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Ecological Implications of Marine Resource Development:
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Ecological Implications of Marine Resource Development: An International Sociological Study

By

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ABSTRACT

This research is a global study of marine resource development as explained by ecological theory. The two theoretical questions were formulated by Gibbs and Martin in 1959. These questions ask, (1) under what conditions will certain characteristics of sustenance organizations be present or not; and (2) what is the consequence if these characteristics of sustenance organizations are not present in resource exploitation. Data on 181 countries was collected including an expansion of Borgstrom's (1962) formula of fish protein dependency. The questions were answered using multiple regression analysis.

The findings indicate that land pressure does affect a country's reason for entering a new ecological niche. Regardless of the income level it is the poorer nations which are becoming the most dependent on protein from the sea. Since the ocean has proven to be an expensive commitment, the poorer nations will need to enter into joint sustenance organizations if they plan to continue to develop in the marine area. Poorer nations will also utilize Service Sustenance Organizations if they are to avoid the social consequences historically associated with land resource

depletion. This is especially significant if there is to be a long-term global strategy regarding the ocean as a resource.

DEDICATION

It is with great appreciation and respect that I dedicate this thesis to Dr. Georg Borgstrom.

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I would like to thank Professor Craig Harris, my thesis chairman, for his helpful suggestions throughout this research project. I appreciate in particular his extra efforts involved in finishing the data.

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INTRODUCTION

Social scientists often ignore the ecological issues surrounding the exploitation of the physical environment. The process, activity, and change involved with exploiting a physical resource base is usually narrowly conceived. The importance for humankind to continue to produce is without question, but the chosen production process is often studied only in terms of maximized profit. The historical evidence of forgotten cost to the resource base, in the form of environmental stress, is usually considered unimportant. The growing land degradation is commonly studied as isolated events, outside of the control of humans (Catton and Dunlap, 1983).

Desertification (encroaching deserts) continued to increase as population pressure forced humans to misuse land in an effort to feed more and more people. Land once fertile would become a desert from continuous use. Deforestation would claim some of the world's densest forests, as foreign trade demanded more lumber and people needed more firewood for fuel. As the forests disappeared, mountains would erode causing floods which would destroy farmland. Industrialized nations would begin to feel the effects of acid deposition on the very lakes and forests they had so carefully tried to preserve (Eckholm, 1976; Ophuls, 1977).

The social consequences of such degradation have been repeated throughout history in such examples as Mount Lebanon, Easter Island, the U.S. dust bowl of the 1930's, the Sahel drought of the 1970's, and today's tragedy throughout Africa (Catton, 1980; Carson, 1962; Steinbeck, 1939; Schumacher, 1973; New York Times, 1984). One result of this degradation of land- based resources was that nations looked more to the marine environment for base resources. This increased reliance on the sea meant that protein shortage, over fishing, toxic waste, and oil spills, although not recent phenomenon in human history, assumed new dimensions and importance. The social repercussions of these previous tragedies, and the ability of a few oil producing nations to organize a global oil shortage, helped set the stage for the United Nations Law of the Sea (L.O.S.) negotiations of the 1970's.

President Johnson declared the seventies the `decade of the ocean' (Wenk, 1978) and one hundred and fifty eight nations came together at the United Nations Law of the Sea Conference (L.O.S.) to establish a new international ocean regime. Marine resources were to be looked toward as a means to fill the gap left by scarce, or damaged, land resources, and the importance of these resources to the future sustainability of a nation's development was rarely minimized. As a group their primary goal was to develop a new social system that would encourage marine sustenance activities that would benefit all members of the global community. This new social system would determine governance over the exploitation and management of a global common property resource. (A common property resource is a natural resource which is owned in common, yet is exploited under conditions of individual competition.) Establishing this new social system proved to be a herculean task. Not only was the ocean an area of 139,705,000 square miles, it was a common property resource divided into the Atlantic, Pacific, Indian, Arctic, and Antarctic oceans as well as smaller regions such as the North Sea and the Mediterranean Sea. Each region was governed separately and had different traditions, customs and power structures, as well as various types of resources and fluctuating climatic conditions. Each locality needed to be considered ecologically unique.

However, the L.O.S. negotiations were not the first time in modern history that the ocean became the object of negotiations. As early as 1945, the U.S. set a legal precedent in the form of the `Truman Proclamations´ (actually signed by President Roosevelt two weeks before his death). This written proclamation declared U.S. control over all natural resources of the continental shelf contiguous to the United States. The proclamation also guaranteed protection of fisheries in certain areas of the high sea, and established possible joint management between the state and the national levels as well as limited foreign fishing rights (Jones, 1972; Hollick, 1981).

The world community responded with the establishment of even wider unilateral zones, licensing fees, and other restrictions (Hollick, 1981). As an example, Ecuador not only established a two hundred mile limit, but demanded that the United States fishcatchers have a license to fish for tuna off their shoreline. The United States refused to recognize their right to do this and through taxes we paid fines given to our fishcatchers over twenty years (Henkin, 1974; Steinmuller, 1982).

The I.C.N.A.F. treaty (International Commission for the Northwest Atlantic Fisheries) was another step in the development of a worldwide treaty dealing with the oceans as a resource production area. Fifteen countries signed the treaty in a regional effort to establish joint management over the Northwest Atlantic fisheries. One major benefit of such an arrangement was that `catch data´ was greatly improved. Quotas of fish in this joint arrangement were based on the concept of `historical right´. Forty percent of the quota for a given year went to countries that had participated in the fishery for the past ten years (at the signing of the treaty). Another forty percent of the quota went to countries that had participated in the fishery for three years. Ten percent of the quota went to surrounding coastal countries and the last ten percent went to newcomers (Anderson, 1977).

There was also a regional treaty that divided the North Sea between its riparian states, and another for the division of the Baltic Sea. The negotiation of treaties, the issuance of legal proclamations, and disputes over ownership continue for straits, rights of access for land-locked nations, and the area of shipping and pollution control (Hollick, 1981).

The historic cases are usually interpreted as formal, usually written arrangements made through negotiation. However, it should also be noted that such treaties are social decisions with ecological ramifications. A treaty is a chosen social option, one which has ecological implications, since, as demonstrated by Bennett (1976), such an event as the L.O.S. is a `social process´ and not a `natural process´. Human actions determine the particular outcomes related to exploiting resources.

Although the processes which influenced the nature of the final text of the L.O.S. treaty were international, the negotiators were also pressured from the business world, such as the shipping industry, transnational corporations and world fishcatchers. Unfortunately, what may have been forgotten were the perceived needs of people at the local community level. The international setting of the L.O.S. was built upon the historic right of previous treaties. Regional interests dominated the conference, and the L.O.S. negotiating text resulted in 71 parts and 220 articles (U.N. Chronicle, 1983). Unfortunately, this did not mean that exploitation of the ocean would stop until all nations could agree on some form of sound resource conservation.

Most coastal nations had already declared unilateral control over the ocean, in the form of Exclusive Economic Zones (E.E.Z.s´), areas beyond and adjacent to the territorial sea (Appendix A). Supervision of a piece of the ocean was a national endeavor to guarantee essential protein and oil sustenance from the sea. These Exclusive Economic

Zones were made subject to the specific legal regime established by the L.O.S. (L.O.S. Negotiating Text, Part V, Article 55).

It wasas though countries presumed that this elaborate enclosure would assure their exclusive right to exploit the living and non-living resources from the sea. The view that an E.E.Z. was sitting in reserve did not include the fact that the ocean was still a common property resource, one which touches or influences every nation in the world. There continued to be boundary disputes over favored fishing areas. The expense of exploiting offshore oil, as well as the need for expertise, often depended upon foreign capital. Shipping accidents which happened thousands of miles away could destroy the subsistence of an entire village (Detroit Free Press, 1980).

An ocean should be considered a resource area which exists as though it were three separate eco-systems. (1) For the fishcatcher in the coastal community, the ocean is a system of traditional resource management (Faris, 1972; McKay, 1980; Maril, 1983). It is a way of life, a means of subsistence characterized by accepted practices, myths and traditions.

(2) At the national level, extended jurisdiction has generated a bureaucracy of national programs and regional offices. It should be viewed as an eco-system where resources are exploited for the "maximum social benefit" of the nation (Maiolo and Orbach, 1982). Sustenance activities of the fishcatchers are more numerous; technology is larger, e.g., fishing fleets and factory ships; and ownership patterns become more differentiated. Several social groups influence the choice of activities which set precedents which require adaptation by local fishing communities.

(3) The marine eco-system is also managed as if the ocean were a system of highly technological capacity, i.e., offshore oil wells, container ships, as well as military and communication devices. At this level activities become an undertaking of multinational corporations, joint ventures and international programs.

Conflict between the three eco-systems has interfered with the levels of sustenance activities. All the actors want increased sustenance and each is trying to make the necessary adaptation, i.e., they either adapt to the marine resource they want to exploit, or the resource area is adapted to their needs (Bennett, 1976). It is the social process which determines the particular ecological outcome related to exploiting resources.

This brief overview of the L.O.S. and the different marine activities illustrates how nations during the seventies attempted to apply social governance processes to the use and exploitation of the world's oceans. It is also a reflection of a time of growing global interdependence of marine sustenance activities. As sociologists, we should understand the decisions used to determine how the ocean is exploited (whether at the international, national or community level).

Sustenance activities at any of the three levels are parallel since all draw on the same resource. For example, fishers, whether through labor intensive means or with the newest capital intensive equipment, derive a means of subsistence from the productive environment of the ocean. In 1970, their joint effort produced a world fish catch of 59,495,000 metric tonnes. By 1980, this had increased to only 64,576,200 metric tonnes (Food and Agriculture Organization of the United Nations [hereafter F.A.O.], 1980). Although the increase was small percentage wise, fish was an important contribution to human diet, through intake of direct protein or by being ground into meal and used to produce more chicken, beef and pork (F.A.O., 1980). This increase in protein production was taking place in combination with the increase of numerous other marine resource activities (Appendix B).

