AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY
Batch 94 ARDA

1. SUBJECT CLASSIFICATION

A. PRIMARY: Food production and nutrition — AE50-0000-0000

B. SECONDARY: Rural sociology

2. TITLE AND SUBTITLE

Continuity and change in marine fishing communities

3. AUTHOR(S)

Pollnac,R.B.

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1976	115p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS

R.I.

8. SUPPLEMENTARY NOTES (Sponsoring Organization, Publishers, Availability)

(In Anthropology working paper no.10)

9. ABSTRACT

10. CONTROL NUMBER

PN-AAG-194

11. PRICE OF DOCUMENT

12. DESCRIPTORS

Adaptation
Continuity
Cultural factor
Fisheries
Fishermen
Psychological aspects
Social change
Reviews
Technology transfer

13. PROJECT NUMBER

931011300

14. CONTRACT NUMBER

CSD-2455 211(d)

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

Anthropology Working Paper No. 10

Continuity and Change in Marine Fishing Communities

by

Richard B. Pollnac
Department of Sociology and Anthropology
International Center for Marine Resource Development
University of Rhode Island

July 1976

A State-of Art Paper prepared for the
United States Agency for International Development

TABLE OF CONTENTS

LIST OF TABLES iii

LIST OF FIGURES iii

FORWARD 1

SOCIOCULTURAL CONCOMITANTS OF TECHNO-ECONOMIC CHANGE 3

- Introduction 3
- A Model of the Transfer of Techno-economic Innovations 5
  - Development of innovation by resource scientists 7
  - Contact 9
  - Perceptions 15
  - The adoption stage 26
  - The institutionalization stage 27
  - Summary 30

MAN'S PSYCHOCULTURAL ADAPTATION TO THE MARINE ENVIRONMENT 32

- Introduction 32
- The Physical Environment 34
- Technology 37
- The Social Environment 41
- Social Organization 47
  - Political organization and social stratification 47
  - Occupational specialization, division of labor by sex, and social stratification 49
  - Share system of distribution, reciprocal exchange, extended kin ties, and occupational specialization 52
  - Equipment ownership, social stratification, and occupational mobility 55
  - Workgroups, egalitarianism, male society 57
  - Sea tenure 61
  - Summary 63
- Individual Biopsychological Characteristics 65
- Ideology 72

CONTINUITY AND CHANGE IN MARINE ENVIRONMENTS 76

- Introduction 76
- Technological Change, Independence, and Workgroups 76
- Cooperative Organizations 78

CONTINUITY AND CHANGE IN MARINE ENVIRONMENTS (Cont.)

Technological Change, Social Stratification, and Workgroups 82

The Model of Man's Psychocultural Adaptation to the Marine Environment and Change in Fishing Communities: A General Appraisal 86

ACQUISITION OF DATA BASE FOR UNDERSTANDING CHANGE IN MARINE COMMUNITIES 88

Introduction 88

Physical Environment Data 89

Technological Data 90

Social Environment Data 91

Social Organization Data 91

Individual Biopsychological Characteristics Data 92

Ideological Data 93

Summary 93

LIST OF TABLES

Table 1. Attributes associated with early adoption of innovations. 17

Table 2. General aspects of the marine environment influencing human adaptation.

LIST OF FIGURES

Figure 1. Factors influencing the transfer of techno-economic innovations. 6

Figure 2. Model of human ecology 33

Figure 3. Relationships between marine environment and technology. 41

Figure 4. Relationship between physical and social environments in maritime communities. 46

Figure 5. Relationships between marine environment, mediating variables, and social organization 64

Figure 6. Relationship between marine environment, mediating variables, and biopsychological characteristics. 71

Figure 7. Relationship between marine environment, mediating variables, and ideology. 75

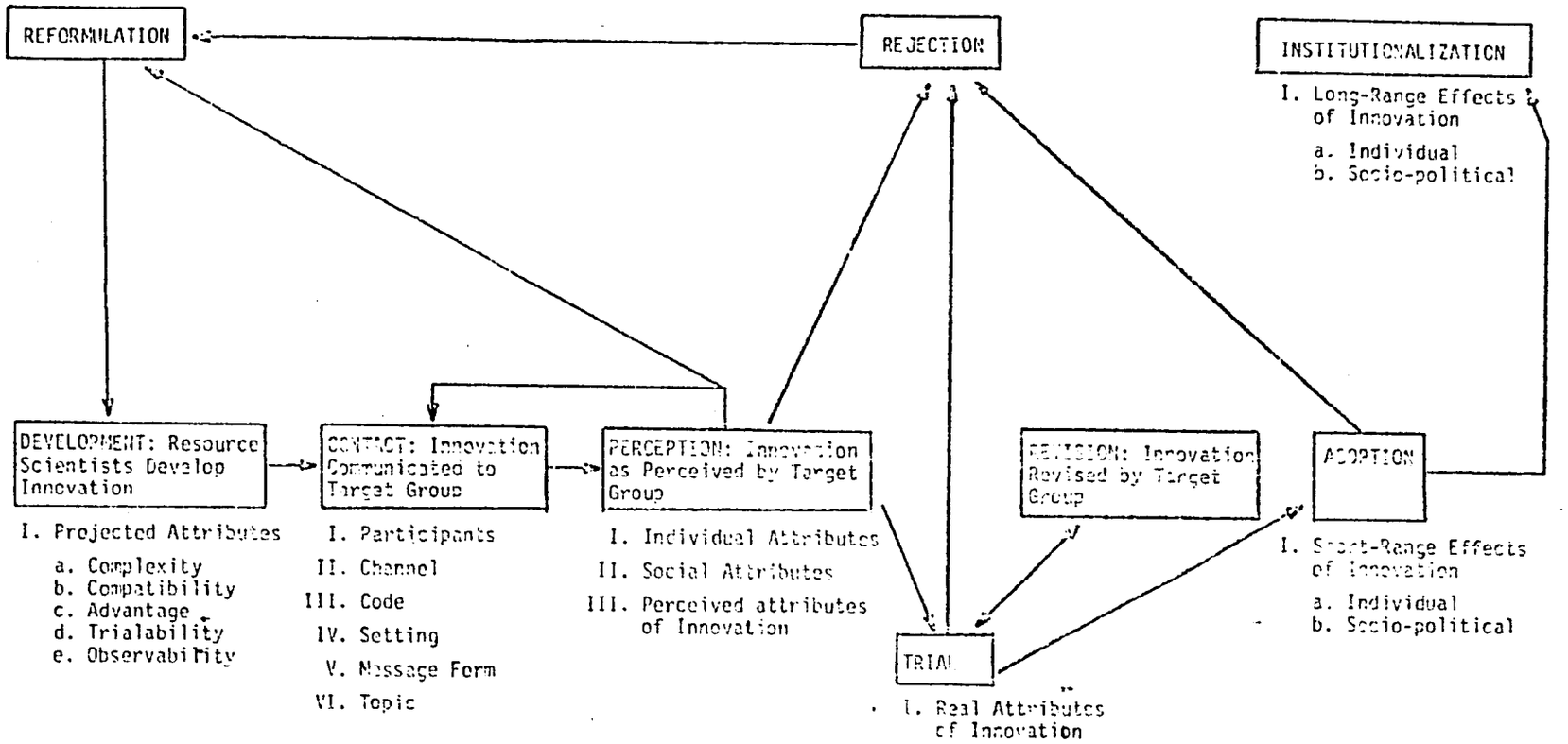

Figure 1. Factors influencing the transfer of techno-economic innovations.

FORWARD

The primary objectives of this paper are fourfold: first, literature dealing with the sociocultural concomitants of the transfer of technology will be reviewed, second, a model outlining man's psychocultural adaptation to the marine environment will be developed, third, psychocultural constraints placed upon the transfer of technology by specific characteristics of the small-scale fishing occupational subculture will be examined; and finally, suggestions will be made concerning the types of data needed to understand the dynamics of psychocultural adaptation in a marine subculture undergoing socio-economic and technological change.

Although a great deal has been written concerning psychological, social, and cultural responses to techno-economic change in agrarian and industrial sectors of society no systematic effort of comparable magnitude has been directed at the small-scale fisheries. This is probably a direct result of the fact that small-scale fisheries at present have much smaller impacts on national economies than agriculture and industry. Despite the apparent insignificance of small-scale fisheries in the national context, their numbers are impressive when viewed on a world-wide basis. FAO has recently estimated that there are 9.2 million small-scale fishermen in developing countries (F.A.O. 1974). This figure does not include the approximately 4 million employed in associated activities such as fish processing, selling, equipment manufacture, etc.

As producers of high quality protein in a world suffering from food shortages, the importance of this occupational subculture should not be underestimated. Ongoing and future attempts to improve the technology and production of small-scale fishermen will meet and hopefully overcome many of the same social, cultural, and psychological dislocations that occurred and

are occuring as a result of change in the agrarian and industrial sectors of society. The review of current literature dealing with these changes and concomitant problems will focus on those areas which small-scale fishermen share with other sectors of society. It is argued, however, that the social, cultural, psychological environment of the small-scale maritime fisherman places unique constraints on the change process. The model of man's psycho-cultural adaptation to the marine environment will lead toward an understanding of these constraints and indicate the types of data needed to facilitate change in small-scale fisheries.

SOCIOCULTURAL CONCOMITANTS OF TECHNO-ECONOMIC CHANGE

INTRODUCTION Social scientists have been investigating the sociocultural antecedents and consequences of the diffusion of innovations and the innovative process for a number of years. Rogers and Agarwala-Rogers (1976.171) have recently noted that some 2,700 published studies deal with this subject. Some of these studies have succeeded in accounting for over 80% of the variance in innovative behavior (e.g. Moulik et al 1968 Wish 1967). Despite this apparent mountain of knowledge numerous technological transfer programs are slowed down and sometimes fail due to sociocultural factors. This cannot be due to any lack of systematization of research on this topic. Rogers and his colleagues have done excellent jobs summarizing the published material while making substantial contributions of their own (Rogers 1969 Rogers and Shoemaker 1971, Rogers and Agarwala-Rogers 1976).

Failure to take adequate account of sociocultural factors involved in the innovative process may be due to one of two major factors: (1) reservations concerning the value of sociocultural research on the part of development assistance agencies (Cochrane 1979), and/or (2) inadequate research on the part of social scientists. It is obvious, however, that the former can be a consequence of the latter. A lack of understanding of the importance of sociocultural factors may also contribute to their being underemphasized by development assistance agencies. The social scientist is obligated to overcome this problem by effectively communicating the results of relevant research to these agencies.

Factors contributing to inadequate research on the part of social scientists are quite complex and hard to overcome. First we find that social scientists are often expected to conduct research in an unrealistically short time period.

This could be due to failure on the part of either sponsoring agencies or investigators to perceive the complexity of the variables involved and problems associated with collection of sociocultural data. One researcher, in a recent editorial in Science, notes similar problems with respect to environmental impact studies. He suggests that failure to understand, or lack of sympathy for, environmental problems leads to inadequate, token funding of necessary research. Nevertheless, he points out that "someone is inevitably available to receive these funds, conduct the studies regardless of how quickly results are demanded, write large, diffuse reports containing reams of uninterpreted and incomplete descriptive data, and in some cases, construct "predictive" models irrespective of the quality of the data base" (Schindler 1973:509). He goes on to note the inadequacies of such research and its potentially negative impact on both the resources involved and the credibility of all scientists in the involved discipline whether or not they conduct such research. This criticism applies equally well to the involvement of social scientists in development projects.

A second problem is that the researcher may be attempting to apply research valid for one occupational subculture to other occupational subcultures without first testing their applicability. Most research on diffusion of innovations has dealt with agriculture and is not necessarily applicable to other occupational subcultures.

In an attempt to overcome these problems, the remainder of this chapter will be involved with outlining the complexity of the sociocultural variables associated with the innovative process. The following chapters will deal with occupational subculture variability and data collection problems.

A MODEL OF THE TRANSFER OF TECHNO-ECONOMIC INNOVATIONS This section of the paper presents and discusses a model representing the transfer of techno-economic innovations. The concept "innovation" as used here refers to "...an idea, practice, or object perceived as new by the relevant unit of adoption" (Rogers add Agarwala-Rogers 1976:150). The relevant unit of adoption is referred to as the target group. Most social scientists agree that an effective program of techno-economic innovation transfer consists of the following essential and interrelated ingredients: (1) development by resource scientists of an innovation which is compatible with the target environment and economy, (2) effective communication of the new idea to the target population (3) recognition by the target group that the new idea will fulfill a perceived need and will be, or can be, made consonant with existing beliefs, values, attitudes, and status and role relationships. These three key ingredients form the first stages in the transfer of an innovation as depicted in figure 1.

Figure 1 illustrates, in diagrammatic form, factors influencing the transfer of techno-economic innovations. The feed-back loops in the model indicate the dynamic nature of the innovation transfer process. Focusing on one very important aspect of the model we find that innovation attributes (cf. Rogers and Shoemaker 1971) are entered under several stages of the transfer process. This multiple entry indicates the dynamic, multicomponential nature of an innovation. The attributes indicate the categories of meaning attached to an innovation, and their multiple entry reflects the fact that this meaning has the potential of changing as the innovation becomes known, tested, and adopted or rejected (Pollnac 1973). These various aspects of the meaning of an innovation and their systemic effects are examined below where we focus on each stage of the transfer of innovations.

Prior to discussing the various stages of the transfer of innovations, it should be noted that the model presented in figure 1, unless viewed properly, oversimplifies the complexity of the processes involved. As will be seen below, each stage is composed of interlocking subsystems each of which plays an important role in either facilitating or impeding the transfer of innovations.

Development of Innovation by Resource Scientists Little will be said about the actual development process since that falls within the domain of the technical specialist. Nevertheless, some criteria should be specified for selection of items to be transferred as innovations to a target population. Often an item is selected because it "worked" elsewhere. Sometimes items are developed specifically for a given situation. At this stage of the transfer process, the attributes of an innovation are those that the change agent predicts for the innovation in the target group context. The accuracy of these

predictions is strongly related to knowledge of the target group. For example, one must determine if the innovation is too complex for the target group, e.g., what levels of training are necessary to operate it, and do sufficient numbers of qualified individuals exist among the target group? One must project the compatibility of the innovation, and this is no simple matter since it is a multivariate compatibility we are concerned with. Is it compatible with the environment--e.g., will it improperly exploit the resources? Is it compatible with the social system? Will it result in increasing social stratification and unequal distribution of wealth thus increasing potential for social unrest? Will it break-up traditional work groups which were key elements of social control? Will it change traditional distributions of items associated with prestige and power? Will the new tasks required be compatible with the psychological make-up of involved individuals in the target group? In determining this, it must be determined if quantity is more important than quality, if leisure time is more important than either more quality or quantity, etc. The change agent must also assess the trialability of the innovation--can it be made available for tests by all concerned individuals in the target group or will only the richest be able to acquire the innovation? Finally, and very important with regard to the meaning of an innovation is its observability. Can the results of its application be readily observed, and if not, how can the target group be convinced of its efficacy? These and many other questions concerning the meaning of an innovation will be examined in detail in relation to other stages of the transfer of techno-economic innovations.

At this point, however, it should be stressed that the more similar the attributes at the development stage are to those at the perception, trial,

adoption, and institution stages, the more likely the innovation transfer process will be successful. The probability of achieving this goal can be enhanced by prior acquisition of relevant socioeconomic, cultural, and environmental data and most importantly, proper communication of the multicomponential meaning of the innovation to the target group at the contact stage. Communication is one of the key ingredients in the transfer of techno-economic innovations which will be examined in the next section.

Contact It is obvious that no innovation can be transferred without the target group's first being made aware of its existence. Knowledge of the innovation must be communicated, and many aspects of the communication process have an effect on its evaluation and acceptance by the target group. As one of the first, crucial stages of the transfer of innovations, the communication process deserves careful attention.

The communication event entails several important components (Hymes 1964_a): (1) the participants--senders, receivers, interpreters, spokesmen, etc., (2) the channels--speaking, newspapers, pamphlet, radio, television, wall posters, etc.; (3) the codes--the language (national, local dialect, etc.), combination of language and pictures, etc., (4) the setting--formal meeting, schoolroom, on the beach, etc., (5) the message form--salesman's pitch, sermon, informal chat, etc.; and finally (6) the topic--here information concerning attributes of the innovation. It is important to note that these components of a communication event form an interrelated whole--a system. The topic may define certain characteristics of senders and receivers. For example, the change agent should be of the same sex as the target group for the diffusion of information concerning birth control in many societies. Relative social status and familiarity of sender and receiver dictate

message form and code in many cultures. Familiar message forms or codes may be taken as insulting when used by strangers. Characteristics of the receiver may also dictate the channel and code. It is obvious that written messages or the national language cannot be used with people who have only a rudimentary grasp of reading or the national tongue. The intricacies of these interrelationships suggest that one must become sensitive to the structure of communication events within the target group either through extensive exposure or with the use of a good local-level assistant. A brief examination of the interaction between the components of communicative events and the transfer of innovations will indicate some important areas for further study.

Turning to the participant component of the communicative event we focus first on the sender whom we identify as the change agent. Rogers and Shoemaker's (1971) extensive review of the literature identified several change agent attributes associated with successful innovation transfer. (1) target group rather than change agency orientation, (2) empathy with target group; (3) homophily (overall similarity) with target group, and (4) credibility in the eyes of the target group. The first three characteristics imply a sensitive understanding of the target group, while the last, credibility, is probably a result of this understanding. Barnett (1953) makes an important and related point when he notes that advocates of change must not be offensive. One who understands and can empathize with the target group probably knows how to be least offensive. A lack of this type of understanding on the part of the change agent (sender) can lead to difficult situations which may result in project failure. For example, Jones (1974) reports that relationships between farmers and official government change agents among the Plateau Tonga in Zambia broke down into hostility and withdrawal due to misunderstandings

about what each could expect from the other. Such misunderstandings, of course, also lead to a loss of credibility on the part of the change agent.

Initial target group recipients of the message must be identified. The ideal is to diffuse the message and ultimately the innovation to as many individuals as possible within the target group. Nevertheless, experience has shown that change agent success is positively related to working through opinion leaders (Rogers and Shoemaker 1971). Barnett (1953) notes that prestige is not a good means of identifying opinion leaders who will be effective within specific domains because the prestige rating of the same person may vary from context to context. For example, an opinion leader with regard to net fishing may not be an opinion leader for trap fishing. Attempts to introduce a hydraulic palm oil press in Africa were less than successful because change agents communicated the information about the innovation to males with the belief that the women would acquiesce to their husbands (Obibuaku 1967). Women traditionally pressed the seeds and knew the importance of byproducts which would be destroyed by the new hydraulic press. The press was introduced through the males and subsequently rejected.

Rogers and Shoemaker (1971) present a number of attributes associated with opinion leaders. Nevertheless, even within a specific domain it is difficult to identify an opinion leader with only the use of identifying characteristics such as social status, degree of social participation, mass media exposure, etc. It is often necessary to rely on sociometric techniques (cf. Menzel and Katz 1955, Lionberger and Copus 1972). If for some reason (i.e. presence of opinion leaders with a vested interest in the status quo) it is not advisable to work through opinion leaders, the change agent should try to inform as many concerned individuals as possible. If

funds limit the number of people who can be reached, those possessing characteristics associated with early adoption of innovations (cf. next section) are probably the most effective target since their adoption could lead to more adoption through the demonstration effect (Erasmus 1961).

Turning to communication channels, those most likely to result in effective, credible message delivery to the target group should be used. Knowledgeable individuals within the society can be consulted (e.g. marketing specialists), or opinion surveys of attitudes, beliefs, and values concerning the various channels can be conducted to determine the most effective. Sometimes this must be done on a trail and error basis. Nevertheless, even when an effective medium has been isolated, its success often depends on other factors. For example, Sinha and Mehta (1972) note that success of instructional television in India often depends on the farmer's motivation to change. Rogers and Shoemaker (1971) cite numerous studies which indicate that although mass media (e.g. radio, newspapers, television) are important at the knowledge function (bringing to awareness), interpersonal channels are important at the persuasion function. They note, however, that the mass media are relatively more important than interpersonal channels of communication for early adopters. Most important for international development programs, they indicate that the mass media channels are more effective among peasants in lesser developed countries when used in combination with interpersonal channels in organized small groups of individuals who regularly meet to attend and discuss mass media programs.

Although it is obvious, it must be noted that degree of functional literacy must be determined before written mass media channels can be considered a viable alternative. Additionally, and less obvious, if pictures form

an important part of the communicative event, target group familiarity with the interpretation of two-dimensional pictorial material should be taken into consideration (cf. Hudson 1967).

