

**JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT**

STATE: Territory of Guam

PROJECT NO.: F-1R-7
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, 1998 to September 30, 1999

SUMMARY

Monthly inshore fisheries surveys were conducted along Guam's shoreline from October, 1998 through September, 1999. The total estimated inshore fisheries catch for this time period was 70.6 mt (metric tonnes), 89% 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 59% of the total participation (excludes seasonal mañâhak and atulai data) or 47,074 participants. In terms of catch rate, other methods were the most successful of all the daytime methods, yielding approximately 1.38 kg/gear-hour (gh) with a daytime harvest of 1.4 mt, and drag net was the most successful nighttime fishing method, yielding approximately 2.31 kg/gh with a nighttime harvest of 0.8 mt. Hook and line was the most successful method in terms of the overall harvest, yielding approximately 0.27 kg/gh with a total harvest of 23.4 mt. The seasonal mañâhak and achemsom catch was not surveyed in FY99.

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.

Abandoned Gill Net Removal/Pilot Study

The gill net removal/study preliminary results, is included in Appendix 3.

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 FY99, 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 FY99, 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.

A new participation study was conducted from July to September 1999 to account for the participation and percent coverage of fishing methods that occurred during the inshore creel survey. Methods observed during the creel survey were listed according to the numbers of fishermen and gear for reef zones and locations within the survey route. The total number of method entries were compared to the non-interviews and calculated as a percent coverage for each method. The purpose of this study is to quantify the occurrence of methods during the creel survey.

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 (mañahak), 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.

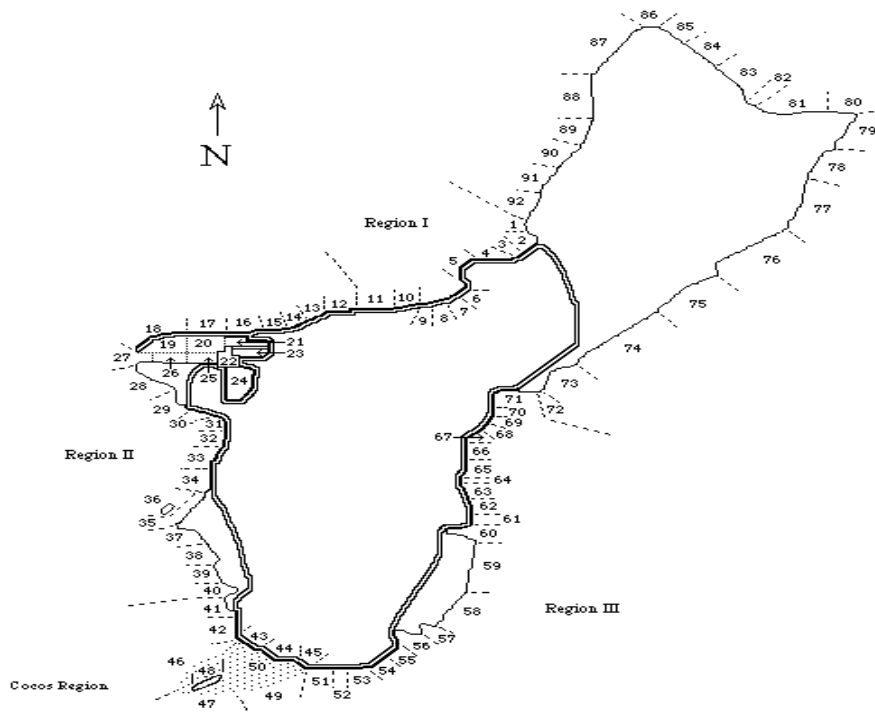


Figure 1. Inshore Fisheries “Participation Survey” Route with Area and Location Codes.

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.

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 *Mulloidies flavolineatus* and *M. vanicolensis* with nets, when they occur.

The FY99 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 FY99, the estimated inshore harvest for day, night, and seasonal fishing around Guam was 70.6 mt. Finfish accounted for 89% of total harvest or 62.7 mt. The seasonal mañâhak and achemsom harvests were significant in certain locations on the east and west sides of the island during the months of April and May, e.g. East Agana, Pago Bay, and Merizo Pier, but were not recorded in FY99. The total inshore catch (finfish and invertebrates) resulted from a total effort of 269,950 person-hours (ph) and 235,057 gear-hours (gh). Overall, approximately 0.30 kg/gh of fish were harvested with 168 daytime and 226 nighttime species identified in FY99 (Table 1). In addition to seasonal species, a significant number of juvenile reef fish recruited on reefs in FY99. Species caught / observed (April/May 1999) in significant numbers included the following: *Epinephelus merra*, *Gnathodentex aurolineatus*, *Gymnosarda unicolor*, *Heteropriacanthus cruenatus*, and *Rhinecanthus aculeatus*.

