

Cetacean stranding records along the Danish coastline: records for the period 2008-2017 and a comparative review

Carl Chr. Kinze¹, Charlotte B. Thøstesen² & Morten T. Olsen³

¹ Cetacean Atlas of Denmark, Rosenørn Alle 55 2tv, DK-1970 Frederiksberg C, Denmark,
e-mail: cck@hvaler.dk

² Fisheries and Maritime Museum, Tarpbagevej 2, DK- 6710 Esbjerg, Denmark

³ Natural History Museum of Denmark, University of Copenhagen, Øster Voldgade 5-7, 1350 Copenhagen K, Denmark

Abstract: For the period 2008-2017, finds of stranded cetaceans along the Danish coastline are listed and reviewed in comparison to the preceding 40-year period (1968-2007). The harbour porpoise (*Phocoena phocoena*) was by far the most commonly stranded species with a total of 1177 individuals for the period 2008-2017. Of these, 62.4% ($n=735$) originated from the North Sea and Skagerrak coastlines, i.e. the outer Danish waters (ODW), 37.0% ($n=435$) from the Kattegat and Belt Sea, i.e. the inner Danish waters (IDW), and 0.6% ($n=7$) from the waters around Bornholm (WAB), i.e. the Baltic Sea proper. Due to the large number and the amount of information for these records only a summary is given. In addition, 90 strandings of twelve other cetacean species occurred between 2008-2017. These comprise 49 white-beaked dolphins (*Lagenorhynchus albirostris*), three white-sided dolphins (*Leucopleurus acutus*), seven common dolphins (*Delphinus delphis*), a striped dolphin (*Stenella coeruleoalba*), a Risso's dolphin (*Grampus griseus*), four long-finned pilot whales (*Globicephala melas*), a killer whale (*Orcinus orca*), a Sowerby's beaked whale (*Mesoplodon bidens*), six sperm whales (*Physeter macrocephalus*), 14 minke whales (*Balaenoptera acutorostrata*), two fin whales (*Balaenoptera physalus*) and a humpback whale (*Megaptera novaeangliae*). During the last 50 years (1968-2017) five additional cetacean species have stranded on the Danish coasts: bottlenose dolphin (*Tursiops truncatus*) in 1968, 1975 and 1976, beluga (*Delphinapterus leucas*) in 1976 and 1987, northern bottlenose whale (*Hyperoodon ampullatus*) in 1969 and 1998, Bryde's whale (*Balaenoptera brydei*) in 2000, and sei whale (*Balaenoptera borealis*) in 1980. The cetacean fauna around Denmark falls into the following categories: 1. native species such as the harbour porpoise, white-beaked dolphin, and minke whale; 2. resilient visitors, i.e. species such as common dolphin, fin whale and humpback whale that during their occurrences adapt well to altered environmental conditions encountered; and 3. erratic stragglers of oceanic, pelagic origin failing to adapt, such as long-finned pilot whale, Sowerby's beaked whale and sperm whale.

Keywords: cetaceans, strandings, Denmark, comparative review.

Introduction

Cetacean strandings constitute one of the most important sources for the study of

regional and temporal cetacean diversity and the retrieval of basic population parameters, and hence nature management and conservation measures. The first comprehensive review covering the waters around Denmark and the period 1575-1992 was provided by Kinze (1995) with subsequent compilations

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and reviews covering the periods 1993-1997 (Kinze et al. 1998) and 1998-2007 (Kinze et al. 2010). For the most common species, the harbour porpoise (*Phocoena phocoena*), comparable quantitative data were not collected before the year 2008 and are therefore not available for an analysis. This article presents a detailed overview of cetacean strandings for the entire Danish coastline covering the period 2008-2017 and provides a comparative analysis with the preceding four decadal periods (1968-2007).

Material and methods

Although a formal stranding network for rare sea creatures was set up in Denmark as early as 1885, for many years specimens were not collected systematically and compilations of records rather restricted to summarising accounts (Tauber 1880, Winge 1899, 1908, Degerbøl 1935). Bondesen (1951, 1977) published popular overviews of cetacean strandings including records dating back to the 17th century, but collecting efforts were continuously hampered by the lack of funds, and for the more common species also the lack of attention. Only in 1980, the Zoological Museum of Copenhagen (now the Natural History Museum of Denmark) began to register cetacean strandings systematically and to collect as many non-phocoenid specimens as possible. These efforts provided the basis for the Danish Contingency Plan which was launched in 1993, and has been in operation ever since as a co-operative network between the Natural History Museum of Denmark, the Fisheries and Maritime Museum, Esbjerg and the Danish Environmental Protection Agency. Recently, also the Department of Bioscience at University of Aarhus and DTU Vet National Veterinary Institute became partners. Annual or biannual reports have been published since 2003 (Thøstesen 2018). Having no dedicated personnel to patrol the beaches, the records rely strongly on observations by the public and

Table 1. Summary of harbour porpoise strandings for the period 2008-2017 divided by zoo-geographical region outer Danish waters (ODW), inner Danish waters (IDW) and the waters around Bornholm (WAB)

Year	Zoo-geographical region			Total
	ODW	IDW	WAB	
2008	149	75	0	224
2009	49	84	1	134
2010	73	46	0	119
2011	97	50	1	148
2012	66	52	3	121
2013	102	34	0	136
2014	78	43	0	121
2015	9	13	1	23
2016	57	19	1	77
2017	55	19	0	74
Total	735	435	7	1177

local game wardens and numbers thus constitute a minimum. For several cases, strandings were preceded by sightings near the stranding location, in which case the date of the observation was retained in the record.

The present study summarises the cetacean strandings for the period 2008-2017 and compares with four preceding decadal periods (1968-2007) – for each species and in a zoo-geographical context.

Results and review

Harbour porpoise (*Phocoena phocoena*)

The harbour porpoise is regarded as the only native cetacean species occurring in all waters around Denmark, i.e. both along the North Sea and Skagerrak coastlines (ODW=outer Danish waters), the Kattegat and Belt Sea coastlines (IDW =inner Danish waters), and the waters around Bornholm (WAB part of the Baltic Sea proper). In contrast to other national compilations in adjacent countries, in Denmark harbour porpoise stranding data were not systematically collected and compiled before 2008. Dedicated schemes during

