BULLETIN DE L'INSTITUT ROYAL DES SCIENCES NATURELLES DE BELGIQUE
BULLETIN VAN HET KONINKLIJK BELGISCH INSTITUUT VOOR NATUURWETENSCHAPPEN

BIOLOGIE, 67-SUPPL.: 15-28, 1997
BIOLOGIE, 67-SUPPL.: 15-28, 1997

Strandings of sperm whales *Physeter macrocephalus* in the North Sea: history and patterns

by C. SMEENK

Abstract

Strandings of sperm whales *Physeter macrocephalus* L., 1758 in the countries bordering the North Sea have been documented since the end of the 16th century. All known strandings in this area are summarized. There is no clear temporal pattern in the occurrence of sperm whales in the North Sea except that there are very few strandings between the late 18th and early 20th century. All sperm whales of which details are known have been males, ranging from about 12 to 18 m in size. Most strandings occur during the period November-February. It seems likely that the majority of sperm whales enter the North Sea during their southward migration. If the animals do not find their way out in time, they become weakened and many will die at sea or become stranded. The North Sea can be described as a sperm whale trap, and multiple strandings mainly occur in the southern part of the area, where the coastal configuration is characterized by vast expanses of sandbanks, mudflats and estuaries. The large gap in the occurrence of sperm whales in the North Sea from the late 18th till the early 20th century may be connected with whaling activities over the last centuries, by which sperm whale numbers in the North Atlantic were considerably reduced. Sperm whales have been increasing again in the North Sea, particularly since the 1970s and, again, the 1990s, possibly as a response to a population increase following the decline and the end of whaling in this area.

Keywords: sperm whale, strandings, North Sea, history, whaling.

Résumé

Des échouages de cachalots *Physeter macrocephalus* L., 1758 sur le littoral des pays de la mer du Nord ont été documentés depuis le 16ème siècle. L'article donne un aperçu de tous les échouages connus dans cette région. Il n'y a pas d'évolution temporelle claire de la présence du cachalot en mer du Nord si ce n'est qu'on ne relève que très peu d'échouages entre la fin du 18ème siècle et le début du 20ème. Tous les cachalots pour lesquels on dispose d'informations détaillées étaient des mâles dont la taille varie entre environ 12 et 18 m. La plupart des échouages se produisent entre novembre et février. Il est probable que la majorité des cachalots concernés pénètrent dans la mer du Nord pendant leur migration vers le sud; si les animaux ne parviennent pas à en trouver la sortie à temps, ils s'affaiblissent et beaucoup d'entre eux sont appelés à mourir en mer ou à s'échouer. La mer du Nord peut être décrite comme un piège à cachalot, et les échouages multiples se produisent surtout dans la partie sud de la région où la configuration de la côte se caractérise par de vastes étendues de bancs de sable, de platiers vaseux et d'estuaires. La longue interruption dans l'apparition de cachalots en mer du Nord entre la fin du 18ème siècle et le début du 20ème peut être liée à la chasse à la baleine pratiquée aux siècles derniers et qui avait considérablement réduit le nombre des cachalots dans l'Atlantique nord. Les cachalots sont réapparus plus fréquemment en mer du Nord depuis les années 1970 particulièrement, et à nouveau depuis 1990. Peut-être s'agit-il là d'une conséquence d'un accroissement de population succédant à un déclin, puis à la disparition de la pêche baleinière dans cette région.

Mots-clés: cachalot, échouages, mer du Nord, histoire, pêche baleinière.

Introduction

Strandings of sperm whales *Physeter macrocephalus* L., 1758 in the North Sea countries have always been major events, attracting vast crowds of spectators. In the past, chroniclers, artists and the editors of leaflets made many sperm whales unforgettable. Etchings and engravings reached a high circulation and several animals were quite accurately described, measured and drawn (Figs. 1, 2). The oldest tradition of this kind exists in the Netherlands and Flanders, where in the late 16th and early 17th century a number of sperm whales were stranded near important centres of culture and learning, such as Antwerp and Haarlem. Illustrations made during that period were liberally copied in later years and have greatly influenced the iconography and (mis)conceptions about sperm whales in both popular and scientific works, far into the 19th century (DE SMET, 1977; BARTHELMEß & MÜNZING, 1991; SLIGGERS & WERTHEIM, 1992).

Sperm whale strandings in our countries have thus been reasonably well documented over the last 400 years. Strandings in remote places were, of course, less often and less reliably recorded than those in more populated areas, and documentation nowadays is far more complete than it has ever been before. Nevertheless, we have a fair idea about the occurrence of sperm whale strandings around the North Sea since the end of the 16th century. When attempting to summarize our knowledge of sperm whales in this area, we should start with looking at this historical information, to see what it may tell us.

Material and methods

To that end, I have brought together all documented sperm whale strandings (and observations of live ani-

