

**JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT**

STATE: Territory of Guam

PROJECT NO.: F-1R-6
SUB-PROJECT NO.: F-1
STUDY NO.: 1
JOB NO.: 2

STUDY: Fisheries Participation, Effort, and Harvest Surveys (2430)

JOB TITLE: Inshore Fisheries Survey

PERIOD COVERED: October 1, 1997 to September 30, 1998

SUMMARY

Monthly inshore fisheries surveys were conducted along Guam's shoreline from October 1997 through September 1998. The total estimated inshore fisheries catch for this time period was 49.5 mt (metric tonnes), 88% of which were finfish (excluding the juvenile rabbitfish or mañâhak and juvenile fusilier or achemsom). Hook and line was the most practiced method accounting for 57% of the total participation (excludes seasonal mañâhak and atulai data) or 42,330 participants. In terms of catch rate, snorkel spearfishing was the most successful of all the daytime methods, yielding approximately 2.41 kg/gear-hour (gh) with a daytime harvest of 5.6 mt, and drag net was the most successful nighttime fishing method, yielding approximately 10.18 kg/gh with a nighttime harvest of 0.26 mt. Hook and line was the most successful method in terms of the overall harvest, yielding approximately 0.22 kg/gh with a total harvest of 17.4 mt. The seasonal mañâhak and achemsom catch was not surveyed in FY98.

Aerial Survey

The aerial survey report is included in Appendix 1.

Kid's Fishing Derby

The Kid's Fishing Derby report is included in Appendix 2.

BACKGROUND

Effective management of Guam's inshore fishery resources requires accumulating data on the types of fishing methods used, fishing pressure, and annual catch. To identify trends in fishing participation, effort, and catch, the Division of Aquatics and Wildlife Resources (DAWR) has been monitoring marine fishing activities since the early 1960's. Over this period of time, survey and analysis methodologies have changed in response to fluctuations in budget and staff. In the last several years, however, field survey techniques have been expanded and refined, while estimates of Guam's recreational / subsistence fishing activities have come to be based on more reliable data analysis techniques.

Data Analysis

The adoption of the 4th Dimension (4D) database program has greatly reduced the time needed to compile and analyze Guam's inshore survey data. This has allowed more time to upgrade data collection procedures and to ensure statistical reliability.

OBJECTIVES

- 1) To establish baseline catch and effort data for reef fish species necessary to develop a fisheries management plan for Guam.
- 2) To gather limited biological data on Guam's fisheries for management purposes.

PROCEDURES

During FY98, four "inshore-catch" survey days were selected per month. Fishermen-intercept interviews were conducted to determine amount of effort, fishing method, location, reef zone, species composition, and amount caught for both day and night fishing. The day survey covered a six-hour interval (beginning at 0630h) and the night survey covered a five-hour interval (beginning at dusk or 1900h). On any given survey day, one survey area (Figure 1), is randomly selected from either Gun Beach to Adelupe (region I: locations 1-11), Adelupe to Agat (region II: locations 12-34), or Pago to Merizo (region III: locations 71-41) and inshore data collection is restricted within the selected region. However, because of infrequently interviewed methods, e.g., surround netting, and low participation, representative samples can be difficult to obtain. Therefore, if this situation occurred, one or both of the other two adjacent areas could be surveyed.

During FY98, day and night "inshore-participation" surveys were conducted on four randomly selected days per month, which did not occur on the same days as the "inshore creel" surveys. These surveys entailed making visual observations of fishing participation within readily accessible portions of Guam's coastline (Fig. 1, locations: 1-21, 23-26, 29-35, 40-43, 51-57, 60-69, 71, 72). Fishing catch and effort data is collected by instantaneous counts, while driving in a continuous route, around the island. The route is alternated each survey between "clockwise" and "counterclockwise" and the starting locations are randomly selected (Fig. 1). Since the participation survey includes both day and night fishing, start times begin at 0630h and 1900h and end once the entire island circuit has been completed.

Seasonal data on the scad mackerel (atulai), goatfish (ti'ao), and jacks (i'e') were acquired through actual participation and catch surveys. Species of fish that seasonally recruit *en masse* on Guam's reefs, i.e., juveniles of rabbitfish (mañâhak), and fusiliers (achemsom) were not entered into the database due to the sporadic nature of these fisheries.

