APPENDIX 6

THE TUNA BAITFISH PROBLEM OF HAWAII--AN ASSESSMENT AND DEVELOPMENT OF AN ACTION PROGRAM

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The northern anchovy has been transported to Hawaii in the past on several occasions, mostly on an opportunistic basis and in small quantities. Results show, however, that anchovy can be brought here with relatively low mortality. For example, the Anela 1/ brought about 130 buckets 2/ of anchovy to Hawaii in December 1971 from the west coast at a density of 10 kg anchovy/m^3 of water and suffered about a 15-20 percent mortality.

In 1965 the R/V Charles H. Gilbert successfully transported 130 buckets of anchovy from San Diego to Hawaii over a period of 17 days at a density of 24 kg anchovy/m^3 of water. The Gilbert on that same cruise transported 140 buckets of anchovy at about the same density to Manzanillo Harbor. The transit time was over a period of 17 days and through waters ranging in temperature from 15°C to 29.5°C.

Three thousand scoops 3/ of a similar baitfish, the anchovetta (Cetengraulis mysticetus) were transported from Mexico to the Marquesas Is. in 6 baitwells by the Cape Falcon in 1959. The mortality during the transport was estimated to be 3-4 percent over the 10-day period.

The R/V David Starr Jordan carried 52 buckets of anchovy to Hawaii in August 1973 with practically no mortality. Sea surface water temperatures encountered during transport ranged from 16.1°C-28°C.

In summary, the several experiences with the anchovy provide evidence that it is a hardier species than the nehu and would allow the Hawaiian tuna boats to range farther from base port than is now possible with the nehu. Because of the lower mortality to be expected with anchovy, the catch per unit of bait carried to sea should increase substantially. Although not detailed in this report, the anchovy has been used successfully in fishing for skipjack tuna in the central Pacific. Further, the anchovy is the principal baitfish used by the tuna baitboats in the eastern Pacific.

1/ The Anela, a 26.6 m steel vessel, was the most recent addition to the Hawaiian skipjack fishery, having joined the fleet in December 1971. Unlike the remainder of the skipjack fleet (about 12 vessels), which consists of boats 17.8 to 24.5 m in length and with bait-carrying capacity of only about 35 buckets, the Anela is capable of carrying 130 buckets. The Anela also has greater fish-carrying capacity and greater range, and represents a new look in the Hawaiian skipjack fishery.

2/ A "bucket" comprises approximately 7 pounds (3.2 kg) of baitfish.

3/ A "scoop," a term commonly used in the eastern Pacific, is roughly equivalent to the Hawaiian "bucket."

Hawaii-California Baitfish-Moving Problems

There are numerous problems attendant to moving bait from California to Hawaii. Some of the more obvious are (1) locating a dependable supply of anchovy of suitable size for use in Hawaii throughout the year, (2) finding suitable means of transporting a sufficient supply of anchovy on a regular basis at costs in line with the economic viability of the procedure, and (3) persuading the Hawaiian fishermen to purchase and use the anchovy for skipjack fishing.

The first two problems are not yet solved and considerable study is needed. Also, an immediate willingness on the part of the fishermen to purchase their live bait rather than spend valuable time in catching it should not be expected. Some of the boat owners will continue to catch their own bait from a resource that is there for the taking; expending as many days as are required to obtain a sufficient supply. It has to be clearly demonstrated that purchasing baitfish will be to their benefit; that the benefit outweighs the cost. A great many fishermen in Hawaii have always fished with nehu and feel that any other baitfish would be a poor substitute. There are numerous psychological barriers that need to be overcome before these fishermen will consider purchasing anchovy. To the advantage of our proposed study is the fact that the captain and crew of the Anela have experienced using other bait (e.g., Marquesan sardines and other species in French Oceania, sardines in the Trust Territory), and would probably be the very first to accept the anchovy. They could very well be the ones to demonstrate the effectiveness of anchovy as baitfish in Hawaiian waters, showing that the purchase of bait could greatly increase fishing effort, and thus the skipjack catch. Present indications are that there are other boat owners in Hawaii willing to at least give the anchovy a good try. Successes achieved by a few boats should go a long way in promoting the program to the fleet.

