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RAPPORT D'UNE ETUDE DE MARCHE SUR LE PRODUIT DE LA PECHE AUX ESPECES
RECIFALES ET LAGONAIRES AU SAMOA-OCCIDENTAL

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RESUME

Les statistiques concernant la petite pêche côtière au Samoa-Occidental sont à la fois incomplètes et d'une valeur douteuse, comme le révèlent les dernières estimations du total des débarquements qui, selon les sources consultées, vont de 120 tonnes courtes à 932 tonnes métriques par an. Le ministère des pêches a par conséquent instauré un programme destiné à produire une estimation plus précise de la production halieutique locale. Ce programme est en oeuvre depuis plus de deux ans.

Les ressources étant très limitées, la collecte des statistiques n'a porté que sur le marché aux poissons d'Apia. On a ainsi pu obtenir, pour les deux années écoulées depuis le lancement du programme, une évaluation correcte du chiffre d'affaires réalisé pour une série d'espèces ou de groupes d'espèces, en l'occurrence 247 tonnes en 1986 et 175 tonnes pour les 11 premiers mois de 1987. L'écart ainsi enregistré est attribué à des facteurs intrinsèques à la pêche (et non pas au fait du programme statistique utilisé), et il s'est assorti d'une augmentation marquée des prix pratiqués entre 1986 et 1987 (tableau 1, figures 1 et 2). On a également constaté une variation notable de la composition des prises d'une année à l'autre. Ainsi, le sélar coulisou Selar cruménphthalmus, qui représentait 5 % du poids débarqué en 1986, n'en constituait plus que 0,3 % en 1987.

Dans le cas du Samoa-Occidental, il est également difficile d'établir, pour une espèce côtière donnée, la correspondance entre les quantités écoulées sur le marché et le total des prises. En effet, que ce soit du point de vue quantitatif ou de la composition par espèce, le marché aux poissons n'absorbe pas nécessairement un pourcentage constant des prises totales débarquées. Il conviendrait donc de recueillir des données complémentaires sur la pêche pratiquée par les villageois, ce qui permettrait d'obtenir un tableau plus précis de la production d'ensemble et de mieux déterminer l'importance relative du marché aux poissons et des ventes du produit de la pêche côtière dans l'économie rurale du Samoa-Occidental.

Cette étude a permis de recueillir à peu de frais certaines données fondamentales révélatrices de l'évolution d'ensemble du secteur halieutique. Mais puisque les ressources dont le ministère des pêches peut disposer restent malgré tout très limitées, il serait bon de revoir les besoins futurs en matière de collecte des données pour établir un ordre de priorité, en insistant sur le fait que les renseignements d'ordre biologique doivent impérativement fournir une indication du niveau d'exploitation actuel des stocks d'espèces côtières.

Introduction

The market survey of reef and lagoon fish catch is a Fisheries Division program in which sales of inshore fish and invertebrates at the Apia Fish Market are monitored on a regular basis. For the purpose of this program "inshore" is defined as the area from the outer edge of the fringing reef landward which is accessible to non-motorized fishing craft. In Western Samoa this area is heavily fished by thousands of individuals using a wide variety of non-mechanized fishing methods. Traditionally this has been a strictly subsistence fishery. The urbanization of the Apia area and the development of a central fish market have brought about changes in the fishery over the past twenty years. The sale of reef and lagoon fish in the Apia Fish Market has become an increasingly important source of income for village fishermen. Inshore fishing is still a source of food for villagers but it can also be a source of cash when there is an of excess fish or when there is a great need for cash income.

Obtaining accurate catch data – even an estimate of catch size – on a fishery as diverse as this one can be an extremely difficult problem. A Department of Statistics survey in 1978 estimated Western Samoa's inshore fish catch to be about 666 metric tons. Other recent estimates have ranged from 40% greater than this figure, or 932 metric tons, (Johannes, 1982) to 120 short tons reported by the 1983 Fisheries Annual Report.

