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The Role of Women in Community-based Small-Scale Fisheries Management: The Case of the South West Madagascar Octopus Fishery

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Abstract — Ensuring that benefits from natural resource management initiatives are shared equally amongst both men and women is crucial to achieving long-term conservation and development objectives. In south west Madagascar, community-managed temporary closures of octopus (*Octopus cyanea*) fisheries have become a popular approach in management of the resource, and have been shown to increase catches with lasting results. Women regionally account for well over half of octopus fishers, and are influenced by efforts to manage the resource. We assessed the role of gender in this fisheries management initiative, comparing fisheries landings for men and women over a seven-year period, and assessing female involvement in the management process through a series of focus groups and workshop discussions. Our findings showed that, while both genders benefit from the fisheries management initiative, men tend to harvest bigger octopus and dominate reserve management discourse and decision-making. We discuss these findings in relation to other natural resource management initiatives and recommend strategies to ensure better integration of women in octopus fishery management.

INTRODUCTION

Men and women generally play distinct roles in community-level natural resource management, with differing economic, social, political and cultural factors defining resource use. Recognition and understanding of these differences, and how men and women access, use, and benefit from natural resources and management decisions, are critical to ensure the long-term sustainability of management and conservation initiatives (Harper *et al*., 2012; Johnson *et al*., 2004; Agarwal, 2000). Women must have a role in natural resource management for management systems to be inclusive and equitable (Chuenpagdee *et al*., 2006; Upadhyay, 2005; Johnson *et al*., 2004); however, management institutions often fail to include women adequately (Agarwal 2000). Similarly, while the incorporation of

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gender into decentralised natural resource management has gained increasing attention over the last several decades, it is still often overlooked or inadequately addressed at management, research or policy levels (Williams, 2010; Beck & Nesmith, 2001; Diamond *et al*., 2001) and, when gender is addressed, it is often seen as a component of anthropological studies, with relatively little economic or social research (Bennett, 2005). Fisheries literature and research and discussion on women's roles is particularly under-represented (Williams, 2010; Chuenpagdee *et al*., 2006; Bennett 2005). Management guidelines for and case studies of community-based marine conservation, however, do frequently emphasize the importance of including all stakeholders – including women – in marine resource management (LMMA Network, 2009; Govan *et al*., 2008; White *et al*., 2006), although specific strategies for doing so are not often included.

Small scale octopus fisheries in the western Indian Ocean (WIO) present an interesting case study in which to explore gender roles in natural resource management, as octopus represent a significant source of income, particularly for women, in many developing coastal countries in this region (notably Tanzania, Kenya, Comoros and Madagascar, as well as other wealthier nations such as Mauritius; Sauer *et al*., 2011; Barnes & Rawlinson, 2009; Guard, 2009). Common property resources, such as marine fisheries, comprise a crucial element of poor people's livelihood, with women often playing a primary role in accessing these resources (Beck & Nesmith, 2001; Agrawal, 2001) as in the case of the WIO octopus fishery. Despite its importance, very little research has been conducted to examine gender dimensions within the octopus fishery; we contacted four octopus fisheries researchers around the world who have published papers on octopus biology and/or fisheries management (Leite *et al*., 2009; Katsanevakis& Verriopoulos, 200; Håkansson *et al*., 2012; Storero *et al*.,2012) but none were aware of any such studies[1], although it was noted that some broader studies have included a small gender component (Håkansson *et al*., 2012).

The Velondriake locally managed marine area (LMMA) located in south west Madagascar is home to nearly 8 000 semi-nomadic, sea-faring Vezo inhabitants (Harris, 2007). The local economy is based on a combination of activities, primarily focused on fishing and littoral gleaning for food and income, with over 85% of local income derived from these activities (Harris, 2011). The LMMA began in 2004 and is a community-led initiative to promote sustainable fisheries management and improve local livelihoods (Harris, 2007). Management initiatives within the area are overseen and enforced by elected representatives from each of the LMMA's 25 villages, and include bans on destructive fishing practices, protection of permanent marine and mangrove reserves, and implementation of temporary octopus fishery closures. A local set of laws, called dina (Rakotoson & Tanner, 2006), governs the LMMA and enforcement is the responsibility of community members (Andriamalala & Gardner, 2010).

