Secretariat of the Pacific Community

ISSN 1028-7752

Issue 19 – February 2009

WOMEN IN FISHERIES
information bulletin

Inside this issue

Editor
Veikila Vuki
Marine Laboratory
University of Guam
UOG Station, PO Box 5214
Mangilao
Guam 96913
Email: vuki61@yahoo.co.uk

Production
Information Section,
Marine Resources Division
SPC, BP D5, 98848 Noumea Cedex
New Caledonia
Fax: +687 263818
Email: cfpinfo@spc.int
www.spc.int/coastfish

Produced with financial assistance from Australia, France and New Zealand

Editor's note

Welcome to this issue of the Secretariat of the Pacific Community (SPC) *Women in Fisheries Information Bulletin*, which highlights gender roles in coastal fisheries, women's fishing activities in urban and rural communities and gender issues in development.

In this issue, Mecki Kronen and Aliti Vunisea report on the results of a study of gender roles in coastal fisheries across 17 Pacific Island countries and territories. The study examined the major differences in exploitation of finfisheries by major cultural groups, including variations according to gender groups and variations in habitats fished. The findings showed that the high rates of finfisheries exploitation in Micronesian and Polynesian communities were essentially due to the work of fishermen rather than fisherwomen. In contrast, Melanesian fisherwomen play a significant role in the exploitations of reef resources in their communities. It is recommended that future fisheries management strategies consider variations in culture regarding gender and habitats fished.

There are two reports on unique fisheries. The first one, by Mecki Kronen and Siola Malimali, reports on octopus fishing by the women of Lofanga, Tonga. Fisherwomen in Lofanga contribute significantly to the high invertebrate consumption (17 kg per capita per year) and family income because of the exploitations of octopus and giant clams. The long shelf life of sun-dried octopus has provided Lofanga fisherwomen with a reliable fishery that supplies food continuously for the family and also generates household income. A short report on the seahare fishery in Fiji Islands is provided by Sandeep Singh and Veikila Vuki. The article briefly describes the behaviour, habitats, exploitation and sale of seahare (*Dolabella auricularia*) in Fiji Islands.

A report on changes in subsistence fishing activities and seafood consumption was written by Dorothy Munro Solomona, Teina Tuatai, Veikila Vuki and Metusela Koroa. The study, undertaken from 1989 to 2001, showed changes in the fishing methods used, fishing grounds used and composition of fish catches. A decrease in seafood consumption was reported.

There are two articles on women's issues and fisheries policies in this issue. In the article 'Meeting the challenge', Meryl Williams addresses the challenges involved in making fisheries policies more gender sensitive. She emphasises that through action and research, progress on the issues surrounding women in fisheries is slowly gaining momentum.

In 'Recognising women in fisheries: policy and considerations for developing countries', Vina Ram Bidesi discussed the need to build fisheries policies on gender through greater cross-sectoral policy dialogues, advocacy and information exchange. She recommends a gender analysis of policies in different fisheries sectors as an important step in the right direction to inform decision-makers.

In a short article, Meryl Williams reports on the 2nd Global Symposium on Gender and Fisheries during the 8th Asian Fisheries Forum. The symposium continued with its efforts to seek 'solutions through research' in fisheries and aquaculture. Some of the areas covered in the symposium included inland and coastal resource management, aquaculture, income, trade, nutrition, health, globalisation and gender mainstreaming in fisheries and aquaculture projects.

This issue of the bulletin discusses issues related to women's fishing and women's contributions to sustaining households. I welcome any feedback on the articles in this issue and encourage you to submit articles about women and community fishing issues from your country or region.

Veikila Vuki

Cover picture: Image by Mecki Kronen ©.

PIMRIS is a joint project of five international organisations concerned with fisheries and marine resource development in the Pacific Islands region. The project is executed by the Secretariat of the Pacific Community (SPC), the Pacific Islands Forum Fisheries Agency (FFA), the University of the South Pacific (USP), the Pacific Islands Applied Geoscience Commission (SOPAC), and the Pacific Regional Environment Programme (SPREP). This bulletin is produced by SPC as part of its commitment to PIMRIS. The aim of PIMRIS is to improve the availability of information on marine resources to users in the region, so as to support their rational development and management. PIMRIS activities include: the active collection, cataloguing and archiving of technical documents, especially ephemera ("grey literature"); evaluation, repackaging and dissemination of information; provision of literature searches, question-and-answer services and bibliographic support; and assistance with the development of in-country reference collections and databases on marine resources.

PIMRIS

Pacific Islands Marine Resources Information System

Fishing impact and food security – Gender differences in finfisheries across Pacific Island countries and cultural groups

Mecki Kronen[1] and Aliti Vunisea[2]

Introduction

Gender in coastal reef fisheries has been discussed frequently to enhance the understanding of women's and men's roles and their needs, strategies and contributions to food security and income (Bennett 2005; Kronen and Vunisea 2007; Matthews 1991, 2002; Williams 2001). While generally speaking, women and men, and consequently fishermen and fisherwomen, are believed to be different, the question remains how they are different and to what extent fishing strategies and thus fishing impact may or may not vary between gender groups. Such knowledge is an essential input to make fisheries management more effective in order to tailor strategies, programmes and support to all target groups (Lambeth et al. 2002; FAO 2007; Sultana et al. 2002; Williams 2008).

Methods

The PROCFish[3] regional socio-economic database includes gender-specific fishery data across 63 coastal communities in 17 Pacific Island countries and territories (PICTs). The 17 PICTs can further be separated by major cultural group, i.e. Melanesia, Micronesia and Polynesia. Fishery data is further specified by three different habitats as perceived by fishers, including sheltered coastal reef, lagoon and outer reef. This nested design is used to illuminate the major question: What are the commonalities and differences between fishermen and fisherwomen across all 17 PICTs, by cultural group, gender group and habitat fished?

Data was collected by surveying a comparative sample of fishers who represented the proportion of gender participation in fisheries, commercial and subsistence driven fishing strategies, and habitats targeted in each of the 63 communities. A snapshot approach was adopted, with field surveys conducted once in each community between mid-2003 and 2008. Information was mainly collected by using standardised fully structured closed questionnaire surveys (Kronen 2007).

For this study a number of variables from the socio-economic database were selected; these are listed below. Each variable is broken down by gender and by each of the 63 communities surveyed.

- Total annual catch
- Total hours fished, and total hours fished by habitat
- Timing of fishing, i.e. fishing during day or night
- Frequency of fishing trips per week, and per month
- Average duration of a fishing trip
- Catch per unit effort (catch in kg per hour of fishing trip)
- Average annual catch per fisher, and per habitat and fisher
- Use of boat transport for fishing: always, sometimes or never

Linear and multi-linear regressions and single-factor analysis of variance (ANOVA) were used for statistical analysis.

Results

Taking into consideration that communities were purposefully selected to represent important rural coastal fishing communities in each of the PICTs included, women and men showed significant differences in their participation in finfishing at the regional, cultural and habitat levels. Table 1 shows that not each community studied had all three habitats available. However, as compared to the total number of communities having access to any of the three available habitats, fisherwomen only participated in 76 per cent, 66 per cent and 20 per cent of all possible sheltered coastal reef, lagoon and outer reef fishing respectively. These figures underscore

[1] Community Fisheries Scientist, Reef Fisheries Observatory, Secretariat of the Pacific Community, Nouméa, New Caledonia
[2] Development Adviser, Human Development Programme, Secretariat of the Pacific Community, Pohnpei regional office
[3] The Pacific Regional Oceanic and Coastal Fisheries Programme is funded by the European Union and implemented by the Secretariat of the Pacific Community's (SPC's) Reef Fisheries Observatory. The data and results presented here were obtained in the framework of the programme's coastal and socio-economic component.

that fisherwomen prefer the close-by habitats that are usually also easier to access than the outer reef area (Kronen and Vunisea 2005; Lambeth et al. 2002). Comparison of gender participation between cultural groups shows that Melanesian women are the most active finfishers. There are also higher percentages of Melanesian and Micronesian women targeting the outer reef as compared to Polynesian fisherwomen.

Fishing impact

Regional and cultural gender comparison (Fig. 1) regarding the contribution to the community's total annual catch, a proxy used for assessing fishing impact, shows that fisherwomen contribute relatively little (i.e. 9.5–22%). However, Melanesian fisherwomen contribute substantially to the total annual subsistence demand of the community (i.e. approximately 80%). In contrast, Polynesian and Micronesian fisherwomen's annual catches cover about 20–25 per cent of their communities' subsistence needs for finfish. ANOVA confirmed the highly significant differences across the three cultural groups in the contribution of fisherwomen to total annual catch ($F = 5.356^{**}$) and total annual subsistence needs ($F = 7.200^{**}$).

Fishing time

Comparison across all 17 PICTs and 63 communities clearly indicates that the fishing impact measured as the total annual catch (t year^{-1}) sourced by the entire community from its fishing ground is determined by the total hours spent fishing by fishermen ($R^2 = 0.84^{***}$) (Fig. 2) and not by fisherwomen ($R^2 = 0.33^{n/a}$) (Fig. 3). This picture remains consistent if we compare the relationship between total hours spent fishing by gender and total annual catch per each community amongst cultural groups (Table 2). However, if we analyse differences between gender groups within each of the three cultural groups, and take into consideration only sites where women reported to participate in finfisheries, the time Melanesian women spend fishing does make a significant impact ($R^2 = 0.82^{***}$) on the total annual catch of the community. Melanesian fisherwomen thus differ substantially from Micronesian and Polynesian fisherwomen, whose time spent fishing has no or little impact on the community's total annual catch.

The preference, discussed above, of fisherwomen for targeting fishing grounds that are closer to shore and hence easier to access is confirmed by highly significant relationships between women's hours

Table 1. Gender participation in finfisheries at the regional, cultural and habitat levels

Habitat	Total number	Regional	Melanesia	Micronesia	Polynesia
		63 (100%)	21 (33%)	17 (27%)	25 (40%)
With sheltered coastal reef fisheries	Total	58	21	15	20
	with women fisher data	41	19 (90%)	9 (60%)	13 (65%)
With lagoon fisheries	Total	53	17	13	20
	with women fisher data	35	15 (88%)	8 (62%)	12 (60%)
With outer reef fisheries	Total	61	19	17	21
	with women fisher data	12	5 (26%)	4 (24%)	3 (14%)

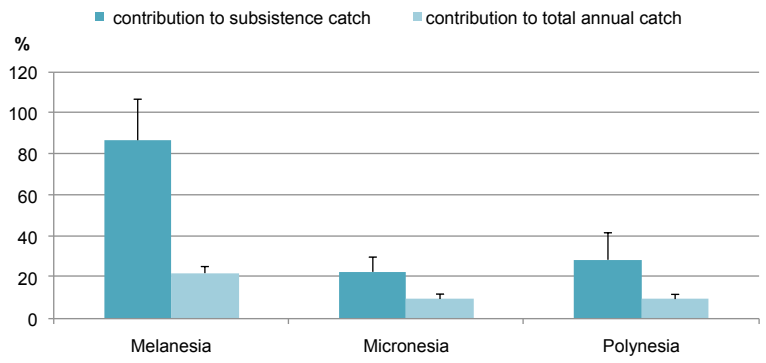


Figure 1. Average contribution (+SE) of fisherwomen to the total annual subsistence catch and the total annual catch by cultural groups

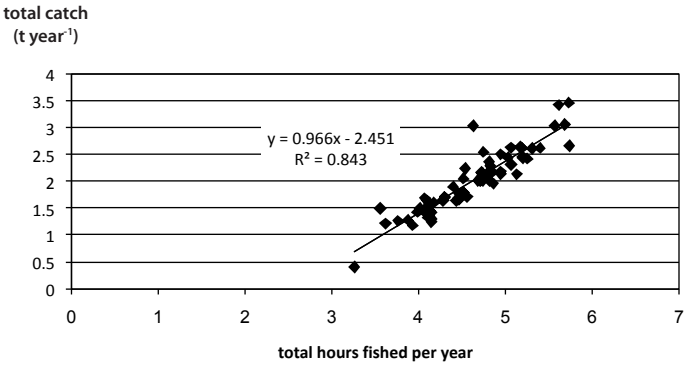


Figure 2. Regression between total hours spent fishing by fishermen and total annual catch (t), log-data for 63 communities studied

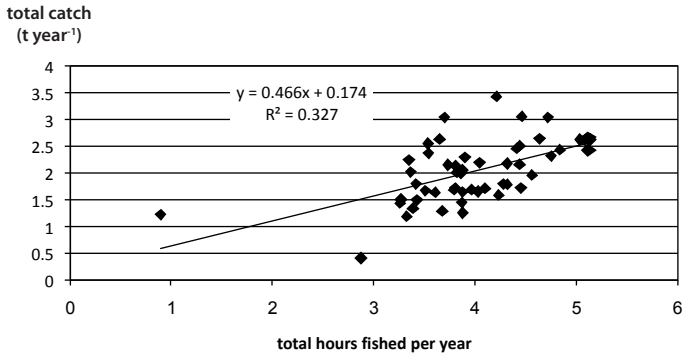


Figure 3. Regression between total hours spent fishing by fisherwomen and total annual catch (t), log-data for 63 communities studied

spent fishing in the lagoon, or the sheltered coastal reef, and the total annual catches per habitat. No significant relationship of this sort was found for the outer reef catches. However, by comparison to fishermen, regression coefficients obtained for fisherwomen and habitat are not very strong (Table 3).

Stronger relationships appear when communities with no fisherwomen data are removed from the analysis (Table 4). Again, strongest relationships occur for the time spent fishing by Melanesian fisherwomen in the sheltered coastal reef and lagoon habitats, while time spent fishing by Micronesian and Polynesian women correlates with total sheltered coastal reef and lagoon catches respectively.

ANOVA (single factor, log+1 data) confirmed that on the regional level, total time spent fishing in coastal reef habitats varies significantly between fishermen and fisherwomen (Table 5). This result is also confirmed at the cultural level for Micronesian and Polynesian communities, and for all habitats targeted. As expected based on previous results, differences in the total time spent fishing in sheltered coastal reef and lagoon habitats are not significant between Melanesian fisherwomen and fishermen.

