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Fisheries of the Canary Current Large Marine Ecosystem: From capture to trade with a consideration of migratory fisheries

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ARTICLE INFO

Keywords:

CCMLE
Fishery
Migratory fisheries
Fish trade
Up-welling
Climate change
Nutritional security

ABSTRACT

Canary Current Large Marine Ecosystem (CCLME) captures continue to increase. They are now reaching 3.5 million tonnes compared to 2.5 million tonnes 20 years ago. While demersal resources reached a plateau by the end of the 1990s, small pelagic resources continue to increase due to the quality of the up-welling in recent years and now represent 80% of the total catches. Distant water fleets have considerably reduced their presence in CCLME waters and are progressively replaced predominantly by West African fleets of canoes. The importance of the migratory fishery is growing as a strategy to cope with the drastic decline of coastal fish stocks in key fishing nations such as Senegal and Gambia. They contribute to about 20% of the catches of the sub-Saharan countries of the CCLME despite not appearing in any statistic and not being regulated at both national and regional scales. Trade is also a concern as the main routes are still those toward Europe and Asia for the high value species while low value fish goes to African countries, mainly bordering the Gulf of Guinea. In that regard, the CCLME remains the fish tank of Europe and, to a lower extent, of Asia. Less than 1% of the total catches are traded within the CCLME countries, indicating the strength of trade barriers in place.

1. Introduction

The Canary Current Large Marine Ecosystem (CCMLE) captures are increasing over time, reaching 3.5 million tonnes in 2017 compared to 2.5 million tonnes (t) twenty years ago (FAO FISHSTAT, 2020). Making up about 75% of the total catches, small pelagics constitute the bulk of the captures and the main reason of the overall catch increase. Nevertheless, the growth rate is progressively slowing, showing signs of fully exploited and overexploited situations for many key species such as sardinella and chinchard, especially during periods of less intense up-welling (FAO/COPACE, 2019). Captures of demersal, cephalopods and crustaceans reached a plateau 20 years ago and since have been stable around an annual overall quantity of about 500 000 t while the tuna fishery is increasing slightly, reaching 80 000 t in recent years. The share of the distant water fleets is decreasing over time: from 45% in 1997 compared to 20% in 2017. Today they are mainly targeting tuna fisheries, with the exception of small pelagics and deep-sea species in Mauritania waters, as well as black hake in Senegal. This is compared to wide range of species targeted in the 1990s and prior. African coastal nations have strongly increased their fishing capacities over the last 20 years, holding 80% of the total catches in 2017 compared to 55% in 1997. Apart from the deployment of the Moroccan fleet in the Occidental Sahara that allowed the national catches to make a significant jump over the last decade, the increase of the catches in the sub-Sahara region is mainly due to the dynamism of the migrant fishery that accounted for almost 20% of the total catches in the early 2010s (Failler and Binet, 2012). Despite the large quantity of

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<https://doi.org/10.1016/j.envdev.2020.100573>

Received 19 June 2020; Received in revised form 23 September 2020; Accepted 25 September 2020

Available online 2 October 2020

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catches, the trade among CCLME nations remain very low, where only about 1% of the catches of west African coastal nations is traded within the region (Failler et al., 2015a, 2015b). The main trade routes are to Europe and Asia with a significant increase of the exports over the last two decades, having multiplied by 2.5 since 1997.

The paper aims to present the evolution of the CCLME fisheries and fish product trade over the last two decades, with a focus on the



Fig. 1. The CCLME area.
Source: NOAA/university of Rhode Island.

unregulated migratory fisheries as it becomes a major management issue in the West African region. It relies on continuous work done in West Africa since mid-1990 in collaboration with oceanographic and fishery research centres from Morocco, Mauritania, Senegal, Cabo Verde, Gambia, Guinea Bissau and Guinea. The captures data have been extracted from the FAO FISHSTAT database and the ICCAT database for tuna catches. The trade data are extracted from UNCTAD trade database and country customs databases and the qualitative information was formulated in work done for the CCLME project in 2015 looking at the CCLME transboundary fish trade.

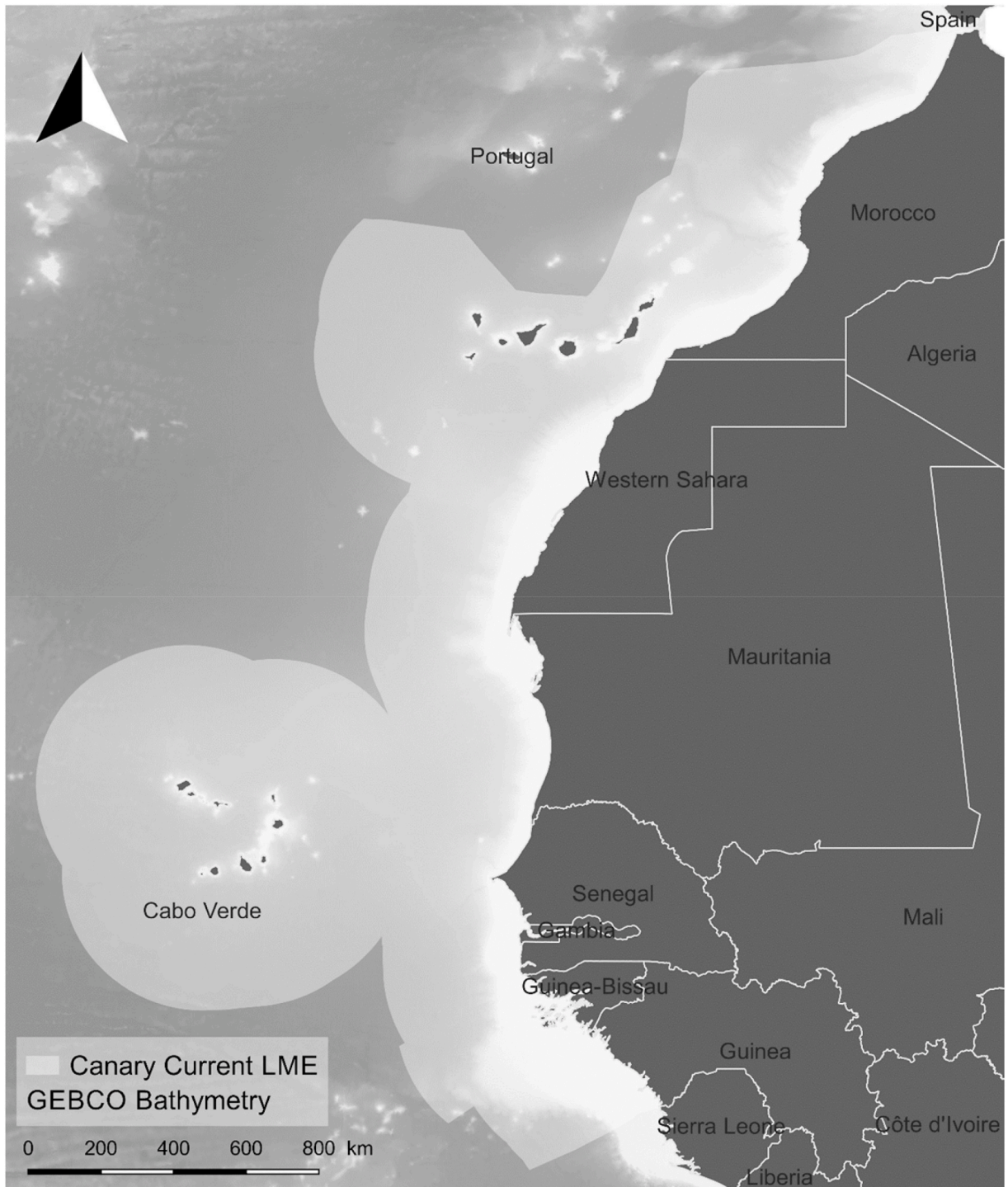


Fig. 2. CCLME area using EEZ boundaries.
Source: CCLME Website.

The migratory data and information come from the continued with IUCN in West Africa since 2009 and more recently within the GREPPAO project (2019–2022).

The paper is structured in three parts. In the first part, the main characteristic of the CCLME fisheries over a 20-year period of time are explained. In the second part, the management issues of the are presented. The third part provides fish trade figures with a highlight on the national nutritional shortfall forecast for a short time horizon. The conclusion recalls the key findings and provides suggestions for the management of the CCLME fishery.

1.1. Overview and trends of the CCLME fisheries

The CCLME area is depicted in Fig. 1. The Fig. 2 below shows the CCLME area using the boundaries of the EEZ as limits. The FAO data coverage for the CCLME sits within the CECAF area and includes the NOAA CCLME area (Fig. 3).

The main characteristic of the CCLME fisheries is the constant increase of the catches over the last 20 years. Nevertheless, over a longer period of time, the catches are fluctuating due to the effect of up-welling (Fréon, 1984) with a seasonality of about 10 years (Roy and Reason, 2001; Roy and Cury, 2003). This seasonality of the upwelling is also occurring on an annual basis (Fig. 4) with a strong manifestation leading to a high level of biomass of small pelagics in recent years (Braham et al., 2014).

