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New Extralimital Record of a Narwhal (*Monodon monoceros*) in Europe

Jan Haelters,¹ Francis Kerckhof,¹ Marjan Doom,² Peter G. H. Evans,³
Tom Van den Neucker,⁴ and Thierry Jauniaux⁵

¹Royal Belgian Institute of Natural Sciences (RBINS), Operational Directorate Natural Environment,
3de en 23ste Liniregimentsplein, B-8400 Oostende, Belgium
E-mail: jan.haelters@naturalsciences.be

²Department of Morphology, Faculty of Veterinary Medicine, Ghent University,
Salisburylaan 133, B-9820 Merelbeke, Belgium

³Sea Watch Foundation, Ewyn y Don, Bull Bay, Amlwch, Anglesey, LL68 9SD, UK

⁴University of Antwerp, Department of Biology, Ecosystem Management Research Group,
Universiteitsplein 1C, B-2160 Wilrijk, Belgium

⁵Department of Pathology, FARA, University of Liège, Sart Tilman B.43, B-4000 Liège, Belgium

Abstract

On 27 April 2016, a dead narwhal (*Monodon monoceros*) was found on the bank of the River Scheldt, Belgium. It was the first record of this high Arctic cetacean in Belgium, and one of the most southerly records ever in Europe. Due to the decomposition of the carcass, the results of the autopsy remained inconclusive, but it is likely that the animal had died due to a long process of starvation. In the stomach, a large number of litter items were found which were probably ingested during the process of dying. We further provide information on the sighting of the live animal prior to the stranding and present an overview of the very few known records of narwhal in northwestern Europe.

Key Words: narwhal, *Monodon monoceros*, stranding, Belgium, historic records

Introduction

The narwhal (*Monodon monoceros*) is, together with the beluga (*Delphinapterus leucas*) and bowhead whale (*Balaena mysticetus*), a cetacean that spends its entire life in Arctic waters. Narwhals are exclusively found in waters that are at least seasonally covered by ice and are in most seasons associated with sea ice. They occur largely between 65° and 80° N (Reeves & Tracey, 1980; Culik, 2010). In the North Sea and adjacent area, sightings and strandings of narwhal are very rare. In this paper, we describe the first record of a narwhal in Belgium and the sighting of the live animal prior to the stranding. To demonstrate the extreme rarity of this species in northwestern Europe, we have made a literature study on previous records of sightings and strandings in this area.

Methods

In Belgium, the Royal Belgian Institute of Natural Sciences (RBINS) is responsible for recording strandings and incidental catches of marine mammals, as well as for organising the collection and scientific investigation of a selection of stranded and bycaught animals. Data on stranded animals, including the results of the autopsy and the availability of tissue samples, are included in a database that can be consulted online (www.marinemammals.be).

On 27 April 2016, a dead narwhal was found in the River Scheldt, near the sluice of Wintam (Bornem, Belgium; 51° 07.27' N; 004° 18.38' E; Figure 1), 92 km from the mouth of the River Scheldt in the North Sea. The day after, the carcass of the animal was recovered from the river bank by local firemen and the technical services of the community of Bornem, and then collected by the RBINS. It was transported to the Faculty of Veterinary Medicine of the University of Ghent, Belgium, where, on the same day, pathologists of the Universities of Ghent and Liège performed an autopsy, according to a standardized protocol (Kuiken & Garcia-Hartmann, 1991; Jauniaux et al., 2002). The autopsy started with an external examination and measurements, followed by an internal examination and the sampling of organs and blubber. The digestive tract was completely opened to recover all of its content. Stomach and intestine contents were cleaned over a 212-µm meshed sieve, fixed in buffered formalin, and stored in ethanol. For the identification of items, a stereoscopic binocular microscope was used. The skeleton was added to the collections of the RBINS.