Table 2. Linear regression coefficients (R^2) and significant level *p* of total hours fished by men and women fishers and total reported annual catch by cultural group

Cultural group	Fishermen	*p*	Fisherwomen	*p*	Fisherwomen[1]	*p*
Melanesia	0.95	***	0.45	***	0.82	***
Micronesia	0.86	***	0.01	n/a	0.29	n/a
Polynesia	0.73	***	0.28	*	0.31	**

[1] Site with 0 data for fisherwomen removed

Table 3. Linear regression coefficients (R^2) and significant level *p* of total hours fished by men and women fishers and total reported annual catch by habitat

Habitat fished	Fishermen	*p*	Fisherwomen	*p*
Sheltered coastal reef	0.76	***	0.11	**
Lagoon	0.82	***	0.34	***
Outer reef	0.75	***	0.04	n/a

Table 4. Linear regression coefficients (R^2) and significant level *p* of total hours fished by men and women fishers and total reported annual catch by cultural group and by habitat

Culture/habitat fished	Fishermen (n)	*p*	Fisherwomen (all sites) (n)	*p*	Fisherwomen[1] (n)	*p*
Melanesia						
Sheltered coastal reef	0.60 (21)	***	0.28 (21)	*	0.60 (19)	***
Lagoon	0.92 (17)	***	0.56 (17)	***	0.90 (15)	***
Outer reef	0.96 (19)	***	0.08 (19)	n/a	0.54 (5)	n/a
Micronesia						
Sheltered coastal reef	0.87 (15)	***	0.00 (15)	n/a	0.85 (9)	***
Lagoon	0.89 (13)	***	0.01 (13)	n/a	0.55 (8)	*
Outer reef	0.74 (17)	***	0.01 (17)	n/a	0.98 (3)	n/a
Polynesia						
Sheltered coastal reef	0.94 (20)	***	0.20 (20)	*	0.45 (13)	*
Lagoon	0.88 (20)	***	0.47 (20)	***	0.71 (12)	***
Outer reef	0.52 (21)	***	0.02 (21)	n/a	0.24 (3)	n/a

[1] Sites with 0 data of fisherwomen removed

Table 5. ANOVA of total hours fished by fishermen and fisherwomen per habitat, and by cultural group and habitat

Cultural group	Habitat	*F* value	*p*
Regional	Sheltered coastal reef	12.15	***
	Lagoon	17.22	***
	Outer reef	151.40	***
Melanesia	Sheltered coastal reef	0.03	n/a
	Lagoon	1.51	n/a
	Outer reef	33.55	***
Micronesia	Sheltered coastal reef	10.62	**
	Lagoon	6.89	*
	Outer reef	65.02	***
Polynesia	Sheltered coastal reef	5.88	*
	Lagoon	10.13	**
	Outer reef	60.00	***

Fishing strategies

In order to further understand differences found between the total time spent fishing and total annual catch or impact on the community's reef resources, a number of fishing strategy variables common to PICTs were compared for differences and commonalities between gender, cultural groups and habitats fished.

First, continuity of fishing activities and timing of fishing trips were compared at the regional level. The continuity of fishing activities showed significant differences between gender groups at the regional level only (F = 12.067***), with fishermen fishing all year around (11.5 months per year on average across all 63 sites) but fisherwomen having periods with no fishing at all (9.5 months fishing per year on average across all 63 sites). No differences were found between cultural groups.

ANOVA revealed that while differences are not very pronounced for daytime fishing between gender groups (on average across all 63 sites, 90% of all fishermen and 80% of all fisherwomen fish during the day)(F=5.535*), fishermen are the dominant group scheduling their fishing at night. On average across all 63 sites, 60% of all fishermen fish at night as compared to 30% of all fisherwomen. Differences between both groups were highly significant (F = 44.548***).

While the dominance of fishermen in night-time fishing was confirmed for all cultural groups, daytime fishing amongst fishermen is significantly different (F = 10.288***). As demonstrated in Figure 4, fishing during the day is much more practiced by Melanesian as compared to Micronesian and Polynesian fishermen. Fisherwomen do not behave differently in their choice of daytime or night-time fishing amongst cultural groups.

Furthermore, fishermen were found to go fishing more frequently than fisherwomen (F = 17.716***), and fishing trips of fishermen take longer as compared to those of fisherwomen (F = 26.589***). Across all 63 sites, on average fishermen and fisherwomen go fishing twice and once per week respectively. While fishermen's trips take approximately 4.3 hours, fisherwomen only spend about 3 hours per average fishing trip.

Figure 4. Comparison of fishing during daytime by fishermen from three cultural groups (average of absent-present data by site and group)

The analysis of differences within gender groups confirmed that the average duration of fishing trips varies significantly between gender and within each cultural group. The same confirmation was obtained for Micronesia and Polynesian communities concerning significant gender differences in the frequency of fishing trips. This difference, however, did not apply for Melanesian communities, where both gender groups show a comparable frequency of fishing trips.

At the regional level (63 sites), 60 per cent of all fishermen always use boat transport for their fishing. By comparison, this holds only true for 37 per cent of all fisherwomen. The difference between both gender groups in the use of regular boat transport was highly significant (F = 14.363***), and this trend was also confirmed for gender comparisons within Micronesian and Polynesian fishing communities. Melanesian communities, however, showed no significant difference between gender groups in the regular use of boat transport for fishing. Melanesian fisherwomen and fishermen use much more boat transport for fishing than their Micronesian and Polynesian counterparts do, as was demonstrated with pair wise ANOVA (Table 6).

Table 6. Pair wise ANOVA to show differences in the use of boat transport of fishing between cultural groups and by gender

Fishermen: never using boat transport for fishing		
	F value	*p*
Melanesia/Micronesia	6.945	*
Melanesia/Polynesia	10.737	**
Micronesia/Polynesia	1.569	n/a
Fisherwomen: always using boat transport for fishing		
	F value	*p*
Melanesia/Micronesia	4.632	*
Melanesia/Polynesia	7.450	**
Micronesia/Polynesia	0.057	n/a

The average annual catch per fisher was significantly different across all sites and between fishermen and fisherwomen. The strongest variations were found for average annual lagoon (15.779***) and outer reef (34.201***) catches, while differences between fishermen's and fisherwomen's average annual catches from sheltered coastal reefs were weaker (5.811**). These differences between genders by habitat fished were strongest when the analysis was done individually for each cultural group; however, the trend was weaker for Micronesia.

The comparison of log+1 transformed average annual catch data (Fig. 5) suggests three observations. Firstly, average annual catches of fishermen are always higher than those of fisherwomen, regardless of the cultural group and habitat fished. Secondly, average annual catches of fishermen are either comparable between habitats targeted, or increase slightly with distance from shore. Average annual catches for fisherwomen are comparable only for sheltered coastal reef and lagoon habitats, while catches for outer reef fishing are always significantly lower. Thirdly, Micronesian and Polynesian fishermen have higher annual catches than Melanesian fishermen. This observation cannot be confirmed in the case of fisherwomen.

Investigating possible variations in catch rates also showed significant differences between fishermen and fisherwomen. This difference becomes very strong when comparing catch per unit effort (CPUE) by gender for each habitat (Table 7). Again, several similarities and differences appear if we apply ANOVA for CPUE by gender, habitat and cultural group (Table 8). The biggest differences between fishermen's and fisherwomen's CPUE were found for Polynesia, and the smallest for Micronesia.

Similarities and differences are explained by average CPUE depicted in Figure 6. In contrast to the average annual catch rates (Fig. 5), which were similar between cultural groups, significantly highest CPUE rates were found for Polynesia. Micronesian CPUE rates are slightly higher as compared to Melanesian data. This trend applies for both gender groups. Similar to results for average annual catch rates, CPUE rates of fishermen are either comparative between habitats, or increase slightly with distance from shore. Again, this observation does not hold true for fisherwomen, who have significantly

Table 7. ANOVA of CPUE by gender and habitat across all 63 sites and 17 PICTs

	Average CPUE	CPUE sheltered coastal reef	CPUE lagoon	CPUE outer reef
F value	6.053	16.432	18.024	54.126
P	*	***	***	***

Table 8. ANOVA of CPUE by gender, habitat and cultural group

	CPUE sheltered coastal reef		CPUE lagoon		CPUE outer reef	
	F value	*p*	*F* value	*p*	*F* value	*p*
Melanesia	10.813	**	4.393	*	34.651	***
Micronesia	1.327	n/a	5.350	n/a	10.466	**
Polynesia	16.467	***	9.665	**	26.651	***

lower CPUE rates at the outer reef as compared to habitats closer to shore.

Summary and conclusions

While there is no doubt that fishing and its related activities are extremely important for men and women in coastal areas of PICTs (Lambeth 2000; Williams et al. 2002; Bennett 2005), it is uncertain what percentage of the estimated subsistence catch (about 70–80% of the total inshore catch) is accounted for by fisherwomen (Lambeth et al. 2002). Our results provide insight into quantitative catch rates of fisherwomen across the region, and as compared by cultural groups. Earlier studies that suggested that women's contributions are substantive (Avalos 1995; Passfield 2001; Rawlinson et al. 1985) are confirmed, particularly for Melanesian communities. However, our results also indicate that fishermen are mainly responsible for the total annual catch of a community, most of which is sold on the local market to people not belonging to the fishermen's community. Thus, our results highlight the importance of targeting subsistence and commercial artisanal fishers, differences in gender contributions to both of these, and differences between cultural groups.

Our results also reveal that in addition to major differences that exist between fishermen's and fisherwoman's finfisheries by impact (measured as total annual catch), the fishing done by both gender groups varies substantially by investment (measured in total hours spent fishing), fishing strategy (measured in number of months fished during the year, frequency and duration of fishing trips, use of boat transport for fishing, timing of fishing trips), productivity (measured as average annual catch) and efficiency (measured as CPUE, i.e. kg of catch per hour of fishing trip). The fact that men spent significantly more time fishing than women is a function of a higher number of months fished throughout the year, a higher frequency of fishing trips and a longer duration of an average fishing trip. Taking into account the often-quoted double responsibilities of a woman living in rural conditions, i.e. the role of being housewife or caretaker of the family and that of assisting the household's economy (Aguilar and Castaneda 2000; Levine et al. 2001; William et al. 2002; CGIAR News 2002; Lambeth et al. 2002; Tindall and Holvoet 2008; Zein 2008), it is no surprise that fisherwomen in PICTs have, on average, considerably less time available to invest in fishing activities as compared to men. In addition, cultural taboos against women's involvement in men's fishing activities (and sometimes vice versa) continue to limit women's engagement in finfisheries. Cultural differences in the impact of taboos show in our comparison of Melanesian, Micronesian and Polynesian fisherwomen regarding the use of boat transport, fishing at night, and the use of fishing gear.

Generally speaking, our data show that fishermen target any of the available habitats, regardless of accessibility and distance from shore, which is made possible by or linked to a much higher use of regular boat transport for fishing. Also, fishermen, as compared to fisherwomen, are flexible and able to fish during daytime or night-time, which increases the chances of a higher catch and provides access to a larger target group of fish. However, if we compare these variables between the three major cultural groups, Melanesian fisherwomen, as opposed to their Micronesian and Polynesian counterparts, have a significant impact on the reef resources. This impact is explained by their frequency of fishing trips and their use of regular boat transport at a comparable rate to Melanesian fishermen.

Overall, fishermen were found to be more effective, as fishermen's CPUE rates are higher as compared to those of fisherwomen. Comparison between cultural groups also shows that Melanesian fishermen

have the lowest average annual catch rate per fisherman. Regardless of gender, Polynesian fishers have outstandingly high CPUE rates in all three habitats studied. While differences in the average annual catch rates of fisherwomen are not conclusive between cultural groups and by habitat, Melanesian fisherwomen show the lowest CPUE rates across all three habitats fished.

The fact that Melanesian fisherwomen's contribution to the total annual catch or impact of their respective community is still inferior to that of Melanesian fishermen is determined by their preference for less distant and thus more easily accessible habitats (sheltered coastal reef and lagoon), shorter average duration of fishing trips, preference for daytime fishing, and lower CPUE rates.

Based on these major findings, we have reached the following conclusions:

- Fisheries management strategies need to take into account cultural and also gender differences in view of impact, fishing strategies and habitats fished.
- While most reef finfisheries impact in Micronesian and Polynesian communities is determined by fishermen rather than fisherwomen, Melanesian fisherwomen play a significant role in the total annual exploitation, and thus in the consequences on the community's reef resources.
- In terms of fishing objectives, fisherwomen across all cultural groups play an important role in securing protein and food supply through finfish for their families and their communities. This is particularly true for Melanesian communities, where fisherwomen may account for a total annual catch that corresponds to about 80 per cent of the community's finfish demand.
- Maintaining sustainable catch rates in the community's fishing grounds must take into consideration habitats that are targeted by fishermen and fisherwomen, and in particular by one gender group only, as well as the major objectives of their fishing activities, i.e. subsistence or commercial interests. If the role of meeting subsistence needs is strongly associated with women's finfishing activities, closures and restrictive measures need to take into consideration their limitations in time available for fishing, their

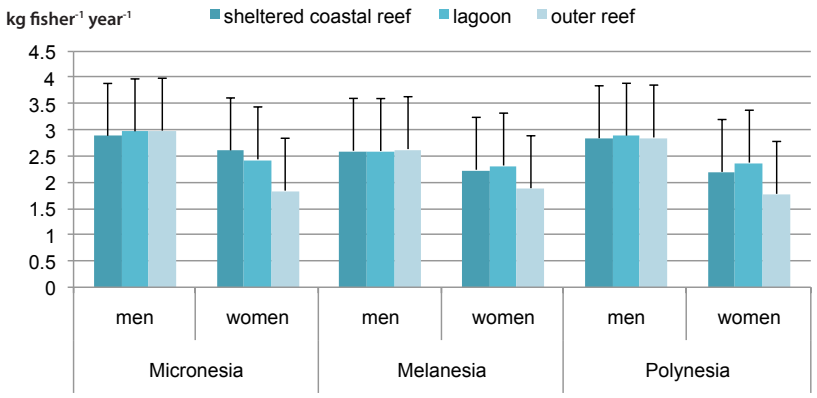


Figure 5. Average annual catches per fisher by habitat fished, gender and cultural group (log+1 data, SE)

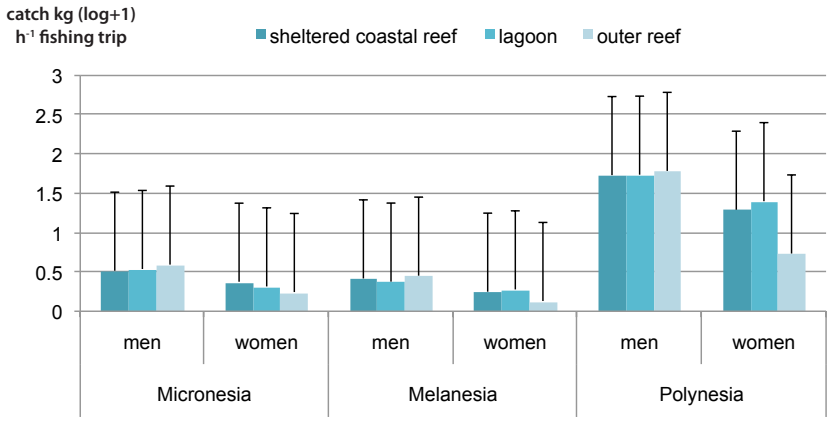


Figure 6. Average CPUE by gender, habitat and cultural group (log+1 transformed data, SE)

preference for daytime fishing, and their use of gear (boat transport, fishing techniques, etc.).
- Further analysis is needed to take into account fishing techniques and their potentially destructive impacts by gender, by habitats targeted and by cultural groups.
- The outstandingly high CPUE rates reported for Polynesian fishers and the low CPUE and average annual catch rates for Melanesian fishers demand further analysis regarding to what extent these differences are determined by fishing techniques used and/or resource status.

