JOB PROJECT REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO: F-1R-8
SUB-PROJECT NO.: F-1
STUDY: 1

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

JOB TITLE: Offshore Fisheries Survey

PERIOD COVERED: October 1, 1999 to September 30, 2000

SUMMARY

Monthly offshore fisheries surveys were conducted at the Agana Boat Basin (ABB), Agat Marina, and the Merizo boat ramp facilities from October 1999 through September 2000. The FY00 island-wide offshore catch was from primarily small recreational-type vessels and estimated at 98.3 metric tons (m.t.) (Table 1). The majority of total harvests (64.6 m.t.) were landed by trolling, which consisted primarily of 5 pelagic species. Bottomfishing harvested an estimated 13.4 m.t., snorkel and SCUBA spearfishing harvested a total of 15.5 m.t., while Atulai night-light jigging harvested an estimated 0.3 m.t. Other methods encountered during offshore surveys such as surround net, gill net, cast net, jigging, spin-casting, and other rarely encountered methods, accounted for 4.5 m.t.

Table 1: Composition of the Guam offshore catch during FY00. Weights are in metric tons (m.t.).

Offshore Fishing Method	FY00 Catch (m.t.)
Trolling	64.6
Bottomfishing	13.4
Spearfishing	15.5
Atulai night-light jigging	0.3
Other Methods	4.5
Total FY00 Offshore Catch	98.3

Compared with FY99, the total FY00 offshore catch significantly decreased by 82%, where trolling, bottomfishing, spearfishing, and atulai night-light jigging decreased by 80%. Decreased harvests were expanded for the following methods: trolling 80% (64.6 m.t. from 329.7 m.t.); bottomfishing 79% (13.4 m.t. from 63.2 m.t.); spearfishing 75% (15.5 m.t. from 61.4 m.t.); Atulai night-light jigging 99% (0.3 m.t. from 21.6 m.t.); and other methods 94% (4.5 m.t. from 74 m.t.). Boat-based gillnet and surround net catches of Bigeye scad *(Selar*

crumenophthalmus) were the primary "other methods" encountered and interviewed during offshore creel surveys, which resulted in the second-biggest decline in harvest for FY00.

BACKGROUND

Effective management of the island's offshore fishery resources requires the collection and analysis of boat-based offshore data on participation, fishing effort, methods used, and harvest. The Fisheries section at the Department of Agriculture's Division of Aquatic and Wildlife Resources (DAWR) has been monitoring offshore fishing activities for the past 23 years in order to identify trends in fishing activities. During this period, survey and analysis methodologies have changed in response to fluctuations in budget and staff, changes in the fishery, and the development of computer hardware and software.

The National Marine Fisheries Service (NMFS) and DAWR have been developing and are completing a computerized database program to collect and analyze the entire offshore fisheries data collected since FY97. The expansion program's algorithms are currently being reviewed, verified, and improved and should be completed by FY01. The loss of two senior fisheries staff and an increase in fisheries-related projects prevented the final completion of the program during FY00. Because of this, the data in this report should still be considered preliminary. The historical offshore data from FY82 to the present have been entered into the new database system, and the remainder of the data should be entered during FY01. The statistical basis for the expansion can be found in NOAA SWFC Admin. Reports H-83-21C and H-92-08.

OBJECTIVES

1) To quantify fishing participation, effort, and catch of boat-based fishing methods, which generally occur outside the reef margin.

2) To collect biological data from the specimens examined during interviews.

3) To continue and complete the review and verification of the Guam Offshore Expansion System.

PROCEDURES

Boat-based fishermen interviews were conducted at the 3 major boat ramps on island, for 8 randomly selected days each month. The ABB was sampled 4 times a month on 2 weekdays (we) and 2 weekend/holidays (we/h), while the Agat Marina and the Merizo boat ramps were each sampled twice in a month on 1 wd and 1 we/h. The days were randomly selected within wd and we/h fields. ABB surveys consist of two survey periods a day, from 0500 -1200h and from 1600 - 2400h. The Agat Marina and Merizo boat ramp facility survey times differ slightly with the morning survey hours, respectively 0530-1200h and 0600-1100h, with the evening survey the same as at ABB. A morning and evening participation survey on 2 wd and 2 we/h a month during inshore surveys, determined island-wide participation. All public boat launching

areas and accessible makeshift launching sites were surveyed by counting the number of vehicles with trailers (VTs) attached. The expansion program uses the assumption that a percentage of fishing boats operating out of the ABB, Agat Marina, and the Merizo boat ramp facilities are proportional to the types of fishing occurring around the island as a whole.

