Gender and small-scale fisheries: a case for counting women and beyond

DANIKA KLEIBER

Corresponding Author: d.kleiber@fisheries.ubc.ca

LEILA M. HARRIS

AMANDA C. J. VINCENT

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ABSTRACT

Marine ecosystem scale fisheries research and management must include the fishing effort of women and men. Even with growing recognition that women do fish, there remains an imperative to engage in more meaningful and relevant gender analysis to improve socio-ecological approaches to fisheries research and management. The implications of a gender approach to fisheries have been explored in social approaches to fisheries, but the relevance of gender analysis for ecological understandings has yet to be fully elaborated. To examine the importance of gender to the understanding of marine ecology we identified 106 case studies of small-scale fisheries from the last 20 years that detail the participation of women in fishing (data on women fishers being the most common limiting factor to gender analysis). We found that beyond gender difference in fishing practices throughout the world, the literature reveals a quantitative data gap in the characterization of gender in small-scale fisheries. The descriptive details of women's often distinct fishing practices none-the-less provide important ecological information with implications for understanding the human role in marine ecosystems. Finally, we examined why the data gap on women's fishing practices has persisted, detailing several ways in which commonly used research methods may perpetuate biased sampling that overlooks women's fishing. This review sheds light on a new aspect of the application of gender research to fisheries research, with an emphasis on ecological understanding within a broader context of interdisciplinary approaches.

Key words: Ecosystem-scale Management, Gender, Small-scale Fisheries,

INTRODUCTION

This paper demonstrates the importance of gender analysis for rigorous and comprehensive understanding of small-scale fisheries in the marine ecosystem. Most small-scale fisheries data is limited in its application at an ecosystem level because certain fishers and fisheries, particularly women fishers and the fisheries they participate in, are frequently overlooked in data collection. The fact that they are overlooked is often embedded in biased sampling methods. The exclusion of women and gender analysis from small-scale fisheries research results in an underestimation of human catch, and also an underestimation of the diversity of animals and habitats targeted by fishers. Furthermore it impedes a broader socio-ecological understanding of fisheries that links human social systems to the marine environment.

A gender approach to fisheries aligns with emerging ecosystem approaches that intentionally work at the intersection of social and ecological systems (Arkema et al. 2006; Hall-Arber et al. 2009; Garcia 2010). The importance of gender analysis to fisheries social systems such as food security, and livelihood, has been reviewed (Weeratunge et al. 2010; Williams 2010; Harper et al. 2013), but a synthesis of the application of gender approaches to ecological understanding of marine ecosystems is still needed. Our discussion here offers an analysis to fill this gap, providing a review and assessment of why gender relevant data is often still missing in fisheries research, and how these gaps might be closed.

We focus on small-scale fisheries—characterized as dynamic multi-method, multi-species fisheries that occur throughout the world (Béné, Macfayden, & Allison, 2007). Our interest in elaborating the importance of a gender approach for improved ecological understanding leads us to focus on small-scale fisheries for at least two reasons. First most fishers are small-scale fishers. Up to 90% of the world's fishers are in the small-scale sector (Béné, Macfayden, & Allison, 2007). Secondly, the diversity of methods used, species targeted, and the use of

catch characteristic of small-scale fisheries mean that gender differences in fishing practices may be much more evident in these settings.

To examine the import of gender approaches to ecological understanding of small-scale fisheries we analyze the past two decades of original research and build on key reviews that have given the current state of knowledge and outlined avenues for future research (Bennett 2005; Walker & Robinson 2009; Weeratunge et al. 2010; Williams 2010; Harper et al. 2013). We outline common patterns found in varied geographic examples, and detail the diversity and the adaptability of how women and men fish. Building on this base, we offer a discussion of how gender approaches to small-scale fisheries is crucial to improve our understanding of the human role in marine ecosystems, and taking marine protected areas as an example, explore how this understanding relates to fisheries management. Finally we explore how specific fisheries research methods may fail to collect relevant gender data and contribute to a data gap in women's fisheries and comprehensive ecosystem level understanding. This article reveals that gender approaches contribute to recent trends and novel directions in fisheries science and marine conservation.

1. Gender and small-scale fisheries – global review

1.1 Research Context

In the past two decades there has been an increasing, if still relatively small, representation of gender approaches in fisheries literature and policy. Men's fishing practices and their role in fishing communities and economies are far more likely to be documented than women's, creating a bias in the data used to make management decisions, and a barrier to approaching fishing practices from a gender perspective (Matthews 2002; Bennett 2005). While gender approaches go beyond the study of women, the overall lack of data on women and women's fishing practices often means that there is insufficient baseline data or potential for comparative analysis. Recent reviews have rightly pointed out that an

expanded socio-ecological view of fisheries further justifies the need to include gender as a key variable in our understanding of the fishing communities and economies as women participate and often dominate many aspects of the fisheries production chain (Bennett 2005; Weeratunge et al. 2010; Williams 2010; Harper et al. 2013). For instance, to better reflect the role of the production chain into our understanding of fisheries, sustainable livelihood approaches have been presented as an appropriate research and management framework (Bennett 2005; Weeratunge *et al.* 2010). Similar to an ecosystem approach, livelihood approaches often incorporate both social and ecological factors in the assessment of livelihoods, and provides explicit recognition of gender and other social variables (Allison and Ellis 2001).

