Tracking the trade of octopus across East Africa and onto the Global Market – Challenges to Marine Stewardship Council Certification Ambitions

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Abstract

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In Kenya and Tanzania octopus are a common food, and increasingly, a source of economic security as demand for octopus from international markets grow. Both Kenya and Tanzania's octopus fisheries managers are interested in seeking Marine Stewardship Council certification in the future. However, little is known about the sustainability and market challenges faced by exporting actors and middlemen– key links between small-scale octopus fishers and their global markets. In this analysis, we synthesize the perspectives of exporters, middlemen, and key informants in order to provide the first available assessment of potential sustainability barriers both nations could face as they consider engaging with Marine Stewardship Council certification. We find that presently the Marine Stewardship's three sustainability principles – sustainable stocks, reducing environmental impacts, and effective fisheries management are challenged by including, scarcity of product, the informal trade of immature octopus from Tanzania to Kenya and to the local market; and insufficient funding for management. Additionally, we found that Southern Tanzanian traders and agents are now buying octopus from Mozambique traders, so that trade volumes mask to some degree the extent of declining catch levels in Tanzania. This information will help local fisheries managers and interested organizations in assessing the viability and practicality of certification at this time.

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1. Introduction

For many developing countries, being connected to the global seafood market can be a double-edged sword; both in terms of impacts on the ecology of the marine system, and the socioeconomic dynamics and livelihoods of those engaged in the fishery value chain [1]. Seafood, as the most valuable globally traded food commodity, has the potential to redistribute wealth and improve the livelihoods of fishers and traders engaged in trade [2]. However, it is also understood that this global trade can promote overfishing, harm the future sustainability of a local food source, and marginalize small-scale fisheries [3,4].

Views on whether the benefits of trading seafood internationally outweigh the costs often depend on the scale at which one is measuring success [5]. While seafood export can drive increased GDP at the national level, it can also adversely affect local food security. Simultaneously fishermen, traders and the livelihoods of individuals along the value chain are increasingly vulnerable to environmental and economic change acting across multiple scales [1,6].

Both marine resource access and material well-being improve the resiliency of fishery-dependent communities against both market and environmental changes [7,8]. Interventions often strive for economic profitability and increased catch per unit effort through improvements in infrastructure and fishing technology [6]. However, historically these investments in technology have also led to overfishing. Rather than continue to focus development efforts on national economic indicators related to short-term gains from marine resource extraction, aid agencies are increasingly looking to understanding value chains to help address issues of poverty alleviation and development, thru upgrading, lowering barriers to entry, and promoting equitable benefit distribution.

Sustainable seafood labeling is one intervention dependent on transparent value chain dynamics. It is being advocated as a way to help small-scale fishers gain access to the global market in a manner that rewards improved management. Benefits that developing fisheries have received from certification center around a triple-bottom-line approach: economic such as additional market access and/or higher prices, ecologically from increased monitoring and management, and socially from an increased public recognition and governance improvements such as greater stakeholder participation [9]. However interventions have been observed to undermine both social and ecological resilience when livelihood preferences and adaptive capacity of individuals throughout the value chain are poorly understood [10].

In the context of wild-catch seafood, the Marine Stewardship Council (MSC) is the leading third-party certified ecolabel [11]. Seafood that gets the Marine Stewardship Council Label gains a certain amount of credibility, preferred market access, and in some cases, certification results in a price premium. Yet, only a handful of developing-country small-scale fisheries have been able to meet the stringent ecological and traceability standards needed for MSC certification. As of June 2018, just 8% of MSC certified fisheries are small-scale fisheries from developing nations [12], while 60% of global seafood catch comes from these nations [13]. As such, a majority of the social science literature surrounding MSC and small-scale fisheries in developing countries considers the accessibility of the certification process to small-scale fisheries in these nations, as it is often infeasible for them to acquire both the data and funding necessary to achieve certification. Another particularly well explored avenue of research considers the extent to which MSC certification results in a price premium at the retail level [14–17], but this benefit does not necessarily trickle down to fishers themselves [18,19].

A global survey of key MSC stakeholders – including members of the Stakeholder Council of MSC and the MSC Developing World Working Group, found insufficient stock data, and unclear benefit of certification for the fishery to be the most severe constraints to fisheries seeking MSC certification in the developing world [20]. Understanding these barriers – and acknowledging that developing country fisheries often lack the resources necessary to achieve

MSC certification – there remains limited understanding of certain links in the supply chain, specifically, the barriers faced by exporters and traders. In weak management regimes, with extensive informal trade and various middle supply chain actors (like traders and agents of exporters), trade networks are often difficult for government officials and managers to regulate. In this context, Kenyan and Tanzanian octopus fisheries provide a valuable case study of how small-scale fisheries, in developing countries, attempt to organize in the initial phases of MSC certification and the challenges to sustainability and traceability they often face.

Within this case study, we evaluate barriers to MSC certification, specifically, those barriers associated with MSC's principles and 'chain of custody' requirements, as well as indirect barriers, such as tensions between local and migrant fishers. We focus our attention on where the supply chain bottlenecks prior to export – at the middlemen and exporter portion of the supply chain. Here there are relatively few actors but their perspectives and actions are vital to the future sustainability of the fishery and thus the potential for MSC certification. By targeting the middlemen and the exporters we were able to ask questions regarding the upstream and downstream supply chain actors engage with. With this information, we created preliminary maps of the octopus supply chain in both nations. Below, most notably, we present the perspectives of exporters and middlemen of what challenges Tanzania and Kenya will need to overcome in order to ensure sustainability of their octopus fisheries, and thus eventually attain MSC certification.

2. Background

The octopus fisheries of Kenya and Tanzania

Kenya and Tanzania are East African nations that have historic fisheries trade relationships with the Europe Union. Both nations were some of the first in Africa to meet European Union hygiene standards and qualify for export [21]. Both countries have continued to meet these standards through enforcement of national legislations and EU directives 91/493/EEC and 98/83/EEC, whereby the fisheries departments of both nations are approved by the EU to ensure exporters meet food safety criteria [22]. Nile Perch and other lake fish are the primary fisheries sector export [22], but marine catches have also become increasingly popular trade commodities for the last thirty years [23,24]. Historically, octopus was a traditional coastal food source, and sold sun-dried at local markets for low buying prices [25]. Improvements in storage and transportation connected producers to the international market in 1998 and today octopus is a now a lucrative export fishery [25]. This poses a quandary, as octopus is also still an important local nutrient source, often used as an aphrodisiac [26,27], and a key part of the regional seafood trade.

Octopus cyanea is the only commercial octopus fishery in Kenya and Tanzania and is particularly suitable for sustainability certification given their rapid growth rate and prevalence along the shallow coast [28–30]. Although scientific reports in both countries have referred to the species as *Octopus vulgaris* [25,31], biological studies have confirmed that 99% of the octopus in Tanzania is *Octopus cyanea* [30], with indication that *O. cyanea* rather than *O. vulgaris* is also being fished in Kenya [32]. Both Tanzania and Kenya fisheries managers would like to pursue MSC certification for their *O. cyanea* fisheries [23,25]. The Marine Stewardship Council themselves are interested in mapping the sustainability of octopus fisheries and their supply chains throughout East Africa, in hopes of eventually adding these nations to their developing fisheries program (personal communication, Oluyemisi Oloruntuyi October 2017).

However, there is also growing concern about the status of these stocks [25,30]. In their most recent analysis, the United Nation's Food and Agriculture Organization (FAO) considered Kenya's octopus fishery fully-exploited and Tanzania's octopus fishery overexploited [33,34]. However, international demand for octopus is increasing and driving Kenyan and Tanzanian

fishermen to heavily fish this species. In both countries, however, the fast reproduction rate of octopus has protected the species from collapse.

Realizing the need to protect their octopus fishery from overfishing, in 2009, Section 59 of the Fisheries Regulations of Tanzania introduced a minimum size restriction of > 500g per octopus caught or traded [25,35]. 500g was selected as the minimum weight restriction, as this is the size at which 50% of male octopus are suspected to be mature[35]. Waiting to catch octopus until they have reached this size improves the probability of their reproduction at least once prior to being caught. Kenya's octopus fishery does not have such a size restriction, although one has been proposed [36].

Through an additional restriction added to Kenyan Fisheries Act Chapter 378 spear gun fishing for octopus was made illegal in 2001 in Kenya (Kenya Gazette Notice No. 7565). In Tanzania, the onset of the European market for East African octopus led to the use of spear guns to catch octopus [25], although spear guns were prohibited in the 2003 Fisheries Act of Tanzania and restated in Section 59 of the Fisheries Regulations of Tanzania of 2009. Now although octopus fisheries gear is technically restricted to wooden hooks in both nations. However enforcement of these regulations are low and spear gun fishing is still commonly practiced is many fisheries[37] including octopus in Kenya [38], and in Tanzania[25], accounting for an estimated 70-80% of octopus catches in 2009 [25]. Both fisheries are also near-open access with fishermen and traders registered through community level beach management units or city councils [23,24].