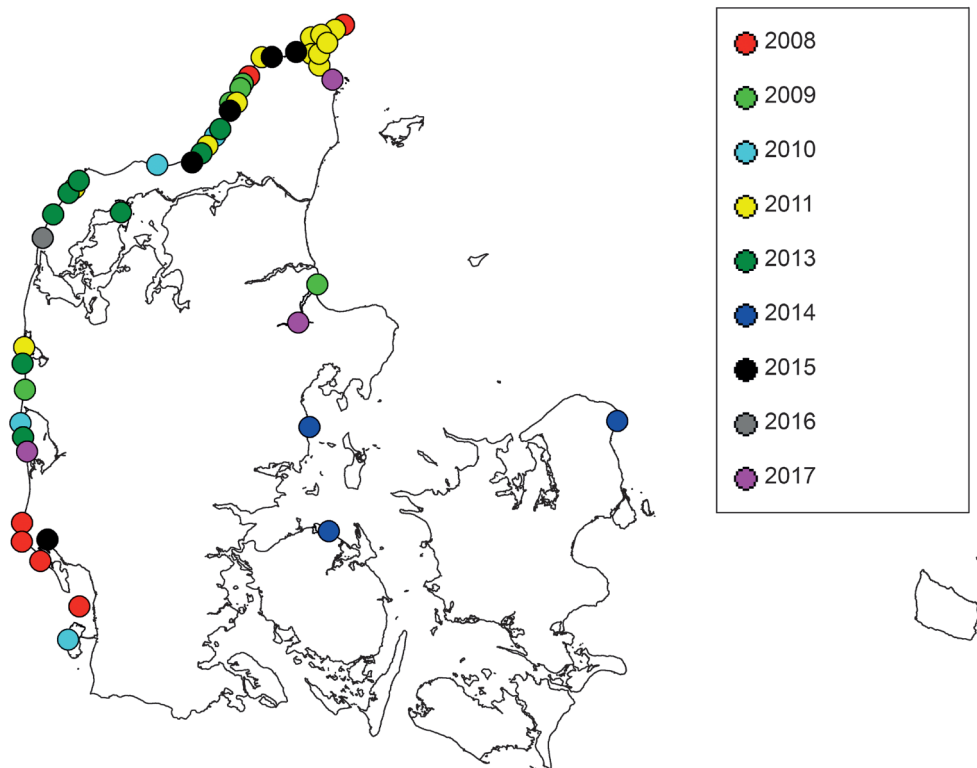


Figure 1. Strandings of white-beaked dolphin recorded between 2008-2017.

certain periods collected larger numbers of specimens, such as *Projekt Marsvin* (1983-1990; Kinze 1990) and *Fokus på Hvaler i Danmark* (2000-2003; Kinze et al. 2003).

For the years 2008-2017 a total of 1177 animals was documented (table 1). Geographically subdivided, they fall into 735 (62.4%) animals from the ODW, 435 (37.0%) from the IDW, and just 7 (0.6%) from the WAB. While the ODW and the WAB exhibit relatively straight coastlines of 606 km and 158 km, respectively, the inner Danish waters constitute an archipelago of islands, straits and peninsulas with a total coastline approaching 8000 km in length. Thus, stranding figures from this latter region are certainly underestimated.

For 2015-2017, figures are not comparable to the preceding years due to a break in the reporting effort. Between 2008 and 2014, figures fluctuated between 121 and 224 records per year.

White-beaked dolphin (*Lagenorhynchus albirostris*)

Once considered a rare northern species, the white-beaked dolphin now is regarded as native to the outer Danish waters, i.e. the Skagerrak and the north-eastern North Sea (figure 1). It is by far the most frequent non-phocoenid cetacean in the stranding record (table 2, figure 2). The most recent period from 2008-2017 yielded 49 individuals, the second highest total after the preceding 10-year period. Noteworthy is that the year 2012 did not yield a single specimen. Just four individuals (8% of the total) originated from the inner Danish waters south of Skagen. The comparable figures for the period 1998-2007 for the inner Danish waters were 8 out of 69 animals (11.6%) and 6 out of 41 animals (14.6%) for 1988-1997.

Table 2. Summary of cetacean strandings along the Danish coastline over a 50-year period from 1968 to 2017.

Species	Abbrevia- tion	First record	1968-1977	1978-1987	1988-1997	1998-2007	2008-2017	Total
White-beaked dolphin	WBD	1845	6	19	41	69	49	184
White-sided dolphin	WSD	1942	1	0	2	6	3	11
Common dolphin	CMD	1865	0	1	0	8	7	16
Striped dolphin	STD	1998	0	0	0	1	1	2
Bottlenose dolphin	BND	1844	4	0	0	0	0	4
Long-finned pilot whale	LFP	1863	0	2	8	4	4	18
Killer whale	KIW	1679	1	1	2	1	1	6
Risso's dolpin	RID	1938	0	0	0	0	1	1
Beluga	BEW	1903	1	1	0	0	0	2
Sowerby's beaked whale	SBW	1880	1	0	1	0	1	3
Bottlenose whale	NBW	1838	1	1	1	0	0	3
Sperm whale	SPW	1572	1	4	39	1	7	51
Minke whale	MIW	1824	3	5	6	18	14	43
Bryde's whale	BRW	2000	0	0	0	1	0	1
Sei whale	SEW	1955	0	1	0	0	0	1
Fin whale	FIW	1603	0	0	0	0	2	2
Humpback whale	HUW	1806	0	0	0	0	1	1
Total			19	35	100	109	90	349

Two pregnant females were documented; their foetuses measured 43 cm (18 January) and 35 cm (27 November), adding to the rather limited knowledge of reproduction in this species.

White-sided dolphin (*Leucopleurus acutus*)

The white-sided dolphin, formerly known as *Lagenorhynchus acutus*, has a more pelagic habitat than the white-beaked dolphin. Surprisingly therefore, it was documented for the first time in Denmark in the inner Danish waters in 1942 (Isefjord, Sealand; Degerbøl 1943). Between 1988 and 2007 finds mirror the general distribution of the species in the adjacent deeper parts of the North Sea along the North Sea and Skagerrak coastlines since all strandings have hitherto taken place here. In the present period, two strandings have been documented from the North Sea coastline and, interestingly, also one from

the inner Danish waters (figure 3). Overall, this is a decline in comparison to the preceding 10-year period and the same figure as for 1988-97 (table 2).

Common dolphin (*Delphinus delphis*)

The first documented common dolphin specimen from Denmark originates from the year 1865 (Kinze 1995). It is a shelf species usually inhabiting warmer and more southerly waters than the seas around Denmark. During certain times, however, an influx has been noted with individuals taking residence for longer periods. Sightings of small schools and individual animals have been reported since about 1990, and strandings occurred almost every year (Jensen & Kinze 2005) (table 2). For the years 2008-2017, individuals were found both in ODW and IDW (figure 3; appendix).

