning, before the first primary observation and after the last, the ship's presence in a given location is determined largely by convenience, and could be altered without significantly affecting the immediate scientific mission of the ship.

An inspection of the cruise reports reveals approximately when the ship entered or departed the 200 mile zone. The moment when the boundary was crossed can then be determined to a high degree of accuracy by consulting the relevant portions of the ship's deck logs and standard methods of fix to fix plotting. The first and last primary observations are found in the ship's deck logs. They are invaluably accompanied by a change in ship's motion and are therefore recorded. The time is then arithmetically apportioned to 'work' or 'transit' in either the 200 mile zone or the open area as appropriate.

The above methodology was developed by a marine technician at G.S.O., Mark Weishan in an earlier study (1973) of the TRIDENT's activities for the period 1968-1972. It was used in an exactly similar manner in this study for the period 1973-1975 to make the two studies comparable.

Tables VI, VII and VIII show the data for each cruise. The cruise numbers are the same as those shown in figures 3-5. The total number of days at sea calculated here is for time of departure to time of arrival in the next port. The data in the G.S.O. report summary (table V) considers any part of a day at sea as an entire day at sea to simplify record keeping. Thus, the total number of days at sea in the G.S.O.data

TABLE VI

Summary of Activities of R/V TRIDENT 1973

Cruise No.	In 200 Mile Zone (Days) Transit	Working	Total	In Open Area (Days) Transit	Working	Total	Total Transit	Total Working	Total at Sea this Study[1]	Total at Sea GSO Report[2]	% Total in 200 Mile Zone	% Transit Time in 200 Mile Zone	% Working Time in 2 Mile Zone
TR-129	0	0	0	1.5	0.5	2.0	1.5	0.5	2.0	3.0	0	0	0
TR-130	0	0	0	0.5	13.3	13.8	0.5	13.3	13.8	15	0	0	0
TR-131	0	14.9	14.9	1.8	2.3	4.1	1.8	17.2	19	11, 9	78	0	87
TR-132	0	0	0	2.2	5.6	7.8	2.2	5.6	7.8	9	0	0	0
TR-133	0.9	0	0.9	2.4	20.4	22.8	3.3	20.4	23.7	25	4	13	0
TR-134	1.0	9.8	10.8	0	0	0	1.0	9.8	10.8	12	100	100	100
TR-135	0.7	0.3	1.0	0	12.4	12.4	0.7	12.7	13.4	15	8	100	2
TR-136	1.4	0.1	1.5	0.8	20.6	21.4	2.2	20.7	22.9	24	7	64	0.5
TR-137	0.7	0.2	0.9	0.1	4.8	4.9	0.8	5.0	5.8	7	16	88	3
TR-138	0.2	0.5	0.7	2.8	18.2	21.0	3.0	18.7	21.7	23	3	7	3
TR-139	0.3	19	19.3	0	2.5	2.5	0.3	21.5	21.8	23	89	100	88
TR-140	1.6	12.1	13.7	0	0	0	1.6	12.1	13.7	16	100	100	100
TR-141	1.1	5.3	6.4	0.4	9.0	9.4	1.5	14.3	15.8	17	41	73	37
TR-142	0	0	0	1.4	0.7	2.1	0.7	1.4	2.1	3	0	0	0
TR-143	0	0	0	0.4	1.8	2.2	0.4	1.8	2.2	2	0	0	0
TR-144	0.1	2.2	2.3	0	6.6	6.6	0.1	8.8	8.9	9	27	100	26
TR-145	0.1	1.8	1.9	0.2	9.3	9.5	0.3	11.1	11.4	12	17	33	16
Average 1973[3]	-	-	-	-	-	-	-	-	-	-	(34)	(37)	(34)

1 Calculated from time of departure to arrival in port.
2 Any part of a day at sea is considered a whole day at sea.
3 Calculated from totals, not the average of the % values from each cruise.

TABLE VII

Summary of Activities of R/V TRIDENT 1974

Cruise No.	Transit	Working	Total	Transit	Working	Total	Total Transit	Total Working	Total at sea[1] this study	Total at sea GSO Report	% Total in 200 Mile Zone	% Transit Time in 200 Mile Zone	% Working Time in 200 Mile Zone
TR-146	0	0.8	0.8	1.9	7.0	8.9	1.9	7.8	9.7	11	8	0	10
TR-147	0.9	10.9	11.8	0.8	0	0.8	1.7	10.9	12.6	5,9	94	53	100
TR-148	0.4	16.7	17.1	0	0	0	0.4	16.7	17.1	18	100	100	100
TR-149	0	14.3	14.3	0.5	0.6	1.1	0.5	14.9	15.4	17	93	0	96
TR-150	0	0	0	2.5	5.5	8.0	2.5	5.5	8.0	5,4	0	0	0
TR-151	0	1.6	1.6	0.8	8.3	9.1	0.8	9.9	10.7	12	15	0	16
TR-152	0.2	2.7	2.9	0.7	7.2	7.9	0.9	9.9	10.8	12	27	22	27
TR-153	0.8	0	0.8	1.3	6.5	7.8	2.1	6.5	8.6	6,4	9	38	0
TR-154	1.0	12.2	13.2	2.5	7.3	9.8	3.5	19.5	23.0	14,10	57	29	66
TR-155	1.5	0	1.5	0.9	19.8	20.7	2.4	19.8	22.2	23	7	62	0
TR-156	1.1	0.8	1.9	0	19.0	19.0	1.1	19.8	20.9	22	9	100	4
TR-157	0.9	10.3	11.2	0	12.0	12.0	0.9	22.3	23.2	24	48	100	4
TR-158	0.8	8.3	9.1	0	0	0	0.8	8.3	9.1	10	100	100	100
TR-159	0.3	12.1	12.4	1.3	4.6	5.9	1.6	16.7	18.3	15,4	68	19	72
TR-160	0.5	10.5	11.0	0.5	4.5	5.0	1.0	15.0	16.0	17	69	50	70
TR-161	0.5	0.5	1.0	0.7	11.1	11.8	1.2	11.6	12.8	14	8	42	4
Average 1974[3]											(46)	(38)	(47)

1 Calculated from time of departure to arrival in port.
2 Any part of a day at sea is considered a whole day at sea.
3 Calculated from totals, not the average of the % values from each cruise.

