APPENDIX 2

A SYSTEM FOR DEVELOPMENT OF THE CENTRAL PACIFIC SKIPJACK TUNA RESOURCE

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1. Synopsis

There is a valuable, underutilized, skipjack tuna resource in the central Pacific. If an economical means of harvesting can be worked out this resource is capable of supporting an industry in Hawaii of a magnitude approaching that of the pineapple, sugar, or tourism industries. Harvesting this resource should not, in principle, be difficult. The use of modern fishing technology will, however, be required. Application of this technology to Hawaii fishing conditions requires the development of a system. The system requires certain information and actions. The information concerns both the resource itself and the economics of the resource. Much of the information is already available. The actions which center around the development of a purse seine technology, that is appropriate for a Hawaii-based fishery, also include operations research on bait fishing development of bait substitutes, sutdies on skipjack tuna and the environment, and further assessments of skipjack tuna population dynamics. The approximate cost of the entire program is primarily that associated with the purse seine trials, which amounts to $2,500,000 for a 5-year period. Additional costs amount to $900,000.

2. The need for a system

The skipjack tuna resource of the central Pacific Ocean can produce hundreds of thousands of tons of skipjack tuna each year. One hundred thousand tons of skipjack tuna has a value of $25 million to the fishermen, $62 million to the processor, and $100 million at the retail level. This resource is therefore of particular interest to the State of Hawaii because it is a virtually unused economic base, which, when utilized, will generate a monetary flow in the State approaching that generated by pineapple, sugar, or tourism.

Efficient utilization of the central Pacific skipjack tuna resource requires development of a fishing technology in which the revenue from fishing must be sufficiently greater than the cost of fishing to the extent that (1) the fishermen make a good living relative to that which they could obtain in a comparable industry, and (2) the boat owners and processors obtain a return on their investment that is favorable when compared to that which they could obtain from alternative investment opportunities.

Development of a technology that is optimal for a Hawaii-based skipjack tuna fleet and attractive to the investor should not, in principle, be difficult since there is already a large store of knowledge concerning (1) the skipjack resource in the central Pacific, (2) bait fishing operations in Hawaii and elsewhere, and (3) purse seine fishing and technology in general. Although the development of an optimal skipjack fishing technology for Hawaii will not, in principle, be difficult, there are pressing problems that need to be solved before such a technology can be realized. These problems result from the large number of variables that must be considered, evaluated, and forged into an optimal technology. Examples of some of the diverse variables are the temporal and spatial distribution of expected catch, the problems associated with purse seine design, cannery construction, characteristics of the labor force, the oceanic environment as it relates to the skipjack tuna, etc. Arriving at an optimal combination of all the various possible variables by an intuitive judgment would be a horrendous task. In order to avoid these intuitive judgments a systematic foundation for considering all of the elements relevant to the development of the skipjack resource in the central Pacific has been constructed. This systematic foundation will provide a prospectus that will guide the development of a maximized profit skipjack tuna industry. The following describes this system in terms of the information and actions required to realize the optimal utilization of the skipjack resource.

3. The information required

A system for guiding the development of a maximized-profit central Pacific skipjack tuna fishery is outlined in figure 1. The system depicted in figure 1 is constructed of an information block and an action block. The elements in the information block are conceptual and spatially arranged whereas the elements in the action block refer to activities and are temporally arranged. The two blocks are linked by feedback so that information resulting from past strategies will sequentially modify and optimize conduct in future actions.

The information block contains two lines of information. One concerns the resource and the other concerns the economic potentials of the resource. In each line the initial operation defines the contemporaneous potentials. Methods of expanding the potentials for the future are then considered. Finally the economic potentials are matched with the resource potentials, enabling a definition of those cost-receipt areas that will be favorable for fishery development. The feasible cost-receipt areas and the information pertaining to these are then assembled and used to formulate the activities that will be conducted for fishery development.

At this point emphasis should be placed on the fact that the information block already contains a considerable amount of information. This information may be synthesized by repeating that there is a substantial, virtually unharvested, skipjack tuna resource in the central Pacific, that this resource has a high unit value and is, in distinction to most other fishery resources, in high demand and technologically available. Furthermore we know that the present method of fishing for skipjack in the central Pacific, with pole and line and live bait is inefficient (when compared to the potential of purse seining).