Until 2003, the octopus (*Octopus cyanea*) market in Velondriake was based almost entirely on local daily food needs and dried octopus for trade with inland communities. Higher value seafood markets were limited, as a result of the lack of refrigeration and transport facilities within this isolated region (Epps, 2007). However, upon the arrival in the region of a buyer and international exporter in 2003, octopus became a higher more valuable commercial product with a virtually unlimited market demand (L'Haridon, 2006). Within Velondriake, approximately 99% of octopus harvested are sold (Blue Ventures, unpublished data), accounting for 95% of marine resource sales (Epps, 2007). Octopus are sold to companies based in Toliara and Morondava, and then exported to southern

[1] T Leite, personal communication, 2012; SKatsanevakis, personal communication, 2012; M de la Torre-Castro, personal communication, 2012; L Storero, personal communication, 2012

Europe and Mauritius (L'Haridon, 2006). This burgeoning market led to rapid exploitation of local octopus stocks, and harvesters quickly began to report a decrease in octopus numbers (Harris, 2007; Langley 2006).

Following the shift towards commercialisation and the concomitant widely perceived decrease in local octopus stocks, the village of Andavadoaka (the principle village within Velondriake, located at its geographical centre) established a pilot temporary closure of octopus harvesting at a single 200 ha fishing site for seven months between November 2004 and June 2005 (Harris 2007, Humber *et al*., 2006). While catch per unit effort (CPUE) was relatively low due to the large number of harvesters attracted when the fishery was reopened, the overall catch was significantly higher than control sites, demonstrating that the closure had been an overall success in terms of the increased absolute weight and profits from the octopus landed (Benbow & Harris, 2011). Further research has demonstrated that only three months of closure are needed to achieve such benefits and are much more socially acceptable to fishing communities (Benbow & Harris, 2011) and, today, most coastal villages with access to suitable reef flats within Velondriake routinely implement annual temporary closures during the austral winter months (June-August). As of June 2013, the LMMA had implemented a total of 84 closures.

Octopus undergo rapid periods of near exponential growth and have a relatively short life span (Caveriviere, 2006; Van Heukelem, 1973), which makes them an ideal target species for management interventions, as harvesters can quickly see results after only a few months (Harris, 2007). Closures on relatively small areas of reef flat in Velondriake (representing on average less than 25% of a village's typical octopus fishing grounds: Blue Ventures, unpublished data) allow octopus to recruit and grow without being disturbed (Raberinary & Benbow, 2012). These closures have proven to increase CPUE for at least six weeks following the opening, while not decreasing total landings (Benbow & Harris, 2011). Results also show that village revenue does not decline during closure periods, and that the majority of closures increased profit by nearly 500 USD (Purchasing Power Parity: Blue Ventures, unpublished data). The closures are opened on a specific 'opening day' and harvesters from nearby villages converge on the beach; an elder conducts a traditional blessing after which everyone is allowed to enter the water and begin harvesting.

Following the early success of these temporary closures, the Malagasy government instituted a regional (southwest) mandatory annual closure from December 15th – January 31st in 2005, meaning many Velondriake villages now institute two closures per year. Since 2009, an additional 25 villages along the south west coast (outside of the Velondriake LMMA) have also begun experimenting with similar octopus fishery closures. This method has even spread outside of the south west region, having been implemented in an LMMA in northern Madagascar in 2010. This management technique has also gained favour within the broader western Indian Ocean region and was piloted as a nationally enforced fisheries management strategy on the Mauritian island of Rodrigues in 2012.