There is significant national interest from government and NGOs in certifying Tanzania's octopus fishery in particular, given their stricter catch regulations as compared to Kenya. Tanzania has been involved in informal fisheries improvement projects over the past decade through WWF financial backing [39]. In 2009, the United Nations Environment Programme assessed the suitability of Tanzania's octopus fishery for MSC certification from a fisheries science perspective. Analyzing catch data at three fishing locations, consultant Martin Guard found octopus to be in danger of recruit overfishing at all three locations. Guard noted that through improved management and the combined efforts of exporters and fishers to reduce catch, "there is no reason why the octopus fishery could not in the future receive MSC certification"[40]. The following year, the Tanzanian fishery conducted a MSC confidential pre-assessment to determine its ability to receive MSC certification and identify any sustainable issues of concern. While this information is not publically available, it is clear that since Tanzania did not pursue MSC certification at that time, there remained considerable work to accomplish before they could enter into a formal MSC certification process [40].

Here we address the question of barriers to the possibility of MSC certification openly and do so through the lenses of social scientists synthesizing perspectives of traders, exporters, and key informants regarding the international trade of octopus, and the sustainability and management of the fishery. We highlight that while it is the sustainability of the stocks that will ultimately decide whether Kenya and Tanzania's octopus fisheries qualify for MSC certification, the value chain dynamics and perspective of key actors will determine whether these nation's attempt certification, and whether they are likely to succeed in this attempt. Additionally, our rapid qualitative inquiry provides a cost-effective means of determining the challenges these fisheries face and the social momentum available to overcome these barriers to certification.

The MSC certification process

MSC Certification begins with a confidential pre-assessment of a fishery's readiness for entering the certification process. This confidentiality also makes it difficult for fisheries in similarly early stages of considering certification to learn the road to sustainability taken by other developing fisheries with certification goals. Publically available information on the challenges and opportunities faced by fisheries in the initial stages of MSC certification provides an example for other nations.

A fishery is awarded MSC certification only after it has the met the standards corresponding to the three principles of MSC:

Principle 1) fishing activity must be at a sustainable level
Principle 2) fishing operations should be managed to maintain the structure productivity, function, and diversity of the ecosystem on which the fishery depends; and
Principle 3) the fishery must meet all local national and international laws and must have a management system in place that responds to changing circumstances while maintaining sustainability [41].

Besides fisheries-specific indicators corresponding to the three MSC standards, receiving the MSC label also requires meeting strict traceability requirements throughout the supply chain to ensure that certified and uncertified seafood are not combined [13]. MSC refers to these traceability requirements as 'chain of custody requirements'.

Barriers to MSC certification can be categorized as directly linked to these MSC standards and chain of custody requirements (such as lack of data/stock assessment, weak enforcement of harvest rules) [20], or indirectly related to achieving MSC certification (such as the existence of information and communication barriers).

3. Methods

To elucidate the obstacles, Kenya and Tanzania will face before they can enter the formal MSC certification process, we conducted hour-long elite interviews[42] (both semi-structured and open-ended) in 10 fishing and port locations in Tanzania and Kenya. Interview questions were aimed at elucidating respondent opinions of MSC certification, the challenges they faced, and their suggestions for improving the sustainability of both the fishery and the global market. Using interview data on the suppliers and buyers of each respondent we also created preliminary maps of the octopus supply chains of both nations, tracing the flow of octopus from fishers to exporters.

Interview Methodology

To understand the trade of octopus across East Africa and onto the global market, initial fieldwork was conducted in the known octopus exporting port cities of Dar es Salaam, Tanzania and Mombasa, Kenya. From five initial, exploratory interviews with government officials and university researchers additional field sites of importance to the trade of octopus were selected (Mayungu, Shimoni, Vanga in Kenya and Tanga, Lindi, and Mtwara in Tanzania). Mayungu, Shimoni and Vanga, and Lindi are small fishing villages along the Swahili coast, while Tanga and Mtwara are large coastal cities. For these large coastal cities, interviews were conducted near landing sites throughout the Tanga and Mtwara region. A total of 75 interviews were conducted; 46 interviews were conducted with exporters and middlemen and 29 interviews were conducted with key informants (Table 1).

Middlemen, as defined here, include company agents as well as large and small-scale traders. Middlemen explained their role in the value chain and self-identified as octopus traders, octopus traders-fryers or company agents. Small-scale and large-scale traders were differentiated based on whether they bought or sold octopus outside their local region, with those selling or buying from outside the area considered large-scale. The categories of actors interviewed and their role in the value chain are further described in Table 2.

Of these interviews, 75 interviews 36 were conducted in Kenya (6 in Mayungu, 7 in Mombasa, 6 in Vanga, and 17 in Shimoni), and 39 were conducted with individuals in Tanzania, (17 in Dar es Salaam, 1 in Lindi, 11 in Mtwara, 8 in Tanga, and 2 over the phone in Zanzibar) (Figure 1).

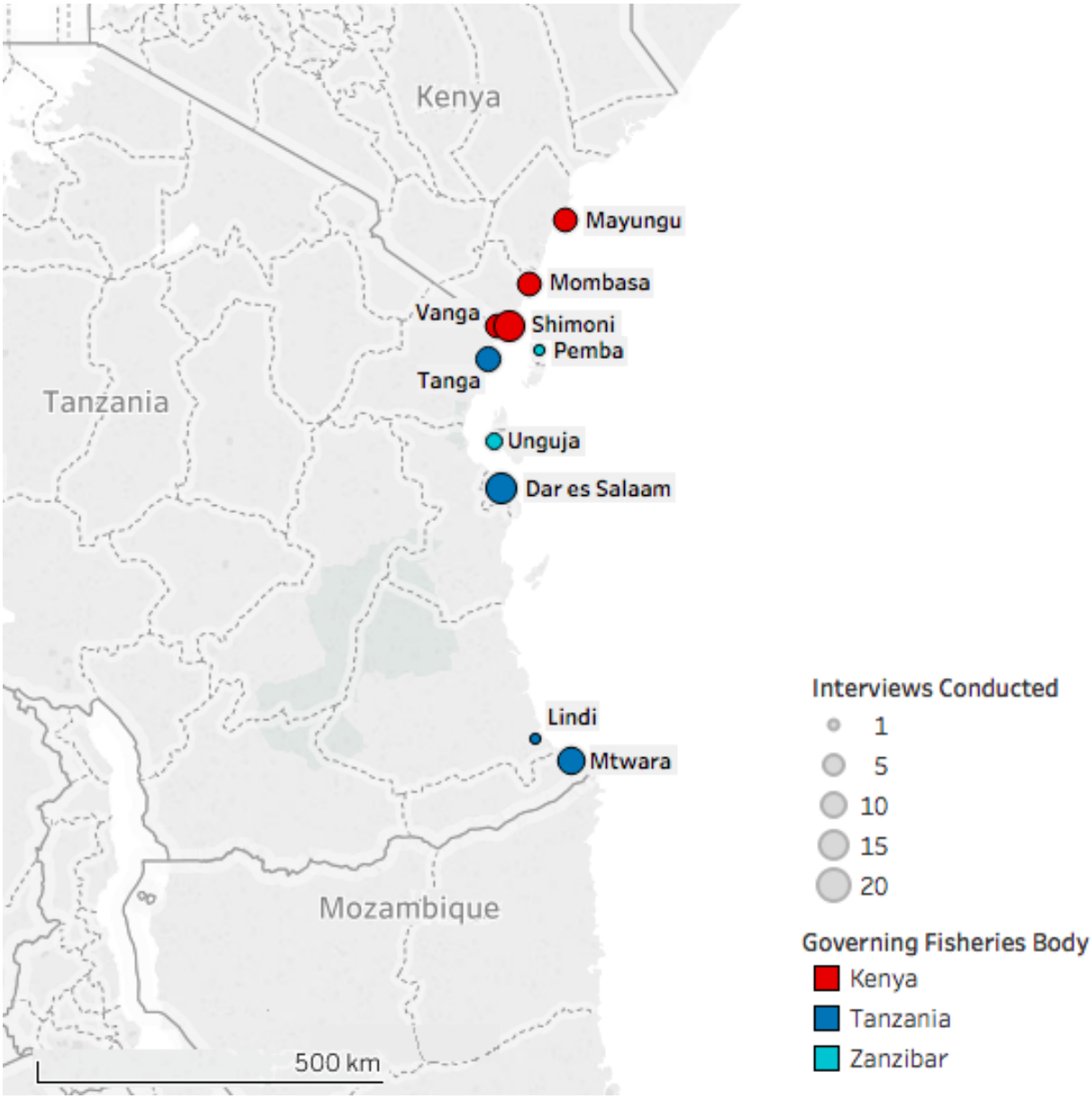

Figure 1. Map of interview study sites with number of interviews conducted represented by the size of the marker. Note that Zanzibar is considered part of the United Republic of Tanzania.

		Role						
Country	Location	Key informant	Exporter	Company agent	Large-scale trader	Small-scale trader	Small-scale trader (fryer)	Grand Total
Kenya	Shimoni	8		3		6		17
	Vanga	2		3		1		6
	Mayungu	1		2		3		6
	Mombasa	2	3			2		7
	Total	13	3	8		12		36
Tanzania	Tanga	2	1	5				8
	Mtwara	3	1	2	5			11
	Dar es Salaam	9	2		2	2	2	17
	Lindi		1					1
	Pemba, Zanzibar	1						1
	Unguja, Zanzibar	1						1
	Total	16	5	7	7	2	2	39
Grand Total		29	8	15	7	14	2	75

Table 1. Total number of interviews per location and role in the value chain with shading based on number of interviews conducted.