Use of proper code is also an important consideration, and it is not as simple as merely selecting a language with which the target group is familiar. In bilingual contexts, one language may have more prestige than another (Lambert, et al 1960, Rubin 1968) or may be situationally dependent with respect to its usage. For example, Rubin (1968) reports that variance in use of either Guarani or Spanish in Paraguay depends on location, degree of formality intimacy, seriousness of situation, and sex of participants. Even when only one language is spoken there may be different codes which signify degree of respect, social class and other variables. Brown and Ford (1961) clarified the extent to which degree of intimacy and status effect direct address usage in American English. Further, Geertz (1960) indicates that Javanese has three levels of speech, including honorifics which are related to the participants age, sex, kinship relation, occupation, wealth, education, religious commitment, family background, social setting, content of conversation, the background of social interaction between the speakers, and the presence of a third person. The foregoing are not isolated examples. Such variance in language usage occurs in many societies around the world (cf. Gurling 1970, Hymes 1964b) and failure to adhere to these usually unwritten rules may lessen the credibility of a message.

It should be noted that strict adherence to the foregoing precautions will not necessarily guarantee adequate communication. As one sensitive change agent noted "we spoke the same language but we didn't communicate" (Weller 1965:1). Recent psycholinguistic research (Pollnac 1975a, 1975b; Szalay, Lysne,

and Bryson 1972) has indicated a significant degree of variability in semantic structure which could impede effective communication. Wallman (1965) indicates that in Basutoland the failure of a number of development schemes can be attributed to semantic problems in the communication of measurement. Pollnac (1974) demonstrates a fair amount of semantic variability with respect to food plants among the Baganda of Uganda and argues that agricultural change agents must become sensitive to variability in the semantics of agriculture if they are to effectively communicate with various sectors of the population.

The setting of the communication, like the channel, depends upon determining the most effective technique within the target group. As was noted above, however, the setting may effect the code used as well as message form. For example, in our society, a sermon is not the proper message form to be used between friends at a party. Situational constraints such as these operate in other societies in contexts which the change agent may not be aware of without previous research. For example, in much of the world schooling is associated with children. If communication of instruction concerning an innovation is held in a schoolroom setting with a student-teacher message form, adults in such societies may be reluctant to attend (Foster 1973).

Finally turning to the topic, the message must focus on the various attributes of the innovation listed above, emphasizing points congruent with the attitudes, beliefs, and values of the target group. If part of the message content is a demonstration, it must use items which are familiar and available to the target group. For example, in one developing country where the author worked, a television program was constructed to increase the use of a fish product through verbal information about its nutritive content and

preparation. The demonstration was conducted on an electric range in a country where most of the target population used charcoal, wood, or kerosene. Thus, the cooking times and techniques were not applicable to most of the target group. A valuable discussion of the style, structure, and content of effective messages can be found in Triandis (1971).

The target group's perception of the innovation is greatly influenced by the above discussed attributes of the contact stage. In the next section we turn to other variables which influence the perception of a new item or thing.

Perceptions of innovations by the target group are perhaps the most difficult and least tangible variables to be considered in the transfer of innovation process. Nevertheless, they are among the most important. The communication stage is aimed at influencing these perceptions which will result in either trial and subsequent adoption or rejection of the innovation. Foster has written that

> When people are confronted with new opportunities, acceptance or rejection depends not only upon the basic cultural articulation, a favorable pattern of social relations, and economic possibility, but also upon psychological factors. How does the novelty appear to the individual? That is, how does he perceive it? Does he see it in the same light as the technical specialist who presents it to him? Does it convey the same message? Since perception is largely determined by culture, people of different cultures often perceive the same phenomenon in different ways (1973:130).

Furthermore Rogers and Shoemaker (1971) cite numerous empirical studies indicating a relationship between the perception of the attributes of an innovation listed in our model (Figure 1) and its rate of adoption. Kivlin and Fliegel (1967) note that perception of innovations account for over fifty percent of the variance in adoption rate.

As can be seen in figure 1, there is feedback between perception, contact, and reformulation. It is essential to constantly, and sensitively, monitor the perception of innovations. This type of feedback can result in reformulation of either the communication or the innovation and prevent its untimely rejection.

Many different variables influence the perception of an innovation's attributes. The communication of the innovation as discussed above is one. Other variables can be classified as individual, social, or cultural. Identification of these variables can be a complex problem but if it is agreed that favorable perception of an innovation is accompanied by early adoption, we can begin with the thirty individual characteristics associated with early adoption which Rogers add Shoemaker (1971) derived from a massive review of the literature. These thirty characteristics can be found in Table 1. The categories used are those presented by Rogers and Shoemaker (1971,174-193) except that the socio-economic characteristics are divided into individual and entreprenureal characteristics.

The figures in parentheses following each variable in Table 1 indicate direction of the relationship, number of empirical studies reviewed, and percent of studies which support the relationship. For example, education is positively related to early adoption, and 74% of the 275 studies testing the relationship between these two variables support the generalization Most of the generalizations are supported by about 60 to 70% of the studies and only two by 100%. Additionally most of the studies are statistical in nature, eg. some studies present findings which indicate that given individual with quality X, there is a good likelihood (with a stated probability) that he will be an early adopter, or given a group of individuals with

Table 1. Attributes associated with early adoption of Innovations (Rogers and Shoemaker 1971).

Socioeconomic Attributes

Individual

1. Education (+275, 74%)
2. Literacy (+38, 63%)
3. Social Status (+402, 66%)
4. Upward Mobility (+5, 100%)
   + 10%
5. Age 0 220, 48%
   - 33%

Entrepreneural

1. Larger units (+227, 67%)
2. Commercial Orientation (+28, 71%)
3. Favorable Attitude Toward Credit (+25, 79%)
4. Specialized Operations (+15, 60%)

Personality Attributes

1. Empathy (+14, 64%)
2. Dogmatism (-3%, 47%)
3. Ability to Deal with Abstractions (+8, 63%)
4. Rationality (+14, 79%)
5. Intelligence (+5, 100%)
6. Favorable Attitude Toward Change (+37, 75%)
7. Favorable Attitude Toward Risk (+37, 73%)
8. Favorable Attitude Toward Education (+31, 81%)
9. Favorable Attitude Toward Science (+27, 7[illegible])
10. Fatalism (-17, 82%)
11. Achievement Motivation (+23, 81%)
12. Level of Aspiration (+3[illegible], 74%)

Communication behavior

1. Social Participation (+149, 73%)
2. Integration with Social System (+[illegible], 100%)
3. Cosmopolitness (+175, 79%)
4. Change Agent Contact (+156, 87%)
5. Exposure to Mass Media (+116, 69%)
6. Interpersonal Communication Channels (+[illegible], 77%)
7. Information Seeking about Innovations (+14, 85%)
8. Knowledge of Innovation (+80, 76%)
9. Degree of Opinion Leadership (+55, 76%)

quality X, there will be more early innovators than you would expect on the basis of chance alone. Because of the nature of these relationships, it is often necessary to take more than one variable at a time into account as a means of increasing the probability of predicting early adoption. For example, Chattopadhyay and Pareek (1967) interrelated five psychological variables with innovation adoption behavior in India (fatalism, conservatism, authoritarianism, change proneness, level of aspiration). Individually these variables account for between 24 and 40 percent of the variance in innovative behavior. A multiple regression analysis, however, indicated that fatalism, conservatism, and authoritarianism together account for 53 percent of the variance with the other two adding an insignificant amount to the total. It is therefore essential to examine the individual attributes associated with the perception of innovations as bundles of attributes and not rely on any one indicator. As indicated above, reliance on single indicators decreases the probability of accurate prediction.

Although individual differences are important for understanding variability in the innovative process, it is important to realize that the sociocultural context plays a significant role in determining the distribution of many of the characteristics listed in table 1. For example, among the individual characteristics in table 1, education and literacy depend, in large part, upon the educational opportunity structure of the matrix society. Social status, upward mobility, and variance in productive unit size are interrelated and more likely to be manifested in communities with a fair amount of socioeconomic differentiation than in relatively homogeneous peasant farming villages. This interpretation is supported by Stanfield and Whiting who note that although social status and wealth are related to innovativeness

regardless of community type, "...farmers in communities with less land-ownership concentration are somewhat more prone to innovate" (1972.101). Turning to other characteristics in table 1, a commercial orientation and favorable attitude towards credit is rare in a subsistence economy but relatively common in market economies, while specialized operations occur more frequently in market oriented systems.

The personality characteristics can also be understood as reflections of the sociocultural matrix. Empathy, dogmatism, ability to deal with abstractions, rationality, intelligence (as commonly measured), fatalism, and favorable attitudes toward change, education, and science are all obviously related to various sociocultural variables. For example, the existence of a modern educational system functions to acquaint individuals with new ideas and other peoples, thus fostering a degree of empathy and reducing dogmatism. A good educational system also increases the ability to deal with abstractions and problems in what we refer to as a rational manner. An individual from a traditional village, relatively isolated from the outside world, has little basis for empathy with a change agent or government official. His behavior, which outsiders may view as dogmatic, may be the only effective (and therefore rational) means he has of dealing with a specific problem, and his subsistence status allows for little error.

Favorable attitudes toward change, education, and science are fostered in systems with successful ongoing change, where the fruits of education and science can be seen. Fatalism is often common in situations where the individual perceives that he has little control over natural and social conditions-as this control increases, the degree of fatalism decreases (Foster 1973). In addition, Edgerton (1971) notes that among East African pastoralists and

farmers, fatalism is related to crowding in residence--another sociocultural variable. Favorable attitudes toward risk are found in sociocultural contexts where the future is reasonably secure (cf. Parsons 1971, Thompson 1975, Pollnac and Poggie 1976). Individuals in unpredictable sociocultural environments, living on the margins of existence can afford little risk--the slightest problems can result in failure and starvation. Achievement motivation is a complex, difficult to measure variable (cf. Sutcliffe 1974) which is closely related to level of aspiration. Both variables have been related to traditional cultural institutions. The extreme importance of this variable has been indicated by Felt (1971) who suggests that it mediates between education, literacy, mass media exposure, and innovative behavior (also see Rogers 1969).

Among the communication variables, cosmopolitness and exposure to mass media depend on the transportation network and communication channels of the matrix society--what Frey (1971) refers to as the 'developmental climate.' Knowledge of and information seeking about an innovation are related to exposure through travel (cosmopolitness), the mass media, and or change agent contact. All three of these variables, once again, are dependent on communication and transportation networks.

Overall, it can be seen that several sociocultural variables are associated with the individual characteristics related to perceptions of an innovation. Most important among these are the social stratification system, educational opportunity structure, degree of sociocultural stability, degree of market versus subsistence orientation, and extent of communication and transportation networks. Some of these variables, along with several others, directly affect the perception of the attributes of innovations.

Turning first to perceived compatibility we find that in some societies where social obligations are extremely time consuming, any innovation which is perceived as conflicting with these temporal demands would meet resistance (cf. Brown 1957). Another example of cultural incompatibility with innovation attributes occurs when procedures of work traditionally associated with one sex are to be performed by the other as a part of the innovation. Lowie (1954) notes that among the Plains Indians, females normally practiced horticulture while men hunted. Any man who took up ploughing was likely to be jeered at because he was performing woman's work. Some societies have cultural barriers to the transfer of innovations in the form of superstitions which prescribe certain ways of doing things, violation of which can result in punishment (cf. Foster 1973). Innovations which are perceived as changing existing social relations are also resisted (Aceves 1971). For example, if the organizational constraints of the innovation necessitate reorganizing a formally egalitarian work group into one composed of superordinates and subordinates or vice-versa resistance could occur. Dasgupta (1975) demonstrates how the caste structure of an Indian village can either impede or facilitate modernization of agriculture. Another example is provided by Rotblat (1975) who notes that traditional interaction patterns found in Iranian bazaars result in a high degree of social distance between people which inhibits development of normative systems appropriate to a developed market system. Sellers who fail to maintain the status quo are reported to suffer sanctions.

Innovations may also be perceived as being physically incompatible. Foster (1973) provides several examples of how innovations not consistent with traditional motor patterns meet with strong resistance. For example, if the new innovation requires a new bodily position for work, the new position

may be more exhausting due to its strangeness and result in resistance or rejection (cf. Dube 1958).

With regard to psychological compatibility, Doob (1960) notes that people in a society are likely to accept forms of behavior which they perceive as psychologically congenial and reject those perceived as uncongenial. He cites examples from American Indian acculturation studies to support his observation.

The advantage attribute of the innovation is usually not perceived in a similar manner by both the change agent and target group. We usually think of advantage in terms of financial return. This perception of advantage is not a universal as evidenced by a study which indicates that Indian in contrast to U.S. farmers, attach more importance to social approval of an innovation than to its financial return (Fliegel, Kivlin, and Sekhan 1968). Advantage may also be perceived as more than just an increase in quantity of the product. For example, sometimes the plant involved has multiple uses for parts other than the fruits or grains. Marriott (1952) notes that a new variant of wheat was rejected in one area of India because in comparison with the old variety it produced a straw the animals did not like, produced inferior fire and thatch, and did not grind, knead, or result in as good a bread. Foster (1973) cites several such examples of multifunctional traditional items being replaced by monofunctional innovations which were subsequently rejected or revised. With regard to differential perception of advantage, the marginal utility of leisure time can be an important factor. Hewes (1974) discusses the interrelationships between dietary deficiencies, malnourishment, and lack of energy to do a full day's work. There has been some disagreement concerning the role of nutrition in economic development (cf. Franke and Barrett 1975, Belli 1971) but it seems reasonable that leisure time would be

an important factor in perceptions of the relative advantage of innovations within a malnourished target group. Perhaps the sleeping peasant is not lazy but conserving energy to perform the vital tasks that keep him and his family alive. Advantage is also relative--what is perceived as advantage by one individual may not be perceived as advantage by another. For example, resistance often occurs when vested interests perceive an innovation as decreasing their socioeconomic position (eg. middlemen faced with a marketing cooperative). In this case, the vested interests, who usually have considerable socioeconomic power and prestige, will actively campaign against the innovation. In a similar vein, Jones (1974) points out that the traditional superior position of elders among the Plateau Tonga of Zambia placed constraints on the success of younger men with respect to farming activities.

Perceived complexity of an innovation is also related to its adoption. Complexity is a relative judgement related to the level of technological development and educational opportunity structure of the target population. Once again the sociocultural context is an important variable. Rogers and Shoemaker (1971) cite several studies supporting the hypothesis that there is a negative relation between the complexity of an innovation and its adoption rate. One study cited (Petrini 1966) finds that complexity in combination with relative advantage explains 71 percent of the variance in rate of innovation among Swedish farmers.

Perceived trialability of an innovation is also an important determinant of adoption. Trialability is related to costs involved in obtaining an innovation and its relative availability. Perceptions of cost are related to the economic status of target group members. Subsistence level producers are less apt to perceive an innovation as trialable if it will cost them

something since they usually do not have slack resources for investment (cf. DeWalt 1975, Gartrell, Wilkening, and Presser 1973; Cancian 1967). Rogers and Agarwala-Rogers (1976) discuss the importance of slack resources in the innovation process. Kivlin and Fliegel (1968), however, note that small-scale farmers are more likely than middle-scale farmers to take short-run risks. They have less financial committment, less to lose, and more to gain by emphasizing short run returns. Thus, trialability is complexly related to the economic sector of the sociocultural matrix. Rogers and Shoemaker (1971) cite several studies indicating that the rate of adoption of an innovation is positively related to its trialability as perceived by members of the target group.

Erasmus (1961) places a great deal of emphasis on the observability of the results of an innovation. He points out that innovations most likely to succeed are those for which a quantitative appraisal of advantages are possible with only casual observation. Rogers and Shoemaker (1971) once again cite several studies which support the hypothesis that an innovation's rate of adoption is positively related to its perceived observability.

As the model indicates, the perception stage can be followed by either trial or rejection. Additionally, if perceptions are sampled by the change agent, perceived incompatibilities can be reduced by either new instructional messages (communications regarding the innovation) or restructuring of the innovation by resource scientists. Nevertheless, many of the socio-cultural and individual incompatibilities do not appear until the trial stage or later. This results in restructuring of the perceived attributes of the innovation at these later stages. We next turn to the trial stage, an important stage for determining some of the real attributes of an innovation.

The trial stage is when many of the real short-term attributes of an innovation are discerned by the target group. At the trial stage the target group determines if the innovation is in fact too complex, if its operations are compatible, at least in the short run, with the social and physical environment, if its advantages are observable, and, if in fact they can afford to give it a trial. Many of the same sociocultural and individual constraints which we discussed at the perception stage will now be tested for short- term compatibility. Short-term compatibility is stressed since the trial stage is often short and sociocultural dysfunctions often take some time to develop.

Some sociocultural strains do appear at this stage, however. If the cost of the innovation is such that few can afford it, and if it is perceived as giving more advantage to those few, the disadvantaged may actually campaign against it. Additionally, many subsistence level societies have a norm of reciprocity which functions to distribute some good (e.g. food, money etc.) to kinsmen, friends, etc. who are in need with the understanding that they will give to the donor when he is in need. Since during the trial stage (and later) not all develop at the same rate, there will be demands on the resources of the most advanced. If they heed the demands, they often loose advantages gained by the innovation, if they disregard the demands, they may face ostracism or severe criticism (Foster 1970). Thus, under trial the earlier perceived advantage may disappear into the reciprocity network. As a result, some may perceive the innovation as being more trouble than its worth and reject it.

Other sociocultural constraints cited in the perception stage may become more salient at the trial stage and result in revision or rejection. Rogers and Agarwala-Rogers (1976) note that many innovations go through extensive

revision in the process of adoption. Such revision often serves to reduce unanticipated incompatibilities and results in adoption after subsequent trial.

The adoption stage is reached when substantial numbers of the target population begin to use the innovation. At this stage its environmental sociocultural, and individual compatibilities are severely tested. Are the resources sufficient to support the more intensive exploitation? Do the byproducts result in unmanageable pollution? Does unequal acquisition result in intensification of the social stratification system (cf. Galjart 1972 Bernard and Pelto 1972)? Is it compatible with or does it upset traditional work, recreation, kin, and reciprocity groups (cf. Foster 1973)? Is the nutritive status of the population sufficient to maintain the required effort (Jelliffe 1971)? Is the sociocultural matrix sufficiently stable to permit reinvestment of excess product to sustain development (cf. Parsons 1971, Thompson 1972 Pollnac and Poggie 1973)? Does the innovation provide a real advantage in terms of overall good? Does it provide all the good the older item did plus something in addition (i.e. more leisure time, more quality or quantity, etc.)? These and other questions raised in the discussion above will be asked by the target group at the adoption stage. The literature (cf. Erasmus 1961, Rogers and Shoemaker 1971 Foster 1973) is filled with examples of innovations which were adopted and then rejected due to unanticipated incompatibilities. There is, of course, once again the possibility for revision by the target group and subsequent adoption.

Rejection Sometimes, after either the perception, trial, or adoption stage the innovation is rejected. Many reasons for this potential rejection are discussed above. Although the innovation is rejected, the change agency

might not wish to cease its efforts, especially if the failure was due to factors which can be reformulated. Whether or not the agency wishes to pursue the transfer of the rejected innovation, it is important to determine the reasons for rejection. It is important to determine which attributes of the innovation, real or perceived, resulted in its failure. A survey concerning the attitudes, beliefs, and values associated with the innovation following its rejection may aid in pinpointing specific reasons for its failure and facilitate further efforts within the same or other target groups. If the innovation is not rejected, it becomes institutionalized following the adoption stage.

At the institutionalization stage the sociocultural system adapts to the innovation. The "innovation" status is removed and it becomes an integral part of the sociocultural system (Rogers and Agarwala-Rogers 1976). The adaptation of a cultural system to an introduced item can have broad repercussions. The influence of the automobile on American lifestyles is one obvious example. Even the introduction of an innovation as simple as the wagon can greatly affect a cultural system. For example, Bliss (1952) writes that the introduction of the wagon among the Papago (an American Indian group) resulted in displacement of some parts of the technology, establishment of new technologies and specialities, effected shifts in the division of labor, and influenced community solidarity and the relations of the Papago with surrounding peoples. Such changes can even affect household structure. Handwerker (1974) clearly shows how household organization was restructured as a consequence of the introduction of a system of industrial technologies in Liberia. Men lost their status as subsistence providers, and women moved into market selling. Murdock (1949) further notes how changes in subsistence

strategy and household structure can effect changes in kinship terminology. On the individual level, Doob (1960) provides evidence that basic changes in personality occur as people accept innovations and begin to modernize. These changes, some of which are not of interest to aid organizations, are cited as a means of demonstrating the systemic relationships between many seemingly unconnected facets of a society.