TABLE VIII

Summary of Activities of R/V TRIDENT 1975

Cruise No.	In 200 Mile Zone (Days) Transit	Working	Total	In Open Area (Days) Transit	Working	Total	Total Transit	Total Working	Total at Sea this study[1]	Total at Sea GSO Report[2]	% Total in 200 Mile Zone	% Transit Time in 200 Mile Zone	% Working Time in 200 Mile Zone
TR-162	3.8	6.6	10.4	0.2	0	0.2	4.0	6.6	10.6	11	98	95	100
TR-163	1.3	18.1	19.4	0	0	0	1.3	18.1	19.4	21	100	100	100
TR-164	0.9	23.2	24.1	0	0	0	0.9	23.2	24.1	25	100	100	100
TR-165	4.8	13.0	17.8	0	0	0	4.8	13.0	17.8	19	100	100	100
TR-166	2.0	8.8	10.8	0.7	1.2	1.9	2.7	10.0	12.7	14	85	74	88
TR-167	2.7	0	2.7	2.0	3.1	5.1	4.7	3.1	7.8	9	35	57	0
TR-168	0	0	0	1.3	16.6	17.9	1.3	16.6	17.9	19	0	0	0
TR-169	1.2	8.3	9.5	0.9	5.9	6.8	2.1	14.2	16.3	8.10	67	57	58
TR-170	3.4	6.8	10.2	1.9	11.0	12.9	5.3	17.8	23.1	3.22	44	64	38
TR-171	0.6	12.6	13.2	0	0	0	0.6	12.6	13.2	14	100	100	100
TR-172	0.4	15.9	16.3	0	0	0	0.4	15.9	16.3	17	100	100	100
TR-173	0.6	11.0	11.6	0	0	0	0.6	11.0	11.6	13	100	100	100
TR-174	1.2	5.7	6.9	0	16	0	1.2	21.7	22.9	24	30	100	26
TR-175	0.2	1.0	1.2	0.2	19.2	19.4	0.4	20.2	20.6	21	5	50	5
Average 1975[3]	-	-	-	-	-	-	-	-	-	-	(66)	(76)	(64)

1 Calculated from time of departure to arrival in port.
2 Any part of a day at sea is considered a whole day at sea.
3 Calculated from totals, not the average of the % values from each cruise.

differs in some cases from that calculated here. The percentage of time in the 200 mile zone in both transit and working modes is calculated for each cruise. The percentage is also calculated for the total amount of time in the 200 mile zone relative to the total time at sea. An annual average percentage is also calculated from the total number of days spent in transit and working in the 200 mile zone. It is not valid to average the individual percentages from each cruise because the cruises last varying numbers of days.

Table IX shows a summary of this study for 1973-1975 and Weishan's study for 1968-1972. During this eight year period 43% of the transit time, 47% of the working time and 47% of the total time at sea was spent within the proposed 200 mile economic zone.

Ross (1974) reported that 39% of the ship time Woods Hole Oceanographic Institution (WHOI) vessels was spent in the 200 mile zone in the period 1969-1973.

It is clear that denials of access to coastal waters will have a significant impact on developed countries' programs of oceanographic research. How this will affect the acquisition of knowledge some feel is essential for survival of the marine environment cannot be predicted. The cruise summaries were also examined to show the extent of participation by foreign scientists on TRIDENT cruises. This data is presented in table X. The list does not distinguish foreign students attending URI from U.S. scientists. In 1972 1 out of 212 scientists was from a foreign country. In 1973 there were no foreign scientists among the 167 scientists utilizing TRIDENT. In 1974 3 out of 173 scientists were foreigners. In 1975 9 of the 150 scientists were from foreign nations. Many of the

TABLE IX

Eight Year Summary of Work in the 200 Mile Zone

Year	% Total Transit Time in 200 Mile Zone	% Total Working Time in 200 mile Zone	% Total Time at Sea in 200 mile Zone
1968	30	33	32
1969	60	57	58
1970	49	62	59
1971	24	35	33
1972	53	43	45
1973	37	34	34
1974	38	47	46
1975	76	64	66
8 Year Average	43	47	47

foreign scientists were from developed countries.

Ross (1974) reported that 49 of 175 foreign participants taken to sea on UNOLS ships in 1972 went aboard WHOI ships. He found that over the period 1967-1973 there was 5% foreign participation, 25% from other American universities and 69% Woods Hole participation. In the past it does not seem that foreign nations have been very adamant about requiring participation on U.S. cruises. The ships from southern institutions frequenting the Caribbean may show a different pattern.

It is unclear what the future fate of the Law of the Sea Conference will be. Even if the developing countries reach consensus, the developed countries may not ratify the treaty. Customary law appears to be changing away from the freedom of the seas to growing coastal state jurisdiction over 200 mile economic zones. U.S. vessels seem clearly to be facing a period of increasing restrictions. It should be possible to gain access to waters of friendly nations by means of bilateral agreements. Without a tribunal to decide which research is valid and assure access, other areas may well be closed off to research activities by U.S. vessels. The role of international organizations in facilitating access seems unclear.

The National Academy of Sciences (1977a) has indicated that recently half of the applications for access to foreign waters have been denied. The developing nations are beginning to influence what areas are being studied and when. The common heritage of mankind seems to have become somewhat more limited because of their restrictions.

