Cetaceans stranded in the Netherlands in 2020-2023

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Abstract: Between January 2020 and December 2023 a total of 1940 (live and) dead stranded cetaceans were reported in the Netherlands, belonging to 14 species. With 1896 individuals, harbour porpoise (*Phocoena phocoena*) was the most commonly reported species. Most porpoises were found in the south-west of the country (Delta), but highest densities were encountered on the Wadden Sea islands. An Unusual Mortality Event (UME) occurred between 23 August and 4 September 2021, when 197 porpoises washed ashore on the Wadden Sea islands. They possibly originated from the Dogger Bank area and appeared to have died from a bacterial infection with *Erysipelothrix rusiopathiae*. Due to the UME, the strandings density of porpoises was especially high in the Wadden Sea area: 1.5 (individuals / km / yr), compared to 0.7 along the mainland coast and 0.2 in the Delta area. Despite the UME, the countrywide density decreased from 0.6 during 2015-2019 to 0.4 in 2020-2023. Since the unusually high number of strandings during 2011-2013, the average number of strandings per year is steadily decreasing. The proportion of males is decreasing (59% in 1998-2007, 56.2% in 2020-2023), the proportion of neonates is increasing (12.4% versus 14.9%). About 50 fresh porpoises per year are necropsied. Causes of death have changed slightly (bycatch from 16% during 2014-2019 to 12%, grey seal (*Halichoerus grypus*) predation from 24% to 19%, malnutrition/starvation from 17% to 15%, infectious disease from 32% to 37%), but whether this is influenced by selecting only fresh porpoises for necropsy is yet unclear. Rare species stranded were killer whale (*Orcinus orca*) and bottlenose whale (*Hyperoodon ampullatus*). The number of species is slowly increasing, the number of individuals other than porpoise only marginally. Other species were minke whale (*Balaenoptera acutorostrata*), fin whale (*B. physalus*), humpback whale (*Megaptera novaeangliae*), common dolphin (*Delphinus delphis*), striped dolphin (*Stenella coeruleoalba*), and Sowerby's beaked whale (*Mesoplodon bidens*), all of which seem to be increasing (as strandings) in the south-eastern North Sea. Also reported, but decreasing as strandings, is white-beaked dolphin (*Lagenorhynchus albirostris*). Species stranded, but not showing any long term trend, during this period are long-finned pilot whale (Globicephala melas), white-sided dolphin (*Leucopleurus acutus*), sperm whale (*Physeter macrocephalus*) and bottlenose dolphin (*Tursiops truncatus*). The number of stranded cetaceans left unidentified increased from 17% since 2000 to 66% since 2020, for various reasons. Naturalis Biodiversity Center has stopped registering cetacean strandings as of 16 January 2024. Strandings can now be reported at and/or requested from www.stranding.nl. On this new platform the archive of www.walvisstrandingen.nl can also be found.

Keywords: Cetacea, harbour porpoise, *Phocoena phocoena*, UME, mortality, North Sea.

Introduction

We present a validated list of cetaceans stranded on the Dutch coast during the years 2020-2023. It follows the report on stranded

cetaceans summarizing five years by Keijl et al. (2021). The strandings during the focal period have again been reported by hundreds of people and various organizations and were collected by staff of the zoological museum of Naturalis Biodiversity Center in Leiden, the Netherlands. The reason for now summarizing four years instead of five, as in previous reports, is that Naturalis Biodiversity Center in Leiden, as of 16 January 2024, no longer supervises the cetacean strandings database.

Even with all single strandings being available on the internet and monthly reports produced, it is considered valuable to keep on reporting printed reviews instead of viewing single events or, at most, digital graphs summarizing years. Only an analysis of collated data of irregularly occurring stranding events may provide new insights in a slowly changing environment, although reviewing a few years only (such as this review) does not elucidate the larger picture. Strandings only form part of our knowledge on cetacean presence and ecology in the North Sea. Other important sources are observations of live animals and by-caught individuals. In the Netherlands, strandings and live observations are covered to a certain degree, the third source is still shrouded in mystery, with investigating stranded animals only partly elucidating bycatch events. By following strandings through time, as is happening in other countries bordering the North Sea, a picture is built from the cetacean community in the North Sea.

Methods

Stranding records have been verified by staff of Naturalis Biodiversity Center in Leiden. Records were received from people inside the regular strandings network, by day trippers filling in the form on the website walvisstrandingen.nl, and – increasingly – by records on waarneming.nl and in chat groups on whatsapp. Data collected are date, location, name of reporter, and, if possible, species name, sex, length, state, whether or not it was necropsied and/or collected, and other peculiarities (for instance entanglement). As most records are accompanied by photographs, information on state and sex can often be verified.

In this report, all individual records are presented, except for porpoises, for which this is unfeasible. Finds of loose bones or skulls are also mentioned, as well as live strandings, large whales caught on the bow of ships, or floating carcasses at sea, as long as they are found within Dutch waters. The results are summarized in Table 1. Unless stated otherwise, remains are destructed, but especially smaller whales (e.g. porpoises) are often buried locally. The taxonomic order follows Wilson & Reeder (2005).

Area

The area from which strandings are reported stretches from the Belgian border in the south-west of the Netherlands to the German border in the north-east, and includes the inner waters of the Delta area in the south-west of the country and the entire Dutch part of the Wadden Sea. As the coast consists of parts of varying nature (sandy, muddy, stony) and exposure, it is subdivided into three parts following Camphuysen et al. (2008): 1. The Delta area, in the south-west, from the Belgian border up to and including the artificially created Maasvlakte. It includes the 'inner Delta', i.e. the borders of rivers Western Scheldt and the partly closed Eastern Scheldt (no strandings were recorded in Grevelingenmeer and Haringvliet); 2. The mainland coast, from Hoek van Holland to Den Helder; and 3. The Wadden Sea. This extensive area stretches from the sand spit Razende Bol in the west to the uninhabited islet of Rottumeroog in the east. The Wadden Sea is subdivided into the North Sea (mostly north-facing) coast of the Wadden Sea islands, and the Wadden Sea proper, the latter including the Wadden Sea (mostly

Table 1. Stranded cetaceans on the Dutch coast in 2020-2023, including unidentified ones. The third last column gives the total per species in the twenty years preceding the focal period, the last two columns the average number per year during two different periods. Records of loose bones/skulls are excluded.

						Average / year	
	2020	2021	2022	2023	2000-2019	2010-2023	1990-2009
Common minke whale	2	1	-	1	19	1.1	0.6
Fin whale	-	1	1	1	15	0.9	0.3
Humpback whale	-	-	1	1	7	0.4	0.2
Common dolphin	4	1	1	1	9	1.1	0.2
Long-finned pilot whale	-	-	-	1	6	0.4	0.2
White-sided dolphin	-	1	-	-	4	0.07	0.3
White-beaked dolphin	-	-	-	1	56	0.6	6.0
Killer whale	-	-	1	-	1	0.1	0.0
Striped dolphin	1	-	-	1	6	0.4	0.3
Harbour porpoise	433	715	423	325	8961	578	161
Sperm whale	-	1	-	-	15	0.9	0.7
Bottlenose whale	2	-	-	-	0	0.1	0.1
Sowerby's beaked whale	1	2	2	-	9	0.9	0.1
Blainville's beaked whale	-	-	-	-	1	0	0.05
Unidentified Cetacea	1	1	5	5	19	1.4	1.0
Total	444	723	434	337	9128		

south-facing) side of the islands, the north-eastern part of the province of Noord-Holland, Afsluitdijk and the mainland coast of the provinces of Friesland and Groningen. The uninhabited islets Razende Bol are combined with Texel - North Sea coast, Griend with Vlieland - Wadden Sea, and Engelsmanplaat with Schiermonnikoog - North Sea coast, while the easternmost islets Rottumerplaat and Rottumeroog are combined to 'Rottum' - Wadden Sea. The length of the coast of the subareas is given in Table 2.

Coverage and effort

Coverage is comparable with that in previous periods, see Keijl et al. (2016, 2021) for details. Only during the UME in late summer 2021 occurring on the eastern Frisian islands, daily surveys, or even multiple surveys per day, were undertaken by car to collect porpoise carcasses. Outside this period, no special activities have been undertaken to locate stranded cetaceans, although dedicated surveys are executed locally to locate abandoned seal pups or entangled seals.

