

SEA TURTLES - GUAM

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G.H. BALAZS

1 of 3

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SOME FACTORS AFFECTING HOUSEHOLD CONSUMPTION
OF SEAFOOD AND FISH PRODUCTS ON GUAM

BY

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RICARDO J. BORDALLO
GOVERNOR



Hafa Adai!

Being a small island, much of Guam's potential economic resource base is marine in nature. As many areas would rely most heavily on their forests and farmlands, Guam will increasingly look towards the sea for economic production. The development of fisheries can increase self-sufficiency which is in line with my stated objective of transforming Guam from a consumptive to a productive society.

Currently research management and development of marine resources is in a pioneer stage. This study is among the first of several studies to be prepared in providing a foundation for future development. Other more detailed fisheries plans should follow, which will establish guidelines for the transformation of Guam's fishery industry into a viable, income producing sector.

Si Yuus Naase,


RICARDO J. BORDALLO

PREFACE

The development of mariculture on Guam is a function of both consumption (demand) and production (supply) factors. This study analyses the factors influencing local consumption, or demand, for fish or fish products. It is intended that this study be followed by a Fisheries Plan, which will also include an analysis of the factors influencing the supply of fish and fish products and a strategy for increasing their production.

One finding of this study is that consumption of fish and fish products appears to be much higher than previously estimated and that a third of those surveyed would like to eat more fish than they presently do. Household size, income and ethnic background are determinants of consumer expenditure although statistical tests lead us to believe that supply factors are even more important.

The study was conducted by Dr. Paul Callaghan, a Professor of Economics at the College of Business and Agriculture, University of Guam. Dr. Callaghan holds a Ph.D. from the University of Hawaii with emphasis in Marine Economics and has taken strong interest in mariculture and fisheries activities. The assistance of the Bureau of Labor Statistics in the survey phase of the project is appreciated.


PAUL B. SOUDER

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I. PURPOSE AND OBJECTIVES

In the past there have been a few rough estimates as to the extent of fish consumption on Guam. For example, it has been estimated that in 1974, Guam consumed fresh and frozen fish products with a market value of \$1,235,010 of which \$1,104,010 was imported.¹ It has further been estimated that by 1980 Guam will need approximately 5 million pounds of fish and fish products to satisfy local demands.² Based upon these figures there has been a recent upsurge of interest, investigation, and investment in mariculture and fishing activities in Guam. Several aquaculture, as well as fisheries, ventures have been proposed--some are well past the planning stage, and some, like the Vietnamese operation, have already been added to a long list of commercial fishing failures.

The purpose of this study is to investigate more thoroughly than has previously been done the household demand for fish products on Guam. Baseline information on current household preference and consumption patterns will be developed, and an attempt will be made to isolate some social and economic factors which influence the extent of current household fish consumption. Special attention will be given to the effect of ethnic and income differences on seafood and fish consumption.

It is hoped that information presented in this paper will provide a more firm foundation than that which has existed in the past for the planning of mariculture and fishery projects on Guam.

II. DATA COLLECTION AND CHARACTERISTICS OF THOSE SURVEYED

The empirical analysis, results, and projections presented in this paper are based upon a questionnaire which was appended to the regular quarterly labor force survey conducted by the Government of Guam, Bureau of Labor Statistics. Information was gathered from a cross section of 1,054 households in 19 villages during the week ending March 18, 1977. Households were randomly selected based on census data and housing maps of each village according to standard Labor Department procedures.³ A summary of households surveyed from each village appears in Table I.

When making the survey, the enumerator asked to interview the household head or the wife of the head. In some cases neither of these individuals was available and the enumerator was forced to interview other household members. The general characteristics of those interviewed are presented in Tables II and III.

Although some discrepancies do exist, the characteristics of respondents and households surveyed for this study approximate quite closely the most recent demographic data for Guam as published in the Bureau of Planning's Overall Economic Development Plan, June 1977. There is every reason to believe that the households surveyed in this study do constitute a sufficiently large random sample which is representative of all households on Guam; however, extreme caution should be exercised when drawing conclusions for the population as a whole based upon the information presented in Tables II and III.

TABLE I

HOUSEHOLDS INTERVIEWED IN EACH VILLAGE
BY NUMBER AND PERCENT OF THE TOTAL SURVEY

Village	Number of Households Surveyed	Percent of the Total Survey
Agana	11	1.0
Agana Heights	34	3.2
Agat	46	4.4
Asan/Maina	16	1.5
Barrigada	72	6.8
Chalan Pago/Ordot	40	3.8
Dededo	220	20.9
Inarajan	22	2.1
Mangilao	86	8.2
Merizo	21	2.0
Mongmong/Toto/Maite	65	6.2
Piti	16	1.5
Santa Rita	40	3.8
Sinajana	27	2.6
Talofofo	25	2.4
Tamuning	195	18.5
Umatac	7	0.7
Yigo	60	5.7
Yona	51	4.8
TOTAL	1054	100.0

TABLE II
CHARACTERISTICS OF RESPONDENTS SURVEYED

Characteristics of Respondents	Number of Respondents*	Percent of Total Respondents
RELATION TO HEAD OF HOUSEHOLD:		
Head	468	44.4
Wife of Head	459	43.5
Other Relative of Head	112	10.6
Not Related to Head	15	1.4
TOTAL	1054	100.0
SEX:		
Male	397	37.8
Female	653	62.2
TOTAL	1050	100.0
ETHNIC BACKGROUND:		
Guamanian	476	45.3
Filipino	229	21.8
Caucasian	167	15.9
Micronesian	35	3.3
Japanese	33	3.1
Chinese	15	1.4
Korean	21	2.0
Guamanian/Filipino	16	1.5
Guamanian/Caucasian	6	0.6
All Other Mixtures	37	3.5
Not Ascertainable	16	1.5
TOTAL	1051	100.0
MARITAL STATUS:		
Married	755	72.0
Widowed	45	4.3
Divorced	54	5.2
Separated	33	3.1
Never Married	161	15.4
TOTAL	1048	100.0

TABLE II (Continued)

Characteristics of Respondents	Number of Respondents*	Percent of Total Respondents
VETERAN STATUS:		
Veteran	129	12.3
Non-Veteran	919	87.7
TOTAL	1048	100.0
CITIZENSHIP:		
U.S. Citizen	828	79.1
Permanent Resident Alien	203	19.4
Not Ascertainable	16	1.5
TOTAL	1047	100.0

*The sample size does not always total 1054 since some respondents either refused or were unable to answer certain questions.

TABLE III
 ADDITIONAL CHARACTERISTICS OF RESPONDENTS
 AND HOUSEHOLDS SURVEYED

Characteristic	Number of Respondents*	Mean	Median	Mode	Standard Deviation	Standard Error
Age of Respondent (years)	1049	37.86	36.00	29.00	13.393	.4135
Education Level of Respondents (years)	1051	11.49	12.00	12.00	4.023	.1239
Household Size	1054	4.63	4.00	4.00	2.634	.0811
Household Income Per Capita	948	14,330.17	11,000.00	8,500.00	10,989.890	356.9350

*The sample size does not always total 1054 since some respondents either refused or were unable to answer certain questions.

III. SCOPE AND LIMITATIONS

The data upon which this study is based was collected at a single point in time and represents a random cross section of households. Without time series data on fish and seafood prices and consumption patterns it is impossible to construct a meaningful and comprehensive demand relationship--this study does not attempt to do so. Cross sectional information, however, does allow estimation of current consumption patterns as well as isolation of some factors which may affect future consumption patterns. If in the future the survey used in this study were administered on an annual or quarterly basis, the resulting time series comparisons would facilitate the development of much more precise demand relationships than those presented here.

This study covers only household consumption of fish and seafood products. It does not include consideration of commercial (hotel and restaurant) demand. A survey of commercial establishments could easily be undertaken and the result would be quite enlightening when combined with the information presented here.

It must be remembered that consumers' preferences are influenced to some extent by their knowledge and expectations as to the currently available supplies. What a consumer actually does in the market place may differ greatly from what he truly would like to do. He may often purchase fish products not because they are his favorite but because his true preference is unavailable. The survey done for this study provides some information on both consumer preferences and consumer actions. The reader should judiciously pick his way through the information presented remembering that current market actions may not necessarily reflect true consumer desires.

IV. CONSUMER PREFERENCES AND BEHAVIOR

When asked the question "Does the household ever eat fish or seafood products?", 943 households (89.5 percent of the respondents) answered affirmatively. The remaining 111 households (10.5 percent of the respondents) either do not eat fish or did not answer the question.⁴ Of those households eating fish, 81.4 percent indicated a preference for fresh fish over frozen, canned, dried, and smoked fish. When asked whether the household would prefer to eat fish more often, 52.3 percent of the fish consuming households said that they would prefer to maintain their present consumption rate. Some 34.4 percent indicated that they would prefer to eat fish more often, and 12.9 percent indicated a desire to consume fish less often than presently.

When questioned regarding size preferences, 19.3 percent of the fish consuming households indicated a preference for fish under 7 inches in length, 59.8 percent preferred fish between 7 and 14 inches in length, and 14.4 percent preferred fish larger than 14 inches. Some 6.5 percent of the respondents indicated that they had no size preference.

The respondent in each fish consuming household was shown a flash card and asked to choose which type of canned fish product the household most often bought. The resulting consumption pattern is presented in Table IV. Respondents were also asked which types of frozen and fresh fish products the household most often bought. Answers were recorded in the language given and later translated into one of 69 categories based on a compilation of common and local names (see Appendix A for a summary of categories). The eleven most frequently purchased categories of frozen and fresh fish appear in Tables V and VI.

TABLE IV

CANNED FISH PRODUCTS MOST FREQUENTLY
BOUGHT BY FISH CONSUMING HOUSEHOLDS ON GUAM

Canned Product	Number of Respondents	Percent of Total Respondents
Tuna	400	42.4
Sardines	208	22.1
Salmon	116	12.3
Mackerel	30	3.2
Crab	7	.7
Clams	6	.6
Shrimp	6	.6
Abalone	3	.3
Oysters	3	.3
Other	1	.1
No Response*	163	17.3
TOTAL	943	100.0

*These households either do not buy canned fish, or refused, or were unable to answer.

TABLE V

TYPES OF FROZEN FISH MOST FREQUENTLY
BOUGHT BY HOUSEHOLDS ON GUAM, RANKED IN
ORDER OF FREQUENCY

Rank	Common and Local Names
1st	<u>Mackerel</u> (achuman, alumanhan, atulai, lumahan, saba, tangigi)
2nd	<u>Shrimp</u> (Sugpo, uhang)
3rd	<u>Milkfish</u> (agua, bangus)
4th	<u>Tuna</u> (albakora, gulyasan, katsuo (aku), mangro (ahi))
5th	<u>Rabbitfish</u> (manahac, dage, sesjun, hiting, kicho, samaral)
6th	<u>Snapper</u> (bua, dalangbukid, fafaet, funai, hamala, kakaka, lilikuke, mafute, matanhagon, mayamaya, salagi, tagafi)
7th	<u>Surgeonfish</u> (guase, hangon, tataga, hijuk, hugupao)
8th	<u>Prepared fish products</u> (fish sticks, fish patties, etc.)
9th	<u>Rudderfish</u> (anaha, gepan, gueli)
10th	<u>Salmon</u> (sake, satmon)
11th	<u>Parrotfish</u> (atuhon, dafa, gualig, gulafi, lacha, lagua, laguan agaga, magaham, mulmul, ogos, packak, palacse, tuchugon)

TABLE VI

TYPES OF FRESH FISH MOST FREQUENTLY BOUGHT BY
HOUSEHOLDS ON GUAM, RANKED IN ORDER OF FREQUENCY

Rank	Common and Local Names
1st	<u>Milkfish</u> (agua, bangus)
2nd	<u>Rabbitfish</u> (manahac, dage, sesjun, hiting, kicho, samaral)
3rd	<u>Mackerel</u> (achuman, alumahan, atulai, lumahan, saba, tangigi)
4th	<u>Shrimp</u> (sugpo, uhang)
5th	<u>Snapper</u> (bua, dalagang bukid, fafaet, funai, hamala, kakaka, lilikuke, mafute, matanhagon, mayamaya, salagi, tagafi)
6th	<u>Surgeonfish</u> (guase, hangon, hijuk, hugupao, tataga)
7th	<u>Tuna</u> (albakora, gulyasan, katsuo, mangro)
8th	<u>Parrotfish</u> (atuhon, dafa, gualig, gulafi, lacha, lagua, lagan agaga, magaham, mulmul, ogos, packak, palacse, tuchugon)
9th	<u>Grouper</u> (gadao, lapulapu, salmoniya)
10th	<u>Rudderfish</u> (anaha, gepan, gueli)
11th	<u>Jack/Skipjack</u> (ee ei, hagi, mamulan, pampano, tarakito, tarakitiyon, talakito)

As indicated in Table VII the households surveyed ate fish at a main meal 1.56 times per week on average. They also ate two substitutes, chicken and ground meat, 1.84 and 1.34 times per week respectively. The standard errors for these figures are such that we can be 95 percent confident that the true mean consumption frequencies for all households on Guam lie within an interval of $\pm .16$ times per week. The large standard deviations in Table VII imply that there is a large variation among households with respect to the frequency of fish consumption.

Some 814 of the 1054 households surveyed answered questions regarding quantities of fish purchased and prices paid. Table VIII, which shows household spending per week on fish products, was constructed using the information supplied by these 814 households. Mean household spending on all fish and seafood products amounts to \$11.26 per week. Just as with frequency of consumption, the amount spent on fish products varies greatly among households throughout Guam. Average household spending is apportioned approximately 31 percent for canned, 26 percent for frozen, 36 percent for fresh, and 7 percent for dried products. In the case of each fish product in Table VIII, we can be 95 percent confident that the true mean weekly household spending for all households on Guam lies within an interval of plus or minus 3 times the standard error.

The mean weekly household spending figures in Table VIII can be multiplied by the estimated 16000 households on Guam.⁵ This product can then be reduced by the 10.5 percent of households which do not eat fish⁶ and multiplied by 52 in order to arrive at an annual estimate for retail dollar value of household fish consumption on Guam. These estimates along with their corresponding confidence intervals appear in Table IX.

TABLE VII

FISH AND SEAFOOD PRODUCT CONSUMPTION COMPARED TO CHICKEN AND
GROUND MEAT: FREQUENCY PER WEEK BY HOUSEHOLDS AT A MAIN MEAL
(N = 1054)

Item	Mean Frequency Per Week	Standard Deviation	Standard Error	Coefficient of Variation
Fish and Fish Products	1.56	1.699	.0523	109
Chicken	1.84	1.617	.0498	88
Ground Meat	1.34	1.451	.0447	108

TABLE VIII

TOTAL WEEKLY HOUSEHOLD SPENDING ON VARIOUS
FISH PRODUCTS
(dollars, N = 814)

Fish Product	Mean Spending	Standard Deviation	Standard Error	Coefficient of Variation
Canned	3.51	4.448	.1610	127
Frozen	2.94	7.098	.1043	241
Fresh	4.06	7.573	.1441	187
Dried and Smoked	.75	1.444	.0264	193
All Fish Products	11.26	13.463	.4720	120

TABLE IX

ESTIMATED CURRENT ANNUAL RETAIL VALUE OF SEAFOOD AND FISH
 PRODUCTS CONSUMED BY HOUSEHOLDS ON GUAM
 (Thousands of dollars)

Fish Products	Estimated Retail Value*	95 Percent Confidence Interval
Canned	2,614	± 480
Frozen	2,189	± 311
Fresh	3,023	± 429
Dried and Smoked	258	± 79
All Fish and Seafood Products	8,385	± 1,406

*Assuming 16,000 households, 89.5 percent of which consume fish and seafood products.

V. ETHNIC DIFFERENCES IN FISH AND SEAFOOD CONSUMPTION

Each respondent to the survey was shown a flash card and asked to indicate which of ten categories best described his ethnic background. Based upon this response households were classified according to ethnic group. It was assumed that the ethnic background of the respondent reflects that of the entire household.

Tables X and XI provide an ethnic breakdown for both frequency of consumption and weekly household spending on fish and seafood products. The Filipino and Japanese populations rank first and second respectively in both frequency of consumption and weekly spending. Although the Chinese rank third in frequency of consumption, they rank fifth in weekly spending. This difference in ranking may be partially explained by smaller household sizes among the Chinese community (see Appendix B). Guamanian households ranked fourth with respect to frequency of consumption and third with respect to total weekly spending. Again this difference in ranking between frequency of consumption and weekly spending may be partially explained by a relatively large household size in the Guamanian community (see Appendix B). Among all ethnic groups surveyed, Caucasians appear to have the lowest total weekly spending as well as the second lowest frequency of consumption.

Although there are statistically significant differences between group means in Tables X and XI, the standard deviations of all groups are relatively high - often in excess of the group mean. Thus, it becomes apparent that there is a wide variation in consumption habits within each ethnic group as well as among the population as a whole (see Table VII and VIII).

TABLE X

FISH AND SEAFOOD PRODUCT CONSUMPTION: FREQUENCY PER WEEK
BY HOUSEHOLDS AT A MAIN MEAL, BY ETHNIC GROUP

Ethnic Group	Mean Frequency Per Week*	Sample Size	Standard Deviation	Standard Error
Filipino	2.569	229	1.774	.117
Japanese	2.561	33	2.671	.465
Chinese	1.667	15	1.447	.374
Guamanian	1.340	479	1.634	.075
Other	1.257	53	1.251	.172
Guamanian-Filipino	1.255	16	1.716	.429
Korean	1.133	21	1.137	.248
Micronesian	1.034	35	1.026	.173
Caucasian	0.919	167	1.148	.089
Guamanian-Caucasian	0.718	6	0.748	.305

*An analysis of variance yields an F statistic of 16.6626 which indicates a significant difference between ethnic groups at the 95 percent confidence level.

TABLE XI

TOTAL WEEKLY HOUSEHOLD SPENDING FOR ALL
FISH AND SEAFOOD PRODUCTS BY ETHNIC GROUP
(dollars)

Ethnic Group	Mean * Weekly Spending	Sample Size	Standard Deviation	Standard Error
Filipino	15.97	200	17.97	1.270
Japanese	12.14	24	13.70	2.797
Guamanian	11.51	375	11.95	0.617
Guamanian-Caucasian	11.14	4	8.49	4.245
Chinese	9.90	10	10.12	3.201
Micronesian	8.68	30	9.46	1.727
Other	7.89	40	10.76	1.701
Guamanian-Filipino	7.61	12	8.41	2.429
Korean	6.72	15	8.66	2.235
Caucasian	4.34	104	6.79	0.665

*An analysis of variance yields an F statistic of 6.9285 which indicates a significant difference between ethnic groups at the 95 percent confidence level.

As previously discussed in Section I, respondents were asked to identify which types of canned, fresh, and frozen fish products the household most often bought. Answers were recorded in any language given and later translated into one of 69 categories (see Appendix A for a summary of categories). The most frequently purchased categories of fresh and frozen fish by ethnic group appear in Tables XII, XIII, and XIV.

Category	Percentage	Number	Percentage	Category
100.1	15.87	100	15.87	Japanese
100.2	13.70	88	13.70	Japanese
100.3	11.98	79	11.98	Japanese
100.4	8.88	58	11.98	Japanese-American
100.5	10.15	67	8.88	Japanese
100.6	9.88	65	8.88	Japanese
100.7	10.15	67	7.88	Other
100.8	7.88	52	7.88	Japanese-American
100.9	8.88	58	6.75	Other
100.0	8.88	58	6.75	Japanese

The weights of columns total 100 percent. The percentages in the columns are based on the total number of respondents who answered the question. The percentages in the rows are based on the total number of respondents who answered the question.

TABLE XII

TYPES OF CANNED FISH PRODUCTS MOST FREQUENTLY BOUGHT BY HOUSEHOLDS ON GUAM, RANKED IN ORDER OF FREQUENCY, BY ETHNIC GROUPS

Canned Product	Rank by Ethnic Group									
	Guam. (476)*	Filip. (229)	Cauc. (167)	Micro. (35)	Jap. (33)	Chin. (15)	Korean (21)	Guam/ Filip. (16)	Guam/ Cauc. (5)	Other (37)
Tuna	2	2	1	1	1	2	1	1	1	1
Sardines	1	1	2	2	3	1	3	2		2
Salmon	3	3	3	3	2		2	3	2	3
Mackerel	4	4	4	4	4		4	4		4
Crab		5			5	4	5			5
Clams	5		5							
Shrimp								5		
Abalone						3				
Oysters										5

*Numbers in parenthesis indicate sample size.

TABLE XIII (continued)

Common & Local Names	Rank by Ethnic Group								
	Guam.	Filip.	Cauc.	Micro.	Jap.	Chin.	Korean	Guam/ Filip. Cauc.	Other
<u>Grouper</u> (gadao, Tapulapu, salmoniya)	(476)*	(229)	(167)	(35)	(33)	(15)	(21)	(16)	(37)
<u>Prepared Fish Products</u> (fish sticks, fillets)		2							
<u>Other</u>		3			3	1	1		1
<u>Octopus</u> (gumson)					5				
<u>Crab</u> (panglao, alimgao, alimasak, alimango, kane, ayuyu)						4			
<u>Squid</u> (Nosnus)							4		
<u>Salmon</u> (satmon, sake)								2	4

*Number in parenthesis indicates sample size.

TABLE XIV

TYPES OF FRESH FISH MOST FREQUENTLY BOUGHT BY HOUSEHOLDS ON GUAM, RANKED IN ORDER OF FREQUENCY, BY ETHNIC GROUPS

Common & Local Names	Rank by Ethnic Group									
	Guam. (476)*	Filip. (229)	Cauc. (167)	Micro. (35)	Jap. (33)	Chin. (15)	Korean (21)	Guam/ Filip. (16)	Guam/ Cauc. (5)	Other (37)
<u>Milkfish</u> (agua, bangus)		1				1				3
<u>Rabbitfish</u> (manahac, dage, sesjun, hitting, kicho, samaral)	1							2	2	
<u>Mackerel</u> (achuman, alumahan, atulai, lumahan, saba, tangigi)	2	3			5			1	1	
<u>Shrimp</u> (sugpo, uhang)		2	5	5	4	2	2			
<u>Snapper</u> (bua, dalangbukid, fafaet, funai, hamala, kakaka, lilikuke, mafute, matanhagon, mayamaya, salagi, tagafi)	4		1		3	5		5		
<u>Surgeonfish</u> (guase, hangon, hijuk, hugupao, tataga)	3		3	3			5	3		4
<u>Tuna</u> (albakora, gulyasan, katsuo)			4	2	1		3			
<u>Parrotfish</u> (atuhon, dafa, gualig, gulafi, lacha, lagua, laguan-agaga, magaham, mulmul, ogos, packak, palacse, tuchugon)				4						
<u>Grouper</u> (gadao, lapulapu, saImoniya)		5	2	1	2	3	1	4		2
<u>Other</u>		4								5
<u>Squid</u> (nosnus)							4			

*Number in parenthesis indicates sample size.