Important changes in the data expansion process have been incorporated into the offshore survey since FY97. This includes the use of: 1) quarterly expansions to account for seasonal fisheries; 2) boat log data to calculate participation in the expansion process; 3) expansion data from the 3 surveyed ports; 4) separating charter and non-charter fishing activity; and 5) separating bottomfishing into shallow and deepwater strata.

Historical offshore data has been recorded by gender and length for several parrotfish species in the family *Scaridae,* to determine whether or not size-overfishing is affecting the reproductive potential and average age at maturity of these species. This allows an opportunity to compile collected length data (archival-present) for future analysis.

All complete interviews included catch, participation, and effort data collected for each fishing method encountered. For most interviews, it was possible to identify the entire catch to the species level. However, an estimated total weight was occasionally used, depending on the level of fishermen cooperation. A small percentage of fishers declined interviews and although obtaining survey data is voluntary on Guam, the vast majority of them were cooperative and supportive of our staff and program.

RESULTS

Trolling

Five pelagic species accounted for 93% of the total troll catch by weight and four species plus other species accounted for 5% and lised in Table 2. Certain pelagic species such as the Indo-Pacific sailfish (*Istiophorus platypterus*) were rarely if ever encountered during offshore surveys. Therefore, expansions were not possible for this species, despite receiving anecdotal information about them outside of the survey periods.

Table 2: Composition of the Guam offshore troll catch during FY00 by most common species. Weights are in kilograms (kg).

Troll Species	Total Catch	% Troll Species
Katsuwonus pelamis	28,903	45
Coryphaena hippurus	9,268	14
Thunnus albacares	8,865	13
Makaira mazara	7,395	11
Acanthocybium solandri	6,856	10
Elagatis bipinnulatus	965	<2
Euthynnus affinis	858	<2

Sphyraena barracuda	602	<1
Gymnosarda unicolor	465	<1
Other species	400	<1
Total	64,577	100

Results from comparing trolling participation between FY00 and FY99, showed that the number of trolling trips decreased by 80%, 3,136 from 15,883 trips, while the number of people trolling decreased by 77%, 11,300 vs. 49,747 people in FY99. Wd results had an average of 10.4 trolling trips per day, while we/h results averaged 20.0 trips a day for an overall average of 15.2 troll trips per day. Approximately 49% of all boats interviewed on offshore surveys were trolling trips, 3,136 out of 6,387 total offshore trips. Non-charter boats made up 74% of the trolling trips, with each trolling trip averaging 4.0 hours with an average of 3.6 fishermen. Comparisons between ports revealed that 64% of all trolling trips originated from the ABB.

Results from comparing effort, the number of hours spent trolling decreased by 80%, 12,267 vs. 60,958 h in FY99. There were 46,045 gear hours (gh) and 37,756 person hours (ph) of trolling effort during FY00, an 80% and 76% decrease respectively.

The overall troll catch decreased by 80%, 64.6 m.t. from 329.7 m.t. in FY99. Landings decreased for the following pelagic species: Yellowfin tuna 89% (8.9 m.t. vs. 83.4 m.t.); Mahimahi 88% (9.3 m.t. vs. 79.3 m.t.); Wahoo 84% (6.9 m.t. vs. 42.1 m.t.); Bonita 44% (28.9 m.t. vs. 52.0 m.t.); and Indo-Pacific Blue marlin 82% (7.4 m.t. vs. 40.4 m.t.). Bonita was the top pelagic species caught in FY00 over the Yellowfin tuna from FY99.

Trolling catch rates remained approximately the same compared with FY99. Kg/gh fished decreased less than 2%, 5.32 kg/gh vs. 5.41 kg/gh in FY99, while kg/gh decreased less than 2%, 1.38 kg/gh vs. 1.40 kg/gh in FY99.