Research

As in the previous period, research on stranded cetaceans was performed by the division of pathology of Utrecht University (e.g. IJsseldijk et al. 2020a, Keijl et al. 2021). This research focuses on the cause of death, following national and international rules of protection of marine mammals (Camphuysen & Siemensma 2011, Pierce et al. 2022). Species other than porpoise and animals too long to fit in a van are examined on the beach, when possible, or transferred to Utrecht University when smaller. Selection of carcasses of porpoise is done *ad hoc* and depends largely on the state of decomposition, but also on the location of stranding and associated logistics to retrieve specimens timely for post-mortem investigation. Approximately

Table 2. Total number of harbour porpoises in 2020-2023 in the Netherlands per subarea. Also given are density (average density, *n*.km^{-1} year^{-1}), sexual composition (percentage of males, with total number of sexed individuals between brackets), and age (as percentage per length class, in cm; see text). See also the Methods section for the geographic subdivision. A single porpoise found in inland waters (Elburg, IJsselmeer) is not included. No porpoises have been reported in Grevelingenmeer and Haringvliet, part of the inner Delta.

	Total	Density	% males (*n*)	<90	90-130	>130	(*n*)
Delta (408 km)	*387*	*0.2*	*57.0 (286)*	*17.2*	*34.5*	*48.3*	*(116)*
Zeeuws-Vlaanderen	15	0.2	63.6 (11)	33.3	33.3	33.3	(3)
Walcheren	156	0.7	54.0 (124)	14.8	40.7	44.4	(27)
Schouwen	53	0.4	61.1 (36)	22.2	55.6	22.2	(9)
Goeree	25	0.3	56.3 (16)	9.1	45.5	45.5	(11)
Voorne	19	0.4	66.7 (15)	30.0	40.0	30.0	(10)
Inner Delta	83	0.1	60.0 (60)	15.6	28.1	56.3	(32)
Maasvlakte	36	0.4	50.0 (24)	16.7	20.8	62.5	(24)
Mainland coast (153 km)	*569*	*0.7*	*59.9 (364)*	*17.2*	*43.0*	*39.7*	*(151)*
Zuid-Holland	299	0.8	62.9 (205)	14.9	45.9	39.2	(74)
Noord-Holland	270	0.7	56.0 (159)	19.5	40.3	40.3	(77)
Wadden Sea total (384 km)	*939*	*0.5*	*52.5 (421)*	*13.5*	*66.9*	*43.9*	*(446)*
North Sea coast (107 km)	*803*	*1.5*	*52.2 (356)*	*13.6*	*64.0*	*46.7*	*(390)*
Texel	184	1.2	53.9 (115)	19.2	49.5	31.3	(99)
Vlieland	194	1.3	50.0 (42)	9.2	30.0	60.8	(120)
Terschelling	145	2.6	47.6 (42)	13.8	62.1	24.1	(29)
Ameland	186	2.3	52.2 (122)	17.2	34.3	48.5	(99)
Schiermonnikoog	94	1.0	54.3 (35)	4.7	41.9	53.5	(43)
Wadden Sea (277 km)	*136*	*0.1*	*53.8 (65)*	*12.5*	*62.5*	*25.0*	*(56)*
Texel	29	0.2	37.5 (16)	5.0	75.0	20.0	(20)
Vlieland	3	0.1	33.3 (3)	0.0	0.0	100.0	(3)
Terschelling	15	0.1	33.3 (9)	66.7	33.3	0.0	(3)
Ameland	8	0.0	66.7 (3)	0.0	100.0	0.0	(4)
Schiermonnikoog	0	0.0	0.0 (0)	–	–	–	(0)
Rottum	28	0.6	66.7 (12)	15.4	38.5	46.2	(13)
Noord-Holland	7	0.1	66.7 (3)	0.0	50.0	50.0	(2)
Friesland	29	0.1	73.3 (15)	28.6	71.4	0.0	(7)
Groningen	17	0.1	50.0 (4)	0.0	100.0	0.0	(4)
Total (945 km)	*1895*	*0.4*	*56.2 (1071)*	*14.9*	*41.4*	*43.8*	*(1678)*

10-15% of all porpoises, about 50 (fresh) individuals per year, are assessed to determine causes of death, with only basic strandings data recorded from remaining cases. Apart from porpoises, 53% of the other species of stranded cetaceans were necropsied, with carcass freshness again as the most pressing criteria for selection. Information on results of necropsies of porpoises, and of individual cases of rare species, can be found at https://www.uu.nl/onderzoek/strandingsonderzoek.

The following zoological museums collected one or more (parts of) cetaceans stranded during the focal period:

- Ecomare at Texel, Noord-Holland (collection numbers starting with B),
- Het Natuurhistorisch in Rotterdam, Zuid-Holland (collection numbers starting with NMR),
- Naturalis Biodiversity Center in Leiden,

Zuid-Holland (collection numbers starting with RMNH.MAM), and
- Terra Maris at Oostkapelle, Zeeland.

Systematic list

In 2020-2023 1940 cetaceans were recorded, comprising 14 different species (Table 1). These strandings include recent bones of five different individuals (skull, rib, single vertebra, vertebral column, and a penis with pelvic bones still attached). They also include eight cetaceans not stranded but either accidentally brought in on the bulb of ships, found afloat nearshore or offshore (a large whale, three fin whales, one Sowerby's beaked whale *Mesoplodon bidens*), near-stranded (two or three Sowerby's beaked whales), or live-stranded and pushed back (striped dolphin *Stenella coeruleoalba*). New species for the Netherlands were not recorded during the present period, but there were several species which are not recorded yearly. Especially the strandings of a live killer whale (*Orcinus orca*) and of two bottlenose whales (*Hyperoodon ampullatus*) were notable events. Remarkable is the apparent increase in strandings of common dolphins. Thirteen cetaceans remained unidentified. As usual, the most common species was porpoise, with 1896 reported strandings (97.6% of all strandings in this period).

Common minke whale (*Balaenoptera acutorostrata*)

2020-2023: 4 records
2000-2019: 19 records
Before 2000: 27 records

12 July 2020, Schiermonnikoog, Friesland. Sex unknown, length unknown (but estimated 400 cm from a boat when the carcass was still afloat), weight unknown. Rotten, incomplete: skull and possibly one jaw missing. Reported by R. Arends and others, and coast guard Den Helder. Not collected, not necropsied, buried locally. Identification not certain.

25 November 2020, Rottumerplaat, Groningen. Male, 470 cm (measured), weight unknown. Decomposed, complete. Reported by J. Kostwinner and F.J. de Wal. Not collected, not necropsied. Entire carcass left above the high tide line on the island, rate of decomposition monitored until spring 2023, but skeleton still present in spring 2024.

14 April 2021, Razende Bol, Noord-Holland. Sex unknown, length 410 cm (measured from decomposed carcass), weight unknown. Reported by H. Eelman. Decomposed, fairly complete but tail fin and baleens missing (Figure 1). Part of the vertebrae, skull, mandibulae, tongue bone, jaws, and flippers collected by Ecomare Nature Museum (collection number B2-2122). Remainder buried locally.

20 December 2023, Brouwersdam, Zuid-Holland. Sex unknown, 750 cm (estimated), weight unknown. Decomposed, incomplete: jaws and baleens missing. Reported by R. van Aperen. Not collected, not necropsied, remains destructed.

The minke whale from 12 July 2020 was found floating between the island of Schiermonnikoog and Het Rif, to the west. It stranded nearby on the 14th. As the carcass was incomplete and discoloured, and because it was not seen by us and nothing was collected, identification based on the photographs alone could not be established beyond doubt.

Of the minke whale that stranded in November 2020, the process of decomposition was studied in detail, which had not been done before in the Netherlands. Apart from the rate of decomposition, nuisances brought about by a stranded whale, such as stench, the risk of explosion, pollution of the soil by heavy metals and DDT, and vertebrate and invertebrate biodiversity following decomposition, were evaluated by direct or remote observa-

Figure 1. Remains of a minke whale (*Balaenoptera acutorostrata*), Razende Bol, 14 April 2021. *Photo: Wilma Eelman.*

tion. Unfortunately, the carcass was not studied on the stranding site, but was taken to a different location on the same island and deposited far above the tide line, to prevent it from washing away. The trial lasted seven months, but the bones are still in the same location (September 2024), and are still being reported every once in a while (www.waarneming.nl and www.stranding.nl). See Baptist et al. (2024) for the full study report and Baptist & Leopold (2024) for an evaluation and recommendations for leaving cetacean carcasses to decompose in nature instead of destructing them.

None of the minke whales stranded between 2020-2023 were necropsied and, hence, no information is available on causes of death. None of the stomach contents were studied either. This is in stark contrast with the six studied out of the eight that stranded between 2015-2019. Two out of those six had been hit by ships.

