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A review of cephalopods (Phylum: Mollusca) of the Canary Current Large Marine Ecosystem (Central-East Atlantic, African coast)

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Review

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Abstract

An extensive review of cephalopod fauna in the Central and North Atlantic coast of Africa was performed based on material collected during 10 research cruises in these waters. In the Canary Current Large Marine Ecosystem (CCLME) area, a total of 378,377 cephalopod specimens was collected from 1247 bottom trawl stations. Of those specimens, 300 were sampled for subsequent identification in the laboratory and found to belong to 65 different species and 23 families. After an exhaustive review of the existing literature on the cephalopods and new data obtained from the surveys, an updated checklist of 138 species was generated for the CCLME area. Our knowledge of the known geographic distribution ranges of several species has been expanded: *Muusoctopus januarii* has been cited from Guinea–Bissau waters, passing through Western Sahara, to Morocco waters for the first time; *Lepidoteuthis grimaldii* and *Octopus salutii* have been sighted off Morocco waters for the first time; *Austrorossia mastigophora*, *Abralia* (*Heterabralia*) *siedleckyi*, *Abralia* (*Pygmabralia*) *redfieldi* and *Sepiola atlantica* have been cited off Western Sahara waters for the first time; *Magnoteuthis magna*, *Abralia* (*Asteroteuthis*) *veranyi* and *Octopoteuthis megaptera* have been cited off Moroccan and Western Sahara waters for the first time; *Ancistroteuthis lichtensteinii*, *Opisthoteuthis grimaldii*, *Onykia robsoni*, *Muusoctopus levis* and *Bathypolypus valdiviae* have been cited in the Guinea–Bissau coast for the first time; the northern geographic limit of *Bathypolypus ergasticus* has been expanded to Morocco, Western Sahara and Mauritania and southward to Guinea–Bissau waters. The presence of *Muusoctopus johnsonianus* in Senegalese waters has been reported for the first time. A *Chtenopteryx sicula* specimen was reported in Western Sahara waters. A specimen belonging to the poorly known *Cirrothauma murrayi* species was found in South Moroccan waters. *Amphitretus pelagicus*, a probably cosmopolitan species, has been reported in the Western Sahara and Guinea–Bissau waters. Some species that were previously recorded in the area, *Sepia angulata*, *Sepia hieronis*, *Heteroteuthis dagamensis*, *Helicocranchia joubini* and *Tremoctopus gelatus*, were removed from the final checklist and considered to be not present in the CCLME area. *Cycloteuthis akimushkini* was substituted with *Cycloteuthis sirventi*, its senior synonym, in the final checklist. Similarly, *Mastigoteuthis flammea* and *Mastigoteuthis grimaldii* were substituted with *Mastigoteuthis agassizii*.

Introduction

Cephalopods, as indicated by Landman *et al.* (2007), are an important component of marine ecosystems worldwide. They are a well-defined class of Mollusca, and a diverse and highly complex group (Jereb & Roper, 2005). The cephalopod fauna in the North-west African region includes species that are widely distributed and of high commercial value as fisheries resources (Grant *et al.*, 1981; Rocha & Cheikh, 2015; Rocha *et al.*, 2017).

The Canary Current Large Marine Ecosystem (CCLME) is one of the four major marine upwelling systems worldwide and the third concerning primary productivity (Valdés & Déniz-González, 2015). In addition, the CCLME supports the largest fisheries of the African coast. It has an annual fisheries production of ~2–3 million tons (Valdés & Déniz-González, 2015), including squids, cuttlefishes and octopuses. Thus, one of the most important cephalopod fisheries in the Atlantic Ocean has been developed in its waters, with catches that reach 80,000–120,000 tons per year. Octopuses exported globally under the name *Octopus vulgaris* Cuvier, 1797, currently considered part of the *O. vulgaris* species complex (Amor *et al.*, 2017), have been experiencing a high exploitation level since the end of the 1960s in the Cape Blanc area (Inejih *et al.*, 1995). Today, the individuals found in this area are assigned to *O. vulgaris* sensu stricto (s. s.), that occurs in the Mediterranean and along the west coast of Africa in the FAO (Food and Agriculture Organization of the United Nations) area 34 (Amor *et al.*, 2017; Sauer *et al.*, 2019; Avendaño *et al.*, 2020). Currently, two species of the *O. vulgaris* species complex are identified in the CCLME area: *O. vulgaris* (s. s.) and *O. vulgaris* type III, distributed in FAO area 47 (south-western Africa; Sauer *et al.*, 2019; Avendaño *et al.*, 2020). It is difficult to assess the percentage of octopus in catches off Mauritania, Senegal and The Gambia due to massive under-reporting, lack of records and illegal fishing activities in this

region (Belhabib *et al.*, 2012). However, it is still the most exploited group of species in Mauritanian waters, both by artisanal and industrial fisheries (Faure *et al.*, 2000; Jouffre *et al.*, 2002; Sauer *et al.*, 2019).

Although most of the cephalopod species with commercial value in the region have been well-studied, many aspects of the systematics, biogeography and ecology of other cephalopod species in the CCLME area are practically unknown (Roeleveld, 1998; Hoving *et al.*, 2014; Rocha *et al.*, 2017).

The geographic distribution of many cephalopod species in this area is unclear, uncertain or unknown because of the lack of both biodiversity and resource intensive studies. Some surveys of the West African coast were conducted, but the overall records from the Guinea Gulf (Bayer *et al.*, 1966; Villanueva *et al.*, 2002) and South Africa (Chun, 1910; Thiele, 1920) are scattered and incomplete.

During the 19th and 20th centuries, several expeditions with interest in teuthological research were conducted along the North-west African coast: the *Talisman* (Fischer & Fischer, 1892) and the *Travailleur* (Fischer & Joubin, 1906) surveys were conducted from the North-west African coast to Senegal. Thanks to the two expeditions, 18 species (from six families) were added to the 49 species already known by then on the North-eastern Atlantic Ocean coasts (Fischer & Joubin, 1906). The *Valdivia* survey (Chun, 1910) was a deep-water exploration of the North-east Atlantic and the Indian Ocean, and a total of 52 cephalopod species from 19 families were reported. The *Princesse Alice* and *Hirondelle II* surveys (Joubin, 1900, 1920; Joubin & Grimaldi, 1924) found 55 cephalopod species in 16 families from the Mediterranean Sea to Azores Island, including Morocco and Canary Islands; the *Michael Sars* survey (Murray & Hjort, 1912) explored the North Atlantic and found 45 cephalopod species from 18 different families. In 2017, a review of marine biodiversity in the Eastern Central Atlantic (Polidoro *et al.*, 2017) reported a total of 114 cephalopod species from 33 families in the area.

Many studies have been conducted in Moroccan and Western Sahara waters because of the importance of their fisheries. The *Consejo Superior de Investigaciones Científicas* (CSIC, Spain) (Allué *et al.*, 1977) and FAO species identification sheets (Fischer *et al.*, 1981; Guerra *et al.*, 2014), which cover the CECAF 34 area (from the Strait of Gibraltar to Angola) are good examples. The Atlantic waters of Morocco are important for cephalopod trawl fisheries (Suda *et al.*, 1996; ARVI, 2013). Especially, the common octopus (*O. vulgaris*) has been the subject of an important industrial fishery that has used several freezer fleets since the 1960s to capture cuttlefish (*Sepia officinalis* Linnaeus, 1758) and squid (*Loligo vulgaris* Lamarck, 1798), as well as octopus (ARVI, 2013).

The coast of Mauritania supports important cephalopod fisheries (Inejih *et al.*, 1995; Faure *et al.*, 2000; Jouffre *et al.*, 2002; Belhabib *et al.*, 2012; Sauer *et al.*, 2019). Based on previous publications on cephalopods in the Atlantic (Roper *et al.*, 1984; Nesis, 1987; Mangold, 1998; Jereb & Roper, 2005, 2010; Jereb *et al.*, 2013; Guerra *et al.*, 2014) and research surveys in the area (Hernández-González *et al.*, 2006, 2008; Hernández-González, 2007; Ramos *et al.*, 2017; Rocha *et al.*, 2017), a total of 132 cephalopod species belonging to 39 families have been reported from Mauritanian waters.

There is no available information on cephalopod diversity and biology in Senegalese and Gambian waters (like several other countries in the area), except for the most important commercial species (Gulland & García, 1984; Caverivière *et al.*, 1999; Darboe & Mendy, 2002; Diallo *et al.*, 2002; Tandstad & Caramelo, 2011; FAO, 2019). There is limited information on cuttlefishes (mainly *S. officinalis*), bobtail squids (Sepiolidae Leach, 1817), octopuses (mainly *O. vulgaris*) and squids (Loliginidae Lesueur, 1821, mainly *L. vulgaris*, and Ommastrephidae Steenstrup, 1857 species) (Tandstad & Caramelo, 2011). These countries have difficulties in regulating the effort or number of fishing captures, and it is probable that most of these species are overexploited (FAO, 2019). Because of this lack of information in Senegal and The Gambia, it is clear that more prospective surveys and studies are needed to not only understand cephalopod diversity but also other potential commercial species in the region.

The cephalopod diversity in Guinean waters is poorly understood. Two surveys by the R/V 'Dr Fridtjof Nansen' at the beginning of the 21st century found only four cephalopod species: the cuttlefish *Sepia hierredda* Rang, 1835; squids *Illex coindetii* (Vérany, 1839) and *Todaropsis eblanae* (Ball, 1841) and the Lilliput longarm octopus, *Macrotritopus defilippi* (Verany, 1851). Both cruise reports established that cephalopods contributed only marginally to the total catch from this region (Huse *et al.*, 2006; Mehl *et al.*, 2007).

Between 2004 and 2012, the Spanish Institute of Oceanography (IEO) and the Institute of Marine Research (IMR) of Norway conducted 12 multidisciplinary programmes along the North-west African margin in the waters off Morocco, Western Sahara, Mauritania, Senegal, The Gambia, Guinea–Bissau, Guinea, and Cabo Verde. In this intensive sampling programme for benthos, quantitative data, environmental parameters of the water column and seabed, an extended collection of wildlife specimens (both pelagic and benthic) and databases that were only partially studied were obtained. Their study will allow us to acquire a more complete view on cephalopod biodiversity, composition and distribution in the coast of Africa and information on the ecosystems and natural marine resources of the area.

In the technical reports of these *CCLME* surveys in 2011 and 2012 (Krakstad *et al.*, 2011, 2012) which included the EEZ (exclusive economic zone) of seven countries – Cape Verde, Guinea, Guinea–Bissau, Senegal, The Gambia, Mauritania and Morocco – the following 12 cephalopod species were reported: *Alloteuthis africana* Adam, 1950, *Octopoteuthis megaptera* (Verrill, 1885), *Opisthoteuthis agassizii* Verrill, 1883, *I. coindetii* and *T. eblanae*; cuttlefishes *Sepia elegans* Blainville, 1827, *Sepia hieronis* (Robson, 1924), *S. hierredda*, *S. officinalis*, *Sepia orbignyana* Férussac, 1826 and *Sepiella ornata* (Rang, 1837) and the common octopus, *O. vulgaris*.

Additionally, several taxonomic studies on cephalopods, including species present in the CCLME area, have been performed. These monographic publications include the genus *Enoploteuthis* d'Orbigny, 1842 (Roper, 1966; Young & Harman, 1998), families Joubiniteuthidae Naef, 1922 and Cycloteuthidae Naef, 1923 in the North Atlantic (Young & Roper, 1969*a*, 1969*b*) and the subfamily Rossiinae Appellöf, 1898 (Boletzky, 1971). Cephalopod species of interest to fisheries in the area have been reported in the identification sheets for zone 34 of the Fishery Committee for the Eastern Central Atlantic (CECAF, FAO; Allué *et al.*, 1977; Guerra *et al.*, 2014). Finally, other specific publications on cephalopods can be found for the oceanic squids *Sthenoteuthis pteropus* (Steenstrup, 1855) in the Atlantic Ocean (Zuyev *et al.*, 2002), *Lepidoteuthis grimaldii* Joubin, 1895 in the Canary Islands (Escánez *et al.*, 2017) and families Histioteuthidae Verrill, 1881, Cranchiidae Prosch, 1847 and Octopodidae d'Orbigny, 1840 in the Azores Islands (Gomes-Pereira *et al.*, 2016).

In this review, we focused on the taxonomic study of the cephalopod collections obtained from the water off Morocco, Western Sahara and Guinea–Bissau during the Spanish programmes (2004–2008) as well as those collected during the two regional programmes of FAO, *CCLME*–2011 and *CCLME*–2012, in the Strait of Gibraltar and that border Sierra Leone. These collections represent an exceptional source of information that will provide a global view of the biodiversity, composition and distribution of

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Table 1. Summary of the characteristics and main objectives of the studied surveys

Survey	Geographic area	No. of Trawls	Bathymetric range (m)	Objective
Maroc–0411	North Morocco	93	500–2000	Prospecting of the deep-sea demersal resources
Maroc–0511	South Morocco	95	500–2000	Prospecting of the deep-sea demersal resources
Maroc–0611	Western Sahara	100	200–2000	Prospecting of the deep-sea demersal resources
Maurit–1107	Mauritania	77	400–2000	Prospecting of the deep-sea demersal resources
Maurit–0811	Mauritania	99	80–2000	Study of the deep-sea demersal resources and ecosystems
Maurit–0911	Mauritania	57	80–2000	Study of the deep-sea demersal resources and ecosystems
Maurit–1011	Mauritania	56	80–2000	Study of the deep-sea demersal resources and ecosystems
Bissau–0811	Guinea–Bissau	100	20–1000	Evaluation of the demersal resources
CCLME–1110	North-west Africa (Guinea–Morocco)	269	20–900	Evaluation of pelagic and demersal resources and study of the ecosystems
CCLME–1205	North-west Africa (Guinea–Morocco)	301	20–900	Evaluation of pelagic and demersal resources and study of the ecosystems

cephalopods from the North-west coast of Africa. In addition to specimen identification, inventory and characterization of the teuthological fauna of the North-west African coast at the regional level were performed. Special emphasis was placed on the study of the less-known species and those whose known distributional ranges have been expanded by this study.