Nevertheless, some of the changes that occur in a society after the institutionalization of an innovation are of vital concern to aid organizations. For example, in a discussion of disease and development Puges and Hunter (1972) point out the relationship between the new diets and stress associated with modernization and a number of forms of physical disability. On the societal level, Apter suggests that "the most direct impact of modernization on traditional societies is in the formation of new roles associated with the modernizing process" (1965:123). Bernard and Pelto (1972) note that individuals who are already in advantageous positions in a socioeconomic hierarchy can be expected to be the ones who take advantage of innovations--they have both the slack resources (free capital) and are in more favorable positions with respect to information sources. They suggest that in most cases the socioeconomic effects of technical change lead to increased socioeconomic stratification. Henderson's research in British Honduras (1972) and Alexander's in Sri Lanka (1975) support this generalization. Such increases in social stratification are often manifested by further concentration of control over productive resources (cf. Havens and Flinn 1975). Fromm and Maccoby (1970), basing their interpretation on psychological characteristics, argue that landholders with "productive-hoarding" characteristics will become richer while the peasants with "unproductive-receptive" characteristics will fall to the bottom.

The importance of regional variability with respect to these responses to the institution of innovations was clearly demonstrated by Pelto and Poggie (1974). In a regional approach to the study of modernization, they find differential responses to the modernization process in two regions of Mexico. In one, modernization of the existing agricultural technology resulted in an intensification of the social stratification system. In another, the introduction of a new productive technology (industrial plants) involved a sharp departure from the past agrarian economy, reduced the importance of the old elites, and produced a restructuring of the social stratification system--a rise of a new middle class and a reduction of the importance of the established agrarian elite.

Irrespective of the basis for these deleterious changes in social structure, Erasmus (1961) notes that they will result in emotional distress among peasants who have lost their old prestige system and who lack the opportunity to take part in the new one. These increases in social stratification will lead to more relative deprivation among future generations and enhance chances for social upheaval with disasterous long-range effects (Peres 1974).

Bodley (1975), in what is perhaps an overly pessimistic view, discusses other potential dysfunctions of modernization which we will not go into here. Suffice it to say that the institutionalization of innovations can lead to both positive and negative consequences. Change agencies should be familiar with both potentialities, especially the latter, and do their utmost to construct programs which will result in the greatest good for all concerned, which in many instances will not be a simple increase in gross national product.

SUMMARY In sum, one finds a complex network of environmental, sociocultural, and psychological variables related to the successful transfer of innovations. A very recent study conducted by Development Alternatives, Incorporated (Morss, et al 1976) provides a detailed examination of factors related to success or failure in 36 rural development projects in Africa, Mexico, and South America. Their findings substantiate the importance of many aspects of the model discussed in this section. Development Alternatives, Incorporated found that strong leisure preference and extended family obligations affected success in 10 projects; social obligations in six, and local sanctions against innovation or accumulation in five projects. Overall, they found that project success was most affected by local action taken by small farmers to complement outside aid. Local action included farmer involvement in decision making during design and implementation, the importance of which we indicated by the feedback loops from perception to communication and reformulation. Level of local action was, in turn, affected by the specificity of agricultural information offered by the extension service, the importance of local organizations in the project, and effective two-way communication between participants and management, once again reinforcing the importance of proper communication networks in the development process.

Overall, our review of the literature indicates that selection and development of innovations must take into account the various attributes of innovation complexity, trialability, observability, compatibility, and advantage. Communications involved with the transfer should be culturally appropriate and emphasize the attributes most compatible with the attitudes, beliefs, and values of the target group. Target group perceptions of the innovation are important determinants of success at all stages from the first contact on through institutionalization, and these perceptions are based on messages received

during communication and the real attributes of the innovation which manifest themselves during the trial and adoption stages. At all these stages the key role played by environmental, sociocultural, and psychological variables emphasize the importance of a systematic, multivariate approach to the study of the transfer of innovation process. In the next chapter, we outline the systemic nature of man's psychocultural adaptation to the marine environment to provide a matrix for our discussion of techno-economic change among small-scale fishermen.

MAN'S PSYCHOCULTURAL ADAPTATION TO THE MARINE ENVIRONMENT

INTRODUCTION Man's adaptation to the marine environment poses problems which are, in some cases, distinct from those posed by the demands of other ecological nitches. In most cases he has effected this adaptation through cultural means--through the development of technologies, ideologies, forms of social organization, and cognitive orientations which facilitate attempts to fulfill his needs. In terms of sociocultural adaptation much attention has been paid to hunters and gatherers, nomadic pastoralists, and horticulturalists, but little systematic study has been done concerning adaptation to the marine environment--perhaps one of man's most extreme forms of adaptation.

Adaptation in man has been defined as "...the process by which he makes effective use for productive ends of the energy potential in his habitat" (Cohen 1974:40). This process is multicomponential and includes a complex network of interactions between man's physical environment, technology, social organization, social environment, ideology, and individual biopsychological needs and characteristics. The complexities of these interactions are perhaps most clearly illustrated by the model of human ecology presented by Poggie, Pelto, and Pelto (1975) in a discussion of human adaptations (see figure 2).

The lines connecting all components of the model of human ecology indicate that a fundamental and important assumption is being made: That changes in any one component have the potential of effecting changes in other components. For example, if there is an increase in population which results in a change in residential density (a change in the social environment), there may be changes in social organization to control the increased interaction, economic distribution problems, etc. The new social organization and increased interaction implied by

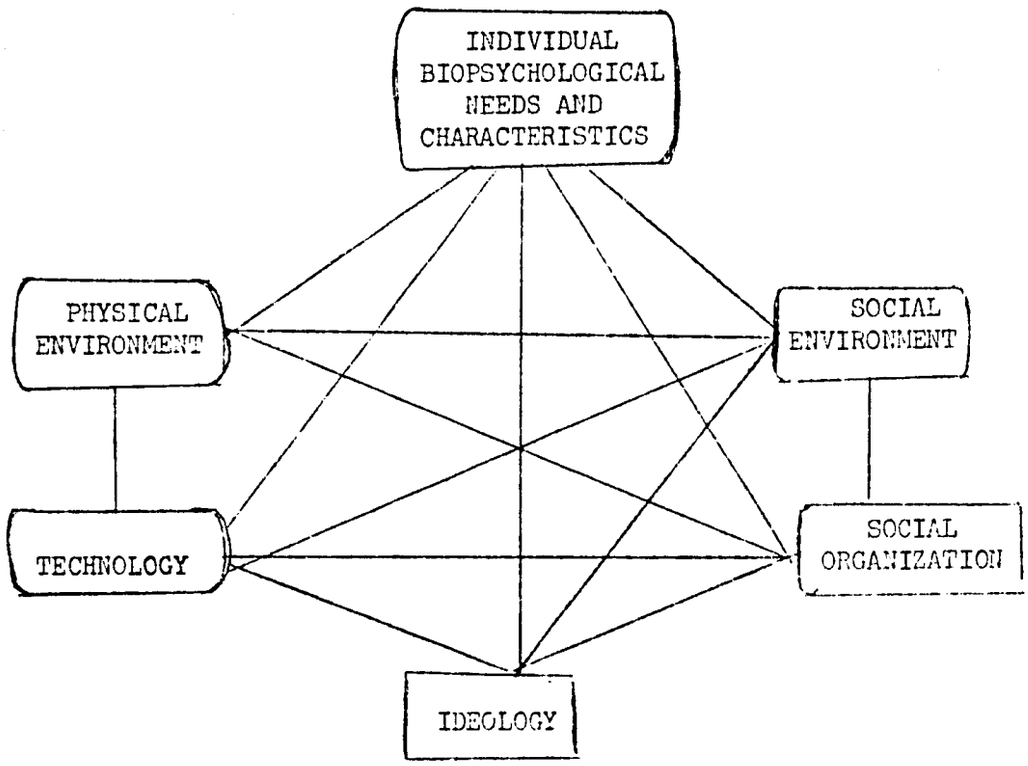

Figure 2. Model of Human Ecology (Adapted from Poggie, Pelto, and Pelto 1975:10).

increased population density require changes in ideology (attitudes, beliefs, and values) to insure proper function and acceptance by the people. Differences in population density are also related to individual psychological variables such as depression, fear, independence, etc. (cf. Edgerton 1971). With respect to the physical environment, increased residential density creates waste disposal problems, decreases in agricultural land, etc. These changes in turn necessitate new technologies if man is to effectively cope with the changing situation.

This brief discussion of the interrelatedness of the various components of the model is provided merely as an illustration. We have scarcely scratched the surface of the numerous ramifications of changes in population and residential density. The relationship between human society and culture and the physical environment has been the subject of much debate in the social sciences (e.g. Forde 1949; Steward 1955; Harris 1968). Rather than arguing for any priority with respect to directionality, the model presented here simply allows for interaction between human cultural and social systems and the environment. Ample evidence concerning the mutual influence that one has on the other will be presented, and the complexities and usefulness of the model will become more clear as we proceed with our discussion of man's adaptation to the marine environment.

THE PHYSICAL ENVIRONMENT There is a great diversity of marine environments around the world ranging from the cold arctic to the hot tropics. Details concerning this diversity will not be examined here. The more modest scope of this section is to discuss general features of the marine environment present in nearly all areas where man has lived. The scope is further reduced by limiting our examination to elements of the environment which influence aspects

of the human psychocultural adaptation system.

Perhaps the most important aspect of the sea with respect to adjacent human populations is its food, especially protein, production potential. Carl Sauer argues that for pre-agricultural man "the sea, in particular the tidal shore, presented the best opportunity to eat, settle, increase and learn. It afforded diversity and abundance of provisions, continuous and inexhaustible"; that "between high and low tide a wide assemblage of life forms useful to man is to be had for the taking" (1963:309). In comparison to land areas, especially arctic, the sea contains an immense amount of organisms which can be used by man. Fitzhugh (1972) notes that this relatively high diversity of organisms results in long food chains with complex ecological structures which provide feedback and regulatory mechanisms that serve to dampen population fluctuations. Additionally, fish have high reproductive rates, and small-scale fishermen can only exploit a small portion of the sea, thus allowing the fish to reproduce and move from the larger ocean (Lenski and Lenski 1974). The margins of the sea and land also provide an extremely rich ecological zone. Tidal marshes, river mouths, and coastal bays are characteristic of neither salt or fresh water, but their access to the sea, concentration and retention of land and sea nutrients, protective shelter, and shallow water rooted or attached plants make them extremely productive (Turk, et al 1974). We must, however, maintain an awareness of the fact that man, even primitive man, can measurably affect the population structure of marine animals (cf. Shawcross 1975).

Despite the long-term population stability of marine organisms, numerous desirable species manifest short-term cycles of availability. For example, species such as salmon and other migratory fish can be exploited only during certain times of the year by small-scale fishermen. Additionally, periods of

inclement weather may prevent small-scale fishermen from going to sea. Thus, although the sea is highly productive and continuous over the long-run, there is a short-term periodicity with respect to the availability of some desirable species. Overall, however, we find that the sea provides a relatively long-term continuous and short-term periodic supply of animal protein.

Another salient aspect of the marine environment is that the food source, the prey, is often hard to see--it is located beneath the water or in the sand and silt at the bottom. Even when prey are visible, they are often displaced and distorted by the refraction of light in the water. Even sea animals which surface for air spend considerable amounts of time hidden beneath the water, especially when they perceive danger above. Not only are the prey hard to see, but they are located in an environment alien to man--a liquid environment, fluid, saline, and always in motion--an environment in which man is biologically ill-equipped to survive. Dense objects sink; some things dissolve and loosely anchored things are swept away (cf. Hewes 1948).

Another feature of the marine environment is that it is flat except for minor surface irregularities caused by waves and swell. When one moves beyond sight of land, it becomes relatively featureless. These factors in combination with the alien nature of a liquid environment result in a condition of relative removal from land based society when one is at sea.

The sea's margin with the land is in general a relatively narrow strip. This is true even where estuaries penetrate the land if one compares the width of the estuarian system to the total land mass. The narrowness of this strip permits rather easy access to flora and fauna of both land and sea. Additionally, various features of this narrow strip are considered attractive to man; e.g. its recreation potential, the diversity of forms, etc. People inhabiting

the littoral zone are also most likely to have first contact with long-distance travelers from the sea or coastal migration routes.

In sum, Table 2 presents general aspects of the marine environment which have some influence on human psychocultural adaptations to this important resource zone. Further sections examine the relationship between these features and other aspects of the model of human ecology.

Table 2. General aspects of the marine environment influencing human adaptation

1. Diversity of organisms
2. Long-term continuity of food sources high in protein
3. Short-term periodicity of food source.
4. Prey are hard to see.
5. The sea is fluid and in motion.
6. The sea is saline.
7. The sea is dangerous.
8. The sea is flat.
9. The sea is relatively featureless.
10. Removal from land based society.
11. Narrow margin with land (lineality).
12. Attractive for recreation and aesthetic reasons.
13. Relatively open to outside influence.

TECHNOLOGY The objective of this section is to examine constraints placed upon exploitation technology by the marine environmnnt. There will be no attempt to catalog the diverse technologies man has developed to take advantage of the sea's resources. Only general factors which characterize the technologies in most, if not all, maritime oriented societies will be examined here, and these features will be directly related to attributes of the marine environment discussed in the previous section and related to other aspects of maritime soc-

ieties in following sections.

In general, marine exploitation technologies are quite diverse. In terms of activity, they range from the basically passive collection of organisms from the natural margins of the sea or from fixed facilities such as traps, nets, or weirs to the active pursuit of large sea mammals with harpoons. In terms of size, they range from small hooks, harpoons, and basket traps to giant stone tidal weirs more than 1200 meters in length (cf. Nishimura 1975); from small one-man dugout canoes to large ocean-going vessels complete with processing equipment. With regard to spatial and temporal constraints, they range from a few hours collecting along the seashore, close to home to months at sea exploiting resources hundreds, or even thousands of miles distant. Finally, in manpower requirements they range from the solitary individual to hundreds of coordinated individuals. Despite this great diversity, the technologies must cope with certain general characteristics of the marine environment.

Turning first to the long-term continuous and short-term periodic nature of the productivity of marine organisms, it was argued above that long-term continuity results from the diversity of organisms in the sea. This diversity allows man to exploit a number of different organisms, indicating the need for a diversity of capture techniques and equipment. Most fishing societies, in fact, manifest a range of fishing techniques which permit them to exploit numerous species. The periodic nature with regard to the production and exploitation of some species necessitates variation in techniques at different times of the year as well as some sort of preservation (e.g. drying, smoking, fermenting, etc.) and storage techniques.

Various approaches are taken to overcome the difficulty of seeing marine organisms. For example, natural signs such as feeding birds are used, dogs

are trained to search-out seal breathing holes in the ice, detailed traditional knowledge of the behavior of marine organisms is passed down from generation to generation (cf. Morrill 1967), and finally, complex electronic devices such as sonar are used. Even when these various techniques are used, the location and capture of marine organisms is an uncertain matter; thus fishermen often mix their strategies to insure adequate catches (cf. Davenport 1960).

The fluid nature of the marine environment places important constraints on technology (cf. Poggie and Gersuny 1974; Hewes 1948). Man needs air to live and work, thus he must either stay above the water, somehow obtain air beneath the water, or remain in the water for only short periods of time. Vessels of various kinds from hand-powered dugout canoes and rafts to huge metal ships with diesel engines and sometimes platforms on stilts keep him above the water. Aqualungs and diving bells permit man to work beneath water but only for limited periods of time. All these technologies have one thing in common--the work space is limited and surrounded by a life threatening medium, enhancing man's removal from land-based society.

The continual motion of the sea requires a technology to keep things from being swept away (cf. Hewes 1948). Boats must be brought onshore or anchored far enough off-shore that they not be damaged by wave motion. Unloading in the latter case requires docking facilities or small load transferring boats. The salinity of the sea makes it extremely corrosive for many building materials; thus vessels, platforms, and docking facilities must be carefully maintained and built of anti-corrosive material whenever possible. Further, man cannot drink sea water, so fresh water must be provided on long voyages from storage or distilling facilities. Inadequacies of any of these technologies result in danger for man, thus they must be designed and maintained for safety.

The flat, featureless nature of the sea has resulted in the development of various techniques for location of either desired landings or fishing areas. Some are based on the use of triangulation from landmarks, thus confining fishermen to areas of the sea within sight of shore (cf. Prins 1965; Forman 1970). Some use complex combinations of astronomical navigation, currents, swells, birds, etc. (cf. Lewis 1972) permitting movement into the open ocean. Finally, others use modern electronic navigation aids. These are all relatively complex techniques, especially the latter two, requiring a fair amount of knowledge for safe and effective use.

Many of the above noted aspects of the marine environment result in a relative removal of seamen from land based society. This removal is enhanced by the smallness of the platform man takes to sea and the life-threatening nature of the fluid environment which surrounds him. This relative removal has resulted in the development of emergency procedures (e.g. life boats, life vests, etc.), sea to shore and boat to boat communication devices, as well as techniques for preserving provisions and the catch until they can be eaten or brought to shore.

The features discussed above concerning man's technological adaptation to the marine environment are quite obvious. Anyone who has had some contact with the sea has knowledge of them. Nevertheless, they are reviewed here in an attempt to prepare the background for a discussion of the interrelationships between these environmental and technological attributes and various aspects of man's sociocultural system. These technological attributes along with their environmental correlates are presented in Figure 3.

MARINE ENVIRONMENT		TECHNOLOGY
diversity of organisms long-term continuity short-term periodicity	→	diversity of capture techniques need for preservation and storage
prey hard to see	→	development of location techniques
sea fluid and in motion	→	vessels, platforms, diving devices anchoring techniques
salinity	→	provision of fresh water at sea preventative maintenance procedures, anti-corrosive materials
danger	→	maintenance and design for safety
flat/featureless	→	navigation techniques
removal from land-based society	→	emergency procedures communication devices food and catch preservation

Figure 3. Relationships between marine environment and technology.

THE SOCIAL ENVIRONMENT The social environment of a society is defined as including demographic characteristics such as population size, density, sex ratio, and distribution, as well as a consideration of populations within interaction range.

Turning first to the long-term continuous productivity of the marine environment, we find that fishing economies usually have a potential for supporting relatively large, sedentary populations in comparison to other hunting and gathering societies. For example, archeological evidence indicates that after early Peruvian hunters and gatherers turned to the sea, there was a radical increase in population (Moseley 1975). Chard (1974) writes that increasing sea-levels, which maximized during the early Jomon (7000-6000BP) in Japan,

resulted in a more irregular coast, with longer linear dimensions and an increase in shallow water. This combination of factors increased the potential for coast dwellers to exploit the sea's resources and promoted a marked increase in population and settlement size. Beals and Hester (1974) note that southern California was one of the most heavily populated sections of native North America, and that the coastal strip, inhabited by the Chumash Indians, was the most densely settled section. The relatively large and dense population of the Indians of the Northwest Coast of America has been commented on by several authors (cf. Kroeber 1963; Driver 1961; Drucker 1955). Even in the relatively inhospitable arctic, maritime adaptations seem to permit relatively large populations (cf. McCartney 1975, Dumond 1975; Fitzhugh 1972). In summarizing the evidence for Arctic areas, Fitzhugh (1975a) notes that an increase in the size of settlements and regional population seems to be related to the intensification of maritime adaptations. Diamond (1969) suggests that Ku'n Shen, Taiwan, because it is a fishing village, can support several times the population found in farming villages. Further evidence is provided by Kroeber's (1963) discussion of native population density in North America. Overall he finds the densest populations in coastal areas. The density is even more marked when it is calculated on the basis of shore-line miles which provide a more accurate estimate of population densities for maritime oriented communities (Kroeber 1963:168). The tendency for maritime oriented communities to be more sedentary than other hunters and gatherers has been noted in archeological evidence from the Aleutians (McCartney 1975), Alaska (Dumond 1975), Labrador (Fitzhugh 1972) Peru (Moseley 1975), and Japan (Chard 1974). Lenski and Lenski (1974) note that 49 percent of the fishing societies live in permanent settlements as contrasted with only 10 percent of other hunting and gathering societies. In sum, there is ample

evidence to indicate that the long-term continuous productivity of the marine environment has provided man with a resource base which in many cases facilitates both population growth and the establishment of permanent settlements. It was not until plants and animals were domesticated that land-based subsistence activities could support such dense, sedentary populations.