While several recent reviews have detailed key data gaps in our understanding of the social and economic aspects of fisheries, they have been less explicit about the role of gender for ecological process understanding. Providing some insights towards this end, Weerantugne et al. (2010) point out the data gap with respect to the role of gender in the acquisition of marine ecological knowledge, while Harper et al. (2013) emphasize women's ecological knowledge as an untapped resource in data poor systems. We build on the work of these previous efforts by expanding more explicitly on the relevance of gender sensitive approaches and data to key ecological components of fisheries science and management.

1.2 Case study literature review methods

We identified the primary literature by searching for original research published between 1992 and 2012 (searching the Web of Knowledge database for articles containing the keywords “gender” OR “women” AND “fisheries”). With no limits on methods of data collection used or geographic focus of the work, we identified 32 peer-reviewed articles that described small-scale fisheries. Examination of references produced a further 16 peer reviewed articles and 5 book chapters. Finally we included research conducted or published by the International

Collective in Support of Fishworkers (ICSF), the Secretariat of the Pacific Community (SPC), and the proceedings of Global Symposia on Gender and Fisheries from 1998 to 2011 producing 30 more articles. In cases where data specific to gender and fisheries was reported in multiple related articles, the peer-reviewed article, or the latest among them was chosen.

Small-scale fisheries was defined broadly as it is often very context dependent. Many factors including gear type, boat size, habitats exploited, use of catch, and identity of fishers can play a role in the characterization of the scale of fisheries. For the purposes of this review we automatically included all fisheries described as artisanal, subsistence, non-boat, non-motorized, and single occupant boat fisheries. In the small selection of case studies that did describe commercial fisheries with multi-crew boats, we examined the manuscript for characterizations of the fisheries as small-scale by the authors. We included all studies that used the descriptor “small-scale”, but also other descriptors such as “family owned”, “in-shore”, and “small boat” which were used in the text to distinguish the fisheries of their study from large-scale fisheries. We did exclude fisheries defined solely as “recreational”.

1.3 Case study review findings

The case studies provide examples from a diversity of cultural and ecological contexts (Figure 1). While the map representing research sites is geographically diverse, the fact that data are often unavailable means that this is not a comprehensive geographic representation of women’s participation in fishing. In particular the sparse number of examples from Europe and North America may be due to the roots of gender and fisheries research in the field of development, which is primarily focused on developing country contexts (Walker and Robinson 2009). Our deliberate inclusion of literature from regionally specific institutions such as the SPC, and the Global Symposium on Women and Fisheries as part of the Asian Fisheries Forum also gave greater representation to the Asian and Pacific regions. There were many detailed studies of gender and fisheries in

North American and European contexts, but they rarely described women's fishing practices and instead focused on women's role in processing, or on-shore management.

Gender roles in fishing were most commonly described in terms of methods, animals targeted, and habitats used. These descriptions highlight that women and men often interact with different parts of the marine ecosystem. However, quantitative measures commonly used in fisheries science such as biomass of catch and catch per unit effort (CPUE) were not commonly reported (Figure 2). In fisheries science, questions related to fishing pressure rely on the quantification of catch and effort and these are addressed far less frequently in the gender literature representing a considerable gap in our understanding. The description rather than quantification of women's fishing may be due to the assumption that women's fishing is supplemental and hence negligible in terms of overall human pressure on the marine ecosystem (Quinn and Davis 1997). The lack of quantification may also be due to trends in gender research which have increasingly focused on qualitative approaches to understanding power relations, rather than the quantitative documentation of material realities of women's and men's lives (Porter and Mbezi 2010). The characterization of gendered fishing practices may have also been descriptive because it was not always central to the articles. In many instances, women's fishing was discussed as context for a focus on development, marine management, or livelihoods in fishing communities. In other cases quantitative data is given, but only focuses on women's fisheries and so does not allow for a more comprehensive gender analysis (de Boer *et al.* 2002; Ashworth *et al.* 2004; Fay *et al.* 2007). Examples of quantitative gender data were mostly found from human ecology research (Bliege Bird 2007), and SPC studies quantifying the small-scale fisheries of Pacific Island countries (Kronen 2004, 2008; Kronen and Vunisea 2007).

