

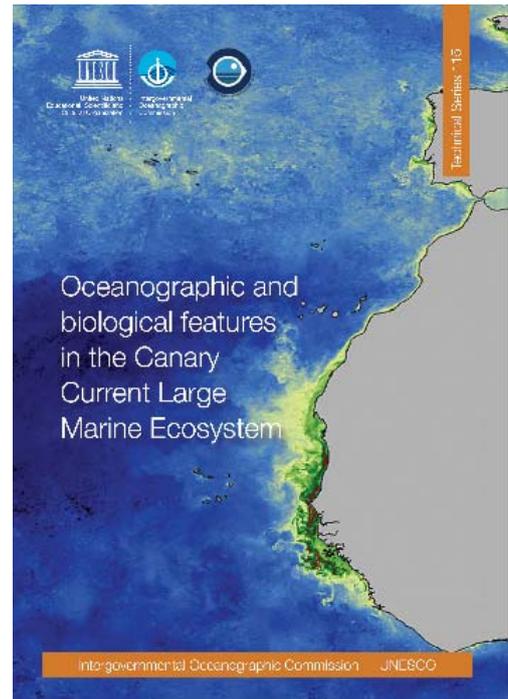
## 5.7. Biodiversity of cetaceans in coastal waters of Northwest Africa: new insights through platform-of-opportunity visual surveying in 2011-2013

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The report *Oceanographic and biological features in the Canary Current Large Marine Ecosystem* and its separate parts are available on-line at: <http://www.unesco.org/new/en/ioc/ts115>.

The bibliography of the entire publication is listed in alphabetical order on pages 351-379. The bibliography cited in this particular article was extracted from the full bibliography and is listed in alphabetical order at the end of this offprint, in unnumbered pages.

### ABSTRACT

We summarize diversity, group size and habitat of cetaceans documented through ship-based visual survey effort (13,694 km; 1163.5 h) off NW Africa (Conakry to Tangier) in spring and fall of 2011-2013. Study area covered mainly continental shelf with some slope waters. Platform-of-opportunity surveying yielded 270 primary sightings of 14 species. Due to passing mode, 35.7% were identifiable only to family/category: unidentified Delphinidae (25.0%), unidentified rorquals (5.88%) and unidentified whales (4.78%). *Delphinus delphis* predominated with 28.7% of total sightings (32.7%, including probable) and a massive 71.3% (76.5%) of total number of cetaceans observed (n=15,595). Encounter rate was 81.2 common dolphins 100 km<sup>-1</sup>; mean group size 124.92. *Tursiops truncatus*, primarily inshore ecotype (median depth, 44.5 m), accounted for 9.56% (11.4%) of sightings and 1.35% (1.83%) of total cetaceans. *Megaptera novaeangliae* (6.25%) was regularly seen south of Dakar with a Southern Hemisphere seasonality. Other species showed a relatively low % occurrence: *Globicephala* spp. (2.57), *Orcinus orca* (1.10), *Grampus griseus* (0.73), *Stenella frontalis* (1.84), *S. attenuata* (0.37), *S. clymene* (0.37), *S. coeruleoalba* (0.37), *Balaenoptera brydei* (1.10), *B. musculus* (0.37), beaked whale (0.37), probable-*B. borealis* (0.37). Baleen plates recovered from a bottom-trawl also evidenced *B. borealis* presence. Seven new range state records included: *G. griseus*, *S. coeruleoalba* (Atlantic Morocco), *O. orca*, *B. musculus* (The Gambia), *G. macrorhynchus*, *S. frontalis* (Guinea-Bissau), *S. attenuata* (Guinea).

**Keywords:** Cetacean diversity · Relative abundance · Group size · Population identity · Habitat · Canary Current Large Marine Ecosystem · Northwest Africa



## **BIODIVERSITY OF CETACEANS IN COASTAL WATERS OF NORTHWEST AFRICA: NEW INSIGHTS THROUGH PLATFORM-OF-OPPORTUNITY VISUAL SURVEYING IN 2011-2013**

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### **5.7.1. INTRODUCTION**

With the exception of the Canary and Cabo Verde Archipelagos, very few dedicated vessel-based surveys have studied the spatio-temporal distribution of cetaceans in most parts of the Canary Current Large Marine Ecosystem (CCLME) (e.g. Diallo et al., 2002, 2004; Boisseau et al., 2007; Wenzel et al., 2009; Bamy, 2011). Historically, modest levels of information on the biodiversity of cetaceans from Northwest Africa (NWA) have been derived mainly from incidental stranding and sighting accounts and more recently from limited directed monitoring of strandings and by-catches (reviewed in e.g. Bayed and Beaubrun, 1987; Reiner et al., 1996; Jefferson et al., 1997; Murphy et al., 1997; Robineau and Vély, 1998; Van Waerebeek et al., 2000, 2003; Bamy et al., 2010; Ritter, 2011; Hazevoet et al., 2010; Perrin and Van Waerebeek, 2012; Mullié et al., 2013). Distributional insights obtained through vessel-based surveys sponsored by Japan (e.g. Diallo et al., 2002, 2004) and from a number of geophysical seismic surveys remain buried in unpublished internal reports. The incomplete record in the CCLME region means that even observer effort from platforms-of-opportunity can contribute significantly to our understanding of marine mammal biodiversity and their spatial and seasonal distribution. The joint Norwegian Ecosystem Approach to Fisheries (EAF) Nansen Project, FAO/CCLME and ODINAFRICA-IODE-IOC-UNESCO projects in 2011-2013 offered a platform for shipboard surveys, preliminary results of which are presented below.