The trend of the total catches follows the one of the small pelagics. It tends to be even more similar in recent years as the percentage of small pelagics reached almost 80% of total catch in 2017 compared to 70% in 1997. As the catches of the other resources combined remained stable over the two decades, around 500 000 tonnes, the variability of the total catches is thus dependent solely on the small pelagics. Abundance of these species is highly dependent on the sea surface temperature (STT) (Binet, 2005; Lancker et al., 2019): the colder the waters in winter, the greater the abundance of small pelagics in the following year. For instance, Failler and Samb (2005) showed an inverse correlation between the STT of the major estuaries in Senegal, Gambia and Guinea Bissau and the abundance of the sardinella that use these ecosystems as nurseries.

The progressive withdrawal of the distant water fleets in CCLME waters started in the early 2000s following the non-renew of the fishing agreement between Morocco and the EU in 1999 (with more than 300 EU vessels involved) and the sharp decline in catches of cephalopods, deep-sea fisheries and small pelagics in Mauritania at the beginning of the 2000s (Fig. 5). The adoption by the EU of the sustainability principles in 2004 led to a change of the EU fishing agreement types: they became Sustainable Fishing Agreements (SFA) and follow the UNCLOS rules on the surplus (Article 62.2). As most of the demersal fisheries in CCLME countries were not showing any signs of surplus, the content of the SFA became limited to the tuna species for which no sign of overexploitation was found at the ICCAT level (Stilwell et al., 2010).

The Asian fleets are following the European pattern with a progressive removal of the vessels from the CCLME space. They are still in service in the tuna fishery (long-line segment) but have disappeared from the coastal fisheries. The American fleet is mainly composed of the vessels operating under a flag of convenience mainly from the Bahamas and Belize. These nations are active in the tuna fishery (purse-seine segment) as almost half of the Spanish tuna fleet is under these flags (the other half being under the EU registration and operate under the SFA).

From the CCLME side, Morocco is continuing to develop and modernise its fleet capacity in the Sahara Occidental area: almost 70% of the fish is caught from this region (Failler et al., 2018). In 2009, the country launched a vast fishery development plan called Halieutis that includes the modernisation of the whole fishery chain. The Halieutis plan also sought to increase the catches to over 1.2 million tonnes by 2020, which was already reached in 2017. Mauritania has chosen to develop partnerships with countries such as China and Turkey for the development of its catch capacities. While the Chinese cooperation was aborted in 2018, the cooperation with Turkey is flourishing with the development of fish meal processing in the free zone of Nouadhibou. Mauritania continues to give licences to foreign small pelagics trawlers, mainly from the former Russian political bloc. It also provides access to EU vessels under the bilateral fishing agreement. For the other countries of the CCLME area, the development of the fishing capacity is done through the increase of the number of canoes. While the countries tend to have a control on their number, the lack of registration of canoes and enrolment of fishermen makes controlling the industry relatively intractable.

The small pelagics fish stocks of the CCLME are overall fully exploited or overexploited (see Table 1). Key small pelagics such as sardinella are overexploited and the FAO/COPACE working Group recommends an immediate reduction of the fishing effort. None of the countries of the CCLME area are keen to take such a recommendation on board as it is a major source of revenue for them from the industrial fleet and a major source of protein for the population supplied by artisanal fisheries.

For the demersal species, most are showing decline in past years. Among the stocks assessed by the FAO/COPACE working group in 2018, nine are overexploited: Thiof (*Epinephelus aeneus*) in Mauritania-Senegal-Gambia, deep-water rose shrimps (*Parapenaeus longirostris*) in Senegal-Gambia and Morocco, rubber-lip grunt (*Plectorhynchus mediterraneus*) in Morocco, southern pink shrimp (*Penaeus notialis*) in Senegal-Gambia, octopus (*Octopus vulgaris*) stock in Dakhla, common cuttlefish (*Sepia officinalis*) stock in Dakhla, and white hake (*Merluccius merluccius*) and seabream (*Pagrus* spp.) in Morocco. Seven stocks are considered fully exploited: Black hake (*Merluccius* spp.) in Morocco-Mauritania-Senegal-Gambia, bluespotted seabream (*Sparus caeruleostictus*) in Mauritania-Senegal, axillary seabream (*Pagellus acarne*) in Morocco, the southern pink shrimp (*Penaeus notialis*) in Mauritania, the octopus (*Octopus vulgaris*) in Cape Blanc, marine catfish (*Arius* spp.) in Senegal-Gambia, and *Pagellus bellottii* in Mauritania-Senegal-Gambia. Three stocks were considered as non-fully exploited: Deep-water rose shrimp (*Parapenaeus longirostris*) in Mauritania, the common cuttlefish (*Sepia officinalis*) in Cape Blanc and the large-eye dentex (*Dentex macropthalmus*) in Morocco-Mauritania-Senegal. Another set of seven stocks couldn't be assessed due to the lack of sufficient data. Overall, demersal fisheries of the CCLME region are clearly showing signs of mis-management over a long period of time, as was similarly reported in the mid-2000s (Failler and Gascuel, 2008).

Stocks of tuna and associated species are also showing signs of fishing overcapacity. ICCAT estimates that the Atlantic bigeye tuna

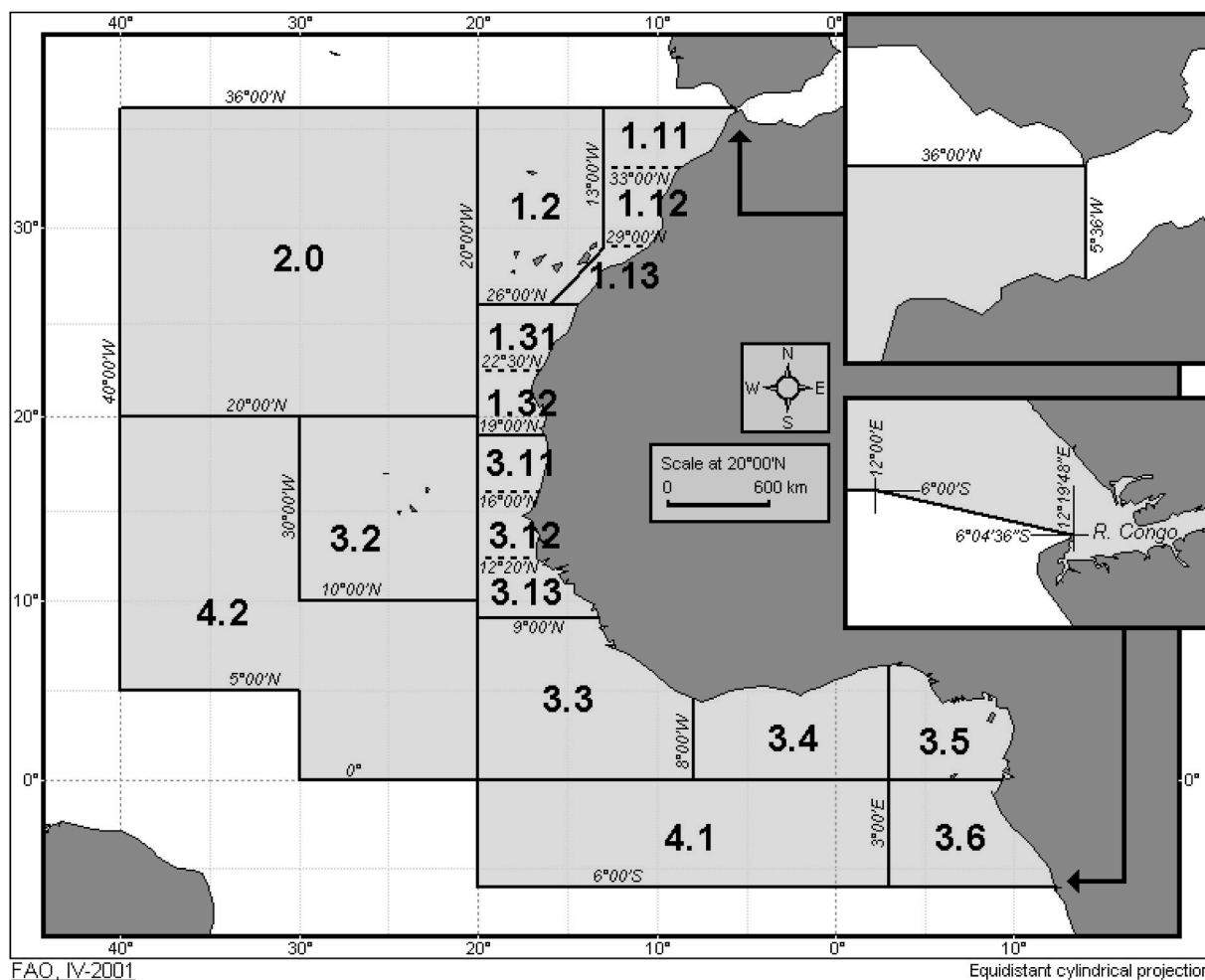


Fig. 3. The CCLME area corresponding to the FAO sub-divisions 1.11, 1.12, 1.13, 1.31, 1.32, 2, 3.11, 3.12, 3.13 and 3.2 of the division 34 of the CECAF area of competence.