VI. SOME FACTORS AFFECTING HOUSEHOLD SPENDING FOR FISH AND SEAFOOD PRODUCTS

In an attempt to determine the relative importance of those factors which affect fish consumption among households on Guam, the following linear model was hypothesized:

$$TS_j = \beta_1 + \beta_2 Pmc_j + \beta_3 I_j + \beta_4 S_j + \sum_{i=1}^9 \beta_i E_i + \epsilon \quad (1)$$

Variables in the model take on the following meanings:

- TS_j : total weekly spending (measured in dollars) by the j th household on canned, fresh, frozen, and dried fish products as estimated by the respondent;
- pmc_j : the average price paid (measured in dollars) by the j th household for ground meat and chicken products (substitutes for fish) as estimated by the respondent;
- I_j : the total household income (measured in thousands of dollars) as estimated by the respondent;
- S_j : the number of household members;
- E_i : a set of dummy variables designed to capture ethnic differences in consumption spending, $i = 1, 2, \dots, 9$

E_1 : Guamanian

E_2 : Filipino

E_3 : Micronesian

E_4 : Japanese

E_5 : Chinese

E_6 : Korean

E_7 : Guamanian/Filipino

E_8 : Guamanian/Caucasian

E_9 : Other.

The parameters β_1 through β_{13} represent constants with ϵ included as an error term to account for variations in TS_j explained by factors other than those included in equation (1).

The ordinary least square estimation of equation (1), based on a sample size of 545 households, resulted in an estimated value of β_2 which was insignificantly different from zero at the 95 percent confidence level. From this result it can be concluded that the average price of meat and chicken (substitutes for fish), as perceived by the respondents sampled, is not a significant factor influencing total household spending on fish and seafood products.

After removing P_{mc} from the model, sample size was increased to 753 households and ordinary least square estimation resulted in the following:

$$\begin{aligned}
 TS_j = & -222 + .013 I_j + 1.039 S_j + 5.027 E_1 + 10.328 E_2 \\
 & \quad (1.636) \quad (5.261) \quad (3.628) \quad (6.976) \\
 + & 3.798 E_3 + 7.126 E_4 + 4.920 E_5 + 3.308 E_6 + 2.380 E_7 \\
 & \quad (1.312) \quad (2.337) \quad (1.095) \quad (.696) \quad (.579) \\
 + & 5.860 E_8 + 10.938 E_9 + \epsilon \\
 & \quad (.886) \quad (2.304) \quad (2)
 \end{aligned}$$

$$R^2 = .1168$$

$$F = 9.026$$

$$n = 753$$

Numbers in parenthesis represent t values.

The explanatory and predictive value of this model is quite poor. Variations in household size, income, and ethnic background account for only 11 percent of the variation in total household spending on fish products. The remaining variation in TS_j is accounted for by factors other than those included in equation (2).

There are several possible explanations for the failure of equation (2) to explain more adequately total household spending. First, the relationship between weekly household spending and the explanatory variables may not in reality be linear. Second, significant sampling error could be embodied in the data. Both the measurement and homogeneity of variables used in the model are open to question since the data was

collected by different enumerators who may have interpreted and recorded data inconsistently. The assumption that the ethnic background of entire households is reflected by the stated ethnic background of respondents is only one example of the homogeneity problems involved.

A major reason for the relatively poor explanatory and predictive power of equation (2) can reasonably be attributed to the lack of any measure of product availability. Total household spending, TS_j , is dependent on both demand and supply considerations. Only demand considerations are included as independent variables in the above model. The results seem to imply that supply constraints are a very important determinant of total household spending for fish and seafood products on Guam.

Aside from underscoring the importance of fish product availability as a determinant of TS_j , equation (2) does provide other interesting results. Both income and family size are statistically significant (95 percent confidence level) and affect household spending positively. All else remaining constant, each additional household member has a positive impact on TS_j of 1.029 dollars per week. Similarly, each additional thousand dollars of household income has a positive impact on TS_j of .013 dollars per week, all else remaining constant.

The nine coefficients for ethnic groups represent estimated differences in household spending relative to Caucasian household spending which is included in the intercept term, β_2 . Coefficients for Guamanian (E_1), Filipino (E_2), Japanese (E_4), and Other (E_9) all imply household spending patterns significantly higher than that of Caucasians. Other ethnic groups have coefficients which are not statistically different from zero, at the 95 percent confidence level, and thus do not differ significantly from Caucasians with respect to TS_j .

VII. CONCLUSIONS AND RECOMMENDATIONS

A random survey of 1054 households on Guam provides the following major results:

1. A significant portion of the households surveyed (34.4 percent) would like to eat fish more frequently than they presently do.
2. The average current household consumption rate for fish and seafood products is 1.56 times per week; however, this consumption rate varies extensively among households and between ethnic groups.
3. The average current household spending on fish and seafood products is \$11.26 per week; however, this spending rate varies widely among households and between ethnic groups.
4. A minimum estimate (at a 95 percent confidence level) of annual household retail spending for all fish and seafood products on Guam is \$6.9 million. This spending is apportioned approximately 31 percent for canned, 26 percent for frozen, 36 percent for fresh, and 7 percent for dried and smoked fish products.
5. The most frequently purchased canned fish product is tuna while the most frequently purchased frozen and fresh fish products are mackerel (achuman, alumahan, atulai, lumahan, saba, tangigi) and milkfish (agua, bangus) respectively. Considerable variation in buying habits between ethnic groups is apparent.
6. With respect to frequency of consumption and total weekly spending on fish and seafood products, the Filipino population ranks first followed by the Japanese and Guamanian populations respectively. Caucasians have the lowest total weekly spending as well as the second lowest frequency of consumption.
7. Both income and household size have a statistically significant and positive effect upon the total dollar value of household consumption. Ethnic back-

ground also seems to be an important determinant of consumption; however, respondents' perception of the price of substitutes (ground meat and chicken) has no statistically significant effect upon total household consumption.

8. Despite their significance, variations in household size, income and ethnic background together explain only 11 percent of the variation in total household spending for fish and seafood products. The remaining variation in household spending must be explained by factors other than those measured in this study.

Based upon the foregoing survey results, it appears that there currently exists on Guam a retail market for fresh and frozen fish which is in excess of \$4 million annually. It also appears that households would consume more fish if it were conveniently supplied. The major constraints to retail market growth seem to be those associated with supply (availability) rather than those associated with demand. Unfortunately, the lack of time series data on household consumption and fish product prices precludes a more detailed investigation of the relevant demand elasticities which are necessary to fully analyze the potential market growth.

A \$4 million estimate for annual fresh and frozen consumption is considerably higher than most previous estimates; however, when considering commercial fishing or aquaculture ventures based upon these local market sales, one should keep in mind several points. First, the figure of \$4 million purchases is a current market estimate at retail prices and thus includes all middleman markups which can be well in excess of 100 percent. Second, these fish product sales are highly fragmented through many small enterprises island-wide. Third, the market for fish is also highly segmented with respect to desired species. It appears that certain consumers favor one species of fish above others and this favoritism may not be easily overcome. Finally,

seasonal factors must be considered. The most profitable fish to catch is often not the fish which is most abundant and therefore easiest to catch. A portion of Guam's fish market may always be captured by imports simply because during some seasons certain species are unavailable in Guam waters. Unfortunately consumer tastes do not change easily nor with the seasons.

In order to ensure maximum local producer participation in Guam's fish and seafood markets an effort should be made to centralize both production and distribution activities in one or two locations. A market and storage area proximal to docking facilities will facilitate both production and consumption. Safe vessel moorage and convenient fuel and ice supplies for fishermen are essential. Freezer storage is also necessary in order to compensate for seasonal fluctuations in demand and supply as well as to provide the potential for tapping export markets.

In conclusion it appears that the dollar value of household demand for fish and seafood products on Guam is substantial, but tastes are quite varied and distribution highly fragmented. Further study should be devoted to analyses of the local commercial and export demands as well as local production potentials for import substitution. Update of this particular study at various points in time would allow some projection as to how household consumption patterns change as income and ethnic composition change.

A P P E N D I C E S

APPENDIX A
SUMMARY OF FISH NAME CATEGORIES⁷

English Common	Chamorro	Filipino	Other
Abalone			
Anchovy	fadgya faya		
Barracuda	alu		
Bass	atingyet umatan		
Butterfish			
Catfish	itol	hito	
Clams	hema dogas tapun	tahong	kaii
Codfish			
Crab	panglao almangao alimasak ayuyu	alimango	kane
Carp		mudfish	koi
Eels	hasule titugi hasule palus padpada		
Flatfish	tampat		
Flyingfish	gaaga		
Flounder			
Goatfish	tiao equan salmonetiyon salmoneti	salmoneti	
Goby	atot		
Grouper	gadao salmoniya	lapulapu	

APPENDIX A (Continued)
SUMMARY OF FISH NAME CATEGORIES

English Common	Chamorro	Filipino	Other
Halfbeak			
Halibut			
Herring			
Jack	ee ei tarakitiyon tarakito mamulan hagi	pampano talakito	
Lobster	mahonggan gupolalao		ese ebi
Mackereel	achuman atulai	tumahan alumahan tangigi	saba
Mahimahi			dolphin
Marline/Sailfish		malasagi	
Milkfish	agua	bangus	
Mullet	laiguan aguas laiguan ugis	banak	
Needlefish	bajak pulus hankut		unagi
Octopus	gumson		taco
Oysters			
Parrotfish	palacse packak atuhon dafa lagua tuchugon gulafi gualig lacha magaham lagua agaga	ogos mulmul	

APPENDIX A (Continued)
SUMMARY OF FISH NAME CATEGORIES

English Common	Chamorro	Filipino	Other
Prawn/Shrimp	uhang	sugpo	
Porcupine/puffer	butete butete tituka		
Rabbitfish	manahac dage sesjun hiting kicho	samaral	
Rainbow runner		hasahasa salmon	
Rays	quadrau fanihen tase hafula		
Rockfish			
Rudderfish	anaha gepan gueli		
Salmon	satmon		sake
Sapsap			
Scorpionfish	nufu		
Sea Cucumber	balate		
Sardines	satdinas	sardinas	
Scallop			
Sharks	katsunsi to haluo		same
Shrimp/Prawn	uhang	sugpo	
Silver perch/Perch	guaguas cajao ginyo		
Smelt			

APPENDIX A (Continued)
SUMMARY OF FISH NAME CATEGORIES

English Common	Chamorro	Filipino	Other
Snappers	lilikuke mafute bua kakaka funai tagafi fafaet salagi hamala matanhagon	mayamaya dalang bukid dalgang bukid	
Squid (cuttle fish)	nosnus		
Sole			
Squirrelfish	sagsag sagamilon sesiok chala	besugo sagapa	mempochi
Surgeonfish	hugupao hangan tataga guase hijuk		
Swordfish			
Tilapia	talapia	tilapia	
Tarpon	pulan		
Triggerfish	pulonon sasadu		
Turbot			
Trout			
Tuna - Skipjack - Yellowfin - Dog tooth		gulyasan albakora	katsuo (aku) mangro (ahi)
Turtle - green - hawksbill	hagan hagan karai		kame

APPENDIX A (Continued)
SUMMARY OF FISH NAME CATEGORIES

English Common	Chamorro	Filipino	Other
Urchin			laun
Wahoo	tasun		ono
Whitefish			
Wrasse	alulou gayu gadas aaga tasing guaguan tanguisson		

APPENDIX B

TOTAL HOUSEHOLD SIZE BY ETHNIC GROUP

Ethnic Group	Mean*	Sample Size	Standard Deviation	Standard Error
Guamanian	5.346	479	2.754	.126
Filipino	4.838	229	2.392	.158
Caucasian	2.910	167	1.671	.129
Micronesian	5.629	35	2.745	.464
Japanese	2.636	33	1.141	.199
Chinese	3.400	15	1.957	.505
Korean	3.714	21	1.765	.385
Guam./Filip.	4.812	16	2.880	.720
Guam./Cauc.	5.000	6	2.280	.931
Other	3.868	53	2.624	.360

*An analysis of variance yields an F statistic of 18.1474 which indicates a significant difference between ethnic groups at the 95 percent confidence level.

FOOTNOTES

¹Overseas Bechtel, Inc., Guam Development Master Plan Preliminary Survey, November 1973, pp. 5-15 to 5-21.

²Isaac I. Ikehara, "The Mariculture Potential for Guam" in Impact of Modern Technology Upon a Developing Insular Region: Guam, p. 80-83.

³Sampling techniques developed as standard procedures by the Bureau of Labor Statistics, Department of Labor, Government of Guam.

⁴Lack of time and funding precluded the resampling of response failures. In view of the relatively large number of responses to most questions it is assumed that the opinions and characteristics of non-respondents are adequately reflected by the responding group.

⁵Economic Planning Division, Overall Economic Development Plan, June 1977, Bureau of Planning, Government of Guam, p. 22.

⁶This 10.5 percent figure represents both non-fish eaters and non-respondents. For the purposes of conservative estimation we will assume that those who failed to answer the questionnaire are also non-fish eaters.

⁷In order to compile this list, data from several local informants was combined with information presented in the following publications:

Kami, Harry T., "Check-List of Guam Fishes, Supplement I", Micronesica, Vol. 7, No. 1 and 2, 1971, p. 215-228.

Kami, Harry T., Issac I. Ikehara, and Francisco P. DeLeon, "Check-List of Guam Fishes", Micronesica, Vol. 1, 1968, p. 95-131.

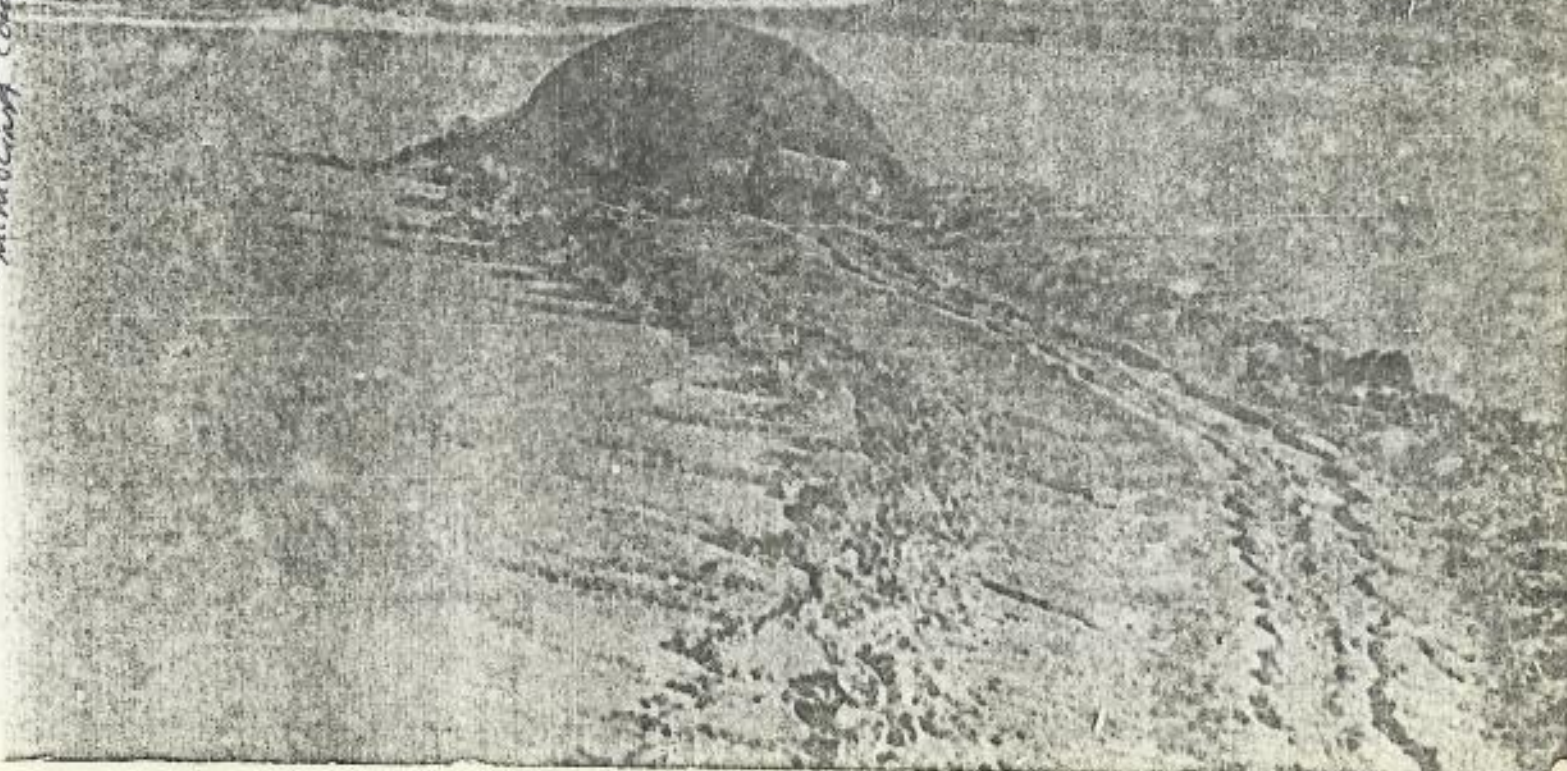
Guam, Government of, Department of Agriculture, Compilation of a Check-list of the Food and Game Fishes Found in Guam Waters. Project No. FW-2-R-2, Job No: F-2, July 1, 1964 to June 30, 1965.

Biology and Conservation of Sea Turtles

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Marine Turtles of Micronesia

The islands of Micronesia comprise 1 of the 3 great groups of Pacific Oceanic Islands. They are almost all located north of the Equator, being situated east of the Philippines and southwest of the Hawaiian Islands. The boundaries of Micronesia are almost identical to those of the U.S. Trust Territory, with the exception that Guam, an unincorporated territory of the United States, is not part of the Trust Territory, while the Gilbert Islands (part of the independent Kiribati), and the independent Nauru are considered part of Micronesia. Nukuoro and Kapingamarangi Atoll, though included in the Trust Territory, are culturally considered to be part of Polynesia. Moreover, the northern Marianas Islands have recently achieved Commonwealth status with the United States. The islands are all small and distances between them are large. Micronesia occupies an area equal to that of the United States, yet the land area is only half that of Rhode Island. Bryan (1971) calculates the total number of islands in Micronesia as 2,203. The 1973 population was 114,973 (excluding Guam), with an annual growth rate of 3.6 percent. The total land area is only 1,851 km².

Geologically the islands are all of volcanic origin, but differing age and subsequent weathering, subsidence, and coral formation have given them a very varied physiognomy. As a first-order approximation, the eastern islands are typically low atolls, often composed of many dozens of small, narrow islands surrounding a large central lagoon. The westernmost islands contain much weathered limestone and reach much higher altitudes. The highest islands, such as Ponape, attract an exceedingly high rainfall, with consequently lush vegetation. Shoreline vegetation throughout the Territory shows certain dominant species, such as coconut palms (*Cocos*), *Pandanus*, *Messerschmidia*, *Portulaca*, *Sida*, and *Scaevola*.

Species Present

The hawksbill (*Eretmochelys imbricata*) and the green turtle (*Chelonia mydas*) are present throughout Micro-

nesia and are widely recognized animals among those familiar with marine life in all districts. Nearly everywhere the green turtle is the more plentiful species, although in the Palau Lagoon area the hawksbill appears to be more common.

Two other species have been recorded on rare occasions. The olive ridley (*Lepidochelys olivacea*) was first recorded in Micronesia by Falanruw, McCoy, and Namlug (1975), who observed a mating pair in M'il Channel, northwest of Yap, on 30 November 1973. These authors also recorded a small (29 cm) *L. olivacea* from Lamotrek, in the eastern Yap District. Cushing (1974) reported 5 *L. olivacea* that were caught accidentally by long lines and plankton nets between 13 and 20 September 1974, in the southern Palau District (0° to 4°N, 131° to 137°E). In addition, I saw an immature stuffed *L. olivacea* for sale in a souvenir shop on Saipan in April 1976 that was said to have been locally caught and preserved.

The leatherback (*Dermochelys coriacea*) is reported occasionally in Micronesia, although it appears to be encountered only in deep water and has never been reported nesting in Micronesia. McCoy (1974) mentioned a very young leatherback, 69.4 cm in carapace length, that was captured near Satawal, in the eastern Yap District, on 2 September 1972. The turtle was tagged and released. McCoy also mentioned a leatherback caught at Woleai in 1971 that was captured and consumed by local people. I also have an unidentified newspaper cutting describing a large leatherback (444 kg in weight, 2.167 m in total length) caught by 2 Kapingamarangi fishermen off Parem Reef, Ponape Island.

Conservation Laws and Jurisdictional Background

Three completely different legal systems prevail concurrently in the Trust Territory: traditional law, vested in the hereditary chiefs; Micronesian law, as elaborated by elected delegates to the Micronesian Legislature; and U. S. federal law. As far as turtles are concerned, traditional law reflects patterns of hereditary ownership of the turtle resource, and the need for permission to be sought from traditional owners before turtles can be exploited. Micronesian law, as reflected in the Trust Territory Code (Title 45, Section 2) prohibits the capture of hawksbills less than 27 inches (69 cm) long, or green turtles less than 34 inches (86 cm) long (although only recently has the code differentiated between the 2 species). In addition, turtles are totally protected by Trust Territory law during the months of 1 June to 31 August and 1 December to 31 January, inclusive. They may also not be captured on the nesting beaches.

Federal law at present offers total protection to the hawksbill turtle, which is listed as an endangered spe-

cies. The green turtle is listed as a threatened species, with certain populations, namely those of Florida and Pacific Mexico, being listed as endangered. The Department of the Interior Regulations recognize and permit the continuation of certain patterns of traditional subsistence use of turtles in the Trust Territory.

Traditional ownership patterns are still respected to a large extent in Micronesia, and flagrant violations of these rights may lead to protest or sanctions of one kind or another. The Trust Territory Code, however, is not widely respected; hawksbills, for example, tend to be chased and caught whenever seen, whatever their size or whatever the season of the year, and the nests too are frequently raided. The green turtle has traditionally been collected on nesting beaches in many parts of Micronesia, especially in the Yap District, and no attempts have been made to enforce that section of the Trust Territory Code that prohibits such activities.

Little attempt is made to enforce the Endangered Species Act in the Trust Territory, and the law is ignored throughout Micronesia. Indeed, some question exists as to whether provisions of the Endangered Species Act even apply in the Trust Territory, but most legal opinions now hold that it does; for purposes of import and export of listed wildlife, the Act specifically refers to the Trust Territory as having the status of a State of the Union. Reluctance to enforce federal endangered species law in the Trust Territory probably stems from several considerations:

1. The Trust Territory has for years had but a single American conservation officer, based in Palau, to whom local people have made clear that his life may be in danger if he insists on rigorous enforcement of turtle protection laws.
2. The United States has been sensitive to charges of colonialism in thrusting conservation laws passed in Washington, D.C. on peoples leading traditional subsistence life-styles in remote islands on the far side of the world.
3. The Trust Territory is not a permanent political entity, and in the years to come the various districts will be electing whether or not they wish to remain associated with the United States. The United States has not deemed it politic or appropriate to thrust unwelcome conservation obligations upon people who would be likely to reject them totally on reaching political independence.