References

Agilar L. and Castaneda I. 2000. About fishermen, fisherwomen, oceans and tides: a gender perspective in marine coastal zones. San Jose, Costa Rica: IUCN Regional Office for Meso-America.

Avalos B. 1995. Women and development. Pacific Economic Bulletin 10(1):73–83.

Bennett E. 2005. Gender, fisheries and development. Marine Policy 29:451–459.

CGIAR News. 2002: Where are the women in fisheries? March 2002: 8.

FAO. 2007. Policies to support gender equity and livelihoods in small-scale fisheries. Rome: FAO.

Kronen M. and Vunisea A. 2005. Women in two Pacific island fisheries and aquaculture. In: Williams S.B., Hochet-Kibongui A.-M. and Nauen, C.E. (eds). Gender, fisheries and aquaculture: Social capital and knowledge for the transition towards sustainable use of aquatic ecosystems. ACP-EU Fisheries Report No. 16. Brussels: European Community.

Kronen M. and Vunisea A. 2007. Women never hunt-but fish: Highlighting equity for women in policy formulation and strategic planning in the coastal fisheries sector in Pacific Island countries. SPC Women in Fisheries Information Bulletin 17:3–15.

Kronen M. 2007. Socioeconomic fisheries surveys in Pacific Islands: a manual for the collection of a minimum dataset. Noumea, New Caledonia: Secretariat of the Pacific Community.

Lambeth L. 2000. An assessment of the role of women within fishing communities in Tuvalu. Noumea, New Caledonia: Secretariat of the Pacific Community. 29 p.

Lambeth L., Hanchard B., Aslin H., Fay-Sauni L., Tuara P., DesRochers K.D. and Vunisea A. 2002. An overview of the involvement of women in fisheries activities in Oceania. In: Williams M.J., Chao N.H., Choo P.S., Matics K., Nandeesha M.C., Shariff M., Siason I., Tech E. and Wong J.M.C. (eds). Global symposium on women in fisheries. Sixth Asian Fisheries Forum, 29 November 2001, Kaohsiung, Taiwan. Penang, Malaysia: ICLARM – The World Fish Center.

Levine J.A., Weisell R., Chevassus S., Martinez C.D., Burlingame B. and Coward W.A. 2001. The work burden of women. Science 294:812.

Matthews E. 1991. Women and fishing in traditional Pacific Island cultures. In: Workshop on people, society and Pacific Islands fisheries development and management: Selected papers. Inshore Fisheries Research Project Technical Document No. 5:29–33. Noumea, New Caledonia: South Pacific Commission.

Matthews E. 2002. Integrating women's subsistence fishing into Pacific fisheries and conservation programmes. SPC Women in Fisheries Information Bulletin 11:13–14.

Passfield K. 2001. Profile of village fisheries in Samoa. Project milestone 17, April, 2001. Samoa Fisheries Project, GRM International. 33 p.

Rawlinson N.J.F., Milton D.A., Blaber S.J.M., Sesewa A. and Sharma S.P. 1985. A survey of the subsistence and artisanal fisheries in rural areas of Viti Levu, Fiji. Canberra, Australia: Australian Centre for International Agricultural Research.

Sultana P., Thompson P.M. and Ahmed M. 2002. Women-led fisheries management-a case study from Bangladesh. p. 89–96. In: Williams M.J., Chao N.H., Choo P.S., Matics K., Nandeesha M.C., Shariff M., Siason I., Tech E. and Wong J.M.C. (eds). Global symposium on women in fisheries. Sixth Asian Fisheries Forum, 29 November 2001. Kaohsiung, Taiwan. Penang, Malaysia: ICLARM – The World Fish Center.

Tindall C. and Holvoet K. 2008. From the lake to the plate: Assessing gender vulnerability throughout the fisheries chain. Development 51(2):205–211.

Williams M.J. 2001. Women in fisheries: Pointers for development. p. vii–xv. In: Williams M.J., Chao N.H., Choo P.S., Matics K., Nandeesha M.C., Shariff M., Siason I., Tech E. and Wong J.M.C. (eds). Global symposium on women in fisheries. Sixth Asian Fisheries Forum, 29 November 2001. Kaohsiung, Taiwan. Penang, Malaysia: ICLARM – The World Fish Center.

Williams M.J., Williams S.B. and Choo P.S. 2002: From women in fisheries to gender and fisheries. p. 13–18. In: Williams M.J., Chao N.H., Choo P.S., Matics K., Nandeesha M.C., Shariff M., Siason I., Tech E. and Wong J.M.C. (eds). Global symposium on women in fisheries. Sixth Asian Fisheries Forum, 29 November 2001. Kaohsiung, Taiwan. Penang, Malaysia: ICLARM – The World Fish Center.

Williams M.J. 2008. Why look at fisheries through a gender lens? Development 51(2):180–185.

Zein A. 2008. The role of fisher-women on food security at the traditional fishermen household of West Sumatra, Indonesia. www.neys_vanhoogstraten.nl/. Retrieved from the Internet 12 December 2008.

The octopus fishery on Lofanga, Kingdom of Tonga

Mecki Kronen[1] and Siola'a Malimali[2]

Introduction

Lofanga is a small coastal community of 39 households and a current (2008) resident population of 187 people that constitutes the sole population of the island of Lofanga, Ha'apai Group, Kingdom of Tonga (Fig. 1). Boat transport is needed to connect between the island and Pangai, the center of the Ha'apai mainland of Lifuka, some 20 km away. Lofanga island has an area of about 1.4 km^2 that is mostly used for crop cultivation. The island of Lofanga belongs to the noble Tupouto'a, who also owns a small piece of land at Hihifo, a settlement attached to Pangai on Lifuka, that he has allocated to the people of Lofanga as a squatter settlement. Thus, the families of Lofanga have an alternative base on Lifuka to make it easier for them to access to education, markets and medical care.

While the lifestyle in Lofanga does not differ much from that in other isolated and rural coastal communities in Tonga, the community is the only one in the Ha'apai group that has yet to benefit from the national rural electrification program. Thus, day-to-day life on the island itself is limited due to the absence of electrical power. The consequences, in particular for the island's fisheries activities, were confirmed by observations made during the 2008 socioeconomic survey undertaken by the Pacific Regional Oceanic and Coastal Fisheries Development (PROCFish) programme, in close cooperation with the Tonga Ministry of Agriculture, Food, Forestry and Fisheries. With no readily available electricity supply, it is difficult to adequately ensure the cold chain during fishing trips, storage and transport of the catch to mainland markets. Ice must be purchased from the Fisheries Department in Pangai, Lifuka, which accounts for additional labour and transport costs. Without cooling facilities, fish has to be sold and consumed within 24 hours after it is caught. Because of the lack of infrastructure such as electricity, elevated labour and transport cost and limited access to markets, conditions today continue to be unfavourable for commercial fishing in Lofanga (Bender et al. 2002). This observation applies to both the finfish and invertebrate fisheries. However, fishers have adopted various strategies to cope with some of these unfavourable conditions, in particular the increasing costs for ice provision and transport. In this article, we focus on Lofanga's octopus fishery (evidence of which one cannot miss when visiting Lofanga island, see Fig. 2), women's and men's engagement in the fishery, and its role for income generation. Results presented here come

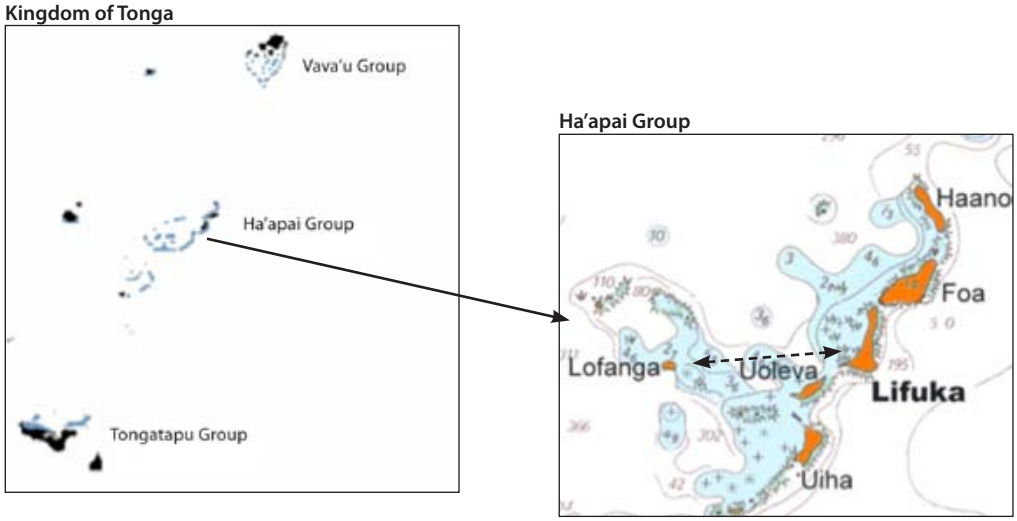


Figure 1. Location of Lofanga island, Ha'apai Group, Kingdom of Tonga

[1] SPC Community Fisheries Scientist, Reef Fisheries Observatory, Noumea, New Caledonia
[2] Senior Fisheries Officer, Fisheries Division, Ministry of Agriculture, Food, Forestry and Fisheries, Tonga

from the 2008 PROCFish socio-economic survey undertaken in the community of Lofanga.

Figure 2. Tree-drying of octopus, visible evidence of the octopus fishery on Lofanga island

The role of fishing

Fishing plays a central role in the lifestyle of Lofanga's community. About 85 per cent of all households have one or several members who are actively involved in some kind of fishing. Seafood consumption is high — much higher than elsewhere in Tonga (Coyne et al. 1984; Finau et al. 1994). On average, Lofanga's people eat some kind of seafood every day and it constitutes their main protein source and contributes considerably to their total energy intake. Survey results suggest that on average fresh fish is consumed three times a week and invertebrates and canned fish are eaten twice a week each. On average, the annual per capita consumption is approximately 65 kg for finfish, 17 kg for invertebrates (edible parts only) and 21 kg for canned fish. Fishing also represents the most important income source for 70 per cent of all households (Fig. 3), while agriculture and handicrafts only provide 10–12 per cent of all households with a primary source of income, and another 30–60 per cent with a secondary source of income. Lofanga's fishing is characterised by little entrepreneurial skill, small informal groups, small fishing vessels, low capital investment, and correspondingly low productivity (Sabri 1977; Veitayaki 1993; Tu'avao et al. 1994; Passfield 2001).

In addition, the Lofanga community is highly dependent on remittances. About 75 per cent of all households receive them, mostly from family members living overseas. These remittances, which average USD 770 per year, cover about 34 per cent of the average annual reported household expenditures for those families that receive them. This situation qualifies Lofanga as being part of the MIRAB (migration, remittances, aid, and bureaucracy) economy (Bertram and Walters 1985) that is considered to yield flexible economic and stable conditions in Tonga's outer island communities (Evans 2001).

Traditionally, Tongan women are not engaged in finfisheries, but are the major players in invertebrate collection (Bataille-Benguigui 1988; Bender 2001; Matthews 1991; Tonga et al. 2000). Previous studies have shown that Tongan and also Lofanga women may also catch finfish at times, although only very small amounts (i.e. about 2 per cent of the total annual finfish catch in Lofanga, as found in a previous survey) (Kronen 2002, 2004a; Kronen & Vunisea 2005; Kronen and Bender 2007). It is therefore not surprising that Figure 4 illustrates the traditional separation of men exclusively targeting finfish while women exclusively target invertebrates. However, about 38 per cent of men in Lofanga are engaged in both finfishing and invertebrate collection. The proportion (approximately 38 per cent) of women who target only invertebrates corresponds to a participation of over half of the total adult female population in Lofanga (52 per cent).

Invertebrate and octopus fishery

Fisherwomen only perform reeftop gleaning, while fishermen prefer free diving, in particular for giant

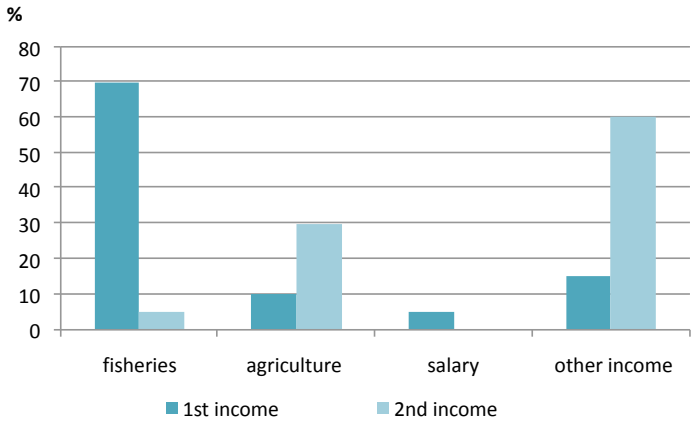


Figure 3. Importance of fisheries, agriculture, salaries and handicrafts (other) for income generation on Lofanga island

clams. Figure 5 demonstrates that the average annual catches (wet weight) reported by fisherwomen for reeftop gleaning are substantial, amounting to approximately 600 kg fisher^{-1} year^{-1}. Average annual reported harvests of fishermen who dive for giant clams are about 150 kg higher.