Materials and methods

The surveys

The specimens were obtained during 10 bottom trawl surveys developed between 2004 and 2012 by the IEO of Spain and the IMR of Norway. These surveys (Table 1) were part of the EcoAfrik project (Biodiversity of benthic ecosystems of Africa) by the IEO, within the programme of study of African fishery resources (CECAF, Committee for Eastern Central Atlantic Fisheries). Waters of the shelf and continental slope were explored by the Spanish R/V 'Vizconde de Eza' and Norwegian 'Dr Fridtjof Nansen' vessels, from the Strait of Gibraltar in Moroccan waters (~36°N) to the northern border of Sierra Leone waters (9°N), and the EEZ of seven countries (Morocco, Western Sahara, Mauritania, Senegal, The Gambia, Guinea–Bissau and Guinea), to evaluate the pelagic and demersal resources and reference the state of the ecosystem at the regional level (Krakstad *et al.*, 2011, 2012) between 20 and 2000 m. *Maroc* surveys were conducted in Morocco and Western Sahara waters (Ramos *et al.*, 2005; Hernández-González *et al.*, 2006), *Maurit* surveys in Mauritanian waters (Hernández-González *et al.*, 2006, 2008; Hernández-González, 2007; Ramos *et al.*, 2017), *Bissau*–0810 survey was conducted in Guinea–Bissau waters (García-Isarch *et al.*, 2009), and the two FAO regional surveys (*CCLME* surveys) were conducted across the CCLME region between the Strait of Gibraltar and the waters of the border between Guinea and Sierra Leone. Information about the surveys is available in Table 1.

The trawls used in the surveys were a commercial trawl (Lofoten type) for *Maroc* and *Maurit* surveys (Hernández-González *et al.*, 2006), a commercial Conakry cod-end type trawl for *Bissau*–0810 (García-Isarch *et al.*, 2009), and a Gisund super bottom trawl for the regional *CCLME* surveys (Krakstad *et al.*, 2011, 2012).

As a result, quantitative data from 1298 sampling stations (Figure 1) were obtained and an important collection of cephalopods was preserved, which have been deposited in the Reference Collections of the IEO of the Canary Islands and Málaga, and the Cephalopod Laboratory of the University of Vigo (Faculty of Marine Sciences). With regard to the four *Maurit* surveys, this study is complementary to the previous one performed by Rocha *et al.* (2017).

Taxonomic analysis

The study was performed at the University of Vigo (Vigo, Spain) and the Spanish Institute of Oceanography of the Canary Islands (Tenerife, Spain). The specimens identified in the present paper were those preserved for later study during the surveys because it was not possible to identify them soon after capture (except for the specimens from *Bissau*–0810 which were previously identified on board and already thoroughly checked in the laboratory). Identification included morphological analyses of each specimen. The specimens were preserved during the campaigns in 4% formalin in seawater. Upon examination, the preservative was replaced by successive washings in fresh water and ethyl alcohol at different increasing concentrations (25–40–70%), until its final conservation in 70–80% alcohol in fresh water. The deteriorated specimens were kept in 4–7% formalin. The individuals were identified using their external taxonomic characters and morphometry. For taxonomic identification to the genus and species levels, cephalopod descriptions and taxonomic keys published by Robson (1929, 1932), Nesis (1987), Guerra (1992), Okutani & Clarke (1992), Bello (1995, 2013, 2015), Muus (2002), Gleadall (2004), Jereb & Roper (2005, 2010), Allcock *et al.* (2006), Bolstad (2010), Gleadall *et al.* (2010), Jereb *et al.* (2013), Guerra *et al.* (2014) and Bolstad *et al.* (2018) were used. The specimens in poor condition were identified by their mandibles or internal shells using specific literature (Voss, 1956; Roper, 1966; Lipinski, 1983; Clarke, 1986; Pérez-Gándaras, 1986; Guerra *et al.*, 2001; Lu & Ickeringill, 2002; Xavier & Cherel, 2009; Bolstad, 2010). We also consulted websites that specialize in taxonomy, for example, World Register of Marine Species (WoRMS), Tree of Life (ToL), Encyclopedia of Life (EOL) and Global Biodiversity Information Facility (GBIF). The classification by Young *et al.* (2019), available on the ToL website, was followed for the taxonomic classification of the specimens. The recommendations of Roper & Voss (1983) were taken into account for the measurement, indexing and characterization of the specimens. The lesser-known species and those whose range of distribution has been extended were also described using the guidelines provided by Roper & Voss (1983). Photographs of the fresh specimens taken during the surveys were used to determine their colouration patterns and general appearance. Then, each species

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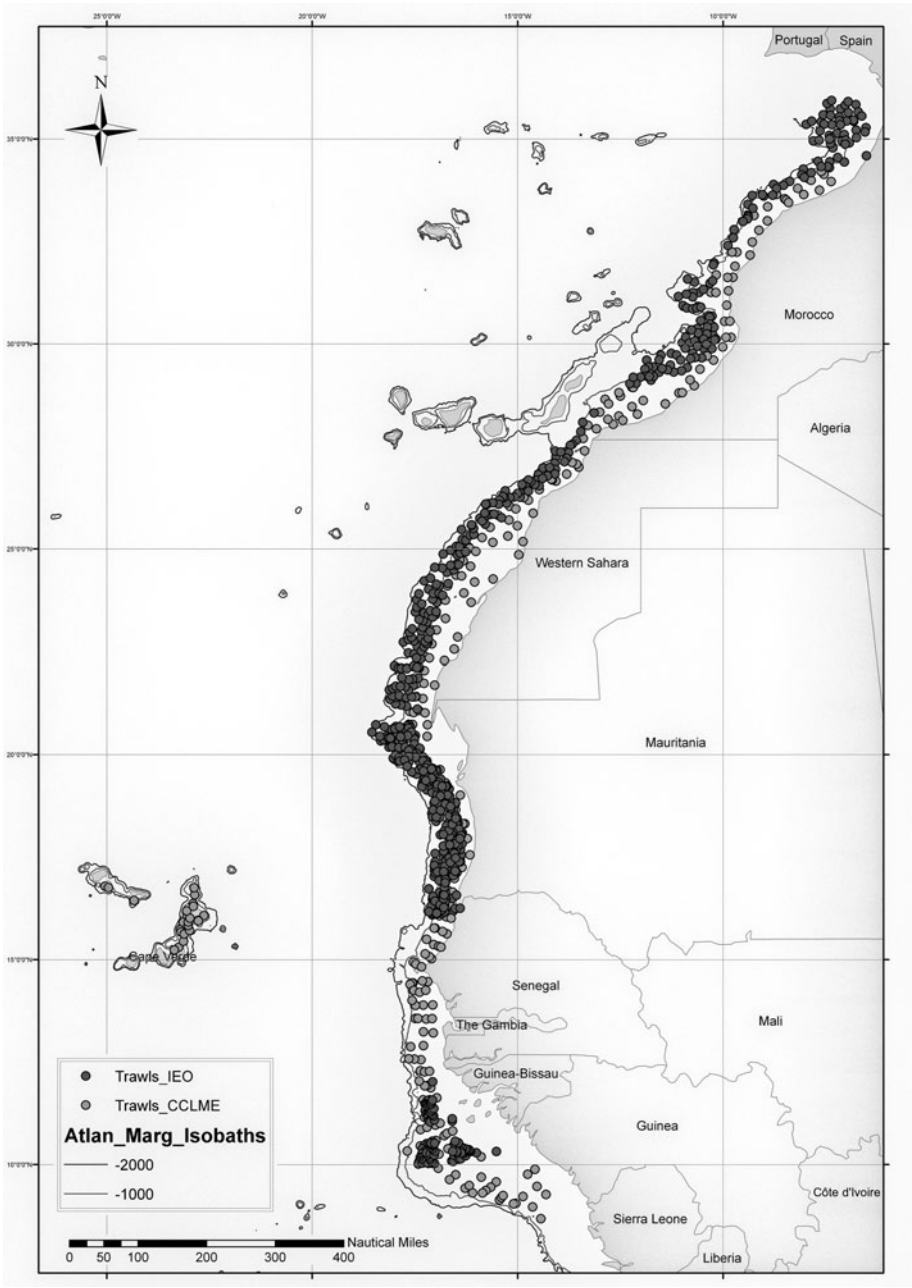

Fig. 1. Map of CCLME campaign stations. In dark grey, the stations carried out by the IEO campaigns (Maroc, Maurit and Bissau); in light grey, the regional campaigns of the CCLME (CCLME). The isobaths of −1000 m and −2000 m of the Atlantic margin are shown.

was re-tagged, and their peculiar identification characters were photographed. Finally, after an exhaustive review of the existing literature on cephalopods, an updated checklist for the species recorded in the study area was generated.

Results

The cephalopods in the CCLME region

After an exhaustive review of the existing cephalopod literature and new data obtained from the surveys, an updated checklist of 138 species for the CCLME area was generated (Table 2). We have documented the geographic ranges of a total of 23 species, and seven others were removed from the initial list because their presence is uncertain in the area or changes in the information on their taxonomy or distribution have occurred.

In the CCLME area, a total of 378,377 cephalopod specimens were collected from 1247 trawl stations (Table 1). From the 300 specimens preserved for posterior identification, we found 65 different species in 23 families. Table 3 includes the specimen information by survey (zone, numerosity of taxa examined, species and families), and Table 4 the number of species and families by cephalopod order. The presence/absence of each species is listed by countries in the area (Table 2).

Of 193 specimens collected from Moroccan waters, 52 species belonging to 23 families were identified: two species in the order Myopsida Naef, 1916 (3.8% of the total species from Moroccan waters), 21 from Oegopsida Orbigny, 1845 (40.4%), seven species from Sepiolida Keferstein, 1866 (13.3%), three from Sepiidae Keferstein, 1866 (5.7%), 17 species (32.7%) from Octopoda Leach, 1818 and one species from Spirulida Haeckel, 1896 (1.9%). The families with the largest number of species found in Moroccan waters were Octopodidae, with five species (9.6% of the total), followed by Histioteuthidae, with four species (7.7%).

Guerra *et al.* (2014) reported 88 cephalopod species in Moroccan waters that were classified into 30 families and six orders. In the checklist for Moroccan waters, three newly reported cephalopod families (Mastigoteuthidae, Lepidoteuthidae and Enteroctopodidae) and 15 new species have been included: one in the order Sepiolida (*Austrorossia mastigophora* (Chun, 1915)),

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Table 2. Checklist of all specimens recorded and found in the CCLME area, arranged alphabetically by order and family

Species	Cited	Found (this study)
ORDER: MYOPSIDA Naef, 1916		
FAMILY LOLIGINIDAE Lesueur, 1821		
Afrololigo mercatoris (Adam, 1941)	Gui, Bi, Ga, Se, Ma, Sa	Bi
Alloteuthis africana Adam, 1950	Gui, Bi, Ga, Se, Ma, Sa	Bi, Ma, Se, Sa
Alloteuthis media (Linnaeus, 1758)	Mo, Ma	
Alloteuthis subulata (Lamarck, 1798)	All	Sa, Ma, Bi
Loligo forbesii Steenstrup, 1856	Se, Ma, Sa, Mo	
Loligo vulgaris Lamarck, 1798	All	
ORDER: UNCERTAIN		
SUPERFAMILY BATHYTEUTHOIDEA Vecchione, Young & Sweeney, 2004		
FAMILY BATHYTEUTHIDAE Pfeffer, 1900		
Bathyteuthis abyssicola Hoyle, 1885	Ma?	Mo
FAMILY CHTENOPTERYGIDAE Grimpe, 1922		
Chtenopteryx sicula (Verany, 1851)	All	Mo, Sa
ORDER OEGOPSIDA d'Orbigny, 1845		
FAMILY ANCISTROCHEIRIDAE Pfeffer, 1912		
Ancistrocheirus lesueurii (d'Orbigny, 1842)	All	
FAMILY BRACHIOTEUTHIDAE Pfeffer, 1908		
Brachioteuthis picta Chun, 1910	Ma	
Brachioteuthis riisei (Steenstrup, 1882)	Ma	
FAMILY CHIROTEUTHIDAE Gray, 1849		
Chiroteuthis veranii (Férussac, 1834)	All	Ma, Mo, Sa
Grimalditeuthis bonplandi (Verany, 1839)	Mad, CV, Ma	
Planctoteuthis danae (Joubin, 1931)	Bi, Ga, Se, Ma, Sa, Mo	
Planctoteuthis exophthalmica (Chun, 1908)	EAtl, Mad	
FAMILY CRANCHIIDAE Prosch, 1847		
SUBFAMILY CRANCHIINAE Pfeffer, 1912		
Cranchia scabra Leach, 1817	Ma	
Leachia atlantica (Degner, 1925)	Se, Ma, Sa, Mo	
Liocranchia reinhardtii (Steenstrup, 1856)	All	Ma, Mo, Sa, Se
SUBFAMILY TAONIINAE Pfeffer, 1912		
Bathothauma lyromma Chun, 1906	Ma	
Egea inermis Joubin, 1933	Ma	
Galiteuthis armata Joubin, 1898	All	Ma, Mo, Sa
Helicocranchia pfefferi Massy, 1907	Ma	
Liguriella podophthalma Issel, 1908	Ma	
Megalocranchia oceanica (Voss, 1960)	Ma	
Sandalops melancholicus Chun, 1906	Ma	
Taonius pavo (Lesueur, 1821)	Ma	Se, Ma
Teuthowenia maculata (Leach, 1817)	Gui, Bi, Ga, Se, Ma	Ma
FAMILY CYCLOTEUTHIDAE Naef, 1923		
Cycloteuthis sirventi Joubin, 1919	Ma	
Discoteuthis discus Young & Roper, 1969	Ma	
Discoteuthis laciniosa Young & Roper, 1969	Ma	
FAMILY ENOPLOTEUTHIDAE Pfeffer, 1900		
Abralia (*Pygmabralia*) *redfieldi* Voss, 1955	Bi, Se	Sa

(*Continued*)

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Table 2. (*Continued.*)