Along with this increase in production came an increase in membership in ocean related organizations such as the Intergovernmental Maritime Organization (I.M.O.) and the Intergovernmental Oceanographic Commission (I.O.C.) as countries began to become interested in maritime resource development. New marine institutes were established and many new marine scientists were trained (Schechter, 1981; F.A.O., 1977).

For my purpose, these illustrative activities which involve the actual exploitation of a marine resource, membership criteria or even training of marine scientists must be considered sustenance activities. It is the combination of these activities which determines the potential not only for future subsistence of an individual country, but for the survival of the ocean as a future resource for all nations.

Sociology has slowly begun to recognize that the environmental crisis is global and that countries can no longer depend on the profligate use of resources. This thesis is an ecological analysis of marine resource development at the global level. As stated the seventies was a decade of growth in marine activities. As a result, more countries are depending on marine resources (specifically fish and off-shore oil) as their land resources decay or swiftly decline. This marine exploitation may appear as increased self-sufficiency at the individual level, or, because of growing ecological dependence, it may be increased pressure on an already global environmental crisis.

THEORY AND LITERATURE

Ecology was previously regarded as a discipline explaining the traits of animals within a unique environment. Most social scientists refused to use a theory which generalized from other species to humans. If humans could be creative enough to alter the environment they lived in, then human actions were outside the framework of ecological theory (Hawley, 1950; Cottrell, 1955; Odum, 1959; Odum, 1973; Eckholm, 1976; Catton and Dunlap, 1980; Bennett, 1980).

Humans have always been part of a larger community or ecosystem. Although humans greatly modify the environment they live in, they do not `create´ the environment and are as ecologically dependent as other less intelligent organisms. Unless reminded by a major disaster, i.e., flood, hurricane, drought, humans often forget this dependence; they often assume total dominance over their surroundings. What may currently be believed to be environmental mastery, may in the long-term be ambient disruption.

Richard Wilkinson (1973), in his discussion on the structure of development, specified that historically, humans have increasingly dominated and restructured their environment. As the level of environmental exploitation increased more work had to be done by the humans. Processing and production techniques became more complicated as they changed to exploiting less convenient resources. This resulted in two consequences: (1) there was the need for complex tools, and (2) labor saving machinery and equipment was needed for increased labor productivity.

Increased complexity became a necessary response toward needing more sustenance activities. As resources that had previously been plentiful became scarce, local communities became less self-reliant. Colonial regimes became a response to a home country resource shortage. Imports were used to fill the growing demand for raw materials, or in the few countries that were technologically proficient, new resources were substituted, or scarce resources were exploited even further. Countries no longer remained `neutral´ toward neighboring nations. There was more involvement in trade, greater use of capital-intensive equipment, and eventually a world quest for additional sources of power.

Countries began to change from one ecological niche to another by substituting one resource base for another. To accomplish this move, countries eventually had to increase their interaction at the international level. Changing one´s ecological niche began to encompass more than just changing from one resource to another.

Countries had to learn how to survive in a global community, under the conditions in which certain nations were better suited (Hardesty, 1975); i.e., they needed to produce the best products necessary, relying on imports for shortages, while reaching for a trade balance. Countries began to realize that the activities of each actor (country, international program, transnational corporation), influenced the activities of other actors in the sustenance organization (Hawley, 1950). The position or status of a country within a niche depended upon its ability to adapt to increasing competition (Odum, 1972).

The ocean is a difficult resource to exploit; it is a harsh environment and there is a need to work together. When the E.E.Z.´s became a reality, most countries found that they now controlled a section of the ocean that they could not manage. They lacked the technology, the personnel, and the markets to use the resource efficiently. This required countries to develop a new form of sustenance organization, one that could work at the international level. This meant that the different actors needed to adapt through what Catton (1982) called "niche diversification". There needed to be a way to differentiate activities across a variety of resources which would allow a country to supplement resources which had been exploited beyond the limit. This ability to adapt to several different conditions is what allows a nation to survive under increasing global complexity.

SUSTENANCE ORGANIZATION

In 1959, Gibbs and Martin developed a theoretical system of human ecology based on the nature of the sustenance organization of human populations. They focused on two research goals: (1) under what conditions will certain characteristics of sustenance organization be present or absent, and (2) what is the consequence if these certain sustenance characteristics are not present in resource exploitation. Gibbs and Martin´s conception of a population was an aggregate of individuals engaged in activities that provided a livelihood. My conception of a population is a international community made up of individual countries, with individual incomes, engaged in activities that allow them to survive as nations. I specifically exclude all institutions not directly related to the exploitation of natural resources, i.e., culture, and religion. Although such activties are important to the understanding of a country´s performance, they are beyond the scope of this paper.

My focus is on the pattern of social relationships within the global community that are manifested in sustenance activities. I want to emphasize that for countries, sustenance activities are survival activities. This means that the sustenance organization of various groups of countries must be analyzed from the viewpoint of a long-term adaptive strategy. For example, Cottrell (1955) observed that by tracing energy back to its sources, estimates have been made to assess the geographical basis needed for the people in an area to generate enough power to sustain themselves. He proposed that the opportunity to use an area that offers a nation the opportunity to use high-technology should be viewed from the activities the nation engages in. This view makes no assumption about a state's capacity to develop a long-term adaptive strategy which would allow it to prosper in the far future.

Georg Borgstrom (1961) took Cottrell's idea further by measuring a country's dependency beyond its own resources, i.e., trade and fisheries. His `ghost acreage" concept allows us to determine the degree of dependence upon territory and resources beyond national control. His study indicated that the ocean as a resource could not support the additional burden of the third world countries as they become technologically capable of harvesting the ocean. At the same time, however, he also suggested that several countries incorrectly view fish as an insignificant alternative to meat protein. In actuality, the nutritive value of fish is equal to meat. It is a good source of vitamins A and D. Most important, it is an excellent source of protein (Borgstrom, 1962).

For many of the people in the less technologically advanced nations fish is the only form of animal protein that reaches them. In places where fish is part of the diet; protein deficient diseases such as kwashiorkor, culebrilla, and boubfissure l´ Annam (a disease which causes diarrhea in children, skin lesions, and edema of the legs and feet, and which is fatal if not treated) are very rare (Borgstrom, 1965). Without a strategic, international long-term plan of sustenance organization, the global community could be deprived of an essential protein resource.

Whether the activities are within the national boundaries or beyond, sustenance activities are highly integrated. They are commonplace, easy to replicate and enduring. It is the pattern caused by these activities that constitutes a sustenance organization. Any country may participate in more than one sustenance organization (Gibbs and Martin, 1959).

Focusing on the `activities´ and not the `country´ is especially significant when exploiting a resource such as the ocean at the international level. As mentioned before, a resource is often managed and exploited through transnational corporations, joint ventures between private firms, or development programs from agencies such as the F.A.O. or the World Bank. Countries are no longer necessarily the unit of activity. Yet, they are still affected since the resource on which the country is relying is continuing to be exploited.

Sustenance organization can either be collective or non-collective. The former condition describes nations banding together to coordinate activities to obtain objects of consumption. Collective sustenance organizations include international trade, joint ventures, and development programs. The activities might be undifferentiated(a single nation may be responsible for all aspects of the production and distribution of a specific commodity), or the organization may have a high degree of division of labor (one nation invents the needed technology and supplies the manpower, another supplies the energy, another manages the capital).

In non-collective sustenance organization, nations obtain their objects of consumption through their individual efforts. This type of sustenance organization, when applied to the global level, resembles the theory of self-reliance (Young, 1983). However, the interdependence of nations within the world system severely inhibits countries from establishing marine development programs based on isolated sustenance organization.

For a growing number of nations, obstacles such as increased land degradation and the lack of needed technology have left them incapable of self-reliance. This is a major reason why Third World Nations insisted during the L.O.S. that a new international economic order (N.I.E.O.) be developed. There was also a section in the negotiating text carefully outlining `international cooperation´ in such areas as transfer of marine technology, multilateral programs to facilitate marine scientific research, and appropriate international funding for ocean research and development (Section 2, Article 270, L.O.S., 1983).

Instead of `self-reliance´, this appears as an option for different countries to participate in `collective self-reliance´ or an `exchange network´. Exchange networks may also be in the form of service sustenance organization, where a collective of individual countries obtain their objects of consumption by rendering or receiving a service (development projects, technical expertise such as marine scientists, educators or health personnel).

If a country is dependent on a product or a service of another then it may consider itself involved in a single unit. Gibbs and Martin designated these units as Organizational Complexes. As an example, the major developed countries have become very dependent on metal from the L.D.C.´s (zinc, copper, lead and ferroalloys). The developing nations are in need of advanced technology and knowledge to mine and process these metals. The object is to maintain a balanced trade.

The fear of losing the necessary balance within the different organizational complexes helped to prevent the L.O.S. conference from ending in a consensus. The L.O.S. text maintained that the `principle of the common heritage of mankind´ was to insure equitable exploitation of resources of the area beyond national control, equitable meaning for the benefit of all humankind. The management of ocean metal would be regulated on the basis of the market value for metal exploited from the land. Conveyance of marine knowledge about the area, as well as technology transfer, would also be regulated by an international authority (Part XI 133-155). This would give the developing countries a reasonable guarantee that the market price for their land-based metals would be stable. It was also looked upon as a promise of advanced technology.

All the actors, regardless of the type of sustenance organization they choose, must adapt to the specific and marginal resource parameters of the ocean, or, as actors, they must adapt to the ocean as a unique ecological niche. As previously stated, countries adapt by either expanding an existing niche or finding new ecological niches. My working definition for ecological niche is "the certain environmental conditions or activities countries (or other actors) use to exploit a variety of resources for subsistence".