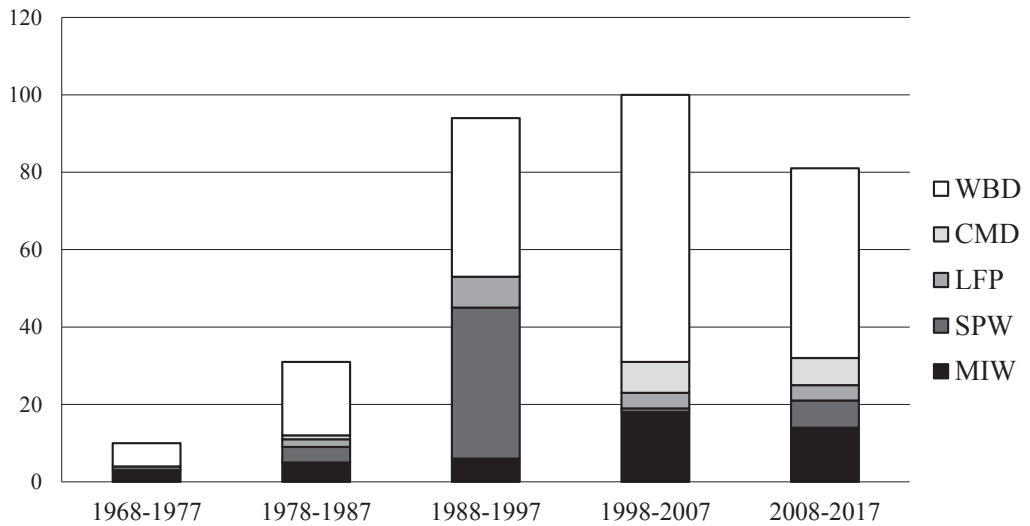


Figure 2. Number of recorded strandings in Denmark during 1968-2017 summarised for the five most common non-phocoenid species; white-beaked dolphin (WBD, 52%), sperm whale (SPW, 15%), minke whale (MIW, 12%), long-finned pilot whale (LFP, 5%) and common dolphin (CMD, 4%).

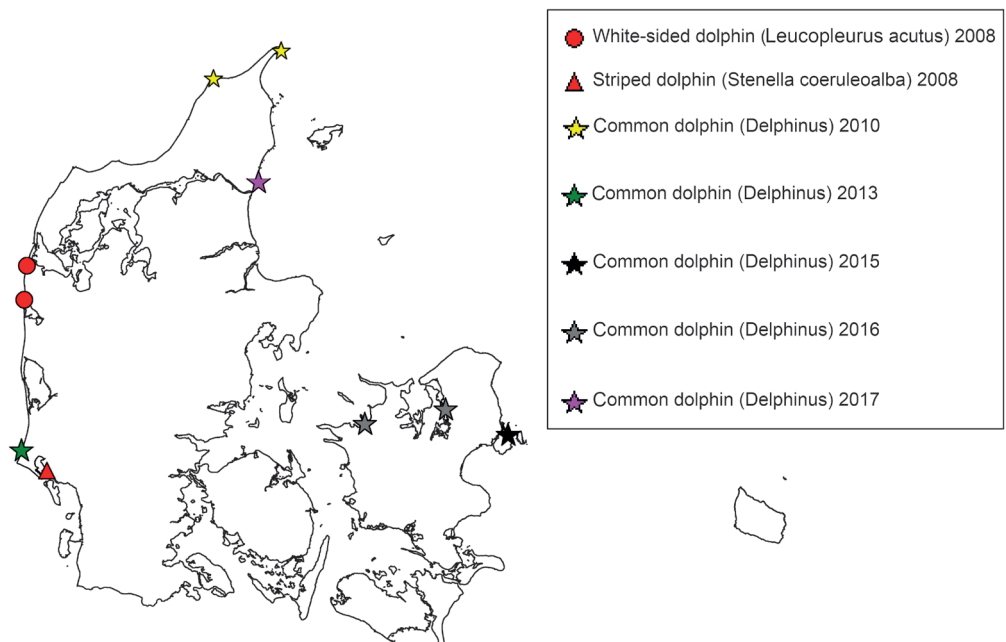


Figure 3. Strandings of white-sided dolphin, common dolphin and striped dolphin recorded between 2008-2017.

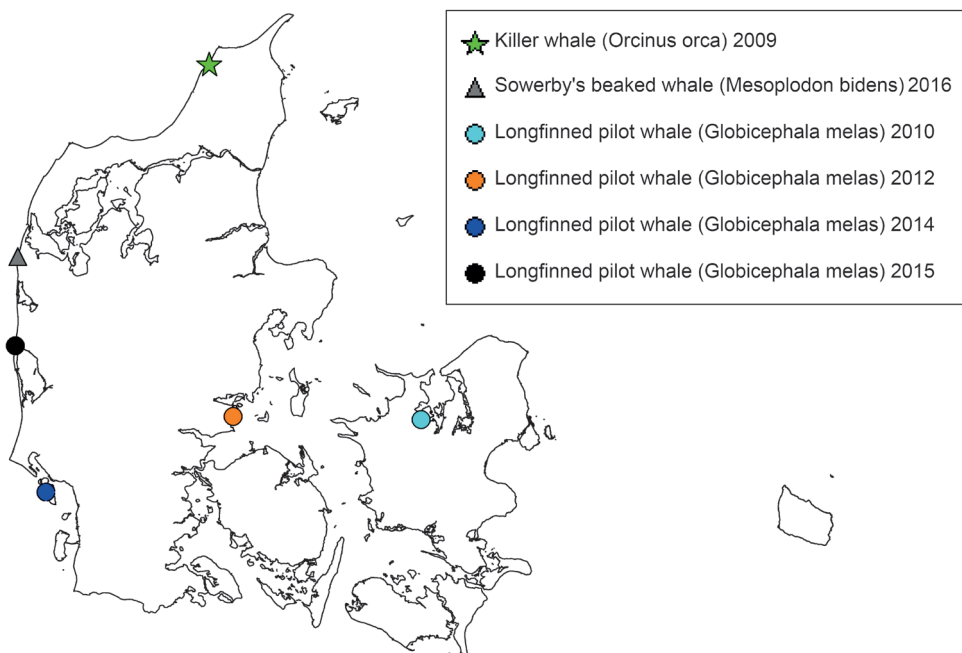


Figure 4. Strandings of killer whale, long-finned pilot whale and Sowerby's beaked whale recorded between 2008-2017.

Striped dolphin (*Stenella coeruleoalba*)

The striped dolphin is a tropical and subtropical pelagic species, only recorded from the Danish coasts twice, in 1998 and 2008 (Kinze et al. 2000, Thøstesen et al. 2009) (table 2, figure 3). Additionally, a single individual was sighted in 2000 near the island of Anholt (Kinze 2007).

Bottlenose dolphin (*Tursiops truncatus*)

The bottlenose dolphin has a long history of occurrence in the North Sea, yet there are rather few recorded strandings from the Danish North Sea coast (table 2). There are only two confirmed records, from Manø in 1957 and from Trans Strand in 1968, and in addition a dubious record from Blåvandshuk in 1847 for which verification has not been possible (Kinze 1995). The first record of this species from the inner Danish waters was

documented in 1844 when a small school was killed at Frederiksgave near Assens in the Little Belt (Kinze 1995). In 1870, there was a large influx into the Baltic Sea, yielding 49 individuals at the porpoise catch site at Gamborg Fjord, and in the 1940s and 1970s, there were periodical occurrences. In 1998, a specimen was found in the Baltic proper on the border between Lithuania and Latvia. Most recently, in 2015-2016, a small school entered the Baltic Sea, with one female stranding on the island of Öland, Sweden, and three live males observed at various localities in the inner Danish waters (Kinze & Thøstesen 2016).

