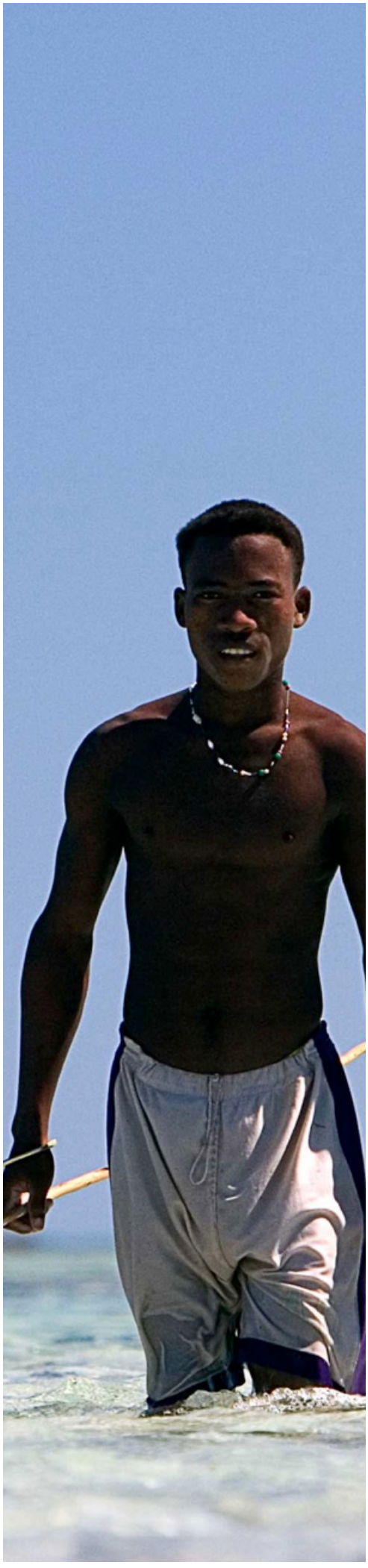

Steve Rocliffe and Alasdair Harris

Blue Ventures Report: The status of octopus fisheries in the Western Indian Ocean.

April 2016

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Front page: Searching for reef octopus in Madagascar; photo: Garth Cripps.

List of abbreviations and acronyms

APR	Annual Percentage Growth Rate
FAO	Fisheries and Agriculture Organisation
IOC	Indian Ocean Commission
IUCN	International Union for Conservation of Nature
MPA	Marine Protected Area
MSC	Marine Stewardship Council
LMMA	Locally Managed Marine Area
WIO	Western Indian Ocean
WIOMSA	Western Indian Ocean Marine Science Association

1. Summary

Octopus fisheries are an important resource for coastal communities throughout much the WIO region. In many coastal zones with coral reefs, octopus fishing dominates small-scale fishing effort and is a particularly important economic activity for women as well as men. This report reviews the status of octopus fisheries in the Western Indian Ocean, as part of efforts to improve regional knowledge. It examines trends in catches, imports and exports of octopus at both the global and regional level, and explores the status, extent and structure of the fisheries in eight WIO states: Madagascar, Rodrigues, Comoros, Tanzania, Zanzibar, The Seychelles, Kenya and Mozambique. The report's key findings are:

- Global octopus catch peaked at almost 380,000 tonnes in 2007, and has since declined by a tenth to 335,865 tonnes in 2012.
- The growth in octopus catches since 1990 has not occurred evenly. Africa was the primary region for octopus capture in 1990, but has since seen its share of the global total halved from 35% in 1990 to 18% in 2012.
- At a global scale, China, Morocco, Mauritania, Spain and Vietnam are the main exporters of octopus.
- Global imports of octopus totalled an average of US$ 1.6 billion dollars per year between 2009 and 2013. Major markets are centred in Asia and Europe, particularly Japan, South Korea, Italy and Spain.
- Tanzania, Madagascar and Kenya are the largest exporters of octopus in the Western Indian Ocean and target EU markets primarily, particularly Portugal, Italy, France and Spain.
- Artisanal fishing for octopus has been practiced for centuries in the Western Indian Ocean and is an important economic and subsistence activity for many coastal communities, especially in Tanzania, Madagascar, Rodrigues and Mozambique.

2. Introduction

This short report synthesises and analyses top-line data on global octopus fisheries, including landings statistics and import and export data. For convenience, results are split into three sections. The first section presents an overview of trends in global octopus catches, together with main exporters and importers. The second examines catches and imports and exports from artisanal fisheries for octopus, both in the Western Indian Ocean (WIO) and in Africa more broadly. The final section explores the structure of the fisheries in eight WIO states: Madagascar, Rodrigues, Comoros, Tanzania, Zanzibar, The Seychelles, Kenya and Mozambique.

This research is part of a trio of reports prepared by Blue Ventures for the *Scaling Success in Octopus Fisheries Management in the Western Indian Ocean* workshop, held in Stone Town, Zanzibar, from 3-5 December 2014. The other two reports are *Experiences of Short-term Fishery Closures in Non-octopus Fisheries* and *Scaling Success in Octopus Fisheries Management: Proceedings of the Western Indian Ocean Workshop, 3-5 December 2014, Stone Town, Zanzibar*.

Limitations

Many of the figures throughout this report are based on FAO fisheries data. The quality of these data depend on the quality of information provided by FAO member nations, which can at times by undermined by limited political will or financial resource (Jacquet et al., 2010; UN FAO, 2014). There are three further key data limitations. First, the FAO reports landings, not catches, so discarded fish are excluded from datasets (Jacquet et al., 2010; Pauly, 2006). Second, it is estimated that between 10% and 60% of the catch in some areas is landed illegally (Asche and Smith, 2009). Finally, many fisheries are unmonitored and/or unregulated, either because they are small-scale and not reported to national bodies, or because they take place on the high seas (Pauly, 2006). Although data presented here have been cross-referenced where possible to help ensure validity, results should be treated with a degree of caution.

3. Part one: trends in global octopus fisheries

Global capture fisheries

In 2012, total reported world fishery production (excluding aquatic plants) reached 158 million tonnes, with 59 percent (93.7 million tonnes) originating from capture fisheries (UN FAO, 2014). The FAO describes the global catch as stable and, whilst it is true that production has stagnated at around 90 million tonnes since 2001, this stagnation hides several underlying trends (Arnason et al., 2009).

The proportion of stocks fished within biologically sustainable levels has continued to decrease, falling from 90% in 1974 to 71.2% in 2011, the latest year for which figures are available. As such, in 2011, more than a quarter of stocks (28.8%) were estimated to be overfished, and a further 61.3% are fully fished (UN FAO, 2014). This combined percentage of 90.1 is the highest recorded since records commenced in 1950, which even the FAO acknowledges is cause for concern. The remaining 9.9% of marine capture fisheries are estimated to be underexploited (UN FAO, 2014). Although this suggests that they could produce more than their current catches, many are low-value species or uneconomical to harvest (Arnason et al., 2009).

Moreover, increasing evidence suggests that there has been substantial 'fishing down' of marine food webs, with low-tropic level fish and invertebrates supplanting higher-level piscivores like cod and tuna (Pauly et al., 1998; Swartz et al., 2010). Cephalopods (squid, cuttlefish and octopus) are one such group of invertebrates and as such, are being increasingly targeted by artisanal and industrial fisheries (Sauer et al., 2011).

Global cephalopod fisheries

The total catch of cephalopods slowed for several years after peaking at 4.3 million tonnes in 2007, but rebounded to more than 4 million tonnes again in 2012 (Figure 1). Global catches have increased by more than two thirds since 1990 (69.9%), with the proportion of the global catch attributable to cephalopods seeing a corresponding jump from 2.8% to 4.4%.

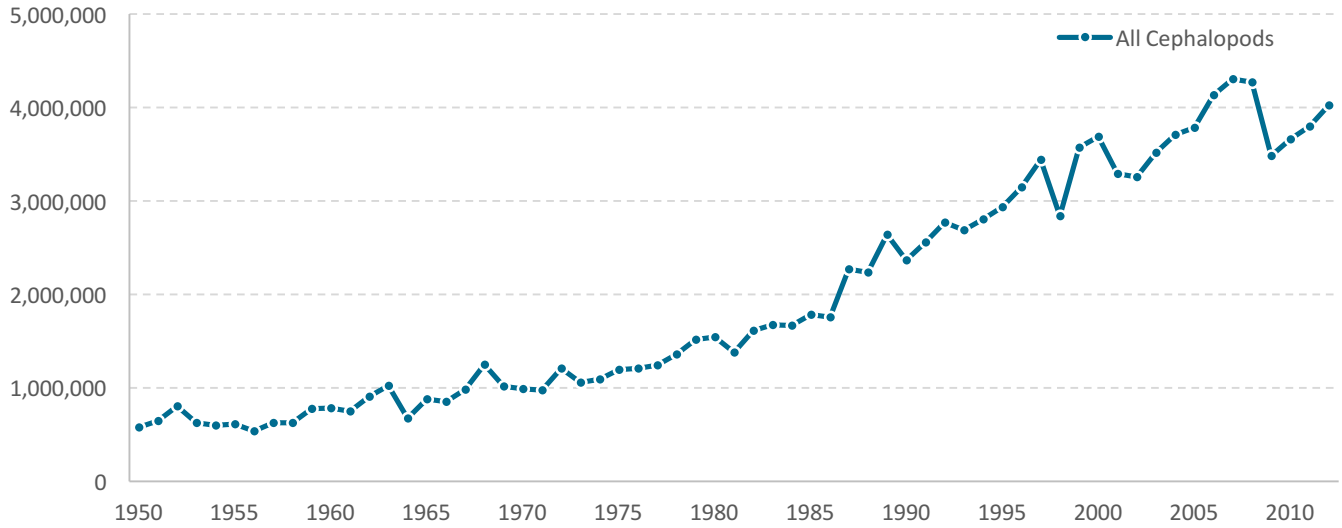


Figure 1. Trends in cephalopod catches, 1950-2012, tonnes. Source: FAO Fisheries and Aquaculture Department, 2014

The squid species *Dosidicus gigas* (Humboldt or jumbo flying squid) and *Todarodes pacificus* (Japanese flying squid) from the Pacific, and *Illex argentines* (Argentine shortfin squid) from the Southwest Atlantic dominate the global cephalopod catch.

In terms of imports and exports, cephalopods comprised 3% of world fish trade by value in 2012 (UN FAO, 2014). Thailand, Spain, China and Argentina are the principal exporters of squid and cuttlefish, whilst Morocco and Mauritania are the largest exporters of octopus (UN FAO, 2014). The primary consumers and importers of cephalopods are Spain, Italy and Japan (UN FAO, 2014). In spite of a challenging economic outlook and high prices, demand for cephalopods remained strong in these main markets in 2013 (UN FAO, 2014).

Global octopus fisheries

Octopus catch increased rapidly between 1950 and 1990, rising by more than 720% from 35,844 tonnes in 1950 to 294,386 tonnes in 1990 (Figure 2). Though the rate of growth has since slowed, catches still increased by 14.1% between 1990 and 2012. Global catch peaked at 376,326 tonnes in 2007 but has since declined by a tenth to 335,865 tonnes in 2012. The percentage of world cephalopod catches attributable to octopus has decreased substantially since 1990, declining from 12.4% to 8.3%.