Trolling by charter boats continued to be a significant fishing sector on Guam. Charter boats made up approximately 5% of the trolling fleet, accounted for 16% of the total troll catch, 19% of trolling hours and 26% of all trolling trips in FY00. Charter boats accounted for 41% of the total Indo-Pacific Blue marlin catch and 22% of Mahimahi caught during FY00. However, charter boats experienced a decrease in total catch (m.t.), CPUE, and participation. Troll trips decreased by 73%, 819 down from 3,068 trips in FY99, while total charter troll catch (m.t.) decreased by 72%, 10.4 m.t. down from 36.9 m.t. Charter boat CPUE also decreased by 32%, 1.04 kg/gh from 1.52 kg/gh in FY99.

Bottomfishing

An estimated 13.4 m.t. of bottomfish were landed during FY00, a decrease of 79% from FY99 and was dominated by five major families with six species (Table 3). Significant decreases of all

groups of bottomfish were observed in comparison with FY99, which had snappers, emperors, triggerfish, and trevally's decreasing 70%, 79%, 56%, and 83% respectively for FY00.

Significant decreases were observed for all major bottomfish species caught in FY00, which included: Onaga by 79% (1.4 m.t. vs. 6.7 m.t.); Kalikali by 58% (0.8 m.t. vs. 1.9 m.t.); Lehi by 49% (0.6 m.t. vs. 1.2 m.t.); Red-Gilled emperors by 71% (1.5 m.t. vs. 5.1 m.t.); Yellowstripe emperors by 76% (0.4 m.t. vs. 1.6 m.t.); Blackspot emperors (*Lethrinus harak*) by 85% (0.3 m.t. vs. 2.1 m.t.); Yellowlip emperors by 88% (0.2 m.t. vs. 1.8 m.t.); and Black-tipped groupers (*Epinephelus fasciatus*) by 90%.

Table 3: Composition of the Guam offshore bottomfish catch during FY00 by family and most common species. Estimated weights are in kilograms (kg).

Family/Species	Total Catch	% Total Catch
Lutjanidae	5,026	38
E. coruscans	1,439	29*
P. auricilla	792	16*
A. rutilans	609	12*
E. carbunculus	434	9*
P. seiboldi	309	6*
A. virescens	297	6*
P. zonatus	273	5*
Lethrinidae	2,810	21
L. rubrioperculatus	1,468	52*
L. obsoletus	393	14*
L. harak	326	12*
L. xanthocheilus	229	8*
Serranidae	1,168	9
E. fasciatus	361	31*
E. merra	293	25*
Balistidae	1,019	8
M. vidua	373	37*
*Carangidae**	704	5
C. lugubris	332	47*
Mullidae	514	4
Holocentridae	271	2
Shallow water bottomfish**	730	5
Deep water bottomfish**	404	3
Total Bottomfish	13,349	

*percent in family

**unable to obtain species breakdown

Species breakdowns were not obtained for 9% of the bottomfish interviews, due to time constraints imposed by the fishermen. However, for bottomfish trips that were interviewed, a partition of deep and shallow bottomfishing was obtained.

Results from comparing bottomfish participation showed the number of bottomfish trips had decreased by 83%, 1,808 vs. 10,365 trips in FY99. Approximately 79% of these trips were from recreational and subsistence fishermen with some selling of fish periodically to pay for boating and gear expenses. The number of people bottomfishing significantly decreased by 84%, 8,036 vs. 49,747 people in FY99 (46% primarily recreational and subsistence and 54% from charter boats). There were an average of 5.7 bottomfishing trips per day, 4.0 wd and 7.4 we/h. Between the 3 sampled ports, a higher percentage of recreational and subsistence bottomfishing trips occurred out of the Merizo boat ramp (~23%). Merizo-launched bottomfish trips usually targeted the Cocos Lagoon, southern coast, and southern banks (11-Mile, Santa Rosa, Stu, Galvez, Baby, and White Tuna) of Guam.

In results comparing FY00 effort with FY99, the number of boat hours (bh) decreased by 81%, 7,794 bh vs. 41,547 bh during FY99. Approximately 70% of these efforts were from non-chartered boats. In bottomfishing, there were 27,207 ph and 26,346 gh during FY00, an 81% and 82% decrease respectively, compared with FY99. The overall catch rate in FY00 increased slightly, 0.51 kg/gh vs. 0.43 kg/gh in FY99.