Long-finned pilot whale (*Globicephala melas*)

The long-finned pilot whale is a pelagic, primarily squid eating boreal species rather commonly occurring in the Skagerrak. The first documented find originated from the Isef-

jord area (Reinhardt 1864). Quite commonly, there are sightings in the deeper parts of the Skagerrak have been reported, hence most strandings have taken place along the Skagerrak coasts, with occasional records further south along the Danish North Sea coastline. For the period 2008-2017, two records originated from the inner Danish waters and two from the North Sea coast of Denmark (figure 4, table 2).

Killer whale (*Orcinus orca*)

The killer whale used to share with the minke whale the position of third most common cetacean species along the Danish coasts. However, the fifty-year period 1968-2017 produced six specimens (including one record between 2008 and 2017; figure 4), slightly less than the preceding periods 1868-1917 and 1918-1967, each providing nine records (Kinze 1995; table 1). Taking into account the increased effort and hence possibility of detection, we regard this as an indication for a decline in occurrence.

Risso's Dolphin (*Grampus griseus*)

The Risso's dolphin is a rare visitor to the inner Danish waters where it has been encountered only three times: twice in 1938 (Degerbøl 1939) and once in 2007 (Kinze et al. 2010; table 1). Due to its teuthophagic habit, it should be considered an erratic species. Likewise, there are few records of the species from adjacent waters, with a single find from the Swedish Kattegat coast in 1927 (Lepiksaar 1966) and two German records from the North Sea coast, both for the year 1873 (Möbius 1873).

Beluga (*Delphinapterus leucas*)

The beluga is an arctic species with a preference for coastal habitats, but extra-limital

occurrences in adjacent temperate waters are not infrequent. Jensen et al. (1987) and Kinze (1988) reviewed the occurrences in Danish waters, describing several historic intrusions of belugas through Danish straits into the Baltic Sea proper in 1841, 1869, 1884 and from 1903-1908 (Kinze et al. 2011). More recently, the species has been sighted in 1995 and 2012 in Danish waters, and in 2016 in adjacent Swedish waters (Kinze 2007, Jensen 2012, Lysen 2016). Due to its great resilience to cope with even complex coastal conditions, individual belugas may often survive their beaching and get free, and in contrast to almost all other cetacean species, belugas may be underrepresented in the stranding record (considering strandings as an indicator of occurrence), because sightings may occur much more frequently than fatal strandings. For instance, during the fifty-year period from 1968-2017 only three dead corpses have been recorded (in 1964, 1976 and 1987), all originating from incidental catches in fishing gear (Kinze 1995) (table 2).

Sowerby's beaked whale (*Mesoplodon bidens*)

Sowerby's beaked whale is an oceanic species encountered irregularly along the Danish coasts, mostly when entering from the deeper parts of the Skagerrak. The period 2008-2017 only yielded a single specimen, a young male and presumably the youngest individual so far encountered along the Danish coastline (table 1, figure 4). During 2015, another individual swam undetected through the Danish straits and was first sighted off the German Baltic coast. It was eventually found dead near Karlskrona on the Swedish Baltic Sea coast (Dähne 2015, Lyrholm 2015).

Bottlenose whale (*Hyperoodon ampullatus*)

The bottlenose whale is a North Atlantic oceanic species with infrequent occurrence in

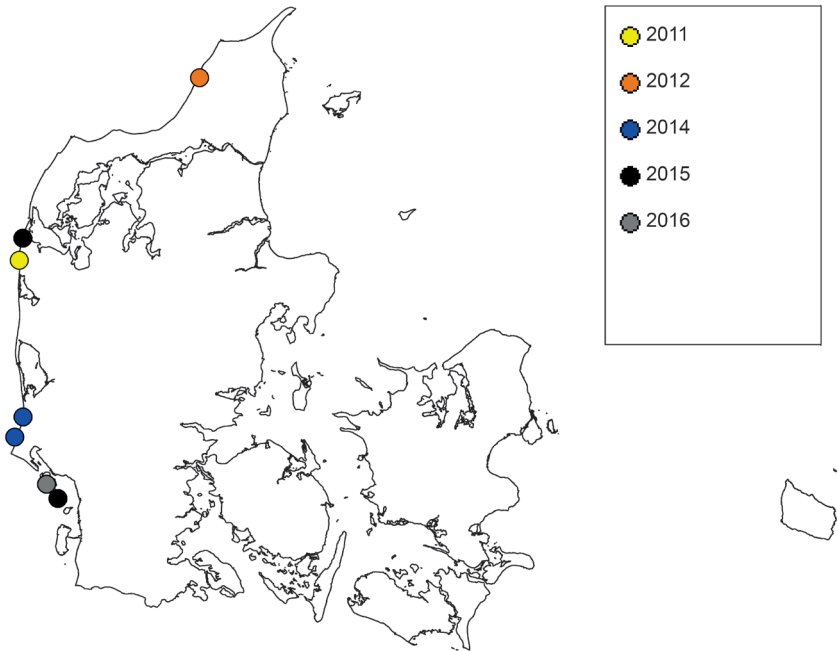


Figure 5. Strandings of sperm whale recorded between 2008-2017.

Danish waters. The latest stranding took place in the inner waters on the island of Tåsinge in 1998, while in 2000 there was a live stranding near Hundested at the entrance of the Isefjord on the island of Sealand (table 2). A rescue operation prevented a fatal stranding. The occurrence of this species in Danish and adjacent waters can be traced back in time to at least 1661, with a catch in the harbour of Aabenraa, Little Belt coast of Jutland (Kinze et al. 2011), and possibly even to 1634 in the Flensborg Fjord (Kinze 1995).

Sperm whale (*Physeter macrocephalus*)

The present period (2008-2017) yielded five single strandings of sperm whales as well as a stranding of two individuals (table 2, figure 5, Hansen et al. 2016). Records from the inner Danish waters are very rare, but in 2016, an individual was sighted in the northern Sound and Kattegat at several localities, and it is believed that it eventually escaped these unfam-

miliar waters.

It is obvious that during the present period, a relatively large number of strandings occurred when compared with the preceding ten-year period. However, the figure is still very low in comparison to the period before that (1988-1997), totalling 69 individuals with several mass strandings - in particular on the island of Rømø in April 1996 (16 individuals) and December 1997 (13 individuals) (Jensen & Tougaard 1997, 1998, Tougaard & Kinze 1999; table 2). Sperm whale strandings along the Danish North Sea and Skagerrak coast have been documented back to the year 1572 and fit the general North Sea scenario, i.e. all males stranding, and mainly from November through April (Smeenk 1997, Smeenk & Evans, this volume). It is noteworthy that only a single specimen was documented from the Danish west coast in the aftermath of the North Sea mass-stranding event of 2016 (Ijs-seldijk et al. 2018).