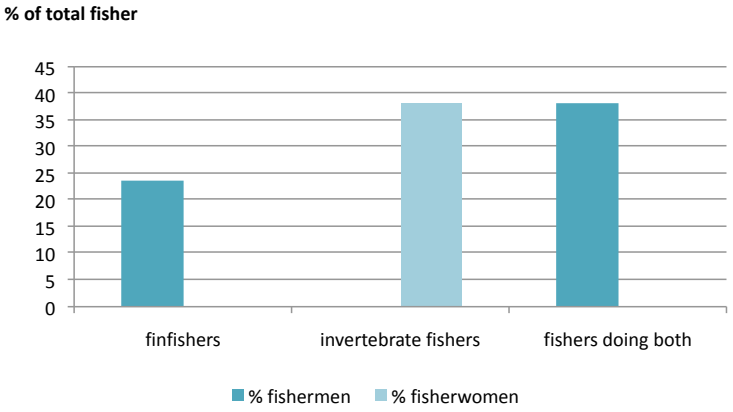


Figure 4. Participation of fishermen and fisherwomen in the different fisheries on Lofanga

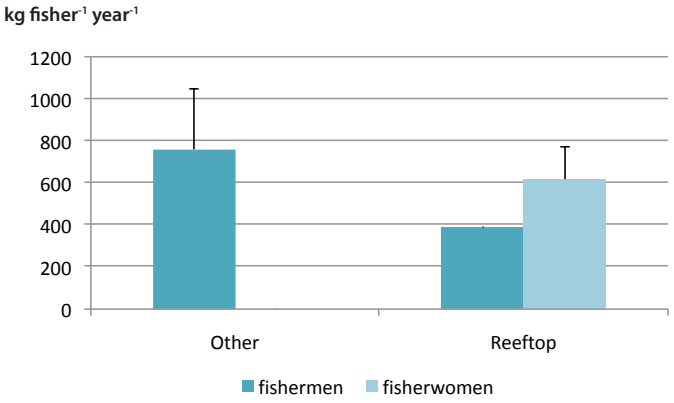


Figure 5. Average annual catch (wet weight) (+SE) of fishermen and fisherwomen targeting reefs for free diving and gleaning

Reported catch by species groups indicates the role that each of the target species plays (Fig. 6). Overall, giant clams are the most important target species (approximately 48 per cent of the total annual catch), followed by octopus catches with about 31 per cent of the total annual invertebrate harvest. Taking into account that we have assumed an average wet weight of 500 g for a giant clam and 550 g for an octopus, these figures indicate that more giant clam than octopus specimens are collected on Lofanga's reefs. However, if we consider only the edible and useful part of these catches, the proportion between the two species changes substantially. We have assumed that the edible meat of a giant clam represents 19 per cent, on average, of its wet weight, while 90 per cent of an octopus is edible. In other words, the exploitable annual weight from octopus catches is about three times higher than for giant clam catches in terms of edible meat.

Other invertebrates that do not play a major role in terms of the proportion of total annual catch by wet weight, including sea urchins (*tukumesi*), gastropods (*elili, hulihuli*) and sea cucumbers (*loli*), are exclusively collected for home consumption, but never sold. It should be noted that subsistence needs also include a considerable share of non-commercial distribution of catches (*fetokoni'ai*) (Halapua 1982; Veitayaki 1993) — including commercialised and non-commercialised species — amongst community members and extended families, which is an

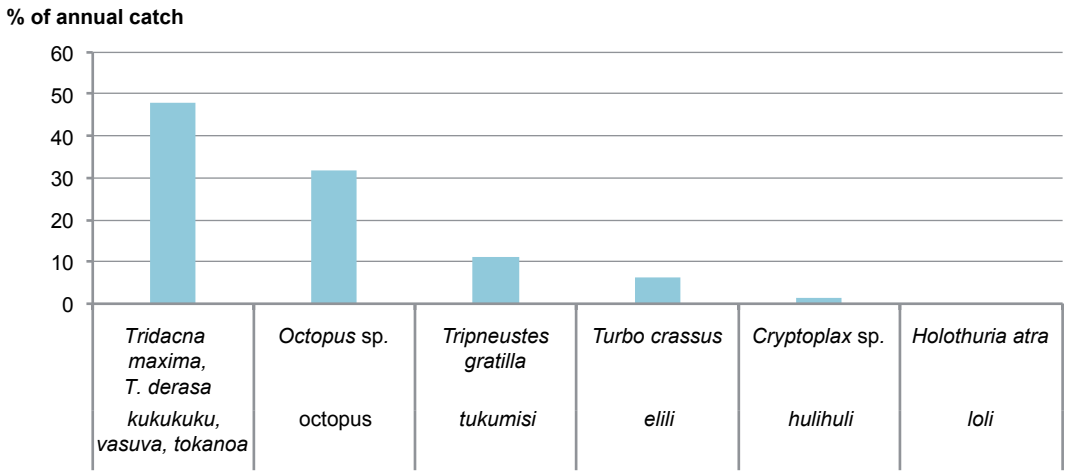


Figure 6. Importance of target species calculated from reported annual catches (wet weight) on Lofanga island

integral component of Lofanga's lifestyle (Bender 2001, 2004; Kronen 2002).

Considering that three quarters of the total annual invertebrate catch in Lofanga is accounted for by fisherwomen (Table 1), and that octopus constitute 40 per cent of the total reeftop gleaning catch (Fig. 7), fisherwomen account for a considerable share of both octopus and giant clam catches. The 20 per cent of total annual invertebrate catches harvested by fishermen performing free diving is mainly accounted for by giant clam catches, as shown in Figure 8. The importance of fisherwomen's participation in octopus fishing, and to an important extent also in giant clam fishing is highlighted by Table 2. Of all invertebrate catches, octopus and giant clams are the only species that are also sold. In fact, almost 80 per cent of all octopus harvested are intended for sale, while only 31 per cent of all giant clams are exclusively harvested for commercial interest, and another 14 per cent may or may not be commercially used. If we assume that half of all catches classified as being used for both purposes may be allocated for subsistence and the other half for income generation, about 60–62 per cent of all octopus and giant clam catches are for income generation. This comparison must also take into account that the edible or useful part of both species varies considerably (i.e. 90 per cent versus 19 per cent of exploitable or edible weight for octopus and giant clams, respectively).

Table 1. Proportion (%) of recorded annual invertebrate catches by fishery and gender

Fishery	Fishermen	Fisherwomen
Reeftop gleaning	3.5	76.4
Reef free diving	20.1	0
Total	23.6	76.4

In addition, the expense of boat transport to reach Lofanga's closest urban market of Pangai on mainland Lifuka forces fishers to reduce their travel frequency to a minimum or makes it unaffordable. Usually, people visit the main island about twice a month. This frequency does not allow a continuous commercial giant clam fishery due to its short shelf life without cooling or freezing, which are unavailable on the island. Octopus, however, is dried on the island (Fig. 9) and therefore has an extended shelf life and can be sold upon arrival of the next transport or at the next marketing occasion. While fishermen are mainly in charge of selling the finfish catch, processing and marketing of invertebrate catches is mainly the responsibility of fisherwomen or the wives of the fishermen who harvest them.

Local prices for octopus are also more attractive as compared to fresh giant clam meat. A dried octopus fetches around TOP 4.00 (average prices quoted

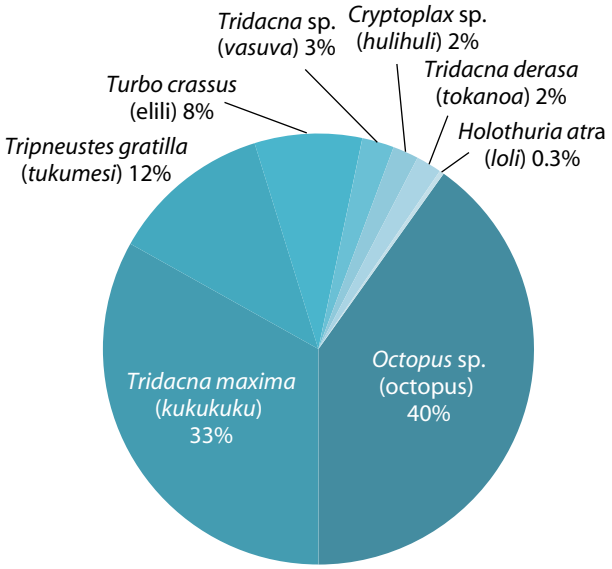


Figure 7. Proportion (%) of target species that constitute the reported total annual catch by reeftop gleaning in Lofanga (contribution of reeftop gleaning to Lofanga's total annual reported invertebrate catch by wet weight is approximately 80 per cent)

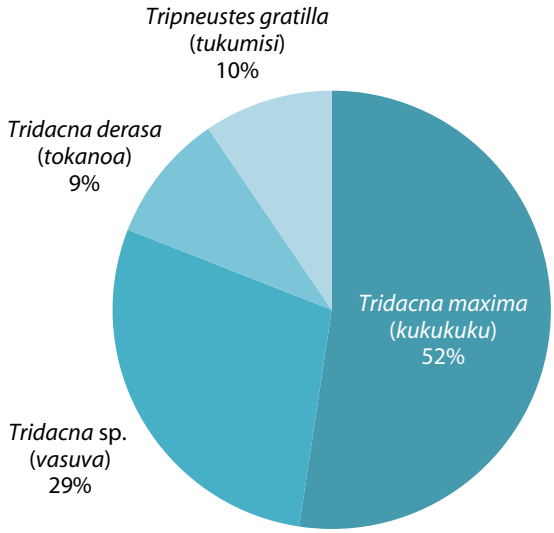


Figure 8. Proportion (%) of species that constitute the reported total annual catch by reef free diving in Lofanga (contribution of reef free diving to Lofanga's total annual reported invertebrate catch by wet weight is approximately 20 per cent)

Table 2. Percentage of invertebrate catches by species groups that are caught for home consumption or for commercial purposes

Vernacular names	Scientific names	% exclusive consumption	% exclusive sale	% consumption and sale
Kukukuku, vasuva, tokanoa	*Tridacna maxima, T. derasa, T.* spp.	55	31	14
Octopus	*Octopus* sp.	21	0	79
Tukumisi	*Tripneustes gratilla*	100	0	0
Elili	*Turbo crassus*	100	0	0
Hulihuli	*Cryptoplax* sp.	100	0	0
Loli	*Holothuria atra*	100	0	0

range between TOP 60 and TOP 100 for 20 octopuses). At the Pangai market, consumers pay between TOP 10 and TOP 15 per kilo of fresh giant clam meat, corresponding to an average of TOP 1.50 per reasonably sized giant clam (shell included). These selling prices are favourable if compared to the local reef fish price, which is currently about TOP 4.00–5.00 kg^{-1}. In addition, sellers of reef fish must purchase ice to ensure an adequate cold chain for maintaining fish quality.

Figure 9. Octopus is sun dried on Lofanga to extend its shelf life for commercialisation

Conclusions

Fisherwomen from Lofanga contribute substantially to the population's high per capita invertebrate consumption and generate complementary income for family expenditures by fishing, cleaning, drying and marketing octopus, as well as by collecting, de-shelling and occasionally selling giant clams. Fisherwomen and fishermen on Lofanga continue to apply fishing and processing strategies in response to the island's natural resource endowment, particularly its marine resources, and unfavourable economic conditions (Kronen 2004). Fishing and sun-drying of octopus is an example of such a strategy adapted to the natural resources and economic situation on the island. The activities of the fishers provide subsistence as well as a means to meet social obligations and the need to generate income to maintain the community's traditional livelihood and social institutional networking (Iwariki and Ram 1984).

Lofanga's relatively high per capita invertebrate consumption of approximately 17 kg/year is mainly accounted for by octopus and giant clams, complemented by small catch rates of sea urchins, gastropods and sea cucumber gonads. Only octopus and giant clams are also targeted commercially. Due to the lack of continuous cooling and freezing capacities on the island, giant clams can only be collected and de-shelled for selling the fresh meat if transport to Pangai's market is guaranteed.

By comparison, sun-drying octopus has extended its shelf-life and rendered the product less vulnerable to fluctuations in the frequency and cost of transport to the market on Lifuka, providing Lofanga's women with a continuous fishery that supplies food for the family and generates complementary household income.

References

Bataille-Benguigui M.-C. 1988. The fish of Tonga: Prey or social partners? Journal of the Polynesian Society 97(2):185–198.

Bender A. 2001. Fischer im Netz: Strategien der Ressourcennutzung und Konfliktbewältigung in Ha'apai, Tonga. Herbolzheim, Germany: Centaurus. 330 p.

Bender A., Kägi W. and Mohr E. 2002. Informal insurance and sustainable management of common pool marine resources in Ha'apai, Tonga. Economic Development and Cultural Change 50(2):427–439.

Bender A. 2008. Meshing a tight net: A cultural response to the threat of open access fishing grounds. p. 197–218. In: Casimir M.J. (ed). Culture and the changing environment: Uncertainty, cognition, and risk management in cross-cultural perspective. Oxford, UK: Berghahn. 394 p.

Bertram I.G. and Watters R.F. 1985. The MIRAB economy in South Pacific microstates. Pacific Viewpoint 26(3): 497–519.

Coyne T., Badcock J. and Taylor R. 1984. The effect of urbanisation and western diet on the health of Pacific island populations. SPC Technical Paper No. 186. Noumea, New Caledonia: South Pacific Commission. 175 p.

Evans M. 2001. Persistence of the gift: Tongan tradition in transnational context. Waterloo, Canada: Wilfrid Laurier University Press. 208 p.

Finau T.L., Udagawa K. and Nakajo N. 1994. Fish and meat consumption of Tongan people. Fisheries Bulletin of Tonga 1:29–36.

Halapua S. 1982. Fishermen of Tonga: Their means of survival. Suva, Fiji Islands: Institute of Pacific Studies, USP. 100 p.

Iwariki S. and Ram V. 1984. An introductory study of the socio-economic aspects of household fisheries in the small island economies of the South Pacific. Memorial Kagoshima University Research Center South Pacific 5(1):53–65.

Kronen M. 2002. Women's fishing in Tonga: Case studies from Ha'apai and Vava'u islands. SPC Women in Fisheries Information Bulletin 11: 17–22.

Kronen M. 2004(a). DemEcoFish Tonga country report socioeconomic component. Noumea, New Caledonia: Secretariat of the Pacific Community. 108 p.

Kronen M. 2004(b). Fishing for fortunes? A socio-economic assessment of Tonga's artisanal fisheries. Fisheries Research. 70:121–134.

Kronen M. and Vunisea A. 2005. Gender in fisheries and aquaculture. Social capital and knowledge for the transition towards sustainable use of aquatic ecosystems. Noumea, New Caledonia: Secretariat of the Pacific Community. 19 p.

Kronen M. and Bender A. 2007. Assessing marine resource exploitation in Lofanga, Tonga: One case study - two approaches. Human Ecology 35(2):195–207.

Matthews E. 1991. Women and fishing in traditional Pacific Island cultures. Fisheries Information Paper 14. Noumea, New Caledonia: South Pacific Commission. 7 p.

Passfield K. 2001. Profile of village fisheries in Samoa. Samoa Fisheries Project. Technical Report. Government of Samoa, Fisheries Division, Ministry of Agriculture, Forests, Fisheries and Meteorology, Apia, Samoa.

Sabri J. 1977. Small-scale fisheries and development in Peninsula Malaysia-problems, prospects. P. 63–74. In: Lockwood B. and Ruddle K. (eds). Proceedings of the Planning Meeting on Small-scale Fishery Development: Social Science Contribution. East-West Food Institute, Honolulu, Hawaii, 6–11 September. Honolulu: East-West Center. 215 p.

