FINAL REPORT

Contract NASW 2133

U.S. FISHING INDUSTRY PARTICIPATION IN NASA'S EARTH RESOURCES SURVEY PROGRAM

COMMUNICATIONS BETWEEN NASA AND THE U.S. FISHING INDUSTRY

Prepared for

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Technical Monitor

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EXECUTIVE SUMMARY

This report presents the results of a NASA-funded research and development program investigating the applications of remote sensing in commercial fishing. Specifically, this report presents findings and conclusions of a study undertaken by Earth Satellite Corporation (EarthSat), with assistance from Living Marine Resources, Inc. (LMR), regarding communications between NASA and the U. S. fishing industry. The overriding theme of the material presented emphasizes communication pathways which will best serve to transmit information of an educational nature regarding remote sensing techniques and applications.

Organization of the Fishing Complex

The fishing complex includes all industrial, private, university, governmental, and international agencies involved in the commercial harvesting of living marine resources in the United States. Because this group is a diversified aggregation of frequently divergent institutions, the organization of the fishing complex was examined in detail in order to establish the framework for two-way communications.

Within the federal, state, and local government structure, only those legislative and executive agencies which interact directly with the fishing effort in this country are considered as part of the fishing complex. There are two dozen such bureaus or programs within the federal government, of which three are especially noteworthy: the National Marine Fishery Service, the Office of Sea Grant, and the National Weather Service.

In addition to the government agencies, there are five principal international, and three regional, fisheries commissions which are closely

associated with the federal and state governments and which are part of the fishing complex.

The U. S. fishing industry has three principal components: the fisheries, the trade associations, and manufacturing, service, and support organizations. The fisheries include all of the functional bodies involved in the hunting, capturing, processing, and distributing of a specific marine species or assemblage of species. Included in the fisheries are the producers, the processors, and the distributors and marketers. The trade associations perform a variety of functions, not the least of which involves serving as an interface between the industry and the various governments and fisheries commissions. The day-to-day activities of the fishing industry generally revolve around the producers and the processors. The manufacturing, service, and support component supplies all of the various services and supplies necessary to the functioning of the fishing industry.

Communications in the Fishing Complex

We have found three distinct levels of communications in the fishing complex:

- Communications regarding long-term considerations within the industry, dealing principally with industry policy and regulation. In general, three components of the fishing complex fit into this category: trade associations, governments, and fisheries commissions.
- Communications on a day-to-day basis, dealing principally with the operational aspects of the industry. In general, two components of the fishing complex fit into this category: producers and processors.
- Communications on an irregular, as necessary, basis, dealing principally with supportive inputs and product outputs of the industry. In general, two components of the fishing complex fit into this category: manufacturing, service, and support organizations and distributors and marketers.

In addition to the distinct levels of communications, we have found a rather clear-cut distinction in the type of communications within the fishing complex. In general, those groups most intimately involved with operations within any one fishery tend to favor a type of communication which is rather informal and largely verbal. On the other hand, those groups most removed from the fisheries tend to favor a more formal, written type of communication.

The government-to-industry communications are of the written, formal type, whereas the industry-to-government communications are of the oral, informal type. The exception is the communication between the trade associations and the government and fisheries commissions, where more formal communications are generally preferred.

Government and Fisheries Commissions

There are two easily identifiable groups of administrators and scientists within the federal government who deal with the industry: one group communicates infrequently and formally on program and policy matters while the other group communicates frequently and informally on scientific and technological matters. The latter individuals generally are those who have developed professional associates within the industry.

The federal government agency that has the most contact with the industry is, of course, the National Marine Fisheries Service (NMFS). However, there is no formal established working level communication link between the NMFS and the industry except through statistical agents, who regularly contact producers and processors. These statistical agents, in turn, communicate with the principal offices and laboratories of the NMFS. Formal communications between the NMFS and the industry tend to

be confined to long-term policy considerations with regard to the general direction of the industry.

Almost without exception, there is a linear reduction in the frequency of communication as one moves into the operating branch of the industry. For example, vessel captains are only occasionally in contact with NMFS staff members. The exception to the general rule is the individual scientist, the marketing specialist, or the statistical agent on the dock. There is, without question, a high degree of scientific and technical competence within the NMFS, and specialists who are in personal communication with individuals in the industry generally have a good working relationship with them. This is where the pertinent information about technological advances and innovations tends to be communicated. If the communication must be formalized for one reason or another, communication channels tend to break down.

It is premature to judge the Office of Sea Grant (OSG) as a potential communication link between the federal government and the industry, inasmuch as its marine advisory services are just being initiated. However, it is our opinion that the OSG has the potential of being one of the principal mechanisms for communication on a broad base with the industry, although this potential may take as many as five years to be fully realized.

The National Weather Service undoubtedly has the most consistent communication link with the fishing industry. Unfortunately, this link is almost exclusively one-way and, as such, is not readily adaptable to the present needs of either NASA or the fishing industry with respect to remote sensing information.

The international fisheries commissions cannot be considered in the mainstream of communications between the federal government and the

U. S. fishing industry. These commissions are largely supportive in their efforts, and it is only when individual members of the commissions participate in both government and industry affairs that any direct communication is effected between the two bodies.

At the present time, the coastal states generally do not have effective communications with the local fisheries, except in a regulatory function. Since most states are working actively to correct this situation, it is our opinion that the states should be brought into any educational and operational remote sensing communication links, and that NASA should make every attempt to work with states in establishing these links.

Although the regional (interstate) fisheries commissions are composed of representatives from government and industry in each of the states they serve, each commissions tends to reflect the interest of its executive secretary. If the executive secretary wishes to have the commission participate actively in regional fishery affairs, the commission is usually actively involved. Due to the structure of the present regional commissions, they would provide only a minor communication link between the government and the industry.

U. S. Fishing Industry

The domestic fishing industry is divided into approximately 30 separate fisheries, each of which operates on one or more species. Multiple species fisheries generally concentrate on fishing species which have similar spatial distributions and which are closely related economically. From this large number of fisheries, we selected eight representative fisheries for detailed analysis: Maine sardine, New England groundfish, Atlantic and Gulf menhaden, Gulf shrimp, California wetfish, U. S. tuna, Pacific Northwest salmon, and Alaskan king crab.

The lack of comparability between separate parts of the same industry is one of the unique features of the U. S. fishing

industry. The communications required to insure satisfactory functioning of each fishery grew out of a close knit, almost familial, relationship that encompasses individuals fishing or processing a common species. Thus, there was no requirement to establish uniform and more sophisticated communication channels in order to operate effectively. Essentially the same situation exists today. To meaningfully describe communications in the U. S. fishing industry, one must consider each fishery separately.

For purposes of this "Executive Summary", there are, however, several statements which can be made regarding the few comparable communication channels in the U. S. fishing industry:

- The producers and processors are unquestionably the principal operating components of each fishery, and the management decisions which are made by these groups affect the entire fishery. The communication links required, on one hand, to carry out the day-to-day operations and, on the other hand, to insure business growth and expansion are very informal, largely oral, and highly effective. Variations in communications in the operating components tend to be effectively incorporated into and, in many cases, to enhance the producer-to-processor communication pathways. These variations include communication through: spotter aircraft in Atlantic and Gulf menhaden, U. S. tuna, and California wetfish; carrier or tender vessels in Maine sardine and Pacific Northwest salmon; auctions in New England groundfish; and "producers" and fish houses in Gulf shrimp.

- The trade associations generally provide the major formal communication link between the operating components (producers and processors) of the fisheries and the federal and state governments, as well as international and regional fisheries commissions. In almost every fishery, we were able to identify major two-way communication pathways through the trade associations.

- Communications between the manufacturing, service, and support organizations and the distributors and marketers and other components of the fishing complex are of little significance to this study.

Communication Media

Two principal media were analyzed for their potential effectiveness

as communication vehicles to the fishing industry: published material, such as trade newspapers and magazines, and regional or national meetings and seminars, which are attended by representatives of the various groups in the fishing complex.

Although a considerable number of markedly diverse trade newspapers and magazines are published specifically for the fishing industry, they generally lack the capability of communicating the type of information necessary to provide the industry with a cogent picture of the remote sensing state of the art and NASA plans. The majority of the trade newspapers and journals are mass-mailed free of charge, and while most people who receive these publications take the time to briefly scan them, few have the time to regularly read them in depth.

None of the regularly attended national meetings draws on a large enough cross section of the industry to provide an adequate remote sensing information channel to the operating units of the fisheries. This is not the case with many of the regional and local association meetings. These latter meetings, coupled with the newsletters published by many of the same associations, provide perhaps the most favorable communication pathways.

Recommendations

WE RECOMMEND THAT NASA FOLLOW A RELATIVELY LOW PROFILE BUT POSITIVE APPROACH IN INVOLVING THE U. S. FISHING INDUSTRY IN THE ERS PROGRAM

The U. S. fishing industry is, undoubtedly, one of the most likely user groups to participate in, and benefit from, the ERS program, once the capabilities and applications of remote sensing technology are understood by the industry. However, as the U. S. fishing industry is

shown in this report to be unique in many respects, the degree of success attained in involving this industry in the ERS program will be largely dependent on NASA's approach to the industry.

It is important, therefore, that NASA continue to approach the fishing industry on the industry's terms and with a relatively low visibility. It may be to the advantage of NASA to operate through an intermediate group familiar with both the fishery and the individuals who make up the fishery. Further, this group should be cognizant of both the latest developments in remote sensing (and capable of translating these developments and their applications into a language acceptable and meaningful to the fishing industry) and the multifaceted problems and data demands of the fishing industry. This approach would be in lieu of NASA's, or another government agency's acting in NASA's behalf, attempting to make direct contact with the fishing industry. This type of approach seems particularly prudent in view of the prevailing reluctance of the industry to work with the government or universities.

WE RECOMMEND THAT ONE FISHERY BE SELECTED FOR STUDY EMPHASIS LEADING TO A FRUITFUL PARTICIPATION IN THE ERS PROGRAM

One of the basic problems facing NASA in attempting to draw the fisheries community into the ERS program as a user group is that of demonstrating a definitive area in which NASA can contribute to the fishing industry. Although several fisheries are at the point where the step to operational utilization of aerial electronic remote sensing is very close, there is, at present, no clear example of the integrated use of remote sensing (other than subsurface, acoustical techniques) as a data input to either the operational or management aspects of commercial fishing. Many of the individuals in the industry have partial acquaintance with remote sensing; yet, even these individuals, as well as

those who have no prior exposure to remote sensing, will very quickly become discouraged unless some concrete evidence of the actual returns from a remote sensing comitmentcan be demonstrated.

WE RECOMMEND THAT AN EDUCATIONAL PROGRAM BE INITIATED WITH THE U. S. FISHING INDUSTRY TO INFORM THE APPROPRIATE INDIVIDUALS OF REMOTE SENSING POTENTIALS

Almost without exception, we found that those individuals with some prior exposure to remote sensing techniques (regardless of how minimal) were generally more convinced of, and more willing to accept, the potential for remote sensing in commercial fisheries than those individuals who had not had any previous exposure and with whom we could not go into very great detail on the background of remote sensing. These latter individuals generally showed great skepticism in regard to the potential for applications of remote sensing techniques to any facet of commercial fishing. Given the generally accepted potential for remote sensing in fisheries which exists in the remote sensing technical and scientific community, it seems imperative to reach out to the commercial fishing industry with a program structured to their needs and backgrounds.

Conclusions

It was our feeling as we entered into this study, a feeling now confirmed, that there are two basic statements which can be made about the domestic fishing industry concerning remote sensing:

- Many, but not all, fisheries have a need for remotely sensed data in their operational decisions, but
- Remotely sensed data will ultimately contribute to predictive modeling provided to the fisheries by various components of the fishing complex.

Those fisheries which operate on organisms responding to the distribution of environmental variables at the surface have an obvious

potential for locating these organisms through a knowledge of the distribution of the related surface phenomena. Remote detection of these phenomena would, therefore, contribute to the immediate location and exploitation of these species. Conversely, those organisms which spend the majority of their time in deep water or on the bottom are relatively unaffected by surface phenomena and, thus, are only secondarily, at best, influenced by the distribution of surface phenomena. Therefore, remote sensing of surface phenomena will contribute much less to detection of deep or demersal species.

However, one of the basic problems facing all of the domestic fisheries is lack of sufficient predictive capability. A rough generalization can be made that nearly all commercially important species are dependent at one time or another on the surface environment, in that they either live as adults, or spend a portion of their developmental stages, in near-surface waters. For this reason, continued, large-scale monitoring of surface phenomena has the potential to contribute to predictive modeling for nearly all species of marine animals currently exploited by the domestic fishing industry. Therefore, all fisheries will ultimately have a use for remote sensed data in their predictive models.

These same predictive models will lead not only to better management, but to better conservation of the resource. Ultimately, remote sensing techniques should contribute heavily to proper management and conservation of the marine environment.

I. INTRODUCTION

Purpose of the Study

A number of objectives form the basis for this study. Central to these are the imminent launches of the Earth Resource Technology Satellites, ERTS A and B, dedicated to the survey of terrestrial resources. These satellites represent a major element of the U. S. program to expand the practical applications of space technology to specific segments of the user community within this country.

Following the launch of ERTS-B, a series of Earth Observation Satellites (EOS) are expected to be flown. EOS-A will provide the first space platform dedicated primarily to the survey of marine resources.

The full potential of both the ERTS and EOS satellite systems will only be realized when the data they generate are used in management decision models of the various organizations and individuals concerned with resource use and development. Benefits offered should not be viewed in the narrow terms of the advantages or disadvantages of specific aspects of the acquisition systems, such as multispectral or microwave imaging, but rather in the specific terms of the information requirements necessary for management decision-making processes and for research purposes. For this reason, it seems clear that the ultimate users of the earth resource data must be closely involved in the planning stages of the ERS program.

The U. S. fishing industry is a prime example of a potential user of such information. Last year domestic fishermen caught more than a half billion dollars worth of fish. This represents only a third of the value of the processed fishery products produced in this country.

The importance of this industry is also embodied in the necessity for its continued presence on the open seas as a vital contribution to our international posture. However, the fishing industry has significant resource harvesting and management problems, many of which are directly related to a lack of predictive information. The predictive information required is directly dependent on synoptic, repetitive surveys of the marine environment. Satellites may provide one of the best means for effective surveying of this nature.

To ascertain fishing industry management information needs, it is necessary to educate the industry on the potential use of remote sensing and to elicit its participation in the ERS program. To do so, we must first define effective channels of communication between NASA and the fishing industry, so that the information about remote sensing can pass in both directions and the industry can be offered the opportunity to participate in planning for such missions.

This task is, unfortunately, not as straightforward as the above discussion would indicate. The fishing industry is not a homogeneous assemblage of components; rather, it is a complex conglomerate of various-sized groups tied together through a loose organizational structure. In many cases, significant fractions of the industry have grown up around familial relationships, their only common ground being the resource. This lack of homogeneity within the fishing industry makes it very difficult to effectively communicate new technology to potential users within the industry. This is due not only to the complexity of the industry, but also to the fact that each fishery has different information requirements, the industry as a whole generally resists interference from outside groups, and there is no single unified indivi-

dual or group which speaks for the entire fishing industry.

It therefore seems necessary to develop the means, techniques, and procedures to inform the fishing industry of the kinds of information and methods that will become available to it through the ERS program and to enlist the industry's participation in the development of the program. The remote sensing community and NASA, through an iterative process with the U. S. fishing industry, will make it possible for the industry to develop and define its own informational needs and applications, to begin assessing the economic and operational benefits to be realized from the program,and to take the first steps towards implementation of a remote sensing program. At the same time, this will make it possible for NASA to respond effectively and immediately to the needs of the industry and to insure the fullest possible utilization of space technology by the fishing industry.

The involvement of the U. S. fishing industry in ERS program planning will result indirectly in the achievement of certain specific national goals, which include a more efficient U. S. fishing fleet with an increased harvesting efficiency; more effective management of the resources of the coastal waters of the U. S. and, ultimately, the resources of the world's ocean; higher domestic dollar returns for the domestic landings; and increased international stature for the U. S. fishing effort. Secondary benefits of this study will likely come from the establishment of a continuing and diversifying dialogue between remote sensing technologists and the various user groups of remote sensing technology. This should be helpful to both the fishing industry and the ERS program, as it will begin to draw a principal group of users into the program while making available to program planners insights in-

to the operational benefits of, and problems involved in, remote sensing applications for EOS-A and B.

The study effort documented herein may be considered as the first phase of a logical sequence of planning with the U. S. fishing industry towards the ultimate goal of specific requirements for EOS-A and B, resulting in the best utilization of remote sensing techniques by the industry, as well as direct orientation of EOS-A and B towards resource management. The next phase will be multifaceted in that it will contain, first, a specific demonstration experiment involving one fishery of the U. S. fishing industry, in which the implications and applications of remote sensing techniques will become apparent, and, second, a program whereby major segments of the industry will be made cognizant of the state of the art and potentials for remote sensing in their specific interest areas.

Study Methods

In order to assure ourselves of a comprehensive examination of industry communications, we initially determined to examine certain representative fisheries in depth, rather than attempt to consider superficially all of the 30 or more separate fisheries, each operating on one or more separate commercial species. For this reason, the report will be viewed by many as overly restricted, particularly because certain of the selected fisheries were not considered in their total geographic setting. For example, the shrimp fishery exists on all coasts of the United States, but the major segment exists, and the major landings are made, in the Gulf of Mexico; thus, the investigations into the shrimp fishery were conducted in the Gulf of Mexico to the exclusion of all other minor centers of fishing. At the same time, our familiarity

with the majority of government agencies responsive to the fishing industry allowed us to consider in depth, and to document, the established communication channels between these government agencies and the fishing industry.

Our approach to assembling the necessary data proceeded as follows:

- A review and documentation of EarthSat's and LMR's collective knowledge about the fishing complex was undertaken.
- Extensive, in-depth, face-to-face discussions with key individuals in the fisheries complex were initiated. The individuals contacted as part of the interview program were drawn primarily from the eight fisheries selected for specific study.
- Where necessary, library research was undertaken to document, substantiate, or complete analysis of pertinent segments.

Once again, it should be emphasized that the overriding concern through the course of this study was to identify those existing pathways which could be used to transfer educational information on remote sensing techniques and applications to the fishing industry. At the same time, and where necessary, sufficient information was collected so that communication pathways to transfer this type of information could be suggested where they did not presently exist. The degree to which an obvious pathway for reaching an industry was evident determined, in a large part, the degree to which further detail was extracted from the conversations with the various key individuals of the fisheries selected.

Description of the Report

This report represents the findings and conclusions of a study funded by the National Aeronautics and Space Administration, under its research and development program, to evaluate the applications of remote sensing in commercial fishing. The study effort was undertaken by Earth

Satellite Corporation (EarthSat), with assistance from Living Marine Resources, Inc. (LMR), of San Diego, California. It represents the effort of a number of individuals from both groups over a period of approximately six months. The field studies involved many discussions with members of the commercial fishing community, as well as related government and other industrial groups.

The material contained herein will detail the following information, which is deemed relevant to this study:

- The components and organization of the U. S. fishing complex and communication levels within and between the components of the fishing complex. *
- The detailed organization of the U. S. fishing industry and the communications within and between both selected fisheries of the industry and various fishing industry groups.
- The relationships and communications between federal, state, and local government agencies and the U. S. fishing industry.
- The relationships and communications between the several international and regional fisheries commissions.
- The report will detail also the intergovernmental agency relationships which are relevant to the fishing industry.

The report establishes the basis for effective communications between NASA and the U. S. fishing industry regarding the potential for remote sensing techniques in various aspects of the U. S. fishing industry operations. It describes, as well, the extent of the fishing industry's present understanding of remote sensing applications and potentials. The report discussed the role the Earth Resource Survey (ERS) Program

* One of the major difficulties encountered in a study of this nature is the use of consistent terminology. Therefore, to avoid any unnecessary confusion, we have provided, at the end of this section, definitions of all of the terminology contained in this report which may be new or unfamiliar to the reader.

should play in assessing and confirming the practical value of remote sensing from aircraft and spacecraft for both operational and management practices in the fishing industry.

Preliminary to any major incorporation of remote sensing techniques in the U. S. fishing industry, it will first be necessary to educate those individuals who will ultimately have access to the techniques and the resultant data, regarding the methods of acquiring and using these data and, explicitly, what can and cannot be implied and/or inferred from the data. Obviously, the information required will vary from group to group and individual to individual, based in part on the individual's prior exposure, his degree of technological assimilation, and his interests in the fishing industry activities. Specifically, the report recommends the most effective information channels for distribution of educational information to selected fisheries and describes alternate approaches to insure that the information is properly distributed.

Lastly, the report establishes recommended procedures for information return from the fishing industry to NASA. Similarly, these return or feedback information loops will result in the industry's capability in making a contribution to the research and development programs, and specifically to ERS planning, with respect to the marine environmental management programs.

We will make no attempt herein to document the fishing industry's specific information needs and requirements relevant to remote sensing, nor will any reference be made to the operational aspects of remote sensing, data conversion, data management, and data distribution. The specific information channels considered herein are for distribution of information about remote sensing applications in commercial fisheries operations. They are neither designed for, nor suitable for, operational

data administration and distribution.

Although this study contains a great deal of information concerning the organizational structure and present communications within the U. S. fishing complex, the emphasis has been on remote sensing related aspects. Therefore, when we evaluated current information flow, it was with a view towards the potential any given communication pathway exhibited for the transfer of remote sensing educational material.

Definitions

To provide a basis for a consistent discussion of fisheries communications, we have established a set of working definitions. For this study, all individuals and groups (including industrial, private, university, government, and international) involved with commercial fishing will be called the U. S. FISHING COMPLEX. The complex is divided into seven principal components (Figure I-1):

- GOVERNMENT
  Tax-supported agencies that have resource management and regulatory control and provide for a certain amount of research and development.
- FISHERIES COMMISSIONS
  Groups who coordinate activities in support of national and international fisheries.
- TRADE ASSOCIATIONS
  Groups supported by the industry to promote the industry's well being.
- PRODUCERS
  Groups or individuals who harvest the raw material.
- PROCESSORS
  Groups who convert the raw material into foodstuff.
- MANUFACTURING, SERVICE, AND SUPPORT ORGANIZATIONS
  Groups supplying material and services to the industry.
- DISTRIBUTORS AND MARKETERS
  Groups responsible for insuring the product reaches the consumer.

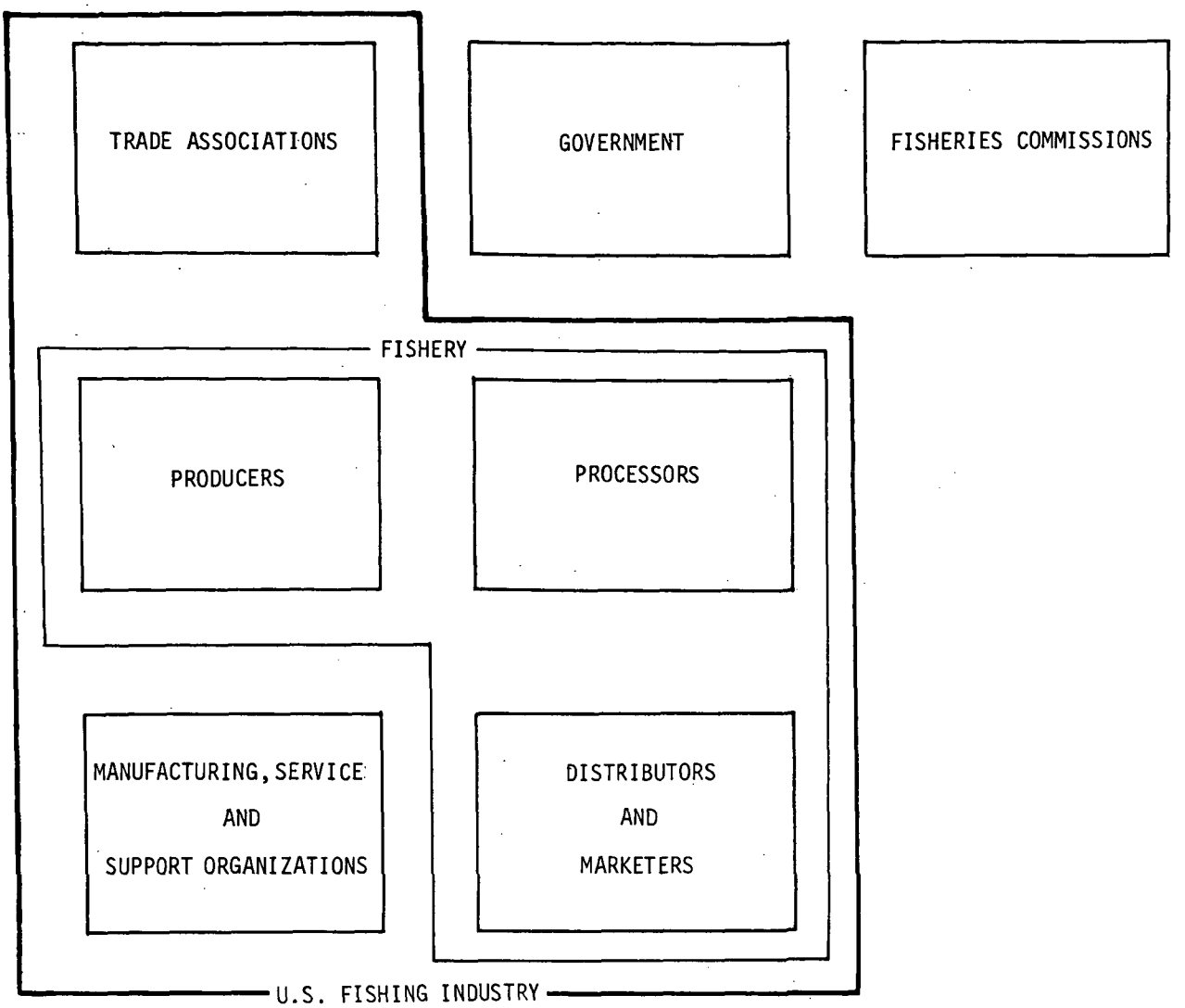

Figure I-1. Principal Components of the U. S. Fishing Complex.

The U. S. FISHING INDUSTRY encompasses all individuals and groups except the government and fisheries commissions. Five of the seven components of the fishing complex are included in this category: the trade associations; the manufacturing, service, and support organizations; the producers; the processors; and the distributors and marketers. The latter three components make up a FISHERY (plural - FISHERIES), that is, those industry groups dealing with individual, or groups of, commercial fish species.

Within the U. S. fishing industry (Figure I-2), the TRADE ASSOCIATIONS are composed of:

- National Associations
  Groups supported primarily by a number of fisheries to represent their viewpoint and lobby for them at a federal level. National associations may do research and development for the industry.

- Regional Associations
  Groups usually supported by a single fishery but geographically spread over a broad area, such as several states. These groups represent the industry viewpoint on regional matters.

- Local Associations
  Groups supported by a single fishery, and confined to usually one or two ports, which represent the industry viewpoint concerning local fishery matters.

- Cooperatives
  Groups participating in, and supported by, a number of fishing boat owners with common interests. Cooperatives generally deal in raw material, promote marketing and selling, and provide certain other services at cost (such as providing equipment) to the membership.

- Unions
  Groups supported by dues from individual members to represent their interest to management. Unions include both boat and processing plant laborers.

MANUFACTURING, SERVICE, AND SUPPORT ORGANIZATIONS include:

- Boat Builders and Engine Manufacturers
  Groups who design, construct, sell, and repair fishing boats and engines.

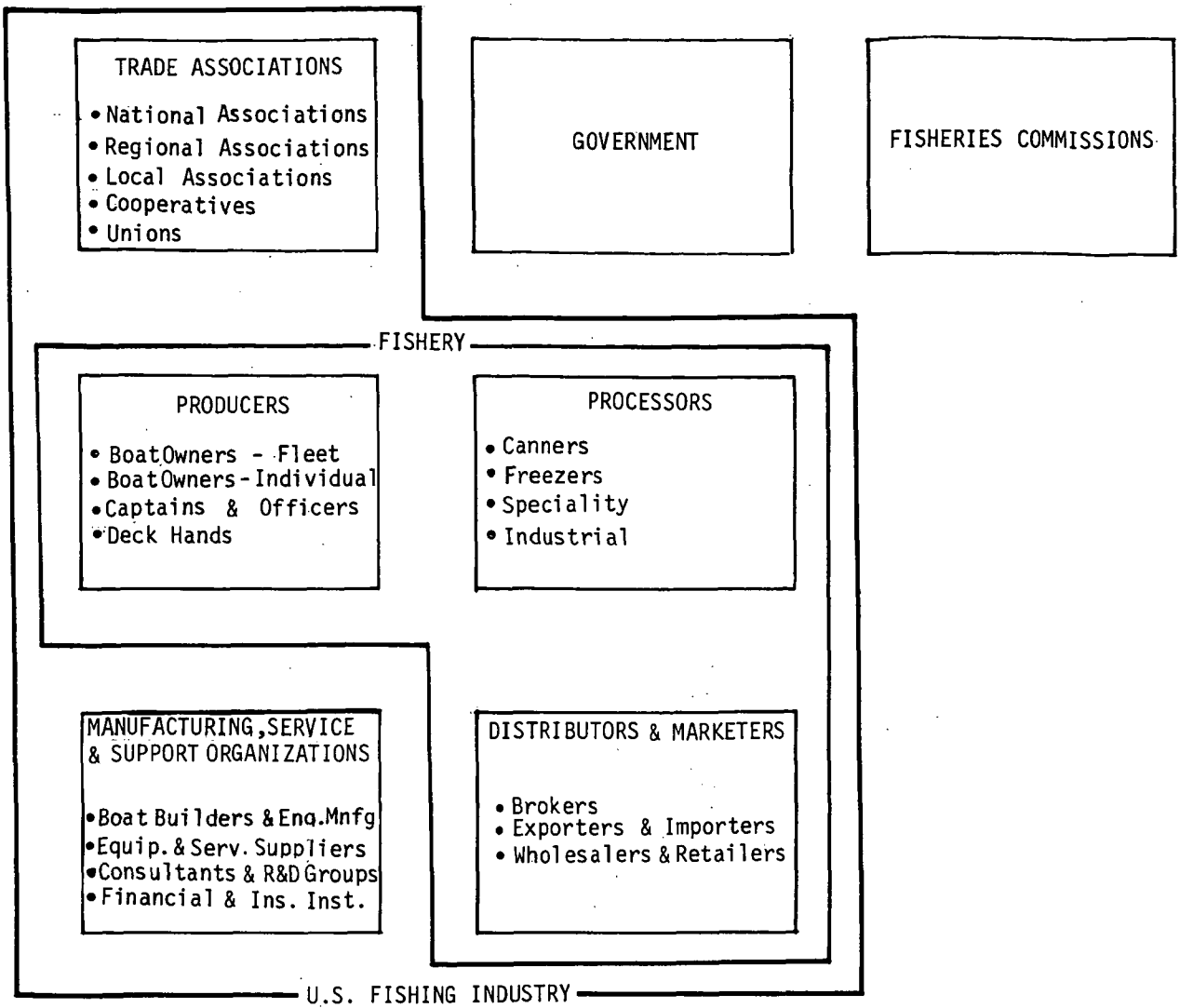

Figure I-2. Organization of U. S. Fishing Industry.