Mañâhak *en masse* recruitment events are predicted to occur up to three times a year for approximately one-week, depending on the overall size of the run. Recruitment events are expected to begin the day of or days following the fourth, fifth, and tenth last quarter moon phase. Recruitments of achemsom are irregular, but have been significant in terms of island-wide total harvest in certain years and usually recruit with mañâhak when they occur.

Atulai migrate into inshore areas throughout the year, which may cover a period lasting up to nine months. They usually enter protected locations, e.g., bays and channels, at daybreak and swim into deeper water before evening. A significant portion of the annual catch is not reported from this fishery because the larger net catches are sporadic and seldom appear on regular surveys.

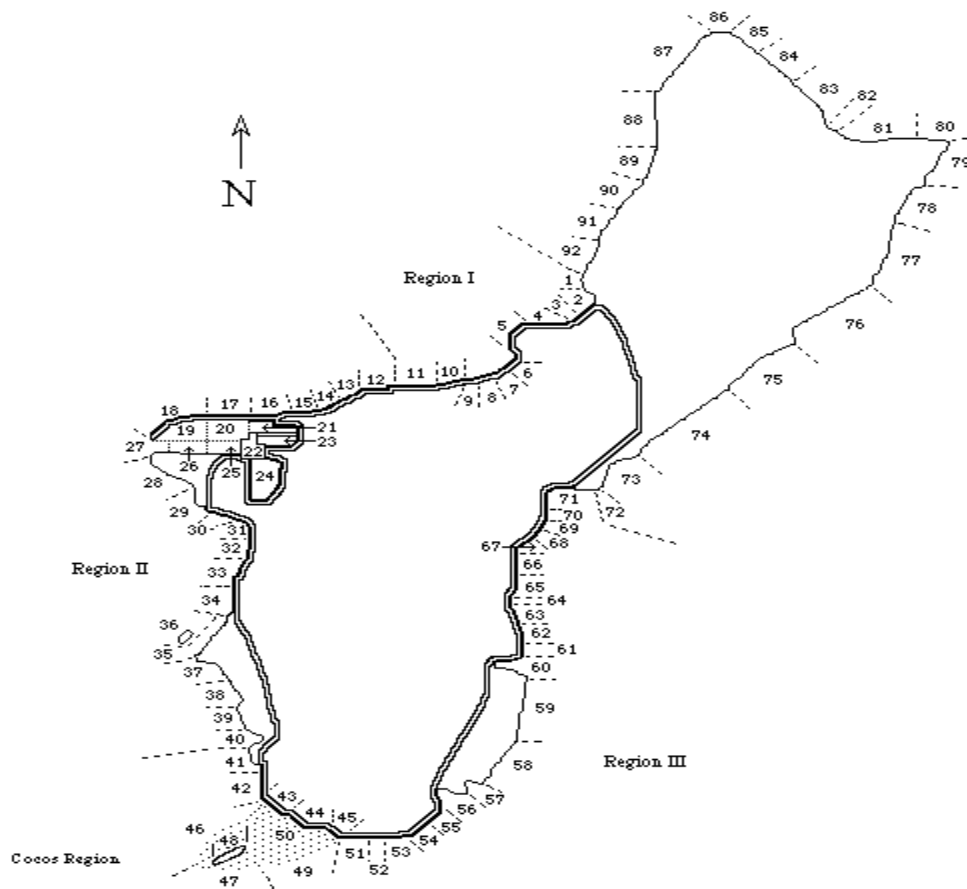


Figure 1. Inshore Fisheries “Participation Survey” Route with Area and Location Codes.

Ti’ao and i’e’ recruit annually on reef flats and make up a large portion of the annual catch and effort. Ti’ao generally recruit within a few days of the May full moon and during strong recruitment years, pulses of new recruits will also follow the June and July full moons. I’e’ runs also follow the full moon starting in May and can continue after each full moon through November. It is speculated that continued recruitment may be linked to rainfall. Past recruitment events of these species have shown to be highly significant in terms of total catch, especially *Caranx ignobilis*, *C. melampygous*, *C. papuensis*, and *C. sexfasciatus* with hook and line, and *Mulloides flavolineatus* and *M. vanicolensis* with nets, when they occur.

The FY98 inshore harvest estimates were statistically expanded by a computer software package for Macintosh known as the Fourth Dimension (4D) database program. The 4D

program utilizes formulae described in the FY83 report (Project FW-2R-20, Sub-Project F, Study F-1, Job 2) to compile and expand inshore survey data for the fiscal year.