In January 1986 the research section of the Fisheries Division began a program of regular and ongoing data collection from the inshore fishery. Due to extremely limited resources we had access to only one component of the fishery: the Apia Fish Market. A program was designed in which data would be collected on the total sales of inshore fish and shellfish at the market two days per week. The primary goal was to estimate the total catch from the inshore fishery more accurately and on a continuing basis. We also hoped to obtain useful information on catch composition, fishing methods and economics of the fishery.

Data collection methods

In order to discuss the methods used in this program it is necessary to first describe the Apia Fish Market and its operation. The market, located in central Apia near the produce market, was built in 1981 under a Japanese government aid program. It consists of a total of 996 sq. meters of floor space encompassing both an open sales area and a closed area for office space, cold storage and sales. The 496 sq. meters of open sales area contain tiled sales counters and four fresh water sinks. These sales counters are available to the general public for sales of fish. All sellers pay WS$1.00 per day tray rental fee which is collected by the leasee of the market and retained by him. Spaces cannot be reserved from day to day. The 400 sq. meters of enclosed area are used by the leasee of the market for fish processing, storage, and sales to the public. The enclosed section of the fish market takes in fish from Western Samoa's fleet of small, motorized vessels and processes fish both for export and for sales to the general public. In the open sales area fish are sold from the motorized fleet and from the inshore fishery. Inshore fish are sold only in the open section of the market.

Fish are sold at the Apia Fish Market by individual fishermen or members of their families, occasionally by one or two people representing a small group of fishermen. All prices are set by the sellers, though occasional bartering does take place. Small fish are sold on strings while larger ones are sold individually. Fish are brought to the market every day of the week beginning at about 6:00 a.m. During the week fish are brought in throughout the day until mid-afternoon. On Saturdays most activity ceases shortly after noon while on Sundays sales start very early and last until about 8:00 a.m. Sunday sales provide fresh fish for the important Sunday noon meal. Tuna and bottom fish from the motorized "alia" fleet are also sold in the Apia Fish Market in a similar manner. There is no requirement for sellers to report their sales, therefore, this survey is the only source of information on sales from the public section of the fish market.

Typically an individual seller brings five to thirty kg of fish to the market at one time. This is usually the catch of one fisherman or a small group employing a single fishing method. Two to ten species of fish and one or more species of invertebrates are generally represented in the catch. Often the catch consists entirely of fish on strings but larger fish, sold individually, are not uncommon.

Data collection takes place at the fish market one or two days per week from 6:00 am to 4:00 pm. The day of sampling changes each week in order to equally represent all days since the volume of sales is usually greater toward the end of the week. Each person selling fish is treated as a single survey unit. An attempt is made to interview each seller and to weigh a sample of his or her fish. This forms the basis for estimating total sales for each sampling day from which the total monthly and annual sales are calculated.

Ideally, each seller is interviewed soon after arriving at the market. The person conducting the survey approaches the seller and asks permission to weigh some of the fish using a hand-held spring balance. If there are strings of fish he chooses one string which appears representative of the catch as a whole, weighs it, asks the price of the string, and records the kind of fish on the string and the number of each kind. The same procedure is repeated for any individual fish and for each kind of shellfish. Prices of shellfish are not recorded. The data collector writes down the total number of strings, fish, crabs, lobster, clams and octopus which the seller has. Fishing method and the village where the fish were caught are also recorded.

Assumptions

As in any program of data collection certain assumptions are made about the universe being sampled and about the data. A statement of these assumptions and discussion of their justification is presented here.

1. The strings sampled are representative, in weight and composition, of each person's total catch.

   Discussion: Catches usually include fish of more than one species and a range of sizes. For ease of handling sellers make up strings of fish which can all be sold for the same price. In most cases this results in strings which are about the same weight and have a similar mix of fish species.