These interviews met the standards of the United States' Institutional Review Board Human Subjects Standards (STUDY00002735). A consistent introduction of the research agenda and identical anonymity clauses were agreed to by participants. The flexible nature of the semi-structured and open-ended interviewing tactics used acknowledged that we did not know all of the important questions to be asked in advance, rather respondents revealed their knowledge bases, preferences, and special interest topics during the course of the interview. Interviews were conducted using the methodologies of rapid qualitative inquiry [43] and elite interviewing- where the interviewer explicitly acknowledges the interviewee's superior knowledge of what the most important problems, questions, and situations may be [42]. These methods draw upon techniques associated with traditional long-term ethnography and include participant observation [44].

Description of Process and Respondent Details

The 38 octopus traders and agents interviewed supply octopus from a total of 570 fishers and 104 other traders in Kenya, Tanzania and Northern Mozambique, with company agents supplying from an average of 23 fishers and 2 traders, and traders supplying from an average of 9 fishers and 4 other traders, respectively. All major exporters in Tanzania and Kenya were interviewed (respondents P39 through P46). Through quantity calculations not presented here, we estimate that combined these interviews account for 95% of Kenya and Tanzania's international octopus market share.

An additional 29 open-ended interviews were conducted with key informants including customs officers, other government officials, NGO workers, local managers, community fishery leaders and fisheries researchers (K1 through K29). Given their detailed knowledge of the local fishery, 8 of these interviews were given using a semi-structured interview tool, while 21 were conducted using an open-ended format, if respondents had either expertise regarding the octopus trade system in general or specific expertise, for example, customs fees. Two researchers took detailed notes during and immediately after each interview. Some key informants also provided additional documents including local catch data, management plans, and trade policies.

Value chain actor type	Defining characteristic	Typical function performed	Gender	Typical relationship with their buyers	Independence
Small-scale trader	Buys directly from fishers or other small-scale traders, village collectors in the area and sell in the area only.	Preserving on ice, cleaning, a few gutting	All male	Receive credit from agents or other traders and give credit to fishers	Solo trader or in partnership of 2
Large-scale trader	Either buy or sell octopus from fishers or traders or to traders not in their area	Preserving on ice, cleaning, a few gutting	5 male, 1 female	Sell directly to final consumers, fryers, and occasionally export companies	Solo trader or in partnership of 2
Small-scale trader (fryer)	Buys from traders and sells directly to final consumer in fried form	Cleaning, gutting, boiling and frying	Both male	Buy from small or large-scale traders	Solo trader
Company agents	Buys either directly from fishers or traders from the area or intra-regionally.	Preserving on ice in cooler boxes provided by the company	14 male, 1 female	Informal verbal contracts with usually one or sometimes two exporters. Receive credit, ice, or bonuses.	Solo trader or partnership of 2 with up to 4 employees
Exporter	Administrative positions for companies that export octopus abroad via large shipping containers from either Mombasa or Dar es Salaam	Processing	All male	Formal employees of an export company but can work at outlet processing or collection facilities.	Work alone for only one company with up to 500 employees

Table 2. Description of middlemen and exporter actor types.

Analysis Methodology

All interviews were compiled in a MAXQDA database and respondent transcripts were organized based on their role in the value chain. By reading through the transcripts all challenges discussed by respondent groups were first identified through exploratory holistic coding methods [45,46]. This was followed by a second-round of focused-coding to identified the barriers that applied specifically to Marine Stewardship Council certification. These discrete barriers were then categorized based on whether they affected one or both nations and subsequently, whether they were challenges directly linked to MSC principles and chain-of-custody requirements [20] or whether they were linked to MSC certification through indirect avenues. Direct challenges identified were those that currently disqualify the fisheries from meeting MSC Principle 1, 2, 3 and chain-of-custody requirements. Indirect challenges are related to certification achievement through auxiliary avenues. For example, an issue was

considered an indirect challenge to MSC certification if it reduces the social momentum needed to create the changes that will be necessary for compliance with MSC principles or chain-of-custody requirements.

Using the MAXQDA interview database of upstream and downstream actors identified by respondents, both researchers who had conducted these field interviews also drew maps of the octopus supply chain for each nation. The maps of each researcher were then compared to each other, with minute discrepancy discussed, before arriving at the final versions presented here.

4. Results and Discussion

Through analysis of our interviews with exporters, middlemen, and key informants, we identified substantial challenges to Kenya and Tanzania in terms of the fisheries current capacities to meet the guiding principles of MSC and chain-of-custody requirements. We also identified issues affecting the fisheries that are indirectly linked to the achievement of certification. Table 3 summarizes these challenges, as well as challenges that were brought up by respondents in only Kenya or Tanzania. The following analysis presents direct challenges to MSC principles and chain-of-custody requirements faced by both nations first, followed by indirect challenges facing both nations. Lastly, we discuss both direct and indirect challenges facing only one nation.

Country	Challenge Identified	Classification of Challenge	Interviews Referenced
Both Kenya & Tanzania	Competition between the global and local market	Indirect	P8-Mayungu, P17-Mtwara, P30-Tanga, P31-Tanga, P34-Tanga, P42-Lindi, P43-Tanga, K3-Shimoni, K4-Dar es Salaam, K9-Unguja, K10-Pemba, K12-Tanga, K17-Shimoni, K23-Tanga
	Export companies delay payments to agents	Indirect	P4-Dar es Salaam, P8-Mayungu, P14-Mtwara P21-Shimoni P23-Shimoni, P24-Shimoni, P28-Shimoni, P29-Shimoni, P37-Vanga
	Insufficient funding for management	Principle 3	P17-Mtwara, P43-Tanga, K3-Shimoni, K9-Unguja, K10-Pemba, K12-Tanga
	Mixing of supply before export	Chain-of-custody	P38-Vanga, P39-Dar es Salaam, P41-Mtwara
	Scarcity/reduced supply of octopus	Principle 1	P4-Dar es Salaam, P7-Mayungu, P8-Mayungu, P12-Mombasa, P17-Mtwara, P27-Shimoni, P35-Vanga, P36-Vanga, P40-Dar es Salaam, P41-Mtwara, P42-Lindi, P43-Tanga, P44-Mombasa, P46-Mombasa
	Taxonomic mislabeling of octopus species	Chain-of-custody	P39-Dar es Salaam, P40-Dar es Salaam, P41-Mtwara, P42-Lindi, P43-Tanga, K4-Dar es Salaam, K8-Dar es Salaam
	Unenforced gear regulations	Principle 2 & 3	P14-Mtwara, P31-Tanga, P39-Dar es Salaam, P40-Dar es Salaam, P41-Mtwara, P44-Mombasa, K8-Dar es Salaam, K10-Pemba, K22-Vanga
	Unenforced size restriction and informal trade between Kenya and Tanza..	Principle 1 & 3	P30-Tanga, P31-Tanga, P32-Tanga, P33-Tanga, P34-Tanga, P35-Vanga, P36-Vanga, P37-Vanga, P38-Vanga, P43-Tanga, K7-Mombasa, K12-Tanga, K25-Dar es Salaam, K27-Dar es Salaam, K28-Dar es Salaam
Kenya only	High mortality rates for octopus fishers	Indirect	K2-Shimoni, K3-Shimoni
	Tensions between local and migrant fishers	Indirect	P8-Mayungu, P9-Mayungu, P10-Mayungu
Tanzania only	Incentive for MSC certification not seen by export companies	Indirect	P38-Vanga, P39-Dar es Salaam, P41-Mtwara
	Informal import of octopus from Mozambique to meet demand	Chain-of-custody	P15-Mtwara, P16-Mtwara, P17-Mtwara, P18-Mtwara, P19-Mtwara, P20-Mtwara, P41-Mtwara, P42-Lindi, K4-Dar es Salaam, K5-Dar es Salaam, K6-Mtwara, K19-Mtwara, K20-Mtwara, K27-Dar es Salaam, K28-Dar es Salaam

Table 3. Challenges faced by both nations as well as Kenya and Tanzania uniquely were categorized as direct and indirect challenges to MSC certification, as described in the Methods section. The ID numbers of respondents that provided empirical support for each challenge are available in the right-hand column.

Challenges to MSC certification affecting both Kenya and Tanzania

Principle 1 issue: Scarcity/reduced supply of octopus

Octopus exporters and middlemen suggest that MSC Principle 1 (fishing activity must be at a sustainable level) is not met for either fishery. Market demand, combined with other factors discussed later on, may lead to overfishing of octopus in both countries, with scarcity being potentially more severe in Kenya due to a lack of minimum size restriction and an influx of octopus fishers.