RESULTS

During FY98, the estimated inshore harvest for day, night, and seasonal fishing around Guam was 49.5 mt. Finfish accounted for 88% of total harvest or 43.7 mt. The seasonal mañahak and achemsom harvests were marginal and not recorded in FY98. The total inshore catch (finfish and invertebrates) resulted from a total effort of 260,497 person-hours (ph) and 210,131 gear-hours (gh). Overall, approximately 0.24 kg/gh of fish were harvested with 137 daytime and 176 nighttime species identified in FY98.

CATCH

Hook and line fishing yielded the largest overall catch with 17.3 mt or 40% of the total finfish harvest. Snorkel spearfishing was second with 11.3 mt or 26%, while gill netting was third with 8.5 mt or 19%, and cast netting was fourth with 5.9 mt or 13% of the total finfish harvest (Table 1).

Table 1. Combined estimated inshore participation, effort, and total harvest (kg) for all methods during the day and night in FY98.

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	Finfish	Inverts	CPUE†
Hook & Line	42,330	41,206	24,258	145,056	141,611	17,373	17,294	79	0.22 wd
Cast Net	8,717	7,908	7,122	19,469	17,605	5,852	5,852	0	1.35 wn
Gill Net	14,421	5,755	2,840	73,809	29,649	8,789	8,478	311	0.39 wen
Surround Net	0	0	0	0	0	0	0	0	0.0
Spear Snorkel	4,804	4,580	2,452	10,752	10,275	13,460	11,295	2,165	2.41 wd
Spear SCUBA	127	127	58	247	247	299	295	4	1.28 wn
Drag Net	337	49	49	523	80	288	282	6	10.18 wen
Hooks & Gaffs	1,085	1,099	759	2,066	2,088	1,292	126	1,166	1.16 wd
Other††	3,002	3,002	2,216	8,576	8,576	2,158	70	2,088	1.04 wd
TOTAL	74,824	63,730	39,759	260,497	210,131	49,511	43,692	5,819	0.24

†CPUE summary derives the greatest weekday (wd), weeknight (wn), weekend day (wed), or weekend night (wen) from Tables 2 and 3. The greatest CPUE value for hook and line was in regions 1 and 2.

††Other Methods usually includes: gleaning, hand nets, traps, and spears.

The top three daytime methods accounted for approximately 84% of the daytime total and 58% of the combined total harvest (Table 2). Hook and line fishing accounted for the most fish with 14.1 mt or 47% of the day finfish harvest. Gill netting was second with 5.6 mt or 19%, while cast netting was third with 5.5 mt or 18%, and snorkel spearfishing was fourth with 4.7 mt or 16% of the total day finfish harvest.

The top three nighttime methods accounted for approximately 93% of the night total and 29% of the combined total finfish harvest (Table 3). Snorkel spearfishing accounted for the most fish caught with 6.6 mt or 49% of the total night finfish harvest and hook and line fishing was second with 3.2 mt or 24%. Gill netting was third with 2.9 mt or 21% and cast netting was fourth with 0.3 mt or 2% of the total night finfish harvest.

EFFORT

Hook and line fishing was the most practiced fishing method overall (Table 1), accounting for 42,330 persons or approximately 57% of total participation. Gill netting was the second most practiced method overall, accounting for 14,421 participants or 19%, while cast netting followed in third with 8,717 participants or 12% of the total participation.

The rank order for day fishing participation placed hook and line first with 29,287 or 56% participants. Gill netting and cast netting placed second and third respectively with 9,946 or 19% and 8,440 or 16% of the participants (Table 2). Hook and line fishing remained the most practiced night fishing method with 13,044 participants or 59% of night participation. The second most practiced method was gill netting with 4,475 participants or 20%, while snorkel spearfishing followed in third with 3,065 participants or 14% of night participation (Table 3).

CATCH PER UNIT EFFORT (CPUE)

Snorkel spearfishing had the highest daytime CPUE of 2.41 kg/gh for weekday fishing and drag netting followed in second with 2.11 kg/gh and hook and gaffs were third with 1.16 kg/gh (Tables 1 and 2). Drag netting had the highest nighttime CPUE of 10.18 kg/gh for weekend night fishing, cast netting followed in second with 1.35 kg/gh, and SCUBA spearfishing was in third with 1.28 kg/gh (Tables 1 and 3).

Summary information concerning effort and harvest for methods not discussed are included in Tables 1-3. Other nearshore fisheries harvests on Guam, including spear and net fishing off berthed and boats with trailers, were recorded in the FY98 Offshore Fisheries Report (Study F-1, Job 1).