2. The sampling days each month form a representative sample of the month as a whole.

   Discussion: Sampling days are changed each week but no sampling is done on Saturdays and Sundays. Because of the high level of activity on weekend mornings it was felt that accurate sampling would not be possible and that attempts to interview sellers would interfere with their work. Observations of the market on weekends and estimates of total sales volume indicate that the increased level of activity is offset by the shorter working day. The catch composition also appears to be similar although shellfish may be under-represented by sampling only on weekdays.

3. Accurate information is obtained by interviewing the persons selling fish.

   Discussion: The fish sellers are generally the fishermen themselves or members of their families who, no doubt, know the correct answers to the questions asked. Some early resistance to the interviews was encountered but that has largely disappeared as the sellers have become accustomed to the survey. Sellers sometimes attempt to joke or give obviously false answers but experienced data collectors can quickly pick this up and find ways to obtain accurate answers.

Data analysis methods

Data collected in the fish market are analyzed on a monthly basis and annual summaries are also produced. The following information is obtained from this analysis:

1. An estimate of the total weight of fish and shellfish sold in the market

2. An estimate of the total value of fish sales and the average cost per kg of fish

3. The approximate composition of the catch by major taxon

4. The relative importance of the major fishing methods

5. The relative importance of various outlying areas in supplying fish to the Apia Fish

The following formulae are used in analyzing the market data:

Total Daily Fish Catch = Σ [((wt. of string)x(# of strings))+((wt. of fish)x(# of fish))]

Total Daily Shellfish Catch = Σ [((wt. of crabs)x(# of crabs))+((wt. of lobster)x(# of lobster))+((wt. of clams)x(# of clams))+((wt. of octopus)x(# of octopus))]

Total Monthly Catch = (Mean of Total Daily Catch for all Sampling Days)x (# of Days in the Month)

Ave. Price Per Kg (fish only) = (price. of all sampled fish and strings)/(wt of all sampled fish and strings)

The composition of the shellfish catch is computed as the percentage of the total shellfish weight made up by each of the four major groupings of shellfish.

For example:

% Crabs = Σ [(wt. of crabs)x(# of crabs)] x 100

Total Catch

Fish catch composition is based on 15 major taxa -- either genus or family -- and is initially computed as a percentage of the total number of fish. Percentage by number of fish is used because individual weights cannot be obtained for fish sold on strings. Total number of each taxon is calculated by multiplying the number of fish of that taxon on a sampled string by the total number of strings for that seller. For each taxon a monthly total is obtained by adding the values from all sellers for the entire month.

An additional calculation is used to estimate the fish catch composition by weight. This is based on the observation that most of the fish sold in the market tend to be of a typical size for each species. Using a chart of standard length/weight relationships for various types of fish (based on fishes of Fiji and produced by Leon Zann, Univ.of the South Pacific, Suva) an average weight for each major taxon was estimated. The total number of fish of each taxon is multiplied by the estimated average weight to obtain a total weight for each taxon. From this the catch composition by weight is calculated.

This method of calculating the fish catch composition is, admittedly, convoluted and can be considered only a rough estimate. One way of testing its validity is to compare the weight obtained by adding the estimated total weight for all taxa for one month with the weight obtained by summing the total daily fish catch for all sampling days in that month. These numbers are generally found to be within ten percent of each other.