Tonga N., Naqasima-Sobey M. and Quinn N. 2000. Local marine biological knowledge and management practices in Hihifo village, Ha'apai, Kingdom of Tonga. SPC Women in Fisheries Information Bulletin 7:9–13.

Tu'avao T., Kava V. and Udagawa K. 1994. The present situation of fisheries in the Tongatapu Island group. Fisheries Research Bulletin of Tonga 2:27–42.

Veitayaki J. 1993. Village-level fishing in the Pacific. p. 73–97. In: South G.R. (ed). Marine resources and development. Suva, Fiji Islands, The Ray Parkinson Memorial Lectures, PIMRIS, University of the South Pacific. 154 p.

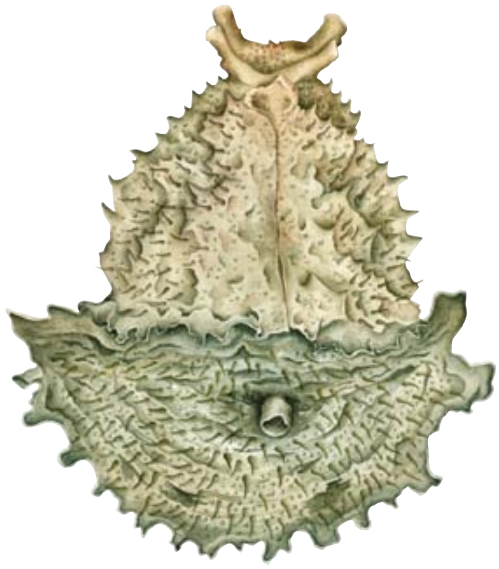
The sea hare fishery in Fiji Islands

Sandeep Singh[1] and Veikila Vuki[2]

Introduction

Women fishers in Fiji are well known for gleaning the inshore mudflats and inshore reefs (Vunisea 1996). Marine invertebrates such as sea hares form a portion of women's catch and a good cheap source of protein (Fay-Sauni 2001). The sea hare, *Dolabella auricularia* (Lightfoot, 1786) is often gleaned by women in Fiji Islands in shallow inshore areas that are susceptible to high fishing pressure and human development. Therefore, there is a need for information on this species for managing the resource. Sea hare is a mollusc and is known in Fijian as *veata*. It is one of the fisheries resource specifically exploited by women.

In this paper, we describe the behaviour and habitats of the sea hare, *D. auricularia*, specifically collected by women in Fiji Islands. We also present a brief overview of the exploitations and sales of sea hares. Sea hares are one of the most important fisheries resources collected by women for household consumption and for sale to supplement household income. There is very little information available on the sea hare fishery and we hope this paper will provide some information in managing the fishery.



Dolabella auricularia
(artwork: Rachel O'Shea, © SPC 2009)

Description, behaviour and habitats of sea hare (*Dolabella auricularia*)

D. auricularia is a sea hare that can weigh up to 500 g. Its colours vary, but always consist of mottled shades of green and brown, which make it extremely well camouflaged in nature. It is normally found in sheltered bays or lagoons, in seagrass beds or on sand or mud.

D. auricularia is widely distributed on the mudflats in Fiji Islands. Its usual habitat is the shallow seagrass community, though it may also be found in tide pools protected by reefs. It is typically found in groups. This clumped distribution may be related to the species' breeding habits.

Sea hares are essentially nocturnal. During the day, individuals lie buried in the sand and with only their siphons exposed. This makes it very difficult to find them during the day. From late afternoon to early morning, especially during the lowest tide, *D. auricularia* are observed to feed, mate, spawn or move about (Calumpong 1979).

Exploitation and sale of *D. auricularia* in Fiji Islands

It is an important fisheries resource exploited mainly by Fijian women who spend 4–5 hours a day during low tides in the afternoons on the mudflats collecting them.

Most women in Fiji Islands glean sea hares together with other non-fish products such as shellfish, mud crabs, lobsters and seaweeds. On an average fishing trip more than 20 *D. auricularia* may be collected. Though women in most of Fiji do not normally go out to collect sea hares specifically, those from Naselesele, Taveuni take fishing trips targeting sea hare only.

D. auricularia is collected both for subsistence and sale. It is sold in the municipal markets and at stalls along the road by women. Women interviewed from around the Suva area indicated that income from the sales of sea hare help them pay school fees, buy food and pay bus fares for school children.

[1] School of Marine Studies, University of the South Pacific, PO Box 1168, Suva, Fiji Islands
[2] Marine Laboratory, University of Guam, Mangilao, Guam 96913, vuki61@yahoo.co.uk

The egg masses (*kavere*) are usually found near the seahare. The egg masses, the heart and the upperside of *D. auricularia* are sold at the Suva municipal market for FJD 3.00 per heap of 30 sea hares. The underside of the seahare is usually discarded at sea by cutting the seahare in two. All the women interviewed from the Suva area stated that the underside (muscular foot) of the seahare is usually discarded because grains of sand get stuck to it.

The egg masses are also used as food in many parts of the world such as the Philippines, Samoa and Kiribati. In Fiji Islands, the egg masses and the animal are eaten either raw or half-cooked and are usually marinated with lemon juice. Sea hare is a delicacy for indigenous Fijians.

The women interviewed also said that sea hares are not found during rainy days. Research on other opisthobranchs shows that sea hares generally avoid extremely low salinity because they are not able to tolerate it or due to lack of food availability (Carefoot 1987).

Whilst the example of *D. auricularia* highlights the involvement of women in the sea hare fishery in Fiji Islands, Fijian women contribute significantly to the catch and sale of other non-fish resources. *Anadara antiquata* (*kaikoso*) and mangrove crabs (*qari*) are collected either by hand or with traps. Small hand nets are used to collect prawns (*moci*). Other marine resources like sea urchins (*cawaki*), seaweed (*lumi, nama*) and giant clams are gleaned from reef tops and mudflats by these industrious women.

References

Carefoot T.H. 1987. *Aplysia*: its biology and ecology. Marine Biology: Annual Review 25: 167–284.

Calumpong H.P. 1979. Some aspects of ecology of sea hare *Dolabella auricularia* (Lightfoot), in the central Philippines. Silliman Journal 26: 134–146.

Fay-Sauni L. 2001. A comparative study of women's involvement and the management of the arkshell fisheries (*Anadara* sp.) in Kiribati and Fiji. MSc Thesis. University of the South Pacific. Fiji.

Vunisea A. 1996. Village fishing in Fiji: Modernisation and women's changing role: A case study of Ucunivanua and Kumi villages, Verata District, Eastern Viti Levu. MA thesis. University of the South Pacific, Fiji.

Decadal changes in subsistence fishing and seafood consumption patterns on Rarotonga, Cook Islands

Dorothy Munro Solomona[1], Teina Tuatai[1], Veikila Vuki[2] and Metusela Koroa[1]

Introduction

Cook Islands is located east of Samoa and west of French Polynesia. It lies between latitudes 8 to 23 degrees south and longitudes 156 to 167 degrees west. The northern Cook Islands are mainly atolls formed from tips of submerged, coral-encrusted mountains. These include Manihiki, Rakahanga, Pukapuka, Nassau, Penrhyn and Suwarrow. The southern Cook Islands include Aitutaki, Atiu, Mangaia, Manuae, Mauke, Mitiaro, Palmerston, Rarotonga and Takutea (What's on in the Cook Islands 2001). Manuae, Suwarrow and Takutea are the only uninhabited islands. The Southern Cook Islands are volcanic in origin with elevated encircling reef platforms adjacent to the coast (Tatuava 2001; Chapman and Cusack 1997).

The 15 islands of Cook Islands have a total land area of 237 square kilometres that is encompassed by a sea area of 200 nautical miles known as the exclusive economic zone (EEZ). The reefs and lagoons support a wide range of demersal fish, corals, molluscs, crustaceans, echinoderms and other marine organisms. Beyond the reefs, tuna (albacore, yellowfin and skipjack) form part of the Western and Central Pacific tuna stocks, which are the basis of the world's tuna fishery (MMR 1998).

Tourism is the major foreign exchange earner apart from offshore banking and the black pearl industry. Agricultural products (including pawpaw, taro, oranges, maire [*Alyxia stellata*], black pearls and pearl shells, live fish and fresh or chilled fish) are the main exports. The pearl industry alone accounts for 60 per cent of total exports. Imported goods consist of food and live animals, minerals, fuels, transportation equipment, manufactured goods, chemicals and crude materials, beverages and tobacco. More than 56 per cent of total imports are from New Zealand (MMR 1998; Cook Islands Statistics Office 2001; Cook Islands Tourism Corporation 2001).

Fishing activities in Cook Islands are classified into three main categories. Subsistence fishing comprises 55 per cent of the fishing activity in terms of the number of people involved. Artisanal fishing (whereby the harvest is sold for income at local markets, restaurants and hotels) makes up 35 per cent of the total fishery sector. Commercial and industrial fishing make up the remaining 10 per cent. This operation requires more gear and capital and is aimed at export markets. However, gathering of sedentary products relies on simple techniques and low technology.

The main focus of the fisheries sector has been on commercial fishing, which includes tuna fishing by foreign fleets with access licenses from countries and territories such as Korea, Taiwan, French Polynesia and American Samoa (Tatuava 2001; Chapman and Cusack 1997).

The common fishing methods used in Cook Islands are hook-and-line, net fishing, spear fishing and gleaning. Other fishing methods include traps using coral fencing and plaited baskets to catch schools of lagoon fish and fresh water eels, jabbing methods used to catch mantis shrimp, freshwater fishing using gillnets and hook-and-line to catch tilapia, eels and snake mackerel (MMR 1998).

Destructive fishing methods, e.g. the use of the poisonous vine *Derris* sp., have been prohibited. The fruit of the barringtonia tree (*Barringtonia asiatica*) and dynamite have been banned because these methods are destructive. They kill all types of fish, shellfish and corals, harming larvae and juvenile marine organism (MMR 1998).

This paper documents subsistence fishing activities and fishing efforts over a twelve-year period in Rarotonga. It also assesses the importance of seafood in household diets and investigates seafood consumption trends from 1989 to 2001. Seafood consumption in the context of this research includes the consumption of imported canned fish, frozen fresh fish fillets sent from the outer islands to Rarotonga and other imported processed seafood, e.g. chilled and marinated mussels, oysters and prawns.

[1] Ministry of Marine Resources, Rarotonga, Cook Islands, d.solomona@mmr.gov.ck, t.tuatai@mmr.gov.ck, metu65@bellsouth.net
[2] Marine Laboratory, University of Guam, UOG Station, Mangilao, Guam 96913, vuki61@yahoo.co.uk

Methods

Study site

Rarotonga is the largest island in Cook Islands, with an estimated area of 67 km^2, and is oval in shape (MMR 1998; What's on in the Cook Islands 2001). According to census counts, the population of Rarotonga was 10,337 in 1996 compared to 9,678 in 1986 (Cook Islands Statistics Office 1997). Avarua is the main township and the centre for administration and shopping.

Rarotonga's fringing reef (2.6 km^2) is close to the shore, while the shallow lagoon covers eight square kilometres. Several interior freshwater streams around the Ngatangiia, Avatiu and Avarua have inhibited coral growth, causing reef passages to form. Avatiu harbour is used by local fishing boats and dive operators, both private and commercial, and is the main port of entry for large ships and cruising yachts.

The surrounding coral reefs and lagoons have provided sufficient fishery resources to the population of Rarotonga for many generations. However, over the years, increases in fishing activities for subsistence consumption and for the cash economy have caused heavy fishing pressure on the marine environment on Rarotonga. In recent years, there has been resurgence in the *rau'i* (traditional management of the marine environment). Harvesting of marine resources is banned from these areas until the *rau'i* is lifted.

Figure 1. Satellite map of Rarotonga island, Cook Islands, showing coral reefs and coastal villages (Source: http://earth.google.com)

Subsistence fishery survey

Surveys were undertaken of the fishery between December and February of 1989 and 2001. The survey consisted of a combination of household and seafood consumption surveys as per methods described in Zann and Aleta (1984), Zann et al. (1984), Vuki (1991), and Kuster et al. (2005).

Households were selected at random and a senior member was interviewed. Interviews were conducted in the Cook Islands Maori language. A total of 100 households were surveyed each year in 1989 and 2001.

The questionnaire consisted of three main sections. The first section asked about the socio-economic status of each household. Another section had details of the subsistence fishing activities, time and area of fishing, fishing craft and gear used, fishing effort and species caught. The third section consisted of an estimate of the quantity (kg) and identity of fish, shellfish and invertebrates consumed the day before the survey. This also included imported canned fish and meat consumed. In the seafood consumption section of the questionnaire, bivalves and gastropods were classified as shellfish. This included meat of black pearl oyster, giant clams, mussels, trochus and snails. Crustaceans, sea cucumbers, sea urchins and octopus were grouped as other invertebrates. Captured fish included those that were harvested from the sea and those received locally from friends and family.

Results and discussion

Socio-economics

The average number of people per household was 4 in 2001, while in 1989 it was 5. This may indicate that Cook Islanders are moving away from living

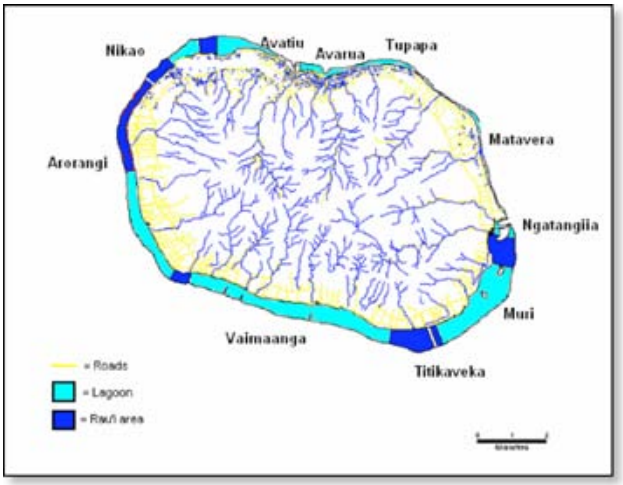


Figure 2. Map of Rarotonga showing districts

in extended households and toward a nuclear type family (Cook Islands Statistics Office 1997).

The average weekly income per household has increased from NZD 232 in 1989 to NZD 327 in 2001. This is an increase of NZD 7 per year over the twelve-year period. The increase in income could be due to inflation and also to increases in the minimum wage.

Salaried workers from the public and private sectors made up the majority of workers per household during the twelve-year period (Figs 3 and 4). Retired workers received regular fortnightly or monthly income from superannuation and pensions. Other contributions to the household income were made by those who were unemployed but on welfare benefits such as child benefits (mainly mothers).

