RESEARCH REPORT SERIES

Caribbean Fishermen Farmers

A Social Assessment of Smithsonian King Crab Mariculture

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1986

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PREFACE AND ACKNOWLEDGMENT

Applied social scientists often become involved with developmental change efforts that deserve special attention. This is such a project. The technology discussed here is simple but has enormous potential for helping to feed and provide economic stability for people in Third World countries. There is no indication that the technology will harm the natural environment. In fact, there are some indications that it may help protect and restore the natural environment by reducing fishing pressures on certain ocean species. The personnel representing the Smithsonian Institution and the Agency for International Development (AID) who have been associated with the project are both highly skilled and deeply committed to the goals of the project. Caribbean governments, scientists, business leaders, and local fishermen seem genuinely excited about the prospects of having the new mariculture in their lands. The combination is almost too good to be true, given the abundance of projects that involve serious tradeoffs between improving the human condition and deteriorating the natural environment.

Because of these special features, this social soundness analysis has been expanded far beyond what was contracted for by the Smithsonian and expected by AID. The findings from the social soundness analysis were presented in verbal and written form in a meeting at the Washington AID office on September 15, 1985. In response to observations made at that meeting, as well as to feedback received during the field work, the author decided to further explain and to provide more extensive documentation of the initial findings. Chapter 2, on project history, development theory, and Caribbean culture was written to provide a broader context within which to understand the project. The site specific chapters were expanded with findings from previous social science research in the Caribbean. The Epilogue was written to bring the reader of this report up to date on the project and to provide a preliminary basis for evaluating the initial findings and recommendations.

This report is the product of many individual efforts. It is important to thank the people of Antigua and Barbuda and of the Dominican Republic who spent so many hours explaining how they live and helping assess what might occur if they become "farmers of the sea." Special thanks go to the guys in Antigua--"Fat Man," Ian, and Roy--for their

friendship and a ride on the big pond. Also special thanks go to Ms. E. Cartey for sharing her knowledge of the marketing practices and Antiguan culture. In Buen Hombre, Dominican Republic, special thanks go to the many fishermen and farmers who took time out of busy days to discuss the project. Special thanks go to Tuba and Narcisco, who missed a number of meals in order to help clarify field observations. Special thanks to Cobito and Andrea and their children for sharing their home and feeding hungry researchers great Sunday dinners.

A number of persons in Washington made this report possible. Maria Hatziolos has been the AID project representative to the project and has helped frame the study. Kate Hartley, project manager based in the Smithsonian's Marine Systems Laboratory, greatly facilitated doing the research as well as provided extensive intellectual support. Kate understood the potential benefits of mariculture adoption by local fishermen and helped to keep the day-to-day efforts on track. She served as a reviewer of this report and provided a number of important insights.

In the field the researchers were welcomed as shipmates by various members of the Marine Systems Laboratory scientific crews. On the Smithsonian research vessel, the Marsys Resolute, Karl Porter, Kim Moller, Kimberly Peyton, Tim Goertemiller, Coreen Ehrlich, Pamela Reid, and Sally Burke were teachers and friends. Thanks go to Tim for providing transportation from Carnival. On the boat Contessa in Antigua, thanks go to Vince Kuark for sharing very tight quarters, limited food, and one great meal on a mountain top. In the Dominican Republic on the Smithsonian vessel, the Centolla, Jon Igelhart and Alan Bittlecomb shared their cramped space, limited food and water supply, and deep insights with the researchers. Their normal 70-hour work weeks are symbolic of the individual investments in this technology. In Buen Hombre, newly arrived PCV Greg Colianni shared his initial impressions and helped complete a survey of fishermen. In Santa Domingo, Kathy and Bill Bernard were friends, teachers, and thoughtful critics of the research. Together, the Marine Systems Laboratory crew ran an on-going seminar about the Mithrax mariculture and its potential adoption by local fishermen. These scientists conveyed a great eagerness about their work as well as a willingness to share these hard-won observations.

A number of colleagues have read drafts of this manuscipt and have made essential contributions. Among these are Gaye Burpee, Riva Berleant-Schiller, Hank Dobyns,

Stuart Hart, and Don Pelz. Michael Rubino helped make the connection between resource economics and people. Florence Jensen helped edit numerous drafts of the report and provided new interpretations of these data. The four maps were expertly drawn by Nancy Witter. Henry Dobyns and Brent Stoffle helped with the Spanish translation of Chapter 1. Linda Stafford in the Publishing Division of the Institute for Social Research has helped to bring all these efforts together into the present volume. Special thanks go to Carla Stoffle who has been the author's research partner for 25 years.

Finally, it must be recognized that the technology, the people, and the development plan were brought together because of Dr. Walter Adey, Director of the Marine Systems Laboratory of the Smithsonian Institution. Dr. Adey has the rare combination of interdisciplinary scientific insights and the values of a concerned humanist. Not only was he able to solve the "mystery of the coral reef," but he wanted to put his technological breakthrough to the service of people. Instead of permitting others to find practical applications for his technology, he sought to do so himself. His expressed goal was to make, with only a moderate investment, the tropical seas a major new source of carbohydrate and protein for a hungry world (Adey 1983). He felt the best way to accomplish this goal was to place the technology directly in the hands of individual producers in Third World countries. For three critical years, Dr. Adey held to the goal of adoption by individual fishermen despite strong pressures to release the technology to large international corporations. So if the following pages are at times critical of the process by which this mariculture has been developed, this criticism must be understood in the context of the project's great development potential and of the motivation and vision of the project's director.

Richard W. Stoffle
Ann Arbor, Michigan
August 1986

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CHAPTER ONE: MANAGEMENT SUMMARY

This is an assessment of the social and cultural factors that potentially will influence the transfer of Caribbean King Crab or Mithrax mariculture as it has been developed in two West Indian project sites. The projects are located in Nonsuch Bay, Antigua, and Buen Hombre, Dominican Republic. The projects derive from an original proposal entitled "A New Mariculture Project for the Lesser Antilles," which was submitted by the Smithsonian Institution, Marine Systems Laboratory (MSL), to the U.S. Agency for International Development (AID). That project was funded as AID Project No. 598-065. This anthropological and sociological assessment was contracted by the Smithsonian Institution as specified in P.O. No. ST5080090000 on July 10, 1985.

APPROPRIATE TECHNOLOGY

Based upon the field work completed under this contract, there are a number of observations that can be made that apply to both the Antigua and Dominican Republic sites. The Mithrax mariculture, as currently being proposed by the Marine Systems Laboratory, appears to be an "appropriate technology" in the fullest sense of that commonly used development term. Fishermen in both sites conveyed a positive attitude toward the idea of mariculture and seemed ready to give it a try as soon as the demonstration stage is completed and the adoption stage in the transference process is reached. Fishermen currently have many of the values, motor skills, understandings, and experiences that will be required for the successful transference of the mariculture. The prime unit of adoption appears to be an existing fishing crew, which is but one of a variety of potential adoption units. Fishermen understand and partially control a seafood products marketing system that can be utilized (at least initially) for the local, regional, and international distribution of mariculture crabs. In other words, based upon these variables, Mithrax mariculture appears to be very possible for these Caribbean sites.

SOCIAL AND CULTURAL IMPLICATIONS

Although transferring Mithrax mariculture seems highly possible, the probability of the transference hinges upon a

number of additional social and cultural variables. Economically, most fishing crews would not be able to venture the risk capital to pay for their own Mithrax crab mariculture unit; external low-risk or no-risk investment capital would be required. Widespread adoption of the mariculture would depend upon the success of one or more "real life" demonstration production units. Fishermen would have to acquire some new values, motor skills, understandings, and experiences in order to carry on the mariculture. The fishing crew would have to fit the mariculture into a complex adaptive strategy usually termed "occupational multiplicity." Whether they eliminate some adaptive tactics or simply adjust levels of commitment, these changes would modify the fishermen's social relationships with members of their family and community. While the existing marketing system should provide the initial means of distributing the mariculture Mithrax crabs, some aspects of the current marketing system would have to be adjusted.

Full-scale adoption and MSL-predicted levels of mariculture unit production could combine to stress the social and cultural systems of the fishermen and their home communities. For example, while existing marketing systems should function appropriately early in the adoption stage, under full production by the total expected number of adopters the volume of crabs might overload existing marketing system. Attraction to mariculture could drastically reduce the targeting and distribution of subsistence seafood products. If mariculture were to become successful at levels predicted by MSL, then the social hierarchy of the fishing village could be drastically modified. Rapid changes in the hierarchy of the fishing village could reduce community cohesion and even modify production in other sectors of the village economy.

RECOMMENDED ACTION

The Mithrax mariculture is a desired and an appropriate technology for these Caribbean sites, but there are a number of social and cultural changes that must occur before the technology can be adopted and also yield maximum social benefit (Berleant-Schiller 1981:224). Based upon the findings of this social soundness analysis, comparative fisheries studies, and developmental change theory, the following actions are recommended: (1) the inclusion of social and cultural variables in the planning process and (2) the formation of a project implementation plan.

Until the present research was funded, social and

cultural variables associated with Mithrax mariculture had not been scientifically studied and had no formal role in key planning decisions. The fishermen who ultimately must decide to adopt or to reject the Mithrax mariculture have had no voice in assessing: (1) whether they have any felt needs for a change in their fishing activities; (2) whether the mariculture fits any felt needs; (3) where a demonstration project should be located; (4) where a demonstration should be operated; (5) who--in the case of Buen Hombre--should participate in the demonstration project; and (6) how, if the demonstration proves a success, they should fully adopt mariculture. From this researcher's perspective, key project decisions have been based on two assumptions: (1) that because it is a new technology it had to be demonstrated where environmental conditions were best, and (2) that poor people in the Caribbean will immediately recognize the value of the mariculture and adopt it without problems to themselves. Given the long history of fishery project failures in the Caribbean and given the well-documented adverse impacts of the Green Revolution elsewhere in the world, it is surprising to find the "Blue Revolution" proceeding in a social and cultural vacuum.

Assuming that the previous analysis fairly represents the history of the project to date, where do these conclusions lead? It is recommended that a project implementation plan be developed as soon as possible. This plan should include social and cultural variables along with environmental considerations. Potential mariculture adopters should have a meaningful role in the development of this implementation plan. The plan should indicate what steps remain in this project. Especially important is to consider developing a new "early adopter" or "demonstration" stage to be located between the successful single mariculture pilot stage and the full adoption stage. The plan should detail the potential social and cultural costs and benefits of mariculture adoption. The plan should suggest a procedure that will assure that potential adopters have been informed of these costs and benefits and have reached an informed decision regarding adoption. The plan should identify strategic research needs, especially those focused on the interface of the human and technological systems. The plan, also, should address the long-term implications of full mariculture adoption and success.

CAPITULO UNO: SUMARIO DE DIRECCION

Este es un avaluo de los factores sociales y culturales que potencialmente influiran en la traslado a pescadores aldeanas del cultivo marino del Mithrax Cangrejo Rey del Caribe de acuerdo a como este cultivo marino se ha desarrollado en dos lugares experimentales en las Indias Occidentales. Los experimentos estan ubicados en la Bahia de Nonsuch en Antigua, y Buen Hombre en la Republica Dominicana. Los experimentos se derivan de una propuesta que se titulo "Un Proyecto de Cultivo Marino Nuevo para las Antillas Menores," el mismo que fue sometido por la Institucion Smithsonian (Smithsonian Institution), Laboratorio de Sistemas Marinos (Marine Systems Laboratory, MSL) a la Agencia de los Estados Unidos para el Desarrolo Internacional (U.S. Agency for International Development, AID). El referido projecto fue financiado como el Proyecto AID No. 598-065. Este avaluo antropologico y sociologico fue contratado por la Institucion Smithsonian segun se especifica en el P.O. No. ST5080090000 del 10 de Julio de 1985.

TECNOLOGIA APROPIADA

Como resultado del estudio realizado bajo este contrato, varias observaciones se ofrecen que se aplican tanto a Antigua y como a la Republica Dominicana. Parece ser que el Cultivo marino del Mithrax, como actualmente ha sido propuesto por el Laboratorio de Sistemas Marinos, constituye una "tecnologia apropiada" en el sentido mas completo de esa expresion de desarrollo comunmente usada. Los pescadores en ambros lugares mostraron una actitud positiva con respecto al concepto del cultivo marino y parecian listos a tratar de aplicarla tan pronto como la etapa de demonstracion hubiera terminado y la etapa de adopcion en el proceso de transferencia sea alcanzada. Actualmente los pescadores tienen muchos de los valores, destrezas motoras, comprensiones y experiencias que se requeriran para el traslado exitoso del cultivo marino. La unidad principal de adopcion parece ser un equipo existente de pescadores, el cual constituye solo una de las tantas unidades potenciales de adopcion. Los pescadores entienden y parcialmente controlan un sistema de mercadeo de los productos marinos que puede ser utilizado (al menos inicialmente) para la distribucion de los congrejos cultivados a nivel local, regional, e internacional. En

otras palabras, basado en estas facatores, parece ser que el cultivo marino del cangrejo Mithrax sea muy posible de introducirse en esto lugares del caribe.

IMPLICACIONES SOCIALES Y CULTURALES

A pesar de que el cultivo marino del cangrejo Mithrax parece altamente factible, la realizacion de esto depende de un numero adicional de factores sociales y culturales. Economicamente, la mayoria de los equipos de pescadores mismos no serian capaces de aventurar la capital de riesgo para pagar por sus propias unidades de cultivo del cangrejo Mithrax. Es decir que exito requereria la inversion de capital de poco o no riesgo proveniente de fuera de los equipos. Una adopcion generalizada del cultivo marino dependeria del exito de las demostraciones en "vida real" de una o mas unidades demostrativas de produccion. Los pescadores tendrian que adquirir algunos nuevos valores, destrezas motoras, entendimientos, y nuevas experiencias a fin de conducir un sistema del cultivo marino. El equipo de pescadores tendra que ajustar el cultivo marino dentro de una estrategia compleja de adaptacion tipicamente denominada "multiplicidad ocupacional". Si ellos eliminan algunas de las tacticas de adaptacion o simplemente modifican los niveles de obligacion, mutual estos cambios en si modificaran las relaciones sociales de los pescadores con miembros de sus familias y sus comunidades. Mientras que el sistema de mercadeo existente deberia de proveer los medios iniciales para la distribucion del cangrejo Mithrax, algunos aspectos del sistema de mercadeo actual tendrian que ser modificados.

La adopcion total del sistema y el alcanzar los niveles de produccion de las unidades de cultivo marino pronosticados por el Laboratorio de Sistemas Marinos, pueden combinar para crear problemas en los sistemas sociales y culturales de los pescadores y sus comunidades. Por ejemplo, mientras los sistemas de mercadeo existentes deberian funcionar apropiadamente desde el principio de la etapa de adopcion, en caso de darse una produccion maxima por parte del numero esperado de personas adoptantetes, el volumen de cangrejos puede sobrecargar el sistema de mercadeo existente. Participar en el cultivo marino podria reducir drasticamente la pesca y la distribucion de los productos del mar subsistentes. Si el cultivo marino tendria exito de acuerdo a los niveles pronosticados por el Laboratorio de Sistemas Marinos, entonces la estructura jerarquica del sistema social de las aldeas de pescadores podria modificarse drasticamente. Cambios rapidos en la

jeraquia de las aldas pesqueras podrian debilitar la unidad de la comunidad y mas aun podrian modificar la produccion en otros sectores de la economia aldeana.

ACCION RECOMENDADA

En realidad el cultivo marino del Mithrax constituye una tecnologia anhelada y apropiada. Sin embargo, hay varios cambios sociales y culturales que tienen que suceder antes de que la tecnologia sea adoptada, y pudiera tambien producir el maximo beneficio social (Berleant-Schiller 1981:224). Basado en los hallazgos de esta investigacion, estudios comparativos de la industria pesquera, y la teoria de cambio de desarrollo, se recomienda tomar las siguientes medidas: (1) la integracion de factores sociales y culturales en el proceso de planificacions, y (2) la desenvolvimienta de un plan para la ejecucion del proyecto.

Hasta la fecha de la presente investigacion, factores sociales y culturales en el cultivo marino no habian sido cientificamente estudiadas y no tenian un papel formal en las decisiones claves del planeamiento. Los pescadores, quienes a la larga tienen que decidir si adoptan o rechazan el cultivo marino, no han tenido participacion alguna (a) para hacer conocer si ellos sienten la necesidad de realizar cambios en su actividad pesquera, o (b) si el cultivo marino satisface sus necesidades sentadas, o (c) donde un proyecto de demostracion deberia ser ubicado, (d) donde deberia funcionar una demostracion, (e) quien (en el caso de Buen Hombre) deberian participar en el proyecto de demostracion, y (f) como ellos deberian adoptar el cultivo marino si la demostracion resulte tener exito. De acuerdo al punto de vista del investigador, decisiones claves del proyecto han sido tomadas en base a dos postulades: (1) que debido a que esta es una tecnologia nueva, la demostracion tuvo que realizarce bajo las mejores condiciones ambientales, y (2) que la gente pobre en el Caribe inmediatamente reconocera el valor del cultivo marino adoptandolo sin crearse ningun problema. Dado la larga historia de fracasos de proyectos pesqueros en el Caribe y dado los efcetos adversos ampliamente documentados de la "Revolucion Verde" en otras partes del mundo, es sorprendente encontrar la "Revolucion Azul" andando en un vacio social y cultural.

Asumiendo que el analisis previo representa una justa resena historica del proyecto a la fecha, Adonde conducen estas conclusiones? Se recomienda que un plan para la ejecucion del proyecto sea desarrollado tan pronto como sea posible. Ese plan deberia incluir factores sociales y culturales tantocomo consideraciones ambientales.

Adoptantes potenciales del cultivo marino deberian tener un papel significativo en el desessvolvimiento del plan de ejecucion. El plan deberia indicar los pasos que quedan todavia para tomarse en este proyecto. Especialmente importante es la consideracion en desessvolver una nueva etapa de "demonstracion" para "adoptantes inicials" que sea llevado a cabo entre el exito de la etapa experimental unica del cultivo marino y la etapa de adopcion completa. El plan deberia detallar los posibles costos sociales y culturales asi como los beneficios potenciales que produciria la adopcion del cultivo marino. El plan deberia sugerir un procedimiento para asegurar que los adoptantes potenciales han sido bien informados tanto de estos costos comos las beneficios, y que la decision tomada con respecto a la adopcion ha sido alcanzada con pleno conocimiento del asunto. El plan deberia identificar necesidades estrategicas de investigacion, especialmente aquellas que se concentran en la interaccion de los sistemas humanos y tecnologicos. El plan deberia tambien indicar las implicaciones a largo plazo de una adopcion completa pleno del cultivo marino.

CHAPTER TWO: HISTORY, THEORY, AND CULTURE

This chapter discusses the three major contexts within which the Mithrax mariculture must be understood: (1) the history of the project; (2) a theoretical perspective on planned change that guides the project; and (3) the society and culture of the people for whom the development is occurring. First, every development project has a unique history that is a product of predicted and unpredicted events, negotiations by multiple actors, emergent knowledge, and trials and errors. Once established, a project's history in great measure influences where it will go in the future. This is especially true of highly experimental development efforts like this one.

The second context is that of developmental theory. Much development activity occurs in an explicitly atheoretical context, or so it seems by the absence of formal theoretical discussions in many development proposals. In fact, however, a development proposal takes a theoretical stance implicitly even though it never appears in formal documents. Such theories are often held in the minds of the project director and serve to guide a project only to the extent that a director can influence decisions. When other actors assume decision-making responsibilities on a project, even for day-to-day decisions, they can push the project in new directions by their implicit theories of development. Evaluation and social impact predictions are more accurate when the theories guiding a development effort are explicit.

Finally, the third major context within which this project must be understood is that of the people who should be helped by the development effort. Of special concern here are the major elements of their history, society, and culture that have influenced, or can or will influence the unfolding of the developmental effort. For the Caribbean culture area the key issue is the long history of being reformed and utilized to suit the developmental needs of Europe and the United States.

PROJECT HISTORY

THE SMITHSONIAN PROPOSAL

On September 20, 1983, a proposal entitled "Primary Production of Algal Turfs and the 'Caribbean King Crab'" was submitted by Dr. Walter Adey (Director, Marine Systems

Laboratory, National Museum of Natural History, Smithsonian Institution) to the United States Agency for International Development. That proposal defined the major scientific and developmental goals against which the present social soundness analysis must be understood.

In that proposal, Dr. Adey expressed the belief that recent scientific findings regarding the growth of algal turfs could be utilized to help solve economic and subsistence problems of the planet. Algae is one of the major types of plants that grow on a coral reef. Forty or more algae species often live together in colonies on the surface of the coral. These colonies, called "turfs" by scientists, "...produce dense, lawn-like mats of rapidly growing vegetation that contribute to make coral reefs ...the most productive of ecosystems in the biosphere" (Adey 1983:9).

These scientific findings led to what is called the "coral reef question"--that is, how can we understand the enormous biological productivity of coral reefs when they are contrasted with the low levels of nutrients of their environment, the oceans. Oceans are often termed "biological deserts." One answer to this question derived from the Living Reef Exhibit produced by the Marine Systems Laboratory (MSL) at the Smithsonian's Natural History Museum. The Living Reef Exhibit enabled Dr. Adey to experiment with algal turf grown on artificial surfaces. He was able to replicate the natural turf communities on fiberglass screens and achieve high levels of growth. The natural grazing of reef animals was duplicated by scraping (or harvesting) algae from the screens. Dr. Adey simultaneously solved the "coral reef problem" and discovered a mechanism for harvesting the productivity of the coral reef. The technological breakthrough was termed "algal turf scrubbers" and was registered as U.S. Patent #4,333,263.

The next phase of Dr. Adey's research involved finding practical applications for this new technology. MSL scientists working on the research vessel the Marsys Resolute, found that a few hundred screens, cages for raising animals that harvest algal turf, and the natural movement of ocean currents are all that is needed to farm the sea (see Photo 1). The screens are about the size of a normal house window and are made of a wood or plastic frame and a fine mesh plastic screen. The MSL scientists found that growth rates varied with the depth of the screen in water and whether it was held upright or flat in the water (see Photo 2). Most important, however, was the amount of

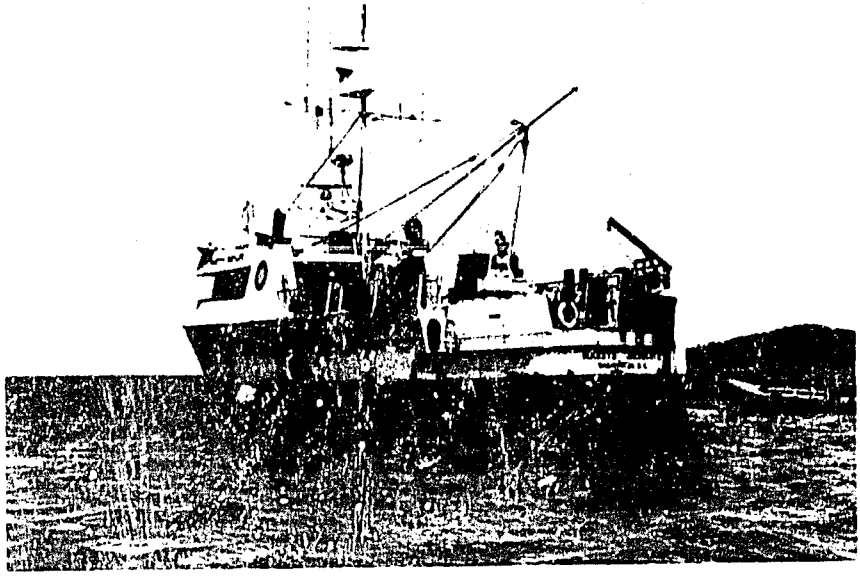


PHOTO 1: Marsys Resolute, Smithsonian Marine Systems Laboratory research vessel, Nonsuch Bay, Antigua.

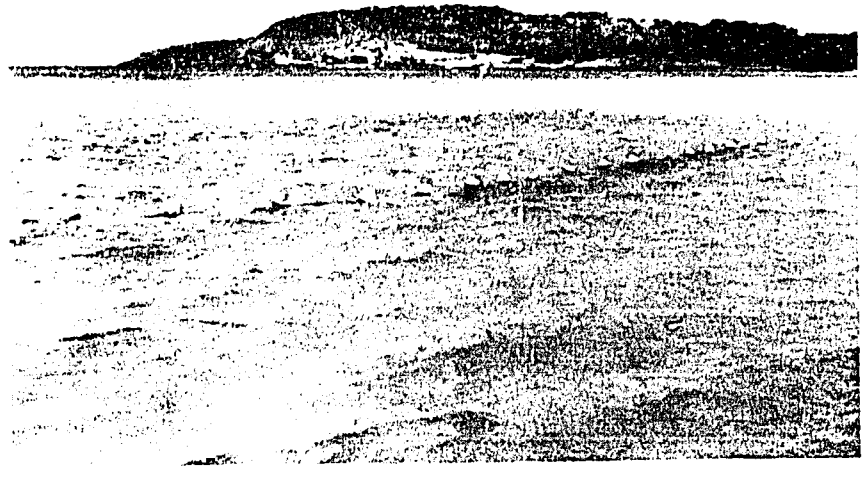


PHOTO 2: Scientific experiment involving algal screens suspended upright inside the Nonsuch Bay reef.

water flowing over the screens. More wave action results in more algal growth.

Cages with frames of wood and plastic are utilized to combine the turf algae laden screens with some sea animal. Some type of ocean animal that eats algae is placed in the cages. Experiments have demonstrated that fish, conch, and crabs can be raised in such cages. The cages permit the algal screens to be changed once the turf is eaten away by the animal. In general, the more often the screens are changed, the faster the animal grows. This raises a conflict in the decision to locate the technology. The algae laden screens grow best in heavy waves, but the animals grow best in quiet water. Thus, the screens are best located near the outer portions of reefs and the cages are best located in quiet bays. This means frequent trips in and out of heavy seas for mariculturalists who must tend these screens and cages.

When a land-based hatchery is not available to provide juveniles of the species being raised, small floating boxes called "baby cages" are used to house gravid females until the release of their eggs (see Photo 3). The small rectangular cages (.45m x .75m x .30m) are covered with a 2mm polyester monofilament screen. When the babies are released, the mothers are removed from the cages.

The new babies remain in this protected environment until they are large enough to compete with other animals. Changing the algal turf screens in baby boxes is dangerous for the babies inasmuch as the screens may contain predators. Only one closely searched screen may be placed in the box while the babies are growing to the juvenile stage (see Photo 4). Babies are kept in the box for up to 100 days. Then, the juveniles are moved to larger, floating "grow out" boxes where the mesh is more open and the screens can be changed daily or as necessary.

This technology is inexpensive to build, labor intensive to operate, and easy to learn, thus suggesting the technology can be readily transferred to a food hungry and economically poor world. Marine Systems Laboratory scientists were struck with the similarity between this mariculture innovation and those agriculture innovations that led to the "Green Revolution." The comparison is convincing, and the term "Blue Revolution" is now being utilized to summarize the potential worldwide impacts of the algal turf scrubber technology (Miller 1985:220).

The U.S. Agency for International Development (AID) recognized the developmental potential of the algal turf scrubber technology and funded a three-year project that was

PHOTO 3: Mithrax "baby box" (foreground) and MSL scientific experiments involving algal growth (background), Nonsuch Bay.

PHOTO 4: Searching algal turf screen for predators before placing it in the baby box, Nonsuch Bay.

to begin October 1, 1983 and continue through September 30, 1986. The proposal carried the following commitments (Adey 1983:iii):

> (1) To carry out basic laboratory and field research on the factors controlling community structure and the internal dynamics of algal turfs. Understanding this system will likely lead to optimizing production.
> (2) To establish a base of operations in Grand Turk, Turks and Caicos Islands in January 1984, to develop over three years a "Caribbean King Crab" fishery for 20-50 fishermen.
> (3) To extend this entirely new approach to mariculture to at least two other Caribbean countries in 1985 and 1986.
> (4) To develop a variety of other fisheries based on algal turfs, as well as direct uses for the turf itself.

This proposal focused the efforts of the Marine Systems Laboratory in three special ways. First, they committed to the Caribbean as the region where the technology would be tested. Second, they selected the Caribbean King Crab--Mithrax spinosissimus, Lamarck--as the target species for the pilot stage of their efforts. Third, they committed to first transferring the technology to local fishermen. Additionally, the proposal suggests but does not detail a "physical field support" role for Earthwatch and the Peace Corps (Adey 1983:68).

SOCIAL AND ECONOMIC SOUNDNESS STUDIES

The present social soundness analysis was funded on July 10, 1985 (Smithsonian Institution P.O. No. ST5080090000). A sister study, headed by Dr. Rubino of The Traverse Group, Inc., focused on economic soundness and was funded at the same time. By this time, the Marine Systems Laboratory project was approaching its third year of AID funding. By the time the present study was initiated, two original mariculture projects had been well-established on Grand Turk and South Caicos islands, and two new mariculture sites were started, one on the north coast of the Dominican Republic near the village of Buen Hombre and a second on the northeast coast of Antigua near the village of Willikies. Plans for two additional sites were underway for Puerto Viejo, near Azua on the south coast of the Dominican Republic, and on the island of Carriacou, which is within

the nation of Grenada. Thus, a total of six Mithrax mariculture sites were planned or under way during this social soundness analysis.

Like the original Turks and Caicos sites, new MSL projects retained a focus on Mithrax crab even though MSL was experimenting with other algal-feeding species in the Turk and Caicos. Lack of adoption by local fishermen in the Turk and Caicos caused MSL to consider other individual fishermen adoption scenarios in the Dominican Republic and Antigua and to work with an expatriate company to develop a commercial pilot project in Carriacou, Grenada.

The social and economic soundness analyses, conducted by Stoffle and Rubino during the summer of 1985, were limited in scope to considering the pilot projects on the north coast of the Dominican Republic and in Antigua. No analysis of the Grand Turk, South Caicos, Azua, or Carriacou sites was requested.

By the time the social and economic analyses were funded, scientific research had proceeded as expected and there appeared to be few unexpected problems with the actual production of Mithrax crabs. Lack of adoption by local fishermen in the Turks and Caicos, then, appeared to derive from social or economic considerations rather than from problems with the mariculture technology. Questions of particular concern were:

(1) Who are the most appropriate adopters for the technology?
(2) Does the technology fit with existing local technology?
(3) What impact will the technology have on current social and cultural systems?
(4) What impact will Mithrax crab production have on the current market system?

These four primary questions were supplemented by a series of more specific questions having to do with either social or economic considerations. Social questions included the factors affecting the choice of fishing mode, role of non-fishing family or community members in the fishing sector of the economy, and the relationship of fishermen to persons in other sectors of the economy.

THEORIES OF DEVELOPMENT

In addition to questions deriving from the perceptions of the Smithsonian proposal or AID personnel, certain questions derive from the scientific literature on

development. Of particular importance for this analysis are macro theories that attempt to explain why whole societies and cultures change. Such theories define the broadest parameters within which any particular planned change effort must occur. It is also important to consider micro theories that attempt to explain why particular planned changes may or may not succeed.