While some of the existing boats may not consider using anchovy, the successes achieved by those that do will help remove one of the present major constraints to new investments in the fishery. Although potential boat owners may be interested in entering the skipjack fishery, they are held back by the problem of bait supply in Hawaii. New boats would probably be in the Anela class, capable of ranging farther offshore and with a greater bait-carrying capacity. The availability of anchovy may encourage new investments, and a fleet of boats based exclusively on such imported bait is not beyond the realm of possibility. These boats can fish in Hawaii during the peak season and range off to areas such as the Leeward Islands or the Line Islands during the offseason in Hawaii. The hardier anchovy will permit this type of an operation.

Another possible advantage with anchovy, particularly with respect to the Anela and other vessels that may join the fleet later, is that crew size would no longer be regulated by the need to capture bait. Under

present practice, the crew size during the height of the fishing season is generally around 12 men. The actual tuna fishing can probably be undertaken effectively with as few as 6-7 men; whereas, the baiting operation would require from 8 to 10 men. The latter is especially true when the total fishing regime (baiting and fishing) is carried out over an extended period.

The anchovy will probably never replace completely the nehu as a baitfish in Hawaii. By the same token, even if purse seining is developed to a high degree in Hawaiian waters, be it with the combination of baitboats or by the development of new seining techniques, there will always remain a core of small, short-range skipjack boats continuing to fish in the traditional manner and continuing to rely on the nehu. These boats will primarily supply the local fresh fish markets. The operations of boats relying on anchovy will mark the beginning of a new fishery, one that can greatly expand the market potential of skipjack.

An experiment to move anchovy from California to Hawaii must be viewed as the start of a program to move baitfish from areas of baitfish abundance to areas of baitfish scarcity and high skipjack abundance, places such as American Samoa, Guam, and the Trust Territory. The feasibility of such a plan can be gauged by how successful this experiment is in Hawaii.

PROPOSED PROGRAM

The activities of this program will be conducted in four phases with a time table as shown in Figure 1. Details of the work plan are provided in the following sections.

Phase 1 - Preliminary Baitfish Engineering Study

Phase 1 will encompass a preliminary review and assessment of baitfish transport alternatives. Each alternative has a particular set of advantages and disadvantages that must be identified, quantified, and "traded-off" in order to determine the optimum (most cost effective) method for the timely transport and holding of sufficient quantities of livebait. Quantities should be sufficient to allow the fleet to fish to the extent of its ability without lost time due to baiting or lack of bait.

The following provides a list of alternatives with brief discussions of the types of advantages, associated problems, and disadvantages that must be further studied during phase 1:

Tug and Barge. Advantages: Large volume shipment possible. Barge could be utilized as bait receiver until sufficient quantity is caught and stored in it, then towed across. Also, could be used as receiver to store and dispense bait in Hawaii. Disadvantages: Suitable barge not available--would have to be specially built--cost unknown but probably high. Charter of ocean tug costs $25,000 to $30,000 one way. Slow--30-day crossing time.