The increase in minke whale strandings since the last century has been noted earlier (Keijl et al. 2021). Since 2000, an average of 0.95 minke whales stranded per year, which is considerably higher than before the turn of the century, when it was only 0.16 (1950-1999).

Fin whale (*Balaenoptera physalus*)

2020-2023: 3 records
2000-2019: 15 records
Before 2000: 26 records

27 July 2021, Terneuzen, Zeeland. Male, 1475 cm (measured), weight 15,000-17,000 kg (estimated). Not fresh, complete. Skull, one flipper, baleens, atlas, axis and tissue collected (RMNH.MAM.59331). Remainder destructed. Reported by H. Jonkers and J. van der Hiele. Necropsied by Utrecht University (case no. BP08).

2 October 2022, Westkapelle, Zeeland. Male, 1318 cm (measured), weight 13,000 kg (estimated based on weight of destructed material, so body fluids largely excluded). Not fresh, complete. Single tympanic bulla and tissue collected (RMNH.MAM.63697). Both mandibulae, baleen (part) and atlas and axis collected by Museum Terra Maris in Oostkapelle, Zeeland (no collection number yet).

Reported by J. van der Hiele. Necropsied by Utrecht University (case no. BP09).

29 August 2023, Zeeland (but discovered only in Antwerp, Belgium). Male, 1050 cm (measured), 9000 kg (estimated). Not fresh, complete. Parasites and tissue collected by Universities of Ghent and Liège, Belgium (no collection numbers), flippers collected by University of Antwerp, Belgium (no collection number). Necropsied by Universities of Antwerp, Ghent and Liège. Reported by J. Haelters.

All three fin whales concerned relatively small, and thus immature, individuals. The one from August 2023 at Terneuzen was the second smallest ever recorded in the Netherlands (the smallest one was a female from 15 January 2012 at Vlissingen (Flushing), measuring 877 cm). Fin whale calves are born in November-December and measure 600-700 cm at birth (Cawardine 2020), so individuals of this size are (less than) one or two years old.

All three were necropsied for establishing the cause of death (the one from August 2023 in Belgium), and all were probably hit by ships alive (see also Haelters & Kerckhof 2024). They were brought in during the now 'classic' period of the year, i.e. late summer/early autumn. Up to and including 2023, the average number of 'strandings' per year has risen from 0.75 since 2000 to 0.92 since 2010. There are now 44 registered 'strandings' of fin whales in the database, of which 31 have been sexed; 20 of these (70%) were males. Since 2000, 16 out of 18 have been sexed, resulting in 10 males and 6 females.

Humpback whale (*Megaptera novaeangliae*)

2020-2023: 2 records
2000-2019: 7 records
Before 2000: 0 records

5 July 2022, Vlieland, Friesland. Female, 638 cm (measured), 4000 kg (estimated on basis of destructed tissues, weight of skeleton and body length, but body fluids largely excluded). Slightly decomposed, complete. Complete skeleton and tissue collected (RMNH.MAM.63662). Reported by R. Bijma and J. Hoekendijk. Necropsied by Utrecht University (case no. MN02).

2 July 2023, floating at Steenbank, 7.5 mile north-west off Westkapelle, Zeeland. Female, 846 cm (measured), 5500 kg (estimated) (Figure 2). Decomposed, incomplete: baleens and stomach missing. Single flipper and tissue collected (RMNH.MAM.63882). Reported by P. van Leeuwen and T. de Ruiter. Necropsied by Utrecht University (case no. MN03).

Another two humpback whales, elevating the total number of stranded individuals in the Netherlands to eight (the one from March 2012 concerned a single vertebra). Since the first two strandings, both in 2003, humpbacks have been found in 2004, 2009, 2010, 2012, 2022 and 2023. Living and often apparently healthy humpbacks occur virtually yearly in Dutch waters since 2003 (Leopold et al. 2018, waarneming.nl) and although, based on their size, the stranded individuals seem to be mainly immature, large individuals, probably adults, have been observed in Dutch waters as well.

Common dolphin (*Delphinus delphis*)

2020-2023: 9 records
2000-2019: 9 records
Before 2000: 83 records

31 August 2020, Balgzand, Noord-Holland. Female, 201 cm (measured), 71 kg (weighed). Fairly fresh, complete. Skull and tissue collected (RMNH.MAM.59836). Reported by T. Zutt. Necropsied by Utrecht University (case no. DD07).

Figure 2. Humpback whale (*Megaptera novaeangliae*) at Steenbank, 7.5 mile north-west off Westkapelle, 2 July 2023. *Photo: coast guard*.

11 September 2020, Neeltje Jans, Oosterschelde, Zeeland. Female, 195 cm (measured), 42 kg (weighed). Incomplete: jaws, teeth and part of tissue missing. Dried out. Reported by J. van der Hiele.
Skull and flippers collected (RMNH.MAM.63844). Necropsied by Utrecht University (case no. DD08).

21 November 2020, Zierikzee, Zeeland. Male, 150 cm (measured), 35 kg (weighed). Fresh, probably live-stranded, complete. Skull, flipper and tissue collected (RMNH.MAM.59814). Reported by J. Dhont and R. van Aperen. Necropsied by Utrecht University (case no. DD09).

22 November 2020, Breskens, Westerschelde, Zeeland. Male, 173 cm (measured), 52,5 kg (weighed). Live-stranded, complete, died. Skull, neck vertebrae and tissue collected (RMNH.MAM.59815). Reported by J. van der Hiele. Necropsied by Utrecht University (case no. DD10).

28 November 2021, Westenschouwen, Zeeland. Sex unknown, 220 cm (measured, but tail missing), weight unknown. Old and incomplete carcass, teeth missing. Incomplete disarticulated skeleton collected by Het Natuurhistorisch (collection nr. NMR999000204210). Reported by R. van Aperen and W. Kraak. Not necropsied.

5 April 2022, Grevelingendam, Zuid-Holland. Male, 219 cm (measured), 88 kg (weighed). Decomposed, complete. Reported by RTZ Zuidwest. Complete skeleton collected (RMNH.MAM.63673). Necropsied by Utrecht University (case no. DD11).

10 January 2023, Texel, Noord-Holland. Male, 170 cm (measured), 47 kg (weighed). Not fresh, some tissue missing. Reported by J. Havermans and S. de Wolf. Collected by Ecomare Nature Museum (collection number B2-2123). Necropsied by Utrecht University (case no. DD12).

11 November 2023, Scheveningen, Zuid-Holland. Male, 187 cm (measured), 46 kg (weighed). Decomposed, complete. Reported by T. van Rijmenam. Not collected. Necropsied by Utrecht University (case no. DD13).

24 December 2023, Maasvlakte, Zuid-Holland. Male, 213 cm (measured), 72 kg (weighed). Fresh, complete. Reported by A.

Sajet and A. van den Berge. Tissue collected by Naturalis (RMNH.MAM.63895) and Utrecht University (no collection number). Necropsied by Utrecht University (case no. DD14).

The common dolphin from 24 December 2023 at Maasvlakte looked 'odd', and *D. capensis* was considered a possibility (even though the nearest area of occurrence lies off West-Africa, e.g. Morais Pinela 2015). It was necropsied, but the skull was not collected. DNA-analysis showed it to be *D. delphis*, but it is unknown whether the two are identifiable on the basis of the sequenced CO1-gene. Taxonomy of *Delphinus* is complicated, because different geographic forms are morphologically similar but appear to occur sympatrically. Researchers painstakingly try to find differences between them, usually on the basis of cranial measurements and/or DNA-analysis (e.g. Ngqulana et al. 2019). Recently, the long-beaked form occurring in the eastern Pacific has been re-named as *D. bairdii* (Jefferson et al. 2024), while the long-beaked form occurring in Senegalese waters appears to be distinct from both local short-beaked *D. delphis* and long-beaked forms elsewhere (but has not specifically been named yet, Becker et al. 2024). At present, *D. capensis* is (e.g. Wilson & Reeder 2005), or is not (e.g. Committee on Taxonomy 2024) accepted as a separate species. What is presently called *D. capensis* may be identifiable by DNA-analysis (Rosel et al. 1994), but possibly not in the Atlantic Ocean (Cunha et al. 2015). The species has not been recorded in Europe yet, but thorough inspection of skulls, perhaps in combination with DNA-analysis, could shed light on identification and distribution.