### **5.7.2. DATA SOURCES AND METHODS**

The 56.8 m fisheries research vessel R/V *Dr Fridtjof Nansen* served as a platform of opportunity for three visual marine mammal surveys in passing mode (i.e. the vessel did not close on sightings) off NWA in 2011-2013. The study area stretched from Conakry (9.509°N, 13.712°W) to Tangier (35.767°N, 5.800°W), comprising the continental shelf and (limited) contiguous slope waters off Guinea, Guinea-Bissau, The Gambia, Senegal, Mauritania, Western Sahara and Morocco. In 2012, the survey area included also two deep-water transits to and from Las Palmas de Gran Canaria. The 1-22 May 2013 *Sardinella* spp. stock evaluation cruise was limited to shelf waters between Senegal's Cap-Vert and northern Guinea-Bissau. Cruise tracks were designed for the purposes of fisheries and oceanographic research (e.g. Krakstad et al., 2012) and vessel speed was often reduced (0-5 km h<sup>-1</sup>). Low, varying speeds impeded the application of line

transect sampling protocol for abundance estimation, with model assumptions unfulfilled, e.g. that animals surveyed should move slowly relative to the observer (Buckland et al., 1993). Mean velocity along tracklines while on-effort was 13.65 km h<sup>-1</sup>. Cruise speed reached a maximum of 18.5 km h<sup>-1</sup> (10 knots), which most cetaceans can match or exceed. Observers were vigilant to detect potential re-sightings, both in real-time and at analysis. Continuous use of a hull-mounted multibeam sonar, while some interference was possible, was not thought significantly to affect encounter rates. Many dolphin groups evidently ignored it when approaching and bowriding the ship.

During transits, observers visually scanned 180° forwards with compass-equipped 7x50 marine binoculars and naked eye. When at lowspeed or stationary, 360° were scanned, to anticipate any cetaceans approaching from the stern. In 2013, high-magnification (18x50) image-stabilized binoculars aided with identification. Observers were stationed on the radar deck (eye-height, 17 m) or, rarely, on the forecastle deck (14 m). Standard sighting data protocol comprised 37 variables, including i.a.: species, confirmation, observers, start/end time, position, relative location to ship (estimated angle, initial and minimum radial distance), group size estimates (best-minimum-maximum), group composition, diagnostic and unusual features, behaviour including reaction to vessel, visibility (good>5 km; moderate 1-5 km; poor <1 km), Beaufort sea state, and swell (low<2 m; medium 2-4 m; high>4 m). A numbered paper data form was filled out for each sighting, linked to a GPS waypoint. Group dynamics versus vessel and any relevant features were sketched. Observer effort (duration, distance covered) and the ship's activity were also logged. All sea bottom depths (further “depths”) were determined by echosounder.

Overall survey effort covered 13,694 km of transects, for a total effective observer time of 69,812 min (1163 h, 32 min) by four alternating observers (authors), with at any time 1-2 observers on effort. Distance and duration surveyed for each of the three cruises in 2011, 2012 and 2013 (Table 5.7.1) amounted to, respectively, 5334 km (27,238 min), 6278 km (31,153 min) and 2081 km (11,421 min).

Table 5.7.1. Summary parameters of visual observer effort for marine mammals from the R/V *Dr. Fridtjof Nansen*, in CCLME study area, 2011-2013. Observers include (initials, effort in min): A. Djiba (AD, 35,704); I. L. Bamy (ILB, 9079); A. Samba Ould Bilal (ASOB, 7049); and K. Van Waerebeek (KVW, 44,390). Ornithologist P. Robinson (PR) assisted with searching, however secondary to seabird observations.

Code	Cruise transects	Period	Observers	Effort (minutes)	Effort (km)
A	Conakry - Cap-Vert	21 Oct-02 Nov 2011 (13 d)	KVW	6925	1742.1
B	Cap-Vert - Cape Blanc	04 Nov-15 Nov 2011 (12 d)	AD, KVW	5910	1119.53
C	Cape Blanc - Agadir	17 Nov-15 Dec 2011 (27 d)	AD	14,403	2472.72
D	Conakry - Cap-Vert	09 May-25 May 2012 (17 d)	ILB, KVW	9079	2008
E	Cap-Vert - Nouakchott	27 May-03 June 2012 (8 d)	AD, PR	3970	781
F	Nouakchott-Cape Juby-Las Palmas de Gran Canaria	08 June-21 June 2012 (14 d)	ASOB, PR	7049	1206
G	Las Palmas de Gran Canaria-Laayoune-Tangier	27 June-20 July 2012 (24 d)	KVW	11,055	2283
H	Kayar- Guinea-Bissau	01 May-22 May 2013 (22d)	AD, KVW	11,421	2081.85

When species could not be positively confirmed through diagnostic morphological features and behaviour, only genus or family was registered. Confirmed records were routinely supported by photos or video taken with DSLR cameras (Canon EOS-350D, 6D) and 70-300 mm telephoto lenses. Probable records ('like-species') were defined as  $p > 90\%$ . Three relative abundance measures were calculated per species: % of total number of groups sighted, % of total number of individual cetaceans sighted, and an overall encounter rate defined as the total estimated number of individuals sighted per 100 km effective survey effort. Best group estimates or, if missing, minimum estimates were used, implying that for some species a negative bias may exist.

### 5.7.3. RESULTS

During the three CCLME fisheries research cruises (2011-2013) we collected information on 270 primary sightings (excluding re-sightings), comprising 14 different species. Group composition data are summarized in Table 5.7.2. While searches targeted all marine mammals, only odontocetes (10 species) and mysticetes (4 species) were encountered. Below we succinctly discuss group size, relative densities, population identity, habitat and distributional parameters, including range states, for each species encountered.

#### 5.7.3.1. Short-beaked common dolphins, *Delphinus delphis* Linnaeus, 1758

Common dolphins were by far the dominant marine mammals encountered, accounting for (at a minimum) 28.7% of total sightings, or 32.7% if including probable-*Delphinus* sightings. Common dolphins also represented three quarters (71.3%, or 76.5%) of total number of cetaceans observed (Table 5.7.2). Mean group size was 124.92 (SD=124.37; range 2-450; n=54). Encounter rate was estimated as 81.2 common dolphins 100 km<sup>-1</sup>, and they were found in all areas surveyed, from nearshore neritic to offshore continental slope waters.

Although many groups that were observed closely were confidently identified as *D. delphis* (Plate 5.7.1 (1) and (2)) many other sightings were at great distance at which it would be unfeasible reliably to differentiate between *D. delphis* and the long-beaked common dolphin *D. capensis*. Positive identification of common dolphins in African seas are hindered by their incompletely resolved taxonomy and a lack of combined morphological and molecular analyses (Van Waerebeek, 1997; Westgate, 2007; Amaral et al., 2009; Mirimin et al., 2009; Pinela et al., 2011). A region-wide study of geographic variation in metric and non-metric cranial and external features would be desirable. A cursory check of colouration patterns documented here indicates significant, but possibly clinal, variation (Plate 5.7.1 (1) and (2)). Some molecular studies suggest a single common dolphin taxon off NWA (Pinela et al., 2011). Nonetheless, population structure of *Delphinus* in West Africa should be compared to these from the Gulf of Guinea and SW African waters (Van Waerebeek, 1997).