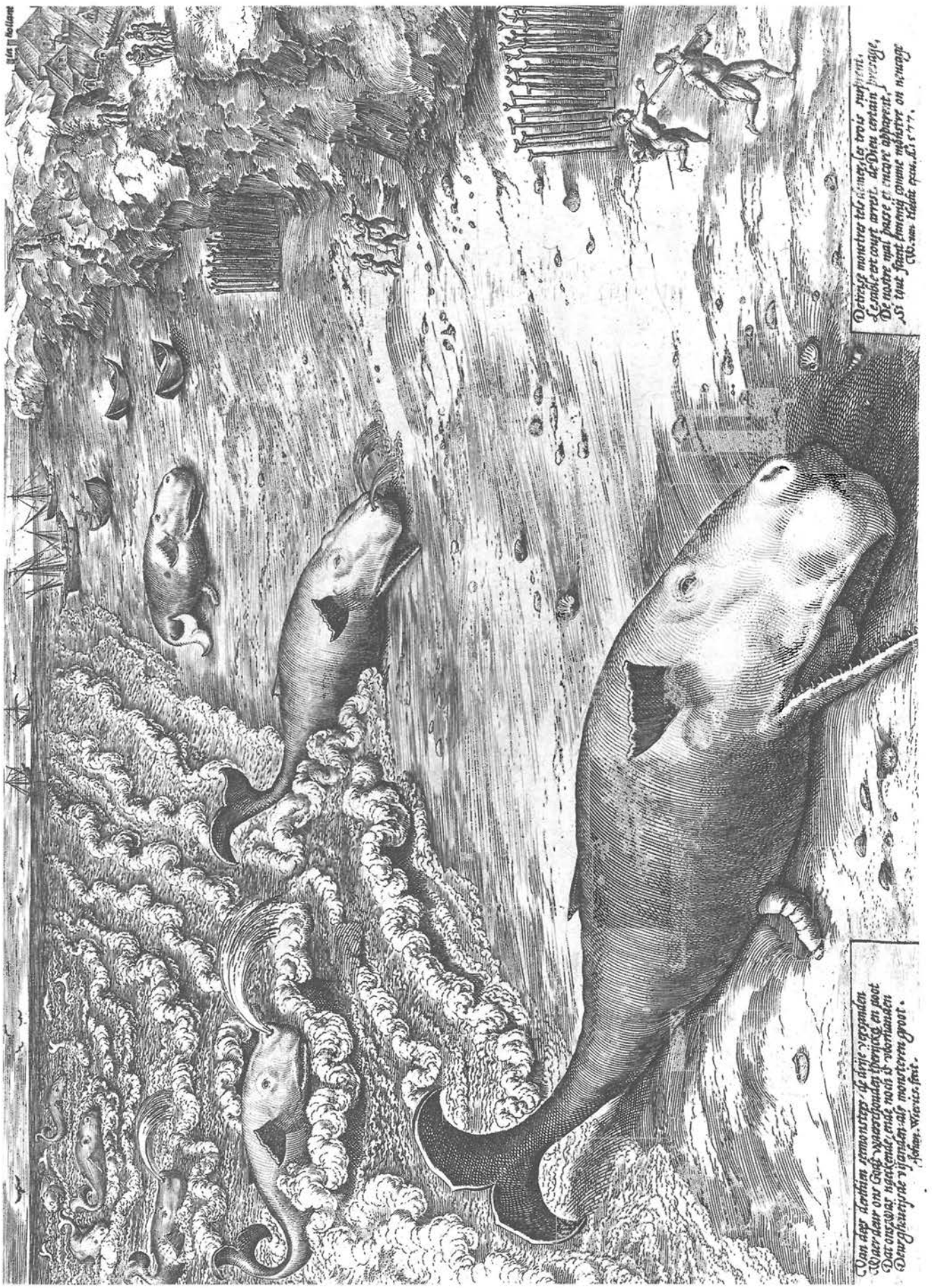


Fig. 2 – Sperm whale stranding near Egmond, the Netherlands, 15 February 1764. The picture shows that measurements were not always made very accurately. Anonymous drawing in East Indian ink, collection Municipal Archive, Haarlem.

mals) which I could find for the North Sea over the period 1560-1995; a review is given in the Appendix. These include the records for the east coasts of Scotland and England (but excluding Orkney and Shetland), the coasts of France north of Cap Gris Nez, Belgium, the Netherlands, Germany, Denmark and Sweden. For southern Norway I did not find any records. I have distinguished the following categories: single strandings, multiple or mass strandings, and sightings of live animals.

These categories are to some extent arbitrary. It is not always possible to distinguish between a multiple stranding and a number of single, unrelated events. Associations of male sperm whales may be loose and temporary and it seems hard to define what exactly a group is (RICE, 1989; see also BEST, 1979). Moreover, when such a group lands into difficulties, e.g. in coastal waters (see below), the exhausted or dying animals may become widely scattered and not all be stranded on the same day and in the same place. There are reliable reports of events where some sperm whales beached themselves and others seemed to escape (BARTHELMEß & MÜNZING, 1991; SMEENK & ADDINK, 1993). But then some or all of the latter may have become stranded elsewhere, after some time, or may have died at sea. Single sperm whales may have been members of a social unit during life. Although I have treated all strandings of single animals individually here, several cases seem to be related and might as well have been combined. In some years there were so many strandings that it appears difficult to count them as separate events. The most outstanding season in this respect is the winter of 1761/62, when one or more groups of sperm whales roamed the North Sea (Van DEINSE, 1918, 1931; SLIGGERS & WERTHEIM, 1992; see the Appendix; note: several of these strandings were wrongly dated 1763 or even 1788 by various authors, or were double-counted for some of those years). Another example is the winter of 1994/95 (and again the end of 1997).

Keeping these restrictions in mind, all known sperm whale strandings in the North Sea since the second half of the 16th century have been summarized in Fig. 3. For the sake of clarity, the study period has been divided

←

Fig. 1 – Sperm whale stranding near Ter Heijde, the Netherlands, 22/23 November 1577. Three animals were stranded alive, 10 or 11 escaped; apart from those three on the beach, ten others can be distinguished in the sea. Engraving by Johan Wierics, collection National Museum of Natural History, Leiden.

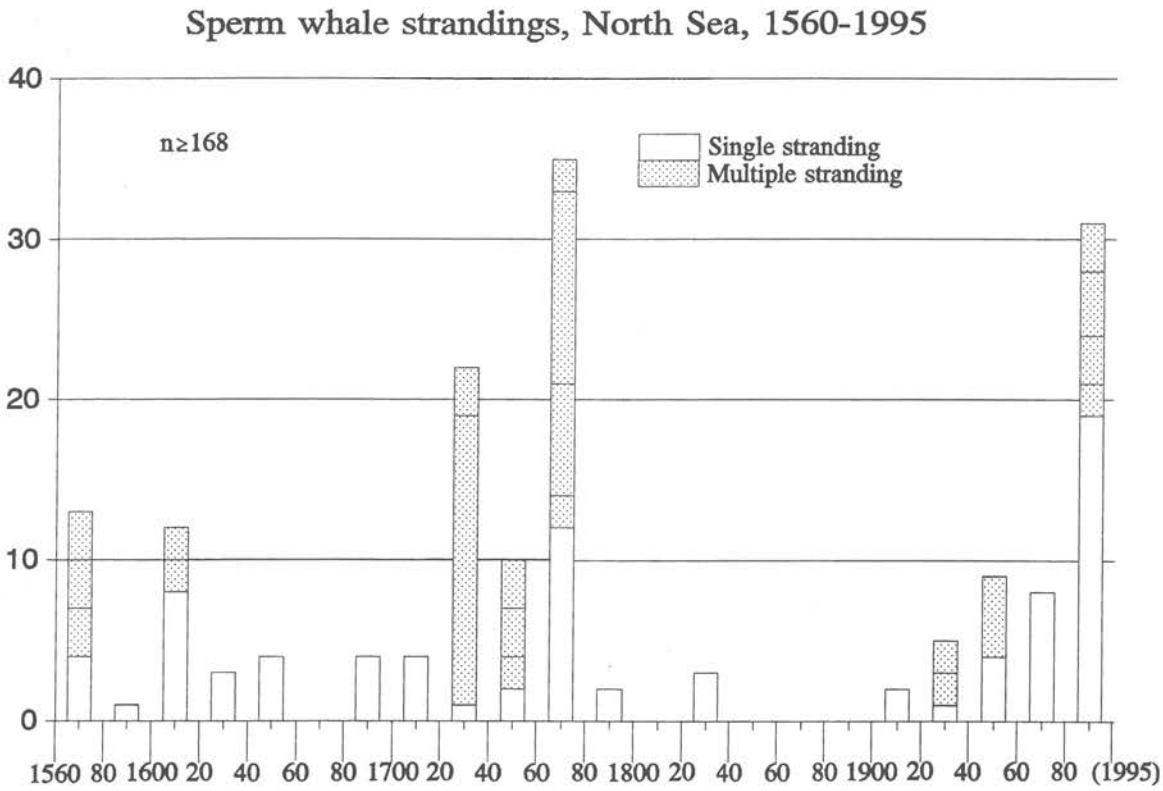


Fig. 3 – Sperm whale strandings in the North Sea, 1560-1995, in periods of 20 years. White bars: total number of single strandings reported for each period; stippled bars: multiple strandings showing the number of animals known to have been involved in each event (in several cases there may have been more, or some animals escaped). See the Appendix for further details.