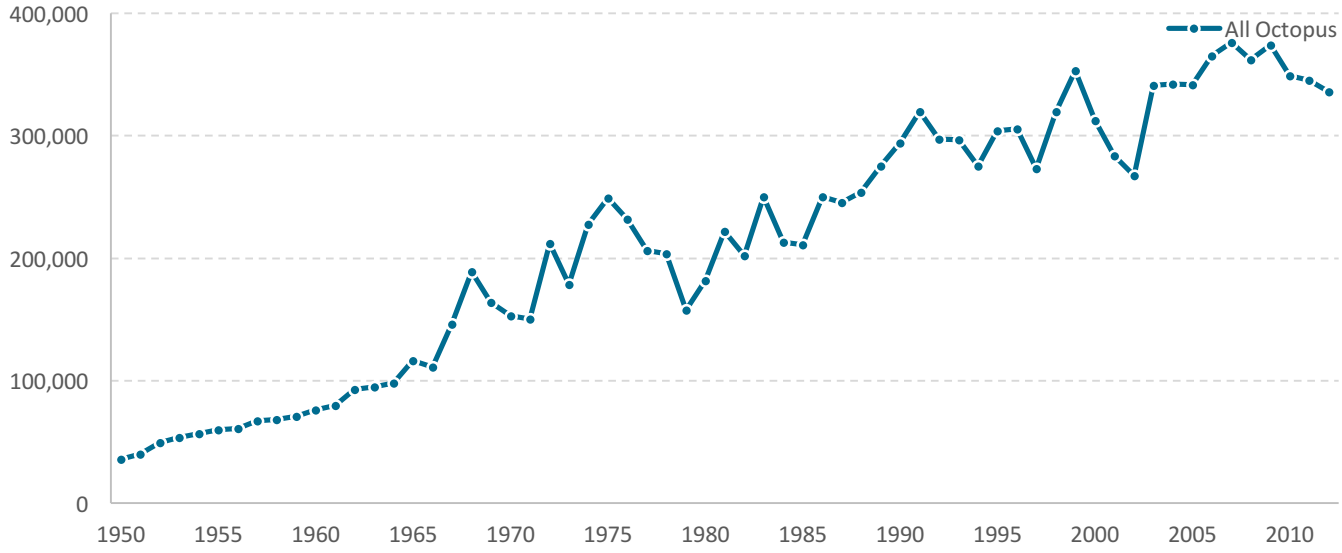


Figure 2. Trends in global octopus catches, 1950-2012, tonnes. Source: FAO Fisheries and Aquaculture Department, 2014

At the global level, octopus catches are more stable than those of squids. (UN FAO, 2014). The most important commercial species include *Octopus cyanea*, *Octopus maya*, *Octopus tetricus*, *Octopus dolfleini* and *Octopus vulgaris*, though the latter remains overfished (Humber et al., 2006; UN FAO, 2014)

Octopus aquaculture has typically been a negligible contributor to global production and has largely involved the capture of smaller wild specimens, which are raised in captivity and sold during times of peak demand (García et

al., 2014; Globefish, 2014). However, this may be about to change. The Spanish Institute of Oceanography in Vigo is pioneering research into full life-cycle octopus farming and expects to overcome initial barriers within three years, paving the way for large-scale octopus aquaculture in the near future (Globefish, 2014).

Global octopus exports

Although more than 100 countries exported octopus products between 2009 and 2013 (Figure 3), the ten largest players account for more than 85% of the global total by weight (Figure 4). Between 2009 and 2013, China dominated the rankings, exporting an average of 56 million kilograms per year, worth more than US$308.5 million, almost one fifth of total global production by both weight and value. Over the same period, the other main exporting countries were Morocco, Mauritania, Spain and Vietnam. Although overall catches of have declined in recent years, there are signs that production is stabilising (Humber et al., 2006; UN FAO, 2014).

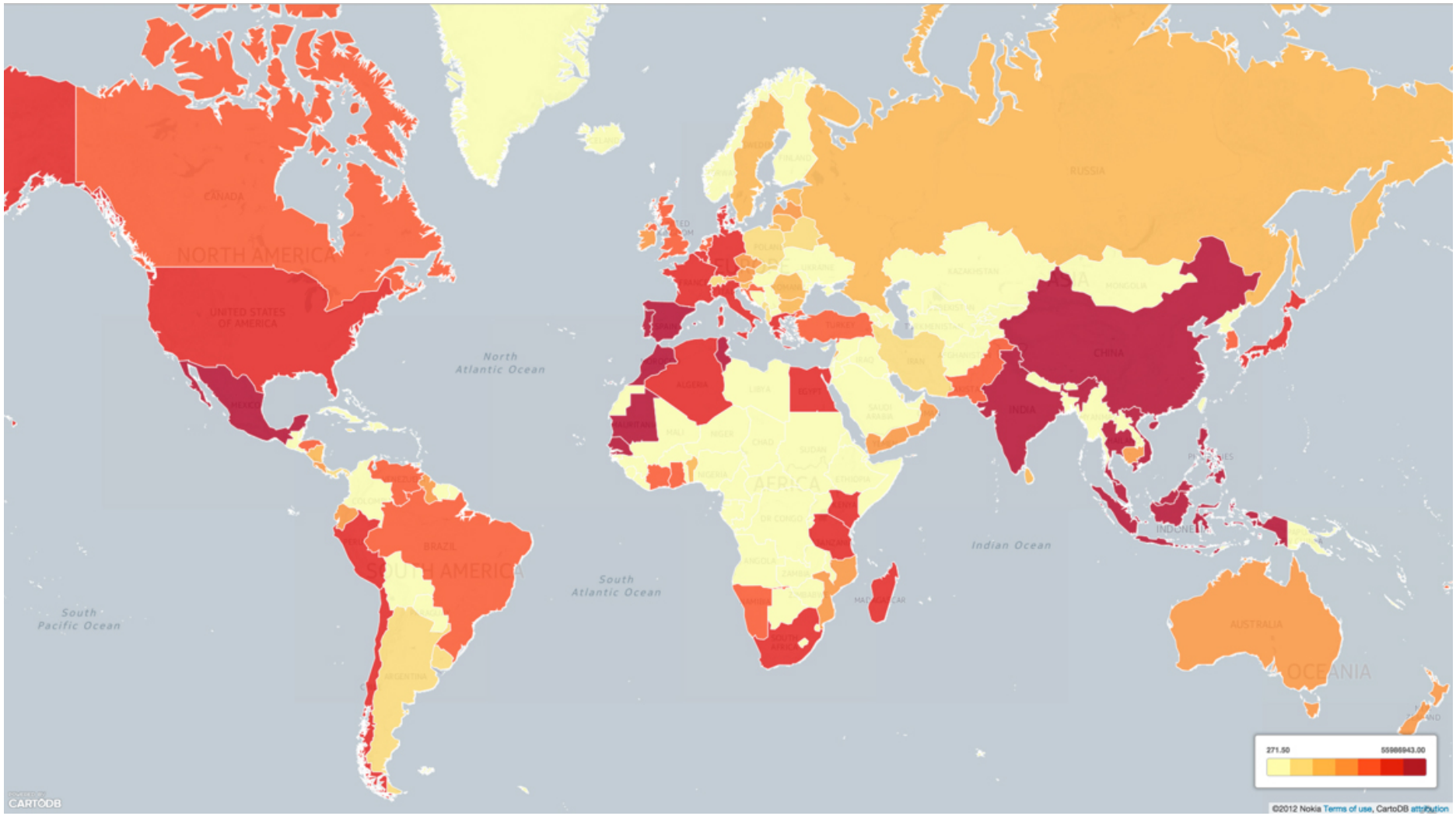


Figure 3. Global octopus exports in tonnes, 2009-2013 average. Source: Comtrade, 2014. The darker the shade of red, the higher the total weight of exports from the country. Average for Madagascar is 2008-2012 due to inconsistencies in the data for 2013

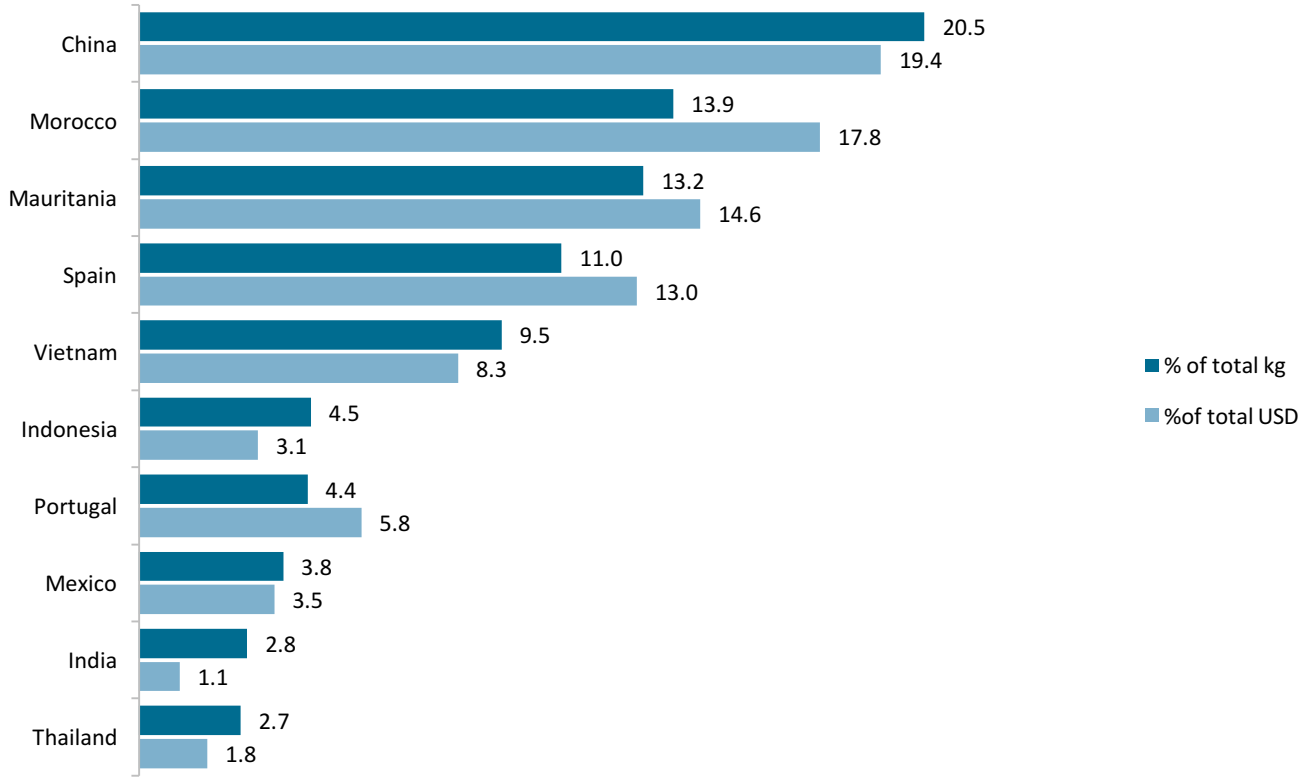


Figure 4. Principal exporters of octopus by weight (kg) and value (US$), 2009-2013 average. Source: Comtrade, 2014

Global octopus imports

Imports of octopus totalled an average of US$ 1.6 billion dollars per year between 2009 and 2013. These data also show major markets are centred in Asia and Europe, with Japan being the largest in the world by value (Figure 5,6), South Korea being the largest by weight, and Italy being the largest in Europe for both. The top ten importers of octopus collectively accounted for 92% of the total weight of global imports, with South Korea alone responsible for a quarter of the global total by weight, and Japan for more than a fifth by value.

2013 was a record year for Japanese octopus imports, with volumes increasing from 47,400 tonnes in 2012 to 58,400 tonnes in 2013. However, early indications from 2014 are that imports will decline to normal levels once more: during the first quarter of the year, imports were 10,200 tonnes, close to the 2012 figure of 9,100 but significantly lower than the 17,000 tonnes imported over the same period in 2013. Shipments from Morocco and Mauritania, Japan's main suppliers, were slightly lower during Q1 2014, although imports from China registered modest increases (Globefish, 2014). Japan imports four main species, mostly in live or fresh form: *Octopus vulgaris* (the common octopus), *Paroctopus dofleini* (Pacific giant octopus), *O. conispadiceus* (the chestnut octopus) and *O. ocellatus* (the ocellated octopus). It does not import *O. cyanea,* the dominant species caught in the Western Indian Ocean, due to its small size and the wounds usually inflicted during capture of this predominantly reef species, which conflict with cultural preferences for perfection in Japanese cuisine (Moreno, 2011).