Scarcity was not mentioned in relation to the future of the export market in Tanzania but was the reasoning behind all mentions of future market decline in Kenya, with three Kenyan octopus

traders mentioning that they thought the export market would decline due to scarcity of product[1]. Three Kenyan middlemen also attributed their declining supply to an increase in the number of octopus fishers[2]. An increase in octopus fishers in both nations can be attribute to the near open-access management of the fisheries combined with increasing profitability of the industry [25]. However, if scarcity becomes more severe fishers and traders may switch to more abundant fisheries.

While scarcity was mentioned by fewer middlemen in Tanzania, a few Tanzanian middlemen thought that more octopus were available in Tanzanian waters just 5 years ago[3]. Three middlemen expressed concern that they will need to find new areas from which to source octopus[4], with one stating that he would start sourcing from fishers from Mozambique in order to take advantage of increasing demand by hotels, companies and local consumers[5].

Exporters in both nations were more adamant than middlemen about the issue of scarcity, often considering getting enough supply to be their main challenge[6]. " (P40, P41, P42, P44). "Ten years ago, we were shipping 150 tons of octopus a year. But between 2010 and 2015 we shipped only 50-70 tons a year", said a Dar es Salaam Exporter[7]. Last year (2016) they were able to ship 100 tonnes abroad and he attributes this to increased management efforts of the Tanzanian government to enforce sustainable fishing practices. The processor linked to this exporter in Tanga noted that in Tanga, "there has been a 40-50% reduction in catch even though we will always have a market for whatever we bring in"[8].

One Mombasa exporter mentioned that low supply combined with higher demand is making it hard for them to meet buyers demands on time[9]. The juxtaposition between concurrent high market demand and low product availability was echoed by many respondents. Exporters and middlemen in both Kenya and Tanzania noted increasing demand for octopus[10]. This regional and global demand impacts the value of MSC certification to these nations and the possibilities of reducing catch to a sustainable level[6]. MSC certification is meant to increase niche demand for a sustainable market. Yet even without MSC certification international demand is projected by exporters to increase, "while the raw material is depleting"[11].

In response to this issue of scarcity one Tanzania exporter recently "convinced fisheries officials that the size at maturity for male *octopus cyanea* is actually 300g"[4] and in doing so they are now able to ship anything above this size restriction. In a 2009 status report on their octopus fishery the current Director of Tanzania Fisheries Research Institute also noted that increasing international demand led to rampant effort and increased capture of undersized octopus, which in turn led to a decline in octopus production. The size restriction of 2009 in Tanzania was put in place to deal with this scarcity, which makes lowering the size restriction stipulation in response to further demand and scarcity seem troubling. However, there is some evidence that relaxing the size restriction to 300g (as discussed by the Tanzanian exporter) is in line with the biology of *O. cyanea*. A recent study using gonad histology does provide some

[1] P9- Mayungu small-scale trader, P11- Mayungu small-scale trader, P12- Mayungu small-scale trader
[2] P12- Mayungu small-scale trader, P26- Shimoni small-scale trader, P36- Vanga agent
[3] P33- Tanga agent
[4] P7- Mayungu agent, P15- Mtwara agent, P3-Dar es Salaam small-scale trader
[5] P3- Dar es Salaam small-scale trader
[6] P40- Dar es Salaam exporter, P41-Mtwara exporter, P42-Lindi exporter, P44- Mombasa exporter
[7] P40- Dar es Salaam exporter
[8] P43-Tanga exporter
[9] P40- Dar es Salaam exporter
[10] P2- Dar es Salaam agent, P23-Shimoni agent, P33-Tanga agent, P3- Dar es Salaam small-scale trader, P10-Mayungu small-scale trader, P24-Shimoni small-scale trader, P26-Shimoni small-scale trader, P27-Shimoni small-scale trader, P38-Vanga small-scale trader
[11] P44- Mombasa exporter

support for this claim. Herwig et al. 2017 found 50% of all males were mature at ~ .35kg. However, it is important to note that 50% of all female did not reach sexual maturity until 1.35kg [28], which suggests that .5 kg is a reasonable if not liberal size restriction.

In contrast, another respondent from the same export company considers seasonal closures to be a good solution to octopus scarcity, by allowing octopus a chance to grow. "Bigger sizes will lead to bigger returns", said the Mtwara exporter[12]. Bigger sizes also increase the chance of reproduction prior to capture. In this context, a closer look at the capture of undersized octopus as an underlying cause contributing to resource scarcity is offered below.

Principle 1 & 3 issue: unenforced size restriction and informal trade between Kenya and Tanzania

Intra-country trade of immature octopus

Our preliminary maps of the octopus supply chain in Kenya show every trade avenue to be a path for immature octopus to move up the supply chain (Figure 2). This is because of the nation's lack of a minimum size restriction. Without a size restriction similar to that in place in Tanzania, Kenya is unlikely to qualify for MSC certification. While Kenya's octopus fishery does not currently have a size restriction one has been proposed [36]. In fact, Kenya's Ministry of Agriculture, Livestock and Fisheries considers the prospect of MSC certification as an incentive for management changes[13]. Even with its size restriction regulation, the Tanzania octopus fishery is also unlikely to currently meet MSC principles 1 and 3, given varying enforcement of the size regulation and issues with informal trade of octopus of all sizes to Kenya.

Due to low supply and ready markets for octopuses of all sizes as discussed above, some Kenyan middlemen buy all octopus- mature and immature[14]. Market measures do seem to be working in some instances. At least one Kenyan exporter buys immature octopus at a lower price than mature octopus[15] and thus, some traders focus on trading mostly big octopus for better pricing[16].

While changing the preferences of downstream actors will help reduce the catch of undersized octopus significantly, the responses of one Kenyan trader illustrate the difficulties of stopping undersize catch through only market measures[17]. While he understands the importance of only trading mature octopus one small-scale trader mentioned that he must continue to buy small or poor-quality octopus to motivate his fishers and uses these small octopus for home consumption, as does another Kenyan trader [18]. Thus, alongside market measures, strong management measures including the enforcement of a minimum size restriction are needed to improve sustainability.

Besides pleasing their fishers, incentives for middlemen to trade undersize octopus include accessibility. During the low season, undersized octopus is what is primarily available in some locations. This is because it is particularly difficult for fishers to catch mature octopus during the low season when the harsh conditions prevent them from going to deeper water[19].

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[12] P41-Mtwara exporter
[13] K11- Mombasa key informant
[14] P24- Shimoni small-scale trader, P11- Mayungu small-scale trader, P7- Mayungu agent, P8- Mayungu agent
[15] P44- Mombasa exporter
[16] P25- Shimoni small-scale trader
[17] P26- Shimoni small-scale trader
[18] P25 Shimoni small-scale trader
[19] P13- Mombasa small-scale trader

Within Tanzania, there is less sale of undersized octopus at the export level than in Kenya (Figure 3). Throughout Tanzania the size restriction may be being better enforced more recently. "Last year, 2016 the catch was quite good as compared with 2010 through 2015; maybe this is because size restrictions for fishing are now better enforced", said one Dar es Salaam Exporter[20]. Undersize octopus trading is now being treated as an illegal fishing crime with fines ranging from 100,000– 300,000 Tanzanian shillings ($42 to $132 USD) depending on the intensity and frequency of the crime. In response, traders are reducing the amount of undersized octopus they trade even to the local market[21]. Three Mtwara traders emphasized that they only bought octopus above 500g for sustainability and market reasons[22]. Some traders educate their fishers on the importance of catching big octopus[23], while one large-scale trader noted that in Southern Tanzania, "The market price of big octopus is higher compared to the small octopus hence I buy big octopus so I get good income"[24].

However, in Tanzania, like in Kenya, at the domestic level cooking preferences and economic incentives still cause local fryers to buy small octopus. Locally, most octopus that is sold weighs less than 500g because local consumers want to buy small pieces from fryers and it is easier for fryers to fry the octopus if they are small[25], as large octopus have to be beaten hard to make them as tender[26]. Additionally, fryers in Dar es Salaam mentioned that they prefer small octopus because they are cheaper than mature octopus and they are then able to accrue more profit from their sale[27]. We hypothesize that lower buying prices from export companies and their agents in East Africa for small octopus leads to lower selling prices for small octopus at the local market as well, creating an unintended economic incentive for local fryers and final consumers to buy small octopus.

Informal trade between Kenya and Tanzania

Our analysis of intra-regional trade in both Southern Kenya and Northern Tanzania revealed that undersized octopus are often caught by Tanzanian fishers in Tanzanian waters and smuggled alongside mature octopus to Kenya where they are then sold to Kenyan exporters. This is happening through four illegal trade routes which will be described in depth in a follow-up article that will specifically explore informal octopus trade routes between Kenya, Tanzania, and Mozambique and calculate approximate quantities traded via each route. In brief, fishers in Pemba and Tanga cooperate to sell to traders who smuggled octopuses to Kenya due to higher prices in Kenya.[28]

Three informal trade routes between Tanzania and Kenya occur by boat with one occurring via motorbike. These routes are as followed:

1) Between Pemba Island, Tanzania and Shimoni, Kenya (we estimate 35 to 105 tonnes of octopus/yr.) are traded each year. (Shimoni respondents estimated that including both formal and informal trade between 40 and 53% of the octopus traded in the area is actually octopus caught in Pemba Island, Tanzania coming via these trades routes[29]).