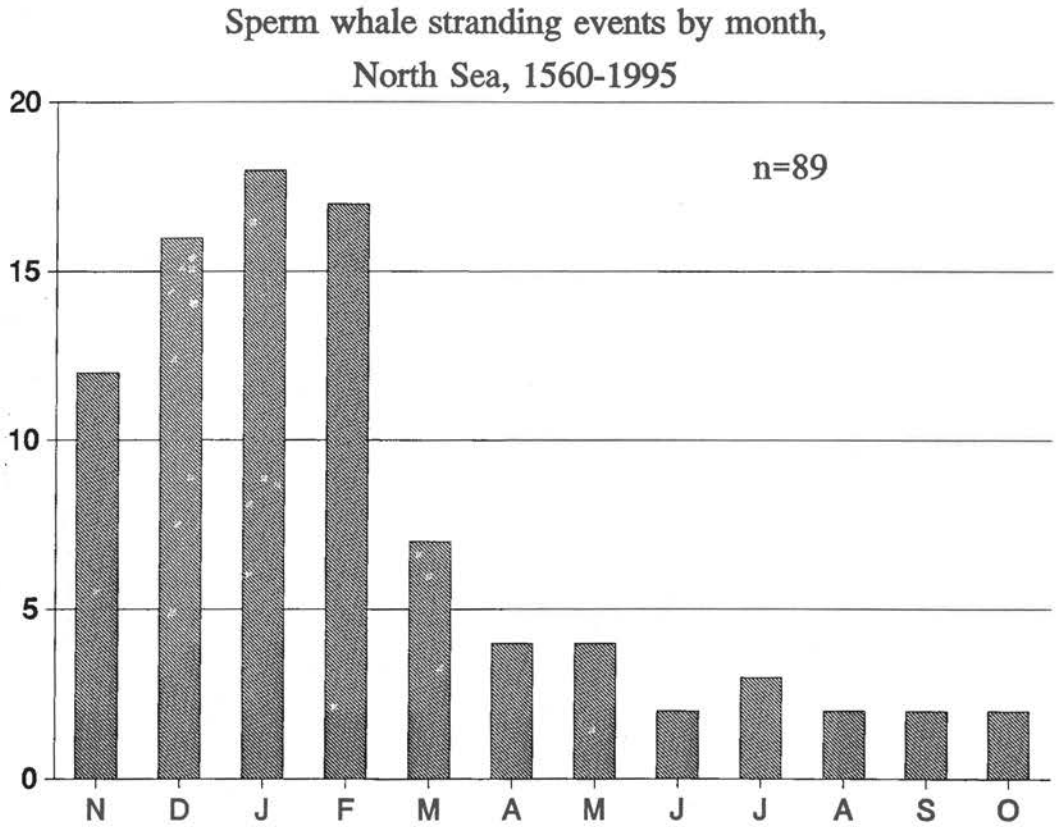


Fig. 4 – Sperm whale strandings in the North Sea, arranged by month. Multiple strandings have been counted as one event except where they were spread over more than one month.

into blocks of 20 years. For multiple strandings, the minimum number of individuals known to be involved is given. Several old records of mass strandings state that there could have been more animals stranded in some nearby locality, or that some were seen to swim away, such as in 1577 (Fig. 1). It should be emphasized once more that the past centuries are underrepresented. For the 20th century we probably have a good picture of sperm whale strandings around the North Sea. But many earlier cases must have gone unnoticed by literate people or were not recorded in any now accessible source.

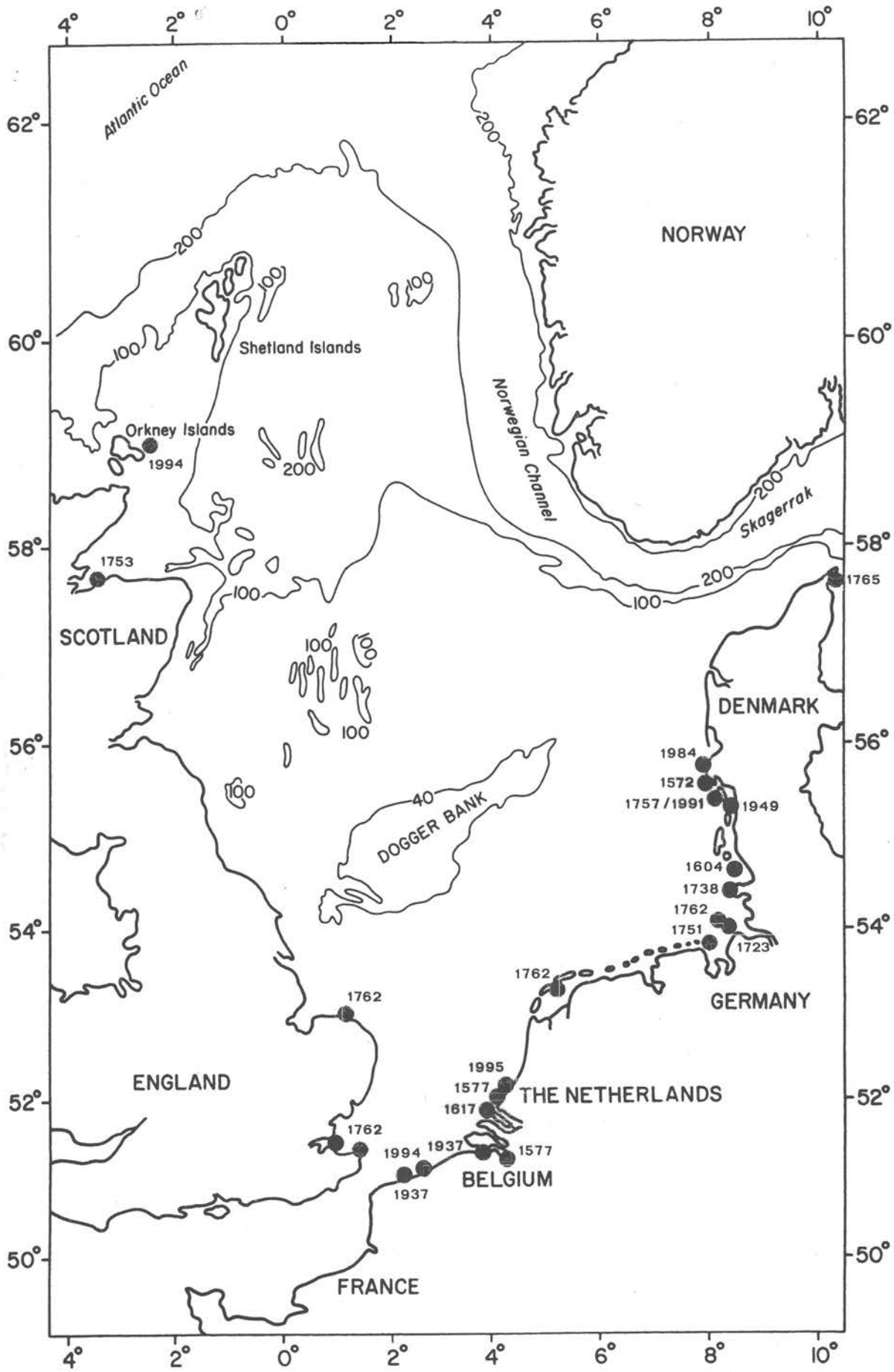
One more thing should be borne in mind. Strandings and sightings in coastal waters are the only events we see, as people living on the periphery of the North Sea. We generally fail to notice what is happening to cetaceans in the North Sea at large. Not all sperm whales entering the North Sea will eventually be washed up onto the beach and we rarely will know the fate of those animals which escape from a tricky situation and are not again found. The whole of the shallow southern North Sea is to be regarded as one vast coastal area, at least where sperm whales are concerned (see below). Certain animals may leave the North Sea again, but others probably die offshore without being washed up and without being noticed. This is indicated by many recent finds of sperm whale bones dredged up by fishing vessels in various places in the southern North Sea (E.J.O. KOMPANJE & K. POST, pers. comm.). Our records of stranded sperm whales and the few sightings that we have can only give an incomplete picture of the occurrence and fate of sperm whales in the North Sea.