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Figure 1. Case studies presented geographically. 1, 2, 4, 5, 6, 7, 49, 52, 55, 56, 57 & 59 (Kronen and Vunisea 2007); 3 (Kronen 2002); 3 (Kronen and Malimali 2009); 3 (Kronen and Bender 2007); 4 (Kronen 2008); 4 & 5 (Lasi and Kronen 2008); 6 (Walker and Robinson 2009); 8 (Reedy-Maschner 2009); 9 (Conway *et al.* 2002); 10 (Tyrrell 2009); 11 (Shannon 2006); 12 & 21 (Thiessen *et al.* 1992); 13 (Savard and Fraga 2005); 13 (Arce-Ibarra and Charles 2008); 14 (Gammage 2004); 14 & 32 (Crawford *et al.* 2010); 15 & 16 (Trimble and Johnson 2013); 17 (Di Ciommo and Schiavetti 2012); 18 (Silva-Cavalcanti and Costa 2009); 19 (Frangoudes *et al.* 2008); 20 (Nightingale 2011); 20 (Zhao *et al.* 2013); 21 (Pettersen 1996); 22 (Göncüoğlu and Ünal 2011); 23 (Ashworth *et al.* 2004); 24 (Tindall and Holvoet 2008); 25 (Iyun 1998); 25 (Akanni 2008); 26 (Brummett *et al.* 2010); 27 (Béné *et al.* 2009); 28 (Ngwenya *et al.* 2012); 29 (Branch *et al.* 2002); 30 (Kyle 1997); 30 (de Boer *et al.* 2002); 31 (Geheb *et al.* 2008); 32 (Jiddawi and Ohman 2002); 32 (Porter and Mbezi 2010); 33 (Hauzer *et al.* 2013); 34 (Peterson and Stead 2011); 35 (Rubinoff 1999); 36 (Thamizoli and MSSRT Team 2004); 37 (Pramanik 1994); 38 (Ahmed *et al.* 1998); 38 (Sultana *et al.* 2002); 38 (Ahmed *et al.* 2010); 39 (Lim & Apong 2012); 39 (Johnson 2001); 40 (Nowak 2008); 41 (Shams and Ahmed 2000); 41 (Resurreccion 2006); 42 (Hao 2012); 43 (Ko *et al.* 2010); 44 (Lim *et al.* 2012); 45 (Israel-Sobritchea 1994); 45 (dela Pena and Marte 1998); 45 (Sotto *et al.* 1998); 45 (Asong *et al.* 2002); 45 (Siar 2003); 45 (D'Agnes *et al.* 2005); 45 (Eder 2005); 45 (Fabinyi 2007); 46 (Fitriana and Stacey 2012); 47 (Thorburn 2000); 48 (Matthews and Oiterong 1992); 49 (Kronen and Tafileichig 2008); 50 (Bliege Bird 2007); 51 (Kinch 2003); 53 (Aswani and Weiant 2004); 53 (Molea and Vuki 2008); 54 (Lambeth 2000); 55 (Tekanene 2006); 55 & 58 (Fay *et al.* 2007); 55 (Thomas 2007); 57 (Tarisesei and Novaczek 2006); 57 (Gereva and Vuki 2010); 58 (Quinn & Davis 1997); 58 (Kronen 2004); 58 (Kuster *et al.* 2005); 58 (Tawake *et al.* 2007); 58 (Fay-Sauni *et al.* 2008); 58 (Verebalavu 2009); 59 (Sauni and Sauni 2005). (Kronen and Vunisea 2009) is not presented here as it presents data by Oceania cultural region.

Figure 2. Frequency of data types presented in case studies. The 106 case studies of original data found in the 83 articles were each coded for the types of data they used to describe small-scale fishing. Descriptive categories of how, what, where and when fishers interact with the marine ecosystem were placed in the following four categories 1) Method: gear or fishing method names, 2) Species: wild caught marine animals or plants, and 3) Habitat: marine habitats used. Measures of fishing commonly associated with the calculation of fishing pressure were divided into the following four categories 1) Fisher count: number of fishers, 2) Catch size: biomass, animal count, or Kcal measured in total or average, 3) Effort: time or frequency of fishing measured in hours, days, or weeks, and 4) CPUE: calculation of catch per unit effort both of which may vary. Finally the social and economic importance of fishing catch as described by how it was used was placed in the final category: Use of catch: eaten, sold, given away, used as bait. The proportion of studies offering data related to the specific categories are presented (all case studies), as well as a subcategory of case studies that offered data on women and men (gender analysis). It should be noted that within the CPUE category, 73% of all studies are case studies done by the Secretariat of the Pacific Community.