- Equipment and Service Suppliers
  Groups who design, manufacture, sell, and service fishing and other gear, as well as groups who provide specialized services to the industry on a cost-reimbursable basis.

- Consultants and Research and Development Groups
  Individuals or groups who plan, perform, and report basic and applied research and development studies for the industry.

- Financial and Insurance Institutions
  Groups who lend interest-bearing money to the industry and provide hull and P & L (personal and liability) insurance.

PRODUCERS include:

- Boat Owners - Fleet
  Groups or individuals who own/manage two or more fishing vessels.

- Boat Owners - Individuals
  Groups or individuals who own/manage a single fishing vessel.

- Captains and Other Officers
  Skippers, navigators, chief engineers, and deck bosses who are considered officers of a fishing boat.

- Deck Hands
  Individuals hired by the captain to work aboard a fishing boat.

PROCESSORS include:

- Canners
  Prepare whole or portioned product in cans or other containers. Frequently, specialty items are processed into cans.

- Freezers
  Prepare whole or portioned product in bulk or individually quick frozen packages. Frequently, specialty items are marketed frozen.

- Specialty
  Prepare product as smoked, pickled, salted, breaded, precooked, or similarly processed material.

- Industrial
  Reduce fish to meal, oil or other products for non-consumption uses.

DISTRIBUTORS AND MARKETERS include:

- Brokers
  Intermediaries between other elements of the distributing component. They are responsible for buying and selling fish products, but are rarely in physical contact with the product. They most frequently act as middlemen between distributors and marketers or between distributors and importers or exporters.

- Exporters and Importers
  Groups (may be separate companies) set up to import and/or export fish. In many cases, processors do their own importing and exporting.

- Wholesalers and Retailers
  Groups or individuals, as the name implies, who are the final links in the chain between the processors and consumers Many processors act as their own wholesalers.

All levels of GOVERNMENT, including federal, state, and local governments, interface in some manner with the domestic fishing industry (Figure I-3). Within each level, primary and secondary agencies can be identified with respect to their involvement with the industry. In all cases, only a very small portion of the total government effort is directly concerned with the domestic fishing industry.

Two types of FISHERIES COMMISSIONS deal directly with the domestic fishing industry. Where there is multi-nation fishing upon a resource, and research and management effort are required, the coordination of the various national efforts are effected through international commissions. These commissions may have their own research staffs or they may utilize the research efforts of the national agencies. The regional commissions are more concerned with interfacing between the federal and multi-state jurisdictional problems (Figure I-3).

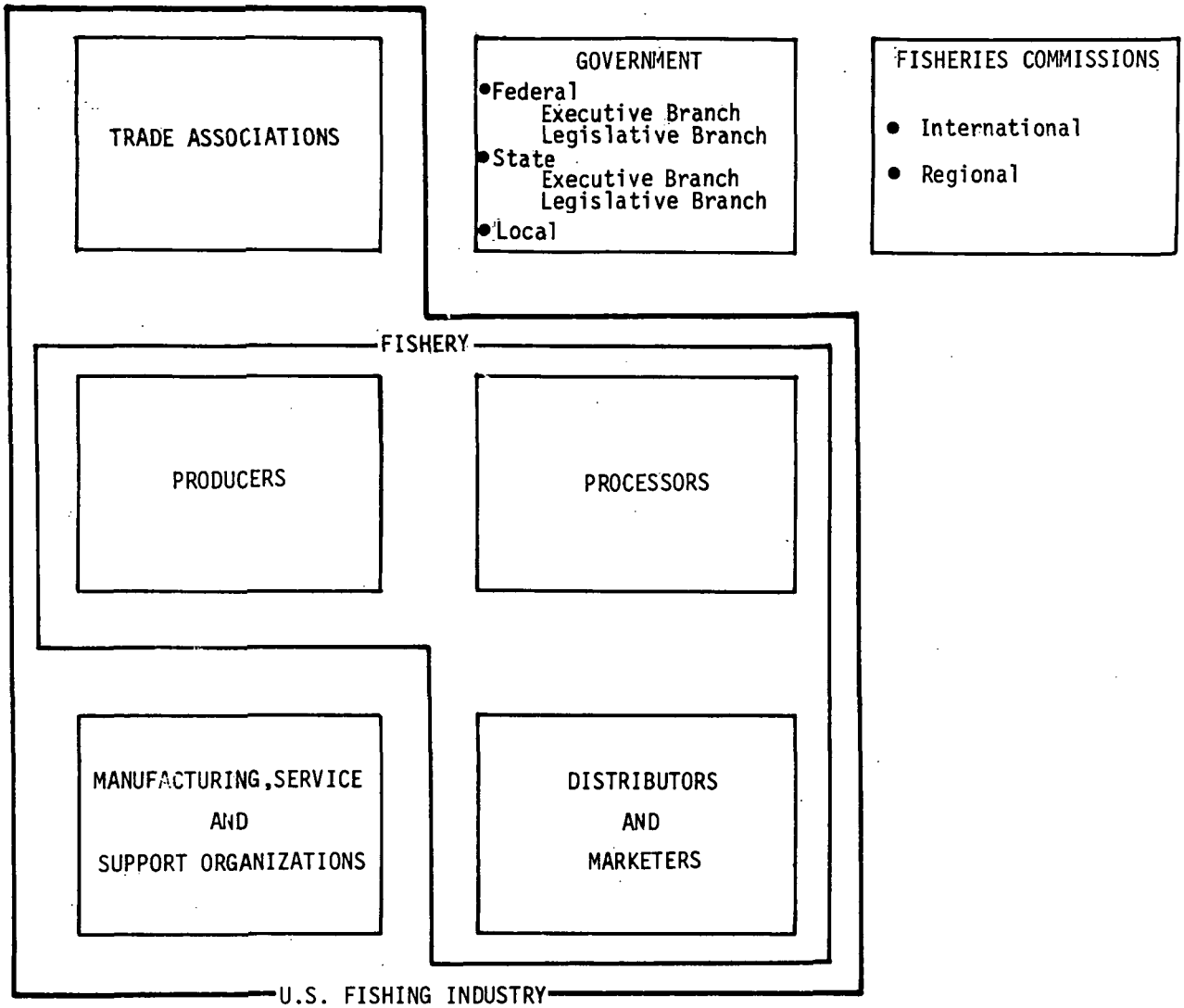

Figure I-3. Principal Components of the Fishing Complex. Not Included in the U. S. Fishing Industry.

II. FINDINGS AND EVALUATION

The actual findings of our investigation into the communications in the fishing complex are documented in this section. A detailed description of the organization of the fishing complex is presented to provide a framework from which the communication links within the fishing complex can be identified. Our focal point has been communications within the U. S. fishing industry; discussions of communications in the federal, state, and local governments and the fisheries commissions are described only as they contribute to the actual or potential information flow between NASA and the U. S. fishing industry. A discussion of communications media in the fishing complex completes the investigation of fisheries communications.

Organization of the Fishing Complex

The fishing complex is an extremely diversified aggregation of frequently divergent institutions. It is therefore important that we understand the organization of the complex as a framework upon which to identify the communication links.

Within the federal, state, and local governmental structure, only those legislative and executive bodies which interact directly with the fishing effort in this country are considered as part of the fishing complex. For example, both the Army's Corps of Engineers and the Environmental Protection Agency's Water Quality Office would be considered part of the fishing complex, as their policies and activities impinge on commercial fishing, whereas the relationship between the Department of Interior's Bureau of Land Management and the commercial fishing effort is remote, and this agency would not normally be

considered part of the complex. International and regional fisheries commissions included in the complex are exemplified by such bodies as the Inter-American Tropical Tuna Commission and the Gulf States Marine Fisheries Commission. There are presently six principal international commissions and three regional commissions affecting domestic fisheries.

The U. S. fishing industry can be considered to be made up of three separate component parts, the fisheries, the trade associations, and the manufacturing, service, and support organizations. The fisheries include all the functional bodies involved in the hunt, capture, processing, and distribution of one species or a number of species forming a commodity group, as, for example, the tuna fishery. The trade associations and the manufacturing, service, and support organizations serve, in many cases, a large number of fisheries. For example, the National Canners Association serves, among others, the Maine sardine fishery and the salmon fishery. Certain manufacturing groups supply material to a large number of fisheries, as well, such as supplying cans to both the tuna and shrimp fisheries.

In general, we can identify a number of principal working relationships within the fishing complex (Figure II-1). The manufacturing, service, and support organizations and the distributors and marketers generally interact with only two groups, the producers and processors. Furthermore, the manufacturing, service, and support organizations are somewhat isolated from the mainstream of the industry, in that they may service other industries as well as the fishing industry and are thus participating in industry operations only as part of their total effort. Likewise, when a fisheries product reaches a distributor, it has entered the mainstream of the economy and left the mainstream of

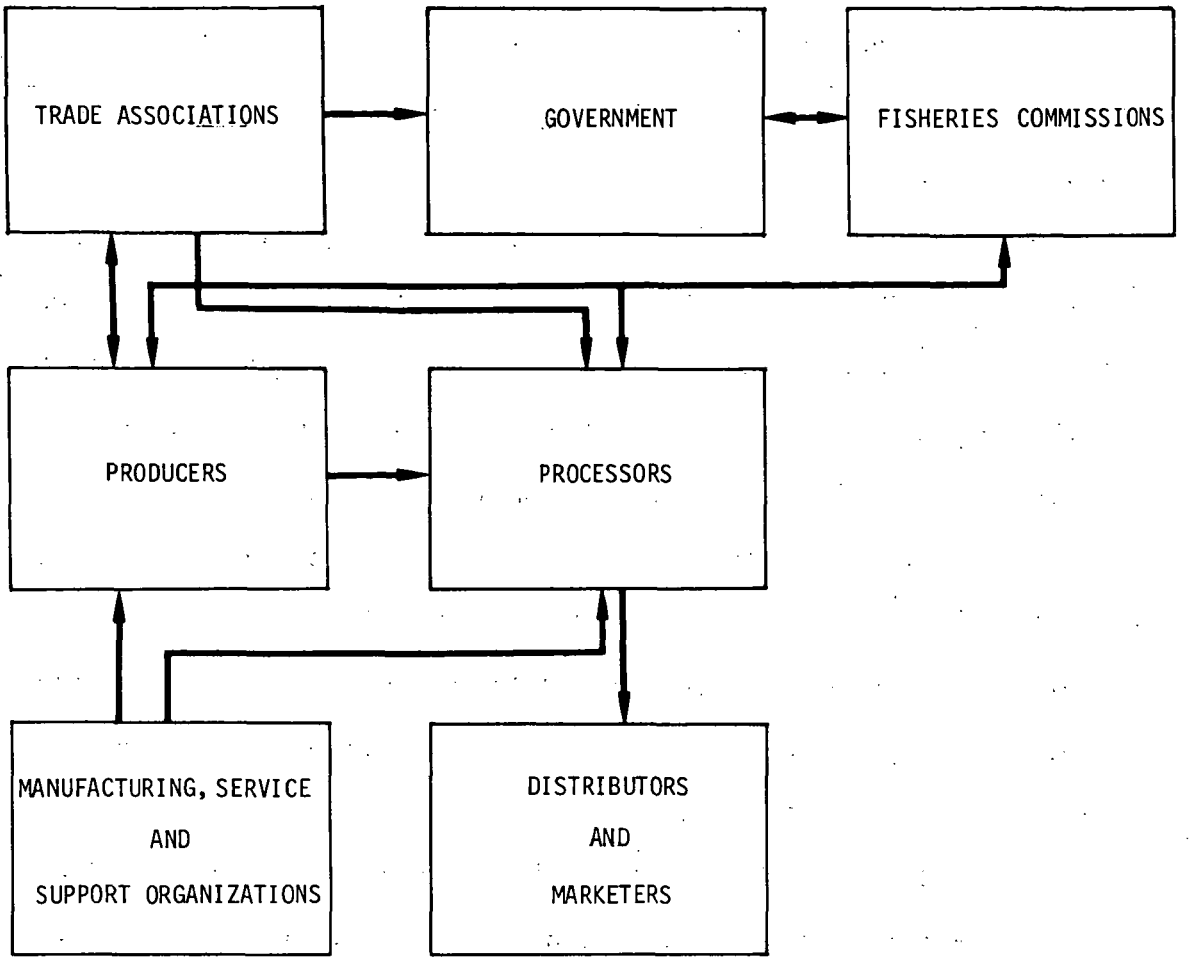

Figure II-1. Principal Working Relationships in the Fishing Complex.

the fishing industry. Thus, distributors and marketers also participate in industry operations only as part of their efforts and only part of the time.

As will become clear in the following sections, the activities of the U. S. fishing industry generally revolve around the producers and processors. Because processors are, in general, larger and better organized, the producers are, in general, somewhat reliant on the processors for supporting economic and technological advancements.

The trade associations, in many instances, provide the major working relationship between the industry and the government and fisheries commissions. Here again, however, we are out of the mainstream industry activities and have entered an area of relevant, but less real time, relationships.

The major patterns which occur in all fisheries, and which are summarized in the preceding paragraphs, serve to emphasize that the main body of this report will deal primarily with producers, processors, and trade associations, that is, the fisheries, as these form the focus of the fishing industry. Less emphasis will be given to government and supporting agencies, which, in general, are peripheral to the industry.

Communications in the Fishing Complex

A general representation of the existing communications in all fisheries addressed in this study can best be gained by considering three levels of communications. These are:

- Level I. Communications regarding longer term considerations within the industry, dealing principally with industry policy and regulation.

- Level II. Communications on a day-to-day basis, dealing principally with the operational aspects of the industry.

- Level III. Communications on an irregular, as necessary, basis, dealing principally with supportive inputs and product outputs of the industry.

The organization presentation of the fisheries complex (shown in Figure II-2 and subsequent figures) reflects these three levels of communications.

In addition to the distinct levels of communications, we have found that a dichotomy exists in the types of communications which preponderate in the fishing complex. In general, those groups most intimately involved with operations within any one fishery utilize informal, and largely oral, communication. On the other hand, those groups most removed from the fisheries tend to favor a more rigid, written, formal type of communication.

As shown in Figure II-2, the type of communication originating at all levels within the government is of the written, formal type, whereas that originating in the industry and directed to the government frequently bears more resemblance to the informal, internal type preferred by the fisheries. The exception is the communication between the government and the trade associations and fisheries commissions, where more formal communication is generally preferred. Communications of a strictly internal nature in the U. S. fishing industry are usually informal.

Again, these are generalities, and numerous specific contradictory examples could be cited. As each of the major groups is treated specifically, the exact nature of both content and format for internal, as well as external, communication will become evident. However,

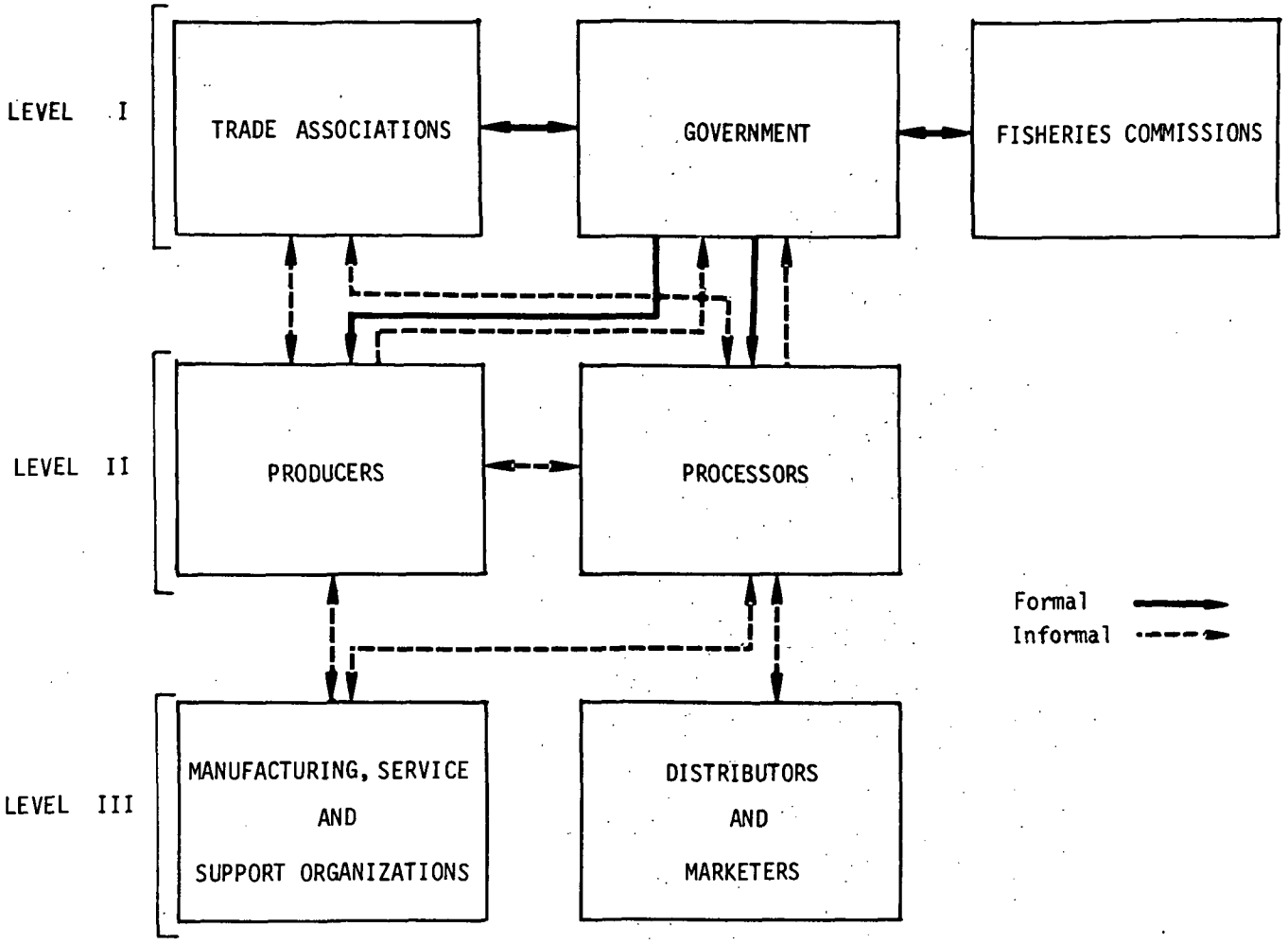

Figure II-2. Levels and General Types of Communications in the Fishing Complex.

Figure II-2 provides an insight into the general nature and origin of these communications, as indicated by the type of arrow between each component.

We have not attempted to address the full spectrum of communication links within the fishing complex, but rather to identify two types of communication links and to categorize these as either major or minor communication links. The distinction is based upon the frequency of contact and the importance of the information passed on that pathway. Obviously, such a decision is subjective and based largely on our impression of the individuals and groups connected by the pathway. Nonetheless, throughout the following discussions the concept of major or minor communication links will be indicative of the total communication capabilities of each component of the fishing complex.

GOVERNMENT AND FISHERIES COMMISSIONS

Communications between the government and the U. S. fishing industry include those originating within federal, state, and local government agencies. Since we are concerned primarily with communications between NASA and the U.S. fishing industry, emphasis has been placed on assessing extra-government communications, that is, communications between the government and industry; inter- and intra-government communications were considered only when the information passing from one government agency to another, or among the federal, state, and local governments, was altered in form before reaching the industry.

We found only a few local government agencies that are organized and involved to any degree with the local fisheries -- usually a local fish commission (such as the Gloucester Fish Commission) that is tax supported and designed to assist the local fishermen. Thus, local government communications will be discussed within the appropriate fishery.

Communications between the fisheries commissions and the U.S. fishing industry include those originating with international and regional groups. Due to their close working relationships, the international fisheries commissions will be discussed following the federal government. Similarly, the regional fisheries commissions will be discussed following the state governments.

Federal Government Communications

We have been able to identify over two dozen major federal agencies that, on an irregular basis, communicate with one component or another of the U.S. fishing industry. Table II-1 lists these and the general nature of their communications with the industry.

The significance of the communication to the fishing industry varies

Table II-1. Principal components of the federal government communicating with the U. S. fishing industry.

Department or Office	Bureau or Programs		Nature of Communications
EXECUTIVE BRANCH			
National Aeronautics and Space Administration	Earth Observations Program		Communicates irregularly with a few key industry people, principally through general information talks given by Headquarters Staff or NASA centers dealing informally with local industry. Occasional communications of a general nature of remote sensing applications to the industry through the Spacecraft Oceanography Project (SPOC) and press releases to newspapers read by industry.
Environmental Protection Agency	Water Quality Office (formerly FWQA)		Communicates only indirectly with the industry through informal communication links established with NMFS and BSF&W. Primarily concerned with water quality in streams, lakes, and estuaries.
National Science Foundation			Develops and disseminates scientific information; funds research and is therefore in contact with marine researchers and research programs. Influences scientific research directions. Communicates only indirectly with the industry.
Atomic Energy Commission			Communicates with Federal and state agencies, local governments, fisheries and conservation groups with respect to the impact of atomic installations, especially power plants on environment.
Smithsonian Institution			In its research functions communicates with researchers in the field of marine biology. Maintains the Oceanographic Sorting Center, curates and distributes specimens. Does not communicate directly with the industry.
National Council on Marine Resources and Engineering Development			Superceded by NOAA during contract performance.
Health, Education and Welfare	Food and Drug Administration		Protects the public's health by ensuring that foods are safe, pure, and wholesome. Works directly with industry in carrying out regulatory functions. For example, in the question of mercury contamination of tuna, FDA had contact and a high level conference with fishery representatives of the National Canners Association. Communications with industry is as required.
Commerce: National Oceanic and Atmospheric Administration (NOAA)	National Marine Fisheries Service (NMFS)		Refer to detailed discussion
	Office of Sea Grant (OSG)		Refer to detailed discussion
	National Weather Service (NWS)		Refer to detailed discussion
	National Data Buoy Project Office		Presently developing a system of automatic buoys for obtaining continuous marine environmental data. This information will eventually be made available to industry; interfaces with industry only superficial usually to query for user needs.
	National Oceanographic Instrumentation Center		Tests and calibrates oceanographic instruments and equipment and disseminates operational results and technical information to interested users. Passive communications with the industry.
	National Ocean Survey		Prepares and distributes nautical charts and conducts geodetic, oceanographic surveys; predicts tides and currents which are made available to the industry.
	National Environmental Satellite Center		Plans and operates environmental satellite systems. Has no direct communication with fishing industry.
	Environmental Data Service		Publishes, among other information, oceanographic information providing a single source of readily available environmental data to user groups. Passive communications with industry.
Commerce	Maritime Administration		Aids in the development, promotion, and operation of the U. S. Merchant Marine. Administers subsidies and overseas construction of ships and regulates the sale of U. S. owned ships. Does not interface in any significant capacity with the fishing industry.
Interior	Bureau of Sports Fisheries and Wildlife (BSF&W)		Regulates sport fisheries and is in contact with that group directly through publications or state agencies. Has formal contacts with Bureau of Outdoor Recreation, National Park Service, Bureau of Mines and the Corps of Engineers on fish and wildlife related projects. Indirectly interfaces with commercial fishing industry regarding sports/fish commercial/fish conflicts. See also Transportation's Coast Guard.
	Office of Marine Affairs		Serves as Staff to Secretary of Department for Planning in the area of marine affairs. Does not communicate directly with industry.
	Fish Commissioner		Serves a broad planning function which includes fisheries area. Communicates within NMFS regarding matters of budget and general policy that does not communicate with the industry directly.
Defense	Naval Weather Service		Communicates principally through charts made available from Fleet Numerical Weather Center. Data relay at various NMFS and universities who communicate with industry.
	Naval Oceanographic Office		Communicates indirectly with industry through NMFS. Also administers SPOC program, which indirectly communicates with industry.
	Corps of Engineers		Communicates, by law, with NMFS and BSF&W on matters and projects which affect the fish and wildlife ecosystem. Communicates only indirectly with the industry.
State	Special Assistant to the Secretary for Fish & Wildlife		Responsible for international fisheries treaties. In this function interfaces closely with NMFS, but only indirectly with industry.
	Agency for International Development		Developing Fish Protein Concentrate through contracts. Communicates only indirectly with U. S. fishing industry.
Transportation	Coast Guard		Personnel interface with local fishermen. There are no formal channels to the fishing industry except for distribution of monthly nearshore sea surface temperature charts prepared in connection with Interior's BSF&W. Surveys foreign fishing fleets operations with respect to international fishing agreements.
LEGISLATIVE BRANCH			
Senate	Committee on Commerce	Subcommittee on Merchant Marine and Fisheries	The subcommittee is in direct contact with individual fishermen, fishing industry firms, and particularly with national fisheries associations. While the subcommittee may call on these sources, it is usually contacted by them. Its contacts to other government agencies concerned with fisheries is continuous and informal.
House of Representatives	Committee on Appropriations	Subcommittee on State, Justice, Commerce and the Judiciary	Makes budget recommendations to the Committee of Appropriations. While the subcommittee may call on representation it is also approached by various interests, given opinions, requests and information. Information contacts are informally by phone, by person, or through correspondence and trade publications. During the 1970 Hearing for 1971 the subcommittee heard testimony on fisheries related questions by 20 congressmen, 22 representatives of national associations, 9 representatives of fisheries research, 2 conservation representatives and 4 representatives of state fisheries agencies.
		Subcommittee on Interior and Related Agencies	The commercial fisheries and oceanography functions of this committee were formerly lodged with the Subcommittee on Fisheries and Wildlife Conservation and the Subcommittee on Oceanography. Those committees have heard testimony of representatives of fisheries associations, researchers, congressmen of coastal states and those concerned with oceanographic research and development as well as spokesmen for conservation.

from agency to agency. Those agencies concerned primarily with regulation have different communication links than those dealing principally with scientific and business concerns. Because our specific interest dealt with an in-depth analysis of the latter subjects, we were able to focus on a finite number of federal agencies, rather than concern ourselves with the large number of agencies that have only occasional dealings with the U.S. fishing industry.

The primary federal government-to-industry communication occurs through the National Marine Fisheries Service. However, both the Office of Sea Grant and the National Weather Service form a secondary, but important, communication link between the federal government and industry.

National Marine Fisheries Service

The National Marine Fisheries Service (NMFS) is the principal spokesman for the federal government in fisheries matters. NMFS is concerned with programs and policies which could:

- "Reduce production costs by providing improved resource information and reliable forecasts to cut search time for fish and improve scheduling and equipment use; developing more efficient harvesting technology; encouraging adoption of economic management systems which will discourage over-capitalization and overbuilding of vessels for harvesting limited resources; and assisting the states to improve their management capabilities in the interest of more efficient harvesting operations;

- Expand production opportunities by developing harvesting and processing technology which will help bring new resources into production; providing fish protein concentrate (FPC) technology for developing a self sustaining FPC industry which will provide a market for underutilized fish; and assisting industry to develop techniques and procedures for economic aquaculture operations; and

- Improve catches (and thus reduce per unit costs) by developing techniques and means to preserve the critical estuarine areas as commercial fishery resources; and securing a preferred position for U.S. fishing vessels in international waters adjacent to U.S. coasts."*

(*"Marine Science Affairs-Selecting Priority Programs," April, 1970).

NMFS contributes to a number of domestic and international programs planned to manage fisheries for conservation purposes and to assure that the resources will be maintained in a healthy condition. Thus, the NMFS is essentially responsible for developing adequate management techniques and works closely with the Department of State in activities relating to international agreements affecting fishery resources. It is in contact with the various states to provide whatever management information is required for regulating the fisheries on a statewide basis.

It is within the context of a data gathering and a basic and applied research organization that the NMFS communicates with the U.S. fishing industry (Figure II-3). Much of the pertinent information transmitted to the industry is via statistical agents or their equivalent working on the waterfront in proximity with the producers and processors of the various fisheries. However, this is principally a data-collection function of the NMFS, and only occasional information (not specifically related to catch and prices) is transmitted between the fishermen and the NMFS employees.