Although we have emphasized the long-term continuous production of organisms in the marine environment, it should be noted that there are local variations with respect to both the periodicity and relative availability of desired flora and fauna. Periodicity and differential availability of various organisms have influenced several behavioral responses which are manifested in the social environment. For example, periodicity in the availability of desired species has led in some cases to annual movements between seashore and interior settlements in both arctic and tropical regions (e.g. Fitzhugh 1975b, Sarhar 1974). In some instances fishermen live on their boats and follow the fish, as among the boat dwelling Bajau of the Sulu Archipelago (Nimo 1972), and in others, the fishermen shift residence to different parts of the coast as on the Azuero Peninsula of Panama (Pollnac and Ruiz-Stout 1975).

Differential distribution of marine resources has also led to elaborate trade and ritual exchange networks as illustrated by many Pacific Island populations (e.g. Malinowski 1961, Alkire 1965) and the Southern Kwakiutl of the Northwest Coast of America (Piddocke 1965). Maritime peoples also trade coastal resources such as shells (cf. Paulsen 1974), salt, and fish products with interior peoples. All of these exterior contacts form an important part of the social environment--ideas as well as scarce goods are exchanged.

Variability in the resource base may also result in greater power or status being allocated to communities in favorable locations. Intercommunity power

and status relationships are important aspects of the social environment because they may explain how communities influence each other. Donald and Mitchell (1975) found strong and statistically significant relationships between size of salmon run, variation in salmon run, population, and local group rank among the Southern Kwakuitl of the Northwest Coast of North America-- the larger the salmon run, the greater the population, and the higher the local group rank.

The dangerous aspects of the marine environment may also affect certain demographic characteristics. Poggie and Gersuny (1974) note that the commercial fishermen of the United States record more fatalities per million man-days than coal mining, the most dangerous of land occupations. Since males do practically all of the dangerous deep-sea fishing in most societies, one would expect an imbalance in the sex ratio in maritime communities unless other factors operate to lower the population of females. Some evidence for such an imbalance in the sex ratio is provided by Firth (1966) who notes that among the Malay fishermen, overseas voyaging has reduced the proportion of males in the population: of the 69 recorded male deaths in the area where he conducted his research, 23 resulted from accidents during sea voyages. Ohnuki-Tierney (1976) provides further support by noting that the high mortality rate of Ainu men during hunting and fishing is among the factors contributing to a shortage of men.

Settlement patterns are also influenced by various aspects of the marine environment. We have discussed above the relationship between the long-term continuous nature of production and settlement stability. The relationship between short-term periodicity and migration was also noted. In addition, the margins of the sea are often agriculturally unproductive; thus, maritime oriented people who also practice subsistence agriculture must make a decision as to whether they will live inland and travel to the sea to fish, or live along

the shore and keep their gardens inland. Those who choose to live by the shore often occupy narrow, lineal strips backed by lagoons and swamps, thus increasing the probability of unacceptable levels of population density as population growth occurs. Population pressure in such a narrow zone would result in a splitting-off and radiation of population units into like habitats. Maddox (1975) discusses such a process for a riverine adapted people which should be applicable to the thin strip of the littoral zone. Sahlins (1962) notes that fishermen communities on Moala in the Fiji Islands are located in bays and inlets along the shore far enough apart to permit effective production. Locations in bays and inlets are favorable because they provide some protection from the destructive effect of wave motion and permit easier landings. Some fishermen in densely populated areas live on their boats (cf. Anderson 1975). If the maritime society is located on an island, population pressure can increase rapidly, resulting in migration to other islands as has occurred many times in the South Pacific.

In many instances fishermen, like many other occupational subcultures, form societies unto themselves. Fishermen, however, are often residentially isolated as well because of their location along the narrow margins of the sea. This isolation is enhanced by their separation from land based society while at sea; hence, in many societies the larger land-based society treats fishermen as social outcasts. For example, in India fishermen are classified as untouchables (Norr 1972, 1975), in both China and Korea they are the object of considerable prejudice and oppression (Ward 1955; Anderson 1975; Brandt 1971), in Japan fishermen are ranked very low on the social scale (Norbeck 1954, 1968), and on the Horn of Africa the Somali leave the fishing to "...the midgan and other despised groups" (Murdock 1959;321). In cases such as these, the external

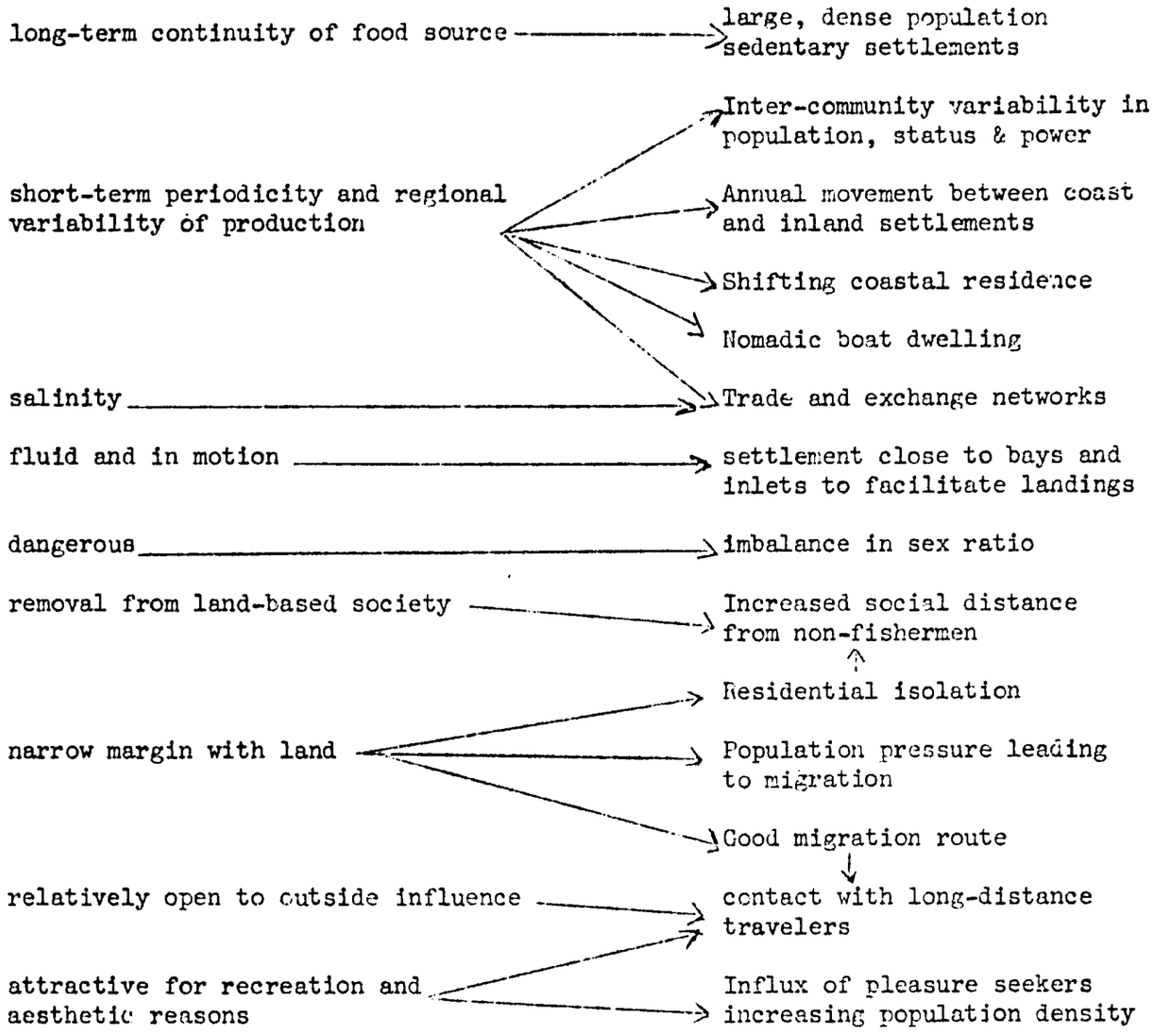

Figure 4. Relationship between physical and social environments in maritime communities

social environment is in a position perceived to be superior to the fisherman.

Finally, maritime societies are relatively open to contacts with long-distance travelers. Their shores are open to vessels from other maritime societies, the narrow margins of land and sea form perfect migration routes (cf. Hewes 1948; Sauer 1963), and the attractiveness of the marine environment attracts tourists and other individuals who simply want to enjoy the sea. Sometimes such pleasure seekers increase population pressure in the littoral zone when they begin to build residences and other facilities.

In sum, the relationship between the physical and social environments in maritime communities is summarized in Figure 4. In the next section we will examine the interrelationships between the physical and social environments, technology, and the social organization of maritime communities.

SOCIAL ORGANIZATION The social organization of a community includes elements which govern human interaction in areas such as family life, production, distribution, property relationships, and status and role relationships. It includes consideration of institutions such as family, kinship, work, and social control groups. The discussion presented here will include consideration of the interaction between social organization and the physical, technological, and social environments of maritime communities.

Political organization and social stratification The first important feature of the marine environment that we will consider is the long-term continuous production of food sources high in animal protein. Earlier in the paper it was noted that this productivity can result in relatively large and dense populations as well as sedentary settlements. Relatively large, dense populations require more complex systems of political organization than small,

thinly scattered populations. This proposition is supported in the ethnographic literature which indicates that nearly 25 percent of the fishing societies are organized into multicommunity societies in contrast to less than ten percent of other hunters and gatherers (Lenski and Lenski 1974). Sedentary living also permits a greater accumulation of goods than a nomadic life. Accumulation of goods leads to the potential for some to accumulate more than others, leading to the development of social stratification. This generalization is supported by the observation that 32 percent of the fishing societies in the ethnographic atlas (Murdock 1967) have some sort of hereditary nobility in contrast to only two percent of other hunters and gatherers (Lenski and Lenski 1974). Sahlins (1958) notes that there is a direct link between environmental productivity, technological efficiency and degree of social stratification. He presents empirical evidence from Polynesia which indicates that when other factors are held constant, the degree of social stratification varies directly with productivity. Knudson (1970) reports a similar relationship for a number of Micronesian coral islands.

Despite the fact that fishing societies manifest more advanced forms of political organization that other hunters and gatherers, their level of political integration is usually less than that of farmers and pastoralists. The political integration of societies within which fishing is the dominant subsistence activity is characterized by politically independent local groups not exceeding 1,500 in average population. The autonomous local communities are proportionately more common in dominant fishing societies than in other types of societies (62) percent versus 38 percent respectively). In keeping with this low level of political integration, there is a strong tendency for codified laws to be unimportant or absent (phi = .34, p = .025) and individual rights in real property or rules of inheritance to be absent

(phi = .17, p = .005) in dominant fishing societies as compared to other societal types (Pollnac 1974b). Lenski and Lenski (1974) attribute this low level of political integration to the fact that consolidation of fishing communities into larger political entities is inhibited by the fact that they are usually strung out along thin coastal strips. Archeological evidence suggests that higher levels of political integration were achieved only after coastal populations moved inland and focused on farming (cf. Moseley 1975; Coe and Flannery 1967).

In sum the relatively large, dense, sedentary population units of fishing societies have led to the development of forms of political organization more complex than found among other hunters and gatherers. Nevertheless, large multicommunity forms of political integration have been inhibited by the dispersed nature of fishing communities.

Occupational specialization, division of labor by sex, and social stratification Another feature of the marine environment related to aspects of social organization is the diversity of marine organisms. This diversity has led to the development of technologies manifesting a diversity of capture techniques. Additionally, as noted above, other features of the marine environment have led to the development of complex technologies (see Figure 3). Such complex technologies often lead to the development of occupational specialization to a degree that is usually absent in simple horticultural and hunting and gathering societies. For example, boat building specialists exist in West and East Africa (e.g. Quinn 1971; Prins 1965), Oceania (e.g. Sahlins 1958; Hogbin 1964; Burrows and Spiro 1953; Sahlins 1962), the Caribbean (e.g. Davenport 1956), South East Asia (e.g. Firth 1966), and South America (e.g. Forman 1970). As a matter of fact, there are very few fishing societies within which fishermen make their own boats. In Oceania where traditional navigation systems are highly developed,

some individuals specialize as navigators (cf. Lewis 1972; T. Gladwin 1970; Burrows and Spiro 1953). Comparing the degree of occupational specialization among farmers and fishermen in Tikopia, Firth (1965) finds that there is no specialization associated with the relatively simple farming techniques, but that there is a marked degree of occupational specialization associated with fishing, especially deep sea fishing. He attributes this specialization to the complexity of the technology.

The long-term continuous production of the marine environment also contributes to occupational specialization. If the resource base is productive enough to provide for the needs of the community with only a portion of the work force involved in subsistence activities, then non-fishermen can specialize in other activities. The archeological record provides evidence of the development of occupational specialists concurrent with a shift from general hunting and gathering to a focus on maritime adaptations in several regions of the world (cf. Simonsen 1975; Moseley 1975; Chard 1974).

Occupational specialization is also related to other aspects of the marine environment: danger and the extent of removal from land-based society. In subsistence level and peasant societies women perform subsistence functions, but they are also expected to bear and care for children. Fishing, especially deep sea fishing from boats, is of such a nature that it is difficult to include less than fully active members in a crew. The size of most artisan fishing vessels and the degree of coordinated activity required in relatively cramped work areas simply will not allow it. Therefore women are usually confined to shoreline fishing activities where the work will not conflict with childcare duties. The ethnographic sample supports these generalizations concerning the division of labor by sex in fishing communities. With regard to societies in which fishing

is the dominant subsistence strategy, males do the fishing with negligible female participation in most cases (49 percent). In 28 percent of these societies both sexes participate with males conducting most of the activity. Males and females contribute equally in 8 percent and females contribute most in only 3 percent. 10 percent of the dominant fishing societies manifest a division of labor in which males do the major fishing and/or marine hunting while females conduct minor shore or reef fishing and/or shell fishing. Data were unavailable for 5 percent of these societies.

In societies where fishing is codominant with some other subsistence activity, 39 percent manifest the pattern where the males do the major fishing and/or marine hunting while females conduct minor shore or reef fishing and/or collect shellfish. In 33 percent of the codominant societies males fish with negligible female participation. Both sexes participate with males predominating in 18 percent of the societies and both sexes contributing equally in only 3 percent. Data was unavailable for 6 percent of the codominant societies.

Overall, males conduct most of the fishing activity in the societies in the ethnographic sample. Of the 330 societies for which data concerning the division of labor in fishing is available, both sexes participate equally in only 10 percent of the cases and female participation predominates only 5 percent (Pollnac 1974b).

Numerous ethnographies provide interesting descriptions of the division of labor by sex in fishing communities around the world. One interesting feature which is frequently found is that females often provide marketing services (cf. Norr 1972, H. Gladwin 1970, Forman 1970, Aronoff 1967, Fraser 1966, Glacken 1955). Sometimes this functions to keep at least some of the profits within the family--the men fish and their female relatives act as middlemen

(cf. Forman 1970). Norr (1972) has suggested that this separate economic role combined with the physical absence of men should lead to increased independence for females in fishing communities. Norr (1972) reports that women in fishing villages in South India are relatively more independent and free than women in farming villages. She attributes this to their economic activities in the market place where they sell fish, rice beer, weave nets, etc. Women also appear to manifest more independence in fishing villages in West Africa (H. Gladwin 1970), Japan (Norbeck 1954), and Taiwan (Diamond 1969).

Occupational specialization is also related to other aspects of social organization. Occupational specialists often have differential access to resources, thus suggesting that in some instances occupational specialization will be related to social stratification. Sahlins (1958) has demonstrated that in general, social stratification is positively related to the degree of occupational specialization in Polynesia. Davenport (1956) found the same relationship in Jamaica.

In sum, we find that the long term continuous productive nature and diversity of organisms in the marine environment both contribute to occupational specialization in maritime communities. Additionally, all aspects of the marine environment which result in the complexity of exploitative technology contribute to the need for occupational specialists. Isolation from land-based society and the dangerous nature of the marine environment have resulted in a division of labor based on sex because of childcare requirements. Finally, we noted that occupational specialization can be related to another aspect of social organization--social stratification.

<u>Share system of distribution, reciprocal exchange, extended kin ties, and occupational specialization</u> Turning next to the short-term periodicity of

food resources in the marine environment, we find that it affects several elements of social organization. Perhaps most obvious is the effect that it has on the distribution system. In nearly all artisanal fishing societies where fishing is conducted from small boats, the catch is divided up into as many shares as there are crewmen (usually three or four) plus one or more for the boat and other equipment (cf. Forman 1970:82-88, Glacken 1955:167; Quinn 1971: 106). As the cost of capital equipment and its maintenance increases, the equipment share usually increases also (cf. Sabella 1974:221, 223). Additionally, where fishing technology is complex enough to require specialists in the crew, some specialists receive larger shares of the catch than others (cf. Glacken 1955:167; Prins 1965:166). The important point about the share system is that it is functional in the maritime environment where resource availability can fluctuate widely on a short-term basis. If capital equipment owners were to pay their fishermen fixed wages, they could suffer financial ruin in periods when fishing is bad (Forman 1970). Another element of the marine environment related to the share system is the relative removal from land-based society of fishermen who fish from boats. Here, especially in situations where the owner does not fish, the share system serves to maintain the incentive of an unsupervised crew (Forman 1970). Further, Norr and Norr (1974) have suggested that the division of the proceeds into approximately equal shares for all workers emphasizes the cooperative nature of marine fishing.

Periodicity also affects catch distribution by necessitating the development of kin- and friendship-linked reciprocal exchange networks. If a boat does not catch any fish or if a man is too sick to fish, he can usually depend on others to provide him with subsistence needs. In many societies, women and children of men who did not fish on a given day will be at the beach to help unload a return-

ing vessel. They are always given some fish for their often unnecessary help. For example, Mfantese fishermen of Ghana "... say that it is useful to have someone else carry the fish because it spreads out some of the work and profit of fishing..." (H. Gladwin 1970:39). In many other societies there is no need to perform even token labor to acquire a share of the catch. For example, among the Miskito Indians of Nicaragua a turtle fisherman will distribute quite a bit of a large turtle to reduce his portion to a level which is socially acceptable. He gives meat to those in reciprocal exchange relationships with him who could or did not acquire meat of their own that day (Nietschmann 1973).

Turning to the regional variability in production of the marine environment, we can see, on the basis of the previous discussion, how it can be related to the distribution of goods. We have noted that periodicity and regional variability result in the need for either exchange networks or shifting residence. Sahlins (1958) provides a clear description of how maintenance of kinship ties is an adaptation to the economic necessity of cooperation in situations where there is differential distribution of resources. He presents empirical evidence from Polynesia relating the permanence of relationships between segmented kinship groups to the need to exploit diverse, widely spread resource areas. He notes that where segmented kinship groups inhabit homogeneous resource areas, kin ties are less likely to be maintained.

Regional variability in production also results in variability in distance to fishing grounds which is related to elements of social organization through technology which acts as a mediating variable. In a comparison of two fishing villages in Jamaica, Davenport (1956) shows how increased distance to fishing grounds results in the need for larger vessels of a more complex type. This results in a greater need for specialization of labor in building the vessels;

thus increasing the costs and increasing the capital necessary for independent fishing. Overall, increased distance to fishing spots resulted in greater specialization in the fishing industry with its attendant increase in social stratification as was discussed above. The higher costs of the equipment also resulted in a clearer distinction between owners and workers.

In sum, the share system of catch distribution within fishing groups appears to be a functional adaptation to both the short-term periodic nature of marine resources and the lack of supervision in an operation well-removed from land-based society. We have also seen that periodicity and regional variability in production results in the need to establish reciprocal exchange ties to ensure survival of both individuals and groups momentarily lacking resources. It was indicated that extensive kinship ties are often maintained to facilitate such exchange. Finally, it is argued that regional variation in production can lead to differential distance to resources which can result in the need for more complex technology with attendant occupational specialization and increased social stratification.

Equipment ownership, social stratification, and occupational mobility

As discussed above, constraints of the marine environment result in the need for relatively complex technologies to effectively exploit available resources. The construction of fishing equipment, especially boats and large nets, is usually expensive in terms of material, labor, and knowledge. Thus patterns of ownership of the means of production is an important element of social organization which is related to the relative complexity of required technology, which is, in turn, related to constraints of the marine environment.

Focussing the discussion on boat ownership, we find individual fisherman owners (e.g. Firth 1966; Kottak 1966) and non-fisherman owners (e.g. Forman

1970). In some cases several members of a crew will cooperatively own a large boat (cf. Fraser 1960). In other cases large, sea-going canoes are owned by lineage heads (cf. Firth 1965) or lineage members in common (cf. Lessa 1966). In general, the larger and more complex the technology, the more likely it will be owned by non- fishing entrepreneurs (e.g. middlemen, local elites, etc. cf. Forman 1970) or groups of individuals (e.g. kin groups; cf. Nason 1975).