The NGO Natuurpunt Studie vzw and Stichting Natuurinformatie collect incidental records of

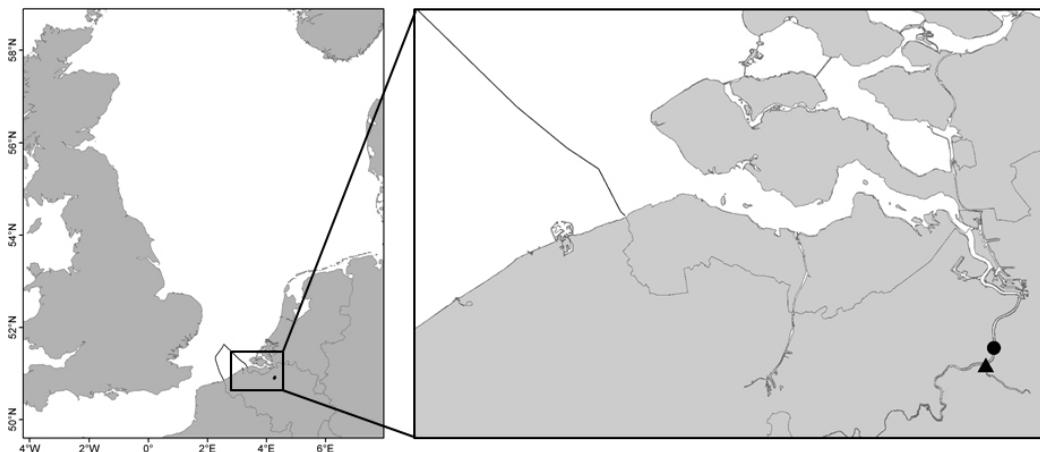


Figure 1. North Sea with delimitation of Belgian waters (*left*) and detailed map (*right*) with location of the stranding of the narwhal (triangle) and prior sighting (circle)

observations of species of different taxonomic groups, including cetaceans, and make them available through the website www.waarnemingen.be. In some cases, records are submitted that include photographs. The records of marine mammals reported to www.waarnemingen.be were reviewed online to investigate whether the narwhal could have been recorded prior to the stranding.

Finally, a literature study was carried out for the preparation of an overview of historical observations and strandings in the North Sea.

Results

External Description

The narwhal was a male with a length of 3.04 m, excluding the tusk (Figure 2). Its state of decomposition was described as in Class 4 (Geraci & Lounsbury, 2005), with carcass intact; bloating; tongue, penis, and blowhole slightly protruded; a fairly strong odour; shrunken eyes; skin sloughing; and epidermis missing from a large part of the body. The narwhal had a girth of 1.81 m, with its remains weighing 290 kg. The external tusk length was 50 cm, while its total length, measured after processing the skeleton, was 76.5 cm. Even despite the extensive skin abrasion, traces that had the appearance of healed scars were discernible on the head through a locally lighter colour and a slight depression of the skin/blubber (Figure 3). No other external lesions were present.

Results of the Autopsy

As a consequence of the decomposition, the blubber of the animal was soft and blood tinged, and the organs were recognisable but soft and fragile,

losing both texture and consistency. The blubber layer, measured dorsally, was 23 mm thick. Other observations were a thyroid hypertrophy, the gland being enlarged uniformly and homogeneously, and an eccentric cardiac hypertrophy. Both ventricles were enlarged: the right ventricle of the heart had a cavity diameter of 15 cm, while the diameter of the left cavity was 10 cm. No other morphological alterations were observed. No rudimentary teeth, as described by Nweeia et al. (2012), were found.

A number of items were found in the stomach and intestine of the narwhal, but only one was the remains of a potential food item. The content of the first stomach consisted of the remains of decomposing parasites (*Anisakis* sp.; Nematoda, Anisakidae); small litter items, mostly plastic; a tiny fragment of glass; small fragments of eroded wood; remains of other plant material; an unidentified cephalopod beak; and sediment ranging from small stones to sand and silt (Table 1; Figures 4 & 5). Some of the litter items had an uneroded appearance. The second stomach was empty apart from a very small amount of sand. The intestine contained a green muddy liquid.