2) Between Pemba Island, Tanzania and Vanga, Kenya we estimate 37- 75 tonnes/yr. are traded informally by sea.

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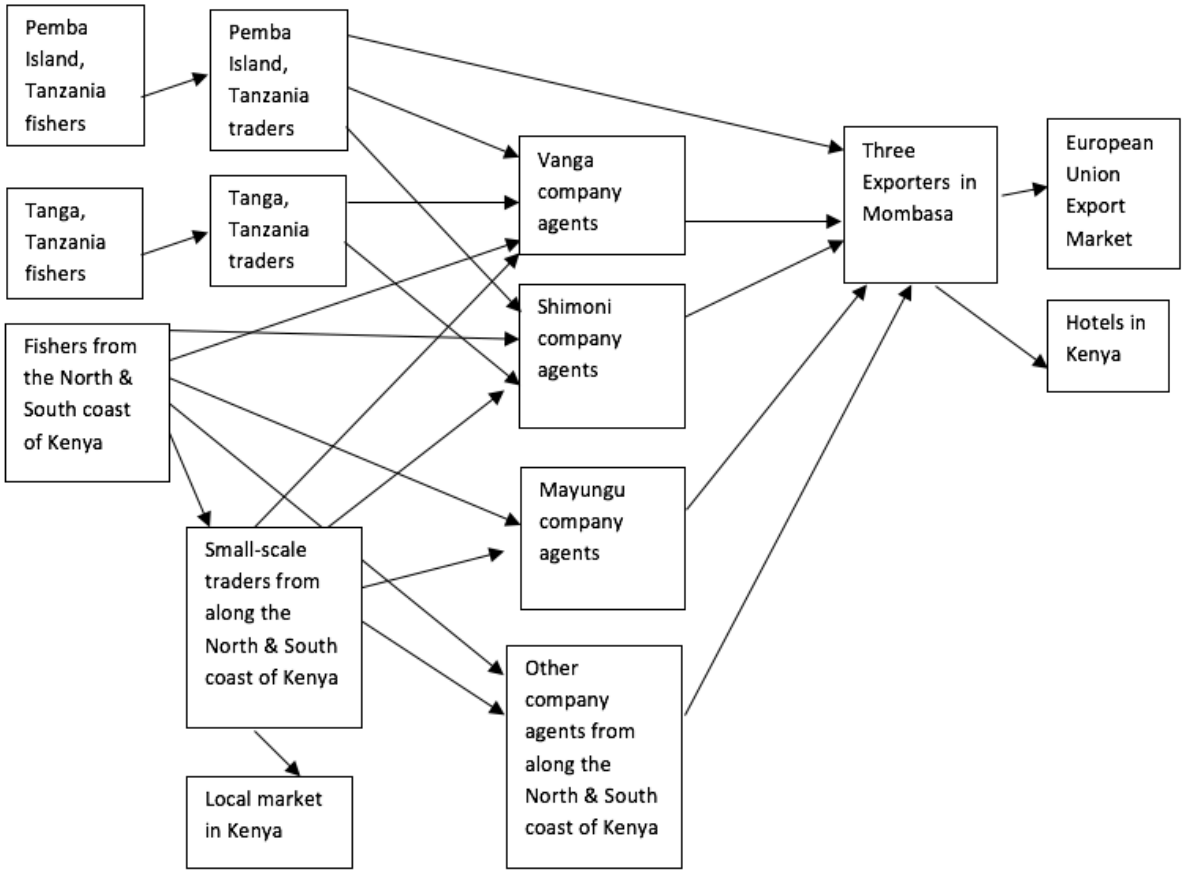
[20] P40- Dar es Salaam exporter
[21] K19- Mtwara key informant
[22] P16- Mtwara, P17- Mtwara large-scale trader, P18- Mtwara large scale trader
[23] P18- Dar es Salaam large-scale trader
[24] P17- Mtwara large-scale trader
[25] K4- Dar es Salaam key informant
[26] K4- Dar es Salaam key informant
[27] P5- Dar es Salaam and P5- Dar es Salaam octopus fryers
[28] K23- Tanga key informant
[29] P25- Shimoni small-scale trader, K21- Shimoni key informant

2) An additional, 6 to 18 tonnes/yr are also estimated to be informally traded by sea from Tanga, Tanzania to Vanga, Kenya.

3) Originating from Tanga, Tanzania an estimated 8 to 18 tonnes/yr. of octopus are also informally traded to Kenyan company agents in Vanga, Kenya by motorbike[30].

This informal trade leads to lower export royalties for the central government of Tanzania as export fees are not paid as well as undermines fisheries management efforts. This trade occurs because Kenyan company agents are willing to pay more for illegal octopus than Tanzanian company agents are able to pay for legal octopus. These differences in market price and demand for undersized octopus need further investigation. They may be indirectly linked to the fact that the main international buyers of Tanzania are Portugal and France, rather than Italy and Greece like in Kenya[31], or to the strength of Kenyan currency as compared to Tanzanian currency.

Tanzanian government officials and exporters are aware of this intraregional trade. "Kenyan currency is strong, and it looks like the traders are selling to Kenyan agents…", said the exporter in Tanga[32]. Year-around, but particularly during the low season, Tanzania agents continue not to buy the immature octopus but Kenyan buyers will take octopus at any size. This is a conservation issue because, "informal traders buy all octopus regardless of size. There is more of them in the low season and even if there are a few of them they disturb [local management efforts] substantially", he said.



[30] K22- Vanga key informant

[31] P40-Dar es Salaam exporter, P41-Mtwara exporter, P42-Lindi exporter

[32] P43-Tanga exporter

Figure 2. Octopus fishery supply chains in Kenya, where the main international buyers are Italy and Greece. All arrows represented avenues for trading immature octopus.

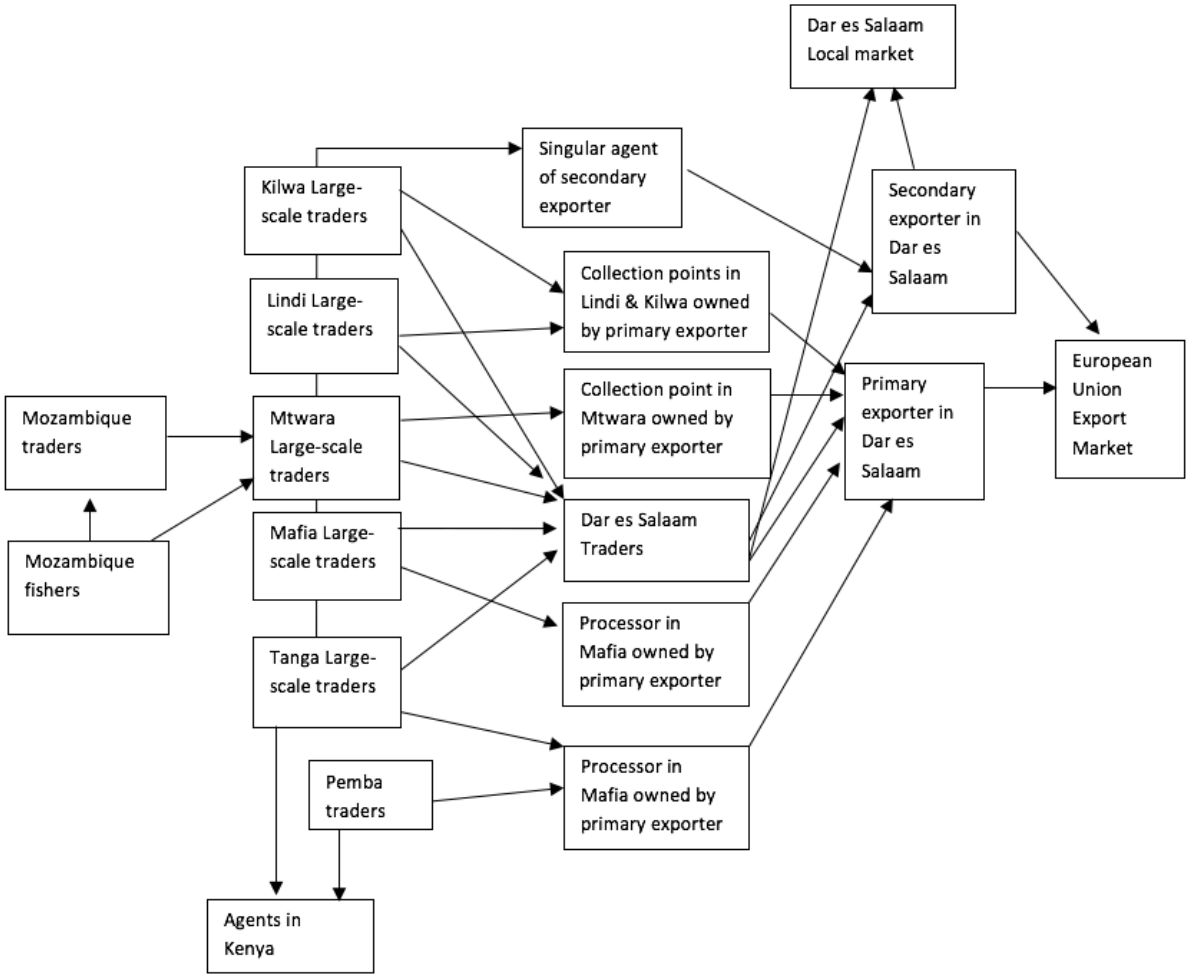


Figure 3. The octopus fishery supply chain in Tanzania, where the main international buyers are Portugal and France. Unlike in Kenya, trading immature octopus is illegal in Tanzania. Avenues for trading immature octopus given low enforcement capacity are only represented by the two arrows leading to the local market.