Source: [FAO FISHSTAT \(2020\)](#).

stock is overfished while the yellowfin, skipjack and swordfish are fully exploited ([ICCAT, 2020](#)). For Atlantic bigeye tuna species, a significant decrease of catches is required for many years. For the others, maintaining the catch level to that of the 2012–2013 levels is recommended.

Overall, the increase of the CCLME catches is putting stocks under severe pressure as all the key species are overexploited or fully exploited. This raises the question of the effectiveness of countries, the COPACE and the ICCAT alongside the Sub-Regional Fishery Commission and the Ministerial Conference on Fisheries Cooperation among African States Bordering the Atlantic (COMHAFAT-ATLAFCO) to manage fisheries and to ensure the full engagement of countries. Despite the depletion of major fish stocks, countries are still referring to the development paradigm or ideology for the management of their fishery. The competition between countries and the fact that no shared stocks such as sardinellas and other small pelagics are commonly managed further exacerbates these issues.

1.2. Migratory fisheries: a major issue for management

Migratory fishing is an undeniable feature of the exploitation of fishery resources along the West African coast ([Fig. 6](#)). It expresses the flexibility and strong adaptability of fishermen to changes in the natural, institutional and economic environment ([Binet et al., 2012a, 2012b; 2012c](#)). Overall, it has amplified over time with a move from occasional fishing activities outside of the national EEZ during demersal fishing season to permanent migratory patterns at the beginning of the 1980 ([Binet et al., 2012a](#)). The migratory fishing activity concerns exclusively the sub-Saharan countries with Senegal as the main provider of migratory fleets ([Binet et al., 2012b](#)). The migratory routes include Sierra Leone, which is not part of the CCLME area, but interferes within CCLME fisheries as Sierra Leoneans continue to fish in the Guinea and Guinea Bissau waters despite the end of the civil war in the early 2000s, being installed on the Tristao island at the border of the two countries ([Camara Youssouf et al., 2012](#)). Sierra Leone is furthermore hosting migratory fishermen from the CCLME countries. A total of 27 migratory movements characterize West African migrant fisheries (see

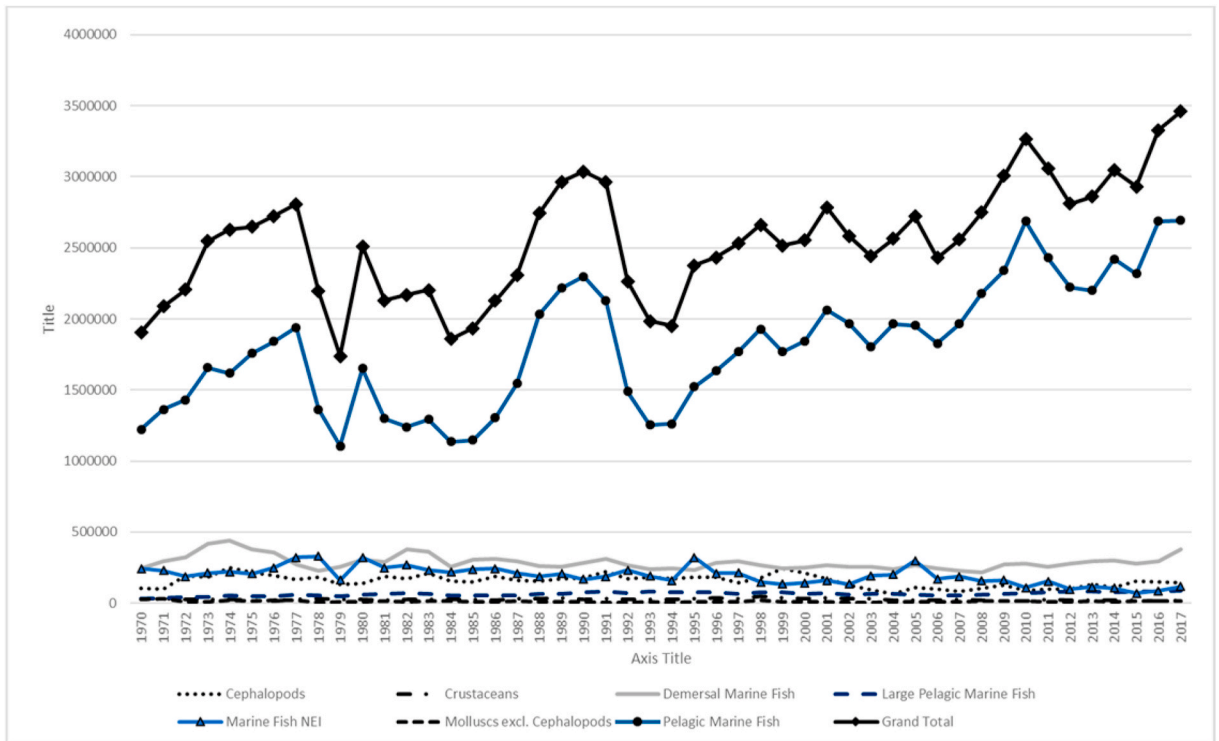


Fig. 4. Catches per species 1970–2017.
Source: [FAO FISHSTAT \(2020\)](#).

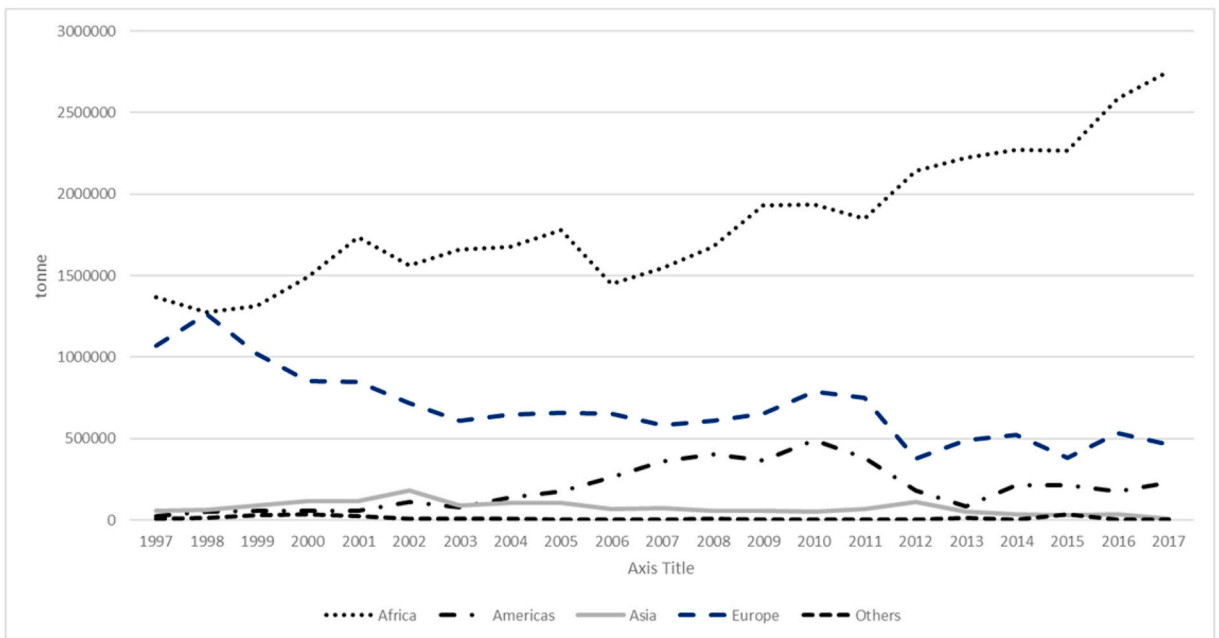


Fig. 5. CCLME catches per continent 1997–2017.
Source: [FAO FISHSTAT \(2020\)](#).

Table 1

Condition of the small pelagic stocks in relation to assessment, status and management recommendation.

Stocks	Assessment	Management recommendations from 2018 COPACE working Groups (Zone A and B: West Africa)
Sardine <i>S. pilchardus</i>	Not fully exploited	Projections show that the stock could support an increase in catch. However, the instability of the resource vis-à-vis the hydro-climatic changes requires the adoption of a precautionary approach to limit the sardine catch in this zone.
Sardinella (<i>S. aurita</i> , <i>S. maderensis</i> , <i>Sardinella</i> spp)	Overexploited	Immediate and substantial reduction in fishing effort and catch in all countries of the sub-region.
Horse mackerel (<i>T. trachurus</i> , <i>T. trecae</i>)	Overexploited	Reduction of effort and catches for both species at the level of the different zones and fleets is required.
Chub mackerel (<i>Scomber colias</i>)	Fully Exploited	The projection results of the global and analytical models indicate different trends, to this end, the group recommends a precautionary approach.
Anchovy (<i>Engraulis Encrasicolus</i>)	Fully Exploited	The availability of this species is highly dependent on environmental factors. It is fished opportunistically and catches vary a lot from one year to the next. The effort should therefore be adjusted to the natural fluctuations of this stock.
Bonga (<i>Ethmalosa fimbriata</i>)	Overexploited	Effort and catch should be reduced compared to current levels which would allow bonga to reach a level of biomass that can ensure sustainability.