Table 1. Combined estimated inshore participation, effort, and total harvest (kg) for all methods during the day and night in FY99.

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	Finfish	Inverts	CPUE†
Hook & Line	47,074	45,911	25,010	169,456	165,485	23,433	23,295	138	0.27 wd
Cast Net	9,897	9,097	7,971	23,230	21,354	7,613	7,220	393	0.54 wed
Gill Net	10,612	4,834	2,789	50,064	23,000	13,310	12,968	342	0.68 wed
Surround Net	0	0	0	0	0	0	0	0	0.0
Spear Snorkel	7,835	7,609	4,146	18,739	18,113	20,094	17,610	2,484	1.22 wen
Spear SCUBA	0	0	0	0	0	0	0	0	0.0
Drag Net	917	180	135	2,275	448	820	794	26	2.31 wn
Hooks & Gaffs	1,486	1,709	1,384	2,784	3,253	3,563	11	3,552	1.11 wd
Other††	2,586	2,586	1,796	3,403	3,403	1,798	791	1,007	1.38 wd
TOTAL	80,405	71,926	43,232	269,950	235,057	70,631	62,689	7,942	0.30

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

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

CATCH

Hook and line fishing yielded the largest overall catch with 23.3 mt or 33% of the total finfish harvest. Snorkel spearfishing was second with 17.6 mt or 25%, while gill netting was third with 13.0 mt or 18%, and cast netting was fourth with 7.2 mt or 10% of the total finfish harvest (Table 1).

The top three daytime methods accounted for approximately 76% of the daytime total and 57% of the combined total harvest (Table 2). Hook and line fishing accounted for the most fish with 19.8 mt or 42% of the day finfish harvest. Gill netting was second with 10.8 mt or 23%, while snorkel spearfishing was third with 8.5 mt or 18%, and cast netting was fourth with 7.2 mt or 15% of the total day finfish harvest.

Table 2. Estimated inshore participation, effort, and total harvest (kg) for all methods during the day in FY99.

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	Finfish	Inverts	CPUE†
Hook & Line	33,615	33,254	19,583	117,909	116,698	19,829	19,777	52	0.27 wd
Cast Net	9,847	9,048	7,924	23,147	21,271	7,590	7,198	393	0.54 wed
Gill Net	6,575	3,181	1,988	35,539	17,052	11,035	10,806	228	0.68 wed
Surround Net	0	0	0	0	0	0	0	0	0.0
Spear Snorkel	3,399	3,233	2,295	9,162	8,672	9,332	8,514	818	1.08 wed
Spear Scuba	0	0	0	0	0	0	0	0	0.0
Drag Net	0	0	0	0	0	0	0	0	0.0
Hooks & Gaffs	1,485	1,709	1,384	2,784	3,253	3,563	11	3,552	1.11 wd
Other††	2,119	2,119	1,627	2,072	2,072	1,429	719	710	1.38 wd
TOTAL	57,040	52,544	34,801	190,613	169,018	52,778	47,025	5,753	0.31

†CPUE summary derives the greatest weekday (wd) and weekend day (wed) values. The greatest CPUE value for hook and line was in region 3.

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

The top three nighttime methods accounted for approximately 93% of the night total and 24% of the combined total finfish harvest (Table 3). Snorkel spearfishing accounted for the most fish caught with 9.1 mt or 58% of the total night finfish harvest and hook and line fishing was second with 3.5 mt or 22%. Gill netting was third with 2.2 mt or 14% and drag netting was fourth with 0.8 mt or 5% of the total night finfish harvest.

Table 3. Estimated inshore participation, effort, and total harvest (kg) for all methods during the night in FY99.