A loophole that has resulted from the wording of the Endangered Species Act, which considers the Trust Territory to have the status of a state, is that products of the hawksbill turtle hand-carried by tourists entering Honolulu from the Trust Territory can no longer be confiscated. Such transportation of products is legally

simply a case of carrying personal effects across state lines, unless it can be proven that the material is post-Act in origin.

Palau District

The hawksbill is more abundant than the green turtle in the Palau District, or is at least more conspicuous in the more accessible areas such as the Palau Lagoon. Douglas Faulkner, the underwater photographer, reports that hawksbills may be seen virtually every day in the Palau Lagoon by a competent scuba diver, and immature hawksbills are also reported to be numerous in the Kayangel Lagoon at the northern end of the Palau system. However, Robert Owen, conservation officer for Micronesia from 1949 to 1978, reports a gradual but steady decline in abundance. Natural predators are relatively few, and no natural egg predators have been reported, but the turtles are eaten by crocodiles (*Crocodylus porosus*), and the human pressure on eggs is intense—estimated at 80 percent by Jim McVey, who conducted a head-starting program for hawksbills in Palau in the early 1970s. Adult turtles too are highly persecuted. Hawksbill meat is eaten locally, but the economic pressure on the species is definitely from the shell trade. Tourism in the islands increased about 300 percent with the advent of regular air service in the early 1970s; a large proportion of tourists in Palau are from Japan, which of course offers no legal impediments to the free importation of hawksbill products.

The hawksbill turtle nests on small beaches on limestone islands in the Palau Lagoon. The principal nesting months are July and August, but some nesting takes place in June and September, and a few may nest in any month of the year. Their nesting site fidelity is reported to be strong, and they nest at approximately 15-day intervals, 2 or 3 times in a season. Favored islands include Eomogan, where Jeff June of the Peace Corps saw 3 turtles nesting in 1 night in late August 1975, and Ngerugelbtang Island, where the turtles often walk the length of a long spit before reaching a nesting area safe from tidal inundation. Other islands sometimes used for nesting include Aulong, Ngeangas, Ngobadangel, Unkaseri, and Abappaomogan.

Green turtles are not often seen in the Palau Lagoon, but achieve substantial populations in the northern and southern extremes of the Palau District. Richard Howell, district fisheries officer on Truk, reported that about 10 years ago he found fully mature green turtles to be plentiful in the Ngaruangel Lagoon, at the northern tip of the Palau complex. Villagers from Kayangel could catch 5 in 30 to 60 minutes. The turtles were resident there year-round, feeding on the large strands of turtle grass present especially on the western edge of the reef. Howell reported seeing only 1 male turtle in the area. Nesting (probably by greens) takes place on the

barely exposed Ngaruangel Island, since natives of Kayangel returned from the lagoon with fresh eggs. Raids on the turtles were sporadic, and could be made only during calm weather. The turtles were only used by Kayangel people for special occasions, although they were also used for trade with villagers on northern Babelthaup.

Green turtles also nest in small numbers on Honeymoon Beach, Pelelieu Island, and, on 1 occasion, a female was seen inside the reef on Morei Island. However, the best green turtle beaches by far in the Palau System are on the southern islands of Merir and Helen Reef, located many kilometers to the south; coordinates are 4°19'N, 132°19'E for Merir, and 2°48' to 3°01'N, 131°44' to 131°51'E for Helen Reef. Merir now unfortunately has a small permanent settlement, numbering 7 people in 1976. Even such a small group of people can cause havoc to the turtle population on such a tiny island. Helen Reef, whose single emergent point of land, Helen Island, is too small for permanent settlement, still has heavy pressure on its marine resources, especially by pirates, the majority of whom come from Taiwan. When caught, they may be jailed in Palau for variable periods of time. Another serious problem for turtles in the outlying islands is that the crew of the government field trip vessel, far from being a positive force for law enforcement, take advantage of their subsidized trip to Helen Island, Merir, and other turtle islands to gather as many turtles as they can for themselves, which can be taken back to markets for personal profit.

There is an extensive folklore and legend regarding turtles in Palau. For example, the discovery of the approximately 2-week nesting cycle for both the green and the hawksbill turtles is attributed to a chance discovery described as follows:

"A young couple arranged to spend the night on a remote beach on Pelelieu Island. They used the girl's grass skirt as a pillow, and after making love, went to sleep. When they woke the next morning, there were turtle tracks on the beach and a nest right beside them but, to their great embarrassment, the grass skirt had disappeared. Nevertheless, they decided to repeat the rendezvous two weeks later, and just before they fell asleep, noticed a large turtle crawling ashore with the remains of the grass skirt still attached to a front flipper."

This story is a favorite subject of Palauan story boards.

Yap District

Chief informant on sea turtles in the Yap District is Mike McCoy (this volume), formerly of the Peace Corps and now chief fisheries officer for Ponape and associate of the Yap Institute of Natural Sciences. McCoy's 1974 paper "Man and Turtles in the Central Carolines" is

#7 DAWR
Table 1. Summary of turtle sightings by aerial survey region, Guam, Fiscal Years 1975 through 1979

	Region												Total sightings	Number of months
	1	2	3	4	5	6	7	8	9	10	11	12		
FY 1979	4	1	1	1		1	6	2	43	31	18	77	185	12
FY 1978	6	3	1	9		6	14	3	10	1	15	15	83	12
FY 1977	0	3	1	1		4	1	5	10	0	8	8	41	2
FY 1976	7	5	6	6		35	8	14	44	10	12	42	189	9
FY 1975	14	5	18	3		23	11	9	37	16	6	143	285	6
Total	31	17	27	20		69	40	33	144	58	59	285	783	41
\bar{x} /Region	6	4	6	4		15	8	8	31	12	13	59	—	—

Source: Molina, unpublished report.

one of the most valuable sources available on human attitudes to turtles in Micronesia. To avoid duplication, reference is made to McCoy's paper herein for information on turtles in the Yap District.

Marianas District and Guam

Hendrickson (in manuscript) quoted the following information, received from Isaac I. Ikehara, chief of the Guam Division of Fish and Wildlife, regarding the available information on sea turtles in Guam in 1968:

#2 } *Green turtles and hawksbills are reported to occur in Guam waters. They apparently nest on the island beaches, but only sporadically; eggs were harvested more commonly during the time before the second World War, in many areas of the island, especially on the northern and southern ends (Tarague, Ritidian, Uruao, Orote, Cocos Island, Asiga Beach, and other localities).*

It appears from local residents that sea turtles are a rarity on the local market and the consultant found none on three of his visits. Skin divers occasionally bring them back but they are not considered a normal commercial item although red turtle meat is reputed to sell at \$0.75 (US) per pound. There is no export of turtle products from Guam. In 1968 there were reportedly two divers specializing in turtles each catching three or four turtles on a good day.

There is apparently no legislation protecting sea turtles or regulating the catch in any way, but there are some good catch statistics. All sizes from 15 lb. to 400 lb. are taken, but the informant estimates that the average size is around 60 lb. (the type most likely to be taken by divers). No special feeding grounds have been identified.

#3 } Harry Kami, enforcement officer for the Guam Fish and Wildlife Division, made a number of flights over the Guam coast during the last couple of years, and saw sea turtles—sometimes in concentrations of 40 or 50 individuals—off the northern coast of Guam, between Ritidian Point and Pati Point. Kami also sometimes saw 3 or 4 turtles off the coast near Inarajan Bay, on the southeast coast, and said that turtles formerly nested on Cocos Island, off the southwest coast, although the island was now too intensively visited for nesting to take place.

#4 } The north coast of Guam, near which the turtles were seen, was under Air Force control, and was rather little visited. However, despite the presence of a good beach, little nesting took place here. Factors that lessen the suitability of this beach for nesting may include the shallow reef (only 1 m submergence by high tide), and the presence of dense vegetation above the high tide line on the beach. Most of the turtles seen off Guam were of adult size, and indeed appeared to be very

#6 } #7 DAWR
Table 2. Summary of turtle sightings by month, Guam, Fiscal Years 1975 through 1979

	Month												Total sightings	Number of flights
	J	A	S	O	N	D	J	F	M	A	M	J		
FY 1979	12	3	6	6	7	12	18	52	24	14	20	11	185	24
FY 1978	7	6	10	4	16	17	7	5	0	3	4	4	83	24
FY 1977	23	—	—	18	—	—	—	—	—	—	—	—	41	4
FY 1976	—	20	28	24	20	42	16	10	7	22	—	—	189	18
FY 1975	—	—	—	—	—	—	45	44	32	46	54	64	285	12
Total	42	29	44	52	43	71	86	111	63	85	78	79	783	82
\bar{x} /Month	14	12	15	13	14	24	22	28	16	21	26	26	—	—

Source: Molina, unpublished report.

large from an aircraft at 65 to 80-m altitude; but mating pairs had not been seen.

Kami found 1 green turtle nest on the east coast of Guam between Ylig Bay and Togcha in 1974. Because of the extensive human use of this beach, the eggs were moved and, while reburying them, several incomplete nests were found.

Dr. Lucius Eldredge informed me by letter (dated 12 July 1976) that Dick Randall of the University of Guam Marine Laboratory reported 6 recent turtle nests on June 26, 1976, at the north edge of Sella Bay on the southwest coast of Guam.

A recent unpublished report by Molina includes the results of 5 years of aerial surveys of turtles around Guam. The following section is extracted from this report:

The island of Guam was divided into 12 survey regions (Figure 1). Marine turtles have been sighted within every survey region (Table 1) and during all months of the year (Table 2). Region 5 has not been censused due to military restriction. Two flights were made each month in all cases. A total of 783 marine turtles have been sighted around Guam on 41 aerial surveys made during the past 5 years. Far more turtles were sighted within region 12 (Pati Pt.-Ritidian Pt.) than in any other (Table 1). Approximately 74 percent of the observed turtles were seen within regions 8 to 12. The most probable explanations for this distribution are the low levels of development and fishing pressure in these areas.

Marine turtle abundance appears to peak twice during the year (Table 2). In general, these peaks coincide with the winter (December to February) and late spring (May to June) months. This also loosely correlates with Guam's "dry," tradewind season which usually lasts from December to June. It is unclear at the present time whether or not the turtles are mating during the entire period, yet it seems likely. The time of nesting is also unclear. However, reports from local fishermen indicate that nesting occurs around June.

Reports have been made of larger than usual numbers of turtles visiting Guam about every 3 years. The last of these visits happened in 1976, and is reflected in our aerial survey data (Table 2). Another visit was expected this year. Again, our data show the winter increase in numbers.

Since it is difficult to make positive species identifications on turtles from a moving airplane, we have no reliable estimate of the species composition of Guam's marine turtle community. However, it is generally regarded that *Chelonia mydas* is by far the major component.

Human interference with nesting turtles is a serious problem at Tarague Beach. The majority of the problem lies with the friends and relatives of the Tarague landowners who use the beach for "4-wheeling" and who actively hunt for turtle eggs. Since Tarague Beach is privately owned and enjoys military isolation, there may be a good chance

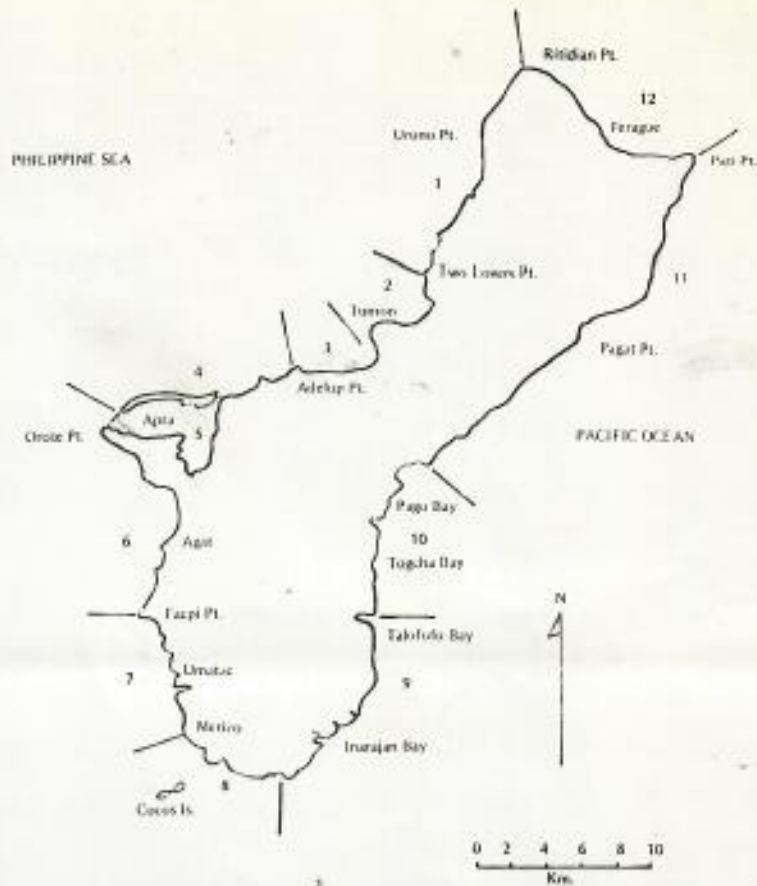


Figure 1. The island of Guam with its 12 aerial survey regions.

of controlling this problem, especially if the area could be designated as a marine turtle sanctuary. If it is not already too late, Tarague Beach may be Guam's only hope for such a valuable natural resource. Mr. Castro appears to be pro-turtle conservation and has offered to do what he can in cooperation with our office to help protect these animals.

Turtle meat is occasionally sold in Guam, but is very expensive—although it can on occasion be purchased with U.S. government food stamps at Perez Market. There are no laws protecting turtles in Guam at the present time, and some opposition to establishing local laws because turtles protected in Guam may well be caught in the Trust Territory. However, because Guam is an unincorporated territory of the United States, federal law unquestionably applies, and hawksbills should already have legal protection. The green turtle too should soon receive nominal protection.

Very few Guamanians are expert at spearing sea turtles, with the exception of a few old-timers, and nets are never used nowadays for catching turtles.

North of Guam, the Northern Marianas Islands stretch in a slightly curved elongated chain. Few turtles appear to nest anywhere in the Marianas; to a large extent this may reflect shortage of nesting beach, most of the uninhabited islands having no beach whatsoever. Saipan has several kilometers of beach on the west coast, but

the area is rather extensively developed with hotels and other beach facilities, and few if any turtles nest there. However, dense patches of turtle grass within a few meters of the beach suggest good feeding habitat for green turtles. Rota has several beaches, and Tinian 2 small, marginal ones, but I have no evidence that these are used by nesting turtles.

Stuffed turtles are for sale at several locations on Saipan. In a handcraft shop on Beach Road, 13 stuffed green turtles (half-grown to maturity) were for sale; also 3 hawksbills and 1 olive ridley. The turtles were reportedly all locally caught.

Turtles are being caught in increasing—and now rather large—numbers in the northern Marianas. The turtles were captured by divers for sale to hotels and gift shops, and 1 diver could easily catch 4 or 5 turtles in a day (Ben Sablan, personal communication).

Truk District

The islands of the Truk District lie to the east of the Yap District. Truk itself is composed of a large lagoon, roughly circular in shape, about 40 miles in diameter. The lagoon is fringed by a reef, broken in several places and reaching above sea level to form small, low islets, principally in the northern and southeastern sections. Most of the human inhabitants, who numbered 20,105 in 1970, however, do not live on the reef islands, but rather on several mountainous, large islands near the middle of the reef. The other islands of the Truk District—the Lower and Upper Mortlocks, to the southeast; the Hall Islands to the north; and the so-called Western Islands of Namonuito, Palap, Puluwat and Pulusuk—are low atolls.

Although only 2 days were spent on Truk during the survey reported here, I was able to learn a good deal regarding sea turtles in the District, through the kindness and efficiency of Mr. Richard Howell and Mr. Tawn Paul of the Fisheries Office. Informants for turtles in the outer islands were Mr. Casian Orik (Western Islands), Mr. Marion Henry (Mortlocks), and Mr. Appo Pius (Truk Lagoon).

Three species of sea turtles are recognized in the Truk District: the leatherback (locally called "mirang"); the green turtle ("winimon") and the hawksbill ("winichen"). The leatherback is seen only occasionally and always in deep water; there are no nesting records in the area. The other 2 species are both widespread, but the green turtle is generally more plentiful than the hawksbill.

The hawksbill is found principally in the Truk Lagoon and in the Mortlocks. On the northern fringe of the Truk Lagoon, hawksbills nest in small numbers on the islands of Holap, Tora, Ruac, Lap, Ushi, Onao, Tonelik, Pis, Alanenkobwe, Lemoil and Falalu. The largest of the islands, Pis, has human inhabitants, and

turtles nesting there are likely to get killed. Mr. Pius informed me that the casual nesting in this area (perhaps 1 or 2 turtles per night on each beach during May to October) had not diminished perceptibly during the last 50 years. In the Lower Mortlocks, Marion Henry reported casual hawksbill nesting in all 3 atolls (Eral, Lukunor, and Satawan), but not commonly on the inhabited islands (Kutu, Mor Satawan and Ta in Satawan atoll; Eral Islet; and Lukunor Islet).

The tiny island of East Fayu, about 100 km north-northwest of the Northeast Pass leading out of the Truk Lagoon, is an important one for green turtle nesting. About 6 or 7 turtles are reported to nest here each night during the season, which begins remarkably early (February), and lasts until about June. The island is elongate, less than 2-km long, and has a sandy beach with a deep water approach all around. The rights to the turtle resource are vested in the people of Nomwin Atoll, a few kilometers to the east. A few green turtles (1 to 3 per night) are also reported to nest on Fanang Islet, at the eastern end of Nomwin Atoll, and on a few tiny islets in adjacent Murilo atoll. A few also nest on northern Murilo Island.

Turtle nesting has not been reported in the Western Islands, all of which are inhabited. However, the people of Pulusuk, and also of Puluwat and Pulap (Tamam Islet) take advantage of the March-April trade-winds to travel to Pikelot, in eastern Yap District, to collect turtles. This journey may be made 3 or 4 times during the 2-month period, and a typical catch is about 20 turtles, which are collected on the beach during a stay of 1 or a few nights. The eggs are also collected. It was estimated that about 30 turtles nest each night at Pikelot; however, from data obtained in the Yap District, I believe this to be a distinct exaggeration. Turtles were reported to be diminishing in Pikelot, but holding their own in the Hall Island-East Fayu region.

In the Truk Lagoon both species of turtle are found (mostly adults) and are about equally common; however, only the hawksbill is known to nest. Rather few turtle fishermen are operating, and the turtles are obtained by spearing. A turtle can be obtained on demand within 24 hours by certain fishermen. Reportedly, the hawksbills are killed for use of their shell, which is sold in souvenir shops; however, I did not see any for sale at the time of my visit.

In the Truk District, it was reported to me that the green turtle often weighs 300 to 350 lbs. (136 to 159 kg), and occasionally 400 lbs. (181 kg), and usually laid 80 to 120 eggs. The hawksbill weighed 100 to 150 lbs. (45 to 68 kg) and laid 110 or more eggs (maximum observed: 152). There is no reason to question the accuracy of these figures. I was also informed that *both* species eat seagrass and algae. When I questioned an informant (Appo Pius, a fisherman of 50 years' standing) on this, he appeared absolutely certain that stom-

achs of the hawksbill as well as the green contained such plant material, even when I pointed out that in most parts of the world the hawksbill is carnivorous.

Ponape District

The Ponape District is situated to the east of the Truk District. Ponape, the District Headquarters, is a large (129.04 square-mile), centrally located island, which is highly elevated, reaching an altitude of over 2,500 feet. Rainfall is heavy, and vegetation lush. The island is roughly circular in shape and is surrounded by a barrier reef penetrated by about twenty entrances. There are some sizeable offshore islands, including Sokehs, Langer, Parem, Mwahnd Peidi, Mwahnd Peidak, Takaiu, Dehpehk, and Temwen. The population of the island was estimated to be 14,520 in 1970.

Kusaie is the second largest single island of the Ponape District; it has an area of 42 square miles, an altitude of 2,064 feet, and a 1970 population of 3,743. It is situated approximately 300 miles east-southeast of Ponape.

The other islands of the District are all atolls. Mokil (population 1970, 411) and Pingelap (population 849) lie between Ponape and Kusaie. The atolls of Ant and Pakin lie close to the west coast of Ponape; Pakin had a population of 36 in 1973; Ant had 10. Oroluk atoll, which had a population of 42 in 1935, none in 1948 or 1970, but since mid-1973 inhabited by about 18 people, lies west-northwest of Ponape. Southwest of Ponape are the atolls of Ngatik (population 442) and Nukuoro (population 420). Far to the southwest, nearly 500 miles from Ponape, is the atoll of Kapingamarangi, inhabited by 432 people in 1970, but with a permanent overflow population now living on Ponape, and a few others on Oroluk.

I spent 5 days on Ponape, where my chief informant was Ben Sablan of the Fisheries Department. Valuable information was also received from Alan Millikan, the District Fisheries Specialist, and David Fullaway, the chief Forestry Officer.

Populations of sea turtles around Ponape itself appear to be relatively insignificant and very little nesting, if any, takes place. Indeed, Ponape has very few sandy beaches. Turtles used to provide an important source of food to the people of Kapingamarangi, but they are now rarely seen in that area (Niering 1963). Nesting does not take place on Pingelap and Mokil, but Mokil has a shallow lagoon in which small green turtles (less than about 50 cm long) are easily seen and caught. Ben Sablan observed 5 such turtles on an underwater survey of the 15.5 km² Mokil Lagoon in 1974.

Around Kusaie, Sablan found 31 green turtles and 6 hawksbills during a 3-day underwater survey in August 1973; nesting, however, appears to be sparse at best.

No details are available for nesting on Ngatik, but Sablan reports some nesting on the eastern islets of Peina, Bigen Karakar, Jirup, Bigen Kelang, Piken Matagan, Dekehman, and Wat. Two green turtles were seen in the water during an underwater survey in September 1973.

Green turtles have been seen around Ant Atoll and it is rumored that daytime nesting occurs; but this needs confirmation.

Green turtles appear to be rather plentiful around Nukuoro, where Sablan counted 52 (but no hawksbills) during an October 1973 underwater survey. Nearly all were of adult size and were relatively inactive. They probably nest on the island, but there is no evidence of high-density nesting. Sablan also saw 3 green turtles underwater in Pakin.