Two out of the nine common dolphins stranded alive. Several were emaciated and/or underweight. The weight of a healthy adult common dolphin lies between 100-200 kg (Cawardine 2020), although weight data in literature vary widely. In the Dutch strandings database, there are now 101 common dolphins, of which 26 males and 26 females (52% sexed). Also among the 18 common dolphins stranded since 2000, sex ratio is remarkably equal (seven males, seven females, four unsexed). Six out of the nine common dolphins stranded between 2020-2023 were necropsied.

Nine strandings in just four years is quite impressive, considering that the total number in the database amounts to only 101 individuals. Moreover, four stranded but unidentified dolphins during the focal period probably also concerned common dolphins, making a total of twelve strandings in just four years. During the 1930s-1950s, common dolphin was common in the central and/or southern North Sea, coinciding with Atlantic water extending further northward, but the species disappeared after that and the number of strandings decreased. Between 1925-1960, the average number of strandings per year was 2.06, between 1961-2000 0.15, and since 2001 0.75.

Long-finned pilot whale (*Globicephala melas*)

2020-2023: 1 record
2000-2019: 6 records
Before 2000: 18 records (124 individuals)

3 December 2023, Vlieland, Friesland. Female, 427 cm (measured), 1013 kg (weighed). Fresh, complete. Reported by F. Janssens. Entire skeleton collected by Ecomare Nature Museum (collection number B2-2124). Necropsied by Utrecht University (case no. GM05).

White-sided dolphin (*Leucopleurus acutus*)

2020-2023: 1 record
2000-2019: 4 records
Before 2000: 8 records

20 August 2021, Baarland, Westerschelde, Zeeland. Male, 245 cm (measured), 194 kg (weighed). Fresh, complete, probably live-

Figure 3. Killer whale (*Orcinus orca*), dying in the surf at Cadzand, 15 October 2022. *Photo: Jaap van der Hiele.*

stranded. Skull and tissue collected (RMNH. MAM.63677). Reported by J. van der Linden and J. van der Hiele. Necropsied by Utrecht University (case no. LA12).

White-beaked dolphin (*Lagenorhynchus albirostris*)

2020-2023: 1 record
2000-2019: 54 records
Before 2000: 173 records

20 February 2023, Engelsmanplaat, Wadden Sea, Friesland. Female, 202 cm (measured), 96.4 kg (weighed). Fairly fresh, complete, scavenged. Skull and tissue collected (RMNH.MAM.63879). Reported by T. de Vries and A. Dijkstra. Necropsied by Utrecht University (case no. LA13).

Only a single record in four years, but at least three unidentified dolphins (3 July 2022, Terschelling, Friesland, 5 July 2022, Dishoek, Zeeland, and 6 February 2020, Oostdijk, Zuid-Holland) probably also concerned this species.

In the previous review (Keijl et al. 2021), the total of 57 stranded white-beaked dolphins for the period 2000-2014 was erroneous. Prior to 1900, only two white-beaked dolphins had been identified, so 61% of the 282 strandings are from the twentieth century. Especially between 1980 and 2019, white-beaked dolphin was the most common cetacean on our beach next to harbour porpoise, with 182 strandings, so almost 80% of the total number of strandings was recorded in just 40 years. At present, the species is becoming increasingly rare in the southern North Sea. The average number of strandings per year has dropped from 6.1 between 1981-2000 to 2.4 since.

Killer whale (*Orcinus orca*)

2020-2023: 1 record
2000-2019: 6 records
Before 2000: 31 records

15 October 2022, Cadzand, Zeeland. Female, 517 cm (measured), 2003 kg (weighed). Fresh, complete, live-stranded (Figure 3). Complete skeleton collected (no collection number yet). Reported by J. van der Hiele. Necropsied by Utrecht University (case no. OO01).

Prior to 1964 there have been at least 24 strandings of killer whales in the Netherlands, the oldest in 1783, and five in the nineteenth century. Between 1920-1970, a relatively steady stream of on average 0.3-0.6 killer whales were found per decade. Since 1964, there has only been one stranding (22 June 2010, Lauwersoog, Friesland, also a live stranding), apart from a handful of records of loose bones and skull fragments.

The killer whale from Cadzand in 2022 concerned an adult female. She had not eaten for a considerable period, probably because of severe gingivitis (infection of dental gum), rotten, fractured and loose teeth, and infections in various organs. She was originally part of a pod of about 50 killer whales living in Iberian waters, known by her code name IB6, alias Gala, and usually in the company of a male coded IB13. Whether he was her mate or her son is unknown. Gala had been seen for the first time twenty years earlier, when she was already mature. This means that she could have been at least thirty years old when she died. Due to the severely damaged teeth, the animal's age based on dental growth layers could not be determined any more.

Striped dolphin (*Stenella coeruleoalba*)

2020-2023: 3 records
2000-2019: 6 records
Before 2000: 6 records

30 May 2020, Harlingen, Friesland. Sex, length and weight unknown. Live-stranded, pushed back into the Wadden Sea. Nothing collected, not necropsied. Reported by R. Oost.

8 June 2023, Domburg, Zeeland. Male, 210 cm (measured), weight unknown. Tissue collected (RMNH.MAM.63894). Reported by EHBZ zuidwest. Not necropsied.

14 July 2023, Vlieland, Friesland. Sex, length and weight unknown. Skull only, collected by Ecomare Nature Museum (collection number B2-2125). Reported by F. Janssens. Not necropsied.

The very decomposed and discoloured dolphin from 8 June 2023 found at Domburg could not be identified on the basis of morphological characters. Luckily, a tissue sample for DNA-identification could be collected and it turned out to be a striped dolphin, the fourteenth for the Netherlands and the eighth since 2000. (Note that the skull found on Vlieland in July 2023 possibly belonged to the striped dolphin that stranded alive nearby a month earlier and was pushed back into the sea. Hence, due to its rarity in the Netherlands, the two separate records are counted as one individual.) It was only the third cetacean in the Netherlands to be identified by DNA-analysis. The distribution of stranded striped dolphins along the coast of the Netherlands (with the first stranded in 1967) is somewhat peculiar for a species that is supposed to have a tropical/subtropical distribution: only four have been found in the province of Zeeland, in the south-west, one in (the south of) Zuid-Holland, and nine in the Wadden Sea area, in the very north of the Netherlands.

Bottlenose dolphin (*Tursiops truncatus*)

2020-2023: 2 records
2000-2019: 10 records
Before 2000: 360 records

12 May 2020, Wijk aan Zee, Noord-Holland. Male, not measured, not weighed (but see IJsseldijk et al. 2020b). Fresh, incomplete: tail and part of hind body missing. Entire skeleton collected (RMNH.MAM.59783). Reported by R. van Wilgenburg. Necropsied by Utrecht University (case no. TT02).

4 December 2021, Scherpenisse, Ooster-

schelde, Zeeland. Male, 274.5 cm (measured), 242 kg (weighed). Fresh, complete. Skull, neck vertebrae, flipper and tissue collected (RMNH.MAM.63674). Reported by foundation SOS Dolfijn. Necropsied by Utrecht University (case no. TT03).

The individual found in May 2020 concerned the fourteen year old bottlenose dolphin named Zafar (IJsseldijk et al. 2020b). This solitary living bottlenose dolphin, which preferred to mingle with humans rather than conspecifics since at least 2017, accompanied a sailing boat from the Atlantic coast of France through the Channel all the way to the (freshwater) port of Amsterdam, after which it was lured back to the North Sea through the Noordzee channel and the sluices at IJmuiden. It was last seen alive off Callantsoog, Noord-Holland, accompanying a beam trawler. It tragically died from a ship propeller strike, which cut off its tail.

The strandings database contains close to 400 bottlenose dolphins. Although the species has stranded in every decade since 1900, it has become particularly rare after the 1970s (on average 9.4 per year between 1931-1940, 1.3 between 1971-80, 0.5 since 2000).

Harbour porpoise (*Phocoena phocoena*)

2020-2023: 1896 records
2020: 433 records
2021: 715 records
2022: 423 records
2023: 325 records
2000-2019: 8961 records
Before 2000: 2371 records

Numbers and density

In 2020-2023 the average number of stranded harbour porpoises per year was 474. This is below the long-term average of 578 (2010-2023, *n*=8089) and also lower than the 552 during the previous period (Keijl et al. 2021). The yearly number of strandings fit in a trend with decreasing totals since the exceptional stranding numbers in 2011-2013.