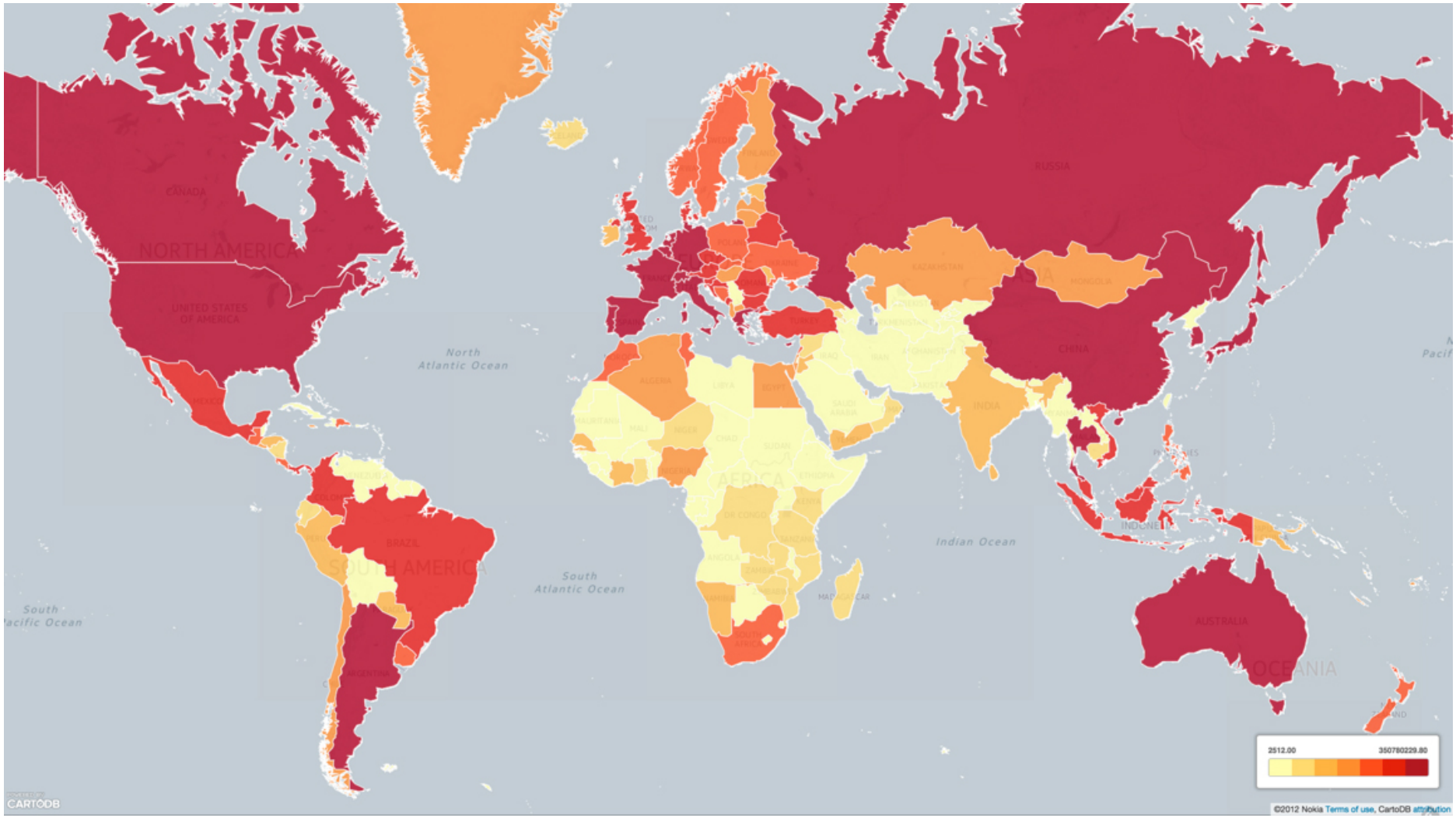


Figure 5. Global octopus imports in tonnes, 2009-2013 average. **Source: Comtrade, 2014. The darker the shade red, the higher the total weight of octopus imported by the country**

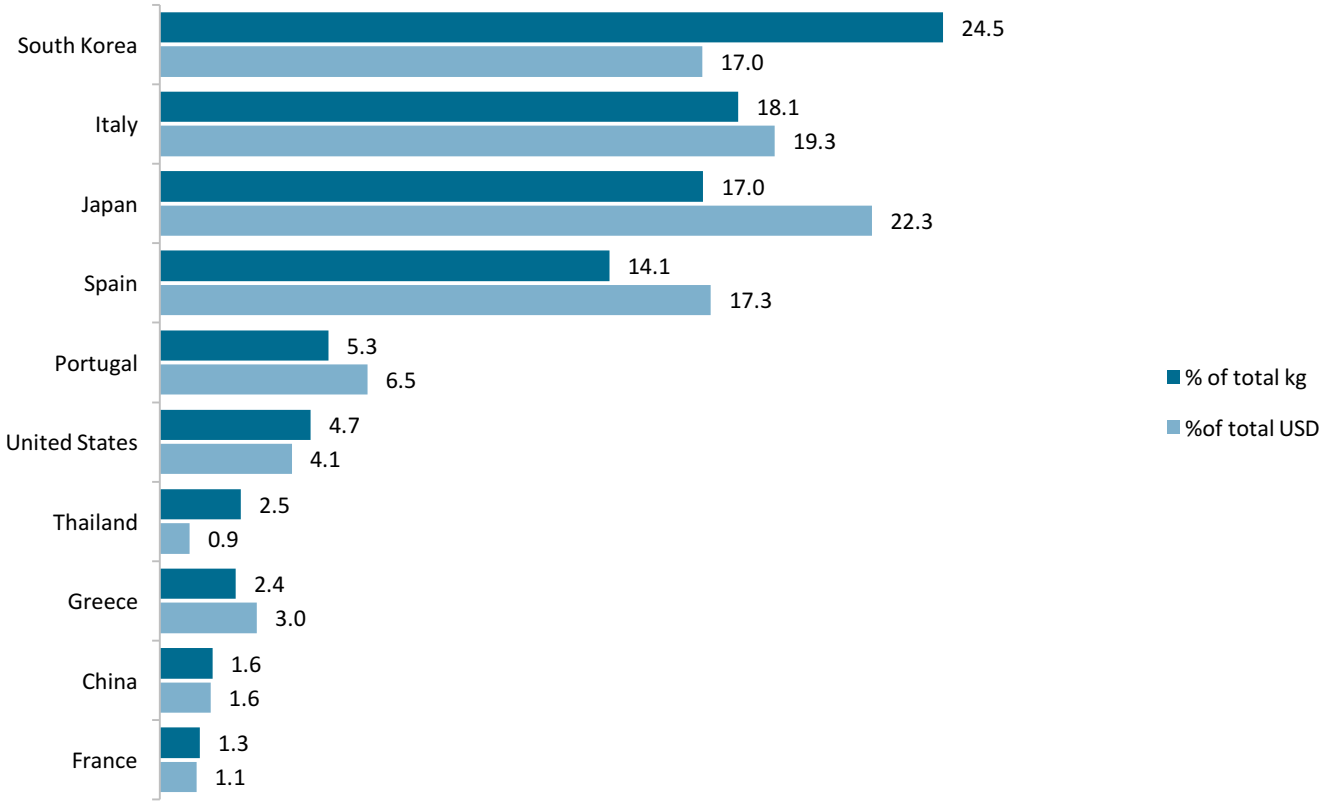


Figure 6. Principal importers of octopus by weight (kg) and value (US$), 2009-2013 average. Source: Comtrade, 2014

Like Japan, Italy has specific customer demands that make it a challenging market to enter (Moreno, 2011). Italy's preferred species is *O. Vulgaris*, as in the other major European importer Spain. Imports have been relatively stable for several years, however they have declined slightly in Italy since 2010 (Globefish, 2014). By contrast, Spain's octopus imports increased by 30.5% to 41,500 tonnes in 2013, up from 31,800 tonnes in 2012. During the first quarter of 2014, imports were moderately lower than over the same period in 2013 (14%) but higher than in both 2012 and 2011.

4. Part two: octopus fisheries: the regional picture

Catches of Octopus by continent

The growth in octopus catches since 1990 has not occurred evenly, with only Asia and the Americas seeing increases (Figure 7). Asia, where catches doubled to more than 200,000 tonnes between 1990 and 2012, saw its share of the global total rise from 32.8% to almost 60% over the same period. Catches from the Americas grew by 43.6% to 37,866 in 2012, 11.3% of the global total. Both Africa and Europe saw decreases of around 40% in catches between 1990 and 2012. The primary continent for octopus capture in 1990, Africa's catches have since dropped from more than 100,000 tonnes in 1990 to just over 60,000 in 2012. Its share of the global total has halved from 35% in 1990 to 18% in 2012. Similarly, Europe's catches have fallen from nearly 66,000 tonnes to just over 36,000 tonnes over the same period, and its share of the total has halved from 22% to 11%.

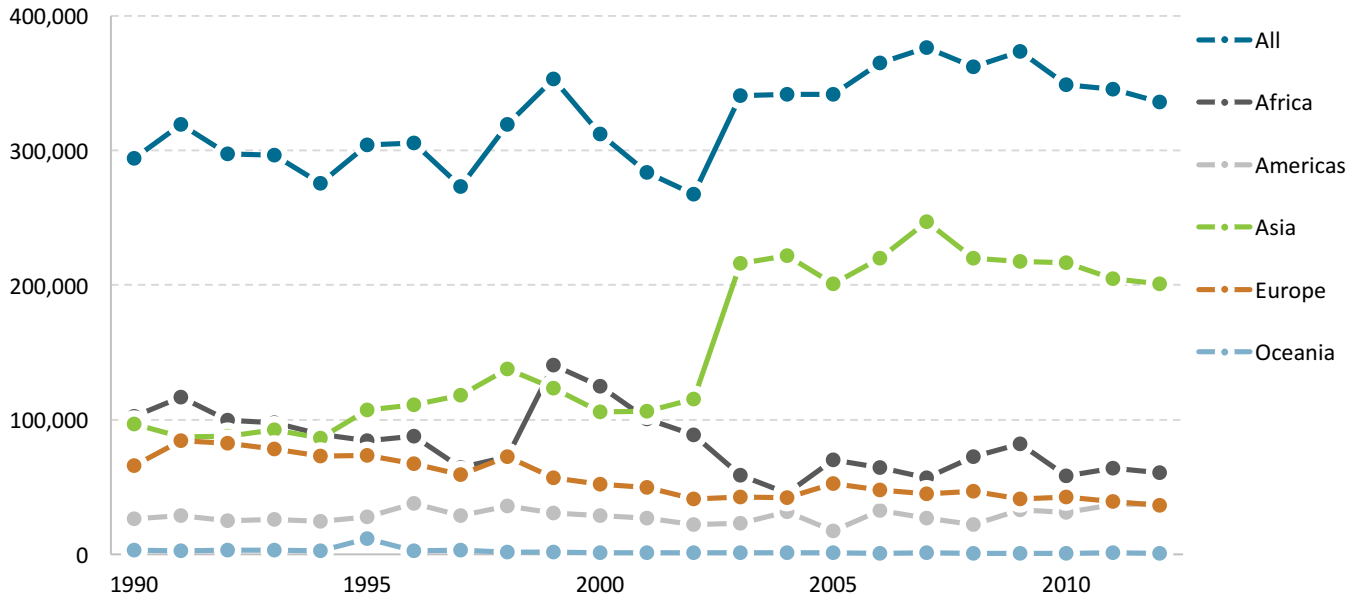


Figure 7. Catches of octopus species by continent, 1990-2012, tonnes. Source: FAO Fisheries and Aquaculture Department, 2014

The reduction in the African octopus catch is largely attributable to a decrease in production in Morocco (Figure 8). In 1990, the Morocco fishery caught 52,338 tonnes of octopus, more than half of the African total. Since then, catches have declined by two thirds, reaching 18,411 tonnes in 2012. Early indications are that catches have dropped further in 2014, with just 4,419 tonnes landed between 01 Jan and 31 May. However, this is explained in part by a newly established closed season, which ran from 01 November 2013 to 01 February 2014 (Globefish, 2014). Declines in other major African producers have generally been less dramatic, though many do appear to have peaked. Although Mauritania saw its catches plummet from 28,500 tonnes in 1990 to 7,605 in 2008, they have since rebounded to more than 25,000 tonnes, an overall decrease of 11.5%. Third-placed Senegal's catches have remained stable, but Tunisia's have dropped by more than a third between 1990 and 2012, declining from 6,417 tonnes to 4,244 tonnes. Of the five largest African octopus fisheries, only Tanzania has increased its catches since 1990, up from 483 tonnes to 1,251, although landings peaked in 2003 at 1,700 tonnes.