Apparently the only nesting ground of importance in the Ponape District is the atoll of Oroluk, which once boasted as many as 19 islets, but apparently all but Oroluk Islet itself, at the extreme northwest of the atoll, have now disappeared. The District Administrator of Truk reported to me that he had seen green turtles nesting by daylight on Oroluk, on the lagoon side of the island, during a helicopter visit in November 1964. The island was uninhabited at that time, and the turtles reportedly showed no fear of the observers. Turtles in Oroluk are considered to have a split nesting season (December to January and June to July), and this may have been the original rationale for the split closed season throughout the Trust Territory. It is estimated that between 9 and 15 turtles nest on Oroluk on the average night, with up to 20 on a very good night. The local people, about 18 in number and resident on the island since mid-1973, catch a substantial proportion of the nesting turtles.

In a memorandum dated February 3, 1976, Sablan described the findings of a July 1975 visit to Oroluk. The islanders reported that since they first settled on the island 2 years ago, the number of turtles nesting had dropped considerably. This may well have been due to excessive predation, although Sablan also recorded the following human disturbances to the nesting beach during the night he was on the beach: 1) very active human activities until the early morning; 2) several campfires maintained until midnight; 3) co-pira operation with outboard motor until 9:00 a.m.; 4) ship generator and lights on until morning. However, at West Fayu in the Yap District, the tagging and hatchery crew in 1972 found that the turtles continued to nest even though a wrecked cargo ship containing 300 Toyotas was being salvaged on the island with extensive lights, noise and other disturbance by the salvage crew every night. The ship had spilled 600 tons of oil and was not completely defueled until more than 6 months after the wrecking.

Marshall Islands District

The Marshall Islands comprise a widespread District at the eastern end of Micronesia. With the exception of a few small isolated reef islands, such as Jemo, the Marshalls are comprised exclusively of atolls, most of which are made up of a few to many dozens of islets. The atolls are roughly aligned along 2 parallel axes, the northeastern being the Ratak Chain and the south-western the Ralik Chain. None of the islands reaches a height of more than a few meters above sea level, and the total land area of the District is only 180.82 km². The human population, numbering 20,206 in 1970, is widely distributed, but only the atolls of Majuro, Kwajalein, and Ailinglapalap have more than a thousand people.

Bryan (1971) lists Taongi, Bikar, Taka, Jemo, and Erikub as the only atolls or islands that have never had human populations, while the people of Bikini and Enewetak were displaced after the second World War when these islands were used for atomic weapons testing. Rongerik is listed by Bryan as having 6 people in 1935 and 1948, but as being uninhabited in 1970; this island was used temporarily by the displaced people of Bikini, but proved unsatisfactory. The Marshall Islands are well described by Anonymous (1965), while excellent maps and directories to names of islands are provided by Bryan (1971).

Only Kwajalein and Majuro were visited during the present survey. However, much useful information on turtles elsewhere in the Marshalls was provided by Ben Sablan on Ponape, who was formerly resident in the Marshalls; by Major Ron Barnett and Rev. Elden Buck on Kwajalein; Jim Hiyane, the agricultural officer on Ponape; George Balazs in Hawaii; and Jobel Emos, a janitor at the Kwajalein Missile Range.

Bikar Atoll

The atoll of Bikar, one of the northernmost of the Marshalls, is generally thought to have the highest concentration of breeding green turtles in the District. The atoll is composed of several islets, the named ones being Jabwelo and Almani on the east, Bikar on the south, and the sandbank of Jaboero between Bikar and Almani. Bikar is the largest with an area of 0.063 miles².

Bikar has been thus described (Anonymous 1956): "Sea birds of many kinds are abundant, but the outstanding feature is the great number of turtles that come ashore to lay eggs on Bikar Islet." Fosberg (1969) recounted his experiences with the turtles of Bikar as follows:

On the night of August 6, a few baby black turtles were seen hurrying toward the sea. They were being attacked by large red hermit crabs (Coenobita perlata) and by rats (Rattus exulans). The hermit crabs bit through the car-

apace, the rats through the plastron. Almost all of the female turtles that visited Bikar Atoll, well over 300 in the seven nights, August 5-12, came ashore on Bikar Islet. One set of tracks and a pit were noted on Jaboero Islet, a few on the south part of Almani Islet, but none on Jaliklik Islet, which is rocky and has no loose sand.

Judging by the numbers given in an earlier part of this paper, it is possible that the "over 300" turtles is a misprint for "over 30."

From the large numbers of tracks seen, the relatively light nesting observed and the observations on hatchlings, it appears that the season on Bikar reaches its peak probably around June and July.

In 1958 Bikar Atoll and Pokak (Taongi) Atoll, which lies to the north of it, were set aside as preserved natural areas by administrative decree by the then District Administrator, Maynard Neas. It is hoped that this protection may be strengthened, as clearly Bikar is the principal turtle nesting area in the Marshalls and should be kept as a stocking area for the rest of the archipelago.

Hendrickson (in manuscript) was able to visit Bikar on 2-3 July 1971 and made the following observations:

The consultant visited Bikar Atoll and all 3 of its islets judged suitable for green turtle nesting (Bikar, Arumeni and Jaboerukku). These are the only vegetated islets in the atoll, the remainder being barren bars and banks which are presumably swept by high wave action. The timing of the visit was particularly favorable, being at the end of a 7-day period of diminishing tides during calm weather. This left a series of high tide marks on the clear areas of beach where rocks had not confused the wave wash pattern and, for the most part, it was possible to identify the night on which recent beach ascents had been made by nesting turtles, by noting the particular high tide mark where the track ceased to be evident. It was possible to say with some confidence that 39 turtles had ascended the beaches during the preceding 6 days (78 tracks, half ascending, half descending). Thirty-five of the 39 turtles had used the beach on Bikar Islet, 1 had ascended the Arumeni and 2 had ascended Jaboerukku. One of the 35 tracks on Bikar was a hawksbill track (not ridley); all others were presumed made by green turtles (loggerheads have not been reported from the area).

Hendrickson made some calculations of the possible size of the nesting population on Bikar, concluding that the order of magnitude of the population was 711 sexually active adult female turtles in the Bikar breeding population. From these figures, he reasoned that "even the most favorable interpretation of the data available (granting the assumptions made) allows consideration of a population of only small size, not constituting an exploitable wild resource of any significant magnitude."

Jemo Island

Jemo is an isolated, tiny island situated at 10°8'N, 169°32'E, located between the atolls of Ailuk and Likiep. The land area of Jemo is only 1.55 km². The turtles on Jemo were described as follows (Anonymous 1956): "Many turtles visited Jemo to lay their eggs. Jemo was formerly tabu for most of the year, being regarded as a bird and turtle reservation. Only during one month in the year were these animals hunted and their eggs taken."

Fosberg (1969) visited Jemo from 18 to 22 December 1951 and observed tracks corresponding to the nesting of 22 turtles during the past several days.

The Rev. Elden Buck of Kwajalein informed me that a boat from Likiep sometimes brings 10 to 15 turtles for sale on Ebeye. These turtles were presumably caught on Jemo, which is the closest turtle island to Likiep. Likiep itself has few turtles, according to Ben Sablan on Ponape. Further confirmation of the presence of nesting turtles on Jemo was provided by several informants during my survey.

Arno Atoll

Green turtles nest occasionally on the sandy beaches of Arno Atoll, but they are scarce and of no commercial importance (Hiatt* 1951). Ben Sablan reported that nesting on Arno takes place on the islet of Ine, in the south and southwest.

Erikub Atoll

Erikub is an uninhabited atoll composed of 16 islets lying just south of the inhabited atoll of Wotje. Jim Hiyane, the agricultural officer on Ponape, informed me that he had seen turtles nesting on Erikub, and estimated that 6 or 8 turtles nested nightly. He mentioned that people from Wotje go to Erikub for copra, coconut, crabs, etc., and often picked up turtles when there, but did not go specifically for turtles.

Jobel Emos on Kwajalein confirmed that turtles nested on Erikub and pinpointed the northwestern islets of Enogo and Loj as being the most favored for nesting. Emos claimed that nesting on Erikub was year-round, but that the turtles were usually exploited during summer months because of the prevailing calm water at that season. He said that the Wotje people, when they caught a female turtle on Erikub, would tether it in shallow water so that it would attract males, which were captured as they mounted her. Emos' estimate was that 3 or 4 turtles nest nightly on Erikub.

On Kwajalein, the Rev. Buck showed me a photograph of a boatload of over twenty turtles that had been brought in from Erikub and Bikar for sale on Ebeye, the islet where the Marshallese workers on the Kwajalein Missile Range reside.

Taka Atoll

Taka is an uninhabited atoll lying very close to, and southwest of, the inhabited atoll of Utirik. It has five islets, the largest of which is Taka itself (2.5795 km²). According to the Rev. Buck, people from Utirik collect turtles and turtle eggs on Taka, but further details are not available.

Ebon Atoll

Ebon is the southernmost of the Marshall Islands. It is a roughly circular atoll composed of 22 islets, by far the largest of which is Ebon itself, an elongate island that makes up the southern side of the atoll; it is about 10-km long and has an area of 2.804 km². Bryan (1971) lists the 1970 population of Ebon as 480—substantially reduced from the 1935 and 1948 censuses. Ebon has a reputation for abundance of food of all kinds, and although no definite information on turtle nesting is available, it is considered to be the best area for catching turtles in the water. The turtles are nearly all of adult size and are caught with nets. Each night 2 to 4 can be caught. Rev. Buck said that if a turtle on Ebon is captured in a certain place, the next night it is often found that another turtle has moved to the same spot.

Kwajalein Atoll

Kwajalein is the largest atoll in the Marshalls, and reputedly the largest in the world. Ninety-three islets are listed by Bryan (1971). The islets of Kwajalein (at the southern tip) and Roi and Namur (now connected by a runway and called Roi-Namur) are devoted exclusively to U.S. military uses. The Marshallese residents live on Ebeye, a small and highly overcrowded islet a short distance north of Kwajalein, on the eastern edge of the atoll. Most of the other islets are very small, and in some parts the bounding reef is without islets for distances of 15 to 25 km.

Major Ron Barnett on Kwajalein gave me considerable information on turtle observations on Kwajalein. Turtles are often seen around Kwajalein Islet, and between Kwajalein and Ebeye. A few turtles appear to be extraordinarily static in range; a certain green turtle is reported to have resided at a certain coral head (known as K5) off the lagoon shore of Kwajalein for 2 to 3 years, and is very familiar to skin divers. Green turtles are also seen on the ocean side of Kwajalein at the end of the runway, where they scavenge for the kitchen scraps that are thrown in each day. They are usually of less than mature size. One turtle that I saw feeding on the kitchen scraps of Kwajalein, however, appeared to be of adult size.

No records are available for turtle nesting on Kwajalein, and indeed there is a shortage of good beaches. However, much of the atoll is poorly studied and a

Marshallese informant on Kwajalein informed me that turtles do nest sometimes on the islands at the northwestern end of the atoll.

Major Barnett, in a letter dated 16 July 1976, reported that on July 10 a green turtle had been found nesting on the ocean side of Bigej Island, about 19 km north of Kwajalein Islet.

Ujelang Atoll

Ujelang or Ujilang, is an elongate atoll about 20-km long located at the western extreme of the Marshalls, being closer to Ponape than to the population centers of the Marshalls. It had a small native population of about 40 people (plus 12 non-natives) in 1935. It was uninhabited in 1948 according to Bryan, but this is presumably in error, since Helfich (in manuscript) reports that the Enewetakese people displaced by atomic tests were settled on Ujelang in 1947. The 1970 population, according to Bryan (1971), was 281.

Ujelang is listed by Carr (1965) as a "minor nesting beach" for the green turtle. The source of this information was not quoted, but Carr informs me that he based this record on an observation made by the crew of a U.S. Naval vessel anchored off Ujelang one night in 1962. Baby green turtles were attracted to the lights of the ship in very large numbers—although at this point it is not possible to ascertain whether the numbers represented only 1 or 2 successful nests, or whether there were numerous nests erupting simultaneously. Two of these hatchlings were transmitted alive to Carr. Phil Helfich, in a brief manuscript, reports on an interview with Chief Johannes, chief of the exiled Enewetakese people on Ujelang: "Chief Johannes indicated that turtles nested all around the island Ujilang. Ujilang is the island which has been occupied by the Enewetakese since 1947, and it is difficult to visualize that they did not decimate the nesting turtle populations, because Ujilang is such a small island."

None of the informants on my survey had any information about turtles on Ujelang. The island is extremely remote and is not often visited. This would appear to be a priority for future studies.

Enewetak Atoll

Enewetak is a rather large, almost circular atoll in the western Marshalls. According to Bryan (1971), it is composed of 44 islets, has a land area of 2.26 miles² and had 128 people in 1948, but none in 1970. However, according to one writer (Anonymous 1972), 100 people, mostly civilians, live on Enewetak. Another report (Anonymous 1975) gives 1947 as the year in which the 136 Enewetakese residents were transferred to Ujelang; the island was used for nuclear tests between 1948 and 1958. Since 1954, the University of

Hawaii has operated the Mid-Pacific Marine Laboratory on Medren Island, Enewetak, which is financed almost completely by the U.S. Energy Research and Development Administration.

Helfich (in manuscript) quotes Chief Johannes of Enewetak, who lived on the atoll until 1946, as reporting turtle nesting (up to 1946) taking place from May through August on the islets of Alice, Bell, Runit (Yvonne), Glen through Keith, Leroy, Wilma, and Vero. The last 2 islands had the best nesting areas. Another islet by the name of "Vikai" was reported by Johannes to have abundant nesting turtles, but no island of this name is shown on available maps of Enewetak.

At the present time there appears to be little turtle nesting on Enewetak. However, George Balazs has prepared reporting sheets for observations of turtles by scientists at the Mid-Pacific Marine Laboratory and others, and valuable information may eventually be forthcoming from this program.

Majuro Atoll

Majuro, the District Headquarters, is an elongate atoll approximately 30-km long. The southern rim of Majuro was originally composed of a single extremely attenuated island, Majuro, and a series of much smaller islands to the west. However, these islands have now been connected in order to provide vehicular access between the principal town (known as D-U-D, from its constituent and now coalesced islets of Carrit, Uliga, and Dalap) and the airport; and the blockage of the former passages between islets, with no provision for bridges or culverts, has led to substantial pollution problems in the Majuro lagoon.

Turtle nesting has not been reported on Majuro, although turtles are spotted in the waters of Majuro relatively frequently. Ben Sablan informed me that large turtles are seen resting near the Windward Islands of Majuro, and on an afternoon dive one summer he had seen more than 15 turtles, all females.

Jaluit

Jaluit is a large, irregularly shaped atoll, about 30-miles long from north to south. It is composed of 91 islets. Bryan (1971) gives the 1970 population as 881, substantially reduced from former years. Ben Sablan informed me that turtles nest in small numbers on Lijeron Islet, near the northern end on the west side of the atoll.

Aur, Maloelap and Likiep Atolls

Ben Sablan reports that turtles may be found on each of these atolls, but that in no case were they plentiful.

Bikini and Taongi Atolls

Although my informants did not mention these atolls, both were recorded by Hendrickson (in manuscript) as being second in importance only to Bikar among the Marshall Island turtle nesting atolls. Hendrickson obtained his information about Bikini from Mr. Robert Ward, a heavy equipment maintenance supervisor for the Bikini Atoll Rehabilitation Project. Additionally, the popular movie *Mondo Cane* made several years ago showed rather large numbers of dead green turtles on Bikini, though the interpretation made that these had been disoriented by radiation damage and had wandered into the interior of the island to die is somewhat questionable. I have seen dozens of dead green turtles inland from the nesting beach on Baltra Island, Galapagos. This island appears to lack the normal sea-finding (or land-fleeing) cues that enable a turtle to identify the proper heading for the ocean.

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PHOTO BY CHRIS WILLE

COCONUT CRAB

The coconut crab or "ayuyu" is very popular at fiestas because it is so good to eat. They can grow as big as three feet across. Most are captured by crab hunters, before they get very big.

Coconut crabs begin their life in the ocean. Adult females lay their eggs in the sea. The tiny crabs float around for a few months and then climb inside of a seashell and crawl up on the beach. At this time they look very much like hermit crabs. Soon the coconut crabs leave their seashell and depend on their own hard shell for protection.

Coconut crabs dig a hole in which they hide during the day. At night they come out to look for food. They will eat almost anything including fruits, plants, rotten wood and soil. Their favorite food, of course, is the coconut. Using their very strong claws, they tear away the tough coconut husk and then, somehow, crack the nut inside.

Full grown crabs have no natural enemies other than man. Young crabs may be eaten by some of the predators that man has brought to the island such as the rat, pig and monitor lizard. In some places, people have eaten all the coconut crabs. On Guam giant crabs are now rare and even small ones are becoming harder to find.



PHOTO BY CHRIS WILLE

HERMIT CRAB

This popular little animal is called a hermit crab because it hides in its shell like a hermit whenever anyone bothers it. It only hides from people and other possible predators. When other hermit crabs come around they are quite friendly. Hermit crabs or "duk duk" are often seen in groups searching for food or new shells.

Hermit crabs are born in the ocean. They find a tiny empty shell to live in and crawl out of the sea onto the beach. Once they hit the beach, the hermit crabs stay on land, except when the female returns to the water to lay eggs.

Hermit crabs spend their entire lives inside of a borrowed shell. They use the shell for protection. Their own body covering is soft and weak. When they outgrow a shell they simply find another, slightly larger, and trade. The giant African snail has been a real friend to the hermit crab as their empty shells make perfect crab homes.

Hermit crabs usually live near the beach, but they may also be found far inland. They feed mostly at night and find a cool shady place during the hot afternoon. They will eat almost anything including coconuts, fruits, rotting logs, dead animals, garbage and plants. Finding food is no problem for hermit crabs.



J. Micuda

SA Micuda attended the monthly meeting of USDA and other federal agencies with Guam Customs Supervisors.

SA Micuda attended the monthly meeting of the Marianas Security Association.

At the invitation of SA Micuda, the chief of CNMI F&G, Rufo Lujan, is now attending the LECC meetings sponsored by the USA on Guam.

At the request of NPS personnel from Hawaii, SA Micuda set up and attended a meeting with the USA on Guam to discuss the NPS LE program on Guam.

SA Micuda has met with Guam Customs and Guam AG's office personnel several times in the last month to discuss the enforcement of Guam custom law "Failure to Declare". The law was passed in the 1950's but has never been enforced. While Guam Custom officers working on the line want to enforce it and the AG's office is willing to prosecute if presented cases, the process appears to break down somewhere in the higher echelon of Guam Customs.

SA Micuda has been monitoring some of the new retail stores in Guam for ES products but has not observed any violation so far.

Apparently, we still have some sea turtle nesting occurring on Guam. At present, there are 11 nesting sites on the north end of Guam in the Ritidian Point area. The area is located within the boundaries of the U.S. naval facility. Although there is some private land located adjacent to this area, the landowners can only visit this land by entering the naval facility. In order to do this, they are subject to signing in and out and may be searched at any time by naval facility personnel. Persons leaving the naval facility may also be searched a second time at Potts junction which is on the U.S. Air Force land. SA Micuda has been in contact with security personnel of both DOD facilities. There has been no publicity of the nesting in hopes that possible violations will be kept to a minimum.

MONTHLY REPORT
April 1984 - SA J. Micuda

From April 9 to 12, SA Micuda and SAC Marshall (NMFS) attended the Micronesian Chief of Police meeting held in Palau. DOI personnel in DC will be in the future requesting USFWS and NMFS to access the wildlife resources in Micronesia and make recommendations on how to protect these.

5/11

WPPD	
DOJ	L
DOE	L
PTB	✓
ETN	✓
PAM	✓
NEW	✓
WCS	✓
IPS	✓
SKH	
SMI	
NTAA	

On 4/18/84 SA Micuda and Guam Wildlife biologist Gary Wiles investigated a marianas bat poaching incident south of Mergogan Point on Andersen APB. According to evidence found, the incident took place approximately 7 to 14 days prior to 4/18/84. Forty two shotgun shells were found (19-20 gauge and 23-12 gauge). Photographs were taken and the shells picked up. No other evidence was found. Primer comparisons indicates that only one 20 gauge and one 12 gauge shotgun were used.

On 4/14 & 4/15/84 the Guam station was visited by SAC G. Marshall of NMFS for a station evaluation.

On 4/25/84 SA Micuda delivered a lecture and slide presentation to 45 students attending a Military Customs Training Class held at the Naval Station on Guam.

On 4/9 the 5 Subjects mentioned in the last monthly report who took a sea turtle on Guam last August or September met at the USA's office on Guam and each signed a pre-trial diversion promising to pay a \$200.00 fine each over a period of 4 months probation. This is the first federal prosecution and is the highest fine yet paid on Guam for a turtle take.

1983

99pp.

TERRITORY OF GUAM
FISHERIES DEVELOPMENT AND MANAGEMENT PLAN

Prepared By
Steven S. Amesbury and Paul Callaghan

Table 1-2

MAY 1981

refrigerator
electricity
telephone
flush toilet
TV
car
paved roads
income
means of catch
boat
outboard motor

CHAPTER I
THE TERRITORY OF GUAM

The Marianas Archipelago forms a 700-mile long chain consisting of 14 major islands having a combined land area of 370 square miles and a population of less than 150,000 (see figure 1-1). The Territory of Guam, lying at 13.27 N latitude, is the southern-most, largest, and most populous island in the group. From Guam, the Marianas chain stretches northward between the longitudes of 144.40 E and 146.04 E to the island of Farallon de Pajaros at 20.33 N latitude.

The Marianas are divided into two political entities - the U. S. Commonwealth of the Northern Mariana Islands (CNMI) and the U. S. Territory of Guam. The southern-most island of CNMI, Rota, lies only 40 miles north of Guam. There is scheduled air service between the islands of Guam, Rota, Tinian, and Saipan. Inter-island trading or fishing vessels provide sporadic service between these islands and Anatahan, Sarigan, Alamagan, Pagan, and Agrihan. The islands of Guam and Saipan are linked by telephone and telex to overseas communication networks. Guam is serviced by several international airlines on a daily basis (Guam Growth Council, 1980).

The Territory of Guam is located 1550 miles south-southeast of Tokyo, 1600 miles east of Manila, and 3700 miles west-southwest of Honolulu (see figure 1-2). The island is approximately 30 miles long and 4 to 8.5 miles wide, having an estimated land area of 214 square miles (see figure 1-3). The northern portion consists of a limestone plateau rising to an elevation of 850 feet and containing a freshwater lens which provides the island's major source of fresh water. The southern region is of volcanic origin with several rivers, protected bays, a lagoon, and highlands rising to 1300 feet. Apra Harbor, located on the western side of the island, serves both military and commercial activity and is considered one of the best natural harbors in the Western Pacific (Guam Growth Council, 1980).