Sighting Prior to the Discovery of the Carcass

On 30 March 2016, birdwatchers observed a live marine mammal in the River Scheldt at Bazel (51° 08.96' N; 004° 19.72' E; Figure 1), about 85 km upriver, and reported the observation online to www.waarnemingen.be, including some pictures. The animal was initially identified as a grey seal (*Halichoerus grypus*). In July 2016, 2.5 mo after the stranding of the narwhal at Bornem, the pictures originally submitted



Figure 2. Narwhal arriving at Ghent University (*Photo credit: J. Haelters*)

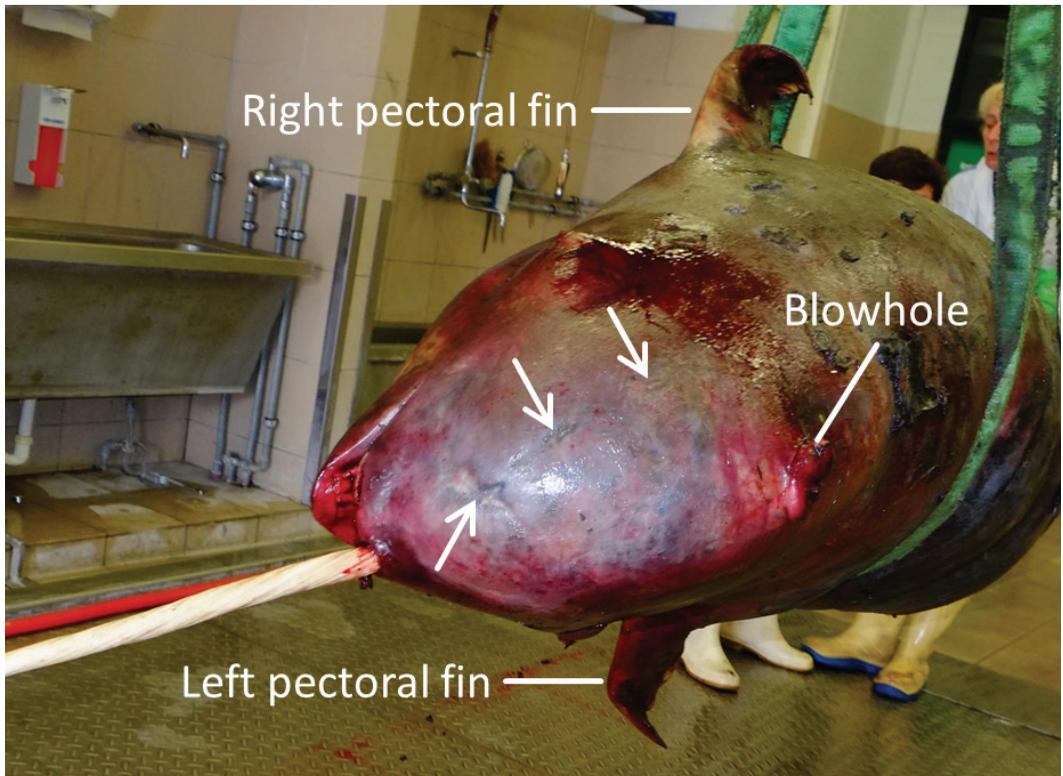


Figure 3. Traces of healed scars (arrows) on the head of the narwhal and position of the blowhole; the image is a fronto-dorsal view of the animal (right of the image is dorsal, left is ventral). (*Photo credit: J. Haelters*)