By using this definition, I would like to operationalize the two theoretical questions presented by Gibbs and Martin (1965). (1) Under what conditions will certain characteristics of sustenance organization be present or not? and (2) What is the consequence if these certain sustenance organizations are not present in resource exploitation? These questions will be elaborated and tested through the development of four working hypotheses.

HYPOTHESES TO BE TESTED:

Hypothesis One: Countries enter into marine resource development to maintain self-reliance.

1a. As (population) land pressure increases, marine resource development increases.

1b. As a country increases its economic resources and technology, it increases its dependency on the ocean.

Although `niche diversification´ is seen by Catton as the best ecological model for a country to gain self-reliance, Borgstrom (1965) pointed out that increased population pressure has left countries without the ability to depend on land resources. More and more countries are exploiting fish to replace, not supplement, the declining protein supplied by land. His study indicated that the ocean as a resource could not support the continued burden of the third world as they become technologically capable of harvesting the ocean. Only those with the ability to remain diversified both in the land and marine areas would survive.

HYPOTHESIS TWO: As niche diversification increases, countries depend more on the service sustenance organizations.

2a: Countries which are more dependent on fish, will have more marine scientists.

2b: As a country increases its dependence on fish, it will increase its fish science capability.

When a country enters into a new ecological niche there is a need for more complex tools and increased labor productivity. As mentioned previously the ocean is a harsh environment to work in. Conditions surrounding marine resource use are very non- predictable, i.e., the amount of and nature of fishing effort goes up with the introduction of new technology, or as new markets are found, only to go down as catch declines and fishcatchers turn to more profitable stocks (Gulland, 1978).

The third world countries will need experts such as marine scientists, as well as marine institutions, to fill the gap in marine research and teaching skills. This means countries need increased people at the tertiary education level, and there will be a demand for foreign expertise to do the research until many of the third world countries can train their own citizens as scientists.

Hypothesis Three: As `niche diversification´ expands to exploitation of non-living marine resources, local communities become less self-reliant.

3a: Increased offshore oil drilling increases urban population.

3b: Increased offshore oil drilling decreases labor in agriculture.

Countries turned toward producing offshore oil during the energy crisis of the 1970´s. As highlighted by the media, the consequences of this enormous commitment by a few countries meant boomtowns, and urban blight. Rural populations flocked to cities in search of the promise of jobs from foreign oil companies.

This migration to the urban oil processing centers drew from the agricultural labor pool leaving fewer to work in the fields. Agriculture production often suffered and cities were unable to adjust to the new way of life that accompanied this collective organization (New York Times,1982; Wall Street Journal, 1982; Lansing State Journal, 1982). Although there may have been an increase in marine technology for these countries, the quality of life and agricultural subsistence has also been affected.

DATA AND METHOD

This section is concerned with the methodology used in the study. It is divided into three parts: (1) collection of data, (2) operationalization of variables, and (3) analysis of data.

Collection of Data

As seen in the literature, international interest in marine resource development expanded rapidly during the decade of the seventies. In order to determine the change in the extent of ocean use, I decided to compare the year 1970 with the year 1980.

Secondary data was collected from governments, international intergovernmental organizations, and private sources. All data was collected and presented by the various publications for analytic or comparative purposes. However, the data was also used for political purposes and there were several problems affecting reliability. Some counties refused to submit certain statistics, especially Eastern bloc nations, and as governments changed, or countries gained independence, statistical techniques changed. Some of the 1980 statistics were preliminary and some statistics for other years have been estimated from incomplete data. Monetary values have been converted from national currencies to U.S. dollars, so the data only provide an approximate measure of economic conditions and trends. The actual data may be only estimated value, since it is difficult to convert some currencies specifically to dollar equivalents. I also substitute `most recent estimate´ for data still not available for the year 1980.

Due to the limitations, I was careful to check the data throughout the decade (year by year in some cases). If I felt there were discrepancies, then data from different international statistical material was cross-checked to see if the numbers were comparable.

Estimates were recorded in the codebook, and suspected problems listed. The code book has a total of 122 variables comparing 181 countries, for two points in time, 1970 and 1980 (Merson and Harris, 1984).

Operationalization of Variables

In order to measure the concept of a country´s reliance on fish protein, I used the concept `fish acreage´ from Dr. Georg Borgstrom of Michigan State University. We used Borgstrom´s (1965) formula to establish "how many hectares in each particular country would need to be tilled and devoted to an intensive production of feedstuffs in order to produce an amount of protein equal to that provided by fish". Fortunately, I were able to work very closely with Dr. Borgstrom in obtaining his original formula for the computation of his `fish acreage´ variable. His concept encompassed a unique approach to the importance of fish as a protein source at the national level. Since the development of the concept in the early 1960´s (Borgstrom, 1962), experts in such fields as social science, nutrition, and marine policy around the world have referred to this analysis to explain the importance of marine protein to the ecological survival of a country´s subsistance.

Due to the increased availability of international data, I was able to add to the original formula and acquire new informative findings. One of the most interesting aspects of my research was the use of longitudinal analysis. The data was available for the two points in time in which I was most interested, 1970 and 1980. This supplied us with an interesting comparison of what had been happening during a brief, but intensive, ten year period of marine resource development. I collected data for approximately 140 countries. (Information on individual countries is available in Appendix C.)

The logic of Borgstrom's 'fish acreage' is explained as follows: Very few countries are capable of feeding their population by their own agricultural means. Individual countries often depend on food imports from other countries, or they may turn to the ocean to supplement shortages.

I reconstructed Borgstrom's formula to expand the comparability of the data. This helped me to understand some of the conditions under which countries turn to ocean resources, and allowed me to predict what may happen in the future if marine exploitation continues in the same pattern as seen in the decade of the seventies.

I followed the initial steps presented by Borgstrom but I concentrated on adapting the technique toward a global longitudinal study. It should be re-emphasized that due to the availability of data I decided to change the original formula presented by Borgstrom in the early sixties and apply the results to my study. The correctness of Borgstrom's logic remains unchallenged; if anything my research has demonstrated even greater strength in his analysis.

The Formula

The first step in the computation was to find the amount of fish protein, per person per year. I took an average of fish protein for three years to minimize annual fluctuations. Since the data for fish protein was in grams per day, I divided by 1000 and multiplied by 365 to convert to kilograms per year. I computed the amount of fish protein per person in 1970 (xFPPCPY7) and 1980 (xFPPCPY8).

(1) xfppcpy7 = 365 * (fshpro69+fshpro70+fshpro71) / 3000

(2) xfppcpy8 = 365 * fshpro80 / 1000

where fshpro69 is the amount of fish protein consumed per capita in 1969, fshpro70 is the amount of fish protein consumed per capita in 1970, and fshpro71 is the amount of fish protein consumed per capita in 1971. I then divided by 3000 to obtain an average in kilograms. The amount of fish protein for 1980 was originally presented by F.A.O. as a three year average of 1979,1980 and 1981 data. I divided this total by 1000 to convert to kilograms.

The second step determined the fish protein consumed per year by the population (xFPPY70 and xFPPY80). Since the data for population (POP1970 and POP1980) was in thousands, I multiplied by 1000 to get an actual figure.

(3) xfppy70 = pop1970 * xfppcpy7 * 1000

(4) xfppy80 = pop1980 * xfppcpy8 * 1000

Step three switched from fish protein to protein produced from feedstuffs (pulses), and computed the number of hectares that would be needed to replace direct fish consumption (DFSHHEC7 and DFSHHEC8).

(5) dfshhec7 = xfppy70 / (0.25 * pulses70)

(6) dfshhec8 = xfppy80 / (0.25 * pulses80)

Where pulses70 is the amount of feedstuff (edible biomass) in kilograms per hectare produced by country in 1970, and pulses80 is the amount of feedstuff in kilograms per hectare produced in 1980. The figure was multiplied by 0.25 to reflect the fact that, on the average, 25 percent of the edible pulse biomass is protein.

In step four I calculated the total amount of fish a country had at its disposal (TOFISH70 and TOFISH80). To do this, I simply added the total amount of the marine fish catch (MAFISH70 and MAFISH80) and the total amount of fish imports (FSHIMP70 and FSHIMP80), minus the total amount of fish exports (FSHEXP 70 and FSHEXP 80).

(7) tofish70 = mafish70 + (fshimp70 * 1000.) - (fshexp70 * 1000.)

(8) tofish80 = mafish80 + (fshimp80 * 1000.) - (fshexp80 * 1000.)

Since the data for fish imports and fish exports was in thousands of metric tonnes, I multiplied by 1000 to get an actual figure.

Next, I wished to ascertain the number of hectares that would be needed to replace indirect fish consumption, e.g. fishmeal used to produce chicken, beef and pork. Since no data could be found on indirect fish consumption, I had to compute it as a residual after direct consumption. To estimate direct consumption (TDC70 and TDC80) I had to convert data on fish protein into fish biomass. Because approximately 18 percent of fish biomass is protein on the average (Borgstrom, 1962), my fifth step took the total fish protein and divided it by 0.18 to get the total fish biomass directly consumed by a country's population.

(10) tdckg70 = xfppykg70 / 0.18

(11) tdc80 = xfppy80 / 0.18

In step six, I subtracted the amount of fish used for direct consumption from the total amount of fish, to obtain an estmate of indirect consumption (IDC70 and IDC80). I divided by 1000 to obtain a figure in metric tonnes.

(12) idcmt70 = tofishmt70 - (tdckg70 / 1000.)

(13) idc80 = tofish80 - (tdc80 / 1000.)

The average composition of digestible protein available in fish biomass is 53.6 percent (Morrison, 1956). In step seven, the amount of indirect protein consumption was obtained by multiplying by 0.536.

(14) idcpmt70 = idc70 * 0.536

(15) idcp80 = idc80 * 0.536

Step eight was a calculation of the amount of tilled land a country would need to produce pulses if this protein from fishmeal was not available. Since the data for pulses was in kilograms per hectare, I multiplied indirect consumption (in metric tonnes) by 1,000.