TABLE X

Foreign Participation in R/V TRIDENT Cruises

	Total Scientists	URI	Other U.S. Not URI	Foreign	% Foreign	% Other U.S.	% URI	Country of Foreign
(1972)								
TR-109	14	10	4	0	0	29	71	-
TR-110	9	3	6	0	0	33	67	-
TR-111	10	5	5	0	0	50	50	-
TR-112	12	9	3	0	0	25	75	-
TR-113	9	9	0	0	0	0	100	-
TR-114	13	10	3	0	0	23	77	-
TR-115	12	11	1	0	0	8	92	-
TR-116	12	12	0	0	0	0	100	-
TR-117	10	3	7	0	0	70	30	-
TR-118	9	3	6	0	0	67	33	-
TR-119	13	8	5	0	0	38	62	-
TR-120	8	5	3	0	0	37	63	-
TR-121	12	10	1	1	8	8	83	U.K.
TR-122	8	7	1	0	0	12	88	-
TR-123	11	11	0	0	0	0	100	-
TR-124	7	3	4	0	0	57	43	-
TR-125	10	10	0	0	0	0	100	-
TR-126	12	9	3	0	0	25	75	-
TR-127	12	3	9	0	0	75	25	-
TR-128	9	4	5	0	0	56	44	-
Total	212	145	66	1	0.5	31.1	68.4	-
(1973)								
TR-129	8	5	3	0	0	37	63	-
TR-130	13	11	2	0	0	15	85	-
TR-131	13	9	4	0	0	31	69	-
TR-132	11	5	6	0	0	55	45	-
TR-133	11	7	4	0	0	34	66	-
TR-134	10	10	0	0	0	0	100	-
TR-135	9	7	2	0	0	22	78	-
TR-136	11	2	9	0	0	82	18	-
TR-137	10	8	2	0	0	20	80	-
TR-138	12	6	6	0	0	50	50	-
TR-139	12	7	5	0	0	42	58	-
TR-140	7	5	2	0	0	29	71	-
TR-141	5	0	5	0	0	100	0	-
TR-142	6	6	0	0	0	0	100	-
TR-143	9	4	5	0	0	56	44	-
TR-144	7	7	0	0	0	0	100	-
TR-145	13	12	1	0	0	8	92	-
Total	167	111	56	0	0	35.5	66.5	-

	Scientists	URI	Other U.S. Not URI	Foreign	% Foreign	% Other U.S.	% URI	Country of Foreign
(1974)								
TR-146	9	2	7	0	0	78	22	-
TR-147	11	6	5	0	0	45	55	-
TR-148	11	11	0	0	0	0	100	-
TR-149	11	10	0	1	9	0	91	France
TR-150	8	0	8	0	0	0	100	-
TR-151	9	4	5	0	0	44	56	-
TR-152	12	8	4	0	0	33	67	-
TR-153	11	10	1	0	0	9	91	-
TR-154	12	7	5	0	0	42	58	-
TR-155	13	12	0	1	8	0	92	Bermuda
TR-156	12	11	1	0	0	0	92	-
TR-157	7	4	3	0	0	43	57	-
TR-158	13	3	9	1	8	77	23	Trinidad
TR-159	16	7	9	0	0	56	44	-
TR-160	12	9	3	0	0	25	75	-
TR-161	6	5	1	0	0	17	83	-
Total	173	109	61	3	1.7	35.3	63	-
(1975)								
TR-162	6	3	3	0	0	50	50	-
TR-163	10	10	0	0	0	0	100	-
TR-164	14	9	2	3	22	14	64	Ecuador
TR-165	12	5	5	2	16	42	42	France, Panama
TR-166	10	3	7	0	0	70	30	-
TR-167	9	4	5	0	0	56	44	-
TR-168	13	7	6	0	0	46	54	-
TR-169	14	13	1	0	0	7	93	-
TR-170	13	9	4	0	0	31	69	-
TR-171	13	12	1	0	0	8	92	-
TR-172	12	7	2	3	25	17	58	France, Austr.,U.K.
TR-173	10	2	8	0	0	80	20	-
TR-174	7	4	3	0	0	43	57	-
TR-175	7	3	3	1	14	43	43	Canada
Total	150	91	50	9	6	33.3	60.7	-

SUMMARY

1972	212	145	66	1	0.5	31.1	68.4
1973	167	111	56	0	0.0	33.5	66.5
1974	173	109	61	3	1.7	35.3	63.0
1975	150	91	50	9	6	33.3	60.7
				Average	2.05	33.3	64.65

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Appendix A

A Summary of the Articles dealing with Marine Scientific Research in the Informal Composite Negotiating Text[1]

Article 19: Ships conducting research or hydrographic surveys in the territorial sea or the contiguous zone are considered to be conducting activities prejudicial to the coastal State and thus, are not undergoing innocent passage.

Article 21: The coastal State may make laws and regulations relating to marine scientific research in the territorial sea and the contiguous zone.

Article 40: While in passage through straits used for international navigation no ship can carry out any research or survey activities without the prior authorization of the States bordering the straits.

Article 54: No research or survey activities are allowed during passage through archipelagic waters without the prior authorization of the archipelagic State.

Article 56: In the exclusive economic zone (the region extending outward 200 nautical miles from the coastal State baselines) the coastal State has sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or nonliving, of the seabed and subsoil and the superjacent waters, and with regard to other activities for the economic exploration and explora-

tion of the zone. The coastal State has jurisdiction with regard to all marine scientific research in the zone.

Article 62: With regard to (foreign) fishing in the economic zone, the coastal State may make regulations requiring (under its authorization and control) the conduct of specified fisheries research programs and regulating the conduct of such research, including, the sampling of catches, disposition of samples, and the reporting of associated scientific data.

Article 77: The coastal State exercises sovereign rights over its continental shelf (seabed and subsoil extending to the edge of the continental margin or out to 200 miles where the outer margin does not extend that far) for the purpose of exploring and exploiting its natural resources. These rights are exclusive -- no one may undertake these activities without the express consent of the coastal State.

Article 78: The rights of the coastal State over its continental shelf do not affect the status of the superjacent waters.

Article 81: The coastal State has the exclusive right to authorize and regulate drilling on the continental shelf for all purposes.

Article 87: There is freedom of scientific research on the high seas in those areas which are beyond national jurisdiction and not under the jurisdiction of the International Seabed

Authority.