A notable exception in the dwindling numbers was 2021, with 715 strandings. This number was surpassed only by the years 2011, 2012 and 2013 (with 887, 755 and 873 respectively). Note that without the unusual mortality event (UME) in 2021 (see below), the total number of strandings in this year would have still been higher than during 2020, 2022 and 2023. The stranding number of 2021 was elevated considerably by an UME occurring between 23 August and 4 September, when 197 decomposed porpoises stranded on the Wadden Sea islands of Vlieland, Terschelling, Ameland and Schiermonnikoog, an area of about 100 km wide. For comparison: in 2017-2020 in exactly the same area on the exact same dates a combined total of 83 porpoises was reported, i.e. an average of only 20.8 per year. During the 2021 event, the local density was elevated to 2.6 individuals km^{-1} $year^{-1}$, compared to 0.3 in the other years, again stressing the uniqueness of this event. The mass stranding was likely caused by an infection with the bacterium *Erysipelothrix rusiopathiae*, which had not previously been linked to mass strandings of marine mammals in the Netherlands (IJsseldijk et al. 2023a). Another unique characteristic of this event was that it predominantly hit adult females in good body condition (37.7% males, *n*=151 sexed individuals between 1 August and 30 September 2021, compared to 57.9% males in 2010-2023 in the same area and period excepting 2021, *n*=190 sexed individuals, and 80.0% adult females in 2021, *n*=65 measured, compared to 60.4% adult females, *n*=129 measured). Necropsies were conducted on a subset of 22 porpoises. Assessment of stomachs showed that none had eaten anything significant shortly before death. How the porpoises got infected by this bacterium remains unknown, and the same goes for why mainly adult females were involved. A model taking into account sea surface currents and wind direction, car-

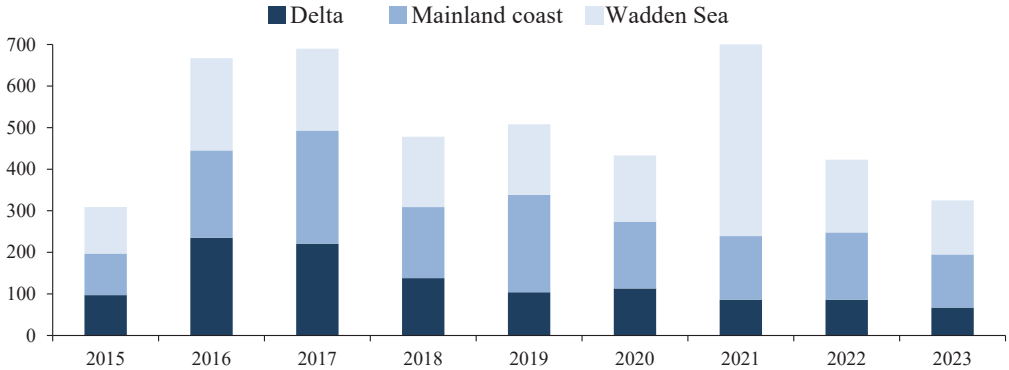

Figure 4. Number of dead harbour porpoises in 2020-2023 along the Dutch coast, with 2015-2019 added for comparison (www.walvisstrandingen.nl; *n*=4547).

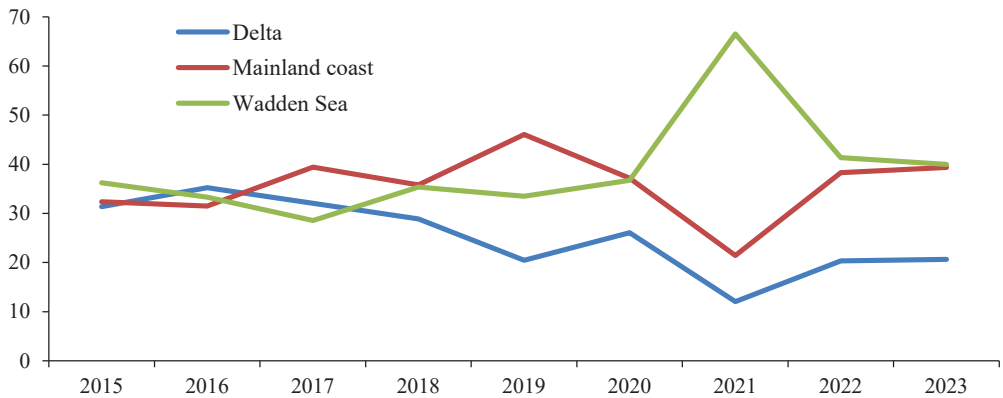

Figure 5. Proportion of dead harbour porpoise in three subareas (Delta, mainland coast and Wadden Sea area) in 2020-2023, with 2015-2019 added for comparison (source: www.walvisstrandingen.nl).

ried out by Rijkswaterstaat (part of the Dutch Ministry of Infrastructure and Water Management), indicated that the porpoises likely stemmed from a small area between the Frisian Front and Dogger Bank, about 100 km north-west of Texel and a bit further from the main area of the stranding (M.F. Leopold personal communication).

The country-wide average density of 0.4 porpoise is a third lower than during the previous period, when it was 0.6 (Table 2). The density in the Wadden Sea area remained the same, which can be ascribed to the UME described above. The normally high density on Vlieland however was lower than usual, while higher densities than normal were established at Terschelling and Ameland (2.6 and 2.3 respectively). Densities along the mainland coast were below 1.0. Compared to 2015-2017, when porpoises were spread about equal over the three areas (about one third each) (Figure 4), the total numbers are not just decreasing, but the proportion stranding in the Delta is decreasing to about a fifth of the countrywide total (Figure 5).

A single porpoise, found on 31 Mayt 2021 at Elburg, IJsselmeer (lake IJssel), was believed to have been placed there from an unknown location.

Sex and age

The proportion of males is decreasing through the years: it was 59% in 1998-2007

(Camphuysen et al. 2008), 58.2% in 2008-2014 (Keijl et al. 2016), 58.0% in 2015-2019 (Keijl et al. 2021) and 56.2% in 2020-2024, even though, as mentioned above, the mass stranding in 2021 involved only 32.5% males. The slow decrease of males (washing ashore) is intriguing and warrants further investigation to whether the sex ratio in the population is changing, whether there is differential mortality, or whether digital photography is still influencing the results (cf. Keijl 2022a).

The proportion of neonates (individuals <90 cm, Lockyer et al. 2001) on the other hand is increasing, albeit marginally: it changed from 12.4% before 2008 via 13.5% and 13.5% to 14.9% in the present (Camphuysen et al. 2008, Keijl et al. 2016, 2021 respectively) (and – again – despite the mass stranding involving mainly adults).

Causes of death

In 2020 49 porpoises were necropsied, in 2021 54, in 2022 57 and in 2023 47 by the division of pathology of Utrecht University (IJsseldijk et al. 2021, van Schalkwijk et al. 2022, 2023, 2024). The aim of the post-mortem investigation is to determine the cause of death of each individual. A comparison with the previous years shows a decrease in by-catch (from 16% to 12%, 2014-2019 compared to the focal period), grey seal predation (24% to 19%) and nutritional status (17% to 15%), but an increase in infection (32% to 37%) (*n*=474 porpoises). Porpoises from the UME from 2021 are not included in these figures.

A comparison can be made with the previous period as there is no difference in sampling methods any more (prior to 2016 also a proportion of decomposed porpoises was collected, from 2016 onwards fresh ones were preferred). However, by selecting only fresh porpoises, there may be a bias in causes of death: fresh individuals have died near-shore or onshore and/or have washed ashore soon after death, while decomposed ones (Figure 6) may come from farther away. This, for instance, could be an explanation for the decrease in by-caught

Figure 6. Decomposed male harbour porpoise *Phocoena phocoena*, 4 June 2021, Ameland, in a 'sea' of thorny sea mat (*Electra pilosa*). *Photo: Johan Krol.*

individuals, which may originate from further offshore and need time to make landfall (if at all). This issue has not been solved yet.

Sperm whale (*Physeter macrocephalus*)

2020-2023: 1 record
2000-2019: 18 records
Before 2000: 62 records

7 January 2021, Vlieland, Friesland. Male, 1364 cm (weighed), 35,000 kg (based on weight of destructed material, so body fluids excluded). Fresh, complete, live-stranded. Left flipper, four teeth and tissue collected (RMNH.MAM.59816). Reported by K. Venema and A. van den Berg. Necropsied by Utrecht University (case no. PM11).

Bottlenose whale (*Hyperoodon ampullatus*)

2020-2023: 2 records
2000-2019: 0 records
Before 2000: 21 records

7 September 2020, Terneuzen, Zeeland. Female, 700 cm (estimated), weight 6000 kg

Figure 7. Bottlenose whale (*Hyperoodon ampullatus*) washed ashore at Terneuzen, Zeeland, 7 September 2020. The oblique laceration all the way from the side of the left chest across the belly to the right flank has led to the acute death of this unfortunate whale. *Photo: Jeroen Hoekendijk*.