Source: FAO/COPACE (2019).

Table 2).

The main migratory movements are initiated by Senegalese fishermen (14 movements). Ghanaian fishermen also have a strong presence in the SRFC area (5 movements). About 5000 fishers of all nationalities are concerned with migration, as well as nearly 15 000 people working in fish processing and trade.

The total quantity of catches made by migrant fishermen is, on average (during the period 2006–2012), close to 300 000 t. The monetary value of the catches is estimated at nearly 330 million euros (Table 3).

In terms of total catches of the CCLME Sub-Saharan area over the same period, this represents almost 20% of the total and almost 40% of the small-scale fisheries catches. It signifies that more than a third of the catches of artisanal fisheries are made outside the EEZ of the fishermen's country of origin. Senegalese fishermen, with just over 200 000 t, account for a quarter of all catches in West African artisanal fisheries.

Mauritania's EEZ is the main fishing area for migrant (Senegalese) fishermen, since nearly 130 000 t are caught there each year by Senegalese fishermen. The EEZ of Guinea Bissau and that of Sierra Leone are of equal importance with 55 000 and 57 000 t respectively. The EEZ of Senegal is not frequented by any foreign migrant fishermen, although the smoking of *Ethmalosa* (Bonga) in the Saloum Delta is carried out by Guineans.

The main types of fish caught are, in order of importance and quantity, small pelagics (62%), demersal (29%) and rays and sharks (7%), while the other categories, shrimps and octopus, are poorly represented (see Fig. 7). While the EEZs of Mauritania and Sierra Leone are mainly frequented for small pelagics, that of Guinea Bissau is mainly frequented for its demersal fish resources.

The total catch value of migratory fisheries approaches € 330 million per year. Demersal fish contribute most to the creation of this value (63% of the total value) despite a contribution to the total quantity of around 30%. Conversely, small pelagics, which account for 62% of the total quantity, contribute only 27% to the creation of the total value. Rays and sharks, whose fins cost more than EUR 100/kg, also contribute less to the total value than they do to the total quantity. Almost 90% of production is in the form of carcasses with a very low monetary value, which explains the low market value of this category.

Landings of artisanal fish are made both in the ports of the fishing countries and in those of the countries from which the fishermen originate (more or less equally). Two complementary logics are at work here: the first consists in landing in the ports of origin the fish intended for the external market and for which there is an effective supply chain (the case for demersal fish caught in Guinea and Guinea-Bissau and landed in Senegal); the second consists in landing (camps or fishing port) and processing on the spot and then transporting the finished products to the country of origin (case, for example, of small pelagics fish caught in Guinea-Bissau, smoked and shipped to Sierra Leone, Guinea, Liberia, etc.).

The absence of an export market to Europe (due to the lack of export approval) in some countries such as Guinea or Guinea-Bissau means that all catches of high commercial value must be repatriated to the ports of the country of origin. In the absence of an export channel, domestic prices are generally too low to make migratory fishing activities dedicated to the capture of demersal species profitable. The fishermen then carry out tides of about 10 days from the ports of Mbour and Joal Fadiouth (on the Senegalese coast) and Ziguinchor (Casamance) and take turns on the fishing grounds so that the fishing gear is permanently set. Senegal's ports thus receive nearly 370 000 t of fish each year, including nearly 110 000 t caught outside the Senegalese EEZ. Mauritanian ports benefit from the landings of the Senegalese migrant small pelagics fishery, whether to supply human consumption markets or to supply the fishmeal production in Nouadhibou. A small part of the catches (less than 10%) made by Ghanaian and Liberian fishermen leave the SRFC area by being landed mainly in Tema and Monrovia.

Overall, migrant fishing, because of its scale and hidden nature, is a major management challenge in West Africa. This challenge is manifold. It consists, firstly, of ensuring that the catches and landings of migrant fishers are recorded in the statistics of the countries of the CCLME sub-Saharan area. For example, the statistics on fish landings in Senegal show less than 3000 t of fish caught outside national waters, whereas the figures obtained in the framework of the RECARGAO project show 110 000 t (Deme et al., 2012)! This lack of data also distorts the assessment that each country can make of the state of its resources. When landings are maintained at a high level due to the landings of migrant fishers, it maintains the illusion that the country's fishery resources are in good health. Secondly,

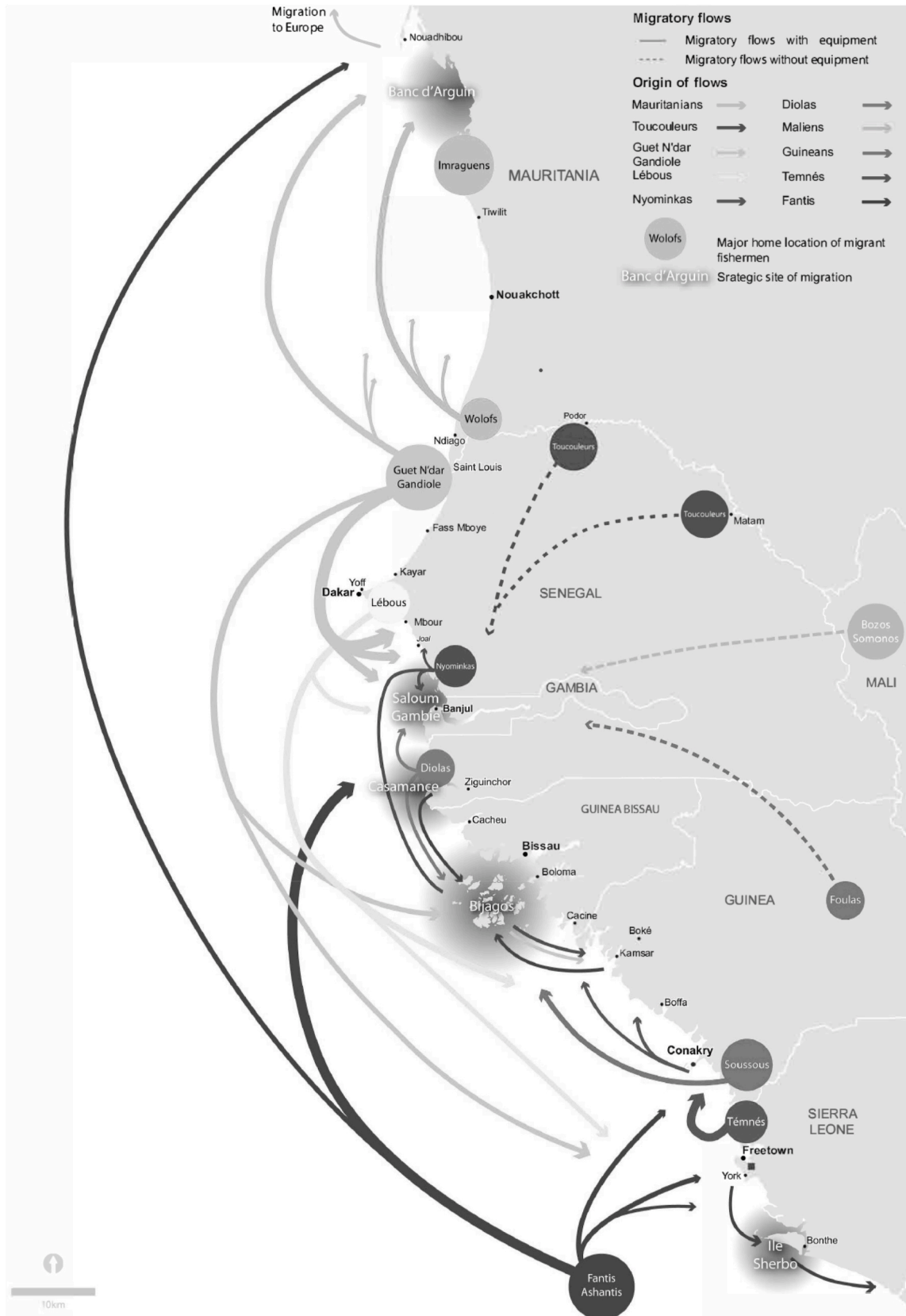


Fig. 6. Migratory fisheries in West Africa in 2010.

Source: Failler et al. (2015a), 2015b.

stock and effort assessments must therefore be carried out, taking into account migratory fishing (currently, only Mauritania does this).

Moreover, most of the management measures are not applicable to migratory fisheries. As it does not exist in any fisheries policy of the SRFC countries (apart from the category “foreign licences”), it ignores all the constraints to which more sedentary fishing units are subject. Furthermore, because of its “invisibility”, the migratory fishery is not subject to any control. The challenge is then, thirdly, to integrate migratory fisheries into fisheries policies, fisheries management plans and monitoring and control programmes. Finally, migratory fisheries set their nets as far as the boundaries of marine protected areas. Faced with the scarcity of fish in waters that were once rich in fish, it is now turning its attention to the areas still preserved in MPAs. Strengthening the monitoring of MPAs is another major challenge.