(16) idhec70 = (idcp70 * 1000.) / (0.25 * pulses70)

(17) idhec80 = (idcp80 * 1000.) / (0.25 * pulses80)

I now have all the steps needed to calculate the total amount of hectares a country would need to replace its fish protein.

Step nine was merely adding the amount of hectares needed to replace fish protein directly consumed to the hectares a country needed to replace the fish protein used indirectly as fish meal.

(18) tfhec70 = dfshhec7 + idhec70

(19) tfhec80 = dfshhec8 + idhec80

In my final step for calculating `fish hectares´ for 1970 I determined by what percentage the existing arable land used for growing protein would have to be increased to provide `fish hectares´.

(20) fshpct70 = 100. * tfhec70 / (arable70 * 1000.)

(21) fshpct80 = 100. * tfhec80 / (arable80 * 1000.)

To facilitate the interest I had in my longitudinal research, I also calculated the percentage change in the amounts of `fish hectares´ a country had in 1970 and in 1980, and the percentage change in the country´s reliance on fish.

(22) dfhec = (tfhec80-tfhec70) / tfhec70

(23) dfshpct = (fshpct80 - fshpct70) / fshpct70

I also calculated what I refer to as `land pressure´- the amount of people per tilled hectare. This was calculated for both points in time, as well as the difference between 1970 and 1980.

(24) lp70=pop1970/arable70

(25) lp80=pop1980/arable80

(26) difflp=(lp80-lp70)/lp70

where `DIFFLP´ is the percentage change in land pressure between 1970 and 1980.

Data from my calculations on individual countries is shown in Appendix E.

In order to test the increased national participation in service sustenance organizations, I collected data on the number of marine scientists claiming affiliation with individual countries and the percentage of students enrolled in tertiary education. A comparision of these two variables with a nation´s dependence on fish hectares will help determine if countries with the expertise are the nations exploiting the sea, or if nations without the scientific capability of maintaining effective ecological standards are increasing a global threat to the environmental security of the ocean.

I will then compare changes in numbers of marine scientists and the amount of advanced training at the tertiary level between the two points in time. This will show the trends during the decade and help project possible future trends in the fish science capability of nations.

The oil crisis of the 1970's began and ended very quickly, during the brief time period of my analysis. It was an effective example of the ecological and social consequences involved when a single resource is exploited at the global level.

My final hypothesis is an analysis of the social and ecological maddess that accompanied the rise and decline of offshore oil production in coastal nations. My last regression analysis looks directly at the effects of offshore oil production on urban population and labor in agriculture. Hopefully, it will serve as an example of the effects of sustenance organization without long-term planning.

Analysis of Data

For the purposes of this thesis the countries were divided into income groups which were established by criteria developed through the World Bank. The breakdown of income groups can be seen in Table One:

TABLE ONE
COUNTRIES BY INCOME CATEGORIES
WORLD BANK FIGURES

INCOME GROUPS	NUMBER OF CASES
Low Income	41
Middle Income	99
High Income-Oil Exporters	6
Industrial Market	22
Non-Market Economies	6
Don´t Know	7
Total	181

*World Development Report, International Bank for Reconstruction and Development The World Bank, Washington, D.C. 1982.

The decision to divide the countries into income groups was based on a couple of factors. As previously mentioned the L.O.S. failed to reach a final consensus over fears surrounding the sharing of very advanced technology and research, a requirement for countries which want to mine in the`area´ (L.O.S. Final Text). Technology, such as offshore oil wells, container ships, and fishing fleets are all very expensive investments. Investments imply that the advanced nations, the ones with the technology, expertise and income, are the nations which are exploiting and depending on marine resources to supplement declining land resources. If this is the case, then advanced countries are the major exploiters, due not only to an ecological drain of land resources, but because they have the capability to profit from the activity. If this group is not the most dependent on marine resources, than the other groups, especially the low and middle income groups must be entering into some form of organization which will supply them with the necessary means to ulitize the ocean as a resource.

Unfortunatly, because of the low numbers in three groups, High Income Oil Exporters, Non-Market Economies, and the Non- Classified Nations were excluded from my analysis at the individual level. They were however, included in my global figures, and in some cases appeared to be responsible for surprisingly large disrepancies between global and individual statistics.

RESULTS OF ANALYSIS

By studying the specific countries within the various income groups, I was able to make some preliminary findings regarding my first hypothesis: `Countries enter into marine activities to maintain self-reliance´. The data looks at two types of conditions which may be possible reasons for countries to expand their sustenance organization to include marine resource development. First, I wanted to determine the amount of `land pressure´ (the number of people per tilled hectare) for each country at both points in time. I then found the difference in amount of land pressure per country between the beginning and end of the decade. Second, I calculated the percentage change in the amount of fish hectares for each country between 1970 and 1980. (As mentioned in the explanation regarding my formula, fish hectares is the amount of tilled land a country would need to devote to intensive protein production, if it needed to replace the protein it receives from the ocean.)

I was especially interested in determining whether certain countries were expanding their `protein niche´ to use fish protein merely to supplement their land resource, or whether their land resource was so inadequate, or depleted, that the ocean was becoming a substitute protein niche.

The amount of land pressure would tell me whether a country had more or fewer people in need of protein. By comparing the increase in land pressure with the difference in fish hectares I could determine if `land pressure´ influences a country´s decision to enter into marine resource development.

At the global level my statistics showed the following results.

Table Two

Summary Table: Ecological Dependency of Nations Toward the Ocean, at the Global Level, Change In Land Pressure, and Change In Fish Hectares 1970-1980.

Land Pressure			Fish Hectares		
Increase	No Change	Decrease	Increase	No Change	Decrease
94	1	13	50	0	42
N=109			N=92		

As a whole, the global community experienced encreased land pressure during the decade. Eighty-seven percent of the nations analyzed experienced increases in land pressure while only approximately 12 percent had decreased land pressure. The effect of land pressure on a nation's marine dependency was less certain. Approximately 55 percent of countries increased their "Fish Hectares", while 44 percent of the nations experienced a decrease.

(Note: Interestingly countries which did increase their land pressure, did so at a much higher rate than countries which felt a decrease in fish hectare dependence. Appendix E, Column 6).

A more detailed analysis of land pressure on marine dependence is illustrated by Tables three and four, where I look at individual income groups. My analysis of specific income groups is as follows:

Low Income Nations

For a majority of low income nations land pressure continued to increase during the decade of the seventies. Only two of the countries, Madagascar (-2.2%) and Haiti (-4.6%) had negative growth in land pressure and both were small improvements. Although the low income countries as a group have a larger percentage of their people needing protein, eight of the countries had decreased their dependence on the ocean for protein and only seven had increased their dependence on fish protein. (Six low income nations had unavailable data).

Middle Income Nations

I had the largest number of cases for the middle income group, and they proved to be one of the most interesting ecologically. As a group, the majority of the nations were facing the problem of growing land pressure. Fifty-five of the nations had increases in land pressure, while only twelve countries had less people per tilled acre to feed in 1980 then in 1970.

By 1980, seven of the countries had over 100 percent dependency on fish hectares (column 3, Appendix E) and one nation had over 200 percent . For these eight middle income nations the loss of fish protein as a resource would be extremely detrimental.

Twenty-four nations would need to increase their tillable land by over 10 percent if they were not able to receive the needed protein from the marine area. Eight of these twenty four nations increased their reliance on the marine resource even as their land pressure decreased.

From the results of my data, it was observed that the majority of middle-income nations were turning toward the ocean as a viable resource alternative by the end of the decade.

Industrial Market Nations

I had data for seventeen industrial market nations, and as a group they are very dependent on the ocean as a protein source (see column 1, Appendix E). Fifteen nations felt an increase in land pressure by the end of the decade. What is interesting, when looking at this group, is the fact that ten of the fifteen countries had negative growth in their dependence on `fish hectares´. More than any other income group the industrial market nations have decreased their over-all dependence on fish protein. However, it should also be noted that the industrial nations which did increase the dependence on fish protein did so by quite a large percentage.

Table Three is a summary table of the three income groups and their ecological dependency on protein production.

It should also be noted, that when Borgstrom did his research, he chose only select countries in which he felt his finding applied (Borgstrom, 1966). As seen by my data, land pressure and dependence on marine resources is becoming increasingly important to a significant number of countries.

Table Three

Summary Table: Ecological Dependency of Nations Toward the Ocean By Income Group, Change In Land Pressure, and Change In Fish Hectares. 1970-1980.

	LAND PRESSURE			FISH HECTARES		
	increase	no chng	decrease	increase	no chng	decrease
Nations:						
Low Income	19	0	2	7	0	8
Middle Income	55	0	12	37	0	24
Industrial Market	15	1	1	5	0	11

My preliminary findings indicate that if a country faces increased land pressure, it may decide to exploit marine protein to gain greater self-reliance. However, further analysis is needed to determine the extent of this importance. I want to know the strength and direction of the relationship between land pressure and a country's dependence on marine protein. For the majority of my cases if a country is facing an increase in land pressure, it is exploiting marine protein. This decision appears to be a means toward greater self-reliance. The country has a means to supplement an inadequate supply of land protein, lessen its dependency on marine imports and keep its population free from protein deficient diseases. However, as mentioned previously the ocean is a harsh environment, as well as an expensive resource to exploit needing advanced technology and marine expertise.

A country may experience a growth in land pressure, without these necessary resources. Under these conditions, niche diversification, although seen by Catton (1982) as the best method toward gaining self reliance, is extremely difficult to accomplish. A country's alternative strategy would be to enter into a joint sustenance organization. The need to determine what countries were becoming more self-reliant in the area of protein production, leads us to my regression analysis.

In my first regression the dependent variable is total amount of fish hectares per country. The following independent variables were used in the analysis, the total population of a country, the gross national product per capita, calorie supply per capita, world fishing fleet, and land pressure.