1.4 Gender differences in small-scale fishing

The literature illustrates a gender division of labour in small-scale fisheries that suggests a common contrast between women's near-shore gleaning for invertebrates and men's offshore boat fishing for finfish—a pattern first documented by Chapman (1987). In the small number of cases where quantitative data on women and men's fishing was presented, men have a greater proportional representation in the number of fishers, catch biomass, fishing effort and CPUE, but not in all fishing methods (Table 1). There is often a distinction made between gleaning, the search for primarily shell species in intertidal environments, and other types of fishing. While non-gleaning fisheries again suggest greater male representation in fishing, for gleaning fisheries women's proportional representation was either greater than or roughly equivalent to that of men in number of fishers (gleaners being a category of fishers), catch biomass, and fishing effort, but not CPUE (Table 1). The quantitative data indicates that gender is an important variable for describing participation in various types of fishing method. While the pattern of women primarily participating in gleaning and men primarily participating in non-gleaning fisheries emerges, it is far from universal and should not be assumed to be true of every system, or unchangeable over time. It may also be due to the greater representation of case studies from Asia and the Pacific.

Table 1. Participation in fishing by gender and method. We present a proportion of case studies that measured the participation of women and men in all fishing activities, gleaning or non-gleaning fishing activities using four different quantitative measures. We further distinguished between cases where fishers numbers, catch size, effort or CPUE was either found to be larger for women ($F > M$), $\leq 10\%$ difference or described a roughly equal between women and men ($F \approx M$), or larger for men ($F < M$). The “n” represents the number of case studies the provided the data. Some case studies presented data on all fishing, but didn’t distinguish between gleaning and other fishing, while other studies only reported gleaning, or non-gleaning fishing catch. Hence, the number of case studies at each category varies.

Measure	Fishing Type	$F > M$	$F \approx M$	$F < M$	n
Number of fishers	All	0.10	0.05	0.85	20
	Glean	0.84	0.16	0	25
	Non-glean	0.00	0.13	0.88	32
Biomass	All	0.00	0.31	0.69	16
	Glean	0.29	0.35	0.35	17
	Non-glean	0.00	0.11	0.89	19
Effort	All	0.00	0.12	0.88	17
	Glean	0.50	0.33	0.17	6
	Non-glean	0.00	0.33	0.67	12
CPUE	All	0.00	0.06	0.94	16
	Glean	0.08	0.17	0.75	12
	Non-glean	0.00	0.31	0.69	13

Fishing methods are often closely linked with the animals targeted, so gender difference are often evident in catch types. The general observation that “*Shells are for women, fish are for men*” (Siar 2003) is well documented throughout the Pacific, and is a distinction we found repeated in South Africa, Egypt, Spain, and the United States (de Boer *et al.* 2002; Ashworth *et al.* 2004; Frangoudes *et al.* 2008; Reedy-Maschner 2009). However, in in most case studies where catch composition was described, women and men caught both fish and invertebrates. In the case studies that described invertebrate only fisheries, women were more often the fishers. In contrast the case studies that described vertebrate only fisheries, men were more often the fishers (Figure 3). Greater detail reveals gender distinctions even in cases where men and women catch both invertebrates and vertebrates. For example in the Philippines, while both men and women engage in invertebrate and vertebrate fisheries, a greater proportion of women’s catch is made of invertebrates while the inverse is true for men (Kleiber *et al.* in review). In different examples from the Philippines and the Comoros Islands, women’s vertebrate fisheries concentrated on smaller fish caught near shore while men caught larger fish offshore (Eder 2005; Hauzer *et al.* 2013).

Figure 3. Gender and type of catch. Fisheries divided into vertebrate only (almost entirely fish, but in some cases including mammals and reptiles), invertebrate only (including shells, arthropods, cephalopods and echinoderms), or participation in fishing that targets all animal types. Only gender analysis case studies were included.

Figure 4. Gender and habitats used for fishing. The proportional distribution of case studies (n) that describe use of fisheries habitats by gender. Only case studies that presented data on women and men's habitat use were included (n=45). The number of case studies represented by each habitat varies because not each habitat was included in every case study.

Across the data sampled, gender patterns in the types of marine fishing habitats exploited emerged, with near-shore habitats such as estuaries, mangroves, and intertidal flats being more frequently described as either women-only or shared spaces. Most case studies described habitats such as reef edges or pelagic offshore to be exclusively fished in by men. (Figure 4). Examining the freshwater examples in greater detail also revealed spatial distinctions. In Mexico women were described as fishing closer to home (Arce-Ibarra and Charles 2008), and in the Democratic Republic of the Congo, women fished along the shore while men fish in the deeper water mid-stream (Béné *et al.* 2009).

1.5 Social context for gender differences in small-scale fishing

“Gleaning shellfish is women’s major fishing activity because it can be done close to home, takes relatively little time, require no costly fishing equipment and may be done in the company of children” (Tekanene 2006)

“Most women do not want to be equal to men in fishing because the social rewards are not the same for them” (Reedy-Maschner 2009).