MACRO THEORIES

Much of the literature on development assumes that there are advanced forms of social organizations. Today, the western post-industrial society is held up as the most advanced. These theories further assume that all societies evolve toward such superior forms of social organization as a natural evolutionary process. Pre-industrial societies that fail to evolve are assumed by these theories to face extinction. Thus change toward superior forms of social organization is viewed as adaptive to this macro process and resistance to such change is viewed as maladaptive.

Societies that have not had the opportunity to evolve are called traditional, premodern, or undeveloped. The assumption is that people in these societies simply require opportunity and they will become modern and developed. If the society has had the opportunity to become modern and fails to do so, it is termed backward or underdeveloped. Such a condition sets into motion a number of research questions focused on what is wrong with this society inasmuch as it failed to accept an opportunity to change. Often such questions focus on what is wrong with individuals or groups or types of people who are most resistant to change.

Modernization Theory. Modernization Theory is a type of macro theory that combines social evolutionary theory with a theory of development. Modernization theory makes the assumption "...that it is impossible for a state to move into the twentieth century if its people continue to live in an earlier era" (Inkeles and Smith 1974:3-4). From such a perspective, the research is focused on the need to better understand the process of changing individual personalities from traditional to modern. Modern personality qualities are those likely to be inculcated by efficiently and effectively participating in large-scale modern productive enterprises such as the factory (Inkeles and Smith 1974:19).

Developmental Change Theory. In contrast with the social evolutionist theory are what can be defined as developmental change theories (Gallaher 1968). These theories do not deny that different forms of social

organization and cultural systems have been in competition and replaced one another through time. Instead, developmental change theories challenge the assumption that the social and cultural change must be evolutionary, in that it is unidirectional and governed by inherent Darwinian principles. Edward Spicer perceived developmental change as follows:

> (It is a) process which is directed toward a new kind of integration...(It) may be evolutionary or not. If it is evolutionary, it aims at a new level of integration, but all new integration is not necessarily of this kind. Some forms of new integration may definitely block or inhibit evolutionary development (1968:196-198).

Developmental change involves local people in the evaluation of a proposed project, and this process can lead to a decision not to adopt new technology as well as to change traditional patterns of social organization or culture. In other words, "if it is really developmental change that is desired, then allowance must be made for adaptation of the plans and the people planned for..." (Spicer 1968:197).

Following in this theoretical tradition, Wallman maintains that autonomy is a key parameter in developmental change. Because development usually involves costs as well as benefits for the people being developed, the people must retain the power to decide whether or not to give up what they must in order to gain what they desire. Drawing upon Galtung's (1973) "mini theory of power," Wallman maintains that any development project should consider self-respect, self-sufficiency, and fearlessness as facets of autonomy:

> (1) self-respect is no longer taking for granted that the ideas of others are superior to one's own.
> (2) self-sufficiency follows from the ability to make do with one's own resources; and
> (3) fearlessness replaces anxiety about losing what one has, even losing what one is (1977:11).

Wallman concludes that autonomy should be an essential parameter of developmental change models because development either can leave a people more independent or it can increase their dependency. Development, for those who are subjects of it rather than subjected to it, means both better meeting basic needs and achieving greater autonomy and authenticity of self and/or nationhood (Wallman 1977:12).

MICRO THEORIES

Micro theories are focused on aspects of social and cultural change as these involve the relationship between specific knowledge or technologies and specific societies, groups, or institutions. Only two of the many potentially relevant micro theories have been chosen for discussion in this analysis. These theories seem to address issues or perspectives that are most important for understanding and predicting the impact of *Mithrax* mariculture. Full understanding of the impacts would involve the additional perspectives of other theories.

Utilization of scientific knowledge. Knowledge utilization is concerned with why scientific research findings do or do not get used by persons or organizations who could logically profit from the findings (Glaser, Abelson, and Garrison 1983; Tornatzky et al. 1983). Knowledge utilization research has been a response to a growing national and international awareness that scientific knowledge will not be utilized simply because it is "timely, relevant, objective, and given to the right people in usable form." Instead, "bureaucratic, ethical, attitudinal, and social considerations take precedence over the value of information in its own right" (Caplan 1980:4).

Knowledge utilization brings an essentially new perspective to international development projects like the *Mithrax* mariculture. It lacks the condescending "Big I, Little You" element so common in the literature on Third World development. Instead, it considers the adoption and utilization process as being conducted in a more egalitarian environment. Because it was developed out of a concern for the utilization of knowledge by socially and politically powerful adopters, it views adopters and their social and cultural commitments as equally important as those of the scientists in the adoption and utilization process.

Utilization research, according to Caplan (1983:255-256; Caplan, Morrison, and Stambaugh 1975:x-xi), can be classified by one of three major theoretical orientations.

1. *Knowledge-Specific Theories*. These explain nonutilization of scientific knowledge as a consequence of the findings themselves, the research techniques, or the behaviors of the scientists.
2. *Two-Communities Theories*. These explain nonutilization in terms of the relationships

between the researchers and the systems within which they work and the potential adopters and their work systems. The scientists and adopters live in separate worlds with different and often conflicting values, different reward systems, and concerned with different issues.

3. Adopter Constraint Theories. These explain nonutilization in terms of constraints under which the adopters must operate. Such contraints include time frames for receiving information, only having a few variables that are open to manipulation, and whether the decision is politically feasible.

The more egalitarian perspective of utilization research permits the scientist to focus inwardly upon himself, his knowledge, and his system as a potential source of nonutilization rather than conveniently attributing the causes of nonutilization to problems with the potential adopters. Similarily, when nonutilization appears to stem from conflicts between the scientific and adopter systems both systems are viewed as legitimate. Shared conflicts are often cured with mutual adjustments. This is in contrast with most development theories, which resolve conflicts between scientific ideas and traditional adopter systems to meet the demands of the former.

Ethnoscience: Development From Below. Development efforts based solely upon the skills, knowledge, and planning inputs of Western developers and Western-trained local developers have often failed. Generally called "top-down" development, these projects have often failed because they lacked the inputs of local people. So common are such failures that developers are proposing that development must not only take into consideration local inputs but that it should begin at the local level--that is, "bottom-up development" (Pitt 1976; Stohr and Taylor 1981).

In addition to arguments based on the rights of local people to a measure of autonomy over their own societies and resources, it has been argued that local people have a scientific data base that is as valuable or even more valuable than those of the Western scientists (cf. Brokensha, Warren and Werner 1980; Glick 1981). This local scientific data base, termed "ethnoscience" has now been documented for dozens of developmental cases throughout the world. Utilizing indigenous knowledge systems in development projects is a simple recognition that human groups living in an environment for generations perhaps for thousands of years, learn about that environment and accumulate this knowledge (Stoffle, Jake, Bunte, and Evans

1982:108-116). Their success as human groups in these environments hinged upon the accuracy of their ethnoscience and the appropriateness of resultant adaptive strategies (Stoffle and Evans 1976). Similarly, new development efforts derived from distant parts of the nation or from other countries can profitably draw upon the local knowledge base.

In retrospect, some recognition of ethnoscience utility probably was a stimulus for planners who shifted their efforts from planned change based on social evolutionary models to those of developmental change. Earlier arguments, however, were primarily based on socio-political stances argued in terms of human rights and the failure record of top-down planning projects. Today these positions are being strengthened by an expanding knowledge of ethnoscience data bases and by cases where ethnoscience has been used successfully in development projects. Development theory has literally been stood on its head by ethnoscience.

Fishery Modernization Theory. Various components of modernization and developmental theories have been focused on the issue of planned change efforts with traditional fisheries. According to Maiolo and Orbach (1982:1) a key result of many contemporary efforts to modernize fishing is to reduce local fishermen's control over decisions that affect themselves and their fishery. Modernization efforts involve a centralization of authority and reponsibility for what then becomes a policy for the management of fishery. This centralization derives in part from the need to integrate local policy decisions with national and international policies. In this instance, centralized decision making can prove useful for protecting local fishermen and fisheries. On the other hand, centralization may also occur in order to perpetuate and expand national bureaucratic organizations (Maiolo and Orbach 1982:5). In the latter instance, the fishery policies can have little value to local fishermen, who often resist and eventually undermine the policies.

Unlike so many theorists who perceive modernization as an inevitable process of sociocultural evolution, Maiolo and Orbach (1982:7) perceive change to be a two-way process and reversible. Just as the fishermen's traditional systems must adjust to the managers of fishery policy, so too must the managers and their modern systems adjust to the fishermen. The modernization process is perceived to be reversible if planned change efforts are not sensitive to traditional systems. Technology can be rejected after it is adopted and cooperatives can fail for lack of membership support (Pollnac 1982:236,240).

Subsistence-Commercial Market Theories. In addition to models that concentrate on social and cultural variables in development, there are other potentially relevant theories focused on the dynamic interaction of traditional subsistence and commercialized marketing systems. This literature is especially important because it deals with cases that closely parallel the potential impacts of Mithrax mariculture on the subsistence markets in Antigua and the Dominican Republic.

Dewey's (1962) research on the peasant marketing system in Java was the first to document a dynamic relationship between the peasant subsistence market system and the national commercial market system. According to her theory, each system is guided by different operating principles and has different sociological and cultural implications for the local producer. Basically, the two marketing systems mutually conflict and compete.

The research of Forman and Reigelhaupt (1970) on changing market systems in northeastern Brazil indicates that the subsistence market system of peasants makes an important social and economic contribution to the region and even the nation. They conclude that:

> the Brazilian peasant is not an 'economic zero' who buys little and sells little..., but an integral part of national patterns of food production, distribution, and consumption. He is deeply involved in regional and national marketing systems and reacts to changes in these systems (Forman and Reigelhaupt 1970:189).

When the national commercial market system "takes over" the local peasant marketing system, certain adverse impacts occur in Brazil. The commercialization of the subsistence oriented market system not only displaces the peasants from the system but adversely affects production, "...leading to an insufficient supply of food staples to burgeoning urban centers and to widespread discontent in the countryside" (Forman and Reigelhaupt 1970:189).

The Brazilian case further suggests that the "take over" occurs as a process that has a series of steps, each in turn having its own consequences. This process can be understood as a developmental cycle that may occur whenever a peasant market is changed into a commercial market. Figure 1 presents the five stages of this transition. Note especially, the modifications in social relationships that occur during this transition. The stages are explained as follows (Forman and Riegelhaupt 1970:207-209):

FIGURE 1: STAGES IN THE COMMERCIALIZATION OF MARKETING SYSTEMS*

Stage	Participants	Predominant Types of Markets	Marketing Inputs	Production Inputs
1.	pp-co	Local Market Place	Labor intensive	Labor intensive
2.	pp-mm-co	Local Market Place and Distribution Fair	Labor intensive	Labor intensive
3.	pp-mm-W-co	Distribution Fair with increased growth in local Market Place	Increased capitalization through wholesaling	Labor intensive
4.	pp-W-co	Distribution Fair and Urban Consumers' Market	Increased capitalization on all levels of distribution	Labor intensive
5.	alternatives:			
	(a) P-W-co	Urban Consumers' Market	Capital intensive	Capital intensive
	(b) pp-Wmm-co	Marketing cooperatives for urban areas	Capital intensive	Capital intensive
	(c) Ppp-W-co	Urban Consumers' Market	Capital intensive	Capital intensive through voluntary cooperation

pp = peasant producer co = consumer mm = middlemen W = wholesalers P = large-scale producers

*Source: Shepard Forman and J.F. Riegelhaupt, 1970. "Market Place and Marketing System: Toward a Theory of Peasant Economic Integration," in Comparative Studies in Society and History, 12 (2): pp. 180-212.

Stage 1: The peasant retails his own goods in the local market place. There are strict controls over the marketing of certain produce.
Stage 2: The incipient upward flow of goods by peasants who sell to middlemen. This occurs primarily at the local market place but also at distribution fairs. Most sales to middlemen are done on credit, the producer being paid immediately after the cash resale has been transacted. Up to now both stages have labor intensive production and distribution.
Stage 3: Middlemen go to the source to buy in larger quantities and sell either in the market place or, occasionally, to wholesalers. Initial transactions are usually on credit while subsequent sales are for cash. Production is labor intensive but marketing is capitalized. The growth of the local market is stimulated.
Stage 4: Wholesalers begin to by-pass the middlemen and go directly to the peasant producer. Since they pay cash, the peasant producer is willing to sell on a first come first served basis, often at a lower price. A high degree of capitalization is involved in the distributive sector. Prices for the entire system are controlled at this level by the wholesalers.

Between stages 4 and 5a, a transition occurs in which market demands require adjustments in the structure of the agrarian society. This leads to a number of possible alternatives:

Stage 5a: Wholesalers operate in highly capitalized economies of scale and deal with large-scale producers who assure a steady and continuous supply of food staples at a central delivery point. Credit predominates.
Stage 5b: Foodstuffs are grown on small individual plots and marketed through cooperatives.
Stage 5c: Peasants form cooperatives for the production and sale of goods to wholesalers. Only cooperatives are viable at this level.

Throughout this developmental cycle, the peasant marketing system becomes increasingly supplanted by the national marketing system. This results in an overall commercialization of interpersonal relations in the peasant community.

Of special importance is the loss of large numbers of

middlemen. These middlemen often serve a range of functions for the traditional fishermen. Having a number of middlemen, each making small purchases, spreads the economic risks both for themselves and the peasant producer. This pattern is especially adaptive in economic situations that are extremely marginal (Acheson 1981:282; Forman and Riegelhaupt 1970:201-203). Pollnac's (1982:233-234) analysis of why fishermen in Costa Rica selected their middlemen suggests that the price offered for fish was most important to urban fishermen. In contrast, rural fishermen more highly valued a middleman's personal services and cultural sensitivity. Kottak's (1983:101-105) analysis of a Brazilian fishing village demonstrates that middlemen who did not learn local customs and presented themselves as superior to the fishermen were marginalized. Partially due to the insensitivity of outsider middlemen, increased commercialization of fishing eventually led local villagers to assume all middlemen marketing functions. This is a notable negative case to the developmental cycle of peasant market commercialization documented by Forman and Rieglehaupt, thus suggesting that the typical commercialization cycle is not inevitable.

KEY ELEMENTS OF CARIBBEAN CULTURE

The culture of a people will always influence the outcome of a development project because people incorporate their beliefs, values, and norms into their behavior. The more voice they have in the operation of a development project, the more these elements of their culture can be incorporated. Cultural elements are one set of parameters in any development project.

Theoretically, all elements of a people's culture potentially impact a project. Some elements, however, are more immediately relevant to any specific project. Because certain cultural elements are shared from society to society, the Caribbean is defined as a "culture area." The following is a discussion of three shared elements that have importance for understanding the relationship of mariculture and the people of the Caribbean culture area: (1) sovereignty, (2) subsistence fishing, and (3) occupational multiplicity.

SOVEREIGNTY

The West Indies were created by European nations to serve as their tropical kitchen gardens. Being much closer to Europe than the East Indies, the islands of the Caribbean

were systematically modified by a massive planned change effort that impacted the entire planet (Crosby 1972). Not only were thousands of plants moved to the West Indies to be produced in industrial agriculture systems called plantations, but millions of people were brought there to provide the labor. Eric Williams (1966) suggests that these peoples be called "unfree laborers." Whether they were relocated American Indians from the Virginia colony, paupers from the streets of London, Hausa from West Africa, Scottish prisoners of war, or indentured East Indians, all unfree laborers were subjected to the industrial agricultural demands that dominated the life and economies of these West Indian colonies.

After hundreds of years of colonial intervention and decades of postcolonial intervention, few issues are of more importance to West Indians than sovereignty--the power to decide for themselves what should be. Sovereignty issues involve politics, economics, education, social structure, and culture. They range from wanting the United States to leave Grenada, to resenting foreign investment, to wanting to set the competency exams for high school leavers, to rejecting the European definiton of legal marriage, to demanding the right to define non-European phenotypes as beautiful. Concern for sovereignty is manifested in the personality of school children who demand respect from teachers, the man and woman who desire a separate house for their nuclear family even if it is but two feet from a parent's home, the difficulty of establishing cooperatives, and the Rastifarians' desire to return to the freedom of Africa and leave "the Babylon" of the West Indies. Frank Manning (1978:201) has suggested that in Antigua, and perhaps elsewhere in the Caribbean, even carnival performances for tourists are a symbolic device for expressing national and racial sovereignty.

The list of behavioral manifestations of sovereignty goes on and on. How can sovereignty be defined? One definition seems most appopriate for colonial situations like the Caribbean. Maxwell Owusu (1975:33) suggests that sovereignty be used as a sociological variable that defines the relationship between competitive or rival political publics and states. In order to avoid the issue of legal sovereignty, Owusu suggested that it be defined as:

> ...the probability that a given group or groups have the capability and resolve to control, make, and execute effectively major and vital policy decisions in the face of significant opposition from other groups, internal or external (1975:33).

Perceived in this way, the decision of a group of local fishermen to undermine a development project that has encroached upon their traditionally owned but legally open fishing grounds is an expression of sovereignty.

The point is that sovereignty ranks as one of the more important pan-Caribbean values that define this as a culture area (Williams 1970:500-504). Any project designed to help Caribbean people should therefore consider sovereignty as one of the major parameters in the success or failure of the project.

SUBSISTENCE FISHING

Early economic studies of West Indian society largely ignored subsistence activities. Perhaps the plantation system of production so dominated the social organization of West Indian societies (Wagley 1957) that economic studies tended to focus upon wage labor. Even in the landmark research of M. G. Smith in Grenada (1965:131), analysis was restricted to taxable income. Studies of isolated peasant villages, however, tended to place more emphasis on subsistence production (cf. Banks 1956; Horwitz 1967:24-38). Still these studies often perceived subsistence production as what a West Indian does when there are no wage labor options (Horwitz 1967:24).

Mintz's (1956) analysis of rural sugar plantation villages on the coast of Puerto Rico provided a new perspective on subsistence fishing. Plantation agriculture provided most of the cash for the people but subsidiary economic activities, like fishing, were valuable in terms of providing meals, ceremonial obligations as a means of fulfillment, and meaning and motivation in the cultural life of the people (Mintz 1956:360). Mintz noted that people who were defined as full-time fishermen spent some time working in the cane during the height of harvest, and many full-time sugar cane workers fell back on their fishing skills during the slack season in cane (Mintz 1956:362). Mintz documented the importance of local people having more than one occupation in order to adapt to the seasonal and marginal economies of the Caribbean.

Subsistence fishing can derive from two occupational strategies: full-time or part-time commitment to fishing. The primary goal of the full-time subsistence fisherman is to provide basic needs for himself and others who are dependent upon him. His catch is valued by all the people in his home community, as well as by the dispersed network of people who receive the fish. Obviously, the fish

themselves satisfy a basic need by serving as food. The fish also serve as an item of barter when they are exchanged for a "culturally recognized" amount of some other basic commodity. Finally, the fish are utilized as gifts to establish and maintain social relationships that can be relied upon for help with basic need problems at some future time. Fish, so utilized in this subsistence system, are often better for establishing basic needs security than cash would be. Fish are usually available while the supply of cash is often unreliable. In contrast, the part-time subsistence fisherman, engages in subsistence fishing to supplement his diet when wage labor or the commercial market for the fish fails. The part-time subsistence fishermen may also fish for recreation (Wilson 1973:21) and even to fulfill cultural needs (Mintz 1956:362).

Contemporary studies suggest that both full-time and part-time subsistence fishing are essential economic components of normal West Indian adaptive strategies (LaFlamme 1985:35), at least for small islands (Wilson 1973:20-21) and for communities located along coastal regions of large islands. In Grenada, for example, a study conducted as part of the Fiscal Reform Project assigned Eastern Caribbean (EC) dollar values to subsistence activities called "direct production." The average farming and fishing family earned or saved $2,935 EC a year when both wages and direct production are counted (Burpee, Morgan, and Dragon 1986:16). Of this annual income, only an average of $706 EC was derived from wages. Although most people expressed a desire for more wage labor, the least interest was expressed by rural people having the highest levels of direct production (Burpee, Morgan, and Dragon 1986:12). Instead of being used as substitutes for one another, wage work is utilized to increase direct production (Burpee, Morgan, and Dragon 1986:17). Findings from this Grenada study suggest that high levels of direct production have long-term adaptive advantages for the people of the West Indies and should not be perceived as a "problem" to be "cured" by wage-labor developments.

OCCUPATIONAL MULTIPLICITY AS AN ADAPTIVE STRATEGY

The concept of dependency, like that of fishing for subsistence, has many important dimensions. Few people, including adolescents, are fully dependent in the Caribbean. Young children assume a wide range of commitments such as maintaining the house, caring for siblings, herding or staking animals, and gardening. Adults are involved in a wide range of subsistence and cash activities designed to

assure the maintenance of themselves, family, and friends.

In general, a person becomes involved in a social web of mutual dependencies that are designed to maximize the personal resources of the individual. Such resources include skills, physical property, kin ties, and even nonmaterial elements such as prestige and respect (Wilson 1973). The term "occupational multiplicity" (Comitas 1973) has been used to describe the web of subsistence and economic activities that constitute the adaptive strategies that groups, villages, or societies make available to their members. According to Comitas' analysis of five rural Jamaican fishing villages:

> The social organizational implications of occupational multiplicy have intrinsic significance...A worker in one of these settlements theoretically, can be involved in as many as six different economic statuses: subsistence cultivator, commercial agriculturalist, wage laborer, own-account artisan or tradesman, subsistence fisherman and commercial fisherman. In each status, he is interlocked with a distinct set of individuals who perform requisite roles in production, distribution and consumption (1973:170-171).

This occupational web, however, cannot be understood apart from a more encompassing web of social relationships designed to provide personal and family security. The man who is involved in mixed fishing and farming may exchange free labor in the fields and work with a three man fishing a crew, be tied to higglers (hawkers) who sell the excess subsistence fish and agricultural produce, and be organized into island-wide producer associations (Comitas 1973:171). This pattern of having multiple occupations requires a set of culturally defined rules which help establish work priorities and schedules. People are tied into a convoluted set of social obligations that connect the members of horizontal socioeconomic segments of society. The participants in this system understand that it creates a socioeconomic balance "which offers maximum security with minimum risk, in a basically limited environment" (Comitas 1973:171).

Comitas (1973:171-172) concluded that the system of occupational multiplicity does have certain disadvantages for its participants. It causes tensions, reduces individual social mobility, and restricts capital accumulation. In other words, the system provides community

stability at the expense of individual mobility. This type of adaptive strategy is a serious barrier to the success of action programs aimed at the socioeconomic amelioration of such people but based on uni-occupational models (emphasis added) developed in Western countries.

> Occupational pluralists in Jamaica will not reject the material aid that often accompanies such schemes but they do reject...the objectives and the intent of these programs. By their own logic, they find it impractical to develop fully one aspect of their economic life to the detriment of others (Comitas 1973:171-172).

Comitas illustrates his point with reference to a series of fishery projects that had just failed in the five fishing villages under study. Examples of such project failures continue to fill the professional social science literature on fishery development in the Caribbean.

CHAPTER THREE: THE ANTIGUA PROJECT

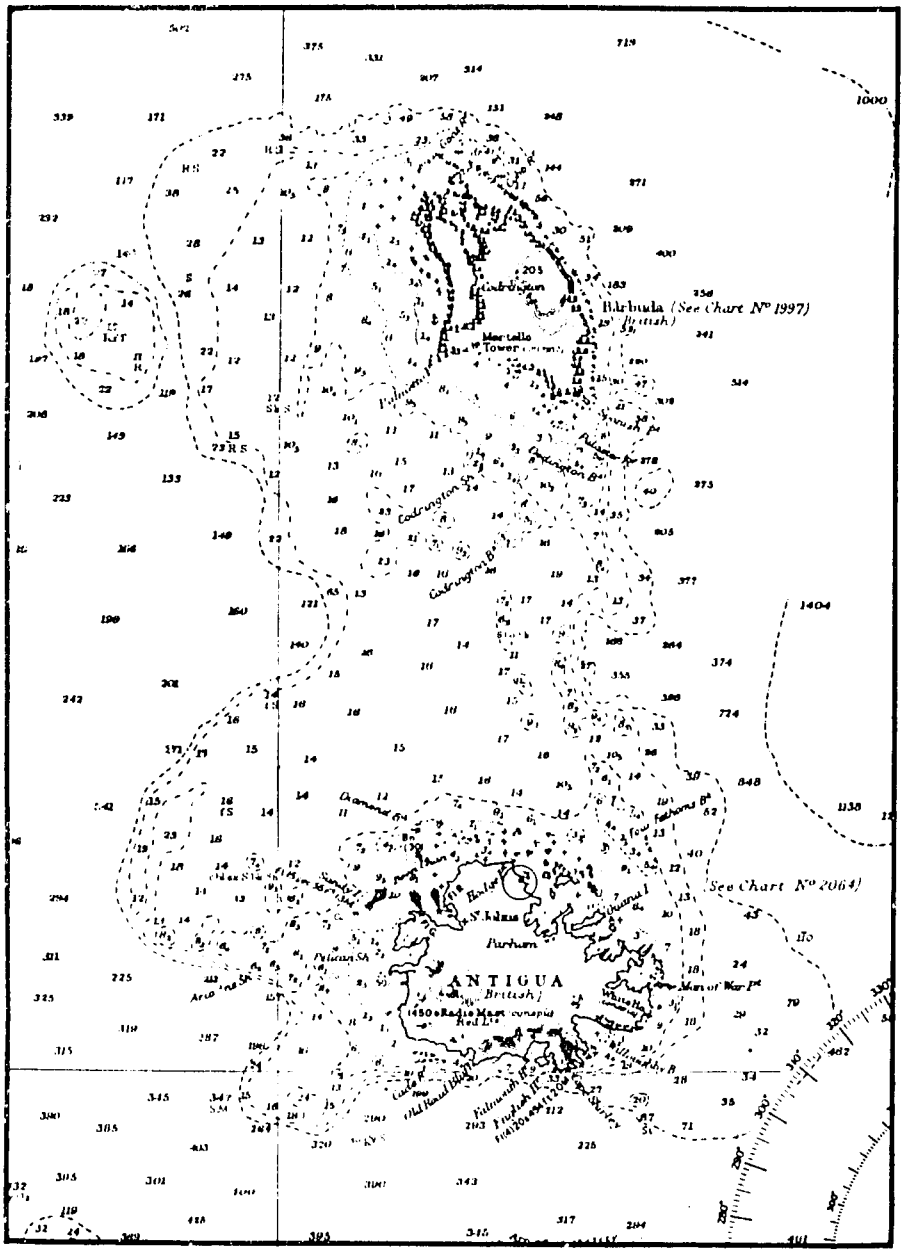
This chapter discusses the Smithsonian Mithrax mariculture project located in Nonsuch Bay on the island of Antigua (see Maps 1 and 2). The chapter presents some relevant historical background to the project as it has been uniquely worked out in this site. In addition, the chapter discusses the various project adoption scenarios as these relate to the types of fishermen located in the island. Then, certain social and cultural characteristics of prime potential adopters, the mixed-fishing type of fishermen, are discussed in relation to the demands of the Mithrax technology. Finally, the recommendations for the island are presented.

PROJECT HISTORY

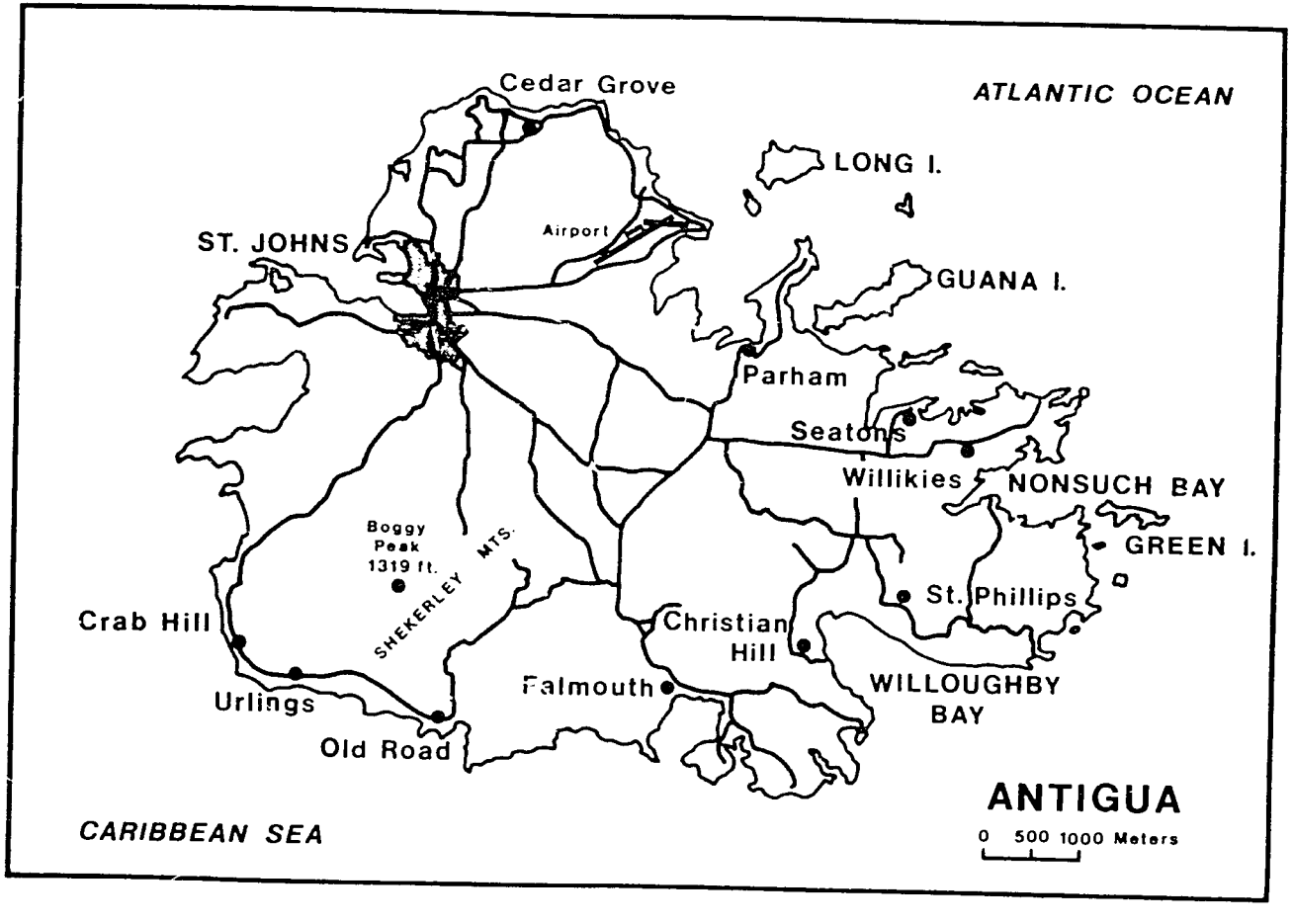
The country of Antigua and Barbuda received the fourth Smithsonian Marine Systems Laboratory (MSL) pilot site. It is located on the northeastern portion of the island of Antigua in Nonsuch Bay. The nearest fishing community to the site is Willikies. Impetus for selecting Antigua as a pilot site derived from the Peace Corps, which has an active program in the country. At the request of the Peace Corps and with additional funds provided by the Agency for International Development, the Smithsonian entered negotiations with the government of Antigua and Barbuda. As part of these negotiations, members of the MSL surveyed the island of Antigua for a site containing an ideal combination of environmental variables for Mithrax crab mariculture. Such a site was found in Nonsuch Bay. Then, the government of Antigua and Barbuda defined the pilot project as falling within the scope of an existing agreement, dating back to 1980, between themselves and the Peace Corps that permits the Peace Corps to operate development projects in the country. In the final memorandum of agreement, MSL added to their initial AID contractual obligations:

> (1) To train Peace Corps Volunteers in the production of algal turfs and to use this production to carry out mariculture activites, including the establishment of a hatchery and fishery operation using the Spider Crab, with Antiguan fishermen trained and assisted by the Peace Corps Volunteers.
> (2) To work with the Peace Corps Volunteers and

MAP 1: Antigua and Barbuda, showing ocean depths



MAP 2: Antigua, showing road system and major towns



the Ministry of Agriculture (fisheries office) and private entrepreneurs to develop the appropriate processing and marketing of Spider Crabs.
(3) To provide technical assistance to the Peace Corps Volunteers, private sector and Ministry of Agriculture individuals during a second year's activities which will focus on the commercialization aspects of the project (Antigua and Barbuda Government 1985: Annex I, 1-2).