Article 123: States bordering enclosed or semi-enclosed seas should coordinate their scientific research policies, and undertake where appropriate joint programs of scientific research. They should invite, as appropriate, other interested States or competent international organizations to cooperate with them.

Article 133: All activities of exploration and exploitation of the resources (mineral resources in situ) of the Area (the seabed and ocean floor and subsoil thereof beyond the limits of national jurisdiction) are under the jurisdiction of the International Seabed Authority. Recovered resources are known as minerals and include the following:

1. Liquid or gaseous substances such as petroleum, gas, condensate, helium, nitrogen, carbon dioxide, water, steam, hot water, as well as sulfur and salts extracted in liquid form in solution;
2. Useful minerals occurring on the seabed or at depths less than 3 meters beneath the surface as well as concretions of phosphorites and other minerals;
3. Solid minerals in the ocean floor at depths of more than 3 meters from the surface;
4. Ore-bearing silt and brine.

Article 143: Marine scientific research in the Area shall be carried out

exclusively for peaceful purposes and for the benefit of mankind as a whole. States' parties shall promote international cooperation in marine scientific research in the following ways:

1. Participation in international programs and encouraging cooperation in marine scientific research by personnel of different countries of the Authority;
2. Ensuing that programs are developed through the Authority or other international bodies for the benefit of developing countries with a view to a) strengthening their research capabilities, b) training their personnel and those of the Authority in the techniques and applications of research, and c) fostering the employment of their qualified personnel in activities of research in the Area;
3. Effective dissemination of the results and analyses when available through the Authority or other international channel.

Article 144: The Authority and States' parties shall cooperate in promoting the transfer of technology and scientific knowledge relating to activities in the Area so that the Enterprise and all States benefit from them. They shall initiate and promote programs facilitating the access of the Enterprise and developing countries to the relevant technology (for the exploration and exploitation of resources) under fair

and reasonable conditions. They should initiate and promote measures directed toward the advancement of the technology of the Enterprise and the domestic technology of developing countries by opening opportunities to personnel from the Enterprise and developing countries for training in marine science and technology and their full participation in activities in the Area.

Article 147: Activities in the Area shall be carried out with regard for other activities in the marine environment. Stationary and mobile installations relating to the conduct of activities in the Area shall be erected, emplaced and removed solely in accordance with this Convention, subject to rules and regulations adopted by the Authority.

Article 151: Activities in the Area shall be carried out by the Authority on behalf of mankind as a whole. The Authority shall carry out marine scientific research concerning the Area and its resources, and may enter into contracts for that purpose. The Authority shall promote and encourage the conduct of marine scientific research in the Area, harmonize and coordinate such research, and arrange for the effective dissemination of the results thereof. The Authority shall take measures to acquire technology and scientific knowledge relating to activities in the Area and to promote and encourage the transfer of such technology and scientific knowledge so that all States benefit

therefrom.

Article 163: The Technical Commission of the Authority will make recommendations to the Council of the Authority with regard to the carrying out of the Authority's functions with respect to scientific research and transfer of technology.

Article 201: States shall cooperate directly or through competent international organizations, global or regional, for the purpose of promoting studies, undertaking programs of scientific research and encouraging the exchange of information and data acquired about pollution of the marine environment including such areas as the assessment of the nature and extent of pollution and the pathways and risks of exposures, as well as the remedies for pollution.

Article 203: States shall directly or through international or regional organizations promote programs of scientific, educational, technical, and other assistance to developing States for the protection and preservation of the marine environment and the prevention, reduction and control of marine pollution.

Article 205: States shall individually or collectively observe, measure, evaluate and analyze the risks or effects of pollution of the marine environment.

Article 206: States shall publish reports of the results obtained re-

lating to risks or effects of pollution of the marine environment.

Article 239: (All) States and competent international organizations have the right to conduct marine scientific research subject to the rights and duties of other States.

Article 240: States and competent international organizations shall promote and facilitate the development and conduct of marine scientific research.

Article 241: Marine scientific research is to be conducted 1) exclusively for peaceful purposes, 2) with appropriate means and methods compatible with the Convention, 3) such that research activities do not unjustifiably interfere with other legitimate uses of the sea and such research activities shall be duly respected in the course of such uses, 4) so that it complies with all the regulations of this Convention including protection and preservation of the marine environment.

Article 242: Marine scientific research activities do not form the legal basis for any claim to any part of the marine environment or its resources.

Article 243: States and international organizations shall promote international cooperation in marine scientific research for peaceful purposes.

Article 244: States and organizations shall cooperate through the conclusion of bilateral, regional and multilateral agreements to create favorable conditions for the conduct of marine scientific research and to integrate the efforts of scientists in studying the essence of and the interrelations between phenomena and the processes occurring in the marine environment.

Article 245: States and competent international organizations shall make available information on proposed programs and their objectives as well as the knowledge resulting from marine scientific research through publication and dissemination through appropriate channels. States shall promote the flow of data and transfer of knowledge resulting from marine research especially to developing countries. They should promote strengthening of the autonomous marine research capabilities of developing countries through the education and training of their scientific and technical personnel.

Article 246: Coastal States have the exclusive right to regulate, authorize and conduct marine scientific research within their territorial sea. Research shall be conducted only with the express consent of and under the conditions set forth by the coastal State.

Article 247: Coastal States have the right to regulate, authorize and

conduct marine scientific research in their exclusive economic zone and on their continental shelf. Marine scientific research activities in the exclusive economic zone and on the continental shelf require the consent of the coastal State. In normal circumstances coastal States shall grant their consent for marine scientific research by other States or competent international organizations in their exclusive economic zone or on their continental shelf if it is to increase scientific knowledge of the marine environment for the benefit of mankind and is for peaceful purposes. Coastal States shall establish rules and procedures ensuring that such consent will not be delayed or denied unreasonably. Coastal States may however in their discretion withhold consent for any research project in their exclusive economic zone or on their continental shelf if that project 1) is of direct significance for the exploration and exploitation of natural resources whether living or non-living; 2) involves drilling into the continental shelf, the use of explosives, or the introduction of harmful substances into the environment; 3) involves the construction, operation, or use of artificial islands, installations and structures; 4) contains information regarding the nature and objectives of the project which is inaccurate, or if the researching State or international organization has outstanding obligations to the coastal State from a prior research project. Marine scientific research acti-

vities shall not unjustifiably interfere with activities undertaken by coastal States in accordance with their sovereign rights and jurisdiction.