Unlike many octopus fisheries around the world (e.g. Zanzibar, Brazil, Greece, Patagonia) where men dominate exploitation (Håkansson *et al*., 2012; T.Leite, personal communication, 2012; S. Katsanevakis, personal communication, 2012; L.Storero, personal communication, 2012), women traditionally play an important role in octopus harvesting in Madagascar (Bruggemann *et al*., 2012; Barnes & Rawlinson, 2009). However, the gender balance of octopus harvesters changed in Velondriake when the demands of a more lucrative market developed. Before the collection market for octopus was established, men rarely harvested octopus, preferring instead to concentrate on the more lucrative finfish fishery. Once the commercial market was established, however, there was a noticeable growth in the numbers of male octopus harvesters entering the fishery, and at the same time women quickly saw an increase in their ability to earn money (Langley, 2006). Although today both men and women harvest

octopus in the Velondriake LMMA, the fishery is still dominated by women (86% of adult women harvest octopus vs 31% of adult men: Blue Ventures, unpublished data). The discourse on food production is often that men tend to focus on more 'cash crop' resources while women are involved in subsistence food production (Koopman, 1993; Randolph & Sanders, 1988). However, this probably due to the fact that women rarely have similar access to assets and markets as men (Hill & Vigneri, 2011; Doss, 1999). Within the Velondriake LMMA where octopus is a "cash crop" (99% are sold directly to commercial collectors: Blue Ventures, unpublished data), women have easy and socially-acceptable access to the market, thus allowing them to participate fully. Women also remain more numerous in the octopus fishery, possibly as a result of the relatively recent commercialisation (L'Haridon, 2006) of a traditionally female fishery.

Male and female artisanal fishers in Velondriake harvest octopus using gender-specific methods (Humber *et al*., 2006). Women glean octopus on reef flats using long spears or rebar, and harvest is restricted to only 2-4 hours over a 5-7 day period every two weeks during spring tides when the water is low enough to access the reef flat on foot. It has been noted that this tide-dependent method of fishing is well suited to accommodate women's role in daily household chores alongside fishing (Chuenpagdee *et al*., 2006; Iida, 2005). Octopus fishing is not as popular with men, who preferentially target finfish; however, men who target octopus free dive with masks and spears (to <5 m), targeting subtidal octopus. They are thus less restricted by water depth, although they still preferentially target the low spring tides (Blue Ventures, unpublished data).

In this paper, we examine the octopus fishery and management initiatives within the Velondriake LMMA, using data on octopus landings from 14 coastal villages collected since 2004 (the year of the first fishery closure), as well as information gathered during focus groups and workshop discussions. We analysed the quantuty of octopus caught by women and men, and the economic importance of female-landed vs male-landed octopus to household income. We also examined the extent to which men and women are currently involved in decision-making about octopus fishery closures and discuss how this may ultimately influence sustainability of this management initiative.

METHODS

From September 2004 to December 2011, researchers of the conservation NGO Blue Ventures worked with community members employed as octopus data collectors to gather detailed daily fishery landings (individual weight, number caught, octopus sex, fishing site, method of fishing, and name, gender and age of fisher) at 14 villages (Fig. 1). A total of 64 seasonal octopus fishery closures was implemented in these villages over this period, of which 20 generated sufficient data for analysis of gender composition of the fishers. Octopus fishery closures are predominantly two to three month in duration on specific reef flats and include subtidal habitat around the reef crest.

We calculated catch per unit effort (CPUE) as kilograms of octopus landed per fisher trip (weight per unit effort, WPUE) from the landings data and generated a monthly mean trip value for male and female fishers. We also calculated the mean monthly number of octopus harvested per fisher trip (number per unit effort, NPUE) and the mean octopus size landed. We do not currently have accurate time data to calculate catch per effort per hour, so the unit of effort was standardised as a fishing trip. When fishers glean, they are dependent on tidal height, so a fishing trip is believed to be an accurate proxy for time spent fishing as most fishing trips are focused on a 2-4 hour period when the tide is lowest. Both men and women tend to harvest octopus during spring low tides. Welch two sample t-tests were used to determine the statistical significance of distributions.