The NMFS has approximately 30 major laboratories and centers and more than 50 lesser installations, such as statistics and market news offices scattered along the U.S. coasts and the Great Lakes. Scientists and other individuals within these offices, depending on the nature of their work, have some contact with members of the fishing industry. The NMFS Gear Research and Development Bases have the closest contact with the industry. These bases are more concerned with the harvesting techniques and systems employed by the industry and, thus, remain in close communication with the production component of the industry. The biological, technological, and oceanographic laboratories maintain irregular formal communications with members of the industry.

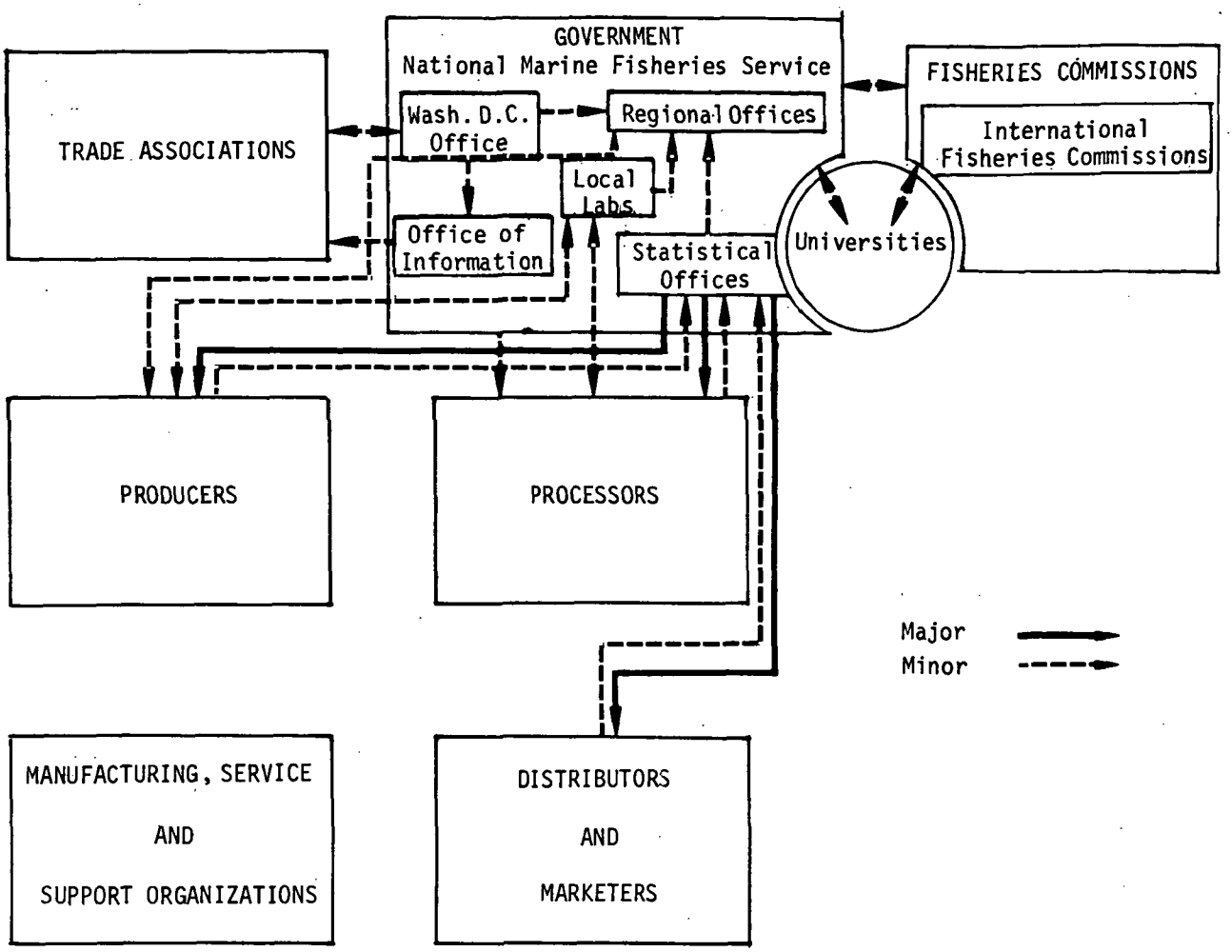

Figure II-3. Principal Communication Channels Between the National Marine Fisheries Service and the U. S. Fishing Industry.

The NMFS also communicates with the fishing industry through publications prepared at laboratory, regional, and Washington, D.C. headquarters levels. The NMFS publishes a large number of scientific and quasi-scientific journals, which are listed and discussed in the section on "Communications Media."

The reliability of the principal communication links between the NMFS and the industry varies from fishery to fishery; however, NMFS regional directors are charged with the primary responsibility of dealing directly with the industry.

Office of Sea Grant

The Office of Sea Grant (OSG) directs the National Sea Grant Program, which provides support for institutions engaged in comprehensive marine research, education, and advisory service programs, supports individual projects in marine research development, and sponsors education of ocean scientists and engineers, marine technicians, and other specialists at selected colleges and universities. Funds are channeled through one of two offices: Sea Grant Institutional Support or Sea Grant Project Support (Figure II-4).

Sea Grant Institutional Support funds have thus far gone to nine major U.S. universities: California, Hawaii, Miami, Michigan, Oregon State, Southern California, Rhode Island, Washington, and Wisconsin. Several major universities have established marine extension services, which, it is hoped, will ultimately compare to agricultural extension services.

Oregon State University has shown leadership in the area of marine extension, and, although the most important communication channels are yet to be established, there is a strong effort to tie the Sea Grant program to the operational components of the local fisheries. Under consideration is a Pacific Sea Grant Advisory Program (PSGAP), which

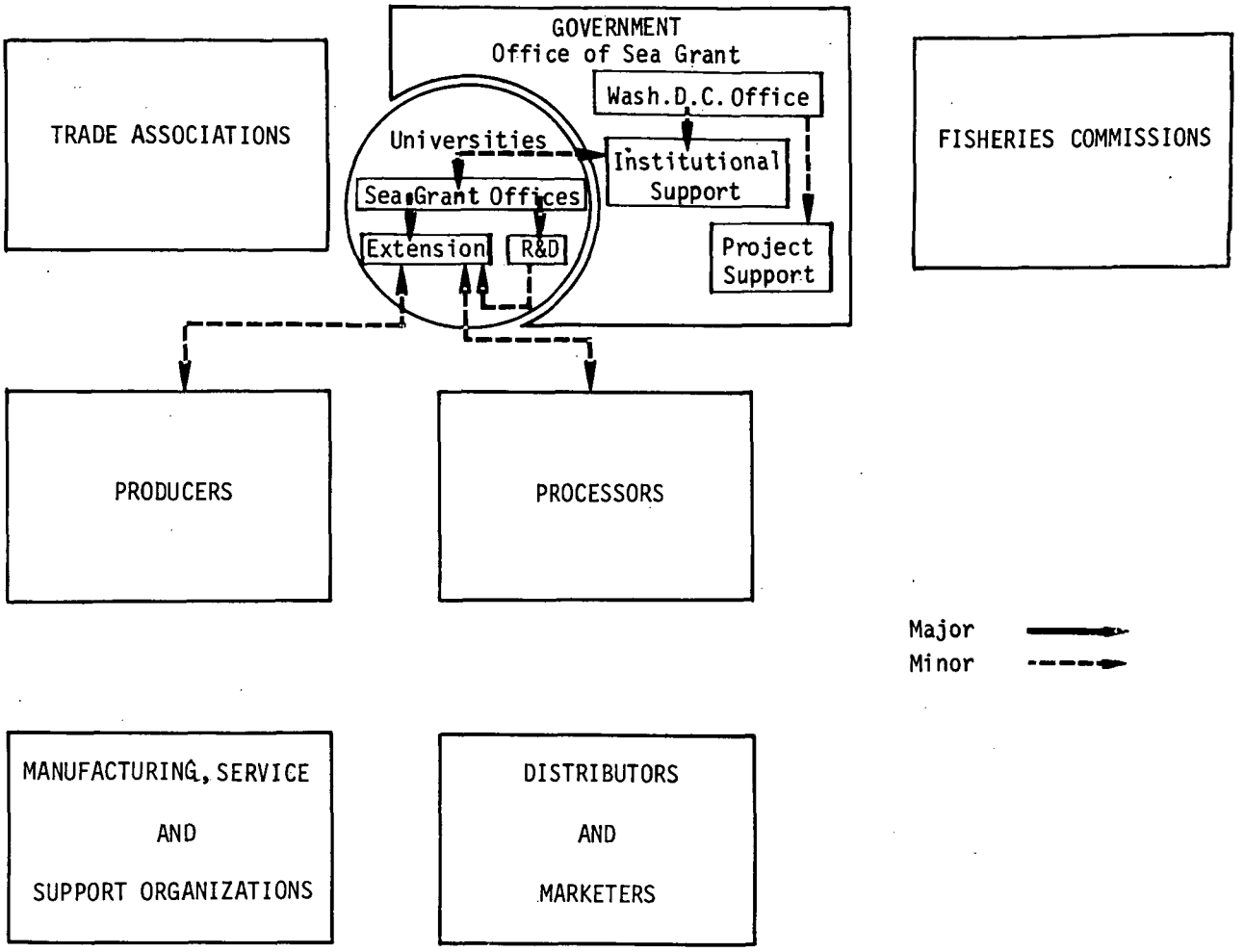

Figure II-4. Principal Communication Channels Between the Office of Sea Grant and the U. S. Fishing Industry.

would involve the Pacific states of Alaska, Oregon, Washington, California, and Hawaii. The NMFS regional office, located in Seattle, has also expressed an interest in participating in such as advisory service, correctly recognizing that this would be an additional point of contact for them with the fishing industry.

To insure regional coordination of PSGAP, two people from each state will serve on an advisory committee. In addition, there are plans to have a central pool of specialists available on call to assist any given area with a particular problem.

The emphasis in the advisory program will be on direct communication with members of the marine community, in particular with members of the fishing industry. In addition to personal contact, regional publications will be developed from material supplied from Sea Grant and NMFS research. It is hoped that an editorial group will redraft much of the material to make it more easily assimilable by members of the working marine community.

The OSG requires that all institution grants establish some form of marine advisory services. Although, in most cases, the development of these services is still in the initial phase, several institutions, including Texas A&M and the University of Rhode Island, have shown good progress in this area. It is expected that other Sea Grant Institutions will rapidly develop advisory programs.

National Weather Service

In addition to carrying out its responsibility to report the weather and provide weather forecasts and storm warnings to the general public, the National Weather Service (NWS) also develops and furnishes specialized weather services which support the needs of the maritime industry.

Special marine forecasts and bulletins are issued on a regular basis to anyone with proper equipment to receive the transmissions. These services are supported by a national network of observing and forecasting stations, communications links, aircraft and satellite observation systems, and computers.

The Weather Service's 5,000 employees are located at approximately 400 facilities within the 50 states, at 14 overseas offices, and on 20 ships. There are certain special facilities which include the National Meteorological Center in Suitland, Maryland; the National Hurricane Center in Miami, Florida; and the National Severe Storms Forecast Center in Kansas City, Missouri.

The main communication channel between the NWS and the U.S. fishing industry is between the National Meteorological Center and the producer, who has an obvious interest in up-to-date weather information (Figure II-5). There are, however, minor communications between the local offices, which service particular ports, and the producers and processors in that locale.

The communication link between the NWS and the industry is probably the best-established operational communication link between the federal government and the industry, but is, unfortunately, largely unidirectional. Fishermen invariably look to the marine advisories issued by the NWS for day-to-day operational information.

International Fisheries Commission Communications

All communications on an international level regarding domestic fishing come through the U.S. State Department. The federal government has jurisdiction over only those fisheries which come under international

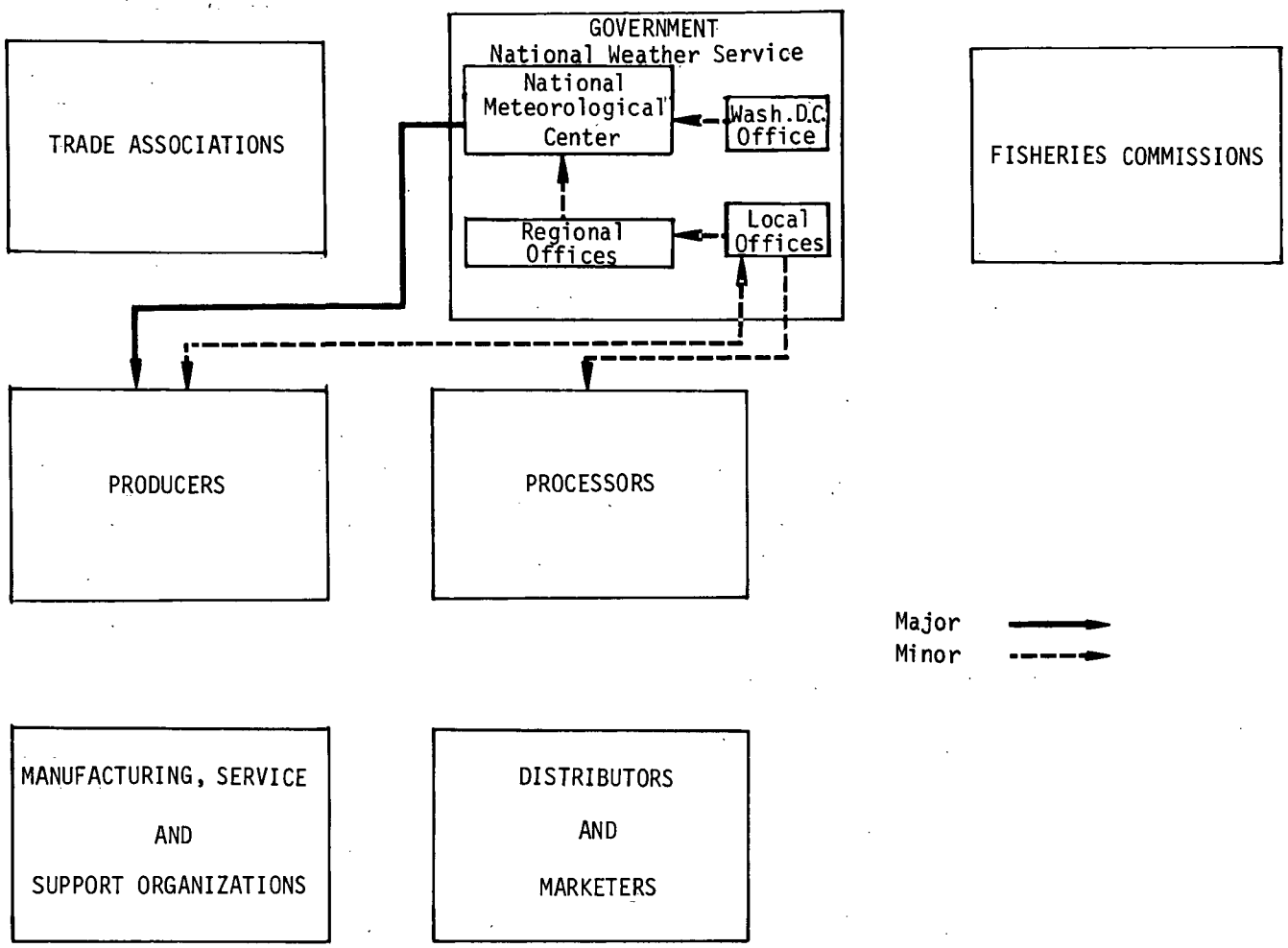

Figure II-5. Principal Communication Channels Between the National Weather Service and the U. S. Fishing Industry.

treaties.

International conventions and agreements determine the specific regulatory power of each nation over the individual species. At present, there are six international commissions, which play a vital role in the development of information that forms the basis for international regulation:

- Inter-American Tropical Tuna Commission (IATTC)
  Concerned principally with yellowfin, skipjack, and bigeye tuna in the eastern tropical Pacific. Collects and interprets information for the management of these species. Established by convention between the U.S. and Costa Rica in 1950. Member nations in 1969 included the U.S., Canada, Costa Rica, Japan, Mexico, and Panama.

- International Commission for the Conservation of Atlantic Tuna (ICCAT)
  Organizes and promotes research on albacore, yellowfin, bluefin, bigeye and skipjack tuna, and billfishes in the Atlantic and adjacent seas. Members are: U.S., Brazil, Japan, Republic of Korea, Spain, Canada, France, South Africa, Moracco, Ghana, and Portugal.

- International Commission for the Northwest Atlantic Fisheries (ICNAF)
  Carries out research and proposes government actions for the protection and conservation of the fisheries of the northwest Atlantic. Consists of 14 member nations.

- International Pacific Halibut Commission (Halibut Commission)
  Organized in 1924 for the investigation of scientific management by the U.S. and Canada of the Halibut resource of the northern Pacific and Bering Sea.

- International Pacific Salmon Fisheries Commission (IPSFC)
  Appointed under a convention between Canada and the U.S. for the protection, preservation, and extension of the sockeye and pink salmon fisheries in the Fraser River System.

- International North Pacific Fisheries Commission (INPFC)
  Composed of Canada, Japan, and the U.S., it determines stocks which require conservation, administers observation systems, and enforces conservation measures by international control on high seas. It covers all waters of the North Pacific and adjacent seas, excluding territorial waters.

Two other international commissions dealing with marine resources should be mentioned, also, but are somewhat less important because of the low level of U.S. involvement in the resources. These include:

- Great Lakes Fishery Commission
  Concerned with the management and control of the Great Lakes Fisheries. The commission's activities include coordination of studies and regulation, as well as stocking and control, of fish populations. Established by convention in 1955 between the U.S. and Canada.

- International Whaling Commission
  Concerned with the management and control of whales. Member nations include the U.S., Argentina, Australia, Canada, Denmark, France, Iceland, Japan, Mexico, the Netherlands, New Zealand, Norway, Panama, South Africa, the U.S.S.R., and the United Kingdom.

In addition to the eight international fisheries commissions described above, there are a number of international groups that coordinate fishery research and development programs, but have no official charter. Those most important to the domestic fisheries include:

- Gulf and Caribbean Fisheries Institute
  Coordinates and encourages studies on fish resources in the Gulf and Caribbean.

- Intergovernmental Oceanographic Commission
  Concerned with, among other oceanographic objectives, fisheries resources of the sea, including their legal aspects. The commission has 58 member nations.

- International Council for the Exploration of the Sea
  Primarily concerned with the marine resources of the eastern North Atlantic, but is expanding its emphasis to the entire North Atlantic. The council promotes investigations of living marine resources, and publishes and disseminates information.

- Advisory Committee of Marine Resources Research
  A nongovernmental organization of the Food and Agricultural Organization (FAO) of the UN. It advises the FAO director general on research of marine fisheries resources and acts as an advisory body to the Intergovernmental Oceanographic Commission (OPC) of the UNESCO.

- Fishery Committee for the Eastern Central Atlantic
  An intergovernmental regional body concerned with marine fisheries. Composed of 15 member countries of the FAO.

- Committee on Fisheries, Department of Fisheries
  This committee meets annually to review the work program of the Department of Fisheries (FAO) and considers fishery problems of an international character. It promotes international cooperation in fisheries. In addition, the committee has concerned itself with education and training in the field of fisheries.

The staffs of the international fishery commissions are in close communication with the industry. For example, staffs of IATTC and IPSFC communicate on a regular, but informal, basis with the industry. The official communications, in the form of directives and regulations, are very formal.

The international commissions generally meet annually, but the commisssioners meet more regularly in preparation for the annual meeting, in which all member nations participate. Make-up varies from commission to commission, but commissioners are usually drawn from both government and industry representatives.

State Government Communications

Each state government has jurisdiction over marine resources out to the three-mile limit adjacent to the state and also over those fish and fishery products which are landed within the confines of the state. The relationships of the various state governments to the domestic fishing industry are variable and complex. As in the case with the federal government, only a small fraction of the governmental structure in each state has an immediate relevancy to commercial fisheries. This relationship takes the principal form of service and regulatory functions.

Aside from the legislative committees devoted to fisheries problems, each state has a commission or department mandated to regulate marine fisheries as all or part of its activity (Figure II-6). However, the autonomy of these commissions is far from uniform, and they may either rule unbridled over marine fisheries, act only as an advisory body to the legislture, or assume a position between these extremes. Nonetheless, at some point the rulings of the body, or of the legislature at the advice of the body, must reach the industry.

Laws governing marine fisheries are made public in a published format. In most instances, there is little direct contact between state governmments and the fisheries operating in that state, except where strong law enforcement, as with salmon in the Northwest, is required.

In a number of states, there is a developing extension service. However, these services, to date, do not provide a major function in the communication between the states and the U. S. fishing industry.

The states, as well as the federal government, have health regulations affecting processing, but these laws and their enforcement are distinct from the fishing effort itself and, thus, are not within the scope of the study.

Regional Fisheries Commission Communications

There are presently three regional marine fisheries commissions, which coordinate the activities of their state membership in research and in the regulation and conservation of marine species of commercial importance. The Atlantic States Marine Fisheries Commission includes the 14 coastal states from Maine to Florida; the Gulf States Marine Fisheries Commission includes the five states bordering the Gulf of

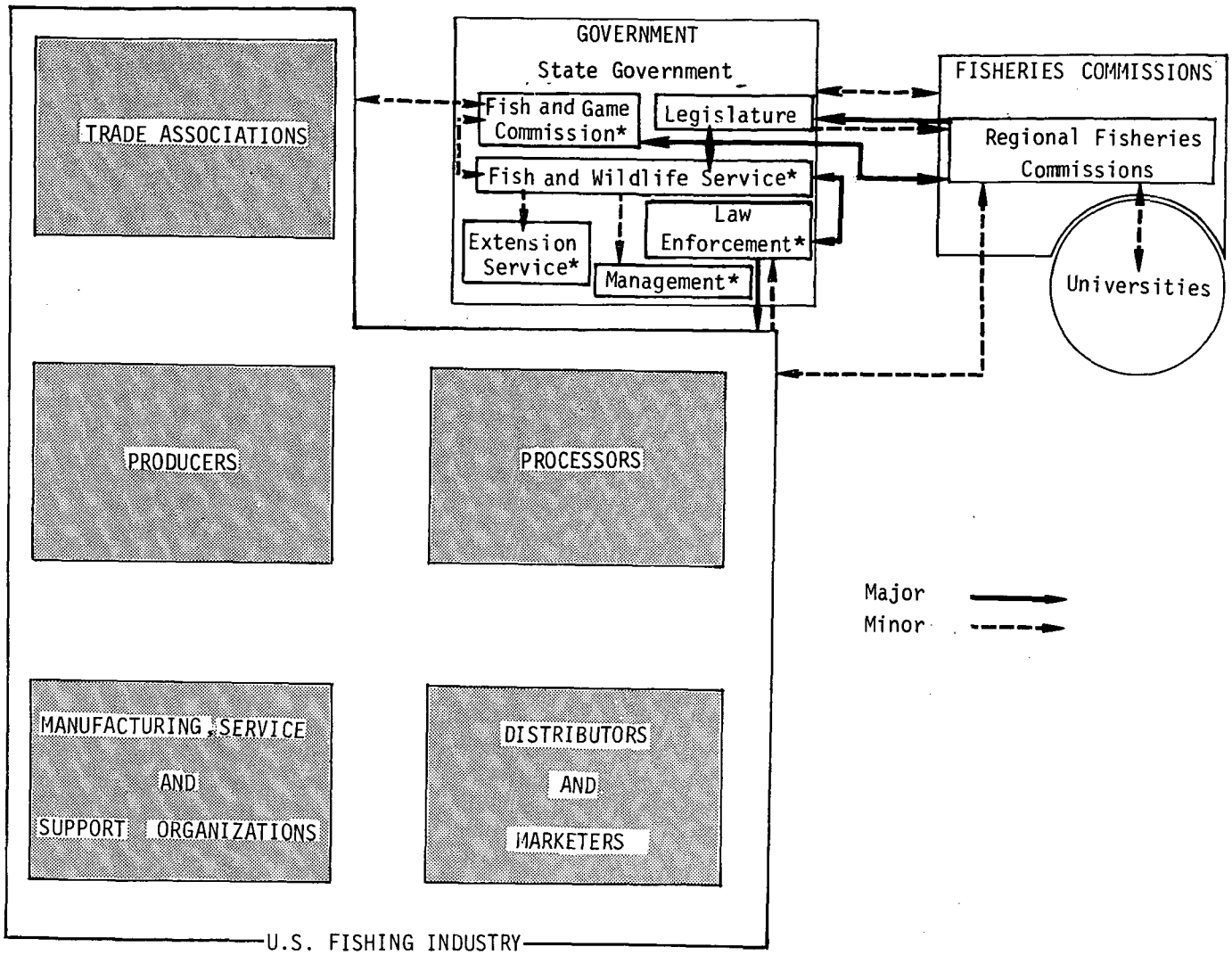

Figure II-6. Principal Communication Channels Between the State Governments and the U. S. Fishing Industry.
* Means or Equivalent Title.

Mexico; and the Pacific States Marine Fisheries Commission includes the three coastal states of the Pacific coast, as well as Idaho and Alaska. Each regional commission works with the various state regulatory agencies and legislatures to insure adequate and equal protection to both the living resources and fisheries throughout the area of concern to each regional commission.

Frequently, contiguous states regulate fisheries which exploit the same resource. It is desirable, therefore, to establish a uniform set of regulations for exploitation and conservation of the resource. This interstate coordination is the function of the respective regional commission. Each of the commissions functions essentially the same way: At the recommendation of one or more of the states involved, the regional commission will adopt a policy statement regarding the way in which a resource should be utilized and protected. Having adopted this policy, the regional commission will then attempt to influence each of the states involved to adopt a similar position and enforce it as part of their regulatory policy. Obviously, if each state already has a similar regulatory policy, such activity by the regional commission is not necessary. Usually, however, one state's regulatory attitude will be considerably different from that of its neighbor, and this is the point at which the regional commission will enter to equilibrate the two positions. However, the regional commissions cannot, by themselves, enter into such a negotiation and may do so only when requested by one of their member states.

The regional marine fisheries commissions are thus primarily involved in the coordination of activities relevant to interstate coastal fisheries. For this reason, the Pacific States Marine Fisheries

Commission is not directly involved with king crab, as this species is solely a fishery of the state of Alaska; nor is it involved with the Pacific tuna fishery, as the majority of tuna fishing takes place outside of the coastal waters of the states of California and Oregon.

Each regional commission is composed of three members from each of the states party to the regional commission. These individuals represent the legislature, fish commission, and industry in each state. They, therefore, act as the primary communication link to each of these groups within the state. In addition, the executive secretary of each regional commission acts as a liaison between that regional commission and all of the groups which work with it. This liaison may take the form of oral contact, letters, or published material. Each regional commission irregularly publishes a bulletin or similar memorandum. These generally carry information on one or another of the species or fisheries in the region.

The regional commissions themselves meet annually, although each has a board of directors which meets more frequently. In addition, the Pacific States Marine Fisheries Commission has advisory committees on recreation, scientific, and industrial aspects of the fisheries on the West Coast. These committees increase the contact between this commission and the fisheries of its region over that found in the other regions.

At best, though, the regional commissions are only irregularly in contact with the fisheries of their regions and tend to be remote from the day-to-day activities of the fisheries.

Finally, the regional commissions represent the interests of the states on fisheries matters at the federal level, encouraging federal

participation in conservation activities. The commissions attempt to stimulate and coordinate research at the federal, state, and university levels as well.

Evaluation of Government and Fisheries Commission Communications

There are two easily identifiable groups of administrators and scientists within the federal government who deal with the industry: one group communicates infrequently and formally on program and policy matters while the other group communicates frequently and informally on scientific and technological matters. The latter individuals generally are those who have developed professional associates within the industry.

The agency within the federal government that has the most contact with the industry is the National Marine Fisheries Service (NMFS). A major share of the communications between the NMFS and the industry tend to be confined to long-term (level I) policy in regards to the general direction of the industry. Almost without exception, there is a linear reduction in communication as one moves into the operating branch of the industry. For example, vessel captains do not have frequent contact with NMFS staff members. The exceptions are individual scientists, marketing specialists, or statistical agents on the dock. Pertinent information about technological advances and innovations tends to be communicated through informal channels and, if formalized for one reason or another, communication links tend to break down.

The NMFS publications, with the exception of Fishery Market News Report, Commercial Fisheries Review, and statistical reports, tend to be directed toward other scientists, rather than toward the commercial

fishing industry.

It is premature to judge the Office of Sea Grant (OSG) as a potential communication link between the federal government and the industry, inasmuch as its marine advisory services are just being initiated. However, it is our opinion that the OSG has the potential for being one of the principal mechanisms of communication on a broad base with the industry, but this potential may take as many as five years to be fully realized.

Whereas the National Weather Service (NWS) is probably the best-established operating communication link between the federal government and the industry, the communication links which carry the environmental information are not readily adaptable to carrying educational information with regards to advance remote sensing technology. This is especially true in that this is essentially a unidirectional link.

The international fisheries commissions are not in the mainstream of communications between the federal government and the U.S. fishing industry. These commissions are largely supportive in their efforts, and it is only when individual staff or advisory members of the commissions participate in both government and industry affairs that any direct communication is effected between the two bodies.

The international fishery commissions are structured more formally for international efforts in response to the requirements of the U.S. State Department. However, the staffs of the commissions are usually highly qualified and capable individuals who perform research and provide supportive information during negotiation between the various member countries. Thus, the commissions primarily serve a research function and, within their terms of reference, are specifically excluded

from acting as a communication link between NASA and the U.S. fishing industry.

The states play more active roles than is generally thought in responding to fishery requirements and needs. Although we were unable to communicate with all coastal states within the constraints of the time and resources available for this contract, those that we did contact were genuinely concerned about the best interests of the industry and were slowly adjusting to respond more directly to industry needs. In some cases, this adjustment took the form of supporting an extension service in conjunction with either the OSG, NMFS, or both, or providing legislative mandates that gave the state a broader charter to participate more actively in industry affairs.