#### 5.7.3.2. Common bottlenose dolphins, *Tursiops truncatus* (Montagu, 1821)

Common bottlenose dolphins are frequently observed in coastal waters of Senegal, The Gambia and Guinea-Bissau (Cadenat, 1959a, b; Cadenat and Lassarat, 1959; Spaans, 1990; Murphy et al., 1997; Van Waerebeek et al., 1997, 2000, 2003, 2008a). In 2011-2013, *T. truncatus* was the second-most frequently encountered cetacean (Table 5.7.2) accounting for, at a minimum, 9.56% of total sightings, or 11.4% including probable-bottlenose dolphin sightings. However the estimated 210 (or 285) *T. truncatus* observed represented only 1.35% (or 1.83%) of the total number of cetaceans encountered (Table 5.7.2). Mean group size was 9.30 individuals (SD=10.61, range 2-50, n=23). Encounter rate was estimated at 1.53

bottlenose dolphins  $100 \text{ km}^{-1}$ . The small group sizes in relatively shallow water, 44.5 m median depth (mean=115.8 m; SD=154.8; range 25.1–538.6 m, n=21), 18 of 21 in neritic waters, are mostly consistent with an inshore ecotype. The largest group of 50 (45-60) dolphins was encountered on the slope (312 m depth) off Guinea-Bissau on 15 May 2012 (Plate 5.7.1 (3)). This raises the question whether, as in many other seas (Wells and Scott, 2009), two partially allopatric ecotypes exist off NWA, a neritic shallow-water population and an offshore population. Additional offshore surveying and morphological and molecular studies are necessary. A presumed offshore ecotype typically associates with short-finned pilot whales over and beyond the continental slope. As co-occurring species they likely feed on similar deep-water prey (Cadenat 1959b), such as squid and small mesopelagic fishes. Stable isotope analysis of food items (Pinela et al., 2010) indicated similar  $\delta^{15}\text{N}$  values (relative abundance of heavy to light nitrogen) for short-finned pilot whales and bottlenose dolphins in Mauritania, suggesting equivalent trophic level and prey. This adds to the case for a distinct offshore ecotype.

Behavioural traits in five small groups of *T. truncatus* seen nearshore of Ngor Island, Dakar, in April-June 2013 (Van Waerebeek and Djiba, personal observations) concur with the traits of an inshore population, including small groups (median=10; range 1-15) foraging behind the surfzone and slow travel parallel to the coastline. Photo-identification studies are needed to determine the affinity of the Dakar inshore community with the southern riverine communities inhabiting the Gambia and Casamance Rivers (Van Waerebeek et al., 2000, 2003, 2008a). Circumstantial evidence, including fishermen's observations, suggests the latter feed on neritic fish such as mullet (*Mugil* spp.) and bonga fish (*Ethmalosa fimbriata*).

### 5.7.3.3. Short-finned pilot whales, *Globicephala macrorhynchus* (Gray, 1846)

Reports of pilot whales in NWA are often insufficiently documented, or plainly misidentified, as they may refer to either *G. macrorhynchus* or *G. melas*, considering a range overlap in the study area (Norez and Pérez, 1988). One of the earliest reports of *G. macrorhynchus* consisted of a mass-stranding (n=151) including all age and sex classes, at Yoff, Senegal, in May 1943 (Cadenat, 1947). Another group of minimum 15 individuals live-stranded, and died, at Yoff on 17 August 2005 (Plate 5.7.1 (4)). The only record for The Gambia is a specimen washed ashore at Saniang Point in 1998 (Murphy et al., 1997; Jallow et al., 2005). A single sighting was reported from Guinea (Bamy et al., 2010). *G. macrorhynchus* is fairly common off the Canary Islands (Ritter, 2011). Other range states include Morocco, Mauritania and Cabo Verde (e.g. Jefferson et al., 1997; Van Waerebeek et al., 2000, 2003, 2008b; Hazevoet et al., 2010; Perrin and Van Waerebeek, 2012).

CCLME surveys yielded 5 new sightings of *G. macrorhynchus*, supported by inconspicuous grey saddles and a faint cape and eyestripes (Olson, 2009), all in warm waters. For a small pilot whale group (n=4) off Morocco in November 2011, *G. melas* could not be excluded. In deeper water off Guinea-Bissau, on 15 May 2013, we sighted two groups, one of 30 (20-40) pilot whales at  $12^{\circ}0.051'\text{N}$ ,  $17^{\circ}25.725'\text{W}$  (789 m depth), and a smaller group of 10 (10-20) individuals at  $11^{\circ}47.228'\text{N}$ ,  $17^{\circ}25.728'\text{W}$  (830 m depth), the first records for Guinea-Bissau. The resting animals moved very slowly in a single direction. The larger group was accompanied by some smaller-sized dolphins, likely *T. truncatus*. Furthermore we recorded three *G. macrorhynchus* sightings off Guinea in 2011-12. Overall encounter rate was estimated as 0.50 pilot whales  $100 \text{ km}^{-1}$  (or 0.47 confirmed *G. macrorhynchus*).

#### 5.7.3.4. Killer whales, *Orcinus orca* Linnaeus, 1758

We recorded a cluster of three small groups of *O. orca* over a five day-period in 2013. On 9 May, 3 (2-3) females or juvenile orcas moved south (Plate 5.7.1(5)) parallel to shore near Kayar (at 14°51.587'N, 17°15.959'W) in shallow water (42.3 m; SST 21.2°C). The next day, 5 (4-6) orcas, of which 2 subadult males, were seen travelling NE in deep water (1482 m; SST 19.4°C) at 15°46.995'N, 17°19.154'W, south of Cap-Vert Peninsula. On 13 May, 5 (5-6) orcas, of which one adult male, moved in deep water (908 m; SST 22.3°C) at 13°24.701'N, 17°33'W off The Gambia, a new range state for *O. orca*.

While *O. orca* is irregularly documented in West Africa (Hammond and Lockyer, 1988), we compiled 26 records for Senegal, including the earliest case, a female captured near Hann in February 1942, amongst the 17 (65%) around the Cap-Vert Peninsula, and two unusual sightings in the Senegal River (Maigret, 1977). Cadenat (1959a) suggested *O. orca* to be absent from Senegal in the hot season but sightings exist for all seasons, albeit records are still lacking for March-April, August-September and November, and some seasonality is possible. Group sizes have consistently been very small, often 1-2 individuals. Maigret (1977) also observed orcas alone or in pairs in Mauritanian waters.