Kottak (1966) provides a good discussion of how the relatively simple technology of the fishermen of Arembepe, Brazil provides relatively equal opportunities for all fishermen to own capital equipment and thus results in a relatively egalitarian community. He notes that the cost of the technology is approximately equal to the average annual earnings of fishermen in the community; thus the opportunity to buy a boat is theoretically open to all fishermen. He points out, however, that other mechanisms operate to prevent the development of social stratification resulting from income variance between successful versus non-successful fishermen. These mechanisms include the reciprocal exchange networks discussed above as well as annual festivals which demand more resources from the more wealthy; thus, leveling out the distribution of wealth. He also notes that the relatively short lifespan of plank boats inhibits transgeneration transfer of ownership differentials through inheritance.

When environmental constraints require relatively complex equipment and the ownership pattern is individual entrepreneurship rather than cooperative kinship or work groups, there is great potential for increasing social stratification as was discussed above (cf. Davenport 1956; Forman 1970; Norr and Norr 1974).

Several scholars have made important observations concerning differences between ownership of the means of production in farming and fishing communities. Firth (1966) notes that land ownership has a permanency not associated with fish-

ing equipment. The ceasless motion and fluidity of the marine environment in combination with sudden, violent storms at sea make fishing equipment especially liable to sudden damage and loss. Norr and Norr (1974) argue that the rapid depreciation of fishing equipment in combination with occasional losses result in higher rates of occupational mobility in fishing than in farming. They suggest that this results in smaller social and economic distance between owners and laborers in fishing.

In sum, we have noted the interrelationships between the physical constraints of the marine environment, complexity of equipment, equipment costs, and type of ownership. As equipment costs increase, the likelihood of individual fisherman ownership decreases, thus promoting the development of social stratification. In most instances, however, differences between owners and workers in small-scale fishing communities are minimized by the relatively low cost and impermanence of capital equipment which is subject to sudden loss or damage. These factors enhance the possibility for occupational mobility among small-scale fishermen.

Workgroups, egalitarianism, male society Discussions of equipment ownership lead naturally into a consideration of boat crew composition. In comparing Thai fishermen and farmers, Foster (1975) notes that in contrast to farming groups the size of fishing groups is rigidly determined by technology. This is obviously related to the limited space on a vessel. Further, Norr and Norr (1974) note that ocean fishing demands much more reliance on reciprocal interdependence and coordination of crewmen than agriculture. Pulling a net, launching a boat through a heavy surf, and responding to the ever changing nature of the sea requires a high degree of skillful coordination among a compatible workgroup. Thus, technological constraints limit the size of the workgroup and environmental and technological constraints select for worker efficiency. It appears, there-

fore, that crew composition should be flexible and not based on prescribed social criteria such as kinship relations.

Among many groups, however, crews consist primarily of kin (Sabella 1974; Andersen and Wadel 1972; Blehr 1963). This probably functions to keep profits within the family, but it is important to note that crews consist primarily but not exclusively of kinsmen. In other cases crews consist primarily of friends (e.g. H. Gladwin 1970; Diamond 1969), but H. Gladwin (1970) notes that among the Mfante, boat crews with family cores are more stable than non-kin linked crews. One author explicitly stated that crews on Okinawa could not contain kinsmen (Glacken 1955). The rational provided was that if a boat were lost, the family would perhaps loose both the father and his successor. An unusual form of work group organization for small scale fishermen is found on Isla de Margarita, Venezuela. There, fishermen are rural wage earners organized into rancherias. Rancherias are fishing camps wherein the fishing equipment is privately owned by one or several individuals (Orona 1968). These rancherias appear to be a seaward extention of the plantation system, an unusual but noteworthy form of workgroup organization among small-scale fishermen.

Norr and Norr (1974) have suggested that the need for coordination within fishing crews and the physical risks associated with the marine environment increase both the need for interdependence and the importance of each worker. This, in combination with the rapid depreciation of equipment and the possibility of equipment loss, decreases the social and economic distance between owners and laborers. Hence, they argue that work relationships in fishing crews should be more egalitarian than among farmers. Their data and the ethnographic literature supports this proposition. For example, Norr (1972) reports that few distinctions are made within workgroups among fishermen of South India; that the

owner does not direct work--he participates as an equal. Burrows and Spiro (1953) comment on the egalitarian nature of fishing workgroups in Ifaluk, and contrast this with the general rank consciousness of Ifaluk society. On Taiwan, Diamond (1969) notes that friendship characterizes the relationships between crew members. T. Gladwin (1970) reports that although the navigator is in command of the vessel on Puluwat, he is not aloof--he pays attention to the suggestions of crew members and imparts a sense of egalitarianism. At Arembepe, Brazil, Kottak (1966) writes that the captain works like all the other crew members. When the fishing begins he is the same as the crew. Knudson (1970) stresses the fact that the exploitation of terrestrial resources is an individual act in Micronesia while marine resources are exploited by cooperative groups. The same general relationship hold in Nicaragua among Miskito turtle fishermen. There, land hunting partnerships are loose in contrast to the close cooperation demanded between turtle fishermen. Turtle men must have partners they can rely on; thus, partnerships form around each individual's skill, reliability, and temperament (Nietschmann 1973). The need for cooperation in trap fishing among the Matupit of New Britain is given structural expression in groups known as <u>motoni</u> which are associated with particular areas of beach used for fishing related activities (Epstein 1969). On Saint Kitts in the Caribbean, Aronoff (1967) notes that fishing crews are integrated and cooperative with little stratification in comparison to cane cutter groups. He notes that fishermen are likely to view their captain as helpful and nurturant in contrast to cane cutters who view the head cutter in a negative manner, suggesting that he takes advantage of the men. Firth (1966) reports that among Malay fishermen the crew leader shows a readiness to consult the crew on matters of policy. Mfantese fishermen of Ghana believe that harmony in the boat is essential to safety at sea (Quinn

1971). Sabella (1974) writes that cooperation is so necessary among the fishermen of Caleta San Pablo, Peru that arguments stop short of the beach. He further notes that crews are very egalitarian-- even the captain performs the same work as the crew. Finally, Brandt (1971) comments on the egalitarian nature of interaction aboard fishing vessels in Korea.

The egalitarian nature of artisanal fishermen workgroups was commented on in detail because of the important function of workgroup organization as an element of social organization. Workgroup organization is so important that when fishing people form part of a society that has a strong system of social stratification, ocean fishing is organized as the occupation of a low status, caste-like group (e.g. as in Japan and India). Norr and Norr (1974) suggest that this caste-like separation of fishermen functions to insulate the larger society from these potentially threatening egalitarian relationships.

Additionally, workgroup organization is often related to shore-side social organization. In many societies crew leaders (e.g. navigators in Polynesia, captains, etc.) also enjoy a leadership role ashore (cf. Davenport 1956; T. Gladwin 1970). Further, the friendships which often develop between crew members can form the basis for non-fishing groups. Fraser (1960) reports that among Malay fishermen of South Thailand, boat groups are very durable and frequently serve as the foundation for other social and economic groups.

The division of labor by sex in fishing leads to boat crews composed exclusively of men in practically every society around the world. The strong interdependence of these men on each other as they gain their subsistence in a dangerous environment frequently finds expression ashore in institutions reflecting male solidarity. For example, Brandt notes that much of the Korean fisherman's leisure time is spent in the company of other men. He writes that

"the company of fishermen is more exclusively a man's society than agriculture where women share much of the work" (1971:65).

In sum, constraints of the marine environment are related to both vessel size and technological complexity, both of which affect crew size and the recruitment of crew on the basis of skill. Many tasks onboard require close cooperation between fishermen; thus, workgroups tend to be egalitarian. Low costs of small scale fishing technology, the impermanent nature of fishing equipment, and the close cooperation required usually result in little social distinction between owner and laborer, thus enhancing the egalitarian nature of the workgroup. Finally, the division of labor by sex and the close interdependence ties between crew members often results in the formation of male groups ashore based on the maritime workgroup.

Sea tenure A very important element of social organization is control of natural resources. Land tenure is important among horticultural societies, and sea tenure is just as important among fishing societies. Nevertheless, this topic is rarely discussed with respect to small scale fishermen. Perhaps our legal definition of the sea as an open access resource has influenced the manner by which we view sea tenure in other societies. Additionally, the flat, relatively featureless nature of the sea and its broad expanse presents boundary marking problems not associated with land.

A review of the literature revealed several types of sea tenure operating in fishing communities. Least frequent was individual ownership. Suttles (1974) reports that among the Straits Salish of Western Washington, some shellfish beds and fishing areas were formally owned by important men in the community. Rights to this property were claimed through inheritance. Perhaps the most frequent form of sea tenure is communal ownership. For example, in Ulithi,

Micronesia, a canoe fishing in grounds belonging to another district was traditionally subject to seizure (Lessa 1966). Knudson (1970) suggests that in Micronesian coral islands, level of production influenced population growth, which, in turn, increased the societal level of territorial integration; finally, higher levels of territorial integration are related to degree of leader control over marine resources. In Polynesia, areas of ocean are corporate estates of groups of people, but title to the areas is associated with the group leader. Although all group members have use rights, the leader has the prerogative of administering use (Sahlins 1958). In South India, villages as a whole have rights to specific fishing grounds (Norr 1972). Norbeck (1954) notes that Japanese fishing waters are defined by prefectural law which usually conforms with traditional assignment of fishing waters. Among the Yoruk Indians of Northwest California, beach and seacoast rights were traditionally communal property (Beals and Hester 1974). Even in present day U.S. society where the sea is legally defined as an open access resource, Main lobstermen claim fishing rights to particular areas. The lobstering territories are associated with harbor gangs, and violation of territory has resulted in equipment destruction and other forms of violence (Acheson 1975).

In some areas where there is no formal recognition of sea tenure rights, fishing spots are kept secret. For example at Arembepe, Brazil the fishermen view the sea as an open access resource, but good fishing spots are kept secret (Kottak 1966). Forman (1970) reports a complex system of named fishing grounds and landmarks among the raft fishermen of Brazil. Location of the fishing grounds is made by visual triangulation and knowledge of fish within them is transmitted from father to son over the generations. Forman suggests that secrecy regarding spots acts as a spacing mechanism.

Finally, some societies claim that there is true open access to marine resources. Fishermen of Isla de Margarita, Venezuela report that any man fishes where he wishes (Orona 1968). Davenport (1956) suggests that although fishermen usually set their pots in the same area off Jamaica, there is no permanent tenure over sea areas. Finally, Firth (1965) notes that on Tikopia no fish resources are owned.

In sum, despite the difficulty of boundary maintenance in the sea, some societies do recognize rights over fishing grounds. Most commonly these rights seem to be communal.

Summary The complex interrelationships between the physical and social environments, technology, and social organization discussed in the previous section are illustrated in Figure 5. It is important to note that although our approach was to determine antecedents of social organization, elements of social organization can also affect other elements in the model. For example, we noted that larger, more complex technologies are often controlled by groups of individuals. It should be noted that as cooperative groups such as these develop (either kinship based or otherwise) they facilitate development of even larger and more complex technologies. For example, Nishimura (1975) notes that it would have been impossible to build the large stone tidal weirs found in Japan without the great amount of manpower brought together by royal command under the feudal system.

Overall, as we consider more elements of the model of human ecology, the systems of interrelationships become more and more complex. The complexity of these interrelationships indicate that changes in any subsystem might have broad repercussions throughout the system.

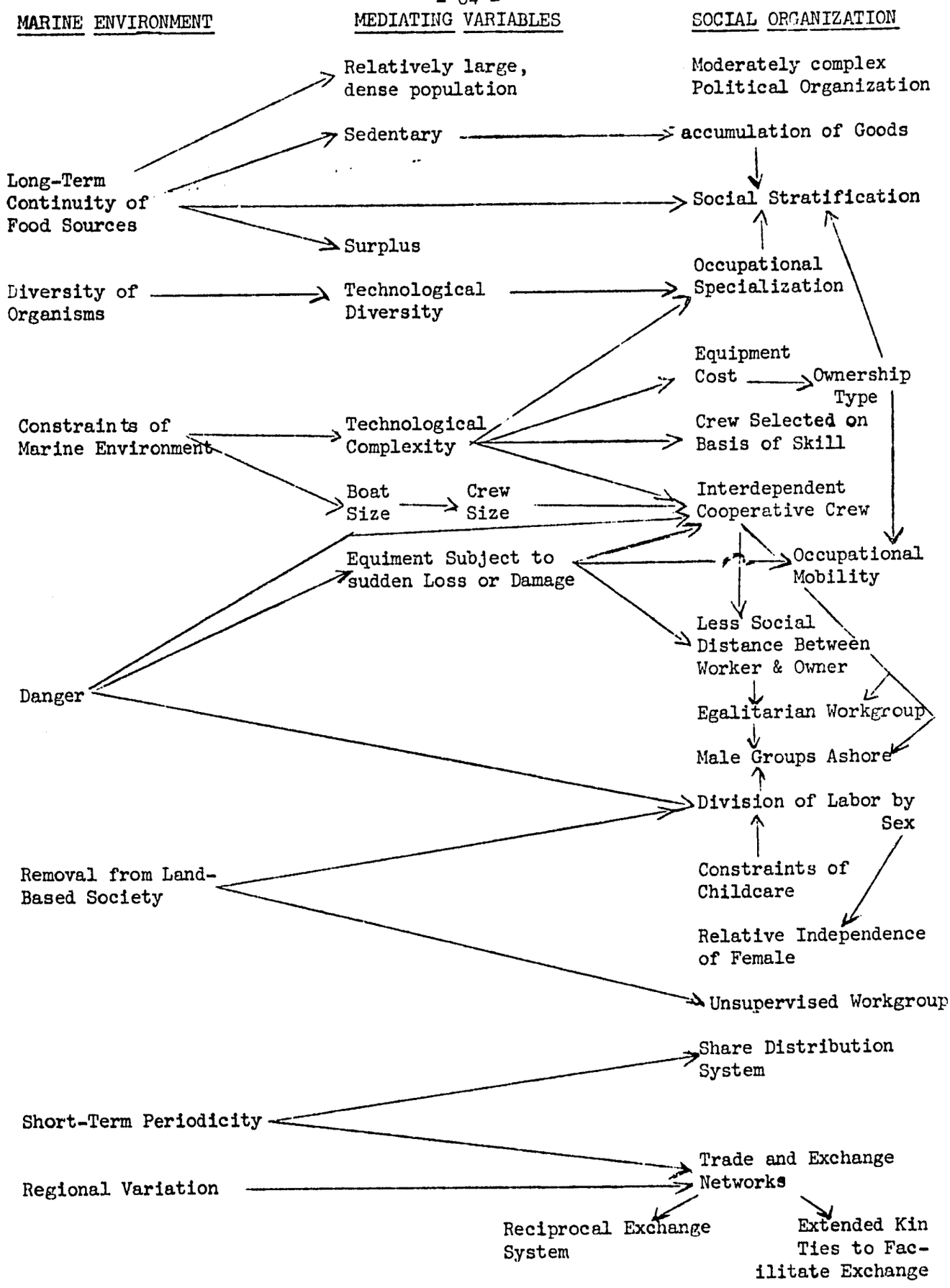

Figure 5. Relationships between marine environment, mediating variables, and social organization.

INDIVIDUAL BIOPSYCHOLOGICAL CHARACTERISTICS Particular aspects of the occupation and subsistence pattern of marine fishing allow one to make suggestions concerning psychological characteristics of individuals following this pursuit. Perhaps the most important aspect is the challenge and danger associated with braving the sea. Man faces alone, or with small groups of men, the perils of an environment he is ill adapted for. He must rely on his man-made vessel for support and protection from the sea and the creatures therein. The necessity of facing up to this dangerous and challenging environment probably selects for a certain type of personality configuration. This configuration would serve to psychologically adapt the individual to the situational requirements of the marine environment. It is therefore expected that fishermen will be relatively more active, aggressive, and courageous than individuals gaining subsistence from land based pursuits. For example, Poggie & Gersuny (1974) report that fishermen from Southern New England are adventurous, outdoor types in comparison with millworkers from the same region. Support for the claim that fishermen are more aggressive is provided by Aronoff (1967) who notes that a Saint Kitts fisherman is more likely than a cane cutter to take active response when mistreated by a crew leader. He also notes that aggression between males and females is more frequent among fishermen than cane cutters. Glacken (1955) notes that on Okinawa fishing villages use more "rough language" than farming villages. Use of rough language may be interpreted as an expression of aggressiveness. Abrahams (1974) writes that the fishing captain in Tobago must be brave to encourage his men. T. Gladwin (1970) reports that on Puluwat there is an heroic quality to sailing--the risks taken result in a zest and occasion heroes. He writes that fishermen often troll simply for the excitement of it, although it is less productive than other methods. The emotional appeal of

trolling was also noted on Ifaluk by Burrows and Spiro (1953). Panamanian small scale fishermen emphasize the sporting, pleasurable aspects of their occupation when asked what they like about fishing (Pollnac and Ruiz-Stout 1975). Forman (1970) points out that raft fishermen have become legendary heroes along the Brazilian coast with tales of their daring and courage told over the generations. Finally, Bernard (1972) comments on the folk heroic nature of successful sponge divers on Kalymnos, Greece. Overall, the literature supports the proposition that fishermen manifest the psychological characteristics of being active, aggressive, and courageous.

Despite the proposed psychological adaptation to the perilous nature of marine fishing, it is expected that the dangers involved will result in a certain amount of anxiety. The anxiety generated for concern with safety of person will coexist with anxiety concerning production (cf. Firth 1967; Cove 1973). Indirect evidence for the existence of this anxiety is manifested in ritual with regard to both domains. The relationship between anxiety and ritual will be discussed below in conjunction with our development of the ideological component of the model of human ecology. T. Gladwin has suggested, however, that psychological tests indicate a "... lack of clearly formulated concern over the self or the future..." which helps seafarers in the Truk area withstand anxieties generated by personal danger during long sea voyages (T. Gladwin 1958:897).

As noted above, fishermen meet the demands of their occupation alone or with small groups of men. The decisions they are forced to make in the face of uncertainty have immediate effects with respect to the safety of the vessel and its crew as well as the success of the hunt. These decisions must often be made with little hesitation because of the rapidly changing nature of the sea. It is thus expected that fishermen will exhibit tendencies toward independence

and self control. This expectation is partially supported by Poggie and Gersuny (1974) finding that fishermen are characterized as 'independent' types. Further, Pollnac and Ruiz-Stout (1975) note that fishermen often cite independence as an important characteristic of their work. Kottak (1966) reports that successful marine fishing at Arembepe, Brazil requires individualistic behavior. In South Thailand, the economic orientation of Malay fishermen stresses individualism (Fraser 1966). Harrison (1970) notes that among the Malay of South West Sarawak, fishing develops an independent discipline of mind. Finally, Caribbean fishermen from Saint Kitts emphasize independence and self reliance in statements concerning reasons why they chose to fish (Aronoff 1967). Overall, the literature appears to support our expectation that environmental and technical constraints of ocean fishing result in independent, self reliant fishermen.

An additional, significant facet of marine adaptations is that fishing from boats is conducted almost solely by males. Thus the relatively rigorous situational demands are met in the company of other males and tend to reinforce an image of "ideal masculinity" characterized by bravery, independence, and a capacity to endure hardship. This is probably associated with an emphasis on the distinction between the sexes resulting in a machismo complex among males which most feel compelled to live up to. T. Gladwin (1970) reports that drinking on Puluwat is almost exclusviely male activity and is viewed as an enhancement to masculinity. Bernard (1972:301) related bravery in sponge diving among Kalymnos divers to perceptions of the diver's virility. In general, the discussion provided above concerning the importance of bravery and courage among fishermen can be used to support our suggestion that in many instances the constraints of the marine environment result in a machismo complex among fishermen.

Several other authors present alternative explanations of the machismo complex among fishermen who stay at sea for extended periods of time. Andersen and Wadel (1972) suggest that in societies where men spend long periods of time at sea, the women control the household. When men are at home they react to this female control by masculine displays which reinforce their self-perception of being in control. They also suggest that the long period of time spent at sea without females is conducive to homosexual behavior. The fisherman's hyper-masculine display is, in this case, considered a reaction against homosexual activity. Finally, Tiller (1958) suggests that characteristics of child rearing in maritime families where there is prolonged father absence is related to the display of compensatory masculine traits. He suggests that father absence results in over protection by the mother and the development of feminine traits and cross-sex identity problems in sailor's male children. Tiller suggests that feminine identity in male children would probably be hidden by the presence of compensatory masculine traits. In sum, several authors have concerned themselves with masculine display behaviour among fishermen, and their explanations range from work group experiences to child rearing practices.