It is our opinion that the states should be brought into any educational and operational remote sensing communication links and that NASA should make every attempt to work with the states in establishing these links. At the present time, however, the states do not generally have an effective communication link with the local fishery, except in a regulatory function.

The regional fisheries commissions tend to reflect the interest of the executive secretary of each commission. If the executive secretary wishes to have the commission participate actively in regional (interstate) fishery affairs, the activities of the commission generally reflect his interest. Again, the regional commissions would provide only a secondary communication link between the government and the industry.

U. S. FISHING INDUSTRY

The 30 or more separate fisheries that comprise the domestic fishing industry are dependent upon several hundred species of finfish and shellfish. Multiple species fisheries generally utilize species which have similar spatial distributions and which are closely related economically. From this larger number of fisheries, it was out first task to select a representative number of fisheries or fishery segments for detailed analysis. Given the highly variable, multifaceted nature of the U. S. fishing complex, it was difficult to select a sample which adequately represents the whole. At the same time, it was obviously impossible to critically examine all fisheries within the constraints of the resources to be devoted to this study. The subsample was therefore chosen such that the fisheries selected as a group satisfied all of the following criteria:

Represent a Significant Fraction of the Total Industry Economy

The economic return of various fish species to the fishermen and the overall fishing economy is variable. Of all the species fished, three represent the major economic input to the industry: Gulf shrimp, U. S. tuna, and Pacific Northwest salmon.

Represent the State of Economic Depression Facing Some Fisheries

Many of the domestic fisheries are currently in a state of economic decline. The reasons for this decline are variable, but include such factors as low vessel efficiency, poor markets, high operating costs, political constraints, and resource decline, due to increased fishing efforts or environmental degradation. Both California wetfish and New England groundfish are representative of this current economic depression in some of the industry.

Represent the Major Ecological Types of Fish

Of the various species of fish exploited by the domestic fishing industry, several basic groups can be classified by habitat preference. These groups include coastal pelagic species, of which Atlantic and Gulf menhaden and Maine sardine are primary examples; oceanic pelagic species, of which U. S. tuna is the best example; demersal or bottom living species, of

which Gulf shrimp, Alaskan king crab, and New England groundfish are the best examples; and anadromous species, of which Pacific Northwest salmon is the best example.

Represent the Major Products of Commercially Fished Species

The majority of the species fished commercially directly enter the domestic or foreign food trade. However, Atlantic or Gulf menhaden and anchovies are utilized to make fish meal, an animal grade fish protein concentrate, for use in poultry rations.

Represent Fisheries which have an Obvious Requirement for the Operational Use of Remotely Sensed Data

Several of the domestic fisheries currently operating function in such a manner that there is an obvious data need which could be filled by remote sensing or which is being filled by remote sensing. Fisheries in this group include U. S. tuna, Atlantic and Gulf menhaden, and California wetfish. Conversely, there are a number of fisheries currently operating which have no obvious immediate operational use for remote sensed data. Included here are Gulf shrimp, New England groundfish, Alaskan king crab, and others. As will become clearer in the following paragraphs, nearly all domestic fisheries will ultimately have a use for remote sensed data, as an input into predictive models for those fisheries.

Represent Fisheries which are Either Geographically Restricted or Broadly Distributed

Several of the species fished by the domestic fleet range over broad geographic areas and are fished by U. S. nationals over a broad geographic area. The most obvious examples of fisheries of this type are U. S. tuna and Gulf shrimp. Opposed to this, there are a number of species which either have a very narrow geographic range or which are exploited by the domestic fishery only in a very narrow portion of their range. Examples of these types of fisheries are the present extent of the Atlantic and Gulf menhaden fishery and the California wetfish fishery.

Represent the Industry as it Occurrs on All Coasts

The domestic fishing industry in this country currently operates on all coastlines of our country. Therefore, it seemed prudent to select fisheries which represent all of the various coastal areas of the country. This representation is graphically depicted in Figure II-7.

The fisheries selected were:

- Maine sardine
- New England groundfish
- Atlantic and Gulf menhaden
- Gulf shrimp

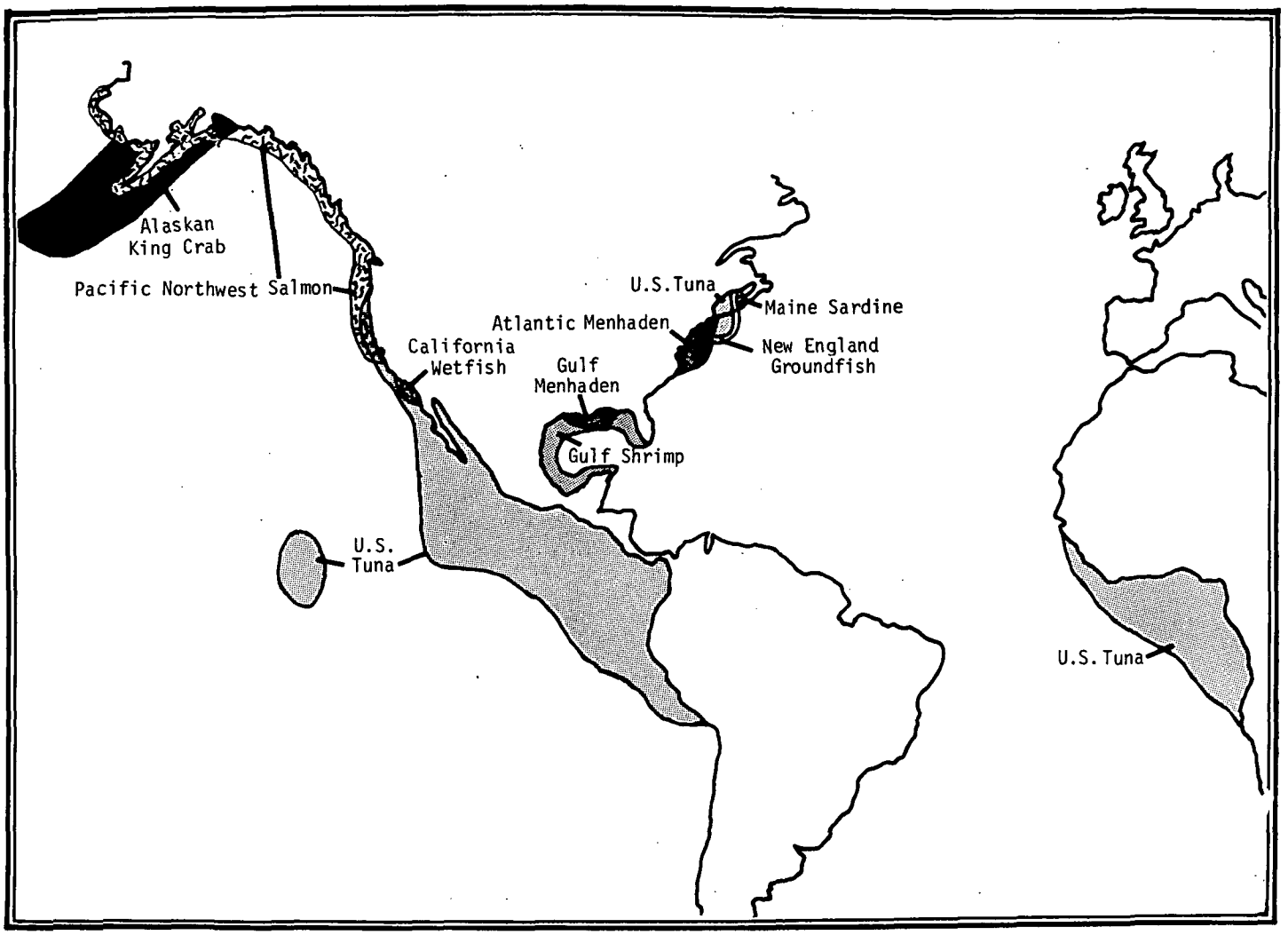

Figure II-7. Geographic Extent of the Eight Fisheries.

- California wetfish
- U. S. tuna
- Pacific Northwest salmon
- Alaskan king crab

As a group, they satisfy all of the above criteria, although no single fishery satisfies all of the criteria, nor do all of the fisheries satisfy each individual criteria. Nonetheless, it was felt that these eight fisheries were sufficiently representative of all domestic fisheries to warrant detailed analysis as part of this study.

In the previous section, the distinction between the fishing complex, the fishing industry, and the individual fisheries, as used in this report, was discussed in some detail. Emphasis should be placed on the fact that the functional units of the fishing industry are the individual fisheries. Thus, when one speaks of, for instance, the U. S. tuna industry, it is the U. S. tuna fishery which is the functional unit of that industry. For this reason, it is the activities within the individual fisheries which are of prime importance to this study; the day-to-day activities and long term events to which remote sensing techniques will contribute occur within the fisheries.

It is also in the fisheries that the majority of relevant communications occur. For this reason, the discussions to follow are oriented such that the focus of attention is placed upon the fishery segment of the individual industries. The fisheries are the center of the communications which are of prime importance to the interests of NASA. Communications from the fishery through the fisheries trade associations to the various government and intergovernmental agencies assume a lesser significance. Obviously, for the transmittal of remote sensing

data from NASA to industry, some government communication pathways, at least, will ultimately assume a more important stance.

Although the trade associations will be discussed in detail for each of the eight fisheries, several of these associations have broad industry representation. The principal national associations which represent the production and producing segments of the fisheries include:

- National Fisheries Institute (NFI)
  This association represents nearly all of the fresh and frozen fish industries. Within NFI is the National Fish Meal and Oil Association (NFMOA), which represents most of the fisheries for nonedible species.

- National Canners Association (NCA)
  This association represents the canning industry of the United States. As a part of this total effort, it promotes canned fish products. NCA has three laboratories, which work very closely with the Food and Drug Administration.

Both national associations spend a large part of their budget in promoting fishery products in general and representing the interests of their various members to both the legislative and executive branches of the federal government. As such, both associations communicate only with the higher level of management within the fisheries and government, and are not oriented for effective communication of operational information. Both NFI and NCA have confident, energetic executive secretaries who are well known to industry management, as well as to government personnel.

There are a number of other national associations which represent narrower interests of the industry and government. Those pertinent to this study include: American Seafood Distributors Association, American Shrimp Canners Association, and National Shellfisheries

Association. In addition, the International Shrimp Council provides some interface between the importers of shrimp and the U. S. shrimp fishery, and the National Shrimp Congress, Inc., represents the interests of the domestic shrimp industries in international affairs.

Although a great many ancillary organizations operate peripherally to the industry (i.e., boat builders and gear manufacturers), these tend to operate apart from the main thrust of the industry. The industry mainstream is a linear progression from resource to fleet to producer to processor to product. This flow relationship consumes the day-to-day interest of the individuals in the industry. Business involving peripheral areas is conducted on a longer time scale and on a different level than the operational aspects. Hence, these peripheral or support groups are not directly involved with the fishing operations and have not been treated in as much detail as the other components. Only in those cases where significant differences occur is a discussion of any detail involving the manufacturing arm entered into.

Each industry, in the order listed above, is discussed in the following manner: A brief background is given, including the species fished, the fishing grounds, the production and dollar volume both domestically and worldwide and, lastly, the various types of vessels and fishing gear used to capture the species. Next, the organization of the fishery is documented, with emphasis placed on the three branches of the fishery, the producers, the processors, and the trade associations. These subgroups are discussed in considerable detail for each fishery. Following the organization of the fishery, the organizational relationships between that fishery and relevant outside

groups as federal and state government agencies, universities, fisheries commissions, and so forth, are discussed. The next section considers communications as they exist within the fishery and from the fishery to the relevant outside or peripheral groups. Lastly, for each fishery an evaluation is made of the identified communication pathways, with reference to their pertinence to the transmittal of educational materials about remote sensing techniques and potentials from NASA to that fishery. The evaluation also contains a statement concerning the current state of remote sensing awareness within each fishery.

Maine Sardine Industry

Background

Although the shore facilities for this fishery are, in fact, primarily in the state of Maine, the name of the fishery is misleading,as the species utilized is the Atlantic herring, Clupea harengus.

Fishing Grounds

The Atlantic herring range from northern Labrador, Canada, to west Greenland and as far south as Cape Hatteras, North Carolina. In the winter, the fish are widely distributed over a very broad area in unstable concentrations. In the spring, they concentrate on parts of Georges Bank and close to shore. These are the areas where Maine fishermen concentrate their effort.

U. S. Production

The Atlantic herring supports a very large fishery off the east coasts of both the U.S. and Canada. Not only do nationals of these two countries participate in the fishery, but, in recent years, the fishery included the nationals of West Germany, East Germany, Poland, Romania, the U.S.S.R., and Iceland. Despite their proximity to the fishing grounds, New England fishermen have taken less than six percent of the total catch in recent years.

Landings by U. S. fishermen has fluctuated over the last several years. The average value to the fishermen for the years 1966 to 1969 was $1.6 million, with a peak value of $2.3 million in 1968. Of these landings, 80 percent occurred in the State of Maine, with the remainder in neighboring coastal states.

The major portion of the landings in Maine go into canned products. The "pack" in 1969 was slightly over 100 million cans with a total value of $11.5 million. The scrap from the cannery operations goes into fish meal and oil valued at approximately $0.5 million.

Vessels and Gear

Atlantic herring are taken with purse seines, stop seines, weirs, and floating traps. The latter three types of gear are passive, are fixed as to the area of operation,and their success is migrational and subject to the patterns of the fish. By contrast, the purse seine vessel can actively scout for fish and is very mobile and aggressive. During the four-year period from 1966 to 1969, purse seines accounted for more than 45 percent of the fish caught, stop seines 36 percent, and weirs and floating traps the remaining 19 percent.

The purse seine vessels (40 to 60 feet in length) generally deliver their catch to carrier vessels, which, in turn, transport the fish to the canneries. Occasionally, however, the purse seine vessel delivers its catch directly to the processor. Upon arrival at the cannery, the fish are immediately pumped ashore and processed.

Because of the inherent advantages in the purse seine gear, the number of purse seine vessels is expected to increase in the next few years.

Organization of the Fishery

The Atlantic herring fishery operates from a number of ports scattered along the coast of Maine; the principal ones include Prospect Harbor, Lubec, Rockland, East Port, and Milbridge. Each port has approximately the same organizational characteristics,with the processor being the focal point of the operating industry.

The carrier vessels, owned by the processors, form a principal component of the operating unit.

Producers

In 1969, there were nine purse seine vessels and 14 stop seine vessels operating in the Atlantic herring fleet. The number of stop seine, weir, and floating trap vessels and carrier vessels which serve as an intermediate between the processors and fishing vessels is unknown. The producers have no fishermen's unions or vessel associations that are directly responsible for their welfare, and, as such, the producers are without an identifiable organization.

Processors

There are currently 20 processors canning Atlantic herring in Maine. Individual ports are not formally organized and operate somewhat independently from other ports. All Atlantic herring processed by the Maine sardine industry is received fresh.

Trade Associations

There are no associations operating in support of the Maine sardine fishery,except the somewhat remote connection with the National Canners Association and the National Fish Meal and Oil Association. There is just one union representing the fishermen and shore workers in Maine. We were unable to ascertain the extent of the union's organization.

Relevant Organizations

The Maine sardine fishery is state regulated, the regulations being the responsibility of the law enforcement branch of the Department of Sea and Shore Fisheries.

Processors are organized by a State of Maine law and represented by the Maine Sardine Council. This situation is unique in the eight fisheries examined in this study. The council consists of seven members appointed by the Commissioner of Sea and Shore Fisheries. The members, who serve without pay, are executives of sardine packers operating within the state who have been actively engaged in packing of sardines for at least five years. The council is supported by an assessment paid by the processor amounting to 25 cents per case packed. The principal function of the council is to advertise, provide public relations, and, in general, promote the Maine sardine industry. The council's executive secretary manages the operations of the council and is responsible for overseeing the council's quality control laboratory. This laboratory is responsible for insuring quality of the sardine pack.

The National Marine Fisheries Service Laboratory at Boothbay Harbor, Maine conducts biological research on Atlantic herring as part of its broad fishery research program.

Communications

The Maine Sardine Council provides the major communication link between the operating elements of the industry and the government (Figure II-8). Although the council does not belong to any national association, the executive secretary of the council is well known and participates in many activities at a national level. In this way, the industry is able to communicate in a minor way with the federal government through the national associations.

The Maine Sardine Council serves as a clearing house both to receive and disseminate information from the sardine processors. The council issues , on an irregular basis, a newsletter which announces information

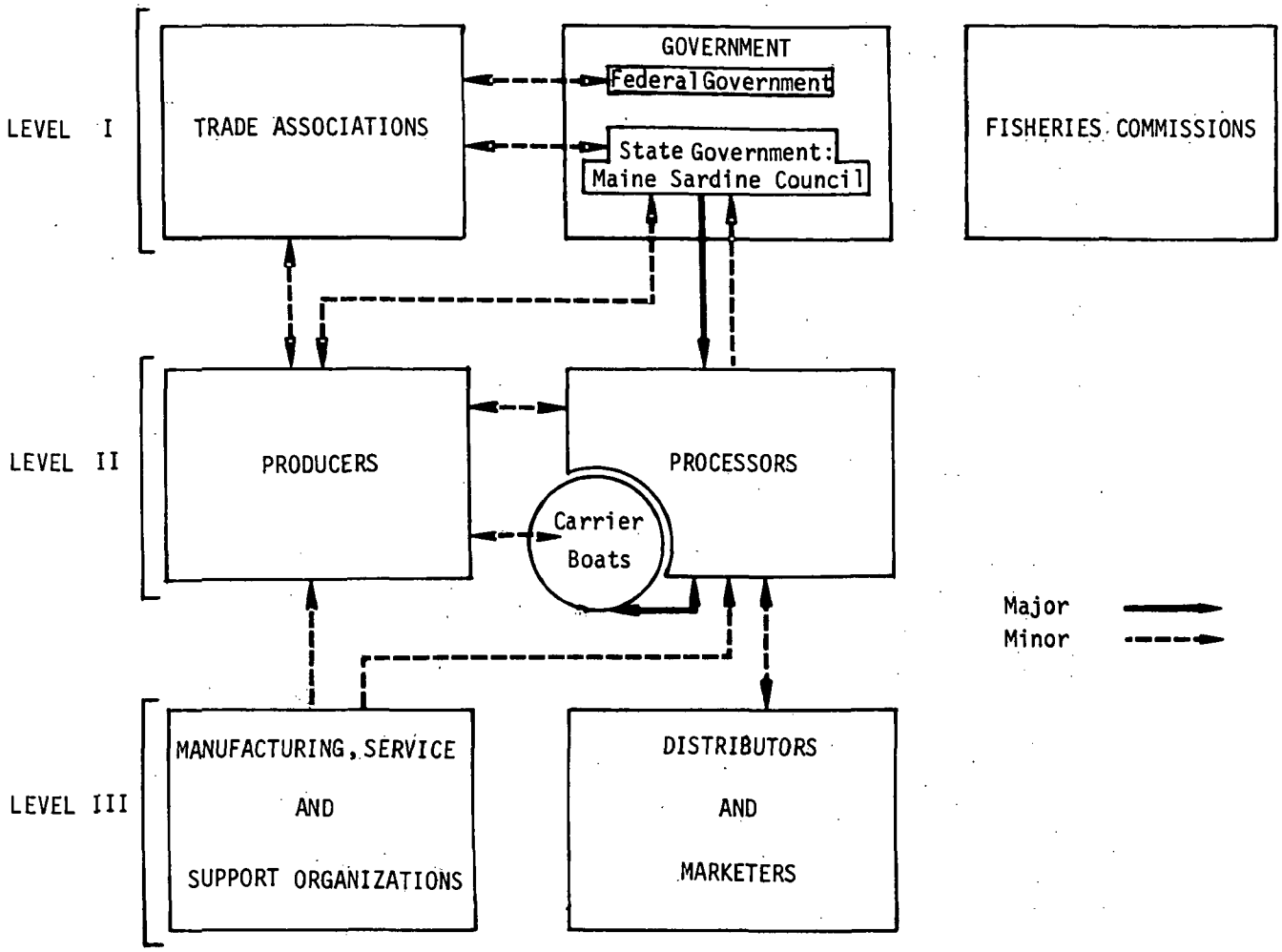

Figure II-8. Principal Communication Channels in the Maine Sardine Industry.

on meetings and recent developments of interest to the industry, among other topics. However, most of the information from the council to the industry is passed by word of mouth, and there is essentially no formal mechanism for communication between the various members of the industry.

We can define one other major communication link between principal components of the industry. Because the carrier vessels belong to the processors, there is close communication between the company managers and the carrier vessel captains. Company managers, on the other hand, communicate with the fishing vessel captains only as necessary, principally to negotiate the price and to be paid for the catch. This type of communication holds also for any dialogue which occurs between the fishing vessel and carrier vessel captains.

Within the production end of the industry, there is a close working and communicating link between the vessel owners and the captains. In many cases, which is particularly true with the smaller vessels, the vessel owners are the captains.

With the exception of an occasional spotter aircraft* assisting in the location of schools of Atlantic herring, most of the locating of fish is done by eye from the vessels, or with occasional help from depth recorders. After the fish schools are caught, the fishing vessel captain deals over the radio with a processor on shore, and agreement is reached on price. The carrier vessel, sent out by the processor , then loads the fish and delivers it fresh to the processor.

Evaluation

Because this fishery is essentially confined to a single state,

* The spotter aircraft are not a significant operating unit of the industry.

defining pertinent communication links is relatively simple. The Maine Sardine Council appears to be the contact point through which NASA could focus its educational efforts, particularly since the council's executive secretary has expressed a high degree of interest in remote sensing as applied to his industry. The council would insure an equitable distribution of information to those operating units within the Maine sardine fishery. As to the potential feedback communication channel, the council appears to be a definite candidate. However, without testing it is difficult to evaluate its potential effectiveness.

An alternative channel would be through the developing programs of the Sea Grant Advisory Service centered at the University of Rhode Island. The communication channels to the operating units are, as yet, not clearly defined and thus were not discussed under "Relevant Organizations". However, considerable effort is being exerted to establish communication channels with all the New England fisheries (including the Maine sardine); these should be established in the next 2 to 4 years. Another alternative would be through existing NMFS communication channels via the Boothbay Harbor Laboratory.

With the exception of the executive secretary of the Maine Sardine Council, we found no individuals in the operating units who were aware of remote sensing applications. Thus, there is a need for education on remote sensing in this fishery.

Published fishing information distributed to, and read by, the Maine sardine industry is of a general nature,such as that obtained in the National Fisherman. The fishermen generally do not read NMFS publications other than the NMFS Fishery Market News Report.

New England Groundfish Industry

Background

The term "groundfish" is generally used to describe those fish that live on or near the bottom of the ocean in continental shelf areas. In addition to having similar spatial distributions, the relatively few species that are exploited commercially are closely related economically. They are caught by similar gear and form the raw material base for further processing into various categories of product.

Haddock, cod, pollock, whiting (family Gadidae), ocean perch (family Scorpaenidae), yellow tail flounder, and black back flounder (family Pleuronectidae) are generally considered to form the New England groundfish resource base. Species contributing minor quantities of the total landings are cusk, seadab, fluke, ray sole, and lemon sole. Although a bottom fish, the halibut has traditionally been considered separately from the groundfish, principally because of differences in marketing. Halibut is a high-priced fish and, therefore, is not a ready raw material substitute for groundfish products.

Fishing Grounds

The groundfish industry off New England is the oldest fishery in the U. S., having begun shortly after the arrival of the first colonists in the early 1600's. By 1800, all of the familiar grounds that are fished today were known to the early New England fishermen: Georges Bank, Browns Bank, the Gulf of Maine, and Nantucket Shoals.

U. S. Production

While the world production of groundfish has grown steadily over the last decade, reaching over 11 million metric tons in 1969, the U. S. production of groundfish has been decreasing. This is in sharp contrast to the U. S. demand for groundfish products, which has been increasing at an average annual rate of 4.5 percent.

U. S. requirements for groundfish are being increasingly met by imports as domestic production declines. In 1960, imports supplied 42 percent of the total apparent consumption; by 1969, this share had increased to 78 percent.

At the present time, New England fishermen account for approximately 70 percent of the U. S. landings of groundfish. Landings have been decreasing since 1965 due to an unfavorable economic climate and increasing foreign competition on the traditional fishing grounds. In 1968, vessels from Canada, West Germany, Denmark, France, Norway, Poland, Portugal, Romania, Spain, and the U.S.S.R., among others, were fishing the western Atlantic grounds in competition with the U. S. fleet.

In 1969, over 119 thousand metric tons of groundfish, worth slightly over 28 million dollars, were landed by New England fishermen. The prices paid for groundfish were the highest in history in 1969 and, although the landings were substantially less than any previous year since 1963, the values were nearly the same.

Vessels and Gear

Most of the groundfish taken by New England fishermen are accounted for by otter trawlers, with small quantities being taken by line trawlers. The gear used by the two types of vessels carries the same designation

as the vessels.

The otter trawlers are of two types, stern or side, with the newer and larger craft favoring stern trawling. They range in size from 50 to 132 feet, and several have a carrying capacity of 200 tons.

The line trawlers are generally smaller vessels, averaging 50 feet in length.

Organization of the Fishery

Although the New England groundfish industry is geographically restricted to a relatively small area in the western Atlantic, there are eight principal ports where the processing is centered. These ports include, in descending rank of 1969 landings: New Bedford, Gloucester, and Boston, Massachusetts; Rockland and Portland, Maine; Provincetown, Massachusetts; Point Judith, Rhode Island; and Stonington, Connecticut. Combined, these eight ports received more than 99 percent of the total groundfish landings in New England.

At several of the ports, the fish are auctioned through a procedure unique to the groundfish industry. These auctions, such as the New England Fish Exchange in Boston, provide communication between the major operating components of the industry. Relationships between the various components of the industry and government agencies or international fishery commissions will be discussed in the communications section. The following discussion deals principally with the organization of the industry.

Producers

In 1969, there were 521 otter trawlers and 11 line trawlers in operation in the fishery. Each port has major and minor producers.

For example, the F. J. O'Hara Company in Boston is considered by many to be one of the most progressive (and, apparently, profitable) groups. The eight trawlers managed by the O'Hara Company are organized as separate corporations (to reduce liability) but are, in essence, controlled and owned by the principals in the O'Hara Company. O'Hara employs a fleet manager responsible for the operations of their three Boston-based trawlers.

The F. J. O'Hara Company is one of two companies in Boston that is both a producer and a processor of groundfish. In addition, the O'Hara Company is the only fleet boat owner in the New England groundfish industry; all other vessels are individually owned.

Processors

The processing industry is formally organized at all major ports. The processors can be divided into two principal groups, those that process domestic catch and those that process import material. The former are characterized by processors such as the F. J. O'Hara Company and O'Donnell-Usen in Boston, Massachusetts, and the latter by the Gorton Company in Gloucester, Massachusetts.

In New Bedford alone, there are 13 firms that process domestic landings. A proportionate number of processors are located in the other five major ports scattered along the New England coast.

Trade Associations

The principal regional association in the New England groundfish industry is the Massachusetts Seafood Council. The council is a nonprofit organization whose purpose is to promote the use of fish and shellfish. The council is principally a coordinating body to direct

promotional efforts and, as such, relates to individual processors within the New England groundfish industry. The council is federally supported and requires no contribution from participating members. At the present time, the executive secretary of the council is also the executive secretary of a local association, the Boston Fishery Association, which is concerned with the processors in the Boston area.

There are numerous local groundfish associations, but the two most important appear to be:

- Boston Fishery Association
- Seafood Dealers Association of New Bedford

There are presently five cooperatives operating in the New England groundfish industry, representing 604 members and 459 vessels. Two cooperatives are widely known, principally because of the capabilities of their executive secretaries. These cooperatives include:

- New Bedford Seafood Cooperative Association, Inc.
- Point Judith Fisherman's Cooperative Association, Inc.

Eight unions can be identified with the New England groundfish industry. The unions primarily represent deck hands, but, in New Bedford, there was a particularly close working relationship between the unions and the local associations.

Relevant Organizations

The New England groundfish fishery operates under the International Commission of the Northwest Atlantic Fisheries (ICNAF) and is thus internationally regulated, with quotas set by international negotiation. In 1970, for example, the haddock fishery was closed earlier than in previous years to protect the declining haddock population.

A large amount of groundfish is imported to New England groundfish processors. There is no quota on frozen fish blocks, the major source of raw material. Quotas on fish fillets depend on the previous year's use.

Although the New England groundfish industry involves several states, the Atlantic States Marine Fisheries Commission has very little part in coordinating federal/state activities. This is largely due to the fact that the executive secretary of the commission is located in Florida, too distant for any effective working relationship with the New England states.

Unique to the New England groundfish industry is a local tax-supported group called the Gloucester Fisheries Commission. The commission is composed of the mayor of Gloucester and 12 persons appointed by him. Two of the members of the commission are members of the city council and five are connected with the production/processing/employment phases of the Gloucester fishing industry.

The commission was established to promote, preserve, and protect the Gloucester fishing industry and is apparently doing an effective job. The commission has presented numerous briefs before the state and federal legislative committees, giving the Gloucester fishing industry viewpoints on pending legislation. The commission was also a recipient of a federal grant of nearly $44 thousand to establish a fisheries extension service for the benefit of the Gloucester fishing industry.

The National Marine Fisheries Service regional office in Gloucester is actively assisting the New England groundfish industry. For example, the NMFS associate regional director for fisheries made a presentation

before the Gloucester Fisheries Commission regarding the closing of the haddock fishery. The local NMFS laboratories are generally less intimately associated with the industry.