This extension of the original AID contract reflected MSL's emergent concern that individual fishermen might not be the only or the best adopters of the algal turf scrubber mariculture. Also, among the three countries where Peace Corps Volunteers (PCVs) are associated with MSL mariculture pilots, it is the most specific definition of the role relationship between the Smithsonian project and the Peace Corps. The memorandum of agreement, however, more clearly defines the obligations of the Smithsonian than it does those of the Peace Corps. The latter was obligated to provide up to six volunteers with background training in marine biology or related fields to help implement the mariculture activities among the fishermen and help commercialize the project (Antigua and Barbuda Government 1985:2). While no further detail was contained in the memorandum of agreement, informally a number of people used the term "extension agent" in order to summarize the role components of the PCVs associated with the mariculture project. If so, then a conflict exists between the characterization of the volunteers as marine biologists and business persons and the role of extension agent which requires other types of disciplinary training such as applied social science. The memorandum of agreement also contained a commitment of contributions from the Antigua and Barbuda Government for fishery personnel to act as a counterpart with MSL personnel and for other agreed to "in-kind" contributions.

This memorandum of agreement was to become effective from June 1, 1985 through December 31, 1987. MSL activity on the project began in early 1985 with a site feasibility survey and scientific tests. The Marsys Resolute research vessel arrived in Antigua in spring of 1985 with a full crew to continue the scientific research and begin the applied aspects of the project.

As of July 14, 1985, when Dr. Stoffle arrived on site, the Peace Corps had assigned one volunteer to the project; this PCV had worked intermittently on the project for about one month. The Antigua and Barbuda government fishery

officers had been kept informed of the project's progress by the MSL staff, but no clear role for these fishery officers had been defined as yet nor had any "in-kind" resources been committed to the pilot project.

In other words, at the time of this social soundness analysis the project was only a few months old in actual effort and officially only one month old. Few resources beyond those of the MSL had been invested in the project. Few people in the nearby community of Willikies had even heard of the project. An even smaller percentage of the national population knew about the project. No newspaper, radio, or TV coverage was indicated in any of the interviews. It was simply too soon to be able to evaluate any impacts the pilot project had had upon the community. Therefore, this analysis is focused on potential future impacts.

FIELD METHODS

Dr. Stoffle collected information for the social soundness analysis in Antigua from July 14th through July 30, 1985. During these fifteen days, information was collected by participant observation and through more than a hundred direct interviews. Where appropriate, certain persons were interviewed repeatedly in order to clarify information and to explore new ideas. The interviews were conducted with local government officials, fishermen and their families, Peace Corps staff and PCVs, and with MSL staff. A significant portion of the three weeks was devoted to participant observation: while fishing with one fishing crew, observing fishing-related activities in and around the village of Willikies, and observing activity in the public markets of St. Johns.

ADOPTION SCENARIOS

The social and economic soundness analyses were guided by the assumption that four adoption scenarios were currently being considered by MSL. These scenarios are adoption by: (1) local fishermen; (2) a local fishermen cooperative; (3) a public or private corporation from the host country; or (4) an international business. Despite the decision to utilize adoption Scenario 4 in Grenada, the preference in Antigua was for adoption to begin with Scenario 1 or Scenario 2 and to follow with a Scenario number 3 adoption.

In addition to these four types of adoption scenarios, there were a number of possible modifications suggested by

MSL. The most likely modification was the full-time versus part-time adoption. The full adoption unit of 20 crab cages and a thousand algal screens could be reduced in scope. As the scope of each mariculture operation is reduced, however, the number of mariculture operations has to be increased in order to sustain the commercial market. A second, and related assumption, is that the mariculture could be operated either for profit or for subsistence. Like the full-time versus part-time commitment issue, the degree of profit orientation for each operation could vary. Again, there would have to be a minimum number of mariculture operations in order to sustain the commercial market.

LOCAL FISHERMEN ADOPTERS

There is a wide range of salt water fishing styles in Antigua and Barbuda. Fishing is conducted by net, line, and trap or pots. Fishing occurs in surf, in shallow bays, along reefs, out to the edge of island banks, and in deep ocean. Fishermen work while standing on piers or shore, free skin diving, skin diving from rafts, and in boats of all sizes; they work individually or in crews. Fishing can be either subsistence or commercial in orientation and it is almost always related to other economic activities and thus is usually not a full-time activity.

Given the wide range of fishing styles, fishing and fishermen can be classified in many different ways. For purpose of this analysis, three categories have been chosen: (1) subsistence, (2) mixed, and (3) commercial. Each category is defined in terms of a combination of factors: equipment, structure of production unit, degree of time committed to the activity, and primary goal of activity.

Subsistence Fishermen. The subsistence fisherman works primarily towards providing fish and other seafoods for consumption by his family. He has a low level of capital investment in fishing equipment; he may not even use a boat, choosing instead to fish from the shore with hand-thrown nets, to dig clams in shallow bays, or to hunt lobster at night when the tide is low. When he uses a raft or boat it is usually homemade and motorless. Rafts are made from the stalk of the century plant, locally called "dagger plant" (see Photo 5). The rafts are paddled into shallow portions of lagoons and used as diving platforms for gathering conch (Strombus gigas) and snail (Cittarium pica) and for spear fishing. Boats are made of wood and are rarely more than 15 feet in length (see Photo 6). They are rowed within bays and to just beyond the edge of the reefs where fish pots (traps) are placed. The fish pots are usually made by

PHOTO 5: Dagger raft located on beach near Willikies, Antigua. Note century plant in background.

PHOTO 6: Subsistence fisherman's boat on an isolated and sheltered beach in Nonsuch Bay, Antigua.

the fisherman and he generally has fewer than ten. The pots are usually not marked with float and rope and so must either be recovered with a long hooked stick or, more commonly, by skin diving.

Subsistence fishermen often work alone, although occasionally older men take along a young boy to help pull up and empty fish pots. This "loner pattern" may derive from a desire for independence and a high value placed on individual labor. It may also derive from the marginal yields of these fishing activities. The lagoons and near shore reefs have been fished to capacity, and perhaps overfished. The quality and quantity of the fish and seafood products accessible by these methods in these ecological niches are barely sufficient to feed the fisherman and his family.

Mixed Fishermen. The mixed fisherman is oriented toward both subsistence and the commercial market. He has a moderate investment in equipment, which is shared by his regular fishing companions or "crew." The crew consists of two to four members who work together on a regular basis to maintain their fishing equipment and their commercial market and subsistence relationships.

The crew, as a corporate unit, may own a dagger raft for lagoon fishing, one or more boats of from 15 to 23 feet in length, and one or more outboard motors. The best of these boats are made of fiberglass and are based on the design of the pirogue, which is reputed to be of Spanish origin and to have diffused from Trinidad, West Indies. Fishing gear owned by the crew can include shallow water casting nets, lagoon gill nets, deep water hand-line fishing gear, and upwards of 60 deep water fish pots with associated marker floats and connecting line. In addition, the crew will control a portion of a beach (see Photo 7) near a protected harbor, which serves as an equipment-repair and seafood-processing area. Here is where their excess equipment is kept, boats are landed, and lobsters are placed in cages to await the market (see Photo 8).

The crew maintains both commercial market and subsistence commitments but the degree of commitment will vary widely between crews and perhaps over time. The degree of variance may prove to be important (as discussed at the end of this chapter). The one crew for which in-depth data are available contributed about 20 percent of its catch to subsistence and about 80 percent was sold in the market. Based on comparative observations with other fishing crews, this crew was more commercially oriented than most.

Crew members have other activities that fill out their total occupational multiplicity commitments. These

PHOTO 7: Beach and lagoon traditionally controlled by one mixed-fishing crew from Willikies, Antigua.

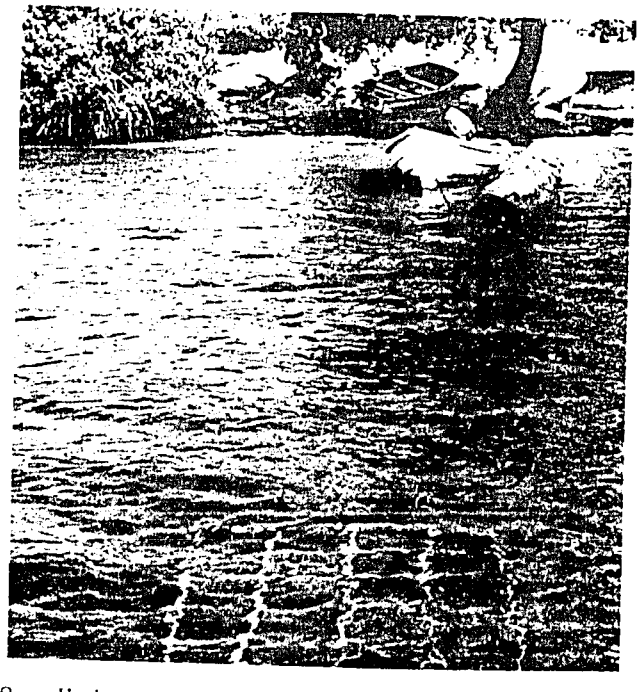


PHOTO 8: Underwater cage used by mixed-fishing crew to keep lobsters until they are ready for market.

activities often force them to miss one or more days of fishing with the crew. Because the crew must maintain its own corporate commitments, it must have a "support pool" of trained and ready temporary replacements. The composition of the support pool is not well understood, but it appears to contain elderly and juvenile family members. Many support pool members would normally be subsistence fishermen.

Two major ecological niches are utilized by the mixed-fishing crews. They utilize the shore, lagoon, and nearshore reefs just as do the subsistence fishermen. In addition, they utilize the shallow water bank that surrounds Antigua and Barbuda (see Map 1). This bank tends to drop off steeply at 30 to 40 fathoms. Beyond this edge of the bank, the water deepens to hundreds of fathoms and is beyond the reach of the men and equipment of the mixed-fishing category. Customary fishing areas are recognized as belonging to specific fishing crews, although this ownership is not recognized by national laws or regulations.

Commercial Fishermen. Commercial fishermen fish on a full-time basis and only for the commercial market. They work on large boats that leave the island and return as much as four or five days later (see Photos 9 and 10). The boats are of wood or fiberglass construction and from 24 to 55 feet in length, with a deck, cooking facilities, and sleeping quarters. They are powered by a combination of sail and inboard engines. On deck each fisherman has his own cooler in which he keeps his catch on ice. For comparison, Matthiessen (1975) provides a detailed description of similar boats in the Cayman Islands.

The Antigua commercial boat is usually owned by the captain, who fishes along with others on the boat. Each fisherman may own the gear he uses to fish with but he can use the captain's gear. If he does so, it means that a higher percentage of his catch goes to the boat.

Commercial fishermen fish the deep waters beyond the 40-fathom bank. They fish with fish pots, set lines, and hand lines. Because they set their pots in 150 fathoms of water the pots must be pulled with winches. Equipment is constantly being stressed by pulling pots from the deep water and so regular repairs are needed. Repairs are usually made by professionals in St. Johns, Antigua, because the fishermen spend so much time on the ship they cannot make the repairs themselves. Set lines, called "long lines" are filled with hundreds of hooks and are left suspended from floats while the boat pulls pots or sets other lines elsewhere. They are collected again at the end of the day.

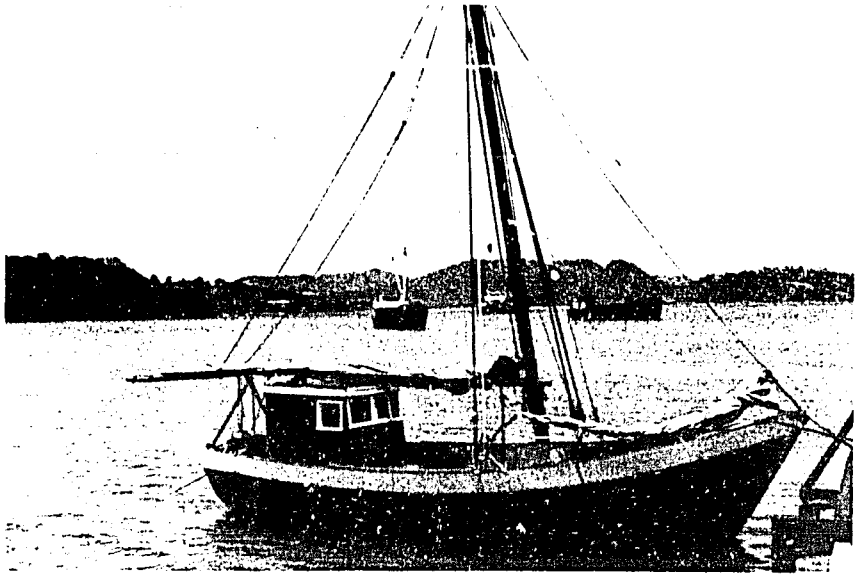


PHOTO 9: Small commercial fishing boat in St. Johns harbor Antigua. This boat has both sail and motor.

PHOTO 10: St. Johns harbor--government fishery officers Arrington and Mussington and researcher Stoffle. Note commercial ships near dock.

Hand lines, and sometimes rods and reels, are used to catch pelagic fish such as shark, barracuda, and tuna.

The commercial fishermen have the highest financial investment in fishing and so it is not surprising to find them with the greatest personal commitments to it. Although not complete, available data suggest that the commercial fishermen are full-time occupational specialists. As such, they are very dependent upon fishing and do not have a wide range of outside occupations as is typical of fishermen in the other two categories. Antiguan commercial fishermen tend to live in St. Johns, their point of contact with the international markets and with their major local consumers. Thus, commercial fishermen are unevenly distributed throughout the island and the nation.

Summary. The Antigua and Barbuda government estimates that its fishing industry contains 1200 fishermen who operate 350 fishing boats (Joseph 1984:1). Interviews with Fisheries Division officers suggest that 43 percent of these boats are of the subsistence type; 43 percent are of the mixed-fishing type, and 14 percent are of the commercial type. Assuming one person per subsistence boat, three persons per mixed fishing boat, and five persons per commercial boat, there would be 850 fishermen on the island, including 150 subsistence fishermen, 450 mixed fishermen, and 250 commercial fishermen. The difference between the 1200 reported fishermen and the 850 calculated fishermen probably reflects a large number of unregistered subsistence boats and the fact that some fishermen fish from shore. There is general agreement on the number of fishermen per boat, so the minimum number of fishermen can be calculated from the number of registered boats. The number of fishermen engaged in different types of fishing is a critical factor because it defines the pool from which will come successful adopters of the Mithrax mariculture.

LOCAL FISHERMEN COOPERATIVE AS ADOPTER

The second adoption scenario is the local fishermen's cooperative. The use of a local fishermen's cooperative is theoretically a good idea. It has been used in many areas of the Caribbean to pool the scarce resources of people to achieve a critical mass of resources (cf. Epple 1977). The local fishermen cooperative is also an official organizational unit that can be incorporated and can directly receive development funds and technical assistance.

Unfortunately, from the first interview until the last, there was no encouragement forthcoming from Antiguan people regarding the prospects of a fishermen cooperative. A

similar conclusion was reached in a recent survey of Antiguan fishermen by Anne Simon (1983:9). In the present research, different people drew upon different explanations for why a cooperative would not be a good adoption scenario, but all said something to the effect that it had been tried and failed so why try again. Unless sufficient resources are available to experiment with the cooperative adoption scenario, it probably will not produce satisfactory results.

HOST COUNTRY CORPORATION AS ADOPTER

The third adoption scenario to be considered is to have a host country corporation own the Mithrax mariculture equipment and hire local employees. Both public and private corporations would fall within this adoption scenario.

Public Host Corporation. The future of a public host corporation adopting Mithrax at this time is not positive. People interviewed during this study seemed to agree on this point and all used the recent failure of the Antigua Fisheries Development Limited (AFDL) as the negative case. The AFDL was jointly owned by the Antigua and Barbuda government and a series of development banks. Its purpose was to modernize the fishery with the infusion of millions of dollars of venture capital. New boats were purchased from a U.S. firm in Mississippi, a new processing and freezer facility was built in St. Johns, and crews were trained and hired for the boats.

The perception of what happened to AFDL seems to have been influenced somewhat by where the observer was in the process. Everyone, however, agreed that two years after starting, AFDL closed down all aspects of its operation except the sale of ice from its freezer plant. Some observers said that the plan was ill conceived from an environmental point of view because the waters were already producing as much demersal fish as they could yield. Other observers noted that the project was proposed by the government as being "for the fishermen," but then only a few fishermen were hired as workers on the boats. Still others noted that AFDL placed their fish pots on the traditional fishing grounds of other fishermen. Finally, others said that the equipment was inappropriate for the type of fishing that was being done. Whatever the reason for its failure, it did fail and that failure reduced the confidence of many Antiguans in the ability of a public corporation to be economically viable.

A point of some importance for this social analysis has to do with the procedures AFDL utilized to derive information about the fishermen and their attitudes toward

the project. A former AFDL employee noted that a research project was funded to gather the information. Findings derived from a survey developed and administered by a recent high school leaver. Funds were not available to conduct interviews throughout the island, so only fishermen who landed their fish at the main pier in the St. Johns harbor behind the AFDL plant were interviewed. This sampling strategy introduced significant bias into the survey results because it is primarily commercial fishermen who land their catch in St. Johns and less than 14 percent of the island's fishermen are commercial. Of this 14 percent, many do not land their fish at this dock but instead sell fish at one of two other piers in the harbor. This was a surprisingly weak social data base for a multimillion dollar project.

Private Host Corporation. A number of private business persons in Antigua expressed an interest in being considered as potential Mithrax mariculture adopters. These host national business interests currently work together on a number of successful business ventures, such as the annual Antigua Sportfishing Tournament (Antiqua Sports Fishing Committee 1979) and there is no reason to believe that they could not successfully organize to operate a mariculture project.

A private host corporation mariculture project would share some of the problems that beset the AFDL. Foremost of these would be the issue of potential territorial conflicts within the lagoons and bays. Most of these business persons live and work in St. Johns, but that bay is unsuitable for Mithrax mariculture. Therefore a private commercial operation would have to be established in one or more of the better bays in the more isolated parts of the island. Although officially open water, these bays and their associated resources, like beaches for landing boats, are traditionally owned by local fishermen. Failure to involve local fishermen in the development of a commercial mariculture project in their bay can substantially reduce the project's prospects.

INTERNATIONAL BUSINESS AS ADOPTER

International business could become the Mithrax mariculture adopter if the other adoption scenarios were either unattractive or appeared to be inappropriate. In the case of Antigua and Barbuda, neither of these problems is present. The mariculture seems to be attractive to and appropriate for both individual fishermen adopters and a private host corporation. No Antiguans expressed a desire to have an international business adopt mariculture before

host nationals had the first opportunity to try the concept.

At the time of the social analysis, however, a Canadian national had made a request for permission from the Antigua and Barbuda government to establish an international Mithrax mariculture project on the island. No action on this request had been taken at the time of the field work.

PRIME ADOPTERS AND MITHRAX MARICULTURE

The preceding discussion of possible adoption scenarios provided an initial evaluation of the relationship between the Mithrax mariculture and various potential adopters in the country of Antigua and Barbuda. This social soundness analysis suggests that the initial Smithsonian MSL adoption projections for Antigua are sound. Adoption could very well occur among individual fishermen (Scenario 1) and by private host corporations (Scenario 3b). Given the high probability of these adoption scenarios working, then it is important to concentrate our analysis on the special social and cultural issues associated with the "prime adopters" in Scenario 1.

The highest probability for successful adoption of the Mithrax mariculture will be by the mixed-fishermen type who reside in a village that overlooks a bay where Mithrax cages could be kept. This does not exclude persons or crews of the subsistence-fishermen type or of the commercial-fishermen type, for they also have many of the skills, values, and knowledge that would make them good adopters. Unfortunately, both subsistence and commercial types have social or economic constraints that make adoption more difficult for them. These research data suggest that fishermen from these two types probably will become later adopters. Nor would this recommendation exclude bays without associated fishing villages. Such bays may prove to be good locations once the issue of mariculture security is better understood. Thus, the prime early adopters would be local fishermen currently involved in mixed-fishing who could live in line-of-sight proximity to their Mithrax cages.

The following analysis considers a number of parameters that should be included in any model designed to predict the outcomes of Mithrax mariculture adoption in Scenario 1. The parameters are: (1) unit of adoption; (2) occupational multiplicity; (3) cultural orientations; and (4) technology fit. The content of the discussion will focus exclusively on data derived from and about Antiguans already engaged in mixed-fishing. It would not be appropriate to extrapolate from this analysis to predict the outcomes of adoption by other types of fishermen or by fishermen in Barbuda.

UNIT OF ADOPTION

Mixed fishing is conducted by a fishing crew and this social unit appears to be the best one for initial adoption of the Mithrax mariculture. The crew has the following characteristics that make it better than other social units: (1) it continues through time; (2) it has corporate resources and responsibilities; (3) it has a mechanism for replacing members; and (4) it has trust and legitimacy.

Continues Through Time. The crew continues to function over reasonably long periods of time. Evidence suggests that a crew can persist for decades and even over the lifetime of individual members. There is some evidence that some mixed fishermen are second and third generation fishermen. It would be important to know if their fathers fished together. Perhaps the crew is a multigenerational social unit. If additional research supports these initial observations (see the recommendations at the end of this chapter), the mixed-fishing crew may prove to be one of the more persistent production units in this society.

The scientific literature on Caribbean social structure suggests that individuals have important lifetime attachments to only a few social units other than the nuclear family (Clark 1957; Rodman 1971; Smith 1962) and male cliques (Smith 1965:58-106). The nuclear family is a corporate unit but rarely is a unit of production. The male clique tends to be neither corporate nor oriented towards production (Stoffle 1969; Wilson 1971), however, clique membership may reflect occupation and status (Smith 1965). Previous research suggests that families and cliques are more likely to conflict with new forms of economic production than they are to support such changes (Stoffle 1977a,b). It is intriguing that in some islands male cliques are referred to as "crews."

Corporate Resources and Responsibilities. One reason that the mixed-fishing type crew persists through time is because it has corporate resources and responsibilities. The crew is a social unit that is truly greater than the sum of its parts. Each portion of the equipment used by the crew is owned by some member, but the array of equipment that is owned can only be understood within the context of the crew itself. One person may own the boat and another may own the motor, but the two pieces of equipment were purchased to be used together. Another crew may have a different combination of motor and boat. The 60 or more fishing pots used by a crew are individually owned, but they are designed to be a part of sets containing 15 or 20 units.

Each set is especially designed to catch special types of seafood and each type of seafood has a specific function for meeting the crew's commercial market and subsistence obligations.

Gill nets are stretched out at night by the crew who must work together to row the boat, drop the net, and retrieve the net. The work is difficult and dangerous because it occurs at night and often in bays that are miles away from the home village. The team may have to row the small boat in open ocean to move to the next bay. Catches are usually rewarding but the net may catch a combination of dangerous fish like shark and barracuda that require special handling in the small boat at night. Team work, mutual trust, and mutual understanding of functionally interdependent tasks permit successful gill netting.

The crew must "hold by use" the territory it has. This also may be how crews come to have territory in the first place. The hold-by-use factor is especially important for deep water pot fishing which occurs near the edge of the 40-fathom bank. If a crew does not regularly attend to its sets of pots located in such water, either the environment will destroy the pots or competitive fishing crews will remove them. There is little protection from the latter except by knowing within a short period when one's pots have been stolen and checking on the fish sales or equipment holdings of nearby crews.

Beyond the equipment and territory that are held in common by a crew, are the obligations to others that derive from the distribution of catch. The most obvious obligation is to the commercial market. The crew studied in depth during this research especially targeted red-colored fish on two days of every week. They fished only for these fish and would bring in 80 to 100 pounds of such fish each time they went out. They were so effective that they almost never caught anything other than a red-colored fish. All of the fish were iced and sent to St. Johns for distribution to the international market. This market was controlled by the crew's middleman, who maintained regular purchases of such fish and took requests for additional red-colored fish. In order for this market to work it had to meet both regular and special consumer needs. Similar marketing relationships were observed between fishermen in another village and the lady hawker who sold most of their catch in the St. Johns public fish market.

The commercial market must be kept operating because the mixed-fishing crew has a fairly high investment in equipment, as well as costs for repair and replacement. The crew's 60 fish pots, for example, have a market value of

about $125 EC each for an investment of about $7,500 EC. Depending upon the depth where the pot is used, a pot will last about one year on the average. More expensive pots will last two years, but they require mending by crew members. Without a regular flow of cash the crew will not be able to keep its equipment in repair and will lose its market ties. Without fishing for the market on a regular basis, the crew will lose its market connections and its cash flow.

The crew has subsistence obligations that are met by catching second-class and third-class fish. About 20 percent of the second- and third-class fish are distributed by crew members to a network of family and friends and to those with something important to barter. The nature of these obligations are not well known in the scientific literature, probably because such relations are not based on cash and therefore have been defined as less important (see discussion of subsistence in Chapter Two). For the fisherman, however, maintaining these relationships not only validates his provider roles as son, father, husband, but it also maintains a network of social relationships that serve as a "social security net" for himself and family in times of need.

Mechanism For Replacing Members. The mixed-fishing crew has corporate responsibilities so it must be able to replace members when they cannot participate in fishing. Crew members are pulled away from fishing commitments with the crew for a number of reasons. There may be other types of fishing to be done that do not require the crew. Skin diving from a dagger raft for conch is such an example. A crew member may have to meet a commitment in another portion of his occupational complex. For example, one crew member who makes charcoal needed to take a day off from fishing to cut up trees that had been bulldozed for a new road in the village. Had his flexible schedule not allowed him to take that day, the trees would have been covered up by the next day of road construction activity. Needless to say, any person occasionally will have personal obligations that could keep him from fishing for a day. During Carnival a man's stomach may be too influenced by rum to permit him to work on rough seas.

Whatever the reason, crews need to have a pool of temporary replacements when a regular crew member cannot go fishing. The need for such a pool may influence the initial structuring of the crew itself because the most common members of the replacement pool are family members. Were all crew members of the same family, it would greatly reduce the size of the pool of replacements. Replacement members

must exactly fill the roles of the member they replace, and perhaps this is why the most common replacement member of the one crew observed was a former fisherman and father of one of the crew. This replacement pool is critical to the functioning of the crew, but little is known of its composition and functioning over time. It should be a high priority for additional project research.

Trust and Legitimacy. The issue of where people place their trust and which social units others define as legitimately owning things is critical. Any social unit, such as a fishermen cooperative, can hold corporate resources and use them for fishing. However, can they hold the trust of their members and can they legitimately lay claim to territory in a bay? Perhaps not, because cooperatives fail with great frequency. Why do their members withhold full commitment? Why do others vandalize or steal their equipment? Perhaps a lack of legitimacy and trust are the answers to these questions.

The mixed-fishing crew has the loyalty of both its members and its replacement pool. It also has legitimacy derived by others recognizing its operation as a corporate unit with equipment, territory, a portion of the market, and subsistence commitments. The fishing crew has held its own against multimillion dollar commercial fishery operations, against other mixed-fishing crews, and against other economic options that crew members could elect to pursue. The mixed-fishing crew is a proven fishing unit.

OCCUPATIONAL MULTIPLICITY

The concept of occupational multiplicity has been discussed in Chapter Two, so it need not be repeated here. Needless to say, most Caribbean fishermen are involved in a web of commercial and subsistence commitments that permit them to survive in a marginal economic environment where any single adaptive strategy might fail unexpectedly. Thus, having multiple adaptive strategies or multiple occupations conveys greater security upon the producer, her or his dependents, and others in the social network of mutually interdependent people than if people focused their production efforts only on one occupation.

A detailed analysis of social organization in Barbuda suggests that the dyadic economic role relationships that produce a society-wide pattern of occupational multiplicity are a key factor in community integration (Berleant-Schiller 1977:258). Berleant-Schiller suggests that Barbudan society lacks vertical segmentation and horizontal stratification, so cooperation around productive activities assumes a

central role in community integration. It is not clear, however, that occupational role relationships have as important a function in community integration in Antigua, which is a much more complex society. Nonetheless, community integration must be considered an important parameter in the social analysis of Mithrax mariculture in both Antigua and Barbuda.

In Barbuda there is no sharp distinction between land and sea exploitations (Berleant-Schiller 1984:804). The island's internal economy includes a wide range of complementary and alternative productive activities, whether they be for cash or for subsistence. For example, garden plots are often chosen because they are located en route to a fisherman's favorite fishing area. A fisherman also may choose a place for his fish pots that is along a route from his home to his charcoal kilns. Although in Antigua there is a much sharper distinction between occupational strategies than there is in Barbuda, the following analysis does emphasize the interdependency of occupational strategies of the mixed fishermen.

The complex web of relationships that a mixed-fishing type of fisherman derives from having access to a wide range of types of commercial and subsistence seafood has just been discussed. In addition, a fisherman develops a wide range of occupational commitments that must complement his core fishing commitments. Implicit in mixed fishing is occupational choice. Some types of occupational commitments conflict with mixed fishing and are, therefore, precluded. Foremost among these occupations would be full-time industrial employment, that demands regular eight-hour work days and urban white collar professions that involve status inconsistencies with fishing.

A set of occupational commitments that can be adopted to complement mixed-fishing includes: (1) charcoal production; (2) kitchen gardening and raising ground provisions; (3) part-time wage labor; (4) storm carpentry; and (5) animal raising. A similar set of commitments has been documented for Barbuda (Berleant-Schiller 1977:225-257).