Guam's climate is tropical with an average temperature of 81° Fahrenheit. Rainfall averages 85 inches a year with 75 percent of the rain falling between the months of June and December (see Table 1-1). Easterly trade winds predominate throughout most of the year and are generally strongest during the period from December to May. During these times small boat fishing is often restricted to nearshore areas on the lee (west) side of the island. The east side of Guam and the offshore bank areas are most accessible to small boats during the summer months, although it is during the summer and fall that tropical storms and typhoons are most likely to occur (see Table 1-1). Weather conditions are an important determinant of local fishing activities on Guam; small-boat fishing effort during any particular month is more influenced by weather than it is by resource availability.

Centuries of immigration have resulted in a cosmopolitan ethnic and cultural mixture among Guam's approximately 105,000 population. Most recent estimates indicate an ethnic composition of the resident civilian population as follows: 62 percent Chamorro, 21 percent Filipino, 8 percent Caucasian, 3

670

percent Micronesian and the remainder a mixture of Japanese, Chinese, Korean, and other ethnic backgrounds (Guam Department of Commerce, 1979). Guam's population grew by 32 percent between 1970 and 1980; a significant portion of the growth was the result of immigration from the Philippines, other Asian countries, Micronesia, and the U. S. Almost half the island's population is 19 years of age or younger.

The civilian labor force is estimated at 35,000 with a current unemployment rate of approximately 7 percent. The civilian labor force does not include members of the armed forces, civilians living on military bases, nonimmigrant aliens, and persons under 16 years of age. In addition to the civilian labor force, there are from 3,000 to 5,000 nonimmigrant alien workers on temporary H-2 visas working primarily in the construction and agricultural sectors. In January 1980 payroll employment on Guam amounted to 33,000, of which 55 percent were adult males, 38 percent were adult females, and 7 percent were teenagers (Guam Department of Labor, 1980).

Table 1-2 presents a summary of employment by industry and provides some insight into the relative importance of various sectors of the economy. Note that the federal and local governments together employ 47 percent of all payroll employees. The relatively high employment in local government can be partially explained by the fact that the power, water, telephone, sewer services, garbage collection, some public construction and housing, the commercial port, hospital, air terminal, and educational institutions are run directly by the Territorial Government.

Private sector economic activity on Guam can be inferred from the following facts (Guam Growth Council, 1980): There are 31 firms which have payrolls larger than 100 employees. These firms are concentrated entirely in the construction, manufacturing, retail, service, and visitor industry sectors. There are 14 major hotels having a combined capacity of 2,514 rooms. The island has 5 radio and 3 television stations, 11 commercial banks, and 2 savings and loan institutions. There are several engineering and architectural firms, 85 members of the Guam Bar Association, and 75 practicing civilian physicians.

Guam became an unincorporated territory with the passage of the Organic Act by the U. S. Congress in 1950, and all citizens of Guam became citizens of the United States at that time. A Governor, Lieutenant Governor, and unicameral Legislature are locally elected. The judiciary consists of a Federal District and a Territorial Superior Court. Guam has a single elected representative in the U. S. House of Representatives who has committee and subcommittee voting power, but no vote on the floor. U. S. citizens of Guam cannot vote in U. S. presidential elections.

Table 1-3 provides a territorial government income and expense summary for the year 1978. The essential importance of federal financial aid to the island should be noted. Residents of Guam pay income taxes which are identical to federal income taxes paid by all U. S. citizens. The Territorial government is responsible for tax collection, and the proceeds remain in Guam. The U. S. Internal Revenue Service refunds to the Territory any taxes which it collects on earned income from the island.

Table 1-1
Monthly Average Weather Conditions on Guam

Month	Average ¹ Temperature	Average ² Rainfall	Average ³ Relative Humidity	Experienced ⁴ No. of Typhoons and Tropical Storms 1948-1975	Average ⁵ Windspeed and Direction
January	79.6	4.87	77	0 (1)	8.2 E
February	79.5	2.99	76	0 (1)	10.2 NE
March	80.0	2.79	77	0 (1)	9.0 E
April	80.9	3.62	77	3 (1)	8.9 E
May	81.3	5.61	78	2 (2)	8.3 E
June	81.8	4.91	79	0 (3)	6.4 E
July	81.4	9.48	82	1 (5)	5.1 E
August	81.2	12.4	83	3 (5)	4.8 E
September	81.2	13.28	83	5 (5)	4.7 E
October	81.3	2.32	81	3 (16)	6.2 E
November	81.2	8.29	81	6 (10)	7.8 E
December	80.5	4.86	78	2 (1)	9.1 E

¹degrees Fahrenheit

²inches

³percent

⁴These numbers represent the total number of typhoons (tropical storms in parentheses) which passed within 180 nautical miles of Guam from 1948 through 1975, aggregated by month of occurrence. Winds in excess of 75 miles per hour are considered typhoon force.

⁵Miles per hour; data from 1961-1964 and 1970-1971.

Sources: Guam Growth Council, Community/Business Profile, Territory of Guam January 1980: V-26; Fleet Weather Central/Joint Typhoon Warning Center, Tropical Cyclones Affecting Guam. FLEWEACEN Tech. Note JTWC 75-3; Environmental Data and Information Service, NOAA, Local Climatological Data, Annual Summary with Comparative Data, 1978, Guam, Pacific, U.S. Department of Commerce.

CHAPTER II

HISTORY OF FISHERIES ON GUAM

According to radiocarbon dating studies, the Mariana Islands, including Guam, were inhabited by 1327 BC. These original inhabitants were probably seafarers of Asian origin who, over generations, migrated through the Philippines, Western Caroline Islands and perhaps Japan, before arriving in the Marianas. These early settlers were undoubtedly joined by many subsequent migrations over the centuries before western contact. These travelers brought with them the technologies of rice cultivation, pottery making, fishing, and canoe building (Jennison-Nolan, 1979).

Since Guam is a high island with fertile soil and lush river valleys, pre-contact food production was primarily horticultural and gathering in nature. Finfish and other edible aquatic fauna provided the major source of animal protein. Canoe building and sailing had developed to a sophisticated level by the time of early Spanish contact. Large voyaging canoes allowed trade, commerce, and fishing throughout the Marianas and probably into the Carolines. Precontact population estimates run as high as 100,000; thus, subsistence fishing and agricultural activity provided adequate food supplies for a population not greatly different from today's.

Prehistoric and early contact information on fishing activities is very sparse; however, fishing methods were most likely quite similar to those used by other Micronesians inhabiting similar high islands. The size of hooks and other fishing gear found in archaeological sites indicates that Chamorros fished well beyond the reefs for large fish, both demersal and pelagic (Jennison-Nolan, 1979).

Ferdinand Magellan arrived in Guam in 1521 and was followed by Spanish colonization. As Spanish influence over the island increased during the 19th century, interisland trade was curtailed and the large ocean-going canoes fell into disuse; however, the population continued to fill protein needs by fishing in waters surrounding the island. The first recorded attempt to develop a commercial fishery in Guam was undertaken during the governorship of Villalobos which began in 1828. He attempted to encourage the production of tortoise shell, mother-of-pearl, and beche-de-mer (dried sea cucumber). Results of this effort are not known; however, there appears to be no evidence of lasting success (Jennison-Nolan, 1979).

Guam was ceded by Spain to the United States in 1898. The rest of the Marianas was sold to Germany and, in 1917, mandated to Japan by the League of Nations. By the outbreak of World War II the Japanese in the northern Marianas had increased commercial fishery production to an annual high of 8 million pounds (Orbach, 1980). With the exception of the Japanese occupation during World War II, Guam was administered for five decades by the U. S. Navy. Little or nothing was done during this time to develop commercial fishing. In 1950 the U. S. Congress passed the Organic Act which established an elected civilian government and transferred authority over the Island from the Navy to the Interior Department. The governor was appointed by

the Secretary of Interior until 1970 when amendment of the Organic Act allowed for a locally elected governor.

Under naval rule, Chamorro society became increasingly dependent on a monetary economy. By 1911, one-fourth of the employable Guamanian men worked for the Navy; however, extended family subsistence fishing activities were of major economic importance until well after World War II (Jennison-Nolan, 1979). Due to the lack of long-distance voyaging craft most fishing was done fairly near shore. Nets were used to catch manahac and atulai. Fish weirs were constructed in bays. Portable and permanent traps were used along the seaward reef slopes and within the lagoons. Throw nets were used to harvest small fish along the shallow reef and lagoon margins. Spearfishing was practiced by day and by night using torches made of coconut spathes. It is well-documented fact that divers from many Pacific islands can fish effectively at depths of 60 to 90 feet; there is no reason to believe that the Chamorros were any different. Use of hook and line fishing from small inshore canoes was probably quite prevalent. Such fishing was probably carried on in waters shallower than 300 feet. Several local plants were used to prepare a narcotic which could be used to stun fish in shallow tidepools (Jennison-Nolan, 1979).

During the pre-war period, few fish were sold on the monetary market except in Agana, the center of population. The continued importance of subsistence fishing is underscored by a government survey in 1941 which reported a conservative estimate of 200 outrigger canoes scattered in various locations around the island. "Mr. Jose Lizama Charfauros of Agat recalls an average of at least one canoe and usually more for every third household in the pre-war village of Agat where he has lived all of his seventy-eight years" (Jennison-Nolan, 1979). When the joint effort of several fisherman, families, or villages was needed for the harvest, catches were divided among the group in respect to the varying amounts of capital, labor, or perceived resource ownership contributed to the production effort. Such a share system persists even today for the harvest of atulai (Trachurops crumenophthalmus) and manahac (Siganus spinus). The catch was divided among the extended family and provided a supplement to whatever monetary income existed within the group. Fish was also bartered and used to repay obligations and fulfill family or community obligations during funerals, marriages, and fiestas.

As Guam has been forced more and more into a monetary economy, a greater proportion of the fish harvest has been entering commercial markets. Although subsistence fishing is not as prevalent in Guam as it once was, it can be said with some certainty that the majority of fish caught by local fisherman does not enter the monetary market. The funerals, marriages, christenings, and fiestas still exist much as they have for hundreds of years. For large segments of the population, fishing still provides supplementary income, family nutrition, recreation, and "an integral part of family and community life and reinforcement of cultural traditions" (Orbach, 1980).

CHAPTER III

CURRENT FISHERIES ACTIVITY ON GUAM

A. The Socio-Economic Importance of Fisheries

The importance of fishery commerce to the economy of Guam cannot be judged on the basis of its contribution to gross island product or employment. In the first place, gross island product statistics are not currently maintained by the government. Gross receipt information is available on an annual basis; however, the broad categories used do not allow separation of transactions associated solely with fishery commerce. In the second place, employment statistics are not kept in fine enough detail to allow summary of employment associated with harvest, wholesale, and retail fishery commerce. Thirdly, there are no comprehensive data on commercial fish landings or sales. Finally, even if the above information did exist, it would provide a gross understatement of the socio-economic impact of subsistence, recreational, and part-time commercial catches which do not enter monetary markets.

Given the lack of sufficient hard data, the importance of fisheries must be judged subjectively on the basis of the few existing studies, evidence from similar island economies, and the opinions of knowledgeable informants.

In Guam, the mean family money income for 1977 was estimated at \$16,405 (DOC GUAM, 1979). If we assume an average annual tax rate of 11 percent, the average family disposable income becomes \$14,621. Average annual household spending on fishery products was estimated for the same year at \$586 (Callaghan, 1977). Dividing this number by the disposable income indicates that the average household spends 4 percent of its disposable income on fishery products. By comparison, in the United States during 1977, fish consumption as a percentage of disposable personal income was estimated at .79 percent (Perrin and Crews, 1979).

In a survey of 127 fish-consuming households (Jennison-Nolan, 1979), 49 indicated that at least one member goes fishing. These 49 households contained 103 fishermen ranging in age from 10 to 64 years, 80 percent of whom indicated that they spent at least one day a week fishing. None of the respondents considered themselves a commercial fisherman, yet reported catches by the 46 households averaged 72 pounds and ranged from 2 to 1000 pounds per month. Most fishing activities were shoreside or near-shore oriented. Although none of the fishermen respondents owned a boat, many of them had access to boats owned by others.

Aerial surveys carried out by the Guam Division of Aquatic and Wildlife Resources further serve to underline the importance of small scale recreational and subsistence fishing on Guam (Division of Aquatic & Wildlife Resources, 1979). During FY 1979, 21 survey flights were made in a small, fixed wing aircraft following a prescribed course around the perimeter of the island. These flights were conducted on 10 weekends and 11 weekdays, and averaged 1.5 hours in duration during late morning and early afternoon. They resulted in the sighting of 858 inshore fishermen and 228 offshore fishermen in 195 boats. The sighting of 858 probably reflects a minimum of activity since subsistence and recreational fishing is concentrated on weekends and oriented to prevailing tidal conditions.

all
JSCG

It is currently difficult to determine the number and type of fishing vessels on Guam. Registration of vessels is carried out by the Department of Public Safety. Section 8995.3 of the Guam Code requires registration and numbering every three years. There is no system set up to retire registered vessels that have subsequently been sunk, abandoned, or destroyed. If a vessel is not re-registered after three years, the registration number is supposed to be available for reassignment; however the current practice is to wait 1 to 2 years before reassigning a number. A further complication arises from the fact that vessels documented under federal law are not required to apply for registration and numbering by local authorities. Therefore, simply reviewing the registration files will not provide accurate information on number and type of active vessels. There are presently some 1001 vessels listed in the registration files at the Department of Public Safety (Planning Information Section, Bureau of Planning, 1979, unpublished). Most recent estimates by the Department of Public Safety indicate that of the 1001 registered vessels, 349 are inoperable or sunk, 50 are sailboats, and the remaining vessels are operational craft used in subsistence, recreational, or commercial activities (Guam Department of Commerce, 1980 unpublished).

Currently on Guam there are 4 major sporting goods dealers specializing in diving and fishing gear and 6 major boat and boating supply firms. Based on brief owner interviews, retail sales of diving and fishing gear are estimated at \$900,000 annually, and sales of boats and boating supplies are estimated at over \$1,150,000 annually.

In a study of 386 non-charter recreational-commercial vessels based in Kailau-Kona, Hawaii, the net recreational-commercial benefits were estimated at \$1,117,000 per annum. These benefits average \$2,894 per vessel (Western Pacific Regional Fishery Management Council, 1979). Extrapolating to Guam without adjusting for differences in fish prices, factor costs, catch rates, or effort, and making the conservative assumption of a 400-vessel fleet, the net recreational-commercial benefits of such fishing in Guam are estimated at over \$1,157,000.

Table 3-1 presents recent estimates of the type, value, and number of full-time commercial fishing vessels on Guam. These estimates were made by the Guam Fishermen's Cooperative Association and represent the best available data. Most of these vessels are constructed of fiberglass by major U. S. companies. There are currently no steel hulls being used in the domestic fishery. Most boats have limited overnight accommodations; vessels over 25 feet are primarily moored, while the majority of the rest are trailered. About 90 percent of the larger vessels (over 25 feet) have VHF radio and approximately 70% of the smaller boats carry CB radios. Recording depth sounders are found on all vessels over 25 feet and on about one third of the smaller boats. with a car

Most of the fishing vessels listed in Table 3-1 are master-owned by local residents who have owned a series of progressively larger boats. The smaller boats carry crews of one or two. Up to four fishermen are employed on the largest vessels. Surface trolling and bottom fishing with electric or hydraulic reels are the primary techniques employed. Three vessels engage in some longlining and deep trapping and two vessels regularly engage in night fishing.

Table 3-1
 Estimated Number, Type, and Value of Full-Time Commercial
 Fishing Vessels on Guam - 1979*

Estimated Number	Type	Estimated Dollar Value Per Unit
8	gasoline outboard 18-21'	11,000
4	gasoline inboard 18-21'	20,000
5	gasoline inboard 21-24'	21,000
3	gasoline inboard 24-36'	35,000
5	diesel inboards 20-25'	35,000
5	diesel inboards 30-42'	50,000

*The above listing does not include boats used in part-time commercial, subsistence, and recreational fishing, but does include charter vessels used to fish commercially when no charters are available.

Source: John Eads, Guam Fishermen's Cooperative Association (unpublished interview)

B. Market Structure and Distribution

A diagrammatic model of Guam's seafood marketing and distribution system appears in Figure 3-1. Sources of seafood products can be divided into three general categories: local-caught landings, imports, and foreign-caught landings. The latter category refers to landings of tuna and "incidental catch" by foreign and U. S. vessels, not based in Guam, but calling at Guam Commercial Port. The category of imports refers to fresh, frozen, packaged, or canned seafood products which arrive on the island via scheduled surface or air carriers. The category of local-caught landings refers to fish caught by locally-based subsistence, recreational, or commercial fishermen within the FCZ around Guam.

The ultimate users of seafood products are categorized as local households or visitors. The visitor category is served by commercial hotels and restaurants. Many households also consume seafood products by eating at local restaurants or through federal (school lunch) programs or military exchanges and restaurants. Exports of seafood products are omitted from Figure 3-1 for the sake of simplicity. They are relatively insignificant and will be discussed further in section C of this chapter.

Transaction modes occurring along the various distribution channels of Figure 3-1 can be classified as monetary exchange, barter exchange, or reciprocal exchange. Monetary transactions refer to the exchange of fish products for money. Barter refers to the exchange of fish products for other goods and services. Reciprocity refers to friendly gifts or transfers within the extended family or village in order to fulfill social responsibilities and cultural obligations.

Intermediary organizations which import, store, process, and distribute seafood products are grouped into two general categories in Figure 3-1: wholesale and retail. These categories have considerable overlap since many enterprises operate on wholesale and retail levels simultaneously.

C. Use of Fishery Products

Household Consumption

There is no time-series information on consumption patterns of commonly caught fish in Guam. The only published evidence on this topic comes from two cross-sectional studies, both done in 1977. The first is based on a random survey of 1054 households, stratified by village population (Callaghan, 1977). The second is based on a smaller sample of 127 fish-consuming households (Jernison-Nolan, 1979). Although these two studies are not strictly comparable, they appear to support the general conclusions presented below.

At least 90 percent of the households surveyed indicated that they eat fish products. Consumption frequency of fish and seafood products averages between 6 and 8 meals per month, but frequencies vary widely between households and ethnic groups. At least 34 percent of the households would like to eat fish more often than they presently do, and 81 percent indicated a preference for fresh fish over canned, frozen, dried, or smoked. Fish under 7 inches in length were preferred by 19 percent of the respondents. Some 60 percent

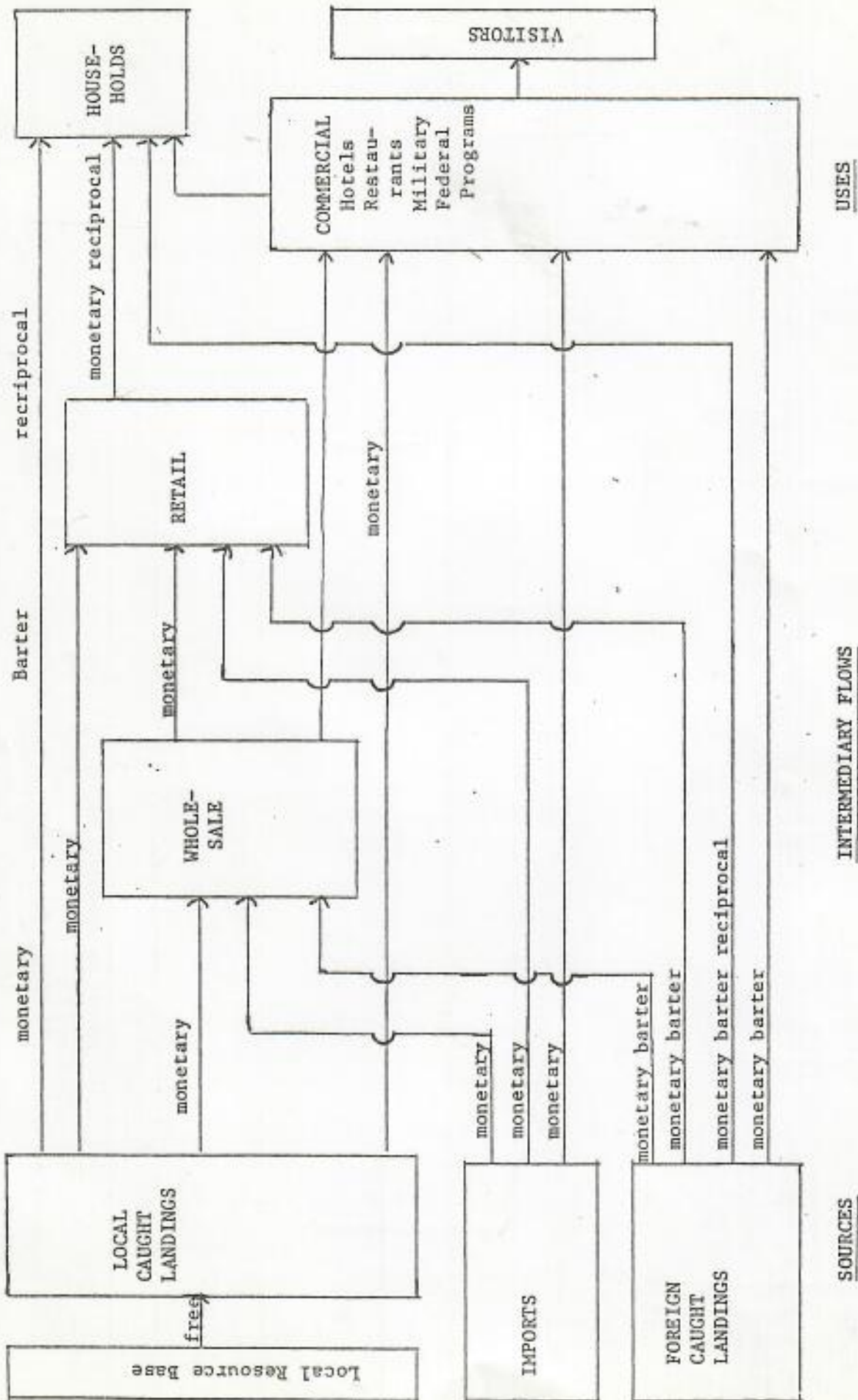


Figure 3-1. Distribution Channels for Transaction Modes for Seafood Products Marketed in Guam.

preferred fish between 7 and 14 inches in length, while 14 percent preferred larger fish, and the remainder expressed no preference.

Household spending on seafood products is estimated to average around \$586 per year in Guam, with spending apportioned approximately 31 percent for canned, 26 percent for frozen, 36 percent for fresh, and 7 percent for dried and smoked products. The United States consumption of fish products amounted to \$47.66 per capita in 1977 (Penn & Crews, 1979). If we assume an average household size of 5, Guam's per capita consumption amounts to \$117.11 or almost 2.5 times the national average.

make about for just coastal states?