My first step in the regression analysis was to look at the global situation in 1970 and again in 1980. In 1970, as indicated by its beta, land pressure was a positive figure of .28.

2. Population and calories per capita were insignificantly related to a country's dependency on fish hectares. GNP per capita showed only slight significance of -.137, but it did give a hint that it was the poorer nations which were exploiting the ocean. Whether a country had a 'world fishing fleet' showed a positive relationship toward amount of fish hectares a country might depend on, but it was a rather weak relationship .147. The total R2 was .097.

Table Four: Total Fish Hectares - 1970

	Global	Low Income	Middle Income	Industrial Market
Land Pressure	.282	.759	.245	.712
Population	-.048	-	-.012	.417
GNP per capita	-.137	-	-.067	-.227
Calories per capita	.043	-.201	-.030	-.073
World fish fleet	.147	-	.040	.788
Total R2	.097	.582	.061	.740
Total N´s	99	17	62	16

By 1980, the global picture became more intense, land pressure increased its beta to .495. GNP per capita showed a beta of -.523, which was a strong indicator that by the end of the decade poorer countries were the ones turning to the sea as a resource. The variable, world fishing fleet made the greatest change between 1970 and 1980. It increased its beta from .147 to a very positive .727. This was an indication that by 1980, if a poorer country with an increase in population needed protein and had access to a fishing fleet, it was exploiting marine resources. Total R2 for my 1980 analysis was .657, which was a strong indicator that I was seeing a significant relationship between this group of independent variables and the total amount of fish hectares countries relied on.

Table Five: Total Fish Hectares - 1980 (Beta's)

	Global	Low Income	Middle Income	Industrial Market
land Pressure	.495	.962	.540	.773
Population	-.190	-.132	-.063	.202
GNP per capita	-.523	.036	-.201	-.317
Calories per capita	.332	-	.117	-.131
World Fish Fleet	.727	-	.023	.662
Total R2	.657	.927	.269	.887
Total N's	110	21	67	16

In my second step, I broke down the global scene into regressions for the different income groups.

Land pressure had strong betas for all three income groups during 1970, with beta's extremely positive for both low-income nations (.759) and industrialized nations (.712). Population had a significant beta (.417) for industrialized market economies, but proved insignificant for middle income nations.

It was very difficult, because of the low number of cases available in the low-income group, to meet the criteria needed to run the regressions. However, calories per capita was negatively related to fish hectares for all three income groups, yet only low income countries had a significant beta (-.201). The need for a nation to supplement its diet was not a reason for entering into marine resource development only for the poorest of countries. A beta for GNP per capita of -.227 indicates that the poorest of the industrialized market economies were the ones exploiting the sea. This was not as much the case for the middle income nations, and apparently the reverse was the case for the low income countries beta or zero order correlation.

By 1980, land pressure had increased significantly its importance as a reason for exploiting marine protein for all three income groups. Population was now appearing as -.132 for low-income countries and had decreased to .202 for the industrialized nations. This is a possible indication that a large population does not necessarily mean a country needs marine protein. What is important is the number of people which need to be fed protein per hectare. It is the ability of the country to supply protein subsistenance to population which is important.

Based on this analysis, hypothesis 1A, `As land pressure increases, marine resource development increases´, cannot be rejected as false. The strong beta´s for all three groups indicates that land pressure influences a country´s decision to enter into marine resource development.

There was considerable evidence that the hypothesis 1b, `As a country increases its economic resources and technology it increases its dependency on the ocean´, could be rejected as false. My data indicates that it is the poorer nations, as indicated by GNP per capita, which are turning to the ocean for protein. Not only are they using fish protein to supplement their diet (calorie per capita figures) but they have found the increased need to supply more of their population with marine protein (land pressure).

My finding regarding hypothesis 1a and 1b, helped me to form my conclusions regarding hypothesis one, ´Countries enter into marine resource development to maintain self-reliance´. As indicated previously, marine protein is an important resource for countries which had an increase in their land pressure. My data has also shown that it is the poorer nations and those nations which need to supplement their diets which have increased their need for fish protein. When viewed from this perspective, I would state that countries were becoming more self-reliant. However, a country´s self-reliance may in fact be limited if I view marine protein production as a possible long-term ecological strategy.

My marine data about the decade of the seventies demonstrated that 85 percent of the countries had increased land pressure by 1980. Fifty-three percent of my cases had increased their dependency on fish hectares (Table Two). The regression analysis indicated that it was the poorer nations which were exploiting the sea. Based on these findings, I offer two future projections. First, in an attempt to gain more self-reliance regarding protein production, more nations will enter into joint sustenance organizations to acquire the needed technology needed for continued marine resource exploitation. This will be essential if land pressure continues to grow during the next decade and protein is needed in even greater quantities. The poorer countries will not be able to support marine exploitation alone.

Second, if marine resource development is to remain a valued method of acquiring protein, then countries must depend on expertise to guarantee a long-term survival of the resource. My

second set of hypotheses offers further evidence regarding a country's need for marine expertise.

Hypothesis Two: `As niche diversification increases, countries depend more on the service sustenance organizations'.

I adapted Gibbs and Martin's definition of a service sustenance organization, as a collection of individual countries obtaining their objects of consumption by rendering or receiving a service, and I mentioned as examples, development projects, and technical expertise such as marine scientists, educators, and health personnel.

In my second regression analysis, I look at the importance of marine scientists to countries entering marine resource development. As seen in Table Six, the dependent variable is `the number of marine scientists by income group´ and the independent variables are `total percentage of fish hectares´, `percentage of students enrolled in tertiary education´, and `total fish hectares´.

My global analysis for 1970 illustrates that the only variable which determined a country´s number of marine scientists was the variable `students enrolled in tertiary education (beta=.466). By 1980, the total amount of fish hectares had a beta of .219, this was much stronger relationship then in 1970, where the beta was .015.

Table Six: Number of Marine Scientists By Income Group - 1970 (Beta´s)

	Global	Low income	Middle	Industrial
Total Percentage of Fish Hectares	-.061	-.572	-.493	-.434
Total Fish Hectares	.015	.659	.599	.868
Percentage students enrolled Tertiary Education	.466	-.830	.222	.550
Total R2	.316	.283	.109	.815
Total N´s	81	10	45	21

Table Seven: Number of Marine Scientists By Income Group -1980 (Beta´s)

	Global	Low Income	Middle Income	Industrial Market
Total % of fish hectares	-	-.114	-.378	-.540
Total fish hectares	.219	.628	.640	.717
Percent students enrolled tertiary education	.543	.420	.180	.603
Total R2	.495	1.000	.361	.742
Total N´s	64	8	34	17

Total percentage of fish hectares, and total fish hectares, both had interestingly strong beta's for each income group. Global figures, relating to these two variables, were affected by the three groups of nations, High Income-Oil Exporters, Non- Market Economies and Unclassified. This appeared to be the same with the findings for 1980. The total amount of fish hectares a country depended upon was strongly and positively related to the number of marine scientists a country had.

When looking at the total percentage of fish hectares, the beta is in a negative direction. At first glance this might be surprising, as well as confusing, since it is the opposite of the relationship for total fish hectares. However, as pointed out by Borgstrom's original reason for developing his formula, if I continue to look at the percentage of fish as a contribution to a country's total diet, it appears to be an insignificant contribution. It is only when I place its contribution in terms of amount of tilled land I would need to replace the protein acquired from the ocean, that `total fish hectares' becomes meaningful. This can be seen by studying the individual case studies in Appedix E, and once again by my second regression analysis.

My final independent variable is percent students in tertiary education. In 1970, low income countries had a strong negative beta (-.830) representing the relationship between students of tertiary education and number of marine scientists, while, middle and industrial market nations both had positive beta´s. This was an indication that even though the low income group was dependent upon protein from the ocean, they were not ultilizing their tertiary education system to train marine experts. By 1980, this relationship had changed, the beta for students of tertiary education became positive (.420). Those low income countries with the educational structure, were training marine scientists at the tertiary level. There was also a less significant relationship at the middle income level - (beta=.180). However, as seen by the low R2 (.109), more variables are needed to explain what was going on during the decade for middle income group.

As a whole, however, the data supports my second set of hypotheses. As total dependency on fish hectares increased [- low income group - beta=(.628), middle income group - beta=(.640) (TABLE 7)] the relationship with marine scientists became more positive. While with the industrial market nations, their beta for total fish hectares became lower, .717 from .868, it was still highly positive.

Hypothesis 2b (As a country increases its production of fish, it will increase its fish science capability) was supported with the possible exception of the middle income group, which showed a slight decline in the percentage of students being trained at the teriary level.

`Niche diversification´ at least as evidenced by marine resource development, includes more than just the physical resource, i.e., fish, boats, equipment, funding. When considering the extent of diversification a country must also include the type of training and expertise needed for successful long-term resource exploitation. My working definition of ecological niche, as stated earlier, is `the certain environmentalconditions or activities countries (or other actors) use to exploit a variety of resources for subsistence´. As seen by the finding for hypothesis two, the use of marine experts is one of the necessary conditions if niche diversification is to be successful.

Hypothesis three looks at a different aspect of marine resource development, the exploitation of a non-living resource of the sea, offshore oil. As a result of the 1973 "oil crisis" nations turned to joint exploitation of marine oil. This joint sustenance organization was believed to be the result of a land resource being depleted. It is a perfect example of the social consequences of `niche diversification´ if countries do not maintain an ecological balance between all involved resources. Instead of gaining greater self-reliance by entering into what Gibbs and Martin referred to as an `organizational complex´, land resources deteriorated, and by the 1980´s offshore oil was no longer needed.

The relationship in the Low Income group between urban population 1970 and offshore oil wells 1972 was a beta of .604, and again between labor in agriculture and offshore oil 1970, beta = (-.394).