Charter bottomfishing trips in FY00 showed an overall decrease in participation, effort, harvest, and CPUE compared with FY99. The number of charter bottomfish trips decreased 79%, total catch decreased 64%, 1.7 m.t. vs. 4.8 m.t., while the number of gh decreased by 78%, 8,173 gh vs. 36,518 gh and CPUE decreased by 62%, 0.21 kg/gh vs. 0.43 kg/gh. The low CPUE value most likely reflects the charter bottomfishing activity at the Agat Marina, which accounted for 83% of the total charter bottomfishing activity on Guam in FY00. The two main bottomfishing charter boats at Agat had up to 3 trips daily, fished within a short range of localities, and had a maximum of 35 gear units per trip. These boats caught primarily small goatfish, groupers, and triggerfish, which were usually released or served as sashimi (small %) for their patrons.

Similar decreases were observed with non-charter bottomfishing trips in FY00 compared with FY99. The number of non-charter bottomfish trips decreased by 83%, 1,434 vs. 8,586 trips, catch decreased by 80%, 11.6 m.t. vs. 58.4 m.t., and gh decreased 88%, 18,174 gh vs. 147,144 gh. CPUE increased in FY00 by 49%, 0.64 kg/gh vs. 0.43 kg/gh in FY99.

Deepwater species comprised 35% of the total bottomfish catch in FY00 (Table 4).

Table 4: Composition of the Guam offshore deep bottomfish catch during FY00. Estimated weights are in kilograms (kg).

Species	Total Catch (kg)	% Total Deep Bottomfish Catch
Etelis coruscans	1,439	31
Pristipomoides auricilla	792	17
A. rutilans	609	13
E. carbunculus	434	9
Misc. Deep Bottomfish	404	9
P. seiboldi	309	7
P. zonatus	273	6
Epinephelus octofasciatus	147	3
P. argyrogrammicus	105	2
S. dumerili	41	<1
P. filamentosus	34	<1
P. flavipinnis	30	<1
Total	4,617	100.0

*unable to obtain species breakdown

The harvest of deep bottomfish species decreased by 68%, 4,6 m.t. vs. 14.4 m.t., compared with FY99. Three species dominated the deep bottomfish catch, while approximately 0.4 m.t.

of the deep bottomfish catch could not be identified to the species level due to time constraints imposed by the fishermen.

Atulai Night-Light Jigging

Atulai night-light jigging trips were encountered year round during FY00, but not as frequent as during FY99. This method experienced the most significant decrease in participation and catch compared with other offshore survey methods for an estimated 0.32 m.t. of fish landed, 98% down from 31.3 m.t. recorded in FY99 (Table 5). Atulai comprised 98% of the night-light jigging catch (up 15%), while the remainder of the night-light jigging incidental species, e.g., *Sphyraena barracuda* and *Caranx sexfasciatus*, were caught when live Atulai or cut bait were used.

Table 5: Composition of the Guam offshore Atulai or Bigeye scad (*Selar crumenophthalmus*) night- light jigging catch during FY00. Weights are in metric tons (kg).

Species	Total Catch (kg)
Selar crumenophthalmus	320
Lethrinus rubrioperculatus	<20
Aprion virescens	<10
Sphyraena barracuda	anecdotal
Caranx sexfasciatus	anecdotal
Total Catch	<350

The number of Atulai night-light jigging trips decreased 93% in FY00, 67 vs. 917 trips in FY99. Effort comprised 215 fishing hours, 417 ph, and 433 gh with decreases of 96%, 97%, and 97% respectively. CPUE also decreased, with kg/gh decreasing 20%, 1.17 kg/gh vs. 1.47 kg/gh in FY99. Atulai night-light jigging had an average of 0.29 trips per day, 0.14 wd and 0.45 we/h. Each trip had an average of 1.9 fishermen fishing an average of 2.8 h and average catch rates of 1.2 kg/gh and 2.4 kg/h.