As was discussed above under social organization, individual fishermen in work groups manifest a great deal of interdependence and cooperation. It is therefore expected that the demands of a fishermen's work group would select for cooperative individuals. This proposition is supported by Aronoff (1967) who reports that fishermen are more positive toward others and more likely to feel cooperative than cane cutters.

Another feature of the occupation or subsistence pattern of fishing which may influence psychological orientation is periodicity of income. Size of catch is both difficult to predict and highly periodic. In contrast to many salaried

occupations, the fisherman cannot count on an even flow of earnings. This context of relatively high periodicity necessitates skillful management of production. Further, the need for continual preventative maintenance of fishing equipment to counteract the destructive nature of the sea also requires thinking ahead. Thus, the fisherman must have a future temporal perspective if he is to succeed. This hypothesis is supported by Pollnac, Gersuny, and Poggie (1975) and Pollnac and Poggie (1976) who report that fishermen from Southern New England and Puerto Rico defer economic gratification to a greater extent than millworkers and cane cutters from the same regions. Further, Poggie, Bartee, and Pollnac (1976) have demonstrated that a deferred orientation is a strong predictor of success among Puerto Rican Fishermen. Additional support is provided by their finding that millworkers tend to perceive that they have less control over their future than fishermen.

In sum, aspects of the occupation and subsistence pattern of capture fishing are expected to influence the psychological orientations of fishermen. It is suggested that fishermen are active, courageous, aggressive, macho, independent yet cooperative, future oriented individuals who manifest both a high degree of self control and a concern with death. This suggestion is supported in part by both the literature cited above and commonly held stereotypes of fishermen. It is interesting to note that the raft fishermen of Brazil "...claim they would not be agriculturalists under any circumstances because their personalities simply will not allow it" (Forman 1970.23).

The marine environment places demands on the fisherman's body as well as his mind. Dragging a boat through a heavy surf or pulling a net or long line require a certain amount of physical strength. Fraser (1960) notes that among Malay fishermen of South Thailand, men past sixty can still plough but do not have the

strength or inclination to fish. Kottak (1966) suggests that older men at Arambepe limit regular fishing trips due to increased physical infirmities which prevent maximal exertion. Finally, Quinn (1971) notes a tendency among Mfantese fishermen to leave fishing when they get older to retire or practice some less demanding occupation.

Among some fishermen a fair amount of visual acuity is required to locate fishing spots through triangulation. Both Davenport (1956) and Forman (1970) cite instances of failing vision resulting in fishermen either retiring or turning to work as a crew member. Firth (1966) reports that aural acuity is important to Malay fishermen. He notes that one must be trained to discern and identify schools of fish by listening under water.

Perhaps the greatest physical demands are placed on divers. Bernard (1972) notes that in the past, Kalymnos sponge divers worked at depths of 30 to 70 meters without protective gear. This resulted in impaired vision and broken nasal and ear membranes among many fishermen. A new diving system was introduced using a face mask and air tube, but rapid ascents which increased productivity resulted in a great deal of paralysis and death from the bends. Nevertheless, there are reports in the literature which suggest that the human body does, to a certain extent, adapt to some of the stresses placed upon it by diving. It has been reported that divers among the Ama of Japan have larger lung capacities than non-divers. In addition, frequency of diving is positively correlated with thickness of sub-cutaneous fat layers which act as insulation against cold water (Rahn 1965).

In sum, adaptation to the marine environment places demands on both the fisherman's minds and bodies. The interrelationships between individual biopsychological characteristics and other elements of the model of human ecology discussed thus far can be found in Figure 6.

IDEOLOGY The other components of the model of human ecology are codified, justified, and otherwise reflected in a societies ideology. In brief, an ideology is a belief system. There is an ideology, or belief system, associated with practically all aspects of the model of human ecology. An examination of them all would serve no purpose at the present time; hence, we will focus on only several salient aspects of man's ideological adaptation to the marine environment.

It was noted above that uncertainties with respect to both protection of person and production create anxiety among fishermen. As a means of reducing this anxiety, fishermen practice a great deal of ritual behaviour. In general, the more uncertainty associated with the activity, the more complex the ritual involved. For example, Malinowski (1948) notes that among the Trobriand Islanders there is no magic associated with safe and sure lagoon fishing, but extensive magical ritual is practiced to insure safety and good results in the less predictable, more dangerous open sea. On Ifaluk, Burrows and Spiro (1953) found no ritual associated with gardening in contrast to an extensive amount of magic associated with ocean voyages and canoe construction. Lessa (1966) reports that on Ulithi long voyages are associated with extensive magic while short sea voyages have no magic. Additionally, he notes that there is no ritual associated with shell fish collecting, but there is elaborate magic to aid in pelagic fishing. Firth (1967) notes that when the spear or bow and arrow are used for fishing on Tikopia there is no ritual-- the prey can be seen before the strike, and there is an immediate relation between action and result. Ritual is, however, associated with other fishing procedures where the fish are not continually visible. In Kenya, the most uncertain ways of ocean fishing require the services of the highest level of ritual specialists (Prins 1965). Diamond (1969) notes that observances for gods and spirits connected with marine

fishing continue to the present in Taiwan. Watanabe (1972) reports that when swordfish were sought in the open sea, the Ainu became particularly concerned with ritual observances. Oto (1963) writes that Japanese fishermen bolster their luck through adherence to a large number of taboos and the practice of ritual magic. Price (1964) finds a relationship between degree of risk and extent of ritual among fishermen on Martinique. Finally, Poggie, Pollnac, and Gersuny (1976) report a significant relationship between degree of taboo behavior and the amount of risk involved in fishing in Southern New England. They find that age, education, and ethnicity have no effect on taboo behavior, while average number of days spent at sea per trip and not coming from a fishing family do, suggesting that the more days at sea the more risk, and that a fishing family origin culturally preadapts one to the marine environment, thus reducing anxiety. They conclude that the use of taboos functions to reduce anxiety in uncertain environments and thus serves as an adaptive mechanism.

Ritual can also serve as an ideological means of organizing work groups. For example, on Tikopia (Firth 1965) fishing ritual and associated beliefs act as a unifying factor to assemble personnel to perform work on sailing equipment. The ritual imperative also dictates the most appropriate time to overhaul boats. Among Malay fishermen (Firth 1966) a body of ritual acts and beliefs accompanies various stages of fishing and serves to organize both manpower and use of capital. Malinowski (1961) clearly shows how systems of magic and ritual tend to promote systematization of economic effort and further production among Trobriand Islanders.

Aspects of social organization related to maritime adaptations are also reflected in the ideology. For example, in some societies, the separation be-

tween the sexes is emphasized by the ritual proscription of certain classes of females (e.g. adolescent, menstruating, etc.) from certain stages of boat construction (Malinowski 1961), specific areas of the canoe (T. Gladwin 1970), or from boats altogether (Poggie and Gersuny 1974). On Ulithi, men are not supposed to have contact with women for extended periods of time prior to conducting fishing magic (Lessa 1966). Burrows and Spiro (1953) report that Ifaluk fishermen must bathe to remove any body odor or perfume of wife or sweetheart before setting out on a fishing trip or sea voyage. Violations of sex taboos are believed to result in serious accident to fishermen. Finally, among the Matupit of New Britain the fishermen's area on the beach, storage sheds, and meeting houses are taboo to women (Epstein 1969).

Individual psychological characteristics which are adaptive to the marine environment will also form an integral part of the ideology. Active, courageous, aggressive, independent seamen facing up to the dangers of the sea and sometimes dying will be celebrated in song, poetry, and folklore (cf. Beck 1973). For example, in Brazil courageous raft fishermen have become legendary heroes (Forman 1970). Burrows and Spiro (1953) note that a fair proportion of the fishing songs collected on Ifaluk celebrate feats of bonito trolling. Examples from Euroamerican fishing songs are well known and too frequent to enumerate here.

In sum, the ideology of a society is a belief system which reflects most aspects of the model of human ecology. We have focussed on only a few important aspects of ideology in maritime societies to give some indication of the role it plays as a means of human adaptation to the marine environment. These relationships are depicted in Figure 7.

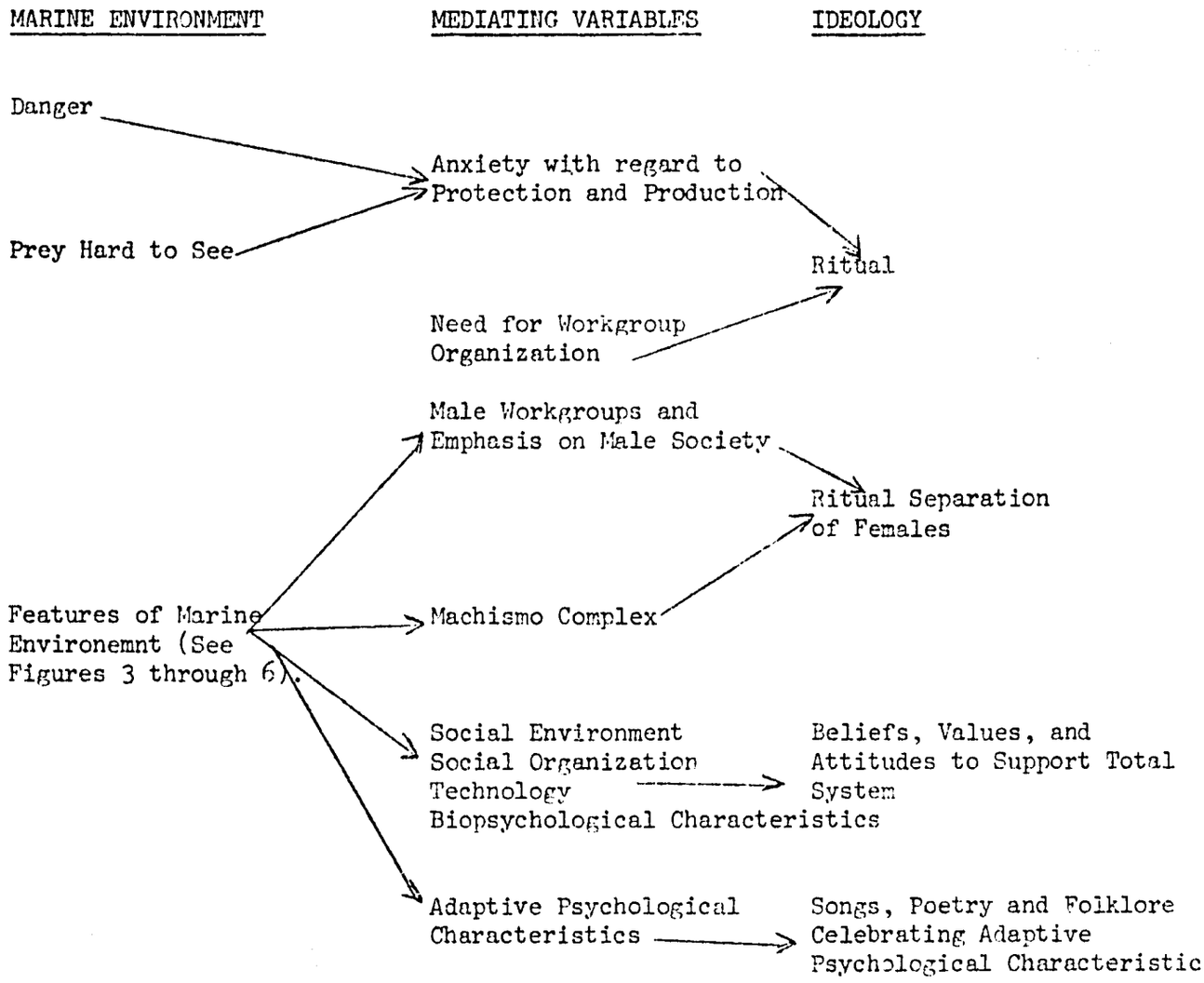

Figure 7. Relationship between marine environment, mediating variables, and Ideology.

CONTINUITY AND CHANGE IN MARINE ENVIRONMENTS

INTRODUCTION The complexity of the variables related to the successful transfer of innovations in combination with the intricate interrelationships between aspects of the marine environment as organized by the model of human ecology suggests that technoeconomic change in ocean fishing communities is a complex matter. As we have seen, many aspects of man's sociocultural and biopsychological adaptation to the marine environment are mediated by forms of technological adaptation. The purpose of this section is, therefore, to examine selected empirical cases which illustrate the psychocultural impact of change in fishing communities and relate these studies to the model of man's psychocultural adaptation to the marine environment.

TECHNOLOGICAL CHANGE, INDEPENDENCE, AND WORKGROUPS In earlier sections we discussed the independent nature of ocean fishermen, the close cooperation involved within workgroups and its relationship to other aspects of social organization. A study conducted by Fraser (1966) among Malay fishermen of South Thailand provides a good example of the impact technological change can have on workgroups and other aspects of the sociocultural system when the independent nature of fishermen is not taken into consideration.

Traditionally, the Malay fishermen of Rusembilan relied on oars and sail to take them to their fishing grounds. In 1956 groups of boat owners and steerers (traditionally a high status position in the boat crew) dominated deliberations concerning the best way to motorize the fleet. They decided to introduce tow boats to take fishing vessels to fishing areas and bring them back. Groups of boats would form tow-groups associated with a particular tow boat. This new technology immediately placed considerable strain on the traditional

social system.

First, membership in two-groups meant that individual boat crews and steerers lost their previous independence with regard to locating fish and timing return to market. Second, after a period of poor fishing, wives of members of the more skillful boat crews realized that they were subsidizing less successful crews since shares were based on the two-group's total catch. Fraser (1966) notes that this situation had broad repercussions in other areas of community life. It resulted in overt hostility between women, and relations between men became strained. The coffee shops, which were the focus for community decision making groups and associated with boat crews, manifested a marked drop in attendance, reflecting the social strains. Attendance at coffee shops never fully recovered. Further, traditional village authority figures, the orang baik (morally good man), were involved in ownership of the tows and their operation, thus, the chief source of authority and means of maintaining village control was undermined. Finally, because the religious leaders of the village remained aloof from the changes, their status increased.

Before long, the strains became too great, and the tow boats were eliminated. The reindividualization of fishing did much to restore good relations in Rusembilan. Nevertheless the degree of community organization which was based on boat crew membership and the traditional authority of the orang baik (whose traditional status depended on boat group affiliation) was never regained. Further, the introduction of nylon nets and individual motorized vessels reduced the need for a large crew, nevertheless, crews were kept larger than necessary. Fraser (1966) argues that this featherbedding plus decreasing catches undermined the sense of pride that traditionally characterized crews. This reduction of group solidarity negatively affected the relatively high status of the steerer and, hence, his status in the community at large.

This example from South Thailand does much to illustrate the value of a human ecological approach to the study of change in marine environments. Independence of fishing groups from one another is necessitated by the fact that there is regional variability and short term periodicity in catches. Boat crews must be independent to search for an elusive prey. They must also be independent because this variability leads to differences in catch rates, thus differential timing for returning to shore. The model of human ecology clearly

facilitates analysis of how strains developed in one element of social organization through the introduction of a new technology ramified into other elements creating further changes and strains which finally resulted in rejection of the new technique.

COOPERATIVE ORGANIZATIONS Many governments, international aid organizations, and individuals view the fishermen's cooperative as the ideal means of improving small-scale fisheries. In some cases marked success has been reported (F.A.O. 1971) and in others, failure. The idea of cooperation is not new to fishermen: a great deal of cooperation is necessary on a boat, and groups of fishermen, sometimes kinsmen, control capital equipment as we have seen above. Perhaps a consideration of continuity and change in a traditional form of cooperative organization will facilitate our understanding of more modern forms.

Nason (1975) presents an interesting example of changing cooperative groups which concerns interrelationships between the ideological, social organization, and technological components of the model of human ecology. In our discussion of equipment ownership in the previous section, it was noted that expensive equipment such as large sea-going canoes were traditionally owned by kinship groups. Nason (1975) reports that on Etal Island, a coral atoll in the Truk District, large sailing canoes were traditionally shared by membership in a named, matrilineal clan under a clan chief. Missionary activity, however, reduced the powers of the clan chiefs which were based on supernatural rights and obligations. Further, Christian ideology contained an emphasis on individual responsibility which was not a part of the traditional belief system. Finally, increased mobility associated with wage labor also emphasized individualistic pursuits. By the middle of the 1960's the individual was primary

property owner and resource producer.

How did all of this affect the technology? First, the large sailing canoe represents the peak of native technology. Its construction consumed nine to fourteen months of an experienced canoe builder's time; thus, it was more expensive than any other piece of movable property and out of the range of the individual consumer. Second, large sailing canoes need a number of men to launch, retrieve, and act as crew members. Hence, the emphasis on individualism and the decrease in importance of matrilineal clans resulted in a decrease in vessel size. Individuals did not have sufficient resources to construct and maintain the traditionally large vessel. Thus a change in ideology resulted in a change in social organization (a decrease in the importance of cooperative productive units) and a subsequent change in technology. What is interesting is that today, young men on Etal want to purchase motor boats. The motor boats are too expensive for individuals, so cooperative groups are forming again, but this time they are not based on kinship ties. We can probably expect a subsequent change in ideology to reflect this change in social organization; thus, we have come full circle through the ideological, social structure, and technological components of the model of human ecology, once again illustrating the importance of the interrelationships between various components.

Cooperative forms of social organization are thus related to other aspects of a sociocultural system, and their successes and failures can best be understood in terms of these relationships. For example, Davenport (1956) in a study of two Jamaican fishing communities notes that a fishermen's cooperative succeeded in one and failed in the other. He notes that the successful cooperative duplicated the basic social organization of the community--

natural interacting groups filled the roles in the cooperative. The cooperative that failed consisted of individuals who really did not understand the idea of a cooperative. The idea behind such an organization had not been properly communicated to them, and Davenport suggests that since the captains had the most to loose from the successful operation of the cooperative, they might have been motivated to keep such information from the fishermen. Davenport also notes that cooperative meetings, in the community where the organization failed, conveyed the moral tone of a church meeting and thus inhibited members from initiating interesting activities such as gambling around which a stable group could be organized. The problem of communicating the idea of a fishermen's cooperative has been emphasized by Pollnac and Ruiz-Stout (1976b) who found a great deal of variability in knowledge concerning the role of a fishermen's cooperative among fishermen in Panama. They suggest that such variability can lead to problems in instituting and maintaining this form of organization due to varying expectations on the part of participants. They thus argue for the development of effective techniques to communicate the total meaning of a cooperative in areas where they are planned or in operation.

Cooperatives are also often resisted by middlemen who have a lot to loose if marketing is taken out of their hands. Fishermen are reluctant to switch to selling through the cooperative because they are frequently indebted to middlemen for supplies of capital in times of need (cf. Firth 1966). Thus the role of the middleman in the social organization of fishing communities cannot be underestimated in attempts to replace him with a marketing cooperative. The periodic nature of marine resources often places him in a role of benefactor to fishermen when the catches are light, and his ability and willingness to give loans when the sea destroys or damages productive equipment reinforces this role.

Fishermen's cooperative organizations must manifest the same type of flexibility to match the periodic nature of the marine resource.

A good example of problems that can develop with cooperatives not responsive to specific demands of the marine environment is reported by Alexander (1975). He notes that in Sri Lanka new fishing gear was introduced, sometimes through cooperative organizations, which was of relatively high cost and subject to relatively rapid deterioration in contrast to the traditional gear, which lasted longer and could be replaced out of current earnings and small loans. The new gear thus required making provision for replacement. Nevertheless, no provisions for replacement were made, even in cooperative organizations. The form of the fishermen's cooperative organizations were transferred directly from farming where the major resource, land, appreciates through time; thus, failure to take the basic technoeconomic differences between farming and fishing into account resulted in difficulties. Another feature of the marine environment also has an adverse effect on cooperative operations. The short term periodicity of marine resources results in variance in catch and, subsequently, in income through time. Loans made by the government to fishermen failed to take this fact into account--the required payments were inflexible, appearing monthly irrespective of catch size (Alexander 1975). Middlemen in most fishing communities have had a long relationship with fishermen and their adaptation to the sea; thus, they understand these environmental constraints and usually act accordingly, adapting to variability of catch by permitting more flexibility in repayment of loans. Thus, wholesale transfer of cooperative organizations from other fields of production to fishermen's organizations without accounting for the sociocultural and environmental constraints exerted by the marine environment can result in serious problems as discussed above. Similar examples of

sociocultural factors influencing cooperative failure can be found in Sabella (1974: 302-308), Norr (1972: 150), and Spoehr (1954: 161).