Although middle income nations were less significant, urban population and offshore oil wells 1972 - R2=(.044) beta=(.209), the relationship between labor in agriculture and offshore oil wells 1972 was R2 of (.065) and beta = (-.254), the relationship becomes comparatively interesting by 1980. The effect of offshore oil upon urban growth and the labor force in agriculture decreased. This was to be expected, as the oil shortage of the early seventies turned into an oil glut by the 1980's. As with other marine resources, offshore oil exploration is expensive and risky. It is only when land shortages are involved that nations reach to the ocean as a resource.

Table Eight: Regression of Urban Population on Offshore Oil Wells 1972 and 1978.

dependent variable - Urban Population

	Low Income	Middle Income	Industrial Market
Offshore oil-72	.604	.209	.421
Total R2	.365	.044	.003
Total N's	34	43	20
Offshore oil-78	-.206	.165	-.042
Total R2	.043	.027	.002
Total N's	32	63	19

Table Nine: Regression of Labor in Agriculture on Offshore Oil Wells - 1972 and 1978. (Beta's)

dependent variable - %labor in Agriculture

	Low Income	Middle Income	Industrial Market
Offshore oil-72	-.394	-.254	-.384
Total R2	.155	.064	.147
Total N's	37	77	13
Offshore oil-78	-.134	-.179	-.362
Total R2	.034	.032	.131
Total N's	32	63	13

My findings support hypothesis three, and illustrate the ecological ramifications involved when countries expand to a new resource niche. Low-income nations had to enter into a collective organization to exploit the oil. The low-income nations were dependent on the specialists and technology of foreign personnel. Their own people left agriculture and flocked to the cities in search of oil related jobs. As shown by the `boom town´ literature (New York Times, 1982; Wall Street Journal, 1982); the way of life of some communities wasgreatly altered, and for some communities the results were disastrous (New York Times, 1982).

The oil glut sent the specialist home, and the service sustenance organization was no longer needed. The balance between the low-income nation having a resource and the market wanting oil disappeared. The mutual dependence needed for an `organizational complex´ no longer existed.

Conclusions

In this section I will reflect upon my findings and the implications toward the two research questions presented by Gibbs and Martin: Under what conditions will certain characteristics of sustenance organization be present or not? and (2) What is the consequence if these certain sustenance organizations are not present in resource exploitation?

My study demonstrated several of the conditions which might be necessary for a country to enter into marine sustenance organization. One such condition is land pressure. My findings have shown that the more people a country needs to feed protein, the more likely they will enter into marine resource development. Once they have diversified into the marine area, they continue to exploit even greater quantities of fish protein. My finding also demonstrated the willingness of nations to train experts in the area of marine resources, if the education structure is available in which to do so.

Increase in land pressure must also be viewed as more than just the `number of people´. If history continues to repeat itself and land resource degradation is not halted, then the lack of land to produce protein will force nations to exploit the ocean´s resources. Marine sustenance organizations will increase at all three eco-system levels. In order for the poorer countries to continue to exploit the resource, they will have to enter into joint sustenance organizations with other countries. (As shown by my data, it is the poorer countries which are already relying the most heavily on fish protein.) Hypothesis two illustrated that the type of sustenance organization would include service sustenance organizations, where countries would either request or supply marine expertise. This is especially necessary, as shown by the results in hypothesis three, if `marine sustenance organization´ is to be part of a long-term survival strategy.

The study of social relationships of sustenance organizations must include methods such as shown by my formula. The gain and loss from what may appear as a very small percentage of protein subsistence acquired new dimensions when I was able to see the pressure which would be placed upon the farming sector if it suddenly needed to replace fish protein.

The social disruption travesty which resulted from the sustenance organization surrounding the exploitation of off-shore oil during the 1970's is an illustration of what could happen in the area of living resource exploitation, if the list of marine expertise does not include prior social analyses. All the physical resources were available, the raw materials, the advance technology, the apparent need. However, the possible long-term social implications were ignored and any social gain was lost as boom turned to bust, and the organizational complex collapsed. It is essential that the sociologist be included in the study of ecological implications of resource development. Marine resource exploitation will continue to increase with land pressure, and caution must be used if we are to avoid what happened to the Peruvian anchovy.

The different decisions leading to a choice in sustenance organization must not be made unless the ecological implications for other resources are considered. Increased marine resource development should not be used as a replacement for depleted land resources.

FUTURE STUDY

The next few decades will see the farming sector of the U.S. change completely. This will be due to economic changes, as well as ecological changes, as water supplies continue to be depleted in the western portion of the United States. I would like to adapt my present methodology used to determine dependence on fish hectares, to a regional study of the U.S. Data on fish consumption patterns on a regional basis will be gathered, and protein consumption will once again be converted into amount of farmland needed if replacement of fish protein became a necessity.

If a transition in farming production does take place, the `blue revolution´ may include increased dependency on the sea. The social and ecological implications of maintaining the sea as a viable resource should be understood before the types of sustenance organization is chosen.

Footnotes

1. World Bank collection methods for population figures are mid-year estimates prepared by the World Bank to provide a consistent set of data from material obtained from the population division of the U.N. Statistical Office, the U.S. Bureau of the Census, and the World Banks own data file.

2. Gross National Product is a measure of the total domestic and foreign output claimed by residents of a country. At market prices, GNP includes compensation of employees, operating surplus, provision for the consumption of fixed capital, and indirect taxes less subsidies to producers. For the purposes of international comparison, GNP in current values of national currencies is converted to U.S. dollars.

3. Calorie supply per capita per country is in the percentage of requirement the population receives.

4. World Fishing Fleet is the total fishing fleet by country. Fleet statistics cover annual data on the national fishing fleet engaged in commercial, industrial, and subsistence operations for catching, processing and landing fish, crustaceans, molluscs and other aquatic animals (except whales), residues and plants in freshwater, brackish water and marine areas. Fishing craft engaged in fish-farming and aquaculture operations are also included. The statistics specifically exclude vessels used exclusively for recreational fishing (sport fishing).

5. Land pressure is the amount of people per tilled acre, which a country needs to support nutritionally. For my research purposes, the amount of people per tilled hectare, which are in need of protein.

Appendix A.

200 meter depth

water (600′) end of shelf, begin slope

Photosynthetic Zone

Continental shelf slope rise avyssal plain

continental margin deep ocean floor

Coastal Economic Zone

(188 miles)

High Seas L.O.S. text definition

12 miles 24 miles

territorial sea contiguous zone

(200 mile limit - Exclusive Economic Zone)

Appendix B

World Production of Marine Resources

RESOURCE	1970	1980	% INCREASE
Goods Loaded (a)	2,605,107	3,468,171	33.0
Goods unloaded (a)	2,529,675	3,442,454	36.0
Petroleum Loaded (a)	1,105,549	1,598,760	45.0
Petroleum unloaded (a)	1,102,627	1,585,373	44.0
World Fleet	217,913,433	415,168,573	91.0
Tankers (b)	85,848,121	171,352,713	100.0
Container ships (b)	1,907,801	112,291,929	544.0
Offshore oil	8,858	13,687	55.0
Offshore gas	11,399	25,668	125.0
World Fish	59,495,000	64,576,200	9.0

(a) quantity expressed in thousand metric tonnes
(b) quantity expressed in gross registered tonnes
(c) quantity expressed in thousands of barrels
(d) quantity expressed in millions of cubic feet
(e) quantity expressed in metric tonnes

Appendix C
Variables, Sources, and Descriptive Statistics

VARIABLE NAME	SOURCE CODE	PAGE	VALID CASES	MEAN	STANDARD DEVIATION
1. FISH PROTEIN 1969-70-71	BS	373-667	157	4.34	.334
2. FISH PROTEIN 1980	BS	373-667	159	4.99	.396
3. PULSES 1969-70-71	FAO	018-019	142	902.09	58.784
4. PULSES 1979-80-81	FAO	018-019	143	1002.32	63.671
5. MARINE SCIENTIST 1970	YFS	007-362	81	81.74	205.267
6. MARINE SCIENTIST 1980	IDMS	007-362	64	168.98	408.523
7.OFFSHORE OIL 1972/1974	OFFSHORE	059	72	43.932	165.696
8.OFFSHORE OIL 1978/1980	OFFSHORE	010	10	27.787	108.947
9.MARINE INSTITUTES 1970	IDMS	007-362	87	15.207	35.554
10.MARINE INSTITUTES 1980	IDMS	007-362	64	26.391	58.295

Appendix C: cont´d

11.ARABLE LAND 1970	FAO	045-056	171	7749.02	27403.672
12.ARABLE LAND 1980	FAO	045-056	171	8073.60	27298.130
13.MARINE CATCH 1970	YFS	053-055	152	380013.82	1382920.1
14.MARINE CATCH 1980	YFS	053-055	152	420661.38	1224667.5
15.FISH IMPORTS 1970	YFS	032-051	138	53.088	148.079
16.FISH IMPORTS 1980	YFS	030-042	151	58.676	157.858
17.FISH EXPORTS 1970	YFS	032-051	138	52.104	202.983
18.FISH EXPORTS 1980	YFS	030-042	151	52.947	150.658
19.%POPULATION TERTIARY ED. 1970	UNESCO	028-083	130	6.493	8.129
20.%POPULATION TERTIARY ED. 1980	UNESCO	028-083	124	10.495	10.916

Appendix C - Source Code

1. FAO - 1981 F.A.O. PRODUCTION YEARBOOK "land use" Vol 35, Table one, Food and Agriculture Organization of the United Nations, 1982.

2. IDMS - INTERNATIONAL DIRECTORY OF MARINE SCIENTISTS

Food and Agriculture Organization of the United Nations, Rome, 1970.

3. OFFSHORE OFFSHORE "The Journal of Ocean Business", A PennWell Publication, June 20, 1980 and June 20, 1981, (well count).

4. UNESCO - UNESCO Statistical Yearbook 1981, Department of International Economic and Social Affairs. 31st issue. United Nations, New York, 1981, Table 32 "School Enrollment Ratios".