Table 2. Estimated inshore participation, effort, and total harvest (kg) for all methods during the day in FY98.

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	Finfish	Inverts	CPUE†
Hook & Line	29,287	28,466	18,489	100,9339	98,285	14,098	14,057	41	0.22 wd
Cast Net	8,440	7,721	6,964	18,847	17,200	5,548	5,548	0	0.34 wd
Gill Net	9,946	4,095	2,004	48,654	20,045	5,787	5,570	217	0.31 wd
Surround Net	0	0	0	0	0	0	0	0	0.0
Spear Snorkel	1,739	1,529	1,074	3,613	3,171	5,612	4,651	961	2.41 wd
Spear Scuba	0	0	0	0	0	0	0	0	0.0
Drag Net	21	11	11	26	13	28	28	0	2.11 wed
Hooks & Gaffs	1,085	1,098	759	2,066	2,088	1,292	126	1,166	1.16 wd
Other††	2,211	2,211	1,851	2,193	2,193	1,459	18	1,441	1.04 wd
TOTAL	52,728	45,130	31,151	176,330	142,994	33,824	29,998	3,826	0.24

†CPUE summary derives the greatest weekday (wd) and weekend day (wed) values. The greatest CPUE value for hook and line was in regions 1 and 2.

††Other Methods usually includes: gleaning, hand nets, traps, and spears.

Table 3. Estimated inshore participation, effort, and total harvest (kg) for all methods during the night in FY98.

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	Finfish	Inverts	CPUE†
Hook & Line	13,044	12,740	5,769	44,123	43,326	3,275	3,237	38	0.19 wn
Cast Net	278	187	158	622	406	304	304	0	1.35 wn
Gill Net	4,475	1,659	836	25,155	9,604	3,002	2,908	94	0.39 wen
Surround Net	0	0	0	0	0	0	0	0	0.0
Spear Snorkel	3,065	3,052	1,379	7,139	7,104	7,849	6,645	1,204	1.26 wen
Spear SCUBA	127	127	58	247	247	299	295	4	1.28 wn
Drag Net	316	43	43	496	67	260	254	6	10.18 wen
Hooks & Gaffs	0	0	0	0	0	0	0	0	0.0
Other††	791	791	365	6,384	6,384	700	53	647	0.11 wn/wen
TOTAL	22,096	18,600	8,607	84,167	67,138	15,688	13,695	1,993	0.23

†CPUE summary derives the greatest weeknight (wn) and weekend night (wen) values. The greatest CPUE value for hook and line was in region 3.

††Other Methods usually includes: gleaning, hand nets, traps, and spears.

Species and Family Harvests

The expanded species composition for the combined day and night efforts were calculated for FY98. The top non-seasonal reef fish species caught was the bluespine unicornfish, *Naso unicornis*, with 4.0 mt or 9.18% of the finfish total and the scad mackerel, *Selar crumenophthalmus* was the top seasonal and overall species caught with 4.1 mt or 9.38% of the finfish total. Acanthuridae was the top family of finfish harvested with 8.9 mt or 20.39% of the combined harvest in FY98 (Table 4).

Table 4. FY98 combined day and night catch composition for the top ten species and families of finfish harvested. Juvenile *Caranx ignobilis*, *C. melampygous*, *C. papuensis*, and *C. sexfasciatus* (i'e' ≤ 200 mm), *Mulloides flavolineatus* (ti'ao ≤ 100 mm), and *Siganus spinus* (mañahak), are listed separately from the intermediate to adult size classes. Finfish harvest percentages were derived from the total day and night catch (43,692 kg).

SPECIES	Harvest		FAMILY	Harvest	
	kg	%		kg	%
<i>Selar crumenophthalmus</i>	4,097.78	9.38	Acanthuridae	8,909.06	20.39
<i>Naso unicornis</i>	4,011.65	9.18	Carangidae	8,834.29	20.22
<i>Kyphosus vaigiensis</i>	3,310.49	7.58	Kyphosidae	3,489.13	7.99
<i>Siganus spinus</i>	2,257.04	5.17	Siganidae	2,625.54	6.01
<i>Caranx i'e'</i>	2,148.65	4.92	Mugilidai	2,486.94	5.69
<i>Acanthurus triostegus</i>	2,021.09	4.63	Mullidae	2,444.55	5.59
<i>Valamugil engeli</i>	1,584.85	3.63	Lethrinidae	2,379.98	5.45
<i>Mulloides flavolineatus</i>	1,495.49	3.42	Scaridae	2,276.89	5.21
<i>Lethrinus harak</i>	980.64	2.24	Holocentridae	1,954.76	4.47
<i>Naso lituratus</i>	841.91	1.93	Lutjanidae	1,811.95	4.15
TOTAL ANNUAL COMBINED CATCH	22,749.59	52.07		37,213.09	85.17