The total catch (both fish and shellfish) is also broken down according to the location of fishing and the fishing method. To simplify data analysis the various fishing methods are grouped into four generalized methods: net, spear, hook and line, and trap (including both fixed and movable traps). The fishing locations are grouped together into eight regions (see figure 1.). For each of these a percentage of the total catch based on weight is calculated.
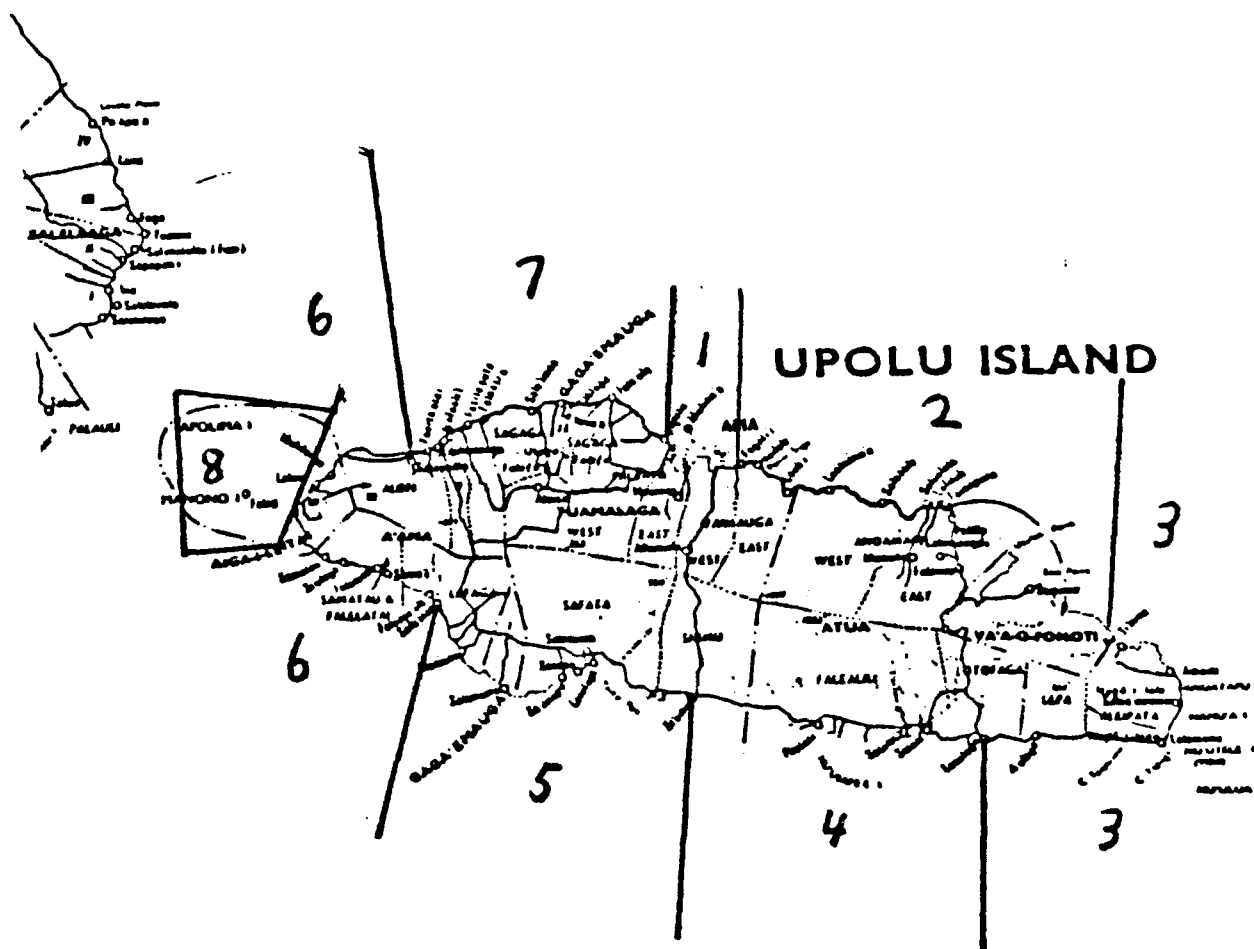

Figure 1.Areas defined for purposes of the survey:

1	Apia area: Vaigaga to Fagalii
2	NE Upolu: Vailele to Fagaloa
3	E Upolu: Tiavea to Lotofaga
4	SE Upolu: Salani to Siumu
5	SW Upolu: Mulivai to Cape Mulitapuili
6	W Upolu: Fagalei Bay to Mulifanua Wharf
7	NW Upolu: Faleolo to Vaitele
8	Manono and Apolima