As the Teakanene quote illustrates women’s participation in gleaning over other forms of fishing may be linked to the spatial and temporal limitations on their activities due to concurrent obligations. Hence, women and men’s fishing is often shaped by broader gender roles and as the quote from Reedy-Maschner explains, gender roles also shape the social rewards derived from various types of fishing. In the case of women their roles may result in limited ability to travel long or far and limited access to capital for equipment such as a boat—both of which may narrow women’s range for fishing to near shore habitats and species. Hence, intertidal areas may be considered as women’s fishing space even as men and women both fish there (Siar 2003). Men’s gender roles also mediate their fishing practices, as do other social variables such as age or poverty. For example, in the Philippines, young men with little capital and few dependents are

more likely to engage in illegal or highly variable fishing (Fabinyi 2007). Alternatively the established role of women as providers of daily food in the Torres Straight Islands leads them to choose fishing methods that have a better guarantee of return, while men derive greater social benefits from fishing for large but variable catch that is shared in the community (Bliege Bird 2007). Women's common obligation of household food provision may also explain why women's fishing catch is frequently directed for household consumption while men may be more likely to target more commercially valuable or culturally prestigious marine animals (Chapman 1987; Kronen 2002).

The physicality and dangers associated with certain types of fishing also used by respondents to explain the types of gender differentiated practices observable across many contexts. In several case studies fear of the waves, or deep water is given as an explanation for why women don't venture off shore. For example in Mexico men and women used the same fishing methods, but women chose fishing grounds closer to home which were described as safer (Arce-Ibarra and Charles 2008). Gender differences in perceived risky behavior are a product of cultural expectations rather than biological limitations (Porter and Mbezi 2010), and in fact in one example women were the primary fishers because men expressed fears of fishing (Brummett *et al.* 2010). In some cases gender divisions of labour are formalized by taboos against women in boats (Rubinoff 1999), and limitations on women's participation may be used as a way to limit the number of fishers and hence competition in offshore fisheries (Geheb *et al.* 2008).

Women's fishing is often described as complimentary to men's, and framed within a household livelihood strategy. For instance, in Mexico "women saw their work [bait fishing] as a source of 'support' for the husbands and households" (Savard and Fraga 2005). Similarly in Vanuatu women's fishing was described as helping to "bridge the gap in seafood supply when the active male fishers are sick or busy with other activities" (Gereva and Vuki 2010). In many such examples, even when women's fishing is documented and discussed, it is represented as secondary to men's fishing. For example in Mali girls were described as "assisting" with fishing (Tindall and Holvoet

2008), or in the Philippines and Palau women who fish offshore with their husbands often describe their own work as “helping” (Matthews & Oiterong, 1992; Kleiber et al. unpublished data). In other cases the gender of the fisher is only mentioned when the method is female dominated (e.g. Jiddawi & Ohman 2002). In such examples, the placement of women’s fishing as secondary suggests it is not fully integrated into the larger analysis of fishing.

1.6 Variations in gender differences in small-scale fishing

The gender division of labour in small-scale fisheries is not absolute or universal. Instead, these divisions are diverse in ways that reflect both cultural and marine biophysical diversity. For example, in some Oceanic communities women are forbidden from participating in some types of fishing (Chapman 1987) while among the Btsisi’ of Malaysia most fishing is done by opposite sex couples working together (Nowak 2008). Paying closer attention to biophysical conditions, we see that variations and fluxes may alter participation in certain fisheries regardless of predominant gender divisions. In the Philippines men’s gleaning is often characterized as secondary to other forms of fishing, but in a community with abundant intertidal habitat ideal for gleaning there was found to be a much higher proportion of male gleaners (Guieb 2008). These variations reinforce the need for greater attention to the cultural and biophysical context in which fishing occurs (Walker and Robinson 2009).

Gender roles are also dynamic and historic norms may vary greatly from current practices. In relation to fishing practices shifts in gender roles may be adaptations to changing environmental and economic realities. Changes in the availability of particular marine species, family economic strategies in response to poverty, commercialization of catch, or diversification of employment opportunities may all lead to changes in how women and men fish. For example, in French Polynesia the overfishing of shell species led women to adopt boat fishing that had been male dominated (Walker and Robinson 2009). In other cases women’s participation in non-gleaning fisheries may be part of a household economic strategy to maintain catch and profit within the family rather than

paying crew or needing to split profits from the catch (Reedy-Maschner 2009). As such, women's participation in fishing may be framed as economic necessity, also showing the importance of poverty to these issues: "*A few wives have gone to sea . . . only the poorest of us. We have been driven into the fishing boat by necessity, as well as by a strong wish.*" (Pettersen 1996). Finally, external economic changes such as the commercialization of specific species or diversification of employment opportunities may also change gendered fishing practices. In Tanzania men came to dominate the previously female dominated octopus fisheries after it had become a commercial product (Porter and Mbezi 2010), and in the Canadian Arctic women's increasing employment by the government led them to fish less frequently as they were no longer able to take time off during the fishing season (Tyrrell 2009).