The top daytime species caught was *Kyphosus vaigiensis*, accounting for 3.1 mt or 10.47% and *Selar crumenophthalmus* was ranked first overall and seasonal, with 3.6 mt or 11.92%

of the day total. Carangidae ranked first with 7.5 mt or 25.05% for the top family day harvest, representing two seasonal species in the top five for FY98 (Table 5).

Table 5. FY98 day catch composition for the top ten species and families of finfish harvested. Juvenile *Caranx ignobilis*, *C. melampygous*, *C. papuensis*, and *C. sexfasciatus* (i'e' ≤ 200mm), *Mulloides flavolineatus* (ti'ao ≤ 100mm), and *Siganus spinus* (mañâhak), are listed separately from the intermediate to adult size classes. Finfish harvest percentages were derived from the total day catch (29,998 kg).

SPECIES	Harvest		FAMILY	Harvest	
	kg	%		kg	%
<i>Selar crumenophthalmus</i>	3,575.30	11.92	Carangidae	7,514.20	25.05
<i>Kyphosus vaigiensis</i>	3,140.68	10.47	Acanthuridae	5,577.64	18.59
<i>Naso unicornis</i>	2,993.33	9.98	Kyphosidae	3,260.38	10.87
<i>Siganus spinus</i>	1,885.62	6.29	Siganidae	2,034.92	6.78
<i>Caranx i'e'</i>	1,678.01	5.59	Lethrinidae	1,774.68	5.92
<i>Acanthurus triostegus</i>	1,539.72	5.13	Mugilidae	1,725.05	5.75
<i>Valamugil engeli</i>	1,209.61	4.03	Mullidae	1,420.54	4.74
<i>Clarias batrachus</i>	824.62	2.75	Scaridae	1,417.59	4.73
<i>Mulloidis flavolineatus</i>	805.22	2.68	Lutjanidae	943.87	3.15
<i>Caranx papuensis</i>	780.36	2.60	Clariidae	824.62	2.75
TOTAL ANNUAL DAY CATCH	18,432.47	61.45		26,493.49	88.32

Naso unicornis topped the night harvest with 1.0 mt or 7.44% of the night total. *Selar crumenophthalmus* and *Caranx i'e'* ranked sixth and eighth respectively for night seasonal species harvest in FY98. Acanthuridae was harvested over two times greater than any other family, with 3.3 mt or 24.33% of the top family with four species making the top ten night harvest list (Table 6).

Method Harvests

The top harvest of finfish species for hook and line method was calculated for FY98 (Table 7). *Naso unicornis* was the top ranked species, with 1.7 mt (8.57%) for day, while *Selar crumenophthalmus* ranked first for seasonal, with 3.6 mt for day (25.37%) and 0.5 mt (15.93%) for night and *Caranx i'e'* ranked in second for seasonal at night, with 0.3 mt (9.51%).

The top harvest of finfish species for gill net method was calculated for FY98 (Table 8). *Valamugil engeli* ranked first for day with 0.8 mt (14.34%) of the daytime harvest and *Mulloidis flavolineatus* ranked first at night, with 0.2 mt (19.0%). Seasonal species did not rank in the top ten for gill net, but *Caranx i'e'* ranked eighth for night, with 0.1 mt (5.19%).

The top harvest of finfish species for snorkel spear method was calculated for FY98 (Table 9). *Kyphosus vaigiensis* ranked first during the day, with 2.1 mt (46.17%), while *Naso unicornis* ranked first at night, with 0.9 mt (13.29%) of the snorkel spear harvest. Seasonal species did not make the top ten rankings for snorkel spear in FY98.

Table 6. FY98 night catch composition for the top ten species and families of finfish harvested. Juvenile *Caranx ignobilis*, *C. melampygous*, *C. papuensis*, and *C. sexfasciatus* (i'e' ≤ 200mm), *Mulloidis flavolineatus* (ti'ao ≤ 100mm), and *Siganus spinus* (mañâhak), are listed separately

from the intermediate to adult size classes. Finfish harvest percentages were derived from the total night catch (13,695 kg).