Table 3-2 presents estimated household spending patterns on fish products by ethnic group. It must be remembered that Table 3-2 is an under-estimate of total fish consumption since it does not include fish acquired through nonmonetary transaction. The study by Jennison-Nolan (1979) reported that only 45 percent of the respondents indicated that their fish products were entirely bought at the store. The importance of subsistence fishing and nonmonetary transfer is further supported by the fact that 44 percent of the fishermen indicated that they eat some of their catch and give some of it away (Jennison-Nolan, 1979). Hawaii's per capita utilization of fishery products is estimated for 1977 at 58.6 pounds (Hudgins, 1980). Whereas approximately 8 percent of the civilian resident population of Hawaii is foreign-born from Asian countries, over 20 percent of Guam's population was born in Asia. Given the fact that Asian countries have substantially higher rates of fish consumption than the United States, there is every reason to believe that Guam's per capita utilization of fishery products is even higher than that of Hawaii.

Commercial Consumption

Published data on the purchase of fishery products by hotels and restaurants on Guam is non-existent. One unpublished survey was done by students from the University of Guam during the Fall of 1979 (Callaghan, unpublished). The survey covered seven hotel and two non-hotel associated restaurants. These nine restaurants had a combined maximum seating capacity of 3,500, and the seven hotels represented 1,787 rooms out of a total island hotel room capacity of 2,514 (Guam Growth Council, 1980). Table 3-3 presents a summary of information collected in the survey; however, the results should be considered only rough estimates. There are 48 non-fast food restaurants listed in the telephone yellow pages. Much more work needs to be done in this area.

Exports

Guam has virtually no fishery exports (except for cultured eels). Although some small exports do appear in the official statistics (Guam, Department of Commerce, 1979), these items represent transshipments of seafood products through Guam. Little value, other than transfer and storage value, is added on the island. Most of these shipments are destined for the Northern Marianas or the Trust Territory. Between October 1978 and September 1979, \$106,480 worth of seafood products were imported into the Northern Marianas from Guam (Orbach, 1980).

Table 3-2

Estimated Seafood Product Spending Patterns of Households on Guam by Ethnic Group.

Ethnic Group	Percent of Total Population*	Av. Annual Spending (Dollars)	Most Frequently Purchased Products		
			Canned	Fresh	Frozen
Filipino	21.2	830	Sardines Tuna	Milkfish Shrimp	Milkfish Shrimp
Japanese	1.8	631	Tuna Sardines	Tuna Other	Shrimp Tuna
Guamanian	62.1	599	Sardines Tuna	Rabbitfish Mackerel	Mackerel Rabbitfish
Chinese	1.2	514	Sardines Tuna	Milkfish Shrimp	Other Tuna
Micronesian	3.4	451	Tuna Sardines	Other Tuna	Tuna Mackerel
Korean	1.6	349	Tuna Sardines	Other Shrimp	Other Tuna
Caucasian	8.1	226	Tuna Sardines	Snapper Other	Shrimp Processed

* As published by Guam Department of Commerce in 1979 Annual Economic Review

Source: Paul Callaghan, Some Factors Affecting Household Consumption of Seafood and Fish Products on Guam, Government of Guam, Bureau of Planning, Economic Planning Division Technical Report No. 77-3.

Table 3-3
 Monthly Purchases of Fresh and Frozen Fishery Products by Nine
 Restaurants on Guam - As Determined by Oral Interview
 In 1979

Fishery Product	Monthly Purchase (in pounds)	Average Price Paid Per Pound (in dollars)	Estimated Monthly Expenditure (in dollars)
Tuna ¹	3,035	1.43	4,340
Shrimp ²	1,940	6.39	12,397
Lobster ³	1,625	7.64	12,415
Salmon ⁴	200	3.27	654
Other Finfish ⁵	1,230	1.76	2,164
Non-Finfish ⁴	220	4.08	898
TOTAL	8,245		32,868

¹Primarily yellowfin

²Frozen; preferred in 16-20/lb. or 26-30/lb. (headless)

³Frozen; preferred in the 8-10 oz. tail category

⁴Entirely imported

⁵Includes: lapu-lapu, mackerel, mahimahi, wahoo, parrotfish, onaga, rainbow runner, and blue marlin; preferred boneless fish over 20 lbs.

D. Source of Fishery Products

Imports

Consistent time-series data on fishery product imports is not available on Guam. The most recent and reliable information exists for the first nine months of 1979 (Guam Department of Commerce, unpublished), and is presented in Table 3-4. Based upon these data, the Guam Department of Commerce estimates 1979 imports at 4.5 - 5.0 million pounds with a declared value of \$6,512,338. They further estimate 1979 imports of fresh, chilled or frozen fish at 2.5 million pounds having a declared value of \$1,447,000. Ignoring beginning and ending inventories, these estimates imply a utilization rate for total imports in the realm of 39.2 pounds per capita, and a utilization rate for imported fresh, chilled and frozen fish of 20 pounds per capita.

Local Landings

The Division of Aquatic & Wildlife Resources conducts creel censuses on a random basis at various locations throughout the island (Division of Aquatic & Wildlife Resources, 1979). Estimates based on these surveys indicate that 35,536 people spent 190,642 hours harvesting 424,456 pounds of fish during FY 1979. Some 68 percent of this catch resulted from offshore trolling, bottomfishing and diving. The remaining 32 percent resulted from a variety of inshore activities including netting, diving, hook-and-line fishing, etc. These estimates represent local landings of about 3.4 pounds per capita.

Foreign-Caught Landings

Tuna fishing vessels from Japan, Korea, Taiwan and the United States frequently call at the Commercial Port of Guam. Since May 1974, over 60,000 metric tons of tuna has been transshipped through Guam to U. S. canneries in Hawaii, Los Angeles, San Diego, and Puerto Rico. A large number of foreign fishing vessels also call at the Port for fuel, provisions, and repair (Callaghan and Simmons, 1980).

As indicated in Figure 3-1, some fish from these vessels finds its way into the local market. The exact quantities are unknown. It is legal for tuna caught anywhere in the world to be landed for sale in Guam by vessels of any nation (see Section G of this Chapter). Fish other than tuna can be landed by foreign vessels only if caught outside the U. S. FCZ. American vessels may land any species for sale in the local market, no matter where it is harvested.

E. Transshipment, Provisioning and Repair

The Commercial Port of Guam is situated on 33 acres of land bordering the deep water, well-protected anchorage of Apra Harbor. The volume of general cargo processed through the Commercial Port increased by 69 percent between 1970 and 1978. During 1978, 827 vessels called at the Port, and over 744,000 metric tons of cargo was processed (Guam Department of Commerce, 1979). The facility has 2,725 feet of dock space and 1.5 million square feet of covered area. Dillingham Corporation, located nearby, provides modern repair facilities and a floating drydock capable of lifting vessels of 1,000 gross tons or up to 200 feet in length. The Port is served by

Table 3-4
Value of fish product imports to Guam by country of origin: January through December, 1979 (dollars)

Country	Fish Fresh, Chilled and Frozen		Fish Salted, Smoked and Dried		Shellfish Fresh & Frozen		Fish in Airtight Containers		Total Import	
	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent
United States	241,291	8.7	57,333	16.1	553,134	19.4	518,703	34.1	1,370,461	21.0
Japan	567,079	20.3	247,070	69.5	290,727	10.2	908,399	59.8	2,013,275	30.9
HongKong & Taiwan	279,138	10.0	14,313	4.0	22,518	0.8	44,118	2.9	360,087	8.5
Philippines	1,419,414	50.9	23,554	6.6	934,555	32.8	46,838	3.1	2,424,361	37.2
Other Countries	281,210	10.1	13,466	3.8	47,878	1.7	1,600	0.1	344,154	5.3
TOTAL	2,788,132	42.8	355,736	5.5	2,848,812	43.7	1,519,658	23.3	6,512,338	100.0

Source: Guam Department of Commerce.

two east-west carriers--U. S. Lines and U. S. President Lines. A north-south link between Japan and Australia is provided by Daiwa Lines (Guam Growth Council, 1980).

Since May, 1974, over 60,000 metric tons of tuna have been transshipped by the Port. During 1978, transshipments have averaged 892 metric tons per month; however, there has been great variation in monthly activity. This variation does not appear to be related to normal seasonal patterns of tuna abundance around Guam (Callaghan and Simmons, 1980).

Tuna transshipments through Guam consist primarily of skipjack which is destined for United States canneries in Hawaii, Los Angeles, San Diego or Puerto Rico. Most tuna discharged at the Port is brought to Guam in either carrier vessels (reefers from Palau or Papua New Guinea) or purse seine vessels. Pole-and-line and longline vessels have seldom transshipped tuna through Guam. Aside from an occasional United States seiner, most fishing and carrier vessels are either foreign-built or fly foreign flags. Such vessels are permitted to unload fish in Guam under a Bureau of Customs regulation--Marine Circular No. 124 (1953).

During the period February through August, 1979, an intensive investigation of tuna transshipment activity was undertaken (Callaghan and Simmons, 1980). During this time 165 fishing and carrier vessels entered the Commercial Port. Vessels arriving for purposes other than transshipment or transfer of tuna accounted for 83 percent of the arrivals and represented cumulative deadweight tonnage of 26,000 metric tons. Non-transshipping vessels were largely of Japanese registry and called mainly for bunkering, water, and supplies. The average length of stay was 2.9 days.

A total of 21 vessels transshipped 6190 metric tons of tuna during the sample period. Purse seiners represented 52 percent of all transshipping vessels. The remainder were carriers. Longline or pole-and-line vessels did not transship during the sample period.

The average transshipping vessel remained in port for 10.5 days and spent an average of \$56,954 on a variety of private and public goods and services. These expenditures average \$193 per metric ton, or \$3,361 per container. The public sector (primarily the Commercial Port of Guam) received 8.5 percent of these expenditures while the private sector received 91.5 percent. It should be noted, however, that 75 percent of these expenditures were paid to shipping firms for outbound container freight charges and to oil companies for fuel. Expenditures in these two areas probably have very low multiplier effects within the Guam economy.

It was discovered that expenditures per vessel are directly related to the amount of tuna discharged as well as to the size and nationality of crews. Evidence indicates that under present conditions a 10 metric ton per month increase in transshipment will result in the creation of one additional man-day of stevedore employment.

During the discharge process, vessel crews work in the hold separating frozen tuna and loading them into nets or buckets which are lifted dockside and emptied into refrigerated containers. The containers are filled to an

average weight of 18 metric tons. Containerized tuna is then shipped out of Guam on scheduled commercial carriers.

Under present conditions, single-hold discharge operations result in an average discharge rate of 12.7 metric tons per hour. Discharge from two holds simultaneously results in an average discharge rate of 16.0 metric tons per hour. The official standard rate charged by the Port for stevedore services and demurrage is \$6.00 per short ton. It is estimated that implementation of minor improvements in the existing discharge process can increase discharge rates above 20 metric tons per hour, while at the same time reducing port costs per ton of tuna transshipped.

E. Small Boat Infrastructure

There currently exist three locations on Guam at which small and medium size boats can be moored. These include Agana Boat Basin, Apra Harbor and Merizo Lagoon (see figure 1-3). The Agana Boat Basin is located on the northwest coast in the center of Agana Bay. It was constructed immediately after World War II from the rubble of the destroyed city of Agana. Access from the Philippine Sea is provided by a channel through the reef with a depth of approximately 15 feet and a width of 120 feet. Two inner basins contain 32 floating slips, and an outer basin provides a small anchorage for larger boats. Agana Boat Basin has a launching ramp but no fueling facilities or other infrastructure.

Merizo lagoon on the southern tip of Guam is a natural anchorage with no man-made breakwaters. The access channel has an eastward exposure, is several hundred feet wide, and ranges in depth from 80 feet at the mouth to 30 feet within the lagoon. Facilities at Merizo include a privately owned fuel pier, launching ramp, marine railway, and several private docks. Besides large commercial port and Navy facilities, Apra Harbor has a small launching ramp and deep water anchorage.

None of the harbors on Guam provide adequate storm protection. Should a major storm occur, small boats must be hauled out or crowded into a very small portion of the Piti Channel in Apra Harbor. With the exception of the fuel pier in Merizo, all vessel supplies (fuel, water, ice, etc.) must be trucked from downtown Agana to the fishing boats. Launching ramps at locations other than the three mentioned harbors are extremely inadequate or non-existent. Hauling-out facilities are available for vessels less than 50 feet in length at the marine railway in Merizo or by use of a rented crane using slings at Agana Boat Basin. Larger vessels must use the Dillingham facilities in Apra Harbor. All three harbors have inadequate dock space and only Agana Boat Basin has slipways. All vessels over 45 feet (including the entire sailboat fleet) are moored at anchor and serviced by dingy.

G. Impact of Federal Laws

The most important Federal laws impacting on fisheries development in Guam are the Shipping Act of 1916, the Merchant Marine Act of 1920, and the Fishery Conservation and Management Act of 1976. Also of importance are various rules, regulations, interpretations, and decisions made by agencies

of the Federal Government. Only the U. S. Congress can change public laws; however, the Secretaries of Commerce, Justice, Labor, Transportation, Treasury, Defense and State, as well as the Office of the President, are given certain administrative, regulatory, and enforcement powers which may impact the fisheries of Guam.

The Fishery Conservation and Management Act of 1976 (FCMA), Public Law 94-265, provides for the conservation and management, by the federal government, of all fishery resources within the U. S. Fishery Conservation Zone (FCZ). The Act also establishes eight Regional Fisheries Management Councils whose responsibility it is to develop Fishery Management Plans (FMP) controlling the harvest of resources within FCZ. Other purposes of the Act include encouragement of international agreements concerning highly migratory species, promotion of domestic commercial and recreational fishing, and development of fisheries for under-utilized species (Singh, 1979).

The FCZ around Guam extends from the seaward boundaries of the territorial sea (3 nautical miles) to 200 nautical miles from shore. The only species which are excluded from regulation under FCMA are tuna. This exclusion rests on the argument that tuna are highly migratory, and in the course of their life cycle, reproduce and migrate over great distances, moving into and out of the national waters of many nations.

Under the FCMA, the Department of State, in cooperation with the Department of Commerce, negotiates a Governing International Fishery Agreement (GIFA) with foreign nations wishing to fish within the U. S. FCZ. The GIFA is subject to Congressional review. Once a GIFA is in force, the foreign nation submits a vessel permit application for each vessel to the Department of State, which forwards it, along with recommendations, to the Assistant Administrator for Fisheries of the National Marine Fisheries Service (NMFS), an agency of the Department of Commerce. NMFS, after receiving input from the Regional Fishery Management Councils and consultation with the Department of State and the Coast Guard, may approve the permit application.

As previously mentioned, the Regional Fishery Management Councils have responsibility for preparation of FMP's which regulate both domestic and foreign harvest of fishery resources within the FCZ. These FMP's must be approved by the Secretary of Commerce and published in the Federal Register before taking affect. In the absence of an FMP, the Secretary of Commerce may prepare and implement a Preliminary Management Plan (PMP) which will remain in force until approval of an FMP.

With respect to the FCZ around Guam, there are currently in force one FMP for precious corals and one PMP for billfish. The U. S. Coast Guard and NMFS are charged with the responsibility of enforcing these plans. The Western Pacific Regional Fishery Management Council is currently in the process of preparing FMP's for billfish, spiny lobster, and bottomfish.

Under Public Law 95-354, the Secretary of Commerce may issue permits allowing U. S. fishermen to transfer catches at sea to foreign fishing or processing vessels. These transfer arrangements are referred to as "joint ventures." "Joint venture" permits can be issued only in the event that harvest capabilities of U. S. fishermen exceed the processing capabilities of U. S. processors for a particular species. A "joint venture" can be

ESA Impact?

negotiated only with a foreign nation. It cannot be negotiated between the U. S. Territories and a foreign nation nor between the U.S. and its territories or possessions (Singh, 1979).

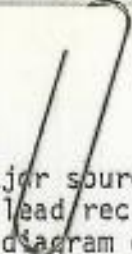
Under the FCMA, only vessels which are documented under the laws of the United States, or registered under the laws of any state of the U. S., are allowed to fish in the FCZ. Foreign-built vessels cannot receive the necessary documentation or registration for use in the fishery. The only exception occurs under a Treasury Department ruling (T.D. 56382-6) which allows vessels under five net tons to be used by U. S. citizens and resident aliens to fish in U. S. waters.

Section 11 of the Merchant Marine Act of 1920 (the Jones Act) states that "...vessels built within the United States and belonging wholly to citizens thereof; ...may be used for coastwise trade," i.e. commerce directly between two U. S. ports. In addition, Section 21 (a) of the Jones Act prohibits foreign flag vessels, except by special treaty, from landing "...in a port of the United States its catch of fish taken on board such vessels on the high seas or fish products processed therefrom, or any fish or fish products taken on board such vessels on the high seas from a vessel engaged in fishing operations or in processing of fish or fish products." Under U. S. Customs regulation (Marine Circular No. 124-1953) foreign-flag fishing vessels are allowed to land fish in Guam; however, Jones Act restrictions with respect to use of foreign built vessels still apply to citizens of Guam both for fisheries and coastwise trade.

In summary, the Federal government does not prohibit the landing of fish in Guam by foreign-built or-owned vessels, so long as the fish are harvested outside the 200 mile FCZ. The only exception is tuna, which can be harvested anywhere outside 3 miles and landed in Guam by foreign-built or-owned vessels. Citizens and residents of Guam may not use foreign-built fishing vessels over five net tons, and, as far as coastwise trade in fisheries is concerned, all vessels must be constructed and registered in the United States.

In addition to the above-mentioned laws, various departments and agencies of the Federal Government exert both enforcement and regulatory powers which directly or indirectly impact upon fisheries development in Guam. For example, the Department of Defense through the Coast Guard and Navy can, in the interest of national defense, limit access to Apra Harbor and control fishing practices which may interfere with military operations. The Department of Justice through the Immigration and Naturalization Service administers regulations which limit access to shore leave for foreign crews. The Department of Labor administers regulations regarding local employment of foreign fishermen for training programs. The Coast Guard enforces a complex of environmental and safety regulations, while the Army Corps of Engineers and the Department of Interior regulate the construction of port and docking facilities in coastal waters.

An in-depth analysis of Federal laws and regulations affecting fishery development and management in Guam is warranted. Where possible, this study should recommend procedures for seeking relief from laws and regulations detrimental to fisheries development and management in Guam.



The major sources of Federal funds for fisheries development and management, along with lead recipient agencies at the local level are presented in Figure 3-2. This diagram emphasizes the complexity of funding channels involved and points out the difficulty of coordination and planning at the Federal as well as local levels (see Harville, 1980). Every effort should be made to coordinate and consolidate Guam's fishery development efforts. The Guam Marine Fisheries Advisory Council established under Executive Order 79-6 provides a potential vehicle for local coordination provided that its activities are fully supported by the line agencies involved.

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Following are summaries of the comments received and the responses made:

1. Director, Department of Parks and Recreation

Suggests that reference be made to insufficient laws and enforcement thereof regarding illegal fishing practices as constraints for development and management of reef fisheries and that the preservation of traditional fishing methods be a management objective. Also notes that the Merizo fuel pier is private and does not serve the general public.

Response:

These suggestions have been addressed in the appropriate areas of the text.

2. Director, Bureau of Planning:

Suggests inclusion of more information on fisheries-related weather conditions around Guam; listing of Office of Coastal Zone Management as a source of Federal funding; statement acknowledging OCZM for preparation of plan.

Response:

More fisheries-related weather information is provided in Chapter I and in Table 1-1; OCZM is listed as a source of Federal funding Chapter VIII; acknowledgement of OCZM for Plan preparation is included inside the front cover.

3. Sam Pooley, Western Pacific Regional Fishery Management Council:

Need for description of interrelationships between Territory of Guam and Western Pacific Regional Fishery Management Council, RAIQMA (Research Assessment Investigations of the Marianas Archipelago), the Pacific Basin Development Council, and the National Marine Fisheries Service; need for underlining the importance of a Territorial lead agency for fisheries development and management; need for summary of data needs and reference to proposed data collection efforts by National Marine Fisheries Service and Western Pacific Regional Fishery Management Council.

Response:

Figure 3-2 has been added to Chapter III in an attempt to indicate the various and complex interrelationships among Federal, Regional, and Territorial organizations concerned with fishery development and management. However, this diagram may soon become an anachronism under the major reprioritization and budget management programs of the new Federal Administration. Until the dust settles, it may be premature to attempt a more detailed description of Federal Regional, and Territorial interactions in the area of fisheries.

The RAIQMA project is described briefly in Chapter VI.

Response:

Clearly, close cooperation between these two agencies (GOMP and DAWR) is necessary for management and development of reef resources; the Plan recognizes this (Chapter V) and, in fact, close cooperation between these two agencies has been established. Budgetary realities may soon determine which agency has the manpower and funding to serve as lead agency for reef resource management.

10. General Manager, Port Authority of Guam:

Need for elaboration of discussion on coordination of government agencies involved in fisheries development on Guam; clarification of discussion on "dumping" of scrap fish by fishing vessels transshipping fish through Guam.

Response:

The Guam Marine Fisheries Advisory Council has made recommendations regarding governmental reorganization to improve government efforts to develop fisheries. Other than the appointment of a Fishery Officer, little has been done. The Department of Commerce, in its efforts to develop an Overall Economic Development Plan, has emerged as the most active Territorial agency in the area of fisheries development. The "dumping" of scrap fish presents marketing problems for local fishermen, as discussed in Chapter VI, Section B. The General Manager of the Port Authority has indicated in his comments that the Port is working with the Department of Revenue and Taxation (Business License Unit) and the Department of Commerce (Division of Customs and Quarantine) to ensure that all applicable regulations and statutes are complied with when large quantities of scrap fish are involved.

11. Pacific Islands Administrator, U.S. Fish and Wildlife Service:

Suggests prioritization of recommendations and project cost analyses; suggests expansion of fishing facilities at Apra Harbor rather than Agana Marina; clarification of Jones Act restrictions; clarification of size over-harvesting; suggests appropriate literature citations; suggests need to implement reef sanctuaries for some species immediately; suggests "rotating" sanctuaries; indicates market potential of limited shark fishery; requests documentation of bottomfish stock depletion and recovery; proposes Territorial leasing of seamount groundfish fishing rights to foreign harvesters such as is done in Papua New Guinea; indicates that at least three supertanker ports have been considered for the Commonwealth of the Northern Mariana Islands; indicates lack of knowledge of larval fish distributions relative to toxic effects of oil; indicates potential harm to fish stocks caused by clean-up efforts.

Response:

Project prioritization is being performed by GMFAC which is serving as the Marine Resource subcommittee for OEDP. Project cost analyses are being developed by OEDP and by the contractor for the PBDC Regional Fishery Development Plan.

Whereas Agana Marina may ultimately be outgrown by domestic fishermen, the development of at least minimal fishery infrastructure (facilities for dockside receipt of catch and facilities for providing fuel and ice) at the Agana Marina appears to be much more immediately possible than would the development of appropriate small boat facilities at Apra Harbor. The Plan does recognize, however, the need to develop Apra Harbor for eventual expansion of the domestic fishing fleet.