METHOD	Persons	Gears	Trips	Per-Hrs	Gear-Hrs	Catch	Finfish	Inverts	CPUE†
Hook & Line	13,459	12,657	5,427	51,548	48,787	3,604	3,518	86	0.11 wn
Cast Net	49	49	47	83	83	23	23	0	0.29 wn
Gill Net	4,037	1,652	802	14,524	5,948	2,276	2,162	114	0.39 wen
Surround Net	0	0	0	0	0	0	0	0	0.0
Spear Snorkel	4,436	4,376	1,851	9,569	9,441	10,761	9,096	1,665	1.22 wen
Spear SCUBA	0	0	0	0	0	0	0	0	0.0
Drag Net	917	180	135	2,275	448	820	794	26	2.31 wn
Hooks & Gaffs	0	0	0	0	0	0	0	0	0.0
Other††	467	467	169	1,331	1,331	369	72	297	0.66 wen
TOTAL	23,365	19,381	8,431	79,330	66,038	17,853	15,664	2,189	0.27

†CPUE summary derives the greatest weeknight (wn) and weekend night (wen) values. The greatest CPUE value for hook and line was in regions 1 and 2.

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

EFFORT

Hook and line fishing was the most practiced fishing method overall (Table 1), accounting for 47,074 persons or approximately 59% of total participation. Gill netting was the

second most practiced method overall, accounting for 10,612 participants or 13%, while cast netting followed in third with 9,897 participants or 12% of the total participation.

The rank order for day fishing participation placed hook and line first with 33,615 or 59% participants. Cast netting and gill netting placed second and third respectively with 9,847 or 17% and 6,575 or 12% of the participants (Table 2). Hook and line fishing remained the most practiced night fishing method with 13,459 participants or 58% of night participation. The second most practiced method was snorkel spearfishing with 4,436 participants or 19%, while gill netting followed in third with 4,037 participants or 17% of night participation (Table 3).

CATCH PER UNIT EFFORT (CPUE)

Other methods had the highest daytime CPUE of 1.38 kg/gh for weekday fishing and hooks and gaffs followed in second with 1.11 kg/gh and snorkel spearfishing was third with 1.08 kg/gh (Table 2). Drag netting had the highest nighttime CPUE of 2.31 kg/gh for weeknight fishing, snorkel spearfishing followed in second with 1.22 kg/gh, and other methods was third with 0.66 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 FY99 Offshore Fisheries Report (Study F-1, Job 1).

Species and Family Harvests

The expanded species composition for the combined day and night efforts were calculated for FY99. The top species caught was the bluespine unicornfish, *Naso unicornis*, with 5.9 mt or 9.35% of the and *Caranx i'e'* was the top seasonal and overall species caught with 7.8 mt or 12.48% of the finfish total. Acanthuridae was the top family harvested, with 14.3 mt or 22.88% of the combined harvest in FY99 (Table 4).

Table 4. FY99 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' ≤ 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 and night catch (62,689 kg).

SPECIES	Harvest		FAMILY	Harvest	
	kg	%		kg	%
<i>Caranx i'e'</i>	7,824.83	12.48	Acanthuridae	14,343.52	22.88
<i>Naso unicornis</i>	5,858.65	9.35	Carangidae	11,551.19	18.43
<i>Naso lituratus</i>	4,979.49	7.94	Scaridae	7,302.03	11.65
<i>Siganus spinus</i>	2,766.46	4.41	Siganidae	3,741.27	5.97
<i>Leptoscarus vaigiensis</i>	2,570.85	4.10	Mullidae	3,626.06	5.78
<i>Triaenodon obesus</i>	2,280.61	3.64	Carcharhinidae	2,845.84	4.54
<i>Caranx melampygus</i>	1,938.69	3.09	Mugilidae	2,640.48	4.21
<i>Gymnothorax javanicus</i>	1,422.77	2.27	Lethrinidae	2,214.09	3.53
<i>Acanthurus lineatus</i>	1,411.95	2.25	Muraenidae	1,789.45	2.85
<i>Mulloides ti'ao</i>	1,379.52	2.20	Kyphosidae	1,374.70	2.19
TOTAL ANNUAL COMBINED CATCH	32,433.82	51.74		51,428.63	82.04

Table 5. FY99 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' \leq 200mm), *Mulloidies 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 catch (47,025 kg).