SPECIES	Harvest		FAMILY	Harvest	
	kg	%		kg	%
<i>Naso unicornis</i>	1,018.32	7.44	Acanthuridae	3,331.42	24.33
<i>Naso lituratus</i>	732.17	5.35	Holocentridae	1,557.39	11.37
<i>Mulloides flavolineatus</i>	690.27	5.04	Carangidae	1,320.09	9.64
<i>Acanthurus lineatus</i>	652.77	4.77	Mullidae	1,024.01	7.48
<i>Myripristis murdjan</i>	586.22	4.28	Lutjanidae	868.08	6.34
<i>Selar crumenophthalmus</i>	522.48	3.82	Scaridae	859.30	6.27
<i>Acanthurus triostegus</i>	481.37	3.51	Mugilidae	761.89	5.56
<i>Caranx i'e'</i>	470.64	3.44	Lethrinidae	605.30	4.42
<i>Valamugil engeli</i>	375.24	2.74	Siganidae	590.62	4.31
<i>Siganus spinus</i>	371.42	2.71	Serranidae	441.30	3.22
TOTAL ANNUAL NIGHT CATCH	5,900.90	43.09		11,359.40	82.95

Table 7. FY98 day and night catch for the top ten species of finfish harvested by hook and line method. Juvenile *Caranx ignobilis*, *C. melampygous*, *C. papuensis*, and *C. sexfasciatus* (*i'e'* \leq 200mm) are listed separately from the intermediate to adult size classes. Finfish harvest percentages were derived from the total day (14,057 kg) and night (3,237 kg) hook and line catch.

Day Species	Harvest		Night Species	Harvest	
	kg	%		kg	%
<i>Selar crumenophthalmus</i>	3,566.11	25.37	<i>Selar crumenophthalmus</i>	515.77	15.93
<i>Naso unicornis</i>	1,695.33	8.57	<i>Caranx i'e'</i>	334.68	9.51
<i>Caranx i'e'</i>	1,302.69	6.59	<i>Lutjanus monostigmus</i>	331.75	9.43
<i>Clarias batrachus</i>	824.62	4.17	<i>Lutjanus fulvus</i>	220.45	6.27
<i>Caranx melampygous</i>	728.44	3.68	<i>Kyphosus vaigiensis</i>	168.95	4.80
<i>Caranx papuensis</i>	660.49	3.34	<i>Lethrinus harak</i>	165.85	4.71
<i>Lethrinus harak</i>	625.12	3.16	<i>Lethrinus xanthochilus</i>	139.18	3.96
<i>Lethrinus olivaceus</i>	465.76	2.36	<i>Epinephelus merra</i>	137.30	3.90
<i>Kyphosus vaigiensis</i>	395.72	2.00	<i>Caranx ignobilis</i>	97.77	2.78
<i>Naso tuberosus</i>	382.50	1.93	<i>Cephalopholis argus</i>	71.18	2.02
Total Top Ten Hook & Line Catch	10,646.78	61.17		2,182.88	63.32
Total Combined Hook & Line Catch	12,829.66				

Table 8. FY98 day and night catch for the top ten species of finfish harvested by gill net method. Juvenile *Caranx ignobilis*, *C. melampygous*, *C. papuensis*, and *C. sexfasciatus* (*i'e'* \leq 200mm),

Mulloides flavolineatus (ti'ao \leq 100mm), and *Siganus spinus* (mañâhak), are listed separately from the intermediate to adult size classes. Finfish harvest percentages were derived from the total day (5,570 kg) and night (2,908 kg) gill net catch.

Day Species	Harvest		Night Species	Harvest	
	kg	%		kg	%
<i>Valamugil engeli</i>	798.75	14.34	<i>Mulloides flavolineatus</i>	552.49	19.00
<i>Mulloides flavolineatus</i>	700.87	6.49	<i>Valamugil engeli</i>	349.13	16.15
<i>Acanthurus triostegus</i>	507.97	4.70	<i>Acanthurus triostegus</i>	202.95	9.39
<i>Scarus sordidus</i>	392.19	3.63	<i>Valamugil seheli</i>	194.17	8.98
<i>Neoniphon sammara</i>	324.66	3.00	<i>Liza vaigiensis</i>	117.61	5.44
<i>Carcharhinus melanopterus</i>	228.23	2.11	<i>Leiognathus equulus</i>	115.46	5.34
<i>Siganus spinus</i>	182.22	1.69	<i>Caranx i'e'</i>	112.28	5.19
<i>Gerres acinaces</i>	155.77	1.44	<i>Hymantura granulata</i>	107.67	4.98
<i>Scolopsis lineatus</i>	125.63	1.16	<i>Gerres acinaces</i>	74.85	3.46
<i>Balistoides viridescens</i>	124.49	1.15	<i>Caranx sexfasciatus</i>	70.43	3.26
Total Top Ten Gill Net Catch	3,540.78	39.72		1,897.04	81.19
Total Combined Gill Net Catch	5,437.82				