Species	Cited	Found (this study)
Abralia (*Heterabralia*) *siedleckyi* Lipinski, 1983	Ma	Sa
Abralia (*Asteroteuthis*) *veranyi* Rüppel, 1844	Gui, Bi, Ga, Se, Ma, Mad	Ma, Bi, Se, Sa, Mo
Abraliopsis atlantica Nesis, 1982	Ma	
Abraliopsis morisii (Verany, 1839)	All	Sa
Enoploteuthis anapsis Roper, 1964	All	
Enoploteuthis leptura (Leach, 1817)	All	
FAMILY HISTIOTEUTHIDAE (Verrill, 1881)		
Histioteuthis bonnellii (Ferussac, 1834)	All	
Histioteuthis celetaria celataria (Voss, 1960)	Az, Mad, Ma	
Histioteuthis corona corona (Voss & Voss, 1962)	All	Ma, Mo, Se
Histioteuthis meleagroteuthis (Chun, 1910)	Bi, Ma, Mo, Mad, Can	Mo
Histioteuthis reversa (Verrill, 1880)	All	Ma, Mo, Se, Bi
Stigmatoteuthis arcturi Robson, 1948	All	Mo
FAMILY JOUBINITEUTHIDAE Naef, 1922		
Joubiniteuthis portieri (Joubin, 1916)	All	
FAMILY LEPIDOTEUTHIDAE Pfeffer, 1912		
Lepidoteuthis grimaldii Joubin, 1895	Ma, Mad, Az, Can	Mo
FAMILY LYCOTEUTHIDAE Pfeffer, 1908		
SUBFAMILY LAMPADIOTEUTHINAE Berry, 1916		
Lampadioteuthis megaleia Berry, 1916	CV, Ma, Mo	
SUBFAMILY LYCOTEUTHINAE Pfeffer, 1908		
Selenoteuthis scintillans Voss, 1959	Ma, Mo, Can	
FAMILY MAGNAPINNIDAE Vecchione & Young, 1998		
Magnapinna talismani (Fisher & Joubin, 1906)	Ma, Az, CV	
FAMILY MASTIGOTEUTHIDAE Verrill, 1881		
Echinoteuthis atlantica (Joubin, 1933)	Tr Atl, Ma	
Echinoteuthis danae Joubin, 1933	Tr Atl, Ma	
Magnoteuthis magna (Joubin, 1913)	Tr Atl, Ma	Mo, Sa
Mastigopsis hjorti (Chun, 1913)	GuiG, Mad	
Mastigoteuthis agassizii Verrill, 1881	Mad, Can, Ma	Ma
FAMILY NEOTEUTHIDAE Naef, 1921		
Neoteuthis thielei Naef, 1921	All	
FAMILY OCTOPOTEUTHIDAE Berry, 1912		
Octopoteuthis danae Joubin, 1931	Bi, Se, Ma	
Octopoteuthis megaptera (Verrill, 1885)	Ma, Nam	Ma, Mo, Sa, Se
Octopoteuthis rugosa Clarke, 1980	Ma, Mo, Nam	
Octopoteuthis sicula Rüppell, 1844	Se, Ma, Az	Ma
Taningia danae Joubin, 1931	All	
FAMILY OMMASTREPHIDAE Steenstrup, 1857		
SUBFAMILY ILLICINAE Posselt, 1891		
Illex coindetii (Vérany, 1839)	All, Nam	Bi, Ma, Sa, Se
SUBFAMILY OMMASTREPHINAE Posselt, 1891		
Hyaloteuthis pelagica (Bosc, 1802)	Ma	
Ommastrephes cylindraceus (d'Orbigny, 1835)	Ma	
Ornithoteuthis antillarum Adam, 1957	Gui, Bi, Ga, Se, Ma, Nam, SAf	Bi
Sthenoteuthis pteropus Steenstrup, 1855	Ma	

(*Continued*)

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Table 2. (*Continued.*)

Species	Cited	Found (this study)
SUBFAMILY TODARODINAE Adam, 1960		
Todaropsis eblanae (Ball, 1841)	All	Bi, Sa
Todarodes sagittatus (Lamarck, 1798)	All	Mo
FAMILY ONYCHOTEUTHIDAE Gray, 1849		
Ancistroteuthis lichtensteinii (Férussac, 1835)	All	Bi, Mo, Sa
Onychoteuthis banksii (Leach, 1817)	All	
Onykia carriboea Lesueur, 1821	CAtl, SAf	
Onykia robsoni (Adam, 1962)	South Atlantic	Bi
Walvisteuthis virilis Nesis & Nikitina, 1986	South Atlantic, Ma	
FAMILY PHOLIDOTEUTHIDAE Voss, 1956		
Pholidoteuthis massyae (Pfeffer, 1912)	South Atlantic	
FAMILY PYROTEUTHIDAE Pfeffer, 1912		
Pterygioteuthis gemmata Chun, 1908	Bi, Ma, Mo, GGui, Nam, SAf	
Pterygioteuthis giardi H. Fischer, 1896	All	Mo
Pyroteuthis margaritifera (Rüppel, 1844)	Ma, Mo, Mad, Can	Mo
FAMILY THYSANOTEUTHIDAE Keferstein, 1866		
Thysanoteuthis rhombus Troschel, 1857	All	
ORDER OCTOPODA Leach, 1818		
SUBORDER CIRRATA Grimpe, 1916		
FAMILY CIRROTEUTHIDAE Keferstein, 1866		
Cirrothauma magna (Hoyle, 1885)	Ma, CV	
Cirrothauma murrayi Chun, 1911	Mo	Mo
FAMILY OPISTHOTEUTHIDAE Verrill, 1896		
Opisthoteuthis agassizii Verrill, 1883	NW Atl, Ma?	Ma?
Opisthoteuthis calypso Villanueva *et al*., 2002	All	Sa, Mo
Opisthoteuthis grimaldii (Joubin, 1903)	Az, Ma, Mo	Bi, Mo
Opisthoteuthis massyae (Grimpe, 1920)	All	Sa
FAMILY GRIMPOTEUTHIDAE O'Shea, 1999		
Grimpoteuthis megaptera (Verrill, 1885)	CAtl	
Grimpoteuthis wuelkeri (Grimpe, 1920)	Mo	
SUBORDER INCIRRATA Grimpe 1916		
FAMILY ALLOPOSIDAE Verrill, 1881		
Haliphron atlanticus Steenstrup, 1861	All	Bi, Ma
FAMILY ALLOPOSIDAE Verrill, 1881		
Haliphron atlanticus Steenstrup, 1861	All	Bi, Ma, Sa
FAMILY AMPHITRETIDAE Hoyle, 1885		
SUBFAMILY BOLITAENINAE Chun, 1911		
Bolitaena pygmaea (A. E. Verrill, 1884)	All	
Japetella diaphana Hoyle, 1885	All	Mo
SUBFAMILY VITRELEDONELLINAE Robson, 1932		
Vitreledonella richardi Joubin, 1918	All	Ma, Ga
FAMILY ARGONAUTIDAE Tryon, 1879		
Argonauta argo Linnaeus, 1758	All, Az, Mad, SAf	
Argonauta hians Lightfoot, 1786	All	
FAMILY OCTOPODIDAE d'Orbigny, 1839		
Amphioctopus burryi (Voss, 1950)	All, Can, CV	

(*Continued*)

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Table 2. (*Continued.*)

Species	Cited	Found (this study)
Callistoctopus macropus (Risso, 1826)	All	Mo, Se
Macrotritopus defilippi (Verany, 1851)	All, CV	Ma, Mo, Sa
Octopus vulgaris Cuvier, 1797	All, CV	Bi
Octopus salutii Vérany, 1836	Port, Med	Mo
Pteroctopus tetracirrhus (delle Chiaje, 1830)	All	Bi, Ma, Mo, Sa
Scaeurgus unicirrhus (delle Chiaje, 1830)	All, Nam	Mo
FAMILY ELEDONIDAE Grimpe, 1921		
Eledone caparti Adam, 1950	Ma, Se, Ga, Bi, Gui	Bi, Se
Eledone cirrhosa (Lamarck, 1798)	Mo, Can	Mo
Eledone moschata (Lamarck, 1798)	Mo	Mo
FAMILY BATHYPOLYPODIDAE Robson, 1932		
Bathypolypus arcticus (Prosch, 1849)	Ma	
Bathypolypus bairdii (Verrill, 1873)	Ma	Ma
Bathypolypus ergasticus (P. Fischer & H. Fischer, 1892)	Se, Ma, Mo	Bi, Ma, Mo, Sa
Bathypolypus sponsalis (P. Fischer & H. Fischer, 1892)	CV, Se, Ma, Sa, Mo	Mo, Sa, Ma
Bathypolypus valdiviae (Chun & Thiele, 1915)	Nam to SAf	Bi, Ma
FAMILY MEGALELEDONIDAE Taki, 1961		
Graneledone verrucosa (A. E. Verril, 1881)	Ma, Se	
FAMILY ENTEROCTOPODIDAE Strugnell *et al.*, 2013		
Muusoctopus fuscus (Taki, 1964)	Jap, Ma	Mo, Se
Muusoctopus januarii (Hoyle, 1885)	Nam?, Ma	Bi, Ma, Mo, Sa
Muusoctopus johnsonianus (Allcock *et al.*, 2006)	UK, W Atl	Se
Muusoctopus levis (Hoyle, 1885)	Austr	Bi
FAMILY OCYTHOIDAE Gray, 1849		
Ocythoe tuberculata Rafinesque, 1814	All, Ma?, Nam, SAf	
FAMILY TREMOCTOPODIDAE Tryon, 1879		
Tremoctopus gelatus Thomas, 1977	Ma?, Az	
Tremoctopus violaceus delle Chiaje, 1830	All	
ORDER: SEPIOIDEA Naef, 1916		
SUBORDER: SEPIIDA Keferstein, 1866		
FAMILY SEPIIDAE Keferstein, 1866		
Sepia bertheloti d'Orbigny, 1835	All	Bi
Sepia elegans Blainville, 1827	All	Bi, Sa
Sepia elobyana Adam, 1941	Gui, Bi, Ga, Se, Ma	
Sepia hieronis (Robson, 1924)	Gui	
Sepia hierredda Rang, 1835	Gui, Bi, Ga, Se, Ma	Bi, Gui
Sepia officinalis Linnaeus, 1758	Se, Ma, Mo	
Sepia orbignyana Férussac, 1826	All	Ma, Mo, Sa
Sepiella ornata (Rang, 1837)	Ma, Se, Ga, Bi, Gui	Bi, Gui, Se
FAMILY SEPIOLIDAE Leach, 1817		
SUBFAMILY ROSSIINAE Appellöf, 1898		
Austrorossia mastigophora (Chun, 1915)	Ma (?), Gui	Sa
Neorossia caroli caroli (Joubin, 1902)	All	Bi, Ma, Mo, Sa
Rossia macrosoma (delle Chiaje, 1830)	All	Ma, Mo
SUBFAMILY SEPIOLINAE Appellöf, 1898		
Rondeletiola minor (Naef, 1912)	All	Bi, Sa, Mo

(*Continued*)

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Table 2. (*Continued.*)

Species	Cited	Found (this study)
Sepietta oweniana (d'Orbigny, 1839–1841)	Se, Ma, Mo, Sa, Mad	Ma, Sa
Sepiola atlantica d'Orbigny, 1845	Mo	Sa, Mo
Sepiola knudseni Adam, 1984	Gui, Se, Ma, Ca	
Sepiola rondeletii Leach, 1817	Se, Ma, Mo	
SUBFAMILY HETEROTEUTHINAE Appellöf, 1898		
Heteroteuthis dispar (Rüppell, 1844)	Bi, Ma, Mo, Sa	Mo, Sa
Stoloteuthis leucoptera (Verrill, 1878)	Nam	
ORDER: SPIRULIDA Stolley, 1919		
FAMILY SPIRULIDAE Owen, 1836		
Spirula spirula (Linnaeus, 1758)	All	Mo, Sa
ORDER: VAMPYROMORPHIDA Pickford, 1939		
FAMILY VAMPYROTEUTHIDAE Thiele, 1915		
Vampyroteuthis infernalis Chun, 1903	All	Ma

All, CCLME area; Austr, Australia; Az, Azores Islands; Bi, Guinea–Bissau; Can, Canary Islands; CAtl, Central Atlantic; Cosm Temp, Cosmopolitan temperate; CV, Cabo Verde Islands; EAtl, Eastern Atlantic; Ga, Gambia; Gui, Guinea; GuiG, Guinea Gulf; Jap, Japan; Ma, Mauritania; Mad, Madeira Islands; Med, Mediterranean; Mo, Morocco; Nam, Namibia; NW Atl, North-western Atlantic; Port, Portugal; Sa, Western Sahara; SAf, South Africa; Se, Senegal.

Table 3. Number of examined specimens (N), species and families identified by survey and zone

Survey	Zone	N	No. Species	No. Families
Maroc–0411	North Morocco	11	10	6
Maroc–0511	South Morocco	38	23	16
Maroc–0611	Western Sahara	65	30	17
	Total *MAROC*	114	36	21
Bissau–0810	Guinea–Bissau	43	22	12
CCLME–1110	North Morocco	7	3	2
	South Morocco	3	2	2
	Western Sahara	18	5	4
	North Senegal	4	2	2
	Guinea–Bissau	6	2	2
	Total *CCLME*–1110	38	12	6
CCLME–1205	North Morocco	27	13	8
	South Morocco	1	1	1
	Western Sahara	37	6	3
	North Senegal	15	8	6
	Gambia	2	1	1
	South Senegal	14	7	6
	Guinea–Bissau	6	3	3
	Guinea	3	2	1
	Total *CCLME*–1205	105	28	15
Total		300	65	23

seven in the order Oegopsida (*Abralia* (*Heterabralia*) *siedleckyi*; *Abralia* (*Asteroteuthis*) *veranyi*; *Histioteuthis meleagroteuthis* (Chun, 1910); *Stigmatoteuthis arcturi*; *Magnoteuthis magna*; *Octopoteuthis megaptera* and *L. grimaldii*) and seven in the order Octopoda (*C. murrayi*; *Eledone cirrhosa* (Lamarck, 1798); *M. fuscus*; *M. januarii*; *O. salutii*; *Scaeurgus unicirrhus* (Delle Chiaje, 1830) and *Opisthoteuthis agassizii*?).