Spearfishing

An estimated 15.5 m.t. of speared fish, crustaceans, and mollusks were landed during FY00, a decrease of 75% from FY99 (Table 6). A species breakdown was not possible for 28% of the spearfish catches, due to time constraints imposed by fishermen. For these interviews, an estimated catch weight and participation and effort data were taken.

Comparing participation in FY00, the number of trips decreased 72%, 855 vs. 3,076 trips in FY99, while the number of people spearfishing decreased 73%, 2,900 vs. 10,702 people in FY99.

Table 6: Composition of the Guam offshore spearfish catch during FY00. Weights are in kilograms (kg).

Family/Species	Total Catch (kg)	% Total Catch
Assorted Reef Fish**	4,356	28.0
Acanthuridae	4,018	25.9
*Naso unicornis**	2,192	54.6
*N. lituratus**	723	18.0
*A. lineatus**	316	7.9
*A. nigricauda**	238	5.9
Scaridae	3,219	20.7
*Hipposcarus longiceps**	918	28.5
*S. altipinnis**	494	15.4
*S. schelegeli**	438	13.6
*S. microrhinos**	402	12.5
*S. sordidus**	287	8.9
Muraenidae	487	3.1
*Gymnothorax javanicus**	487	100
Lethrinidae	629	4.1
*Monotaxis grandoculus**	253	40.2
*L. atkinsoni**	116	18.4
Mullidae	363	5.2
Panlinurinae	357	2.3
*Palinurus penicillatus**	356	2.3
Serranidae	338	2.2
*Epinephelus polyphekadion**	85	25.2
Siganidae	281	1.8
*S. argenteus**	138	49.1
*S. punctatus**	66	23.5
Carangidae	306	2.0
*C. melampygus**	99	32.4
Total	15,534	

* top species harvested in the respective Family
**unable to obtain species breakdown

Snorkel spearfishing had approximately 537 trips, 63% of all spearfishing trips, which decreased 72% from FY99. Snorkel spearfishing harvests decreased 75%, 5.3 m.t. vs. 21.3 m.t. of fish harvested in FY99. Snorkel spearfishing averaged 1.42 trips a day, 1.31 wd, and 1.54 we/h trips. Each trip averaged 2.8 hours and 3.1 fishermen, with an average CPUE of 1.32 kg/gh. Hours spent snorkel spearfishing decreased 75%, 1,517 h vs. 5,956 h in FY99 and the number of gh's decreased 75%, 4,018 gh vs. 16,295 gh in FY99. The most common species caught was the Bluespine unicornfish (0.4 m.t.), which made up 19% of the total snorkel spearfishing catch. Approximately 2,397, or 45%, of the snorkel spearfish catch was estimated due to time constraints imposed by the fishermen.

SCUBA spearfishing included 37% of all spearfishing trips during FY00, which decreased 72%, 318 vs. 1,152 trips in FY99 (Table 7).

Table 7. Comparison of participation and offshore catch between offshore snorkel spearfishing and SCUBA spearfishing during FY00.

Spearfishing Method	Number of Trips	Catch (m.t.)	Catch per Trip (kg/trip)	Catch (kg) per Gear Hour (kg/gh)
Snorkel spear	537	5.3	9.87	1.32
SCUBA spear	318	10.4	32.88	4.51
Total	855	15.7	18.41*	2.49*

*Average of combined snorkel spear and SCUBA spearfishing.

SCUBA spearfishing decreased 74%, 10.4 m.t., vs. 40.0 m.t. and accounted for 66% of the total spearfish catch caught in FY00. SCUBA spearfishing averaged 0.8 trips a day, 2.2 hours per fishing trip, 3.8 fishermen per trip, with an average catch rate of 6.57 kg/gh and 34.68 kg/trip. The FY00 average catch rates of 4.5 kg/gh and 32.9 kg/trip were lower than FY99, (32% and 5% respectively). Hours spent SCUBA spearfishing in FY00 decreased 67%, 710 h vs. 2,144 h in FY99. The number of people engaged in SCUBA spearfishing decreased 68%, 1,259 vs. 3,892 people in FY99, while the number of gh decreased 62%, 2,315 gh vs. 6,079 gh in FY98. The most common species caught by this method were the following: Bluespine unicornfish (1.7 m.t.); Pacific Longnose parrotfish (0.8 m.t.); Orangespine unicornfish (0.5 m.t.); and Filament-finned parrotfish (0.5 m.t.) in FY00.