Principle 2 & 3 issue: Unenforced gear regulations

Unenforced gear regulations also hinder the ability of both nations to meet Principle 2 (fishing operations should be managed to maintain the ecosystem on which the fishery depends) requirements. Fishers will not tell researchers they are using spear guns because of legality issues but they are prevalent both Kenya (personal communication, Christopher Cheupe June 2018) [38] and in Tanzania[33]. Spear gun use hinders ecosystem maintenance because when fishers miss the octopus the spears hit the reef and damage the corals[34], which provide habitat to many other marine species. This regulation is not enforced in both nations[35] which is a principle 3 issue for MSC as well.

[33] K4- Dar es Salaam key informant
[34] K8- Da es Salaam key informant
[35] K8- Dar es Salaam key informant, K17 Shimoni key informant

Although outside the realm of the octopus fishery, agents, exporters and key informants noted the need for greater enforcement of gear regulations in other fisheries. The exporter in Tanga listed illegal types of fishing like dragging beach seines as one of the biggest challenges to the octopus fishery[36]. The exporter in Lindi mentioned that in Lindi "unhealthy fishing practices like dynamite fishing have already made the reefs not as good which has led to migration of fishers from Lindi to Kilwa and more productive areas"[37]. The effect of dynamite fishing on octopus habitat is also a problem in Kenya"[38]. The use of explosives and beach seines destroy coral reefs which are octopus habitats"[39]. Resolving illegal gear use in other fisheries will be needed to promote the sustainability (Principle 1) of the octopus fishery.

Principle 3 issue: Insufficient funding for management

Principle 3 of MSC requires a fishery to have a functioning management system and be in compliance with all local, national and international laws. Of the two countries, only Tanzania has an octopus fishery management plan and beach management units in Kenya do not do any octopus-specific fisheries enforcement[40] . Given the fact that spear gun regulations are poorly enforced, neither country's octopus fishery is in compliance with all national fisheries legislation, nor does Kenya meet the Principle 3 requirement of having a specific management system designed for octopus. Additional funding for management would increase capacity and the ability of both nations to enforce gear regulations and size restrictions.

Chain of custody issue: Mixing of supply before export

Mixing of supply before export was identified during interviews in Tanzania. This is also an issue in Kenya given the fact that informal trade of octopus from Tanzania enters the export market, as described above. In order to meet the size requests of European customers, and given the scarcity of octopus, one container of octopus that is exported abroad may have octopus from Tanga, Mafia, and Mtwara combined[41]. One agent mentioned that even though the supply is mixed before export each location has their own code for traceability if something is wrong with the product[42]. Similarly, one exporter claimed that although they themselves do not have more than ten agents with contracts in total, "their traders' contracts and even their fishers' contracts are known due to traceability requirements"[43]. However, most agents for this company noted having verbal rather than written contracts, with some importing octopus both formally and likely informally from Mozambique. While there are tracking slips accompany octopus as they move from the company's processing location to the export location within the country, these slips do not necessarily indicate the initial origin of the octopus, but rather the first company collection point. For example, tracking slips recording that octopus come from Tanga, Tanzania may actually be octopus from Pemba Island that was brought by a Pemba trader to a Tanga exporter prior to heading to Dar es Salaam for export.

Mafia Island, Tanzania has a strong system of marine protected areas and has established octopus closures- some of which are considered successful management initiatives at regional government, non-profit and local community levels[44]. Additionally, the area may

[36] P43- Tanga exporter
[37] P42- Lindi exporter
[38] P35- Vanga agent
[39] K22- Vanga key informant
[40] K11- Mombasa key informant
[41] P41- Mtwara exporter
[42] P32-Tanga agent
[43] P40-Dar es Salaam exporter
[44] K4- Dar es Salaam, K5- Dar es Salaam

itself by more biological productive [30]. These factors have led to the octopus fishery of Mafia Island being considered more sustainable than mainland Tanzania fishery locations[45], and thus managers will likely attempt to certify the Mafia Island fishery prior to the rest of mainland Tanzania[46]. However, one export company in Tanzania only has one agent in Kilwa collecting everything from around the central and southern coast of Tanzania including Mafia, but they do not actually know where exactly their agent gets his supply from, nor does the exporter know the exact quantities acquired from each location[47]. Additionally, catch from Mafia Island, is currently exported from Dar es Salaam and is mixed with supply from other locations in order to meet market demands for a variation of sizes[48]. This system of mixing supply would have to change if the supply chain for Mafia Island, Tanzania is going to be certified first on its own. This may mean that the size preferences of European importers of certified octopus may not be able to be fulfilled.

Indirect issue: Competition between the global and local market

The low supply of octopus for export may be in part related to high competition with the local market for supply. The local market is understudied[49], but is starting to boom particularly in Tanzania[50]. In Tanzania, two traders interviewed said they believed that the export market would decline because the local market would take over[51]. "If the international market won't be careful, the domestic market will take over because the demand for octopus in the local market has increased. Now 50% of Tanzanians consume octopuses", said one Tanzanian agent[52]. This may be because the reputation of octopus as an aphrodisiac is growing in combination with the growth of the middle class[53]. Its use for this purpose can be heard in the Swahili lyrics of local Bongo Flava and pop songs (see lyrics "*Unapenda ganda la ndizi kuteleza wakati kupambana mpaka mchuzi wa pweza*" from Kijuso by Rayvanny featuring Queen Darleen (2016) and the lyrics "*Siku hizi ujanja ni kunywa mchuzi wa pweza* a*i haya maneno walinena wazee wa zamani*" from Roho yangu by Rich Mavoko (2015).

In Tanzania, agents also indicated that the local market could in some cases outcompete their company's buying prices. "Some traders hike buying prices to get supply to sell in Dar es Salaam or to fryers in their local market in their residential areas", said one Tanga agent[54].This seems to be particularly problem for agents as it is the local traders who are able to buy at higher prices to fry and sell locally[55]. This could by why, in order to get enough supply, one Tanga agent has to buy both small and big octopuses from fishers even though the company will sort out the small ones[56].

Challenges to MSC certification unique to each nation

[45] P41- Mtwara exporter, P43- Tanga exporter
[46] K4- Dar es Salaam
[47] P39- Dar es Salaam exporter
[48] K17- Shimoni key informant
[49] K17- Shimoni key informant
[50] P31-Tanga agent, P34-Tanga agent
[51] P31-Tanga agent, P34-Tanga agent
[52] P31- Tanga agent
[53] K9- Unguja key informant
[54] P30-Tanga agent
[55] P34-Tanga agent
[56] P46- Mombasa exporter

Kenya

Two indirect issues to MSC certification were also identified in Kenya.

Indirect issues: High mortality rates for octopus fishers

Exporters, middlemen, and key informants also mentioned challenges that did not overlap for both nations. In Shimoni, Kenya key informants mentioned high mortality rates for octopus fishers as a significant issue to the performance of the fishery[57] and stressed the need for speedboats. During the last low season, "we lost two octopus fishermen and their bodies weren't found. When people go missing while fishing they call the beach management unit but without speedboats they can't get there in time", said one Shimoni key informant[58].

The skin diving method of fishing octopus makes it riskier than other fishing activities. Unlike in other fisheries where nets are deployed by groups of fishermen, octopus fishing is done by individual fishers separately. In Shimoni and likely other locations, the few motorized boats that exist are now packed with many fishers. After reaching the offshore reef the captain drops off each fisher separately. In case of an emergency, including bad weather (which occurs more often during the low season), high numbers of octopus fishers diving individually means it can take more time before a boat captain can come rescue a fisher or realizes they are missing.

Indirect issues: Tensions between local and migrant fishers

Migrant fishers were of particular concern to middlemen in Mayungu, Kenya[59]. While fisher migrations throughout the region (particularly from Pemba) have been historically practiced [47], middlemen in Mayungu, Kenya mentioned that migrant fishers from Pemba are now not allowed in Mayungu because they had a conflict with local fishers who claimed that migrant fishers exploit the resource. These responses emphasize that migrant fishers require a regional approach to both manage their effort and maintain their livelihoods [48]. In other small-scale developing fisheries considering MSC certification, migrants fishers may still be a part of their fishery. In this context, the process of MSC certification can encourage collective action around defining fishing rights in these areas but it can also can lead to exclusionary practices if the perspectives of all value chain actors are not fully understood [20,49].

Tanzania

In Tanzania, three additional challenges were identified, two of which we classified as chain of custody issues i.e. the taxonomic mislabeling of octopus species and the informal import of octopus from Mozambique to meet demand, while the final challenge of exporters not perceiving an incentive to seek MSC certification is an indirect challenge to certification.