In waters off Senegal, 13 species belonging to 10 families were caught during the cruises (Tables 2 and 3): one in the orders Sepiida and Myopsida (7.7%), seven in the order Oegopsida (53.8%) and four in the order Octopoda (30.8%). Thus, families with the greatest number of species found in Senegalese waters were Histioteuthidae, Cranchiidae and Enteroctopodidae Strugnell, Norman, Vecchione, Guzik & Allcock 2013, with two species each and 15.4% of the total Senegalese species. Taking *O. vulgaris* into account, a total of 14 cephalopod species from 10 families are the total number of cephalopods known in Senegalese waters.

The Gambia has no specific cephalopod literature. The only available information was derived from fisheries data on octopuses NEI (Not Elsewhere Included: Octopodidae, with maximum attention to *O. vulgaris*), cuttlefish (*Sepia* spp.; overall, *S. officinalis*), bobtail squids NEI (Sepiolidae) and various squids NEI (Loliginidae; overall, *L. vulgaris* and Ommastrephidae) (Darboe & Mendy, 2002; Tandstad & Caramelo, 2011; FAO, 2019). In the Gambia waters, only one species was collected: *Vitreledonella richardi* Joubin, 1918, belonging to the family Amphitretidae Hoyle, 1885 (Table 2), with two specimens. With the addition of *V. richardi* to the Gambia fauna, a total of four cephalopod species have been identified in these waters (*O. vulgaris*, *S. officinalis*, *L. vulgaris* and *V. richardi*) (Table 3).

In Guinea–Bissau waters, to date, a total of 13 cephalopod species in five families had been reported (Pereira, 1993; Huse *et al.*, 2006; Mehl *et al.*, 2007; Barri, 2008; Heileman, 2009; Fernández-Caballero, 2014; FAO, 2019). Guerra *et al.* (2014) reported six cephalopod species specifically in Guinea–Bissau waters that were classified into five families and two orders. In addition, in the same work, another 74 species, belonging to 24 families in five orders, seems to be close in distribution to Guinea–Bissau waters, and they could be present here. In the present work, specimens of 25 species belonging to 14 families have been analysed. Four species (16.0%) correspond to the order Sepiida, two to Sepiolida (8.0%), three to Myopsida (12.0%), seven to Oegopsida (28.0%) and nine to Octopoda (36.0%). The most speciose family in waters off Guinea–Bissau was Sepiidae, with four species (16.0% of the total), followed by Loliginidae and

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Table 4. Cephalopod specimens sampled from 1247 commercial trawls in the CCLME area

Order	No Families	Family	No. Specimens	No. Species
Myopsida	1	Loliginidae	48	3
Oegopsida	12	Bathyteuthidae	1	1
		Chenopterygidae	1	1
		Chiroteuthidae	3	1
		Cranchiidae	15	3
		Enoploteuthidae	25	3
		Histioteuthidae	12	6
		Lepidoteuthidae	1	1
		Mastigoteuthidae	2	1
		Octopoteuthidae	7	1
		Ommastrephidae	19	4
		Onychoteuthidae	6	2
		Pyroteuthidae	3	1
Octopoda	8	Alloposidae	1	1
		Amphitretidae	7	3
		Bathypolypodidae	13	3
		Cirroteuthidae	1	1
		Eledonidae	8	3
		Enteroctopodidae	22	4
		Octopodidae	14	5
		Opisthoteuthidae	9	4
Sepioidea	3	Sepiidae	21	5
		Sepiolidae	54	7
Spirulida	1	Spirulidae	7	1
Total		23	300	65

Ommastrephidae, with three species each (12.0%). In consequence, the number of cephalopod species in waters off Guinea–Bissau increased to 20, with the addition of *Eledone moschata* (Lamarck, 1798), *M. defilippi* and *O. vulgaris* from the order Octopoda; *L. vulgaris* from Myopsida; *Todarodes sagittatus* (Lamarck, 1798) from Oegopsida and *S. officinalis* from Sepiida.

Very little diversity data have been obtained from Guinean waters. Only some survey data are available for this country (Huse *et al.*, 2006; Mehl *et al.*, 2007), and four cephalopod species had been reported: the cuttlefishes *S. hieronis* and *S. hierredda*, squids *I. coindetii* and *T. eblanae* and octopus *M. defilippi* (Mehl *et al.*, 2007; Krakstad *et al.*, 2011, 2012). Some other cephalopod groups have been reported as the prey of elasmobranchs in Guinean waters: Theuthidae indet., *Sepia* sp., *Octopus* sp. and *Rossia* sp. Owen, 1835 (Patokina & Litvinov, 2005). In the Guinean waters only two species, *S. ornata* and *S. hierredda*, belonging to the family Sepiidae, have been collected (Table 2). Thus, the total number of cephalopod species off Guinea is five, and they belong to three families.

Species of special concern

Order Sepiolida

In the family Sepiolidae Leach, 1817, two specimens of *A. mastigophora* were identified for the first time in Western Sahara waters (Appendix 1): a female (3.5 cm mantle length (ML)) and a male (2.5 cm ML). The specimens were identified based on diagnostic characters described in Guerra *et al.* (2014): the mantle margin slightly retracted (especially on the dorsal side), without projecting corners, a tentacle club dorsally curved like a horn with very small suckers (30–40 in each row) and pairs of enlarged biserial suckers on ventral, ventrolateral and dorsolateral arms in males (8, 8 and 6 pairs, respectively).

In the subfamily Sepiolinae Appellöf, 1898, a total of 13 specimens of *Sepiola atlantica* d'Orbigny, 1845 were collected (Appendix 1), nine of them caught in Western Sahara waters. The specimens were identified based on the following diagnostic characters: the anteroventral edge of mantle undulate, without deep incision, and a pair of kidney-shaped light organs present inside the mantle cavity on each side of ink sac. In the male, the hectocotylus (left dorsal arm) is strongly bent starting at the middle. The distal part of the hectocotylus has two groups of markedly enlarged suckers in dorsal row, in proximal and midway position. The midway position group presents 4–5 greatly enlarged suckers with fused pedicels and, in the base of the arm, a large swollen bulb, with the copulatory organ in the form of secondary basal lobes. According to Bello (2013), the specimens had eight rows of suckers in the tentacular club, which distinguishes the species from *S. tridens* de Heij & Goud, 2010 and confirms it as *S. atlantica*. Also, this species is characterized by having two sucker series on arms IV, which abruptly change into minute suckers arranged in 4–6 transverse series on tips, which are long and finger-like (Nesis, 1987; Guerra *et al.*, 2014).

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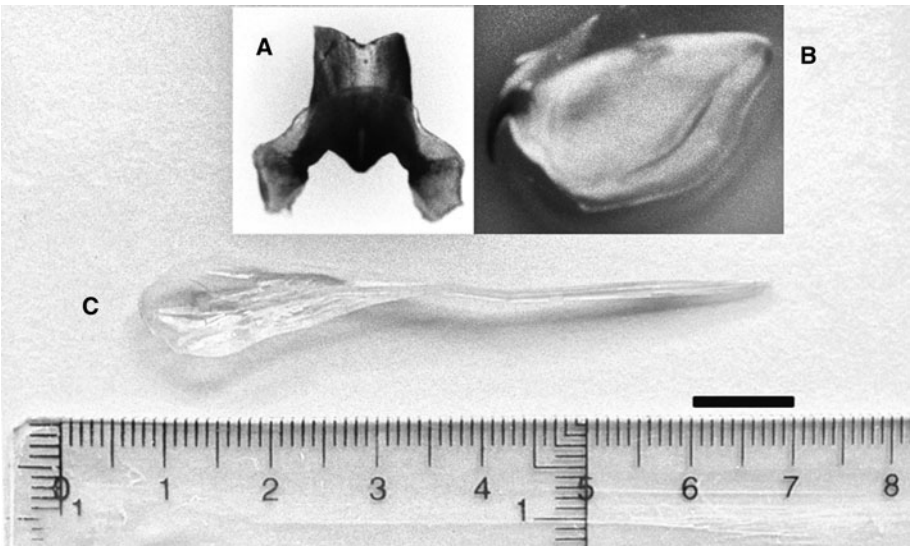

Fig. 2. *Bathyteuthis abyssicola* Hoyle, 1885. Lower beak (A), upper beak (B) and gladius (C). *Maroc*–0511 survey. Scale: each line, 1 cm. (A and B, © IEO; C, © Amanda Luna).

Superfamily Bathyteuthoidea Vecchione, Young and Sweeney, 2004

A female *Chtenopteryx sicula* (Verany, 1851) (Chtenopterygidae Grimpe, 1922) was identified in Western Sahara waters, with 4.6 cm ML (Appendix 1). The specimen was identified according to an indisputable diagnostic character: large photophores on the ventral surface of eyeballs, a feature present in *C. sicula* and absent in other congeneric species as *C. canariensis* specimens (Salcedo-Vargas & Guerrero-Kommritz, 2000; Escánez *et al.*, 2012, 2018; Guerra *et al.*, 2014). The female presents a mantle width (MW) of about 2 cm (42.5% ML) as well as the characteristic number of 4 series of suckers in arms I-II-III and a tentacular club with 8–12 series of suckers. Also, the characteristic tentacular club curvature present in the species was visible.

In the family Bathyteuthidae Pfeffer 1900, *Bathyteuthis abyssicola* Hoyle, 1885 was found in Moroccan waters. This specimen was in very bad condition, but the eyeballs, gladius and mandibles were recovered (Figure 2). The specimen was identified based on figures and descriptions of the gladius (Roper, 1969; Toll, 1998) and mandibles (Clarke, 1986; Lu & Ickeringill, 2002; Xavier & Cherel, 2009) by Guerra (personal communication). However, the morphometric relationships between the beak measurements did not match exactly those described by Clarke (1986). The wing length (a) was 25–26 mm, length of the rostral edge visible in profile (b) was 89–93 mm and edge-wing ratio (b/a) was 3.4, which is larger than 2–3 as reported by Clarke (1986). The hood length in the midline (g) was 68 mm, and the hood to edge ratio (g/a) was 2.7, which is larger than it should be (2–2.5) according to the available literature; the distance in profile from the rostral tip to the interaction of the rostral edge with the wing fold (h) was 40 mm, and the rostral base ratio (h/a) was 1.3, which is less than it should be (>2). It could be a range extension of morphological variability of the beak of this species or population differences.

Order Oegopsida

In the family Cranchiidae, five specimens of *Taonius pavo* (Lesueur, 1821) were found in Senegalese waters (Appendix 1). The specimens were identified as *T. pavo* based on the following features (Nesis, 1987; Guerra *et al.*, 2014): mantle very long, slender, narrow and cone-shaped; mantle fused with head in the nuchal region; small head and bulbous eyes; fins lanceolate, extending half the ML; arms with biserial, spherical suckers, and tentacles a little longer than arms; a tentacular club with four series of suckers (the specimen was an adult), and the manus sucker rings with two large, central, hook-like teeth. As indicated by Young (2014) a secondary ring tooth of manus suckers was absent in the specimens. According to Young (2014), our specimens had the large club suckers of the marginal series of manus not laterally compressed, with long, pointed teeth on distal and lateral margins of the sucker ring, and a distinct carpal cluster at the base of manus with not very obvious six smooth-ringed and matching knobs.

In the family Enoploteuthidae Pfeffer, 1900, a specimen of *Abralia* (*Pygmabralia*) *redfieldi* Voss, 1955 female (3.5 cm ML) was identified in Western Sahara waters from a depth of 74 m (Appendix 1). This species was identified based on the following diagnostic characters: pink buccal membrane characteristic of the genus *Abralia*; 5 rounded ventral optic light organs (the first, third and fifth larger than the second and fourth); and 3–4 hooks on the tentacular club. The specimens have diagnostic characters such as the absence of large black globular photophores on tips of ventral arms and ventral surface of the mantle and head covered with numerous scattered light organs but leaving a bare stripe along the ventral mantle midline (Nesis, 1987; Golub, 2001; Guerra *et al.*, 2014).

A total of 13 *A.* (*H.*) *siedleckyi* Lipinski, 1983 specimens were found onboard the *Maroc*–0611 survey (Appendix 1), with an ML range of 3.4–4.1 cm. The distance between the dactylus and manus is similar to each other in this species, and, according to Nesis (1987), the two rows of tiny suckers on the tips of arms I, II and III clearly distinguish it from its relative *A.* (*A.*) *veranyi* Rüppell, 1844, characters that we could clearly observe. Other important morphological features that our specimens had were the three hooks on the tentacular club and photophore pattern on the ventral region of the eyeball, and five complex photophores, consistent with the description by Sajikumar *et al.* (2018): two terminal oval, creamy white, opaque organs (posterior is extra-large) and three intermediate orange organs. The dorsal part of the eyelid bore 16 black photophores. To date, the maximum ML for this mesopelagic species was 3.8 cm (Hidaka & Kubodera, 2000); thus, the ML range has increased for the species.

Several specimens of *A.* (*A.*) *veranyi* were found in Moroccan and Western Sahara waters as well as the Guinea–Bissau, Senegal and Mauritania coasts, with an ML range of 2.5–5 cm. The distinctive features of this species were the ventral surface of mantle, head and arms covered with numerous scattered light organs; minute distal suckers in three or four series in the arms and five optic light organs with the terminal two oval and larger than the middle three rounded ones (Guerra *et al.*, 2014). This

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Fig. 3. *Magnoteuthis magna* (Joubin, 1913). Dorsal view. *Maroc*–0511 survey. Scale: each line, 1 cm. (© Amanda Luna).

species is distinctive because of other features found in the studied specimens, namely, conical mantle with sagittate posterior fins; arms I to III with biserial suckers proximally, some of them changed into hooks; left ventral arm hectocotylized, with a pair of fleshy distal flaps and tentacular club with three or four (three were found) hooks and a dorsal membrane (Guerra *et al.*, 2014).

In the family Histioteuthidae, a juvenile of *S. arcturi* Robson, 1948, specimen of 2.4 cm ML was obtained in North Moroccan waters at a depth of 995 m (Appendix 1). The specimen, which was in poor condition as it does not have tentacles or web, was identified by the papillated skin (Voss *et al.*, 1998); dorsal pad of funnel organ sculptured with a median ridge down each arm, and the distal portion of the median ridge on arms of dorsal pad funnel organ expanded into a distinct flap (Guerra *et al.*, 2014). According to Voss *et al.*'s (1998) and Guerra *et al.*'s (2014) descriptions, other characters present in the studied juvenile were the lack of distinct terminal light organs on arms and presence of 17 large light organs in a circle around the margin of the right eyelid.