The number of fishers of each gender active per day was calculated and standardised per fishing trip to generate a value for the mean number of fishers of each sex active on

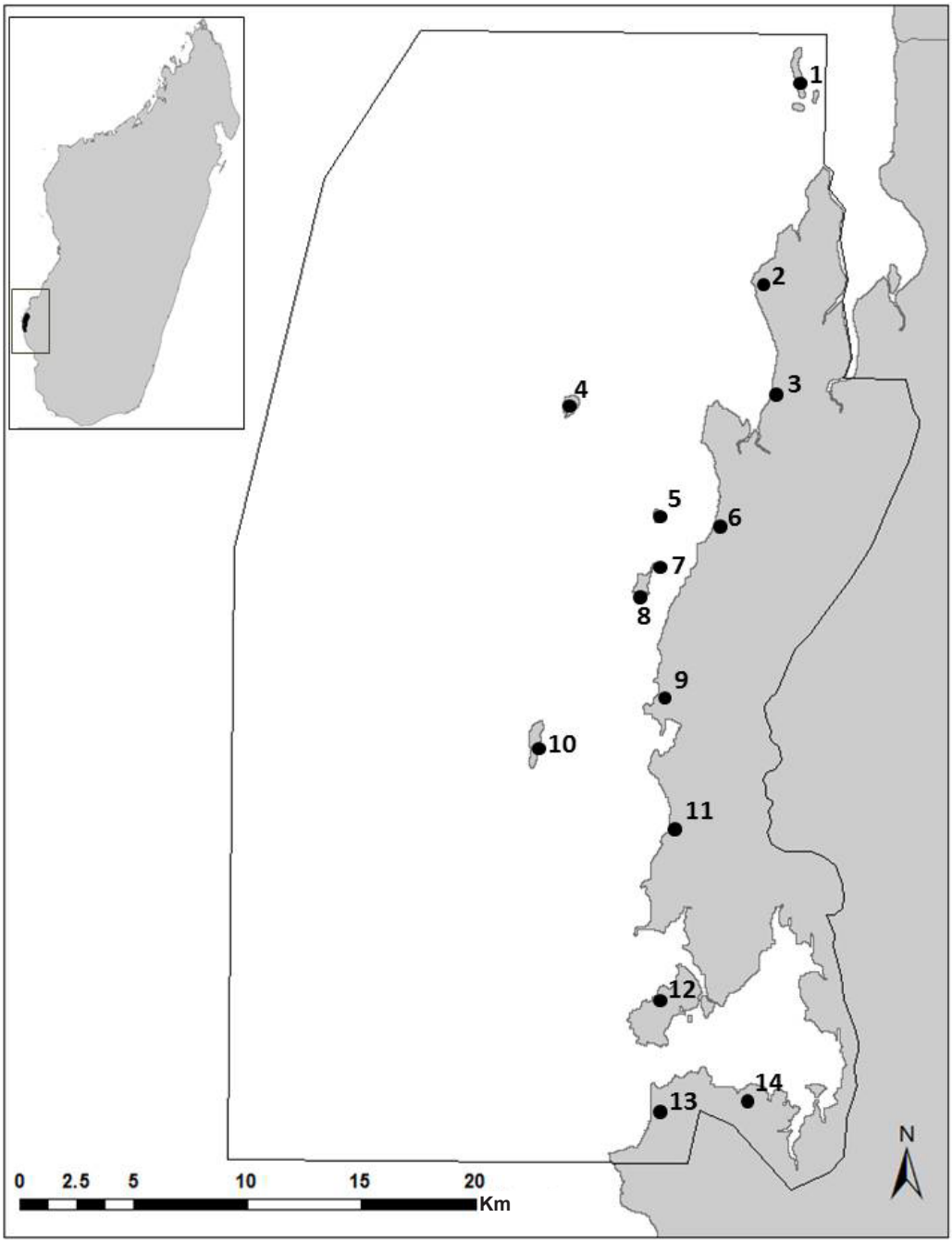

Figure 1. Map of the Velondriake Locally Managed Marine Area. Its extent is denoted by the thin black line. Black dots represent villages where octopus landing data were recorded. 1 = Nosy Be, 2 = Bevato, 3 = Belavenoke, 4 = Andranombala, 5 = Nosy Mitata, 6 = Antsatsamoroy, 7 = Andambatihy, 8 = Nosy Ve, 9 = Andavadoaka, 10 = Nosy Hao, 11 = Ampasilava, 12 = Lamboara, 13 = Ankitambana, 14 = Tampolove.

any active fishing day, i.e. not specifically any open season day. A record of the price paid per kilogram by the commercial companies enabled calculation of the mean daily income from octopus for fishers of each gender, and thereby the relative household importance of octopus-derived income to both men and women.