Other Methods

Boat-based fishing methods other than trolling, bottomfishing, spearfishing, and Atulai night-light jigging were regularly encountered during the offshore surveys and accounted for 4.5 mt. of finfish. Other methods often use boats to access fishing areas not easily accessible from shore. The most important methods encountered during FY00 were the following: gillnetting (3.6 m.t.); spin-casting (0.4 m.t.); and castnetting (0.3 m.t.). The fish species caught by these methods included: Bluefin trevally (*Caranx melampygus)*, 0.4 m.t.; Barred flagtail (*Kuhlia mugil*), 0.4 m.t.); Dash-and-dot goatfish (*Parupeneus barberinus*), 0.3 m.t.; and Yellowstripe goatfish (*Mulloidichthys flavolineatus*), 0.2 m.t. Approximately 0.5 m.t., of finfish caught by these methods could not be identified to the species level due to time constraints imposed by the fishermen.

DISCUSSION

The total offshore catch for FY00 decreased significantly (~ 82%) when compared to the total offshore harvest in FY99. In addition, the top 4 methods experienced an 82% decrease in total harvests for FY00.

Trolling (charter/non-charters) showed significant decreases in catch, participation, and effort with a slight decrease in CPUE. The significant decrease with the trolling catch could be a

continuation of what occurred during FY99. During FY00, overall troll catch and CPUE decreased by 13% and 17% respectively, as shown in the decline of targeted pelagic species, e.g., Wahoo (by 43%) Bonita (by 40%), and Mahimahi (by 27%). This may have further decreased participation for the year, resulting in a subsequent drop in harvest despite no significant change in CPUE. Other factors that should be considered are the effect of temperature and fishing pressure by distant water fleets. Distant water fleets could impact the availability of large pelagic fishes that are targeted, such as Yellowfin tuna and have an adverse impact on non-targeted pelagic fishes, such as Indo-Pacific Blue marlin. High surface water temperature brought on by El Niño events may radically change the occurrence of fish stocks in the Pacific, which may explain why the trolling catch rates on Guam have decreased so much in recent years.

Charter boat activity, (esp. trolling) was still suffering from the low turnout of tourists in FY00. Since FY99, several charter boat companies have either changed ownership or scaled down their operations, due to the deflated Asian currency and desire for tourists to do less expensive activities. Unfortunately, this has resulted in decreased participation and effort for the charter boat industry. However, charter boats still account for a significant portion of the trolling catch, especially Indo-Pacific Blue marlin, which peak during the summer months.

Bottomfishing (charter/non-charters) showed similar drops in participation and harvest, but a slight increase in CPUE (0.43 kg/gear-hr to 0.51 kg/gear-hr). This increase, however, was low compared to historical CPUE, which has followed a three-year trend. The charter bottomfishing catch was almost exclusively made up of small-sized goatfish, triggerfish, and groupers, which may indicate a depleted bottomfish resource.

Atulai night-light jigging showed the most drastic drop in CPUE, catch, and participation during FY00. This may have been due to a low turnout of night-light jiggers or infrequent atulai runs during the FY00 offshore surveys.

A decrease in spearfishing participation (esp. SCUBA), catch, and effort occurred during FY00. This may have been due to an increase in participation by night SCUBA spearfishing highliners out of the Ylig River on Guam. Historically, the Ylig boat ramp has not been surveyed due to the opportunistic nature of the fishing there. One significant result included a 2.2 m.t. decrease in the harvest of Napoleon wrasse (*Cheilinus undulatus*) from FY99-00. This may indicate a need to survey the Ylig River ramp, in order to address the decrease in participation from the ABB and to obtain more harvest information from a less-fished area, such as the eastern side of Guam. In addition, this may allow us to manage reef fish species that appear more vulnerable to overfishing, e.g., Napolean wrasse, Humphead parrotfish (*Bolbometopon muricatum*), Giant sweetlips (*Plectorhinchus albovittatus*), Orangefin emperer (*Lethrinus erythracanthus*), Giant coralgrouper (*Plectropomus laevis*), and Giant grouper (*Epinephelus lanceolatus*), to name a few.