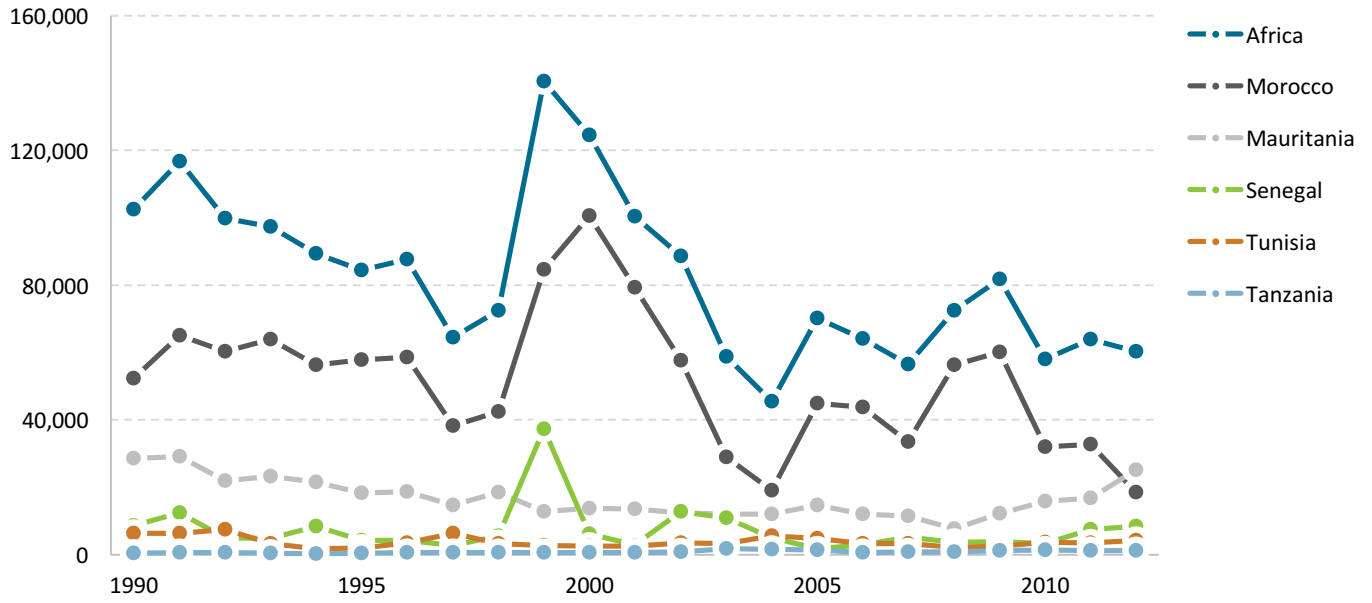


Figure 8. Trends in octopus catches from major African fisheries, 1990-2012, tonnes. Source: FAO Fisheries and Aquaculture Department, 2014

Artisanal fishing for octopus in the western Indian Ocean

Artisanal fishing for octopus has been practiced for centuries in the WIO and is an important economic and subsistence activity for many coastal communities, especially in Tanzania, Madagascar, Rodrigues and Mozambique (Guard, 2009; Guard and Mgaya, 2002; Humber et al., 2006; Indian Ocean Commission, 2014). The region's artisanal catch is dominated by *O. cyanea*, although *O. vulgaris* is also targeted, particularly in the Seychelles (IUCN, 2004; Seychelles Fishing Authority, 2014) .

Octopuses are typically fished at low water on intertidal reef flats and subtidal reefs, especially during spring tides (IUCN, 2004). Many are caught for local consumption, however increasing demand from European and Far Eastern markets, where octopus command a higher price than in the region, has created new market demand for export, intensifying pressures on the fishery (Guard, 2009; IUCN, 2004; Moreno, 2011).

Octopus are collected in one of three ways in the region: i) by walking along the lower reaches of intertidal reef flats at low tide searching for octopus dens – small holes, often marked by small piles of stones and pieces of shell; ii) by snorkelling or diving along the reef edge; or, less commonly, by iii) sighting octopus from pirogues during periods of exceptionally clear water (Blue Ventures Conservation, 2012; Guard, 2009).

Once a den has been located, a spear or harpoon is inserted to determine whether an octopus is present. Where this is the case, the octopus will generally wrap its tentacles around the spear, allowing it to be prised out. On removal the octopus is either killed with a strike to the head from a club, with a spear through the beak into the brain, or by turning it inside out to remove the heart (Blue Ventures Conservation, 2012; Guard, 2009).

Although fishing for octopus has traditionally been dominated by women and children, male involvement is increasing because of high demand for the product in the international market and the greater income

opportunities this affords (Guard and Mgaya, 2002; Humber et al., 2006). Domestic and foreign-owned trading and collection companies now operate throughout the region, and in Tanzania buyers often use specially commissioned boats to take fishers to sites, paying premium prices for catches (Guard, 2009).

Octopus catches in the western Indian Ocean

According to the FAO, around 1,400 tonnes of octopus was caught in 1990 in Area 51, which covers the western Indian Ocean. This increased – though not steadily – to nearly 2,400 tonnes in 2012, a rise of 67% (Figure 9). The contribution of Area 51's catches to the global octopus catch also rose, jumping from 0.5% to 0.7% over the same period. The FAO only records catch data for six countries in the WIO: Tanzania, Mauritius, Kenya, Reunion, Mozambique and Seychelles. Catches from Reunion, Seychelles and Mozambique were negligible in 2012 (0-13 tonnes). Tanzania has the dominant regional fishery, and saw its catches increase by 160% between 1990 and 2012, up from 35% of the WIO total to more than half (53%). However the jagged nature of the line (Figure 9) suggests that the fishery tends towards volatility. Catches from Mauritius and Kenya have also increased, with Mauritius's contribution growing by more than 80%, from 349 tonnes in 1990 to 632 in 2012, and Kenya's rising from 79 to 394 over the same period; an increase of nearly 400%.

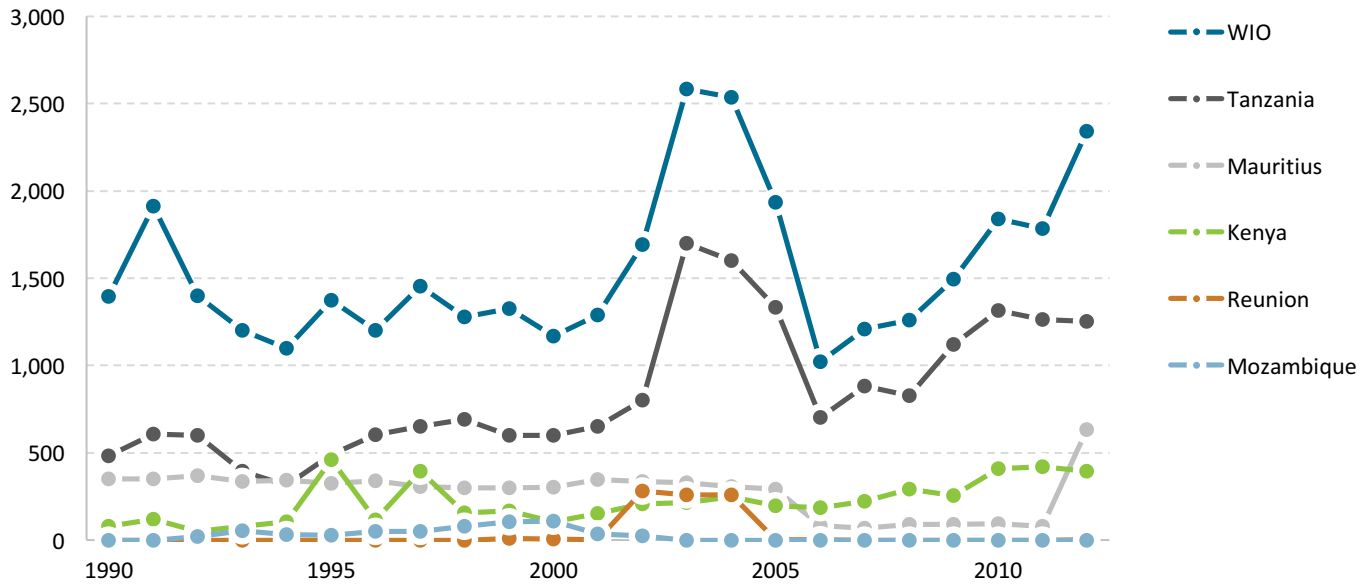


Figure 9. Trends in octopus catches from WIO fisheries, 1990-2012, tonnes. Source: FAO Fisheries and Aquaculture Department, 2014

The Octopus trade in the western Indian Ocean

Trade data for the western Indian Ocean comes from Comtrade, the United Nations database on international trade, and presents a markedly different and somewhat contradictory picture to that provided by the FAO fisheries database, which is the source of much of the catch statistics presented above and throughout. Thus a situation arises where Madagascar appears to be the second largest exporter of octopus by weight and value, despite

apparently not catching any octopus (Figure 10). Analysis suggests a further problem with the data. According to Comtrade figures, Madagascar's exports were relatively stable between 2001 and 2012, at around 1,000 tonnes per year, before spiking to almost 114,000 tonnes in 2013. Since such a leap, a 130-fold increase, calls into question the integrity of the most recent data, we have excluded it from the analysis.

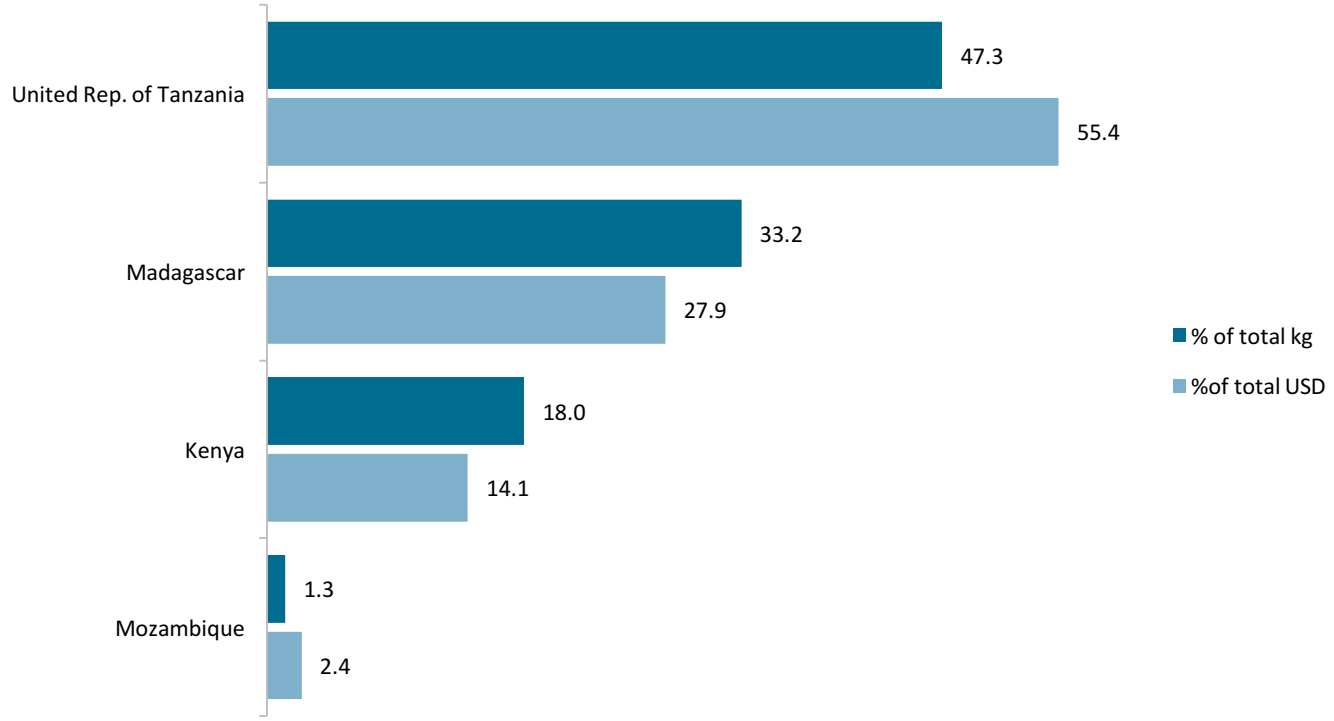


Figure 10. Top exporters of octopus by weight (kg) and value (US$) in the WIO, 2008-2012 average. Source: Comtrade, 2014

An average of 3,224 tonnes of octopus was exported per year between 2008 and 2012 from the western Indian Ocean, with an average value of US$12.2 million per year. This amounts to approximately 1.2% of global octopus exports by weight, but only 0.8% by value, suggesting that prices in the region are lower than elsewhere.