Article 248: A coastal State which is a member of a regional or global organization or has a bilateral agreement with such an organization and in whose exclusive economic zone or on whose continental shelf the organization wants to carry out a marine scientific project, shall be deemed to have authorized the project to be carried out, upon notification to the duly authorized officials of the coastal State by the organization, if that State approved the project when the decision was made by the organization for the undertaking of the project or is willing to participate in it.

Article 249: States and international organizations which plan to undertake marine scientific research in the exclusive economic zone or on the continental shelf shall provide the coastal State with a full description of the project not less than 6 months before the proposed start of the project. The description should include the following:

1. The nature and objectives of the research project;
2. The method and means to be used including the name, tonnage, type and class of vessels to be used and a description of the scientific equipment;
3. The precise geographical areas in which the activities are to be conducted;

4. The expected date of first appearance and final departure of the research vessels or the deployment of the equipment and its removal as appropriate;
5. The name of the sponsoring institution, its director, and person in charge of the research project;
6. The extent to which it is considered that the coastal State should be able to participate or be represented in the research project;

Article 250: States and international organizations undertaking marine scientific research in the exclusive economic zone or on the continental shelf of a coastal State shall comply with the following conditions:

1. Ensure the rights of participation or representation by the coastal State, if it desires, in the research project, especially on board research vessels and other craft or installations, when practical, without payment of any remuneration to the scientists of the coastal State and without obligation (of the coastal State) to contribute towards the costs of the research project;
2. Provide, upon request, preliminary reports to the coastal State as soon as practical, and with the final results and conclusions after the completion of the research;
3. Provide, upon request, access for the coastal State to

all data and samples from the research project and furnish it with data which may be copied and samples which may be divided without detriment to their scientific value;

4. Upon request, assist the coastal State in assessing such data, samples, and results;
5. Ensure that research results are made internationally available through appropriate national or international channels as soon as feasible;
6. Inform the coastal State immediately of any major change in the research program;
7. Unless otherwise agreed, remove the scientific installations or equipment once the research is completed.
8. Article 250 does not prejudice the laws and regulations established by the coastal State governing the conditions for granting of consent.

Article 251: Communications concerning the research project shall be made through appropriate official channels unless otherwise agreed.

Article 252: States shall seek to promote through competent international organizations the establishment of general criteria and guidelines to assist States in ascertaining the nature and implications of marine scientific research.

Article 253: States or competent international organizations may proceed

with a research project upon the expiry of 6 months from the date upon which the information which required under article 249 was provided to the coastal State unless within 4 months of the receipt of the communication containing such information the coastal State has informed the researching State or organization that

1. It has withheld its consent under the provisions of articles 246 and 247;
2. The information given by the researching State or organization regarding the nature or objectives of the research project does not conform to the manifestly evident facts; or
3. It requires supplementary information; or
4. Outstanding obligations exist with respect to a previous project carried out by that State or organization with regard to the conditions established by article 250.

Article 254: The coastal State has the right to require the cessation of any research activities in progress within its economic zone or on its continental shelf if 1) the research project is not being conducted in accordance with the information initially communicated to the coastal State under article 257 regarding the nature, objectives, method, means, or geographical areas of the project; or 2) the researching State or organization fails to comply with the rights of

the coastal State under article 250 and compliance is not secured within a reasonable period of time.

Article 255: States and organizations conducting research in the economic zone or on the continental shelf of a coastal State shall take into account the interests and rights of neighboring land-locked and other geographically disadvantaged States and shall notify these States of the proposed research as well as provide, at their request, relevant information and assistance as provided under Article 249 and 250 to the coastal State.

Article 256: To facilitate marine scientific research activities coastal States shall adopt reasonable procedures, uniformly applied to States and international organizations wishing to carry out research activities in the exclusive economic zone or on the continental shelf and shall adopt measures to facilitate access to their harbors and to promote assistance for scientific vessels carrying out such activities.

Article 257: States, irrespective of their geographic location, as well as competent international organizations shall have the right in conformance with Part XI of the Convention to conduct marine scientific research in the Area.

Article 258: All States and competent international organizations have the right to conduct marine scientific research in the water column beyond the limits of the exclusive economic

zone (beyond 200 nautical miles).

Article 259: The deployment and use of any type of scientific research installations shall be subject to the same conditions as the conduct of research in that area.

Article 260: Installations and equipment used for research shall not have the status of islands or possess their own territorial sea and their presence shall not affect the delimitation of the territorial sea, exclusive economic zone and continental shelf of the coastal State.

Article 261: Safety zones of 500 meters width may be established around research installations and must be respected by vessels of all States.

Article 262: The deployment and use of any type of research installations or equipment shall not constitute an obstacle to established international shipping routes.

Article 263: Installations and equipment shall bear identification and have internationally agreed warning signals to insure safety of sea and air navigation.

Article 264: States and competent international organizations shall be responsible for conducting research in accordance with this Convention. They shall be liable for measures they undertake in contravention to this Convention in respect of marine research activities conducted by other States, their

natural or juridicial persons or by competent international organizations and shall provide compensation for damage resulting from such measures. States are liable for damage arising out of research conducted by them or on their behalf.

Article 265: Unless otherwise agreed or settled by the parties concerned disputes are to be settled as described in Part XIV of the Convention. The coastal State shall not be obliged to so submit to such settlement any dispute arising from
1) the exercise of coastal rights under article 247; or
2) the decision to terminate a research project under article 254.

Article 266: Pending settlement of a dispute the State or organization authorized to conduct research shall not allow research activities to commence or continue without the express approval of the coastal State concerned.