Results and discussion

Temporal pattern

Bearing in mind the many restrictions of our data, one thing is obvious right from the beginning: sperm whales have at all times wandered into the North Sea in small but varying numbers, and the high frequency of strandings we experienced in the winter of 1994/95 (and again in 1997), though rare, is nothing new. Other famous sperm whale years were 1577, 1723 and 1761/62. There appears to be no clear pattern in the occurrence of sperm whale strandings over the years with two exceptions: (1) there are very few strandings in the period between the end of the 18th and the first part of the 20th century, a lapse of about 150 years; and (2) the number of records has been increasing during the last few decades, a trend also observed in the stranding data for the British and Irish coasts as a whole (BERROW *et al.*, 1993). This will be discussed in the section on whaling below.

Fig. 5 – Sperm whale stranded between the islands of Terschelling and Ameland, the Netherlands, 3 November 1994.


4°
2°
0°
2°
4°
6°
8°
10°
62°
60°
58°
56°
54°
52°
50°
Atlantic Ocean
NORWAY
Shetland Islands
Orkney Islands
1994
Norwegian Channel
Skagerrak
1753
1765
SCOTLAND
DENMARK
1984
1572
1757/1991
1949
1604
1738
1762
1751
1723
DOGGER BANK
40
100
200
1762
GERMANY
1762
ENGLAND
1995
1577
THE NETHERLANDS
1617
1762
1994
1937
1577
1937
BELGIUM
FRANCE

Sex and size

All sperm whales in the North Sea found to have been described, measured or pictured in any way have been bulls, ranging from more than 12 to about 18 m in size. No females and no smaller males have ever been recorded in our area. This is consistent with what we know about sperm whale distribution in the eastern North Atlantic: only the larger bulls regularly occur north of about 40°N (EVANS, 1991; GAMBELL, 1995). Sexual dimorphism and sexual segregation in sperm whales are striking: males and females have very different behavioural and distributional patterns. A large proportion of males not taking part in reproduction leaves the area where the breeding herds occur, at least for some time. BEST (1979) has shown that in the Southern Hemisphere the larger bulls (his category of "large bachelors") of more than 12 m in length and over 20 years old make the longest migrations into higher latitudes. It is this category that we find in the North Sea. This process of sexual segregation would reduce intraspecific competition for food and may act as a selection mechanism among maturing and adult bulls (BEST, 1979).

Season

Sperm whales have been found in the North Sea in every month of the year. In Fig. 4 the strandings have been arranged by month, for all cases where this is known. Multiple strandings or events that are probably related are counted as one entry; where those were spread over a longer period, all respective months received a score. The great majority of strandings occur in late autumn and in winter, during the period November-February.

This seasonal pattern is in agreement with the general distribution and migration of sperm whale bulls in the North Atlantic. During the summer, the animals occur at higher latitudes than in winter. They perform more or less regular north-south movements, though certain numbers appear to stay in northern waters for at least part of the winter months. On the other hand, substantial numbers of large males are present near the Azores throughout the year (AVILA DE MELO & MARTIN, 1985). We still know little about this migration and nothing about the cues that regulate these movements. The sperm whale is a truly oceanic species and large males normally feed at depths of 400 m or more (CLARKE, 1986; LOCKYER as quoted by RICE, 1989; WATKINS *et al.*, 1993). Sperm whales are often seen west of the British Isles away from the continental shelf and off the west coast of southern Norway (EVANS, 1991). It seems likely that most sperm whales which – by whatever cue – enter the North Sea, do so during their autumn migration. Others seem to stray into these waters on more irregular wanderings in other times of the year but again, most probably coming from the north. The rarity of strandings in the Channel (DUGUY, 1983; BERROW *et al.*, 1993) suggests that sperm whales hardly ever enter the North Sea via that route.

The fate of sperm whales in the North Sea

Once a sperm whale or group of sperm whales has entered the North Sea and continues due south, the animals will reach progressively shallower waters. The North Sea, and particularly its funnel-shaped southern sector less than 50 m deep, is totally unsuitable for sperm whales. Although they must be able to go without food for quite some time, a prolonged stay in these waters will eventually prove fatal, if the animals do not find their way out in time. This combination of a so-called and as yet unexplained "navigational error" (RICE, 1989) with a long sojourn in the North Sea would account for most sperm whale strandings in the area. This is corroborated by the fact that most sperm whales stranded here have empty stomachs. However, stomach contents were found in the two animals that stranded in the Dutch (see Fig. 5) and German Wadden Sea in November 1994. They consisted of considerable quantities of squid beaks, nearly all of which belonged to *Gonatus fabricii*, a species occurring in the Atlantic Ocean north of the North Sea (LICK *et al.*, 1996; CLARKE, this volume). This would mean that the animals had been travelling south at some speed and continued in that direction after having entered the North Sea, till they perished on the sandbanks of the Frisian Islands.

Sperm whales have been found all around the North Sea; there is no clear geographical pattern in the strandings of individual animals. Most multiple strandings, however, occur in the southern part of the North Sea, in places characterized by intricate systems of sandbanks, mudflats or estuaries (Fig. 6). This too, is in good agreement with the course of events just described. Being animals of the deep ocean, sperm whales have no experience whatsoever in finding their way in this kind of shallow and treacherous waters. If they use echolocation at all during travelling, the signals received from the soft and gently sloping sandbanks or mudflats would mostly be weak, obscured by the background noise of swell, and difficult to interpret. Added to this are the differences in tide, so that the animals may suddenly find themselves grounded or locked in. In most cases they will have gone without food for a considerable time, as long as a few months perhaps for those who are stranded in late winter, and hence will be weakened and under stress. The signs of such a progressive debilitation are clearly descibed for the sperm whales that were beached on the Belgian and Dutch coasts in November 1994 and January 1995, respectively (see this volume and JAUNIAUX *et al.*, 1998). Finding themselves and other members of the group in difficulties, panic may break out and more whales, or even the whole group, will get stuck beyond recovery. The often vivid and emotional eye-witness accounts of mass strandings of the past and present are illustrative of just such a situa-

←

Fig. 6 – Multiple sperm whale strandings in the North Sea, 1560-1995. See the Appendix for further details.

tion. One may compare these events with accidents that happen to exhausted humans who find themselves lost in a totally strange and hostile environment, where one wrong decision or reaction may be fatal. Owing to its geography, the North Sea can aptly be described as a huge and effective sperm whale trap (cf. GERACI & LOUNSBURY, 1993).

Sperm whales in the North Sea: the possible effects of whaling

Finally, we should give some thoughts to the large gap in the occurrence of sperm whale strandings in the North Sea, from the end of the 18th to the first decades of the 20th century (Fig. 3). This seems hard to explain. We have seen that sperm whale bulls in the North Atlantic wander off into northern waters, away from the breeding grounds where they have spent the first 10-15 years of their life. We still do not know what induces this migration, what proportion of the males takes part in this, how far the animals go and how long they stay away. If avoidance of food competition between the sexes is the underlying mechanism, then one may expect that more animals migrate, and disperse further, when food supplies are low or sperm whale numbers high. In other words: migration may to some extent be density-dependent, though we know nothing about natural long-term fluctuations in the numbers of sperm whales or their prey species. One factor, however, has had an enormous influence on sperm whale numbers in the North Atlantic and elsewhere: man's whaling activities during the last three centuries.