Table 9. FY98 day and night catch composition for the top ten species of finfish harvested by snorkel spear method. Finfish harvest percentages were derived from the total day (4,651 kg) and night (6,645 kg) snorkel spear catch.

Day Species	Harvest		Night Species	Harvest	
	kg	%		kg	%
<i>Kyphosus vaigiensis</i>	2,147.49	46.17	<i>Naso unicornis</i>	882.84	13.29
<i>Naso unicornis</i>	1,298.00	15.25	<i>Naso lituratus</i>	652.46	7.17
<i>Trachinotus blochii</i>	421.50	4.95	<i>Acanthurus lineatus</i>	646.46	7.11
<i>Scarus frontalis</i>	369.62	4.34	<i>Myripristis murdjan</i>	544.19	5.98
<i>Scarus microrhinos</i>	188.05	2.21	<i>Cheilinus trilobatus</i>	260.40	2.86
<i>Siganus spinus</i>	97.59	1.15	<i>Acanthurus triostegus</i>	215.28	2.37
<i>Lutjanus argentimaculatus</i>	31.88	0.37	<i>Sargocentron tiere</i>	202.14	2.22
<i>Lethrinus harak</i>	25.72	0.30	<i>Siganus spinus</i>	201.58	2.22
<i>Naso lituratus</i>	25.51	0.30	<i>Scarus psittacus</i>	184.78	2.03
<i>Liza vaigiensis</i>	23.13	0.27	<i>Myripristis violacea</i>	174.82	1.92
Total Top Ten Spear Snorkel Catch	4,628.49	75.31		3,964.95	47.17
Total Combined Spear Snorkel Catch	8,593.44				

Seasonal Harvests

The seasonal catch of certain juvenile fishes is widely anticipated by local fishermen. The FY98 harvests of i'e' and ti'ao were well represented within the expansion estimates (Tables 4 - 6), especially *Caranx i'e'*. During FY98, small pulses of recruiting ti'ao occurred in November and July and i'e' occurred from March - September. I'e' (*Caranx*

spp.) ranked fifth for overall and daytime harvests (Tables 4 and 5) and ranked eighth for the night harvest (Table 6) in FY98.

FY98 marked a below average recruitment year for mañahak (ha'tang or *Siganus spinus* and lessor or *S. argenteus*). Small runs occurred in early June and the middle of September in FY98. As of June 1997, DAWR suspended the collection of mañahak harvest data, because this information was not critical to management of the reef fishery.

The atulai (*Selar crumenophthalmus*) season was successful during the last few months in FY98, but did not reflect this during the creel surveys with 4.1 mt or 9% of the total catch for FY98. The total inshore harvest of atulai (99.7% of day and night harvest) were caught with hook and line, due to the high incidence of catch interviews at the Agana Boat Basin channel (Fig. 1, location 9 and Table 7).

In addition to finfish, a significant number of marine invertebrates were harvested from Guam's reefs. An estimated 2.8 mt of octopus, e.g., *Octopus cyanea* and *O. ornatus*, which made up approximately 49% of the total invertebrates harvested, were caught island-wide in FY98. Daytime octopus harvests accounted for 2.2 mt (53% by hooks and gaffs, 42% by snorkel spear, and 5% by other methods), while nighttime harvests accounted for 0.6 mt (90% by snorkel spear, 8% by other methods, and 2% by gill nets) in FY98.

The mangrove crab, *Scylla serrata*, was the second-most harvested with a day and night island-wide harvest of 0.9 mt (78% by crab trap, 17% by gill net, and 5% by hook and line) in FY98. The third most caught invertebrate was spiny lobster, *Panulirus penicillatus*, with an estimated 0.4 mt (79% by snorkel spear and 21% by gill nets) in FY98. Harvests of reef crustaceans and molluscs accounted for an estimated 1.6 mt and 0.2 mt respectively, in FY98.