In the family Lepidoteuthidae Pfeffer, 1912, a male of *L. grimaldii* (19 cm ML) was collected from South Moroccan waters (Appendix 1) at a depth of 843 m. According to Clarke & Maul (1962), the specimen was identified by the presence of dermal cushions covering the mantle together with the lack of the tentacles (typical in subadult/adult stage of this species) and the presence of a single hook near the base of each arm II (feature characteristic in males of this species).

In the family Mastigoteuthidae Verrill, 1881, two specimens of *M. magna* (Joubin, 1913) were found: one in South Moroccan waters (12.3 cm ML) and the other off Western Sahara waters (7.0 cm ML) (Appendix 1). The features (Figure 3) are consistent with the original description by Joubin (1920): club suckers minute with smooth inner rings; arm suckers increasing in size from base to sucker pair 12 or 13 and next 15 pairs of the same size; then, size diminishes to tip, but the largest suckers of arms IV larger than those of other arms. The funnel-locking apparatus as 'auricular-like groove' and mantle component a 'rectilinear ridge narrow anteriorly and slightly wider posteriorly' (Joubin, 1920) were observed.

In the family Octopoteuthidae Berry, 1912, six *O. megaptera* individuals were found: one in South Moroccan waters (19.0 cm ML), two off the Western Sahara coast (4.5 and 6.0 cm ML), one in water off Mauritania (9.0 cm ML), and two in Senegalese coast (8.0 and 12.0 cm ML) (Appendix 1). Three of the records exceed 1100 m depth (1367–1820 m). The most conspicuous diagnostic characters of this octopoteuthid that we could observe in our specimens were the ventral pair of light organs at the posterior end of the mantle, with transparent mantle tissue covering

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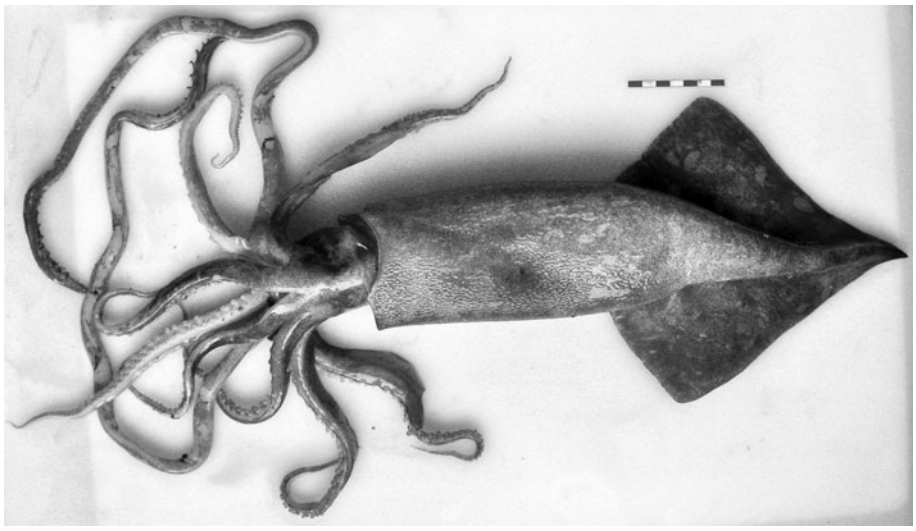

Fig. 4. *Onykia robsoni* (Adam, 1962). Dorsal view. *Bissau*–0810 survey. Scale: each line, 1 cm. © IEO.

them; fin length about 75% ML, with fin not reaching the posterior end of the mantle; and long, acuminated tail flattened from above, with narrow lateral fringes. Other observed characters were a pair of light organs inside the mantle cavity on both sides of the ink sac and arms short and thick, with several ends broken off and biserial hooks covered by a hood of soft tissue.

In the family Onychoteuthidae Gray, 1849, five specimens of *Ancistroteuthis lichtensteinii* (Férussac, 1835) were identified in Moroccan waters (8.0 and 9.2 cm ML), Western Sahara (17.0 and 18.8 cm ML) and Guinea–Bissau (female, 12.0 cm ML) coast (Appendix 1). According to known distribution (Bolstad, 2010) the Guinea–Bissau record expands its known distribution south. The specimens were identified by the sagittate fin width (55–65% ML) and the presence of 10 occipital folds on either side of the head. Other diagnostic features of *A. lichtensteinii* were: distal suckers on club restricted to a terminal pad, and no gladius or photophores visible beneath the skin in the dorsal mantle midline. The specimens also have a double medial series of hooks (20–22) on the manus, 16–18 small suckers on dactylus and a carpal-fixing apparatus on club elliptical with 9–12 suckers. The small posterior patch of tissue of the oval, opaque area on the ventral covering of the eye was present; it was thought to be photogenic tissue by Kubodera *et al.* (1998) and likely to be iridescent (but not photogenic) by Vecchione *et al.* (2010*b*). All the specimens reported in the present study were *A. lichtensteinii* (s. s.) (Type A by Kubodera *et al.* (1998), except the Guinea–Bissau specimen (11.5 cm ML) that seems to be Type B by Kubodera *et al.* (1998)) because of the rhomboidal fin, the number of nuchal folds (6), fin length (6.8 cm) and Fin Length Index (59.1% ML).

Another onychoteuthid species identified was *Onykia robsoni* (Adam, 1962). The specimen was a female with 39.0 cm ML (Figure 4). The record of the specimen expanded the known geographic distribution range to Guinea–Bissau waters (Appendix 1). The observed characters were consistent with the description provided by Bolstad (2010): rugose structure of mantle epidermis, with large, soft, round, well separated, blister-like warts, the epidermis of head and arm-bases smooth; photophores and secondary occipital folds absent; long sagittate fins, with length ~60% ML (51.3% ML in the studied specimen), width ~45.0% ML (46.2% ML) and attenuate posteriorly; funnel groove U-shaped, with Y-shaped ridge present; head noticeably narrower than mantle; 26–28 hooks present on adult tentacle club; lateral grooves on the manus hook claws and gladius not visible dorsally through the mantle.

Order Octopoda

In the order Octopoda, family Cirroteuthidae Keferstein, 1866, one specimen of *Cirrothauma murrayi* Chun, 1911 was found in South Moroccan waters (Appendix 1). The animal was caught at a depth of 1554 m; it was in very bad condition, which caused difficulties in the measurements. The specimen had a gelatinous body elongate in anterior-posterior axis; its eyes are reduced to simple open cups exposed to the exterior and embedded within gelatinous tissue and look like small dark balls, lacking lens or iris. These poorly developed eyes indicate that it may be nearly blind and unlikely to be able to form a focused image (Jereb *et al.*, 2013). It had a pair of large fins on the mantle, attached to the middle of the body, closer to the head than the posterior mantle end, exceeding the mantle width. The arms had a single row of small suckers; the first six were sessile, and the rest were long and spindle-shaped with gelatinous stalks (Jereb *et al.*, 2013). Only a few cirri were found in the present specimen. The web is deep, extending to the tips of the arms (Aldred *et al.*, 1983). The total length of the studied animal was 27 cm. Other diagnostic features of this abyssopelagic species that we could observe were a very conspicuous shell with moderate and large, flared wings, with saddle length less than half-shell length; wings triangular from the lateral view.

In the family Opisthoteuthidae Verrill, 1896, four specimens of *Opisthoteuthis grimaldii* (Joubin 1903) have been reported: two specimens (male and likely female) in Guinea–Bissau waters, a male in waters off Western Sahara and a male in the waters of South Morocco (Appendix 1). Two specimens of *Opisthoteuthis calypso* Villanueva, Collins, Sánchez & Voss 2002, one in waters off South Morocco and one off Western Sahara (Appendix 1), and one *Opisthoteuthis massyae* (Grimpe 1920) specimen (Figure 5) in Western Sahara waters (Appendix 1) were found. The latter three animals were tentatively identified by their mandibles and internal shells because the specimens were poorly preserved. The U-shaped shell and mandibles of the Western Sahara specimen were unequivocally identified as belonging to *O. massyae*, according to the description by Villanueva *et al.* (2002).

In Mauritanian waters, a female *O. calypso* was found. The specimen showed the diagnostic characteristics of the species according to Villanueva *et al.* (2002): arm sucker count in adults 47–58 (58 were counted); distal enlarged sucker field comprises 2-3 (3) contiguous suckers; the first cirrus usually occurs between suckers 1 and 2; maximum diameter of distal enlarged suckers does not exceed that of proximal enlarged suckers and the distal enlarged sucker field formula was IV.III.II.I.

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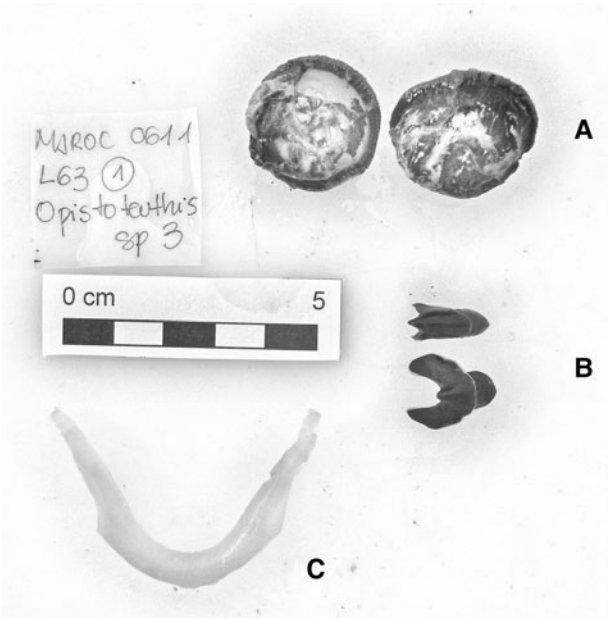

Fig. 5. *Opisthoteuthis massyae* (Grimpe, 1920) eyeballs (A), beaks (B) and shell (C). Maroc–0611 survey. Scale: each line, 1 cm. © Amanda Luna.

Also, in Mauritanian waters, an *O. massyae* specimen was found. The individual was identified according to its markedly increased thickness of arms I in mature male; distal enlarged sucker field composed typically of 9–11 contiguous suckers (the specimen had 9 of them); maximum diameter of proximal enlarged suckers exceeds that of distal enlarged suckers; distal sucker enlargement absent on arms I, slight on arms II, greatest on arms III and IV and first cirri typically occur between suckers 3–4 or 4–5 (Villanueva *et al.*, 2002).

The three specimens were identified as *O. grimaldii*, one collected in South Morocco and two in Guinea–Bissau waters (Appendix 1). The diagnostic features of *O. grimaldii* were the absence of increased robustness of arms I in males; the presence of nine suckers in the distal enlarged sucker field of arms and the distal enlarged sucker diameter was not larger than the proximal one. Others were the distal enlarged sucker field formula (IV≥III≥I≥II), position of the first cirrus between suckers 2 and 3, arm sucker count (about 70) and subterminal fins (Villanueva *et al.*, 2002).

Analyses of another four Mauritanian specimens were performed using photographic material. One of them corresponded to *O. massyae*, another to *O. calypso*, and the other two specimens were not conclusive. Albeit, one of the not conclusive specimens had a conspicuous character attributed to only *O. agassizii* to date: the presence of pigment-free spots on the skin (Villanueva *et al.*, 2002). None among the other Atlantic species have this characteristic. Therefore, *O. agassizii* was retained in the final checklist for the CCLME area.

In the suborder Incirrata Grimpe, 1916, two specimens of *Haliphron atlanticus* Steenstrup, 1861, superfamily Argonautoidea Cantraine, 1841, were found. The first in Western Sahara and the second in Guinea–Bissau waters (Appendix 1). Identification of both animals was difficult because of damage, but the on-board identification and photographs taken during the surveys helped us. The transparent, gelatinous and nearly colourless appearance of the specimens (Figure 6) disappeared; the preserved specimens do not show these specific characters. The Guinea–Bissau specimen was female (about 9.0 cm ML) identified by the very wide mantle aperture and the eyes shape (Vecchione, personal communication). The Saharan specimen (about 7.0 cm ML) lacks the brachial crown, eyes and funnel structures, but it was identified by its gelatinous texture and comparison of the sucker structure and presence of a unique sucker row at the base of each arm with the Guinea–Bissau specimen. This species is characterized by the gelatinous and sac-shaped body; the suckers mostly in two series but grade to single series near the mouth, and the lack of enlarged arm suckers.

In the family Bathypolypodidae Robson, 1932, eight specimens of *Bathypolypus ergasticus* (Fischer & Fischer, 1892) were identified and measured: four in Moroccan waters (three males with 1.8, 5.5 and 9.0 cm ML and an undetermined specimen with 2.8 cm ML), another three specimens (two males and a female with 7.2, 4.5 and 8.1 cm ML) from waters of Guinea–Bissau and a male (9.2 cm ML) found among the specimens sampled from Mauritanian waters (Appendix 1). All the males were identified by the hectocotylus, which is very conspicuous in this species. The hectocotylus of *B. ergasticus* corresponds to the third right arm, which is shorter than the third left one and with 70–85 pairs of suckers. The ligula and calamus are open and pointed, although the latter may appear rounded, inconspicuous and lack suckers on the tip in juvenile specimens. The developed ligula (7% of hectocotylized arm length) has seven strong ridges, with a central rib and slightly developed scalloped walls. The spermatophore groove is strongly developed in the largest specimens. The medium-sized specimens have pointy and open-pointed calamus and ligula, with underdeveloped walls and spermatophoric groove. The undetermined specimen was identified based on eight lamellae in the outer demibranches of the gills and a UU-funnel organ composed of almost square-shaped pads (Muus, 2002). The males had some autotomized arms, with subsequent regeneration evidence. Some diagnostic features found in the specimens were as follows: ink sac absent; not a very firm muscular body completely covered with small chromatophores, which gives it a purplish colour after fixation; mantle sac-like, as long as wide, smooth, with a wide palial aperture reaching to the back of the eyes, which are not very prominent and have a dark halo around them but no ocular papillae or warts; head narrower than the mantle, with a deep nuchal constriction; elongate triangular funnel, only separated from the body in its most distal region; elongated and thin subequal arms (77–87% ML), and round, small and quite separated biserial suckers (about 200 suckers per arm, in a zig-zag pattern, except the first pair placed in line; diameter, about 6% ML). Not greatly enlarged suckers. Well-developed web in the proximal half of the arms (about 25% of the longest arm length), that cause the arms to curve, was observed.