Sperm whale hunting started in the early 18th century and continued through the 19th and the greater part of the 20th century (see GOSHO *et al.*, 1984, for a brief review). At first, sperm whales were caught from land stations. Pelagic whaling developed in the second half of the 18th century. In that period hunting increased rapidly but remained largely confined to the North Atlantic, that part of the world within easiest reach of American and European whalers. During the final decades of the 18th century, sperm whale hunting extended to other oceans. Hunting pressure on the North Atlantic stock remained heavy during the first half of the 19th century but declined afterwards for various reasons, one apparently being the scarcity of sperm whales on the traditional hunting grounds and the resulting difficulty of obtaining a full ship. World catch levels remained relatively low in the late 19th and early 20th century, to rise dramatically after the Second World War to unprecedented levels, with a peak in 1964. The charts published by TOWNSEND (1935) show the areas where sperm whales were taken by American whalers during the period 1761-1920. Though not meant or suited for a quantitative analysis, they clearly illustrate that the vast majority were caught south of 40° N, i.e. within the breeding areas. Nobody has attempted to estimate – if at all possible – the total catches for the North Atlantic over the

Table 1 – Published sperm whale catches in Madeira and the Azores, 1900-1984

	Period	Number
Azores 1900-1949	1900-1909	922
(CLARKE, 1954, 1956)	1910-1919	954
	1920-1929	1484
	1930-1939	2858
	1940-1949	5495
	Total	11713
Azores and Madeira 1946-1966[1]	1946-1956	8511
(DA SILVA, 1987)	1957-1966	6024
(IWS for 1967)	1967	395+
Faial, Pico (Azores)	1978-1984	600
(DA SILVA, 1987)		

[1] Note: these figures may include the 160 animals taken by continental Portugal during 1946-1951 as specified by SANPERA and AGUILAR (1992).

Table 2 – Sperm whale catches Iberian Peninsula, 1921-1980 (SANPERA & AGUILAR, 1992)

Period	Number
1921-1929	524
1933/34	5
1946-1950	337
1951-1960	1673
1961-1970	2725
1971-1980	2207
Total	7471

Table 3 – Sperm whale catches North Atlantic Ocean, 1910-1982 (IWS)

Period	Number
1910-1919	98
1920-1929	206
1930-1939	536
1940-1949	386
1950-1959	1792
1960-1969	1849
1970-1979	1057
1980-1982	231
Total	6155

centuries but, whatever the variation in time, the North Atlantic population may well have been the most depleted of all.

There are no real catch statistics for sperm whales in the North Atlantic covering the 18th and 19th centuries. For the 20th century such data are available, though the published records are incomplete. Nevertheless, they may serve as an illustration of the varying hunting pressure on sperm whales during this period in this part of the ocean. Three main whaling areas can be distinguished here: Madeira and the Azores, the Iberian Peninsula, and the North Atlantic from about Scotland to Norway, Iceland, Greenland and occasionally Canada. In all these areas, sperm whale hunting was carried out from land stations and thus was restricted in range. Beside that, American pelagic whaling was still practised in the Atlantic between 1900 and 1920 (TOWNSEND, 1935; CLARKE, 1954), but the numbers of sperm whales obtained in these operations are unknown. Coastal whaling in the Azores has the longest tradition and dates back to 1832 (CLARKE, 1954); sperm whale hunting off Madeira started only in 1941 (AVILA DE MELO & MARTIN, 1985). Whaling in Madeira ceased in 1981, in the Azores in 1987 (KLINOWSKA, 1991). Off the Iberian Peninsula and the Spanish territory in North Africa, sperm whales were hunted between 1921 and 1980 (SANPERA & AGUILAR, 1992). In northern waters, whaling took place over the greater part of the 20th century, till it came to an end in 1982.

Catch statistics have been taken from the following sources: International Whaling Statistics (IWS: data from 1910 till 1982); CLARKE (1954, 1956) for the Azores, Da SILVA (1987) for the Azores and Madeira, and SANPERA & AGUILAR (1992) for the Iberian Peninsula. The figures are summarized in Tables 1-3. No attempts were made to trace unpublished data, though these are available in archives (see the analysis by AVILA DE MELO & MARTIN, 1985, of the Azorean catches between 1947 and 1982). Discrepancies between different sources have not been pursued, as generally these are minor; in such instances CLARKE (1954, 1956) has been followed for the Azores, SANPERA & AGUILAR (1992) for the Iberian catches. Incomplete as they are, the figures give a good impression of the vicissitudes of sperm whale hunting in the North Atlantic during the 20th century.

Bearing in mind the lack of data for the American whaling between 1900 and 1920 and the incompleteness of readily available catch statistics for Madeira and the Azores for the period 1968-1987, it appears that hunting pressure has been greatest south of 40°N, and during the 1940s to 1970s. Generally, only the total annual catches have been published, but CLARKE (1956) specifies the proportion of each sex for the Azores over the period 1947-1954, and the IWS do this for the Azores and Madeira for the years 1953-1967 (with the exception of 1954, 1955 and 1960). The proportion of females varies considerably from year to year, but the total figures are quite similar in both sources: 31.2% females in CLARKE's tables (n = 4137), 27.8% females in those given by the IWS (Azores and Madeira combined: n = 6557). Furher north, the percentage of females is even smaller (Iberian Peninsula) or zero (North Atlantic waters). This means that in the 20th century males have been the main target in these areas.

As yet, there are no ways of assessing the effects of whaling on the North Atlantic sperm whales. One cannot help wondering, however, whether there may be a relation between this long-standing hunting pressure and the rarity of strandings in the North Sea from the late 18th (or early 19th) till the early 20th century. Hunting would have resulted in a decrease in the numbers of sperm whales and perhaps of bulls in particular, if in those days too, whalers selected the largest animals (reports on this, however, are contradictory: see ALLEN, 1980; GOSHO *et al.*, 1984). Hence there were fewer males to migrate north and sperm whale numbers on the northern feeding grounds must have become relatively low. At the same time, these lower densities would have reduced intraspecific competition and thereby the need for large-scale dispersal of males into and within higher latitudes. The greater part of the bulls would have concentrated on the best feeding grounds and only few would have been forced out into less favourable areas, with a chance of straying into the North Sea. If such effects existed already by the turn of the 18th/19th century, when whaling on the North Atlantic breeding grounds had greatly increased, this might account for the rarity of sperm whales in the North Sea.

AVILA DE MELO & MARTIN (1985) have analysed the length of sperm whale bulls in the catches on Madeira and the Azores during the period 1947-1982. Interpretation of trends appears difficult. Basing themselves on the data presented by TOWNSEND (1935), the authors believe that females were hunted more intensively in historical times when so many whaling operations were directed at areas south of 30° N, where there are relatively more females than near Madeira and the Azores. They also observe that during their study period large males were always present near the Azores, even in summer, when there are peak numbers of bulls in Icelandic waters. The authors conclude that a substantial part of the bulls remain in southern waters throughout the year, or do not migrate north every year. Finally, they find that the proportion of large males (14-15 m) in the catches off Madeira declined during 1965-1971, whereas near the Azores those increased since the early 1970s. By the end of that decade, the average length of animals caught near Iceland was at its lowest level, after a decrease that had set in during the 1950s (MARTIN, 1981). In the authors' view, this could mean, apart from a recovery of the stock after the heavy exploitation in the Azores during the 1940s and 1950s, that a depletion of large males in one area may to some extent have been compensated by an influx of individuals from elsewhere, in this case from the northern feeding grounds.

These findings would seem consistent with the idea outlined above, that more males would stay in south-

ern waters when the sperm whale population is relatively low. A reduced hunting pressure on females in the 20th century may have allowed a fairly rapid recovery of the population, once hunting levels fell. With the decline and eventually the end of whaling in the 1970s-1980s, harvesting of bulls stopped altogether and the migrating segment of the population could grow relatively fast. The numbers of males in northern waters increased again and so did competition between them.

