フィジーガウ島におけるトゲノコギリガザミScylla paramamosainの効率的漁獲と資源管理

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Efficient harvest and management of mangrove crab *Scylla paramamosain* in Gau Island, Fiji

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In an attempt to establish an efficient and effective method to catch mangrove crabs for sale in distant markets such as Suva, and to develop management strategies that will ensure the continued availability of mangrove crab, we tried, for the first time, to encourage local villagers in Gau Island to catch mangrove crabs with baited trap. We provided the traps and with the cooperation of volunteers from some of the villages, we collected 646 individuals in the study period of about one and half year. Analyzed data indicate that crabs in Gau Island are more abundant and heavier in mangrove areas than those in the river and sandy beach areas although there was no significant difference in mean carapace width. The crabs were harvested fairly intensively with baited traps but there were no decreasing trends in mean carapace width and body weight during the study period in any of the villages where more than 80 crabs were harvested. Comparison of catch according to trap size suggests that larger traps may be more effective to catch larger crabs than smaller traps. These results clearly indicate that a trapping is an efficient and effective method to catch mangrove crabs. If village people get used to keeping the record of carapace width and body weight of their catch, they can notice the changes in resources abundance from decreases in the average size of crabs. Thus, continuous monitoring of the catch could be a good tool for resources management because it is simple and easy for local people to implement and evaluate.

Keywords : Baited trap, Carapace width, Mangrove crab,Mangrove forest area,

Introduction

As part of the sustainable development research in Gau Island, we wanted to introduce to new and more valuable sources of income to local villagers. In this particular initiative, we wanted to encourage the local villagers to use more efficient method of catching mangrove crabs. Although that crab is highly priced in urban markets, it is predominantly used for subsistence in the villages. Green mangrove crab or mud crab, which belongs to genus *Scylla* is a large deep green crab found in the shallow waters of mangroves forests and estuaries. Adult green mangrove crab reaches almost 2 kg in weight and has stocky claws that have enough crushing power to break a wooden broom handle. They are sought after as a delicacy and are considered to be one of the finest crustaceans. Despite the widespread distribution and local economic value of the genus *Scylla*, its taxonomy is open to debate. Most authors recognize the existence of only one species – *Scylla serrata*[1)] and FAO[2)] still list mangrove crab harvested in Fiji Island as Indo-Pacific swamp crab (*Scylla serrata*) in its statistics for 2005.

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Large mangrove crab populations are typically associated with well-established mangrove forest so the loss of this habitat represents serious impacts on the mangrove crab population[3]. The extent of mangrove forest in Fiji was calculated to be 38,543 hectares in the late 1980s and the Suva-Navua mangroves and Nadi Bay mangroves are highly affected by development pressure because of their location[4].

The Fisheries Department in Fiji treats the mangrove crab found in Fiji as *Scylla paramamosain* or *qari* in Fijian[5]. In 2004, according to the Annual Report of Fisheries Department, about 135 tonnes of mangrove crab were sold at mean price of FJD12.2/kg in municipal markets and about 189 tonnes at mean price of FJD12.0/kg in non-municipal markets. The mean price is significantly lower than that of green lobster, which was sold at a mean price of FJD20/kg in municipal market and FJD16.7/kg in non-municipal market[5]. Nevertheless, mangrove crabs can fetch the second highest price after green lobster among the fisheries products in the market. Unlike lobsters, mangrove crabs live fairly long period in captivity until being sold so that they have been the focus of an artisanal fishery in Fiji. Despite their importance, little has been done to examine the consequences of harvest on wild populations in developing countries like Fiji[6].

This research was conducted to test the utility of traps in catching mangrove crabs as well as to find out the potential of crabs as an alternative source of income for the villagers. Crabs in Gau are seldom sold given the adhoc manner in which they are caught. The use of baited trap is new to the people.