5. YFS YEARBOOK OF FISHERY STATISTICS, Vol. 39, 48, 50,51. Food and Agriculture Organization of the United Nations.

Appendix D: Global Variables

VARIABLE NAME	Mean	Standard Deviation	Valid cases
(1970)			
Marine Scientists	81.74	205.267	81
% of fish hectares	29.83	114.39	99
Total fish hectares	843693.58	3971472.64	99
Land pressure	21.85	85.30	168
Population	21103.78	79420.65	174
GNP per capita	.80	.98	174
Calories per capita	103.49	16.22	137
World Fish Fleet	10529.45	37139.25	60
(1980)			
Marine Scientists	168.98	408.52	64
% Fish Hectares	36.19	136.94	110
Total Fish Hectares	778513.56	1722951.14	110
Land Pressure	35.48	155.11	167
Population	25431.90	94561.97	173
GNP per capita	3.48	4.95	161
Calorie per capita	106.16	17.85	141
World Fish Fleet	15257.14	49446.54	71
% Students Tertiary Ed.			

Low Income Nations

Variable Name	mean	Standard Deviation	valid cases

(1970)			
Marine Scientists	125.49	310.91	10
% Fish Hectares	6.93	10.46	17
Total fish hectares	210663.19	479649.77	17
land pressure	4.78	5.97	39
Population	43514.80	152003.33	41
GNP per capita	.19	.43	41
calorie per capita	93.44	11.15	35
World fish Fleet	2898.50	5685.22	4
% Students Tertiary Ed.	.82	1.45	36
(1980)			
Marine Scientists	56.75	142.82	8
%Fish Hectares	71.15	297.58	21
Total Fish Hectares	418765.06	852513.81	21
Land Pressure	5.9	8.3	38
Population	54313.38	183459.20	40
GNP per capita	.71	2.42	35
Calorie per capita	92.83	12.79	36
World Fish Fleet	2985.83	7123.36	6
% Students Tertiary Ed	1.41	1.74	34

Middle Income Nations

Variable Name	Mean	Standard Deviation	valid cases
(1970)			
Marine Scientists	21.07	27.88	45
% Fish Hectares	39.77	141.77	62
Total Fish Hectares	805620.78	3462988.45	62
land pressure	24.67	82.05	96
Population	9079.05	17822.50	98
GNP per capita	.49	.41	98
calorie per capita	100.23	12.68	73
World fish Fleet	6605.38	20385.39	34
% Students Tertiary Ed.	.82	1.45	36
(1980)			
Marine Scientists	55.26	77.98	34
%Fish Hectares	27.99	47.58	67
Total Fish Hectares	634799.98	1237505.99	67
Land Pressure	39.80	151.35	96
Population	11673.00	23106.87	98
GNP per capita	1 .76	1.49	91
Calorie per capita	104.17	14.15	76
World Fish Fleet	12918.06	30432.26	43
% Students Tertiary Ed.	9.41	8.35	61

Industrial Market Nations

Variable Name	Mean	Standard Deviation	valid cases
(1970)			
Marine Scientists	180.86	307.95	21
% Fish Hectares	22.39	48.68	16
Total Fish Hectares	1488236.80	2506658.70	16
land pressure	7.3	7.8	20
Population	30068.14	47481.25	22
GNP per capita	2.67	.89	22
calorie per capita	126.61	7.51	20
World fish Fleet	20613.95	59917.08	19
% Students Tertiary Ed.	180.86	307.95	21

(1980)			
Marine Scientists	453.47	706.59	17
%Fish Hectares	36.78	76.25	16
Total Fish Hectares	1544230.66	3032357.28	16
Land Pressure	7.97	8.40	20
Population	32457.18	52442.26	22
GNP per capita	10.36	2.85	22
Calorie per capita	128.52	8.43	20
World Fish Fleet	26559.84	84285.13	19
% Students Tertiary Ed	27.02	8.59	20

Appendix E:

Low Income Nations

Country	Total Fish Hectares	% of fish Hectares	Land Pressure	Difference land Pressure	Difference in % Fish Hectares
Benin	26241	2	3	.122	-.428
Gambia	29482	11	2	.427	.185
Guinea	-	-	4	.363	-
Guinea Bissau	5774	2	3	.361	.300
Mozambique	97621	3	4	.311	1.548
Sierra Leona	55584	3	2	.133	-.560
Somalia	46367	4	4	.331	-.758
Sudan	9622	0	1	.105	-.004
Togo	35376	3	2	.230	-.362
Tanzania	207493	5	4	.286	.184
Zaire	134934	2	5	.415	-.186
Madagascar	24176	1	3	-.022	-.189
Comoros	8317	11	5	.441	.180
Cape Verdes	7672	20	9	.271	-.535
China (Peo)	2010637	2	10	.206	-
India	3490064	2	4	.215	.732
Bangladesh	433063	5	10	.301	-
Pakistan	929328	5	4	.282	-
Burma	875810	9	3	.257	.294
Haiti	16968	3	9	-.046	

Maldives	41085	1370	51	.426

Middle Income Nations

Algeria	152170	2	3	.207	1.233
Congo	46321	7	2	.610	1.648
Egypt	41733	2	15	.206	.911
Gabon	81739	28	2	-.166	5.939
Ghana	1592383	146	11	.176	-.206
Ivory Coast	115324	4	3	.085	-.500
Kenya	49872	3	9	.280	.561
Morocco	529081	9	3	.263	.601
Nigeria	2541960	9	3	.513	2.563
Senegal	845042	16	1	.330	-.018
So.Africa	953393	7	2	.280	-.169
Mauritania	30037	16	9	1.037	-.884
Jordan	5888	-	3	.324	1.772
Tunisia	112145	4	2	.277	.656
Cameroon	65107	1	1	.326	.280
Liberia	47940	38	15	.232	.804
Mauritius	17959	18	10	.146	.049
Reuion	1691	13	10	.212	-.089
Philippines	1344241	19	7	.320	-.010
Thailand	3533743	22	3	-.034	.106
Korea,Rep	2679181	130	19	.261	.761
Iran	140690	1	2	.315	8.147
Iraq	45474	1	2	.248	1.880
Yemen,Rep	15743	1	2	.588	

					1.848
Isreal	42554	13	12	-.003	-.244
Lebanon	6691	3	11	.328	-.077
Brazil	2002540	4	2	.103	1.251
Argentina	456094	2	1	.142	.144
Columbia	100493	2	7	.092	.143
Peru	4969837	160	6	.057	-.851
Venezuela	381292	12	15	.324	-.356
Chile	6388985	120	2	-.001	1.234
Ecuador	1817776	104	5	.348	5.639
Uruguay	111713	6	2	-.017	-
Guyana	49836	14	2	.044	1.550
Suriname	4319	11	9	-.306	-
Turkey	504128	2	2	.270	1.912
Yugoslavia	200799	3	3	.140	-.023
Romania	1191178	12	2	.089	-
Portugal	1733065	58	3	.094	-.259
Greece	108047	4	3	.077	-.129
Cyprus	4831	1	2	.008	-.644
Malta	3632	28	26	.039	-

Appendix E: cont´d

Mexico	3061564	14	3	.326	1.471
Cuba	466797	2	-	-.899	-.896
Guatemala	4700	-	5	.113	-.160
Dominica	16781	2	6	.245	.573
El Salvador	15652	3	8	.064	.896
Honduras	11816	1	2	.296	.125
Nicaragua	36512	3	2	.276	3.833
Jamaica	26639	13	11	.102	-.316
Costa Rica	30094	11	8	.290	.671
Panama	932956	204	4	.182	2.464
Indonesia	2661501	19	10	.156	1.056
Papua N Guinea	23707	119	150	.056	-.587
Trinidad	3402	5	17	-.074	-.144
Guadeloupe	25331	67	9	.191	-
Barbados	3334	10	8	-.027	.242
Bahamas	3874	194	121	.418	.237
St Lucia	1380	28	25	.107	-
Grenada	2383	48	22	-.581	.565
St Vincent	667	5	8	.200	-.406
Dominica	1252	18	12	.107	-.369
St.Kitts	2757	34	6	.195	1.779
Fiji	25623	17	4	.195	1.779
Solomon Is.	5718	14	6	.405	3.355
Belize	491	1	3	.047	-.774

Industrial Market Nations

Japan	12284468	286	27	.277	.415
Germany Fed.	483400	7	8	.000	-.420
Italy	636332	7	6	.257	-.094
U.K.	660230	10	8	.033	-.393
France	493766	3	3	.062	-.436
Spain	2446343	16	2	.146	-.232
Netherlands	226794	27	17	.078	-.058
Belgium	96156	11	12	.050	-.250
Sweden	188743	6	3	.055	-.268
Denmark	1306792	50	2	.050	1.065
Finland	137586	6	2	.087	.439
Norway	-	-	5	.057	-
Ireland	37158	4	3	.322	.657
Iceland	-	-	29	-.014	-
Greenland	-	-	-	-	-
U.S.	3827191	2	1	.110	-.057
Canada	939041	2	1	.056	-.291

Appendix E: cont´d

Austria	-	-	5	.045	-
Switzerland	-	-	17	.008	-
Australia	281584	1	-	.081	-.010
New Zealand	662107	152	8	.353	20.470
Bermuda	-	-	-	-	-

Bibliography

Alexander, Lewis. "The Disadvantaged States and the Law of the Sea," MARINE POLICY (July, 1981): 185-193.

Alexander, Paul. "Innovation in a Cultural Vacuum: The Mechanization of Sri Lanka Fisheries," HUMAN ORGANIZATION (Winter, 1975): Vol. 34. No.4. 333-344.

Altman, Irwin and Joachim, Wohlwill. BEHAVIOR AND THE NATURAL ENVIRONMENT New York: Plenam Press, 1983.

Amin, Samir. UNEQUAL DEVELOPMENT. New York: Monthly Rewiew Press, 1976.