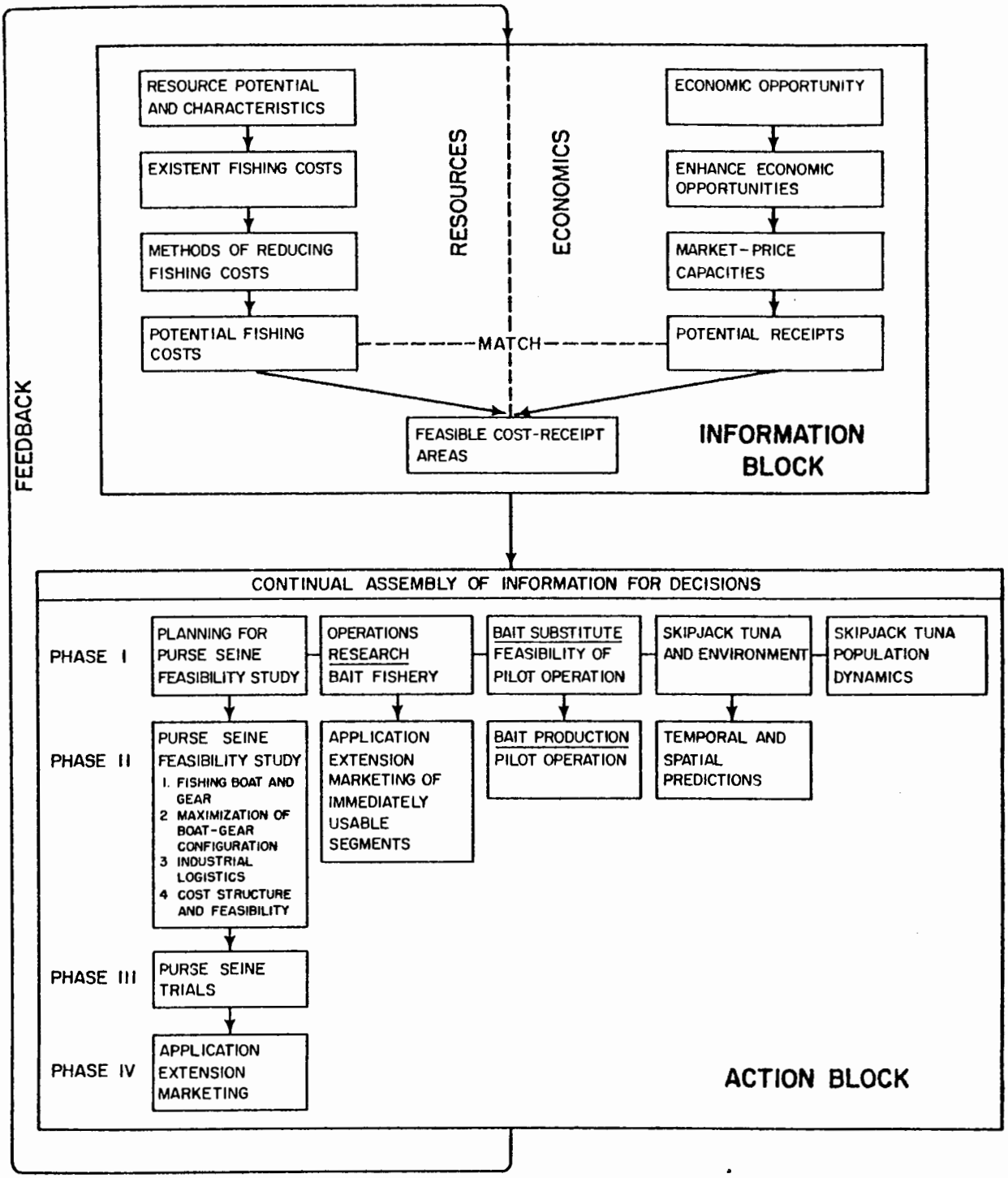

Figure 1.--A system for guiding the development of a central Pacific skipjack tuna fishery.

In the pole-and-line method of fishing, the fishermen spend a considerable amount of time capturing bait when they could be fishing for skipjack tuna and only 50% of the skipjack schools that are encountered "bite" to the extent that at least one skipjack tuna is caught from the school. The inefficiencies of pole-and-line fishing can be eliminated by adopting a gear such as the purse seine which requires neither bait nor the skipjack tuna to bite (in purse seining, fish are caught from about 65% of the schools and no time is lost fishing for bait). In Hawaii the transition from bait fishing to purse seining needs to be carefully planned so as to protect the existing labor force and capital investment. In this way the transition from the less efficient to the more efficient operation can be made with minimal perturbations.

4. The actions required

Thus the present contents of the information block dictate a set of actions for the present and near future. These actions are formulated along several lines in the action block.