Chain-of-custody issue: Taxonomic mislabeling of octopus species

O. cyanea is the commercial species exported from both Tanzania and Kenya, yet for Tanzania, a taxonomic confusion and mislabeling of the octopus species being sold abroad is a critical chain-of-custody issue. In Tanzania, *O. cyanea* is commonly mislabeled as *O. vulgaris*. This occurs sometimes due to purposeful mislabeling, and other times because of accidentally mistaking the species which is exported as *O. vulgaris*[60]. Even within the same overarching export company different branches showed different levels of awareness of which species they

[57] K2- Shimoni key informant, K3- Shimoni key informant
[58] K3- Shimoni key informant
[59] P8- Mayungu small-scale trader, P9- Mayungu small-scale trader, P10- Mayungu small-scale trader
[60] P43-Tanga exporter, P31-Dar es Salaam agent

were exporting, with one branch knowing they are exporting *O. cyanea* and the other thinking they are exporting *O. vulgaris*. One Tanzanian exporter mentioned that while they know the species they are exporting is actually *O. cyanea* they label it as *O. vulgaris,* because *O. vulgaris* is the most commercially well-known octopus species[61]. However, "some customers have realized we are shipping *O. cyanea* and have requested that we start labeling it *O. cyanea*", said this Tanzanian exporter[45]. Now the export company changes the species labelled on the packaging depending on which customer they are selling to abroad.

The national fisheries statistics database in Tanzania labels all octopus catch exported from Tanzania as yet a third species- *Octopus chromatus*[62]. This may be because Tanzanian exporters do not provide the government with octopus trade data in terms of species[63].

In Kenya, there does not seem to be a taxonomic confusion and instead, a growing agreement that the species exported is *O. cyanea*. All three exporters said they were exporting 100% *O. cyanea* and mentioned that *O. vulgaris* was a negligible portion of their product[64]. Additionally, in Kenya, the central fisheries office agrees that the commercially fished species of the nation is *O. cyanea*[65].

The taxonomic confusion at the export level and in the early scientific literature in Tanzania may come from the fact that traders and key informants when interviewed in Swahili (in both Kenya and Tanzania) referred to the octopus traded as "pweza wa kawaida". The direct translation in English is 'the usual or commonly caught octopus'. As one key informant suggested, the confusion may lie in this switching of languages[66]. In English, the common name for *O. vulgaris* is 'the common octopus', while the common name for *O. cyanea* is instead 'the day octopus'. This would lead one to translate a trader who is saying that the type of octopus they catch is "pweza wa kawaida" -or the species commonly traded to 'the common octopus', which may then be further misconstrued into *O. vulgaris*.

Chain-of-custody issue: Informal import from Mozambique to meet demand

Many middlemen, key informants, and exporters provided their insights on both formal and informal import of octopus from Tanzania to Mozambique[67]. The official view of the central Ministry of Livestock and Fisheries Development is that there is no formal import of octopus into Tanzania[68]. However, our preliminary mapping indicates that there is both formal and informal import of octopus from Mozambique into Tanzania.

While Southern Tanzania's octopus catches may look sustainable from looking at landing recorded provided by the government fisheries department, the catch has, according to one trader, been declining over the last 10 years)[69]. Estimates of the percentage of octopus from Southern Tanzania that is actually from Mozambique varied from 30% to 70%. While on paper export numbers being sourced from the Mtwara region seems constant, recent numbers are actually being inflated by the import of octopus from Mozambique, with over half of this trade being done illegally, in that the octopus is not passing through customs. Legal cross-border

[61] P40- Dar es Salaam exporter
[62] K28-Dar es Salaam key informant
[63] K28-Dar es Salaam key informant
[64] P44- Mombasa exporter, P45- Mombasa exporter, P46- Mombasa exporter
[65] K11- Mombasa key informant
[66] K4- Dar es Salaam key informant
[67] P5- Dar es Salaam small-scale trader (fryer), P16-Mtwara large-scale trader, P17-Mtwara large-scale trader, P18-Mtwara large-scale trader, P19-Mtwara large-scale trader, P20-Mtwara large-scale trader, P14- Mtwara agent, P15- Mtwara agent, P33- Tanga agent, K19-Mtwara key informant, K20-Mtwara key informant, and P40- Dar es Salaam exporter, P41- Mtwara exporter and P42- Lindi exporter
[68] K27- Dar es Salaam key informant, K28- Dar es Salaam key informant
[69] P41- Mtwara exporter

trade can be infeasibly expensive or time-consuming[70]. For example, at other land borders fish can rot in the weeks it takes seafood to make it through customs[71].

In Mtwara three individuals who supply octopus from Northern Mozambique were interviewed, one company agent[72] and two large-scale traders[73]. One large-scale trader buys octopus at the Mozambique border by hiring a boat and sails to the in-water border to get octopus from more than 15 Mozambique fishers. He then transports this octopus to Mtwara to sell to consumers and traders of various kinds[74].

The company agent's main suppliers are 5 traders from Mozambique[49]. Only a month before the interview he had begun buying 700kg/week from these traders at 4000TSH, while buying 1800kg/week from Mtwara traders at the same price. The company agent then sells octopus to the company at 5000TSH/kg and 4500TSH/kg to large-scale traders in Mtwara. Their choice to provide quantity information in weekly increments suggests they acquire octopus from Mozambique traders on a weekly basis. These Mozambique traders take three days to arrive to the Mtwara region from Northern Mozambique as they sail only by wind power to avoid using their engines in order to save on fuel costs. They return to Mozambique with products from Mtwara including sugar and cement. Middlemen with trade ties in Southern Tanzania and Mozambique noted that they preferred getting their suppler from Mozambique traders because they bring larger size octopus and large quantities of them. However, Mozambique octopus may not solve Tanzania's supply issues as Portuguese buyers are have complained about a change in the quality of the octopus and they are starting to complain that the texture of this Mozambique octopus is not the same[75].

Indirect issue: Incentive for MSC certification not seen by export companies

While the general sentiment expressed by agents and traders was in support of MSC certification, a few respondents vocalized that they did not think a price premium would trickle down the value chain[76]. The small-scale exporter in Tanzania did not think that MSC certification will be able to help them because they are only able to export octopus is such small quantities and not consistently throughout the year. This is due to scarcity of product and that the cold turbulent low season limits the ability of fishers to dive[77].

Views among the monopoly exporter were mixed with some branches believing that MSC certification is unlikely to results in a price premium for them as a German certification (Naturland) that they received in 2009 for the Nile Perch sector of their company did not result in a higher selling price[78]. Instead they suggest that the market and fishery will be improved when there is greater enforcement of fisheries regulations[79]. Bringing these fisheries up to MSC certification standards will mean improving enforcement of regulations, and thus through increased sustainability, MSC certification may result in indirect benefits to exporters by improving the stability and quantity of their available supply. Notably, at the head Dar es Salaam office the exporter does believe that MSC labelling would raise the export price and said this benefit would trickle down to the fishers[80].

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[70] K7- Mombasa key informant, K26- Dar es Salaam key informant
[71] K7- Mombasa key informant
[72] P14- Mtwara agent
[73] P16- Mtwara large-scale trader, P17- Mtwara large-scale trader
[74] P16- Mtwara large-scale trader
[75] P41- Mtwara exporter
[76] P36- Vanga agent
[77] P39- Dar es Salaam exporter
[78] P41- Mtwara exporter
[79] P41- Mtwara exporter
[80] P40-Dar es Salaam exporter

6. Opportunities for MSC Certification in Tanzania and Kenya

Ties between exporters and fisheries governance

One of the most promising opportunities for overcoming these obstacles to certification is the strong link between government and exporters and the ties between exporters in both nations that make the intraregional trade reform possible. Exporters in both countries are on board with MSC certification (regardless of whether they think they will benefit from receiving certification) if government officials encourage them proceed through chain-of-custody certification requirements. This is because there are strong formal and informal ties between fisheries officers and company administrators. One Dar es Salaam Exporter emphasized the importance of having all documentation ready for each international shipment and noted that no shipment of octopus leaves without a government officer also present[81], which emphasizes the importance they place on issues of legality and government oversight. As the largest exporter in Tanzania and the largest exporter in Kenya are owned by the same overarching company, collaboration between exporters to address informal trade from Tanzania to company agents in Kenya may be possible.

Middlemen as proponents of sustainability

While, middlemen are often considered a parasitic link between producers and final consumers [50], they have also been considered to be key points of credit access offering interest-free loans as well as market access and services in exchange for guaranteed supply [51] [52] [53]. Here we found that middlemen may also be a good entry point for promoting sustainable practices. In Tanzania specifically, middlemen were strong proponents of sustainability. Many middlemen themselves were in support of MSC certification, and implied traders may trade through formal means, if customs fees for octopus import were reduced.