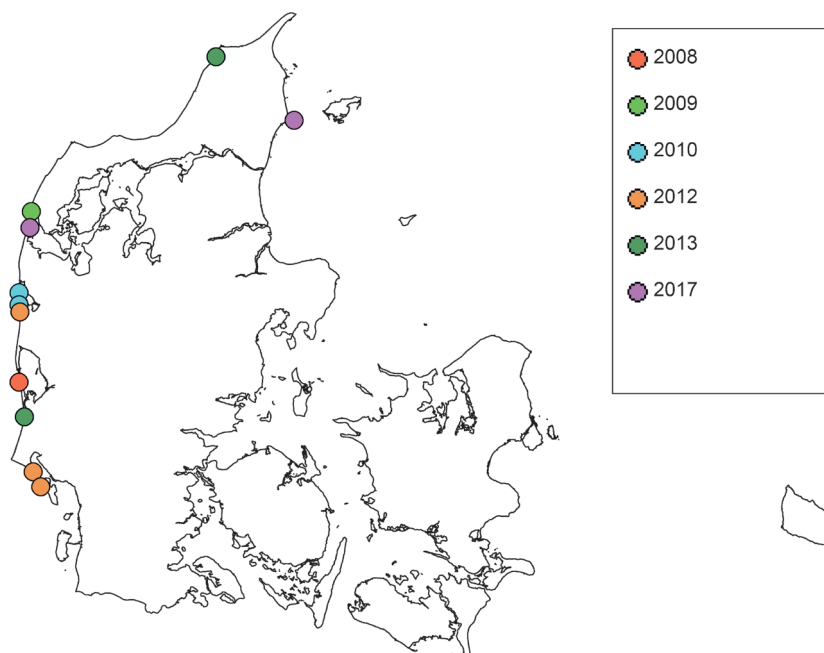


Figure 6. Strandings of minke whale recorded between 2008-2017.

Minke whale (*Balaenoptera acutorostrata*)

The minke whale is to be considered a native species in the central and northern North Sea and hence the outer Danish waters. During 2008-2017, 14 specimens were recorded (16%; $n=89$) (figure 6), further establishing the species as the third most common cetacean species in Danish waters (table 2, figure 2). Corresponding figures for earlier periods are 26% (1998-2007; $n=69$), 15% (1988-1997, $n=41$), 20% (1968-1977, $n=35$), and 16% (1968-1977, $n=19$). The species was not encountered in the inner Danish waters during the period 2008-2017, but several individuals were found stranded on the German and Swedish Baltic coasts as well as sighted in the area (M. Dähne, personal communication, www.valar.se). Earlier ten-year periods yielded five (1998-2007), one (1988-1997), two (1978-1987) and two (1968-1977) individuals.

Bryde's whale (*Balaenoptera brydei*)

This subtropical and tropical pelagic species was documented from the inner Danish waters in 2000 (Kinze 2006; table 2). In addition, there is a likely preceding occurrence from the German Baltic coast in 1944 (Kinze et al. 2011), but, otherwise, the species is extremely rare in northern Europe.

Sei whale (*Balaenoptera borealis*)

This pelagic species was encountered in 1955 for the first time in Danish waters on the island of Tåsinge, inner Danish waters, and again in 1980 on the northern shore of the island of Als, when a heavily decayed whale corpse could be identified as sei whale, based on skeletal features (Kinze 1995). Remarkably, the type specimen of the species originates from a 1819 stranding in the Baltic Sea (Grömitz, Schleswig-Holstein, Germany).

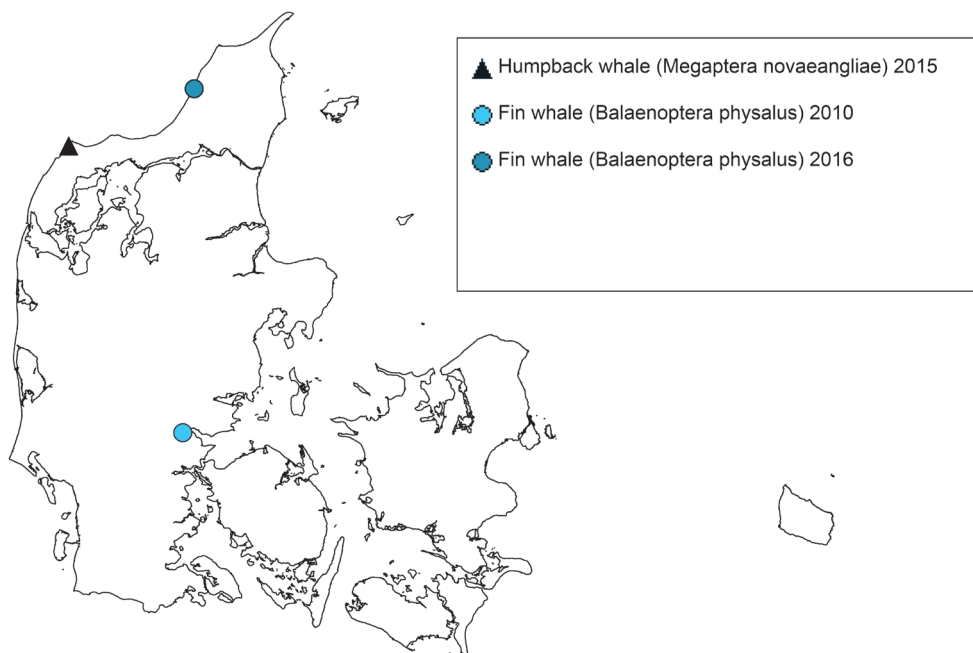


Figure 7. Strandings of fin whale and humpback whale recorded between 2008-2017.

Fin whale (*Balaenoptera physalus*)

Fin whales were found stranded on two occasions: in 2010 and 2016, in the inner Danish waters and on the Skagerrak coastline, respectively (table 2, figure 7). The species had last been recorded stranded in 1958. Both specimens were about 17 m long, but of very different age. The 2010 individual was very old (120 years, according to Nielsen et al. 2012), but of relatively small size, while the 2016 individual was a maturing and much younger male (Jo et al. 2017). Since 2003, one or two fin whales have been sighted regularly in the inner Danish waters (Jensen et al. 2004, Jensen & Kinze 2010) and three individuals have been found dead on the German and Polish Baltic coasts (Harder et al. 2011). Fin whale intrusions into the Baltic proper have been documented over the last centuries and maybe should not be regarded erratic occurrences, but rather trips exploring new feeding areas since individuals have appeared and reappeared at the same localities to prey on shoaling fish (Jensen & Kinze 2011).