2. How gender applies to ecosystem approaches to fisheries

"[T]he fishing enterprise is not solely undertaken by men, and cannot simply be defined in terms of people on boats" (Reed and Christie 2008)

As we have demonstrated women and men often fish in distinct ways, making it inappropriate to use men as a proxy for the entire community. Here we elaborate why these distinctions are crucial for management questions that require ecosystem level understanding. Specifically we detail how a gender approach illuminates our understanding of how different fisheries interact with the ecosystem and each other, and adds important insights for evaluation of marine protected areas (MPAs) as a key conservation and fisheries management tool.

2.1 Gender and connected fisheries

The inclusion of women's fishing not only highlights overlooked human interaction with specific marine species and habitats, but also illustrates the interaction between different habitats, as well as the targeting of animals at different life stages that might otherwise be missed. For example, gleaning in intertidal areas may have direct impacts on habitat such as coral reefs, and seagrass beds through trampling, or overturning of

the substrate. Other human activities such as shell garden construction in intertidal areas could also create habitat and increase species abundance. These direct interactions may also have wider ecological impacts (Sharpe and Keough 1998).

Women's frequent domain of intertidal habitat is an important component to understanding the role of their fishing in the marine ecosystem, as these habitats, including mangroves, and seagrass beds, may be particularly important for juvenile life stages of many species. For example in El Salvador women's estuary fishing was banned because it was felt to "threaten offshore fishing by depleting breeding grounds" (Gammage 2004). In other cases women's fishing in the Philippines and Comoros Islands was seen as detrimental to offshore fisheries because they targeted juveniles of fish species that were of economic importance at older life stages (Eder 2005; Hauzer *et al.* 2013). Indirect fishing of species as by-catch can also have multi-fisheries level affects—such as in Bengal, India where women's participation in river fishing was documented to have stopped due to over-efficient fine-meshed net harvesting done by men (Pramanik 1994). In a different example in Tanzania women octopus fishers attributed the decline of their catch to men diving for the same species in deeper waters, and thereby eliminating a depth refuge that may have been an important component for the sustainability of the fishery (Porter and Mbezi 2010). All of these examples suggest the important ecosystem level interconnections and dynamics between different marine extraction practices. A gender sensitive approach highlights these different practices, helping to better consider the complex interactions among different fishing practices. Still other important factors such as total biomass and number of fishers may be underestimated without considering the catch of all fishers.

2.2 Gender, invertebrates and MPAs

A focus on gender highlights data gaps that hinder the inclusion of all fisheries into ecosystem scale management. For example, the focus of many women on invertebrate species lays bare the data gap on the management of marine invertebrates. The management of sessile benthic invertebrates - the target species of many gleaners – is

often complicated by scarcity of life history information. In this section we will first examine these data gaps in the context of MPAs, a very common and increasingly used management measure.

Within the MPA literature most studies of the effects of no-fishing MPAs have focused on fish assemblages and coral health. Only recently have studies included a focus on non-coral invertebrates and from what we do know the sessile characteristics of these species make them in many ways ideal candidates for small MPAs. However, the studies that have been done suggest mixed results. In some cases increased biomass and size of animals inside and directly adjacent to the MPA have increased. In other cases lack of change in size and abundance may be due to food chain interactions where closure frees both invertebrates and their predators from human fishing pressure (Gell & Roberts 2003).

The utility of MPAs as a fisheries management measure relies on its ability to produce a spill over of targeted species. Unlike fish, sessile invertebrates disperse during their larval stage (Roberts & Hawkins 2000), lending increasing importance to the consideration of ocean currents and their role in the distribution of larvae when deciding on the placement of MPAs. This was demonstrated in the Solomon Islands when women protected an area they felt was an important “seeding” ground for the rest of the gleaning areas (Aswani and Weiant 2004). It may be that the placement and management of MPAs focused on fish species may not lead to optimal management for all fished animals.

Invertebrates and intertidal habitats are integral parts of marine ecosystems. Invertebrates are often keystone species, and intertidal areas can be important habitat for juvenile species. To assess the effects of MPAs and other management measures, it is important to consider a broad range of marine species and habitats, including those commonly targeted by women. As such, gender considerations might affect management priorities, extending beyond fish species, and also enabling consideration of broader ecosystem dynamics that might be critical for ecosystem health and the sustainability of fisheries.

3. Why aren't women included?

As it becomes increasingly clear that women are actively engaged in fishing in many parts of the globe, a key question is why gender specific data is still so scarce. As we have outlined the gender division of labour has clear implications for fisheries science and marine conservation, but data and especially quantitative data regarding women's fishing practices remains limited. In this section we consider methodological approaches commonly used in the characterization of small-scale fisheries that may perpetuate the invisibility of women's fishing and otherwise impede the collection of data that is both gender relevant and more inclusive of a range of marine extractive practices.