We also asked middlemen in Kenya and Tanzania an open-ended question regarding what measures or investments they thought could be done for "sustainability as well as improve the competitiveness of the East African octopus trade"? We then recorded what type of measures were discussed. About a third of traders (7/20) called for additional management measures in Kenya, with half (8/16) of the traders in Tanzania calling for additional management measures. A fifth of traders interviewed in Tanzania (4/20) also called for better-enforced size restrictions. This may mean that the size restriction and stronger management may have imparted a stronger conservation ethic in Tanzania traders as compared to the less managed octopus trade of Kenya. Conservation efforts suggested included stronger enforcement, the introduction of octopus closures and other measures that varied in their scope and the initiating actors. For example, one Tanga agent suggests that companies take initiative in following up with marine conservation issues and that the government educate traders before issuing them with trading licenses[82]. As part of the process of meeting MSC certification standards, these types of efforts will likely be needed.

Vertical integration

Tanzania may have an easier time meeting chain-of-custody requirements for MSC certification given vertical integration of processing and exporting. One company has a near

[81] P40- Dar es Salaam exporter
[82] P31- Tanga agent

monopoly on the international export of octopus from Tanzania[83], and handled all processing themselves. We interviewed collection centers and processors in Tanga, Mtwara, Dar es Salaam and Lindi that are in fact all subsidiaries of the same company operating under different company names. This company considers themselves to have no competition from other exporters in Tanzania although another two smaller export companies do exist[84].

This export company itself is a subsidiary of a larger company that also owns the largest octopus export company in Kenya. Vertical integration occurred after 2012 when the price of octopus temporarily went down and other exporters left or sold their processing facilities to the largest company[85]. This vertical integration can be seen as an opportunity for MSC certification and labeling, given that chain-of-custody requirements will only need to be met by one or possibly two companies. In Kenya, there were only slightly more export companies (with a total of three companies approved for international export). Having a small number of companies may be beneficial to Kenya's certification prospects as well.

It is also unlikely other companies will join Tanzania's or Kenya's export industry in the near future. Market entry for exporters is difficult given the numerous safety and traceability requirements of the European Union[86], with three types of processing approvals needed[87]. One Kenyan exporter mentioned that EU criteria were so extensive that they themselves are still struggling to meet these standards[88]. In Tanzania, one exporter noted that these changes in standards can happen very quickly and that last year the EU added nutritional labeling requirements to all octopus products sent from abroad[89].

While the limited number of exporters in both countries may be beneficial to the ease at which the entire octopus value chain can be certified, it is important to note that traders and agents in both nations felt that a near monopoly on octopus export reduced their own bargaining power[90]. In the words of one Tanga agent" The market will improve when more processing plants are established… this will improve octopus trading which will translate into good income"[91]. In Kenya and Tanzania middlemen suggested that the government encourage more processors to create a wider market[92]. One agent in Tanga believed that "the export market will decline if no new companies are establishing to create a wider market. If not, octopus will be consumed locally instead and the domestic market will boom"[93]. His logic was that traders will sell to the local market instead of agents if the buying prices of the main exporter are not increased through competition with other exporters. This agent felt that the company also exploited them by not covering city council taxes and suggested that agents form cooperatives to influence pricing with the company.

7. Limitations of MSC certification

Tanzania and Kenya may face obstacles that are characteristic of many developing countries. These include the need for additional fisheries management funding and the existence of information asymmetry within the value chain. As one key informant put it, "We do

[83] K12 Tanga key informant
[84] P40- Dar es Salaam exporter, P41- Mtwara exporter, P42- Lindi exporter, P43- Tanga exporter
[85] P39- Dar es Salaam exporter, P43-Tanga exporter
[86] K4- Dar es Salaam key informant
[87] P41- Mtwara exporter
[88] P44- Mombasa exporter
[89] P4- Dar es Salaam exporter
[90] P29- Shimoni small-scale trader, P30- Tanga agent, P32- Tanga agent
[91] P30- Tanga agent
[92] P25- Shimoni small-scale trader, P13- Mombasa small-scale trader, P32- Tanga agent
[93] P32-Tanga agent

not know how much the companies are selling the octopus out for"[94]. Producers are more likely to stick to their initial asking prices if they were aware of the price offered further up the value chain [54] and thus information asymmetry may lead to exploitation [55]. These issues of equity are outside the scope of the sustainability goals of MSC certification but are in critical need of attention if the aim is to improve the material and non-material well-being of those along the octopus supply chain.

Some company agents in Kenya noted that they felt pressured increase the prices they gave fishers even though they knew their company would not increase the prices they paid them for octopus. This has had led to overall lower incomes for these agents without impacting company profit margins[95]. MSC certification has the potential to open up dialogue around equitable profit margins for middlemen and fishers, as government officials indicated that workshops would be held to discuss the certification process and the potential for any price premium from certification to trickle down the supply chain[96]. Other interventions that prevent marginalization of small-scale traders by improving information exchange can be considered in tandem with MSC.

Although not affecting MSC certification directly, there was also evidence of shifting gender dynamics within the fishery. In many towns, octopus fishing used to be a nearshore livelihood activity for women but, as European demand made the industry more profitable, male fishers began to dominate the market. The same trend has begun for local octopus frying as well-with octopus frying becoming an occupation of mainly men in Tanzania[97] and in some parts of Kenya[98]. Increased export prices which may come with certification could continue to change the gender dynamics of the fishery. One opportunity to empower women comes from mobile-banking. Technology can improve the access of women to the benefits of trade [56] and we found evidence of women taking advantage of mobile-banking and serving as large-scale traders while simultaneously caring for their children in Southern Tanzania. This is because mobile-banking allows women to directly receive payments for octopus that they send on public buses to large cities, without having to accompany the octopus or leave the community in which they live. In this manner, they can continue to care for their children while receiving immediate payment for their product[99].

8. Conclusion

Small-scale fishers, and arguably traders, often bear the burden of conservation regulations meant to preserve the use of resources for future generations. Furthermore, conservation and sustainable growth policies are often enacted without a proper understanding of their related markets [57]. This is especially true if market links are informal. We consider the informal intra-regional trade of immature octopus to be one of the greatest obstacles facing both fisheries. This is not only a resource management problem, but also a long-term livelihood concern for fishers and traders. It emphasizes that it is hard to be a good conservationist if your neighbors are not.

This informal trade also presents an obstacle in meeting the chain of custody requirements of MSC. However, attempting to improve traceability in order to meet requirements has the potential to not only improve seafood governance, but also to increase the material and non-material well-being of the individuals actively engaged in the fishery [52]. In

[94] K17- Shimoni key informant
[95] P21-Shimoni agent, P22-Shimoni agent
[96] K5- Dar es Salaam key informant, K12- Tanga key informant
[97] K4- Dar es Salaam key informant
[98] K16- Mayungu key informant
[99] P19- Mtwara large-scale trader

starting these discussions about the potential of MSC certification, managers are now able to understand the scope of environmental, social, and economic obstacles faced by octopus traders and exporters. This will allow them to begin to address some of these issues head-on, by, for example, requiring exporters to give their agents formal written contracts. This work illustrates that understanding management issues, and perspectives along the supply chain are key steps towards increasing the sustainability of a fishery.

Tanzania, as the first developing country octopus fishery to seek certification through continual improvements, also increases its ability to receive greater benefits from certification [13]. However, none of these benefits are guaranteed. Tanzania arguably stands to benefit more from MSC certification than Kenya- as they are further along in the certification process and may be the first developing octopus fishery to qualify for certification, although we show here the barriers they face are significant. As more fisheries gain certification the competitive advantage of MSC certification decreases [58]. If the exporter is expected to pay for the MSC certification they must anticipate a greater revenue from the price premium [59] than the certification cost, which may not occur. Thus, Kenya may follow in the footsteps of Tanzania only after observing Tanzania reap the benefits of certification. However, our findings show that MSC certification for either nation, particularly Kenya, is unlikely without the creation of a size restriction in Kenya and without considerably improved management in both nations.

If a price premium from MSC labeling does trickle down to Tanzanian and Kenyan middlemen, this could help the international market compete with the local market for the supply. If only Tanzania is certified, any price premium that occurs could help Northern Tanzania compete with Kenya for the octopus that is currently being smuggled informally out of Tanzania to Kenya. However, for either nation, MSC certification will not be a cure-all. It is sometimes the case that luxury fish products such as octopus may have the greatest trade inequities [60]. Here, middlemen and key informants raised numerous equity concerns within the fishery, like the pushing out of women from the fishery as the businesses become more profitable, and information asymmetry among traders and exporters surrounding profit margins.

As MSC certification encourages export, the impact of certification to local access to octopus must be investigated. We were also not able to address the potential impacts of MSC certification on equitable benefit sharing and value chain dynamics which are also major concerns. Other barriers not addressed in this study include who will cover the cost of certification. Additional research is needed to understand the socio-economic impacts of MSC certification on all actors of the value chain and the findings we present here may serve as a baseline for future evaluation [20].

The numerous barriers to fulfilling MSC principles 1- the sustainability of these fisheries and principle 3- effective fisheries management, combined with the need to further understand the socio-economic impacts of certification, raises questions regarding whether there is sufficient knowledge and resources to justify pursuing certification at this time, rather than purely improved managed for either country. Ultimately, we hope these findings will help both Kenya and Tanzania reach their sustainability goals. If managers do decide to move forward with certification efforts, a framework against which to establish improvements can now be developed. By understanding the challenges that both Tanzania and Kenya face as they consider MSC certification, this research can also serve as a case study to other developing country fisheries considering MSC certification.

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