Commercial operators on Guam are permitted to use foreign-built vessels if the vessels are less than five net tons; the CNMI is permitted by Executive Order of the President of the U.S., to use foreign-built vessels of any size for commercial purposes for the duration of the Trust Territory trusteeship agreement.

The discussion of size overharvesting has been modified by substitution of the term "optimal size" for "full size".

Bob Johannes' work on traditional methods of fishery management has been cited.

The need for immediate establishment of reef sanctuaries has not been clearly demonstrated yet, and the establishment of sanctuaries without adequate public input and education would be counterproductive. Subsistence reef harvesting is practiced widely on Guam, and most reef harvesters operate on reef areas near their village of residence. There would be considerable resentment among reef fishermen if sanctuaries were imposed on them without opportunities for review and discussion and, under such conditions, poaching would be difficult to eliminate. Studies on the feasibility of establishment of reef sanctuaries should evaluate the possibility of having moving, rather than, or in addition to, fixed sanctuaries.

The Mexican and Central American shark fishery has been noted in Chapter VI.

The bottomfish stock depletion study has been cited in Chapter VI; local bottomfish fishermen report that catches continue to be poor at this location more than a decade after the overfishing occurred.

It would appear that leasing fishing rights to foreign fishermen is not a legal option for Guam under its present relationship with the United States. This could well be an item for discussion in Guam's future status negotiations with the United States.

The comments on supertanker ports and oil pollution have been included in Chapter VI.

12. Executive Director, Western Pacific Regional Fishery Management Council:

Indicates need to show Plan's relationships with WPRFMC's Guam - NMI Integrated Plan, RAICMA, and the PBDC Regional Fishery Development Plan; need to identify Federal lead agencies for fishery development; need to show interrelationships between recommendations which refer to different fishery sectors but which are similar in content.

Some cases don't even make it to court

Second in a series

By SUZETTE KIOSHI
and MARGARET SIZEMORE
Daily News Staff

Government prosecutors dismissed 111 cases out of the 892 filed last year. Before the year is out, many more could be dismissed.

Almost half of the cases referred to the prosecutors office — a majority of which come from the police — don't make it into the courts for a variety of reasons. And sometimes when they do, they are dropped halfway through the proceedings.

Local prosecutors say that on Guam, more than anywhere else, institutional problems with various government departments and agencies often work against them in their criminal work.

A major portion of the problems stem from the cultural biases of the island and other difficulties the culture is encountering in adjusting to a democratic judicial system.

"The place is so small and people are so related, it makes it difficult to get a case together," said Marcie Yeater, a two-year veteran of the office.

Because of the extended family system on Guam, prosecutors often have to wrestle with potential

witnesses who are scared to testify against the accused because somewhere along the line they are related and are afraid of family repercussions.

"The haoles are the ones who make the biggest stink about anything," Yeater pointed out, "because they don't have any family ties here."

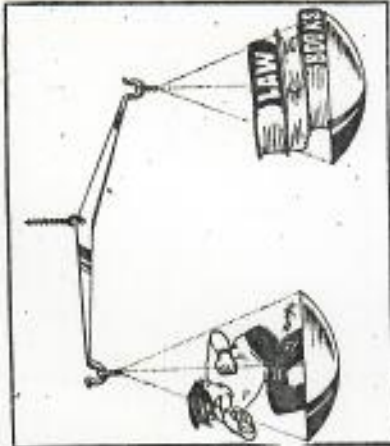
Prosecutors say the "forgive and forget" attitude is prevalent among the ethnic populations here and fosters tolerance for wrongdoing.

But as Yeater pointed out, the contradiction is, "They want us to be tough. Unless it's somebody they know."

Inefficient police work causes the bulk of referrals that are dismissed, says chief prosecutor Ron Pomeroy. Prosecutors say they spend too much of their time doing investigative work and piecing in complete police reports together.

"The police department here is as capable as any anywhere else," said Yeater. "I think it's just improper training and discipline. A lot of higher-ups are not demanding enough. There are those who want to do a good job but they're just frustrated."

But Department of Public Safety director Dr. Judith Guthertz says



frequent turnover in the prosecutor's office makes it difficult for the police to cooperate.

"They're getting their experience now," Guthertz said of the young prosecutors, "but it's at the expense of good government."

The prosecutors office held a series of workshops over the summer to upgrade police skills and inform officers of the necessity for clear, concise and thorough writing. The workshops, said Pomeroy, were also to help officers understand the prosecution process, what attorneys look for in building their cases, and how they could better aid in the pre-trial process.

"Response to the workshops we conducted was nil," said Gregorio

Perez-Seisky, a former Oregon prosecutor.

Guthertz said DPS conducted several special seminars of its own last year, and this year plans to include updates on laws and training in tactical, hostage and terrorist situations.

Recruits at the Police Academy may also be taking two extra weeks of training in police report writing, she said.

But with additional training is the need for more money, a problem that hinders the department in keeping abreast of the growing island population.

Guthertz also said she hopes the department can get its own legal counsel. A request for an attorney's salary will be included in the 1985 budget request, Guthertz said.

But for prosecutors, frustrations don't stop there. Other government agencies and leaders also frustrate the prosecutor.

"It's so depressing when you've done your best to overcome everything, put together a good case and win it in court, only to have the parole board let someone out early or have the governor pardon him, or the clown gets to stay out (of prison) because his case is appealed," said Yeater.

Bill to stiffen fishing penalties vetoed

By ELAINE SANTOS

Daily News Staff
Gov. Ricardo J. Bordallo yesterday vetoed a bill that would stiffen the penalties for fishing with chlorine or cyanide.

Bill 278, authored by Speaker Carl C. Gutierrez, D-Agana Heights, is factual and is full of legal deficiencies, according to Bordallo's legal counsel Steve Unpingco.

Bordallo also vetoed a bill sponsored by Sen. Edward Charfauros, D- , that would make possession of firearms in public places reckless

conduct.

Unpingco said the governor had no objections to establishing more gun control. The basis for Bordallo's veto, Unpingco said, was the administration's objection to a rider in the bill.

The rider, which Unpingco says is a special class, calls for appropriating \$20,000 from the the Guam Power Authority for power extensions in Machanao, Dededo.

"The Legislature can't pass a law specifically catering to just a few people," Unpingco said.

But the senator said he plans to tack

the gun control bill as an amendment to another bill already on the session agenda.

Unpingco said the prison terms prescribed in Bill 278 do not conform with the terms outlined in the Criminal and Correctional Code.

The bill defines violations as felonies and says first time violators "may be imprisoned for not more than 30 days or fined not less than \$100 or not more than \$500, or both."

Unpingco said the prison terms are not what the criminal code prescribes for felons.

The bill also would allow violators of the bill to leave the prison during working hours to resume their regular jobs. Unpingco says this is not consistent with the treatment imposed on other felons.

Unpingco said it is unconstitutional, extreme and unusual punishment to force a violator of the bill to pay the costs of his imprisonment.

Aside from the legal problems, Unpingco said the bill is not practical because it only addresses illegal fishing while the vast number of offenders are poachers.

Coast Guard keeps eye on fishnappers

By ANDREW MacLEOD

SOMEWHERE OVER THE BERING SEA, Alaska (UPI) — Nosing the C-130 below the blanket of clouds, Lt. Frank Tabata leveled out on a patrol for foreign vessels suspected of overharvesting fish worth millions of dollars.

For the next 960 miles, the prop plane pitched and rolled over the slate gray Bering Sea, dropping at times to 400 feet above wind-whipped 20-foot swells.

Green blips on a radar screen located nine foreign fishing vessels. Each time one was spotted, the C-130 dipped through the cloud bank to report the vessel's location and fishing activity to a nearby Coast Guard cutter.

"Basically, the job is to spot and report what they're doing," said Tabata. "The report goes into the computer and if any discrepancies pop out, the cutter is called in."

While the Coast Guard looks down with electronic equipment, many of the boats look up with their own gear.

Since the United States invoked its 200-mile fishing limit in 1976, the patrols have monitored foreign fishing vessels' compliance with limits and fishing grounds.

"It's a catch-up game," said John Strahle, a National Marine Fisheries Service agent. "They devise new ways to cheat and we devise new ways to catch them."

At stake is a multimillion-dollar haul dominated by foreign fleets which have traditionally been ahead of U.S. fishermen in large-scale bottom fishing.

The creation of the 200-mile limit gave the U.S. commercial fishing interests an opportunity to build vessels that could compete with foreign fleets and develop a domestic large-scale fishing industry.

It also created an enforcement problem. Just how much overcatching goes on inside the 200-mile limit off Alaska is not known.

The area is huge, patrolled by only a handful of Coast Guard cutters.

Most of the foreign fleet, which fluctuates between 280 and 600 vessels off Alaska, is thought to comply with the quotas and restrictions in certain waters, officials said.

That assumption is backed up by the relatively small number of vessels (43) seized since the 200-mile limit went into effect. But it's also assumed that some violations go undetected because of the limited patrols.

"I think it's much bigger than the statistics indicate," said Bill Phillips, a fisheries expert on the staff of Sen. Ted Stevens, R-Alaska. "You're looking at maybe 10 to 15 percent of the fishery as a whole at a minimum."

In dollars, the figure ranges from a high of \$40 million to a low of \$10 million, he added.

Stiffer sanctions in recent years against those caught overharvesting have lessened the violations, Phillips said.

Prosecutors have sought higher penalties to more accurately reflect the value of the fish taken, said Greg Taylor, an assistant U.S. attorney for Alaska.

"It's true that in the last couple of years, we've tried to up the ante," he said. "It's a continuing problem. It may have decreased some ... but I think they've gotten more sophisticated, too."

Although the law allows for confiscating vessels, the highest penalty in Alaska has been an \$850,000 fine and suspension of fishing rights for a period, he said.

Most of the seizures made under the act have been of Japanese vessels, which also dominate the foreign fleet and make up for nearly 1 million metric tons of the 1.3 million metric tons of ground fish taken by foreign vessels off Alaska. Japanese officials maintain the violations are due to individual skippers and are not reflective of the industry as a whole.

"We have strict guidelines on logging (catches accurately) and we remind the crew of the Japanese vessels every time

BACKGROUND

Guam is a tropical island located in the western pacific 1500 miles east of the Philippines, 3700 miles west of Hawaii and 6200 miles west of San Francisco. The island is approximately 30 miles long and ranges from 4 to 8 miles in width. The environment ranges from dense jungles and flatlands to open savannahs and mountains. Average rainfall is 86 inches a year with the heavy moisture period occuring from July to November. The mean temperature is 80 degrees fahrenheit.

At the present time, 105,000 people live on Guam with 20,000 of these being military personnel connected with either the U.S. Navy or Air Force base. The population of Guam is a mixture of many people including caucasian, filipinos, chinese, japanese, vietnamese, and pacific islanders. The native poeple of Guam are called chamorros.

The territory of Guam was ceded to the U.S. in accordance with the provision of the treaty of peace between U.S. and Spain signed in Paris in 1898. Guam's relationship with the U.S. as outlined in the Organic Act of 1950 (64 Stat. 384, 48 USC 1421-1425) is that of a unincorporated territory. The government of Guam is composed of three branches; the executive, legislative and judicial. The government of Guam is under the general administrative supervision of the Secretary of Interior. The governor of Guam under the Organic Act Section 6 is "responsible for the faithful execution of the laws of Guam and the laws of the United States applicable to Guam". The legislature is composed of a speaker and 21 senators. Guam has a U.S. congressional representative but no voting power. The citizens of Guam are U.S. citizens but can not vote in U.S. presidential elections. Our counterpartx in government of Guam is the Division of Aquatic and Natural Resources and is under the director of the Guam Department of Agriculture. The divison is staffed by a chief, (Harry Kami), assistant chief (Bob Andersen), 7 biologists and 8 conservation officers. The chief conservation officer is Bob Bond.

US Attorney
ATF ?
Alcohol, Tobacco, Firearms

CHAMORRO CULTURE AND THE U.S. JUDICIAL SYSTEM

Historically, the chamorro family unit was very close and any wrong doings by a family member were taken care of by other family members. No family member was allowed to be disciplined by persons outside the family no matter what the crime. If the crime was of a very serious nature, the wrong doer was at times taken to a seaward cliff and thrown off. Today, the family ties are still strong but the self-discipline has dissipated to a large extent. The justice system in the U.S. is still difficult for the local chamorro to deal with. This is one of the reasons jury trials are difficult at times and a verdict of not guilty is often the outcome. If the defendant is not a chamorro, the verdict is easily reached and that being usually guilty. An example of the scenario is that 2 years ago, Saipan had their first criminal trial ever. The result was a hung jury. Another judicial problem involving chamorro to be dealt with is that of obtaining a true bill from a federal grand jury. The FBI had an investigation into Saipan government officials obtaining bribes from sources to introduce gambling into Saipan. The evidence including confessions, written statements, checks and banks information was overwhelming. The grand jury on Saipan failed to deliver a true bill.

ACCOMPLISHMENTS AND GOALS

1. Initiate and maintain liason with Guam Port Authority, Guam DMV, Guam Customs, Guam F&G, Guam Dept. of Agriculture, Guam AG's office, NMI F&G, NMI Customs, Military Customs, U.S. Navy, U.S. Air Force, U.S. Coast Guard, U.S. Customs, U.S. Attorney, U.S. Dept. of Agriculture and various government officials of Micronesia.
2. Develop and continue to provide training classes on importation and identification of ES and CITES products imported into Guam to Guam F&G, Guam Customs and Military Customs.
 - (A) Assist in developing a liason between Guam F&G and Guam Customs. This is a on going project. The chief of Guam F&G and Guam Customs have only met once in three years and this meeting was set up by SA Micuda. This liason is

crucial in developing and maintaining a conservation enforcement effort on Guam.

3. Provide and update manuals of USFWS regulations given to Military Customs, Guam F&G and Guam Customs.
4. Develop identification guides for CITES enforcement and disperse to Guam Customs.
5. Items 1 through 4 have resulted in numerous seizures of ES/CITES items by Military Customs and Guam Customs. Guam Customs is just now starting to prepare monthly seizure reports of seizures made at the U.S. Post Office, Commercial Port and Air Port (Air cargo and Hand carried baggage). Seizures so far number from 30 to 50 items per month. These seizures are violations of the federal ESA as well as Guam's ESA.
6. Initiate and attempt to develop liason between Guam Customs and the Guam Attorney General's office. When SA Micuda arrived on Guam, there was no liason between the above mentioned offices. One Guam warden stated that "the only way we find out about the disposition of a game violation is when we read about it in the local paper (Pacific Daily News). Great strides have been made in this area with the present situation being an almost daily contact between Guam F&G Assistant Chief Bob Anderson and the AG's office. More game violations are being accepted for prosecution by the Guam AG's office resulting in more prosecution. The affidavits prepared by Guam wardens have also increased 100% in preparation and stated facts compared to the first ones SA Micuda observed. Guam F&G personnel are extremely proud of these accomplishments as they should be. They still, however, have a ways to go.
7. Assist importers on importation of CITES products into Guam. The following areas of assistance are continuing:
 - (a) Develop and disperse of clearance procedures.
 - (b) Dispersal of USFWS regulations and forms.
 - (c) Alerting importers of requirements of foreign countries for export of wildlife.

Definite programs has been made in this area as importers are well aware of a USFWS presence on Guam and know they can obtain answers to their questions.

8. A continuing monitor of commercial outlets on Guam for ES items being sold. Items most often encountered are marine turtle products and canned whale meat. There are few if any retail outlets on Guam who do not know that the sale of marine turtle products are prohibited. Guam's ESA is usually relied on as it prohibits sale of any ES species listed on the federal list. Federal enforcement in this area is difficult as the USFWS must prove either an illegal take or illegal importation in order to prosecute. Many retailers speak little or no english and have either none or extremely poor business records which also create a problem with the federal ESA enforcement.
9. Establish and maintain a relationship with the public media including newspapers, radio and TV.
- The public media is most willing to assist in any way possible to educate the public on Guam as to wildlife conservation efforts. Shortly after arriving on Guam, SA Micuda met with David Wood, U.S. Attorney on Guam. Mr. Wood was most pleased to have a representative of USFWS but stated he wanted a public education effort under taken prior to any seizures and/or prosecutions. In his words "don't come down like gang busters". Mr Wood's request was adhered to.
10. Assist and provide expertise on prosecutions of violations of Guam's conservation laws and federal conservation laws.

Guam Laws - At this time, there have been only 2 apprehensions for violations of Guam's ESA. Both involved considerable time by SA Micuda in the form of assistance in preparation of affidavits for search warrant, statement of facts, securing and serving a search warrant and following the cases through Guams judicial system to a successful prosecution. In one case, a search warrant was obtained. This was the first search warrant ever obtained by Guam F&G. These prosecutions have establish a reliable credibility with Guam's Attorney General's office and has resulted in a good image for Guam F&G as well as USFWS.

Federal Laws - Most violations are prosecuted in Guam courts if there is a joint jurisdiction. The reason being that all fines go directly to Guam's conservation fund. Recently, a

Subjects

case involving five SUBS taking a green sea turtle was submitted to the USA for prosecution. The result was a pre-trial diversion with each SUB paying a \$200.00 fine and put on probation. The total fine was \$1,000.00. This is the highest fine for a turtle take on Guam to date. Federal prosecutions are viewed by the public on Guam to be a bigger threat than local prosecution. The results of the above case will be viewed by the public as confirming this.

11. Assist whenever requested the wildlife conservation personnel of the emerging nations of Micronesia. This has in the past included sending copies of U.S. wildlife laws and regulations, requesting copies of various island wildlife laws, conducting several investigation which were LA violations and recently assisting NMI F&G in developing a firearms policy for their wardens. In the near future, SA Micuda will be assisting in training several NMI wardens who will be on Guam for a one month training session. A definite impression of SA Micuda's attending the Micronesian Chief of Police meeting held in Palau is that specific training by various federal agencies will be sought after in the near future. Marine and wildlife enforcement will be two areas of expertise requested.

PROBLEM AREAS WHICH HAVE AND MAY CONTINUE TO INFLUENCE LE PROGRAM ON GUAM.

1. At times, a resentment of the Guam Fish & Game wardens to the suggestion or guidance from SA.
2. On occasions, Guam wardens failure to obey commands given by the chief and assistant chief of Guam Fish & Game.
3. A general negative feelings between Guam wardens and Guam biologists. (local vs. caucasians).
4. At times, failure of Guam wardens to obey request or take guidance from the Guam's attorney general office.
5. Failure of Guam wardens to take action at times when confronted with a violation.
6. The problem of a current feud between Guam F&G and the Andersen AFB commander stemming from a shooting incident between Guam wardens and poachers which occurred at Andersen AFB. This has resulted in the base commander excluding the Guam wardens from the base if wardens are armed. This base commander is to leave

in July of 1984.

7. Continued complaints and accusations by both Air Force and Navy security personnel concerning Guam F&G wardens association and in some instances cooperation and assistance with poachers. This same accusation is often made by Guam F&G personnel against the military. There is probably some truth on both sides.
8. The inability of Guam F&G wardens to ascertain facts, evidence and prepare statements. Department of Public Safety (local police force) also has the same problems. I must say, however, that this area is improving but additional training is required.
9. The general feeling of the local people that game violations are not a serious crime but instead interfering with their right to hunt and fish.
10. The problem of getting a jury conviction on a game violation no matter what the evidence. There has just recently been a conviction by a jury for a game violation on Guam. This is the first in three years that SA Micuda is aware of.
11. The problem of doing background investigation such as a simple DL check as Guam is a small island and most everybody is related in one way or the other.
12. The feeling by parents that their children can do no wrong and to protect them at whatever the cost. I realize this takes place on the mainland U.S. but not to the degree found on Guam.
13. The reluctance of people to inform on game violations as well as other crimes because of a very real fear of retaliation.
14. Little or no help from Guam wardens on incidents that should be a joint LE enforcement effort. This is particularly true concerning sea turtle takes. The chief of Guam P&G, Harry Kami, believes that sea turtles in Guam waters should not have been listed under the federal ESA until there was sufficient data on the status of the population. Also is the matter of subsistence take in the trust territories and not on Guam.

In closing, I should like to mention that ATF had an agent on Guam for a 2 year period at the end of which the position was closed. As the agent left, so did his program. An important reason for having any federal agent on Guam is so that the local enforcement personnel can use his presence as an excuse to enforce their own

laws else political influence and corruption will prevail. In other words, the locals can tell their relatives when they are caught that they can not look the other way and let them go as "big brother is watching". The USA on Guam has been on Guam for 8 years and continues to stress this point. Most all federal enforcement agencies on Guam are expanding, not closing down. If we want to have an impact on Guam and Micronesia conservation enforcement programs, we should maintain a presence less we have an ATF situation.



University of Guam

MARINE LABORATORY

UOG Station, Mangilao, Guam 96913

Cable: "UnivGuam" Telex: 721 6275

11 slides sent
7/12/84

June 28, 1984

Dear George:

Many thanks for the material which arrived while I was travelling. Again, I found a stamp series for you--new from Tonga; maybe it is another first for you. Enjoyed looking through your turtle-stamp series. Wish there were something similar for invertebrates. I still haven't been able to perfect photographing stamps so that one stamp will fill a full 35 mm slide and screen for projection. I would like to do all my coral/reef stamps to have a popular talk up my sleeve for the Coral Reef Congress in Tahiti next May.

Request--in July I will be giving some lectures to teachers in the CNMT (along with four others from here) to assist them in developing a curriculum for a "natural history of the Marianas." I actually have most of everything in hand. Besides some talks on geography and weather/climate, I am talking on invertebrates and vertebrates and introduced and endangered species. Do you have some reasonably good (not necessarily publishable) slides of sea turtles which I could either borrow or have to illustrate my talks, especially the endangered species one. I'd like to hit that one a bit harder than the others, but unfortunately I'm somewhat weaker there. So, I'd also appreciate receiving information which you might have about turtles in general (I think I have the Pacific material pretty well covered)--not a car load, though. If you have copies of the sea turtle poster, it would be good to illustrate a teaching resource. Many thanks....

Aloha,

L. G. Eldredge

The Johnston MS looks rather long, but you should consider Micronesica for publication. The current issue lookd terrible--this won't happen again. We got stuck in having to have it printed locally, and since they did such a terrible job, we are planning to go back to Japan for its usual high quality.

MAKAI

MINCING FISH: A WAY TO SAVE PROTEINS

by Ed Bartholomew, Maui Agent

The world fish catch has leveled off at about 70 to 75 million metric tons a year for the last decade; the demand for protein by a growing population is increasing; and U.S. fishermen want to displace foreign fishing fleets in U.S. waters. These and other factors are providing the impetus for seafood researchers to find ways of getting the most protein and food production from all fish caught.