SPECIES	Harvest		FAMILY	Harvest	
	kg	%		kg	%
<i>Caranx i'e'</i>	7,462.15	15.87	Carangidae	10,420.43	22.16
<i>Naso unicornis</i>	4,350.43	9.25	Acanthuridae	9,741.67	20.72
<i>Naso lituratus</i>	4,009.77	8.53	Scaridae	6,352.27	13.51
<i>Leptoscarus vaigiensis</i>	2,537.52	5.40	Siganidae	2,560.71	5.45
<i>Siganus spinus</i>	2,112.78	4.49	Mullidae	2,531.46	5.38
<i>Caranx melampygus</i>	1,814.16	3.86	Mugilidae	2,326.22	4.95
<i>Triaenodon obesus</i>	1,588.23	3.38	Carcharhinidae	2,130.32	4.53
<i>Gymnothorax javonicus</i>	1,323.53	2.81	Muraenidae	1,579.03	3.36
<i>Mulloidies ti'ao</i>	1,276.36	2.71	Lethrinidae	1,471.83	3.13
<i>Kyphosus vaigiensis</i>	1,192.26	2.54	Kyphosidae	1,325.29	2.82
TOTAL ANNUAL DAY CATCH	27,667.19	58.84		40,439.23	86.00

Naso unicornis topped the night harvest with 1.5 mt (99% by snorkel spear and 1% by hook and line) or 9.63% and *Acanthurus lineatus* was slightly less with 1.3 mt or 8.49% of the night total. Acanthuridae was harvested over 4 times greater than any other family with 4.6 mt or 29.38% of the top family with 4 species making the top ten night harvest list (Table 6).

Table 6. FY99 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' \leq 200mm), *Mulloidies 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 night catch (15,664 kg).

SPECIES	Harvest		FAMILY	Harvest	
	kg	%		kg	%
<i>Naso unicornis</i>	1,508.22	9.63	Acanthuridae	4,601.85	29.38
<i>Acanthurus lineatus</i>	1,329.39	8.49	Siganidae	1,180.56	7.54
<i>Naso lituratus</i>	969.72	6.19	Carangidae	1,130.76	7.22
<i>Triaenodon obesus</i>	692.38	4.42	Mullidae	1,094.60	6.99
<i>Mulloidies flavolineatus</i>	662.80	4.23	Scaridae	949.76	6.06
<i>Siganus spinus</i>	653.68	4.17	Lethrinidae	742.26	4.74
<i>Caranx i'e'</i>	362.68	2.32	Carcharhinidae	715.52	4.57
<i>Lutjanus argentimaculatus</i>	358.48	2.29	Lutjanidae	592.43	3.78
<i>Acanthurus triostegus</i>	356.12	2.27	Holocentridae	582.37	3.72
<i>Lethrinus xanathochilus</i>	353.05	2.25	Labridae	334.54	2.14
TOTAL ANNUAL NIGHT CATCH	7,246.52	46.26		11,924.65	76.13

Method Harvests

The top harvest of finfish species for hook and line method was calculated for FY99 (Table 7). *Caranx i'e'* ranked first with 6.0 mt for day (30.52%) and second with 0.3 mt (7.12%) for night, while *Traenodon obesus* ranked first with 0.7 mt (19.68%) for night only. A 15.0 kg whitetip shark skewed the night hook and line expansion results.

Table 7. FY99 day and night catch composition 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' ≤ 200mm), are listed separately from the intermediate to adult size classes. Finfish harvest percentages were derived from the total day (19,777 kg) and night (3,518 kg) hook and line catch.

Day Species	Harvest		Night Species	Harvest	
	kg	%		kg	%
<i>Caranx i'e'</i>	6,035.81	30.52	<i>Triaenodon obesus</i>	692.38	19.68
<i>Naso unicornis</i>	2,177.68	11.01	<i>Caranx i'e'</i>	250.56	7.12
<i>Caranx melampygous</i>	1,670.29	8.45	<i>Lutjanus argentimaculatus</i>	343.21	9.76
<i>Triaenodon obesus</i>	1,588.23	8.03	<i>Selar crumenophthalmus</i>	273.39	7.77
<i>Naso lituratus</i>	1,581.24	8.00	<i>Lethrinus xanthochilus</i>	244.26	6.94
<i>Gymnothorax javanicus</i>	1,323.53	6.69	<i>Trachinotus blochii</i>	230.99	6.57
<i>Liza vaigiensis</i>	814.34	4.12	<i>Heteropriacanthus cruenatus</i>	207.76	5.91
<i>Siganus spinus</i>	726.77	3.67	<i>Siganus argenteus</i>	149.44	4.25
<i>Lethrinus harak</i>	382.34	1.93	<i>Caranx melampygus</i>	126.70	3.60
<i>Scomberoides lysan</i>	381.60	1.93	<i>Lethrinus harak</i>	112.99	3.21
Total Top Ten Hook & Line Catch	16,681.83	84.35		2,631.68	74.81
Total Combined Hook & Line Catch	19,313.51				

The top harvest of finfish species for gill net method was calculated for FY99 (Table 8). *Leptoscarus vaigiensis* ranked first for day with 2.5 mt (23.01%) of the daytime harvest. An unusually large gill net harvest of 33.0 kg of the seagrass parrotfish, skewed the day expansion results. *Mulloides flavolineatus* ranked first with 0.2 mt (10.9%) of the night harvest.