Several specimens of *Bathypolypus valdiviae* (Chun & Thiele, 1915) were identified (Figure 7): two females of *B. valdiviae* (3.5 and 3.4 cm ML) off Guinea–Bissau and a male (2.4 cm ML) in Mauritanian waters (Appendix 1). Some characteristic features of this short-armed big-eyed, warty species were observed such as a very wide mantle and presence of supraocular cirri. The specimens have subequal arms, which are rather thick basally and gradually narrow to fine extremities; a narrow pallial aperture and the funnel organ as a pair of widely separated V-shaped pads (Robson, 1932). The warts of the 3.5 cm ML specimen were few and visible on the head, body and arms.

A specimen of the less common species *Bathypolypus bairdii* (Verrill, 1873), 2.2 cm ML, was identified from Mauritanian waters by the erectile pointed cirrus with adjacent smaller protuberances over each eye; papillated dorsal surface, especially in the anterodorsal region and square body, with a broad head and huge and prominent eyeballs (Muus, 2002).

In the family Octopodidae, a specimen *Octopus salutii* Vérany, 1836 male with 6.0 cm ML was caught in Moroccan waters (Appendix 1). The diagnostic features of the species that we could observe were as follows: firm and muscular body, with a

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Fig. 6. *Haliphron atlanticus* Steenstrup, 1861. Dorsal view. *Bissau*–0810 survey. Scale: each line, 1 cm. © IEO.

Fig. 7. *Bathypolypus valdiviae* (Thiele in Chun, 1915). Dorsal view. *Bissau*–0810 survey. Scale: each line, 1 cm. © IEO.

mantle short, broadly oval, and widest posteriorly; dorsal mantle covered with tiny irregular papillae; wide mantle aperture; head slightly narrower than mantle; a large papilla over each eye; arms long, subequal, tapering to narrow rounded tips; arms I shortest. Additionally, the specimen had a characteristic hectocotylus shape: right arm III of male hectocotylized shorter than the opposite arm, bearing 135–150 suckers; ligula long and slender, with deep groove and numerous fine transverse lamellae, margin slightly swelled; and calamus short (Mangold, 1998).

In the family Enteroctopodidae, four species were found: *Muusoctopus januarii* (Hoyle, 1885), *Muusoctopus johnsonianus* (Allcock, Strugnell, Ruggiero & Collins 2006), *Muusoctopus levis* (Hoyle, 1885) and *Muusoctopus fuscus* (Taki, 1964).

A total of 15 specimens of *M. januarii* were found in the CCLME region (Appendix 1). A male was sampled from waters off South Morocco (8.5 cm ML); five other males (4.9, 4.2, 3.5, 2.2 and 2.1 cm ML) and a female (2.5 cm ML) were obtained from Western Sahara and two small males (1.5 and 2.0 cm) and six females (11, 3.5, 2.0, 2.0, 1.5 and 1.7 cm ML) from waters off Guinea–Bissau. These specimens were identified by the hectocotylus in the case of the males, which was consistent with the descriptions of Jereb *et al.* (2013) and Guerra *et al.* (2014): third right arm hectocotylized almost twice shorter than the opposite, bearing ~80 suckers; ligula length from about 6–9% of the hectocotylized arm length, pointed and with a deep central groove, ~20 weakly developed transverse ridges within ligula groove; calamus small (from 15–25% of the hectocotylized arm), but well-defined, sharply pointed. Other diagnostic features observed in the specimens were as follows: large eyes; saccular and elongate mantle, smooth and devoid of sculpture, with a wide

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Fig. 8. *Muusoctopus levis* (Hoyle, 1885). Dorsal view. *Bissau*–0810 survey. Scale: each line, 1 cm. © IEO.

aperture; lack of ink sac; funnel robust, tapered, free for half its length; VV-shaped funnel organ, arms long and slender, cylindrical in cross-section, 3–4 times ML and attenuated towards the tips, becoming filiform; arms 1 and 2 markedly longer than 3 and 4 (1 = 2 > 3 = 4). Small and biserial suckers, with small infundibulum, in two moderately spaced rows directly from the mouth, with enlarged suckers absent, and longest unmodified arms with sucker count of ∼180; gill with 7–8 lamellae per demibranch. After preservation, the dorsal surface of the specimens was pinkish grey to grey, with the ventral surface slightly paler (Guerra *et al.*, 2014).

A juvenile female (4.0 cm ML) of *M. johnsonianus* was caught in Senegalese waters (Appendix 1). The diagnostic characteristics found in the specimen were consistent with the descriptions of Allcock *et al.* (2006) and Strugnell *et al.* (2009): integument smooth; body and arms muscular, very soft; ink sac absent; a mantle slightly ovoid, with head slightly narrower than mantle; funnel short to moderate length, gently tapered; funnel organ W-shaped; arms long (∼3.5 times ML) and subequal (2.1.3.4), with small biserial suckers closely set; anal flaps absent, and gills with 8–11 lamellae per demibranch (the specimen had 8). The preserved specimens have pale colouration and smooth skin (Allcock *et al.*, 2006). This was not observed due to preservation methods.

Two juvenile male specimens of *M. levis* (Figure 8) were sampled from Guinea–Bissau waters (Appendix 1). The specimens showed the characteristics of the species described in Robson (1932): smooth skin, firm and muscular body; head narrower than the saccular or ovoid body; prominent eyes; half-open mantle aperture; ink sac absent; arms short, small suckers (6–8% ML) without a discontinuous increase in size; web 43–33% of the longest arms; small funnel with a short free portion and VV-shaped funnel organ; eight filaments in each demibranch. The primordium of the hectocotylus was observed and fulfilled some particular features of the mature one: the hectocotylized arm is 71% of the longest arm; ligula length about 7% of the arm length; copulatory groove small but distinct, the laminae clearly marked and close-set; the calamus is very long, and its apex is more than half-way from the last sucker to the tip of the ligula, a very unusual feature.

In this study, two *M. fuscus* individuals were caught in Senegalese coast: a female and a male (both with 4 cm ML and about 19 cm TL). The diagnostic features observed in these specimens were coincident with Taki's (1964) description: a muscular body, with fairly well-developed musculature, and soft consistency; surface smooth throughout without any sculpture of integument; ink sac absent; mantle broadly ovoid, its width about 83% ML, widest at halfway of its length; mantle aperture very wide; head broad (61% ML), faintly constricted in front and behind; ocular cirri absent; eye orifice extremely large; slender and long arms, nearly circular in section; the longest arm was 82% of TL, and the arm formula is 2.1.3.4; arm suckers rather small with enlarged suckers absent; the diameter of the largest sucker is 6.1% ML. The male was identified by the hectocotylus: third right arm hectocotylized, 61% of longest arm length and 70% of the opposite mate, 40 pairs of suckers (37 were observed) in the ordinary part; conical ligula that represents 5% of hectocotylized arm length; copulatory groove rather shallow and narrow, pigmented; copulative lamina absent, with a faint roughness on both ridges of the copulatory groove; calamus pointed; very prominent flat seminal channel lacking chromatophores; gill with 7–11 leaflets in each demibranch; this species is characterized by its deep purplish colour, and dorsal and ventral surfaces are homochromatic, although the ventral side is partly lighter in colour.

Discussion

The cephalopods in the CCLME region

This paper completes an exhaustive review of cephalopod fauna present in the CCLME region. Currently, despite numerous surveys and previous studies (Hempel, 1982; Den Hartog, 1984; Van der Land, 1987; Westphal *et al.*, 2007, 2012), there is limited information on the deep-sea fauna and composition and structure of benthic communities of North-west Africa. Therefore, this is one of the least known regions of the world for deep fauna and benthic communities (Decker *et al.*, 2004).

Apart from some papers that refer to the biology of *O. vulgaris* (Caverivière *et al.*, 1999; Diallo *et al.*, 2002), the biodiversity of Senegalese waters has not yet been studied. Here, 13 new species belonging to 10 families were identified. Adding to *O. vulgaris*, 14 cephalopod species from 10 families are the total number of cephalopods known in the waters off Senegal.

Species of special concern

Order Sepiida

No significant changes were found for the Sepiida species reported from the CCLME area, except for three species whose presence was previously doubted there: *Sepia angulata* Roeleveld, 1972; *Sepia pharaonis* Ehrenberg, 1831 and *S. hieronis*.

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The distribution of *S. angulata* was noted as uncertain in the area because of the lack of information, and its presence is known only from cuttlebones in South Africa (Jereb & Roper, 2005; Rocha *et al.*, 2017). Recently, Guerra *et al.* (2014) indicated that this species is not present in the Eastern Central Atlantic. Therefore, *S. angulata* was removed from the final checklist for the area.

The species *S. pharaonis* was recorded in Guinea–Bissau waters by Fernández-Caballero (2014). However, the presence of this well-known species, which inhabits the Indian Ocean and western Pacific (Jereb & Roper, 2005) in the CCLME area is extremely doubtful. Moreover, Fernández-Caballero (2014) did not study sampled specimens but obtained the name from the records of Chinese fishing companies. Therefore, we concluded that the record of *S. pharaonis* in the Atlantic waters of Guinea–Bissau is attributable to a spurious identification and did not include this species in the checklist.

Sepia hieronis was recorded in CCLME waters in the report of Guinea–Morocco *CCLME*–1205 survey (Krakstad *et al.*, 2012). Currently, this species is distributed from Namibia to Kenya (Guerra *et al.*, 2014). Therefore, the record of Krakstad *et al.* (2012), made on board, is very unlikely. Unfortunately, we cannot study these specimens because most of them were not sampled for laboratory analysis. The few *S. hieronis* specimens sampled during the survey were lost during the transfer. It is necessary to find more material to confirm the expansion of its distribution. Therefore, *S. hieronis* was removed from the final checklist for the CCLME.

Order Sepiolida

In the family Sepiolidae, the presence of a species belonging to Rossiinae, *A. mastigophora*, in CCLME waters remained uncertain until now (Jereb & Roper, 2005; Rocha *et al.*, 2017). Thus, two specimens of this species were identified for the first time in Western Sahara waters. The biology of this species is poorly known because of the few available records and the current low interest in fisheries (Guerra *et al.*, 2014). Its distribution in Eastern Africa was from Guinea to the Cape of Good Hope, up to a depth of ~640 m. Thus, the northern distribution range of *A. mastigophora* has been expanded off Western Sahara.

In the subfamily Sepiolinae, *S. atlantica* is distributed in the North-east Atlantic Ocean, from Iceland and Norway to North-west Africa (Morocco), and its southern limit was unknown (Guerra *et al.*, 2014). The specimens of this species collected in Western Saharan waters expanded its southern distribution limits off Western Sahara.

A species of the subfamily Heteroteuthinae Appellöf, 1898, *Heteroteuthis dagamensis* Robson, 1924, was recorded off the western coast of Africa by Jereb & Roper (2005), so this species was included in the list of cephalopods for Mauritanian waters by Rocha *et al.* (2017). This species (as *Heteroteuthis hawaiiensis* var. *dagamensis* Robson, 1924) was found in the Indian Ocean off South Africa (Robson, 1924), but no specimens have been obtained from the CCLME waters to date. More recently, Rotermund & Guerrero-Kommritz (2010) clarified the taxonomy and biogeography of the genus *Heteroteuthis* Gray, 1849 in the Atlantic. They showed that *H. dagamensis* was distributed in only South Atlantic waters, and not in the CCLME region where only *Heteroteuthis dispar* (Rüppell, 1844) is present. Recently, *H. dagamensis* was found in the Gulf of Mexico and South Atlantic by Judkins *et al.* (2016). After, Braid & Bolstad (2019) found it in New Zealand, and Taite *et al.* (2020) in North Atlantic waters. Thus, although the presence of *H. dagamensis* in the area cannot be ruled out with the present data, new molecular or morphological data from the CCLME area are necessary to assess this question. Cautiously, the species was removed from the final checklist.

Superfamily Bathyteuthoidea

Chtenopteryx sicula has been reported in Western Sahara waters. This species was previously reported by Guerra *et al.* (2014) in the CCLME area in waters off Morocco, Mauritania, Canary Islands, Guinea, Cape Verde and Azores. The overlap of the Canaries comb-finned squid *Chtenopteryx canariensis* Salcedo-Vargas & Guerrero-Kommritz, 2000, with the Sicilian comb-finned squid *C. sicula* in the studied area is clear. *Chtenopteryx canariensis* has a tropical Eastern Central Atlantic distribution from the Canary Islands to the equator, and is found at a depth of 1000 m (Salcedo-Vargas & Guerrero-Kommritz, 2000; Guerra *et al.*, 2014); *C. sicula* is a tropical-subtropical species that inhabits Eastern Atlantic waters from the Bay of Biscay to South Africa (36°S), in addition to the Mediterranean Sea, to a depth of 3000 m (Guerra *et al.*, 2014). However, it had an indisputable diagnostic character, the large photophores on the ventral surface of eyeballs, present in *C. sicula* but absent in *C. canariensis* specimens (Salcedo-Vargas & Guerrero-Kommritz, 2000; Escánez *et al.*, 2012, 2018; Guerra *et al.*, 2014). However, the presence of undescribed species in this genus is known (Young & Vecchione 2010) and supported by Braid & Bolstad (2019), which indicates that both families within Bathyteuthoidea are in need of revision, using integrative taxonomy.