Humpback whale (*Megaptera novaeangliae*)

The humpback whale is a piscivorous baleen whale, but unlike the fin whale, it seems to be an opportunistic feeder without 'fixed' feeding localities (Harder et al. 2011). The humpback whale has rarely been encountered stranded along the Danish coasts. The first record was an animal killed in 1806 near Bornholm in the Danish Baltic Sea (Harder et al. 2011). The second record is from 1905, a stranding on the Skagerrak coast (Kinze 1995). In 2015, only the third stranding was recorded - also in the Danish North Sea, in the Skagerrak (table 2, figure 7). During the present period (in 2008, 2012 and 2014), several sightings of the species have been documented on return trips to and from the Baltic proper (Kinze & Jensen 2015). Earlier periods had also yielded sightings of the species in 1978-1979, 2004, and 2006. A single stranding of a young male occurred in 2003 on the German Baltic seaboard (Harder et al. 2011).

Diversity over time and in space

Species origins

According to Kinze et al. (2001), cetaceans encountered in Danish waters have three “waters of origin” in geographical terms: northerly, native and southerly waters, which climatologically can be classified into sub-tropical, temperate, and subarctic-arctic waters. In ecological terms, three categories should also be differentiated: coastal and riverine species, shelf species and pelagic species. The first category consists of native species, the second comprises species that appear capable of adapting to the waters around Denmark (referred to here as “resilient”), while the third includes all remaining erratic species. Whether a species is termed “resilient” or “erratic” hence depends on how well it adapts to or copes with altered abiotic and biotic environmental conditions. As discussed in the following text, several species have exhibited increased stranding frequencies in Danish waters, which may reflect range shifts due to climate change or changes in prey abundance, range expansions due to increase in cetacean populations, increased disease prevalence due to pathogens or contaminants, and/or increased attention and recording of stranded animals (table 3).

Temporal patterns in stranding records

For the period 2008-2017, a total of 90 non-phocoenid cetacean specimens representing ten species have been documented by strandings and a further two species only by sightings, bringing the total to twelve species recorded in Danish waters (table 2; appendix). None of them were new to the Danish fauna list, and three of them – the harbour porpoise, white-beaked dolphin and minke whale – are considered native to Danish waters (Kinze 2007).

During the last 50 years, 18 different ceta-

Table 3. Occurrence of selected cetacean species in the three zoo-geographical regions of Denmark

Species	Zoo-geographical region		
	ODW	IDW	WAB
HBP	N	N	N
WBD	N	R	R
MIW	N	R	E
CMD	R	R	R
BND	R	R	R
KIW	R	R	R
HUW	R	R	R
BEW	R	R	R
FIW	R	R	E
SPW	E	E	E
SBW	E	E	E
WSD	E	E	E
LFP	E	E	E

N = Native, R = Resilient visitors, E = Erratic

cean species, including the harbour porpoise, have been encountered, while five species previously recorded in Denmark have remained absent. Species only encountered before 1968 include the narwhal (*Monodon monoceros*), only recorded once in 1960, pygmy killer whale (*Feresa attenuata*) recorded once in 1944, blue whale (*Balaenoptera musculus*), last recorded in 1936, false killer whale (*Pseudorca crassidens*), last recorded in 1935, and northern right whale (*Eubalaena glacialis*), only known from 1838 (Kinze 1995, 2007, 2013).

Zoo-geographical subdivision

In terms of hydrography, the Danish national waters include outer Danish waters forming part of the North Sea and Skagerrak regime, the inner Danish waters consisting of the Kattegat, Belt Sea and Sound, and the waters around Bornholm as an integral part of the Baltic Sea proper. These regions differ in their average water depth, as well as in their distance to the open Atlantic Ocean, lead-

ing to an expected gradual decline in number of species recorded from the outer Danish waters via the inner Danish waters to the waters around Bornholm (table 3).

Outer Danish waters

With the exception of the shallow Wadden Sea region dominated by strong tidal fluctuations, the outer Danish waters are characterised by depths greater than 30 m, with deeper waters in particular in the Danish part of the Norwegian Trench within the Skagerrak. The outer Danish waters are home to three cetacean species: the harbour porpoise, white-beaked dolphin and minke whale which have all-year presence in the region (Kinze 2007; table 3). In addition, despite their oceanic habit, five other species (all odontocetes) have been frequently encountered in this area. The white-sided dolphin occurs commonly in the deeper parts of the Skagerrak i.e. the Norwegian Trench, and scattered records of the species exist from the west coast of Jutland. In contrast, the long-finned pilot whale, Sowerby's beaked whale, bottlenose whale and sperm whale all are deep-water specialists that only occur sporadically, perhaps being (mis)guided by the deep Norwegian Trench into the shallower Danish waters. There is a lengthy time series of sperm whale strandings, especially along the west coast of Jutland, and in particular within the shallow Wadden Sea region. When entering the North Sea, described by Smeenk (1997) as a sperm whale trap, male groups or singletons apparently rarely find food (see Pierce et al., this volume, and references therein) and most eventually perish on beaches (Smeenk 1997, Smeenk & Evans, this volume). Sometimes dead specimens get re-floated and are washed ashore elsewhere.

Inner Danish waters and waters around Bornholm

The only native species to this region is the harbour porpoise, while both white-beaked dolphins and minke whales are considered regular visitors (table 3). The minke whale

of the North Atlantic is a piscivorous species with a rather frequent occurrence in the inner Danish waters. It is vulnerable to the large numbers of static nets in this area. Common dolphin, killer whale, beluga, fin whale and humpback whale are regarded as periodical or seasonal visitors and can often survive quite well in these waters exhibiting *resilience* to altered environmental conditions.

The common dolphin has probably always had a background occurrence in Danish waters, but since 1990 a marked increase in sightings as well as strandings. However, the species is challenged in particular during winter time due to the occasional formation of sea ice. The bottlenose dolphin only appeared in the stranding records during the period 1968-1977, but in most recent years has been sighted in Danish and inner Baltic waters, possibly as a consequence of increased influx of warm Atlantic water. In earlier times, until about 1975, the source of these occurrences was the southern North Sea. The recent reappearance is instead believed to consist of individuals originating from the Scottish coasts, whose range nowadays extends well beyond the Moray Firth (e.g. Stockin et al. 2006). Potentially, further range expansion could bring about entire schools taking up new residence and lead to the formation of entirely new populations.

The killer whale occurs in habitats of widely different salinity, bathymetry and food availability, but as top predator also is very sensitive to environmental pollution (Jepson et al. 2016). In recent years, the species has become less frequent in the Danish stranding record, possibly supportive of a general lack of reproduction reported in a community from the western British Isles in recent decades (Jepson et al. 2016).

Beluga visits to the inner Danish waters are not infrequent and individuals fare well even in the complicated coastal environments of the Danish archipelago and the Baltic proper. Genuine strandings of the species are rare and corpses encountered should rather be

regarded as by-catch casualties. In the early 1900s, several individuals swam through the Danish straits and subsequently survived in the upper Baltic Sea for years - a phenomenon perhaps to be re-interpreted as a colonisation attempt rather than a mistaken attempt to return to Arctic waters by entering the cul-de-sac of the Bay of Bothnia.