Amin, Samir. "Self-Reliance and the Nwq International Economic Order, " MONTHLY REVIEW (July-August, 1977): 1-21.

Anderson, Charles. THE SOCIOLOGY OF SURVIVAL. Illinois: The Dorsey Press, 1976.

Axinn, George. "The Development Cycle: New Strategies From an Ancient Concept, " INTERNATIONAL DEVELOPMENT REVEIW (1977/4) 9-15.

Boulding, Kenneth. THE MEANING OF THE 20TH CENTURY. New York: Harper and Row. 1965.

Borgstrom, Georg. "New Methods of Appraising the Role of Fisheries in World Nutrition," FOOD SCIENCE (Spring, 1962): 33-47.

Borgstrom, Georg. THE HUNGARY PLANET. New York: Macmillan Company, 1965.

Brown, E.D. "Delimitation of Offshore Areas Hard Labour and Bitter Fruits at UNCLOS III,"MARINE POLICY (July, 1981): 172-184.

Carson, Rachel, L. Silent Spring, Haugton Miffen, Boston, 1962.

"Cash and Crime, come to Shetlands on the Crest of North Sea Oil Boom," NEW YORK TIMES, Monday, January 4, 1982.

Catton, William. OVERSHOOT. Chicago: University of Illinois Press, 1980.

Clark, Calen. "The Economic or Overexploitation," SCIENCE 1973. 181: 630-634.

Chase-Dunn, Christopher. "Comparative Research on World-System Characteristics," INTERNATIONAL STUDIES

QUARTERLY (dECEMBER, 1979): 601-623.

Chase-Dunn, Christopher. "The Effects of International Economice Depandence on Development and Inequality," INTERNATIONAL STUDIES QUARTERLY (December, 1979): 601-623.

Copes, Parzival. "The impact of UNCLOS III on management of the World Fisheries," MARINE POLICY (July, 1981): 155-163.

Cottrell, Fred. ENERGY AND SOCIETY. New York: McGraw-Hill, 1955.

Dahlberg, Kenneth. "Ecological Effects of Curent Developmental Processes in Less Developed Countries."

Eckholm, Erik. LOSING GROUND New York: W.W. Norton and Company, 1976.

Evans, Peter., and Timberlake, Michael. "Dependence, Inequality, and the Growth of the Tertiary: A Comparative Analysis of Less Developed Countries," AMERICAN SOCIOLOGICAL REVIEW (August1980): Vol.45. 531-552.

Forman, Shepard. "Cognition and the Catch: The Location of Fishery Spots In a Brazilian Coastal Village," ETHNOLOGY. 1971, 417-426.

Frank,Andre. REFLECTIONS ON THE WORLD ECONOMIC CRISIS. New York: Hutchinson &Co., 1981.

Fraser, Alex. "Limited Entry: Experience of the British Columbia Salmon Fishery," FISHERY RESEARCH BOARD (March, 1979): 754-769.

Fry, Paul. "The Law of the Sea," MARINE POLICY (july, 1981): 7-12.

Gibbs, Jack and Browning, Harley, "The Division of Labor, Technology, and Organization of Production in Twelve Countries," AMERICAN SOCIOLOGICAL REVEIW, (February, 1966): Vol.31. 81-93.

Gibbs, Jzck, and Martin, Walter, "Toward a Theoretical System of Human Ecology." PACIFIC SOCIOLOGICAL REVIEW (Spring, 1959): 29-35.

Gulland, J.A. "Problems and Priorities in Providing Research Input to Fishery Decisions," DEVELOPMENT AND INTERNATIONAL LAW JOURNAL. 1977. Vol. 4. Number 1. 27-37.

Hardesty, Donald. "The Human Ecological Niche,"

AMERICAN ANTHROPOLOGIST (74): 458-466.

Hardesty, Donald. "The Niche Concept: Suggestion For Its Use in Human Ecology," HUMAN ECOLOGY. Vol. 3. No.2. 1975. 27-35.

Hawley, Amos. HUMAN ECOLGOY. New York: The Ronald Press Company. 1950.

Henkin, Louis. "Politics and the Changing Law of the Sea," POLITICAL SCIENCE QUARTERLY. (March, 19/4): 46-67.

Hollick, Ann. U.S. FOREIGN POLICY AND THE LAW OF THE SEA. New Jersey: Princeton University Press. 1981.

Hollist, Ladd and Rosenau, James. WORLD SYSTEM STRUCTURE. London: Sage Publications 1972.

Jacobson, Jon. "Marine Scientific Research Under Emerging Ocean Law," OCEAN DEVELOPMENT AND INTERNATIONAL LAW JOURNAL. 1981. Vol. 9. Number 3-4. 187-199. 1981.

Kenyon, Peter. "The Nature and Extent of World Poverty,"in HUMAN ECOLOGY AND WORLD DEVELOPMENT, pp.180-211. Edited by Anthony Vann, and Paul Rogers. London: 1974.

Knauss, John. "Marine Policy for the 1980's and Beyond," MARINE POLICY. (July, 1981): 3-6.

Knecht, Robert. "Coastal Zone Management: The First Five Years and Beyond," COASTAL ZONE MANAGEMENT JOURNAL 1979. Vol.6. No4. 259-267.

Luke, Ronald. "Managing Community Acceptance of Major Industrial Projects," COASTAL ZONE MANAGEMENT JOURNAL, 1980, Vol. 7. No.2-3-4. 276-296.

Maiolo, John and Orbach, Michael. MODERNIZATION AND MARINE FISHERIES POLICY. Ann Arbor: Ann Arbor Science Publishers. 1982.

Miles, Edward. "IOC Data and Information exchange Implications of the Law of the Sea Convention" MARINE POLICY (April, 1983): 76-89.

Morris, Michael and Ferreira, Penelope, "Latin America, Africa, and the Third United Naitons Conference on the Law of The Sea: Annotated Bibliography," OCEAN DEVELOPMENT AND INTERNATIONAL LAW JOURNAL 1981, Vol. 9. Number 1-2. 101-185.

National Academy of Sciences. POSTHARVEST FOOD LOSSES IN DEVELOPING COUNTRIES Washington, D.C. 1978.

"Newfoundland Ends Talks with Ottawa on Offshore Control," WALL STREET JOURNAL, February 18,1982.

Nieman, Thomas. "The Visual Environment of the New York Coastal Zone: User Preferences and Pewrception," COASTAL ZONE MANAGEMENT JOURNAL (January, 1980): 45-61.

Odum, Eugene. ECOLOGY New York: Holt, Rinehart, and Winston, 1975.

Odum, Eugene. FUNDAMENTALS OF ECOLOGY Philadelphia, Sauders Co., 1953.

Odum, Howard and Odum,Elisabeth, ENERGY BASIS FOR MAN AND NATURE New York: McGtaw-Hill Book Company, 1976.

"Oil Wealth Worries Ivory Coast Leader," NEW YORK TIMES, February 15, 1982.

Ophuls, William. ECOLOGY AND THE POLITICS OF SCARCITY. CALIFORNIA, fREEMAN AND cO. 1977.

Organization For Economic Co-operation and Development. MARITIME TRANPORT. 1971. 85-109.

Pohl, Reynaldo. "Latin America's Influence and Role in the Third Conference on the Law of the Sea," OCEAN DEVELOPMENT AND INTERNATIONAL LAW JOURNAL 1979. Vol.7. No. 1-2. 65-87.

Quinn, James. "Topical Summary of Current Literature on Human Ecology," THE AMERICAN JOURNAL OF SOCIOLOGY (July, 1940): 191-226.

Sakiyama, Tereyi. "Policies in Pollution, Aquaculture and Coastal Management in Japan," MARINE POLICY. (January, 1979): 21-39.

Schumacher, E.F. SMALL IS BEAUTIFUL. New York: Harper and Row, 1973.

Shapero, Harvy. " The Coastal Access Rights Movement IN Japan." COASTAL ZONE MANAGEMENT JOURNAL, Vol. 4, Number 1. 1-43.

Steinbeck, John. The Grapes of Wrath. New York, Viking Press, 1937.

Swanson, Gerald and Seymour, John. "An Alternative Perspective on Common Property Resource Allocation Decisions in the Coastal Zone," COASTAL ZONE MANAGEMENT JOURNAL. 1978. Vol.4, Number 1/2. 25-45.

Syder, David. "Structural Position in the World System and Economic Growth. 1955-1970: A Multiple-Network Analysis of Transnational Interaction," AMERICAN JOURNAL OF SOCIOLOGY (March, 1979): 1096-1126.

Svalastoga, Kaare. "Space, Population, Energy, and Information in Seven Nations," INTERNATIONAL JOUNRNAL OF COMPARATIVE SOCIOLOGY. XVII, 1-2. 30-47.

Teich, Albert. TECHNOLOGY AND MAN'S FUTURE. New York: St. Martins Press. 1972.

Treves, Tullio. "The Adoption of the Law of the Sea Convention." MARINE POLICY (January, d1983): 3-13.

United Nations. DRAFT FINAL ACT OF THE THIRD UNITED NATIONS CONFERENCE ON THE LAW OF THE SEA. A/CONF. 62/121 (October, 1982).

Velencia, Mark. "Southeast Asia: National Marine Interests and Marine Regionalism," OCEAN DEVELOPMENT AND INTERNATIONAL LAW JOURNAL. Vol.5, Number 4. 1978. 421-449.

Wenk, Edward. The Politics of the Ocean. University of Washington Press, Seattle, 1972.

Wilkinson, Richard. PROVERTY AND PROGRESS. New York: Praeger Publishers. 1973.

Woodhouse, Edward. "Re-Visioning the Future of the Third World," WORLD POLITICS. (October, 1972): 1-33.

Young, Crawford. IDEOLOGY AND DEVELOPMENT IN AFRICA. New Haven: Yale University Press, 1982.

Zuleta, Bernardo. "The Law of the Sea: Myths and Realities," MARINE POLICY (July, 1981): 28-30.