Villagers in Gau Island capture mangrove crabs by removing them from their burrows with their bare hand and keep them until they are used for food, taken to the relatives or sold to the buyers that visit the villages once in a while. Catching crabs requires special skills because it is not easy to find crabs in turbid water and it is also very dangerous to grab them by hand. This is why catching mangrove crabs with baited traps has become popular worldwide[7,8]. In this research, we introduced crab traps into Gau to establish an efficient and effective method to catch mangrove crabs and develop management strategies that will ensure the continued availability of mangrove crabs using a system that is simple for local people to implement and evaluate. If the CPUE (Catch Per Unit Effort) data from the traps surveys are available, CPUE analysis from landings can be used to monitor seasonal and longer-term changes in crab population[9], which will be useful for managing the resource.

Materials and Methods

Study area and description of habitats

Gau Island is situated about 90km on the northeast from the capital city of Suva in Fiji' s main island, Viti Levu. It

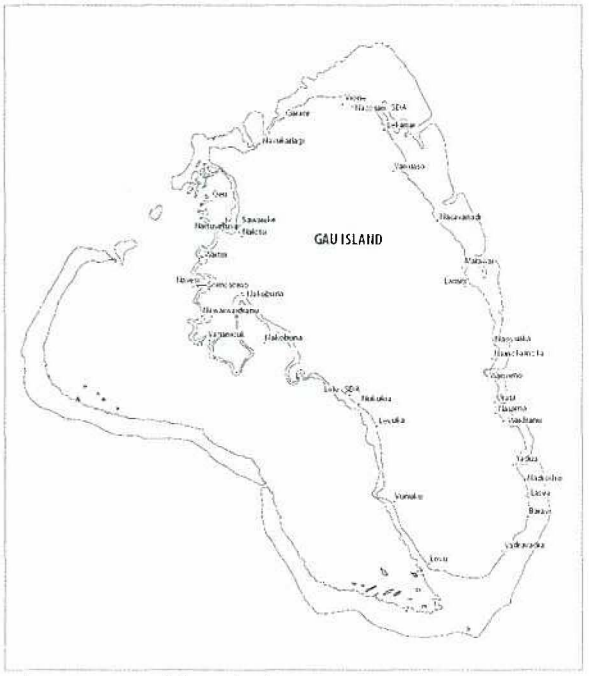

Figure 1. Map of Gau Island.

is in Lomaiviti Province and is the fifth largest island in the Fiji Group. Gau has a cloud forest in its interior, which has never been logged. There are three tikina, namely Sawaieke, Navukailagi and Vanuaso. As shown in the map of Gau Island in Figure 1, there are 16 villages and 11 settlements with a total population of about 2700. Public transportations available between Gau and Viti Levu include air flight once a week and an irregular boat service about twice a month. Many of the village people use their own fiberglass boat to visit Suva but the fuel cost has become prohibitively high.

Thick, intact mangrove forests that provide key habitat for mangrove crabs and fish[10,11], cover the east coast of Gau between Nacavandi and Qarani but its thickness decreases towards the south. In addition, there are mangrove patches along the large rivers between Malawai and Yadua. On the other hand, sandy beaches and rocky shores prevail along the west coast of Gau from Yadua to Qarani where patches of mangrove appear in certain areas like the estuaries of rivers.

Sampling locations

In the preliminary study, we found that crab trap measuring 80x60x25 cm brought from Japan can catch mangrove crab very efficiently and that the abundance of crabs depend on not only the presence of large mangrove forest but also rivers. For example, in Levuka where only small patches of mangrove forest are found, only few mangrove crabs were caught. According to the survey results, the island's coast can be divided into

Figure 2. Photo of crab trap used for this study.

three zones, namely the mangrove forest area from Vione to Nacavanadi, large river system area from Malawai to Waisomo and sandy beach and rocky shore area that extend over the rest of the villages along the west coast.

Crab sampling

In this study, we used locally available crab trap (Figure 2), which is slightly smaller than the Japanese trap (59x43x21cm vs. 80x60x25cm) but the basic structure and materials are almost the same. Based on the results of our preliminary study, one trap was offered to every two volunteers from Vione, Lekani, Vanuaso, Malawai and Lamiti, and one volunteer each from Naovuka, Waisomo, Yadua, Vadravadra, Lovu, Levuka, Somosomo and Qarani.