Charcoal Production. Charcoal production is usually conducted for commercial and subsistence purposes. Because there is a market, there are certain inflexible demands for regular quantities and for timely production. A charcoal producer, however, can collect the required wood and produce charcoal as time is available, thus facilitating fitting this form of production with others. The crew member with this adaptation regularly produced two batches of charcoal a month, with 20 bags of charcoal in each batch. He also

burned his own charcoal for home consumption and may have distributed a portion to family and friends.

Gardening. Kitchen gardens and raising "ground provisions" has become more common in recent years as the sugar plantations have been shut down. Fields that once belonged to private estates are now given by the national government to persons who will grow foodstuffs there. The foodstuffs are grown for home consumption first, but any excess is sold to hawkers who market it in St. Johns. The time required by these activities is flexible. Generally, the more time spent, the higher the yields, but very low levels of commitment also yield a useful product.

Part-Time Wage Labor. Generally, part-time wage labor is low skill, however, it is possible for professionally trained persons to work on a part-time basis. Most fishermen are not professionally trained, although a few have semiprofessional or paraprofessional training. Part-time wage labor may range from helping a friend in a repair shop fix cars, to tending bar in a rum shop. Most part-time work requires a relationship with a person who has a full-time occupational commitment to or owns a small business. Part-time wage labor is more of an option to fishermen who live close to St. Johns or English Harbor. Part-time labor is more likely to occur when the crew needs excess cash for production needs like repairs to a boat or for personal needs like going to Carnival. In either case, the demand is greater than can be met by adjusting the volume of normal fishing activities.

Storm Carpentry. Storm carpenters--or "stormies," as they are often called--are people with sufficient construction skills to repair houses and other types of buildings after a tropical storm blows them down. Stormies were more common in the past when few of the homes were held together at the corners with nails. A hurricane would lift the roof and the walls would fall in. Storm carpenters are especially needed during fix-up times, such as near Easter and just before Carnival in July. Storm carpenters possess the tools and skills that often gives them a place on the mixed-fishing crew as the one who fixes or builds the fish pots.

Domestic Animals. Mixed-fishing fishermen often keep domestic animals, but the time commitment to the animals can vary from almost none to just about full time. Food animals commonly raised include goats, sheep, chickens, pigs, beef cattle, and milk cows. Horses and donkeys are raised for transportation. All animals require feed, health treatments, and holding pens that need daily cleaning. Larger animals are taken out each morning to pasture and are

gathered each evening to be penned up for the night. One crew member had six milk cows that required a lot of attention. Another crew member raised chickens and had a donkey that he used to carry the wood for making charcoal as well as to carry the final product.

Summary. In summary, a mixed-fishing crew member can be involved in a wide range of other occupations. The time commitments to these other occupations will vary with each crew member. Variations will depend upon the skills of the crew member and how he wishes to link himself and his family into the non-fishing sectors of the economy. The available data are barely sufficient to fully describe the occupational multiplicity of even a single mixed-fishing crew. The data do illustrate the existence of an elaborate web of interrelationships that has been documented for fishermen elsewhere in Barbuda and in the Caribbean. There certainly is a need to know such information for every crew that would be a potential adopter of the Mithrax mariculture. Mithrax mariculture can affect a fisherman's complex occupational commitments, and so will affect the fisherman's role in his community and finally the community's social integration.

CULTURAL ORIENTATIONS

It is a bit risky to say that certain cultural orientations of mixed-fishing type fishermen will be more important than others in their adoption and incorporation of an untried innovation like Mithrax mariculture. Nonetheless, there are certain aspects of Antiguan and Barbudan culture that on the face of it have direct relevance to adoption. Selected for discussion here are: (1) fishing, farming, and self identity; (2) experimentation and risk taking; (3) taste, diet and market; (4) territoriality; and (5) theft.

Fishing, Farming, and Self-Identity. In the scientific literature on Caribbean culture there are repeated references to the differences between fishermen and farmers. Fishermen are characterized as wild, experimental, and difficult to control. Farmers are characterized as sedate, conservative, and malleable. This literature suggests that the roots of the difference may go back historically to when fishing communities were composed of Afro-Americans, American Indians, and other folks who were unwilling to live under the tight systems of control imposed on the plantations. Such communities were havens of free spirits who made their living preying off those in power. They would directly attack ships loaded with cargo, or they would

lure ships onto rocky reefs with misplaced lanterns. Today, some whole island societies trace their ancestors back to such romantic origins (Wilson 1973:39-43). Although some fishing communities contained pirates, most simply contained people who fished and exchanged this important source of animal protein for the agricultural products of the plantation.

Whether runaway slaves turned pirate or fisherman with the freedom to go where and when they wanted, fishermen and their communities have a reputation of being culturally different from the agricultural workers and their communities and therefore different from the majority of the people in the Caribbean. This difference has become a concern for many of the scientists and governmental administrators who are associated with the Mithrax mariculture pilot projects focused on individual fisherman adoption. This concern has become so great that by the time this social assessment research began in Antigua, a number of administrators had serious doubts as to whether or not the fishermen would choose to "farm crabs." In fact, this researcher was asked to explore the possibility that individual farmers in Antigua might be better adopters than fishermen. These concerns were not based upon interviews with fishermen but instead derived from the commonly held perceptions just discussed.

When fishermen and farmers were asked about "farming the sea," both agreed that the fishermen were the most likely candidates to do the work. This derives from a simple observation that farmers tend not to like the water and fishermen already farm. The idea that farmers do not like the water and would refuse to go out on it on a regular basis remains to be tested by future research. It is important not to replace one stereotype with another. All interviews with farmers, however, did yield this answer. In addition, most farmers said that they felt fishermen were crazy to risk their lives for what was only a slightly greater amount of money.

Fishermen, for their part, agreed with the farmers about the risks of fishing. One of the crew members confided that during the first year he fished regularly he was sick every day. All crew members interviewed admitted to becoming seasick from time to time. The work is exhausting. Occasionally a motor will cease to work while the crew is out on the 40-fathom bank and all lives are jeopardized. So the fishermen see themselves as special and enjoy the respect that the farmers give them for facing the risk.

Giving fishing a central role in the definition of

one's self image, however, does not mean that one must denigrate land-based occupations. To the contrary, the mixed-fishing type person has a number of significant land-based occupations upon which he depends. In addition, fishermen currently keep lobsters in cages for long periods while waiting to either accumulate sufficient numbers for a trip to the market or for the market price to rise. Simon (1983:13) made a similar observation. These lobster cages are kept near the docking and working beach which is controlled by the fishing crew (see Photo 8). If the lobsters are kept for long periods they are fed on a regular basis. The fishermen perceive this activity as being similar to farming and quite like what must be done with the mariculture.

It does not seem that farming the sea is in conflict with either the current activities or self-definition of mixed-fishing fishermen. Furthermore, it does not seem that farmers would readily take to mariculture because they lack both the equipment for and the interest in going to the sea on a regular basis. It is also not clear just how farmers would gain access to territorial rights in the bays.

Experimentation. An important question is whether or not mixed-fishing fishermen are willing to experiment. As just noted, they are reputed to be open to experimentation, but perhaps this is an inappropriate stereotype.

Evidence as to the the degree of experimentation was provided by observing the normal behavior of one crew over a period of three weeks. During this time it was observed that they seemed to constantly discuss alternative ways of making equipment and of fishing. For example, the placement and order of pots were reconsidered each time a set of pots was pulled. When the yield was low or contained an inappropriate balance of fish, they questioned the spacing and design of pots. Either variable modifies the quantity and mix of the catch. The crew members also expressed great concern over how long equipment lasts. Different types of wood are alternated with different types of wire. One combination includes a local hardwood wrapped by a galvanized wire mesh made in the United States and tied together by a fine wire made in Europe. Cost and durability were the key factors that led to this combination being developed over a period of years. The pot's design is a combination of three other pot styles with further design modifications made by the crew member who makes most of the pots for the crew.

This mixed-fishing crew valued new ideas and consistently looked forward to knowing about the Mithrax mariculture. They took every opportunity to come aboard the

Marsys Resolute to observe the construction and operation of the scientific experiments. They were especially interested in the early growth stages of the crabs, a process that is impossible to observe just from catching wild crabs.

There was no evidence that some portion of their technology was somehow protected from being replaced simply because it had been used traditionally. On the other hand, their preferred process of technological experimentation is important to understand. They do not take a new element of technology and adopt it on a wholesale basis. Instead, they add it to a portion of existing technology and study it for a season or more. If it proves to be superior, they devote more of their equipment to the new technology. It is safe to assume that it would be years before any new technology would totally replace the existing technology. Modern technology is sometimes rejected. In Barbuda, for example, fishermen have chosen not to use more extractive technologies because of perceived adverse environmental and social impacts (Berleant-Schiller 1984:816). Such caution is understandable given the importance of fishing for the crew and the importance of the catch to their friends, family, and community. This observation has important implications for the adoption of Mithrax mariculture, which will be discussed in the recommendations at the end of this chapter.

Taste, Diet, and Market. The researcher was advised before the Antigua study began that there was no market in Antigua and Barbuda for the Mithrax, so the crab may not be considered a valuable food by the people. In addition, this advice continued, the fishermen break up the crabs in their pots and use them as bait. Was it possible that local people would not contribute to the demand for farmed Mithrax?

As to consumption, only one local person said he would not eat the crabs if they became available. Instead, most people highly valued them as a food. The large white land crab is eaten whenever it can be caught. The Mithrax is perceived as a better food than the land crab by some and equally desirable by others.

Fishermen often do chop up the Mithrax when they catch them in pots. They explain this by the fact that the crabs die before returning to shore and should not be eaten dead. Crabs caught while pulling up pots near shore just before coming in are kept and used for home consumption.

The fishermen say that there would be a market for the Mithrax crabs if they could get a regular and sufficient supply of them. They jokingly point out that the Mithrax are red and after all "the French will eat anything that is

red."

A somewhat more serious discussion of the marketing potential of the Mithrax was conducted with three types of marketing people: (1) fish hawkers; (2) produce hawkers; and (3) fish wholesalers. The fish hawkers generally responded with "we can sell all the fish and lobster we can get." Observations at the fish market supported this position. All fish, including very marginal third-class fish, were soldout by mid-afternoon. There was some concern that the price of the Mithrax as a first class fish would place it beyond the means of the average St. Johns' buyer. But the fish hawkers noted that they sell lobster all the time and it never goes to waste.

A similar response came from the produce hawkers. Their opinion was valuable because they had nothing to gain or lose from Mithrax sales. They agreed that the urban consumer in St. Johns would buy the Mithrax and that, in general, the supply of second- and third-class fish is never sufficient to meet demand.

One of the two major fish wholesalers was interviewed on two occasions. He would like to see the market tested by having the Mithrax crabs sold to one or two hotels for a time before introducing them into the general local and international markets. His major concern was that the Mithrax might take away some of the lobster business that is his mainstay.

So, the Mithrax seems to be a desirable food to local people in Antigua, although most people have not yet tasted the crab. Market specialists believe that the crabs would sell well in the urban St. Johns market. Fishermen do not need them for bait; instead, they prefer to use dried cow hides that the fish wholesalers purchase from butchers in the market and give to the fishermen who trade with them. Dried cow hide is a long lasting and very attractive fish pot bait.

Territoriality. The shores, beaches, bays, islands, reefs, and banks and their associated fauna and flora are owned by the country of Antigua and Barbuda. The government officially issue permits to some non-nationals for limited access to these resources. Citizens of the nation, however, can officially use all of these resources.

By tradition, however, the maritime resources of the nation are divided and controlled by customary rules. According to one fisherman, "you can fish anywhere but people will empty your pots if you get in their territory." Some boundaries are clear. A village, for example, controls the waters immediately in front of it. Rarely is there more than one village on a bay. Other boundaries change with

seasonal use. For example, Barbuda has a tourism season that provides employment for most of its subsistence fishermen. During this season, commercial fishermen and an occasional venturesome mixed-fishing crew will move their sets of pots to the banks on the south side of Barbuda (see Map 1). When the tourism season slacks off or is over, the Barbuda fishermen begin to regain control over their territory. Initially they just empty the pots of the Antigua fishermen. If this strategy does not cause removal, they will pull all the pots and stack them ashore where the Antigua fishermen can find them. If this fails, the lines to the pots will be cut. Normally, only a few Barbuda fishermen come back at a time, so the boundary slowly shifts until the Antigua fishermen are fishing just at the limits of the Barbuda territory.

Theft. To take someone's fish from their pots or to take the lobster being kept in cages for market is a crime according to national law. In practice it is more of a way of life. The theft of fish pots is an old and widespread problem in the Caribbean (Thompson 1945:2). In Barbuda "theft of fish pots is both a symptom of the difficulty of fishing for a living and a contributing factor to these difficulties" (Berleant-Schiller 1984:813). Fish pot theft in Barbuda is continuous and reciprocal thus distributing the losses and making it individually and socially bearable (Berleant-Schiller 1984:813).

In Antigua, two types of stealing occur that are considered legitimate according to local custom. The first, discussed above, is a message that a fisherman is invading someone else's territory and that he should move. Failure to respond results in the pot being lost, but it is not taken by the other fishermen. Most pots can be recognized by their shape, patterns of repair, and associated equipment, so stealing a pot for personal gain can often be discovered.

A second type of customary stealing occurs when someone is hungry or in serious need of small amounts of cash. He or she goes to someone else's fish pots and pulls up food for the family. More often, however, lobsters that are being kept for market by a fishing crew are stolen and sold to a nearby hotel. These thefts are often traceable to specific individuals but are rarely pursued with legal action. Instead, the thief is named in gossip.

Theft conducted out of anger or for substantial profit does occur. Boats and motors are a common target but all fishing equipment is vulnerable. When this occurs fishermen go to the local police and file a formal complaint. The action causes hard feelings on both sides and will not be

laid aside by court actions, regardless of the verdict. Such theft is a serious violation of crew territory and may be intended as an effort to move the territorial boundary or even to put another crew out of competition. No such thefts were reported having occurred between persons of the same fishing village. Perhaps this is because the village would be severely harmed by a serious dispute among those who provide an important source of animal protein.

Theft of the Mithrax from their cages could be the single most important threat to the success of a commercial mariculture project. A number of people agreed with the statement that "unless you can watch those cages you will lose those crabs." This one fundamental point gives rise to the recommendation that the initial adoption units be placed in bays overlooked by the villages of the adopters.

Still, theft was not seen as a reason for not going ahead with the mariculture. Theft was described by one fishermen as "a way of life, something you just have to deal with and you should count on some of it occurring." From another standpoint, it should be recognized that there are social controls placed on theft and so the more legitimate the project is to the people of the village, the more they are going to utilize these customary social controls to protect the project's resources. If the project becomes defined as belonging to someone else, intrusive on "our bay," or harming "our fish," then the social controls will be relaxed and persons so inclined will be more likely to steal from the project. Existing fishing territories, and fishermen enforcement of their perceived territorial rights constitute the principal barrier to any host corporation operation.

TECHNOLOGY FIT

The literature on planned change abounds with illustrations of how development projects were influenced by a "lack of fit" between the new technology and that of the receiving community. Generally such studies conclude that the closer the fit the fewer the problems of utilization and incorporation. Conversely, the more "exotic" the new technology the more adverse the impact and difficult the transfer.

The common sense attractiveness of these theories masks a whole set of opposing findings which suggest that the more "exotic" the new technology the faster and easier the transfer. Perhaps there is no general rule of thumb that can be applied anywhere. It is always preferable to look at a specific technology in terms of a specific type of

adopter.

A full description of the Mithrax mariculture technology has not been presented in this report, although a brief description is available in Chapter Two. A more complete description of the technology is available in this report's companion economic assessment by Rubino, Epler, and Wilson (1985:18-22); the previously cited proposal by Dr. Adey; and the article by Miller (1985).

The major technology fit concerns expressed by the Smithsonian and AID before this study began were: (1) the availability of and familarity with materials like PVC pipe and plastic screen; (2) the presence of construction techniques needed to building mariculture cages; and (3) presence of work habits and values required for tending crabs.

Availabilty of Materials. The materials of concern were found to be commonly utilized throughout the island of Antigua. PVC pipe hangs out of the back of most houses in the country where it is used as a fresh water pipe. The large mesh plastic screen, like that being used by the MSL for the large crab grow-out cages, was used to make the fish pots for the now defunct Antigua Fisheries Development Limited project. The plastic screen became generally available to fishermen during that project and are still widely used by fishermen. Smaller mesh plastic screens are not in use by fishermen in their work, but are used occasionally in homes of the wealthy to replace galvanized screens for windows. The MSL mariculture project materials are not identical to those in current use but would not be classified as "exotic."

Construction Techniques. Fishermen commonly use construction techniques such as those required in making the cages and algal turf screen frames. Usually a mixed-fishing crew has one member who specializes in pot construction. If economies of scale are desired by the project, however, a full-time specialist may be required. An interview was conducted with the major pot maker for the island, who operates near the ship yard in St. Johns. He expressed a willingness to do the work and saw no special skills that would be needed. Except for a large-scale commercial corporation, it is unlikely that a specialist would be called upon. It is important to note, too, that many fishermen have skills as storm carpenters.

Work Habits and Crab Tending Values. Fishermen are not bothered by the concept of having to regularly feed algal turf screens to Mithrax crabs or to repair the mariculture equipment. In fact, they regularly conduct similar activities. Additional activities could be fitted into

their normal daily or weekly commitments, or certain role commitments could be reallocated to free up time for the mariculture. One fisherman noted that they now accumulate large quantities of macro algae as the 40 fathoms of pot anchor rope are pulled into the boat. This algae could be kept and fed later in the day to the larger crabs. This fisherman commented that they might have finally found some use for all that algae on the pot ropes.

Summary. The issue of technological fit does not seem to be a problem for the adoption of Mithrax mariculture by mixed-fishing crews. The mariculture technology is not at all exotic, although it is somewhat expensive. The fishermen suggested that, given the opportunity, they could experiment with some of their local types of wood and known imported materials to help improve the quality of the mariculture cages and lower the cost.

RECOMMENDATIONS FOR ANTIGUA AND BARBUDA

The prognosis for successful adoption of the Mithrax mariculture by mixed-fishing type fishermen in Antigua looks good, according to the results of this social soundness analysis. Still, there are important social and cultural issues that must be addressed. Foremost among these is the involvement of potential adopters in the adoption process. This involvement should be subsumed under a broader recommendation, that a project implementation plan be developed.

The project implementation plan should: (1) present a clear description of role relationships between the major participating agencies and the specific responsibilities of their representatives; (2) detail the remaining stages in the adoption process and provide a time frame for proceeding; and (3) discuss the developmental assumptions which will guide the project.

MAJOR PARTICIPATING AGENCIES

Presently there are four agencies involved in the project: (1) the United States Peace Corps; (2) the United States Agency for International Development; (3) the Marine Systems Laboratory of the Smithsonian Institution; and (4) the Government of Antigua and Barbuda. Each of these major agencies have formal role relationships defined in the memorandum of agreement discussed earlier in this chapter. The commitments of the Smithsonian, perhaps appropriately so, are most clearly defined in that agreement.

Lack of clarity exists when the roles of the agents

representing these agencies are considered. What, for example, is the relationship of the PCVs to the project? If the PCVs are technical advisors, who will operate the Nonsuch Bay demonstration project? If the PCVs are to run the demonstration project, then having technical marine biology experience is appropriate. On the other hand, what if the PCVs are, as they have been described, "extension agents" who stand between the adopters and the marine biologists who are running the project? If this latter role is chosen, then, the PCVs should have training in extension work and will need to know more about the social organization of the fishermen than the growing of Mithrax crabs. Similarly, the government has two well-trained fishery officers who express an eagerness to assume a role in the project but they have not been able to define a role for themselves as of yet.

Given that both MSL technical experts and Peace Corp Volunteers were (at the time of this field work) committed to the project for the same period and there was no clear need for that many people to build and run the pilot project, Stoffle and Rubino suggested that it would be useful if the PCVs were permitted to conduct a survey. The survey sample would be taken from as many "prime adopter sites" as possible. To determine which sites would be best, each of the major bays with associated villages were listed. Then each potential adoption site was considered with the help of MSL technical experts, new and experienced PCVs, and the two government fisheries officers. Rubino and Stoffle visited a number of potential sites to check whether or not the sites actually had a significant fishing community.

The result of this effort was the selection of the prime sites for Mithrax mariculture on the two islands. On the island of Antigua, 33 potential sites were identified but 22 sites could be classified as either clearly "not good" or only a "maybe" because of known or potential problems. Some of the known problems were pollution of the bay and lack of significant village or fishermen population. Some of the potential problems were conflict with tourist activities in bays located in front of major hotels and with commercial boat travel. The remaining 11 sites were defined as the prime adopter sites for Antigua. For Barbuda, 8 potential sites were identified and 4 were eliminated. The 15 prime adopter sites, then, become the focus of the proposed research effort.

Ideally, the fishermen in each of these prime adoption sites should be surveyed about territoriality, fishing patterns, fish distribution, and occupational complex commitments. There is a need for site-specific knowledge

before adoption proceeds. Discussion with the PC director suggested that sufficient PCV resources might be available to conduct the full survey. In addition, the two fishery officers expressed an interest in conducting some of the interviews, especially in Barbuda.

Information to be gathered from each interview was summarized on a three page survey instrument developed by Stoffle and Rubino. It is important to note here that further analysis of field work data suggests the need for a number of refinements in that survey instrument. In addition to gathering data in the survey itself, the PCVs would spend long periods in the community and thus learn about fishing, fishermen, and the community through participant observation. Regular feedback among PCVs and between themselves and the two fishery officers while interviews are being conducted would facilitate greater learning as well as permit emergent ideas to be checked by the whole team.

In general, the proposed survey of prime adoption sites and the research process itself would serve to do the following:

(1) to collect information for the development of a project implementation plan;
(2) to provide a legitimatizing role for new PCVs so they could learn more easily about fishing, fishermen, and fishing communities;
(3) to provide a set of legitimate tasks around which government fisheries officers could work with and get to know the new PCVs.

This research study concept was supported by the Antigua-Barbuda PCV director, Mrs. E. Lake, and by the two government fishery officers. Each, however, wished to take the proposal to their respective directors for review. Rubino and Stoffle offered support for any stage of the process if their services were needed. As of September 1985, neither Rubino nor Stoffle had heard about the status of this proposal.

ADOPTION STAGES AND TIME FRAME

Pilot Stage. The present social soundness analysis suggests that full adoption upon the completion of the current pilot project is not likely. Just as in the Turks and Caicos pilots, fishermen in Antigua and Barbuda are apt to just walk away from full adoption efforts. Such behavior would probably stem from the fact that a single pilot

project is unable to serve more than to illustrate the existence of the Mitrax mariculture. It cannot demonstrate the viability of the technology for local fishermen.

Demonstration Stage. For this reason, it is suggested that a second stage in the adoption process be considered. This "demonstration stage" would involve a limited number of specially selected sites and adopters. Environmental as well as social and cultural variables would be considered in the selection of these demonstration projects. The projects would demonstrate: (1) that the technology will work in a variety of bays; (2) that the technology can be handled from a land-based operation instead of an expensive boat near the mariculture; (3) that the presence of a village overlooking the mariculture will reduce theft to acceptable levels; (4) that the mariculture can be incorporated into the occupational multiplicity commitments of a mixed-fishing crew; (5) that extant marketing practices can handle the products of the mariculture; and (6) that there is a measurable high-low range in the market's ability to absorb the crabs.

There seem to be other strong arguments for this demonstration stage in the adoption process. First, the technology has been protected in the selection of environmentally ideal pilot project locations. This was probably a wise decision for a new technology that could not experience failure and still sustain external support. On the other hand, if the technology is to be widely applicable, it needs to be demonstrated in "real" settings. This means locating mariculture projects in less than environmentally ideal bays and having them operated by local people. This research suggests that specially selected mixed-fishing crews would serve as ideal operators of the demonstration projects as well as contribute to the technology itself. They are bright, experimental people who have lived for generations from their knowledge of these bays. That accumulated knowledge has direct relevance to the successful demonstration of this technology. Not only do they understand the normal conditions of these bays better than any outsider, but they understand major seasonal fluctuations and the effects of unexpected disasters like hurricanes. The proactive incorporation of local knowledge can only speed up the perfection of the mariculture technology.

The time frame for a demonstration stage in the project is open to a number of factors, such as the availability of funding, of time to conduct base-line research, and of time to involve and coordinate with local fishermen. Regardless of when the demonstration project begins, it should have two

years before the full adoption stage is attempted. The first year the fishermen still will be learning about the technology, and the new equipment will be in great condition, but there will be no product from the mariculture. The second year there will be crabs to incorporate into the marketing system; there will be profits that will influence the degree of commitment to subsistence activities; there will be real role conflict produced by working on the mariculture while maintaining land-based aspects of the fishermen's occupational multiplicity; and there will be breakage of equipment. It will be during the second year that the fishermen will be most able to make creative contributions to the mariculture. Fishermen will evolve from observers to experimenters and will experience a predictable shift from the role of student to that of teacher.

Not only will the mixed-fishing crew teach the scientists, but the local villagers will have the opportunity to learn about and judge the mariculture. The mixed-fishing crew will have a land-based mariculture. They will work in their backyards or on their public beaches in front of the village. This will permit people to observe, question, learn, and evaluate the mariculture for themselves. This is part of the learning process that currently governs the evaluation of economic alternatives in the village. Formal education will not work here because such instruction follows the agenda of the teacher and not the learning sequences desired by the student. Each will take from the open land-based demonstration project information specific to personal questions.

Full Adoption Stage. Full adoption is the next stage in the project. From the perspective of the current contractual obligations (Antigua and Barbuda Government 1985:Annex I,2) the Smithsonian will within two years have trained a "cadre of Antiguan fishermen who will operate their own mariculture enterprises." The current evidence suggests that as an a priori "target" for that particular memorandum of agreement, such a statement was appropriate. Full adoption, however, implies knowledge of the carrying capacity of the bays, the distribution potential of the market, and the integration of the human social system. Any of these three variables could prove, during the demonstration stage, to limit the total number of adoptions. On the other hand, such limits may simply become a challenge to local fishermen who will, if given the opportunity, turn their innovative skills to modifying the technology in order to increase the carrying capacity of the environment, and to fitting the new production activity and its products into

the local society and market. Whatever the outcome of the current demonstration stage, it is clear that a single pilot project will not provide the data necessary for predicting the potential impacts of mariculture on the society, market, or carrying capacity of the island's natural resources.

PROJECT ASSUMPTIONS

This is a project that began with a "Maine Lobster Fishermen" model for adoption. This idealistic notion lead to a focus on the local fishermen as adopter. The success of the project is still officially tied into the concept of having a certain number of local fishermen adopt the mariculture.

As the time for "success" approaches and with the confusing failure of local fishermen in the Turks and Caicos to adopt the mariculture technology, alternative adoption scenarios are being tried. This raises questions about the purpose of the project and therefore the criteria against which adoption and performance must be considered. Is the project successful if adoption does not occur among local fishermen? Is the project successful if local fishermen adopt the mariculture as a part-time addition to current occupational multiplicity strategies? Is the project successful if a local entrepreneur operates the mariculture for his own profit by employing fishermen or purchasing their harvest of Mizarax? Is the project successful if an international corporation hires local fishermen to work as employees on a mariculture project but removes the profits from the country? Can the project be evaluated in terms of different criteria of success? For example, what is a positive contribution to the economy of the mixed-fishing crew may not be sufficient to reduce the national debt.

These and a host of similar questions should be addressed by the implementation plan and clear answers should be provided. Otherwise the project will always be differentially evaluated by the participating agencies, their representatives, and third parties. Without an explicit developmental philosophy, participants in the day-to-day operation of the project will not know where to go with decisions they must make.

CHAPTER FOUR: THE DOMINICAN REPUBLIC PROJECT

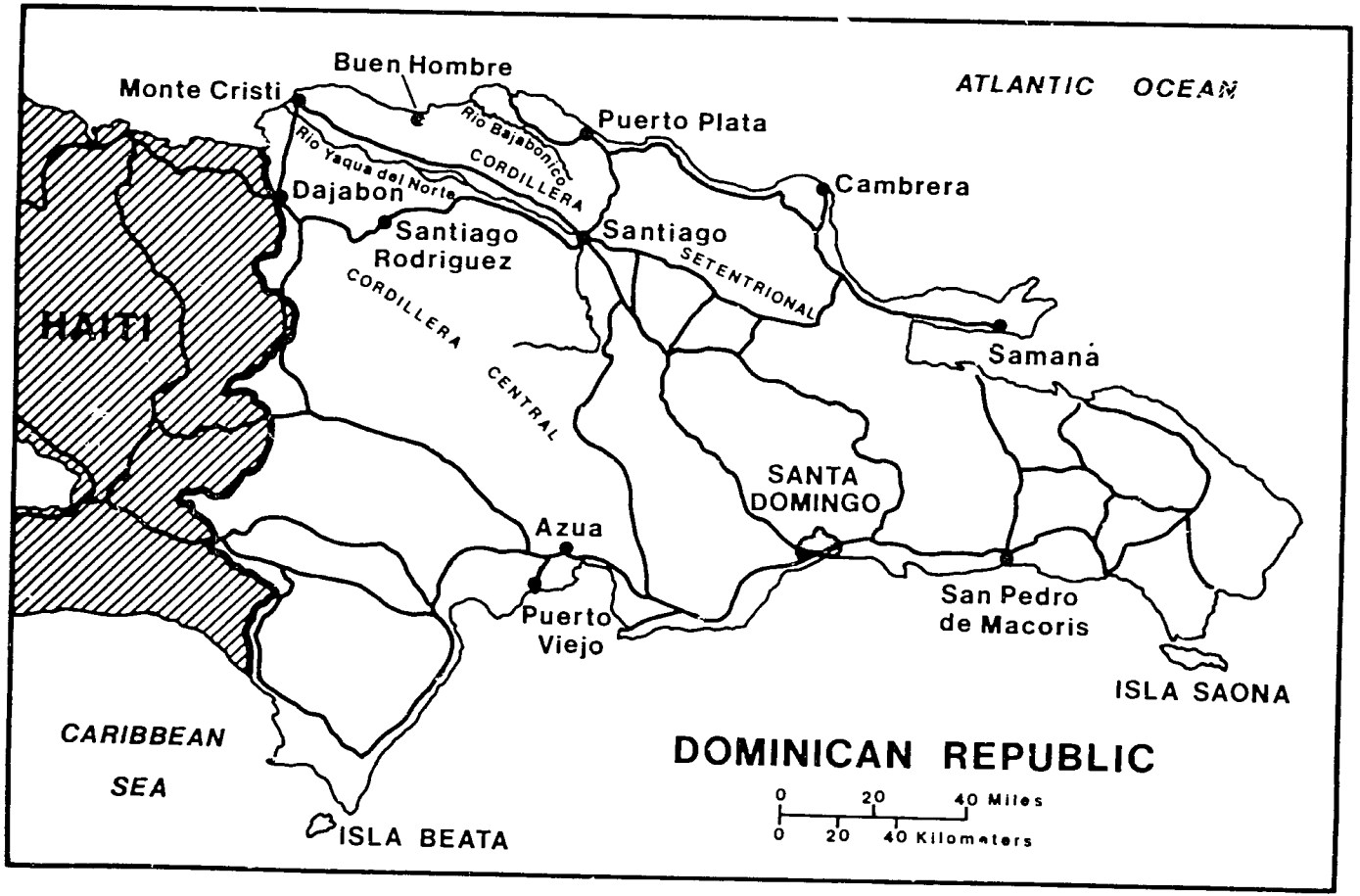
This chapter discusses the Smithsonian Mithrax mariculture project located on the north coast of the Dominican Republic on the island of Hispanola (see Map 3). The project site is adjacent to the fishing and farming village of Buen Hombre. This chapter presents a brief historic overview of the project with special emphasis on the complex funding and organizational arrangements that have influenced the project's development. Then the relationships between the mariculture technology and the people of Buen Hombre are considered. Of special importance here is the "delicacy" of the development relationship that derives from great differences of "scale" (Wilson and Wilson 1968) between the project and the village. Then the chapter assesses the social implications of initial commercialization decisions, including the decision to hire local fishermen as workers on the mariculture. The chapter concludes with specific recommendations.