Bathyteuthis abyssicola was found in Moroccan waters. Within this family, until now three species were recognized: *B. abyssicola*, a cosmopolitan species; *Bathyteuthis bacidifera* Roper, 1968, known from the Eastern equatorial Pacific, and *Bathyteuthis berryi* Roper, 1968, from the Eastern North Pacific (Roper, 1968, 1969; Jereb & Roper, 2010). Albeit, the taxonomy of the family is still unclear. Vecchione *et al.* (2010*a*) studied *Bathyteuthis* sp. A (cf. *B. berryi* Roper, 1968), which is morphologically similar to *B. berryi*, and they pointed out that it is probably a new species inhabiting the North Atlantic. Bush *et al.* (2012) found a brooding female *B. berryi* and a male *B. bacidifera* in the Monterey Submarine Canyon in California. Using morphological analysis and DNA sequencing (COI, 16S), Judkins *et al.* (2019) have described and named three new species from the North Atlantic Ocean: *Bathyteuthis inopinata* Judkins, Lindgren, Villanueva, Clark & Vecchione 2019, which corresponds to *Bathyteuthis* sp. A of Vecchione *et al.* (2010*a*) and Shea *et al.* (2017), and probably *B. abyssicola* of Vecchione & Pohle (2002); *Bathyteuthis devoleii* Judkins, Lindgren, Villanueva, Clark & Vecchione 2019 and *Bathyteuthis numerosa* Judkins, Lindgren, Villanueva, Clark & Vecchione 2019. Judkins *et al.* (2019) did not describe the gladius and mandibles of the new species; consequently, we could not confirm that our specimen corresponds to any of them. Anyway, *B. abyssicola* was reported in Mauritanian waters by Rocha *et al.* (2017) because of its circumglobal distribution (Jereb & Roper, 2010). However, the most recent review of Atlantic cephalopods (Guerra *et al.*, 2014) showed that this cosmopolitan species is more frequently found in the Southern Ocean and productive waters of the Eastern Pacific, Atlantic and Indian Oceans. The fact that this species has also been reported in the Mediterranean Sea (Guerra *et al.*, 2014) could indicate the presence of *B. abyssicola* farther to the north, in CCLME waters. The identification of this species in Moroccan waters could confirm this fact.

Order Oegopsida

The peacock cranchiid squid, *T. pavo* is widely distributed in the Central North Atlantic Ocean from 59.98°N to the Southern Subtropical Convergence, and its distribution may be extended to the western Indian Ocean in the area of the Agulhas Current (Voss *et al.*, 1992; Guerra *et al.*, 2014; Young, 2014). It was found in Mauritanian waters by Rocha *et al.* (2017), and, in this study, new specimens were found off Senegal.

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Cycloteuthis akimushkini Filippova, 1968 was reported in Mauritanian waters by Rocha *et al.* (2017). This species has been considered as a synonym of *Cycloteuthis sirventi* Joubin, 1919 (Guerra *et al.*, 2014; ToL, 2019). The description of *C. akimushkini* was based on a very large specimen, and apparent differences between this species and *C. sirventi* may be due to size effects alone (ToL, 2019). Therefore, the species found by Rocha *et al.* (2017) should be *C. sirventi*. The presence of *Discoteuthis laciniosa* Young & Roper, 1969, from the same family was considered as uncertain in Mauritanian waters by Rocha *et al.* (2017). Nevertheless, this species was reported in the Eastern Atlantic off West Africa, Madeira and Cabo Verde Islands to Mauritania by Guerra *et al.* (2014).

An *A.* (*P.*) *redfieldi* was first identified in Western Sahara waters. This species has been previously reported in Guinea–Bissau and South African waters in the Eastern Atlantic and off Senegal (Lu & Clarke, 1975), and it inhabits waters of 50 to ~720 m in depth (Guerra *et al.*, 2014). The northern limit of *A.* (*P.*) *redfieldi* is in Nova Scotia (Vecchione & Pohle, 2002).

The *A.* (*H.*) *siedleckyi* specimens identified in Moroccan waters represent a relevant contribution to its distribution range. The species was distributed in the South-east Atlantic, from the Schmitt–Ott Seamount to south-west from the Cape of Good Hope. Its known distribution did not exceed 34°S. Our knowledge of the known geographic distribution ranges of *A.* (*H.*) *siedleckyi* (Lipinski, 1983; Sajikumar *et al.*, 2018) have been expanded to western to 16°N, placing this species off Western Sahara, inside CCLME waters.

The presence of *A.* (*A.*) *veranyi* in Moroccan and Western Sahara waters, as well as Guinea–Bissau, Senegal and Mauritania coasts, is consistent with previous publications. The species has been reported in Guinean, Guinea–Bissau, Gambian, Senegalese, Mauritanian, Madeira and Mediterranean waters but not in Moroccan waters (Guerra *et al.*, 2014; Rocha *et al.*, 2017).

Stigmatoteuthis arcturi has been previously reported in the North Atlantic Ocean, from Gibraltar to 45°S, and in the western Atlantic, from Nova Scotia to the Gulf of Mexico and Brazil (Guerra *et al.*, 2014). A specimen of *Histioteuthis dofleini* (Pfeffer, 1912) (synonymized name of *Stigmatoteuthis dofleini* Pfeffer, 1912) was mentioned by Gomes-Pereira *et al.* (2016), nowadays considered *S. arcturi*, off Azores Islands. The data presented here complete the southern distribution of this species that has a poorly understood biology and is not of interest for fisheries (Guerra *et al.*, 2014).

Jereb & Roper (2010) indicated that the *L. grimaldii* occurrence in Moroccan waters is probable, and Rocha *et al.* (2017) reported its presence in the Mauritanian coast. Finally, the known distribution of *L. grimaldii* is the North-east Atlantic, from Ireland to Spain, and the Azores, Madeira and Canary Islands and eastern South Atlantic (Guerra *et al.*, 2014; Escánez *et al.*, 2017). Therefore, its presence in Moroccan waters was confirmed. The biology of this rarely captured squid is not well-known. Until recently, very few specimens have been studied: adults were found from the stomachs of predators (Guerra *et al.*, 2014; Escánez *et al.*, 2017); a juvenile with abortive tentacles and a few abortive suckers lacking horny rings was described by Clarke (1964), and paralarvae (at least 1 cm ML) have been found (Young & Vecchione, 2016). The quasi-unequivocal diagnostic character of this species is dermal cushions covering the mantle. This character is shared with *Pholidoteuthis adami* Voss, 1956 (Vecchione & Richard, 2012). Both species have dermal cushions with similar histological structure; however, the lack of tentacles and the unique hook on arm II confirm the identification.

Magnoteuthis magna occurs throughout the tropical and warm temperate Atlantic, at least from 50°N, 27°W to 40°S, 26°W (Vecchione & Young, 2017). Guerra *et al.* (2014) reported the species in Madeira and Azores Islands; Rocha *et al.* (2017), in Mauritanian waters and Shea *et al.* (2017), in New England waters. It has also been reported from the Indian Ocean by Nesis (1987), but it could be a different species of *Magnoteuthis* (Vecchione & Young, 2017). In fact, another species, *Mastigoteuthis inermis*, described by Rancurel (1972) in the Ivory Coast waters, is currently considered as a synonym of *M. magna* (Guerra *et al.*, 2014). The geographic distribution of this species is better known after the captures in this study. In the case of both studied specimens, their characters are consistent with the original description by Joubin (1920).

The existence of *Mastigoteuthis flammea* Chun, 1908 and *Mastigoteuthis grimaldii* (Joubin, 1895) in the Atlantic was reported by Nesis (1987), but Vecchione & Young (2014) placed them in synonymy with the valid species *Mastigoteuthis agassizii* Verrill, 1881. This species may have two forms: a north temperate/boreal, wrongly assigned to *M. grimaldii* and *Mastigoteuthis schmidti* Degner, 1925, and tropical (wrongly assigned to *M. flammea*), and they could not be separated with any certainty (Vecchione & Young, 2014). *Mastigoteuthis flammea* specimens were found in Mauritanian waters by Rocha *et al.* (2017); they should probably be reassigned as *M. agassizii*.

Several *O. megaptera* were found in South Moroccan waters, Western Sahara coast, Mauritania and Senegalese waters. This species has been recorded in Mauritania (Rocha *et al.*, 2017), Gulf of Guinea, Namibia and Central Atlantic waters (Guerra *et al.*, 2014). As has been indicated, three specimens were caught with trawls at 1367 to 1820 m, which exceed the 1100 m depth that is the maximum depth known for the species (Guerra *et al.*, 2014). Thus, knowledge of the northward expansion of the species' documented geographic range and vertical distribution are reported.

In the family Onychoteuthidae, some remarkable species exist. *Ancistroteuthis lichtensteinii* is a species whose distribution appears very disjunctive because only a few specimens have been reported outside the Mediterranean in the scientific literature (Guerra *et al.*, 2014). Many onychoteuthid species distributions remain poorly understood, and actual absence from a region cannot be concluded from the absence of local records (Bolstad *et al.*, 2018). For example, Bolstad (2010) studied Onychoteuthidae from the Central and Southern Atlantic and did not include this species. It is known from the northern Mid-Atlantic Ridge (Vecchione *et al.*, 2010*a*). And, in the Eastern Atlantic, *A. lichtensteinii* has been reported from North-west Spanish waters, Sahara Bank, Mauritania and Angola (Guerra *et al.*, 2014; Rocha *et al.*, 2017). This species presumably could be found in the entire CCLME area. In the present study, specimens of this species were found in Moroccan, Western Sahara and Guinea–Bissau coast. According to Bolstad (2010), this species is distributed in North Atlantic waters, primarily 20–60°N, including the Mediterranean Sea, between the surface and 800 m. Therefore, the specimens are within the geographic range, except the Guinea–Bissau record that expands its distribution southwards. This genus has been considered monotypic since its description; however, the presence of a second species in Central Atlantic waters (*A. lichtensteinii* Type B) has been suggested by different authors (Kubodera *et al.*, 1998; Vecchione *et al.*, 2010*b*). About the *O. robsoni* specimen found, the known distribution of this species is subtropical to sub-Antarctic waters in the southern hemisphere (generally between 20° and 50°S), and in the Gulf of Mexico. The type locality is somewhere off Angola waters (Bolstad, 2010). In the present study, the record of the specimen expanded the known geographic distribution range to Guinea–Bissau waters (Kubodera *et al.*, 1998; Bolstad, 2010). The observed characters of the present specimen were

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consistent with the description provided by Bolstad (2010) who remarked that *O. robsoni* juvenile specimens have not yet been described to date.

Finally, the presence of some oegopsid species is doubtful in the area. In the family Cranchiidae, *Helicocranchia joubini* (Voss, 1962) was reported to be probably present in Mauritanian waters (Rocha *et al*., 2017) based on bibliographic data. However, the species was not recorded in the area by the most recent review of Atlantic cephalopods (Guerra *et al*., 2014). This poorly known species is probably a synonym of *Helicocranchia pfefferi* Massy, 1907 (Jereb & Roper, 2010) also present in the CCLME zone (Rocha *et al*., 2017). For these reasons, *H. joubini* was considered a synonym of *H. pfefferi* and removed from the checklist.

Order Octopoda

In the order Octopoda, some families from the suborder Cirrata Grimpe, 1916 were remarkable. In the family Cirroteuthidae, the only species reported to date in the CCLME area is *Cirrothauma magna* (Hoyle 1885) (Guerra *et al*., 2014). However, Guerra *et al.* (2014) stated that *C. murrayi* might occur in the area because of its wide distribution range, although the assumed worldwide distribution of this species requires further review. Previously, Aldred *et al.* (1983) recorded two specimens in Moroccan waters, which represents a unique record of this species in the area. Here, one *C. murrayi* specimen was found in South Moroccan waters although it was in a very bad condition, which caused difficulties in measurement procedures. Anyway, this record is a new contribution to information on this poorly known species and support its presence in CCLME waters.

Collins & Villanueva (2006) studied the family Opisthoteuthidae and reported three species in Eastern Atlantic waters: *O. calypso*, *O. grimaldii* and *O. massyae*. These species were also recorded in the North-west Atlantic (Villanueva *et al*., 2002; Collins & Villanueva, 2006) and Mauritanian waters (Rocha *et al*., 2017). In the present study, several specimens of *O. grimaldii*, *O. calypso* and *O. massyae* have been reported in the CCLME zone.

Based on the studies by Villanueva *et al.* (2002) and Collins & Villanueva (2006), the presence of *O. agassizii* in Mauritanian waters reported by Rocha *et al.* (2017) could be erroneous. Several authors have identified specimens from the North Atlantic as *O. agassizii*, but further studies assigned these records to *O. calypso* (Villanueva *et al*., 2002; Guerra *et al*., 2014). As reported in the Results section, of the four examined *Opisthoteuthis* specimens, one was assigned to *O. massyae*, another *O. calypso*, whereas the analysis of the other two was not conclusive. Therefore, *O. agassizii* was retained in the final checklist for the CCLME area.

The geographic distribution of *O. grimaldii* (Joubin 1903) extends from the North-east Atlantic (west coast of the British Isles) to the South-east Atlantic (Namibia), passing through the Azores and off Cape Blanc (Guerra *et al*., 2014). New specimens were identified as *O. grimaldii* in water off South Morocco and Guinea–Bissau.

The presence of several deep-water *Bathypolyphus* species (family Bathypolypodidae) in CCLME waters should be noted. Data given in this paper expanded the geographic distribution of *B. ergasticus* and *B. valdiviae*. The former species was reported from the North-east Atlantic to waters off Senegal (Guerra *et al*., 2014). In the present study, its distribution expanded to Guinea–Bissau waters. *Bathypolypus valdiviae* (Figure 7) has been reported from the Agulhas Bank and adjacent areas in South Africa and off the Namibian coast (Guerra *et al*., 2014). Until recently, this species was known only in the southern hemisphere (Muus, 2002; Rocha *et al*., 2017). Specimens of this species have been found in Mauritanian waters (Rocha *et al*., 2017), and, in the present study, new specimens of *B. valdiviae* were identified in Guinea–Bissau waters. As a result, the geographic distribution of the species is expanded to waters off Guinea–Bissau.

A specimen of the rare *B. bairdii* was identified in Mauritanian waters. It has been reported from north of the North Sea to southern parts of the Barents Sea, in the southern slopes of the Iceland–Greenland Ridge, from Labrador to Miami in West Atlantic waters (Muus, 2002) and North-west Iberian waters in the East Atlantic (Pérez-Gándaras & Guerra, 1978); it has been previously recorded in Mauritanian waters by Rocha *et al.* (2017). Because of the records of this species in Mauritanian waters (this study; Rocha *et al*., 2017), the replacement of *B. bairdii* with *Bathypolypus sponsalis* (P. Fischer & H. Fischer, 1892) in the East Atlantic proposed by Roura *et al.* (2010) is disproved. In consequence, we proposed that both species cohabit in this area.