1.3. Regional fish trade: a major stake for development

Several pathways structure the flow of fish from production to consumption in each of the seven CCLME countries (see Fig. 8). The two main ones are those organised from artisanal and coastal fisheries to markets near or far from the production centres (around 900

Table 2
Main migratory moves.

	Country of fishing location	Country of origin	Ethnicities or communities	Fishing Zone	Species targeted
1	Gambia	Ghana	Fanti	Gambia	Sharks and Rays only
2	Guinea-Bissau	Ghana	Fanti	Guinea-Bissau, Bijagos and south of the country	Sharks and Rays mainly
3	Guinea	Ghana	Fanti	Guinea (Conakry, Kamsar, kaktchek)	Sharks and Rays only
4	Sierra Leone	Ghana	Fanti	Sierra Leone, peninsula of Freetown	Sharks and Rays mainly
5	Sierra Leone	Ghana	Fanti	Sierra Leone, peninsula of Freetown	Small pelagics
6	Gambia	Guinea	Foulas	Gambia	Small pelagics: ethmalose and sardinella and mâchoiron
7	Guinea-Bissau	Guinea	Soussous	Guinea Bissau (Bijagos)	Small pelagics: ethmalose and sardinella and mâchoiron
8	Sierra Leone	Guinea	Soussous	Nord Sierra Leone	Small pelagics: ethmalose and sardinella and mâchoiron
9	Sierra Leone	Guinea	Soussous	Nord Sierra Leone	Small pelagics: ethmalose and sardinella and mâchoiron
10	Sierra Leone	Libéria	Kru, Vais	South of the country	Small pelagics
11	Gambia	Senegal	Lébous from Petite Côte, Wolofs from Guet n’Dar, Saint Louis	Gambian coast	Demersal fishes: groupers and snappers
12	Gambia	Senegal	Nyominkas, Wolofs from Guet n’Dar, Saint Louis	Coast and estuaries of Gambia	Ethmalose (Small pelagics) and barracudas
13	Gambia	Senegal	Toucouleurs	Gambia River	Shrimps
14	Guinea-Bissau	Senegal	Wolofs from Guet n’Dar, Saint Louis	Guinea-Bissau (Bijagos), Rio Cacine, Cacheu	Demersal: groupers and snappers (red carp, etc.)
15	Guinea-Bissau	Senegal	Lébous from e Petite Côte	Guinea-Bissau	Sharks, barracudas, demersal fishes like plaice
16	Guinea	Senegal	Wolofs, lébous from Saint Louis, petite côte	Guinea	Sharks and Rays only
17	Guinea	Senegal	Wolofs, lébous from Saint Louis, petite côte	Guinea	Demersal species
18	Mauritania	Senegal	Wolofs from Guet n’Dar, Saint Louis	Nouadhibou, Nouakchott, and south of Nouakchott	Small pelagics
19	Mauritania	Senegal	Wolofs from Guet n’Dar, Saint Louis	Nouadhibou, Nouakchott, and south of Nouakchott	Small pelagics
20	Mauritania	Senegal	Wolofs from Guet n’Dar, Saint Louis	Nouadhibou, Nouakchott, and south of Nouakchott	Demersal species
21	Mauritania	Senegal	Wolofs from Guet n’Dar, Saint Louis	Nouadhibou, Nouakchott, and south of Nouakchott	Demersal species
22	Mauritania	Senegal	Wolofs from Guet n’Dar, Saint Louis	Nouadhibou, Nouakchott, and south of Nouakchott	Octopus
23	Sierra Leone	Senegal	Wolofs from Saint Louis, lébous from petite côte	Sierra Leone	Demersal species
24	Sierra Leone	Senegal	Wolofs from Saint Louis, lébous from petite côte	Sierra Leone	Demersal species
25	Guinea-Bissau	Sierra Leone	Temnés	Sud Guinea-Bissau, Bijagos	Small pelagics: ethmalose and sardinella
26	Guinea	Sierra Leone	Temnés	Guinea (Conakry) and southern part of the country to the North	Small pelagics: ethmalose and sardinella
27	Guinea	Sierra Leone	Temnés	Guinea (Conakry) and southern part of the country to the North	Demersal species

Source: Failler and Binet (2012).

Table 3
Quantity and Value of the CCLME migratory fisheries (average 2006–2012).

	Country of fishing	Country of Origin	Species	Landing sites	quantity	Average price t/€	Value of catches €
1	GAM	GHA	SHA*	AUT**	8000	200	1 600 000
2	GBI	GHA	SHA	AUT	1000	200	200 000
3	GUI	GHA	SHA	AUT	1000	200	200 000
4	SLE	GHA	SHA	AUT	4000	2500	10 000 000
5	SLE	GHA	SMP	AUT	14 000	200	800 000
6	GAM	GUI	SMP	GUI	7000	250	1 750 000
7	GBI	GUI	SMP	GBI	10 000	250	2 500 000
8	SLE	GUI	SMP	GUI	14 000	2500	35 000 000
9	SLE	GUI	SMP	SLE	6000	2500	15 000 000
10	SLE	LIB	SMP	AUT	9000	250	2 250 000
11	GAM	SEN	DEM	SEN	13 000	2500	32 500 000
12	GAM	SEN	SMP	SEN	5000	250	1 250 000
13	GAM	SEN	SHR	SEN	1500	4000	6 000 000
14	GBI	SEN	DEM	SEN	36 000	2500	90 000 000
15	GBI	SEN	SHA	SEN	5000	200	1 000 000
16	GUI	SEN	SHA	SEN	1500	2500	3 750 000
17	GUI	SEN	DEM	SEN	4000	2500	10 000 000
18	MAU	SEN	SMP	MAU	77 000	250	19 250 000
19	MAU	SEN	SMP	SEN	30 000	250	7 500 000
20	MAU	SEN	DEM	MAU	10 000	2500	25 000 000
21	MAU	SEN	DEM	SEN	7500	2500	18 750 000
22	MAU	SEN	OCT	MAU	3800	2500	9 500 000
23	SLE	SEN	DEM	SEN	4000	2500	10 000 000
24	SLE	SEN	DEM	SLE	6000	2500	15 000 000
25	GBI	SLE	SMP	GBI	3000	250	750 000
26	GUI	SLE	SMP	GUI	5200	250	1 300 000
27	GUI	SLE	DEM	GUI	2500	2500	6 250 000
			Total		289 000		Total 327 100 000

* GAM: Gambia; GBI: Guinea Bissau; SLE: Sierra Leone; GUI: Guinea; MAU: Mauritania.

** SHA: SHAuins; SMP: small pelagics; DEM: demersals; SHP: Shrimps; OCT: Octopus.

*** AUT: Outside of CCLME; SEN: Senegal.

Source: Failler and Binet (2012).

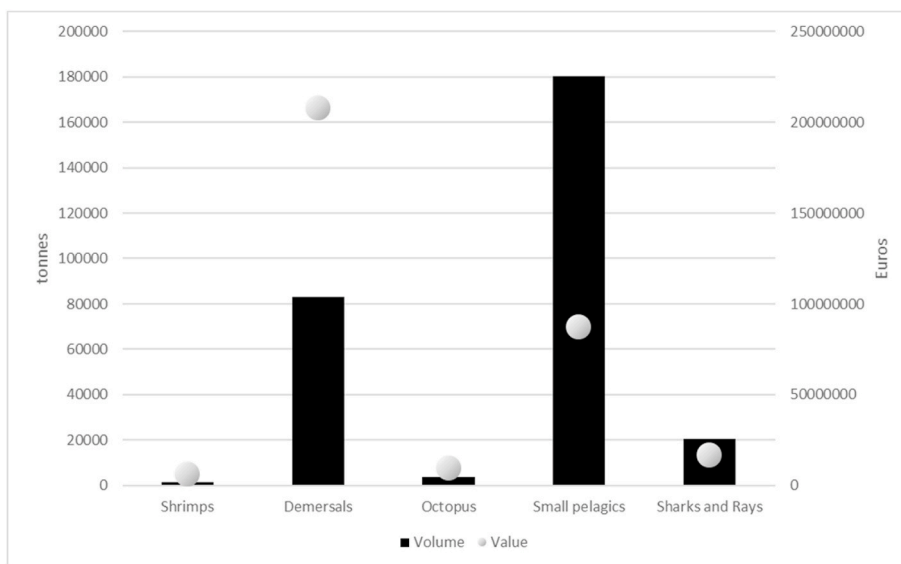


Fig. 7. Quantity et value of the migratory fisheries per species.