TECHNOLOGICAL CHANGE, SOCIAL STRATIFICATION, AND WORKGROUPS In our review of the sociocultural concomitants of the transfer of innovations and our discussion of man's psychocultural adaptation to the marine environment, the relationship between technical change and social stratification has been referred to. Several facets of man's adaptation to the marine environment result in this relationship being an especially important consideration with respect to planned change in fishing communities. First, as was discussed above, small-scale fishermen, in comparison to farmers, are relatively free, independent, and occupationally mobile. The relatively open access nature of the sea and the low cost of equipment in comparison to the relatively closed access to expensive land resources contributes to the formation of this complex of characteristics. Additionally, as was discussed in the subsection on man's biopsychological adaptation to the marine environment, this independent nature is related to aspects of the physical environment, as well as the technology, and is commonly cited as an important life-style characteristic by the fishermen themselves. Second, environmental and technological constraints result in an effectively adapted workgroup which is relatively egalitarian, interdependent, and cooperative. These characteristics are also manifested in the fisherman's personality structure (cf. above; Norr and Norr 1974; Aronoff 1967). It seems, therefore, that changes which would affect these basic features of man's psychocultural adaptation to the marine environment would result in serious problems in the long run. Either the innovations would fail, or the increasing strains within the fishing community could result in apathetic withdrawal

or social upheaval.

A good example of the rejection of such a change is reported by Forman (1970). He notes that among the raft fishermen of Coqueiral in Northeastern Brazil, the local elites have such strong control over the fishing industry, through the pricing of fish, taxation, etc. that the socioeconomic system does not permit capital formation among the peasant fishermen in the local economy. Thus, no matter how much initiative the fishermen have, one cannot expect to find effective entrepreneurship among them with respect to expensive, new productive technology. The introduction of hull sailboats was one such change. The only people in Coqueiral with sufficient capital to acquire the new sailboats were the local elites, and they did. Nevertheless, the elites needed local fishermen to work on the boats. The fishermen soon found out, however, that even though the total catch would increase with the use of hull sailboats, the share that would go to capital equipment actually decreased their share and the shares of their kinsmen in the reciprocal exchange network; thus, they resisted the change and it failed. Forman (1970) makes the important point that where fishermen can construct their own rafts and continue as independent producers, it is often to their advantage to resist change even if the new technology results in greater overall catch. Based on the discussion we presented above, we argue that there are both economic and fundamental psychological reasons for this resistance. As Forman (1970) notes, when this type of change occurs in situations such as he described for Coqueiral, the formerly independent producers become reduced to a kind of share cropper.

Firth (1966) has noted another type of problem related to income distribution which is associated with the introduction of new, relatively costly technology. He notes that equipment modernization among Malay fishermen has

resulted in greater overall returns, but that the increased capital cost has led to a marked drop in the percentage of earnings going to the labor force. Despite the fact that the fisherman has become, in effect, an employed laborer in the new system, he is treated as a participant in a common enterprise and thus not put on a regular wage basis. His income is still based on a share of the catch. It will be recalled that we discussed the adaptive features of this nearly universal share system among fishermen in the subsection on distribution of catch. Firth (1966) notes that among the Malay fishermen, costs are removed from the catch before shares are calculated; thus, given the periodic nature of production in the marine environment, fishermen often receive next to nothing. He therefore reports that in 1963, the fishermen were in a less advantageous position than when he first studied them in 1939-1940.

Even when governments are aware of new technologies' potential effect on social stratification because of initial costs, problems occur and increased disparity in wealth result. For example, Alexander (1975) reports that in Sri Lanka the government was aware of financing problems associated with costly new fishing technology, so they introduced a hire, purchase scheme. Individuals who took part were selected by ballot from qualified applicants. The individual fisherman had to provide a deposit and received a government loan, repayable over five years, to purchase a hull boat with an engine. Unforseen problems developed, however. First, the deposit in combination with the fact that the loan covered vessel and engine, but not gear, meant that the fisherman had to go to private money lenders. Second, the new equipment deteriorated faster than the old, and there was no provision of maintenance funds. Third, as discussed above, the loan repayment was not related to the value of the catch--it was a fixed monthly payment; thus, during off-periods the payment

could exceed income. Nevertheless, production increased, so the government viewed the project as a success and invested more funds in it. The total income to the fishing village also increased, but other, less visible problems also increased. Since the number of fishermen increased little over the years since the innovation was first introduced, and the population increased, there was increased unemployment. New boats were introduced, but they rightfully went only to experienced deep sea fishermen. Important for our discussion, however, is the fact that inexperienced recruits were only drawn from relatives; therefore, few opportunities existed for those not related to the boat owning elite to acquire the experience necessary for allocation of a boat. The elite in the community is larger than it was in the past, but the large group of middle-class free peasants are finding life much more difficult. Thus, in place of the small group living in poverty, the large class of free peasants, and the small elite which existed in the past, there is now a substantial elite with the bulk of the population being reduced to the poverty level. Alexander (1975) suggests that since the elite have political power and control recruitment to the most favorable occupations, the degree of social stratification will become even more marked in the future. Increases in social stratification have been attributed to similar factors in other communities where costly innovations were introduced (cf. Sabella 1974; Norr 1972).

Turning next to the effects that such increases in stratification have on workgroups, Norr writes that "...there seems to be some indication that increased economic stratification may lead to some changes in the work organization of fishing that make it resemble the work organization of more stratified agricultural communities" (1972:137). We have noted several times above that fishermen workgroup organization is adapted to both technological and environ-

mental constraints of the marine environment.

What kinds of effects will changes in workgroup organization have on these adaptive functions? Norr and Norr (1975) note that where non-fishermen gain control of the means of production, workgroups become more stratified and the powers of owners increase. The Norrs argue that "extreme inegalitarian patterns tend to become dysfunctional: fishing crews become unstable, increased authority interferes with the cooperation needed for fishing, captains are encouraged to take excessive risks, and injuries and loss of life increase" (Norr and Norr 1975: 10).

In sum, our examination of the interrelationships between technological change, social stratification, and workgroups in light of our model of man's psychocultural adaptation to the marine environment has indicated a number of potential dysfunctions that should be kept in mind and dealt with in programs dealing with planned change in ocean fishing communities.

THE MODEL OF MAN'S PSYCHOCULTURAL ADAPTATION TO THE MARINE ENVIRONMENT AND CHANGE IN FISHING COMMUNITIES: A GENERAL APPRAISAL The preceeding discussion of change among ocean fishermen has merely touched on several very important aspects of the interrelationship between problems associated with directed change and man's psychocultural adaptation to the marine environment. We could extend our discussion by noting technology transfer problems involved with conceptual differences between modern forms of navigation and traditional systems in the south Pacific (cf. Gladwin 1970) or the undesirability of fishing as an occupation because of its low status in some societies (cf. Norr 1972), but these difficulties are directly analogous to problems in change associated with other occupational subgroups which were discussed in the first section.

We feel, however, that examples discussed in this section illustrate basic, important problems associated with the transfer of technoeconomic innovations in marine communities and represent the most significant that could be derived from the relatively scanty literature.

The complexity of the variables associated with the transfer of innovations in combination with the intricate interrelationships between elements in the model of human ecology as applied to the marine environment suggest other areas of interaction between the two models. The interconnectedness of elements in our model of man's psychocultural adaptation to the marine environment make such deductions obvious. Nevertheless, this paper is a first approach which should serve to generate hypotheses to tested in further research.

with determining proper techniques of information transfer. The model thus serves to delineate important areas of concern and insures that essential, interrelated variables are not overlooked prior to investing large sums of money in a development project.

Since the necessary data base varies with specific innovation transfer problems, it would be presumptuous to present a data gathering schedule which would apply to all situations. Some of the data would be superfluous in specific contexts, and the question forms would be inappropriate in others. The objective of this section of the paper is to provide references to sources which deal with specific data collection problems such as scale construction, translation, and cultural appropriateness. The section is arranged to conform with the separate elements of the model of human ecology.

PHYSICAL ENVIRONMENT DATA It is expected that resource scientists will provide an evaluation of the physical environment including important characteristics such as stock assessment and description of meteorological and oceanographic characteristics. The resource assessment should include both land and sea resources. The meteorological and oceanographic assessment should include consideration of phenomena which affect man's interaction with the sea such as winds and other inclement weather, bottom characteristics, and wave, surf, and tide conditions. Observations should be made to determine how these physical phenomena affect man's patterns of interaction with the sea; e.g. what types of meteorological and oceanographic phenomena keep them from fishing? What resources do they exploit and where?, etc.

The fishermen's view of the physical environment must also be determined. Attempts to change a system must be based on an understanding of the system as

it is viewed by the target groups. Traditional peoples have been interacting with the sea for a long time, and in their attempts to understand it, they have made inferences from their observations and constructed taxonomies and theories concerning the marine environment and its flora and fauna. This folk ocean science, or ethno-oceanography, is as real and important to the local fisherman as theories concerning ocean systems are to the American oceanographer. Thus, attempts to communicate information concerning the ocean must take these folk scientific systems into account. Often their linguistic classification of wave forms, beach areas, etc. will be more complex than standard American English classifications of similar phenomena (cf. Prins 1965). Morrill's (1967) discussion of the ethnoicthyology of the Cha-Cha provides a good description of such an analysis and its importance, and Tyler (1969) describes methodologies used to arrive at such descriptions.

One very important aspect of the marine environment with regard to data acquisition is its short-term periodic nature. As we have seen above, features of the environment either directly, or indirectly, influence all other aspects of man's psychocultural adaptation system. Thus, if there is variability in the environment throughout the year, it is essential that one determines covarying aspects of the technoeconomic and sociocultural systems. This means that investigators must spend a minimum of one-year in a community to insure that at least yearly variation has been sampled. Anyone who has worked in peasant communities (or elsewhere for that matter) knows that one cannot rely on memory for such information. Memory is selective and often emphasizes what the informant wants you to hear.

<u>TECHNOLOGICAL DATA</u> Data on technology should include a description of capture,

processing, and distribution gear and techniques as appropriate. The description should include size, salient features, potential, and use. Once again, for reasons stated above, the description should be supplemented by the local fishermen's perceptions of the traditional technology (cf. Tyler 1969). Details concerning the construction of relevant gear should be described, including sources and economics of distribution of raw materials, construction techniques including source of tools, amount of time and specialists involved, and cost to the fisherman. Where appropriate, evaluation of depreciation, maintenance, and replacement costs in terms of time, money, and manpower should be made. Resource economists can provide valuable direction concerning collection of economic data.

SOCIAL ENVIRONMENT DATA Social environment data should include population size, sex ratio, age structure, and population density. Where appropriate, consideration should be given to residence patterns (e.g. locations in terms of resource) and systems of internal migration. Community relations with other communities in terms of population, status, power, trade, and degree of modernization should be determined along with a description of outside communication links (e.g. public transportation networks, telephone, radio, etc.). Techniques for constructing scales of community, social, and structural differentiation can be found in F. Young, et al (1968) and F. Young and Fujimoto (1965). General techniques for obtaining information about the social environment can be found in P. Young (1966) and Naroll and Cohen (1970).

SOCIAL ORGANIZATION DATA General information on social organization data collection and analysis procedures can be found in Thomas (1976), Pelto (1970),

and Naroll and Cohen (1970). Temporal variation in human behavior suggests that a minimum of one year's observation is required. As appropriate, data concerning the local political organization and its relative stability should be determined. Local distributions of wealth, power, capital equipment, and resources should be described along with their relationships to traditional techniques of borrowing, lending, leasing, renting, inheritance, and administration. Distribution of production in terms of reciprocal exchange networks, redistribution systems, and market systems must be analyzed. Firth (1966) and H. Gladwin (1970) provide valuable information concerning problems associated with various techniques of economic data collection among small-scale fishermen. The occupation structure of the community in combination with occupational training techniques, and occupational mobility is often an important element to be considered. Communication networks, especially those related to innovative behaviour as discussed in the first section (e.g. availability of mass media, local information exchange networks, etc.) should be analysed for use in transferring information. Finally, the organization of work and leisure must be analysed, including owner-laborer relationships and workgroup organization as it relates to such elements as workgroup size, recruitment procedures, and interpersonal relationships. Use of leisure time should be evaluated if the proposed innovation results in changes in work schedules.

INDIVIDUAL BIOPSYCHOLOGICAL CHARACTERISTICS DATA Individual attributes associated with the early adoption of innovations should be assessed for the target population (see Table 1). Rogers and Shoemaker (1971) and Rogers (1969) provide illustrations of scales and references to interview schedules which can be used to collect such information. Other psychological characteristics

associated with man's adaptation to the marine environment, which were discussed above, can be assessed with the use of scales contained in Robinson, Athanasion, and Head (1974) or techniques suggested in Levine (1973). Use of such procedures cross culturally involves translation problems discussed in Brislin (1970).

Where appropriate, attention should be paid to special sensory acuity requirements associated with certain productive tasks (e.g. listening for fish or sighting land marks as discussed above). An evaluation of traditional motor patterns should be conducted if it is suspected that introduced techniques will result in motor pattern changes. Nutritional and general health status are often important predictors of responses to technologies that demand increased activity levels and should be evaluated in these cases.

IDEOLOGICAL DATA Attitudes, beliefs, and values concerning aspects of present social organization and technology which will be affected by proposed changes should be ascertained. Discussions of techniques for assessing attitudes, beliefs, and values can be found in Rokeach (1968), Blalock and Blalock (1968), and Naroll and Cohen (1970). Ritual associated with production techniques involved in proposed changes should be examined to determine if aspects extend to other areas of the sociocultural system such as event scheduling and relative involvement of ritual specialists who might perceive the change as a threat to their status. Temporal variation in ritual behavior suggests that a minimum of one year's observation is necessary.

SUMMARY In sum, the models presented in this paper illustrate the complexity of planned change in the marine environment and its relationship to elements specific to this particular form of human adaptation. It was illustrated above

that the models can be used to focus one's attention on key variables in any given situation of planned change. In addition, the models serve to maintain an awareness of possible ramifications of innovations with regard to all elements of the model of human ecology. A brief description of the general types of data involved was provided along with references to sources detailing the collection and analysis of such data. It was emphasized that the short-term periodic nature of variation in marine resources and the concomitant variation in human behaviour make it essential that the investigator sample the full range of variation, which often requires at least one year's observation. Overall, the complexity of the systems involved suggest that reliance on relative brief fact-finding missions which derive much of their data from local bureaucrats may be the principal factor involved in project failure.

REFERENCES CITED

Abrahams, Roger D.
1974 Deep the Water, Shallow the Shore. Austin: University of Texas Press.

Aceves, Joseph
1971 Social Change in a Spanish Village. Cambridge: Schenkman Publishing Co.

Acheson, James M.
1975 The lobster fiefs: economic and ecological effects of territoriality in the Maine lobster industry. Human Ecology 3: 183-207.

Alexander, Paul
1975 Innovation in a cultural vacuum: the mechanization of Sri Lanka Fisheries. Human Organization 34: 333-344.

Alkire, William H.
1965 Lamotrek Atoll and Interisland Socioeconomic Ties. Urbana: University of Illinois Press.

Anderson, E.N.
1975 Chinese Fishermen in Hong Kong and in Malaysia. in Maritime Adaptations of The Pacific (R.W. Casteel and G. Quimby, eds.). The Hague: Mouton Publishers.

Andersen, Raoul and Cato Wadel
1972 Comparative problems in fishing adaptations. in North Atlantic Fishermen (R. Andersen and C. Wadel, eds.). Memorial University of Newfoundland: Institute of Social and Economic Research.

Apter, David E.
1965 The Politics of Modernization. Chicago: University of Chicago Press.

Aronoff, Joel
1967 Psychological Needs and Cultural Systems. Princeton: D. Van Nostrand Co., Inc.

Barnett, Homer G.
1953 Innovation. New York: McGraw Hill Book Co.

Beals, Ralph and J. Hester
1974 California Indians I (Vol. 1). New York: Garland Publishing Company.

Beck, Horace
1973 Folklore and the Sea. Middletown, Conn.: Wesleyan University Press.

Belli, Fedro
1971 The economic implications of malnutrition: The dismal science revisited. Economic Development and Cultural Change 20: 1-23.

Bernard, H. Russell
1972 Kalymnos, island of the sponge fishermen. in Technology and Social Change. (H.R. Bernard and P. Pelto, eds.). New York: The Macmillan Company.

Bernard, H. Russell and P. Pelto
1972 Technology and social change: some concluding observations. in Technology and Social Change (H.R. Bernard & P. Pelto, eds.). New York: Macmillan Co.

Blalock, Hubert M. and A.B. Blalock
1968 Methodology in Social Research. New York: McGraw-Hill Book Co.

Blehr, O.
1963 Action groups in a society with bilateral kinship: a case study from the Faroe Islands. Ethnology 2: 269-275.

Bliss, Wesley L.
1952 In the wake of the wheel. in Human Problems in Technological Change (E.H. Spicer, ed.). New York: Russell Sage Foundation.

Bodley, John H.
1975 Victims of Progress. Menlo Park, Calif.: Cummings Publishing Co.

Brandt, Vincent S.R.
1971 A Korean Village. Cambridge: Harvard University Press.

Brislin, Richard W.
1970 Back-translation for cross-cultural research. Journal of Cross Cultural Psychology 1: 185-216.

Brown, G. Gorden
1957 Some problems of culture contact with illustrations from East Africa and Samoa. Human Organization 16(3): 11-14.

Beck, Horace
1973 Folklore and the Sea. Middletown, Conn.: Wesleyan University Press.

Belli, Pedro
1971 The economic implications of malnutrition: The dismal science revisited. Economic Development and Cultural Change 20: 1-23.

Bernard, H. Russell
1972 Kalymnos, island of the sponge fishermen. in Technology and Social Change. (H.R. Bernard and P. Pelto, eds.). New York: The Macmillan Company.

Bernard, H. Russell and P. Pelto
1972 Technology and social change: some concluding observations. in Technology and Social Change (H.R. Bernard & P. Pelto, eds.). New York: Macmillan Co.

Blalock, Hubert M. and A.B. Blalock
1968 Methodology in Social Research. New York: McGraw-Hill Book Co.

Blehr, O.
1963 Action groups in a society with bilateral kinship: a case study from the Faroe Islands. Ethnology 2: 269-275.

Bliss, Wesley L.
1952 In the wake of the wheel. in Human Problems in Technological Change (E.H. Spicer, ed.). New York: Russell Sage Foundation.

Bodley, John H.
1975 Victims of Progress. Menlo Park, Calif.: Cummings Publishing Co.

Brandt, Vincent S.R.
1971 A Korean Village. Cambridge: Harvard University Press.

Brislin, Richard W.
1970 Back-translation for cross-cultural research. Journal of Cross Cultural Psychology 1: 185-216.

Brown, G. Gorden
1957 Some problems of culture contact with illustrations from East Africa and Samoa. Human Organization 16(3): 11-14.

Brown, Roger and M. Ford
1961 Address in American English. Journal of Abnormal and Social Psychology 62: 375-385.

Burling, Robbins
1970 Man's Many Voices. New York: Holt, Rinehart, and Winston, Inc.

Burrows, Edwin G. and M.E. Spiro
1953 An Atoll Culture: Ethnography of Ifaluk in the Central Carolines. New Haven: Human Relations Area Files.

Cancian, Frank
1967 Stratification and risk taking: a theory tested on agricultural innovation. American Sociological Review 32: 912-927.

Chard, Chester S.
1974 North East Asia in Prehistory. Madison: University of Wisconsin Press.

Chattopadhyay, S.N. and U. Pareek
1967 Prediction of multi-practice adoption behavior from some psychological variables. Rural Sociology 32: 324-333.

Cochrane, Glynn
1974 What can anthropology do for development. Finance and Development 11: 20-23.

Coe, Michael D. and Kent V. Flannery
1967 Early Cultures and Human Ecology in South Coastal Guatemala. Smithsonian Contributions to Anthropology 3.

Cohen, Yehudi A.
1974 "Culture as Adaptation" in Man in Adaptation: The Cultural Present (2nd ed.). Pp. 45-68 Yehudi A. Cohen, ed. Chicago: Aldine Pub. Co.

Coult, A. and R. Habenstein
1965 Cross Tabulations of Murdock's Ethnographic Sample. Columbia, Missouri: University of Missouri Press.