(estimated). Fresh, incomplete: part of organs missing. Skull, mandibulae, flipper, neck vertebrae and ribs collected (RMNH.MAM.59810). Reported by W.J. Strietman. Necropsied by Utrecht University (case no. HA01).

8 September 2020, Borssele, Zeeland. Female, length and weight unknown. Fresh, incomplete: cut into pieces by ship screw, only head and part of torso found. Skull, mandibulae, flipper, neck vertebrae and ribs collected (RMNH.MAM.59809). Reported by J. van der Hiele. Necropsied by Utrecht University (case no. HA02).

There are 23 stranded bottlenose whales in the database, but only once before was there a stranding of two more or less together (24 August 1956, Texel and 26 August 1956, Ameland). Remarkably, the bottlenose whales that stranded in September 2020 were observed alive on all days between 20 and 23 August 2020 in the partly closed Oosterschelde further north. They were elusive though and seemed to have disappeared after 23 August, despite thorough searches by multiple observers in the usually calm waters of Oosterschelde. The next time they popped up again they were in the river Westerschelde, on 6 September, which they almost certainly must have reached via the North Sea. (The alternative route, through the Rijn-Schelde channel, is extremely unlikely, as they then must have not just passed one or more sluices, but also done that undetected.) On 7 and 8 September however, they were dead, both unintentionally killed by ships. One had a large laceration expanding over the entire ventral body side and opening the abdominal cavity (Figure 7), the other was cut into three separate pieces, which stranded apart from each other. Stomach contents consisted of squid (*Gonatus fabricii*). See Keijl (2020) for more information on these and other bottlenose whales in the Netherlands. The previous strandings of this species were almost two decades earlier, in August and November 1993.

Sowerby's beaked whale (*Mesoplodon bidens*)

2020-2023: 5 records
2000-2019: 9 records
Before 2000: 16 records

17 August 2020, Neeltje Jans, Zeeland. Female, 382 cm (measured), 438 kg (weighed). Decomposed, complete. Skull, mandibulae and tissue collected (RMNH.MAM.59808). Reported by RTZ zuidwest. Necropsied by Utrecht University (case no. MB06).

5 October 2021, Ter Heijde, Zuid-Holland. Female, 473 cm (measured), 922 kg (weighed). Fresh, complete, live-stranded. Skull, mandibulae and tissue collected (RMNH.MAM.59830). Reported by K. Kooimans and R. Noort. Necropsied by Utrecht University (case no. MB07).

5 October 2021, Ter Heijde, Zuid-Holland. Female, 460 cm (measured), 799 kg (weighed). Fresh, complete, live-stranded. Skull, mandibulae and some vertebrae collected (NMR999000204890). Reported by K. Kooimans and R. Noort. Necropsied by Utrecht University (case no. MB08).

19 July 2022, Zandvoort, Noord Holland. Sex, length and weight unknown. Near-stranding. Reported by A. van den Berg. Not necropsied.

18 August 2022, Texel, Noord-Holland. Female, 400 cm (measured), 550 kg (weighed). Decomposed, complete (Figure 8). Reported by J. Hoekendijk. Necropsied by Utrecht University (case no. MB9).

The record of 19 July 2022 involved two, allegedly three, live individuals swimming very close to the beach at Zandvoort on a hot day. The animals were photographed and filmed from the shore, while there were many people bathing, but there is no material showing three different individuals, let alone three together. They were estimated by the public standing in the water to measure 2.5, 3 and 4 metres. The largest animal reportedly swam purposefully towards the beach and would probably have stranded, but several bathers could prevent that by physically redirecting it

Figure 8. Sowerby's beaked whale (*Mesoplodon bidens*), 18 August 2020, Texel. *Photo: Jeroen Hoekendijk.*

back towards the sea. It stranded again a while later on a flooded sand bar, and was set free again by hand. Then the animals swam away not to be seen any more. A report of a dead sea mammal measuring approximately 3.5 metres seen about eight kilometres away from where the whales near-stranded could not be confirmed (there were three floating dead porpoises at this site). See https://www.dumpert.nl/item/100036411_f0842381 and https://www.dumpert.nl/item/100036383_1985aa63 for video footage of the beaked whales. At least one of the Sowerby's beaked whales, showing very dark pigmented spots on the head, was not the same as the one that stranded in Wenduine, Belgium, on 8 August 2020.

The previously reported increase in strandings of this species seems to continue. Of the total of 30 records (32 individuals, and excluding one unidentified beaked whale in April 2016), almost half have been reported since 2000. Twenty-five out of thirty occurred in July-October. The majority are females (12 females, 7 males, 11 unknown), also since 2000 (6 females, 3 males, 5 unknown). The average length is 394 cm (only measured individuals (n=11); males 386 cm (n=4), females 405 cm (n=6)).

It is known that mass strandings of beaked

whales may be inflicted by sonar (low or mid-frequency active sonar, used by the military to detect submarines), which causes damage to the internal ears and/or causes the whales to leave the area (e.g. d'Amico et al. 2009, Chouinard et al. 2023). Beaked whales do not usually occur in the southern North Sea, they live in deep oceanic waters, for instance near Scotland and Norway. Naturally, one or two individuals cannot be considered a mass stranding, but the steady increase in strandings is worrying, as is the mass stranding of beaked whales scattered over a range of countries (among which the Netherlands) in the north-eastern Atlantic in summer 2020 (Dolman et al. 2021).

Unidentified cetaceans

2020-2023: 13 records
2000-2019: 19 records
Before 2000: 57 records

Small whale

14 January 2021, Noordwijk, Zuid-Holland. Single recent vertebra only, possibly from a *Balaenoptera spec*. or *Megaptera novaeangliae*. Reported by K. Kooimans and R. Noort.

Large whale

22 January 2022, Noordwijk, Zuid-Holland. Single rib from a large whale. Reported by R. and N. Burgler-van Dam.

Large balaenopterid

9 August 2022, Cleaver Bank, Dutch continental North Sea about 160 km north-west of Den Helder, Noord-Holland. Male, length and weight unknown. Reported by MV Capella. Not necropsied.

Rotten and inflated but apparently intact balaenopterid whale floating belly-up. Length estimate was not provided, photographs do not allow identification.

Harbour porpoise / unidentified dolphin

23 December 2023, Westkapelle, Zeeland. Sex, length and weight unkown. Decomposed and discoloured hump of meat, showing a row of small teeth, of which a few pointed and recurved. Reported by K. Nilsen. Not collected, not necropsied, left on the spot.

White-sided / White-beaked dolphin *(Leucopleurus acutus / Lagenorhynchus albirostris)*

6 September 2022, Texel, North-Holland. Sex and weight unkown, length estimated at 100 cm, but about one third of tail stock missing. Mummified, left on the spot. Reported by P. Bonnet.

Photographs offered to staff of Ecomare showed teeth resembling those of white-sided or white-beaked dolphin. Photographs not kept, a search on the beach remained unsuccessful.

Unidentified dolphin

6 February 2020, Oostdijk, Zuid-Holland. Penis and pelvic bones only. Reported by I. Scheijgrond.
Almost a copy of the penis attached to the pelvic bones found on 27 April 2011 at Terschelling, which at the time was identified as belonging to either a white-sided or a white-beaked dolphin, based on size and shape of the bones. A remarkable coincidence, since both species are uncommon at most in Dutch waters, while encounters of penises attached to the pelvic bones of the much more common

harbour porpoise have never been reported.

11 January 2022, Engelsmanplaat, Friesland. Incomplete vertebral column, fairly recent. Reported by Arjen.
Considering the size of the vertebrae possibly white-beaked or bottlenose dolphin.

1 July 2022, Wadden Sea and Terschelling, Friesland. Male, 297 cm (measured), not weighed.
Decomposed, complete (Figure 9). Washed ashore on 3 July about 13 km east. Nothing collected. Reported by M. Poot and M. van der Meulen. Not necropsied.

5 July 2022, Dishoek, Zeeland. Male, 220 cm (measured), not weighed. Decomposed, complete. Reported by RTZ zuidwest. Nothing collected, destructed.
The dolphins of 1 July 2022 at Wadden Sea and (two days later) Terschelling, and 5 July 2022 Dishoek possibly concerned white-beaked dolphins. Unfortunately, the humpback whale that stranded on Vlieland a few days later attracted more attention, leaving the dolphins unidentified.