During the first seven months of this program all data analysis was performed using a hand-held, programmable calculator. In August 1986 access was obtained to a computerized data base program -- "dBase III" installed on an IBM-PCxt at the Department of Statistics. Since that time all data has been converted to dBase records and analyzed using "dBase" programs. In October 1987 the data and programs stored on 5 1/4 inch diskettes at the Department of Statistics were transferred to "dBase III+" installed on a Hewlett-Packard Vectra in the Fisheries Division. Appendix 2 provides the structure of the database file and the formats of all reports.

Results and discussion

The data obtained from the market survey are summarized as monthly and annual reports. Table 1 shows the summary reports for all of 1986 and the first eleven months of 1987. Although it is unwise to make general conclusions about Western Samoa's entire inshore fishery from this small data collection effort, some of the results are worth noting. The most obvious differences between the two years are the drop in volume and increase in price. Even after estimating a twelve month total for 1987 the volume of fish sales was 55,000 kg less then 1986 and the shellfish sales were off by 10,000 kg. The average price of fish in 1987 was nearly 25% greater than in 1986.

Another obvious difference is the lack of "atule" (_Selar crumenophthalmus_) catch in 1987. In 1986 atule made up a large portion of the catch during the period March to June. At that time the appearance of atule was reported to be a regular seasonal event but the catch never materialized in 1987.

Figures 2. and 3. show the average fish price and total volume of fish sales on a monthly basis for 1986 and 1987. Here the trend of decreasing volume and increasing price is clearly evident. The free market structure of the fish market allows fluctuations in supply and demand to control the price. Demand for reef and lagoon fish is consistently high in the fish market since these favored species are not otherwise available to most of the Apia area population. The strength of demand and the willingness of customers to pay premium prices for these fish is evident in the large price increase between December 1986 and February 1987. This price increase is not coupled to a correspondingly large drop in total volume and observations indicate that it was encouraged by a cooperative effort by sellers to raise prices.

It is not at all clear, from these data, whether or not the decrease in volume at the fish market is part of a long-term trend. The extremely high volume seen in March to June of 1986 is due, at least in part, to the large catch of atule at this time. The same period in 1987 saw almost no atule catch. In addition, the low volume in May and June of 1987 is probably related to activities surrounding the celebration of Western Samoa's 25th Anniversary of Independence. These activities apparently took precedence over fishing leading to a substantial decrease in effort. With the exception of the month of September, some recovery in total volume seems evident at the end of 1987. The September value seems improbably low and may indicate problems in data collection.

It is, however, equally possible that we are seeing a steady decline in catch rate for Western Samoa's nearshore waters due to overfishing. Fishing pressure in easily accessible areas is very high and Samoans are noted for their utilization of almost any marine organism of any size. Although no length-frequency data have been collected, casual observation at the Apia Fish Market shows that the average size of all species is quite small. In addition, the high price of fish, relative ease of entry into the fishery, and lack of sources of income for villagers make it unlikely that rural fishermen are decreasing their fishing effort.

Table 1.REEF AND LAGOON CATCH
(Market Sales)

Summary	1986 TOTAL	1987 (Jan. through Nov.)
Fish Total Catch =	246,472 kg	175,307 kg
Estimated 12 Month Total =		191,256 kg
Ave. Price/Kg =	$3.72	$4.63
Shell Total Catch =	37,076 kg	24,597 kg
Estimated 12 Month Total =		26,832 kg

Catch by Region	% Wt.	% Wt.
1 Apia Area	15	16
2 NE Upolu	14	8
3 E Upolu	3	0.3
4 SE Upolu	1	0.2
5 SW Upolu	3	3
6 W Upolu	7	2
7 NW Upolu	22	20
8 Manono & Apolima	35	50