Confirmed CCLME range states now include Morocco, Mauritania, Senegal, The Gambia, Canary Islands and Cabo Verde (Bayed and Beaubrun, 1987; Hammond and Lockyer, 1988; Van Waerebeek et al., 2000; Hazevoet et al., 2010; Ritter, 2011). *O. orca* has not yet been recorded in Guinea-Bissau and Guinea (Van Waerebeek et al., 2000, 2003; Perrin and Van Waerebeek, 2012) and although it will surely be found there in future, abundance seems higher in Senegal, irrespective of a higher reporting rate. With only three observations the overall encounter rate was a low 0.088 orcas 100 km<sup>-1</sup>. Population structure in West Africa remains unstudied (Foote et al., 2009), but orcas from Senegal's and Mauritanian coasts likely belong to the same population.

Also, scarce information exists on prey and foraging strategies. Stomach contents of one female captured in Senegal contained remains of 'many fishes' (Cadenat, 1947). Ritter (2011) suggested that orcas in the Canaries follow tuna schools. In 2012, a fisheries officer reported (personal communication to Djiba) that a group of killer whales attacked green turtles (*Chelonia mydas*) nearshore at Joal, Senegal. One photo (Plate 5.7.1(6)) shows a small, obviously juvenile orca pushing and partly lifting a turtle, however this incident remains inconclusive, interpretable as either play or predation. Stable isotope analysis suggested that *O. orca* in Mauritania may be an offshore ecotype preying on fish, while orcas appeared to avoid other marine mammals, including the monk seal (Pinela et al., 2010).

#### 5.7.3.5. Risso's dolphin, *Grampus griseus* (Cuvier, 1812)

A cluster of two confirmed and one probable sighting was recorded off central Morocco within 4 days. Respectively, a slowly moving group of 3 (3-4) at 33°0.753'N, 8°59.789'W on 8 July 2012 (photos archived); a larger group of 15 (12-20) at 34°14.121'N, 7°08.517'W including several large, pale-coloured adults (Plate 5.7.1 (7)) keeping parallel with the ship steaming 10 knots, on 11 July 2012 (09:51); and one hour later (11:02), a very distant group of at least 3 individuals, at 34°14.569'N, 7°03.721'W, their whitish body colouration and large dorsal fins standing out. Bottom depths (and SST) for the location of each sighting were 502 m (18.2°C), 181 m (20.3°C) and 170 m (20.3°C) respectively. These represent first authenticated records of *G. griseus* for Morocco, although an unsupported stranding 31 km north of Agadir in 1984 was mentioned by Bayed and Beaubrun (1987). *G. griseus* is otherwise known from a stranded skull collected in Mauritania (Duguy, 1976) and a pod of 9 individuals sighted at 18°7.50'N, 16°42.36'W on 6 December 2012 by one of us (ASOB, personal observations) during an R/V *Al Awam* survey off Mauritania. There are

reported sightings off the Canaries (Ritter, 2011), Cabo Verde (Hazevoet and Wenzel, 2000) and Guinea-Bissau (Van Waerebeek et al., 2000), the latter two unauthenticated. Overall encounter rate is estimated as 0.131 Risso's dolphins 100 km<sup>-1</sup>.

#### **5.7.3.6. Pantropical spotted dolphin, *Stenella attenuata* (Gray, 1846)**

One confirmed and one unconfirmed sightings were made. A small group of 22 (20-30) *S. attenuata* was filmed in deeper water (897 m; SST 27.3°C) at 9°1.5702'N, 15°26.772'W off Guinea, on 22 October 2011, the first documented record for that country. The dolphins approached from the stern and briefly rode the bow wave. A tentative sighting off Senegal, at 13°59.665'N, 17°31.042'W occurred on 20 May 2013. Some 50 (30-80) delphinids, observed at 750 m distance under moderate visibility conditions and 3-4 Beaufort sea state, were tentatively identified as a mixed group of *D. delphis* and *S. attenuata* in continental slope waters (434 m; SST 24.1°C).

The encounter rate for (confirmed) *S. attenuata* was a low 0.163 dolphins 100 km<sup>-1</sup>. Presumably the species is less rare at the oceanic side of the NWA continental slope which was poorly covered by the 2011-2013 cruises. Hazevoet et al. (2010) documented a live-stranding of 17 *S. attenuata* at Mindelo. Without however referring to other specific cases, they noted that it was one of the commoner dolphin species in Cabo Verde.

*S. attenuata* has a preference for tropical oceanic waters and may largely avoid the cooler, upwelling-modified neritic habitat of the Canary Current system, which would explain the lack of records between Morocco and Senegal, including the Canaries (Jefferson et al., 1997, Van Waerebeek et al., 2000, 2003; Ritter, 2011; Perrin and Van Waerebeek, 2012).

#### **5.7.3.7. Clymene dolphin, *Stenella clymene* (Gray, 1850)**

One of us (K.V.W.) sighted a group of 13 (12-18) *S. clymene* at 15°06.868'N, 17°22.404'W, off Kayar, on 22 May 2013 (depth 603 m; SST 23.3°C), the first documented sighting in Senegal (photos archived). Interestingly, small body size was the most striking phenotypic feature. Their presence near Kayar may be linked to the unusual topography of deep underwater canyons on the north face of the Cap-Vert Peninsula which could facilitate oceanic species to approach nearshore. Several whales, including sperm and one humpback whale are known to have stranded near Kayar.

Based on a few specimens, confirmed CCLME range states for *S. clymene* include Mauritania, Senegal and The Gambia. The northernmost record in the NE Atlantic is 113 km north of Nouakchott at 19°1.9'N, 16°13.5'N (Cadenat, 1959a; Robineau et al., 1994; Van Waerebeek et al., 2000, 2003; Fertl et al., 2003; Perrin and Van Waerebeek, 2012). *S. clymene* is rare in neritic waters off NWA, with an encounter rate of only 0.095 Clymene dolphins 100 km<sup>-1</sup>. It is as yet unknown from Cabo Verde (Hazevoet et al., 2010) and Canary Islands (Ritter, 2011) despite commercial whale and dolphin-watching. This stands in stark contrast with *S. clymene* status as most-exploited dolphin species in Ghana (Gulf of Guinea) which prompted a Convention on Migratory Species (CMS) Appendix I listing of that population (Van Waerebeek and Perrin, 2007a).