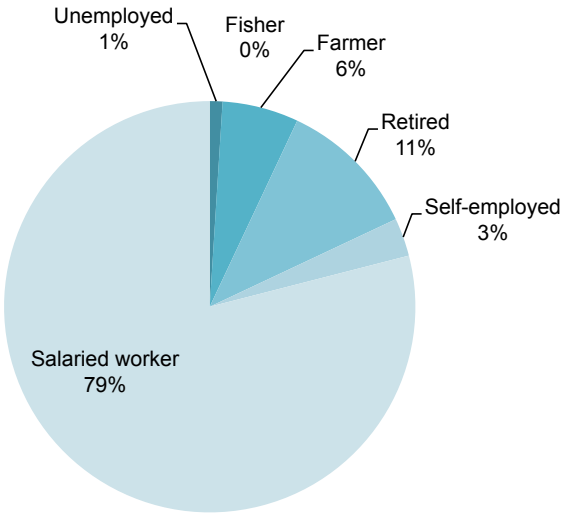


Figure 3. Occupation in 1989

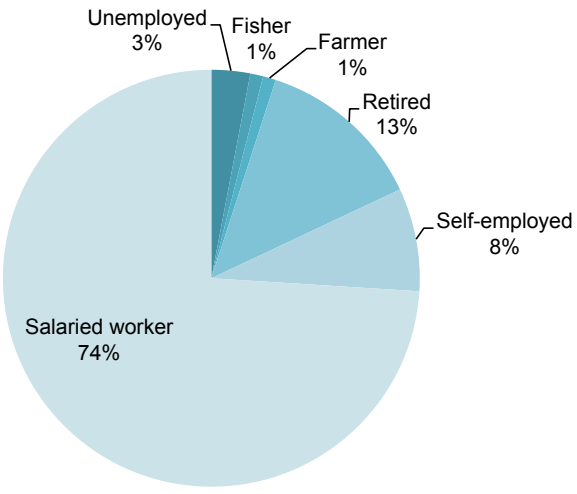


Figure 4. Occupation in 2001

Subsistence fishing

Subsistence fishing activities

Our surveys indicated that 14 households took part in fishing activities in 2001 compared to 17 households in 1989. Each household spent 3.4 days and 2.2 days fishing per week in 1989 and 2001 respectively. Therefore, time per week spent on fishing has decreased even though our surveys indicated that the number of household members who go fishing and the hours spent on each fishing trip have remained the same. The increase in the average salary and wages earned per week in the private and public employment sectors may have contributed to more than 55 per cent of the households spending less time taking part in some form of fishing activity. This has resulted in the frequency of seafood meals (mainly fish) declining from 2.8 times per week in 1989 to 1.8 times per week in 2001.

Studies undertaken in Penrhyn in the outer islands of Cook Islands showed that over 90 per cent of households took part in fishing activities (Passfield 1998). The lower income earned per week in Penrhyn may have contributed to the high percentage of fishing activities performed by household members. Fish meals were more frequent, averaging six times per week (Passfield 1998).

The fishing activities were mainly carried out in the lagoon and inshore reef areas of Rarotonga (Fig. 5). Spear guns, fishing nets and fishing handlines were the main gear used. There were some variations in the times of fishing between the surveys in 1989 and in 2001. An average of two individuals went on each fishing trip. Each trip took about two hours on average.

Spear fishing was the most popular fishing method; 50 per cent and 29 per cent of households surveyed used this method in 1989 and 2001 respectively (Fig. 5). Gleaning decreased while net fishing increased. Net fishing included set gillnet fishing and drive gillnet fishing. Handline fishing increased over the period (see Fig. 5).

In stationary or passive gillnet fishing, gillnets are anchored in the lagoon along the reef slope and usually left overnight. This method is non-selective and destructive as it catches many kinds and sizes of fish which could be wasted because they may not be eaten.

Drive or active gillnet fishing is carried out by a large group of fishers (normally five or more) who sight and stalk a school of fish and then place a net across a reef channel to trap the school. In another method, fishers use a long net to surround the school and then beat the water and chase the school toward the half-encircling net.

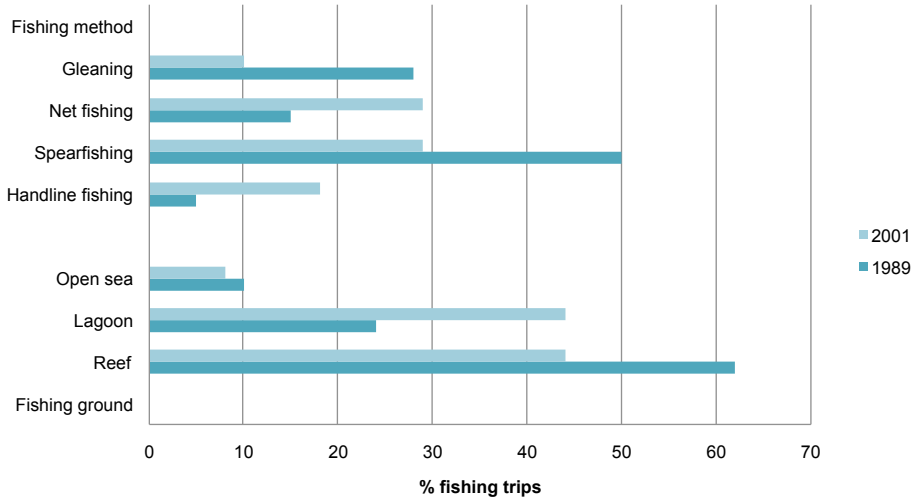


Figure 5. Percentage of fishing trips using different methods and fishing grounds

The reef was the most popular fishing ground (62%) in 1989 (Fig. 5). In 2001, both the reef and lagoon were commonly used fishing grounds. The open sea was not fished as often as the lagoon and reef (Fig. 5).

There were no fishing crafts used in 1989; however, 12 per cent of the households surveyed in 2001 used motorized boats during fishing trips. In both years, there were no traditional canoes used for fishing.

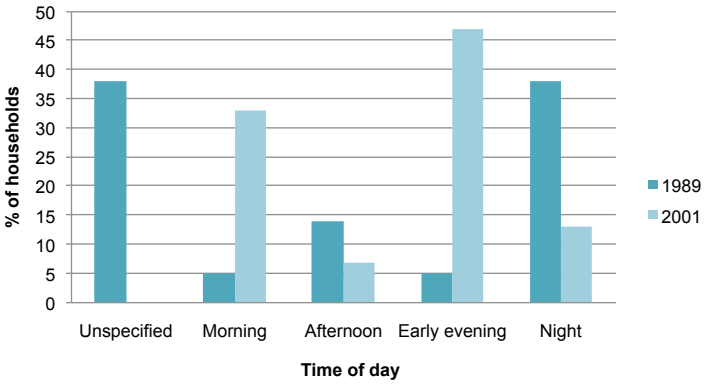


Figure 6. Time of the day fishing occurred

Time of fishing and fishing effort

In 1989, most households preferred to fish at night (38%), while only a few fished in the morning (5%), afternoon (14%) and evening (5%) (Fig. 6). However, a different trend was observed in 2001: the morning (33%) and evening (47%) hours were the times fishers were most likely to go fishing. Only a few fished late at night (13%) and in the afternoon (7%). Thirty eight per cent of the fishing households in 1989 did not state the time they went fishing (Fig. 6).

An average of two hours were spent fishing. An average catch per unit effort of approximately 0.61 kg per person per hour was recorded in 2001, which is almost the same as that in 1989. Spear guns have remained the popular choice of gear amongst the fishing households. Most spear fishing activities took place in the lagoon at night in 1989. Households using spear guns in 2001 fished equally in the lagoon, the reef and the open sea in the evenings and at night. This gear type landed 1.3 kg and 1.2 kg of finfish per person per hour in 1989 and 2001 respectively (Table 1). The catch per unit effort of household surveys in Rarotonga was higher than those from household surveys on Ono-i-Lau, Fiji Islands.

The catch per unit effort for gleaning activities and the use of fishing handlines could not be calculated for 2001 because most households could not estimate the total weight of fish and shellfish landed. Thus, comparisons could not be made with catch per unit effort in 1989 for these two fishing activities (Table 1). The household surveys showed that catch per unit effort on Ono-i-Lau were higher than those on Rarotonga for handline (Table 1). Handline fishing is a more popular method of fishing on Ono-i-Lau than on Rarotonga. Ono-i-Lau has larger areas of reef and lagoon and is an isolated island with a very small population. It was noted however that the number of households taking part in gleaning activities on Rarotonga has decreased, while use of the handline method has increased (Fig. 5). The catch per unit effort in gleaning and net fishing was

Table 1. Summary of catch per unit effort (kg person^{-1} hour^{-1}) from household surveys on Rarotonga (Cook Islands) and Ono-i-Lau (Fiji Islands) by gear used.

Fishing method	Catch per unit effort 1989 (Rarotonga)	Catch per unit effort 2001 (Rarotonga)	Catch per unit effort (Ono-i-Lau, Fiji Islands) (Kuster et al. 2006)
Handline	1.00	Unavailable	1.78
Spear	1.30	1.20	0.88
Net	0.05	0.02	0.37
Gleaning	0.02	Unavailable	0.32

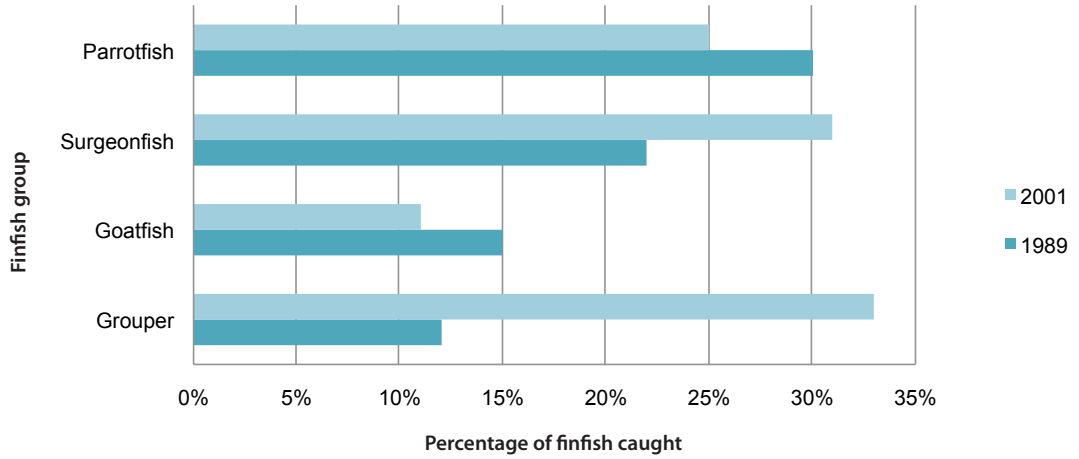


Figure 7. Importance of the major finfish groups caught

higher on Ono-i-Lau than on Rarotonga (Table 1). The use of gillnets on Rarotonga produced similar catch per unit effort in 1989 and 2001: 0.05 kg and 0.02 kg per person per hour, respectively (Table 1). The set gillnet fishing method was common in 1989, but this was replaced by the drive gillnet fishing method in 2001.

Major composition of catches

As shown in Figure 7, in 1989 the largest part of the finfish catch (30%) for surveyed households consisted of parrotfish (*pakati, u'u*). Twenty two per cent of the catch consisted of surgeonfish of the species *Naso unicornis* (*ume*), *Acanthurus triostegus* (*manini*) and *Ctenochaetus striatus* (*maito*). The goatfish *Mulloides vanicolensis* (*koma* and *takua*) made up 15 per cent of the catch. The finfish caught least often (12%) was the grouper, *Epinephelus tauvina* (*patuki*).

In contrast, the catch in 2001 consisted of 33 per cent grouper. The second major finfish caught (31%) were the three species of surgeonfish. Twenty five per cent of the catch was made up of parrotfish. The finfish caught the least often (11%) was the goatfish.

In 1989, the shellfish caught most often by surveyed households (71%) was the large worm snail (*Dendropoma maxima*) (*ungakao*). Mussels (*Asaphis violescens*) (*ka'i*) made up 28 per cent of the shellfish collected. The giant clam of the species *Tridacna maxima* (*pau'a*) made up only 1 per cent of the catch.

In 2001, the shellfish collected in largest quantity (77%) was the rough turbo snail (*Turbo setosus*) (*ariri*). Fifteen per cent of shellfish collected were trochus (*Trochus niloticus*) (*torokati*). The shellfish collected in smallest quantity (8%) was the giant clam (*Tridacna maxima*) (*pau'a*). There were no *ungakao* and *ka'i* collected in 2001. *Ka'i* is often harvested seasonally and our ad hoc surveys between November 1998 and 2000 of *rau'i* reef areas show low abundances (1–12 *pau'a* 100 m^{-2}) of *pau'a*. This could indicate over-harvesting of *ungakao* and *ka'i*.

In the category of other invertebrates, 63 per cent of the catch was crayfish (*koura*), caught mainly by spearfishing at night. Sea cucumber gonads (*Holothuria atra*) (*matu ori*) made up 37 per cent of the catch. There were no other invertebrates recorded during the 2001 survey.

Table 2. Finfish sold, given away or received each week

	1989			2001		
	Household %	Weight (kg)		Household %	Weight (kg)	
		Total	Mean		Total	Mean
Sell	3	123.5	41.2	10	25.5	12.8
Give away	35	129.0	3.4	55	12.0	1.7
Receive	62	252.2	4.3	35	24.0	4.8

Finfish sold, given away or received

The majority of the households (62%) in 1989 received finfish and the average quantity was 4.3 kg each week. In 2001, 35 per cent received finfish and the amount rose slightly to 4.8 kg of fish per week on average (Table 2). The percentages of households selling and giving away fish increased. However, the mean weights of fish sold and given away in 2001 were less than in 1989 (Table 2).

Seafood consumption

Frequency of fish meals in household diets and finfish consumption

On average, fish was consumed 1.8 times per week in 2001 as opposed to 2.8 times per week in 1989. Our surveys showed that at mealtimes, households most frequently consumed one fish type. Consumption of two to three fish types was occasional, while consumption of more than three fish types was rare.

A total of 74 and 43 households were recorded to have consumed fish in the week prior to the survey in 1989 and 2001, respectively. The weight of fish consumed per household was divided by the number of people per household to give a per capita estimate (Zann et al. 1984). The average consumption of fish per capita on a daily basis was 148.9 g in 1989 and 167.1 g in 2001.

There were 30 households in 1989 and 13 households in 2001 that captured their finfish. An estimated 8 households in 1989 and 12 households in 2001 purchased fish from fish markets, stores and restaurants. Thus, 38 households in 1989 compared to 25 households in 2001 consumed captured and purchased finfish.