In contrast with the social soundness analysis for Antigua, which considered the entire island, this analysis has been limited by contract to a adopter village, Buen Hombre. This decision was explained as deriving from (1) the Dominican Republic having a social and cultural system that is much too heterogeneous to be characterized by a study of this scope, and (2) the Buen Hombre pilot being (at the time of the social soundness analysis) the only Dominican Republic location that is really controlled by Smithsonian MSL personnel. The social and cultural characteristics of the Buen Hombre community may or may not be typical of other north coast communities, but they are not expected to be typical of the urban communities of the south coast. For these reasons, conclusions from the Buen Hombre social soundness analysis should not be extrapolated to the nation, whereas findings from the Willikies pilot analysis should be applicable throughout Antigua and selectively applicable in Barbuda.

PROJECT HISTORY

The islands of Grand Turk and South Caicos received the first and second MSL pilot projects. The third pilot was established on the north coast of the Dominican Republic. The fifth site, established after the Antigua project began, was located on the south coast of the Dominican Republic. The process by which the third and fifth sites were

MAP 3: Dominican Republic



established illustrates a competition between developmental assumptions that has been critical in the development of the Mithrax mariculture in the Dominican Republic and appears to have been an important dynamic in the other pilot sites.

UNDERLYING ASSUMPTIONS AND PROJECT DUALISM

According to Dr. Adey, it was important to have more than just the Turk and Caicos sites because no one could predict what would happen at any one site. As it turned out this was a good decision because each site has worked out differently (Adey personal communication 1986). Underlying this statement is the assumption that more pilot sites mean a higher probability of success, because with so many unknown factors there is a need to experiment in order to find the best combination. A competing assumption is that more pilot sites result in a lower probability of success because human and physical resources can be spread too thin.

A second set of competing development assumptions concerns the relative weighting of environmental and social factors when selecting a pilot site. The MSL has maintained that greater attention to environmental factors increases the probability of success because the primary purpose of the pilot is to demonstrate the feasibility of raising crabs with the new technology. A competing assumption is that greater attention to social factors increases the probability of success because people are more likely to adopt a technology if they have easy access to a pilot project that is developed in a familiar environment.

There was not, and perhaps could not have been, a "right answer" with which to resolve the pilot site placement debate as it arose in the Dominican Republic. So, a struggle ensued that caused a dualism in most aspects of the project. This dualism is clearly reflected in the development of two pilot sites instead of just one: Buen Hombre on the north coast and Puerto Viejo near Azua on the south coast. The sites are primarily managed by either the Smithsonian's MSL or the Fundacion Natura Dominicana, Inc. (Natura). The latter is a private, nonprofit foundation organized by Dominican Republic citizens in response to the MSL mariculture project. The sites are often termed "their site" and "our site" by different management groups, depending upon their loyalty in the debate. There are two sources of funding, with AID dollars primarily going to the Smithsonian and P.L. 480 pesos (United States Public Law 480 provides for the return of "excess foreign currency" to the country of origin) primarily going to Natura.

To better understand how this duality came about it is

useful to review the chronology of events that led up to the selection of the Buen Hombre and Azua sites.

CHRONOLOGY

This is a selected chronology of major events that highlight the pilot site selection process in the Dominican Republic. The chronology was composed from Smithsonian MSL files and from interviews with Bill Bernard and Walter Adey.

March 1984: Peace Corps Volunteers (PCVs) were first assigned to the Grand Turk and South Caicos pilot sites. The regional Peace Corps office was located in the Dominican Republic. When the director, Richard Soudriette, visited their assigned location, he was impressed with the Smithsonian mariculture project and its prospects for other PCV sites. He provided positive feedback to Peace Corps officials and to the U.S. Ambassador to the Dominican Republic. This report resulted in an invitation for either Walter Adey or one of his representatives to visit the Dominican Republic and discuss the project.

June 1984: Bill Bernard left the Turks and Caicos projects to talk in the Dominican Republic with the U.S. Ambassador, Robert Anderson, and the country director of AID, Phil Schwab. Bill and his wife, Kathy, were former PCVs who now worked with the MSL in the Turk and Caicos. The ambassador and the AID director were positive about a pilot project in the Dominican Republic and suggested that P.L. 480 funds and Caribbean Basin Initiative (CBI) funds might be available to help with a quick start-up. Bernard reported the request to Adey.

July-September 1984: Evaluations of alternative locations for a third site took place among MLS personnel. Based on this review, Adey agreed to consider the Dominican Republic as the third site.

October 1984: The Smithsonian flew its research plane over the north coast of the Dominican Republic looking for possible sites and targeted the area around Buen Hombre. This was the time of first contact with Francisco Geraldes.

November 20, 1984: Francisco Geraldes sent a

proposal, "Desarrollo Rapido De La Maricultura Del Centolla," to the Government of the Dominican Republic. The proposal designated the Bernards as co-directors of the project.

November - December 1984: Negotiations led to a verbal agreement between Adey and Geraldes that there would be two sites.

December 18, 1984: A letter from Francisco Geraldes to James Hester, AID, Washington, D.C., mentioned Azua site but made no mention of a second site on the north coast.

January 1985: Kathy and Bill Bernard left the Turks and Caicos project to work in the Dominican Republic. Two sites were selected.

January 7, 1985: In a letter to Dr. Adey, the Director of AID Washington noted that the Dominican Republic people were still not formally talking about the north coast pilot site.

February 1985: Smithsonian research vessel, the Marsys Resolute, arrived on the north shore to survey possible reef access points and confirmed Buen Hombre as best site.

March 1985: First MSL research vessel, the Centolla, begins work in Buen Hombre. MSL staff aboard were Jon Igelhart, Lynn Dewald, and Alan Bittlecomb.

April 18, 1985: Letter from Carlos Cruz, Secretary of Agriculture in Dominican Republic welcomed Smithsonian MLS project to the country. Cruz noted that government was pleased to have two sites, one at Buen Hombre and one at Azua.

July 1985: Arrival of second MSL boat, the Westwind.

July 8, 1985: Arrival of PCV Greg Colianni in Buen Hombre.

July 5 - August 25, 1985: Social soundness analysis, by Richard Stoffle, through the University of Michigan.

July 5 - August 25, 1985: Economic feasibility analysis, by Michael Rubino and the Traverse Group, Inc.

October 1985: Funds released from P.L. 480, to begin work on the Azua site.

SITE PLACEMENT DEBATE

Francisco Geraldes, Executive Director of the Programa Nacional del Agroacuicultura, Secretaria de Estado de Agricultura, was one of the first host nationals contacted by MSL personnel in regard to developing the third site. Geraldes and others in the aquaculture program were ideal first points of contact. Geraldes, a recent graduate of Auburn University with an M.S. in aquaculture, was intrigued with the prospects of having a pilot site in the Dominican Republic. As Executive Director of the national aquaculture program, he was also the key official to take the lead on the project. He quickly came to share Dr. Adey's enthusiasm for the new technology and the goal of a third pilot site in his country. There was no agreement, however, as to where the pilot site should be situated.

Geraldes and Adey agreed on the site selection parameters but disagreed on their weightings. Figure 2 is an effort to summarize the parameters that were utilized in evaluating the two sites and to simply characterize the positions of Adey and Geraldes.

Dr. Adey's preference for a site located on the north shore of the Dominican Republic stemmed from a number of considerations. Most important, he felt, was that the site should be located where the pilot project had the best possible combination of environmental factors. The reef system along the north shore of Hispanola is one of the best in the Caribbean. Bays such as those along the south shore probably would produce algae and crabs but are more likely to be polluted and to have lower wave action. The north shore of the Dominican Republic was also attractive to Adey because he had studied its reef structure. He had conducted an aerial survey along most of the north shore of Hispanola in 1977; in 1980 he had conducted an intensive study of the reef systems along the north shore of Haiti. Adey had less scientific information about and experience with other bays in the island. The distance from the two existing MSL pilot sites was another factor. The north shore was ideally located near to the Turks and Caicos pilot sites. A north shore site would have fewer logistical problems and would

FIGURE 2: SUMMARY OF PILOT SITE EVALUATIONS IN THE DOMINICAN REPUBLIC.

	ADEY		GERALDES	
PARAMETERS	AZUA	BUEN HOMBRE	AZUA	BUEN HOMBRE
ENVIRONMENT	poor	good	good	good
KNOWLEDGE OF SITE	unknown	known	known	unknown
DISTANCE FROM OTHER SITES	far away	close	close	far away
NUMBER OF ADOPTERS	too many	sufficient	sufficient	too few
TYPES OF ADOPTION COMMUNITY	too urban	ideal rural	ideal urban	too rural

conserve MSL resources. The north shore contained a series of small rural fishing villages, which probably would have sufficient fishermen to provide the few adopters needed to demonstrate the value of the technology. Along the south shore, fishermen live in or near urban centers that could add unnecessary adoption problems.

From Mr. Geraldes' and the aquaculture program's point of view, the north shore waters were perhaps somewhat better for the technology, but elsewhere the waters were sufficient for algae and crab growth. Geraldes and other fishery scientists had studied the waters and fisheries of the south shore and had more experience with them than with those of the north coast. A site on the south shore would be much nearer the capital of Santa Domingo where most fishery officers work and live. Also, most Dominican Republic fishermen live along the south shore, while only a few fishermen live along the north shore. South shore fishing communities provide a large ready market for the Mithrax, whereas the north shore has less population and less tourism.

Geraldes had an additional goal for the project. The Department of Aquaculture had been planning to develop a fishery experiment station and they perceived that funds for starting the fishery experiment station could derive in part from the Mitrax mariculture pilot project. From this point of view, the ideal site would be located at Puerto Viejo near the city of Azua.

DEVELOPING TWO PILOTS

The dispute over the location of the pilot project could not be resolved, so Adey and Geraldes and their respective agencies agreed that there would be two pilot projects. See the Epilogue at the end of this study for an alternative interpretation of these events. The immediate implication of this decision was that funds for the pilot would have to be split. In addition, personnel and equipment would be split. There is no indication that more funds or resources were generated because two sites were selected. Instead, it appears that much effort was devoted to resolving day-to-day disputes over how the division was being accomplished. In addition, a certain percentage of planning manpower and project funds were focused on establishing the fishery experiment station.

Having two sites caused Geraldes to develop a project management capacity that was separate from both the Programa Nacional del Agroacuicultura and the MSL. Central to this effort was the creation of Fundacion Natura Dominicana,

Inc.--usually called Natura. This private, nonprofit foundation was formed to provide planning coordination for the Smithsonian MSL pilot projects and to manage the P.L. 480 pesos that were to be allocated to the project. Members of Natura ranged in employment from the private to the public sector and in training from professional fishery scientists to local businessmen. Because it came into existence with a group of people who had not worked together, Natura had the advantage of beginning to operate with "no image at all" rather than with the negative image problems such organizations have elsewhere in the Caribbean.

A number of the Natura Advisory Board were interviewed by Dr. Stoffle during their two day visit, on August 3rd and 4th of 1985, to the Buen Hombre site. Interviewees included Roberto E. Liz, president of Natura and director of Banco Central de la Republica Dominicana. Board members generally expressed views that had been argued by Geraldes during site selection: (1) The site is isolated--the Natura bus got lost for hours while coming to Buen Hombre from the capital; the author of this report could neither find a map that indicated the road system into the Buen Hombre area nor a map indicating the name of the community. (2) There are too few fishermen in the village for the training to be generally useful or transferable to other fishermen. (3) The site is too far from major markets. Still, board members were pleased that they were to get their site at Azua and were content to continue to support the Buen Hombre site as long as it was part of the agreement with the Smithsonian.

Among the board members interviewed, Geraldes was the most positive about the Buen Hombre site. He stressed the involvement of the local fishermen and their good relationships with the two full-time Smithsonian crew members. He expressed pride at their willingness to accept the new technology and emphasized "how bright and resourceful some of these local people are." He even felt that it would make a stronger case to more "sophisticated fishermen" elsewhere in the Dominican Republic if these "simple fishermen" were successful. Still, all the Natura board members clearly expressed a concern that the Buen Hombre pilot be watched closely so it would not become a wasteful drain on their project near Azua.

FIELD METHODS

In-country information for the social soundness analysis of the Dominican Republic site of Buen Hombre was collected from August 1, 1985, through August 25, 1985.

Information was collected between August 1 and August 15, 1985 by Dr. Stoffle. Danny Rasch, a graduate student at East Carolina University, assisted research collection from August 4 until August 25. Greg Colianni, the Peace Corps Volunteer recently assigned to Buen Hombre, assisted Rasch with information gathering from August 12 until August 25. Bruce Epler, who shared many insights from his research, collected economic feasibility data in Buen Hombre during this period. This analysis, therefore, is based on 51 days of information collection: 15 by Stoffle, 22 by Rasch, and 14 by Colianni. In addition, Stoffle collected site information from MSL professionals while traveling on the Marsys Resolute from Puerto Rico to Puerto Plata.

In-country information was collected from almost two hundred interviews. Initial informal interviews were followed with the development of an interview schedule that was filled out for 33 fishermen. An indepth interview was conducted with at least one member of each of the 10 craftmen fishermen crews that belong to the fishermen association. The remaining interviews were conducted with fishermen who do not fish with crews or do not belong to the fishermen association. Additional data were collected by participant observation and from original fishery documents, such as daily catch records of the fishermen association.

Interviewees included members of Natura, MSL project staff, Buen Hombre officals, local farmers, and local fishermen. Interviews lasted from as little time as a half an hour to as much as a full day. Individuals were reinterviewed to cross check information and to ask further questions.

Three public meetings focusing on the mariculture project were held in Buen Hombre during this data collection period. One was organized by the Natura board members as part of their on site visit; another was organized by Dr. Stoffle to share observations and derive new information in a group setting. A final meeting was requested by the leadership of the Buen Hombre fishermen association. Each public meeting lasted for half a day. No person refused to be interviewed. In fact, many people encouraged interviews, expressed interest in the project, and requested more information from the researchers.

THE BUEN HOMBRE SITE

Buen Hombre is a "fragile" community that has a "delicate" relationship with the MSL pilot project. Although these terms lack scientific conceptualization, they seem to best reflect the reality of this particular

development situation. Buen Hombre is a small community of less than a thousand people who are geographically isolated from other communities. As mentioned earlier in this chapter, the author searched through maps available in the Dominican Republic and through an extensive map collection at the University of Michigan and was unable to find a map that even noted the road system into this coastal area, much less the presence of this village (see Map 3). The community has a mixed economy, part cash and part subsistence in orientation. People depend upon each other for many essential aspects of life. The social fabric of the community is complex due to the "manystranded" relationships (Wolf 1966:81) these people have developed as an adaptation to their situation. Relative to other villages in the country and the Caribbean this is an economically poor village. However, from the standpoint of health, diet, community stability, and public safety, the people of Buen Hombre seem to have a higher quality of life than many others in the country. The people of Buen Hombre do express the desire for change, but they would like it to be in terms they understand and through a process they can affect.

The Mithrax mariculture seems to be an appropriate technology project for Buen Hombre, but the project is likely to modify the "scale" of the village. The concept of scale emerged from the Wilsons' observations of what occurred among subsistence-orientated traditional societies in Central Africa as they were incorporated into the global colonial economy. "By scale of society we mean the number of people in relation and the intensity of those relations" (Wilson and Wilson 1968:25). The intensity of relations in a society is to be considered both in terms of contemporary and historical relations. Adjusting the components of scale presented by Wilson and Wilson to better fit the Buen Hombre case, it appears that the intensity of relations could best be measured by:

(1) the proportion of economic co-operation within the village to the total economic co-operation between villagers and the outsiders;

(2) the proportion of communication of fact in speech and writing deriving from within the village to the total intellectual communication deriving from the outside;

(3) the proportion of emotional expression communicated within the village to the total

emotion expressed with outsiders;

(4) the degree to which a sense of unity and continuity is expressed within the village compared to that expressed with outsiders;

(5) degree of social pressure exerted within the village compared with that exerted on and by outsiders (1968:26-30).

The Wilsons' (1968:26) findings suggest "that as the range of relations increases, the degree of dependence upon neighbours and contemporaries diminishes."

It is expected that the mariculture project will intensify and increase the relationships of the people of Buen Hombre with the outside world. In addition, the project has access to outside resources that greatly exceed what is available to the people of Buen Hombre. For example, the two MSL project boats have a market value that certainly exceeds the value of all the buildings in the village. The MSL project personnel and fishery officers from the Dominican Republic government have access to knowledge that is at the same time both more extensive and increasingly more relevant to the production efforts of the villagers than existed previously.

The people of Buen Hombre contacted during this research effort did express the desire for change in their economic opportunities, and the Mithrax mariculture does appear to be an appropriate technology suited to this purpose. But, do the people understand the social implications of such a change? Will the people be included in the project's decision making process so that they will partially control the rate and direction of change? In this chapter, the analysis will indicate how small project accomplishments have the potential for large positive benefits in the village. Conversely, the analysis will indicate how small project errors have the potential for large negative impacts in the village. Because of these factors, potential social and cultural impacts of the Mithrax mariculture effort must be evaluated carefully in Buen Hombre, perhaps more so than in communities of greater scale such as those in Antigua and Barbuda.

PHYSICAL ENVIRONMENT

Much of the north shore of the island of Hispanola contains ideal environmental conditions for the growth of algae and the raising of Mithrax crabs. Between Monte

Cristi in the west and Puerto Plata in the east, the coast has a continuous near-shore reef structure combined with a smooth sandy shoreline (see Map 4). Deep harbors, such as those found in Antigua, are rare and only occur at the mouths of major rivers that have flowed for hundreds of kilometers from their headwaters in the wet interior of the island. About one kilometer back from the sandy shore is a mountain range (see Photo 11). Unlike the high interior mountains, this range is too low in elevation to cause convectional rainfall and insufficiently faulted to provide artesian springs. The result is a narrow arid strip of marginal agricultural land without good harbors but with fine quality sandy beaches, productive shallows inside the reef, and a long parallel barrier reef that offers some protection from storms.

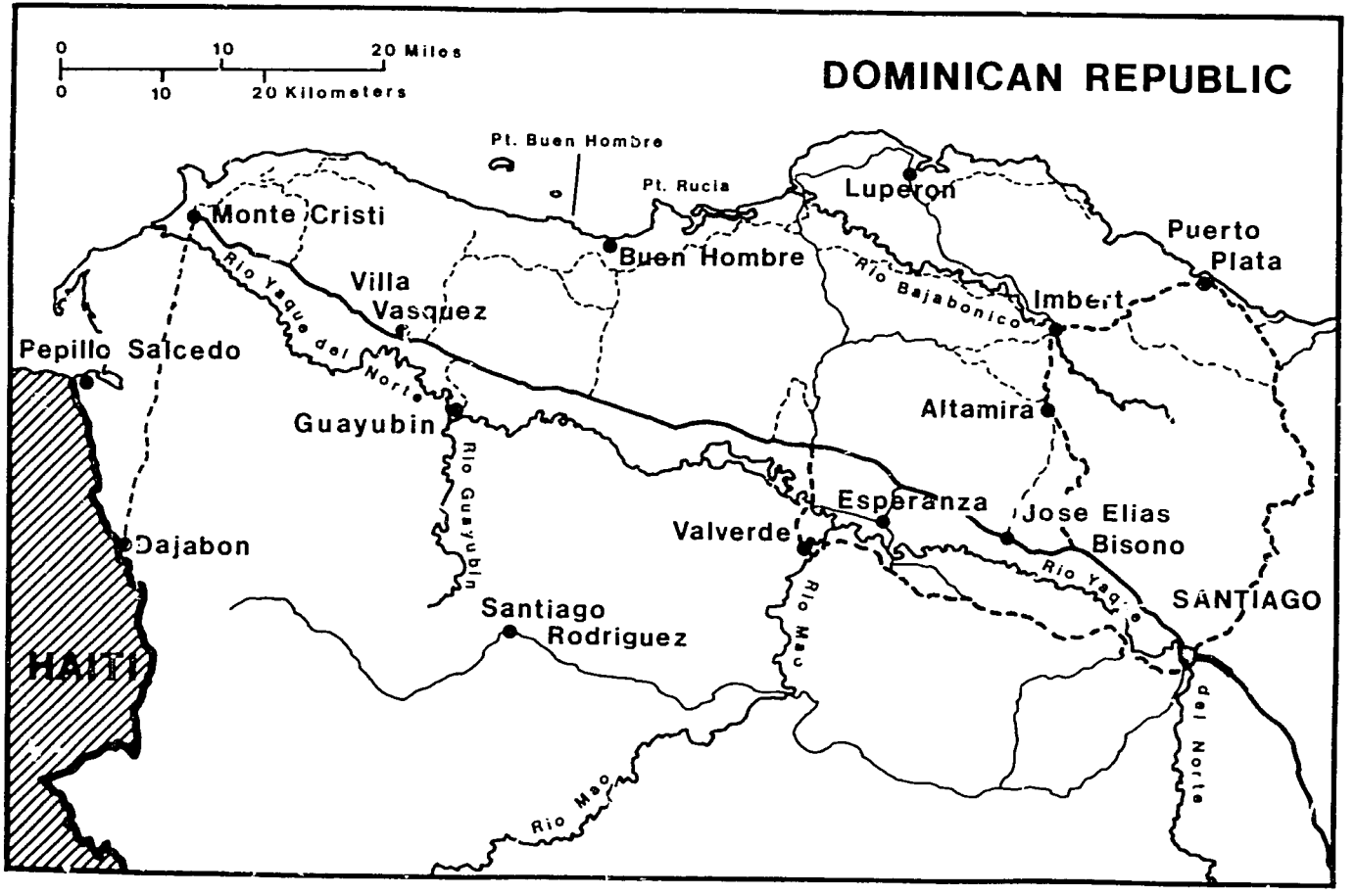
Buen Hombre is located at the only deep break along 30 kilometers of the barrier reef system. The name of the community, according to folk tradition, derives from aid to boaters in trouble that was willingly provided by a local man. Whatever the origin of the community's name, the selection of its location was certainly influenced by the unique break in the barrier reef. Coastal communities backed by high mountains often look to the coastal waters as the primary trade and communication route.

SETTLEMENT PATTERN

The environmental conditions along this stretch of the north shore have prevented large scale agriculture and ranching. Only a few small villages dot the shore. Buen Hombre is best described as a village that has a "rancherian" settlement pattern (Beals 1935:6-7; Dobyns 1986:361-394; Dobyns and Euler 1980:ix-xv). This type of settlement pattern lacks the Spanish style central plaza that is surrounded by church, businesses, and homes. Instead of living in a nucleated village and walking to their fields every day, rancherian people live in dispersed homesteads on or near their agricultural lands (see Photo 12). There is often a winter home, constructed from more substantial wood and mud, and a summer home that may be a simple pole frame with grass thatched roof for shade. This summer house is often called a "ramada."

> The latter (summer home) allowed people to scatter out, place wider distances between families, enjoy the leafy shade of oasis trees, and live close to their cultivated fields. The last point was

MAP 4: Northwestern Dominican Republic



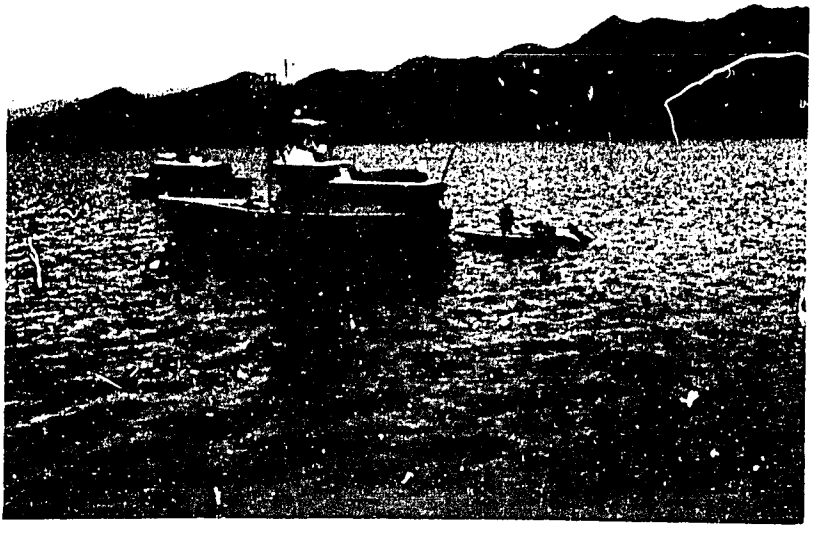


PHOTO 11: Mountain range south of Buen Hombre. The two Smithsonian research vessels are inside the reef.

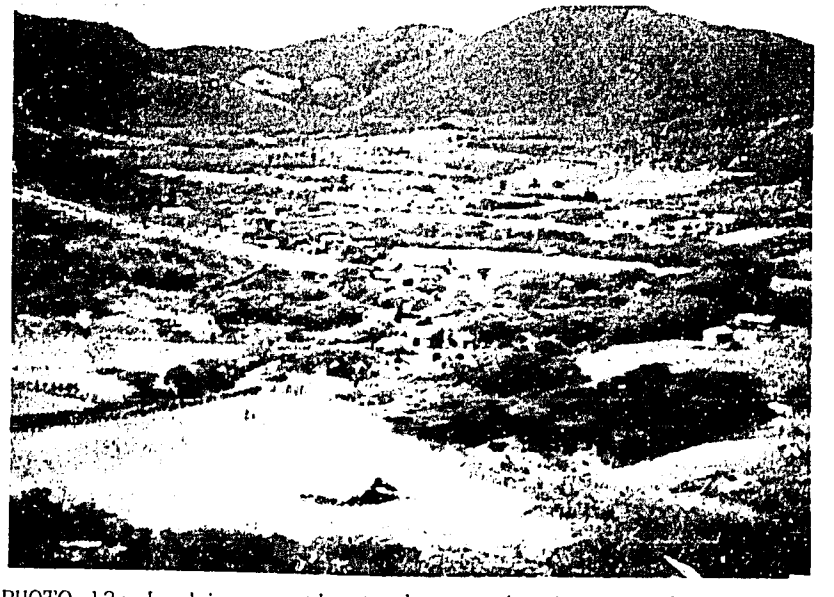


PHOTO 12: Looking south at the rancherian settlement pattern of Buen Hombre. A ramada is in the finca in foreground.

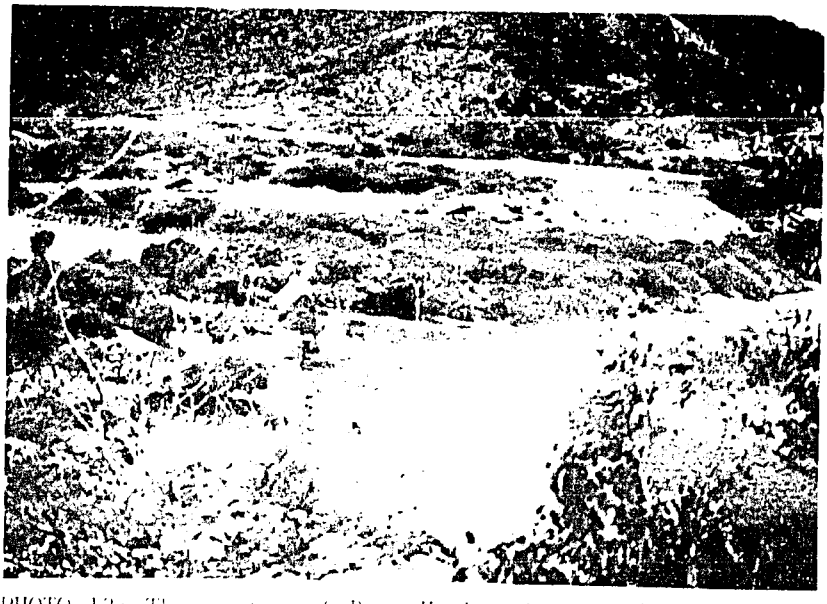


PHOTO 13: The center of Buen Hombre is on a beach where seafood is stored and marketed and a cantina provides entertainment.

PHOTO 14: Buen Hombre lagoon where lobsters are kept alive awaiting the market and the fishing boats are anchored awaiting the next fishing shift.

> especially important during harvest season, when each family needed to defend its harvest against avian pests and human thieves (Dobyns 1986:391).

These settlement patterns help account for differences in residential and seasonal occupational commitments between Buen Hombre agriculturists and fishermen.

In Buen Hombre, people live on small farms scattered for a kilometer or more out from a shallow lagoon. Farmsteads tend to be located along narrow roads, creating a latticework of "line settlements" emanating from the lagoon. In the scattered fields that make up the larger farms, there are pole and grass thatch ramadas. Throughout much of the late summer and early fall, farm family members spend time near their distant fields. This is a time and locational commitment not required of fishermen who have but one home located adjacent to their fields.

Although Buen Hombre does not have a nucleated settlement, it does have something like "a community center" (see Photo 13). Located near the lagoon where fishermen anchor their boats, land their catch, store their equipment, and market their fish is an incipient service center (see Photo 14). This focal point of fishing activity has apparently caused the construction of a number of small wooden buildings. Two are for fishermen, one is jointly owned by the fishermen and agricultural associations, and a couple more are local businesses. In their two buildings, the fishermen keep their seafood catch on blocks of ice in a large wooden chest, store fishing equipment, and sell fish. A small one-room building, jointly owned by the village fishermen and agriculture associations, is used for meetings and equipment storage. Nearby is the first community drinking water tank. It was being built by the joint efforts of the fishermen and agricultural associations.