Conclusion

Returning once more to sperm whale strandings in the North Sea (see the Appendix), we do see a rise in those events during the 1970s, concurrent with a similar trend in British and Irish waters at large (BERROW *et al.*, 1993). The 1990s have seen a further, sharp, increase. If indeed there is a relation between the frequency of sperm whale strandings in the North Sea and adjacent Atlantic waters and the numbers of bulls present at northern latitudes, then this upward trend may be taken as a sign of a recovery of the North Atlantic population, with increasing numbers of migrating bulls. EVANS (this volume) also finds an increase in the numbers of fairly small males (< 14 m) in the British and Irish strandings since the 1970s, which would mean that nowadays more relatively young animals disperse into northern waters. This too, would be consistent with a growing population and an increased intraspecific competition.

Not everything can be readily explained. It still is hard to see why sperm whales did not reappear in the North Sea by the end of the 19th century, when hunting pressure seems to have slackened. However, before that time whaling had always concentrated on the species' breeding grounds where the numbers of females in the catches must have been high, which may have prevented a rapid recovery of the stock. Another point is that sperm whale strandings in the North Sea came in evidence again as early as the 1930s. Although the greatest exploitation of males in the North Atlantic was still to follow, at least the breeding grounds south of Madeira had become free of whaling activities with the end of pelagic operations, and recruitment may therefore have been higher than in the 19th century. Needless to say, the data necessary for making reliable estimates of original sperm whale numbers in the North Atlantic (i.e. before the beginning of 18th-century whaling) and the effects on those of hunting probably will never become available (see also ALLEN, 1980).

Nothing can be proved and we have to be extremely cautious in defining simple relationships where so many essential parameters remain unknown. I have only tried to emphasize that the occurrence (and absence) of sperm whales in the North Sea should at least be considered in the context of the overriding factor of whaling. Any study of sperm whale numbers and migration patterns in North Atlantic waters must include the very sources where our animals come from and to where the most lucky ones may perhaps return, after a narrow escape from the North Sea sperm whale trap.

Acknowledgements

Thanks are due to Peter EVANS, Carl KINZE and Bob REID for providing published and unpublished data on sperm whale strandings and sightings. Marina SEQUEIRA sent literature on sperm whale catches in Madeira and the Azores. Marjan ADDINK executed Figs 3 and 4; she and Dorien HOOGERHEIDE helped in preparing the list of North Sea sperm whale strandings.

References

ALLEN, K.R., 1980. Conservation and management of whales: pp. i-ix, 1-107. University of Washington Press, Seattle/Butterworths, London.

AVILA DE MELO, A.M. and MARTIN, A.R., 1985. A study of male sperm whale length data from the Azorean and Madeiran catches, 1947-82. *Report of the International Whaling Commission*, 35: 209-215.

BARTHELMEß, K., 1995. Serienstrandungen von Pottwalen an den Nordseeküsten. *Deutsche Schiffahrt*, 1995 (1): 6-10.

BARTHELMESS, K., 1997. An unrecorded broadside commemorating cetacean strandings on the Dutch and Flemish coasts 1519 to 1617. *Lutra*, 40: 9-19.

BARTHELMEß, K. and MÜNZING, J., 1991. Monstrum horrendum. Wale und Walstrandungen in der Druckgraphik des 16. Jahrhunderts und ihr motivkundlicher Einfluß. I. Aufsatzteil. II. Katalogteil. III. Referenzteil. *Schriften des Deutschen Schiffahrtsmuseums*, 29: 1-220. Ernst Kabel Verlag, Hamburg.

BERROW, S.D., EVANS, P.G.H. and SHELDRICK, M.L., 1993. An analysis of sperm whale *Physeter macrocephalus* stranding and sighting records, from Britain and Ireland. *Journal of Zoology*, London, 230: 333-337.

BEST, P.B., 1979. Social organization in sperm whales, *Physeter macrocephalus*. Pp. 227-289 in: WINN, H.E. and OLLA, B.L. (eds). Behavior of marine mammals. Current perspectives in research. Vol. 3: Cetaceans. Plenum Press, New York/London.

BORKENHAGEN, P., 1993. Atlas der Säugetiere Schleswig-Holsteins: pp. 1-131. Landesamt für Naturschutz und Landschaftspflege Schleswig-Holstein, Kiel.

CLARKE, M.R., 1986. Cephalopods in the diet of odontocetes. Pp. 281-321 in: BRYDEN, M.M. and HARRISON, R. (eds). Research on dolphins. Clarendon Press, Oxford.

CLARKE, M., 1997. Cephalopods in the stomach of a sperm whale stranded between the islands of Terschelling and Ameland, southern North Sea. This volume.

CLARKE, R., 1954. Open boat whaling in the Azores. The history and present methods of a relic industry. *Discovery Reports*, 26: 281-354, table 10, pls XIII-XVIII.

CLARKE, R., 1956. Sperm whales of the Azores. *Discovery Reports*, 28: 237-298, pls I-II.

DEINSE, A.B. VAN, 1918. Over de potvisschen in Nederland gestrand tusschen de jaren 1531-1788. *Zoologische Mededeelingen*, Leiden, 4: 22-50, pls II-IV.

DEINSE, A.B. VAN, 1931. De fossiele en recente Cetacea van Nederland: i-xi, 1-304, afb. 1-39. H.J. Paris, Amsterdam.

DUGUY, R., 1983. Les cétacés des côtes de France. *Annales de la Société des Sciences Naturelles de la Charente-Maritime*, supplément, mars 1983: 1-112.

EVANS, P.G.H., 1991. Whales, dolphins and porpoises: order Cetacea. Pp. 299-350 in: CORBET, G.B. and HARRIS, S. (eds). The handbook of British mammals. Third edition. Blackwell Scientific Publications, Oxford.

EVANS, P.G.H., 1997. Ecology of sperm whales (*Physeter macrocephalus*) in the Eastern North Atlantic, with special reference to sightings & strandings records from the British Isles. This volume.

FRASER, F.C., 1946. Report on Cetacea stranded on the British coasts from 1933 to 1937: pp. 1-56, maps 1-7. British Museum (Natural History), London.

GAMBELL, R., 1995. *Physeter catodon* Linnaeus, 1758 - Pottwal. Pp. 625-646 in: ROBINEAU, D., DUGUY, R. and KLIMA, M. (eds). Handbuch der Säugetiere Europas. Band 6: Meeressäuger. Teil I: Wale und Delphine - Cetacea. Teil IB: Ziphiidae, Kogiidae, Physeteridae, Balaenidae, Balaenopteridae. Aula-Verlag, Wiesbaden.

GERACI, J. and LOUNSBURY, V.J., 1993. Marine mammals ashore. A field guide for strandings: pp. i-xi, 1-305. Texas A&M University Sea Grant College Program, Galveston.

GOETHE, F., 1983. Wale und Delphine in niedersächsischen Küstengewässern und Flüssen. *Drosera*, 1983: 49-68.

GOSHO, M.E., RICE, D.W. and BREIWICK, J.M., 1984. The sperm whale, *Physeter macrocephalus*. Pp. 54-64 in: BREIWICK, J.M. and BRAHAM, H.W. (eds). The status of endangered whales. A special section of the Marine Fisheries Review. *Marine Fisheries Review*, 46 (4).

HARMER, S.F., 1927. Report on Cetacea stranded on the British coasts from 1913 to 1926: pp. 1-91, maps 1-7. British Museum (Natural History), London.