Cove, J.J.
1973 Hunters, trappers, and gatherers of the sea: a comparative study of fishing strategies. Journal of the Fisheries Research Board of Canada 30: 249-259.

Dasgupta, Satadal
1975 Caste dominance and agricultural development in village India. Human Organization 34: 400-403.

Davenport, William H.
1960 Jamaican fishing: a game theory analysis. Yale University Publications in Anthropology 59: 3-11.

_____ 1956 A Comparative Study of two Jamaican Fishing Communities. Ph.D. Dissertation, Yale University.

DeWalt, Billie R.
1975 Inequalities in wealth, adoption of technology, and production in a Mexican ejido. American Ethnologist 2: 149-168.

Diamond, Norma
1969 K'un Shen: A Taiwan Village. New York: Holt, Rinehart, and Winston.

Donald, L. and D. Mitchell
1975 Some correlates of local group rank among the southern Kwakiutl. Ethnology 14: 325-346.

Doob, Leonard W.
1960 Becoming More Civilized. New Haven: Yale University Press.

Driver, Harold E.
1961 Indians of North America. Chicago: University of Chicago Press.

Drucker, Philip
1955 Indians of the Northwest Coast. New York: McGraw-Hill.

Dube, S.C.
1958 India's Changing Villages: Human Factors in Community Development. London: Routledge and Kegan Paul.

Dumond, Don E.
1975 Coastal adaptation and cultural change in Alaskan Eskimo prehistory. in Prehistoric Maritime Adaptations of the Circumpolar Zone. (W. Fitzhugh, ed.) The Hague: Mouton Publishers.

Edgerton, Robert
1971 The Individual in Cultural Adaptation. Berkeley: University of California Press.

Epstein, A.L.
1969 Matupit. Berkeley: University of California Press.

Erasmus, Charles J.
1961 Man Takes Control. Indianapolis: The Bobbs-Merrill Co., Inc.

F.A.O.
1974 Artisanal Small Scale Fisheries in Developing Countries. U.N.F.A.O. Committee on Fisheries, 9th Session: Appendix One. Rome: U.N.F.A.O.

Felt, John H.
1971 Education, literacy, mass media exposure and farm practice adoption in South Brazil. Rural Sociology 36: 359-366.

F.A.O.
1971 Manual on Fishermen's Cooperatives. Rome: Food and Agricultural Organization of the United Nations.

Firth, Raymond
1967 Tikopia Ritual and Belief. Boston: Beacon Press.

_____
1966 Malay Fishermen (2nd. Ed.). Hamden, Connecticut: Archon Books.

_____
1965 Primitive Polynesian Economy. London: Routledge and K. Paul.

Fitzhugh, William
1975a A comparative approach to northern maritime adaptations. in Prehistoric Maritime Adaptations of the Circumpolar Zone. (W. Fitzhugh, ed.) The Hague: Mouton Publishers.

1975b Prehistoric Maritime Adaptations of the Circumpolar Zone. The Hague: Mouton Publishers.

1972 Environmental Archeology and Cultural Systems in Hamilton Inlet, Labrador. Smithsonian Contributions to Anthropology 16.

Fliegel, Frederick C., J.E. Kivlin, & G.S. Sekhon
1968 A cross-national comparison of farmers' perceptions of innovations as related to adoption behavior. Rural Sociology 33: 238-246.

Forde, C. Daryll
1949 Habitat, Economy and Society. London: Methuen and Co.

Forman, Shepard
1970 The Raft Fishermen. Bloomington: Indiana University Press.

Foster, Brian L.
1975 Labor groups in Thai rice and fishing villages. Human Organization 34: 381-389.

Foster, George M.
1973 Traditional Societies and Technological Change (2nd Edition). Berkeley: University of California Press.

Franke, Richard H. and G.V. Barrett
1975 The economic implications of malnutrition: comment. Economic Development and Cultural Change 23: 341-350.

Fraser, Thomas M.
1966 Fishermen of South Thailand. New York: Holt, Rinehart and Winston, Inc.

_____
1960 Rusembilan. Ithaca, New York: Cornell University Press.

Frey, Frederick W.
1971 Developmental aspects of administration. in Behavioral Change in Agriculture (J.P. Leagans and C.P. Loomis, eds.). Ithaca: Cornell University Press.

Fromm, Erich and M. Maccoby
1970 Social Character in a Mexican Village. Englewood Cliffs, N.J.: Prentice-Hall, Inc.

Galjart, Benno
1975 A model of local systems for understanding rural development processes in the third world. Rural Sociology 40: 344-352.

Gartrell, John W., E.A. Wilkening, & H.A. Presser
1973 Curvilinear and linear models relating status and innovative behavior: a reassessment. Rural Sociology 38: 391-411.

Geertz, Clifford
1960 The Religion of Java. Glencoe, Illinois: The Free Press.

Glacken, Clarence J.
1955 The Great Loochoo. Berkeley: University of California Press.

Gladwin, Hugh
1970 Decision Making in the Cape Coast (Fante) Fishing and Fish Marketing System. Ph.D. Dissertation, Stanford University.

Gladwin, Thomas
1970 East is a Big Bird. Cambridge, Mass.: Harvard University Press.

_____ 1958 Canoe Travel in the Truck area: technology and its psychological correlates. American Anthropologist 60: 893-899.

Handwerker, W. Penn
1974 Changing household organization in the origins of market places in Liberia. Economic Development and Cultural Change 22: 229-248.

Harris, Marvin
1968 The Rise of Anthropological Theory. New York: Thomas Y. Crowell Company.

Harrisson, Tom
1970 The Malays of South-West Sarawak before Malaysia. East Lansing: Michigan State University Press.

Havens, A. Eugene and W. Flinn
1975 Green revolution technology and community development: the limits of action programs. Economic Development and Cultural Change 23: 469-481.

Henderson, Peta M.
1972 A sugar usina in British Honduras. in Technology and Social Change (H.R. Bernard and P. Pelto, eds.) New York: Macmillan Co.

Hewes, Gordon W.
1948 The rubric "fishing and fisheries." American Anthropologist 50: 238-246.

Hewes, Laurence
1974 Rural Development: World Frontiers. Ames, Iowa: State University Press.

Hogbin, Ian
1964 A Guadalcanal Society. New York: Holt, Rinehart, and Winston.

Hudson, W.
1967 The study of the problem of pictorial perception among unacculturated groups. International Journal of Psychology 2: 90-107.

Hymes, Dell
1964a Introduction: toward ethnographies of communication: American Anthropologist 66: No. 6, Part 2: 1-34.

1964b Language in Culture and Society. New York: Harper and Row, Publishers.

Jones, A.D.
1974 Social and psychological factors in teaching farming. Human Organization 33: 27-35.

Kivlin, Joseph E., and F.C. Fliegel
1968 Orientations to agriculture: a factor analysis of farmers' perceptions of new practices. Rural Sociology 33: 127-140.

_____
1967 Differential perceptions of innovations and rate of adoption. Rural Sociology 32: 78-91.

Knudson, Kenneth E.
1970 Resource Fluctuation, Productivity, and Social Organization on Micronesian Coral Islands. Ph.D. Dissertation. University of Oregon.

Kottak, Conrad P.
1966 The Structure of Equality in a Brazilian Fishing Community. Ph.D. Dissertation. Columbia University.

Kroeber, Alfred L.
1963 Cultural and Natural Areas of Native North America. Berkeley: University of California Press.

Lambert, W.E., et al
1958 Evaluation reactions to spoken language. Journal of Abnormal and Social Psychology 60: 44-51.

Lenski, Gerhard and J. Lenski
1974 Human Societies (2nd Edition). New York: McGraw-Hill Book Co.

Lessa, William A.
1966 Ulithi: A Micronesian Design for Living: New York: Holt, Rinehart and Winston.

LeVine, Robert A.
1973 Culture, Behavior, and Personality. Chicago: Aldine Publishing Co.

_____
1966 Dreams and Deeds: Achievement Motivation in Nigeria. Chicago: University of Chicago Press.

Lewis, David
1972 We, the Navigators. Honolulu: University Press of Hawaii.

Lionberger, Herbert F. and G. Copus
1972 Structuring influence of social cliques on farm-innovation-seeking relationships with agricultural elites and non-elites in two Missouri communities. Rural Sociology 37: 73-85.

Lowie, Robert H.
1954 Indians of the Plains. New York: McGraw-Hill.

Maddox
1975 On the distribution of Kuskowagamuit fishcamps: a study in the ecology of adaptive radiation. in Maritime Adaptations of the Pacific. (R.W. Casteel and G. Quimby, eds.) The Hague: Mouton Publishers.

Malinowski, Bronislaw
1961 Argonauts of the Western Pacific. New York: E.P. Dutton and Co.

_____
1948 Magic, Science and Religion. Garden City, New York: Doubleday.

Marriott, McKim
1952 Technological change in overdeveloped rural areas. Economic Development and Cultural Change 1: 261-272.

McCartney, A.P.
1975 Maritime adaptations in cold archipelagoes. in Prehistoric Maritime Adaptations of the Circumpolar Zone (W. Fitzhugh, ed.). The Hague: Mouton Publishers.

Menzel, Herbert and E. Katz
1956 Social relations and innovation in the medical profession: the epidemiology of a new drug. Public Opinion Quarterly 19: 337-352.

Morrill, Warren T.
1967 Ethnoicthyology of the Cha-Cha. Ethnology 6: 405-416.

Morss, Elliott R., et al
1976 Strategies for Small Farmer Development (Vol. 1 and 2). Boulder, Colorado: Westview Press.

Moseley Michael E.
1975 The Maritime Foundations of Andean Civilization. Menlo Park, California: Cummings Publishing Company.

Moulik, T.K. et al
1966 Predictive values of some factors of adoption of nitrogenous fertilizers by North Indian farmers. Rural Sociology 31: 447-467.

Murdock, George P.
1967 Ethnographic Atlas. Pittsburgh: University of Pittsburgh Press.

_____
1959 Africa: Its Peoples and their Culture History. New York: McGraw-Hill Book Co.

_____
1949 Social Structure. New York: Macmillan.

Naroll, Raoul and R. Cohen
1970 A Handbook of Method in Cultural Anthropology. Garden City, N.Y.: Natural History Press.

Nason, James
1975 The effects of social change on marine technology in a Pacific atoll community. in Maritime Adaptations of The Pacific. (R. Casteel and G. Quimby, eds.) The Hague: Mouton Publishers.

Nietschmann, Bernard
1973 Between Land and Water. New York: Seminar Press.

Nimmo, H. Arlo
1972 The Sea People of Sulu. San Francisco: Chandler Publishing Company.

Nishimura, Asahitaro
1975 Cultural and social change in the modes of ownership of stone tidal weirs. in Maritime Adaptations of the Pacific. (R. Casteel and G. Quimby, eds). The Hague: Mouton Publishers.

Norbeck, Edward
1968 Changing Japan. New York: Holt, Rinehart, and Winston.

_____
1954 Takashima: a Japanese Fishing Village. Salt Lake City: Univessity of Utah Press.

Norr, James L. and K. Norr
1975 Increasing capital costs, environmental and technical constraints and work patterns in modern ocean fishing. Unpublished manuscript.

Norr, Kathleen
1975 The organization of coastal fishing in Tamilnadu. Ethnology 14: 357-371.

_____
1972 A South Indian Fishing Village in Comparative Perspective. Ph.D. Dissertation, University of Michigan.

Norr, Kathleen and James L. Norr
1974 Environmental and technical factors influencing power in work organizations: ocean fishing in peasant societies. Sociology of Work and Occupations 1: 219-251.

Obibuaku, L.O.
1967 Socioeconomic problems in the adoption process: introduction of a hydraulic palm oil press. Rural Sociology 32: 464-468.

Ohnuki-Tierney, Emiko
1976 Regional variations in Ainu culture. American Ethnologist 3: 297-329.

Orona, Angelo R.
1968 The Social Organization of the Margariteno Fishermen, Venezuela. Ph.D. Dissertation, U.C.L.A.

Oto, Tokihiko
1963 The taboos of fishermen. in Studies in Japanese Folklore. (R.M. Dorson, ed.). Bloomington: Indiana University Press.

Parsons, Kenneth H.
1971 Agricultural economics. in Behavioral Change in Agriculture (J.P. Leagans & C. Loomis, eds). Ithaca: Cornell University Press.

Paulsen, Allison C.
1974 The thorney oyster and the Voice of God: Spondylus and Strombus in Andean prehistory. American Antiquity 39: 597-607.

Pelto, Pertti J.
1970 Anthropological Research: the Structure of Inquiry. New York: Harper and Row.

Pelto, Pertti J. and J.J. Poggie
1974 Models of modernization: a regional focus. in Rethinking Modernization (J.J. Poggie and R. Lynch eds.). Westport, Conn.: Greenwood Press.

Petrini, Frank
1966 Upplysningsverksamhetes Effekt I, Innovationernas Spridningstakt (The Rate of Adoption of Selected Agricultural Innovations). Uppsala: Agricultural College of Sweden, Report No. 53.

Piddocke, Stuart
1965 The potlatch system of the Southern Kwakiutl: a new perspective. Southwestern Journal of Anthropology 21: 244-264.

Poggie, John J., J.G. Bartee, and R.B. Pollnac
1976 Psychocultural correlates of success among small-scale fishermen in Western Puerto Rico. Paper presented at The Annual Meetings of the North Eastern Anthropological Association, Middletown Conn.

Poggie, John J. and C. Gersuny
1974 Fishermen of Galilee. Kingston: University of Rhode Island Marine Bulletin Series No. 17.

Poggie, John J., Gretel H. Pelto & Pertti J. Pelto
1976 The Evolution of Human Adaptation. New York: Macmillan Publishing Co.

Poggie, John J., R. Pollnac, and C. Gersuny
1976 Risk as a basis for taboos among fishermen in Southern New England. Journal for the Scientific Study of Religion (in press).

Pollnac, Richard B.
1975a Cognitive variability and its sociocultural correlates among the Baganda. Ethos 3: 22-40.

1975b Intracultural variability in the structure of the subjective color lexicon in Buganda. American Ethnologist 2: 89-109.

Pollnac, Richard B.
1974 Intracultural variability in the conceptualization of food plants among the Baganda. in Psychocultural Change in Modern Buganda (M. Robbins and P. Kilbride, eds.) Kampala: Makerere Institute of Social Research.

Pollnac, Richard B.
1974b The sociocultural correlates of fishing as a subsistence activity. Anthropology Working Paper No. 4. Sociology-Anthropology Dept., University of Rhode Island.

Pollnac, Richard B.
1973 Meaning and innovative behavior. Anthropology Working Paper No. 2. Sociology-Anthropology Dept., University of Rhode Island.

Pollnac, Richard B. and John Poggie
1976 Economic gratification patterns among small-scale fishermen in Panama and Puerto Rico. Paper delivered at the Applied Anthropology Meetings, Saint Louis 1976.

Pollnac, Richard B. and R. Ruiz-Stout
1976 Correlates of fishermen's cooperative membership in the Republic of Panama. Anthropology Working Paper No. 8. Sociology-Anthropology, Dept., University of Rhode Island.

Pollnac, Richard B. and R. Ruiz-Stout
1976b Perceptions of fishermen's cooperatives by small-scale fishermen in The Republic of Panama. Anthropology Working Paper No. 7. Sociology-Anthropology Dept., University of Rhode Island.

Pollnac, Richard B. and R. Ruiz-Stout
1975 Artisanal fishermen's attitudes toward the occupation of fishing in The Republic of Panama. Anthropology Working Paper No. 6. Sociology-Anthropology Dept., University of Rhode Island.

Price, Richard
1964 Magie et pêche à la Martinique. L'Homme 4:84-113.

Prins, A. H. J.
1965 Sailing from Lamu. Assen: Van Gorcum and Co.

Quinn, Naomi R.
1971 Mfantese Fishing Crew Composition: A Decision Making Analysis. PhD Dissertation, Stanford University.

Rahn, Hermann (ed.)
1965 Symposium on The Physiology of Breath Hold Diving and The Ama of Japan. Washington, D.C.: National Academy of Sciences.

Robinson, J.P., R. Athanasiou, and K.B. Head
1974 Measures of Occupational Attitudes and Occupational Characteristics. Ann Arbor: Survey Research Center of The Institute for Social Research, Univ. of Michigan.

Rogers, Everett M.
1969 Modernization Among Peasants. New York: Holt, Rinehart, and Winston, Inc.

Rogers, Everett M. and R. Agarwala-Rogers
1976 Communication in Organizations. New York: The Free Press.

Rogers, Everett M. and F. Shoemaker
1971 Communication of Innovations (2nd Edition). New York: The Free Press.

Rokeach, M.
1968 Beliefs, Attitudes and Values. San Francisco: Jossey-Bass Publishers.

Rotblat, Howard J.
1975 Social organization and development in an Iranian provincial bazaar. Economic Development and Cultural Change 23: 292-305.

Rubin, Joan
1968 Bilingual usage in Paraguay. in Readings in The Sociology of Language (Joshua A. Fishman, ed.). The Hague: Mouton and Co.

Sabella, James C.
1974 The Fishermen of Caleta San Pablo. Ph.D. Dissertation. Cornell University.

Sahlins, Marshall D.
1962 Moala: Culture and Nature on a Fijian island. Ann Arbor: University of Michigan Press.

_____
1958 Social Stratification in Polynesia. Seattle: University of Washington Press.

Sarkar, Sabita Ranjan
1974 Socio-economic aspects of Onge fishing. Anthropos 69: 568-589.

Sauer, Carl O.
1963 Seashore-primitive home of man? in Land and Life (J. Leighly, ed.). Berkeley: University of California Press.

Schindler, D.W.
1976 The impact statement boondoggle. Science 192: 509.

Shawcross, Wilfred
1975 Some studies of the influences of prehistoric human predation on marine animal population dynamics. in Maritime Adaptations of The Pacific (R.W. Casteel and G.I. Quimby, eds.). The Hague: Mouton Publishers.

Simonsen, Povl
1975 When and why did occupational specialization begin at the Scandinavian North Coast? in Prehistoric Maritime Adaptations of The Circumpolar Zone. (W. Fitzhugh, ed.). The Hague: Mouton Publishers.

Sinha, B.P. and P. Mehta
1972 Farmers need for achievement and change proneness in acquisition of information from a farm-telecast. Rural Sociology 37: 417-427.

Spoehr, Alexander
1954 Saipan: The Ethnology of a War Devastated Island. Chicago: Chicago Natural History Museum.

Stanfield, J. David and G.C. Whiting
1972 Economic strata and opportunity structure as determinants of innovativeness and productivity in rural Brazil. Rural Sociology 37: 401-416.

Steward, Julian H.
1955 Theory of Culture Change. Urbana: University of Illinois Press.

Sutcliffe, C.R.
1974 Achievement motivation and economic development among peasants. Rural Sociology 39: 238-246.

Suttles, Wayne P.
1974 The Economic Life of The Coast Salish of Haro and Rosario Straits. New York: Garland Publishing Co.

Thomas, David H.
1976 Figuring Anthropology. New York: Holt, Rinehart and Winston.

Thompson, Richard
1975 Gratification patterns in Buganda: an explanation of intracultural diversity. American Ethnologist 2: 193-206.

Tiller, Per Olav
1958 Father Absence and Personality Development of Children in Sailor Families. Nordisk Psykologi's Monograph Series No. 9.

Triandis, Harry C.
1971 Attitudes and Attitude Change. New York: Wiley.

Turk, Amos, et al
1974 Environmental Science. Philadelphia: W.B. Saunders Co.

Tyler, Stephen A.
1969 Cognitive Anthropology. New York: Holt, Rinehart and Winston, Inc.

Wallman, Sandra
1965 The communication of Measurement in Basutoland. Human Organization 24: 236-243.

Ward, Barbara
1955 A Hong Kong fishing village. Journal of Oriental Studies 1: 195-214.

Watanabe, Hitoshi
1972 The Ainu Ecosystem. Seattle: University of Washington Press.

Weller, Jack E.
1965 Yesterday's People: Life in Contemporary Appalachia. Lexington: University of Kentucky Press.

Wish, John
1967 Food Retailing in Economic Development: Puerto Rico 1950-1965. Ph.D. Thesis. East Lansing: Michigan State University

Young, Frank W. and I. Fujimoto
1965 Social differentiation in Latin American communities. Economic Development and Cultural Change 13: 344-352.

Young, Frank W. et al
1968 Differentiation and Solidarity in agricultural communities. Human Organization 27: 344-351.

Young, Pauline V.
1966 Scientific Social Surveys and Research (4th edition). Englewood Cliffs, N.J.: Prentice-Hall, Inc.