An electric generator provides power for a small entertainment complex. The complex consists of a small building, an attached ramada, and a yard. It is fully enclosed by a wooden stake fence. The building contains a large electric refrigerator and freezer for keeping popsicles, beer, and pop. The palm leaf thatched ramada has a cement floor for dancing to the electric jukebox. Under the ramada and in the yard are a number of small tables and chairs for drinking and eating. Women from the community come to the yard to fry fish and plantains for sale to people attending the Saturday fish market. These women cook over their own charcoal-burning clay pots. Nearby, another ramada covers a modern pocket pool table.

POPULATION SIZE

There were no accurate demographic statistics for the population of Buen Hombre available to the researchers, so the population of the village had to be estimated. Village members estimate that there are about 115 adult males currently living in the village. The concept of "adult" carries with it the cultural assumption that the male has a spouse and children. It is estimated by local people, and supported by this study's survey of fisherman, that these couples have an average of five children. In addition, there are elderly persons and widows. Persons no longer living in the village have important role relationships with friends and family back home, but these people do not figure in this population estimate.

TABLE 1: ESTIMATED DEMOGRAPHIC BREAKDOWN OF BUEN HOMBRE POPULATION, BY SEX AND AGE.*

TYPES OF PEOPLE	NUMBERS
Adult Males:	115
Adult Females:	115
Children	575
Widows & Widowers**	50
TOTAL	855

*Sources: Ethnographic interviews in Buen Hombre
** Estimated from observations

ECONOMIC SECTORS

Like many other rural coastal communities in the Caribbean, most adults commit themselves primarily to agriculture or fishing. The main orientation of each sector is toward cash production. Production for subsistence, however, is also important in each sector. Each economic sector is represented by an association that has been organized with government approval and has an official membership list. There are 46 members in the fishermen association including five members from other villages. There is one full-time fisherman who does not belong to the association. It is estimated that about 70 men belong to the agriculture association, but there are a number of

full-time farmers whose current association status is unclear.

Full-time wage labor is virtually absent in a village where each family controls the primary means by which it produces its livelihood. Persons without access to the means of production, usually young adults, leave the community to work for wages in distant towns or in other countries, such as the United States. Remittances from emigrants appear to have a small role in the economy. This is most reflected in the almost total lack of expensive imported material items, such as bicycles and radios, commonly found in small villages elsewhere in the country and throughout the Caribbean.

DIVISION OF LABOR BY SEX

Men are highly visible in the village economy. Only adult males belong to the fishing and agriculture associations. Only men sell fish to the commercial fish market middlemen. Women do sell cooked fish to people attending the Saturday fish market but do not have their traditional "hawker"--sometimes called "higgler" (Katzin 1959:421-440) or "huckster" (Handler1974:128)--fish marketing role that is so typical elsewhere in the English-speaking Caribbean (Slater 1977:118). Perhaps male domination of fishing and fish distribution is more of a cultural pattern in the Hispanic Caribbean (Mintz 1956:362; Seda 1956:285).

Men clear and work the larger agricultural fields, called fincas. Women tend their own smaller fields and household gardens. Production from these smaller fields is important to the household economy.

Even if women have few direct roles in fishing, their lives can still be influenced by the crab mariculture. At the most specific level, modifications in the husband's occupational commitments can be expected to cause his domestic roles to be reallocated. Because a wife often works at her own occupational tasks, she must rely on her husband to assume domestic tasks when she is in her fields or gone from the village. A fishermen turned crab farmer would have to renegotiate his domestic commitments. At a more general level, if the crab mariculture were to modify the social structure of the community these changes would necessarily influence the social position of women.

A TYPICAL HOME, YARD, AND FURNISHINGS

Each home in the village is very much like every other.

Anthropologists would call the construction materials "wattle and daub" (see Photo 15). All construction materials, except metal nails, are available in the local natural environment. A combination of thick upright corner and roof posts provide the frame for each building. The side walls and roof are primarily composed of thin upright poles. Two-foot long and half-inch thick pieces of wood are interwoven between the upright poles to form the side walls. Mud provides a plaster for the inside of the walls. The plaster may not reach the floor so the bottom of the walls permit light to flow into the room. Colorful magazine pictures are glued to the mud walls. The roof is made of palm leaf thatch and overhangs the walls slightly. The outside door is of plank wood. Wood and cardboard serve as a divider between inside rooms and a long cloth serves as a door. Floors are made of packed earth, which is replastered with a fresh mud slip each Sunday to form a new hard surface.

Larger homes have two rectangular buildings. The primary building is divided in half between a room for eating and entertaining guests and a master bedroom. The second building is divided between the kitchen and a room for extra beds for children. Surrounding the primary building is an upright wood stake paling that encloses a yard. Within one corner of the yard is another paling enclosing the privy. The yard contains a palm thatched ramada.

Homes are sparsely furnished. The entertainment room will have a few open shelves on the wall for dishes. Especially important are the porcelain demitasse cups used to serve guests strong, sweet coffee. Two very large wooden rocking chairs contrast with the more numerous small rough wooden chairs, which have hair-out cowhide seats. A small wooden table is covered with a white cotton table cloth. A small inexpensive battery-powered radio may be set on an end table in some homes. Bedrooms have double beds but no built-in closets, and few bressers were observed.

A window in the kitchen helps vent smoke from the charcoal cooking fire. The fire is built between stones located atop a waist-high cooking platform. One or more large cast iron cooking pots sit over the coals. A large five-gallon earthenware jar sits in the corner of the kitchen. It holds all the family's drinking water, which must be brought over the mountains to the village. Dried meat and other foodstuffs hang from the kitchen rafters. Knives, axes, metal files, and fishing equipment also hang from the rafters.

When the family is at home during the day all doors are

PHOTO 15: Typical Buen Hombre home built for the Peace Corps. PCV Greg Colianni is in foreground.

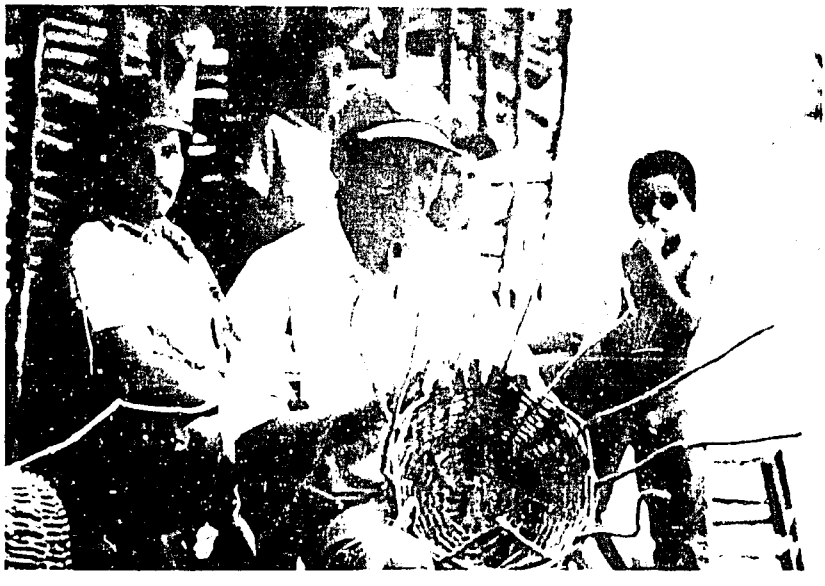


PHOTO 16: Buen Hombre basket-maker and his family. The unfinished basket is for transporting water jugs.

open and the home bustles with the to-and-fro movements of adults, children, and animals. Domestic chickens, turkeys, and goats are kept for food. One family was observed with a box of baby wild doves, which were being fed until full grown and then were to be eaten. Dogs and cats are kept as pets. A horse for transportation and a cow for milk may be tethered outside or in their own wood stake corral.

Plants abound in the home and in the yard. Decorative plants predominate but medicinal and specialized food plants are also common. The yards are too small for garden plots. Decorative plants grow in small tin cans near doors or windows and are situated along the path from the dining room into the yard. Along the inside of the paling are fruit trees like guava and bushy plants like pigeon peas. Spice plants grow in small cans. A tall cactus provides a source of medicine.

DIET

Rice, beans, fish, and some meat are the common components of the diet. The rice is cooked in water that has been flavored with Knorr chicken bouillon. At the bottom of the cast iron skillet the rice hardens and produces a "cracker-like" biscuit, which is served with sauce as a bread. Fatty meat is fried in its own fat, while fish requires coconut oil. Prepared food like soda crackers, small loaves of bread, and small sweet cakes are purchased in town. Most food is prepared in the home. Soda pop is expensive and uncommon in the village.

The diet appears to be well balanced between carbohydrates and animal protein. Food appears to be in sufficient supply. Neither hunger nor obesity was observed in the village. The diet, however, may be deficient in green vegetables. Perhaps vegetables were not observed in the diet because the research was conducted at the end of the dry season just as the fields were being cleared for planting. On the other hand, Dr. Stoffle consulted with a U. S. nutritionist, who was conducting a study of baby growth throughout the Dominican Republic. She concluded from her study that the typical diet is badly deficient in green vegetables because of cultural factors like taste. Unlike Haitians, or former Haitians, many rural people in the Dominican Republic shun cooked or raw green vegetables.

WATER SOURCES

One of the most unique characteristics of Buen Hombre is that it totally lacks its own source of potable water.

There are no wells in the village or for many miles along the coast in either direction. The only surface water is collected in an earthen catchment near the center of the rancherias. The rain water that is caught produces a stagnate pond only useful for watering animals. All water for drinking, bathing, and washing clothes comes from small villages on the other side of the mountains to the south.

Traditionally all water was carried in large pottery jugs held in locally woven baskets and transported by horse or donkey. The demand for water-jug baskets is still sufficient to provide a full-time occupation for one basketmaker in Buen Hombre (see Photo 16). Today, however, with more truck transportation in and out of the village, people usually have their domestic water hauled in five gallon plastic containers. Because these trucks have a primary commercial function, such as trading in a nearby city, the water is more likely to be taken out of local river than from the wells of villages located just over the mountains. It was the impression of the researchers that the river water was much more likely to be contaminated that the well water. Sometimes water is still hauled over the mountains by horse and donkey, especially when the road is washed out.

ADOPTION SCENARIOS

The Buen Hombre pilot site was designed to demonstrate the possibility of adoption by either (1) local fishermen or (2) a local fishermen cooperative. Geographic isolation by rugged terrain, great distances from major markets, low village and nearby coastal population density, lack of local potable water, and roads that are often impassable, make the Buen Hombre site a poor candidate for a private or public mariculture corporation. All four adoption scenarios, however, appear to be possible at the Azua site on the south coast.

As in the Antigua site, these two scenarios have a number of possible modifications. Adoption could be on a full-time or part-time basis. The size of the mariculture production unit could be smaller than the 20 cages and the thousand algal screens perceived as the ideal production unit. Smaller production units would necessitate more adopters in order to support a commercial crab market. Production could be evaluated in terms of its contribution to either subsistence or cash production. Clearly, the preferred adoption scenario is the normal size production unit geared for a cash market.

FINCA DE LA MAR

The Smithsonian crab mariculture project was discussed during this social soundness analysis as a finca de la mar, which roughly translates into "field of the sea." The term, finca, however, implies much more than just an agricultural field. A finca is defined as "real estate, land, or house property" (Peers 1966:425). It is comparable to the mariculture inasmuch as the project involves (1) occupying space at a number of locations in the lagoon, (2) associated equipment that must be kept elsewhere on land perhaps in its own shed, (3) a negative initial investment so that one must wait a year before the "crop comes in," and (4) a product that must be either distributed as a subsistence item or sold in a market. In addition, the two concepts have similar social implications such as (1) a need for a quantity of effort beyond the abilities of one owner and his family, (2) regularly applied effort to maintain the system of production, and (3) social prestige and economic implications for ownership and successful management. The major difference, at least initially for the people of Buen Hombre, is that part of the crab mariculture would occur in the sea.

It was necessary to discuss the crab mariculture in these terms--as "a farm in the sea--because many Buen Hombre people did not have an accurate perception of what the project involved. They were familiar with the Mithrax crab. There it is called centolla and is often caught by fishermen. Many people expressed the belief that the cages were to be used for storing crabs that had been caught. The algae on the screens was perceived as food for the captured crabs until they were ready for the market. The finca de la mar concept seemed to reduce these misunderstandings.

LOCAL FISHERMEN ADOPTERS

Types of Fishing. Lots of people in Buen Hombre acquire seafood for home consumption or for sale. The sea is close to everyone. It is a short walk from anyone's home. A number of seafoods, such as lobsters, can be taken a few feet from shore. Small fish can be taken by net or spear gun in the shallows between the beach and the reef. The reef is wide and shallow and runs for dozens of miles parallel to the beach. The reef is a lush ecosystem containing an abundance of lobsters, crabs, fish, and octopus. All along its length, the reef can be reached from shore by a moderately skilled swimmer. Beyond the reef is the deeper ocean with its special aquatic resources. Other

reefs exist as isolated features located a couple miles off shore.

Fishing occurs from small boats called jolas, by skin diving from shore, and by throwing nets from shore. The fifteen foot long wooden jolas can hold up to four fishermen. Against the wind, the jolas have to be powered by small outboard motor or manually rowed. With a following wind, a homemade sail is utilized. Fishing occurs by hook and line, wire fish pot, and skin diving. The latter method provides the greatest variety of seafood and often the greatest volume of catch on a typical day. The fish pots are expensive to produce and not widely utilized.

Fishing from the shore occurs frequently. Fishermen often do not have access to a boat, or a boat or motor is broken, or the weather is severe, or the fishermen simply finds fishing from the shore more suited to other occupational commitments (these issues will be discussed more fully later in this chapter). Between the sandy beach and the coral reef is water that extends to about 20 feet in depth. The coral reef can be walked on during low tide. Wherever there is coral reef or isolated coral heads a fisherman can catch octopus with a metal wire having a curved tip. Rubberband powered spear guns are used to shoot the fish swimming around the coral. Occassionally lobster are hooked with a wire.

Estimated Catch Levels. There are ways of estimating the productivity of fishing as a economic and subsistence activity. Although no complete study of fishing productivity was attempted, the researchers were given access to the Buen Hombre fishermen association records. These records reflect the proportion of daily catch that is sold to the association.

Fish are classified by classes. First-class fish include conch, grouper, skark, barracuda, lobster, and octopus. Second-class fish include jacks, parrots, and bonefish. Third-class fish include squirrel fish, grunts, and a variety of other small coral fish often caught in fish pots.

The first- and second-class fish caught by local fishermen are sold to the fishermen association, which keeps the fish on ice until market middlemen arrive in trucks to purchase the fish. Most third-class fish are either sold on a daily basis to marketers who ride motorcycles or are consumed within the village of Buen Hombre.

The catch records presented in Table 2 reflects a 63 day period occuring during the summer of 1985. During this period, fishermen sold fish on only 50 days; thus, fishing occurred 80 percent of the time. There were 223 individual

fisherman sales. The average daily catch per fisherman was 10.71 kilos and the average daily catch value was $29.11 pesos. Heavy fishing pressure was placed on lobster and grouper. Lobster accounted for 32 percent of total cash sales.

TABLE 2: FIFTY FISHING DAYS OF BUEN HOMBRE SEAFOOD CATCH, BY WEIGHT AND VALUE.

SPECIES	KILOS LANDED AND SOLD	WHOLESALE CATCH VALUE IN PESOS	AVERAGE PRICE PER KILO IN PESOS
Grouper	423.85	$ 1,577.64	$ 3.72
Lobster	374.05	$ 2,068.38	$ 5.53
Parrot	335.76	$ 509.63	$ 1.52
Octopus	243.78	$ 394.20	$ 1.62
Conch	128.75	$ 407.00	$ 3.16
Barracuda	83.75	$ 292.17	$ 3.49
Grunts	26.60	$ 36.30	$ 1.36
Shark	24.00	$ 39.75	$ 1.66
2nd Class	748.39	$ 1,167.25	$ 1.56
TOTALS	2,388.88	$ 6,492.32	$ 2.72

*Source: Buen Hombre fishermen association records kept over a 63 day period during the summer of 1986

Fishermen retain a percentage of each catch for family and kin subsistence (see fuller discussion later in this chapter). If each fishermen retained three kilos per fishing trip and there were 223 fishing trips that produced seafood for sale, then during this period 669 kilos of seafood was consumed in the village by the fishermen and their relatives. In addition, third-class fish are rarely sold to the fishermen association so this percentage of the catch is missing from Table 2. Also missing are catches

deriving from off-shore subsistence fishing. It is estimated that approximately 669 kilos more bypassed the fishermen association's record book.

Table 3 provides an estimation of the total seafood catch of Buen Hombre fishermen during these 50 fishing days. The estimate assumes an average value of $2.72 pesos per kilo for the seafood consumed by villagers and sold as third class. This assumption is based on observation that fishermen often keep first-class fish, like grouper, for home consumption. Table 3 provides estimates indicating that on an average trip, during these 50 days of fishing, a fisherman caught 16.71 kilos of seafood having a market value of $45.43.

TABLE 3: ESTIMATED TOTAL SEAFOOD CATCH OF BUEN HOMBRE FISHERMEN DURING FIFTY DAYS OF FISHING.

TOTAL CATCH	KILOS LANDED AND SOLD	WHOLESALE CATCH VALUE IN PESOS
Catch Sold	2,388.88	6,492.32
Catch for Subsistence	669.00	1,819.68
Catch for 3rd Class Market	669.00	1,819.68
	3,726.85	$ 10,131.68

*SOURCE: Buen Hombre fishermen association records and ethnographic observations.

Types of Fishermen. It is difficult to talk about types of fishermen when so many people fish in so many ways. Analytical categories are most useful when they are mutually exclusive. Conceptual clarity, however, does not come easily in the Buen Hombre case. With the physical isolation and economic marginality of the area, the people of Buen Hombre must be able to take advantage of new markets for cash crops and still be ready to feed themselves from their own subsistence resources. Subsistence carbohydrates come from kitchen gardens and wild plants, but the sea is the major source of subsistence protein. People fish when and where and only for what they need at a particular moment in

their adaption to a changing economy. All fishermen fish for cash as well as for subsistence.

Still, the concepts "fishermen" and "farmers" exist in the minds of the people. These adult males are primarily defined by the amount of time they devote annually to one or the other task. Perhaps as much as 95 percent of these men are registered as belonging to either the fishermen or agricultural associations. The 47 fishermen who fish out of the Buen Hombre lagoon should be considered the prime potential adopter pool for the mariculture project.

LOCAL FISHERMEN COOPERATIVE AS ADOPTER

In Buen Hombre, as elsewhere in the Dominican Republic and the Caribbean, the term "cooperative" carries negative connotations (Pollnac 1981). It brings with it memories of being manipulated by outsiders as well as of project failure.

The scientific literature suggests that there may be a series of basic factors that have caused the frequent failure of fishermen cooperatives. Cooperatives are often formed from the "top down," with a person or agency from outside a community providing development resources to the community but forcing people to manage these resources in ways that are culturally inappropriate. Pollnac's (1981:34-37) summary of this issue suggests that fishermen have resisted cooperatives because fishermen (1) have a low social status, (2) are suspicious of outsiders, (3) value independent work, (4) are egalitarian in work relationships, and (5) work with environmental constraints that are different from those of agriculture, which is the basis for most cooperative models.

In addition to general social and cultural problems associated with fishermen cooperatives, the fishermen in Buen Hombre are familiar with the specific abuses and failures that have occurred with previous local cooperatives. Most recently, for example, a Peace Corp Volunteer started a food cooperative in Buen Hombre. After more than a year of successful operation a large portion of the cooperative's funds were "mismanaged." Although the cooperative did not fail, the PCV was so frustrated she asked to be reassigned elsewhere in the country. Her replacement, who arrived in August of 1985, was not assigned to the food cooperative but was assigned to the crab mariculture project. Fishermen interviewed in Buen Hombre used the PCV food cooperative and other examples to make an argument against the use of the fishermen cooperative adoption model. So while the literature documents that some

fishermen cooperatives do succeed (Pollnac 1981:37-38), the organizational concept seems to be inappropriate for the transference of mariculture in Buen Hombre.

LOCAL FISHERMEN ASSOCIATON AS ADOPTER

A fishermen association began operating in Buen Hombre in 1984. The concept of a fishermen association is strongly supported by the Dominican Republic government, which encouraged its development and gave it official status. The fishermen association seems to be strongly supported by the local fishemen according to interviews with them; and it appears to be the most appropriate and perhaps the best unit for helping to manage the project.

The fishermen association has a number of "oversight" functions. It (1) works to set the local market price for seafood, (2) provides storage for fishermen's equipment, (3) provides ice for keeping the seafood catch until marketers arrive, and (4) contributes to community projects. Perhaps its most important function is to regulate the wholesale market price of the Buen Hombre fisherman's catch. Before the association was formed, market middlemen negotiated for their purchases from each fisherman as he brought his catch ashore. Without storage capability and with small volumes of fish, fishermen had a weak bargaining position. Fishermen also varied in their ability to bargain. The association now records each fisherman's daily catch by type of fish and weight and keeps the fish on ice until market middlemen arrive.

One member of the association serves a related function for the fishermen by purchasing the daily catch of lobster. These lobsters are then kept in three large cages in the lagoon. The association member hires two men to feed the lobsters on a regular basis. Lobsters are fed third-class fish, extra food from homes, and even tobacco. A market middleman comes to the village once a week and purchases all the lobsters. A sale of more than 200 kilos was observed during the research. If the road washes out or if the market middleman does not arrive for other reasons, then the lobsters continue to be fed and to grow.

Fishermen store their equipment on the beach in an enclosed hut. A stronger building, shared with the agricultural association, is available for more expensive gear such as outboard motors. Having a place to store gear is an advantage to fishermen because of the dispersed rancherian settlement pattern and the lack of transportation.

One hut on the beach contains a large wooden ice chest,

a scale for weighing fish, and an area for the sale of fish. The ice for this chest arrives in big blocks in the back of pickup trucks. A middleman who sells his catch near Santiago was observed bringing blocks of ice to the village several times per week. The ice is insulated by rice husks that come from the highland rice processing factories located near Santiago.

The fishermen association and the agricultural association have combined their human and economic resources in service to the community. The most obvious of these efforts is the construction of a cement water tank to store potable water for the community. The tank was not yet completed during the research period. It was not clear to the researchers how the water would be brought to the tank inasmuch as there is no potable water in the village. The project was noted with pride by a number of people during interviews.

In summary, the fishermen of Buen Hombre are organized into a mutual self-help organization which has a number of corporate features. The joint marketing, common storage facilities, and community public works are functions that require little commitment on the parts of association members and produce an easily evaluated and readily observed product. It is important to note that the association neither owns the means of fishery production nor does it have the authority to regulate the fishermen or their activities. Therefore, it cannot be considered a cooperative.

The fishermen organization could easily transfer its current functions to the mariculture project; could help negotiate with crab market middlemen; could help in the storage of equipment; and, perhaps, could help resolve the community relationship between the mariculture operators and other members of the Buen Hombre village. Corporate functions should only be added to this association with caution, given the distrust of cooperatives that exists in the community (see recommendations at the end of this chapter).

FISHERMEN AND *MITHRAX* MARICULTURE

The following analysis considers a number of parameters that should be included in any model designed to predict the outcomes of *Mithrax* mariculture adoption among the fishermen of Buen Hombre. The parameters are (1) unit of adoption, (2) social organization of fishermen, (3) patterns of crew fishing, (4) sharing and selling the catch, (5) occupational multiplicity, (6) cultural orientations and (7) technology fit.

UNIT OF ADOPTION

Mariculture for Fishermen. During the public meeting, the issue of who should participate in the mariculture project was raised a number of times. The fishermen said that the mariculture, while similar to farming, should be adopted by fishermen. The argument for this hinged upon the fishermen's experience with the water, their access to equipment, and their perception that the project was designed for them. They were open to the idea that agriculturalists might participate in the mariculture project at a later date but felt that the initial commercialization of the project should be with fishermen.

Mariculture for Fishermen Association Members. More specifically, the fishermen interviewed wished the mariculture to be limited to members of the Buen Hombre fishermen association. The argument for this position stems from "oversight" functions that are currently in place for the fishermen association members. The assumption was that some of these oversight functions could be transferred to the new mariculture effort.

This decision would leave at least one fisherman out of the mariculture project and would call into question the status of nonvillage association members. One man in the village is recognized as a fisherman but does not belong to the association. There also may be individuals from villages in the mountains or along the coast who regularly fish from the Buen Hombre lagoon but do not belong to the association. They, too, would be excluded by this criterion.

Five of the fishermen association members are from other villages. They seem to have full rights in the association but are outsiders from their point of view and that of the people of Buen Hombre. Having the dual status of village outsider and member of the fishermen association probably causes role conflicts for them and may result in role strains. This may occur, for example, when the human and economic resources of the association are used for a Buen Hombre community project. This may occur if resources from the mariculture project are used to reinvest in the Buen Hombre community (see the recommendations in this chapter).

Mariculture for Fishing Crews. Members of the fishermen association were asked who should adopt the finca de la mar? After a lengthy debate during their business meeting, held on July 10, 1985, members of the fishermen

association suggested that a fishing crew rather than an individual fisherman would make a better adopter. They argued that members of a crew already work together to build, maintain, and operate fishing equipment. The crew already has a system of temporarily replacing a member when he cannot come to work. They understood these to be important aspects of the mariculture that would severely stress the individual fisherman. Finally, the crew is central to the social organization of fishermen and to the fishermen association. To ignore or de-emphasize the crew would be to undermine the way they have chosen to organize themselves for fish production. They were very clear on this last point.

Summary. The Buen Hombre fishermen would like the "units of adoption" for the Smithsonian Mithrax mariculture to be fishing crews who belong to the fishermen association. Buen Hombre fishermen view the fishermen association as serving certain oversight functions just as it currently serves existing fishing activities. There was no suggestion that the fishermen association would own the crab mariculture. Ownership of the mariculture would cause the association to become a cooperative and, according to local people, this is not desirable.

SOCIAL ORGANIZATION OF FISHING

The fishermen association has a status ranking system that is most clearly manifested by who acquires access to fishing crew membership. The 45 members of the fishermen association are organized into prime units of production called crews. There are ten fishing crews and each has rights of access to a boat. In addition, each crew has some equipment. This equipment inventory may be minimal (fishing lines and diving equipment) or it may include all the necessary equipment such as lines, nets, a motor, a sail, oars, and even the boat itself. The process by which men become members of crews and crews gain access to boats is central to an understanding of how the fishermen association works. It is also central to an understanding of the potential impact of Mithrax mariculture on the fishermen association.

The data collected during this research suggest that movement through the status ranking system of the fishermen association can be understood as a "developmental cycle" (Fortes 1958:1-4; Stoffle 1977:279). This cycle has a series of stages, each of which conveys certain rights and responsibilities upon a fisherman. Movement along to the next stage involves recognition by some portion of the

members in the association. This recognition involves an evaluation of the fisherman's experience, learned skills, demonstrated ability, and equipment. The stages, for this analysis, are referred to by the terms (1) apprentice fisherman, (2) journeyman association member, (3) craftsman crew member, and (4) beached association member. These are descriptive terms developed for this analysis and are not those used by the Buen Hombre fishermen.

In Table 4, the fishermen of Buen Hombre and those from other villages who belong to the fishermen association are presented by the approximate numbers in each category. There we can see that most fishermen belong to the association but are either journeymen, craftsmen, or beached association members. The exception to this development cycle is a journeyman fisherman who refuses to join the fishermen association. The apprentice fishermen are those indicated by their fathers as being prepared for journeyman status in the association.

TABLE 4: NUMBER OF BUEN HOMBRE FISHERMEN BY DEVELOPMENT CYCLE

STAGES IN THE DEVELOPMENT CYCLE	NUMBER OF FISHERMEN
Apprentice Fisherman	8
Journeyman Association Member	8*
Craftsman Crew Member	30
Beached Association Member	8
TOTAL	54

* Table does not include one journeyman fisherman who is qualified to belong but refuses to join the fishermen association.

PHOTO 17: Buen Hombre craftsmen-crew member and Stoffle holding a centolla crab caught for food.

PHOTO 18: Apprentice crew members with subsistence portion of catch. Note spear gun used in skindiving.

Apprentice Fisherman. The "apprentice fisherman" is the first stage in the process of becoming a fisherman (see Photos 17 and 18). Fishermen were asked if they wanted their sons to become fishermen. Most said that it was a hard way to make a living and they hoped that their sons would not have to fish for a living. On the other hand, they recognized that there were few local options. Of the 33 fishermen interviewed, 64 percent had teenage sons, and 38 percent of these fishermen were apprenticing their sons to fishing. The remainder of the fishermen had sons attending school.

Both youths and adults from the agriculture sector become apprentice fishermen. One young fisherman was asked how he began. He said that he had just become interested in fishing and began to talk with one of the fishermen. He hung around and learned more about fishing by listening to fishermen and by watching. Then he got an opportunity to go out in a boat as a replacement for someone who was sick and got a chance to prove himself. Eventually he was permitted to join a fishing crew. Another man who had moved to Buen Hombre from the mountains, recounted a similar story. His father was a farmer and he had been raised and married in an agricultural village over the mountains to the south of Buen Hombre. After establishing a common-law marriage, he moved to Buen Hombre with his spouse and children. It was the second home they owned as a family. They decided to farm and got a marginal finca near the foot of the mountains. He learned fishing from a friend and some time later he became a member of a fishing crew.

The apprentice system is necessary because many current adult fishermen's fathers were not fishermen. Of the 33 fishermen interviewed, 48 percent had fathers who were farmers and 45 percent had fathers who were fishermen. So most current fishermen had to learn about fishing from someone other than their own fathers.

Journeyman Association Member. Becoming a "journeyman association member" is the second stage in the process of becoming a fisherman. This is a stage that has come into existence because of the association. It is a special status for fishermen who are recognized as being able to fish and to belong to the fishermen association but for whom there is no crew status available. Eight persons were in this stage; five of these journeymen were young adult males who reside in other villages. They have motor bikes and much of their own equipment. When they arrive on the beach at Buen Hombre they check to see if there is an opportunity to fish with a crew. If no boat and crew is available to them, they swim out from shore and skindive for fish or hook

octopus.

Craftsman Crew Member. The peak achievement of a Buen Hombre fishermen is to become a "craftsman crew member." This is the productive core of the fishermen association. The average age is 37 years; most (81 percent) are or have been married. They have an average of five children: three males and two females per fishermen family. The average size of a crew is three men, all of whom will be members of the fishermen association. Crews are formed from among family, friends, and compadres. Most important, crews are functionally integrated. In other words, they contain the right combination of people, skills, and equipment for the jobs at hand.

Ideally, a crew is a group of men who have known each other for a long period of time. During this period of time the crew has selected members based upon fishing skills, trustworthiness, and personality. There is usually some variance in the ages of crew members because some tasks such as skin diving are more strenuous while other tasks such as hand lining take skills acquired over long periods. One person may be a better navigator while another knows how to use a sail. Crew members will also own different equipment. One fisherman may have oars, another a sail. Together a crew provides the skills, experience, and equipment that is necessary to meet the full range of opportunities and dangers that confront fishermen. Their success is judged in part by their catch success, which is reflected in their stability as a production unit.