Table 8. FY99 day and night catch composition for the top ten species of finfish harvested by gill net method. Juvenile *Caranx ignobilis*, *C. melampygous*, *C. papuensis*, and *C. sexfasciatus* (i'e' ≤ 200mm), *Mulloides flavolineatus* (ti'ao ≤ 100mm), and *Siganus spinus* (mañahak), are listed separately from the intermediate to adult size classes. Finfish harvest percentages were derived from the total day (10,806 kg) and night (2,162 kg) gill net catch.

Day Species	Harvest		Night Species	Harvest	
	kg	%		kg	%
<i>Leptoscarus vaigiensis</i>	2,486.29	23.01	<i>Mulloides flavolineatus</i>	235.61	10.90
<i>Scarus psittacus</i>	866.57	8.02	<i>Siganus randalli</i>	189.29	8.76
<i>Siganus spinus</i>	720.29	6.67	<i>Siganus spinus</i>	188.83	8.73
<i>Acanthurus triostegus</i>	675.28	6.25	<i>Acanthurus triostegus</i>	140.08	6.48
<i>Lethrinus harak</i>	476.10	4.41	<i>Leiognathus equulus</i>	110.98	5.13
<i>Carcharhinus melanopterus</i>	471.27	4.36	<i>Gerres acinaces</i>	109.35	5.06
<i>Naso unicornis</i>	442.06	4.09	<i>Valamugil engeli</i>	100.87	4.67
<i>Gerres acinaces</i>	440.73	4.08	<i>Kuhlia rupestris</i>	94.71	4.38

<i>Parupeneus barberinus</i>	342.18	3.17	<i>Caranx i'e'</i>	78.17	3.62
<i>Mulloidés flavolineatus</i>	339.67	3.14	<i>Valamugil seheli</i>	55.31	2.56
Total Top Ten Gill Net Catch	7,260.44	67.19		1,303.20	60.28
Total Combined Gill Net Catch	8,563.64				

The top harvest of finfish species for snorkel spear method was calculated for FY99 (Table 9). *Naso lituratus* ranked first with 2.1 mt (24.14%) and third with 0.9 mt (10.44%), while *Naso unicornis* ranked second with 1.7 mt (20.33%) and first with 1.5 mt (16.4%) of the day and night snorkel spear harvest.

Seasonal Harvests

The seasonal catch of certain juvenile fishes is widely anticipated by local fishermen. The FY99 harvests of i'e' and ti'ao were well represented within the expansion estimates (Tables 4-6), especially *Caranx i'e'*. During FY99, small pulses of recruiting ti'ao occurred in November and July and i'e' occurred from March - September. I'e' (*Caranx* spp.) ranked first for overall and daytime harvests (Tables 4 and 5) and ranked seventh for the night harvest (Table 6) in FY99. Ti'ao (*Mulloidés flavolineatus*) ranked tenth for overall harvest (Table 4) and ninth for daytime harvest (Table 5) in FY99.

FY99 marked a significant recruitment year for mañahak (ha'tang or *Siganus spinus* and lessso' or *S. argenteus*). Runs occurred in early April and May of FY99. As of June 1998, DAWR suspended the collection of mañahak harvest data, because this information was not critical to management of the reef fishery. DAWR staff observations and personal accounts from local fishermen interviewed during the creel surveys harvested mañahak on the following dates in 1999: April 12, May 1, 7-11, 16-19, and May 9-12.

Table 9. FY99 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 (8,514 kg) and night (9,096 kg) snorkel spear catch.