The University of Rhode Island's Sea Grant Advisory Program has just completed an initial study on the testing of new gear in cooperation with the Point Judith Cooperative Association. This successful effort is apparently the beginning of a new extension to the groundfish industry by a research and development component of the federal and state governments.

Communications

The trade associations provide the link between the operating components of the industry and the governments (Figure II-9). Most of the local associations and/or cooperatives belong to one of the national associations and depend on them for assistance in communicating with the federal government. However, the local associations and cooperatives deal directly with the state governments on individual problems of the local fisheries and ask only for occasional guidance from the national association and the office of the federal government in the region.

Minor communication links can be identified between the national associations and local associations and/or cooperatives. Most of the communication is in the form of newsletters and an occasional telephone call. However, most of the associations and cooperatives participate in at least one of the meetings of the national associations each year.

The formation of the International Commission for the Northwest Atlantic Fisheries (ICNAF) came as a result of the need for management

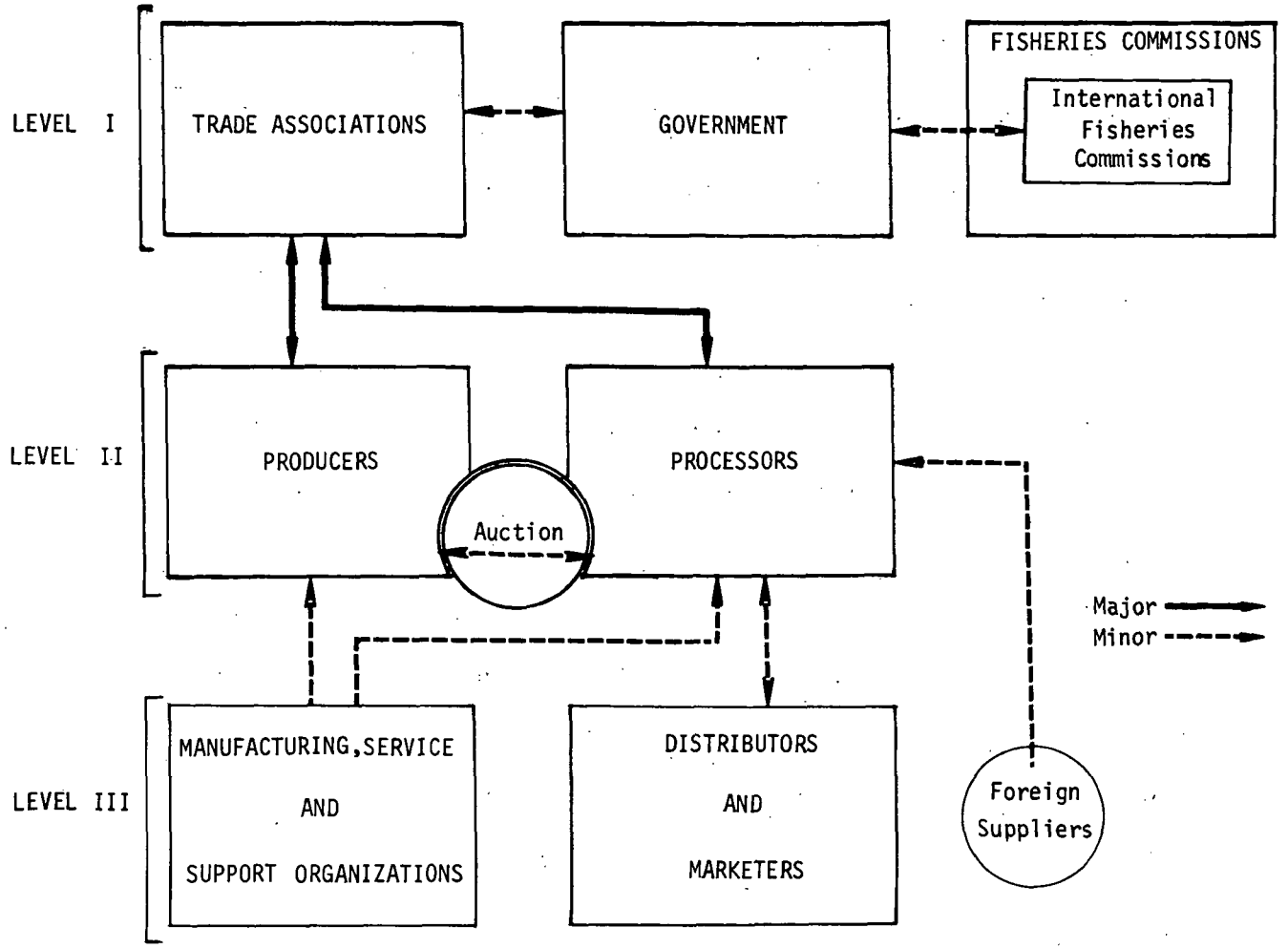

Figure II-9. Principal Communication Channels in the New England Groundfish Industry.

of the groundfish fishery during the late 1940's. At that time the stocks were under heavy pressure by both American and European fishing efforts, and international cooperation was obviously essential to resource management. ICNAF responds principally to research needs and requirements dictated by the federal government and, as such, communicates principally with the NMFS and the U. S. State Department. Members of ICNAF are drawn from both government and industry, and, therefore, some communication takes place during the commission meetings.

We can define a major communication link between the local associations and the processing segment of the New England groundfish industry. In all the major ports, the processors are well organized and support local associations. On the other hand, the producers are clearly unorganized and in only one instance have formed an association.

Fishing trips range in length from 1 to 12 days, depending on such factors as vessel size, species sought, the grounds fished, catch rate, price, and keeping qualities of the various species. The use of ice as a preservative limits trawler trips to about 12 days, as quality diminishes rapidly after that period of time. Haddock, cod, and pollock are eviscerated, washed, sorted for size, and iced down as they are captured. Whiting, ocean perch, and many of the flounders are merely iced without any special handling. Upon arrival in port, the fish are sold through an auction or by direct negotiation with the processors, depending upon the port of landing. Unloading usually takes place within a few hours of landing.

At those ports that have established an auction procedure, the

auction forms a very critical component of the communication network. In Boston, the auction sales are held Monday through Saturday mornings, beginning at 7:30. Vessel owners employ their own auctioneers to sell their fish. Owners cannot bid on their own trips, but have the right to refuse the highest bid if they wish. The auction is by individual species; for example, all haddock on all vessels are sold before any other species is put up for bid. In this way, all vessels carrying the same species can initiate unloading at approximately the same time, which allows processing plants to be in operation the first thing in the morning.

The producers and processor representatives meet at the auction, and there is considerable information exchanged at that time. Most of the communication is oral, and few, if any, written communications are transmitted between the processors and the producers.

A major communication link can be identified between the trade associations and the producers. A majority of vessels belong to local associations and/or cooperatives. The executive secretary of each association/cooperative plays a critical role in establishing effective communication between the membership and other components of the industry. In the case of the New Bedford Seafood Cooperative Association and the Point Judith Fishermen's Cooperative Association, the communication channels are well developed.

No other major communication links can be identified in the New England groundfish industry; however, a number of minor channels do exist. For example, the University of Rhode Island has recently established several programs under the Sea Grant Act to service the local fisheries. These programs now under development include:

- New England Marine Resources Information Program
  A program to disseminate information of interest to the local marine community and, in particular, to the fishing community.

- Fisheries Extension Program
  A program to enable technologists to work with their counterparts in the industry to help advance fishing technology.

- University Marine Advisory Service Program
  A field service that is responsible for promoting Sea Grant activities, particularly Sea Grant publications.

Largely because of their newness, the activities of the Marine Advisory Services have not been effective in communicating with the industry.

Evaluation

Because of the larger number of species fished by the New England groundfish industry and the larger number of ports from which the fishery operates, it is impossible to identify a single definitive pathway from the federal government to the operating components of the industry. In terms of local communications, Boston and New Bedford are more sophisticated than many of the other ports. However, these ports are followed closely by Gloucester and Point Judith. In all cases, effectiveness of the communications results from the activities of one or more individuals who personally provide a link with nonoperating components of the industry and the government.

At Boston, the Boston Fisheries Association provides the most direct communication link to the industry; however, because there is no organized association for the vessel owners, a communication link would have to be established between the executive secretary of the Boston Fishery Association and the fleet manager of the F. J. O'Hara

Company. This would insure information reception by at least the most progressive individuals in the Boston groundfish industry.

At New Bedford, communication links could easily be established with the Seafood Dealers Association of New Bedford and/or the New Bedford Seafood Cooperative Association.

At Gloucester, the Gloucester Fisheries Commission is the principal communication link to the Gloucester groundfish industry. The largest processor of imported fish in Gloucester, Gortons, Inc., would not, however, be reached through this commission.

At Point Judith, the Point Judith Fishermen's Cooperative Association, Inc., is the obvious communications link to the operating components of the industry.

Alternative communication channels can be identified through the NMFS laboratories. Further elaboration on these potential communication links is given in the "Federal Government Communications" section.

The developing Sea Grant Advisory Service Programs offer another alternative communication channel, although the programs are in their formative stages.

All communication links identified at Boston, New Bedford, Gloucester, and Point Judith are potential candidates for communication feedback channels. In all cases, the executive secretary (or equivalent) of the associations and cooperatives is ready to consider participation by the respective fisheries in the application of advanced remote sensing technology. However, some of the producers are not receptive to new ideas, techniques, and equipment unless there is a demonstrable effect on the profits. Such innovations must be carefully introduced to the fishery, usually with the

sponsorship of some well-respected individuals. Reports of success or failure of ideas, techniques, or equipment pass through the fleet very rapidly by word of mouth, and many a worthwhile innovation is lost through improper introduction to the fishery.

There was a general lack of understanding of remote sensing throughout the New England groundfish industry. With the exception of the executive secretaries of the more progressive local associations/cooperatives, few individuals had any concept of fishery remote sensing.

A large percentage of the New England groundfish industry receives the NMFS Fishery Market News Bulletin; the producers and processors generally follow the daily publication releases. The only other publication widely distributed within the industry is the National Fisherman.

Atlantic and Gulf Menhaden Industry

Background

Menhaden is seldom consumed directly by humans, but is processed into fish meal, oil, and protein solubles for animal feed ingredients and many nonedible products. Two species of menhaden constitute over 99 percent of the landings in the Atlantic and Gulf of Mexico. In the Atlantic, Brevoortia tyrannus is the species of prime importance, whereas B. patronus is the major Gulf species.

Fishing Grounds

Menhaden have been fished along the Atlantic coast since colonial times. This fishery formerly extended from Florida to Novia Scotia, but has since been reduced to the coastal area from New Jersey to North Florida. It is presently centered in the Chesapeake Bay and North Carolina regions. Although the adults spend considerable time in deep water, the species is heavily dependent on estuarine areas for development of the young.

The fishing is seasonal and closely related to the warming and cooling of coastal waters. Surface schools are seldom seen before April and are usually last seen off North Carolina in late December, at which time they move offshore and disappear. Their location remains unknown until they reappear along the coast the following April.

The Gulf menhaden fishery is of more recent origin, having developed in the last several decades. B. patronus extends from Florida to Mexico, but is fished primarily from north Texas to Mississippi. During the summer, the fish occur in the shallow coastal waters in the northern part of the Gulf of Mexico, but are found in the greatest concentra-

tions in the area of the Mississippi Delta. They disappear in deeper, more southerly waters during the fall and early winter months. In general, the fishery is from May to November.

U. S. Production

Landings of menhaden along the Atlantic coast have been declining since 1956, when 783 thousand tons were landed. In 1969, catches had dropped to less than 200 thousand tons, but then recovered to nearly 300 thousand tons in 1970. The decreased catches since 1962 have been a coast-wide phenomena, reflecting a definite reduction in abundance. It is widely believed that pollution of estuaries and over-fishing have contributed to the drastic decline in landings.

Landings of Gulf menhaden have increased sharply since the late 1950's, when landings were about 200 thousand per year. In 1970, over 615 thousand tons were landed, principally as a result of increased fishing effort. Although the annual landings are increasing, the catch per vessel has been decreasing because of the increasing number of boats.

The menhaden fishery is of great economic importance to its fishermen, its subsidiary industries, and the general public in the U.S. In an average year, the industry produces about 220 thousand tons of fish meal, 20 million gallons of oil, and 10 thousand tons of fish solubles.

Although fishing for menhaden is done almost exclusively by U. S. nationals, there is recent activity by other nations on this resource. For example, the Russians insist they have no interest in U. S. menhaden, but, during recent negotiations between the U. S. State Department and Russian representatives, Russia agreed only to refrain from

fishing for menhaden in coastal waters from January 1 to April 30. Further discussions of this topic will be found in the section on "Relevant Interrelationships".

Vessels and Gear

Nearly the entire catch of menhaden in both Atlantic and Gulf fisheries is made with purse seines. Two small vessels which carry and set the net are housed aboard a large (60-200 feet in length) vessel, which also stores the catch. Spotter aircraft are an essential component of the operating industry and assist in locating the fish and in setting the net. The number of spotter aircraft operating in the Gulf menhaden fishery has remained fairly constant since 1965. However, there has been a marked decrease in the number of spotter aircraft operating in the Atlantic fishery, as the fishing has declined. (Table II-2). In 1968, approximately 60 percent of the purse seine net placements were made with the aid of a spotter aircraft; this increased to about 90 percent in the 1969 season.

Organization of the Fishery

Although the menhaden industry is the largest volume fishery in the U. S., it is essentially controlled by a few strong, highly competitive companies. The menhaden industry is unique in U. S. fisheries, inasmuch as the processors who own and manage the fish meal plants also own and manage the vessels, and, in one case, the spotter aircraft as well.

The Atlantic menhaden fishery operates out of a number of ports located principally in the states of New Jersey, Virginia, and North Carolina. In the Gulf menhaden fishery, ports are principally concentrated in the Mississippi and Louisiana areas. Only occasionally are

Table II-2. SPOTTER AIRCRAFT OPERATING WITH THE ATLANTIC AND GULF MENHADEN INDUSTRY.

Year	Atlantic	Gulf
1954	23	
1955	29	
1956	33	
1957	37	
1958	41	
1959	40	
1960	32	
1961	34	
1962	34	
1963	35	
1964	39	
1965	31	32-35
1966	27	32-35
1967	22	32-35
1968	23	32-35
1969	18-20	32-35

two or more processors located in any one port.

Producers

All of the vessels fishing for menhaden in the Atlantic and Gulf are company owned and operated. The company management hires the captain and first and second engineers. The captain is responsible for hiring the rest of the crew, which consists of the mate, cook, and 10 to 14 fishermen who serve aboard the large vessel.

Because the boats are company owned, there is no organization which represents the production element of the industry. There have been several attempts to unionize the crewmen, but, to date, this has been unsuccessful.

Another important production component is the fish spotter. With the exception of one company, the aircraft are owned by the pilots themselves. The spotter pilots are hired by the company and paid on a base salary, plus a share of the proceeds from the catch. If the aircraft is owned by the pilot, the aircraft is contracted separately, so that, if the pilot quits during mid season, the use of the aircraft is not jeopardized for the remainder of the season.

Processors

Six major processors can be identified in the menhaden industry:

- Haynie Products, Inc.
  Has processing plants in Mundy Point, Cape Charles, and Reedville, Virginia; Moss Point, Mississippi; Wildwood, New Jersey; and Morehead City, North Carolina. Its headquarters and a research laboratory are located in Baltimore, Maryland.

- Standard Products Company, Inc.
  Has processing plants in Amagansett, New York; Lewes, Port Monmouth, Crab Island, and Tuckerton, New Jersey; Kilmarnock and Reedville, Virginia; Beaufort, Southport, and Morehead City, North Carolina; Lewes,

Delaware; Morgan City and Cameron, Louisiana; Moss Point, Mississippi; and Sabine Pass, Texas. Its headquarters and a research laboratory are located in Kilmarnock, Virginia.

- J. Howard Smith, Inc.
  Has processing plants in Tuckerton, Crab Island, and Port Monmouth, New Jersey and Lewes, Delaware. Its headquarters and a research laboratory are located in Port Monmouth, New Jersey.

- Wallace Menhaden Products, Inc.
  Has processing plants in Empire and Cameron, Louisiana. Its headquarters is located in New Orleans, Louisiana.

- Zapata - Ocean Protein
  Has processing plants in Cameron and Dulac, Louisiana.

- International Protein
  Has a processing plant in Dulac, Louisiana.

The larger companies have research facilities and staffs which are well advanced in their fields of expertise.

Trade Associations

The menhaden industry is represented on the national level by the National Fish Meal and Oil Association (NFMOA). This trade group represents the four largest menhaden companies. NFMOA was formed from the Industrial Products Division of the National Fisheries Institute. It has its own bylaws, officers and funds, as well as a full-time executive officer and secretary located in Washington, D. C. The principal function of the NFMOA is to retain a close liaison between the industry and various federal agencies that provide services to the menhaden industry.

There are no regional or local associations, cooperatives, or unions in the menhaden industry.

Relevant Organizations

Menhaden do not come under an international treaty and, as such,

the federal government has no regulatory power over the industry. However, growing out of a recent interest by the Russians in the menhaden fishery, steps are currently being taken to establish negotiations with respect to the fishing of menhaden breeding stock in international waters.

The industry is regulated by the individual states in which landings are made. The Atlantic and Gulf States Marine Fisheries Commissions coordinate state regulatory activities.

The NMFS Laboratory at Beaufort, North Carolina has been involved in menhaden research for many years. Most of the effort has been in basic biological studies, which are often not available for immediate industry consumption.

Communications

The National Fish Meal and Oil Association (NFMOA) is an important communication link between the operating component of the menhaden industry and the federal government (Figure II-10). The director of NFMOA is supported by capable and progressive individuals within the menhaden industry. He is constantly probing the federal and state establishments to provide better services and information to the industry.

There is a minor communication link between NFMOA and the federal government. However, individual members of NFMOA communicate very effectively on a personal basis with individuals in the federal government.

There are apparently minor communications between the federal and state governments; that which does take place is usually coordinated through the Atlantic or Gulf States Marine Fisheries Commission.

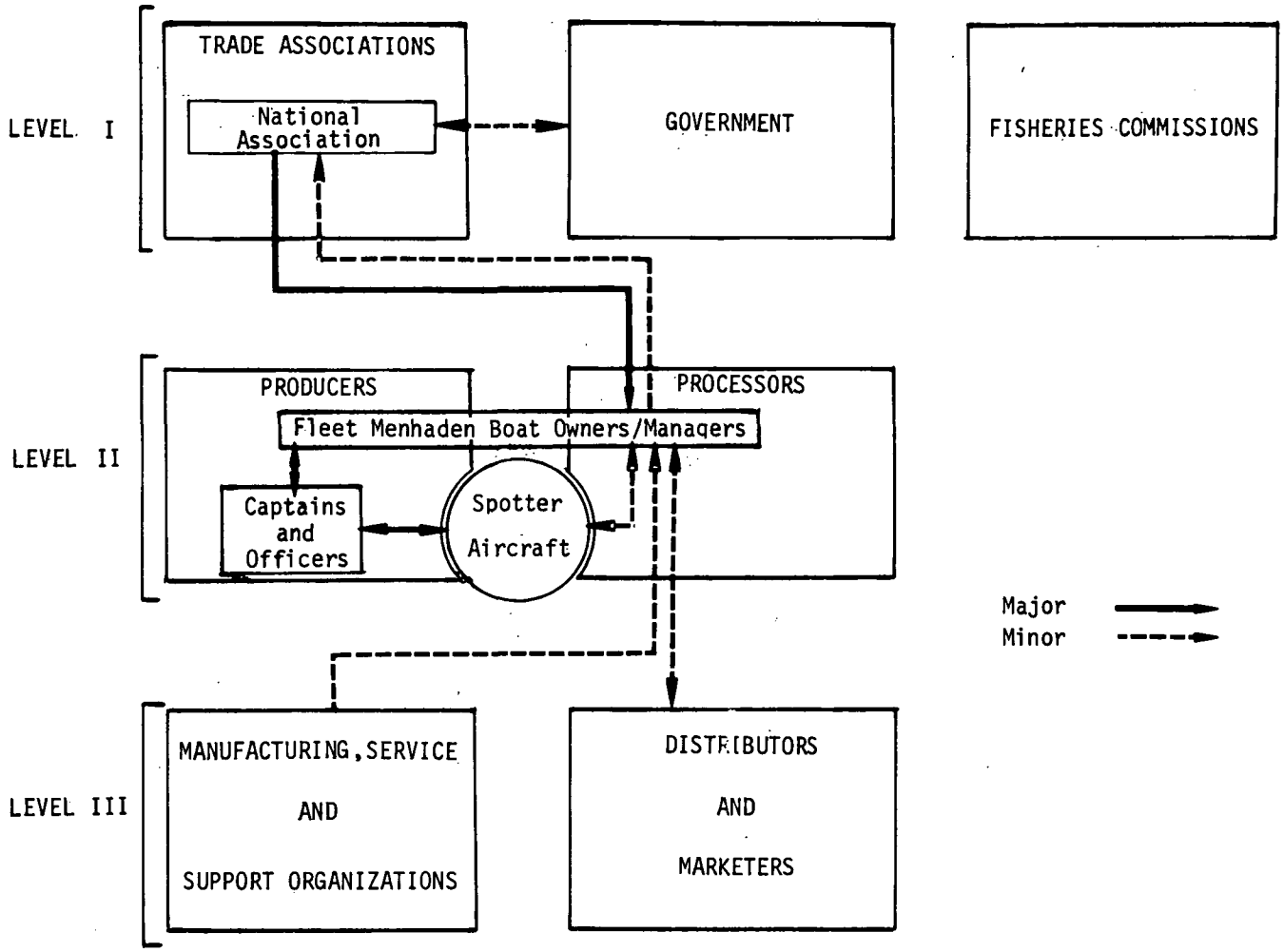

Figure II-10. Principal Communication Channels in the Atlantic and Gulf Menhaden Industry.

The major communication channel exists between NFMOA and the processors/producers. However, this channel carries mainly informal communications. On occasions when an item of interest to all NFMOA members appears in the newspaper or is called into the association headquarters by an interested member of the industry, the director of NFMOA will prepare a memo for distribution to members. This memo usually contains a discussion of only one subject. Bulletins are also occasionally prepared, which are concerned with legislation, various presentations that are going on, and items of interest regarding plans and programs of the NMFS.

Because of the unique common management of the processor/producer and, in one case, the spotter aircraft, we can identify two other major communication links: between the processor/producer management and vessel captains and officers and between vessel captains and spotter pilots. The latter communications are highly informal and usually take place in planning daily operations or carrying out fish location or net placement activities. Spotter aircraft search out the surface fish schools and report their locations to the vessel captains. Usually, one aircraft works with two vessels. However, because of the competitive nature of the industry, the better vessel captains usually work with the better spotter pilots, in which case there is a sharp contrast between the success of the two sets of teams.

Evaluation

The tight organizational structure of the menhaden industry makes it stand out in terms of the effectiveness of internal communications. However, as with other fisheries, there are relatively minor communication links between the industry and the federal and state governments.

The NFMOA generally provides the interface between the government and the industry, but a certain amount of reticence on the part of both industry and government, developed over a number of years, prevents a smoothly continuing dialogue from being developed. This communication link is also the prime candidate for a communication feedback channel.

We found the menhaden fishery, in general, to be one of the most knowledgeable in regard to understanding the potential impact of remote sensing. This is due to, first, their intimate involvement with spotter aircraft, which is essentially a basic remote sensing system, and, second, the high degree of competence, capability, and progressiveness of members of the industry. The industry has expressed a genuine interest in becoming involved in remote sensing programs which would be of direct benefit to the industry as a whole. A specific demonstration of this interest has been reflected in the formation of a "remote sensing" subcommittee of the NFMOA. This subcommittee is charged with ascertaining the potential applications of remote sensing to the menhaden fishery. It is apparent that this industry is ready to step ahead and determine what this tool means in improving harvesting efficiency.

Gulf of Mexico Shrimp Industry

Background

The U. S. shrimp industry consists of two major segments and resource areas: the southern fishery, extending from North Carolina around Florida to Texas, and the northern fishery, which includes the coastal waters from northern California to Alaska on the Pacific side and the Maine-Massachusetts coastline on the Atlantic side. Three species of shrimp are of principal importance in the Gulf of Mexico, the major segment of the southern fishery:

- White shrimp - *Penaeus setiferous*
- Pink shrimp - *Penaeus duorarum*
- Brown shrimp - *Penaeus aztecus*

Fishing Grounds

The Gulf shrimp fishing grounds extend along the Gulf of Mexico, from northern Mexico to the Dry Tortugas. White shrimp are most abundant in the north Texas to Alabama region, with heaviest concentrations in the Mississippi River delta area. Brown shrimp are most abundant in the Texas coastal region, while pink shrimp are found primarily in two small areas, extreme south Texas and the Dry Tortugas. In general, the fishing moves around the Gulf, occurring off Texas and Louisiana during summer and early autumn and off southern Florida in winter and early spring.

U. S. Production

The U. S. is the principal shrimp nation in the world. It produces more shrimp than any other country and is the major world market

for foreign imports. The Gulf shrimp fishery produces about 200 million pounds live weight annually. Apparent consumption of shrimp in the U. S.in 1969 was 330 million pounds of processed shrimp. This consumption is expected to reach nearly 400 million pounds by 1975.

The total value of all shrimp produced in this country in 1958 was nearly $123 million, one quarter of the total dollars paid to U. S. fishermen for all domestic species of finfish and shellfish.

Vessels and Gear

Shrimp-fishing techniques used in most of the world today are styled after the methods developed in the southern fishery. At the present time, virtually the entire American catch of warm water shrimp is made by shrimp (otter) trawls. The most common shrimp vessels are the "Florida-type" boats. They are generally constructed of wood or steel, are 40 to 85 feet in length, are powered by 150-200 horsepower diesel engines, and carry a crew of three. Almost all vessels carry ice as a coolant. They stay at sea from three days to two or three weeks on each trip.

Organization of the Fishery

The Gulf shrimp industry can be characterized as a series of geographically isolated facilities utilizing the same geographically broad resource. To illustrate, the major shrimp ports and processing facilities are located in Brownsville, Aransas Pass, and Galveston, Texas; the Louisiana delta area; and Tampa, Fort Meyer, and Key West, Florida. Yet, the majority of vessels from all of these ports follow the seasonal progression of the resource around the Gulf, fishing off Texas and Louisiana during summer and early autumn and off southern Florida in winter and early spring.

In addition to the fleet maintained at each port, there are "producers"* and processors there, as well. Brokers handling the distribution of the product are generally remote from the fishing area. In the context of shrimping operations, "producers" are distinct from the catching operations and, in fact, act as intermediaries between those who catch and those who process. Fish houses and cooperatives are synonyms for "producers"; however, "producers" tend to be corporate entities, while fish houses and cooperatives tend to be a cooperative venture of a number of independent vessel owners. These relationships will become clearer in the following paragraphs.

Producers

There are an estimated 2,500 high seas shrimp vessels fishing out of American ports in the Gulf of Mexico. Approximately half of these are individually owned and operated; the remainder are fleet owned and operated. These latter vessels are owned by "producers"; few, if any, processors own vessels. Those vessels which are not company owned fish either under a cooperative arrangement or exclusively for a company. A few vessels sell to buyers of opportunity. Frequently, a vessel will have a working arrangement with a "producer" or cooperative in several ports. Under neither arrangement do the companies or cooperative officials have any control over where the vessels fish, how long they fish, or, in an absolute sense, where they will sell their catch.

When the shrimp vessel leaves the dock, the captain will generally decide where and when to fish. Very little contact is made between the shrimp vessels at sea and the "producers", except in cases of emergency

* For the sake of clarity, this special case of producer will be placed in quotations. References to producers in the normal sense will not be placed in quotations.

or when the boats are coming to port. This contact is made by ship-to-shore radio while at sea and orally in port. Most large companies have fleet managers or "pushers" to supervise their captains. Each captain hires his own crew and supervises their activities. Thus, the crews are even further isolated from shore personnel.

Processors

The "producers", which are either private companies or cooperatives, act as an intermediary between the boats and the processors. They accept the raw shrimp from the boats, generally buying them outright, grade them according to species (white, pink, brown) and size (number to the pound), and then sell them, headless, on ice or frozen, to the processors.

The processors buy from the "producers" and process the shrimp into a marketable item. Two types of arrangements exist at this point. First, by longstanding agreement, a processor buys a "producer's" entire output as fast as it is available, paying the current going rate. Alternatively, the processor or "producer" shops around and buys/sells for the best price. All of these functions are carried out orally by phone; a man's word is his contract, and there are no written contractual agreements.

Trade Associations

There are a number of associations to which members of the industry belong, and these operate at all levels, from local to international. These associations tend to be activity oriented, with one set existing for vessel and "producer" oriented individuals and another set for processors. Frequently, individuals belong to local as well as regional associations and some interdisciplinary memberships do occur.

Relevant Organizations

In the Gulf of Mexico, there is little or no local government involvement in shrimping operations. Likewise, shrimp are not affected by international treaty, so there is no federal regulation and no involvement with international commissions. All regulation is manifest at the state level.

Each state government is responsible for regulating the fishery over its coastal waters, and each has an agency mandated to do so. These activities are coordinated by the Gulf States Marine Fisheries Commission, which, in addition, recommends the opening and closing fishing season dates and coordinates all federal, state, and university research. These activities, however, are all remote from the daily activities of the fishery.

The National Marine Fisheries Service Laboratories at Galveston, Pascagoula, and St. Petersburg and several Gulf universities conduct research on shrimp, but most researchers are generally remote from the day-to-day operating component of the industry. The technicians involved with gear research and development are generally exceptions to this situation.

Both the state and federal governments have health regulations applicable to the handling, processing, and shipment of shrimp, but these activities are also remote from the day-to-day fishing operations.