The craftsmen crew members must have a "temporary replacement pool." This is necessitated by the corporate obligations of the crew. They have families to help feed, fishing equipment to fix or upgrade, and a fish market to maintain, so the crew must fish as often as possible. On a day-to-day basis, however, some crew members will be unable to fish due to other occupations (see the next section of this chapter), family commitments, or personal illness. When this occurs, the person must be replaced with someone who has similar fishing skills. The replacement need not bring his equipment but he must permit the crew to function normally. Of the 33 fishermen surveyed, 60 percent draw upon friends, 27 percent use a son, and 12 percent draw upon a member of the fishermen association. The rights and responsibilities of replacement pool members can vary because of how they came to be in the temporary replacement pool. They may be former crew members who have been "beached" because they became physically unable to fish with a crew. Or they may be agricultural friends who do not want permanent fishing commitments. Or they may be journeymen

association members who are waiting for an opportunity to join a fishing crew.

In Buen Hombre, as in Antigua, there is a preference and an advantage for fishing crews to stick together. But due to the economic marginality of Buen Hombre, crew composition changes as events dictate. One crew has fished together for 14 months. The most recently formed crew has been working together for four months. The head of that crew owns a boat, but his outboard motor broke and he could not afford to repair it. His response was to stop fishing with his normal craftsmen crew and to recruit two very young (about 20 years old) fishermen. They had to replace his motor by rowing the boat and diving for him. He then had to go out each trip to "captain" the boat in order to protect his interests. The broken motor, therefore, had placed excessive physical demands upon the more mature craftsmen crew members who then had to be replaced. The adjustment placed added demands upon the boat owner who now had to go out each day with young, unproven and, perhaps, untrustworthy crew members. The situation was inherently unstable because it kept the captain from his trusted mature crew members, from his normal replacement pool, and from his other non-fishing duties which he could otherwise have attended to while his normal crew fished by themselves.

Beached Association Member. A number of factors can cause a craftsmen crew member to leave joint fishing activities and become what might be called a "beached association member." Most important of these factors is a physical disability. Deep skin diving is the most physical and dangerous (see Epilogue) of all fishing activities. Ear drum problems are caused by repeated deep dives. Usually only young crew members engage in this activity. Other activities such as pulling heavy fish pots and rowing require arm strength. Overall, however, just being on the sea from 5 to 14 hours a day is physically taxing. At some point in their lives, all fishermen face the question of whether they are physically able to continue to fish with a crew.

Withdrawal from fishing with a crew does not prevent a man from fishing from shore, from serving in the temporary replacement pool, or from participating in the fishermen association. In fact, beached association members provide wisdom based on years of experience and help with land-based activities of the association.

PATTERNS OF CREW FISHING

The process by which an individual becomes a fisherman

and eventually a part of a crew has just been discussed. That process is influenced by an individual's access to fishing equipment but is determined more by other factors like his skill, honesty, strength, and personality. By contrast, the actual pattern of crew fishing is tied directly into the technology available to them.

There are ten active fishing crews in the fishermen association. Because a crew's boat may be leaking or a motor may break at any time, the crew may have to rely upon the equipment of other crews. Because most Buen Hombre fishermen purchase used equipment and use it heavily, equipment failures are common. The social accommodation to equipment failures is an elaborate system by which the means of fishing can be allocated in work shifts.

There are three shifts each day and these can occur seven days a week: (1) the early morning, (2) the afternoon, and (3) the night. The early morning shift begins about 7:30 am and lasts until noon or 1:00 pm. Researchers were surprised that this shift did not begin sooner, inasmuch as the sun is up hours before. Apparently fishermen tend to other occupational strategies (see later section in this chapter) before fishing. Perhaps the night shift causes the delay. The early morning shift occurs during prime weather conditions, when the ocean is usually calm. There is a preference for fishing due north or to the northwest of the village. This is so that the crew can utilize the afternoon northeasterly on-shore winds for returning home. A crew with a motor will often put out a sail and shut off the motor to save gas on the return trip. Travel to the east of the village is fraught with difficulties due to the afternoon head winds. Were the motor to give out during the trip home, already tired fishermen would have to row into heavy winds in order to reach home. The morning shift is taken by the crew who owns the equipment.

The afternoon shift begins shortly after noon and ends before 6:00 pm. Afternoon fishermen often have a difficult time even leaving the village lagoon. Some days the waves are so high by noon that no boats leave the lagoon. Even one of the Smithsonian's wooden boats sank while returning to the research ship in the afternoon. Another Smithsonian rubber boat simply could not make it back to the MSL ship in the afternoon. Nonetheless, the afternoon shift fishermen begin fresh and even have been observed rowing out in moderate waves. After fishing for four or five hours, afternoon fishermen are hurried home by the highest winds of the day.

The night shift begins between 8:00 pm and 9:00 pm and will be over around 6:00 am. There are major advantages and

disadvantages with fishing at night. The wind usually dies down after dusk and the ocean is calm until noon the next day. This reduces the gasoline needed to travel to a fishing area. It also reduces the effort needed to stabilize the boat while fishing or diving in a specific location. Fishing at night requires staying out until morning because there is no one on shore to weigh the catch and place it on ice. The dangers at night are greatly increased. There are coral heads to tear the bottom out of a boat and break a motor drive shaft. Sharks and barracuda cannot be seen until they are very close. On the other hand, the catches are usually large and working the night shift leaves time to do other occupations during the day.

Three crews went out on the night shift during the research. Members of one night crew discussed the pattern with researchers. The night shift crew goes out as often as four or five times per week. It should be remembered that this was during one of the busiest times of the year, when the fincas have to be cleared for planting. It is also a time when there is a need for cash for the purchase of seed. These fishermen go out at night because their own boat is broken and it is the only time they have access to another crew's equipment. They use an electric light hooked to an auto battery to attract the fish. Fish are caught with a hook and hand line. One of the men will skin dive at night from time to time. The night before the interview the crew returned with about 100 kilos of fish. Most of the fish were sold the next morning at 8:00 am, but each fisherman brought his family some third-class fish. Just after noon the next day the wife of one of these night-shift fishermen prepared lunch and then awakened her husband. After lunch he and his son left to help his crew members clear their fincas. They would not fish again for two nights.

SHARING AND SELLING THE CATCH

The catch is either sold or kept for the family. The pattern of sharing and selling the catch is influenced by a number of factors including whether the fisherman fished alone or with a crew and who owned the fishing equipment. Lone fishermen either sell their catch or take it home based upon their judgment as to which better serves them and their family. Individually these are small-volume transactions but collectively they constitute an important part of the fish marketing system and make a significant contribution to the animal protein in the family's diet.

There is a complex system for rewarding fishermen according to their fishing efforts and the value of the

fishing equipment they contribute. Expenses and daily subsistence contributions to the family come "off the top." A typical fishing trip will take two or three gallons of gasoline for the outboard motor. Gasoline costs $4.50 (pesos) a gallon if purchased in the village and $4.00 a gallon in town. Food is brought each day by the boat owner. His wife will prepare a pot of rice and meat sufficient to feed the whole crew. It costs perhaps $10.00 to $15.00 a trip to fish.

It is customary for each crew member to keep a percentage of the catch for his family. Fishermen estimate that each crew member keeps three kilos of seafood each trip for his family. There is an important relationship between the amount of the catch given to the family and the size of the total catch. If the catch is small, is it more likely to be converted into cash or subsistence food? Because people indicated actual kilos of fish to be given to the family rather than a percentage of the catch, this suggests that meeting perceived basic needs is more important than meeting cash demands. This relationship is key for understanding the impacts of the crab mariculture.

After off-the-top commitments are met, the catch is sold. Fish sales occur throughout the week except for Sunday, but most sales occur on Saturday. Three types of wholesale middlemen were observed purchasing fish in the village during the research: (1) third-class fish purchasers; (2) mixed second- and first-class purchasers; and (3) lobster purchasers. The third-class fish purchasers use small motorbikes or motorcycles to transport them to Buen Hombre from larger cities in the region. As many as four of these middlemen were seen in the village on a Saturday. One or two may be observed during the week. They often have a woven bag with a block of ice surounded by rice husks to carry and perserve the third-class fish they purchase. On the trip into the village, these marketers bring for sale frozen sugared slushes held in plastic. By all evidence, third-class fish are returned to the cities and sold as food for the poorest of the population.

A small pickup truck is used by the only mixed second- and first-class fish marketer. He comes two or more days per week in order to purchase fish for the middle- and upper-class urban people living in towns like Villa Vasques. On the trip into the village, he brings cases of beer and large blocks of extra ice for the owner of the cantina. He also sells ice to the fishermen association and brings drinking water back to Buen Hombre. Prostitutes, probably from Villa Vasques, traveled in the back of the truck on one Saturday. Local fishermen said prostitutes do not make much

money in Buen Hombre. This outside fish marketer seems to have a number of mutually beneficial ties with local fishermen and other villagers.

First-class fish, almost exclusively lobster but occasionally conch, are purchased by one fish marketer. He arrives almost every week on Saturday. But, because he does not come every week, the lobsters must be kept in cages and fed. In order to make a successful load, this marketer visits a number of villages along the coast to make purchases. He then travels with a full truck load directly to Santa Domingo where the lobsters are sold to hotels or shipped overseas to Spain. The marketer was neither observed bringing items into the village, nor did he seem to have special relationships with local villagers. This appered to be a Stage 4 type of market relations, as described by Forman and Riegelhaupt (1970:208).

Once the Mithrax mariculture is producing crabs, market relationships like that with the first-class marketer, are expected to be needed. The mixed second- and first-class marketer may attempt to market the Mithrax to local hotels on the north coast but his current margin of profit appeared so slight that he could easily go broke. Were this to occur, it would not be easy to replace the items he currently brings into the village. If production of the Mithrax precludes sufficient production of third-class fish, it is expected that this portion of the market will be eliminated and the urban poor will have to find alternative sources of inexpensive animal protein.

After the sale of fish to the wholesale middlemen, the net profit is split among the crew members and owners of equipment involved in the catch. In general, there are two separate systems of splitting the catch depending upon whether or not the equipment owner fishes with the crew. If three regular crew members fish together in their own boat and with only their own equipment, they split the net profit three ways. If the owner of the boat does not fish with the crew, they divide the net profit four ways. One share goes to the boat owner and one to each of the three crew members. If there is an outboard motor and the owners of both the boat and motor fish, the net profit is split five ways, with one share going to the motor owner and one for the boat owner. If neither the boat nor the motor owner fish, the net profit is split in half, with the three crew spliting one half and the motor and boat owners splitting the other half. If a fishing net is used, its owner can receive up to 75 percent of the net profit if he fishes with the crew.

Boats and motors are key to the production of Buen Hombre subsistence protein and commercial fish. The boats

are kept running through the shift system for a number of reasons. If a number of fishing crews could not fish they would become an economic and subsistence drain upon the community. In addition, the reduced total village catch might cause the fish market to fail due to insufficient volume. Finally, owners of boats and motors receive economic benefit from renting their equipment.

OCCUPATIONAL MULTIPLICITY

The concept of occupational multiplicity has been discussed in Chapter Two and illustrated by the Antiguan mixed-fishing crews in Chapter Three. In Buen Hombre, as elsewhere in the Caribbean, fishermen are involved in a web of commercial and subsistence commitments that permit them to survive better in an economically uncertain environment. Having more than one adaptive strategy (multiple occupations) conveys greater security upon the fishermen, his family, and his community.

The set of occupational commitments that Buen Hombre fishermen regularly hold includes (1) cash crop farming, (2) kitchen gardening, (3) charcoal production, and (4) raising domestic animals.

Cash Crop Farming. The rancherian settlement pattern can only exist where each family in the community can have access to its own agricultural fields, so each Buen Hombre family has some land. The amount of land and the number and location of the fields distinguishes fishermen from farmers and fishermen from fishermen.

Farmers own more land than fishermen. This point was repeated in interviews but, because our survey was limited to fishermen, exact comparisons are impossible. In addition to owning more land, farmers often own fields that are far removed from the house. For this reason, farmers spend more time away from home in the late summer and early fall just before harvest. Farmers often spend the night and may even live in the distant fields when their crops are close to harvest. These farming commitments would make it more difficult for them to operate a mariculture finca de la mar.

Types of fishermen are distinguished by their farm holdings. There seems to be a relationship between the amount of farmland a person owns and the amount of time he invests in fishing. Craftmen crew members, for example, own an average of 36.8 hectares of land but journeymen and beached association fishermen own an average of 76.3 hectares of land. Are fishermen association members kept off crews because they farm too much land to maintain fishing responsibilities? Or are they unable to fish full

time and so have to acquire more land to support their families? Perhaps both motivations are at work but at different points in the life of a fisherman. In fact, it is the older beached fishermen who have the largest amount of land. Perhaps fishermen anticipate the time when they can no longer meet the rigorous physical commitment of craftsmen crew fishing and invest their resources in increasing amounts of farmland. This suggests another stage in the developmental cycle of fishermen, that of "part-time fisherman/farmer."

The fishermen's commitment to farming as a source of income is reflected by the joint association membership. As part of the survey, fishermen were asked if they belong to the Buen Hombre agricultural association. Out of the 30 fishermen who responded, 60 percent belonged and 40 percent did not belong to the agricultural association. The fishermen who belonged to the agricultural association have a mean average of 57.6 hectares of land, whereas those fishermen who did not belong have a mean average of 16.3 hectares of land. Association membership, then, seems to be a good indicator of the occupational strategies of fishermen.

Fishermen help each other meet farming commitments and are helped by relatives. The top three cash crops grown by fishermen are tobacco, corn, and peas. Tobacco is grown by 81 percent of the fishermen. Each crop requires intensive labor commitments but these commitments do not always overlap. Clearing the fields and harvesting are times when intensive labor is required for all fields at once. Wives and children help 66 percent of the 33 fishermen surveyed, whereas 6 percent hire other people, and 6 percent work the fields by themselves.

Some farmers seek outside capital in order to help with farming commitments. The Bank Agricola in Monte Cristi and the Federal Bank in Puerto Plata have provided farm loans to 15 percent of the fishermen and many of the farmers. These loans permitted the fishermen to hire outsiders to plow the fields and to purchase seed and fertilizer. In the fall of 1985, a good tobacco crop and a drop in market price placed most of these fishermen in financial difficulty. Many homes had the front room filled to the roof with bales of tobacco that could not be sold. This problem may have influenced the patterns of fishing in the summer of 1985 because at that time fishing would have been the only source of cash for both fishermen and farmers having bank loans coming due.

Kitchen Gardens. Most homes have a garden for growing crops for family consumption. These gardens are subsistence in orientation; however, production above the needs of the

family is either sold or distributed to others. Food distributed to others helps to maintain the manystranded social relationships that provide security in times of unexpected crisis.

Kitchen gardens tend to be located as near as possible to the home, which permits regular visits to collect food for daily meals and provides greater security from casual theft. These gardens tend to be controlled by the fisherman's wife: these gardens are defined as "hers", and she can be expected to keep control over any cash deriving from sales of surplus crops. Proximity of the garden to the home permits her to maintain household duties along with gardening.

Charcoal Production. Charcoal production occurs throughout the year but reaches a peak when the fields are cleared in late summer. Charcoal is produced from small trees that have grown up in fields left fallow. During the research, the people of Buen Hombre were selling a half-ton truck load of charcoal every week. They may have produced more to store for future sales, but no stored charcoal was observed by the researchers. Charcoal production can be accomplished on a flexible schedule so it fits easily into a fisherman's schedule. There are limits, however, to its flexibility. If fishermen fail to produce charcoal in sufficient quantities and at regular intervals, it will not pay for outside marketing trucks to travel over very poor mountain roads to the village to purchase charcoal. If this occurs, the fishermen may lose the charcoal market.

Domestic Animals. The full list of domestic animals has been discussed earlier. Important for this part of the analysis is that these animals require a certain amount of attention from the fisherman and his family. Some animals remain in the home compound and are supervised by the wife and older children. Other animals, like cows, must be taken to graze and must be provided with water. A dammed natural sink collects rain water and provides the only available water for animals. Fishermen may not leave earlier in the morning so they can water and stake out the larger animals. There are no fields specifically devoted to pasturing animals, but some fallow fields are fenced and are used to graze animals. Commitments to moving animals to and from grazing and watering areas may influence morning and evening fishing patterns.

Beekeeping. In an environment with few flowers, almost no surface water, and where most trees are cut down for charcoal and to clear the land for agriculture, beekeeping seems a surprising activity. One small house along the coast, however, has permitted a small half hectar of trees

to remain uncut despite the shortage of agricultural land near the house. In order to produce flowers, rubber tires and plastic drums have been cut and upturned to collect and hold water. A series of water plants that apparently flower all year long have been placed in each container. Beehives have been located in the middle of this man-made oasis. The result is an enormous concentration of bees.

Beekeeping does not seem to have been adopted by others in the village as part of their occupational complex. It may be that the loss of land or time to care for the bees is too much of a tradeoff. On the other hand, it may be that these bees produce more honey than the village needs and as much as the local market will absorb. In any event, the bees represent an example of the ingenuity of the people of Buen Hombre to make their environment productive.

CULTURAL ORIENTATIONS

Fishing, Farming, and Self Identity. There is a concern, expressed previously in the Antigua discussion, as to whether or not fishermen will have a cultural conflict with a mariculture project. In other words, will values that guide the motivation of fishermen prevent them from engaging in a farming activity? The answer to this question for the Buen Hombre fishermen is that they see no conflict with the idea of farming the sea and still being fishermen. This is not to say that there are no potential conflicts between the project and their fishing activities, but rather that they do not mind farming if it fits with their fishing schedule. This point was repeatedly made when people were asked to conceive of the mariculture as a finca de la mar. This concept was well received. Also, the occupational multiplicity data just presented document that most fishermen are heavily committed to farming.

Do fishermen perceive themselves as different from farmers? In Buen Hombre, as in Antigua, fishermen do perceive themselves as different from farmers. The latter are perceived by the fishermen as failing to seek out the better life of fishing, as being not as brave, as not being as strong, and perhaps, as not working as hard. It appears from these data that full-time farming is what a fishermen does after he can no longer fish. Such values have influenced the fishermen's expressed desire to have the mariculture project limited to them rather than have it incorporate farmers.

Taste, Diet and Market. The people of Buen Hombre very much value the Mithrax, which is called the centolla. The crab is caught from time to time but not as commonly as

the lobster. Centolla crabs feed at night and are rarely seen in the day. When caught, they are eaten by the family. Crabs are roasted over the cooking coals or boiled in a pot of water. If Mithrax are raised in a mariculture project they could serve the subsistence needs of the community.

There also is a national market demand for centolla. Restaurants in Santa Domingo and in a few hotels on the north coast will list the centolla when available. The national market is not currently sufficiently strong to cause specialized centolla marketers to come to Buen Hombre. Were the domestic Mithrax to be produced in sufficient volume, it is expected that the lobster marketers would add the Mithrax to their marketing networks. A question of some concern is how marketing the Mithrax crab would affect existing marketing relationships (more on this issue in this chapter's recommendations).

Territoritality: Law and Usufruct. The resources of the beaches, lagoons, reefs, and banks near Buen Hombre are important to the people of the village. Therefore these resources are controlled by customary use rights, called "usufruct", which are derived from actually using the resources on a regular basis and in a culturally appropriate manner. Most of these customary rules are not recognized by national law, so there can be a conflict whenever a development project considers only the formal patterns of resource ownership.

The fishermen association is not a corporate unit in terms of owning the means of fish production but it does seem to have strong usufruct rights regarding the major Buen Hombre beach and lagoon. This point emerged during a public meeting during which the possible location of finca de la mar sites were being discussed. It was important, according to the people attending, that the beach and lagoon not be occupied by a private project. The beach and lagoon should be reserved for the docking, cleaning, storage, and selling activities of the fishermen association.

This point raised another issue that the research was unable to resolve. In one conversation, a fisherman said that people in the interior villages were worried that the project would take away their access to the sea. In addition, they were afraid that the project would limit their access to fishing areas along the reef. The researchers were told that the concern was expressed by people in interior villages who fish out of Buen Hombre and did not refer to people from those villages who belong to the fishermen association. The nature and extent of usufruct territorial rights of people from interior villages is not clear but it appears to exist. This should be taken

into consideration before more portions of beach, lagoon, and reef are utilized by the project.

The fishing rights of people from interior villages perhaps are reflected in the village of origin of current craftsmen crew members. Only 63 percent of the 33 fishermen interviewed had parents who lived in Buen Hombre: 12 percent had families in Los Connucos, 6 percent from Las Saquita, 3 percent from Puerta Plata, and 6 percent from elsewhere. So a significant proportion of contemporary crew fishermen came from other villages. This supports the position that other villagers have territorital rights in Buen Hombre. Perhaps rights of access to coastal resources derive from kin ties through these emigrants.

It is important to understand whether individual people from other villages hold these customary access rights or whether the interior village holds such rights. Perhaps individuals in other villagers acquire territorial rights through marriage. Perhaps other villages have such rights as part of reciprocal resource-sharing agreements. It is important to note that people in Buen Hombre must travel to other villages over the mountains just to get drinking water. Also all palm leaves used for thatching the roofs of houses, ramadas, and other structures in Buen Hombre come from other villages. If there are reciprocal resource-sharing relationships between communities or patterns of resource access through intermarriage, such relationships could be endangered by establishing a finca de la mar on another village's territory.

TECHNOLOGY FIT

The Mithrax mariculture technology seems to fit well with the extant fishing technology and values held in Buen Hombre. As in Antigua, there was a concern that specific points of technology would not fit with the existing technology. Would materials like PVC pipe and plastic screen be unfamiliar? Would local people have the skills to build the screens and cages associated with the mariculture? Would "tending crabs" be an economic activity that conflicts with local people's values and self-images?

Mariculture Materials. As in Antigua, the mariculture technology does not seem to conflict with what is now occuring in Buen Hombre. Fishermen are familiar with PVC pipe. About twenty yards of it was observed in a field along a main path through the village. It was part of an irrigation project started by a Peace Corp Volunteer. Despite the failure of this project, the material is known to the people, some have worked with it on that previous

project, and the pipe is even available. Plastic screen is a similar matter. The fishermen use galvanized screen in the construction of their fish pots. Although plastic screen is not used now, there is no apparent reason why the extant knowledge of screen use will not provide a sound base for use of new screen materials.

Mariculture Techniques and Values. Fishermen build fish pots, construct their own homes, and thatch their own roofs. They are skilled at using many of the tools that are required in the construction of the mariculture cages and screens. In addition, they understand the basic concepts of farming and attending to domestic animals. More specifically, some fishermen participate in the keeping of lobsters in the lagoon. This requires special cages, feeding the lobsters, and holding the living product until the market conditions are best. There are no apparent conflicts with the mariculture.

Old Technology Impacts. Although the materials, operating techniques, and work values associated with the proposed mariculture are not particularly new to the fishermen of Buen Hombre, the research suggests that proposed changes in some old technology may prove to be problematic. New wooden boats and motors are proposed as part of the mariculture. Six boats would be provided by the project in order to get fishermen to and from the pilot project. The boats would be owned by the project but would be utilized by the fishermen. These six boats would basically double the number of working boats in the community. The issue of how the boats would be utilized was raised by the fishermen in a public meeting. It should be remembered that boats--especially ones with motors---are the key elements in the system of craftsmen crew fishing. It can be argued that the entire developmental cycle of fishermen hinges upon acquiring access to boats.

INITIAL COMMERCIALIZATION OF MITHRAX MARICULTURE

P.L. 480 FUNDS

The development of Mithrax mariculture in the Dominican Republic is perceived as having three stages (1) pilot, (2) initial commercialization, and (3) full commercialization. The pilot site at Buen Hombre acquired the capacity to move into what might be termed an "initial commercialization" stage when the Dominican Republic agreed to allocate a proportion of its P.L. 480 funds to the project. The funds from AID generally parallel those of P.L. 480, however, as more P.L. 480 funds become committed to the project, less

AID funds are allocated to it. This follows from AID's and MSL's primary commitment being to develop the pilot stage. It also follows from the desire of Natura to assume control of both the northern and southern mariculture projects.

The initial commercialization stage was designed to be the next stage beyond the single pilot project, which had been conceived, constructed, and managed by Smithsonian MSL personnel. The initial commercialization stage was designed to expand the pilot so there would be 10 complete mariculture projects of 20 cages and 1,000 screens each. So 200 cages and 10,000 screen would have to be constructed and managed. The initial commercialization stage would employ ten Buen Hombre fishermen to build and manage the ten mariculture projects. The initial commercialization stage would last 24 months. After the initial commercialization stage, the mariculture technology would be ready for widespread adoption throughout the nation.

By August of 1985, just a few months after the pilot was begun and many months before the pilot would be fully operational, initial commercialization decisions were made in Buen Hombre. This portion of the analysis considers two of these initial commercialization decisions regarding (1) hiring Buen Hombre fishermen and (2) providing project boats and two anticipated decisions regarding (3) ownership of the mariculture and (4) procedures for reinvestment of profits.

HIRING BUEN HOMBRE FISHERMEN

Who Works, Who Owns?. A decision to hire the first five of the anticipated ten Buen Hombre fishermen on the mariculture project had been made by MSL personnel by the time of the social soundness analysis. MSL personnel had talked informally with a number of local fishermen about the project and made at least one public presentation about the mariculture at the regular fishermen association meeting. MSL personnel knew they were to hire up to ten fishermen but did not want to confuse interest in the technology with interest in wages. So MSL personnel did not mention the wage labor but instead encouraged fishermen to visit the two Smithsonian work boats anchored about a mile northwest of the lagoon. MSL personnel had agreed among themselves that they would select the first five project workers from among those who demonstrated the most interest in the project. This interest would primarily be measured by visiting patterns.

During the public meeting with Natura on Saturday, August 3, 1985, the issue of hiring local fishermen was brought up by the Natura board members. At the time they

expresssed interest in participating in the decision to select the participating fishermen. During that meeting and in private interviews over the next few days, fishermen expressed the desire to know more about the hiring and to have some role in the decision. The issue came up again on August 10 in the meeting with the fishermen association, which desired clarity on the issue of the hirings and on a number of other issues discussed later in this section. The fishermen noted that they wanted (1) only fishermen association members to participate, (2) only crews to adopt the finca de la mar, and (3) a voice in how the decisions were to be made. They then asked for a special meeting the next day to discuss these issues with the MSL personnel.

The next day (Sunday August 11, 1985) about 27 people met for more than three hours with the MSL crew. At the request of the secretary of the fishermen association, the MSL crew announced the selection of the first five workers on the project. The five included three members of one of the best fishing crews, a friend of theirs from another fishing crew, and a young boy from another village. It was immediately clear to those assembled that selecting these five people raised a series of problems for the fishermen. The following are some of the problems recorded in the notes from that meeting. Why should the project hire a young boy who was neither a fisherman nor from Buen Hombre? If the purpose of the 10 project workers was to build 10 fincas de la mar, then would one crew own three fincas de la mar? How could three men each eventually manage a finca de la mar? Who would help them? What about access to the mariculture technology for other crews? Who would be chosen? Who would not be chosen? How was this decision made? How would the next decision be made?

Patterns of fishing in Buen Hombre did not reflect the criteria for selecting the five project workers/initial adopters,--that is coming out to visit the MSL boat. Only 30 of the 46 fishermen in the association have access to boats. Of the 30 with access to boats, three crews (9 fishermen) had equipment difficulties and were fishing at night during this period. An additional unknown percentage of boats (perhaps two crews) travel to the west of the village. They would have had great difficulty stopping by the MSL research boats anchored a mile east of the village. By these calculations, it would have been difficult and perhaps impossible for 67.4 percent of the fishermen in the association to meet the employment criteria of expressing interest in the project.

It was commonly recognized that the decision to hire these five people was not reflective of how the fishermen

were organized. The fishermen association is hierarchical in terms of access to resources by different types of fishermen. Apprentices do not belong to the association and journeymen and beached fishermen do not belong to crews. But among craftsmen crews there is a real sharing of the means of production. Boats are not withheld from other crews whose equipment has failed. Instead, there is a norm of sharing that is esssential for the crews, the association, and the village. A great imbalance was created among the crews when only two crews were selected to participate in the project. This problem greatly worried the crew members selected, as well as those who were left out.

Problem Resolution. As the problems emerged in public through public debate, so did some of the solutions. Once MSL personnel understood that the prime fishermen were organized into 10 crews and that the fishermen wanted the crews to be the units of adoption, MSL personnel agreed to either (1) take back the initial five job offers and proceed with one fishermen from each of the 10 crews, or (2) leave the present five employees and ask for three more positions so that the next hiring would allow one fishermen from every crew to be on the project. The second position was greatly preferred.

After Dr. Stoffle left the research site, he met with Bill Bernard and Francisco Geraldes (on August 13, 1985) to present the problem and the preferred solution. It was agreed that having 13 fishermen hired at Buen Hombre was preferable to the inter-crew conflicts that might arise if only 10 were hired. It was generally agreed that each of the 10 crews would have their own finca de la mar at the end of the initial commercialization stage.

It is important to note that both initial commercialization decision errors were made by MSL personnel because they lacked a full understanding of the social organization of fishermen and of fishing patterns. It must also be pointed out that MSL personnel had neither the social science background nor the resources to collect social data about the fishermen. MSL personnel had worked since arriving in March of 1985 six or seven days per week--an estimated 70 hours plus per week--just constructing the pilot project. Certainly they cannot be faulted for not having the social organization data for making a proper hiring decision. Nonetheless, if the decision had gone forward without public discussion and public resolution, the resultant conflict could easily have disrupted the project and caused factions within the fishermen association.

Worker-Employer Relations. It is also important to

note that the resolution of who would be hired and who would own the mariculture projects, does not resolve a host of additional questions. For example, as the MSL becomes the employer of the fishermen, how will it develop a culturally sensitive personnel management policy? Will workers be paid if they have to take time off from their 40 hour a week project commitment to meet other occupational commitments? Can workers meet their commitments to the project by sending a crew member to work in their place? Who is responsible for feeding the workers a noon day meal? Should the money for food be taken out of their wages just like a boat owner does with his crew? If these and other personnel problems are not resolved, then the project will experience worker disatisfaction and turnover.

Worker Turnover. Worker turnover due to unsatisfactory MSL personnel policies could have a number of important implications. First, the best potential adopters of the mariculture may be lost from the project because their occupational strategies do not fit wage labor. Second, there are only so many fishermen in the community and moving to hire agricultural workers without knowing how they are socially organized could result in a repeat of the initial fishermen hiring decision. So the pool of prime adopters and prime adoption units is small and even very little turnover could reduce the size of the initial commercializtion effort. Third, ex-project personnel normally become critics of the project. They sit at the boundary of a development effort and undermine it. The community of Buen Hombre is too small and too functionally interdependent, through all those manystranded relationships described earlier in this chapter, for the project to survive too many critics.