4.1 Development of purse seine fishing in the Hawaiian Islands

As indicated earlier, purse seining will reduce many of the constraints on efficiency that are characteristic of the bait fishing operation. In addition, an increase in efficiency will ensure greater economic returns to the investor. The catch per fisherman should increase as well as the catch per dollar of invested capital. The improved economic structure of an increased-efficiency skipjack fishery would result in increased earnings by the fisherman. Such increased earnings will encourage the flow of labor into fishing. The size of the resource base and the demand for tuna should produce, with equitable investment and labor conditions, a manifold increase in the production of tunas in the State of Hawaii.

The first phase of the purse seine study will involve program planning. The program planning will outline the nature of a purse seine feasibility study. The feasibility study will consider such questions as the design of the fishing boat. Design elements such as cruising speed, maximum size, minimum size, hold capacity, and cruising range are all important. Refrigeration technology is also an important element in the construction of fishing boats. Recent developments in refrigeration technology have supported tremendous increases in the monetary return per unit catch for the Japanese tuna fishing fleet. Another consideration in the design of a fishing boat is whether it should be constructed as a single purpose purse seiner or possibly as a combination purse seiner and bait boat, or purse seiner and longline boat. All of these items will be considered in the feasibility study.

Another element that will be considered in the feasibility study is the design of a purse seine and the gear used to set and retrieve the seine. Such features as mesh size, length, depth, and net construction material will be considered. After the engineering concepts of boat and gear design have been developed, methods to maximize the efficiency of any combination of boat and gear will be considered. This consideration will have to take into account the environment and potential catches and is essentially an operations research study in which all features that might affect the potential purse seine fishery will be considered. The next element in the feasibility study would be the best location for a processing plant. This would have to include harbor facilities and boat servicing facilities. The labor force will be considered as well as land availability and tax structures. The feasibility study will conclude with the construction of simulation models that will depict the actual operation of the fishery. The various elements of the model can be adjusted to obtain an optimum economic return to the investor.

The third phase of the purse seine study will be the actual purse seine trials. The actual nature of these trials will be determined by the feasibility study; they will be a pilot operation of the purse seine feasibility study. Pilot operation will test the sensitivity of the feasibility study models and also provide actual demonstrations of the costs and receipts of the increased efficiency of skipjack fishing to potential investors.

In the fourth phase of the purse seine study, extension techniques for the application of purse seining to a Hawaiian fishing operation will be developed. In addition, a continual alertness toward marketing problems and their solution will be maintained. These aspects will most likely be worked on concomitantly with those in the third phase.

4.2 Operations research for bait fishing operations

The second line of study is the operations research on bait fishing. This is motivated by considering that annual landings made by the boat with the greatest skipjack catch are several times that of the boat with the poorest skipjack catch. This large discrepancy must owe to the difference between the way the best boat operates and the poorest boat operates. The objective of operations research is to discover the cause of this difference and to make recommendations toward its elimination. In addition, these studies on bait boats are necessary to clearly define an economic base level from which the purse seining operations can be developed. The operations research on bait fishing will continue in a second phase of extension, marketing, and development of the immediately usable segments of this study.

4.3 Bait substitutes

The third line of study is that of bait substitutes and bait production. This line of action is intended to eliminate the constraint of the necessity for skipjack fishing capital to be involved in bait fishing. This is intended as an essentially short-term action to stimulate the present fishery until purse seining is activated. In addition, there is always likely to be some bait fishing for skipjack for the purpose of landing exceptionally high-quality fish for fresh consumption. The bait studies will also provide information required for operations research study. The economic implications of bait production, bait raising, and bait technology will also be considered in this line of study.

4.4 Skipjack tuna and the environment

The fourth line of study will consider the relation of the skipjack tuna to the environment. These are specialized studies of great importance. Demonstration of a relation between the environment and the temporal and spatial location of the skipjack can measurably increase the efficiency of catching and processing skipjack tuna.

This is because an understanding of such a relation will enable predictions of the temporal and spatial locations of skipjack and thereby eliminate more or less random searching time by the fleet. In addition this information will enable prediction of the temporal distribution of landings and thereby increase the efficiency of a processing operation. The first phase of this work is to determine the relation between the skipjack tuna and the environment. The second phase is to use this information to make temporal and spatial predictions of the distribution of the fish.

4.5 Population dynamics

The last line of study is the population dynamics (i.e., the study of yield potentials of fish stocks) of skipjack. These studies are required to determine the expected catches per unit of area and also to determine basic information for operations research and system study.