Other methods, e.g., gleaning, crab trapping, and hand netting, produced an estimated 2.2 mt of finfish and invertebrates, e.g., *Arothron* and *Toxopneustes*, with a catch rate of 0.25 kg/ph of fishing effort.

Harvests were not representative of the actual participation, due to the rarity of certain methods within the "inshore-catch" survey window (especially nighttime for certain methods), and includes the following methods for day: surround net, spear SCUBA, hook and gaffs, and drag net; and for night: cast net, surround net, hooks and gaffs, and drag net. Methods encountered more frequently, i.e., hook and line, cast net (day only), gill net, spear snorkel, spear SCUBA (night only, and other methods, had expansion confidence intervals less than 31% for daytime and less than 33% for nighttime fishing activity.

Fishable Index Hours (FIH)

The FIH default is a parameter used in the expansion to identify the amount of time a person can fish with a particular method during a survey day. Windows of survey fishable time included: the a.m. (0600-1200 hours), p.m. (1900-2400 h), whole day (0600-1800 h), and whole night (1900-0200 h). The FIH is determined by dividing the survey fishable time by the whole day fishable time for each method. Fishable hours for each method are determined by the state of the tide. Some methods are not restricted by tide, e.g. hook and line and spearfishing. Net fishing and is limited to tides above 0.5 ft., while hooks and gaffs for octopus and other methods are limited to tides below 0.5 ft (Table 10).

Table 10. Fishable Index Hours (FIH). Methods are listed as follows: Hook and Line (HL); Cast, Gill, Surround, and Drag Nets (N); Snorkel and SCUBA spear (SP); Hooks and Gaffs (HG); and Other Methods (OM), are listed for day and nighttime values for FY98.

**Daytime FIH Values for
FY98**

Method	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sep
Nets	2.40	2.48	2.20	2.20	2.20	2.15	1.90	1.80	1.80	1.73	1.89	2.34
HG	1.00	1.00	1.00	1.00	1.00	1.25	2.50	3.00	4.00	4.00	2.38	2.38

**Nighttime FIH Values
for FY98**

Nets	1.17	1.13	1.29	1.44	1.08	1.75	1.63	1.58	1.50	1.50	1.50	1.44
HG	2.50	1.42	1.88	1.81	2.38	1.13	1.00	1.00	1.00	1.00	1.00	1.25

	Day	Night
HL	2.00	1.40
SP	2.00	1.40
OM	2.00	2.00

RECOMMENDATION

Considering the inshore fisheries survey provides information important for management and planning, it is recommended that this job be continued. Since approximately 10% of the participants and gear-units are not surveyed on the inshore participation route (based on FY98 data), it is recommended that the aerial surveys be continued. The sampling technique has improved since the initiation of the aerial surveys and an improved quantitative analysis has been completed for island-wide inshore fishing effort.

The increased availability and affordability of certain fishing gear methods has also changed on Guam. Hook and line has shown a significant increase since the early 1980's and has grown in popularity, especially with the i'e' and atulai fishery. Gill net use has remained high over the last decade, but the poor quality and disposability of the cheaper nets has created a situation of "ghost-netting" on our reefs. It is recommended that an increase in net dimensions, decrease fishing time, and reduction in net length, be made in order to reduce the overall destructiveness of this method. Inshore data compiled since 1985 supports the need for gill net restrictions because of the alarming reduction of certain species of finfish in the harvest estimates.

SCUBA spearfishing has increased in popularity with the aid of depth finders, bang sticks, and greater volume air-tanks. It is recommended for equipment restrictions be placed on spear SCUBA, e.g., banning of bang sticks and higher volume air tanks, in order to safeguard the rapid decline of our adult reef fish.

Overall declines in annual harvests and shifts in species composition have been documented in the last 14 fiscal years. With the recent legislative approval of marine preserves and the implementation of new fishing regulations, we can begin to manage destructive fishing methods and preserve critical areas for reef fishes to mature and reproduce. As the success of the marine preserves are documented over the next few years, the evidence needed to restrict the most destructive methods, e.g. gill nets, drag nets, and SCUBA spearfishing, will be possible.

There may be an immediate need to modify inshore survey locations in the near future with the implementation of 5 new marine preserves on Guam. This may require the addition of approximately 5 new locations adjacent to the regions currently surveyed, e.g. locations 91, and 92 to region I; 35 to region II; and, 39 and 73 to region III, (Fig. 1).

PROJECT COST

The estimated cost of this project was \$159,000.

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