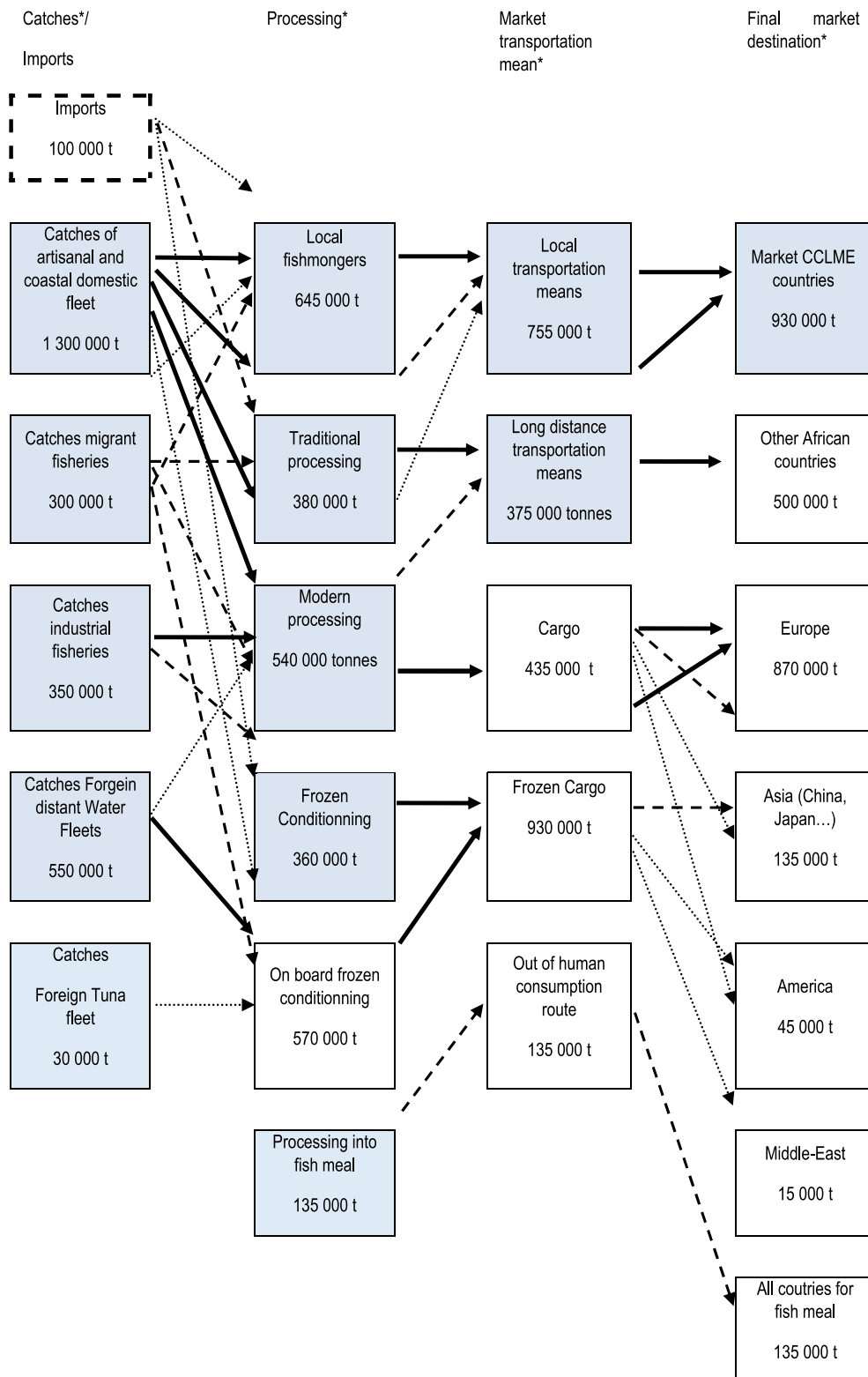


Fig. 8. Fish chain of CCLME countries (average 2008–2013). *: without taking into account wastes. Source: Failler et al. (2015a), 2015b.

000 tonnes/year on average during the period 2008–2013¹) and to external markets (around 480 000 tonnes/year). Alongside them are three other important sectors: that of industrial fishing in the CCLME countries, which contributes mainly to supplying export markets with products of high commercial value (demersal fish, shrimps and cephalopods in quantities of around 350 000 t); that of foreign industrial fishing, which contributes little to supplying national fish markets in the absence of landings in the ports of coastal countries (500 000 t); and foreign tuna fishing, which lands part of its production in the ports of Dakar and Mindelo in order to produce canned tuna, mainly for the European market (landings are then assimilated to imports and the quantity is of the order of 30 000 tonnes of catch for every 10 000 tonnes landed).²

Imports come mainly from Europe (50 000 tonnes/year, mainly from Spain, France,³ the United Kingdom, the Netherlands and Norway), Asian countries (10 000 tonnes, mainly from China and Thailand), South American countries (5000 tonnes, mainly from Peru and Argentina) and African countries outside the CCLME area (5000 tonnes/year, mainly from Ghana and Côte d'Ivoire). CCLME intra-space trade represents around 30 000 tonnes, with Morocco representing the central pivot. Overall, these sectors generate a flow of about 100 000 tonnes per year.

The diagram on the next page (Fig. 8) shows all the routes. For each component of the chain (production, processing, marketing and final consumption), the average quantities of fish during the period 2008–2013 are shown. The flow figures are deliberately rounded off to make them easier to remember. The light blue in the rectangles indicates that the process is taking place in the CCLME space. The importance of the flows between the components of the pathway is represented as follows:

The markets of the CCLME countries are therefore mainly supplied by artisanal and coastal fisheries that operate either in the waters of the country to which they belong or in the waters of neighbouring countries, as is the case for Senegalese artisanal fisheries, which have a very wide range, from the north of Mauritania to the south of Guinea (Binet et al., 2012c).

African countries, especially those of the Gulf of Guinea, Nigeria, Côte d'Ivoire and Cameroon, benefit greatly from the trade in fishery products, mainly small pelagics, from the CCLME countries. About half a million tonnes of fish thus transit each year from West African ports and Las Palmas⁴ to Lagos, Abidjan, Douala and all the other ports of entry of the other African countries of the Atlantic coast (and to a lesser extent those of the Mediterranean, especially the port of Algiers which receives several thousand tonnes of sardines from Morocco each year). In recent years an increasing quantity of fishmeal has been exported from Mauritania to Nigeria and Ghana to produce food for catfish farms (Corten et al., 2017; Failler et al., 2020). Mauritanian production reached 70 000 tonnes in 2013 (compared to only 10 000 tonnes in 2009) using more than 350 000 tonnes of sardinella and other small pelagics fish.⁵ This seems to be starting to affect the national and regional markets, especially considering that the Mauritanian sardinella is the most popular of all types available in Africa.⁶ It also affects the stocks because before the establishment of factories, artisanal fishing boats were limited to 13 tonnes in order not to damage the fish stored at the bottom of the hold. Today they embark up to 75 tonnes, of which only the last tonnes fished are fit for human consumption. The development of aquaculture in the countries of the Gulf of Guinea therefore seems to be causing a series of undesirable effects in West Africa.

In the previous schematic presentation (Fig. 7), the European market includes both EU and Eastern European countries. The EU is mainly supplied with species of high commercial value shipped from countries that have European approval to export to EU countries (Morocco, Mauritania, Cape Verde, Senegal and Gambia). They are exported in a very unprocessed form (fish is gutted and headed, shrimps peeled, cephalopods gutted). They are either used as raw material by European processing plants or sold on the shelves of urban centres and used in restaurants. This market is also supplied with processed products such as canned sardines (from Morocco) and tuna (from Senegal and Cape Verde). Overall, it represents 800 000 tonnes annually. The Eastern European market is characterised by imports of low added value, consisting mainly of small pelagics and other species of low commercial value. This market represents around 80 000 tonnes per year.

The Asian market, led by Japan, is very similar to the EU market in that the species destined for it are of high commercial value (notably octopus). This market is demanding in terms of quality and is very lucrative, with prices often 10–20% higher than the European market. However, the recent development of the Chinese market is likely to change this state of affairs since China is importing increasingly more fishmeal and second-quality cephalopods. The strong growth of the Chinese domestic market and the increased demand for foreign products should also gradually strengthen China's position in all export channels of the CCLME countries. Morocco is currently the leading supplier to the Asian market.

The two main destinations for CCLME products to the American market are the United States and Brazil. Cape Verde and Morocco are Brazil's two main partners, the first for frozen tuna (mainly yellowfin tuna) and the second for sardines and various small pelagics

¹ All figures correspond to the annual average obtained for the reference period 2008–2013.

² These last two channels do not appear in the presentation.

³ For these first two countries, it is very often a question of Spanish and French tuna vessels landing in the ports of Dakar and Mindelo.

⁴ A significant portion of small pelagics are landed in Las Palmas, whether they are caught by foreign vessels operating under the agreements (European vessels), under charter (Eastern European vessels) or free licences (various vessels including Russian vessels for example in Senegal in early 2010).

⁵ According to IMROP, the production of the 24 flour mills in operation in 2014 exceeded 70 000 tonnes using more than 350 000 tonnes of small pelagics (including 1/3 sardinella, 1/3 ethmaloses and 1/3 miscellaneous). New plants are under construction in Nouakchott.