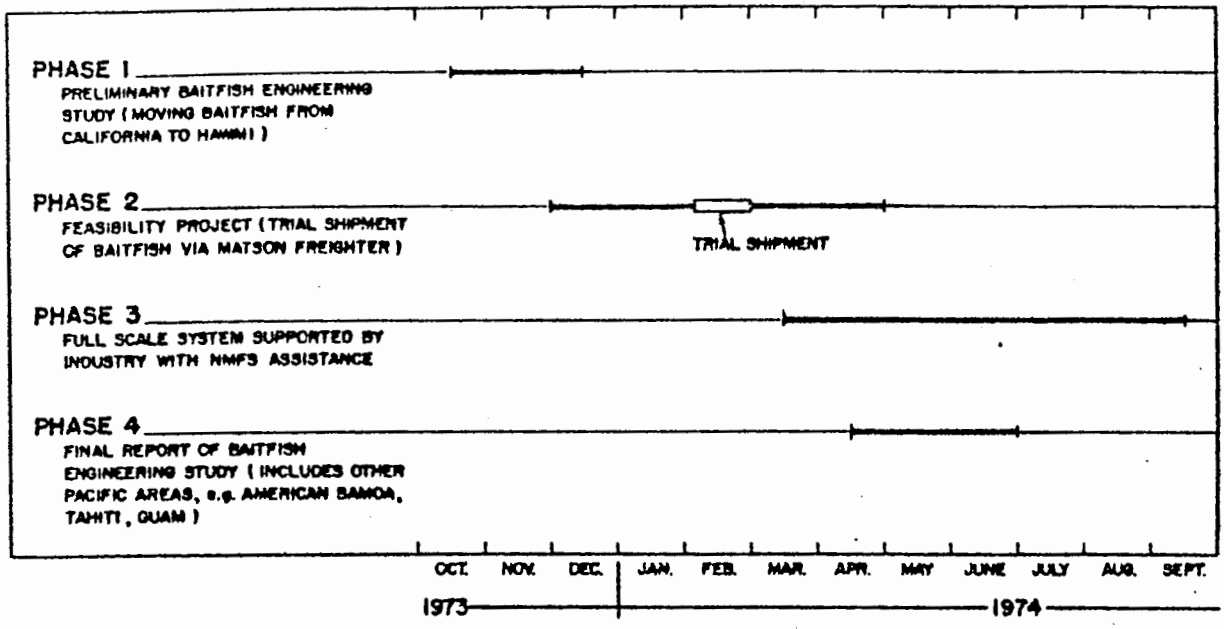

Figure 1.--Baitfish engineering study: Time study.

Bait Boat. Advantages: Designed for holding and carrying bait. Relatively high capacity (up to 3,000 scoops). Proven effectiveness. Disadvantages: Bait more stressed during rough weather. Relatively slow crossing (10 days). Orderly scheduling difficult.

Container Tank. Advantages: Fast crossing (4 days). Good scheduling. Predictable, fixed costs. Disadvantages: Vulnerable to delays in loading, unloading. Suitable tractor-trailer needed. Extra handling of bait required during loading, unloading. Twenty-five tons maximum.

Roll On/Off. Similar to container but does not require a trailer--only a tractor. Cost may be higher but easier and faster loading, unloading.

LASH (lighter aboard ships). To unload, containers are floated off. At present time only hauls dry, lighter-than-water cargo. Present scheduling precludes bait hauling to Hawaii, but could be a way to get bait to Samoa (9-day trip from Long Beach).

There are a number of problems common to most of these alternatives. Some of these are related to supply:

1. Are there legal barriers to taking anchovy from California waters? The sizes desired for bait in Hawaii may be sublegal in California. If there are any problems, they may be resolved by the special permit route.

2. Are there availability problems of anchovy in California during the peak Hawaiian skipjack tuna season from May to September? While considering aspects of legal barriers and availability, it should be borne in mind that the amount of bait required annually by the existing Hawaiian fishery is only 2-3 percent of the voluntarily recorded annual catch of live bait for southern California saltwater sport fishing.

3. Are catching and holding facilities in southern California available during peak demand in Hawaii?

4. Will costs of bait increase because of special requirements of size, aging, feeding, etc.?

5. What methods of loading bait carriers can be employed to minimize mortality due to excessive handling?

No doubt other problems relating to supply will arise during the course of the project. The problems listed above do not appear to present formidable barriers, but nontheless they should be addressed early in the project. Similar problems exist relating to receiving, holding, and dispensing of bait in Hawaii.

Additional information and data will be gathered during this phase, especially those relating to the availability and cost of moving California anchovy to Hawaii. Plans include discussions with Matson Navigation Company officials and site visits to commercial bait catching facilities in southern California. In order to aid us in conducting an adequate and proper study, the services of a consultant will be solicited.

Figure 2 provides details of activities and the time sequence to be followed.

Much of the basic background information is already available in the literature (Appendix C).

Phase 2 - Feasibility Project

A successful trial shipment of anchovy in an obviously cost effective manner will be the single most important part of the bait-moving study. It is doubtful that any other course would convince industry of the feasibility of the plan and move them to act upon it. Another paper study, no matter how favorable it may appear, is not likely to bring about any change in the present conduct of the Hawaiian skipjack tuna fishery. It is therefore essential to set up an easily repeatable demonstration that is within our existing budget framework and one which, through preliminary study conducted in phase 1, appears to be cost effective.

Work already accomplished indicates that the LASH and bait boat alternatives may be discarded because of present scheduling difficulties. The tug-and-barge concept appears to be too expensive. Containerized freight or the roll on/off freight offer definite possibilities, however.