3.1 Limiting definition of fishers and fishing

Narrow definitions of fisher and fishing often may overlook key groups of fishers. For example, census data on occupation, which are often relied on to estimate the number of fishers, may exclude part time labour (Teh and Sumaila 2013), or subsistence labour. As women are often more likely to fish on a part time basis, their participation in fishing is effectively invisible on census forms. For example, official statistics in El Salvador are based on questionnaires that define fishers as those that fish regularly on the open sea and own fishing gear such as a boat, and nets. They found that only 9% of women participated in fishing, however a more detailed study within select communities found closer to 26% of women fished (Gammage 2004). In other cases women fishers may go unreported in part because it is culturally unacceptable for women to fish, and in such cases both women *and* men may discount or downplay women's participation. This may be further complicated by interacting factors of gender, social class and wealth, where women's participation in fishing is viewed as an indication of poverty and subsequently shame. For example in the Philippines many respondents expressed pity for women that fished with their husbands. This helps to explain why women so often described their participation as "Just helping my husband" (Kleiber, unpublished data). This characterization may lead researchers and managers to underestimate and overlook women's participation. In other cases where women's participation in fisheries is a

cultural norm, assumptions by fisheries researchers about gender division of labour may lead them to erroneously exclude women. To unmask the participation of women in fisheries an understanding of local culture coupled with observational studies is essential. This data may be more readily available in anthropological, ethnographic and human behavioral ecology approaches, suggesting an ongoing need for interdisciplinary evaluation of fishing practices.

Similarly, limited definitions of what counts as fishing may also overlook key fisheries. Gleaning, is often not considered as fishing *per se*. Because gleaning occurs in intertidal habitats and primarily targets invertebrates, it may not be counted as a fishing method—either in cultural terms or indeed in ‘scientific’ understandings as found in Spain where gleaning was not included in official definitions of fishing (European Commission 2003). However, as we have detailed, to understand fisheries from a broad ecosystemic perspective, it is important to consider all forms of marine resource extraction, including gleaning. This reality invites us both to reconsider some of our gender assumptions about fishing, as well as the very definition of fishing itself.

3.2 Missing gender as key variable and gender biased sampling methods

Another tendency is for data to be collected in a way that is gender blind. Gender-neutral words such as “fisher”, or even gender specific terms such as “fisherman” might be used to describe women and men. It is therefore necessary to explicitly include gender as a variable. A more general issue observable in the literature is that only data on men is collected. This may be done intentionally, or occur unintentionally through methods that limit respondents to only men. For example, head of household surveys or key informant interviews that rely on political or religious leaders may result in only male respondents. Despite being active participants in the household economics and decision makings, women may be less likely to declare themselves as head of household (Gammage 2004). Interviewing only or predominantly men is a key consideration in situations where the perception of women’s fishing differs along gender lines. For instance, men may discount or have very little interest in talking about

women's fishing activities (Chapman 1987), or may have completely opposite understandings of the gender division of labour as was found in the Canadian Arctic: *"According to Arviat men, fishing for char along the shoreline is predominantly men's work. According to Arviat women, it is predominantly women's work"* (Tyrrell 2009). This also suggests the need for complementary observational data collection. Women-only data collection similarly limits the scale of analysis and understanding. It is often done with the explicit goal of focusing on fishers or fisheries that have previously been overlooked and so may provide important information. However, as with data only on men or only a single fishery, our understanding of its role within the broader context of community fishing is limited.

The locality of the data collection may also bias the sample along gender lines. Data collection methods often rely on centralized landing sites such as markets, ports, or fish vendors. This may bias sampling towards men's catch because women's catch is often exclusively for family consumption and does not travel through these sites making them invisible to the researchers (e.g. Green et al., 2004). In contrast, a randomized sampling approach of all fishing effort within communities would allow for a more comprehensive understanding of the variety of fishing methods used, animals targeted, and use of catch. It would also give a more accurate understanding of the total catch.

Many of these trends are exacerbated by the fact that most fisheries data collectors and managers are men, which in certain contexts may impede the participation of women. In many cultures it is not socially acceptable for unrelated men and women to talk to one another and in other cases respondents may simply be more comfortable with an interviewer of the same gender. In Nigeria, where fisheries officers were predominantly men, women stated that they preferred talking to women officers (Adeokun and Adereti 2003). These gender gaps can have implications for data collection, misrepresentation of the issues of importance, and can also negatively affect conservation and management efforts. For instance in Tuvalu a trochus reintroduction program failed when the fisheries manager neglected to discuss the plan with women who unknowingly gleaned the introduced animals (Seniloli *et al.* 2002). It is also imperative to consider

other social variables such as class, ethnicity, or caste that have been found to affect data collection (O'Reilly 2008).