Tanzania is the dominant regional player, exporting just over 1,500 tonnes per year worth around US$6.8 million, around half of the WIO total by both weight and value, with an average price of US$ 4.45 per kilo. Second-placed Madagascar exported an average of 1,071 tonnes per year between 2008 and 2012, a third of the regional total. This netted US$ 3.4 million at an average price per kilo of US$3.18, more than a quarter below the figure for Tanzania.

Country	Challenges for exporters	Imports US$ 2009-2012 [1]	APR US$ 2009-2012 [2]	Imports kg 2009-2012	APR kg 2009-2012	Avg US$/kg
Portugal	• Very specific consumer demands • Low MSC awareness	3,831,151	-5.1%	895,033	-11.4%	4.28
Italy	• Very specific consumer demands • Low MSC awareness	3,168,714	11.8%	767,659	-0.1%	4.13
France	• Low MSC awareness	1,884,249	2.3%	561,063	-0.9%	3.36
Mauritius		842,958	-4.4%	316,926	-7.2%	2.66
Spain	• Very specific consumer demands • Low MSC awareness	426,971	-9.5%	112,015	-25.9%	3.81
Malta		140,344	-12.7%	50,183	-20.2%	2.80
Greece		133,374		32,775		4.07
Hong Kong	• Very specific consumer demands	116,764	80.4%	16,322	11.7%	7.15
Belgium		114,289		37,999		3.01
Turkey		98,827		31,440		3.14
USA		81,133		25,216		3.22
China	• Low MSC awareness	10,815		29,300		0.37

Table 1. Major export destinations for western Indian Ocean octopus. Sources: Comtrade, 2014; Moreno, 2011; Wharton school of Business, 2013. 1: Average, 2009-2012. 2013 figures were excluded do to inconsistencies in the data. 2: APR refers to the average annual percentage growth rate for 2009–2012

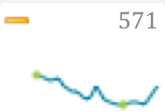
The Top five buyers of octopus from the western Indian Ocean were the same in terms of both value and quantity between 2009 and 2012: Portugal, Italy, France, Mauritius and Spain (Table 1). The top 10 importers bought an average of 2.8 million kilos of octopus per year, with the top three alone responsible for 2.2 million, nearly 80% of the total. By value, purchases totalled nearly US$ 10.8 million for the ten largest importers, with top-ranked Portugal and Italy accounting for US$7 million, 65% of the total. Malta and Spain's share of the market has decreased in recent years, with Malta's imports declining by an average of 12.7% percent per year between 2009 and 2012 by value and 20.2% by quantity, and Spain's dropping by 9.5% and 25.9% respectively over the same period.

Although the leading buyer of WIO octopus between 2009 and 2012, Portugal's imports have also declined, decreasing by an average of 5% per year by value and 11.4% by quantity. Imports by France and Mauritius have

been relatively stable, and whilst the volume purchased by Italy has remained consistent between 2009 and 2012, the value has increased by almost 12% a year, indicating a rise in the price paid to exporters in the region. Also worthy of note is Hong Kong, whose imports have risen by an average of 12% per year in terms of quantity but 80% per year in terms of value. At US$ 7.15, the average price paid per kilo by Hong Kong is almost twice as high as the average for the top 10 importers (US$ 3.78), though it is possible that this is an artefact of the data.

5. Part three: status and structure of octopus fisheries in western Indian Ocean nations

Table 2 summarises the key characteristics of the artisanal octopus fisheries in Comoros, Kenya, Madagascar, Mozambique, Rodrigues, Seychelles, Tanzania and Zanzibar.

Fishery	Comoros	Kenya	Madagascar	Mozambique	Rodrigues	Seychelles	Tanzania	Zanzibar
Target species	O Cyanea	Primarily O Cyanea but also O Vulgaris	O Cyanea (99%)	Primarily O Cyanea	O Cyanea (>80%) and O Vulgaris	O Vulgaris	Primarily *O Cyanea* (99.9%)	Primarily O Cyanea but also O Vulgaris
Fishing method	Walking	Walking or diving	Walking, diving, cruising	Walking or diving	Walking or diving	Walking or diving	Walking or diving	Walking or diving since 2004
No. of fishers	8,500 directly employed in fishing sector (6% of pop). A further 24,000 indirectly employed	6,500 artisanal fisherman employed in total	Estimated at >40,000 artisanal fishermen and women involved	Unknown	1,400 people directly or indirectly engaged in octopus fishing	Unknown	Unknown	7,313 octopus fishers, 30% of whom are female
Fisheries Management	No national management measures but in parts of Moheli MPA, min. size limit of 1kg, gear restricted to spears, fishing only allowed during the spring tide	No national measures but proposed a min size of 10.8 cm for females and 10.5cm for males dorsal mantel length, as well seasonal closure Jun-Aug	Local rotational closures, national min. size limit of 350g and a 6-week closed season	None	Local rotational closures, financial compensation to fishers	Nationally, no active measures but proposed closed season. Voluntary min. size of 1kg and bag limit of 2 octopus per person per day for unlicensed fishers in co-managed area in Praslin and La Digue	Licensing of fishers, min. size limit of 500g, closures at neap tides and export tariffs.	Licensing of fishers, 30 small traditional closures during Ramadan. Voluntary min. size limit of 500g in some areas
Total catch 1990-2012 (t)	Up to 100 tonnes a year							
Total export 2009-2012 (kg)	Not exported				Only exported internally to Mauritius	Not exported		

Fishery	Comoros	Kenya	Madagascar	Mozambique	Rodrigues	Seychelles	Tanzania	Zanzibar
Total export 2009-2012 (US$)	Not exported				Only exported internally to Mauritius	Not exported		
Avg US$/kg 2009-2012	Not exported	2.97	3.18	7.12		Not exported	4.45	4.45
Major exporters	Not exported	Sea Harvest Kenya	93% of catch is exported. Copefrito, Murex International, Sopemo		3 main companies, exporting approx. 40% of the catch to Mauritius	Not exported	90% exported to EU market. TANPESCA, SeaProducts, Bahari, Fruit de la Mer	Less than 10% is exported, primarily to Hong Kong, the Middle East and Kenya
Issues	Destruction of habitat caused by octopus fishers walking across reef flat	Fishery suspected to be fully exploited	Min. size limit is not respected		Financial payment and alternative livelihoods not sustainable	Localised overfishing, poor data collection	Management measures are not working well, dynamite fishing is damaging octopus habitat, stock is 90% exploited	Increasing demand from tourism sector is leading to overfishing, escalating use of destructive methods

Table 2. Status and characteristics of octopus fisheries in western Indian Ocean states. Sources: Anderson, 2014; Benbow et al., 2014; Cachimo, 2014; Comoros Fisheries Resources Directorate, 2014; Comtrade, 2014; Gough, 2014; Jhangeer-Khan and Agathe, 2014a; Moreno, 2011; Okemwa, 2014; Pandu, 2014; Seychelles Fishing Authority, 2014; Wharton school of Business, 2013. Notes: Rodrigues data is not from the FAO but from Shoals Rodrigues, a local NGO. Tanzania and Zanzibar do not report separate catch figures. Madagascar does not report catch figures, but 93% of octopus catch is exported, so we have used export figures as a conservative proxy. Seychelles catch data comes from Seychelles fishing authority not the FAO.

Fishery summary: Madagascar

Background

The fishery for *Octopus cyanea* is a vital economic activity for coastal communities in southwest Madagascar (Benbow et al., 2014; Benbow and Harris, 2011) where an estimated 50% of all artisanal fishing in the country occurs (Benbow et al., 2014). Traditionally a subsistence activity, the arrival of foreign-owned seafood collection companies since 2001 has transformed the fishery into one that is export-led and dominates coastal fishing economies (Benbow et al., 2014; Humber et al., 2006). This has increased both the value of the catch and the quantity harvested, intensifying pressure on the resource and raising concerns about potential overexploitation (Benbow et al., 2014; Humber et al., 2006).

Catches

There are no official figures, but estimates put the total artisanal octopus catch at around 1,700 tonnes per year. There are three major fishing areas: Toliara in the southwest (approx. 1000t/year), Diego in the north (approx. 300t/year) and Ste Marie in the east (approx. 450t/year) (Blue Ventures Conservation, 2014). Eighty percent of the catch is caught by gleaning (*ibid.*).

Due to the absence of catch statistics, we rely here on export quantities. Since an estimated 93% of the octopus catch is exported, (Moreno, 2011) these figures should be treated as a conservative proxy.

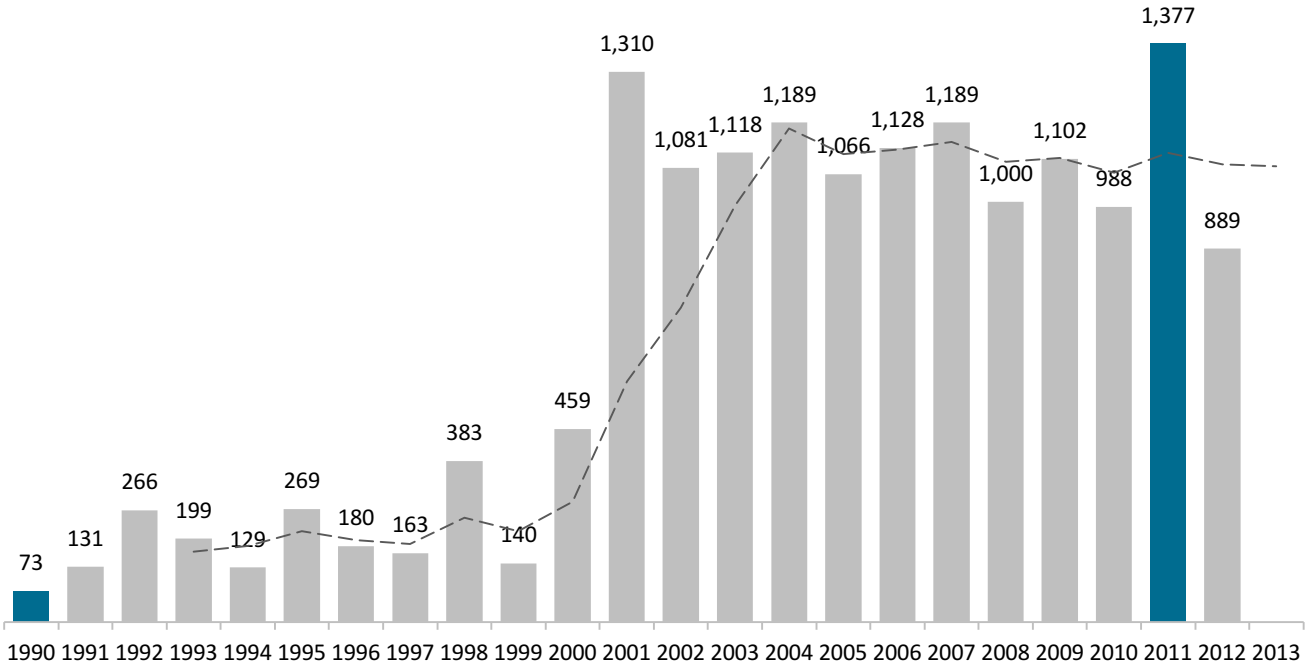


Figure 11. Exports of octopus from Madagascar by weight (tonnes), 1990-2012. Source: Comtrade, 2014. Trend line depicts 4-year moving average

Exports rose sharply at the start of the new millennium with the arrival of commercial collection and export companies, increasing 10 fold from 140 tonnes in 1999 to 1,310 tonnes in 2001 (Figure 11). Since then, they have remained relatively constant at approximately 1,000 tonnes per year, indicating that the fishery is stable. The total for 2012 was the lowest for 12 years, however this is reflective of wider declines seen among other species groups in Madagascar.