#### 5.7.3.8. Atlantic spotted dolphin, *Stenella frontalis* (Cuvier, 1829)

Five sightings of *S. frontalis* were confirmed, two off Guinea, two off Guinea-Bissau (one associated with *D. delphis*), and one far offshore, closer to the Canaries. Depths ranged widely, from 64.8 m on the Guinean shelf, up to 2379 m (median 583 m; n=5) for the offshore sighting of largely unspotted individuals, probably of a distinct population. Some of the many sightings of unidentified delphinids recorded at great distance were also suspected to be *S. frontalis*. A compact group of 6 (4-10) slowly moving *S. frontalis* at 9°58.041'N, 16°48.849'W, on the Guinea-Bissau continental slope (depth 342 m; SST 25.6°C) on 15 May 2012, comprised heavily spotted individuals (Plate 5.7.1(8)). Another 20 spotted *S. frontalis* formed a mixed group with minimum 150 *D. delphis* (conspecifics herded together in subgroups) when foraging near the vessel (11°33.689'N, 017°24.433'W) after dark (21:30) on 29 October 2011. These represent the first records for Guinea-Bissau (KVW confirmed diagnostics). In the study region, only Morocco and The Gambia have no *S. frontalis* records associated (Perrin and Van Waerebeek, 2012). Encounter rate was 0.32 Atlantic spotted dolphins 100 km<sup>-1</sup>.

#### 5.7.3.9. Striped dolphin, *Stenella coeruleoalba* (Meyen, 1833)

A single sighting was recorded of this typical oceanic species. The most common cetacean in the Mediterranean Sea, *S. coeruleoalba* is rarely documented in West Africa. We photographed a small herd of 12 (8-15) individuals in Moroccan waters at 32°33.676'N, 9°43.004'W (depth 497.1 m; SST 18.1°C) on 7 July 2012 (Plate 5.7.1(9)). During the brief encounter (13:49-13:55) several dolphins leaped clear and rode the bowwave at 10 knots. This is the first substantiated record of *S. coeruleoalba* for Morocco's Atlantic coast. Encounter rate was a low 0.088 striped dolphins 100 km<sup>-1</sup>. Other CCLME range states include Cabo Verde (Hazevoet and Wenzel, 2000), Canary Islands (Ritter, 2011), Mauritania and Senegal (Cadenat, 1949; Van Waerebeek et al., 2000; Perrin and Van Waerebeek, 2012). *S. coeruleoalba* is unknown in The Gambia, Guinea-Bissau and Guinea (Bamy et al., 2010). Moreover, the species remains undocumented in coastal waters from Senegal southeast to Angola, bar a unique capture record in Cameroon (Ayissi et al., 2014). Significantly, *S. coeruleoalba* is absent among the many hundreds of verified landings of small cetaceans in Ghana (Debrah et al., 2010).

#### 5.7.3.10. Beaked whales, Ziphiidae

A single unidentified beaked whale, a *Mesoplodon* sp., ca. 3.5-4.5 m in length, was observed in Guinea, at 9°0.078'N, 15°07.431' W (depth 488 m; SST 28.5°C). Dorsally uniformly gray, the triangular dorsal fin was set towards the rear of the back. Either one animal surfaced twice or two similar individuals surfaced sequentially. The minimum encounter rate was 0.007 beaked whales 100 km<sup>-1</sup>. Mesoplodonts, as well as other beaked whales, are deep-diving species rarely reported for most of the study area, but not infrequently in the Canary Islands, and often from strandings related to navy exercises. Blainville's beaked whale *M. densirostris* is well-known from the Canaries (Ritter and Brederlau, 1999) and Morocco. Sowerby's beaked whale *M. bidens* is also reported from the Canaries; Gervais' beaked whale *M. europaeus* from Mauritania, Canary Islands and Guinea-Bissau (Reiner, 1980; Martín et al., 1990; Robineau and Vély, 1993; Ritter, 2011; Perrin and Van Waerebeek, 2012; Koenen et al., 2013). The large, cosmopolitan Cuvier's beaked whale, *Ziphius cavirostris*, is recorded in Morocco, Canary Islands, Mauritania, Cabo Verde and Senegal (Perrin and Van Waerebeek, 2012).

#### **5.7.3.11. Humpback whale, *Megaptera novaeangliae* (Borowski, 1781)**

Arguably the most remarkable cetological finding of the 2011 survey consisted in the discovery of an undescribed stock of humpback whales off NW Africa, thought to comprise the northwestern-most component of the large Southern Hemisphere (SH) breeding assemblage that migrates to and from the Gulf of Guinea in austral winter and spring (Van Waerebeek et al., 2013). Bamy et al. (2010) first formulated a SH stock hypothesis based on a few unseasonal records in Guinea.

*M. novaeangliae* was the most commonly encountered cetacean (17 confirmed, 4 probable sightings) on the wide Conakry-Dakar shelf, surveyed 21 October–5 November 2011 (Van Waerebeek et al., 2013). None were encountered between Dakar and Agadir, 6 November–15 December 2011. Sighting effort was 468 h over 5334 km. The sum of group sizes totalled 33 whales, or 43 whales (including probable records). Encounter rate was 1.74 or 2.27 humpback whales 100 km<sup>-1</sup>, respectively, or 0.24 whales 100 km<sup>-1</sup> for the pooled 2011–2013 effort. Herd sizes ranged 1–6 individuals (median=2). At least 5 of 17 groups (29.4%) consisted of adult–calf pairs, with a minimum crude birth rate ranging 0.060–0.152 (Van Waerebeek et al., 2013). All sightings occurred in very shallow water of 22–60 m (mean=35.0 m). SST was high in 25.5–29.0°C range (mean=27.34°C). *M. novaeangliae* was not encountered during the Conakry–Tangier–Las Palmas survey in May–June 2012.

Cabo Verde, till now, was the only recognised wintering ground in the NE Atlantic (Hazevoet and Wenzel, 2000; Wenzel et al., 2009). Temporal signature of the 2011 records, 6–7 months out-of-phase with mid-season in Cabo Verde, and the presence of small calves strongly suggest that the Conakry–Dakar shelf serves as both wintering and nursery grounds for a South Atlantic stock. Guinea, Guinea-Bissau, The Gambia and Senegal became newly documented range states for *M. novaeangliae* (Bamy et al., 2010; Van Waerebeek et al., 2013).