Table 1. Stomach content of the narwhal of Bornem

| Description | Number | Details |
|---------------------|--------|---|
| Cephalopod beak | 1 | Very eroded; species unidentified; 9 mm long, 7 mm wide |
| Parasites | ∞ | Partly decomposed; largest (incomplete ?) specimen 100 mm long |
| Litter items | 35 | Largest pieces (stretched) – 112 mm by 31 mm and 55 mm by 40 mm, and smallest piece – 22 mm by 4 mm; items include a tampon wrapping; a circular adhesive plaster with a diameter of 23 mm; part of the wrapping of a sweet (?); and part of the wrapping of cold cuts for human or animal consumption, containing chicken skin and beef and imprinted in different languages |
| Glass | 1 | Piece of thin glass, 5 mm by 5 mm |
| Synthetic fibre | 3 | Stretched length, 130 mm, 48 mm, and 30 mm, respectively |
| Pieces of wood | 16 | Eroded, floating in fresh water; size ranging from 8 mm by 4 mm by 3 mm to 31 mm by 13 mm by 7 mm |
| Soft plant material | ∞ | Remains of grasses and other plants |
| Sediment | ∞ | Small stones, sand, and silt |

**Figure 4.** Plant material from the stomach of the narwhal: assorted plant remains (*top*) and eroded wood (*bottom*)

with the observation were re-examined, and it was concluded that the tentative identification was erroneous. A series of 126 additional images provided by the birdwatchers and taken during a time period of about 20 min were investigated. The images were taken with a Canon 70D camera equipped with a Sigma 150 to 600 mm lens. The animal surfaced five to six times during this period and was not spotted again thereafter.

**Figure 5.** Items with an anthropogenic origin found in the stomach of the narwhal

Based on the images, it became clear that a grey seal could be ruled out. On several of the images, a blowhole, white (healed?) scars on the head, a distinct neck, and a long dark back with a dorsal ridge were visible. No dorsal fin was discernible. The combination of the lack of a dorsal fin, the presence of a dorsal ridge, and the greyish-dark colour of the animal ruled out all cetaceans that could possibly occur in this area except narwhal (Figure 6). A tusk was not visible as the animal did not surface high enough.

Comparison of the images provided by the birdwatchers with the images of the stranded narwhal indicate that it was, with a very high certainty, the same individual (Figure 7). Indeed, scars on the right side of the head were clearly visible on the images of the live animal at the same location as the scars on the stranded animal. Not all the scars on the head were visible on the images of the live animal because it did not surface high enough during the time it was spotted by the birdwatchers.



Figure 6. Live narwhal observed in the River Scheldt on 30 March 2016 (Photo credit: Maarten Mortier)

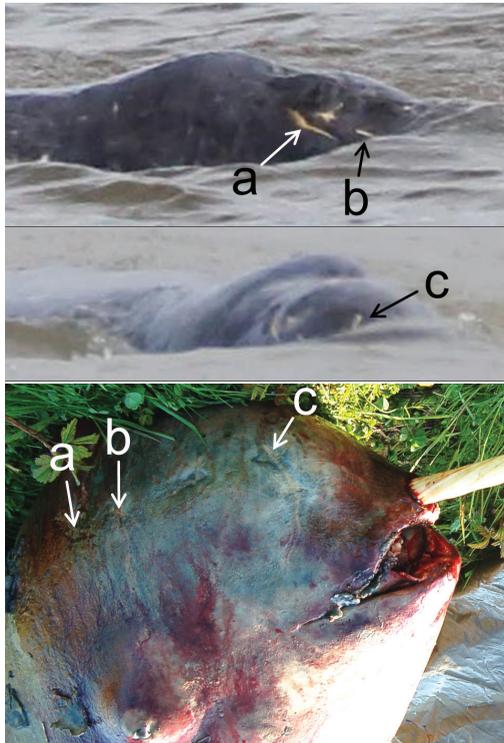


Figure 7. Crops from the images of the live animal showing details of the scars: right lateral view (top: Maarten Mortier), right frontal view (middle: Maarten Mortier), and corresponding scars (a-c) observed on the stranded animal (bottom: Paul Segers)

Additionally, the images of the live animal, taken almost 1 mo prior to the discovery of the carcass, did already indicate skin sloughing (Figure 6).