Article 267: States, directly or through appropriate international organizations shall promote the development and transfer of marine science and technology and shall assist the developing States with the exploration, exploitation, conservation and management of marine resources, the preservation of the marine environment, marine scientific research and other uses of the marine environment compatible with this Convention or with a view to accelerating the social and

economic development of the developing States.

Article 276: States, international organizations, the International Seabed Authority and national marine scientific and technological institutions shall promote the establishment, especially in developing States, of regional marine scientific and technological research centers in order to stimulate and advance the conduct of marine scientific research by developing States and foster the transfer of technology.

Article 277: The functions of regional centers are as follows:

1. Training and educational programs at all levels and various aspects of marine scientific and technological research, particularly marine biology including the conservation and management of living resources, oceanography, hydrography, engineering, sea-bed geological exploration, mining and desalination technologies;
2. Management studies;
3. Study programs related to the protection and preservation of the marine environment, and the prevention, reduction and control of pollution;
4. Organization of regional conferences, seminars, and symposia;
5. Acquisition and processing of marine scientific and technological data and information;
6. Prompt dissemination of results of marine scientific

and technological research in readily available publications;

7. Publicizing national policies with regard to the transfer of technology and systematic comparative study of those policies;
8. Compilation and systematization of information on the marketing of technology and on contracts and other arrangements concerning patents;
9. Technical cooperation with other countries of the region.

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1. Informal Composite Negotiating Text, United Nations, Third Conference on the Law of the Sea, A/Conf.62/WP.10, 15 July, 1977.

APPENDIX B
SOME COMMENTS ON SCIENCE AND THE LAW OF THE SEA

The paradox is that the scientific progress necessary for a fuller utilization of ocean resources is being retarded by new regimes which were established because of such enhanced utilizations. . . The combination of increased requirements for the use of the seas' resources and the rapid improvement of our technological capability to tap these resources has resulted in increased claims by nations of exclusive jurisdiction involving both the geographical extension of existing zones and the creation of new ones. These zones have also introduced restrictions on the conduct of scientific research previously unknown in international law.

(Schaefer, (1969)

Work in the ocean is such that the two groups - the more and the less developed - cannot pursue separate paths - they interact too completely.

It must be evident that an IOC session is not an assemblage of oceanographers but of representatives of States; certainly with limited statuatory powers, but with very considerable authority and with governments behind them.

(Holt, 1975)

Data is a commodity subject to ownership. Heretofore all field scientists including anthropologists, entomologists, geologists, and others including oceanographers have acted as if data belonged to them by virtue of their discovery of it. As the behavior of certain governments towards ocean research suggests, this is no longer an unquestioned position. This, I suggest, is the root issue in the current debate over freedom of access to coastal waters.

(Bernard, 1972)

While the benefits of scientific research may indirectly benefit all of mankind, the immediate benefits of scientific research will flow to the technologically advanced industrialized countries which can best utilize the information gleaned. There is a great scientific, technological and economic inequality of states. . . Poor countries are interested in science not so much for science's sake but more for the contributions that science can make toward economic development.

(H. Franssen, 1973b)

Scientific organizations such as SCOR have been weak in affecting the course of governmental decisions. Scientists themselves are usually reluctant to become involved in the political aspects of their scientific endeavors (this is particularly true of European scientists). Even when they become sufficiently aroused to take a position scientists appear to be unable to convince their own governments, let along those of other governments, to take other than nationalistic positions on such matters.

(Bradley, 1973)

Many non-scientists, in and out of governments, have started to judge scientific research by what they believe are its likely consequences rather than as an ethically neutral search for truth. They assume that he who understands scientific truth is able to use it for whatever purpose - commercial, military, or altruistic. The conclusion frequently reached is that the process of accumulating knowledge must be controlled.

(Friedheim and Kadane, 1972)

It is probably true that the only two major interest groups in the U.S. that would like complete freedom of the seas are the science community and the intelligence community. It is probably also true that science might have a better chance of advancing its cause if the similarity of its interests were not so obvious to all concerned.

(Knauss, 1971a)

Developed countries viewpoint: The issue is to what freedom or protection under international law should marine scientists be entitled, in view of their special research requirements and its benefits to mankind.

Developing countries viewpoint: What regulation by coastal States of scientific research is necessary to protect and promote special national interests in adjacent ocean areas.

(Kilpatrick, 1974)

Forbidding of research by foreign scientists is partly due to lack of sophistication, partly on fears based on past colonial or semi-colonial experiences and partly on their apprehensions that the more advanced countries possess the technology and competence for obtaining information relating to coastal and subsoil features which may be of military or economic value and may in turn be used against them.

(H. Franssen, 1973b)

Science and technology are closely linked and dependence on foreign advanced technology is regarded as a new form of colonialism, "technological colonialism," which they believe is more difficult to erase than classical colonialism. Awareness of the important link between science and technology, on the one hand, and economic development, military power, and prestige on the other, soon leads to the desire to control their own destiny. Research becomes a national resource to be controlled by the State, and wherever possible exclusively conducted by their own nationals for the benefit of the nation. Hence only the kind of foreign-conducted research that contributes towards the enhancement of the domestic capability, complements the research of the coastal State and is perceived to directly benefit the State will be permitted and even encouraged. Other research projects . . . are not likely to be approved.

(Franssen, 1974)

The superpowers are in utter disregard of the just demands of developing countries with their demand for freedom of scientific research as a recognized principle of international law. The superpowers are everywhere gathering marine intelligence on a large scale so as to willfully plunder marine resources under the screen of scientific research. Marine scientific research just as any other scientific research, whether fundamental or applied, serves directly or indirectly definite political, economic and military purposes. Science for science's sake unrelated to social practice does not exist in reality. The superpowers use marine scientific research as a tool for pushing maritime hegemony . . . an indispensable means for realizing their economic plunder and military aggression.

Scientific research should be regulated (by the International Seabed Authority) in areas beyond national jurisdiction to prevent unlawful occupation, exploitation and utilization by the superpowers.