Additional data were collected from 66 open days between 2004 and 2011. The total catch weight was collected at landing sites from the commercial buyers in the field and later verified at the processing plants. A visual head count of male and female fishers active on the reef flat was also recorded by three individual observers and averaged to produce a single estimate of the total number of fishers at each site. An approximate value of catch per fisher (CPUE) was calculated from these figures at each site. Note that it was not possible to separate these data to provide a CPUE for fisher gender.

Open day tidal heights were obtained from Toliara tide tables (the nearest big town, 200 km to the south) and a linear regression analysis was run comparing tidal height with both the observed CPUE calculated from the head count data, and also the fisher WPUE separated according to fisher gender.

Two focus groups were held with young and middle-aged female octopus harvesters (n= 5 each) in late 2011 to gain more qualitative information. Further workshops were held in ten Velondriake villages throughout early 2012, all of which involved in octopus fishery closures in the past. Separate workshops were held for women and men, with participants selected by the village president and local Velondriake representatives in each village. A total of 139 women and 129 men participated. The workshops, led by two Malagasy community educators, facilitated discussion and elicited responses to a series of open-ended questions such as “do you think men and women equally benefit from the reserves”, “do you think women are sufficiently involved in octopus management decisions?” and “how do you think women could be better incorporated into decision-making about the closures?”

RESULTS

The catch from 35 277 fisher trips sampled over the six-year study period comprised 117 249 octopus harvested during 19 692 female fishing outings (58%) and 14 049 male fishing outings (42%). The monthly WPUE (weight per unit effort) was consistently and significantly greater for male fishers than females over the six-year study period (Fig. 2; mean male WPUE = 3.13 kg/fisher/day; mean female WPUE = 2.58 kg/fisher/day; t= 4.54, df = 137, p-value = <0.001). The difference in the mean monthly WPUE between male and female fishers over the six-year period appeared to be driven by male fishers targeting larger individual octopus as the mean octopus size landed by male fishers was significantly larger than that landed by female fishers (925 g and 820 g respectively, t = 5.67, df = 122, p = <0.001). NPUE (number per unit effort) manifested more fluctuation, with females frequently landing greater numbers of octopus than male fishers, although the difference was not significant (t = 0.71, df = 134, p-value = 0.5).

Female fishers were predominant at all of the 20 closure sites studied between 2004 and 2010, on 16 of the open harvesting days (when the ban on harvesting was lifted). The mean proportion of women at sites where they comprised the majority was 60% (total number of female fishers recorded on open days = 1 359); male fishers were predominant on just three of these days and equal numbers of male and female fishers occurred on one occasion. On any given day throughout the study period, more female fishers than males were observed to be fishing (female mean = 18 ±5; male mean = 15 ±4). However, female fishers were absent on some open harvesting days, highlighting the greater tidal restrictions they experience and this affects female fisher effort.

As the price of octopus in the Velondriake LMMA was 1 090 MGA (US$ 0.54, mean price 2003-2011, SE ±70 MGA) per kilogram at the time of the study, female fishers brought in 18% less income daily than male fishers; female fishers earned 2 812 MGA per day and