Preliminary discussions with Matson Navigation Company officials in San Francisco and Hawaii lead us to believe that containerized freight or the roll on/off freight systems could be mechanically and financially feasible for moving baitfish from California to Hawaii. Fire hydrants to supply sea water and 220v 3-phase electrical outlets to supply pumps are conveniently located on shipboard. Exhaust sea water may simply be led over the side. Our tanks can be placed outboard in convenient locations for fast unloading. These tanks can hold 5,000 gallons of sea water and can conservatively maintain 100 buckets of anchovy.

With respect to costs, some Hawaiian fishermen have reportedly paid as high as $25 per bucket for anchovy previously brought over on trial shipments. If this figure can be taken as a first approximation value, one tank shipment is worth $2,500 to the fishermen. Estimated costs of one shipment of anchovy successfully transported by our proposed system are included in table 1.

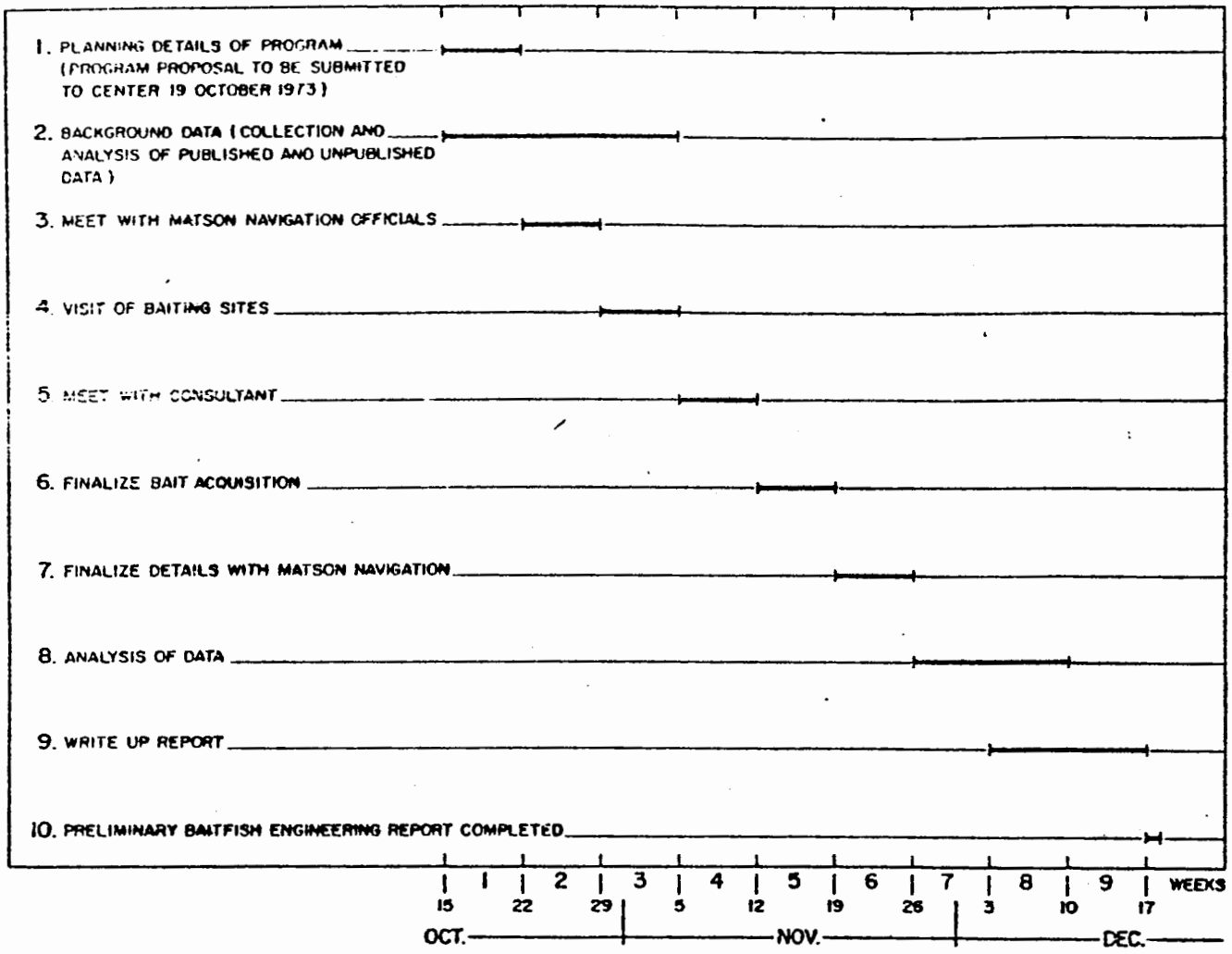

Figure 2.--Phase 1 - Activity and time sequence.

Table 1. Estimated cost of shipping 100 buckets of anchovy by transfer tank on board a commercial freighter.

Cost of anchovies	$200
Drayage	54
Hooking-up charges on freighter	100
Round trip travel	900
Total	$1,254

The projected cost figures leave a sum of $1,246 to cover as yet undetermined capital costs and other expenses.

According to Matson officials, there may be some ancillary financial benefits. Matson may have the need for transfer tanks to ship fish products and live fish from Hawaii to California. The possibility of utilizing the baitfish containers on the return trip will be looked into further. A solution may be found to reduce rates and create further opportunities for the development of central Pacific fisheries.

There is optimism too that the loading density of 100 buckets for the 5,000 gallon tank that we propose to use can be increased. This initial estimate is conservative and based on the lower loading densities experienced on past trial shipments. The Matson schedule of a 4-day transit time compared to the 9 days needed by the Jordan may permit greater crowding of the anchovy per unit volume of sea water. This will be the subject of experimentation in phase 3.

Activities preliminary to the trial shipment(s) will include (1) development of hardware to transport baitfish, (2) development of a flow-through sea water circulatory system for on-board freighter use, (3) development of a closed sea water system for short term docksite and highway use, and (4) resolving logistic problems associated with collecting, loading, unloading and handling baitfish at the California and Hawaii terminals.