It has become more apparent each year that Guam's boat-based fishery has significantly impacted the fish resources on Guam, especially by bottom and spearfishing. A historic decrease in CPUE has been observed, indicating a decrease in the populations of reef-associated fish. As boat-based fishing participation continues to rise, so too will the disappearance of adult reef fish with the highest reproductive potential around Guam.
Commercial SCUBA spearfishing presents a serious threat to all reef fish stocks, since a significant portion of the activity utilizes state-of-the-art dive equipment, which allows fishers to perform multi-tank dives up to 3 times a week to ~ 50 m depth. In recent years, managers have been faced with the situation of "bang sticking" larger reef fish species (e.g., those listed above). Bang sticking poses a problem for managers. They are used for shark defense, but it has also been demonstrated that they tend to target the more vulnerable and larger reef fishes for their high market value. Continued unregulated use of this method will pose a serious threat to the fishery and eventually dictate the absence of these ecologically and aesthetically important reef fish species from Guam.

RECOMMENDATIONS

The new survey design and FoxPro computerized database for offshore data analysis are undergoing a quality control and development phase. In addition to the expansion program, there is the ability to analyze size frequencies of harvested fish. This will enable specific species or families of fishes to be analyzed for the effect of fishing pressure on reproductive size and to determine the sizes currently harvested. This would especially be applied to several species of the parrotfish family *Scaridae,* where gender and size were historically recorded. It is hopeful during next fiscal year, to analyze the size trends of important reef fishes harvested on Guam from the onset of the offshore program to the present.

An expansion of the entire offshore time series should be completed by next fiscal year, once the input of remaining historical data is integrated into the system. The new offshore expansion program will provide managers a standard expansion format, which will enable us to illustrate a historic account of the boat-based fishery on Guam. It is recommended for DAWR to continue working with the NMFS Honolulu Lab, on completing the offshore expansion program, entering historical data for re-expansion/analyses, and incorporate a new design of data sets that will be important tools to manage Guam's fishery resources.

Oceanic temperature data are available from NMFS and should be used to determine if there is a relationship between sea surface temperature and relative abundance of pelagic fishes around Guam. DAWR should also consider exploring several of its offshore banks and FAD systems for the presence of large pelagic species that may avoid capture by trolling on the surface. Data on the catch rates of pelagic species from the Secretariat of the Pacific Community in Noumea, New Caledonia South Pacific island members (formerly the South Pacific Commission), should be correlated with the data from our region. These sources of information could help us track the migratory pathways of pelagic fishes, which in-turn, would allow us to detect their presence or absence in Guam's fishery.

The use of boat-based gillnetting and SCUBA spear needs to be seriously considered for regulation, due to the selective/unselective nature, harvest issues, and habitat degradation associated with these methods. Guam's relatively small fringing reef and inshore reef areas combined with a large population, as compared to other neighboring islands like Belau, FSM, and the CNMI, enable significant removal of reef fish over a short period of time. Banning or imposing restrictions to these methods is recommended in order to prevent further declines in the fishery.

A decline in participation, effort, and catch, may be indicating a downward trend of the fishery. Fishermen encountered during FY00 have expressed concerns that fishing pressure (local and foreign) has resulted in reduced catches and average size, and greater effort to harvest. While weather patterns, such as El Nino events, may additionally affect seasonal abundances of migratory fish stocks, the absence of larger reef fish is not due to the effect of weather and pollution, especially if juveniles are present. It is hoped that with the establishment of the marine preserves on Guam, we should relieve some fishing pressure and provide sanctuary for larger fishes, which have higher fecundity. Analysis of the size frequencies and catch rates is critical in order to provide an accurate picture of the effect of fishing pressure on food fishes of Guam. Anecdotal evidence from fishermen and data from the offshore creel surveys show that management of the fishing resource is, at the present, crucial in order to halt further depletion of Guam's fishing resource, especially those fish which are considered valuable, both culturally and economically.

PROGRAM COSTS

The estimated cost of the project is $93,000.

This report was prepared by: Thomas Flores, Jr., Fisheries Biologist III.