3.3 Gender Evaporation

Even in cases where gender is included as a variable, or as part of a management agenda, gender has often been found to disappear - a phenomenon that has been referred to as gender evaporation, or the loss of gender data during one or more steps of research (term adapted from DFID 2008). Gender evaporation can occur when a gender research agenda is added, but carried out by researchers and managers unfamiliar with and untrained in gender research methods (Harrison 1997). For example a study of small-scale fisheries was unable to include gender analyses, even though gender had been included as a field in the interview. The research assistants had not been trained in gender research methods and the fields on women's participation were mostly left blank (Sayson, personal communication).

All of these dimensions of gender bias in research and data have the effect of minimizing women's roles in fisheries, and also, importantly, may lead to a lessened understanding of crucial aspects of the marine ecosystem that are more likely to be used and targeted by women (e.g. sessile invertebrates). These illustrations, together with the growing body of work on gender and social and economic dimensions of fisheries, demonstrate the clear need for fisheries science to embrace gender approaches to research and a stronger appreciation of women's fisheries in particular as key parts of an interdisciplinary ecosystem approach. From a management perspective as well, it is abundantly clear that lack of attention to women's fishing undercuts the possibility of women being full stakeholders in fisheries management and decision-making. We suggest that a fuller appreciation of women's diverse fishing roles and practices serves as a critical step to overcome the well documented marginalization of women in fisheries related management institutions and practices, including both international programs (Harrison 1997), as well as more localized community based management initiatives (Seniloli *et al.* 2002).

Without explicit consideration of the fishing patterns and practices (including changes therein) of women *and* men, a considerable wealth of information is ignored. To overcome the invisibility of women's fishing and the barrier it poses to our full understanding of marine ecosystems it is important to start our analyses and evaluations with the assumption that women do fish, rather than the inverse. By beginning with this assumption researchers can choose appropriate methods that capture the fishing practices of all community members, and the assumption can then be adequately tested.

CONCLUSION

Overlooking women's fishing practices can lead to data gaps in the direct and interconnected impacts of different fisheries, perpetuate often inaccurate assumptions about the gender division of labour in fisheries, as well as potentially underestimate the total human pressure on the marine ecosystem. In this review we have pursued the suggestion offered by Weerantuge and colleagues (2010) to move beyond the increasingly recognized reality that "women do fish." In particular, we have offered an approach that considers women and men's fishing practices to illustrate the importance of gender not only for socio-economic concerns, but also to gain a more comprehensive and robust understanding of the human role in marine ecosystems. As such, we suggest that progress in terms of gender approaches to fisheries and appreciation of women's fisheries and practices is a key dimension of realizing more inclusive socio-ecological understandings for fisheries science and management. Our review of published case studies that consider women's fishing practices makes clear that the division of labour by gender in fisheries is common, but also highlights variety and mutability of women's and men's fishing practices. Our review also reveals the sparsity of gender data in general, and quantitative data in particular. Despite these limitations it is clear that the fishing efforts of women and men often play distinct and interacting roles in the marine ecosystem. A gender approach has considerable potential to improve our understanding of these varied and interacting roles through greater attention and

sensitivity to different fishing methods, species caught, and areas fished. All of these dimensions are essential to provide sound scientific advice, enriched scientific inquiry, and improved management of marine resources. Furthermore we have also suggested that to truly make progress with respect to ecosystem and livelihood approaches to marine management we also need to change the way we collect data. The implications relate to who is collecting data, how data is collected, and even the very definition and scope of 'fishing' itself. Unchallenged definitions of fishers and fishing, and biased sampling practices present significant obstacles to ecosystem scale data collection. Being aware of these common problems in data collection allows for more suitable and comprehensive collection, enabling higher standards in future research.

While we have chosen to highlight the ecological elements of these debates, this is not to ignore the importance of a gender approach for social aspects of fisheries management, including livelihood and food security approaches. Gender aware research has highlighted that improvements in fisheries dominated by men (both in catch and economic gains) do not necessarily translate into improvements in household and community level food and economic security. Subsistence catch by women may be especially vital for family food security (Porter and Mbezi 2010). The combination of the ecosystem dimensions with social imperatives makes the centrality of gender perspectives to fisheries science and management undeniable.

As participatory management efforts seek to extend a role to women in fisheries management, clearer understandings of gender specific roles in fisheries as well as the larger fishing economy are vital. These combined realities suggest the need for serious caution whenever we see male fisheries officers only talking to male fishers, or situations where men speak for women related to community needs. Further to this, women's distinct ecological knowledge is likely to be a considerable asset to managers, particularly in data poor systems (Harper *et al.* 2013). While in this review we have emphasized fishing practices, we understand that aspects of this discussion are relevant and potentially even more powerful when viewed with attention to larger socio-economic and political frameworks. The inclusion of gender enables us to more

accurately assess the state of fisheries, to better understand the diverse effects of fisheries change and management for populations, and to move towards the interdisciplinary management models that are increasingly demanded by policy makers.

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