In order to find the effect of trap size on catching performance, both the local and Japanese traps were given to different volunteers in Malawai Village. A ruler was provided to every volunteer to measure the carapace width (CW) in cm while a kitchen scale was provided to each village to weigh the body weight (BW) of captured crabs to the nearest 0.1 kilogram. Condition factor CF was evaluated by $CF=BW/CW^3 \times 100$.

The villagers used the meat of any fish available as bait and were asked to release small crabs less than 12.5cm, which is the minimum size limit for retention in Fiji.

Crab trapping and catch recordings by the villagers were carried out from July 2006 to December 2007.

Results and Discussion

Mangrove forests in Gau are still largely intact and crabs are caught almost only for subsistence. Thus, mangrove crabs in Gau can be considered a virgin resource. During the study period of about one and half year, 646 individuals were collected from the 14 villages and one settlement engaged in the research, proving that trapping is an efficient and effective measure to catch mangrove crabs. We assumed that the collected data reflected the distribution and abundance of this species around the coast of Gau Island.

The CPUE could not be calculated because of the poor quality of the data obtained. The people needed to be convinced of the importance of maintaining catch records and monitoring to ensure the sustainable utilization of the resources. While crab catching on Gau was under developed as a commercial activity, the value of the resource can make it very attractive to the villagers particularly if there are market outlets. The introduction of traps showed the complexities of introducing changes into the local communities. In many of the cases, the volunteers kept the traps for themselves and refused to share with the other villagers. In some of the cases, the traps were not used because the volunteers did not fish but refused to allow the other villages to use the equipment. These peculiar situations need to be understood and taken into consideration when new approaches and changes are introduced into local communities.

Environment effects on size and condition of mangrove crab

As environment changes from mangrove forest area to large river and sandy beach and rocky shore areas, the numbers of crabs caught drastically decreased even though there was no significant difference in mean carapace width (Table 1). Mean

Table 1. Number of crabs caught, and their size and condition factor in different environmental areas

Environment	No.	Mean carapace width (cm)	Mean body weight (g)	Condition factor*
Mangrove forest	335	14.54±2.54	730.9±278.2	24.05±7.956
Large river	242	14.94±2.70	710.1±360.2	20.63±8.281
Sandy beach	69	15.45±2.44	607.0±278.1	16.06±4.218

*Condition factor = Body weight (g)/carapace width^3(cm^3) x100

body weight and condition factor also decreased in this order,

which implied that crabs in mangrove area have more meat in their body than those in large river and sandy beach and rocky shore areas. Figure 3 indicates that the dominant size classes based on carapace width to be 13-15 and 15-17 cm in all three

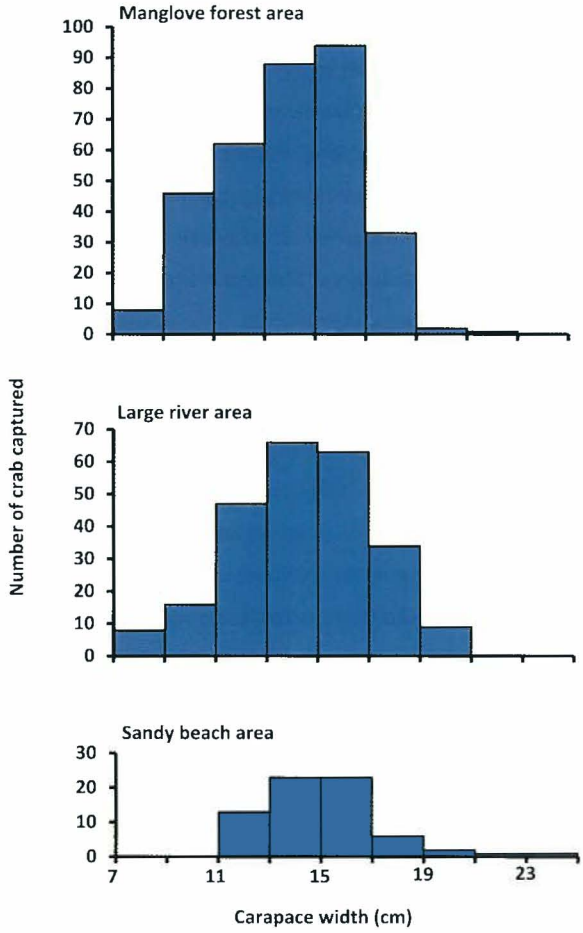

Figure 3. Variation in representation of size classes of mangrove crab by area.