Other Extralimital Records in the North Sea

In Table 2 and Figure 8, we present an overview of historical records of the animal in the North Sea, except for Norway. Norway does not have a stranding scheme, and few strandings get reported there because of low human densities and the remoteness of many areas. Records additional to the ones listed in Table 2, from waters adjacent to the North Sea, include an emaciated female that was killed in the Tempelkrogen inlet, Isefjord (Baltic Sea, Denmark), on 16 July 1960 (Kinze, 2013); an unconfirmed, undated sighting from the Hebrides, UK (Fairweather, 1976); and a stranding in Landskrona (Baltic Sea, Sweden) in 1992 (Kinze et al., 2011). On 15 September 1960, a 213-cm tusk was found underwater off Salcombe in Devon in the English Channel (Western Morning News [WMN], 1960); it could have come from an animal that strayed into this area, or it may have been part of a lost cargo or a sunken vessel.

Discussion

The narwhal of Bornem adds to the very short list of extralimital records of this species in the North Sea. It is the first record in almost 70 y in Western Europe and, to our knowledge, the most southerly case of a live narwhal ever documented in Europe. Even in more northerly European countries, such as Iceland and continental Norway, records are rare (Collett, 1911-1912; Einarsson & Jónsson, 1976; Reeves & Tracey, 1980; Ólafsdóttir & Víkingsson, 2004). Undoubtedly, there were other cases during the last centuries that remained undiscovered, that were misidentified such as initially in Dutch and Danish records of females (Weber, 1912; Kinze, 2013), or that remained unidentified. A significant part of the records, including the one described herein, is from rivers or river mouths. Records of the only close relative of the narwhal, the beluga whale, outside its natural range originate in a number of cases also from rivers or estuaries (Gewalt, 1967; De Smet, 1974, 1981; Van Gompel, 1991; Camphuysen & Peet, 2006).

The Bornem animal was a juvenile, likely around 5 (95% CI: 2 to 11 y) to 6 (95% CI: 2 to 13 y) y old, applying the von Bertalanffy growth model as presented by Garde et al. (2015) for East and West Greenland, respectively. The animal was sexually immature. Hay (1984) estimated sexual and physical maturity at 395 and 470 cm, respectively, for males; and Garde et al. (2015) estimated a length of 350 to 400 cm for sexual

Table 2. Recorded narwhal sightings and strandings in the North Sea

| Year/date | Location | Description | Source |
|-------------------------|---|--|---|
| 1588 | Norfolk (UK) | Stranding, male | Christy, 1896; Harmer, 1927; Fraser, 1949 |
| 9 June 1648 | Isle of May, Firth of Forth (UK) | Stranding, male | Tulpius, 1739; Weber, 1912; Harmer, 1927; Fraser, 1949 |
| March 1669 | Bunderhammrich, Dollard – mouth of the River Ems (Germany) | Stranding, male | Hartmann, 1972; Bartelmeß, 1999 |
| 31 January 1736 | Belum or Neuhaus, River Oste, mouth of the River Elbe (Germany) | Stranding, female | Hampe, 1737; Steigertahl, 1737; Pasteur, 1800; Lacépède, 1804; Weber, 1912; Bartelmeß, 1999 |
| 15 February 1800 | Frieston, near Boston, Lincolnshire (UK) | Live stranding, male | Christy, 1896; Fleming, 1811; Harmer, 1927; Fraser, 1949; Weber, 1912 |
| 1806 | Flamborough, Yorkshire (UK) | Stranding, male | T. Waller; queried by Clarke & Roebuck (1881) on basis of rarity |
| 25 or 26 September 1808 | Sound of Weisdale, Shetland (UK) | Stranding, male | Anonymous, 1808; Fleming, 1811; Weber, 1912 |
| 11 March 1912 | Between Kampen and Elburg, Zuiderzee, currently IJsselmeer (The Netherlands) | Capture, female | Weber, 1912 |
| 17 February 1949 | Rainham, Thames, Essex (currently Kent, UK) | Stranding, female | Fraser, 1949 |
| Late June 1949 | Gairsay Isle, Orkney, UK | Sighting, two animals, presumably part of the group which included the animals stranded in that year | Fraser, 1974 |
| 9 July 1949 | First seen alive between Snodland and New Hythe; later stranded at Wouldham, River Medway, Kent, UK | Stranding, female | Fraser, 1974 |