(Shen Wei-Lang, Chinese delegate
Law of the Sea Conference, 1973)

Preservation of the marine environment may depend on preservation of the right to conduct scientific research in the ocean, and particularly in waters lying above the continental shelf. Although control of marine pollution is as much a political and economic problem as it is a scientific and technical one, scientific information is the prerequisite for prediction of the consequences of alternative actions. Rational management of the ocean as a receiver of wastes as well as an environment for the production of living resources depends, in very large part, on vastly improved understanding of the oceanic processes involved.

(Wooster, 1971)

The fear of some is that the developed states acting in cooperation through the IOC will mount an intensified exploration of ocean resources and an intensified program of scientific research and that the results of these programs, in the absence of deliberate actions to avoid them, will be to benefit solely the developed states, leaving the others to whistle.

(Burke, 1970b)

The solution for science, if faced with national or international government restrictions, whether on land or at sea, is to convince government of its beneficial intentions, its willingness to share its results with the government concerned, and its willingness to respect proprietary interests. On the other hand, intelligent government, if it wishes to profit from science, must maintain a favorable milieu to encourage scientific activities. The age of scientific laissez faire in the oceans is passing, but there is no indication that this is not in the long-range interests of science.

(Hedberg, 1976)

It seems to me that nations, including our own (U.S.) are foolish to provide the tools and the funds for effective study of the oceans, and then to make a lot of rules to prevent their effective use by the sea going scientists. If we strangle the goose, we are not likely to get many eggs.

(Schaefer, (1968)

The new frontier of knowledge should not be the privilege of a limited group of technologically economically advanced countries . . . It is not sufficient to express the view that the sea-bed beyond the limits of national jurisdiction should be regarded as the common heritage of mankind, but it is an absolute necessity to organize the cooperation in and the co-ordination of research programs among States.

(Bouchez, 1970)

In the past, we have had science for intellectual pleasure, and science for the control of nature. We have had science for war. But today, the whole human experience may hang on the question of how fast we now press the development of science for survival.

(Platt, 1969)

Americans judge that the diffusion of knowledge must necessarily be advantageous and the consequences of ignorance fatal.

(A. de Tocqueville, 1835)

At a time when the needs for oceanographic research are growing, particularly with respect to such activities as global pollution and weather forecasting, and when the costs of research even under existing conditions continue to rise, it is ironic that major new impediments are soon to be placed on the freedom of action of scientists in those parts of the world ocean which seem to be most important to the acquisition of oceanographic knowledge.

(Alexander and Hodgson, 1975)

No one has ever demonstrated that the conduct of research has <u>any</u> harmful effects on coastal states. It is perhaps ironic that this instance of alleged unilaterally expanded jurisdiction was in fact expressly authorized in a general international agreement at the apparent insistence of the U.S. Navy.

If there is concern to protect exclusive rights of mineral exploration, both in the intermediate zone and in the deep sea bed, it is not easy to see how a system can be established which will not interfere with research.

(Burke, 1969)

We were always afraid that once there was anything of real economic interest found in Antarctica the Treaty would be terribly stressed.

Scientists would have liked to maintain the purity of Antarctica for scientific purposes only, but that's no longer realistic.

(Zumberge, 1977)

One reads today with a rather bemused disbelief the early accounts of naturalists who travelled the world in search of knowledge. No one questioned the right of Darwin to leave the Beagle and to go ashore where and when he wanted to collect what was necessary. National sovereignty appeared to take no notice of scientists moving along the shore and over the mountains of Europe, Africa, and North and South America, in search of information about such objects as the geology of the Alps or the head waters of the Nile.

Science and scientists are no longer considered as harmless or innocent as was the case a century ago.

(Knauss, 1973)

Much of what we now regard as the customary international law of the seas was developed before marine scientists in any great numbers had begun to venture beyond their home waters to the open seas or to the home waters of other countries.

(Redfield, 1973)

Ocean scientists see scientific data as essentially apolitical and not as a commodity subject to national ownership. Developing nations are indeed defining data as a tangible resource . . . scientists mine data and export it for their own aggrandizement as surely as others mine tin or tuna fish. Science was being defined as an extractive industry.

There is a serious gap in the communications between U.S. marine scientists and policy makers and colleagues in developing nations.

(Bernard and Killworth, 1977)

Where cannon could not take them, however, international political organizations at last have, through the projection not of cannonballs, ships, or navies, but of political power, nonmaritime and even landlocked states now have an equal voice with maritime states in the formulation of conventional law for the oceans. Indeed this political power, combined with the proliferation of new states in recent years has raised the very real possibility that decisions in the formulation of that law may be controlled by non-maritime states.

The result is that even the almost sacred doctrine of the freedom of the high seas is being seriously questioned. This doctrine . . . has been justified as advancing the desirable objectives of maximizing the production of benefits or values from the ocean. Abuses (due to overfishing, oil pollution from tankers, etc.) are often cited by those challenging the doctrine of freedom of the seas and advocating coastal-state control... It appears, however, that a new policy objective is being advanced as well -- that of achieving a more "equitable" or a wider distribution of ocean-derived benefits than has heretofore been obtained. Not infrequently expanded coastal-state jurisdiction is presented as a means to this end...

clearly they wish to obtain more than just a share of the proceeds from royalties and fees paid by those who are actually doing the exploiting. They appear to be looking instead to more substantial benefits, such as technical and scientific know-how, which will truly aid in their development, and perhaps give them a more independent place in the world... The question remains of the extent to which this perception that marine science can and should be made to contribute to development is shared generally among developing states.

(Redfield, 1973)

Today the question arises whether science should first serve society--that is, improve man's material conditions, be a source of technical progress and favor development -- or rather should it be above all a highly disinterested activity which lead to the moon, the bottom of oceans, the Antarctic through curiosity or as a challenge, whatever the cost may be. Science today is accused of contributing to, if not provoking, the degradation of man's living conditions through its capacity to create means of altering the environment. Scientists are apprentice soccerers. We must be distrustful of their discoveries. This distrust has even been communicated to certain among them who feel guilty of carelessness or of negligence in not ensuring the desirable or innocuous use of their discoveries.