Phase 3 - Development of Full-Scale System

If phase 2 is successful and transporting of anchovy to Hawaii is found to be economically feasible from the standpoint of the Hawaiian skipjack tuna fishery, the development of a full-scale system--one which would supply all of the baitfish needs of the skipjack fleet--should naturally follow. NMFS should then be the initiator of the orderly transfer to industry control of a well designed, workable system of baitfish transfer. At this point we will reexamine the various alternatives in the light of studies and experiences gained in phases 1 and 2.

As part of the total program, we will also define the optimum density of anchovy that can be maintained per unit volume of water. This figure is critical to all forms of bait shipping. Because of the relatively high costs involved in transshipment of goods, it is essential that the transfer tanks be used at optimum carrying capacity. Experiments will be performed relating mortality to density under varying conditions of temperature, dissolved oxygen, salinity, flow rates, concentrations of waste products and other environmental variables. The Southwest Fisheries Center at La Jolla would be the best place to perform these experiments because of the availability of a sea water system, availability of anchovy from nearby sources, and the availability of scientists with expertise in rearing anchovy.

Phase 4

The completion report of the bait engineering study will constitute activities of this phase. Although much of the final report will be an expansion of the preliminary report outlined in phase 1, additional information will be covered in this report, e.g., discussion and proposed solutions to meet the baitfish problems faced in other areas of the Pacific such as American Samoa, Tahiti, and Guam.

Table 2.--Proposed Budget

	Lab contribution	Other sources
Personal services		
R. Green (9 months)		$19.0
Various lab scientific staff personnel (39 man-months)	$59.1	
Consultant services (20 days)		2.0
Travel		
R. Green		
Hawaii planning meeting		0.5
Visit bait suppliers (2 trips)		0.5
Meet with consultant		0.3
Hawaii trip (report writing)		0.5
D. Aasted to California (set up equipment)		1.0
Observer to accompany baitfish transport		0.7
Miscellaneous		
Modification of container		2.0
Rental and shipping one container		5.0
Purchase of baitfish (trial shipment)		1.0
Loading bait containers (California)		1.0
Unloading bait containers (Hawaii)		1.0
Holding facility (Hawaii)		1.0
Administrative support (66% of labor)	39.0	13.9
	$98.1	$49.4 = $147.5 Total