areas. The lack of crabs less than 11cm in sandy beach and rocky shore areas implies that either the volunteers discarded all the small ones without keeping the records or small crabs do not inhabit sandy beach and rocky shore areas. However, size classes based on body weight shifted to smaller classes as in mangrove forest areas to large river and sandy beach and rocky shore areas (Figure 4). Thus, mangrove forest areas can provide more food to crabs than the other areass[11] and data prove that the mangrove forests provide better habitat for the specie. However, large bias has been obsereved in catch of mangrove crab by baited trap[12]. Further research on habitat is required.

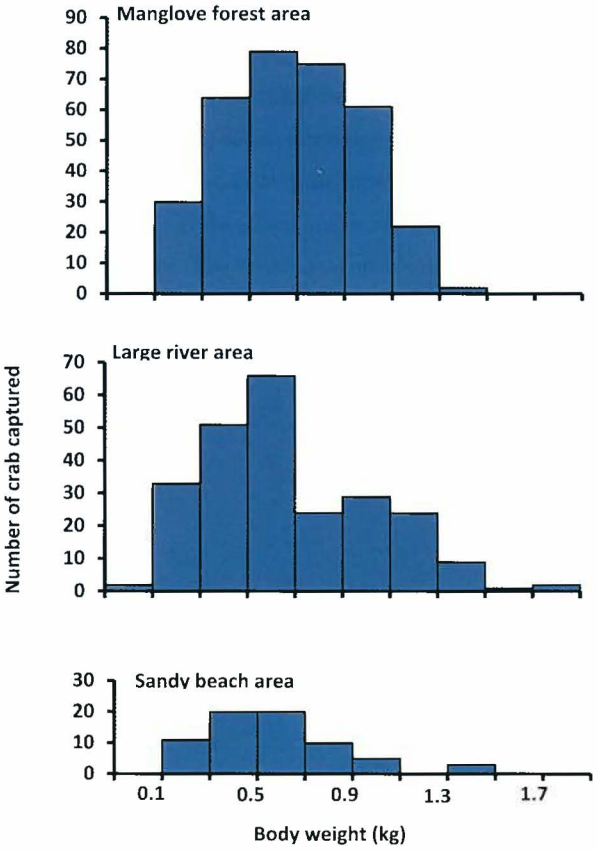

Figure 4. Variation in representation of weight classes of mangrove crab by area.

Long-term changes in mean carapace width and body weight

The people in Gau cannot regularly sell crabs no matter how many crabs they can catch because of the lack of a regular transportation to the market. As a result, they are not so enthusiastic to catch crabs and the frequency of the trapping differed for volunteers even within the same village. For these reasons we could not calculate the CPUE to be used for

Table 2. Long-term changes in mean size of mangrove crab in major villages

	Year	2006			2007					
Village	Month	7-8	9-10	11-12	1-2	3-4	5-6	7-8	9-10	11-12
Vione	CW*	14.7	14.6	14.1	13.6	14.0	16.6	15.3		
	BW**	833	794	768	767	804	950	777		
	Number***	26	32	22	12	24	8	15		
Lekanai	CW*	14.6			16.3	12.3	14.5	15.9	12.2	
	BW**	707			1067	896	678	725	777	
	Number***	22			6	24	25	20	25	
Malawai	CW*	15.4	14.9	14.7	15.2	16.2	15.2	15.4	18.7	17.5
	BW**	660	844	779	830	995	1000	580	871	996
	Number***	5	17	7	14	10	10	10	7	27
Lamiti	CW*	12.1	11.5	11.2	14.5	13.6	13.8		13.2	14.4
	BW**	379	250	318	582	529	533		370	486
	Number***	21	2	5	11	7	6		10	7

*CW: Mean carapace width in cm
**BW: Mean body weight in g
***Number of crab caught

resources management. However, we could follow long-term changes in mean carapace width and body weight in major villages where more than 80 crabs were captured during the study period and use that as an indication of the size of the stock.