JAUNIAUX, T., BROSENS, L., JACQUINET, E., LAMBRIGTS, D., ADDINK, M., SMEENK C., and COIGNOUL, F., 1998 (in press). Postmortem investigations on winter stranded sperm whales from the coasts of Belgium and the Netherlands. *Journal of Wildlilfe Diseases*, 34: 99-109.

KINZE, C.C., 1995. Danish whale records 1575-1991 (Mammalia, Cetacea). Review of whale specimens stranded, directly or incidentally caught along the Danish coasts. *Steenstrupia*, 21: 155-196.

KLINOWSKA, M., 1991. Dolphins, porpoises and whales of the world. The IUCN Red Data Book: pp. i-viii, 1-429. IUCN, Gland/Cambridge.

LEPIKSAAR, J., 1966. Zahnwalfunde in Schweden. *Bijdragen tot de Dierkunde*, 36: 3-16.

LICK, R., BANDOMIR-KRISCHAK, B., STEDE, M., WULF, J. and BENKE, H., 1996. Case report on two large whales (*Megaptera novaeangliae* and *Physeter macrocephalus*) in the German part of the North Sea. Pp. 162-163 in: EVANS, P.G.H. and NICE, H. (eds). European Research on Cetaceans - 9. Proceedings of the Ninth Annual Conference of the European Cetacean Society, Lugano, Switzerland 9-11 February 1995.

LYDEKKER, R., 1895. A hand-book to the British Mammalia: pp. i-xiii, 1-339, pls I-XXXI. W.H. Allen & Co., London.

MARTIN, A.R., 1981. Further analysis of the post-war Icelandic sperm whale catch. *Report of the International Whaling Commission*, 31: 765-768.

MATHIASSON, S., 1989. Valarbete på Naturhistoriska museet i Göteborg eller hur man för en uppdykande femtonmeters kaskelott i hamn. *Göteborgs Naturhistoriska Museum Årstryck*, 1989: 1-14.

MEYER, K.O., 1994. Küstenfunde - Wale und Delphine aus der Deutschen Bucht. *Drosera*, 1994: 1-6.

MILLAIS, J.G., 1906. The mammals of Great Britain and Ireland. Vol. III: pp. 1-384, pls. Longmans, Green & Co., London.

MOHR, E., 1967. Pottwale an den deutschen Nordseeküsten. *Zeitschrift für Säugetierkunde*, 32: 107-113.

RICE, D.W., 1989. Sperm whale *Physeter macrocephalus* Linnaeus, 1758. Pp. 177-233 in: RIDGWAY, S.H. and HARRISON, R. (eds). Handbook of marine mammals. Vol. 4. River dolphins and the larger toothed whales. Academic Press, London/San Diego.

SANPERA, C. and AGUILAR, A., 1992. Modern whaling off the Iberian Peninsula during the 20th century. *Report of the International Whaling Commission*, 42: 723-730.

SCHULTZ, W., 1970. Der Pottwal (*Physeter catodon* Linnaeus, 1758) von Westerhever/Eiderstedt. *Zeitschrift für Säugetierkunde*, 35: 22-27.

SHELDRICK, M.C., 1989. Stranded whale records for the entire British coastline, 1967-1986. *Investigations on Cetacea*, 22: 298-329.

SHELDRICK, M.C., CHIMONIDES, P.J., MUIR, A.I., GEORGE, J.D., REID, R.J., KUIKEN, T., ISKJAER-ACKLEY, C. and KITCHENER, A., 1994. Stranded cetacean records for England, Scotland and Wales, 1987-1992. *Investigations on Cetacea*, 25: 259-283.

SILVA, A. DE MELO MOREIRA DA, 1987. Captura do cachalote e comercialização do óleo, perspectivas futuras na Região Autónoma dos Açores: pp. 1-60. Região Autónoma dos Açores, Secretaria Regional da Agricultura e Pescas, Direcção Regional dos Recursos Florestais.

SLIGGERS, B.C. and WERTHEIM, A.A. (eds), 1992. 'Op het strand gesmeten'. Vijf eeuwen potvisstrandingen aan de Nederlandse kust: pp. 1-120. Walburg Pers, Zutphen.

SMEENK, C. and ADDINK, M.J., 1993. Sighting of a group of sperm whales *Physeter macrocephalus* in Dutch waters, with historical notes and the possible Orkney connection. *Lutra*, 36: 25-29.

SMET, W.M.A. DE, 1974. Inventaris van de walvisachtigen (Cetacea) van de Vlaamse kust en de Schelde. *Bulletin Koninklijk Belgisch Instituut voor Natuurwetenschappen - Biologie*, 50 (1): 1-156, pls I-IV.

SMET, W.M.A. DE, 1977. Een potvis in de omgeving van Antwerpen in 1577. *Antwerpen*, 23: 139-154.

SMET, W.M.A. DE, 1981. Gegevens over de walvisachtigen (Cetacea) van de Vlaamse kust en de Schelde uit de periode 1969-1975. *Bulletin Koninklijk Belgisch Instituut voor Natuurwetenschappen - Biologie*, 53 (4): 1-34.

SOUTHWELL, T., 1881. The seals and whales of the British seas: pp. i-vi, 1-128. Jarrold and Sons, London.

THORBURN, A., 1921. British mammals. Vol. II: pp. 1-108, pls 26-50. Longmans, Green and Co., London.

TOUGAARD, S., 1991. Hvaler på stranden. *Årbog for Fiskeri- og Søfartsmuseet, Saltvandsakvariet i Esbjerg*, 1990: 79-86.

TOWNSEND, C.H., 1935. The distribution of certain whales as shown by logbook records of American whalers. *Zoologica*, 19: 1-50, pls I-IV.

VANDEWALLE, J., 1992. Potvis gestrand voor Belgische kust. *Zoogdier*, 3 (1): 28-29.

WATKINS, W.A., DAHER, M.A., FRISTRUP, K.M. and HOWALD, T.J., 1993. Sperm whales tagged with transponders and tracked underwater by sonar. *Marine Mammal Science*, 9: 55-67.