Despite the beliefs of the researchers the idea of profitability of their research comes into play when funds are voted by governments or boards of directors... Scientific research ... represents the philosophical and material raison de vivre of researchers; it is a source of power for States. Concrete rules must be defined to be applicable to scientific research instead of recognizing an abstract freedom which is nearly void of sense.

The freedom of research is not the same to researchers and to diplomats, and it does not seem that researchers and diplomats have attempted any meaningful dialogue in an effort for mutual understanding. On the contrary, it would seem that each has tried to play on this confusion to obtain the support and collaboration of the other. The researchers would like to believe their freedom to be defended by the States at the International level; governments want to use their influence to support the researchers who work to develop governmental power and prestige.

(Ringeard, 1973)

APPENDIX C
THE DEVELOPMENT OF SCIENCE IN DEVELOPING NATIONS

Basalla (1967) has presented an interesting discussion of the development of science in new nations. It is summarized in detail here because it is relevant to the transfer of technology. Modern science evolved in the 16th and 17th centuries in Europe in Italy, France, England, the Netherlands, Germany, Austria, and the Scandanavian countries. Through military conquest, colonialism, imperial influence, commercial and political relations, and missionary activity European science was diffused throughout the world. He identifies 3 phases: 1) non-science, 2) colonial science and 3) independent science.

Phase I. Non-Science

The non-scientific nation provides a source for European (developed) science. The first phase is characterized by the European who visits the new land, surveys and collects its flora and fauna, studies its physical features and then takes his work back to Europe. Botany, zoology and geology predominate this phase but astronomy, geophysics, topography, cartography, hydrography and meteorology may also be important. Anthropology, ethnology and archeology are far behind the physical studies of the new land. The observer whether trained scientist or amateur is a product of a scientific culture that values the systematic exploration of nature. During this phase science is an extension of geographical exploration including surveys, collection of specimens and classifications and it includes the appraisal of natural resources, the search for native foodstuffs and exportable natural products as part of this initial survey.

Phase 1 science may occur in new uncivilized areas or in regions already occupied by ancient civilizations. Eventually citizens of the new nation begin to participate in the surveys and classifications and new centers for the diffusion of modern science are created. During phase I all of the plant, animal and mineral specimens collected in the foreign lands around the world as well as the information amassed there were returned to Europe (later the U.S.) for the benefits of its scientists. Only the developed countries with modern scientific cultures can appreciate, evaluate and utilize this information. Scientists may work at a high level of attainment but it is made possible only by a reliance upon on an older, established scientific tradition. The new specimens and data in turn affect the development of science in the developed countries as new theories are derived from them.

Phase 2. Colonial Science

Colonial science is dependent science, that is, scientific activity in the new lands is based primarily upon institutions and traditions of a developed country with an established scientific culture. During phase 2 colonial scientists join in the surveys and the range of scientific study will expand until it coincides with the spectrum of scientific endeavor in the developed nation supporting the activity. The colonial scientist will have his source of education and institutional attachments beyond the boundaries of the land where he carries out his work. He may be trained in the developed country and will probably obtain his text books, labortory equipment and scientific instruments from the developed country. Scientific education is inadequate or non-existent in the

developing country. Similarly, scientific organizations and journals are lacking so the colonial scientist seeks the membership and honors of European scientific societies and thus the colonial publishes the results of his research in European journals. The colonial scientist frequently works under conditions where the equipment is not modern and there are insufficient numbers of other scientists to provide intellectual stimulation. They also miss being on the advancing frontiers of science and are often not able to have first hand information on the latest developments in a field. Slowly the colonial scientists are able to develop a scientific tradition of their own. Basalla points out that as late as 1922 American physicists chose to publish in the prestigious English journal Philosophical Magazine rather than in the American Physical Review.

Phase 3. Independent Science

During phase 3 the colonial scientists attempt to create an independent scientific tradition. Political and cultural nationalsim may be the impetus to become independent in science. Gradually the colonial scientist develops institutions and traditions at home which will support independent research. National science organizations and journals will be developed and the research will begin to be considered as a product of the developing country. It is often a difficult process to fully integrate science into a country which has had little contact with Western science. Basalla lists 6 goals for phase 3 science: 1) the scientist should receive most of his training at home; 2) he should be able to gain some respect for his calling, or perhaps earn his living as a scientist, in his own country; 3) he should find intellectual stimulation within his

own expanding scientific community; 4) he should be able to communicate easily his ideas to his fellow scientists at home and abroad; 5) he should have a better opportunity to open new fields of scientific endeavor; and 6) he should look forward to the reward of national honors bestowed by native scientific organizations or the government. He identifies several problems which must be overcome: 1) resistance to science on the basis of philosophical and religious beliefs must be overcome and replaced by positive encouragement of scientific research; 2) the social role and place of the scientist need to be determined in order to insure society's approval of his labors; 3) the relationship between science and government should be classified so that, at most, science receives state financial aid and encouragement, and, at least, the government maintains a neutral position in scientific matters (Basalla points out it is often difficult for a developing country to justify the expenditure of public funds to promote scientific research -- other areas of development are of much higher priority); 4) the teaching of science should be introduced into all levels of the educational system, provided of course, an adequate educational system already exists. Scientists, technicians, instrument makers will all need to be trained; 5) native scientific organizations should be founded which are specifically dedicated to the promotion of science, e.g., a national academy of sciences; 6) channels must be open to facilitate national and international scientific communication; (Generally this is accomplished by founding appropriate scientific journals and then gaining their widespread recognition); 7) a proper technological base should be made available for the growth of science. Technology would provide scientific instruments and facilities to

assist the scientists in their work. A familiarity with advanced technology will generally add to the advancement of science and vice versa.

Basalla concludes the U.S. and U.S.S.R. caught up to European science between World War I and II. Japan, Australia and Canada have made great strides in developing national science programs. Many of the developing countries -- India, China, South America and Africa -- are struggling to develop a scientific culture and have made great strides, but they have a long way to go.