A peek into the past – harbour porpoise strandings in the Netherlands during the mid-twentieth century

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Abstract: Between 1931-1975 two birdwatchers visited the North Sea beach along the central west coast of the Netherlands, independent of each other, but overlapping in both time and geography. On their repeated trips they not only noted the location and length of the stretch of beach they visited, but also the number of dead harbour porpoises (*Phocoena phocoena*). This enables us to calculate the density, i.e. the average number of stranded porpoises per kilometre, which is considered more informative than absolute numbers. The calculated densities of both observers are comparable, as are the monthly and yearly patterns. Combined with the data from the national cetacean strandings database, the porpoise strandings during the study period show a recurrent undulating pattern, also after this period, from 1964 until the late 1980s, when the density was considerably lower.

Keywords: *Phocoena phocoena*, North Sea, mortality, monitoring, historical data.

Introduction

Mapping the at-sea distribution of cetaceans is a methodologically complicated (Buckland et al. 2015) and time-consuming affair. To gain at least some knowledge on cetaceans, an alternative to censusing live individuals is to count dead ones. Counting cetaceans washed on the coast does not give absolute information on the size of a population, but can be considered a finger on the pulse on its state. Also, censusing dead cetaceans is decidedy less costly, while strandings give ample information about the presence and status of various species (Pyenson 2011) as well as provide the opportunity to collect ecological information otherwise difficult to obtain.

In the Netherlands, harbour porpoises (*Phocoena phocoena*) (further: porpoises) have been present for a long time. For instance, they were '*fairly common along the entire coast*' according to Van Bemmelen (1866). Whether or not this status fluctuated or otherwise changed since then is unknown, but during the early decades of the twentieth century Van Deinse (1924) still found the species to be '*always common along our coast, also in inland waterways as long as they can be reached from the sea*'. At that time, porpoises could be observed from the beach, from dikes and piers, apparently anywhere along the coast. Dead porpoises also featured regularly on the beach. For instance, Van Deinse (1924) found six dead porpoises between Katwijk and Scheveningen on 1 July 1923, a stretch of only 16 km, and Slijper (1936), when he needed them for study, simply collected three stranded neonates (newly born) on 8 July 1932 on a stretch of beach of 12 km in Noord-Holland, and a further seven in July 1932 on the beach elsewhere in the same province. In fact, dead porpoises were such a regular phenomenon, that there was a supposedly stable and

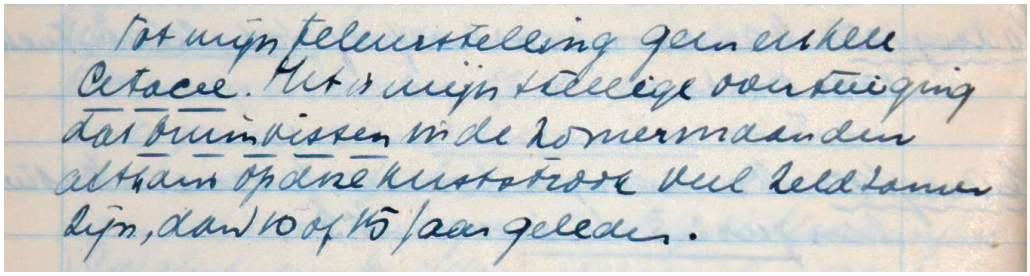

Figure 1. Notes from the diary of Fokko Niesen from 19 August 1950. Apart from notes on birds seen on this day, he mentions the absence of cetaceans (see text). In Dutch, he wrote: "Tot mijn teleurstelling geen enkele Cetacee. Het is mijn stellige overtuiging dat bruinvissen in de zomermaanden althans op deze kuststrook veel zeldzamer zijn, dan 10 of 15 jaar geleden."

pronounced seasonal pattern in strandings, with most encountered in July and August (Van Deinse 1945a). Hence, as is often the case with common species, little attention was paid to their presence and ecology, and porpoises were never mentioned in publications unless there was something special to report (e.g. Van Deinse 1945b). As a consequence, basic ecological information from the first half of the twentieth century, such as numbers, age or diet, is lacking.