Communications

In order to effectively address communications in the Gulf of Mexico shrimp fishery, it is necessary to examine trade associations at the local level and build to the state and regional level (Figure II-11). Conversely, a more detailed account of vessel-"producer"-processor

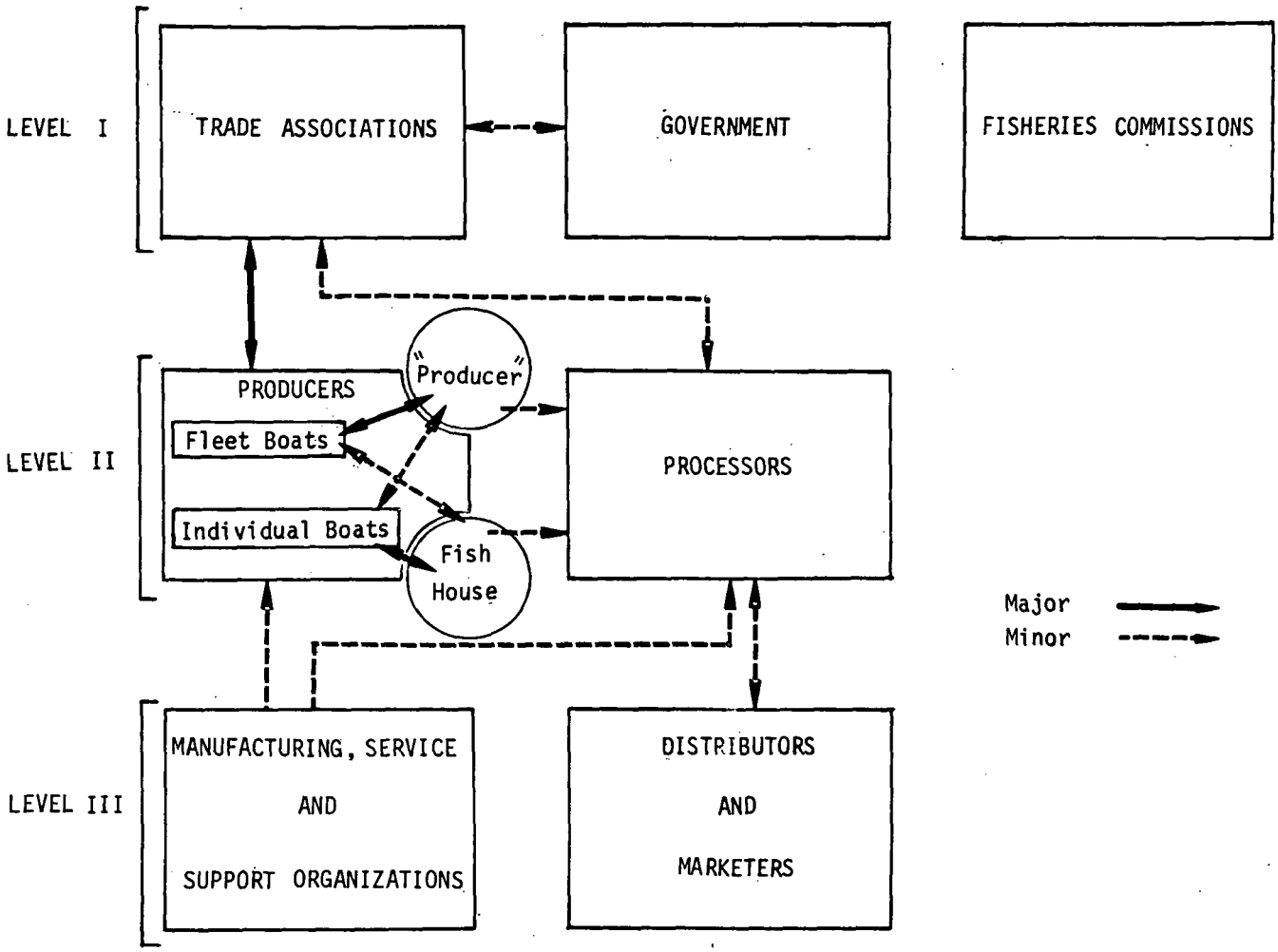

Figure II-11. Principal Communication Channels in the Gulf Shrimp Industry.

relationships, as well as government relationships, will suffice for the entire area. The vertical communication link (level II to I) between producers, processors, and trade associations and the level II link between producers and processors constitute the major communication paths identified in the Gulf shrimp fishery.

It should be emphasized at this time that, regardless of the ownership or allegiance of a vessel, once it leaves the dock all fishing-oriented decisions are the captain's. Therefore, the only communications between the vessel and shore facilities, whether the vessel is at sea or ashore, involve resupply, maintenance, and weather. The captain gains fishing information primarily from other captains already fishing, from intuition, and by use of a small "try" net which is used to prospect for harvestable concentrations of shrimp. The only other regular discussions between a vessel and shore facilities involve price for the catch on the return to port. Between producers and processors, the information exchanged is almost exclusively financial, dealing with the day-to-day price of the raw product. Communications between vessels and the "producers" and processors are on a daily or more frequent basis, although those between vessel and shore tend to be dependent on the vessel's needs.

Information exchanged between NMFS and the industry is on an irregular basis and tends to involve gear or biological research, depending on the mission of the local lab. In St. Petersburg, Florida, the representative of the office of loans and grants maintains close contact with all segments of the industry. The economics, statistics, and market news branch is the only one with regular dockside contact, but information flows almost entirely in one direction, from the vessel to the NMFS.

In the State of Texas, there exists, at present, a very strong

shrimp association, which is divided into a number of local associations. Of these, only the Brownsville-Port Isabel Shrimp Association takes an active role. This may be due, in part, to the fact that both it and the Texas Shrimp Association are run from the same office by the same individual. The Brownsville-Port Isabel association meets monthly and has an irregular program of invited speakers on a variety of subjects of interest to the fishery. One of these speakers in the recent past was Dr. R. S. Stevenson, formerly of the NMFS. His presentation on interpretation of orbital photography was well received and constitutes the sole exposure of most individuals in this area to remote sensing.

The membership of the Texas Shrimp Association, as well as that of the various local associations at the other shrimp ports in Texas, is composed primarily of vessel owners and operators and "producers". Few processors belong, as most join their own associations, such as the National Canners Association. The Texas Association meets annually, but the present executive secretary takes an extremely active role, publishing a bulletin biweekly. The board of directors of the state association meets four times a year. Other local associations within the Texas association are located in Aransas Pass, Freeport, and Galveston. These are much less active than the local Brownsville association and meet only infrequently.

The state association in Louisiana is, at present, in a relatively inactive mode, as few vessel owners, operators, or "producers" have maintained membership. This association meets annually, but the few remaining members are processors. This is in contrast to Texas, where few processors belong to the association. Due to its inactive status, it is difficult, at this time, to estimate the role of the Louisiana

Shrimp Association as a communication pathway to the fishery in Louisiana.

Neither Alabama nor Mississippi support a large shrimping operation, so there are apparently no local shrimp associations in these states.

The Southeastern Fisheries Association draws its membership from members of the various fisheries in the southeastern states. However, its primary membership is drawn from Florida and includes a majority of the individuals in the shrimp industry there. The association meets twice a year. It is divided into 15 regions, of which 12 are in Florida; each region meets at least annually. Before each convention, the executive secretary publishes a bulletin recapping events of significance since the last meeting. In addition, the executive secretary publishes a monthly newsletter which contains items of interest or importance to the membership.

There are several national and international associations which represent shrimp directly, such as the National Shrimp Congress and the International Shrimp Council, and fisheries in general, such as the National Fisheries Institute. The first of these has the state associations, rather than individuals, as members and is primarily concerned with the impact of international law on shrimp operations in international waters. The second functions solely to promote shrimp to the general public. None of these maintains real time contact with the fishery, as none are actually involved with operational activities.

Most of the trade journals associated directly with the commercial fishing industry reach the shrimp fishery in large numbers. Of these, Fish Boat and Fishing Gazette seem to be the most widely read.

Evaluation

In the preceding section, a major pathway was identified as existing between the processors, producers, and trade associations. However, certain differences exist from state to state which require further elaboration. The executive secretary of the Texas association indicated that much of the communication was unidirectional, from association to membership. Thus, a viable pathway exists for transferring information to a large fraction of the producer segment on a frequent basis (the biweekly newsletter). However, some enhancement of this pathway will be necessary to provide a feedback link, and some adjustment or innovation will have to be made to draw the processor segment into the communication loop.

In Florida, the Southeast Fisheries Association has a significant representation from both the producer and processor segments of the shrimp fishery. This association also publishes a monthly newsletter that would suffice for transmittal of information to these individuals. The feedback loop in this association would also have to be strengthened when significant feedback began to be required. Alternatively, the feedback link might by-pass the association if this was the more expedient method.

Communication with the shrimp industry in the State of Louisiana presents a more difficult problem. Its shrimp association is not active, and reaching these fishery members may involve creation of a new communication pathway. One method of initiating such a measure, which might simultaneously involve the lesser operations in Alabama and Mississippi, would be to work through the office of the executive secretary of the Gulf State Marine Fisheries Commission. The executive secretary of this

commission is an extremely active, involved individual who knows quite well a large number of the fisheries personnel from these states. With his help, bidirectional communications similar to those in Texas and Florida might readily be initiated.

Alternate communication channels may be identified, as in other fisheries, through NMFS regional and local laboratories or through Sea Grant extension services currently under development at several Gulf universities. Further elaboration on these potential communication channels will be found in the "Federal Government Communications" section.

The degree of remote sensing awareness varies greatly among the members of the shrimp industry. Most people interviewed were at least perfunctorily acquainted with the techniques, if not the term. Particularly in south Texas, where Dr. Stevenson, working out of the NMFS Galveston Laboratory, had addressed a meeting of several of the local associations, knowledge of photo interpretation potential was widespread. A few individuals in south Texas were vaguely aware of instrumentation possibilities. This generally reflects, also, the awareness of industry personnel in the rest of the Gulf area; either they were not familiar with remote sensing or they had been exposed to space photography. A few individuals were well acquainted with the general types of instrumentation available and their limitations for producing useful data. Nearly everyone with some knowledge of remote sensing felt that such data would not contribute to the operational aspects of shrimping, because the fishery acts on the adults, which are demersal. However, the majority of these people also felt that, because the larvae are planktonic and, as such, dependent on surface current, data acquired by remote sensing techniques would contribute greatly to predictive capabilities.

U. S. Tuna Industry

Background

The U. S. tuna fishery is perhaps the most complex fishery examined, due primarily to the nearly world-wide distribution of the fishing grounds, the diversity of types of fishing vessels, the variety of species captured, and the size of the companies involved in the fishery. Tuna is the second most valuable fishery in the U. S., surpassed only by shrimp.

Tuna are marketed as white or light meat product. Albacore (Thunnus alalunga) is the only species of tuna that can be sold as white meat. Yellowfin (T. albacares), skipjack (Katsuwonus pelamis), three species of bluefin (T. thynnus, T. maccoyii, T. tonggol), bigeye (T. obesus), blackfin (T. altanticus), little tuna or black skipjack (Euthynnus alleteratus), juvenile bluefin, and yellowfin, as well as albacore under certain conditions, are sold as light-meat tuna. However, the major portion of the light meat pack utilizes yellowfin and skipjack as the raw material.

Once many of the species listed above reach a certain size, the meat becomes dark in color and generally unacceptable to the U. S. consumer. Fortunately, the dark meat is highly regarded in the Japanese and European markets.

Fishing Grounds

The fishing grounds for tuna are nearly world-wide, in temperate and tropical waters. Excluding albacore, which is primarily a temperate water species, the major fishing grounds for the U. S. fleet are located off the west coast of the Americas, from southern California

to Chile, offshore in the eastern Central Pacific, off New England, and in the eastern Tropical Atlantic. The western Pacific is considered by many to be the largest and least exploited of the tuna resource areas and can be expected to receive increased attention in the near future.

U. S. Production

The U. S. is the world's major market for tuna and presently utilizes nearly 50 percent of the world catch. The U. S. industry currently markets about 25 million cases (48 half-pound cans per case) each year, valued at $480 million at the retail level. Production of tuna on a world-wide basis increased at the rate of 6 percent per year during the 1950's and early 1960's. Since then, production has continued to increase, but at a lower rate.

Albacore brings the highest price of all tuna and generally sells in excess of $100 per ton above comparable sizes of yellowfin tuna. Following albacore, the value of the other species landed for light meat tuna is somewhat variable and dependent on the size of the fish, product yield, quality of the meat,and labor costs during processing.

Vessels and Gear

Tuna are captured by five basic types of gear; longline, pole and line, purse seine, trolling,and traps.

A unit of longline gear consists of a series of about 2,000 hooks attached by wire leaders to a very long mainline ($\pm$ 50 miles). At the beginning of each fishing day, the hooks are baited with fish (usually saury) and the mainline, with the leaders and hooks attached

at equally spaced intervals, is let out while the vessel steams ahead through potential fishing waters. The mainline is buoyed and weighted so that it fishes in the subsurface feeding grounds (about 300 feet) of the large, deep-swimming tunas. Only one set and retrieval of a unit of gear is made by the vessel each fishing day. The work is arduous, and this technique has been applied successfully only by Japanese, Korean, Taiwanese, and Okinawan fishermen, although many other nationalities have attempted to develop longline operations. The world catch of tunas by the longline method has remained relatively static since 1962 at a little over 440,000 tons per year or about 45 percent of the world supply of albacore and light meat tunas.

Pole and line fishing is employed extensively in Japan and in numerous small vessel fisheries around the world. It was the major method employed in the U. S. until 1960 and is still in use to capture albacore. The pole and line vessels carry live bait, which is thrown out to attract surface schools of tuna near the vessels. A barbless hook is attached by a wire and rope leader to a bamboo pole. The men fish along the side and stern of the vessel, singly or in groups of two or three, depending upon the size of the fish in the school.

A substantial share of the world catch of tunas (about 357,000 tons) is made by pole and line vessels using live bait and fishing on the surface schools of tuna. Although this method has been largely superseded in the eastern Pacific yellowfin and skipjack fishery, it is still the major method of harvesting surface schools in the central and western Pacific, where the very deep mixed layer of water at the ocean's surface and the high degree of water clarity make it difficult to capture surface schools by purse seine.

Purse seine fishing utilizes a long and deep wall of webbing (about 3,600 by 360 feet) to encircle surface schools of tuna. The escape route to deeper water is cut off by drawing the bottom of the net together through closing,in thè same manner as drawstrings are utilized to close a purse. The gear is not efficient on large schools of surface tuna in ocean areas where the sharp temperature gradient is shallow and where the water is turbid. Purse seine fishing assumed a minor role in the production of tunas until the early 1960's. At that time, the introduction of nylon nets, power blocks,and other improvements in gear handling and fishing techniques in the U. S. fleet greatly increased gear efficiency. All suitable baitboat hulls were quickly converted for purse seine fishing; this was followed by the conversion of military hulls to purse seiners and,finally,in recent years, by the boom in new construction. At the present time, about 275,000 tons of tuna are captured by purse seine gear.

The remaining two methods, trolling and trap fishing, account for a very small percentage of the world catch of tunas. Trolling is employed mainly for albacore and trap fishing for bluefin.

Following a period in the late 1950's and early 1960's when supply far exceeded demand, the tuna fishery is now in a position where demand exceeds the available supply. Thus, the domestic fleet is currently expanding, and the vessels that are being added to this fleet are the largest, most modern purse seine vessels in the world. In 1970, 13 new purse seiners with a total capacity of 13,600 tons were added to the fleet.

Organization of the Fishery

The size and development of the U. S. tuna industry has brought about a rather complex organizational structure. The processing and marketing segments of the industry are quite mature, with essentially only eight companies involved. Three of these have garnered over 50 percent of the U. S. market for tuna.

The fishery operates principally out of San Diego and Terminal Island (San Pedro), California and Ponce and Mayaquez, Puerto Rico. The major companies, however, have facilities located adjacent to the majority of the principal fishing grounds.

The high level of sophistication of the U. S. tuna industry is due to the scope of its activities both ashore and at sea. This includes a close association with the universities and research institutions.

Producers

A small amount of yellowfin and skipjack is taken on occasional trips by the albacore bait fishing fleet, small vessels that operate out of California, Oregon, and Washington ports. In addition, there are currently ten larger bait boats (less than 150 tons) which fish yellowfin and skipjack on a regular basis during the off-season for albacore.

The present purse seine fleet (excluding small albacore boats) includes 122 vessels with a capacity of 56,460 tons. Thirty-nine seiners with a capacity of 31,460 tons have been built since 1961. It is estimated that 18 new seiners with a capacity of 18,000 tons will enter the fleet in 1971 and 1972.

The smaller, individually-owned fishing vessels are usually

managed at sea and on the shore by the vessel captain. The larger vessels are managed at sea by the vessel captain, and shore activities are usually directed and coordinated by the managing owner. The managing owner is usually a successful captain who has retired from active duty or a business man who has been associated with the fishing industry through an allied industry, such as grocery supplies, fuel, ship repairs, fishing supplies, or insurance, and who has acquired a financial interest in the vessel.

Each large tuna vessel is generally a separate corporation made up of the managing owner, vessel officers, private and/or company financiers, and a processing company. The latter is involved in a loan or equity position to insure first access to the catch for processing. Westgate California Foods, who has tuna processing plants in California, Oregon, and Puerto Rico, owns and operates 13 medium-sized purse seine vessels through its wholly owned subsidiary, National Marine Terminals in San Diego. It also operates two refrigerated carriers, which are employed in the transportation of tuna from distant grounds to their plants in southern California.

Processors

Eight major processors can be identified in the U. S. tuna industry:

- Star-Kist Foods
  Owned by H. J. Heinz of Pittsburgh, it has tuna-processing plants in Terminal Island, California; Mayaquez, Puerto Rico; and American Samoa. In addition, it has fishing operations and freezing and storage stations in Paita and Coischo, Peru and Tema, Ghana, as well as financial participation in freezing and storage operations in Pointe Moire, Congo (Brazzaville).

- Van Camp Sea Food Company
  Owned by Ralston Purina Company, St. Louis, it shares market leadership equally with Star-Kist Foods. Van Camp has tuna-processing plants in Terminal Island, California; Ponce, Puerto Rico; American Samoa; and Manta, Equador. In addition, it has fishing operations and freezing and storage facilities in Palau, Western Caroline Islands. It also has financial participation in the freezing and storage facilities in Freetown, Sierra Leone, Abidjan, Ivory Coast, and St. Martin's.

- Westgate California Foods
  Has tuna-processing plants in Terminal Island and San Diego, California and Point Adams, Oregon and is presently constructing another plant in Ponce, Puerto Rico. As indicated previously,it also owns and operates a number of purse seine vessels through its subsidiary,National Marine Terminals,in San Diego.

- BumbleBee Sea Foods
  Owned by Castle and Cooke, Inc., of Hawaii. They have tuna-processing plants in Astoria, Oregon, Cambridge, Maryland, and near Honolulu, Hawaii. It also operates one large purse seine vessel based at Astoria, Oregon.

- Delmonte Corporation
  Has a tuna-processing plant in Mayaquez, Puerto Rico. It operates three large purse seine vessels, which are based there.

- C. H. B.
  Has a tuna-processing plant in Terminal Island, California.

- I. B. E. C.
  Operates a tuna-processing plant in Mayaquez, Puerto Rico.

- New England Fish Company
  Based in Seattle, Washington, it has a tuna-processing plant in San Juan Islands.

C. H. B., I. B. E. C., and New England Fish Company are all relatively minor elements in the tuna business, although the New England Fish Company has major interests in other segments of the seafood business.

Trade Associations

The tuna industry is represented at all levels by national and regional associations and cooperatives and unions. At the national level, the National Canners Association (NCA) represents the processing segment of the industry. All the tuna canners except C. H. B. belong to the National Canners Association.

The producers are represented at the national level through the executive directors of the American Tuna Boat Association (ATA) and Tuna Research Foundation (TRF) and through paid representatives of both associations stationed in Washington, D. C. There is also interaction with the processors and their national representative, the NCA.

At the regional level, processors have a very strong trade association, Tuna Research Foundation (TRF). Star-Kist, Van Camp, Westgate,and Delmonte belong to TRF. The executive director of TRF, like many of his peers in the industry, is capable and highly regarded.

TRF also has a Sacramento, California office to which the producers are represented by three regional associations:

- The American Tuna Boat Association (ATA)
  Represents the owners of larger purse seine tuna vessels. The general manager of ATA has been actively involved in industry problems for years.

- American Tuna Sales Association (ATSA)
  A consortium of vessel owners who have established an "auction" to negotiate prices with the processors. ATSA handles no fish as such; it is only involved with price negotiations for the light meat species.

- Western Fishboat Owners Association (WFOA)
  An organization encompassing about 500 of the smaller vessels (no large seiners) of the fishing fleet in Washington, Oregon,and California. WFOA is divided into three districts,with one director for each district. The main offices in San Diego are run by a general manager, a highly regarded, tough, but fair,

representative of the smaller vessel owners. WFOA represents about 80 percent of the total tonnage of the non-purse seine fish boats in the three states. They negotiate with the processors for the local albacore price.

Three unions can be identified which represent the workers in the canneries and aboard the vessels.

- Fishermen's and Canners Workers Union (San Diego)
- Fishermen and Allied Workers (Terminal Island)
- Seine and Line Fishermen's Union (San Pedro)

The executive secretaries of the unions are all well known and represent their members at many of the federal and state meetings.

Relevant Organizations

There are two international treaties and their respective commissions which affect the tuna industry: the Inter-American Tropical Tuna Commission and the more recently formed International Commission for the Conservation of Atlantic Tunas. As discussed previously, these commissions deal with research and management of the tuna stocks in their respective areas.

Universities interface with the tuna industry principally at the regional level. The nature of tuna research has led to a closer bond between the universities and the tuna fishery than between the universities and other fisheries. This is particularly true with respect to albacore, where the environmental-fishery relationship is of primary interest in locating the fish.

The National Marine Fisheries Service Laboratory at La Jolla, California,has demonstrated concern for such environmental-fish problems by providing a particularly useful device in the form of in-season, biweekly sea surface temperature (SST) charts covering the

eastern north Pacific, which are prepared for, and distributed to, the albacore fleet and monthly SST charts covering the entire north Pacific, which are distributed to the entire tuna fleet. This year, in addition, NMFS is placing FAX machines on selected U.S. tuna vessels to receive weather and temperature charts while away from home port on a regular basis. This pilot program is expected to generate real time feedback of environmental data.

A new program currently under development on the west coast, which may have major impact on the communications between the government and the tuna fishery, is the Sea Grant Advisory Service, principally centered at Oregon State University. For the past two summers, this university has established a program to disseminate to the albacore fleet information on SST and other data obtained from vessels, aircraft, and satellite platforms. This program is expected to expand, and, with the addition of extension capabilities, the Sea Grant Advisory Service is expected to encompass the entire west coast. This advisory service has been discussed in detail in the section on "Federal Government Communications".

Communications

The regional associations and cooperatives provide the major communication links between the government and the operating units of the U. S. tuna industry (Figure II-12). Because the Tuna Research Foundation is supported by four of the principal tuna processors, it can respond directly to these processors' requirements and needs and, as such, is in direct and close communication with the processors. The regional associations interface with the National Canners Association (NCA), but the communication link is not as solid as the one

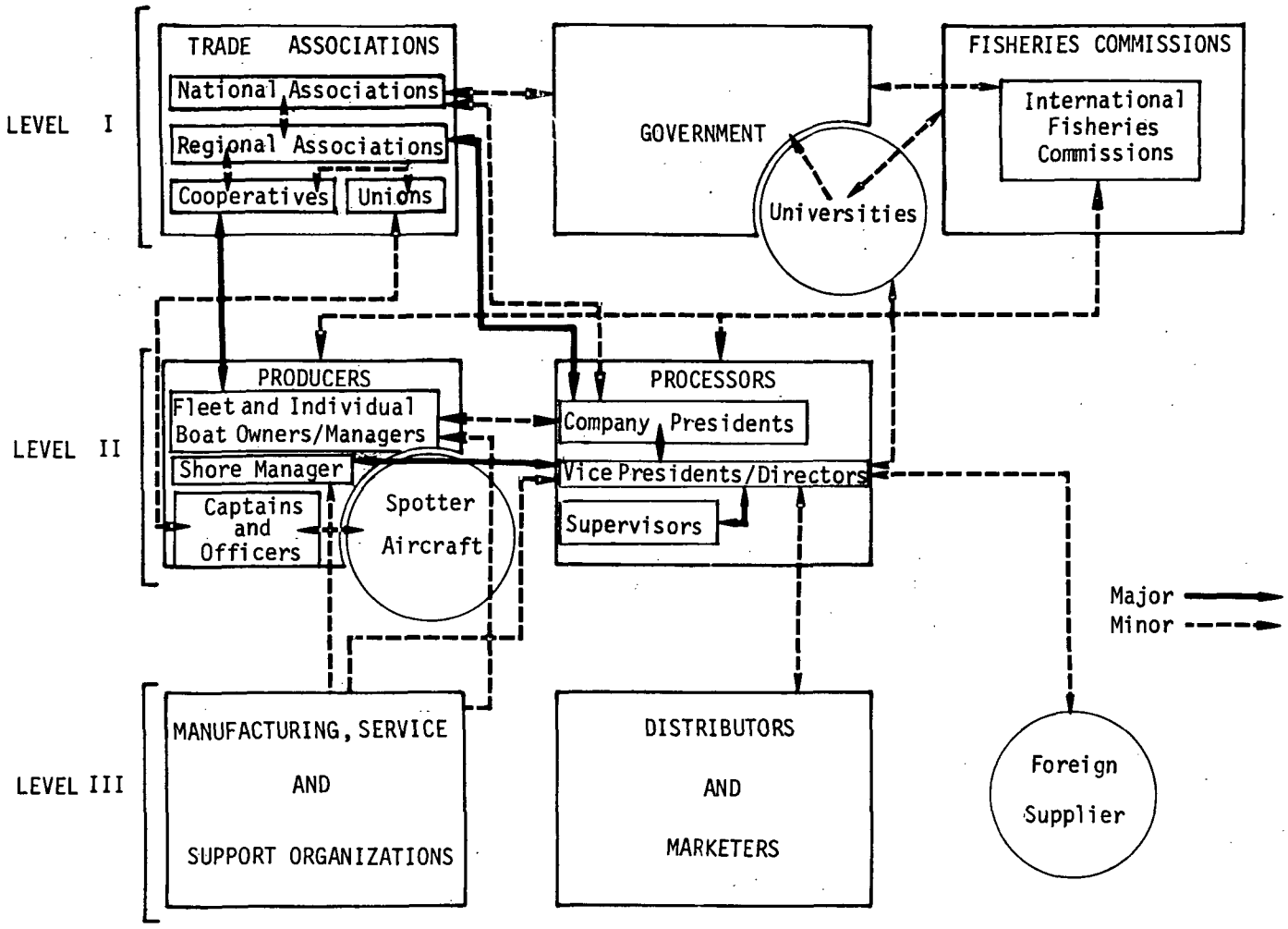

Figure II-12. Principal Communication Channels in the U. S. Tuna Industry.

between the processors and the regional groups. There is often direct communication between the processors and the NCA.

The communications between the trade associations and the government deal primarily with policies affecting the tuna industry. Because of the economic importance of the tuna industry, the national associations keep a watchful eye on government operations on behalf of the industry. The major companies are highly organized, and most have their own resident specialists in Washington, D. C. who represent the interests of the company.

One other major communication link is the one between the cooperatives and the producers and is principally a result of the active participation by the producers in the various cooperatives.

The managing owner of each vessel generally remains on shore and handles all the details of dealing with the processors and the vessel owners' association, as well as financing and the procurement of supplies. He talks by radio to his vessel's skipper regularly, generally two or three times per week. Fishing information obtained on the waterfront is passed to the vessel, and fishing results are relayed ashore, usually in a special code to conceal the vessel's activities. In addition to talking to his managing owner, the vessel skipper will communicate with vessels in his code group of vessels and exchange fishing information in code each evening. Operational decisions are based on data obtained in the shore and vessel exchanges. These code groups are fluid, and members are added or subtracted as groups form and disband regularly.

No fishing information on a real time basis goes from a code group to a government or industry research agency. Vessels in dif-

ferent code groups may meet on the fishing grounds, where the skippers exchange information by talking directly to one another. Communications by radio would indicate to the others that group secrecy was being violated.

Company-owned vessels, such as the National Marine Terminal fleet, are operated in a less independent manner, and fishing skippers often have a larger share of the decisions made ashore. Fishing success by company-directed vessels is only average, at best, as some operational decisions are made for the convenience of the processing plant rather than to maximize fishing success.

Communications between processors and vessels at sea are limited and generally concern unloading schedules. Almost all of this is done through the managing owner. When the vessel is in port, communications usually flow from the company fleet department directly to the skipper and engineer. Almost all communications are oral.

Managing owners circulate daily on the San Diego and San Pedro waterfronts. Stops usually include the fuel docks, the shipyards, the unloading docks, the canneries, and the American Tuna Boat Association. Some managing owners and vessel captains visit the National Marine Fisheries Service and Inter-American Tropical Tuna Commission on occasion, usually to discuss tuna research as it affects the IATTC regulatory program. These research organizations publish their findings, and the processors, trade organizations, and a few vessel captains receive and read these publications.

A major share of the communication between research organizations and vessel crews is done by the former group's port contact staff. These people are the technicians of the research groups and seldom

have access to research findings or the training to transmit them to industry. A major share of the research people remain isolated from the fishing crew, as well as from the rest of the industry. Two exceptions are the IATTC staff who are involved in the regulatory program and the NMFS gear development specialists,who do maintain industry contacts because their work is directed toward industry assistance.