5. Costs

At this point only approximate costs can be developed for this study. Approximation is required by the dependence of the terminal phases of the study upon the outcome of feasibility and background studies that will be conducted during the early phases of the study. For example the purse seine feasibility study will determine the bbest number of boats and the tenure of their operation for the purse seine pilot study. It is likely, however, that one boat would be required for a 5-year period. The cost of this operation would be about $500,000 a year for a 5-year period, or a total of $2,500,000. The approximate costs and schedule are outlined in the attached table.

Attachment: SWFC, Honolulu Laboratory

Table 1

Year	Purse seining Action I		Operations research Action II		Bait substitutes Action III		Skipjack and environment Action IV		Skipjack population dynamics		Total*
	Budget*	Description	Budget*	Description	Budget*	Description	Budget*	Description	Budget*	Description	
1969	$ 75	Feasibility study	$ 50	Completion of ongoing study	$ 25	Feasibility of pilot operation	$ 25	Planning study	$ 50	Comprehensive review	$ 225
1970	75	do	50	Extension and application	100	Development of production facilities	50	Monitoring and prediction systems	75	Tagging	350
1971	500	Pilot study	50	do	100	do	50	do	75	do	775
1972	500	do									500
1973	500	do									500
1974	500	do									500
1975	500	do									500
1976	50	Extension, etc.									50
Total	$2,700		$ 150		$ 225		$ 125		$ 200		$3,400

*In thousands of dollars.

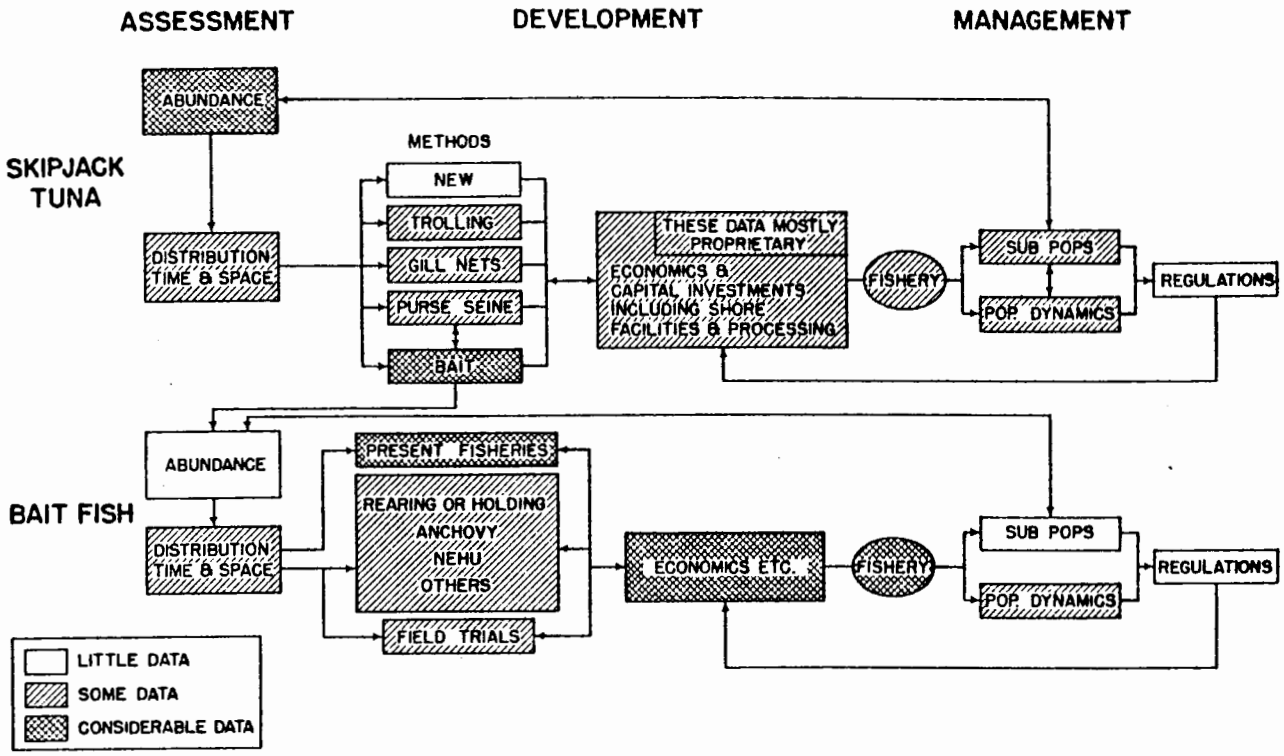

Figure 2.--Flow diagram for the development of skipjack fisheries in the central and western Pacific.