Not all fish caught are saved for food production. In many fisheries, many kinds of fish caught are killed and thrown back into the water. Such underused fish may

make up to 70 percent of the fish in the world's oceans, according to seafood technologist Robert Baker of Cornell University. High quality protein is also lost in filleting operations in which heads, backbones, and entrails are usually wasted.

To recover fish protein now lost, food scientists are using deboning machines to produce minced fish meat from underused fish and backbones from filleting. Dressed fish, minus heads and entrails, are placed between a heavy plastic belt and metal cylinder with thousands of small holes. The belt and cylinder move at different speeds, which causes a scrubbing action that separates the flesh from the skin and bones. The flesh passes through the holes in the cylinder, but the skin and bones cannot and are discarded as waste.

Depending on the species processed, 50 to 70 percent of the flesh from dressed fish can be recovered. The flesh has a texture similar to coarse-ground hamburger. Its bone content, under 1 percent, is less than that of fillets.

Generally, about 45 percent of a whole fish is good quality flesh. Of this, two thirds can be obtained as fillets but the remaining third can only be obtained as minced meat.

Minced fish can be used in a variety of ways, including as a substitute for hamburger. Dishes such as sloppy jonahs, spaghetti and fish balls, creamy fish bites, sweet and sour fish balls, lasagna oceana, chili, tacos, enchiladas, and pizza have been prepared by researchers at Cornell University.

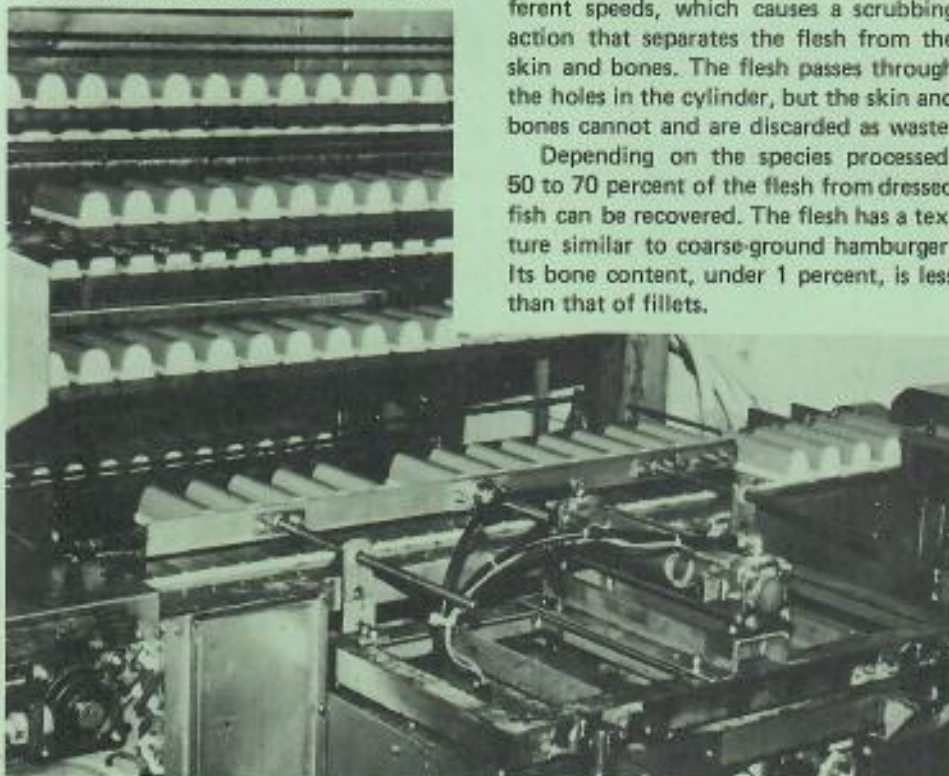
In Hawaii, a minced aku (skipjack tuna) product was developed and test marketed for about a year by Fish Farms Hawaii on the island of Maui. Small aku, 1 to 3 pounds, are normally reduced to fish meal at Hawaii Tuna Packers in Honolulu and fishermen receive a low price for such fish. Minced aku would benefit consumers with an inexpensive source of quality protein and fishermen with increased prices for their catch. While many traditional consumers liked the minced aku product, lack of money prevented Fish Farms Hawaii from further developing this market.

Other local seafood processors in Hawaii such as Fresh Island Fish on Maui and Summer Rain Fish in Kona on the island of Hawaii are using minced meat in fishburgers obtained from backbones after filleting.

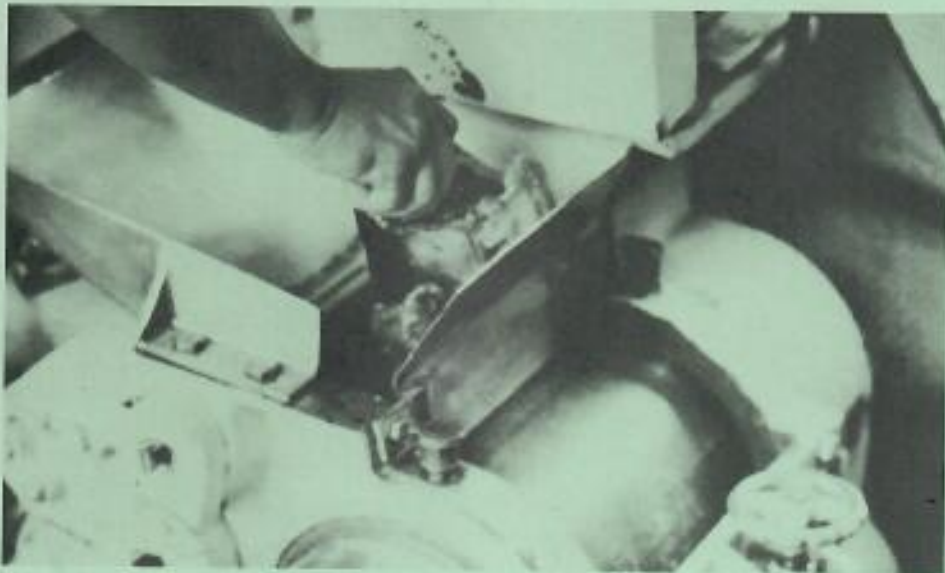
Minced fish meat can be further processed to produce fish paste. Fish paste originated in 15th-century Japan and is

(Continued on page 2)

Fishcake being manufactured at Red & White Foods, Inc. in Honolulu.



MINCING FISH (Continued from page 1)



A fish deboning machine like this one owned by the University of Hawaii can mince fish for use in a variety of processed seafood products.

called surimi. The first Japanese surimi product was "chikuwa," which was made by wrapping surimi paste around a bamboo pole and broiling it. The bamboo was removed leaving a pipe-shaped product.

Chikuwa remains a standard food item today, along with kamaboko and satsumaage. Kamaboko is steamed fish paste and satsumaage is deep fried.

Japan leads the world in surimi production and technology. In 1981, it produced 300,000 tons of the fish paste. In 1959, the Japanese made a breakthrough in processing that provided the key to using the world's largest stock of fish, the Alaska pollock (*Theragra chalcogramma*). By 1965, the Japanese began processing

pollock into the highest quality surimi on board factory ships on the fishing grounds in the Gulf of Alaska and the Bering Sea.

Surimi is prepared from minced fish that is washed to remove fat and blood. Additives such as sugars and phosphates are used to prevent the breakdown of proteins. The product is then frozen and stored.

Anyone who has eaten fish cake made in Hawaii in the last decade has already tasted surimi from Alaska pollock. Hawaii's fish cake manufacturers rarely use local fish anymore because of its high cost and processing requirements. They now rely on 10-kg blocks of frozen pollock surimi from Japan.

Chikuwa, agehan, kushiten, goboten, char-sui ten, naruto, and kamaboko are some of the different locally produced traditional surimi products available at seafood outlets. The first is broiled, the next four are deep-fat fried, and the last two are steamed. To make fish cake products from minced fish, other ingredients such as starch, water, eggs, and seasonings are added.

Food scientists at Ralston Purina Company, interested in studying the effect of adding soybean protein to surimi, evaluated 20 brands of kamaboko and found the following constituents (measured in percentages): water, 72.5; carbohydrate, 8.2; protein, 14; salt, 2.3; and fat, 0.5. Both chikuwa and satsumaage had higher carbohydrate content because of more starch, and satsumaage had more fat, about 4 percent.

The annual retail sales of surimi products in local markets has stabilized at around \$3 to \$4 million, as estimated by two Honolulu manufacturers, Okuhara's and Red and White, Inc.

Within the last few years new surimi products imported from Japan have begun to appear in local and mainland seafood outlets. According to *Seafood Business Report*, these imports into the U.S. have soared from 3 million pounds in 1980 to an expected 29 million pounds in 1983.

Why the sudden increase in surimi imports into the U.S.? A number of factors can be pointed to.

One is that younger Japanese now seem to prefer a fast food hamburger to a fish dinner. In the past, surimi products accounted for half the seafood eaten by Japanese. This dietary shift and increased fishing restrictions in U.S. waters — partly because of the priority development of a U.S. surimi industry by the National Marine Fisheries Service — have forced Japanese producers to develop new products and to expand overseas markets.

Their most successful new product is imitation crab meat, called kanibo. Various types of kanibo are being marketed, some containing real crab meat, some flavored with crab extracts or chemical flavorings. Such product breakthroughs, coupled with the decline of American crab harvests (185 million pounds of king crab in 1980, only 20 million pounds in 1983) suggest tremendous opportunities for the ersatz surimi shellfish in the years ahead.

The minced fish meat revolution could be just beginning. □



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Dedicated Students Earn and Learn As Sea Grant Writers



Student writer Susan Pirsch listens as Dr. Richard Silcox of the Pacific Tsunami Warning Center explains a point.

by Desmond Twigg-Smith

[Editor's note: The author is himself a student writer.]

Student writers with the University of Hawaii Sea Grant Extension Service find themselves learning much more than they would in most other student jobs. Their writing assignments encompass a broad range of marine-related topics from cooking seafood to underwater volcanoes to commercial fishing.

"We can give the students a real-life experience," said Rick Klemm, Extension Service communicator. "It is real and hard work — not the kind of work for a student who just wants a paycheck."

The writers can tailor work schedules to meet their needs, he said, and have a certain amount of freedom in selecting stories to cover. Most students' articles appear in the Extension Service's newsletter *Makai*. Students are able to sometimes use their articles to fulfill class assignments and sometimes other publications print them, too, Klemm said.

To convey scientific and other marine-related information to lay readers requires the student writer to grasp and learn a subject thoroughly, sort of becoming an expert on a particular topic for at least the time it takes to write about it, Klemm said.

Susan Pirsch, a journalism major, who has been with the Extension Service since fall of 1981, said the job has complemented her studies well.

Besides giving her a free education about the ocean, "It forced me to look objectively at my writing. Most journalism students don't get a chance to work on one publication like *Makai* and get to know it," Pirsch said.

Holly Padove, another student writer, has coordinated, written, and produced "Sea Tidings," a weekly 60-second radio featurette on marine topics, which has been aired on commercial radio stations in Hawaii since last summer.

Both Pirsch and Padove were hired under the work-study program, in which the federal government pays for 80 percent of their salaries. "Work-study allows university departments and organizations like ours to hire students that they would not otherwise be able to fund," Klemm said.

"I think our student writers would agree that their work is mutually beneficial. We get their talent and time for important work to be done, and they get important experiences by which they can evaluate their interest in and talent for science and other types of writing," Klemm said. □

TUNA CONFERENCE SET FOR HILO

The Big Island Tuna Conference is scheduled for May 15 and 16 at the Naniloa Surf Hotel in Hilo on the island of Hawaii. The conference is being sponsored by the County of Hawaii Department of Research and Development, University of Hawaii Sea Grant Extension Service, Big Island Aquaculture Development Committee, and County of Hawaii Cooperative Extension Service.

The event will include a trade show and many sessions related to tuna research, industry concerns, and current legislation affecting the tuna fishery.

For more information, call or write Extension Agent Howard Takata at the Sea Grant Extension Service, 875 Komohana St., Hilo, HI 96720, (808) 959-9155. □

FISHERKIDS

SMALL FRY GET WHOLE OF A WORKSHOP

by Rick Klemm

"Fisherkids. I really like that," said Barry Smith, referring to the name a newspaper reporter used in a story to describe boys and girls who graduated from fisheries workshops on the island of Guam. The workshops were the realization of an idea Smith has had for several years.

Smith, an extension agent with the University of Hawaii/University of Guam Sea Grant Program, has long believed that one of the essential keys to successful fisheries development in Guam is to begin training young people. So, last year Smith submitted a proposal for such training that received funding from Sea Grant and 4-H. With additional local support, Smith and the 4-H leaders were able to offer two 4-week sessions of the Summer Youth Fisheries Workshop last summer. One session was held in urban north Guam and the other in rural south Guam.

While what contribution the youth in the workshops may eventually make to the future fisheries development in Guam will not be known for a long time, Smith and the other leaders do know that more than forty young people have acquired skills in traditional and modern fishing methods and, just as importantly, a keen understanding and respect for marine and fishery ecology.

"Regarding solving the problem of dynamiting fish, where best to start than with kids? You're not likely going to change the adults who are already doing it; they're going to continue dynamiting. That goes, too, for chloroxing and any other illegal ways of fishing," Smith said. "So where better to start getting a group of fishermen who have a grasp of marine ecology and conservation than with kids?"

A typical workshop day for the youth, mostly aged from 12 to 16 years, consist-



John Cruz, Jr. shows off a meal-sized fish he speared (inset). Pascual Flores demonstrates the cast net throwing technique he learned during the workshop.

—Guam Tribune photo

ted of 2 to 4 hours of morning classroom activities followed in the afternoon by hands-on activities at field sites. The youth gained such skills as lure tying, spin casting, cast net fishing, spearfishing, and sea-food handling and preparation.

Smith attributes much of the program's success to the generous support which came from the Guam community. "We had old fishermen come in and share their knowledge with the kids. We had young fishermen come in. We also had many experts such as in archaeology, social history, and fisheries biology come in from the University of Guam and various agencies," he explained.

Two major themes that the leaders emphasized continually during the workshops were safety and cooperation. Smith



Like son, like father. At a workshop-ending parents' picnic, a son teaches his father how to use a cast net.

—Guam Tribune photo

said he wanted the youth to understand from the start that survival skills related to fishing are as important, if not more so, than fishing skills themselves. The need for cooperation among fishermen was demonstrated in the workshop by using the buddy system.

"I think the message on these ideas got through to the kids because we only had one 'bare-knuckled' incident during both workshops," Smith said. A few days later, he noted, the two combatants requested



For some of these "fisherkids," the Summer Youth Fisheries Workshop may be the start of careers in commercial fishing.

—Guam Tribune photo



to be buddies during an outing.

The youth were encouraged to sell the fish they caught during the workshops. And, they learned that after the workshops fish could be caught and sold to pay for personal expenses.

"The kids caught a lot of fish, especially the kids in the second workshop," Smith said. "There were two kids who speared enough fish in one afternoon to recover their workshop registration fees. They sold the fish for \$47."

In the time since the workshops were held, Smith finds that many of the youth are still fishing. Parents are being supportive, too, by buying fishing gear for the young fishers. Interestingly, almost all of the youth came from nonfishing families who typically ate little or no seafood.

"Now some entire families are getting in on the act," Smith said. "For example, one boy whose dad would take him snorkeling wouldn't, before the workshop, let his son go beyond the reef. Now, they both go out fishing beyond the reef — and the boy is still outfishing his father. He learned that much in the workshop."

In another case, a boy is teaching his father how to fish. The father bought the son a cast net on the condition that he

teach the father how to fish with it. Now two people know how to fish with the cast net, Smith proudly points out.

Regardless of their levels of experience upon entering the workshops, all the young people gained in self-confidence, Smith said. At first the youth were reluctant, for example, to swim out beyond the reef, always making sure an instructor was close at hand. But, by the end of the workshops, the instructors "literally had to run" to keep up with their learners.

Fishing responsibly was another theme running through the workshops.

"We certainly frowned upon spearing aquarium-type fishes such as butterfly fishes and gobies," Smith said. "We told the kids to only go after food fish such as surgeon fishes and goat fishes and not to spear any too small to eat. No matter what kind of fish was involved we told them not to spear or catch any if they weren't going to eat or sell the fish . . . By the end of the workshops, the kids were really homing in on food fish species."

One of the most important aspects of the workshops, Smith believes, was exposing the youth to traditional Chamorro fishing skills. Chamorro women, for example, taught their young learners how to

weave their own guaguas (creels) from palm fronds. Learning this skill will save money for the youthful fishermen and they can sell guaguas for \$3 to \$4 to local fishermen.

The youth also learned to use the gadi instead of seines. A gadi is made from the central ribs of palm fronds. Strung out in a "corral-like" form, a gadi is used to drive fish into gill nets.

Teaching traditional Chamorro fishing methods to the youth is important for cultural preservation and, said Smith, to show elder Chamorros that young people truly do want to learn the "old ways."

"From my own perspective, having married into a Chamorro family, I always hear the elders say that young people are not interested in the old ways. That's just not true," Smith said. "Given the opportunity, kids are just as interested in the old ways as anybody else is. But often-times, in my opinion, the old people don't give the children the opportunity."

He cited the example of one Chamorro boy who said he had enrolled in the workshop simply because he was interested in fishing. The real reason, as it later turned out, was that the boy was ashamed to ask his grandfather to teach him how. This is an aspect of cultural behavior in Chamorro society.

"In Chamorro culture, if you want to learn to fish, you go watch your elders, following them everywhere as they fish. After a time the elders invite you to try, say, to throw a cast net. You do it wrong and they shout at you, and the cycle repeats until you become proficient at throwing the net," Smith said. "Well, the boy didn't want to go through this, so he found the workshop to be the answer to his problem. He was able to learn how to fish and return home to show his grandfather how well he could fish."

Besides preserving cultural traditions, Smith added that traditional fishing methods work well and in some situations work better than modern ones.

Why the youth enrolled in the Summer Youth Fisheries Workshops instead of a typical summer recreational program varied from one individual to another. Clearly, Smith said, many were enrolled because the parents wanted a convenient babysitting service. Other parents wanted their children to have a chance to go to the beach.

For whatever reason the youth participated in the workshops, what the parents got back after 4 weeks were fisherkids. What Guam may have gotten back are some future first-rate, conservation-minded commercial fishermen. □

Dedicated Students Earn and Learn As Sea Grant Writers



Student writer Susan Pirsch listens as Dr. Richard Sillcox of the Pacific Tsunami Warning Center explains a point.

by Desmond Twigg-Smith

[Editor's note: The author is himself a student writer.]

Student writers with the University of Hawaii Sea Grant Extension Service find themselves learning much more than they would in most other student jobs. Their writing assignments encompass a broad range of marine-related topics from cooking seafood to underwater volcanoes to commercial fishing.

"We can give the students a real-life experience," said Rick Klemm, Extension Service communicator. "It is real and hard work — not the kind of work for a student who just wants a paycheck."

The writers can tailor work schedules to meet their needs, he said, and have a certain amount of freedom in selecting stories to cover. Most students articles appear in the Extension Service's newsletter *Makai*. Students are able to sometimes use their articles to fulfill class assignments and sometimes other publications print them, too, Klemm said.

To convey scientific and other marine-related information to lay readers requires the student writer to grasp and learn a subject thoroughly, sort of becoming an expert on a particular topic for at least the time it takes to write about it, Klemm said.

Susan Pirsch, a journalism major, who has been with the Extension Service since fall of 1981, said the job has complemented her studies well.

Besides giving her a free education about the ocean, "It forced me to look objectively at my writing. Most journalism students don't get a chance to work on one publication like *Makai* and get to know it," Pirsch said.

Holly Padove, another student writer, has coordinated, written, and produced "Sea Tidings," a weekly 60-second radio featurette on marine topics, which has been aired on commercial radio stations in Hawaii since last summer.

Both Pirsch and Padove were hired under the work-study program, in which the federal government pays for 80 percent of their salaries. "Work-study allows university departments and organizations like ours to hire students that they would not otherwise be able to fund," Klemm said.

"I think our student writers would agree that their work is mutually beneficial. We get their talent and time for important work to be done, and they get important experiences by which they can evaluate their interest in and talent for science and other types of writing," Klemm said. □

TUNA CONFERENCE SET FOR HILO

The Big Island Tuna Conference is scheduled for May 15 and 16 at the Naniloa Surf Hotel in Hilo on the island of Hawaii. The conference is being sponsored by the County of Hawaii Department of Research and Development, University of Hawaii Sea Grant Extension Service, Big Island Aquaculture Development Committee, and County of Hawaii Cooperative Extension Service.

The event will include a trade show and many sessions related to tuna research, industry concerns, and current legislation affecting the tuna fishery.

For more information, call or write Extension Agent Howard Takata at the Sea Grant Extension Service, 875 Komohana St., Hilo, HI 96720, (808) 959-9155. □

MARINE MISCELLANY



WAIKIKI AQUARIUM SUMMER ACTIVITIES BROCHURE

Brochures describing the Waikiki Aquarium's Summer 1984 educational activities for adults, children, and families are now available. Beginning in June, mini-adventures like reef walks, coastline hikes, seafood demonstrations, and a Hawaiian fishing workshop are scheduled—as well as courses for adults on coral reefs, Oahu's coastal ecology, life on Hawaiian reefs, and biology of Hawaiian fish.

Especially for children, there are the popular week-long Seashore Life for Children classes and a new program, Arts and Sciences for Kids (ASK). Other summer activities include evening natural history lectures and study tours.

For a brochure and more information, call or write the Waikiki Aquarium Education Section, 2777 Kalakaua Ave., Honolulu, HI 96815, (808) 923-4725.

SOLAR POND DESIGN FINISHED

Sets, Inc., a Hawaii firm under a contract with the Department of Planning and Economic Development (DPED), has completed a design for an alternate energy resource that uses a salt-gradient pond to collect sunlight and store heat. If a high salt concentration is maintained near the bottom of a solar pond, this water becomes denser than the low-salinity water near the surface. The difference in density prevents the usual convection currents that would bring warm water to the surface. The bottom layer can become very hot, as much as 200°F or more.

In its report, "An Engineering Design for Solar Pond OTEC (SPOTEC) Power Plants at Keahole Point," Sets presents several design options for a .64 or 1.2-acre with the Natural Energy Laboratory of Hawaii at Keahole Point on the island of Hawaii in mind as a prospective construction site.

The technical report is available for reference at the DPED Information Office Library, 250 S. King St., 7th Floor, Honolulu, HI.

U.S. FOURTH IN WORLD FISHING

The U.S. was the fourth leading harvester of seafood behind Japan, Russia, and China, according to the 1982 "Fisheries Statistics of the United States." That year, the U.S. landed 3.767 million metric tons of seafood. The top five states in landings were Louisiana, Alaska, California, Virginia, and Mississippi, respectively. □

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