maturity in East and West Greenland animals, and physical maturity at 462 and 456 cm for East and West Greenland animals, respectively. Applying the regression curve for tusk length vs body length from Garde et al. (2015), it is apparent that the tusk of the Bornem animal was relatively long. A male of 5 y old (based on dentinal growth layer groups [GLGs] with one GLG assumed to constitute 1 y of growth) with a body length of 306 cm had a much shorter tusk (external tusk length of 13 cm; total tusk length of 34 cm), while an animal with an unknown length, but with a total tusk length (external tusk length of 62 cm; tusk length of 91.5 cm) similar to the one of the animal of Bornem, had 17 GLGs (Garde et al., 2012). However, it is difficult to interpret age from tusk length as the tusks apparently grow at different speeds, maybe due to the availability and quality of food (E. Garde, pers. comm., 20 February 2017).

Establishing the cause of death of the Bornem animal is difficult. Death was estimated to have occurred at least 2 wks prior to its discovery. The advanced state of decomposition hindered proper histological assessments of the internal organs—not an unusual problem in examining stranded marine mammals (Jauniaux et al., 1998). No traces of a ship collision were present on the carcass, and the animal was sighted alive in the river, so it had not been carried to the area on the bulb of a vessel, for example. It is unlikely that the healed scars on the head had anything to do with the cause of death as they are common in narwhal. They may have been traces of injuries sustained while swimming upside down close to the seabed (Dietz et al., 2007), through contact with ice during temporary ice entrapment (Heide-Jørgensen et al., 2002b; as reported in Huntington et al., 1999, for beluga whale), through failed predation attempts by killer whale (*Orcinus orca*) or polar bear (*Ursus maritimus*) (Hay & Mansfield,

1989; Reeves et al., 1994), or through intraspecific aggressive behaviour, although this is more typical in adult males (Silverman & Dunbar, 1980; Gerson & Hickie, 1985).

Applying the Gompertz body mass growth model for West Greenland narwhal in Garde et al. (2015), the mass of a 5-y-old narwhal would be 447 kg. Applying the equation of Hay (1984) for body mass from length measurements, a narwhal of 3.04 m would weigh 464 kg; therefore, as the Bornem animal was complete, it would have been around 150 kg underweight, although some weight loss due to dehydration and during decomposition may have occurred. The nutritional status prior to death was assessed as poor, with severe emaciation having taken place. In healthy narwhals, the blubber layer thickness is 7 to 10 cm (McLeish, 2013), or more than three times the blubber thickness measured in this animal, although some liquefaction of the blubber might have taken place. There was no indication of recent feeding: the stomach contained no remains of food items except for the remains of a small cephalopod, the beak of which might have been embedded in the mucosa of the stomach for a relatively long time. Also, Fleming (1811) reported a greenish liquid (bile?) in the intestines for a narwhal stranded in Shetland.

Small litter items and fragments of eroded driftwood in the stomach of the narwhal were probably ingested in the river, where concentrations of such items occur (in contrast to at sea in this

area), including at the location where the narwhal was found. The uneroded appearance of some of the litter items and the presence of plant material also suggests a local and recent origin, and it can be excluded that they were either ingested in the North Sea or long before the stranding. Given the size of the litter items and their number, it is unlikely that the animal had purposely ingested them such as is commonly the case in other cetacean species (Baulch & Perry, 2014). Rather, our hypothesis is that they were ingested locally, near the location where the animal died, together with water and shortly before death occurred.