Fin whales exhibit great flexibility in feeding, breeding, and navigational skills. Although several individuals have been found dead, frequent sightings during the last 15 years indicate an adaptability potential to exploit food resources in the inner Danish waters. Individuals seemingly seek and find so-called "food stations" where they prey on shoaling fish, and they have been documented to migrate between such stations (Jensen & Kinze 2011). The slight increase in occurrence in Danish waters may reflect the general recovery of this species from whaling, in its natural habitat. This is probably also the case for the humpback whale, which is increasingly observed in Danish and neighbouring waters, and has been documented during 2008, 2012 and 2014 on return trips into the Baltic proper (Kinze & Jensen 2015).

Finally, five odontocete species have, despite their oceanic habitat, been encountered with some frequency in inner Danish waters. While the white-sided dolphin is native to the deeper parts of the Skagerrak adjacent to the outer Danish waters, intrusions into the inner Danish waters and waters around Bornholm are very rare (Kinze et al. 2010) but have repeatedly occurred, in 1984 (Sweden) in 2006 (Poland), and in 2013 in Denmark (Kinze et al. 2011). The long-finned pilot whale, Sowerby's beaked whale, and bottlenose whale seemingly fit into this general scheme. However, the latter two species are known to have performed long distance erratic intrusions into the Baltic proper. For Risso's dolphin, the most recent find dates from 2007 when a male individual strayed into the Isefjord inlet on the island of Sealand and eventually starved to death here.

Concluding remarks

The present cetacean stranding record constitutes an important source for understanding long term trends in regional and temporal cetacean diversity in Denmark and neighbouring regions, and hence nature management and conservation measures. The past 50 years have seen an increase in strandings and observations of several species, which are currently not considered native to Danish waters but may in time adapt to local conditions and establish permanent or seasonal populations. Successful management of native and putative new species will require national prioritisation to support continuous efforts to register live and stranded cetaceans in Danish waters.

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Samenvatting

Strandingen van walvisachtigen op de Deense kust: waarnemingen in de periode 2008-2017, alsook een vergelijking met waarnemingen in het verleden

Vondsten van walvisachtigen op de Deense kust gedurende 2008-2017 zijn bij elkaar gebracht en worden hier gepresenteerd. Deze waarnemingen worden vergeleken met waarnemingen uit de afgelopen 50 jaar (1968-2017). De bruinvis (*Phocoena phocoena*) was verreweg de meest voorkomende soort (1177 individuen in de periode 2008-2017). Daarvan werd 62,4% ($n=735$) waargenomen langs de

Noordzee en het Skagerrak - 'the outer Danish waters' -, 37,0% ($n=435$) langs het Kattengat, de Grote Belt en de Kleine Belt en 0,6% ($n=7$) rond Bornholm - de beide laatste categorieën vormen tezamen 'the inner Danish waters'. Gezien dit grote aantal waarnemingen en de grote hoeveelheid daaraan gerelateerde informatie wordt op deze plaats alleen een samenvatting van deze waarnemingen van de bruinvis gepresenteerd. Verder werden in de periode 2008-2017 twaalf andere soorten waargenomen, verdeeld over 90 waarnemingen: 49 witsnuitdolfijnen (*Lagenorhynchus albirostris*), drie witflankdolfijnen (*Leucopleurus acutus*), zeven gewone dolfijnen (*Delphinus delphis*), een gestreepte dolfijn (*Stenella coeruleoalba*), een gramper (*Grampus griseus*), vier grienden (*Globicephala melas*), een orka (*Orcinus orca*), een gewone spitssnuitdolfijn (*Mesoplodon bidens*), zes potvissen (*Physeter macrocephalus*), 14 dwergvinvissen (*Balaenoptera acutorostrata*), twee gewone vinvissen (*Balaenoptera physalus*) and een bultrug (*Megaptera novaeangliae*). In de periode 1968-2017 wer-

den daarnaast nog vijf andere soorten waargenomen: de tuimelaar (*Tursiops truncatus*) in 1968, 1975 en 1976, de beloega (*Delphinapterus leucas*) in 1976 en 1987, de butskop (*Hyperoodon ampullatus*) in 1969 en 1998, de Brydevinvis (*Balaenoptera brydei*) in 2000, en een noordse vinvis (*Balaenoptera borealis*) in 1980. De walvisachtigen in de wateren rond Denemarken kunnen gezien hun oorspronkelijke habitat worden gerekend tot de volgende drie categorieën: 1. *inheemse soorten*: bruinvis, witsnuitdolfijn en dwergvinvis; 2. *flexibele bezoekers*, dat wil zeggen die gedurende hun verblijf in deze wateren opgewassen zijn tegen andere leefomstandigheden dan waar ze normaal gesproken mee te maken hebben, zoals gewone dolfijn, gewone vinvis en bultrug; en 3. *dwaalgasten*, afkomstig uit de diepe wateren van de oceaan die zich niet kunnen aanpassen, zoals griend, gewone spitssnuitdolfijn en potvis.

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Appendix. Complete list of all reported cetacean strandings in Denmark in the period 2008-2017, excluding the harbour porpoise. FIMUS = Fishery and Maritime Museum, Esbjerg, ZMUC = Zoological Museum University of Copenhagen, DET NC = species determined but not collected, TL = total length, TW = total weight, pr = pregnant. ODW = outer Danish waters, IDW = inner Danish waters.