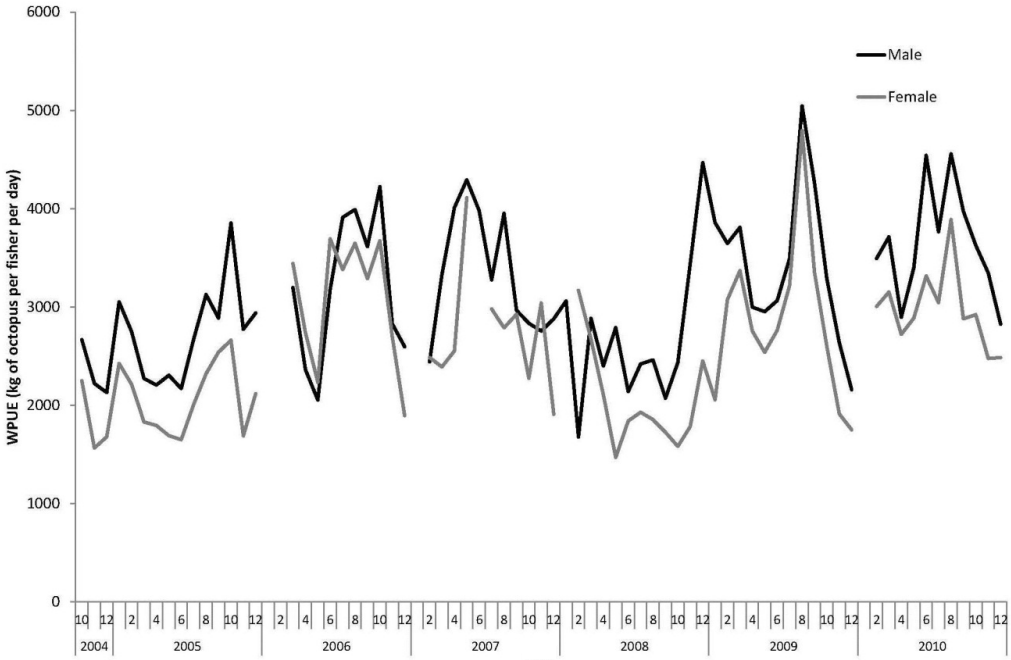

Figure 2. Monthly fluctuations in kg of octopus landed per fisher per day. The black line represents the male fisher catch, the grey line that of female fishers.

male fishers 3 412 MGA based on the mean WPUE. However, on any given day there were likely to be 20% more female fishers than male fishers and their overall income from octopus fishing was thus greater.

Tidal height on the first harvesting day after a closure was found to vary considerably from 0.5 to 1.5 m. Of the 67 closures held within the Velondriake LMMA between 2004 and 2011, 86% (n = 58) were opened on a day with a tidal height of less than 1.0 m. The opening day CPUE (total weight, not gender specific) was negatively correlated with opening day tidal height (Fig. 3). When data were split between male and female fishers for the 19 closures where we had fisher gender data,we saw no significant relationships between CPUE and tidal height (female fishers r^2=0.07, p =0.15; male fishers r^2=0.02, p = 0.12). However, we did note that the mean WPUE for female fishers was reduced by 12% when closures were reopened at tidal heights of ≥1 m, while the male fisher catch varied by only 4%, but these difference were not significant (see Table 1).

During the focus groups and workshop discussions, women frequently reported that men selectively enter the fishery on opening days after a harvesting closure, meaning that those who generally target other species are tempted to harvest octopus opportunistically on opening days. This may place women at a disadvantage. Older women in the

Table 1. Mean octopus catch (WPUE) on harvest opening days at different tidal heights.

	WPUE (kg.fisher^{-1}.day^{-1}) in tides <1 m (n = 16)	WPUE (kg.fisher^{-1}.day^{-1}) in tides ≥1 m (n = 4)
Female fishers	3.97	3.53
Male fishers	4.27	4.13