At the processor level,business and financial information is communicated in memoranda and report forms. The companies subscribe to the trade journals and receive research reports from NMFS and IATTC. Most receive the NMFS Fishery Market News Reports, so that notices or information of a general nature placed in the report do reach the industry.

A number of minor communication channels can be identified between the processors-producers and distributors and marketers, as well as manufacturing, service, and support groups. These, however, are of little or no concern to the description of the overall communications within the U. S. tuna industry.

Evaluation

The communication pathways that were identified in the preceding section are as highly developed as in any U. S. fishery. This results from the relatively high level of sophistication the U. S. tuna industry has developed since 1950 and the fact that it is the only U. S. fishery that fishes nearly world-wide. This degree of sophistication makes an evaluation and recommendation very straightforward.

Once information is made available to the trade associations, the major communication pathways provide for its dissemination. The

regional associations and cooperatives are likely to be the most effective points of contact for disseminating remote sensing educational information. The executive secretaries of the respective associations and cooperatives are, in general, capable individuals who have, without exception, expressed an interest in the application of remote sensing technology to the harvesting of tuna. Further, these major communication pathways are principal candidates for feedback links.

Two alternative communication channels can be identified: first, the multiple-link network from the NMFS regional office at Terminal Island, California through the Statistical Offices to the various production units; second, through the Sea Grant Advisory Service currently under development at Oregon State University. The advantages and disadvantages of both these alternative communication pathways have been previously discussed.

The degree of understanding of remote sensing varies greatly among the members of the U. S. tuna industry. Most of the key people we interviewed in the purse seine tuna fishery were aware of, or at least acquainted with, the technique, if not the term. In particular, the executive officers of Westgate California Foods, Van Camp Sea Food Company, Star-Kist Foods, and the Delmonte Corporation were as familiar with remote sensing applications to fisheries as anybody we interviewed in the industry. Furthermore, almost all key members of the trade associations had attended presentations by the NMFS or the presentations given at the annual Lake Arrowhead Tuna Conference.

California Wetfish Industry

Background

The California wetfish industry derives its name from the way the majority of the catch is landed (daily and pumped fresh or "wet" into the processing plants.) Jack mackerel, anchovy, sardine, bonito, bluefin tuna, and squid are generally considered to form the California wetfish resource base. The majority of the fishing effort is for jack mackerel and anchovy. Mackerel is canned for both humans and domestic pets,and anchovy is processed into oil. Bonito is canned for human consumption only.

The California wetfish fishery is a remnant of the once prolific and lucrative Pacific sardine fishery, which collapsed in the late 1940's and early 1950's from overfishing and competition from anchovy stocks that increased sharply as a result of the environmental regime that favored their survival over the sardines. At one time, this fishery also exploited Pacific mackerel, but this resource , too, has disappeared due to overfishing.

Fishing Grounds

Most of the fishing effort takes place immediately offshore of the San Pedro, California area. In season, several of the larger vessels will venture as far south as Baja California for yellowfin, skipjack and bluefin tuna,and bonito. The remaining vessels fish these species only during the limited time the fish are in close proximity to San Pedro.

U. S. Production

The present fleet derives its major income from jack mackerel and anchovy. During 1970 the jack mackerel landings were 23 thousand tons

valued at $1.8 million, and the anchovy landings were 86 thousand tons valued at $1.7 million. Bluefin and albacore tuna and bonito provide additional income of $0.5 to $1.0 million each year, depending on the availability of the fish and the needs of the canning industry.

The total population of anchovy off California and Baja California is estimated to range from 2.5 to 7 million tons; thus,the present fishery barely exploits this resource. A quota of 100 thousand tons has been imposed,and the lack of processing facilities has prevented a rapid expansion of this fishery. The fishing season is September through May or until the quota is reached.

Vessels and Gear

As presently constituted, there are about 25 active vessels in the California wetfish fleet. The vessels range in size from 40 to 165 tons carrying capacity. The larger vessels are equipped with brine spray refrigeration. At the present time, there are only six of these large vessels operating in the fishery. The small vessels fish mainly for jack mackerel and anchovy.

Four private spotter aircraft are currently being used by the California wetfish fleet. These planes fly out of Long Beach, Los Angeles, or Newport Beach, California. All California wetfish are currently caught with seine nets.

Organization of the Fishery

The organization of the California wetfish industry revolves around four principal processors, whose primary business is in tuna. Thus, in many instances, the California wetfish is the poor sister of the larger tuna industry.

Producers

All of the vessels in the California wetfish fleet are privately owned, and, in many cases, the owner is also the captain of the vessel.

The most strongly organized group in the industry is the Fishermen's Cooperative Association, which represents nearly all the vessel owners.

A minor element of the production component is the fish spotter.

Processors

Five major processors who purchase catches of the California wetfish fleet are:

- Star-Kist Foods
- Van Camp Sea Foods
- C. H. B.
- California Marine Packing and Curing (Westgate California, Inc.)
- Universal Packers Corporation

The first four processors deal primarily with tuna, and details of their operations are given in the previous section on "U. S. Tuna Industry". Universal Packers Corporation is a small operation that makes fish meal and oil from anchovy and cans cat food from jack mackerel.

Trade Associations

The principal trade association in the California wetfish industry is the Fishermen's Cooperative Association. The Association represents about 90% of the boats in the fishery. Only three boats in the area are not members of the cooperative.

The National Canners Association represents the processors at the national level.

There are no regional or local associations in the California

wetfish industry. The unions are similar to the unions that operate in the tuna industry.

Relevant Organizations

The State of California provides essentially all the regulation that is exercised over the California wetfish industry. Certain limits on landings of such species as anchovy have been established through the legislative process, using information supplied by the California Department of Fish and Game and fisheries statistics taken from the wetfish fleet and university research. The only international treaty which imposes any federal regulation upon the fishery does so for yellowfin tuna, which is a very minor element of the overall fishery. Yellowfin tuna are regulated through the IATTC.

Because the processors in the California wetfish industry are those that process tuna, many of the relationships that were discussed regarding the tuna industry also apply to this fishery. For example, the NMFS regional office is only a few miles from the principal port (San Pedro) where California wetfish are landed, and the executive secretary of the Fishermen's Cooperative Association has convenient access to the NMFS staff.

Communications

The Fishermen's Cooperative Association appears to provide the major communication channel between the government and the producers (Figure II-13). The executive secretary of the cooperative is well known and communicates regularly with all of the pertinent regional organizations. There appears to be little horizontal communication between the trade associations and the federal government. A minor amount of communication takes place between the National Canners

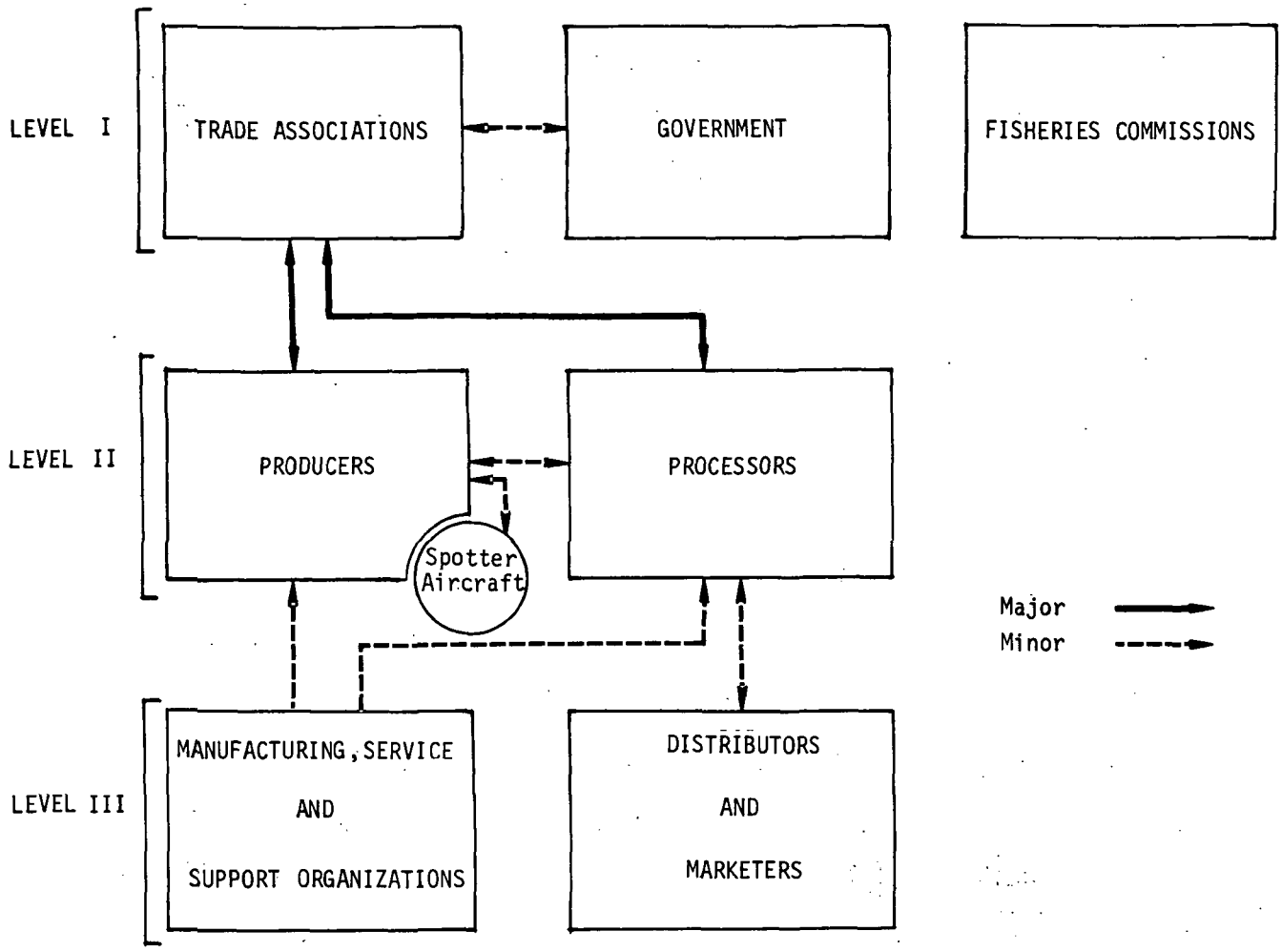

Figure II-13. Principal Communication Channels in the California Wetfish Industry.

Association and the Fishermen's Cooperative Association.

A second major channel of communication can be identified between the National Canners Association and the processors. Further discussion of this channel can be found in the "U. S. Tuna Industry" section.

A minor amount of communication takes place between the spotter pilots and the fishing vessels. These communications deal principally with day-to-day logistical problems of locating the fish.

Evaluation

Although the California wetfish industry encompasses a number of individual species, the geographic confines of the fishery allow a relatively simple identification of relevant communication pathways. The obvious focal point for reaching the operating units of the fishery would be the Fishermen's Cooperative Association; the executive secretary expresses interest in cooperating in any program that would ultimately benefit the fishery as a whole. We believe that this communication pathway would provide the maximum coverage to the production units, as well as a secondary (and redundant) pathway to processors. This secondary pathway would be in addition to definitive communication links that were identified for the tuna industry.

An alternative communication pathway can be identified as a multiple-link network from the NMFS regional office through the statistical office to the production units. The number of diversions in this pathway prevent assurance of uniform coverage to the production units.

As a feedback communications link, the Fishermen's Cooperative Association could provide an integration capability, as well as a relay point to NASA from the fishery. There is no parallel communication link to which a feedback link could be compared; thus, the potential effective-

ness of such a feedback link is unknown.

The degree to which the California wetfish industry is aware of potential applications of remote sensing data varies from component to component. The major processors (who are also the major tuna processors) have been exposed through meetings, publications, etc., to at least the basic concepts behind remote sensing. The degree of acceptance in this case is unknown. However, the production units, to the best of our information, have not been exposed to this type of advanced technology and, with the exception of the trade association, are not aware of its potential applications. Because of his key position in industry, the executive secretary of the Fishermen's Cooperative Association indicates a basic exposure, but not understanding, of such technology. It is apparent, therefore, that considerable education is needed before the California wetfish industry will fully appreciate the potential use of remote sensing in its operations.

Pacific Northwest Salmon Industry

Background

Five species of salmon, all members of the genus Oncorhynchus, form the bulk of the fish harvested in this fishery. All are anadromous fishes, laying their eggs in fresh water, from whence the juveniles migrate to sea and mature. The length of time spent in fresh water varies with species, but all reach maturity and accumulate the majority of their adult weight in the marine environment, where they migrate over thousands of miles during the maturation period. The period spent at sea also varies with species, lasting from 2 to 6 years, after which each adult returns to the stream or lake of its birth to spawn and die. Each fish breeds only once; the breeding season for each species is seasonal, contributing to the phenomenon of vast annual "runs" into restricted geographic areas.

The life history of the salmon is thus markedly different from that of other commercial species and results in salmon being infinitely more vulnerable to the whims of man. Man's impact on the coastal environment has drastically affected the salmon, exterminating it over much of its previous range, primarily by alteration of drainage basins. Salmon runs are subject to strict state, federal, and international control, so that, even though salmon are subject to intense fishing, this fishery is perhaps the most severely regulated of all domestic fisheries.

Fishing Grounds

Salmon are fished from Santa Barbara, California north to the Bering Straits. The phenomenon of "runs" into restricted geographical

areas has resulted in a local fishery having developed in each region where a major "run" occurs. There are approximately a dozen such major runs between California and the Bering Straits, over half of which are in Alaska. A center for processing is associated with most of these local fisheries. In recent years, 82 percent of the total catch was landed in Alaska, 12 percent in Washington, and the remainder in Oregon and California.

U. S. Production

Salmon is the third most valuable species landed in the U. S. Although total landings and, hence, dollar value have fluctuated over the last few years, the value of salmon to the domestic fisherman in 1969 was $54.7 million. The average value over the past five years was $61.6 million, exceeded only by shrimp and tuna.

Vessels and Gear

Three primary types of gear are used to fish for salmon: purse seine nets, gill nets,and trolling gear. The vessels bear the same designation as the gear used. Purse seiners and gill-netters are, by regulation, restricted to fishing in well-defined coastal waters. However, in recent years the netting gear has accounted for over 75 percent of the annual salmon harvest.

In 1967, more than 18,500 craft fished commercially for salmon. Of this number, nearly 5,500 were vessels; the remaining 13,000 were small boats. Most craft fishing for salmon are individually owned or owned in partnership. Few vessels are directly associated with a processor.

Organization of the Fishery

The salmon fishery operates from a number of ports, but the center of activity for the industry is in Seattle.

Producers

The production segment of the salmon fishery consists primarily of the three types of vessels described above. Each fishes a specific region, the gill-netters generally fishing in turbid coastal water and the purse seiners in clearer water. The distinction arises from the necessity for the purse seine boats to see the fish,whereas the gill-netters are fishing blindly. Trolling boats fish farther offshore, in the feeding grounds, and may or may not see the fish.

Processors

The salmon caught are sold directly by the vessel owners to the processors. Generally, a price is negotiated at the beginning of the season which stands for the duration of the season and is paid uniformly to all fishermen of one type vessel. That is, the seiners, the gill-netters ,and the trollers each negotiate their own price for salmon from the processors. For expediency, the processors generally own "tender" vessels. These make periodic trips between the fishing fleet and the shore facilities, taking the catch from the vessels for transport to shore and resupplying the fishing vessels with whatever supplies the vessels may require. This eliminates the necessity of the vessels returning to shore whenever they have filled their storage capacity for fish or depleted their supplies, such as water, fuel, and food. The canners themselves own about 25 to 30 percent of the fishing vessels. The remainder are privately owned vessels.

Trade Associations

The trade associations have a dominant role in the function of the salmon fishery. There is a local association representing each of the various types of fishermen, purse seiners, gill-netters, and trollers. For illustrative purposes, the Seiners Association, headquartered in Seattle, will be examined in detail. This association represents approximately 225 vessel owners and operators in all aspects of fishing. The association negotiates the preseason price that the processors will pay to the purse seine fishermen for the fish. The association also represents the owners by negotiating collectively with the crews to arrive at the share of the product price paid to the crews. Further, the Seiners Association, acting as a cooperative, purchases the necessary supplies for all of the vessels it represents, so that all of the materials normally required for a season's fishing are available to the membership at considerably lower cost than the owners could expect to pay if purchasing singly. Again acting as a cooperative, the association secures the necessary marine insurance for the vessel owners. Lastly, the Seiners Association takes an active interest in the proceedings of the International Pacific Salmon Fisheries Commission, as this commission regulates the Fraser River salmon runs upon which the seiners depend for a large portion of their catch in Puget Sound.

The gill-netters are represented either by the Puget Sound Gillnetters Association or the Grays Harbor Gillnetters Association. The trollers are represented by the Fishermen's Cooperative Association, Inc.

The majority of salmon processors who can salmon belong to the Association of Pacific Fisheries, which represents about 90 percent of the seafood canners in Oregon, Washington, and Alaska. The association

is primarily engaged in representing the interests of its members at the state and federal levels. Those processors marketing fresh and frozen products are similarly represented by their own associations. Other canners belong to the Northwest Salmon Canners Association.

Relevant Organizations

All four of the Pacific states, in whose waters salmon are fished, enforce severe restrictions on where, when, and how the fishing may be carried out. Further, each of the states supports extensive hatchery programs to help assure the continuity of the resource. Most now recognize the magnitude of the damage done to the resource and environment by drainage basin alteration, due primarily to dams and logging, and are attempting restoration of previous natural breeding grounds. All of these activities, as well as reproduction in the remaining natural spawning areas, require intense coordination and cooperation between the salmon fishermen and the state and federal governments. Implicit in this relationship are viable real time communications which will be explored in the next section.

The Pacific Marine Fisheries Commission strives to coordinate the regulatory and research activities of the state and federal governments.

Salmon fishing in the Northwest is subject to coordination by two international commissions. One, the International North Pacific Fisheries Commission, subscribed to by Canada, Japan, and the U. S., oversees high seas fisheries, primarily, and is therefore of concern to U. S. salmon fishermen only because the salmon fished on the high seas by Japan are the same ones later available to U. S. fishermen. The second commission, the International Pacific Salmon Fisheries Commission

(IPSFC), subscribed to by Canada and the U. S., is of direct concern to the domestic fishery, as it regulates fishing on the Fraser River runs in Canada. This run is the prime one fished by Puget Sound purse seine boats.

Many of the colleges and universities on the West Coast have research programs involving salmon, as do the state governments and the National Marine Fisheries Service. Most notable of the university programs is the Fisheries Research Institute of the University of Washington.

Communications

The trade associations form the focal point of communications in the Pacific Northwest salmon industry, and we can identify a major communication link between the associations and the processors and producers (Figure II-14). Communications between the trade associations and the processors are similar to those established by the executive secretary of the Association of Pacific Fisheries, who meets at least bimonthly with nearly all members and is in contact with those in Seattle almost daily. The association publishes an informal bulletin approximately once a month.

The communications between the trade associations and the producers (using the Seiners Association as an example) involve price negotiations, wage negotiations, purchase of supplies, purchase of insurance, and commission dealings and are funneled through the associations' officers and executive secretaries. This places these individuals central to nearly all operations in the industry.

The associations representing the gill-netters and the trollers interact in a similar manner with the processors, negotiating the pre-season price to be received by their respective fishermen. These

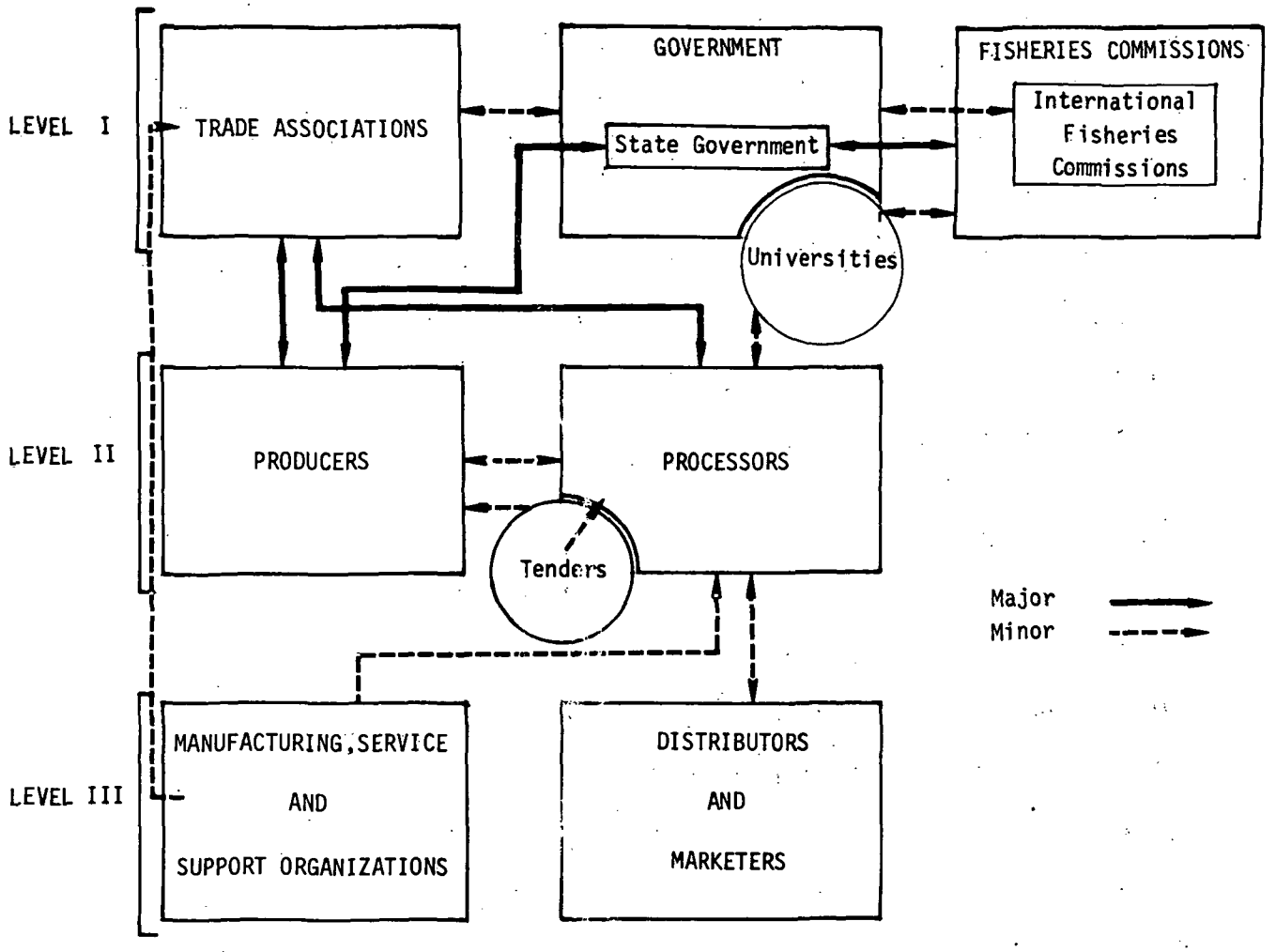

Figure II-14. Principal Communication Channels in the Pacific Salmon Industry.

latter associations may be less involved with the activities of their members, but, nonetheless, occupy a central position in the activities of these two groups.

Once a vessel arrives on the fishing grounds, the fishing decisions are entirely the captain's. However, where and when he fishes are closely controlled by the state in whose waters he is fishing. For instance, in Alaska each type of producer must secure a license to fish. For trollers, these licenses carry no geographic restrictions; however, for seiners and gill-netters, each vessel is licensed to fish in one geographic area only. The area is chosen by the owner or operator, but, once he is licensed for that area,he may fish nowhere else for that season.

Generally, the trollers fish on a hit-or-miss basis, trolling in areas where experience and intuition tell them the fish should be. Although these factors also play a part in where seiners and gill-netters fish, their operations are not nearly as random. Because of their life history, once salmon come onshore or into estuaries, their route of travel is easily predicted, so that gill-netters can simply place their nets across these routes. Purse seiners, on the other hand, being aggressive fishermen, sit athwart the routes waiting to sight the fish, at which point they run up on the fish and set their nets.

The methods employed by net boats and the number of available vessels would permit capture of nearly all the fish in a run if restrictions were not imposed. For all practical purposes, the only fish which reach spawning streams or lakes are those which are allowed to pass the fishermen. Thus, each state (or, in the case of the Fraser River runs, the IPSFC) not only sets a season for fishing, but also

maintains the prerogative of halting the fishing on any day for any period of time during that season. Before the season begins, it is determined how many fish must be allowed to reach each stream where spawning occurs, and the season is gauged accordingly. Each stream is watched as closely as possible, and, if enough fish do not reach that stream, the fishing will be halted over the migration routes to that stream. Thus, the states are in daily, one-way contact with the fishermen during the season and may halt the fishing in any area at any time for any length of time. These decisions are broadcast by civilian commercial stations, are published in newspapers, and are broadcast on ship-to-shore radio to the fishermen.

When the fishing is in progress, the fishing vessels generally remain on the grounds and, as indicated, send their catch back on tender vessels belonging to the processors, being resupplied at the same time. Salmon must be processed as soon after capture as feasible, so these activities require daily or near-daily radio contact between the fishermen and the processors and associations. The contacts are by radio and are, obviously, oral.

Other communications between the fishery and the state government, federal government, and universities also channel through the associations, tending to occur with less immediacy and more formality.

The Pacific Marine Fisheries Commission coordinates state activities in research and regulation and, during its meetings, provides a forum for exchange of information between fisheries scientists from industry, government, and universities. This exchange occurs by virtue of the commission's advisory committee on science and research, which meets annually in subgroups by fishery.

Evaluation

Of the various communication pathways examined in the preceding discussion, those involving the trade associations would seem to be the most pertinent. The associations are central to most of the long-term activities of the salmon fishery and are closer to the daily occurrences (Level II communications) than in other fisheries. The producers belong to one of several cohesive trade organizations and the processors to another. These associations would provide a center for coordinating the initial output of information to the personnel involved, as well as ultimately acting as the feedback communication channel to NASA, through which the salmon fishery's needs could be expressed. Again, the central position occupied by these associations in the activities of the industry puts them in a unique position to coordinate this fishery's communications to NASA. Eventually, the responsible individuals within these associations may well be the ones who will contribute most to the coordination of NASA planning activities.

An alternate, and perhaps politically more expedient, choice might be to coordinate activities through the regional NMFS office in Seattle. The associate director of that office has been quite successful in his efforts to reach the local industry members through frequent phone calls and bimonthly, no-host dinners. With his cooperation, these irregular contacts might be developed into more regular iterative sessions providing feedback to NASA based on the educational information distributed to these people.

Another alternative is provided by the Sea Grant Advisory Service currently under development. This alternate communication channel is discussed in detail under "Federal Government Communications".

Most of the industry personnel contacted indicated they were acquainted with remote sensing, although further questioning indicated this familiarity was very shallow. Most had been exposed to cursory interpretations of Gemini and Apollo photography; few realized that sophisticated instrumentation was available. Opinions on the utility of remote sensing techniques ranged from those who could see no applicability to others who visualized an input into predictive models. None indicated a place for operational use of remote sensing data. These opinions were based on a meager knowledge of remote sensing potential and would probably change on exposure to an appropriate cataloguing of instruments and data applications. However, we are of the opinion that those persons foreseeing an input into predivtive models showed considerable insight. For the salmon fishery, remote sensing will probably have more utility as a data feed to numerical modeling than to daily operational fishery routines.

Alaskan King Crab Industry

Background

Three species of the genus Paralithodes are fished as king crab in the far north Pacific. However, nearly all animals landed by the U. S. fishery belong to one species, P. camschatica.

Fishing Grounds

In the U. S., king crab is entirely an Alaskan fishery, with the heaviest landings occurring in central and western Alaska. Regulation of the fishery is maintained solely by the State of Alaska.

U. S. Production

The catch of king crab has declined in recent years, despite an increase in fishing effort. Legal size limits restrict landings to animals at least seven years old, although king crab may live up to 15 years or more. Prior to the rapid expansion of the fishery in 1961, all year classes above seven years were fished each year. By 1969, the increased fishing pressure had essentially removed all crabs over 7 years old, so that each year's fishing is presently dependent almost exclusively on the incoming class. This accounts for the annual decline in landings since 1966, when the fishing reached a peak production of 159 million pounds worth $15.6 million. Barring exploitation of new geographical areas, landings may be expected to remain at or near the 1969 level of over 55 million pounds worth $16.7 million. In that year, the U. S. produced nearly 30 percent of the world catch.

Vessels and Gear

King crab is unique in this study in that it is the only species

covered which must be landed alive and undamaged. These requirements place severe constraints on both fishing methods and the distance the vessels fish from the processing plants.

King crab is fished in relatively shallow water (from 5 to 100 fathoms), using very large traps called "pots". The pots weigh up to 400 pounds; any one vessel may tend as many as 100 pots and stay at sea for up to two weeks. Captured crab are held in live wells, with provision for circulating sea water. Only males reach the legal size limit, so that both captured females and juveniles are released. The fishing season is such that the crab are taken as they move onshore to breed.

Organization of the Fishery

The necessity for landing king crab alive makes the insertion of intermediaries in the handling of the catch extremely undesirable. Thus, the fishery is composed only of producers and processors, with the vessels each delivering individually to the processor.

Producers

The production arm of the king crab fishery consists entirely of vessels, the majority of which are individually owned and managed.

The principal location where crab is processed is Kodiak, Alaska, with numerous other facilities scattered from Juneau to Dutch Harbor, Alaska. In addition to these shore plants, floating processors (vessels) have been active, mainly west of Kodiak, in the past.

Some of the processors, however, own one or more vessels.