#### **5.7.3.12. Blue whale, *Balaenoptera musculus* (Linnaeus, 1758)**

A herd of three blue whales was sighted above the continental break (depth 383 m; SST 21.2°C) in Gambian coastal waters at 13°17.558'N, 17°33.665'W, on 13 May 2013. A smallish individual (10–12 m), startled by the ship passing closely, blew three times as it fled subsurface exposing a mottled bluish-grey dorsum and a large splash-guard in front of the blowholes, but not its dorsal fin (Plate 5.7.1(10)). At 1 km, it joined a large individual, possibly its mother (Plate 5.7.1(11)). At 2.5 km, a third, adult-sized individual, also a pale bluish-grey, blew with a very tall, vertical columnar blow. Its small dorsal fin at the rear of the back was exposed only seconds before the whale submerged, when its blow had already dissipated. Encounter rate was estimated as 0.022 blue whales 100 km<sup>-1</sup>.

The winter breeding grounds and austral range of NE Atlantic blue whales remain unknown (Sears and Perrin, 2009). Very few historical records from West Africa are documented to any extent, but two concern vague whaling records. On 10 November 1947, the Soviet *Slava* whaling fleet encountered one and then three more blue whales at 18°10'N, 18°W (SST 25°C) (Kirpichnikov, 1950; Tomilin, 1967). On 1 March 1911, 12 blue whales were observed by other whalers at N16° between Cabo Verde and northern Senegal (Kirpichnikov, 1950). Three blue whales were sighted off La Gomera, Canary Islands, in April 1997 (Ritter and Brederlau, 1998; Ritter, 2001), and one large individual was confirmed off Mauritania at 19°22.44'N, 17°4.2'W on 4 December 2012 (Samba Ould Bilal, personal observations). No specimens of blue whales have been substantiated for any of the CCLME countries (Van Waerebeek et al., 2000, 2003). Two possible historical records include Cadenat's (1947) report of an 'enormous' whale of 25 m length at Malika beach, Dakar, on 5 May 1943, though stranded in April. The size alone would seem to confirm this record.

Maximum known size of northern fin whale *Balaenoptera physalus physalus* is 24 m (Gambell, 1985), an equally rare species off West Africa. Duguay (1976) attributed vertebrae and ribs collected from Rio de Oro (Western Sahara) to blue whale, without diagnostic arguments. According to Sears and Perrin (2009), blue whales sighted recently in winter and spring off the Azores and Canary Islands could be migrating north along the mid-Atlantic ridge to Iceland, where they are seen from May to September. The present record from The Gambia is the southernmost observation of *B. musculus* in the eastern North Atlantic.

### 5.7.3.13. Balaenopterid whales

Rorquals (*Balaenoptera* spp.) were commonly observed (n=26 groups) in all parts of the study area (encounter rate 0.26 rorquals 100 km<sup>-1</sup>), however usually from a considerable distance, hampering positive identification. Excluding the *B. musculus* encounter, 3 groups were attributed to Bryde's whale (*B. brydei*), 6 as Bryde's or sei whale, 1 probable sei whale (*B. borealis*), and 16 groups were unidentified *Balaenoptera* sp. The latter most likely comprise Bryde's and sei whales, two of the three most commonly confirmed rorquals in the study area (Bamy et al., 2010; Van Waerebeek et al., 2000). However, the recent stranding of an Omura's whale (*B. omurai*) in Mauritania (Jung et al., 2015), a first record in the Atlantic Ocean, further complicates the identification process. The smallish North Atlantic minke whale, although not uncommon in the region, was not sighted.

Five black baleen plates with pale, very fine fringe hairs, diagnostic for *B. borealis*, were recovered from demersal trawl haul "station 124" (mean depth=367.5 m,) off Mauritania at 17°40.2'N, 16°37.8'W, on 1 June 2012. At base, the baleen exposed non-decomposed connective tissue (Plate 5.7.1(12)). A small fragment of a sixth plate showed shearing edges, evidently ripped apart forcefully. The baleen may have originated from a recently dead carcass on the seafloor, or the bottom-trawl collided with a live sei whale and shear forces pulled out the baleen (deposited at IMROP collection, Nouadhibou).

## 5.7.4. DISCUSSION

### 5.7.4.1. General remarks

Of 270 sightings, 144 (53.3%) could be positively identified to species, and another 57 (21.1%) were tentatively identified as either a 'probable'-species or a rorqual/ziphiid. A quarter of sightings (24.4%) remained 'unidentified Delphinidae', mainly due to great distance and passing mode surveying. That three quarters of sightings were positively or tentatively identified confirms the usefulness of the R/V *Dr. Fridtjof Nansen* as opportunity platform for marine mammal work, despite the obvious limitations of passing mode.

The consistently dominant ecological role common dolphins play in coastal waters of NWA (>69% of total cetaceans) was historically demonstrated by an equivalent preponderance of *Delphinus* skulls at the IFAN-UCAD collection in Dakar, derived from strandings and by-catches, as compared to other marine mammal specimens (Van Waerebeek et al., 2000). *T. truncatus*, *G. macrorhynchus* and *S. attenuata* came a far second, third and fourth place in relative abundance (respectively, 1.80%, 0.61% and 0.59% of total number of cetaceans observed). Numerically, each of all other species represented less than 0.4% of sighted individuals (Table 5.7.2). Stenellid dolphins were infrequently seen, only 3.3% of sightings for 4 species, explainable due to minimal offshore surveying. However, some stenellids may be locally abundant, e.g. *S. frontalis* is one of the more common dolphins off the Canaries (Ritter, 2011). Also both that species and *S. attenuata* are often reported in the oceanic habitat around the Cabo Verde Islands (Hazevoet et al., 2010).

#### 5.7.4.2. Species not encountered in 2011-2013

Below we briefly discuss 11 cetacean species that are occasionally reported in the CCLME but were not encountered during the 2011-2013 surveys. Only the first three can be considered true CCLME species.