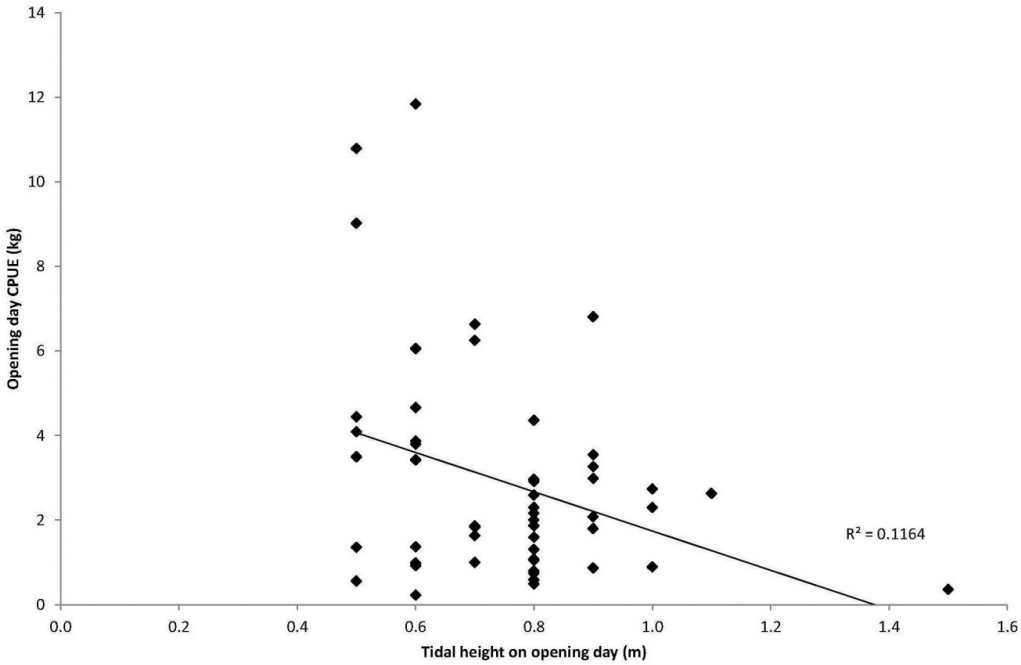

Figure 3. Correlation between octopus harvest on opening day (kg per unit effort) and tidal height (R^2= 0.13, p = <0.001) at all 14 villages on 64 opening days.

focus groups, as well as most women in the workshops, reported that the day and time opening after a harvesting closure is sometimes also not conducive to female harvesting methods, as the water is still too high for women to access the reef flat. Given that 14% of closures were reopened when the tidal height was >1m, this is a particularly relevant point, especially when the mean catches of female fishers were shown to decrease by 12% on opening days with greater tidal heights, although we note that our sample size on this point was small. The reduced WPUE gained by women on such occasions, combined with the general opinion of all focus group participants, suggested that women may rightly feel that the closures are sometimes unfair, and tidal height discussions should be incorporated in future management decisions to ensure more equitable benefit-sharing.

DISCUSSION

Our findings suggest that women tend to catch more individual octopus but that men's catches are generally larger. Female harvesters usually predominate on opening days and throughout harvesting. On an individual basis, women bring in less money than men from octopus per fishing trip but the female harvest overall brings in more money. Finally, we found that increased tidal height negatively affects all fishers, particularly women.

Our research suggests that men still preferentially target low spring tides for harvesting, although their timing is more flexible due to their fishing method (i.e. they can start earlier and end later than women on foot). Future research should determine the average number of hours men and women spend on octopus fishing to verify our current understanding that fishers spend

approximately the same amount of time fishing due to tidal limitations. This would help to refine our current CPUE data and establish the hourly rather than daily catch differences between men and women.

Focus groups and workshop discussions supported many of these findings. Our results showed that opening days may not take women's fishing techniques adequately into account, may thus be biased towards men's fishing practices, and that current female involvement in closure management is low even though the fishery is more important financially to women. We therefore recommend that the participation of women should be strengthened wherever possible to encourage and enhance community benefit-sharing, thereby increasing buy-in to the closure management model.

Although designed to be inclusive, community-based natural resource management initiatives, such as the octopus fishery closures, tend to reinforce gender inequalities because they are based on traditional, usually male-dominated, decision-making (Blaikie, 2006; Ellis & Allison, 2004; Meinzen-Dick & Knox, 1999; Meinzen-Dick & Zwarteveen, 1998). The village meeting setting, where community-based management decisions are often made, does not necessarily encourage participation by women (Thakadu, 2005) and, even though not formally excluded, women are often unable or unwilling to participate in mixed gender meetings (Meynen & Doornbos, 2004). Velondriake octopus fishery closures are run as community initiatives and the decision to close a certain area is made at traditional village meetings. Male elders in the village, comprising current and retired fishers, generally preside at these meetings. Women in the focus groups and workshop discussions revealed that, while some women do attend these meetings, most do not have the time, desire, or support of their husbands and families to attend. Workshop discussions with both men and women highlighted the need to better incorporate women in these meetings.