NEW BOATS - OLD BOATS

The Mithrax projects will need boat access for the operators. There are two logical solutions: (1) get operators who have their own boats, or (2) fund new boats. The P.L. 480 funds made the second alternative reasonable for Buen Hombre. Six boats are planned, which may or may not have motors. The boats would be made by the project workers out of materials and with tools provided by Natura. Although the boats would be owned officially by the project, apparently they would be transferred to the operators at the end of the initial commercialization period. If not, operators would be left with a finca de la mar and no way to get to it.

Fishermen in the public meetings raised a number of issues regarding what happens to these boats. Can a fisherman take a boat fishing on a day or at a time when he is not working on the project? If there are going to be ten fincas de la mar, then how are the other four fishermen going to get to their projects? If the project needs to ask a fisherman to use his own boat, will they pay him for the gas? If the project does not supply motors for the boats, will the project pay the fisherman for the use of his motor?

In addition, this research raises questions regarding the impact of the new boats on existing patterns of fishing and catch marketing. What, for example, will happen to the subsistence level of the community if a number of boats are pulled out of fishing so their owners can participate in the project? What will happen to the fish market if catch levels are reduced so low that it does not profit middleman fish marketers to travel to Buen Hombre? What will happen if the six new boats are used to expand the fishing fleet out of Buen Hombre? Will more fishermen damage fish stocks? Depending upon how the six new boats are managed, it appears that much more or much less fishing is possible in Buen Hombre.

Resolution. Certain aspects of the problem were laid aside during the public meeting. MSL staff, faced with transporting large numbers of fishermen on irregular work schedules to two small research boats a mile east of the village, decided to move aspects of the construction stage onto the beach. Up until then, all materials and all construction of screens and cages had been accomplished on board the two MSL ships. The one exception had been making cement anchors on a nearby beach. This was a well received resolution because project workers could fit commitments into their other work schedules. The decision effectively removed the workers from observation by MSL personnel. This made moot the issue of hours worked per week and placed workers on a piecework system of evaluation.

This resolution, however, only resolves project commitments during screen and cage construction. After these are built, project work will be on the water and the issues of boat use and reimbursement will have to be addressed. Also, there is no current effort to address the issue of what alternative boat use scenarios would do to patterns of fishing, the supply of fish in the village, and the existing marketing system.

MITHRAX PROFITS AND VILLAGE DEVELOPMENT

No fishermen raised the long-term issue of what would

happen to Buen Hombre if the ten Mithrax fincas de la mar really worked as anticipated. Fishermen concentrated on limiting the adoption to association members and equitably distributing the resources among craftsmen crews. The broader issue of community equity was raised by Francisco Geraldes on August 13, 1985, during the debriefing with Dr. Stoffle in Santa Domingo. Mr. Geraldes raised the ethical question of whether it was appropriate to take national funds, P.L. 480 pesos, and invest them in private business ventures, i.e. individually owned fincas de la mar. Stoffle raised the question of what social and cultural implications ten successfully operated fincas de la mar would have for the agricultural members of Buen Hombre.

TABLE 5: FIRST THREE YEARS' PROCEDURE AND ESTIMATED REVENUE FOR REINVESTMENT AND COMMUNITY WELFARE IN BUEN HOMBRE

1st Year	88 kg a cage x 200 cages x $5 a kilo =	$ 88,000*	
	Less 30% =		$26,400
2nd Year	132 kg a cage x 200 cages x $5 a kilo =	$132,000	
	Less 20% =		$26,400
3rd Year	220 kg a cage x 200 cages x $5 a kilo =	$220,000	
	Less 10% =		$22,000
TOTAL EARNINGS		$440,000	
LESS TOTAL REINVESTMENT FUNDS			$ 74,800
PROPOSED ALLOCATION OF REINVESTMENT FUNDS:			
60% General Community			$ 44,880
40% Fishermen			$ 29,920
TOTAL REINVESTMENT FUNDS			$ 74,800

* All values expressed in pesos

Resolution. Mr. Geraldes suggested that an agreement involving Natura and the Buen Hombre village officials be established. The purpose of this agreement would be to provide for (1) a system of project maintenance and reinvestment and (2) a distribution of benefits to the whole community. The first purpose recognizes that by the end of the second year of the initial commercialization stage there will be a need for capital to repair equipment. Also, there will be a need for capital to help other fishermen build their own fincas de la mar. The second purpose recognizes that there will be a need to share the benefits with the majority of community members who have no access to the fincas de la mar. This will help raise the quality of life for all members of this community.

Specifically, the proposal would take a percentage of annual profits and have it held for either project reinvestment/start ups or general community welfare projects.

According to the agreement with Natura, the figures in Table 5 are for the purpose of illustration only; actual figures would vary. There would be no commitment on the part of the project operators to pay more than a percentage of their profits. No profits would mean nothing for reinvestment in their equipment and in their community. This proposal was to be made to the Natura board of directors and then would be presented to the people of Buen Hombre.

RECOMMENDATIONS

The people of Buen Hombre seem to be excited about the new development resources that are being invested in their community. The Smithsonian MSL on-site personnel have established a working relationship with the people that is quite informal but appears to be open to the thoughts of local people. The technology seems to be appropriate for the way the fishermen currently organize themselves and market their products.

Despite these positive components, the project requires social and economic inputs beyond those that either MSL personnel, Peace Corps, or even local people can provide. These inputs have two schedules. There are certain things that the project must know as soon as possible, and there are other things that can be studied as the project proceeds.

It is important to know now what the hiring of the

first five fishermen is doing to their other occupational commitments. It is when a worker has just been hired that key role conflicts and efforts at resolving them through role reduction and role reallocation occur. Research on the transition from agricultural to industrial employment in Barbados (Stoffle 1977a, 1977b) and elsewhere (Stoffle 1975; Van Willigen and Stoffle 1986) suggests that these role reallocation decisions are essential for understanding which workers will remain in the new occupation and which ones will perform well. Understanding the role conflicts and resultant role strains that the new occupation is placing on the worker's preexisting occupational commitments is a first step in developing a culturally sensitive management policy.

It is important that the project establish some formal management policies in consultation with the people of Buen Hombre. For two years MSL and/or Natura project personnel will be the employer and the fishermen will be the employees. Ground rules must be established before problems arise. Otherwise, when a rule is established it can appear to be a punishment for the individual whose behavior caused the rule to be formed. When such a perception occurs, it often results in worker turnover.

It is absolutely essential that significant worker turnover not occur. It is not clear how many workers the project can turn over and still remain viable. At some point, loss of fishermen will create a faction within the fishermen association. If left unresolved, this faction will either disrupt the project or the fishermen association. Although there are ways of resolving ex-worker dissatisfactions, the best solution is to anticipate problems before they arise and put mutually satisfactory solutions into the formal personnel policies of the project.

Long-range research must be conducted regarding marketing networks that are currently in place. It is important to understand where the subsistence fish, both third- and second-class, go when they leave the village. How important is the subsistence portion of the Buen Hombre catch to people in rural villages and the urban poor of larger cities? These are important issues because the developmental change frame of analysis cannot be restricted to the adopters of a new technology and their village.

It is important to understand the territorial rights of other villages in the Buen Hombre beach and lagoon and along the reef system. Violation of such rights could undermine important reciprocal relationships that are essential to all the people in Buen Hombre.

It is important to study how to increase the educational potential of the pilot and initial

commercialization efforts in Buen Hombre. How will fishermen from other parts of the island learn of the technology and profit from the Buen Hombre lessons? Because the village is so isolated, special efforts will have to be made if the site is to have any real value to the rest of the country. Is there, for example, a photographic documentation of the early project stages? Is someone writing a daily log of efforts, problems, and solutions so that another rural community could build upon this pilot rather than repeat its mistakes? Who will write a how-to-do-it manual for other villages? The lessons of these early steps could be lost from memory within a short time. The project could experience personnel turnover and repeat its own mistakes and forget its own successes.

EPILOGUE

The findings contained in the Caribbean Fishermen Farmers report were prepared between September 15, 1985, and February 18, 1986. The report, however, reflects only project-related research that occurred during the summer of 1985. This epilogue updates to July 1986 the Smithsonian MSL, Peace Corps, and AID mariculture activities since September of 1985. Unless otherwise specified, the following information derives from phone conversations with Smithsonian and AID personnel who worked closely with the mariculture projects during this period.

GENERAL TRENDS

The major trend in each of the six Smithsonian MSL project sites (Grand Turk, South Caicos, Buen Hombre, Azua-Puerto Viejo, Antigua, and Carriacou, Grenada) and a new private commercial site on North Caicos island, is a gradual transition to new management. This transition occurs out of (1) an expression of faith in the viability of the mariculture technology, (2) a recognition that a new phase involving both research and commercialization is required before a final phase of full scale adoption is possible, and (3) a recognition that agencies and institutions have different functions in the research and development process.

Despite concern on the part of some that the mariculture technology may not be commercially viable (Idyll and Caperon 1986:4), most persons associated with the project assess the prospects as positive. This is reflected in extensive private sector interest and initial capital investment in the Mithrax mariculture. The Smithsonian received so many requests for information about the technology that they created a private foundation to handle these requests: on October 1, 1985, the Mariculture Institute was officially incorporated as a nonprofit private foundation. It functions to disseminate written information about the project, help private business with mariculture plans, and arrange site visits. Since incorporation, the Mariculture Institute has received hundreds of requests for information and currently has dozens of businesses paying for services. A news article suggesting there is great promise for the future of both the technology and the Mariculture Institute appeared in the Wall Street Journal (Anon. February 11, 1986). In addition to interest

expressed through the Mariculture Institute, there have been hundreds of thousands of dollars of private sector investment in two new mariculture projects: one in Carriacou, Grenada and the other on North Caicos island.

The recognition of a need for a phase between the scientific pilot phase and the full commercialization phase derives from recommendations from all of the external review studies. This social soundness analysis recommended such a phase, as did the economic feasibility study by Rubino (1985). In addition, reports by Cordover (1985) funded by AID, by Idyll and Caperon (1986) funded by AID, and by an English team (marked "Top Secret" by the British government) funded by the British Government all recommended more scientific and commercialization research before proceeding to full commercialization. Because the basic science research pilot phase is completed, firms that can combine elements of basic scientific research with studies of marketing and technology transfer are required.

This transition from Smithsonian MSL management to other commercialization/research/development groups reflects the mission of the Smithsonian to primarily address issues of basic scientific research. Other groups have specialized expertise in applied scientific analysis, commercial mariculture or aquaculture, and technology transfer. The Smithsonian, however, continues in its dual role of conducting the primary scientific research on the technology and advising, where needed, with phase two efforts.

Missing from all these phase two efforts, however, is basic research on the social and cultural impacts of the new technology. It is not clear to this researcher that any attention is to be given to assessing the potential implications of Mithrax mariculture on community integration, subsistence consumption, occupational complexes, or other key elements of local Caribbean life. In addition, local fishermen tend not to be integrated with proactive roles into the scientific experiments and commercialization efforts. Only in Buen Hombre do the local fishermen have something of a "teacher" role where they can contribute indigenous knowledge to the development of the technology. Perhaps such studies and involvements will occur just before the next stage in the development process.

TURKS AND CAICOS

The Peace Corps has removed most of its volunteers from the Turks and Caicos mariculture sites. All PCVs have left the Grand Turk site and, as of March 1986, only one PCV

remained at the South Caicos mariculture site. This removal has occurred because both sites have been redefined in function.

The Grand Turk site has changed from a pilot site oriented toward individual fisherman adoption to a central research site for the Smithsonian MSL work. This has occurred because there seems to be little interest on the part of local fishermen in the mariculture. Instead, AID will continue to fund basic research on the technology. Also, new species that feed on the algal screens, such as parrot fish and conch Cittarium pica, will be considered for cage culture. These findings will be shared with phase two projects in the other Caribbean sites.

A new mariculture site has been started on North Caicos island by West Indies Mariculture, Inc. The project derives from MSL personnel, Kimberly Peyton and Kim Moller, who had worked as scientists aboard the MSL research vessel the Marsys Resolute. They have changed the function of previous Caicos mariculture sites from research pilot to small scale commercial operation. The two former MSL employees have invested their own capital as well as received private commercial capital for the new crab mariculture operation. Their personal financial investment in the project is indicative of their perception of the technology's commercial viability (Peyton personal communication 1986).

DOMINICAN REPUBLIC

THE BERNARDS' REPORT

According to a March 3, 1986, letter to Dr. Stoffle from Katherine and William Bernard, the Buen Hombre and Azua mariculture sites continue to be supported by the Dominican Republic government, Smithsonian, and AID. The current primary source of funds derive from P.L. 480 monies that were finally allocated after extensive negotiations. The first year's allocation was $500,000 (pesos). Natura served as the funding vehicle so that all governments were removed from the handling of these monies. The Bernards were chosen by Natura to serve as Project Co-Directors, however, they continued to be funded by the Smithsonian. According to their letter, the system has worked so well that it has become a model for future non-profit foundations' handling of P.L. 480 funding in the Dominican Republic.

The functional relationship between the two sites has been agreed upon (Bernard and Bernard personal communication 1986:3). Each site will focus upon a different development aspect. Buen Hombre is to work with the mariculture system

as it is "in the water" and has hired fishermen to begin working directly with MSL staff in order that the local fishermen will quickly learn the system and implement the technology in their area. To date, five fishermen have been hired and are working well together and are producing "an incredible amount of crabs" (Bernard and Bernard personal communication 1986:3).

The Azua-Puerto Viejo mariculture site is focused on upscaling both the crab larvae and algae production. It is oriented towards commercial development and technology demonstration. In March 1986, the project was in the process of building an on-land hatchery, marine laboratory, and international training center. Simultanously, the project has hired five fishermen, has placed cages and screens in the water, is growing crabs, has grown an abundance of algae, and has developed new cage and screen designs. The Azua site, due to its small size, will never be able to handle hundreds of crab farmers. However, it is an excellent site for demonstration and training because it is only 1-1/2 hours from Santo Domingo (Bernard and Bernard personal communication 1986:3). The site is expected to be an excellent area for commercial development. Unlike Buen Hombre, Azua has running water and electricity which make on-land operations possible. In addition, the site is developing its own buildings and related facilities.

Beyond these points of information, the Bernards expressed a number of points of disagreement with the draft version of the Caribbean Fishermen Farmer report, especially its interpretion of the history of site selection in the Dominican Republic. The issue of a "dualism" in the development of the two sites is rejected as an interpretation of what occurred (Bernard and Bernard personal communication 1986:1). Instead, it is suggested by the Bernards that there never was a debate over whether to have two sites or where they should be located. According to the Bernards, the two sites were proposed as a compromise (emphasis added) during the initial meeting between Bill Bernard and Mr. Geraldes (Bernard and Bernard personal communicastion 1986:1). In addition, it is suggested that, "There is ABSOLUTELY no dualism in the two project sites...they both have distinct purposes and directions" (Bernard and Bernard personal communication 1986:1). The Bernards also reject the notion that the Azua site is being utilized to produce a fishery experiment station (Bernard and Bernard personal communication 1986:4).

The sensitivity over these issues is apparent from the Bernard's letter and, in fact, was apparent in most interviews conducted during the research. Was there a

split? Did the local fishery biologist seek to link this project with other related fishery development efforts? The full set of data available to this researcher argues for a longstanding debate that lasted at least until the time of Natura interviews by Dr. Stoffle in Buen Hombre in 1985. There was no other reason for the development of two sites during this pilot stage of the mariculture development.

The Bernards' concern over whether or not a legitimate debate occurred between MSL and Natura perhaps derives from a developmental change philosophy that is revealed in the following quote:

> This was hardly a debate and does not reflect the attitude of the Dominican government, USAID, and the Smithsonian Institutiton in their efforts to work together on this program (Bernard and Bernard personal communication 1986:1).

This comment suggests a philosophical position that international development involving multiple agencies is best conducted without debate over resource allocation. Perhaps this is so from a political point of view. Certainly the question of whether crab mariculture should be a priority in the Dominican Republic has been hotly debated since the project began. However, theories of development, discussed earlier in this report, suggest that it is only through an open debate of issues that all positions can be clearly presented and appropriate resolution occur. These theories point out that resource allocation debates do derive from legitimate differences over the means and ends of development. What developmental change project has ever occurred without there being a choice between valued goals and methods that exceed the available resources? If "developmental change" is to occur, it is important that there be an open expression of these legitimate differences, an involvement of critically involved personnel--including the people for whom the project occurs, and a formal resolution of the issue. If this process is made impossible by a political milieu that does not permit open debate and decision making, then the development effort will certainly be adversely affected.

The United States Peace Corps' role at the two Dominican Republic mariculture sites has been clarified since the summer of 1985 field work. As of March of 1986 (Bernard and Bernard personal communication 1986:4) there were six PCVs working on the two projects, with three stationed at each site. The background of the PCVs vary: three are marine biologists, two are trained in business,

and one is a teacher. The business PCVs are focusing their efforts on establishing a business and marketing system for the fishermen. The marine biologists are assisting in the day-to-day management of the mariculture, which involves feeding and caring for the animals and observing changes and conditions that might affect the overall progress of the project. The teacher is developing a training program with various components: for fishermen, for fisheries specialists, and for private capital investors. The training program will have Spanish and English versions and be available for other regions of the Caribbean.

It is estimated that the Smithsonian will turn over all responsibilities to the Peace Corps and Natura at the end of September 1986. The Peace Corps will assume much of the day-to-day operational responsibility for the two projects. AID funding is expected to continue at some level, but PL 480 funds and Peace Corps Volunteer effort are expected to be the primary support for the projects.

KARL PORTER'S REPORT

Further updates on the Buen Hombre site were provided by Karl Porter, a MSL staff member who visited each of the Smithsonian sites during the last week of May. Before leaving for his trip, Porter and Stoffle discussed the types of observations that would be useful for this epilogue. After returning from his trip, Porter provided (via phone conversation on June 5, 1986) information on the following topics: (1) crew hirings, (2) patterns of mariculture operation, (3) impact of crab mariculture on fishing patterns, fishermen consumption, and the village and (4) the dangers of fishing.

Crew Hiring. There are now eight local fishermen hired as mariculturalists on the project. The original five fishermen are still working on the project and three new fishermen from Buen Hombre were hired in the third week of May 1986. Two of the three new mariculturalists are from one of the ten recognized fishing crews and are brothers. The third member is from another formerly unrepresented fishing crew. Thus, in the hiring of eight mariculturalists, the project has been able to incorporate representatives from four of the ten fishing crews.

Mariculture Operation. MSL staff continues to raise the crabs in the "baby boxes" up to a 100 days of age. Then the mariculturalists raise the crabs to market size. Each of the original five mariculturalists has built one or two large crab growout cages, with up to 100 algal screens per cage. The screens are changed daily during the week but not

on the weekend. In the early morning, the mariculturalists go out together to the mariculture project. They travel and work with MSL project boats and motors funded by PL 480 monies. They are each supposed to work on the mariculture 4 hours a day, 5 days a week. For this they receive a weekly wage of $85 pesos. Each day one of the mariculturalists is taken by the MLS staff to feed and care for the baby boxes. This is done in order to provide informal instruction regarding this sensitive stage of the process. The fishermen provide their own noonday meal by going ashore.

The actual pattern of work is that on a typical day one of the five mariculturalists is missing. Sickness and the need to do other business are the most common excuses. When a mariculturalist misses work, the other mariculturalists change his screens for him. Even the young non-fisherman from another village is supported in this fashion. While Porter was on site, this young mariculturalist was sick for three days and the other mariculturalists continued to support him. It was predicted by the author that the Buen Hombre fishermen would eventually "marginalize" this young outsider and cause him to quit the mariculture project. Not only have they not made him quit, the mariculturalists have incorporated him into a new system of mutual support that resembles relationships among a traditional fishing crew.

This system of mutual support seems to be very effective during this early production stage of the project. It will be interesting to observe how the system will be modified when after a year of growth the crabs are ready for sale. Production varies among the crab cages according to Porter. Also, one cage broke loose in a storm and was destroyed on the beach. Although the cost of replacing this cage was borne by the project, the mariculturalist now will have half the production of the others during the second year. Will the mariculturalist crew share profits as well as labor?

Fishermen innovation has, as expected by this author, occurred due to their having a real role in the mariculture project. According to Porter, early changes in the MSL design and materials resulted in less efficient operation. Some of the equipment broke up in heavy seas and the screens were difficult to slide in and out of cages. Mariculturalists now understand where construction measurments are of most importance as well as where changes may be most effective. Jon Ingelhart and his new MSL co-worker on the project, John Tschirky, have taken the position that they should be informed before the mariculturalists innovate, but that all reasonable innovation should be allowed.

Impacts Of Mariculture. After working on the mariculture project, the men then work an average of 20 hours a week on their own fishing, according to Porter. All of the original five mariculturalists have modified their fishing patterns--they now fish with fish traps. Porter estimates that there are an average of 10 fish traps per mariculturalist, with one having 30 to 35 traps. These mariculturalists have created such a demand for fish traps that someone in Buen Hombre is now making and selling fish traps to them. Most aspects of traditional fishing have been given up by these mariculturalists and the pots primarily are placed in deep water far out from the reef.

As a consequence of shifting to deep water placement of fish pots instead of continuing traditional patterns of fishing, these mariculturists have reduced the fishing pressure on traditional fishing econiches without a decrease in the volume of fish they produce. It is expected that lobster and octopus, traditionally heavily targeted species (see Table 2), will benefit most from this modification in fishing patterns.

Other than the fish traps, Porter noticed that each of the mariculturists had purchased expensive diving watches. The watches, which were made in China, lasted one or two dives before leaking water and being ruined. The watches are still worn by some mariculturalists as jewelry.

A number of changes in Buen Hombre were recorded by Porter. The Buen Hombre Fishermen Association had not met in seven months. The only explanation provided to Porter was that there was a lack of interest on the part of members. The bar owner who used to be the only one in the village who bought fish now has competition from one of the mariculturalists. The bar owner began to drink heavily and could not afford to purchase all the catch. The mariculturalist took his own cash and began to purchase the remaining catch from the fishermen. The road into the village is being improved with AID funds. This should keep the road from washing out during the heavy rains.

Without further ethnographic research it is impossible to draw a direct relationship between these community and fishermen changes and the employment of fishermen on the mariculture project. MSL staff on site, however, believe that most of the fishermen changes and many of the community changes were influenced by the project.

Dangers Of Fishing. The differences in self-perception between fishermen and farmers that has to do with a willingness to take risks was highlighted by a tragic accident that occurred near the new mariculture cages. A boat from Buen Hombre was fishing inside the barrier reef.

One of the young crew members was skindiving for fish during the early morning, when he was attacked by a twelve foot long Great White shark that had come through the gap in the reef to feed. The young man was bit in the head. The hair of divers which is bleached almost white due to exposure to sun and salt water, further adds to the risk of diving. Sharks are reputed to be attracted by bright objects in the water. The diver who was attacked had very white hair. The diver lived in another village and was the nephew of one of the crew members. Perhaps he was an apprentice fishermen. At the time of Porter's visit to Buen Hombre, the young fishermen was very sick in a regional hospital. The MSL on-site personnel do not believe that the mariculture cages served to attract the Great White shark to the inside of the reef.

GERALDES' REPORT

A letter from Francisco Geraldes (Director Ejecutivo, Programa Nacional de Agroacuacultura, Republica Dominicana) arrived just as this report was undergoing final editing. The letter dated July 28, 1986, contains a number of new points of interest:

(1) MSL is withdrawing earlier than planned from both sites. MSL ends its consulting and project participation as full partner on September 30, 1986. MSL will continue to be available for short term consulting after then.

(2) Buen Hombre now has a Dominican manager, an agricultural engineer. He is doing very nicely. The manager will stay at Buen Hombre for another full year.

(3) The fishermen at Buen Hombre have chosen the best method for the transfer of the project. This will be done by Natura financing a number of fish pots and crab cages for each fishermen. This financing will have a low interest rate and a year's grace. This will permit cash flow generation for the fishermen while they wait the 14-16 months to harvest their crabs.

(4) At Azua we are by ourself, Bill (Bernard) is stationed back in Grand Turk, and the site is run by a Dominican member of our office and two PCVs.

(5) In general, everything has shifted more to the control of the Dominican participants (NATURA) and assisted by us at the Ministry of Agriculture (PRONAGRO). The animals are in good shape and growing, so we will be seeing--hopefully by October 1986--the first commercial crop consisting of 140 kg of crabs. Let's see what type of problems might arise from this new stage of the project.

Mr. Geraldes letter establishes the connection between the new fish pots and working on the mariculture project. Buen Hombre fishermen suggested the fish pots as a mitigation for lost income during the first year of mariculture start-up. Similar locally-derived innovations are expected now that both Dominican Republic mariculture projects are operated by Dominican managers.

ANTIGUA AND BARBUDA

The next phase in the development of Mithrax mariculture in the nation of Antigua and Barbuda was formally initiated by AID on December 24, 1985, with the announcement of a grant in the Commerce Business Daily. That announcement requested that U.S. firms, institutions, and private voluntary organizations interested in receiving a grant to develop Caribbean King Crab Mariculture in Antigua, West Indies, submit expressions of interest, including capability statements to the AID Caribbean Regional Development Office. The announcement noted that the Smithsonian Institution had produced encouraging results but that it planned to withdraw its researchers from Antigua in June 1986. The Smithsonian has agreed, according to this announcement, to make frequent monitoring and advisory visits to the site at least to June 1987. The purpose of the new grant, estimated to be no more than $500,000, is to move the present project toward a self-sustaining, commercial operation. The grant is expected to entail further study, expansion of pilot crab production, demonstration of profitability, and initial development of commercial units.

A Request for Grant Applications (RFGA:NO.538-0140.21) was issued by the AID regional office on March 1, 1986, to those applicants deemed to have appropriate qualifications to submit a full proposal. The RFGA provided some new information on the growth of the MSL crabs in Antigua and made the evaluation that, "the work here should be considered a relatively good effort that requires strengthening and more scientific guidance." Additionally,

the RFGA suggests that the host government prefers to pursue a small producer model in Antigua and that the large-scale producer model is already being pursued in Grenada. The grantee should design and carry out its research keeping in mind that the ultimate user of the technology in Antigua will be a small-scale producer employing few individuals, if any.

In May 1986 a commercial research firm based in Miami, Florida was selected as the AID grantee. One observer close to the decision on this proposal concluded that the grantee was well qualified in the commercial and scientific components but that the proposal did not indicate how the grantee would address the task of involving local fishermen. The proposal contained only a general reference to coordination with local fishery officers.

GRENADA

Grenada is the last of the planned Smithsonian MSL Mithrax mariculture sites. The commercial adoption model is being tried there. The site is located in Grand Bay on the small island of Carriacou. According to a report funded by Commonwealth Development Corporation (Cordover 1985: 14), a commercial expatriate business headquartered in Jacksonville, Florida, will operate the facility. AID will provide funds to the project through an Infrastructure Revitalization Grant, according to the report. The grant would fund a factory shell, blast freezer, and portable water well. The report concludes that this would be a low-risk effort. If the mariculture project should fail, the commercial business could utilize the permanent facilities for an existing fishing operation and AID could recover most of the movable equipment.

According to the "Statement of Work" in an AID contract (PIO/T 598-0605- 1-5651003) signed on July 12, 1985:

> MSL staff from the Antigua site will be transferred early in 1986 to establish a pilot operations in Grenada and begin training site managers selected and hired by International Fishery Services, Inc. This private sector group has been designated to cooperate with USAID, MSL and the government of Grenada to set up a fully commercialized Caribbean King Crab fishery out of the island of Carriacou. This fishery will include all stages of production from the establishment of a crab hatchery and construction of algae screens and crab cages, to building a processing and freezing facility and

designing a marketing system for the product. MSL will provide the personnel and expertise to train Int'l. Fishery Services site supervisors who will in turn train selected local fishermen. Technicial assistance will be provided through the life of the grant during the various phases of establishment of this commercial fishery in Grenada.

The AID contract included a schedule of activities to occur between August 1985 and September 1986, which is summarized here:

(1) August 1985 to November 1985--Continuing pilot and training operations in Antigua and the Dominican Republic. Fishermen training in the D. R. and Peace Corps training in Antigua. Peace Corps support continues in Grand Turks and Caicos.
(2) December 1985 to January 1986--Antigua site turned over to Peace Corps, MSL staff transferred to Grenada. North Coast D.R. staff reduced to two for monitoring and South Coast training begins.
(3) January 1986 to June 1986--Intensive training operations in Grenada. MSL efforts directed at establishing full commercial fishery. Monitoring continues at other sites.
(4) July 1986 to September 1986 -- Return of MSL research vessels to Grand Turk or Washington. Phase out monitoring.

On the 3rd of February 1986, the government of Grenada sent official notification of approval for the project to Jim Alford, the lawyer for the private corporation. According to that letter, Cabinet Conclusion No. 075 provided the following concessions to West Indies Sea Farms Limited: (1) approval of the company, (2) ten years tax holiday, (3) waiver of witholding taxes or repatriation of wages and dividents, (4) granting an accelerated depreciation, (5) waiver of taxes and duties on importation of raw materials, (6) granting of aliens land holding licences, (7) granting of six work permits to expatriates for an indefinite period, (8) fisherman's discount on fuel prices, (9) granting of a lease for land and processing facilities at Grand Bay, Carriacou, and (10) free entrance of Smithsonian personnel boats and equipment for six months. A letter (dated 12th April, 1985) to Mrs. D. Bartel, owner of the company, from Anselm Clouden (Senior Crown Counsel, Ministry of External Affairs, Grenada) suggests what the Grenada government perceives as the benefit of this project,

"...your project has been discussed with the Prime Minister, and I am instructed to say that such a project would be welcomed especially in the island of Carriacou, where the unemployment situation is very acute."

No mention was made in the Cordover report, AID contract, or any of the half dozen letters among project participants available to this author, regarding the social implications of the commercial mariculture project in Grenada. None of these documents mention involving local fishermen in the planning process. There has not been a social soundness analysis of the project.

A recent survey of household economics in Grenada, however, has documented that people in Carriacou have a high involvement with subsistence activities, termed "direct production" (Burpee, Morgan, and Dragon 1986: Tables 19, 20). Direct production occurs when a household provides its own fish, meat, home repairs, and sewing. In Carriacou, 94 percent of households grow their own vegtables, which is 24 percent more than people in any other parish in Grenada. In Carriacou, 87 percent of households own livestock, which is 18 percent greater than people in any other parish in Grenada. The people in Carriacou do earn less cash than people in any other parish in Grenada, but the value of direct production in Carriacou is greater than that of people in any other parish in Grenada. The average household in Carriacou earns $2,985 EC annually in cash and produces $2,094 EC annual through direct production. Thus 42 percent of household income (as measured by cash income and direct production) in Carriacou comes from direct production. This is a higher percentage than for households in any other parish in Grenada. So the question remains, will employment in a commercial Mithrax mariculture influence commitments to subsistence production and consequently affect the well being of people in Carriacou?

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