White-beaked dolphin (<i>Lagenorhynchus albirostris</i>)					
Date	Locality and sea area	Specimen / determination	Sex	TL cm	TW kg
15-01-2008	Skagen, ODW	ZMUC MCE1595	F	252	230
02-03-2008	Mandø, ODW	FIMUS C 265	M	266	287
17-06-2008	Vejers, ODW	FIMUS C 268	M	221	-
17-06-2008	Skallingen, ODW	FIMUS C 269	M	245	-
28-08-2008	Ferring Sø, ODW	DET NC	U	-	-
20-10-2008	Nørlev Strand, ODW	DET NC	U	-	-
19-02-2009	Lønstrup, ODW	FIMUS C274	M	250	176
06-03-2009	Mårup Kirke, ODW	DET NC	U	-	-
11-03-2009	Mårup Kirke, ODW	DET NC	U	-	-
29-03-2009	Hovvig /Husby, ODW	ZMUC M 1691	M	177	57.5
13-05-2009	Lønstrup Strand, ODW	DET NC	U	-	-
15-11-2009	Sødringholm, IDW	FIMUS C314	F	260	-
13-03-2010	Vester Thorup, ODW	DET NC	U	-	-
31-05-2010	Blokhush-Løkken, ODW	ZMUC	U	-	-
04-06-2010	Nr. Lyngvig Fyr, ODW	FIMUS C318	U	230	-
07-06-2010	Lakolk, Rømø, ODW	FIMUS C319	F	179	-
25-05-2011	Gammel Skagen, ODW	DET NC	U	-	-
28-05-2011	Kandestederne, ODW	FIMUS C325	M	193	-
30-05-2011	Kandestederne, ODW	FIMUS C326	M	280	-
30-05-2011	Klitmøller, ODW	FIMUS	U	-	-
12-06-2011	Skagen, ODW	DET NC	U	-	-
12-06-2011	Højen (Gammel Skagen), ODW	ZMUC	U	257	-
17-06-2011	Højen, ODW	ZMUC	U	-	-
17-06-2011	Højen S, ODW	ZMUC	U	-	-
17-06-2011	Rødhus Blokhush, ODW	ZMUC	M	275	-
17-06-2011	Thorsminde/Husby, ODW	FIMUS C327	F	254	-
18-07-2011	Lønstrup, ODW	DET NC	U	-	-
29-09-2011	Hirtshals, ODW	DET NC	U	210	-
08-02-2013	Klitmøller, ODW	DET NC	U	250	-
19-03-2013	Thorsminde, ODW	FIMUS C340	F	239	-
07-06-2013	Saltum, ODW	FIMUS C342	M	218	-
07-07-2013	Blokhush, ODW	FIMUS C344	U	280	-
12-08-2013	Skarehage, IDW	FIMUS C339	F	200	-
07-12-2013	Hvide Sande, ODW	FIMUS C347	M	260	239.6
10-12-2013	Stenbjerg, ODW	FIMUS C348	F	242	227.2
31-12-2013	Klitmøller, ODW	DET NC	U	285	-
18-01-2014	Fuglsang/Fyn, IDW	FIMUS C349	F pr	262	200.3
29-01-2014	Snekkersten, IDW	ZMUC M 1643	F	254	280
03-03-2014	Ejstrup strand, ODW	ZMUC M 1668	U	275	-

23-05-2015	Marbæk Strand, Esbjerg, ODW	FIMUS C361	F	251	-
24-05-2015	Mouth of Uggerby Å, ODW	FIMUS C360	F	223	-
30-05-2015	Rødhus, ODW	ZMUC M1688	U	-	-
30-05-2015	Nr. Lyngby Løkken, ODW	ZMUC M 1689	F	260	-
01-06-2015	Kjul Hirtshals, ODW	FIMUS C365	U-	-	-
19-06-2016	Lodbjerg Fyr, ODW	FIMUS C377	M	269	-
09-01-2017	Strandby, IDW	ZMUC 1679	F	182	84.5
24-01-2017	Uggeluse Randers Fjord, IDW	ZMUC 1680	F	262	223
21-06- 2017	Haurvig, ODW	DET NC	U	-	-
27-11-2017	Skagen, ODW	ZMUC M08-1690	F pr	246	240
White-sided dolphin (<i>Leucopleurus acutus</i>)					
11-04-2008	Bøvling Klit, ODW	FIMUS C267	M	290	-
22-11-2008	Vrist, ODW	FIMUS C273	F	204	100
24-09-2013	Asnæs Nordstrand, Kalundborg Fjord, IDW	ZMUC	M	235	135.5
Common dolphin (<i>Delphinus delphis</i>)					
03-10-2010	Skagen, ODW	ZMUC M1639	F	c150	-
01-11-2010	Hirtshals, ODW	FIMUS C322	M	c177	-
03-11-2013	Vejers, ODW	FIMUS C343	F	149	43
26-02-2015	Amager, IDW	ZMUC M1665	F	165	53
13-03-2016	Havnsø, IDW	ZMUC M06-1672	F	152	-
05-09-2016	Lejre Vig, Roskilde Fjord, IDW	ZMUC M08-1673	M	158	27
17-10-2017	Hou /Hals, IDW	ZMUC M08-1686	F	200	-
Striped Dolphin (<i>Stenella coeruleoalba</i>)					
06-03-2008	Hjerting, ODW	FIMUS C266	M	189	65
Long-finned pilot whale (<i>Globicephala melas</i>)					
25-05-2010	Tusenæs, IDW	ZMUC M08-1598	SEX	416	-
17-10-2012	As Vig, IDW	FIMUS C333	M	435	680
27-10-2014	Fanø, ODW	FIMUS C356	M	446	-
20-09-2015	Søndervig, ODW	FIMUS C369	M	270	240
Killer whale (<i>Orcinus orca</i>)					
06-05-2009	Nørlev Strand, ODW	FIMUS C276	M	550	-
Sowerby's beaked whale (<i>Mesoplodon bidens</i>)					
07-11-2016	Ferring Sø, ODW	ZMUC M08-1677	M	271	240.5
Sperm whale (<i>Physeter macrocephalus</i>)					
02-04-2011	Bovbjerg Fyr, ODW	FIMUS C324	M	1400	-
12-03-2012	Nr. Lyngby, ODW	FIMUS C330	M	1280	-
16-02-2014	Henne Strand, ODW	ZMUC MCE 1644	M	1450	-
16-02-2014	Henne Strand, ODW	ZMUC MCE 1645	M	1283	-
16-01-2015	Harboøre, ODW	FIMUS C358	M	-	-
11-02-2015	Sønderho, ODW	FIMUS C359	M	1510	-
22-05-2016	Fanø, ODW	DET NC	M	-	-
Minke whale (<i>Balaenoptera acutorostrata</i>)					
30-06-2008	Hvide Sande, ODW	FIMUS	U	400	-
30-09-2009	Agger Tange Høfte 85/84, ODW	FIMUS C280	M	500	-
02-08-2010	Thorsminde Tange, ODW	FIMUS	U	-	-
05-08-2010	Fjand, ODW	DET NC	U	-	-

04-07-2011	Ferring Sø, ODW	ZMUC	F	510	-
21-10-2011	Klitmøller, ODW	FIMUS C329	U	c750	-
12-12-2011	Hvide Sande, ODW	DET NC	U	600	-
18-08-2012	Skallingen, ODW	FIMUS C335	F	755	3330
16-09-2012	Husby, ODW	DET NC	U	900	-
18-10-2012	Skallingen, ODW	DET NC	U	700	-
03-07-2013	Tornby, ODW	DET NC	U	630	-
19-07-2013	Houstrup, ODW	FIMUS C337	U	770	-
14-06-2016	Skagen, ODW	FIMUS C 379	F	542	900
03-01-2017	Thyborøn, ODW	DET NC	U	-	-
Fin whale (<i>Balaenoptera physalus</i>)					
20-06-2010	Vejle Fjord, IDW	ZMUC M08-1507	M	1728	23680
23-02-2016	Løkken, ODW	ZMUC M08-1671	M	1720	-
Humpback whale (<i>Megaptera novaeangliae</i>)					
30-06-2015	Stenbjerg, ODW	ZMUC M08-1666	U	c700	-