A large thyroid size has been reported previously in marine mammals that live in cold waters, and it is suggested that it is an adaptation to maintain body temperature (Cowan & Tajima, 2006). Adenomatous hyperplasia of the thyroid has been described in beluga whales from the St Lawrence Estuary and Hudson Bay (Canada); but in those cases, lesions appeared macroscopically as white nodular masses that distorted the gland (Mikaelian et al., 2003). Cardiac hypertrophy can be a compensatory response to mechanical work or to trophic signals such as in the case of hyperthyroidism (Maxie & Robinson, 2007). As such, the observations of an enlarged thyroid and cardiac hypertrophy are potentially associated, although the poor conservation status of the carcass hampered histological examinations. Parasite load, as far as it was possible to assess, did not seem to be unusual.

Narwhals are slow moving cetaceans with swimming speeds ranging from 2 to 8 km/h (Dietz & Heide-Jørgensen, 1995; Heide-Jørgensen & Dietz, 1995; Laidre et al., 2002, 2003). They can cover distances of around 60 km per day (Dietz & Heide-Jørgensen, 1995; Dietz et al., 2001; Heide-Jørgensen et al., 2002a). As the animal was at least 2,000 km from its home range (the closest area where narwhals occur being East Greenland; Heide-Jørgensen, 2002; Jefferson et al., 2012), it probably wandered around for weeks to months, alone or in a small pod, continuing to stray further south.

The cause of death most probably was a long, natural process of starvation of a solitary individual of a normally gregarious species that was far away from its home range. In their natural habitat, narwhals dive to great depths to feed on fish, squid, and crustaceans (Reeves & Tracey, 1980; Laidre et al., 2003), and neither the River Scheldt nor the southern North Sea can be considered as suitable habitat for them, with their preferred food items not present. The fact that the animal had not been observed after 30 March indicates that it probably died shortly after that date. The River Scheldt has busy boat traffic. There are activities

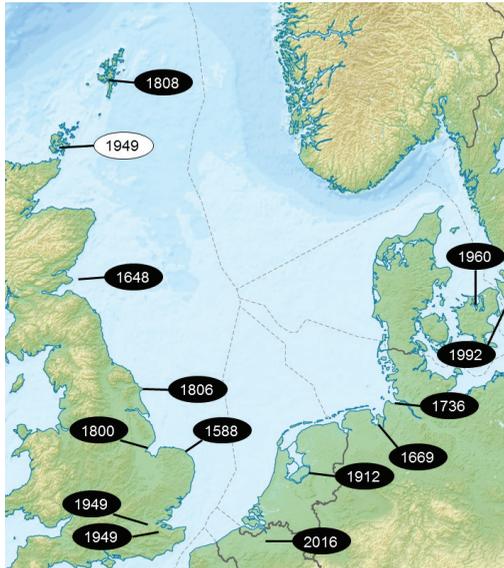


Figure 8. Location of strandings (black ellipses) and sighting (white ellipse) of narwhal in and around the North Sea between 1588 and 2016

of birdwatchers and anglers, and a live, relatively large cetacean would scarcely remain unnoticed.

The possible reasons for the narwhal getting separated from its pod and straying off towards—for this species—such low latitudes remain speculative. Recently, however, other Arctic species have been observed in the North and Baltic Seas, and around the British Isles and the Atlantic coast of France. In February 2015, a bowhead whale was observed off the Isles of Scilly, UK (Sea Watch Foundation, 2015a), a first case for Western Europe of this species. Only 1 y later, in May 2016, the same animal, or another individual bowhead whale, was observed off Penzance, UK (Sea Watch Foundation, 2016; De Boer et al., 2017); off Brittany, France (Anonymous, 2016a); and at Carlingford Lough, Ireland, in the Irish Sea (Whooley, 2016). In March and April 2017, a bowhead whale was observed off the coast of Belgium and The Netherlands (unpub. pers. obs.), which was, to our knowledge, a first case for the North Sea of this species. Off the County Antrim coast of Northern Ireland, a beluga whale was observed on 30 July 2015 (Sea Watch Foundation, 2015b), while on 30 August and 1 September 2015, two more beluga whales were observed off the coast of northeast England (Sea Watch Foundation, 2015c). On 9 January and 5 and 6 April 2016, solitary beluga whales (possibly the same animal) were spotted in Sweden off Öland in the Baltic Sea, and off Halmstad and Gothenburg, both in the Kattegat (Anonymous, 2016b, 2016c; Kullberg, 2016; Welin, 2016). On 9 October 2016, a live but very emaciated harp seal (*Pagophilus groenlandicus*) was found at Den Oever, The Netherlands (Anonymous, 2016d).