Harbour porpoise (*Phocoena phocoena*) – Adapted to cold temperate waters, the NWA population is closely associated with the Canary Current (Van Waerebeek et al., 2000). Recent stranding records, many from by-catches, suggest that *P. phocoena* is most common in Mauritania (Mullié et al., 2013). Near Cape Blanc, porpoises can be observed year-round from cliff-tops (Van Waerebeek and Jiddou, 2006). *P. phocoena* is notoriously hard to spot with sea states >2 Beaufort, hence it is one of few small cetaceans for which passive acoustic monitoring may be more effective than visual surveys (Boisseau et al., 2007). Morocco, Western Sahara, Mauritania and Senegal are range states for what is a highly discrete population, if not an unrecognized subspecies. Joal-Fadiouth (14°09'N, 16°49'W) is the southern confirmed range boundary (Van Waerebeek et al., 2000).

Atlantic humpback dolphin (*Sousa teuszii*) – This obligate inshore-dwelling delphinid was not sighted, despite the ship occasionally entering shallow (20 m depth), nearshore waters and the study region harbouring five of the eight defined stocks: Dakhla Bay, Banc d'Arguin, Saloum-Niumi, Canal do Geba/dos Bissagos and Guinea (Van Waerebeek et al., 2003, 2004; Van Waerebeek and Perrin, 2007b). Its threatened status is reflected in scarce sightings, small groups and an apparently discontinuous distribution. Few new records exist for Senegal and Guinea since earlier reviews, several of these by-catches (Bamy et al., 2010; Bamy, 2011; Van Waerebeek and Bamy, 2012; Djiba, personal observations).

Common minke whale (*Balaenoptera acutorostrata*) – Its seasonal presence in coastal waters of NWA, as far south as Senegal, is well-documented (Van Waerebeek et al., 1999). No minke whales were sighted, arguably because the 2011-2013 cruises did not cover boreal winter months when *B. acutorostrata* is thought to breed in the study area (Van Waerebeek et al., 1999). The rest of the year, minke whales migrate to cooler, higher latitudes, for feeding.

Another five typically offshore, tropical species which may occasionally be present in the more southern, Guinea Current-influenced, parts of the study area, as well as offshore of the Canary and Cabo Verde archipelagos include:

Spinner dolphin (*Stenella longirostris*) – This small tropical offshore delphinid is seldom recorded in the Canary Current, with only a few specimens known, a capture of four animals in Senegal in 1958 (Van Waerebeek et al., 2000) and a single stranding in the Canary Islands (Ritter, 2011). Four sightings were reported from deep waters off Cabo Verde (Reiner et al., 1996; Hazevoet and Wenzel, 2000).

Fraser's dolphin (*Lagenodelphis hosei*) – is known from a single specimen found stranded at Sangomar Island, Senegal, on 17 November 1997 (Van Waerebeek et al., 2000), a few deep-water sightings off the Canaries (Ritter, 2011) and a recent stranding at Cabo Verde (Torda et al., 2010).

Melon-headed whale (*Peponocephala electra*) – An offshore tropical delphinid infrequently recorded in mainland coastal waters of CCLME: a few strandings in Mauritania (Robineau and Vély, 1998), Senegal and Guinea-Bissau (Van Waerebeek et al., 2000). Two successive mass strandings at Boavista, Cabo Verde, on 17 and 19 November 2007 of healthy animals, with evidence of recent feeding, coincided with the passage of a nuclear submarine possibly using active sonar (Van Waerebeek et al., 2008b). A number of other strandings at Cabo Verde have little associated information (Hazevoet et al., 2010).

Pygmy killer whale (*Feresa attenuata*) – Another mid-sized tropical delphinid seldom encountered in the Canary Current. Known from a single skull retrieved in Senegal in 1966 (Van Waerebeek et al., 2000) and a very few sightings in the Canary and Cabo Verde Islands (Ritter, 2011; Hazevoet et al., 2010; Perrin and Van Waerebeek, 2009).

False killer whale (*Pseudorca crassidens*) - A large, deep-water delphinid rarely seen offshore of the Canary Islands (Ritter, 2011), and known from a few stranded specimens at Cabo Verde (Van Waerebeek et al., 2008b; Hazevoet et al., 2010).

Rough-toothed dolphin (*Steno bredanensis*) – Commonly sighted near the Canary (Ritter, 2011) and Cabo Verde Islands (Hazevoet et al., 2010), *S. bredanensis* is known from only a few strandings on the mainland, in Senegal (Cadenat, 1949) and Mauritania (Duguay, 1976; Perrin and Van Waerebeek, 2012).

Physeterids - Unsurprisingly, no physeterids were recorded, including pygmy sperm whale (*Kogia breviceps*) and dwarf sperm whale (*Kogia sima*), considering their normal distribution in deep oceanic waters (Van Waerebeek et al., 2000; Perrin and Van Waerebeek, 2012). However, KVV and Djiba found a partial skull of a sperm whale (*Physeter macrocephalus*) when beach-combing near Kayar on 3 June 2013. The Kayar canyon system may increase the danger of stranding among normally oceanic species, as they readily come close to shore.

#### 5.7.5. RECOMMENDATIONS

While accessory to fisheries research, the significant amount of relevant marine mammal data obtained underscores the value of surveying efforts from the EAF-Nansen platform-of-opportunity. The 2011-2013 cruises provided useful information on biodiversity, cetacean spatial and seasonal distribution, group composition, relative abundance, in addition to data on variation in external morphology. The incidental nature, in particular the absence of the option for closing on sightings, obviously detracts from the potential efficiency when compared to dedicated marine mammal surveys. However, by obviating ship-time, the results *versus* cost factor is highly beneficial. Hence we strongly recommend to systematically include marine mammal monitoring as an integral part of fisheries and oceanographic research cruises. These initial efforts should be expanded to cover all seasons and all African waters. A massive, multiple-year marine mammal dataset obtained through a long-term programme could ultimately minimize biases and compensate for many of the deficiencies of opportunistic sampling. Moreover, platform-of-opportunity cruises often offer convenient circumstances for training purposes, as to strengthen regional expertise in marine mammal research. Fully dedicated shipboard surveys will surely be needed at some point to obtain absolute abundance estimates, implement targeted sampling or answer specific questions. In the meantime, some limited ship-time (e.g. a few 15 min slots per cruise) could be assigned and selectively applied when particularly high-value observations occur.

A region-wide study of geographic variation in metric and non-metric cranial and external features of common dolphins *Delphinus* spp. would be desirable, to help elucidate population structure in African seas. Also, the feasibility of skin biopsy sampling to collect DNA from bowriding common dolphins (and other species), such as with adapted crossbows, coupled to the documentation of external features and ecological data, merits consideration for future projects.

