

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

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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 PROCFish³ 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

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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 ($t \text{ year}^{-1}$) 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%)

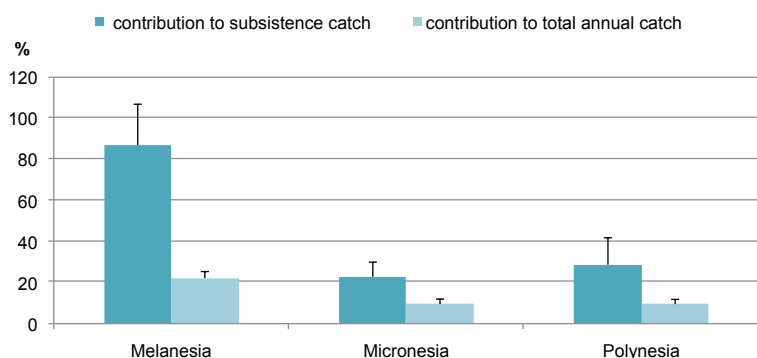


Figure 1. Average contribution (+SE) of fisherwomen to the total annual subsistence catch and the total annual catch by cultural groups

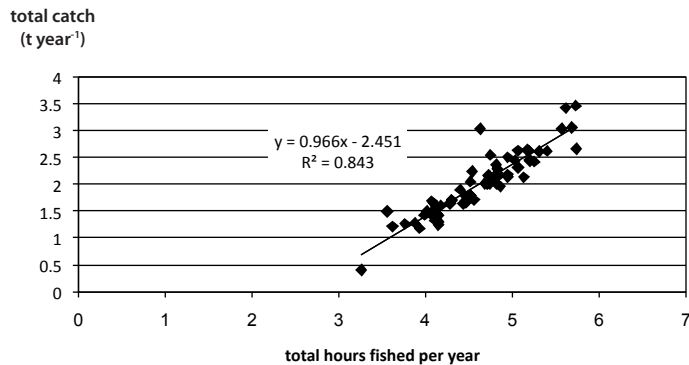


Figure 2. Regression between total hours spent fishing by fishermen and total annual catch (t), log-data for 63 communities studied

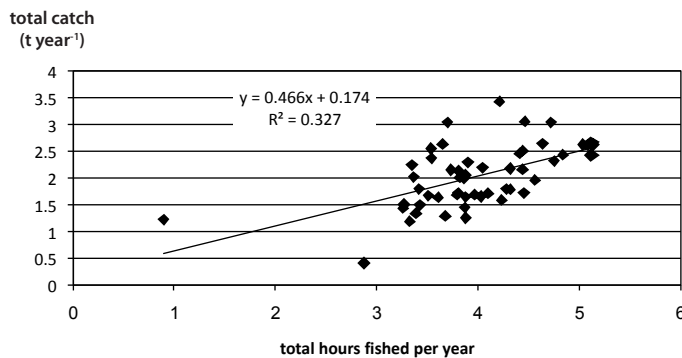


Figure 3. Regression between total hours spent fishing by fisherwomen and total annual catch (t), log-data for 63 communities studied

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, day-time 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.

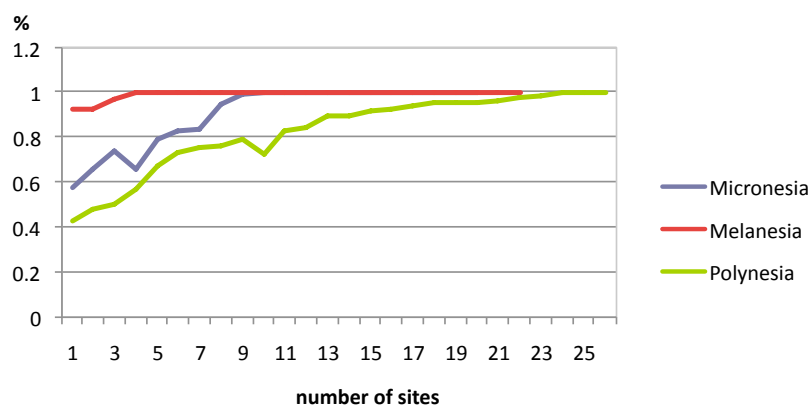


Figure 4. Comparison of fishing during daytime by fishermen from three cultural groups (average of absent-present data by site and group)

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		
	<i>F</i> value	<i>p</i>
Melanesia/Micronesia	6.945	*
Melanesia/Polynesia	10.737	**
Micronesia/Polynesia	1.569	n/a
Fisherwomen: always using boat transport for fishing		
	<i>F</i> value	<i>p</i>
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
<i>F</i> value	6.053	16.432	18.024	54.126
<i>p</i>	*	***	***	***

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

	CPUE sheltered coastal reef		CPUE lagoon		CPUE outer reef	
	<i>F</i> value	<i>p</i>	<i>F</i> value	<i>p</i>	<i>F</i> value	<i>p</i>
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

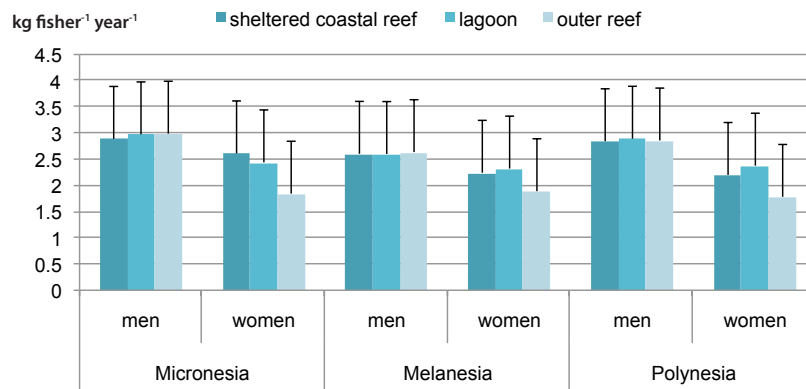


Figure 5. Average annual catches per fisher by habitat fished, gender and cultural group (log+1 data, SE)

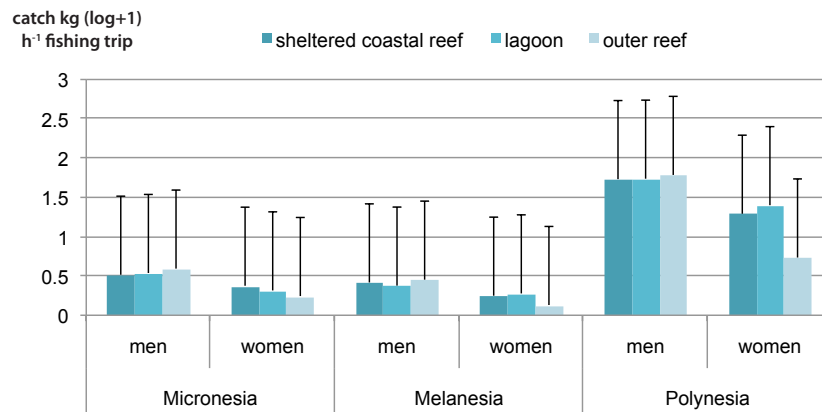


Figure 6. Average CPUE by gender, habitat and cultural group (log+1 transformed data, SE)

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.

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