Catch by Fishing Method	% Wt.	% Wt
Net	24	40
Spear	48	31
Trap	12	16
Hook & Line	16	13

Shellfish Catch Composition	% Wt.	% Wt.
Crabs	26	39
Lobsters	29	34
Clams (Tridacna)	27	7
Octopus	18	19

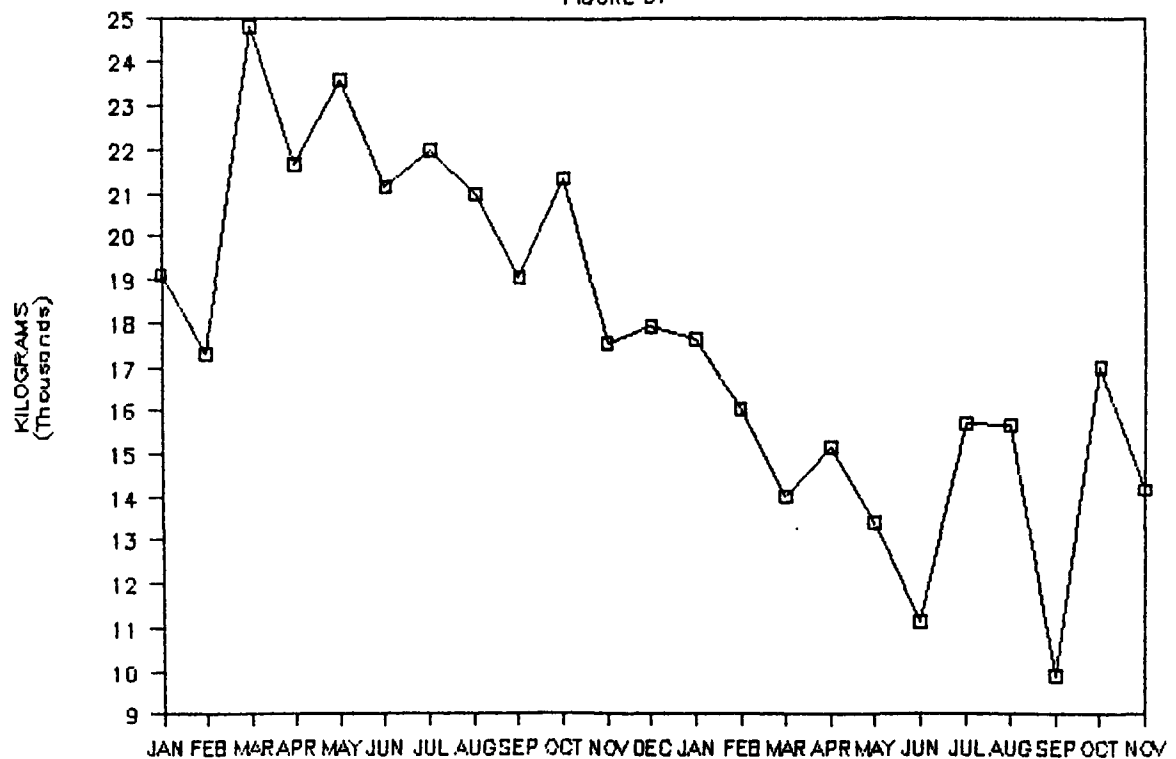| Fish Catch Composition	% #	% Wt.	% #	% Wt.
Naso	4.2	6.5	2.9	6.5
Other Acanthuridae	27.0	11.0	39.0	15.0
Selar	19.0	5.1	1.1	0.3
Other Carangidae	5.6	8.1	2.3	2.6
Scarus	7.3	11.0	10.0	17.0
Mullidae	5.6	7.3	7.8	8.8
Mugil	3.7	11.0	3.5	9.9
Gerres	2.0	0.8	0.8	0.2
Holocentridae	4.4	1.1	8.6	3.4
Serranidae	2.2	2.8	4.5	6.3
Gymnothorax	1.3	3.4	1.4	2.4
Lutjanidae	1.6	2.1	1.3	1.8
Siganus	1.6	1.0	2.9	1.1
Labridae	0.6	0.8	0.6	0.8
Lethrinus	7.7	24.0	5.5	15.0
Other	4.2	4.4	7.1	7.9