The results shown in Table 2 indicate that there are differences in mean carapace width and body weight within the same village and among the villages but no consistent decrease in these figures was detected in any village, which indicates that resources of mangrove crab has not started to decline in any of the village even though baited traps were used to capture crabs in Gau Island for the first time. Village people will be able to start to catch crabs to obtain cash income in near future, if marketing procedure will be established. If they get used to keeping the record of carapace width and body weight, they can notice the changes in resources abundance from decrease in their average size by themselves. This can be a good tool for resources management. In addition, if village people retrieve their crab traps at a regular interval, CPUE can be easily calculated to monitor seasonal and longer-term changes in crab population as Le Vay[3]claims.

Effect of trap size on body size and condition of mangrove crabs caught

Although both volunteers in Malawai, tried to catch mangrove crabs along the same Malawai River, the mean carapace width of crabs caught by large trap was slightly larger than that caught by small trap as shown in Table 3. Student t test indicate that mean body weight and condition factor of crabs caught by large trap was significantly larger (P <0.01) than those caught by small trap. In addition more crabs were caught by large trap than small trap. The results indicate that larger traps may be more effective and efficient especially to catch larger and heavier crabs.

Table 3. Differences in size and condition factor* of mangrove crab caught by small and large crab trap

Size of trap	Mean carapace width (cm)	Mean body weight (g)	Condition factor*
S (59x43x21cm) No.** = 45	15.6 ± 1.46	672 ± 262	17.3 ± 3.70
L (80x60x25cm) No.** = 68	16.4 ± 2.57	996 ± 274	23.1 ± 6.31
t	1.89	6.26	5.56

* Condition factor = Body weight (g)/carapace width^3 (cm) x100

**Number of crabs caught

Conclusion

This study proved that there is a sizable stock of mangrove crabs in Gau and that the villagers can use the traps to catch crabs. The study also showed that mangrove forests are important habitat for crabs and that the stock can be commercially exploited in some parts of the island. Resource management to maintain crab popolatuion, however, is the most important.

The catching of crabs by traps was not used because the traps are sold in the hardware shops in Suva where capital investments are required to acquire them. In the villages, people catch crabs whenever they see them or they apply the traditional method using their hands.

The analysis of the catch figures can depict the impact of the fishing on the crab stock in an area. In Gau, the trends in the main locations where more than 80 crabs were harvested did not show any reduction, which seemingly indicates that the stock is not fully exploited. Thus, the analysis of the stock can be a useful resource management arrangement. However, for the tool to be effective, the people must be committed to record and monitor their catches as well as be prepared to reduce fishing effort when the signals are established.

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フィジーガウ島におけるトゲノコギリガザミ *Scylla paramamosain* の効率的漁獲と資源管理

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フィジー国ガウ島においてスバなど遠方の大きな都市へ出荷するトゲノコギリガザミを効率的に捕獲する方法と資源の持続的な利用のための管理方策の確立を目指す新たな試みとして，餌入り籠網の普及実験を実施した。島民ボランティアに籠網を供与し，1年半に亘る試験期間に646個体のトゲノコギリガザミを捕獲した。得られたデータの解析で，平均甲幅には有意な差は認められなかったが，カニはマングローブ林海域において河川域や砂浜域よりも生息個体数が多く，体重も重い傾向が認められた。餌入り籠網によりカニを非常に良く捕獲でき，多く獲れた村では80個体以上のカニが得られたが，実験期間中に甲幅，体重ともに減少する傾向は認められなかった。籠網のサイズによる比較では，大型の網で大型のカニが良く獲れることが示された。籠網漁法はトゲノコギリガザミを捕獲する有効な方法であることが示された。島民が甲幅と体重を記録していけば，平均サイズの減少から資源量の減少に気づく。単純で容易な漁獲物の継続的なモニタリングは資源管理の効果的な手法である。