5 October 2023, Oostkapelle, Zeeland. Male, 220 cm, 200 kg (estimated). Reported by RTZ zuidwest. Nothing collected, not necropsied. Destructed. With near-certainty a common dolphin.

31 October 2023, Razende Bol, Noord-Holland. Sex, length and weight unknown. Reported by M. Staal.
The islet Razende Bol was visited as soon as the storm, which started on November 1st, had passed, but by then the sea had already washed the dolphin away. Possibly a common dolphin.

21 December 2023, Westkapelle, Zeeland. Sex, length and weight unknown. Reported by J. de Visser. Not necropsied. Possibly a common dolphin.

Figure 9. Unidentified dolphin, probably white-beaked dolphin (*Lagenorhynchus albirostris*), 3 July 2022, Terschelling. *Photo: Marjanna van der Meulen.*

Discussion

After the strong increase in strandings since 2006, and the exceptional numbers in 2011-2013, numbers are decreasing. These fluctuations are completely attributable to variation in the number of porpoise strandings. The increase in the number of different species per year however is continuing: since 1980, the average number of species per year was 4.9, since 2000 5.6, since 2010 6.1. The total number of cetacean species recorded in the Netherlands is 26. This includes remains of grey whale (*Eschrichtius robustus*), which has disappeared altogether from the Atlantic Ocean since the early 18th century. However, there have been recent confirmed records of living grey whales in the Atlantic (Scheinin et al. 2011, Manfrini et al. 2023, McCloud 2023). There are ten species that are regularly

recorded (yearly, or at least once every few years, see also Table 1) and another ten that have not been recorded for decades or longer. These are blue whale (*B. musculus*) (last recorded in 1840), rough-toothed dolphin (*Steno bredanensis*) (1877), narwhal (*Monodon monoceros*) (1912), Cuvier's beaked whale (*Ziphius cavirostris*) (1914), beluga (*Delphinapterus leucas*) (1919), pygmy sperm whale (*Kogia breviceps*) (1925), Gray's beaked whale (*Mesoplodon grayi*) (1927), false killer whale (*Pseudorca crassidens*) (1935), Risso's dolphin (*Grampus griseus*) (1970) and sei whale (*Balaenoptera borealis*) (1986). Note however that some of these have been recorded alive in Dutch waters in later years, for instance Risso's dolphin (1978 and 2004), while some species have been observed alive but never found dead, for instance Greenland whale *Balaena glacialis* (2017) (waarneming.nl, van der Meij & Camphuysen 2006). The last year when a stranded new species of cetacean for the Netherlands was found was in 2005 (Blainville's beaked whale (*Mesoplodon densirostris*)). The number of individuals per year of species other than porpoise has increased marginally since 2000 (average 9.9 since 1980, 10.0 since 2000, 10.4 since 2010). While some species are true vagrants in the south-eastern North Sea, showing no long-term trend in strandings whatsoever (e.g. long-finned pilot whale), (strandings of) other species are definitely decreasing (e.g. white-beaked dolphin) or increasing (e.g. minke whale) (Table 1).

Some cetaceans washed ashore cannot be named, for various reasons. In a few cases nothing recognizable remains. In other cases there are logistic and/or other circumstances preventing a visit to the carcass for identification. In fact, sometimes the primary goal appears to be to get a decomposed cadaver to a destruction site as soon as possible, with identification deemed as less important. Some of these stranded cetaceans can still be identified to the nearest taxon from photographs (for instance 'white-sided or white-beaked dolphin'), many only superficially ('dolphin').

Worryingly, the proportion of cetaceans remaining unidentified is increasing: since 2000, 42 non-porpoises (17.0%) remained unnamed, while this rose to 65.9% in 2020-2023 (see also Keijl 2022b). Due to their relative scarcity, detecting changes in distribution, abundance and species composition of cetaceans in a specific geographic area requires time, while only long-term trends can be used as indicators of a changing environment, and the same goes for evaluating protective measures (van der Meij & Camphuysen 2006, Coombs et al. 2019, Boyd & Punt 2021). Because all species except porpoise are uncommon or rare in the southern North Sea, it takes many years before any pattern in occurrence emerges, let alone changes therein. For many species stranded in the Netherlands, the North Sea lies on the edge of their current usual area of distribution, while this is exactly the area where changes in range shifts can first be detected (Simmonds & Isaac 2007, Pompa et al. 2011). Without a specific name, registering cetaceans is worthless. Nowadays, identification by DNA-analysis is not costly any more, while it is among the most robust methods to identify species. Hence, it is recommended to collect tissue from any cetacean carcass that will not be collected for necropsy or museum storage.

Although numbers of stranded porpoises have decreased since the high numbers in 2011-2013, porpoises are still common in Dutch waters, offshore (van Bemmelen et al. 2022) as well as coastal (trektellen.nl). Stranding numbers fluctuate largely between years, but it is only from 2001 onwards that numbers in excess of 100 per year are found. Analysis of strandings and sightings combined revealed that the high number of strandings in summer correlated well with increased presence in the preceding months (IJsseldijk et al. 2023). The peak in strandings in the summer of 2011 correlated with unusually high numbers of emaciated porpoises, hinting at food shortage and/or an inability to feed, and this mass stranding therefore qualified as an UME

(IJsseldijk et al. 2022b).

For long, the yearly pattern of porpoise strandings in the southern North Sea shows two peaks: one in March and one in summer (e.g. Camphuysen & Siemensma 2011, IJsseldijk et al. 2020). The previously established declining trend of strandings in March continued in 2020-2023. During the early years with elevated numbers since 2006, the March peak was pronounced and about half as high as the summer peak (e.g. Keijl 2009), but since 2017 the number of strandings in March is greatly reduced. In years with a high peak in March many porpoise strandings were recorded in a small area near Voorne-Goeree, and most of them had been attacked by grey seals. Therefore, we hypothesize that one, or a few at most, local grey seals stopped hunting porpoises at this location in March, moved elsewhere, or died. There are other explanations for the decline however, for instance that porpoises learned to avoid the area, or the number of porpoises has become so low that it is not profitable to hunt them in this area anymore.

It is not surprising that the number of porpoise strandings mirrors the numbers counted by bird observers from the coast (trektellen.nl), even though there is a mismatch in timing, with the highest number of strandings taking place in late summer, while most porpoises are seen from the coast in winter. A study combining sightings and strandings found that the number of strandings prior to 1990 and after 2010 could not be explained by increased presence in coastal waters, hinting at apparently prolonged and ongoing excessive mortality (IJsseldijk et al. 2023b), possibly influencing protective measures (Ten Doeschate et al. 2018). The fact that stranding numbers in recent times have been unusually high is corroborated by an analysis of recent strandings along the Dutch west coast with those from 1930-1970 (Keijl & Niesen 2023). For species other than porpoise, a connection between strandings and observations of live individuals seems to be absent due to their rarity, even though (living) cetaceans are occasionally observed from the coast (e.g. Hoekendijk et al. 2021).

The physical state of the Dutch coast, with narrow sandy beaches, makes it an excellent example for thorough long-term censusing of stranded marine mammals, as all parts of the coast are easily accessible, contrary to rocky coasts. However, in the Dutch part of the Wadden Sea, itself being a World Heritage Site (UNESCO 1972; Common Wadden Sea Secretariat and World Heritage Nomination Project Group 2008), stranded harbour porpoise seem to be underreported, not only along the extensive mudflats of the Wadden Sea proper but also on the North Sea-oriented sandy beaches, parts of which are only sparsely visited outside holidays and during the colder season. This situation is similar in Germany and Denmark, and it is recommended to join forces to tackle this problem in order to better assess the conservation status of porpoises as well as of common (*Phoca vitulina*) and grey seals (Scheidat et al. 2023).

The importance of a continuous, sound and thorough registration of cetacean strandings has been demonstrated repeatedly (e.g. Pikesley et al. 2011, Litz et al. 2014, Costa et al. 2017, Coombs et al. 2019, Peltier et al. 2019), even when strandings are used only as baseline information during unusual mortality events, such as the mass stranding in 2021 (Keijl 2021, and summarized above). Although there may be a danger of irregular and/or temporary underreporting during long-term research which leans heavily on data provided by the public (cf. Carmichael et al. 2022), just because of the sheer duration of the 'project', or due to a low stranding density, only long term trends in strandings provide the opportunity to detect changes in, e.g., species composition, abundance, or distribution (Camphuysen & Siemensma 2011).