The stranding of a narwhal in Belgium in 2016 and other recent extralimital records of marine mammals closely associated with sea ice might just be coincidental, but it is tempting to relate them to recent changes in Arctic climate, leading to a disruption in the functioning of the Arctic ecosystem. There has been a dramatic decline in Arctic sea-ice since 1979 (Stocker et al., 2013), although, locally, shorter-term increases have been observed (Laidre & Heide-Jørgensen, 2005). The Arctic sea-ice extended over an average of 13.53 million km² in January 2016, which is 1.04 million km² below the 1981 to 2010 average, resulting in the lowest January extent in the satellite record, beating the previous 2011 (lowest) extent by 90,000 km² (National Snow and Ice Data Center [NSIDC], 2016a). On the Atlantic side, this was largely driven by unusually low ice coverage in the Barents, Kara, and East Greenland Seas. On 24 March 2016, Arctic sea-ice likely reached its maximum extent for the year at 14.52 million km², which was the lowest maximum ice extent during

winter in the satellite record (NSIDC, 2016b). In Baffin Bay (Canada & Greenland), which is the most important wintering ground for narwhal (Laidre & Heide-Jørgensen, 2011; Jefferson et al., 2012), there has been a decline in sea ice over the last two decades in all seasons (Hamilton & Wu, 2013; Peterson & Pettipas, 2013).

Ongoing global change is leading to changes in habitats, especially as a consequence of sea-ice dynamics. Loss of sea ice inevitably leads to changes in the Arctic food web (Fossheim et al., 2015; Kortsch et al., 2015), including due to increased presence of predators and competitive stress (Ferguson, 2009; Higdon & Ferguson, 2009; Kovacs et al., 2011; Ferguson et al., 2012; Reeves et al., 2014; Breed et al., 2017; Vacqu e-Garcia et al., 2017). Sea-ice loss, consequently, is a concern for many species tightly associated with sea ice, including narwhal (International Whaling Commission [IWC], 1997; Laidre & Heide-Jørgensen, 2005; Loeng et al., 2005; Laidre et al., 2008; Moore & Huntington, 2008; Williams et al., 2011; Evans & Bjørge, 2013). In addition to food web changes, loss of sea ice leads to increasing human activities in the Arctic such as shipping and seismic exploration, which possibly further affects narwhal habitat (Evans & Bjørge, 2013; Heide-Jørgensen et al., 2013; Reeves et al., 2014).

For cold-water species, climate-driven redistribution is usually directed poleward (Poloczanska et al., 2013; Pecl et al., 2017) and, as such, the presence of Arctic species in very southerly waters may seem counterintuitive. However, shifts in the distribution and abundance of Arctic cetaceans within their home ranges (Vacqu e-Garcia et al., 2017) and observations outside their home ranges could be indications of some of the less obvious and indirect impacts of climate change.

Conclusions

The narwhal that stranded in Belgium in 2016 adds to the very short list of records of this species in the North Sea. The animal was observed alive in the River Scheldt weeks before its stranding, proving that it had arrived there by its own means. Its general condition and stomach content indicate that it probably died due to starvation, although its state of decomposition did not allow possible physical dysfunction or disease to be excluded. Although this remains speculative, this case, together with other recent cases of Arctic species at locations far away from their home ranges, may be related to changes in the Arctic climate, with consequences for Arctic sea-ice and the functioning of the Arctic ecosystem.

Acknowledgments

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