FISH PRICE 1986 & 1987

FIGURE 2.
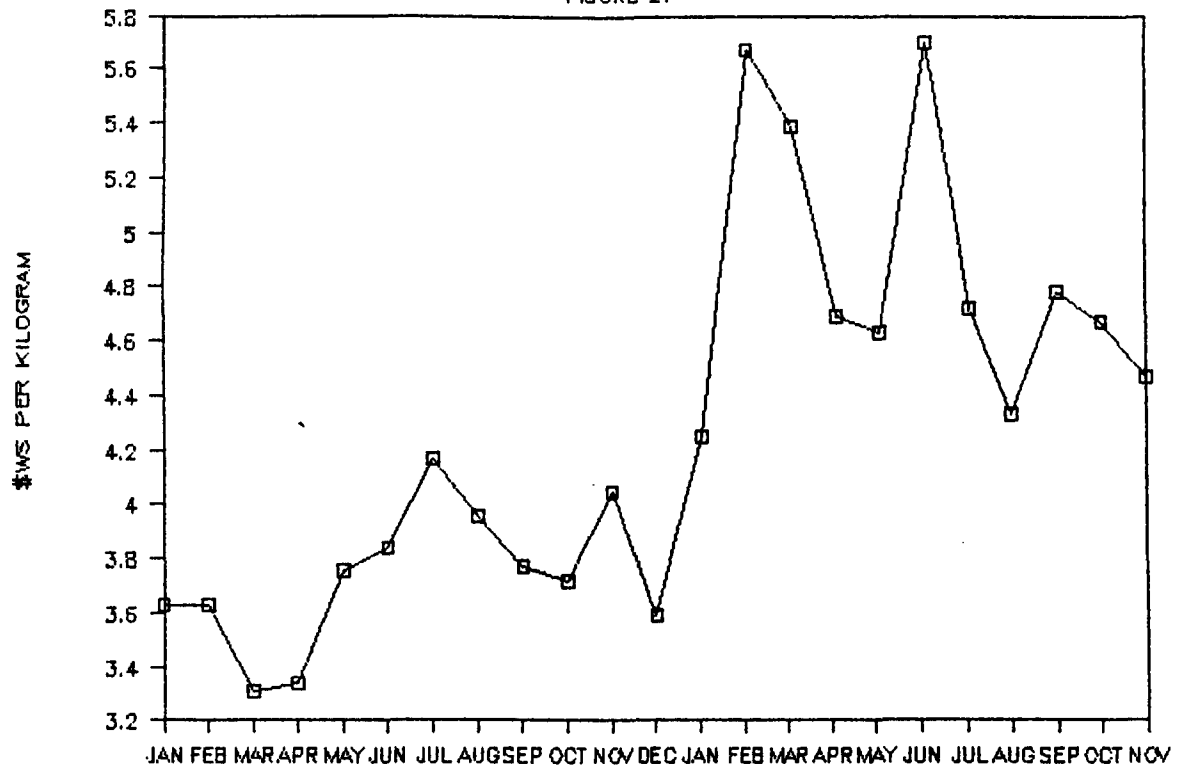
FISH VOLUME 1986 & 1987

FIGURE 3.

Aside from the previously mentioned drop in the atule catch the fish composition by taxa is fairly consistent between 1986 and 1987. It is not surprising to see that Acanthuridae, Scarus, Mugil and Lethrinus make up over 50% of the total market sales. The present analysis does not show catch by taxon for each fishing method but this could be a useful addition to the program. It could, for example, provide confirmation of the observation that a significant fraction of the mullet catch is taken by nets and stationary traps (weirs) during the September to November spawning period.