Octopus salutii had been reported previously from Mediterranean and North-east Atlantic waters to the south of the Portuguese coast (Mangold, 1998; Jereb *et al*., 2013). The report of this species in Moroccan waters indicates that its geographic range should be expanded.

In the family Enteroctopodidae, great attention was paid to the poorly known species of *M. januarii*, *M. johnsonianus*, *M. levis* and *M. fuscus*. *Muusoctopus januarii* has been previously reported from waters off Mauritania (Rocha *et al*., 2017), and it is possibly present in Namibian waters (Guerra *et al*., 2014). The specimens found in waters off South Morocco and Guinea–Bissau exceeded the maximum known ML of 6.9 cm reported by Gleadall (2013). Also, the geographic distribution of *M. januarii* has been expanded to the north of the eastern coast of Africa, from Guinea–Bissau and passing through Western Sahara to Moroccan waters.

Muusoctopus johnsonianus has been recorded in the Atlantic coast of Europe between 49–59°N (Porcupine Seabight, Ireland, to Rockall Trough, UK) at a depth of 1800–2540 m (Allcock *et al*., 2006). Now, the individuals caught in Senegalese waters extended its geographic range to West African waters.

Muusoctopus levis has been reported only from Australian waters (Heard Island; Robson, 1932). The presence of *M. levis* in Atlantic waters expands the distribution range of this species, and it is the first time that *M. levis* has been reported from Atlantic waters and observed in the northern hemisphere. This is a poorly known species and its presence in Atlantic waters represents an extraordinary extension of its geographic distribution. Thus, the presence of specimens of *M. levis* should be sought between the two known locations to complete and understand its distribution. Deeper taxonomic studies are needed, both morphological and genetic, to clarify and check the correct identification of this species and determine its true range.

Muusoctopus fuscus has been recorded only in Kashima Nada (Japan; Taki, 1964) and, recently, in Mauritanian waters (Rocha *et al*., 2017). In this study, new *M. fuscus* individuals were caught in Senegalese waters. Although the characteristics of our specimens fit the previous descriptions of *M. fuscus*, it would be advisable to conduct molecular studies of these specimens and get additional samples to confirm their presence in the area. The two populations could co-exist through the Indian Ocean and the East African coast, which implies that the deep-sea octopod collections in these areas should be reviewed to check if more specimens of this species are present. The substantial geographic distance between these two regions warrants further investigation.

In the suborder Incirrata, a member of the superfamily Argonautoidea, *H. atlanticus*, was found. This is a very widely distributed cosmopolitan species that inhabits from tropical to high latitudes (Guerra *et al*., 2014). The species was also found in water off Mauritania by Rocha *et al.* (2017). However, the identity of these individuals must be considered carefully because the molecular evidence of Lima *et al.* (2017) suggests that the name

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H. atlanticus might encompass two species, both of them cohabiting Atlantic waters. Thus, further morphological and molecular systematics studies using more specimens of this species are needed to confirm this hypothesis.

The presence of *Tremoctopus gelatus* Thomas, 1977, has been mentioned as uncertain in Mauritanian waters by Rocha *et al.* (2017) because no specimens of this species were found by these authors. Moreover, Guerra *et al.* (2014) do not mention the presence of this species in the CCLME area. Therefore, we considered that *T. gelatus* is not present in the area and removed it from the final checklist for cephalopod species in the CCLME.

Final considerations

If we consider the 63 cephalopod species studied in this article together with the updated checklist of 137 cephalopod species for the zone, we can conclude that the CCLME area has been revealed to have a wide and diverse cephalopod fauna. The global patterns of species richness (Rosa *et al.*, 2019) indicate that the number of coastal cephalopods in the Atlantic is 95 species, which is the third most diverse ocean after the Pacific (213 cephalopod species) and Indian (146 species) Oceans. Clarke (2006) reported 82 oceanic mid-water cephalopod species and 16 shelf and slope species in the eastern North Atlantic between 10° and 70°N. Vecchione *et al.* (2010*a*) reported 56 cephalopod species (mostly oceanic species) in the northern Mid-Atlantic Ridge. Shea *et al.* (2017) reported 75 mid-water cephalopod species and 28 benthic species in the Bear Seamount (New England). Thus, the importance of these findings allowed us to provide new information on the diversity of cephalopod species in this scarcely studied zone. New technologies, including video exploration of mid-water and deep seas, could shed more light on global cephalopod biodiversity.

This article completes the taxonomic studies about the cephalopod fauna on the Atlantic coast of Africa. This is one of the projects performed in the area to evaluate the resources and reference the state of this ecosystem at the regional level (Ramos *et al.*, 2005; Hernández-González *et al.*, 2006, 2008; Hernández-González, 2007; García-Isarch *et al.*, 2009; Ramos *et al.*, 2010; Krakstad *et al.*, 2011, 2012).

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Appendix 1. Data of species of special concern studied by survey and station.

Species	Survey	Country	Station	Date	Longitude	Latitude	Main depth (m)	N
Abralia redfieldi	*CCLME–1110*	Western Sahara	179	22/11/2011	−16.9730	23.0116	75	1
Abralia siedleckyi	*Maroc–0611*	Western Sahara	88	09/12/2006	−16.1695	25.3096	444	6
Abralia siedleckyi	*Maroc–0611*	Western Sahara	99	12/12/2006	−15.5908	25.8373	486	1
Abralia veranii	*Maurit–0911*	Mauritania	48	09/12/2009	−16.7493	16.9318	108	9
Abralia veranii	*CCLME–1110*	Guinea–Bissau	31	26/10/2011	−16.9234	9.9007	477	2
Abralia veranii	*CCLME–1110*	Western Sahara	176	21/11/2011	−17.1864	22.6984	150	1
Abralia veranii	*CCLME–1205*	Guinea–Bissau	53	19/05/2012	−17.4045	11.5181	734	2
Abralia veranii	*CCLME–1205*	South Senegal	66	21/05/2012	−17.6554	12.5972	472	3
Abralia veranii	*CCLME–1205*	South Senegal	85	24/05/2012	−17.5335	14.2425	213	3
Abralia veranii	*CCLME–1205*	North Morocco	101	28/05/2012	−17.2835	15.5448	829	1
Abralia veranii	*CCLME–1205*	South Morocco	233	29/06/2012	−12.8077	28.5205	124	1
Abralia veranii	*CCLME–1205*	North Morocco	306	13/07/2012	−6.5359	35.4979	398	4
Haliphron atlanticus	*Maroc–0611*	Western Sahara	63	02/12/2006	−17.0375	23.9367	1054	1
Haliphron atlanticus	*Bissau–0810*	Guinea–Bissau	29	25/10/2008	17.2514	10.3287	504	1
Ancistroteuthis lichtensteinii	*Bissau–0810*	Guinea–Bissau	35	29/10/2008	17.4046	10.0695	869	1
Ancistroteuthis lichtensteinii	*Maroc–0411*	North Morocco	11	17/11/2004	−7.2068	35.5550	995	1
Ancistroteuthis lichtensteinii	*Maroc–0611*	Western Sahara	68	03/12/2006	−16.7173	24.4054	1035	1
Ancistroteuthis lichtensteinii	*Maroc–0611*	Western Sahara	78	06/12/2006	−16.6249	24.6237	1041	1
Ancistroteuthis lichtensteinii	*CCLME–1205*	North Morocco	305	13/07/2012	−6.7352	35.5617	760	1
Austrorossia mastigophora	*Maroc–0611*	Western Sahara	1	14/11/2006	−17.7018	21.1510	560	1
Austrorossia mastigophora	*Maroc–0611*	Western Sahara	81	07/12/2006	−16.4065	24.8689	471	1
Bathypolypus ergasticus	*Maroc–0511*	South Morocco	59	02/12/2005	−13.8193	27. 3985	1291	1
Bathypolypus ergasticus	*Maroc–0511*	South Morocco	66	04/12/2005	−14.0743	27.1100	1282	1
Bathypolypus ergasticus	*Maroc–0511*	South Morocco	86	10/12/2005	−15.1588	26.2633	843	1
Bathypolypus ergasticus	*Maroc–0611*	Western Sahara	65	03/12/2006	−16.8408	23.8418	461	1
Bathypolypus ergasticus	*Bissau–0810*	Guinea–Bissau	23	27/10/2008	17.2675	10.4746	518	1
Bathypolypus ergasticus	*Bissau–0810*	Guinea–Bissau	25	27/10/2008	17.2614	10.3745	488	1
Bathypolypus ergasticus	*Bissau–0810*	Guinea–Bissau	26	27/10/2008	17.3190	10.3806	895	1
Bathypolypus ergasticus	*Maurit–0811*	Mauritania	86	10/12/2008	−16.7858	18.1533	1215	1
Bathypolypus valdiviae	*Bissau–0810*	Guinea–Bissau	28	28/10/2008	17.2245	10.3326	427	1
Bathypolypus valdiviae	*Bissau–0810*	Guinea–Bissau	34	29/10/2008	17.3096	10.1241	698	1
Bathyteuthis abyssicola	*Maroc–0511*	South Morocco	71	06/12/2005	−14.3703	26.9918	1820	1
Chtenopteryx sicula	*Maroc–0611*	Western Sahara	64	02/12/2006	−16.9234	23.9003	699	1
Chtenopteryx sicula	*Maroc–0611*	Western Sahara	64	02/12/2006	−16.9234	23.9003	699	1
Cirrothauma murrayi	*Maroc–0511*	South Morocco	64	03/12/2005	−13.9530	27.3847	1554	1
Lepidoteuthis grimaldii	*Maroc–0511*	North Morocco	86	10/12/2005	−15.1588	26.2633	843	1
Magnoteuthis magna	*Maroc–0511*	South Morocco	65	04/11/2005	−13.8338	27.1407	976	1
Magnoteuthis magna	*Maroc–0611*	Western Sahara	79	07/12/2006	−16.6395	24.9411	1243	1
Muusoctopus fuscus	*CCLME–1205*	North Senegal	102	29/05/2012	−17.0227	15. 7819	234	2
Muusoctopus januarii	*Maroc–0511*	South Morocco	65	04/11/2005	−13.8338	27.1407	976	1
Muusoctopus januarii	*Maroc–0611*	Western Sahara	1	14/11/2006	−17.7018	21.1510	560	6
Muusoctopus januarii	*Bissau–0810*	Guinea–Bissau	18	26/10/2008	17.1563	11.0663	105	1
Muusoctopus januarii	*Bissau–0810*	Guinea–Bissau	31	28/10/2008	17.3294	10.2696	721	3

(*Continued*)

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Appendix 1. (*Continued.*)

Species	Survey	Country	Station	Date	Longitude	Latitude	Main depth (m)	N
Muusoctopus januarii	*Bissau*–0810	Guinea–Bissau	33	29/10/2008	17.3303	10.1727	706	1
Muusoctopus januarii	*Bissau*–0810	Guinea–Bissau	34	29/10/2008	17.3096	10.1241	698	1
Muusoctopus januarii	*Bissau*–0810	Guinea–Bissau	35	29/10/2008	17.4046	10.0695	869	1
Muusoctopus januarii	*Bissau*–0810	Guinea–Bissau	38	30/10/2008	17.2745	10.0758	679	1
Muusoctopus johnsonianus	*CCLME*–1205	North Senegal	94	27/05/2012	−17.6522	14. 9499	797	1
Muusoctopus levis	*Bissau*–0810	Guinea–Bissau	23	27/10/2008	17.2675	10. 4746	518	1
Muusoctopus levis	*Bissau*–0810	Guinea–Bissau	29	28/10/2008	17.2514	10. 3287	504	1
Octopoteuthis megaptera	*Maroc*–0511	South Morocco	71	06/12/2005	−14.3703	26.9918	1820	1
Octopoteuthis megaptera	*Maroc*–0611	Western Sahara	61	02/12/2006	−17.4192	23.8895	1528	1
Octopoteuthis megaptera	*Maroc*–0611	Western Sahara	64	02/12/2006	−16.9234	23.9003	699	1
Octopoteuthis megaptera	*Maurit*–0811	Mauritania	3	17/11/2008	−16.9890	18.6722	1367	1
Octopoteuthis megaptera	*CCLME*–1205	South Senegal	78	23/05/2012	−17.5680	13.9224	769	2
Octopus salutii	*CCLME*–1110	North Morocco	260	11/12/2011	−10.1569	31. 6951	355	1
Onykia robsoni	*Bissau*–0810	Guinea–Bissau	38	30/10/2008	17.2745	10.0758	679	1
Opisthoteuthis massyae	*Maroc*–0611	Western Sahara	63	02/12/2006	−17.0375	23.9367	1054	1
Opisthoteuthis calypso	*Maroc*–0511	South Morocco	11	17/11/2005	−10.6305	30.3520	1774	1
Opisthoteuthis calypso	*Maroc*–0611	Western Sahara	5	15/11/2006	−17.9686	21.3713	1207	1
Opisthoteuthis grimaldii	*Maroc*–0511	South Morocco	61	02/11/2005	−13.8173	27.2282	1126	1
Opisthoteuthis grimaldii	*Bissau*–0810	Guinea–Bissau	33	29/10/2008	17.3303	10.1727	706	2
Sepiola atlantica	*CCLME*–1110	Western Sahara	223	04/12/2011	−13.3694	27.3826	28	8
Sepiola atlantica	*CCLME*–1205	Western Sahara	228	29/06/2012	−13.0815	27.9324	47	1
Sepiola atlantica	*CCLME*–1205	North Morocco	301	12/07/2012	−6.2634	35.0328	47	4
Sepiola atlantica	*CCLME*–1205	North Morocco	301	12/07/2012	−6.2634	35.0328	47	4
Stigmatoteuthis arcturi	*Maroc*–0411	North Morocco	11	17/11/2004	−7.2068	35.550	995	1
Taonius pavo	CCLME–1110	North Senegal	82	04/11/2011	−17.6141	14.3834	656	1
Taonius pavo	CCLME–1205	South Senegal	78	23/05/2012	−17.5680	13.9224	769	1
Taonius pavo	CCLME–1205	North Senegal	98	28/05/2012	−16.9244	15.3186	52	1
Taonius pavo	CCLME–1205	North Senegal	101	28/05/2012	−17.2835	15.5448	829	2

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