While the location of a closure is decided at the village level, the LMMA governing body (Velondriake Association) and the commercial buyers make the final decision on the length of a closure and the date of its reopening. Membership of the Velondriake Association is based on voluntary self-selection and village election; while this system is attractive in that it is likely to identify the most qualified and committed participants, it is also the approach most susceptible to gender bias (Johnson *et al*., 2004). The Association is male-dominated with women currently representing just 16% of its members (13 of 80 members as of 2013), with no women elected to the executive leadership level. We noted that the female members of the committee are rarely vocal at meetings or when decisions are made, possibly due to their cultural outlook on gender position. This suggested that, despite the small female presence on the committee, their involvement in decision-making is currently very low. Unless an effort is made to include women in Velondriake initiatives, the elite of the community – usually older males – will continue to control resources and not facilitate their more equitable distribution or include greater female representation in the Association (Thakadu, 2005; Beck & Nesmith, 2001; Pomeroy *et al*., 2001; Singleton, 2000). Workshop discussions resulted in the suggestion from both genders that women should be more involved in future elections and better represented within the Association.

Failure to adequately include women in natural resource management institutions results in impaired decision-making on resource use and monitoring (Agarwal, 2000), and therefore a reduced sense of community ownership of and support for conservation initiatives. It is crucial that the Velondriake women should feel a keen sense of ownership of and involvement in the management of their octopus fishery for its sustainability, and that of the harvesting closures. If they perceive any reduced benefit or lack of ownership, respect for the closures and the governing dina is likely to diminish. Although women

in the two focus groups reported that they do have some responsibility in enforcing the dina, they also stated that they rely heavily on men to follow up on any infractions such as poaching during a closure. It was also noted that the offender in every reported incident of poaching to date was a male.

Research shows that women are more likely to spend additional income on household needs such as food (Williams, 2010) and, therefore, income from female octopus fishers is an important factor to consider in management of the fishery due to the potential knock-on effects on children's education, health and nutrition. Octopus fishery closures in Velondriake end in August or early September shortly before the beginning of the school year, the timing of which, while chosen for biological reasons, also works out well for families with schoolchildren. Future research should investigate the expenditure of octopus-derived income by men and women to determine how this additional income is used and test the above assumption that women spend more of their income on household needs.

The focus groups and workshops for women identified a solution to the absence of a female voice in decision-making: they suggested that all female gleaners should meet and decide on a unified plan regarding the closures to be presented at the village meetings for discussion with the Velondriake Association. Establishing these side meetings and ensuring that they occur should be a priority for the Velondriake Association, and they, encouragingly, have been incorporated into the plan for future octopus fishery closures.

Another primary reason for a lack of representation in decision-making meetings is that women are often busy at home with domestic duties: caring for children, preparing food and gathering firewood or water. With little free time, women are not able to participate equally. Community-based natural resource management associations, such as Velondriake, must make a concerted effort to incorporate women in decision-making. This could include the facilitation of better transportation to meetings or arranging venues closer to home. For example, Velondriake meetings could be held more often at the village or regional level instead of meeting in the central village which can be up to two days by boat for some participants. Similarly, meetings should be scheduled during times of the month when women have more time (i.e. neap tide, when they are much less likely to be octopus fishing).

Conservation and natural resource management messages and information that target women through female-centred fora should also be considered. For example, meetings on family planning or community health, which attract a large proportion of women, could usefully incorporate such initiatives. In the Velondriake LMMA, community-based distributors of contraception and health supplies meet frequently for training and are also presented information on marine conservation activities, including how the octopus fishery closures work biologically and ecologically. Women who would not normally have access to this information can become informed advocates for the closures and enforcers of the dina through such avenues.

The present study thus demonstrates the importance of gender equity in sustaining inclusive and enduring community-based, small-scale fisheries management. While incorporating women into management may be a challenge, it must be prioritised to ensure everyone feels a meaningful sense of ownership in the management process and gains equal benefits. Given the rapid expansion and proliferation of temporary octopus fishery closures throughout south-west Madagascar and further afield in the WIO region, it is important that women are given the opportunity and encouraged to take a proactive role in these matters.

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