The shellfish catch composition shows a large drop in the catch of tridacnid clams. Despite the fact that composition is based on weight and includes the shell weight of the clams, Tridacna represented only 7% of the shellfish sold in the market in 1987 (down from 27% in 1986). Although this does not necessarily indicate a decrease in the total Tridacna catch it is consistent with other observations of declining stocks of Tridacna.

The breakdown of catch by region shows that, for both 1986 and 1987 more than 75% of the fish sold in the market came from the north side of Upolu and Manono and Apolima. This is to be expected given the larger lagoon area, greater population, and easier access to Apia. The percentage catch from Manono and Apolima is especially high and may indicate an essentially commercial exploitation of Manono Island's large lagoon.

Observations and recommendations

At this point, some recommendations can be made for refinement of the market survey. In any survey the information obtained is only as good as the raw data that are collected. Reliable data collection at the Apia Fish Market requires one individual who can be trusted to be diligent in his observation of market activity and accurate in his recording. This has frequently been the weak link in this survey but can be overcome by hiring reliable casual workers for the research section and by adequate monitoring of their work by the fisheries officer in charge of the program. The later is essential in order to maintain the quality of the data. Someone with fisheries training must remain actively involved by observing data collection occasionally, reviewing the data sheets regularly, and checking the data entry to "dBase".

The design of our data sheet is the result of a series of compromises between getting the necessary information and producing an unwieldy questionnaire that would be burdensome to the fish sellers. Some thought should be given to expanding the information collected but interviewing only a random sample of fish sellers every day. Total volume of sales could be estimated from tray rental receipts provided that the clerks at the market would indicate the type of fish ("inshore or "offshore) on each receipt.

The acquisition of a computer by the Fisheries Division provides an opportunity to improve on the manipulation and analysis of the data. The existing programs allow for easy data entry and generation of functional reports. They do not, however, make maximum use of the power of "dBase III+" to produce more refined reports and perform more complex analysis of the data. More advanced programs could be produced by someone with an understanding of "dBase" and some time to devote to the project.

When this survey was initiated we hoped to be able to use catch data from the Apia Fish Market to estimate the total catch of Western Samoa's inshore fishery. We now recognize that this is not possible without some complimentary data collected directly from the villages. There is no reason to assume that market sales represent a fixed subset, either in composition or volume, of the total inshore catch. This survey does provides a picture of one segment of the fishery. It is undoubtedly the largest single segment of the fishery and provides some clues to the fishery as a whole. It also provides some valuable economic information, such as the role of fish sales in Apia in supplementing rural income, which may merit further study.

Expansion of the inshore catch assessment program to include data collection in rural areas would require a substantial increase in both money and personnel for the project. It should also include the input of someone with advanced training in tropical fisheries statistics. The assessment of any traditional coral reef fishery is a difficult problem. Western Samoa's inshore fishery, with its large number of landing points, fish species, and fishing methods, is especially complex. If collection of catch data in villages is considered worthwhile one way of simplifying it would be to focus on a relatively small and well defined area such as Manono Island and its surrounding lagoon.

The present survey, though incomplete, requires a very small input of resources for the information obtained. Before any major expansion of the program is undertaken some thought must be given to precisely what information is desired and how that information is to be used. Failure to do this would be to run the risk of collecting data merely for the sake of data collection.

It may well be that the resources of the Fisheries Division could be better spent elsewhere. Information from this survey and from other sources suggests that Western Samoa's inshore resources are being fished near, or perhaps above, their maximum sustainable yield. If this is the case then taking pressure off the resource should be at least equal in importance to continued data collection. The information obtained from this survey should be used to determine future inshore data collection needs and the level of priority of data collection for the inshore fishery.

ACKNOWLEDGMENTS

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