Day Species	Harvest		Night Species	Harvest	
	kg	%		kg	%
<i>Naso lituratus</i>	2,055.28	24.14	<i>Naso unicornis</i>	1,491.81	16.40
<i>Naso unicornis</i>	1,730.69	20.33	<i>Acanthurus lineatus</i>	1,315.83	14.47
<i>Scarus schlegeli</i>	898.67	10.56	<i>Naso lituratus</i>	949.56	10.44
<i>Siganus argenteus</i>	425.99	5.00	<i>Siganus spinus</i>	437.90	4.81
<i>Scarus altipinnis</i>	359.04	4.22	<i>Scarus psittacus</i>	233.09	2.56
<i>Scarus sordidus</i>	287.42	3.38	<i>Acanthurus triostegus</i>	215.83	2.37
<i>Hipposcarus longiceps</i>	271.85	3.19	<i>Cheilinus trilobatus</i>	206.69	2.27
<i>Lutjanus argentimaculatus</i>	266.56	3.13	<i>Scarus schlegeli</i>	161.41	1.77
<i>Caranx papuensis</i>	246.16	2.89	<i>Scarus frontalis</i>	136.57	1.50
<i>Kyphosus vaigiensis</i>	233.77	2.75	<i>Naso tuberosus</i>	136.49	1.50
Total Top Ten Spear Snorkel Catch	6,775.43	79.58		5,285.18	58.10
Total Combined Spear Snorkel Catch	12,060.61				

The atulai (*Selar crumenophthalmus*) season was exceptional during the last few months in FY99, but did not reflect this during the creel surveys with 0.3 mt or 0.5% of the total catch for FY99. The total inshore harvest of atulai (94% 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).

Invertebrates Harvested

In addition to finfish, a significant number of marine invertebrates were harvested from Guam's reefs. An estimated 5.7 mt of octopus, e.g., *Octopus cyanea* (0.9 mt) and *O. ornatus* (4.9 mt), which made up approximately 74% of the total invertebrates harvested, were caught island-wide in FY99. Daytime octopus harvests accounted for 4.7 mt (75% by hooks and gaffs, 16% by snorkel spear, 8% by cast nets, and 1% by gill nets), while nighttime harvests accounted for 1.1 mt (93% by snorkel spear, 3% by gill nets, and 2% by other methods and drag nets) in FY99.

The spiny lobster, *Panulirus penicillatus*, was the second most harvested invertebrate with a day and night island-wide harvest of 0.5 mt (74% by snorkel spearfishing and 26% by gill net) in FY99. The third most caught invertebrate was the longspine urchin, *Echinothrix diadema*, with an estimated 0.3 mt (100% by other methods) in FY99. Harvests of reef molluscs, crustaceans, and echinoderms accounted for an estimated 6.3 mt, 1.0 mt, and 0.3 mt respectively, in FY99.

Other methods, e.g., gleaning, crab trapping, and hand netting, produced an estimated 1.8 mt of finfish and invertebrates, e.g., Chaetodontidae for the aquarium trade and *Echinothrix* sea urchins for "uni", with a catch rate of 0.3 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, and drag net; and for night: cast net, surround net, spear SCUBA, and hooks and gaffs. Methods encountered more frequently, i.e., hook and line, cast net (day only), gill net, spear snorkel, hooks and gaffs (day only), drag net (night only), and other methods, had expansion confidence intervals less than 48.2% for daytime and less than 57.5% for nighttime fishing activity.

An Inshore Creel Participation pilot survey was conducted from July to September 1999 to identify methods rarely interviewed. Percent coverage of persons and gears were listed for all methods encountered during the creel survey with results listed in Table 10. Methods with the least number of persons observed included the following for weekday and weekend surveys respectively: SCUBA spear (0/2), surround net (3/6), other methods (4/3), and drag net (5/7). Percent summaries (Table 10) of the previously mentioned methods do not accurately reflect the actual coverage throughout the fiscal year, i.e., SCUBA spear was listed at 100% coverage for weekend surveys based on two observations, which was an inadequate amount of data to expand on 4D. In addition, surround net fishing was not expanded for total harvest in FY99 due to the rarity of this method.

	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 14% of the participants and gear-units are not surveyed on the inshore participation route (based on FY99 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. An abandoned gill net removal/study has been recommended as a separate new project and approved for FY00. This project will address the need to remove derelict nets and to quantify the destruction to marine organisms and coral reef habitat. A three-month pilot study was conducted from July to September 1999 to determine project feasibility with the summary and results included in Appendix 3.

SCUBA spearfishing has increased in popularity with the aid of depth finders, bang sticks, and greater volume airtanks. In addition, it is known that certain species of reef fish, e.g., *Cheilinus undulatus* (Humpheaded Wrasse) and *Bolbometopon muricatum* (Humpheaded Parrotfish), have become increasingly rare due to the use of bangsticks with this method (per com with commercial SCUBA spearfishermen). In FY00, a study will be conducted to address key management issues related to this method.

Overall declines in annual harvests and shifts in species composition have been documented in the last fifteen 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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