Markets

There are three main companies buying, processing and exporting octopus in Madagascar: Copefrito, Murex and Sopemo. The top five export markets for Madagascan octopus between 2009-2012 were France, Mauritius, Italy, Hong Kong and Portugal (Table 3), though several other countries also bought octopus, including Spain, Malaysia, Canada, Senegal, Singapore, India and the United Arab Emirates.

Total export volumes were relatively stable between 2009 and 2012, showing a slight decrease of around 7% per year by weight and 4% per year by value. This was largely driven by a decline in exports to Mauritius of a similar magnitude, and a sharp drop in export volumes to Portugal, which fell by around a fifth in terms of both weight and value. Total exports to both France and Italy remained consistent between 2009 and 2012, but increased rapidly to Hong Kong, leaping by an average of a third by weight per year and almost 90% by value.

Importer	Type	2009	2010	2011	2012	APR
France	US$	1,606,959	1,591,310	1,815,677	1,552,011	-1.2%
	kg	514,848	478,050	531,384	455,908	-4.0%
Mauritius	US$	899,416	653,317	1,032,720	786,380	-4.4%
	kg	354,701	266,588	362,938	283,475	-7.2%
Italy	US$	354,738	524,305	986,377	352,553	-0.2%
	kg	121,025	178,720	331,412	126,580	1.5%
Hong Kong	US$	27,570	82,597	173,702	180,039	86.9%
	kg	5,456	21,592	21,010	13,180	34.2%
Portugal	US$	48,681	50,476	202,521	26,701	-18.1%
	kg	16,365	16,800	61,570	7,543	-22.8%
Total	US$	3,307,997	3,135,136	4,527,295	2,923,839	-4.0%
	kg	1,102,306	988,265	1,377,189	888,846	-6.9%

Table 3. Exports and major importers of octopus from Madagascar from 2009 to 2012 by value ($US) and weight (kg). Source: Comtrade, 2014. APR refers to the average annual percentage growth rate for 2009–2012

Fisheries Management

In 2005, national legislation introduced a minimum size limit of 350g but this has proved difficult to enforce because octopus capture methods are non-selective (Benbow et al., 2014). Since octopus are injured or killed during forced removal from their dens, there is little incentive to discard them if they are found to be below the limit (Benbow et al., 2014).

There are two government-mandated national closed seasons for octopus: from 15 December to 31 January in the southwest, and from 01 June to 15 July in the east. During these periods, the fisheries ministry prohibits buyers from visiting fishing communities, rendering fishers effectively unable to sell catches (Medley and Gaudian, 2010).

The national closures are complemented by a series of locally managed, periodically harvested closures. These closures were first piloted in southwest Madagascar in 2004 and quickly spread along the coastline (Oliver et al., 2015). Results from a seven-year study of the closures within the Velondriake locally managed marine area (LMMA) have shown clear economic, social and fisheries benefits for both individual fishers and for broader coastal communities (Harris, 2011; Oliver et al., 2015). To date there have been 203 closures in Madagascar managed by 51 villages, and since 2009, the approach has been used to improve the management of other marine ecosystems and fisheries including mud crab fisheries in mangrove forests and lobster fisheries on rocky reefs.

In an attempt to gain access to profitable export markets, the octopus fishery of southwest Madagascar became one of the first artisanal fisheries in Africa to be engaged in the Marine Stewardship Council (MSC) fishery certification process, having undergone pre-assessment in 2011. In collaboration with researchers and local stakeholders, the fishery is now taking steps to close information gaps and progress to full MSC assessment.

Fishery summary: Tanzania and Zanzibar

Background

Artisanal fishing for octopus is widespread along the coasts of mainland Tanzania and Zanzibar. In both areas, the catch overwhelmingly comprises *O. cyanea*, though *O. vulgaris* is also caught in smaller volumes in Zanzibar (Guard, 2009; Pandu, 2014). In 2006, Tanzania identified octopus as one of its 10 top priority products (Moreno, 2011). Main fishing areas on the mainland include Tanga, Kilwa and Mtwara (Anderson, 2014).

Catches

The FAO does not report separate fisheries statistics for Zanzibar and mainland Tanzania, so here we present aggregated figures (Figure 12). Catches peaked at around 1,700 tonnes in 2003, before dropping off sharply to 703 tonnes in 2006. Since then, landings have risen steadily, reaching 1,251 tonnes in 2012, an increase of 80%.

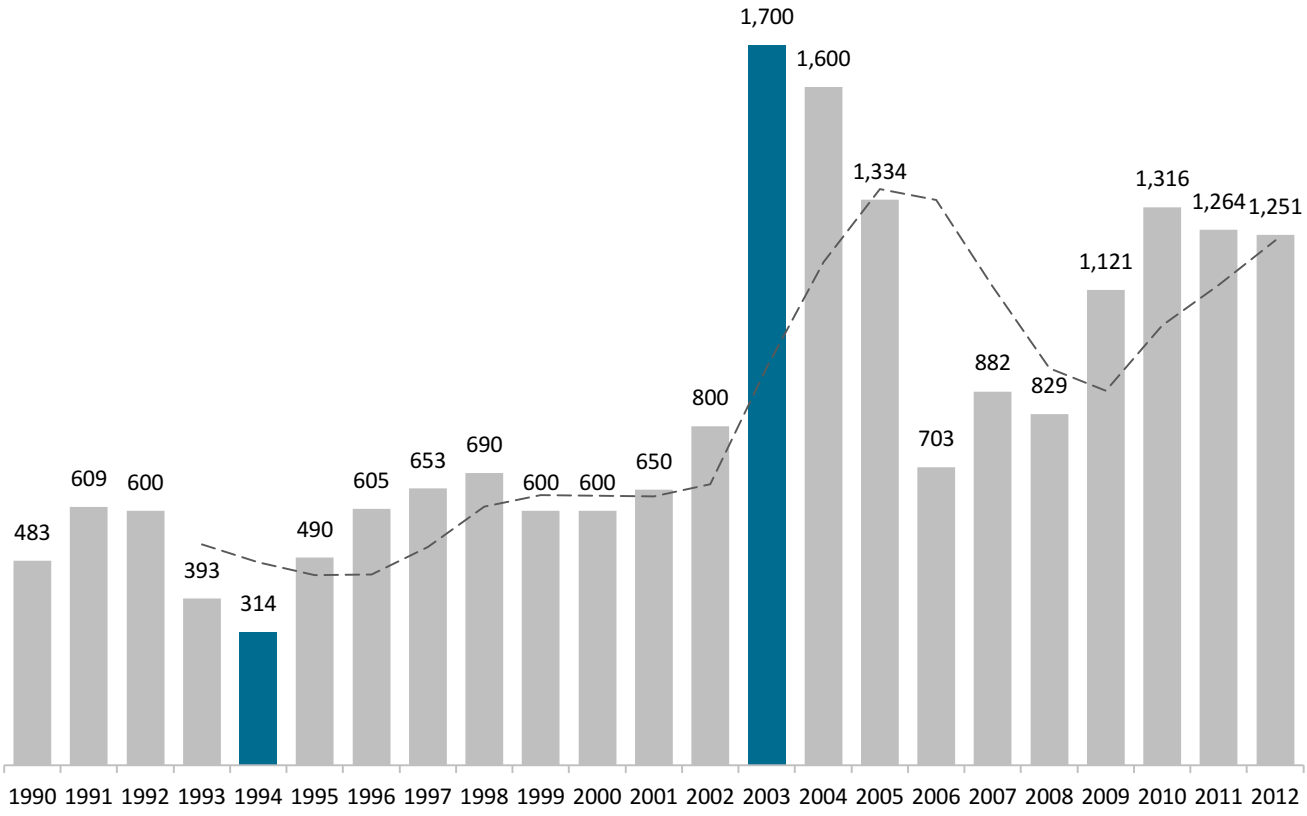


Figure 12. Catches of octopus from Tanzania by weight (tonnes), 1990-2012. Source: FAO Fisheries and Aquaculture Department, 2014. Trend line shows 4-year moving average

Markets

In mainland Tanzania, octopus are collected for both local and inland consumption (around 10% of the total) as well as increasingly for export to foreign markets, primarily in Europe (90%) (Anderson, 2014; Guard and Mgaya,

2002). By contrast, the market for octopus in Zanzibar is dominated by the local tourist sector, with fishers often selling directly to hotels, instead of to buyers and exporters. Less than 10% of catches are exported overseas (Pandu, 2014). Demand from the tourist industry is buoyant, but overreliance on this market could prove troublesome, given ongoing security concerns for western visitors.

There are four main companies buying, processing and exporting octopus: TANPESCA, SeaProducts, Bahari and Fruit de la Mer (Anderson, 2014). The top four export markets between 2009 and 2012 are all in the EU: Portugal, Italy, Spain and France (Table 4), and Tanzanian octopus was also popular in Belgium, Malta, Turkey and Germany. Total export volumes were relatively stable between 2009 and 2012, increasing by around 8% per year by weight and 1.6% per year by value. However, there are indications that exports have dropped since then due to competition from other markets (Anderson, 2014). By far the most important importer is Portugal, buying over 720 tonnes worth US$3.5m in 2012, over half of Tanzanian exports by both weight and volume.

Importer	Type	2009	2010	2011	2012	APR
Portugal	US$	3,735,231	3,442,998	3,372,203	3,505,073	-2.10%
	kg	892,521	907,602	648,672	720,057	-6.91%
Italy	US$	1,033,607	1,585,770	2,808,540	2,088,808	26.43%
	kg	240,547	355,510	501,082	402,299	18.70%
Spain	US$	139,612	606,719	214,728	269,699	24.54%
	kg	45,360	155,520	54,380	44,814	-0.40%
France	US$	151,314	130,579	158,143	412,597	39.71%
	kg	38,295	37,935	43,740	106,785	40.75%
Total	US$	5,239,276	6,112,054	6,678,344	6,548,698	7.7%
	kg	1,294,922	1,561,837	1,272,479	1,358,431	1.6%

Table 4. Exports and major importers of octopus from Tanzania from 2009 to 2012 by value ($US) and weight (kg). Source: Comtrade, 2014. APR refers to the average annual percentage growth rate for 2009–2012

Fisheries Management

Tanzanian law stipulates a minimum size limit of 500g for octopus catches, as well as a fisher licensing programme and export tariffs (Anderson, 2014; Guard, 2009). However, the enforcement of the size limit has proved challenging for the same reasons as in Madagascar and dynamite fishing in some areas is damaging the habit for octopus (Anderson, 2014; Guard, 2009). As in Madagascar, the octopus fishery in Tanzania is also engaged in the Marine Stewardship Council (MSC) fishery certification process, with a fishery improvement project underway supported by WWF.