Up to 16 January 2024 all strandings in the Netherlands, from the very first sperm whale in 1255 until the last harbour porpoise on 16 January 2024, have been individually con-

sultable on the website walvisstrandingen.nl, which was updated weekly by Naturalis Biodiversity Center. At the time, the database contained 14,389 strandings, virtually all consisting of single stranding events of 26 different species (among which five subfossil finds of grey whale), and 99 unidentified cetaceans (go to https://tinyurl.com/4akpn5cc for a download of all validated strandings up to and including 16 January 2024). Only seven records consisted of strandings of more than a single individual. The registration of cetacean strandings by Naturalis has stopped as of 16 January 2024. The strandings database however has not: it has been transferred to a newly created database managed by Foundation Observation International. The (old and new) data are now available from the website www.stranding.nl, a subsite of www.waarneming.nl. Similar to walvisstrandingen.nl, these data are open to the public. Registration of strandings on www.stranding.nl is left to personal initiative, while strandings may be validated by volunteers. Until December 2023, monthly updates on strandings and reports of notable or unusual events have been presented on the news page of walvisstrandingen.nl. Also this series has ceased to exist, but all reports can be freely downloaded from the website natuurtijdschriften.nl. By discontinuing the registration of cetaceans on the Dutch coast as of 16 January 2024 by a zoological museum, a 52 year old tradition has been broken (cf. Husson & van Bree 1972). This is the last report on cetacean strandings provided by Naturalis.

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Samenvatting

Gestrande walvissen op de Nederlandse kust in 2020-2023

In de jaren 2020-2023 zijn 1940 (overwegend dode) walvissen op de Nederlandse kust geregistreerd, behorende tot 14 verschillende soorten. Vooral de strandingen van orka en butskop vielen op vanwege hun zeldzaamheid. Een dolfijn die in december 2023 strandde op de Maasvlakte was misschien een Kaapse dolfijn, in dat geval een nieuwe soort voor Nederland. Helaas is deze dolfijn uiterlijk vrijwel niet te onderscheiden van gewone dolfijn. DNA-analyse wees op de laatste soort, maar of de achterliggende database (BOLD) beide soorten kan onderscheiden op basis van het onderzochte gen (CO1) is twijfelachtig. De schedel, waarop beide soorten wel kunnen worden onderscheiden, is niet bewaard. Kaapse dolfijn is nog niet in Europa vastgesteld, mogelijk omdat waarnemers niet bedacht zijn op deze soort. Het dichtstbijzijnde gebied van voorkomen, voor zover bekend, is West-Afrika. Andere bijzondere soorten die in deze periode zijn gestrand, en die bovendien de laatste decennia algemener lijken te worden, zijn bultrug, dwergvinvis, gestreepte dolfijn, gewone dolfijn, gewone spitssnuitdolfijn en gewone vinvis. Witsnuitdolfijn daarentegen lijkt, als enige soort in de rij van regelmatig aanspoelende soorten, in de zuidelijke Noordzee steeds zeldzamer te worden. Soorten als potvis, griend en tuimelaar, eveneens in deze periode gemeld, stranden onregelmatig.

Een deel van de walvissen (anders dan bruinvis) die aanspoelen wordt niet gedetermineerd. Hiervoor zijn diverse redenen aan te voeren, zoals een lastig te bereiken locatie, of gebrek aan tijd of middelen om het kadaver te bezoeken en/of te bewaren. Het is echter een bedenkelijke en kwalijke zaak dat het aandeel ongedetermineerde walvissen toeneemt, van 17% sinds 2000 naar bijna 66% sinds 2020. Naast genoemde oorzaken lijkt er een afnemende interesse te zijn om soorten te determineren en om materiaal te bewaren. Registratie van ongedetermineerde walvissen is zinloos, want elke soort heeft zijn eigen ecologie. Hier wordt dan ook de aanbeveling gedaan om uiterste inspanning te verrichten voor determinatie van álle aangespoelde walvissen. Determinatie aan de hand van DNA is tegenwoordig eenvoudig en betaalbaar.

De talrijkst aangespoelde soort in 2020-2023 was de bruinvis met 1896 exemplaren. De meeste bruinvissen zijn gevonden in het Deltagebied (387), maar de hoogste dichtheden zijn gemeld van de Noordzeekant van

de Waddeneilanden (gemiddeld 1,5 exemplaar per kilometer per jaar), vooral op Terschelling (2,6) en Ameland (2,3). Deze hoge dichtheid is toe te schrijven aan een opmerkelijke en nog niet eerder in deze omvang geregistreerde massastranding, die plaatsvond tussen 23 augustus en 4 september 2021, toen in totaal 197 rotte bruinvissen aanspoelden tussen Vlieland en Schiermonnikoog. Onderzoek wees uit dat de dieren waren gestorven aan een infectie met *Erysipelothrix rusiopathiae*. Deze bacterie, bekend van onder andere varkens en vissen, was tot dan toe in Nederland nog niet eerder in verband gebracht met een massastranding. Verder viel op dat bij deze stranding hoofdzakelijk volwassen vrouwtjes waren getroffen (67,5%, normaal gesproken is dat 33,3%). Ze waren in goede conditie maar hadden een lege maag en zijn dus een snelle dood gestorven. Een modelmatige analyse, waarin zeestroming en wind waren meegenomen, wees uit dat deze bruinvissen zijn omgekomen in een gebied tussen het Friese Front en de Doggersbank, ruim 100 kilometer ten noordwesten van de plaats van aanspoelen.

Dode bruinvissen zijn gedurende de onderzoeksperiode verspreid langs de hele kust aangetroffen. De landelijke dichtheid ligt tegenwoordig op 0,4 exemplaren per kilometer per jaar, een derde lager dan de 0,6 in 2015-2019. Alleen op de Waddeneilanden was de dichtheid hoger dan 1,0, wat deels is veroorzaakt door de massastranding van 2021. Langs de kust van Zuid- en Noord-Holland bedroeg de dichtheid 0,7, in de Delta was dit meestal nog lager. De reeds eerder geconstateerde afname van de strandingspiek in maart heeft zich in 2020-2023 voortgezet. Dit wordt toegeschreven aan afgenomen predatie van een of enkele grijze zeehonden, maar door de jaren heen neemt het aantal bruinvisstrandingen, na de piekjaren in 2011-2013, sowieso af. In het zuidwesten van het land nemen de aantallen aangespoelde bruinvissen sneller af dan in het midden en noorden.

Het aandeel mannetjes blijft dalen (59% in 1998-2007, 56,2% in de besproken periode; hierbij zijn de dieren van de massastranding in augustus-september 2021 niet meegerekend). De oorzaak blijft onduidelijk, maar zou veroorzaakt kunnen zijn door het nog altijd stijgende aandeel foto's, waardoor ook vrouwtjes nog vanachter het bureau als zodanig te herkennen zijn, terwijl het erop lijkt dat vinders op het strand meer moeite hebben met het herkennen van deze sekse dan van mannetjes. Er zijn natuurlijk ook alternatieve verklaringen te bedenken. Het aandeel pasgeboren bruinvissen is gestegen, zij het marginaal (12,4% in 1998-2007, 14,9% in 2020-2023).

Ook wat betreft doodsoorzaken zijn er kleine verschuivingen in de tijd zichtbaar. Zo is bijvangst als doodsoorzaak afgenomen (van 16% in 2014-2019 naar 12% in de huidige periode), net als predatie door grijze zeehond (24% naar 19%) en ondervoeding / voedseltekort (17% naar 15%), terwijl infecties lijken te zijn toegenomen (32% naar 37%; hierbij is de massastranding van augustus-september 2021 niet meegerekend). Er is echter een verandering opgetreden in het verzamelbeleid: tegenwoordig worden vrijwel alleen verse bruinvissen onderzocht, omdat daaraan de doodsoorzaak – het hoofddoel van de secties – beter te bepalen valt dan bij rotte bruinvissen. Het is daarom nog onduidelijk of de vastgestelde doodsoorzaken representatief zijn voor bruinvissen in de gehele Nederlandse Noordzee of alleen gelden voor de kustzone.

In de afgelopen 52 jaar zijn strandingen bijgehouden door de zoölogische musea van Amsterdam en Leiden. Met ingang van 2024 is een einde gekomen aan deze traditie. Vanaf nu worden strandingen van zeezoogdieren – dus ook van zeehonden – door vrijwilligers bijgehouden op www.stranding.nl, onderdeel van Waarneming.nl, eigendom van Stichting Observation International. Aan waarnemers wordt dan ook dringend verzocht hun vondsten daar te registreren.

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