Due to their wide coastal distribution in the CCLME, *D. delphis*, *T. truncatus*, *P. phocoena* and *S. teuszii* are the four small cetacean species most commonly falling victim to net entanglements on the NWA coasts (Van Waerebeek et al., 2000, 2003, 2004; Mullié et al., 2013). Although gillnets and midwater trawls are the

main suspects as problem gear causing detrimental interactions, there are minimal regional data on the dynamics and trends of fisheries-caused mortality. Fisheries observers should be trained and encouraged to consistently record and report marine mammal by-catches. A comprehensive database would allow a more prudent regional management, including the evaluation and introduction of effective mitigation measures.

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Table 5.7.2. Frequency distribution of number of sightings (and % value) per species or higher taxon, and total number ( $\Sigma$  ind.) of individuals (and %) estimated per species or higher taxon, for each of the 2011-2013 surveys, and pooled. Best estimates or, if missing, minimum estimates were used. Mixed species groups were split into its components and considered two sightings for statistical purposes.

TAXON	2011				2012				2013				2011-2013			
	Sights	%	$\Sigma$ ind.	%	Sights	%	$\Sigma$ ind.	%	Sights	%	$\Sigma$ ind.	%	Sights	%	$\Sigma$ ind.	%
Unidentified Delphinidae	32	26.9	1239	17.2	22	21.8	848	29.6	14	26.9	1000	18.09	68	25.0	3087	19.8
Short-beaked common dolphin	27	22.7	5423	75.3	31	30.7	1522	53.2	20	38.5	4175	75.6	78	28.7	11120	71.3
Probable short-beaked common dolphin	4	3.36	293	4.07	5	4.95	262	9.15	2	3.85	252	4.56	11	4.04	807	5.17
Common bottlenose dolphin	8	6.72	69	0.96	13	12.9	115	4.02	5	9.62	26	0.47	26	9.56	210	1.35
Probable common bottlenose dolphin	2	1.68	44	0.61	3	2.97	31	1.08	0	0	0	0	5	1.84	75	0.48
Pilot whale	3	2.52	24	0.33	2	1.98	4	0.14	2	3.85	40	0.72	7	2.57	68	0.44
Killer whale	0	0	0	0	0	0	0	0	3	5.77	12	0.22	3	1.10	12	0.077
Risso's dolphin	0	0	0	0	2	1.98	18	0.63	0	0	0	0	2	0.73	18	0.11
Probable Risso's dolphin	0	0	0	0	1	0.99	3	0.10	0	0	0	0	1	0.37	3	0.019
Atlantic spotted dolphin	2	1.68	26	0.36	3	2.97	18	0.63	0	0	0	0	5	1.84	44	0.28
Probable Atlantic spotted dolphin	0	0	0	0	1	0.99	5	0.17	0	0	0	0	1	0.37	5	0.032
Pantropical spotted dolphin	1	0.84	22	0.31	0	0	0	0	0	0	0	0	1	0.37	22	0.14
Clymene dolphin	0	0	0	0	0	0	0	0	1	1.92	13	0.24	1	0.37	13	0.083
Striped dolphin	0	0	0	0	1	0.99	12	0.42	0	0	0	0	1	0.37	12	0.077
Unidentified rorquals	4	3.36	5	0.07	10	9.9	17	0.59	2	3.85	2	0.036	16	5.88	24	0.15
Bryde's whale	0	0	0	0	3	2.97	4	0.14	0	0	0	0	3	1.10	4	0.026
Bryde's / sei whale	6	5.04	6	0.08	0	0	0	0	0	0	0	0	6	2.21	6	0.038
Probable sei whale	1	0.84	2	0.03	0	0	0	0	0	0	0	0	1	0.37	2	0.013
Blue whale	0	0	0	0	0	0	0	0	1	1.92	3	0.054	1	0.37	3	0.019
Humpback whale	17	14.3	33	0.46	0	0	0	0	0	0	0	0	17	6.25	33	0.21
Probable humpback whale	4	3.36	10	0.14	0	0	0	0	0	0	0	0	4	1.47	10	0.064
Unidentified cetacean (whale)	8	0	10	0	3	2.97	3	0.10	2	3.84	3	0.054	13	4.78	16	0.10
Beaked whale (Ziphiidae)	0	0	0	0	1	0.99	1	0.03	0	0	0	0	1	0.37	1	0.006
Total	119	100	7206	100	101	100	2863	100	52	100	5526	100	272	100	15595	100

Plate 5.7.1. (1) Short-beaked common dolphin (*Delphinus delphis*), the most widely spread cetacean in the CCLME ecosystem (© Koen Van Waerebeek). (2) Short-beaked common dolphin (*Delphinus delphis*). Note the significant variation in colouration compared to specimen in photo 1. (© Koen Van Waerebeek) (3) Common bottlenose dolphin (*Tursiops truncatus*), 15 May 2012 (© Koen Van Waerebeek) (4) Short-finned pilot whales (*Globicephala macrorhynchus*) live-stranded at Yoff, Senegal, 17 August 2005 (© Abdoulaye Djiba, COREWAM). (5) Small pod of killer whales (*Orcinus orca*) travelling nearshore close to Kayar, Senegal, 9 May 2013 (© Koen Van Waerebeek) (6) Juvenile killer whale (*Orcinus orca*) interacting with green turtle near Joal, Senegal, in 2012 (© Abdoulaye Djiba, COREWAM).



Plate 5.7.2. (1) Adult Risso's dolphin (*Grampus griseus*) off the central Moroccan coast, 11 July 2012 (© Koen Van Waerebeek). (2) A heavily spotted, physically mature Atlantic spotted dolphin (*Stenella frontalis*) (© Koen Van Waerebeek). (3) A first record of the striped dolphin (*Stenella coeruleoalba*) off Atlantic Morocco, 7 July 2012 (© Koen Van Waerebeek). (4) Juvenile blue whale (*Balaenoptera musculus*) fleeing the passing ship, in direction of the adult shown in photo 5. The Gambia, 13 May 2013. Note the mottled bluish-grey dorsum (© Koen Van Waerebeek). (5) Adult blue whale (*Balaenoptera musculus*) surfacing: blow has dissipated but the small dorsal fin, at the rear of the back, is not yet visible (© Koen Van Waerebeek). (6) Fresh baleen plates of sei whale (*Balaenoptera borealis*) recovered from a demersal trawl haul off Mauritania, 1 June 2012 (© A. Samba Ould Bilal).



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