⁶ Because of the special texture of its flesh, it can be cooked over a wood or charcoal fire and then reheated without its organoleptic qualities being altered. Braised fish merchants in all the countries of the Gulf of Guinea and Central Africa praise the quality of this fish. Wholesale traders in Central Africa voluntarily mix boxes of sardinella from South African countries with those from Mauritania in order to be able to better sell the sardinella stocks from southern African countries.

species, both canned and frozen. Morocco is, again, one of the countries that supplies the United States with various canned products.⁷ The other two countries of importance are Senegal and, to a lesser extent, Gambia, the former exporting fresh or chilled demersal fish and the latter frozen flat fish. Guinea exports a few tonnes of smoked fish.⁸ The American market, with an annual quantity of around 45 000 tonnes, is however a secondary market, particularly because the prices charged are generally slightly below those of the main European markets.

The Middle East market is booming, particularly in Jordan, Kuwait, Qatar and Iraq. Morocco and Senegal are the two main supplier countries for these countries. The main products exported are canned sardines and frozen small pelagics. The quantity of flows is constantly increasing and exceeded 25 000 tonnes in 2013 (for an average of 15 000 tonnes between 2008 and 2013).

Overall, therefore, with the exception of the Chinese and Middle Eastern markets, all the export channels of the CCLME countries are traditional. The most recent of these is undoubtedly the one to Russia and the non-EU Eastern European countries. The dismantling of the Soviet bloc at the end of the 1980s and early 1990s severely disrupted flows from the fleets of Eastern European countries operating in the waters of the CCLME countries to Russia and neighbouring countries. A parallel market has gradually developed in the form of a vessel chartering system (Mauritania). Today it seems to be a sustainable market.

The European and Japanese sectors have a very structuring effect on the fishing industry of the CCLME countries that benefit from export approval. Indeed, their operating methods require stakeholders, from catch to export, to be very rigorous in the processing of fish and the application of strict hygiene rules in an environment that must meet strict health standards. The sanitary and technical constraints imposed are such that countries must have in place an institutional tool for certification, control and monitoring (competent authority, accredited laboratories, etc.). The recent introduction of the rule of origin has, moreover, considerably complicated the procedures to be followed.

However, there is still too much compartmentalization between the artisanal export and domestic markets. The image that can be used to illustrate this is that of the fish thrown on the sand of the landing beach when it is destined for the domestic market and that placed in isothermal boxes and carefully transported from the pirogue to the collection truck when its final destination is Europe or Japan. This shows the extent to which basic health rules are not part of the normal process of enhancing the value of the fish. They are perceived as specific rather than general constraints. As no regulatory measures have been taken to change this state of affairs, the domestic sectors remain sectors where quality and health are not major factors for trade. Post-capture losses are significant, just as bacteriological contaminations are common.

CCLME intra-space trade in fishery products is very low by official standards: at most 30 000 tonnes of fish are reported on customs export records (Table 4). However, more than 250 000 tonnes of fish are caught each year by migrant fishermen in the waters of the SRFC countries participating in the CCLME programme and around 200 000 tonnes cross the borders to the fishermen's country of origin.

- As for the flows declared as CCLME intra-space, they are made up of processed products from the artisanal sector (traditional methods) or the industrial sector (canned Moroccan sardines for the most part), which is accompanied by poor road infrastructure and the lack of refrigeration equipment. Smoked products occupy a predominant place. The main trade flows are as follows:
- sardinella, sardines, mackerel and other small pelagics species from the northern CCLME countries to those in the south, particularly Guinea;
- ethmaloses and various smoked products from Senegal to Guinea;
- Moroccan sardines to virtually all other CCLME countries;
- frozen whole tunas from Senegal to Cape Verde and vice versa depending on landings and the needs of the plants in Dakar and Mindelo.

These flows are no different from other flows to domestic markets. Processed fish are not subject to any particular health checks when passing through customs. Their quality is neither better nor worse than that of the same categories of products displayed on national stalls. There is therefore no specificity of CCLME intra-space trade. The weakness of CCLME intra-space trade is patent (see Table 3). Export flows correspond to less than 3% of total CCLME exports. Several reasons can be advanced to characterize this state of affairs:

- the first is due to the simple fact that the categories of fish are identical in the waters of the CCLME countries, benefiting from the same environmental conditions brought by the Canary current. The value of trade between countries is thus limited if we take as a rule that what we import is not available locally.
- The second is financial: prices, as mentioned above, are much more remunerative on export markets outside Africa such as those of Japan and the EU.
- The third is of a practical nature: for all operators in the CCLME area, it is easier to deal with an agent or importer in a European or Asian country which has easy access to the international banking system guaranteeing fluidity in transactions.

In addition, there are other reasons which tend to discourage operators from trading across borders. Firstly, there is the poor state of road infrastructure, particularly near borders (located far from the capitals and therefore from the attention of the administrations),

⁷ It also exports fishmeal in quantities of up to 8000 tonnes per year.

⁸ However, more exports have been recorded since 2008.

Table 4
Exports and imports intra CCLME area (tonnes).

Exports	Cabo-Verde	Gambia	Guinea	Guinea-Bissau	Morocco	Mauritania	Senegal	Total
Cabo-Verde		0	0	0	0	0	120	120
Gambia	150		280	1630	2540	500	7900	13000
Guinea	120				120			
Guinea-Bissau	0	0	0		0	0	230	230
Morocco	1170	1660	1100	200	–	1330	140	5600
Mauritania	0	120	0	0	680		0	800
Senegal	1500	700	11000	400	400	0		14000
Total	2940	2480	12380	2230	3620	1830	8390	33870
Importations	Cabo-Verde	Gambia	Guinea	Guinea-Bissau	Morocco	Mauritania	Senegal	Total
Cabo-Verde		0	0	0	450	0	230	680
Gambia	0			0	0	9000		9000
Guinea	0	120		0	0	0	650	770
Guinea-Bissau	0	0	0		30	0	240	270
Morocco	50	0	300	0		220	1460	2030
Mauritania	0	0	0	0	460		0	460
Senegal	140	1200	230	430	1260	0		3260
Total	190	1320	530	430	11200	220	2580	16470

Source: Failler et al. (2015a), 2015b.

the lack of maritime cabotage between ports in the same country and in different countries, and the lack of air links between certain countries (Portuguese-speaking, English-speaking and French-speaking countries), even though Dakar airport seems to be increasingly playing the role of a regional hub. Secondly, all the administrative red tape which increases the cost of transport and therefore the cost of imports by about 20 per cent.

For all these reasons, the formal channels of exchange between CCLME countries remain embryonic. In such a context, the improvement of trade between countries requires public interventions that go beyond the framework of fisheries trade.

From a nutritional point of view, all countries show large fluctuations from year to year in the contribution of small pelagics fish to the fisheries diet (see Fig. 9). With the exception of Guinea Bissau, the signs of decline are evident for all of them.

In summary, in all CCME countries, fish consumption reduces the contribution of fish to meeting animal protein requirements. For a group with a significant trade surplus (+1.1 million tonnes in 2013), this is a paradox, to say the least. All the more so as the contribution of small pelagics fish to nutritional intake has been decreasing in recent years.

In order to ensure a net supply that can maintain consumption at its current level (13.8 kg/capita/year on average for the period 2008–2013) the availability of fish will have to increase gradually from 930 000 tonnes to 1.25 million tonnes (on average 925 000 tonnes between 2008 and 2013). This means an additional input of almost 300 000 tonnes. At the same time, the population will increase by 17 million (83 million in 2025 against 66 million in 2013 according to the scenario with average fertility). The gap between the level of catches (considered constant in view of the current situation of full exploitation of practically all stocks) and that of net supply will therefore be reduced and will gradually increase from 1.1 million in 2013 to 750 000 tonnes in 2025 (see Fig. 10).

In other words, the exportable potential will be in the order of 750 000 tonnes compared to current 1.1 million tonnes. Exports will therefore have to decline at the risk of further reducing per capita consumption. As an illustration, if the level of exports does not gradually reduce by 350 000 tonnes by 2025, consumption will then be 11 kg/capita/year at that time, compared to 13.8 today and 15.6 in 2009.

The countries that will be most affected should be, on the one hand, those whose mining industry has developed significantly in recent years (Mauritania in particular and Morocco to a lesser extent) and, on the other hand, those whose population will grow steadily, such as Senegal, Morocco and Guinea. Thus, for example, Senegal's needs will be almost similar to those of Morocco, i.e. 500 000 tonnes (see Fig. 11). Guinea's needs will require an additional 65 000 tons. Only the needs of Cape Verde and Guinea-Bissau will remain relatively stable due to low population growth for the former and very low per capita consumption for the latter.

If we project even further ahead, in 2050, still assuming a constant level of per capita consumption, and using the United Nations average population fertility forecasts, we obtain a net supply requirement of around 1.8 million tonnes, i.e. practically the equivalent of current national catches (2 million tonnes). The population will then be almost 120 million people (almost double the present level). In other words, there will be very few export opportunities from domestic catches.