C. SMEENK
National Museum of Natural History
P.O. Box 9517, 2300 RA Leiden
The Netherlands

APPENDIX: SPERM WHALE STRANDINGS AROUND THE NORTH SEA, EXCLUDING SHETLAND AND ORKNEY, 1560-1995

Year	Month	Number	Place and present country	Reference
1563	December	1	Grimsby, England	P.G.H. EVANS, unpubl. data
1566	March	1	Zandvoort, the Netherlands	SLIGGERS & WERTHEIM, 1992
1572	November	3	Skallingen, Denmark	C.C. KINZE, unpubl. data
1575	?	1	Isle of Thanet, England	THORBURN, 1921
1575	?	1	Tønder, Denmark	MOHR, 1967
1577	July	3	Schelde, the Netherlands/Belgium	SLIGGERS & WERTHEIM, 1992
1577	November	3 (10-11 escaped)	Ter Heijde, the Netherlands	SLIGGERS & WERTHEIM, 1992
1598	February	1	Berckhey, the Netherlands	SLIGGERS & WERTHEIM, 1992
1601	December	1	Wijk aan Zee, the Netherlands	SLIGGERS & WERTHEIM, 1992
1603	December	1	Schelde, Belgium	DE SMET, 1974
1604	November	2	Pellworm, Germany	MOHR, 1967
1606	January	1	Brouwershaven, the Netherlands	SLIGGERS & WERTHEIM, 1992
1609	March	1	Fort Rammekens, the Netherlands	BARTHELMESS, 1997
1614	January	1	Calais, France	DE SMET, 1981
1614	December	1	Noordwijk, the Netherlands	SLIGGERS & WERTHEIM, 1992
1617	January	1	Berckhey, the Netherlands	BARTHELMESS, 1997
1617	January	2	Goeree, the Netherlands	SLIGGERS & WERTHEIM, 1992
1617	February	1 (some escaped)	Noordwijk, the Netherlands	BARTHELMESS, 1997
1620	February	1	Zwartewaal, the Netherlands	SLIGGERS & WERTHEIM, 1992
1626	June	1	Hunstanton, England	SOUTHWELL, 1881
1629	January	1	Noordwijk, the Netherlands	SLIGGERS & WERTHEIM, 1992
1641	October	1	Callantsoog, the Netherlands	SLIGGERS & WERTHEIM, 1992
1646	?	1	Wells, England	SOUTHWELL, 1881
1646	December	1	Holme, England	SOUTHWELL, 1881
c. 1652	?	1	Yarmouth, England	SOUTHWELL, 1881
1689	February	1	Limekilns, Scotland	MILLAIS, 1906
1689	?	1	Norfolk, England	MILLAIS, 1906
1690	?	1	The Nore, England	MILLAIS, 1906
1692/93	March	1	Lincolnshire, England	P.G.H. EVANS, unpubl. data
1700	?	1	Læsø, Denmark	C.C. KINZE, unpubl. data
1701	?	1	Cramond, Scotland	MILLAIS, 1906
1703	February	1	Monifieth, Scotland	MILLAIS, 1906
1718	November	1	Överö, Sweden	LEPIKSAAR, 1966
1721	January	1	Wischhafen, Germany	MOHR, 1967
1723	December	18 (3 escaped)	Neuwerk, Germany	MOHR, 1967
1738	January	3-4	St. Peter/Husum, Germany	BARTHELMEß, 1995
1751	March	2	Oldeoog, Germany	GOETHE, 1983
1753	February	3	Findhorn, Scotland	MILLAIS, 1906
1757	January	1	Hvidbjerg, Denmark	KINZE, 1995
1757	Febrary	3	Fanø, Denmark	C.C. KINZE, unpubl. data
1758	?	1	Earlsferry, Scotland	P.G.H. EVANS, unpubl. data
1761	?	1	Bovbjerg, Denmark	C.C. KINZE, unpubl. data
1761	December	1	Eierland, the Netherlands	SLIGGERS & WERTHEIM, 1992
1762	?	1	Borkum/Memmert, Germany	GOETHE, 1983
1762	January	2	Scharhörn/Neuwerk, Germany	MOHR, 1967
1762	January	7-8	Frisian Islands, the Netherlands	SLIGGERS & WERTHEIM, 1992
1762	January	1	Bredene, Belgium	DE SMET, 1974
1762	February	1	Zandvoort, the Netherlands	SLIGGERS & WERTHEIM, 1992
1762	February	12	Norfolk/Essex/Kent, England	P.G.H. EVANS, unpubl. data
1763	June	1	Texel, the Netherlands	SLIGGERS & WERTHEIM, 1992
1764	February	1	Egmond, the Netherlands	SLIGGERS & WERTHEIM, 1992
1765	January	2	Bunken Strand, Denmark	C.C. KINZE, unpubl. data
1765	May	1	Skallingen, Denmark	C.C. KINZE, unpubl. data
1767	April	1	Thisted, Denmark	KINZE, 1995
1769	?	1	Kent, England	MILLAIS, 1906
1769	December	1	Cramond, Scotland	MILLAIS, 1906
1770	December	1 (1 escaped)	Hjarnø, Denmark	KINZE, 1995

1781	May	1	Zandvoort, the Netherlands	SLIGGERS & WERTHEIM, 1992
1794	?	1	Whitstable, England	P.G.H. EVANS, unpubl. data
1822	August	1	Linemouth, England	P.G.H. EVANS, unpubl. data
1825	April	1	Holderness, England	LYDEKKER, 1895
1829	February	1	Whitstable, England	MILLAIS, 1906
1913	December	1	Fort George, Scotland	HARMER, 1927
1917	May	1	Latheron, Scotland	HARMER, 1927
1937	January	1	Bridlington, England	FRASER, 1946
1937	February	2	Terneuzen, the Netherlands	SLIGGERS & WERTHEIM, 1992
1937	July	2	Dunkerque, France	DE SMET, 1974
1941	March	1	Hirtshals, Denmark	KINZE, 1995
1944	February	1	Skagen, Denmark	KINZE, 1995
1949	December	5	Wadden Sea, Denmark	KINZE, 1995
1953	July	1	Texel, the Netherlands	SLIGGERS & WERTHEIM, 1992
1954	December	1	De Panne, Belgium	DE SMET, 1974
1969	April	1	Westerhever, Germany	SCHULTZ, 1970
1970	January	1	Spijkerplaat, the Netherlands	SLIGGERS & WERTHEIM, 1992
1973	October	1	Boulmer, England	SHELDRICK, 1989
1974	January	1	Skidbrooke, England	SHELDRICK, 1989
1974	September	1	Skagen, Denmark	KINZE, 1995
1979	February	1	Tversted, Denmark	KINZE, 1995
1979	August	1	Cullen Bay, Scotland	SHELDRICK, 1989
1979	December	1	Egmond, the Netherlands	SLIGGERS & WERTHEIM, 1992
1980	February	1	Trischen, Germany	BORKENHAGEN, 1993
1984	January	2	Henne, Strand, Denmark	KINZE, 1995
1984	September	1	Brunbjerg, Denmark	KINZE, 1995
1984	November	1	Tegeler Plate, Germany	MEYER, 1994
1985	January	1	Crovie, Scotland	SHELDRICK, 1989
1985	March	1	Skegness, England	SHELDRICK, 1989
1986	November	1	Wells, England	SHELDRICK, 1989
1988	November	1	Sæby, Denmark	KINZE, 1995
1988	December	1	Träslövsläge, Sweden	MATHIASSON, 1989
1989	February	1	Koksijde, Belgium	SLIGGERS & WERTHEIM, 1992
1990	February	1	Findhorn, Scotland	SHELDRICK *et al.*, 1994
1990	April	1	Terschelling, the Netherlands	SLIGGERS & WERTHEIM, 1992
1990	November	1	Nymindegab, Denmark	KINZE, 1995
1991	November	1	Brancaster, England	SHELDRICK *et al.*, 1994
1991	December	3	Fanø, Denmark	KINZE, 1995
1992	May	1	Husby Klit, Denmark	C.C. KINZE, unpubl. data
1993	December	1	Holme, England	P.G.H. EVANS, unpubl. data
1994	November	1	Whitby, England	P.G.H. EVANS, unpubl. data
1994	November	1	Baltrum, Germany	LICK, *et al.*, 1996
1994	November	1	Terschelling/Ameland, the Netherlands	This volume
1994	November	4	Koksijde/Nieuwpoort, Belgium	This volume
1995	January	3	Scheveningen, the Netherlands	This volume
1995	March	1	Nairn, Scotland	R.J. REID, unpubl. data

RECORDS OF LIVE SPERM WHALES (SEE ALSO 1577, 1617, 1723 AND 1770)

1990	April	2	Fanø, Denmark	TOUGAARD, 1991
1991	December	1	Koksijde, Belgium	VANDEWALLE, 1992
1992	June	6	Isle of May, Scotland	P.G.H. EVANS, unpubl. data
1993	April	6	Ameland, the Netherlands	SMEENK & ADDINK, 1993