Zanzibar also has a licencing system for fishers, as well as a voluntary minimum size limit of 500g in some areas, 30 areas that are closed voluntarily during Ramadan and a local closed season in Chakwa Bay (Indian Ocean Commission, 2014). In the early 2000s, there a system of rotational closures was established at Jibondo, Mafia Island, but this has since broken down (Guard, 2009). Further, increasing demand from the hotel sector is leading to overfishing, and use of destructive methods is escalating (Pandu, 2014).

Fishery summary: Kenya

Background

As in most other parts of the WIO, the dominant species in Kenyan catches is also *O. cyanea*. The species is highly valued in Kenya, attracting skilled – mainly male – migrant fishers from Pemba island in the Zanzibar archipelago (Okemwa, 2014; Otieno, 2011). Fishing primarily takes place during the northeast monsoon, especially from November to March. Local dealers pay fishers between $US0.50 and $US1.50 per kilo, depending on the season (Otieno, 2011). The dealers either resell to local hotels at between $US1.50 and $US2.50 or to Sea Harvest, a company specialising in octopus export (Otieno, 2011).

Catches

According to the FAO, catches rose dramatically from 49 tonnes in the early 1990s to more than 450 tonnes three years later, a nine-fold increase (Figure 13). Catches declined again to around 100 tonnes in 2000, before growing steadily once more throughout the decade, stabilising at around 400 tonnes per year in recent years. Around 60% of the catch comes from the Kwale region in the South of Kenya, adjoining the border with Tanzania (Okemwa, 2014).

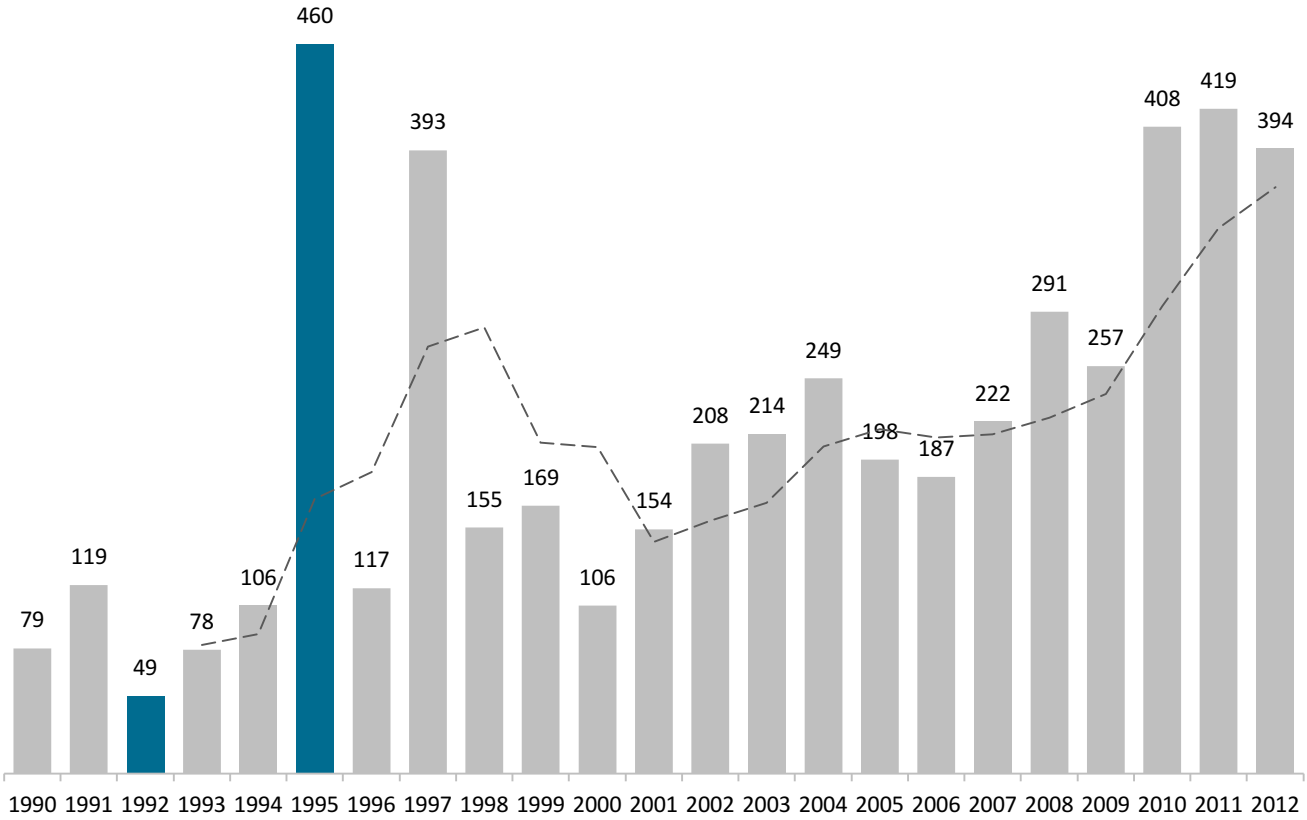


Figure 13. Catches of octopus from Kenya by weight (tonnes), 1990-2012. Source: FAO Fisheries and Aquaculture Department, 2014. Trend line shows 4-year moving average

Markets

As in other parts of the WIO, the octopus fishery has been transitioning from one of local consumption to one of international export over the last 20 years (Wamukota et al., 2014). Yet despite increasing exports, most octopus continues to be sold for domestic consumption (Wamukota et al., 2014).

Like Tanzania, the top four export markets for Kenyan octopus are all in the EU: Italy, Portugal, Malta and Greece (Table 5). It is difficult to draw out trends from the two years of export data available, but export volumes doubled from 692 tonnes to more than 1,400 tonnes between 2009 and 2010, whilst the value of exports increased by a third from US$1.5m to US$2m. This was largely due to an increase of exports to Italy, where figures by both volume and value doubled between 2009 and 2010.

Importer	Type	2009	2010
Italy	US$	692,649	1,418,251
	kg	235,460	455,224
Portugal	US$	474,854	284,881
	kg	168,945	105,702
Malta	US$	102,574	138,901
	kg	41,505	58,050
Greece	US$	110,024	52,719
	kg	22,500	21,990
Total	US$	1,539,994	2,039,329
	kg	692,649	1,418,251

Table 5. Exports and major importers of octopus from Kenya from 2009 to 2010 by value ($US) and weight (kg). Source: Comtrade, 2014. APR refers to the average annual percentage growth rate for 2009–2012

Fisheries Management

The current status of octopus stocks in Kenya is unknown, but they are expected to be fully exploited (Okemwa, 2014). At present, the fishery is open access and unregulated but management measures have recently been proposed (Okemwa, 2014). These include a minimum dorsal mantel length of 10.8 cm for females and 10.5cm for males, as well as a seasonal closure during the peak spawning months of June, July and August (Okemwa, 2014).

Fishery summary: Mozambique

Background

The fishery for octopus in Mozambique is primarily small-scale and low-technology in nature (Gough, 2014). Though *O. cyanea* dominates the catch, *O. vulgaris*, *Amphioctopus aegina* and *Cistopus indicus* are also present (Cachimo, 2014). Both men and women catch octopus, with women fishing during spring tides and the men during neaps (Cachimo, 2014). The catch is sold predominantly for inland consumption, but overseas exports are growing, making the fishery an increasingly important economic activity for many coastal communities (Gough, 2014).

Catches

The FAO only records Mozambique octopus catches between 1992 and 2002 (Figure 14). This limited dataset tells something of a boom and bust story, with catches increasing by nearly 500% from 19 tonnes in 1992 to 109 tonnes in 2000, before declining sharply to near 1992 levels in 2002. Trends since then are unclear, although there are some indications that catches remain low, with fishermen in the north reporting a considerable decline in catch rates over recent decades (Gough, 2014).

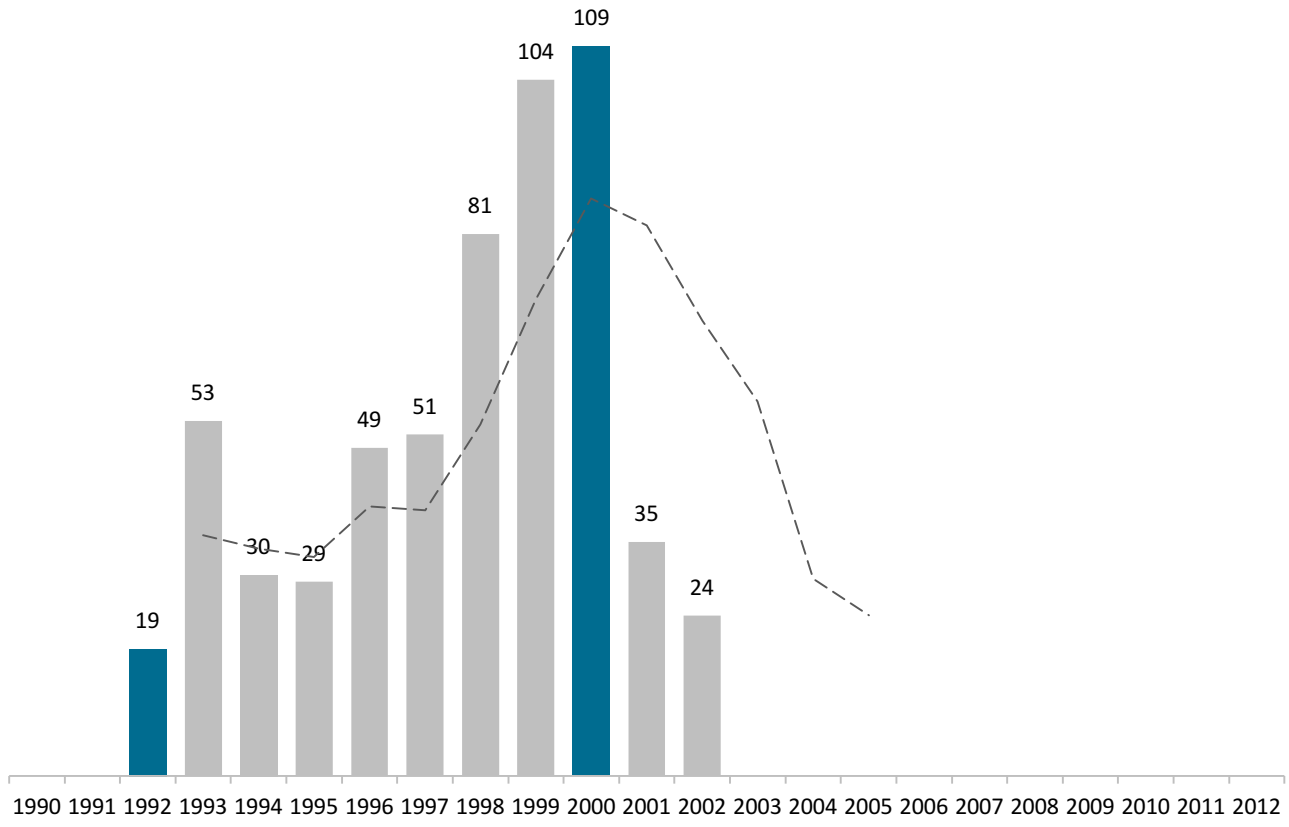


Figure 14. Catches of octopus from Mozambique by weight (tonnes), 1990-2012. Source: FAO Fisheries and Aquaculture Department, 2014. Trend line shows 4-year moving average

Markets

In the north, the majority of the catch is dried and sold to larger markets, either within Mozambique (Nampula, Nacala, Montepuez) or Tanzania (Gough, 2014). These exports do not appear to be recorded in the Comtrade database, however (Table 6). Comtrade figures suggest that by far the most important importer of Mozambican octopus is Italy, which bought 60% of total exports in 2011 by value and 73% in 2012.