All in all, the CCLME countries, which until now have been able to claim to satisfy domestic demand for fishery products, are beginning to face difficulties in supplying the domestic market because of the high rate of increase in exports. This is already reflected in a decline in per capita consumption since the late 2000s and will worsen in the near future if nothing is done, in terms of public policy, to establish a balance between domestic needs and exports. The very strong growth in aquaculture production using fishmeal⁹ in countries such as Nigeria is currently tending to drain West African catches to a processing mode whose products are not fit for human consumption. Price pressure already exists in Mauritania as soon as production levels of small pelagics remain low (Dia et al.,

⁹ Especially for catfish breeding.

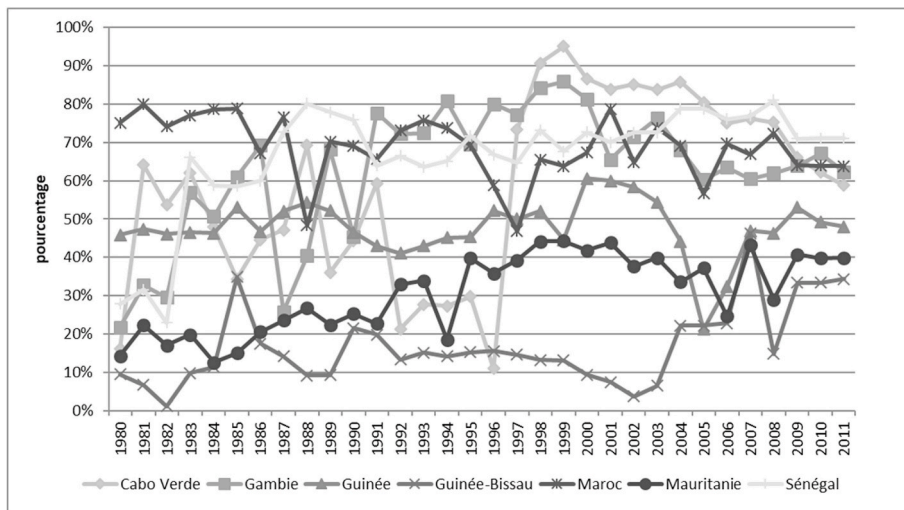


Fig. 9. Contribution of small pelagics to the diet of CCLME area populations. source: FAO.

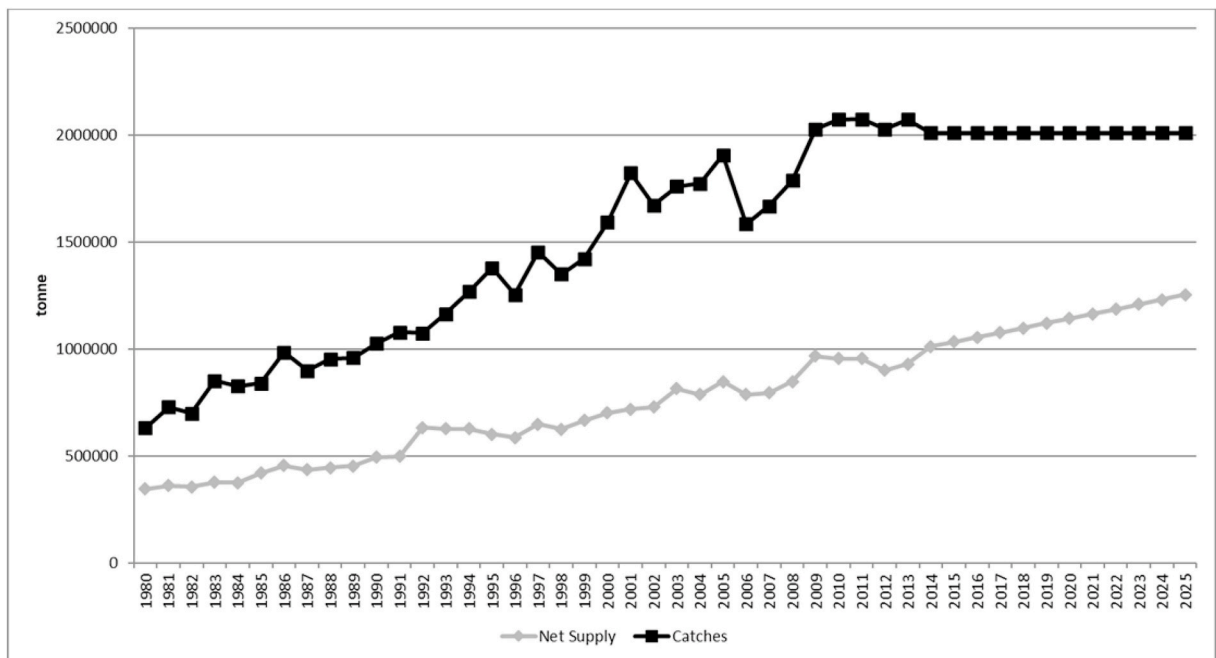


Fig. 10. Net supply and catches of the CCLME countries (forecast from 2013 data). Source: Failler et al. (2015a), 2015b.

2020) and will be exacerbated in the future. All the more so as environmental conditions will become less favourable due to a decrease in the quality of upwelling, which will have the effect of reducing the available biomass of small pelagics (Failler, 2014).

2. Conclusion

CCLME fisheries are facing the most serious issue of their history. Countries still want to develop their fishery and extract economic benefit from them while they have to satisfy their population in terms of food supply. CCLME fisheries have to change their development model. The current increase of catches and exports is putting in danger the whole development scenario based on the sole increase of quantity and not quality that aim to make better with less. Forecasts for 2030 clearly show that fish supply will be an issue if the current development pattern is followed. The issue can be dramatic if the up-welling is weak in coming years.

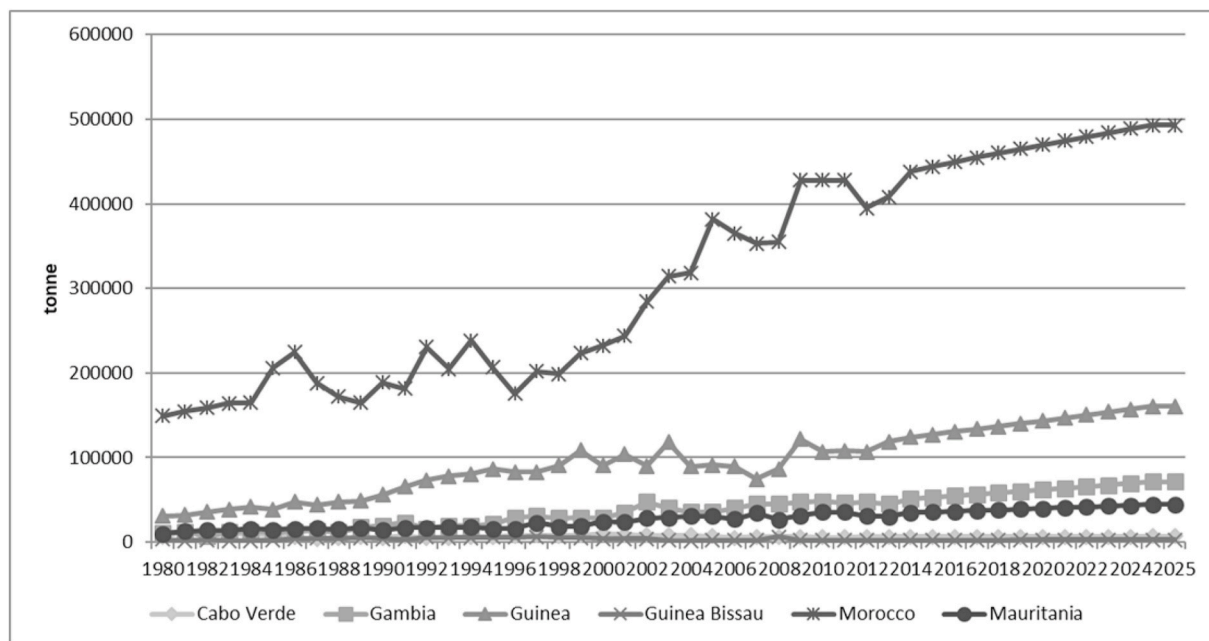


Fig. 11. Net supply of CCLME countries up to 2025.

Source: Failler et al. (2015a), 2015b.

Migrant fishermen constitute another key issue of the CCLME fisheries. Despite an average of 300 000 tonnes that represent nearly 20% of the total of 1.6 million tonnes of fish caught in the EEZs of the CCLME sub-Saharan countries, they are currently absent from national statistics. Lacking a clear picture of the quantities taken annually by migratory fishing, the CCLME countries cannot effectively engage in a resource management process. Thus, there is a need to record catches and landing data from migrant fisheries, both in the country of fishing and in the country of origin. There is also an imperative to review and adapt the elements of each country's fisheries policy and management to include migrant fishing. Finally, it is desirable to develop regional management tools for migrant fisheries in order to provide a framework thereof and ensure that it is a source of high added value.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This work was supported by the Management and Resilience of small pelagic fisheries in West Africa - GREPPAO project, funded by the European Union under the PESCAO program (EuropeAid / 158370 / DD / ACT / Multi), and piloted by the University of Portsmouth.

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