The majority of the households in 1989 and 2001 were fishing households and captured fish from the sea. Commonly consumed fish in 1989 were lagoon and reef species such as parrotfishes (29%) (Table 3). The pelagic fish tuna was consumed by 21 per cent of the households. Surgeonfish was consumed by 12 per cent of the households. A range of 3–7 per cent of the households consumed trevallies, moray eels, flying fish, drummerfish, groupers and snake mackerel. Less than 1 per cent of households consumed goatfish, mahi-mahi, emperor, porcupine fish and wahoo. No mullet and rabbit fish were consumed in 1989 or 2001.

The pelagic fishes flying fish, mahi-mahi and tuna dominated fish consumed by households in 2001 (17–26%) (Table 3). Therefore, there was a shift in fish consumption from reef fishes to pelagic fishes. This could be due to ciguatera poisoning, which was a major problem at that time. A further 8 per cent of households consumed marlin, parrotfish and snake mackerel. A range of 2–4 per cent of households consumed other reef fishes such as surgeonfish, trevally, goatfish, emperor and snapper. Drummerfish was consumed by 1 per cent of the households in 2001. As for purchased fish, most were bought from the fish markets. Pelagic fish such as flying fish and tuna made up the bulk of commonly purchased fish species.

Table 3. Percentages of major finfish consumed

1989		2001	
Parrotfish	29	Flying fish	26
Tuna	21	Mahi-mahi	19
Surgeonfish	12	Tuna	17
Trevally	7	Marlin	8
Moray eel	7	Parrotfish	8
Flying fish	6	Snake mackerel	8
Grouper/cod	6	Others	14
Others	2		

Shellfish consumption

A total of ten households in 1989 and five households in 2001 consumed captured and purchased shellfish, namely giant clams and mussels. A wider variety of shellfish was consumed in 1989 than in 2001 (Table 4). The majority of the households in

2001 purchased shellfish from stores instead of harvesting it from the sea. Three households in 1989 consumed shellfish harvested from the sea compared to no households in 2001. However, the overall shellfish consumption on average rose to 50 g per capita per day in 2001 from 32 g in 1989.

Table 4. Frequency of shellfish consumption (% of households)

1989		2001	
Mussels	54%	Mussels	93%
Pearl oysters	27%	Giant clams	7%
Giant clams	13%		
Large worm snail	5%		
Rough turban snail	1%		
Total	100%	Total	100%

Other invertebrate consumption and sea grape consumption

No invertebrates other than shellfish were captured in 2001. Prawns were the only type of invertebrate consumed in 2001 that were bought from the store (one household). In 1989, crayfish/lobster and coconut crabs were consumed by 68 per cent and 20 per cent of households respectively (Fig. 8). Octopus, sea cucumber gonads and sea urchins gonads were also consumed in 1989 as delicacies (Fig. 8). An average of 88 per cent of invertebrates consumed were captured and 12 per cent were purchased from the fish market. Our results showed a higher household capture and consumption of invertebrates in 1989 (118.4 g per capita per day) than in 2001 (35.7 g).

Only one household in 2001 consumed sea grapes (*Caulerpa racemosa*), which could not be categorized into any of the above sections because it is not an invertebrate or an animal but rather is a plant. Thus it is classified as other seafood. The weight of the consumed sea grapes was not taken into account. These sea grapes could have been sent from Aitutaki. Sea grapes found in Rarotonga are restricted to Ngatangiia and women do not harvest them because they are more calcified in nature and therefore inedible. There were no households in 1989 that consumed sea grapes.

Imported canned fish and meat consumption

A decline in household consumption of imported canned fish the day before the survey was found in 2001. There were 17 households in 2001 consuming canned mackerel with different brand names, and they ate 20 cans of fish, while in 1989 there were 27 households and they consumed 41 cans of fish. The most popular canned fish consumed was the Japanese-made brand Wonderful. These cans came in 425 g sizes at NZD 4.40 for dark coloured cans and NZD 2.50 for light coloured cans. Average canned fish consumption was 18.4 g and 17.9 g per capita per day for 1989 and 2001, respectively.

The ratio of households consuming meat increased from 36.4 per cent in 1989 to 48.8 per cent in 2001 (Fig. 9). Meat consumed was mostly imported and included chicken, mince, lamb chops, beef, bacon and other forms of pork, and sausages. Based on the number of households surveyed, chicken was consumed in larger quantities than finfish, shellfish, invertebrates or imported canned fish.

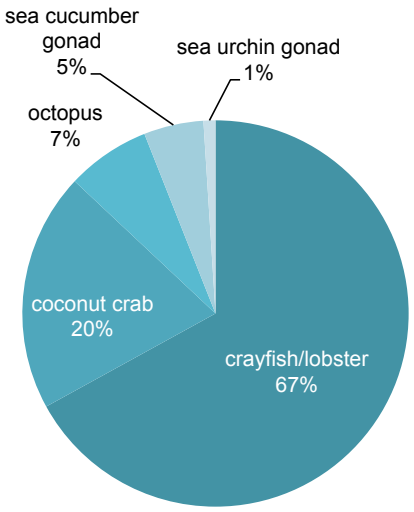


Figure 8. Other invertebrates consumed in 1989

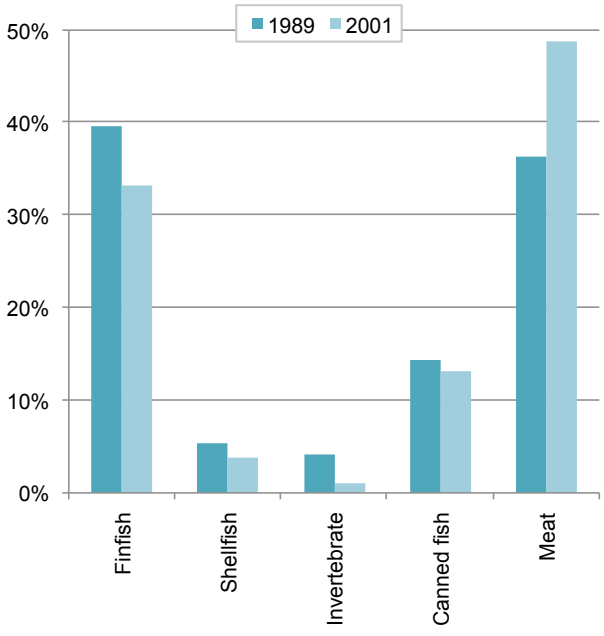


Figure 9. Percentage consumption of five different food groups

Table 5. Average amount of finfish, shellfish, other invertebrates and canned fish consumed daily

	Per capita (g)[1]		Per household (g)	
	1989	2001	1989	2001
Finfish	148.9	167.1	744.6	668.6
Shellfish	32.0	50.0	160.0	200.0
Other invertebrates	118.4	35.7	591.3	142.9
Imported canned fish	18.4	17.9	92.2	71.4
Total seafood consumption	317.7	270.7	1588.1	1082.9

[1] The weight of fish consumed per fish consuming household was divided by the number of people per household to give a per capita estimate (Zann et al. 1984)

Total seafood consumption, meat and trends

A summary of the average amount of finfish, shellfish, other invertebrates and canned fish consumed is presented in Table 5. The most consumed seafood per capita per household is finfish while the least consumed is imported canned fish.

Our surveys showed that the total seafood consumption has decreased over a twelve-year period. The average daily consumption of seafood per capita was 317.7 g in 1989 compared to 270.7 g in 2001 (Table 5).

The major factor contributing to this decline is the fear of ciguatera poisoning that was prevalent during that period. The establishment of marine protected areas (closed areas and permanent), or *rau'i*, also contributed to this decline. This customary community based management system (MMR 1998) was implemented due to heavy fishing pressure in most lagoon and reef areas caused by coastal activities, gleaning and over-fishing. There was also an increase in the use of monofilament gillnets and scuba spear fishing. These activities led to further decline of living marine resources such as giant clams, mussels and certain fish species (Ponia et al. 1999; MMR 1998). Marine protected areas were implemented around Rarotonga's reefs and lagoons as a fisheries management tool.

There was higher (36.4–48.8%) meat consumption in 2001 when compared to 1989. Meat is readily available in stores and is much cheaper than most seafood sold, especially finfish. The purchase of finfish would cost the consumer about NZD 19 per kg of fresh fish sent in from Palmerston (an island in the southern Cook Islands), NZD 22–25 per kg of fresh fish imported from New Zealand or NZD 20 per string with 10 fish per string, or NZD 20–30 per whole tuna fish depending on the size. On the other hand, meat costs about NZD 9–15 per packet or just over NZD 5 per kg.

Importance of seafood in household diets on Rarotonga and other Pacific Islands

In relation to the average consumption of seafood per capita per day, studies conducted by Zann and Aleta (1984) and Zann et al. (1984) in Tokelau and Samoa showed that each household member consumed an average of 481 g and 420 g respectively. Similarly, studies carried out by Vuki (1991) on Dravuni Island (Fiji Islands) revealed that the average daily seafood consumption per capita was 355.7 g. This included imported canned fish, finfish, shellfish and other invertebrates. Thus, the average amount of seafood consumed on Rarotonga is lower (317.7 g in 1989 and 270.7 g in 2001). However, as we have seen, seafood still plays a major role in most household diets on Rarotonga.

Conclusions

Between 1989 and 2001, there were considerable changes in patterns of fishing and seafood consumption on Rarotonga. Though the average amount of finfish consumed increased by 18 g per capita per day from 1989 to 2001, invertebrate consumption decreased by 82.7 g per capita per day. Therefore, total seafood consumption decreased over the twelve-year period from 317.7 g to 270.7 g per capita per day.

The fishing spots visited most often over the twelve-year period were the lagoon and inshore areas. The fish catch was dominated by parrotfish in 1989, while in 2001 grouper was the major fish caught.

The changes in lifestyle in Rarotonga may have been caused partly by the increase in wages earned, which reduced the need for families to fish in order to put food on the table. There were 55 per cent of households spending less time in 2001 than in 1989 in any form of fishing activity, and the frequency of seafood meals declined from three times per week

in 1989 to two times per week in 2001.In addition, the establishment of marine protected areas and the increase in ciguatera poisoning may have contributed to the change in the trend of seafood consumption on Rarotonga.

Acknowledgements

We are grateful to the people of the fishing villages of Nikao, Arorangi and Ngatangiia. This research was possible because of their willingness to participate and we are thankful to them for participating in a long-term study.

Our special thanks to Julian Dashwood and members of his staff for their help in facilitating the first survey in 1989. We are also grateful to Ian Betram, Joshua Mitchell, Kori Raumea, Nooroa Roi, Ben Patai, Ngatamaroa Makikiriti, Lara Manarangi-Trott, Ranga Tutai, Matai Mokoroa, Teggy Tangimetua, Maru Willie, Tanga Morris, Gerald Mc Cormack, Tania Williams, Lupeti Fehaki, Edwin Apera and Loraini Sivo for the support given to us during the surveys.

We thank the staff of the Institute of Marine Resources and the Marine Studies Programme of the University of the South Pacific for logistics support. We also wish to thank Dr Leon Zann for his support and for allowing us to use and modify his questionnaires used for the Ono-i-Lau study for this research.

This research was initiated and financially supported by the authors and their families to support undergraduate research programmes for Dorothy, Teina and Metu under the supervision of Dr Veikila Vuki at the University of the South Pacific.

References

Chapman L.B. and Cusack P. 1997. Unpublished report No. 6. Report on fourth visit to the Cook Islands. Part I, 17 November 1985–29 July 1986 & Part II, 14 November–23 November 1986. Noumea, New Caledonia: Secretariat of the Pacific Community. 51 p.

Cook Islands Statistics Office (CISO). 1997. Cook Islands censuses of population and dwellings 1996, main report. Avarua, Cook Islands: Cook Islands Statistics Office. 104 p.

Cook Islands Statistics Office (CISO). 2001. Cook Islands quarterly statistical bulletin, December quarter 2000. Avarua, Cook Islands: Cook Islands Statistics Office.

Cook Islands Tourism Corporation. 2001. Annual tourism statistical bulletin 2000. Avarua, Cook Islands: Cook Islands Tourism Corporation. 24 p.

Kuster C., Vuki V.C. and Zann L.P. 2005. Long-term trends in subsistence fishing patterns and coral reef fisheries yield from a remote Fijian island. Fisheries Research 76: 221–228.

Kuster C., Vuki V.C. and Zann L.P. 2006. Validation of the accuracy of household reporting of subsistence fishing catch and effort: Fijian case study. Fisheries Management and Ecology 13: 1–8.

Ministry of Marine Resources of the Cook Islands (MMR). 1998. Basic information on the marine resources of the Cook Islands. Avarua, Cook Islands: Ministry of Marine Resources of the Cook Islands. 54 p.

Passfield K. 1998. A report of a survey of the marine resources of Fakaofo Atoll, Tokelau. Fisheries and Environmental Consultants Ltd. Report. 34 p.

Ponia B.K., Raumea K. and Turua T. 1999. 1st monitoring survey of the Rarotonga rau'i: November 1998. Miscellaneous Report: 99/18. Avarua, Cook Islands: Ministry of Marine Resources of the Cook Islands.

Tatuava S. 2001. Monitoring control and surveillance profile, Cook Islands. Ministry of Marine Resources of the Cook Islands. Miscellaneous Report: 2001/04. Avarua, Cook Islands: Ministry of Marine Resources of the Cook Islands.

Vuki V.C. 1991. A fish consumption survey of Dravuni Islanders, Great Astrolabe Reef, Fiji. Institute of Marine Resources Technical Report. Suva, Fiji Islands: Institute of Marine Resources, University of the South Pacific 8 p.

What's on in the Cook Islands. 2001. Auckland, New Zealand: Jason's Travel Media Ltd. 128 p.

Zann L.P. and Aleta S. 1984. A preliminary survey of fish consumption in Tokelau. Suva, Fiji Islands: Institute of Marine Resources, University of the South Pacific.

Zann L.P., Bell L. and Sua T. 1984. A preliminary survey of the inshore fisheries of Upolu Island, Western Samoa. Suva, Fiji Islands: Institute of Marine Resources, University of the South Pacific.