Importer	Type	2009	2010	2011	2012
Italy	US$			363,000	466,259
	kg			55,755	67,021
Portugal	US$	37,375			143,395
	kg	7,486			26,830
Spain	US$	54,164			
	kg	11,122			
Total	US$	93,189	11,907	614,000	638,372
	kg	18,947	2,141	64,736	95,455

Table 6. Exports and major importers of octopus from Mozambique from 2009 to 2012 by value ($US) and weight (kg). Source: Comtrade, 2014. APR refers to the average annual percentage growth rate for 2009–2012

Fisheries Management

Mozambique does not appear to have any national or local management measures in force for octopus.

Fishery summary: Rodrigues

Background

Rodrigues is a semi-autonomous part of the Republic of Mauritius lying approximately 600km east of Mauritius. Around 40,000 people live in Rodrigues, 3.5% of whom are engaged directly or indirectly in octopus fishing (Jhangeer-Khan and Agathe, 2014a). As in other parts of the region, the main species is *O. cyanea*, though about 20% of the catch is composed of *O. vulgaris* (Sauer et al., 2011)

Catches

In the early 1970s, around 1,800 tonnes of octopus was landed each year, but by the mid 1990s, this number had declined by more than half to 775 tonnes. In the early to mid 2000s, as annual catches has decreased to around 250 tonnes a year, spearfishing of octopus by skin divers started to become increasingly popular (Jhangeer-Khan and Agathe, 2014b). This development allowed the fishery to operate during high tides and even at night with the use of underwater torches, though the practice has always been illegal (Jhangeer-Khan and Agathe, 2014b).

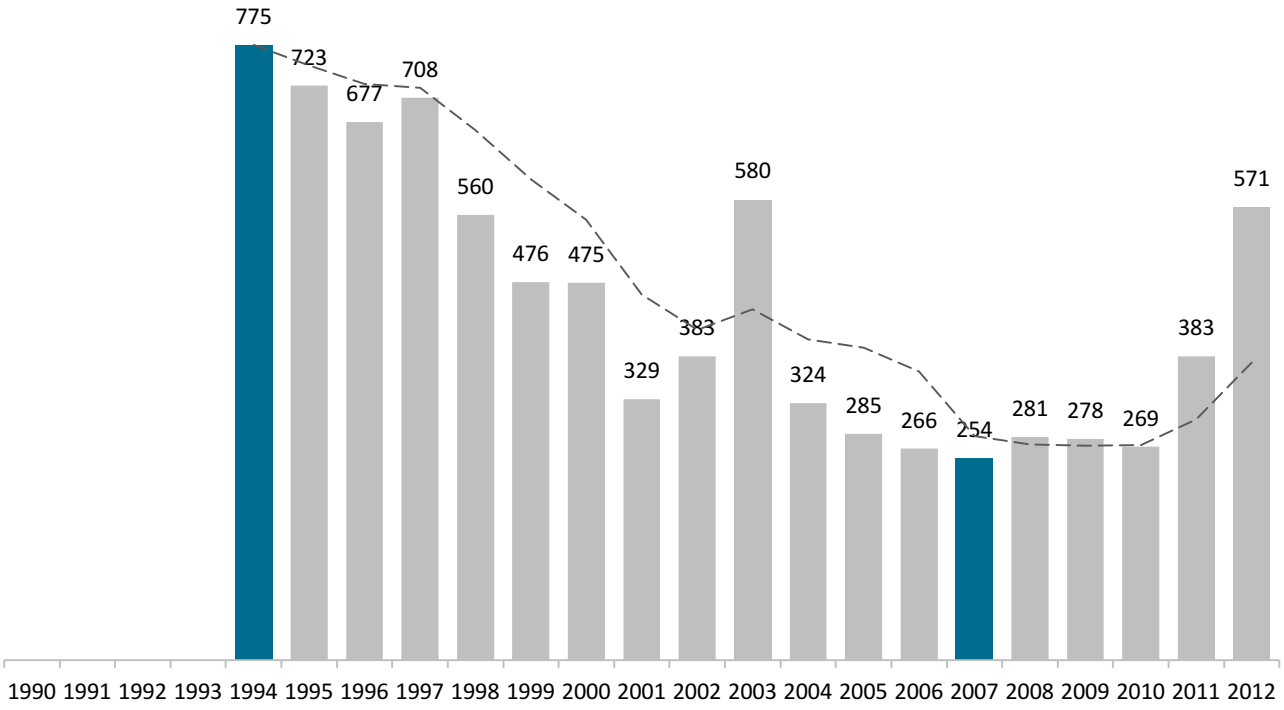


Figure 6. Catches of Octopus from Rodrigues by weight (tonnes), 1990-2012. Source: (Jhangeer-Khan and Agathe, 2014b). Trend line shows 4-year moving average

Markets

Historically, Mauritius has been the sole export market for octopus products from Rodrigues, but competition on the Mauritian market is increasing, in particular from Madagascar (Jhangeer-Khan and Agathe, 2014b). Because

Rodrigues is part of the Republic of Mauritius, these exports are not recorded in the Comtrade database. There are two main companies packaging and retailing Rodrigues frozen octopus in Mauritius: Innodis and Panagora (Jhangeer-Khan and Agathe, 2014b). According to a recent value chain analysis (Sweenarain, 2012), fresh octopus was purchased by export companies at an average price of US$2.84 per kg, then sold frozen at around US$4.74 per kg. In 2013, 142 tonnes of frozen octopus were exported to Mauritius, out of a total estimated production of 561 tonnes (Central Statistic Office, 2013).

Fisheries Management

Temporary closures were proposed as a solution to overexploitation of the resource as early as 1997, but it was not until 2012, with octopus catches at around 20% of their historic highs, that the government of Rodrigues enacted legislation to implement an annual two-month closed season for octopus fishing (Jhangeer-Khan and Agathe, 2014a; Kemp, 2014). Inspired by the short-term closures pioneered in Madagascar since 2004, the first closure took place between August and October 2012 and has since been repeated in 2013 and 2014 (Jhangeer-Khan and Agathe, 2014b; Smartfish, 2014). Following the first closure, annual catches jumped to 571 tonnes, the highest level for 9 years and an increase of 50% over 2011 figures. Local authorities in Rodrigues have also established an alternative livelihoods scheme to provide fishers with income generating activities during the two-month closures, but this does not appear to be financially viable (Jhangeer-Khan and Agathe, 2014a, 2014b). In addition to the closures, Rodrigues requires a minimum size of 7cm mantel length, though this is difficult to enforce for the reasons already outlined (Jhangeer-Khan and Agathe, 2014a).

Fishery summary: Seychelles

Background

In contrast to the other WIO nations, the primary species caught by the artisanal octopus fishery in the Seychelles is *O. vulgaris*, not *O. cyanea*. *O. vulgaris* is a longer-lived, slower-growing species than *O. cyanea* and may therefore not respond as well to temporary closures (Cohen and Foale, 2013).

Catches

Despite the socio-economic and cultural importance of the fishery (Seychelles Fishing Authority, 2014), catches have declined in recent years (Figure 15). The fishery, which tends towards volatility, has seen catches drop from a high of more than 48 tonnes in 1993 to around 8 tonnes per year in recent years, a decrease of more than 80%. The Seychelles Fishing Authority acknowledges that this is cause for concern (Seychelles Fishing Authority, 2014).

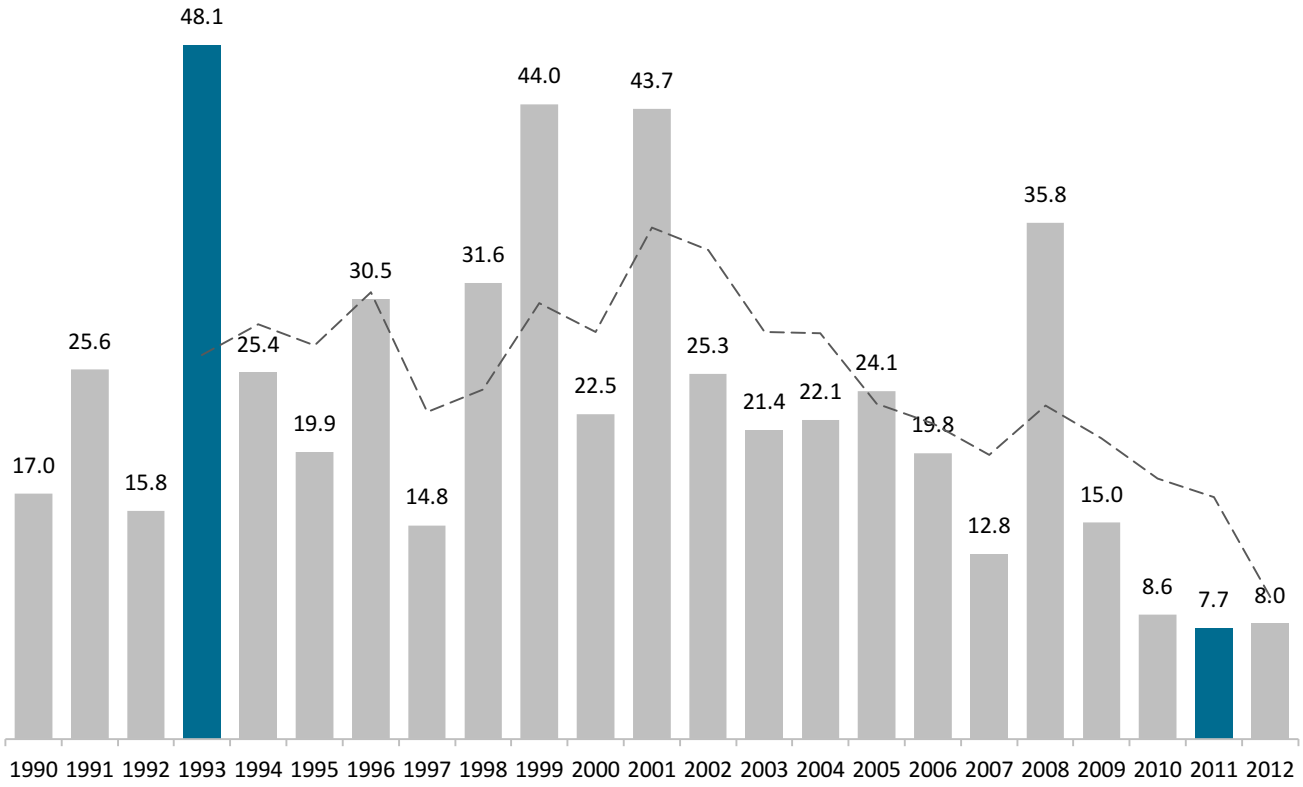


Figure 15. Catches of octopus from Rodrigues by weight (tonnes), 1990-2012. Source: Seychelles Fishing Authority, 2014. Trend line shows 4-year moving average

Markets

No export markets have been established for Seychelles octopus. The main markets are local hotels, restaurants and takeaways (Seychelles Fishing Authority, 2014). In 2013, the average consumer price for a kilo of octopus was around US$$10 per kg (*ibid.*).

Fisheries Management

In 1996, with concerns about overexploitation mounting, authorities undertook a review of the octopus resource. A management plan was developed two years later and several measures were proposed, including a licensing scheme for fishers, an annual catch quota of two thirds of maximum sustainable yield, a closed season between 1 September–31 October and an immediate one-year closure of the fishery (Seychelles Fishing Authority, 2014). Several measures have also been proposed for a pilot co-management initiative in an area around Praslin and La Digue, including a minimum size limit of 1kg and a bag limit of 2 octopus per person per day for unlicensed or recreational fishers (Seychelles Fishing Authority, 2014). However, none of these measures has been implemented to date (Seychelles Fishing Authority, 2014).

Fishery summary: Comoros

Octopus fishing in Comoros is still largely a subsistence activity (Comoros Fisheries Resources Directorate, 2014). More than half of the octopus fishing takes place around Moheli Island, where catches fluctuate considerably from year to year, but can be as high as 58 tonnes annually (Comoros Fisheries Resources Directorate, 2014). No national management measures exist, but in parts of Moheli Marine Park, particularly in the Sambia area, there is a minimum size limit of 1kg, gear is restricted to spears, and fishing is only allowed during spring tides (Comoros Fisheries Resources Directorate, 2014).

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