Processors

The processors in this fishery generally have a number of individual

boats fishing for them. The price paid to the vessels for the live crab is negotiated prior to each season, but does fluctuate.

Associations

In addition to the same national associations which represent the producers and processors of all fisheries, we have been able to identify only one association at the local level in this fishery. This association was referred to by the local fishermen as "the non-resident boat owners association" and is apparently headquartered in Seattle.

Relevant Organizations

Since king crab is fished by Japanese and Russian nationals, as well as U. S. nationals, international coordination is accomplished by means of bilateral agreements between the U. S. and each of these other countries. Although Canada does not fish king crab, the International North Pacific Fisheries Commission has been requested by the U. S. to monitor the status of this resource. With the agreement of the Japanese, the third party to the commission, the commission is investigating the king crab resource.

The State of Alaska is solely responsible for regulating this fishery and licensing the vessels fishing. It also conducts research on various aspects of the life history of, and fishery for, king crab. In addition, the Universities of Alaska and Washington conduct research on king crab. The industry itself also supports a research effort, the King Crab Institute, whose efforts are wholly dependent on industry monies.

Communications

The rather simplistic structure of this fishery, in comparison to

the others investigated in the course of this study, resulted in the identification of only a few significant communication pathways (Figure II-15).

As previously indicated, prior to each season the producers negotiate a price for the catch with the processors. The association of non-resident boat owners takes an active role in these negotiations, but the manner in which the resident boats are represented was not determined. Nonetheless, the negotiated price is not absolute; supply and demand determine the ultimate price. If supply exceeds demand, the processors will not buy unless they get a price reduction. Similarly, if demand exceeds supply, the vessels will not sell unless they get added benefits, such as cash on the side or reduced prices for fuel and supplies. These mocifications require frequent radio, or direct, contact between producers and processors.

Although the State of Alaska simply sets a size limit and opens and closes the season, the fact that regulation of this fishery is entirely a state function results in a major communication pathway existing from the state to the producers. However, the reverse pathway could not be considered major.

The contact between the industry and the universities is irregular and of the formal mode. The communications between the King Crab Institute and the industry are more frequent, perhaps, but no more relevant to real time activities than those of other research groups.

Evaluation

There appear to be three possible pathways for transmittal of educational information to the members of this fishery. The first two would have to work together and would only reach individuals headquartered

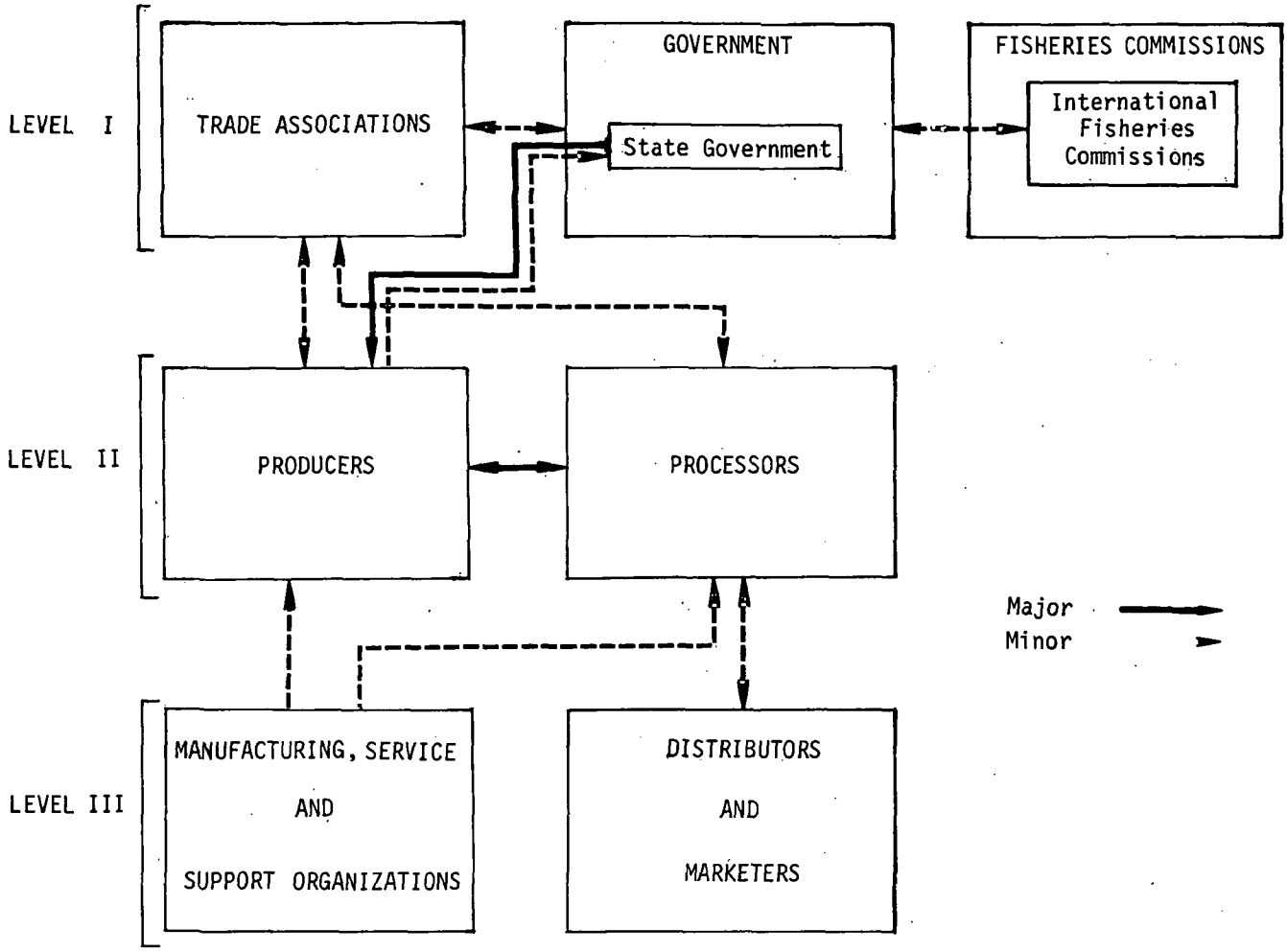

Figure II-15. Principal Communication Channels in the King Crab Industry.

in the State of Washington. These would initiate bidirectional communication to the non-resident (of Alaska) producers through the non-resident boat owners association located in the Puget Sound area. At the same time, the processors of this area could be reached via the Association of Pacific Fisheries, which represents most of the king crab processors. Neither of these suggested pathways is ideal, as they ignore everyone headquartered in Alaska, as well as processors headquartered in Washington who put up frozen or fresh product.

Perhaps the most logical, if not most easily accomplished, alternative would be to work with the appropriate agencies of the State of Alaska in reaching as many of the members of this fishery as possible. Alaska appears to be the only single body in contact with a majority of the fishery personnel.

For all practical purposes, there is no general knowledge of remote sensing techniques or potentials in the king crab fishery. This is due, in part, to the relative remoteness of the members of this fishery, as well as the scattered distribution of the centers of fishing and processing. Many of the executives of the processing companies and some of the vessels are headquartered in Seattle. These individuals, particularly the former, were slightly acquainted with remote sensing through their association with local NMFS and university personnel. Even so, they foresaw no operational use for remote sensing data.

COMMUNICATIONS MEDIA

Background

Within the broad area of communications media, we have considered two principal methods of communication to the U.S. fishing industry. First, published material such as newspapers and trade magazines, and, second, regional or national meetings and seminars which are attended by representatives of the various groups in the fishing complex.

Radio and television were originally considered in our study of communications media, but the extreme variability in program content between stations in various localities made it nearly impossible to establish a quantitative relevancy for these forms. In nearly all fishing centers, broadcast media serve the industry by reporting weather and, frequently, market or related conditions.

Newspapers, in general, presented a similar problem in establishing quantitative relevancy. Similarly, aperiodic, or one of a kind, published material provides an information vector to the fishing industry, but the specialized topics usually dealt with in this type of publication generally preclude their use as a remote sensing educational tool. Publications of this type emanate from both public and private sources. For example, the National Ocean Survey publishes nautical charts, atlases, and navigational aids which are vital to the fisheries for their navigational guidance, but that is the extent of their information value. This section will, therefore, deal primarily with relevant published periodicals and meetings of regional or national scope germane to the U.S. fishing industry.

Published Media

There are several federal government periodicals directed specifically to the U. S. fishing industry, both published by the National Marine Fisheries Service. The Fishery Market News Report is published daily (Monday through Friday) by the NMFS Division of Statistics and Market News. Data published includes landings, receipts, supplies, prices, imports, and movements of fish and fish products in local areas,and market conditions. When space between the tabular statistics is available, fishery developments in the U.S. and foreign countries are also included. Occasionally, a news item may be included as a special insert if the information inserted is of particular significance to the indsutry. The Fishery Market News Report is the result of compilation of the landing statistics and other data gathered at all major ports by members of the statistics division. It is published regionally from seven offices in a mimeographed one-to-four-page format. This publication reaches virtually all producers and processors in the industry.

Another NMFS publication is Commercial Fisheries Review, a monthly journal containing material of quasi-scientific and topical interest to the industry. It addresses both the domestic and international industry. Unfortunately, its total circulation is limited (approximately 5,000), with about 800 paid subscriptions and 4,200 to 4,400 free mailings. Only about half the free mailings reach people in the fishing industry. The remaining mailings each month go to other federal and state government agencies, foreign governments, research institutions, and interested subscribers. Only a few of the individuals we contacted in the industry indicated they received or read this publication.

Table II-3. National Marine Fisheries Service publications relevant to the U. S. fishing industry

Publication	Type of publication and primary audience
Fisheries Bulletin	Contains technical reports on scientific investigations of fishery biology. Being merged with Fisheries Industrial Research, which contains technical reports on scientific investigations of fisheries technology, economics, exploratory fishing, and gear research. It is distributed free to libraries, research institutions, scientists, state agencies, and various fisheries organizations.
Special Scientific Report - Fisheries	Contains preliminary or progress reports and reports on scientific investigations of restricted scope. It is distributed free to libraries and others on a limited mailing list.
Fishery Leaflet	Contains popular information on fishery subjects; it is intended primarily for use in correspondence. It is distributed free on request.
Circular	Contains popular and semitechnical publications of general and regional interest intended to aid conservation and management. It is distributed free on request.
Data Report	Contains reports that include compilations of unanalyzed or partially analyzed data collected during oceanographic investigations. The pages can be read only through a microscope, microfiche "reader", or similar device for enlarging. The Data Report series is the first microfiche series to be used for primary publication of scientific reports. It is distributed free to a restricted mailing list of laboratories, libraries, state fishery agencies, research institutions, and research scientists. Hard (full-size) copy is available for purchase.
Commercial Fisheries Abstracts	Contains a monthly abstract of world literature (chiefly English language) on fishery technology. It has free, but limited, distribution.
Statistical Digest	Contains annual statistics, with detailed tabulations relating to fishery production, manufacture, and commerce.
Current Fisheries Statistics	Contains current statistical information on fishery production, manufacture, and domestic or foreign trade. It is issued in various time frames by states, regions, or larger areas. This publication is sent free to private and government industries in the U. S. and foreign countries and to U. S. embassies.
Fishery Products Report	Included in these reports is the daily Fishery Market News Report treated elsewhere. In addition, monthly and annual data on the same subjects are published from each office. Special Market News Reports are issued intermittently showing statistical data and trends. These are all mailed free to the same recipients as the daily reports.
Current Economic Analysis	Contains reports on prices, landings, production of processed products, imports, exports, and inventories. These reports deal with probable market conditions and prices in the future. About 8,000 copies of the various reports are mailed to industry and government personnel.
Fishery Market Development Series	This series contains popular educational publications on care, preparation, purchase, and nutrition of fishery products. These publications are sold by the government.

Other NMFS publications relevant to commercial fisheries, as well as to their primary audience, are shown in Table II-3.

Nearly all of the trade associations discussed in the previous sections dealing with communications in the various fisheries publish a bulletin or newsletter. These publications are summarized in Table II-4. For the individual industries, trade association publications offer, perhaps, the best-published format for reaching the industry.

Commercially published trade journals can be categorized as being either solicited or unsolicited. To receive a solicited journal, an individual must buy a subscription, whereas, to receive an unsolicited journal, one need only have his name appear in some context related to the commercial fishing industry. The unsolicited journals are advertiser supported and mass-mailed at no charge to recipients. Table II-5 shows the geographical and occupational distribution of the relevant trade journals. As indicated, only National Fisherman and U. S. Maritime Monthly are solicited.

There are, in addition, a number of publications which are concerned with the various aspects of processing seafood. However, most are devoted primarily to all types of food processing, seafood being but one of the foods considered; hence, they carry little specific information of direct interest to the operating fishing industry and are not specifically treated as part of this study.

Meetings and Seminars

There is no single meeting of national or regional scope which represents the interest of a majority of the fisheries. Most meetings are functionally or fishery oriented. For example, the National Canners

Table II-4. Principal publications of the trade associations

Fishery	Trade Association	Publication	Contents and frequency of publication	Useful for Remote Sensing Education*
All Fisheries	National Canners Association	Fishery Information Bulletin	Published weekly. Contains information relating to legislation relevant to fisheries, general information, foreign fishery developments, and certain statistics.	No
	National Fisheries Institute	Flashes	A periodic newsletter carrying news of the associations activities.	No
		Fisheries Blue Book	An annual publication of the institute. Basically, a variously indexed directory to NFI membership.	No
Maine sardine	Maine Sardine Council	Newsletter	News of general interest to the fishery; published approximately every month.	Yes
New England groundfish	Boston Fisheries Association	Newsletter	Items of local interest; published irregularly.	Yes
	Seafood Producers Association	Newsletter	Information concerning local problems; published approximately every month.	Yes
	Gloucester Fisheries Commission	Newsletter	Items of interest to Gloucester fishermen; published irregularly. Minutes of commission meeting also published.	Yes
	Seafood Dealers Association	Newsletter	General interest items; more of a personal letter than published newsletter.	Yes
Atlantic and Gulf menhaden	National Fish Meal and Oil Association	Newsletter	Items of interest to all menhaden processors; published periodically.	Yes
Gulf shrimp	Texas Shrimp Association	Bulletin	Published biweekly; includes items of interest to the industry in Texas.	Yes
	Southeastern Fisheries Association	Newsletter	Published monthly, containing items of interest to the fisheries of the southeastern states.	Yes
U. S. tuna	American Tuna Boat Association	Newsletter	Items of interest to ATA members; published periodically.	Yes
	Western Fishboat Owners Association	Newsletter	Items of interest to tuna fishermen who are members of WFOA; published periodically.	Yes
California wetfish	Fishermans Cooperative Association	Newsletter	Items of local interest to California wetfish fishermen; published periodically.	Yes
Pacific Northwest salmon	Seiners Association; Association of Pacific Fisheries; (Northwest Salmon Canners Association, Puget Sound Gillnetters Association and Fishermen's Cooperative Association, Inc.)	Newsletters or informal mailings	Approximately once-a-month information on various topics of interest to the salmon fishermen. It is mailed to the membership.	Yes
Alaskan king crab	"Non-resident Boat Owners Association	Unknown		

* short relevant items only

Table II-5. Principle monthly commercial publications directed to the U. S. fishing industry.

Publication	Circulation	Distribution Percent Total			Recipients Percent Total		Comments
		Atlantic	Gulf	Pacific	Producers	Processors	
National Fisherman	43,000	60	1	16	78	2	This journal tends to be very much boat oriented, rather than operationally oriented. Very highly regarded on Atlantic and north Pacific coast.
Fish Boat* Magazine	20,000	40	24	26	59	16	Of the various unsolicited publications, this and the next seem to be most frequently read by industry members.
Fishing* Gazette	17,000	43	16	28	75	14	This journal seems to emphasize the Gulf shrimp industry, although this is not reflected in its circulation. Well accepted by the industry in general.
Fisherman's* News							Request for information never acknowledged.
Fisheries* of Canada (Canada)	7,000	United States - 5			Fishing Industry - 80		Distributed free on request, but carries no advertising.
Fishing* News International (United Kingdom)	5,000	United States - 58			35	9	Only about half of the total circulation is by paid subscription; the remainder represents free mailings.
U. S. Maritime Monthly							Addressed primarily to producers and processors on the Pacific coast.
Oceanology* International	33,000	49	12	24			Only a minor percentage of the total circulation reaches the U. S. fishing industry.
Undersea* Technology	32,000	50	5	26			Only a fractional percentage of the total circulation reaches the U. S. fishing industry.
Ocean* Industry							Only a fractional percentage of the total circulation reaches the U. S. fishing industry.

*Unsolicited publications

Association has annual meetings, but the individuals in the U. S. fishing industry who attend are almost exclusively processors dealing in canned fish. On the other hand, a Tuna Conference is held annually in southern California, attracting representatives in government, industry, and universities from all areas of the nation, but the meetings are directed only to problems of the U.S. tuna fishery.

Many periodic national and regional meetings are held, the principal ones being tabulated in Table II-6. The number of such meetings demonstrates the interest of the industry in information exchange.

The local meetings of the various trade associations, cooperatives, and unions are explicitly considered under each fishery.

Evaluation

As they presently exist, few, if any, of the communication pathways classified as formal media will provide useful remote sensing educational channels to the U. S. fishing industry. Basically, this is due to poor coverage and low frequency of contact, in the case of meetings, and to lack of predictable contact, in the case of trade journals.

None of the regularly attended national meetings draw on a large enough cross section of the industry to provide an adequate remote sensing information channel to the operating units of the fisheries. This is not the case with many of the regional and local association meetings. These meetings, coupled with the newsletters published by many of the same associations (Table II-4), provide perhaps the most favorable communication pathway. These possibilities have been treated in detail in the discussion of each of the fisheries involved.

Table II-6. Principal U. S. meetings attended by a significant number of key in each fishery.

Fishery	Title or Sponsor	Type and frequency of meeting	Utility as remote sensing forum
All Fisheries	National Canners Association	Annual convention; more frequent regional and local committee meetings.	Yes, but general introductory information only.
	National Fisheries Institute	Annual convention; more frequent regional and local committee meetings.	Yes, but general introductory information only.
	Fish Expo	Trade show with some presentations. There are Fish Expo's in various parts of the country which are held annually.	Possible; however, mainly hardware display and informal discussion.
Maine sardine	Maine Sardine Council	Monthly business meetings of processors.	Yes, but in a restricted sense to only short, relevant topics.
New England groundfish	Fisherman's Forum	Invited speakers from government and industry on various aspects of fishing. Held one or more times a year.	Yes; presentation on fishery remote sensing was made several years ago.
Atlantic and Gulf menhaden	NFMOA - Fishery symposium	Invited lecturers on use of fish meal; attended annually by about 300 people.	Yes. Special NFMOA committee on remote sensing meets periodically; would be interested in hearing new remote sensing developments.
Gulf shrimp	Gulf and Caribbean Fisheries Institute	Scientific and technical sessions are held. Industry personnel do not attend the scientific sessions, and vice versa. Held annually.	Probably not, due to infrequency of meetings and nature of constituency. Better possibilities exist for this fishery.
	Texas Shrimp Association	Convention which provides an annual forum for discussion of relevant topics.	Yes, but only in general introductory sense.
	Southeastern Fisheries Association	Meetings held semiannually. Proceedings include topics of pertinence to the various fisheries.	Yes, but only in general introductory sense.
U. S. tuna	National Canners	Subcommittee meetings; see "All Fisheries."	Yes, but only general, introductory information.
	Pacific Tuna Conference	Forum to report research and developments in the tuna industry; held annually at Lake Arrowhead, California.	Yes; presentations on fishery remote sensing have been made in past years.
California wetfish	None specifically indicated		
Pacific Northwest salmon	Association of Pacific Fisheries	Bimonthly meeting of processors.	Yes, but only for introductory purposes.
Alaskan king crab	None specifically indicated		

Although a considerable number of trade journals are published specifically for the fishing industry, and even though these journals demonstrate marked diversity, we question their usefulness for communicating a coherent series of information of the type required to transmit to the fishing industry a cogent picture of NASA's aims and the remote sensing state of the art. The problem with these various publications is that one cannot depend on their audience having the time to read them in depth. Since the majority of the trade journals are mass-mailed, most people who receive them rarely have time to do more than scan them for items of specific interest. Only National Fisherman, which must be bought by annual subscription, seems to be read in depth, because people who receive it want it. The individuals we have identified are universally very busy people; their activities tend to become ordered on the basis of priority and urgency. Compared with immediate concerns, educational material on remote sensing will probably be given a low priority. This problem can be overcome, and has been overcome in many instances, by personal contact, in which the ultimate benefits of using remote sensing and remote sensing data are made clear.

Nonetheless, the time available by key members of the industry to be devoted to this educational material will remain a problem. The more accessible the information, the more likely it is to be assimilated. Most of the journals whose representatives we saw indicated a willingness to publish an occasional article. This, however, does not fulfill the need. It means that a coherent series is impossible; either each number of the series would appear months after the last, or the series would have to be spread through several journals. In either case, even interested readers would probably be discouraged by the hunting implicit in

locating several nonsequential issues. Therefore, use of the trade journals for other than the most general introductory material seems unwise.

III. RECOMMENDATIONS

The principal objective of this study was to identify the two-way communication channels capable of carrying remote sensing educational information between NASA and the U. S. fishing industry. In Section II, such communication links within and between each principal component of the fishing complex have been clearly defined. The analyses and evaluations contained in that section may be summarized in several specific recommendations:

- That each of the fisheries be approached individually, informally, and on its own terms, focusing the effort on those individuals and groups with sufficient influence, interest, and stature within the particular fishery to develop and foster effective two-way information exchanges.

- That the present study be extended to include a similar analysis of other major U. S. fisheries which appear to be potential beneficiaries of NASA's remote sensing programs.

- That, in view of the necessarily long lead-times required by the nature of the case, an early start be made on designing and implementing specific programs to make the fishing industry a full participant.

Our general recommendations with respect to an active program are presented below. Before discussing these, however, several other findings of this study require a special note. Contrary to the general attitude which seems to prevail in this country, we did not find the U. S. fishing industry on the brink of collapse, nor was it really dragging its feet

in the 19th century. Quite the contrary, within each fishery there are extremely progressive individuals and groups. Indeed, in many respects, portions of the U. S. fishing fleet are perhaps the most advanced and innovative in the world.

It goes without further elaboration that the U. S. tuna, Gulf shrimp, Pacific Northwest salmon, and Gulf menhaden fisheries are active, lucrative businesses. Yet, beyond that, even among economically depressed fisheries such as the New England groundfish, we found business enclaves making an apparently comfortable profit. Conversely, in each fishery there are those individuals and companies which have failed to innovate, to keep abreast of developments, and are slowly sinking into financial and operational oblivion. But this situation is not unique to the U. S. fishing industry, and the industry should not be judged by these few.

On the other hand, the industry does suffer from certain basic problems, not the least of which is an insufficient data base upon which to make management decisions. Nonetheless, the trite and overused comparison to such world-ranging fishing fleets as those of the Japanese or Russians does not a posteriori apply. These countries do support large modern fleets of fishing and factory vessels, but consider where they are fishing. Many of Japan's and Russia's open-ocean fisheries operating at considerable distances from their shores utilize the same resources as our coastal fisheries. This may pose a threat to equitable usage of a resource, but juxtaposing their large factory ships with our smaller fishing vessels is simple not a fair comparison. Fishing off our own shores, it hardly seems prudent for us to build and maintain large processing ships when shore-side processing facilities are close at hand.

The problem is not so much competition for comparable size vessels as for comparable catch efficiency. Requirements include comparable harvesting technology and adequate management of international efforts. In many instances, the former is being accomplished. Nearly all innovations in shrimp fishing, which is, after all, a global fishery, have originated with our Gulf fleet. Our new tuna purse seiners are the largest and most modern in the world. As it becomes essential that we exploit more distant resources, we will doubtless expand as needed to factory ships or processing plants on distant shores, whichever is the most expedient.

Further, communications and coordination in the industry and, in particular, in the individual fisheries are quite satisfactory. In fact, it may be that the internal communications are better than any industry of comparable scope. Unfortunately, the same cannot be said for communications outside of the industry, particularly in regard to the government.

The "Findings and Evaluations", Section II, have thus provided a wealth of source material for recommending the following:

WE RECOMMEND THAT NASA FOLLOW A RELATIVELY LOW PROFILE BUT POSITIVE APPROACH IN INVOLVING THE U. S. FISHING INDUSTRY IN THE ERS PROGRAM

As repeatedly emphasized in the previous sections, the U. S. fishing industry is undoubtedly one of the most likely user groups to participate in the ERS program. However, as the U. S. fishing industry is shown in this report to be unique in many respects, the degree of success attained in involving this industry in the ERS program will be largely dependent on NASA's approach to the industry.

For reasons detailed previously, and, in part, not really fully understood, the individual fisheries as a body are relatively difficult to approach and even more difficult to engage in a continuing dialogue. More than any other reason, the prime difficulty in communicating with this industry stems from the fact that time is of crucial importance to the operating components of the industry and, yet, is one of the commodities in least supply. Therefore, the individuals within the industry are extremely sensitive to programs which they consider a waste of their time. Furthermore, almost all communications involving fishing industry operations relating to the logistics of raw material acquisition by producers are verbal and in a different "language" than that used by scientists and engineers. This situation is not going to change in the foreseeable future; to be successful, those communicating with the industry will have to adapt to the industry's system. For these reasons, the approach to the fisheries by most outside, research-oriented groups has been one which alienated the industry.

It is important, therefore, that NASA continue to approach the fishing industry on the industry's terms and with a relatively low visibility. It may be to the advantage of NASA to operate through an intermediate group familiar with both the fishery and the individuals who make up the fishery. Further, this group should be cognizant of both the latest developments in remote sensing (and capable of translating these developments and their applications into a language acceptable and assimilable by the fishing industry) and the multifaceted problems and data demands of the fishing industry. This approach would be in lieu of NASA's, or another government agency's acting in NASA's behalf, attempting to make direct contact with the fishing industry. This type

of approach seems particularly prudent in view of the prevailing reluctance of the industry to work with the government or universities.

WE RECOMMEND THAT ONE FISHERY BE SELECTED FOR STUDY EMPHASIS LEADING TO A FRUITFUL PARTICIPATION IN THE ERS PROGRAM

One of the basic problems facing NASA in attempting to draw the fisheries community into the ERS program as a user group is that of demonstrating a definitive area in which NASA can contribute to the fishing industry. Although several fisheries are at the point where the step to operational utilization of aerial electronic remote sensing is very close, there is, at present, no clear example of the integrated use of remote sensing (other than subsurface, acoustical techniques) as a data input to either the operational or management aspects of commercial fishing. Although many of the individuals in the industry have partial acquaintance with remote sensing, even these individuals, as well as those who have no prior exposure to remote sensing, will very quickly become discouraged unless some concrete demonstration of the actual returns on a remote sensing commitment can be demonstrated.

For this reason, we suggest that NASA work specifically with one fishery to solve an explicit operational or management problem as a demonstration of the overall potential that remote sensing offers. This fishery should most logically be one of those which was shown to be close to taking the step to sophisticated remote sensing data inputs. We feel that the greatest impact would be in a demonstration experiment explicitly addressed to an operational utilization of as much of the spectrum of remote sensing capability as is practicable with the selected fishery. This demonstration should entail, initially, the use of low-, medium-, and possibly high-altitude instrumented aircraft in conjunction with the ongoing program of the selected fishery, as well as the ultimate integration of satellite-acquired imagery and data. A convincing demonstra-

tion of this nature will work very quickly, we feel, to draw the other fisheries into the NASA ERS program and into a position where they will be ready and willing to accept the data and apply it to their immediate problems.

WE RECOMMEND THAT AN EDUCATIONAL PROGRAM BE INITIATED WITH THE U. S. FISHING INDUSTRY TO INFORM THE APPROPRIATE INDIVIDUALS OF REMOTE SENSING POTENTIALS

Almost without exception, we found that those individuals with some prior exposure to remote sensing techniques (regardless of how minimal) were generally more convinced of, and more willing to accept, the potential for remote sensing in commercial fisheries than those individuals who had not had any previous exposure and with whom we could not go into very great detail on the background of remote sensing. These latter individuals generally showed great skepticism in regard to the potential for applications of remote sensing techniques to any facet of commercial fishing.

Given the generally accepted potential for remote sensing in fisheries which exists in the remote sensing technical and scientific community, it seems imperative to reach out to the commercial fishing industry with a program structured to their needs and backgrounds. With such a program, designed to expose at least a cross section of pertinent individuals in each fishery to the utility and applications of remote sensing, the manner in which the initial approach is made (as outlined in our first recommendation) is perhaps the most crucial key to general acceptance among the fishing industry. The potential of remote sensing to contribute to fisheries management can only be realized through an extensive iterative process between scientists and technologists re-

presenting NASA and informed individuals in the fishing industry. Yet, one cannot expect industry personnel to contribute to such an iterative process, regardless of their background or level of understanding of the problems, without a clear understanding on their own part of the potential remote sensing has to offer their fishery. Thus, we recommend specifically that a program be developed by NASA, or a consortium of remote sensing and fishing industry technologists, which will present in a cogent, logical sequence the potentials and applications of remote sensing to marine science and, specifically, to fisheries.

It should again be reiterated that the people we are attempting to deal with are not academicians, and they are not primarily interested in accumulating information. Thus, the program must be developed in a manner that will elicit the most information in the least time and with the least disruption to these individuals. The same team must be prepared to graphically demonstrate a positive, unchallengeable result of the applications of remote sensing to specific fisheries problems. If a definitive example of remote sensing applications does not follow rapidly upon the initial introduction, it is quite probable that the fishing community will return to a state of skepticism and the opportunity for reaching this group will have been lost for some time to come.