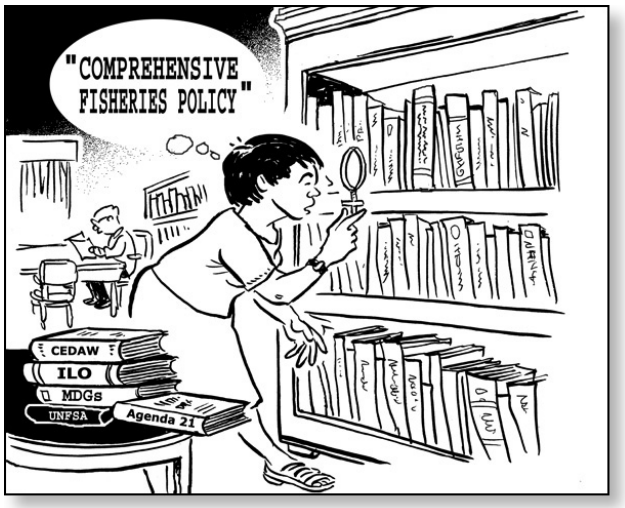
Recognising women in fisheries: Policy considerations for developing countries

Vina Ram-Bidesi[1]

Source: Yemaya (The International Collective in Support of Fishworkers' [ICSF's] newsletter on gender and fisheries), No. 28, August 2008. [http://icsf.net/icsf2006/ControllerServlet?handler=YEMAYA&code=viewPubn&issueno=28&language=EN&subsiteId=2]

Greater cross-sectoral policy dialogue, advocacy and information exchange is needed to build more comprehensive and gender-just fisheries policy

Gender issues in national development are cross-cutting and multi-dimensional, impinging on the activities and performance of several sectors simultaneously. The Convention on the Elimination of all forms of Discrimination Against Women (CEDAW) and the Beijing Declaration and Platform for Action are key instruments that provide the basis for law and policy to address gender-specific issues across sectors, including fisheries, agriculture or manufacturing.



Are the provisions from these instruments, such as those relating to non-discrimination by sex, equal access to resources and opportunities for women and special attention to women in rural and industrial fisheries, reflected in our fisheries policies or their implementation? Do they influence other legal and regulatory regimes?

What are the major drivers for fisheries policies and why are gender issues in the sector yet to be adequately recognised? First and foremost, very few developing countries have a comprehensive national fisheries policy. Consequently, the overarching national policy framework for fisheries management and development is usually derived from development strategies and legislation on fisheries and maritime matters. The legislative framework often provides general provisions on fisheries access, fisheries management, enforcement and monitoring, which are strongly influenced by the United Nations Convention on the Law of the Sea (UNCLOS). The emphasis is on regulation rather than on policy implementation.

As a result, specific principles and goals supporting sustainable fisheries and wider community interests, including the integration of gender issues, are either limited or non-existent. Furthermore, development strategies are focused on the market-driven and export-oriented commercial development of the fisheries sector, with the aim of increasing production and contributing to foreign exchange earnings, while creating employment. The concerns are often related to access to investment capital, development of joint-ventures, improving products for competitive markets, and technological upgrades for cost reduction or increased production. Such strategies are dependent on skilled labour and entrepreneurship, which most women lack. Therefore, in the industrial fisheries sector, despite policies aimed at creating employment, women's labour continues to be marginalised.

Global concern over the sustainability of fisheries resources, and their continued ability to support the livelihood of coastal communities, was highlighted during the United Nations Conference on Environment and Development (UNCED). One of the outcomes of the UNCED process was the development

[1] Senior Lecturer at the University of the South Pacific and member of Women's Information Network (WINET), Fiji Islands. Email: ram_v@usp.ac.fj

of the United Nations Food and Agriculture Organization (FAO) Code of Conduct for Responsible Fisheries (CCRF) and other related FAO fisheries instruments. There has subsequently been a major shift in policy focus toward conservation, protection of critical habitats, reduction in fishing capacity and an ecosystem approach to fisheries management. This policy shift requires greater reliance on decentralised fisheries management, either through community-based approaches or, in the case of shared and straddling stocks, through the establishment of regional fisheries management organisations.

So far there has been very limited research on the gender implications of such policies. What is apparent is that the emphasis is on limiting access to fisheries resources through creating various types of rights-based fisheries, use of more selective gear and technology, and greater reporting requirements, all of which are likely to have differential impacts on men's and women's fishing activities.

Labour laws in the fisheries sector have been notoriously inadequate for both men and women. Given the legal formalities involved, the new International Labour Organization (ILO) Fishing Convention which was adopted in June 2007 will take some time to come into effect. At the same time, the focus of the convention is limited to the safety and protection of fisher's rights on fishing vessels. This does not cover the women in supporting shore-based activities or address social problems associated with seafarers in ports or with their families. With the globalisation of fisheries, anecdotal information already indicates an increase in a wide range of social problems in fishing ports and with communities heavily reliant on fishers' remittances from work on foreign vessels. These social problems are not directly addressed within the context of national fisheries policies but are seen as implementation hurdles for the fisheries administration, and considered beyond their scope.

Instruments such as trade agreements under the World Trade Organization (WTO) and social considerations such as under CEDAW are also seen as indirect instruments of fisheries policy. These instruments are often administered by different government agencies. These may also be at different levels of the government structure and, therefore, may have different priorities and budgets and may not necessarily complement the agenda of the fisheries administration. For example, the responsibility for achieving gender policy goals is often with the women's department or bureau, which may be at a 'lower level' as an implementing agency rather than a policy-making agency. As a result, there is always the risk of a lack of congruency between gender policies of different government agencies.

Many of the grassroots and community level efforts, as well as initiatives at the regional level, are being driven by non-governmental organisations (NGOs) and civil society groups concerned with the environment and with equitable social and economic development. A number of such initiatives aim to protect biodiversity or adapt to climate change. Implementation strategies, in line with the biodiversity and climate change conventions, include the creation of marine protected areas (MPAs) and the diversification of livelihoods, which indirectly address poverty and fisheries issues.

At the national level this work generally falls under the umbrella of the environment administration as the lead agency. In the case of community-focused projects, several factors come into play and determine the extent to which women's concerns and interests are integrated. These may include *inter alia* the type of social structure, cultural norms and practices, the type of NGO group, funding agency priorities, community leadership, status of fisheries resources, availability of alternative sources of income and the level of gender awareness amongst stakeholders. Where there are effective resource management systems and environmental consciousness is high, there is likely to be greater recognition of women's direct and indirect role, and a consideration of the impact of initiatives undertaken on them.

Therefore, if one looks at the status of women in the fisheries sector, their rights and their access to resources and opportunities, one can say that while some progress has been made in areas of aquaculture, post-harvest and marketing, a lot more work is still needed to mainstream gender issues in the fisheries sector. Given the complex policy environment of the fisheries sector, integrating gender issues into policy implementation requires greater cross-sectoral stakeholder platforms for policy dialogue, advocacy and information exchange, so that more comprehensive and socially-acceptable fisheries policies can be formulated. A coordinated approach is, therefore, necessary from the highest policy level, not only to achieve sustainable fisheries but also to meet the social and economic objectives of the sector. Gender analysis of various fisheries policies is an essential first step that can facilitate and better inform this decision-making process.

Meeting the challenge

Meryl Williams[1]

Source: Yemaya (The International Collective in Support of Fishworkers' [ICSF's] newsletter on gender and fisheries), No. 28, August 2008. [http://icsf.net/icsf2006/ControllerServlet?handler=YEMAYA&code=viewPubn&issueno=28&language=EN&subsiteId=2]

Using action and research to make fisheries policies more gender sensitive

Thousands of seasonal fish products are produced by millions of fishworkers, many of them women. Fish trade is booming; fish farming is growing fast; fish prices were escalating well before other food prices rose; fish sustainability is a hot topic; and fuel prices threaten fishing profits. Power and authority are concentrated in the larger companies, the owners of larger fleets and the well-organised fishing countries. The power and authority appear to have always been held by men. Even so, fisheries policies can be eclipsed by those relating to other sectors and national policies, such as for international trade, water and coastal tourism.

Governments and communities have to 'catch up' on fisheries policy development, and women's roles and contributions are often left behind, undervalued or unrecognised. Fisheries policies and industry programmes tend to address fish production, exports and fuel prices. Yet a broader look at gender-differentiated roles and concerns along the whole fish supply chain shows a clearer view of fisheries problems and intervention points. For example, in Palau, a mainstream picture identifies fisheries with men and focuses on offshore tuna resources, the live reef fish trade and tourist game fishing. It ignores women's inshore and lagoon fishing and increasing participation on boats, the need for better fish market facilities, and the importance to all Palauans of inshore fishery resources and marine conservation and of finding better domestic benefits from tuna. With a broader, gender-inclusive view, we can better focus attention on where action is required. And women's contributions become clear.

National governments have been slow to create opportunities, rights and responsibilities that are shared more fairly throughout the chain because they work in bureaucratic and compartmentalised ways. Therefore, through advocacy and the insights they bring, action groups and researchers must focus attention on women in fish supply chains.

Only in the last two decades has a small movement begun to document and understand women's contributions and to ensure they are considered in policy-making. This movement, of which the International Collective in Support of Fishworkers (ICSF) and its newsletter Yemaya, and the Asian Fisheries Society (AFS)/WorldFish Center symposia are important parts, is still in its infancy.

Through action and research, women in fisheries are gaining policy attention, but so far the gains have been small. Development agencies are focusing on gender opportunities in the fisheries, and countries, charities and researchers are responding with proposals. National and international fisheries programmes are paying more attention to women. For example, in India, women's programmes for mussel culture have been successfully developed by the Central Marine Fisheries Research Institute (CMFRI). The Mekong River Commission's Network on Gender and Fisheries is a full member of the policy development committee, the Technical Advisory Body for the Lower Mekong Basin countries. The Food and Agriculture Organization of the United Nations (FAO) covered the role of women in the October 2008 Global Conference on Small-Scale Fisheries.

I see three obstacles to greater policy focus on women in fisheries. First, larger economic and more male-dominated interests control much of fisheries, providing little space for secondary interests, including those of women, crew and other service workers. Second, women's fisheries contributions are diverse, dynamic and not well known. Third, the fisheries sector is eclipsed by other economic sectors, and women are thus doubly overshadowed.

To overcome the power obstacle, activists can aid women by drawing public and political attention to

[1] Meryl Williams is a semi-retired fisheries researcher who is part of several international agriculture, fisheries and environment boards and committees. Email: scylla@myjaring.net.

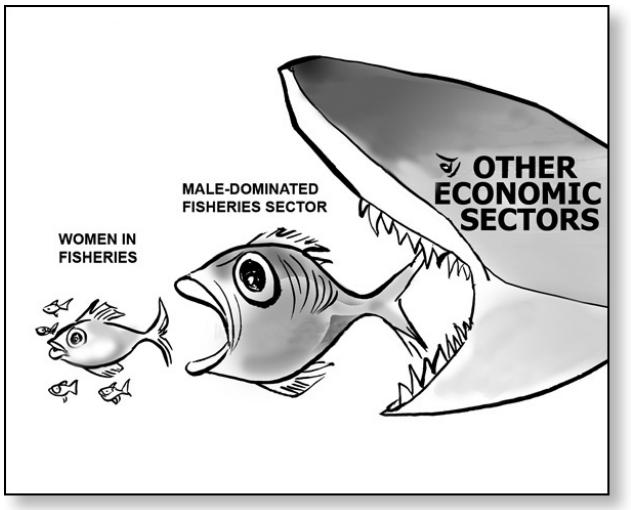
women's real and potential contributions. Activists should aim to get women's needs into fisheries and related policies. This will mean shifting the focus to the whole supply chain.

To address the knowledge obstacle, we have to build the knowledge base on women in fisheries. In Kochi, India, on 22 November 2007, 21 gender experts concluded that social justice arguments have additional policy traction if supported by a deeper understanding and quantification of women's contributions. Studies are needed on women's unpaid and paid labour in fisheries and on whether women have equal opportunities for jobs and promotion throughout the sector, including as researchers.

Fisheries and aquaculture education and vocational training policies also need to incorporate gender sensitivity. University and extension teachers need to share and have access to gender and fisheries curricula, syllabi and case studies. Several projects are now addressing this need. The ICSF Women in Fisheries Bibliography (http://wif.icsf.net/icsf2006/jspFiles/wif/bibliography/biblioHome.jsp) provides useful pointers to research and policy reports.

Research and action agencies need to model their own principles and remove barriers to women's entry. Women may be restricted from professional education and training in fisheries and aquaculture research and extension due to lack of basic facilities, such as student dormitories. At the Assam Agricultural University, India, a girls' hostel was built for the Bachelor of Fisheries Science course. In Bangladesh, CARE developed affirmative action policies for its own staff to better reach rural women.

To remove the obstacle of being doubly overshadowed, women in the fisheries sector should be publicly involved in decision-making committees and management bodies. This can broaden the sector's profile, widen the talent pool and give fisheries a sounder position from which to engage with other sectors.



Symposium on gender and fisheries seeks solutions through research

Meryl Williams

Source: Asian Fisheries Society

The 2nd Global Symposium on Gender and Fisheries, organised during the 8th Asian Fisheries Forum (AFF), 20–23 November 2007 at Kochi, India, sought 'solutions through research' by looking at fisheries and aquaculture through the gender lens, which gives a better, more complete picture — one that is better focused and provides the basis for understanding fisheries issues and taking more appropriate action.

The symposium brought presenters and authors from 14 countries in Asia, Australia, Europe and North America. Participants and chairs included all those coordinating key gender and social action networks for fisheries.

The symposium continued the trend toward presentation of new and original research looking at significant fisheries and aquaculture issues through the gender lens. It covered inland and coastal resource management and aquaculture, income, fish processing, trade and globalisation, nutrition and human health, gender mainstreaming in fisheries projects and models for successful fishing/fish-farming families/communities. Discussion was lively and presenters' research conclusions were tested for their applicability to policy and practice.

Following are some of the highlights:

1. As a result of the 2001 Women in Fisheries Symposium at the 6th AFF where we reported of the problems of HIV/AIDS and fisheries, Uganda and the other Lake Victoria countries now have specific strategies and actions for overcoming the problem in fishing communities.
2. Gender research in Tripura state, India, influenced the government to consider a family approach to all aquaculture support programmes. India is very active in analysing and improving its models of extension to reach women and men.
3. Hard data were reported from many studies on the full extent of unpaid and under-recognised work that women do in the fish supply chain. However, legal and technical difficulties persist when countries formally recognise women's contributions in their welfare systems, even in Europe.
4. Options for coastal resource access and income diversification from aquatic resources have declined for all the small-scale fishing communities studied, whether in Malaysia, India or Africa. Fishing communities typically have missed the economic miracles of otherwise successful human development, such as the Kerala Model and Malaysia.
5. Studying the whole fish supply chain through a gender lens can provide much greater clarity regarding where and how to make successful interventions to remove small-scale household vulnerabilities.
6. The booming fish trade has created many opportunities for women's labour but these are often exploitative. Trade has also created greater competition for fish and taken much access to the product away from women who are small-scale processors and vendors. Trade has also rushed ahead in many countries without due regard to the sustainability of the fisheries.
7. Data mining techniques can provide fruitful insights into many dimensions of fisheries and aquaculture participation when gender-disaggregated statistics are available.

Original text: English

Secretariat of the Pacific Community, Marine Resources Division, Information Section
BP D5, 98848 Noumea Cedex, New Caledonia
Telephone: +687 262000; Fax: +687 263818; cfpinfo@spc.int; http://www.spc.int/coastfish