Jan Verwey, having a life-long interest in porpoises (Verwey 1975), was one of the first to report a change in porpoise presence. He wrote to Van Deinse (1952) (in Dutch): '*The species (Phoc. phoc.) has decreased significantly in the Wadden Sea and its various entrances during the war. In 1945 they were definitely rare and even today I would call them rather scarce. This is not an impression, but a fact.*' Fokko Niesen, a self-made naturalist living in Haarlem, had noticed the decrease as well, although his data did not refer to live porpoises but to dead ones, and also, the decrease noted by him remained unknown to the general public at the time. After a visit to the beach on August 19th 1950 he wrote in his diary (in Dutch) '*To my disappointment no single cetacean. I strongly believe that harbour porpoises have become much rarer in the summer months, at least on this part of the coast, than 10 or 15 years ago*' (Figure 1).

The letter of Verwey stimulated Van Deinse, who had until then been collecting data on stranded cetaceans in the Netherlands *except* porpoises, to include dead porpoises in his study. He notified the people in his cetacean stranding network to not just report the rare species, but all cetaceans. The first year on which he published all stranded porpoises reported to him was 1951 (Van Deinse 1952). The result was a meagre 24 individuals, and even though Van Deinse stated that this number must certainly have been higher as some carcasses had likely remained out of sight, 24 corpses on over 500 km of coastline seems very low indeed for a species that is supposed to be common. During the years following this first complete report on stranded porpoises, rather few individuals per year were recorded, and even for the next thirty years numbers remained low. There were, for instance, 26 porpoises in 1953 (Van Deinse 1954), 13 in 1963 (Van Deinse 1964), 22 in 1973 (Van Bree & Husson 1974) and 26 in 1983 (Smeenk 1986). From the late 1980s onwards, porpoises increased again in Dutch coastal waters (Camphuysen 2004, IJsseldijk et al. 2020) and parallel to it the number of stranded individuals (www.walvisstrandingen.nl). The cause, or causes, for neither the demise nor the return of porpoises in Dutch waters have ever been elucidated.

So, even though the precise evolution of the Dutch porpoise population during the twentieth century remains unknown, there is no

doubt that porpoises were common in Dutch waters in the early decades of the century, decreased strongly around the middle, were very scarce in the 1960s-1980s, and increased again from the late 1980s onwards. An analysis of strandings during the twentieth century revealed that not only had there been a shift in peak numbers from summer prior to the 1950s to winter in the years thereafter, but also that neonate porpoises had largely disappeared after the 1950s (Addink & Smeenk 1999). Anno 2023, living porpoises are again a common sight along the Dutch coast (Soldaat & Poot 2020, IJsseldijk et al. 2021, www.trektellen.nl, www.waarneming.nl), and also neonates are found regularly on the beach in summer (www.walvisstrandingen.nl). In countries neighbouring the Netherlands, a similar trend is observed (IJsseldijk et al. 2020).

Despite extensive research on Dutch porpoises in recent years (e.g. Jansen 2013, Leopold 2015, IJsseldijk 2021), the question as to why porpoises have disappeared and subsequently returned in national waters has not been answered yet (Camphuysen 2004, Camphuysen & Siemensma 2011). Among the many unknowns about porpoises in the Dutch part of the North Sea, a nagging question remains how the supposedly high numbers of dead porpoises on the shore today compare to those a century ago. Even though the national database (www.walvisstrandingen.nl) contains strandings of porpoises from the early twentieth century, it has until now been considered unfeasible to compare present day stranding patterns with those from former times, as the older data were thought to be largely incomplete and any resulting pattern should therefore be seen as unreliable (Smeenk 1987). Nevertheless, a continuous series of counts of stranded porpoises is available since the early 1950s until today, albeit with an annoying break between 1964 and 1970.

Monitoring dead cetaceans is nowadays carried out in most countries bordering of the North Sea. Generally, when the strandings are reviewed, it is common practice to present the total number per country per month or per year (e.g. Smeenk 2003 for the Netherlands, Siebert et al. 2006 for Germany, Leeney et al. 2008 for the United Kingdom, Haelters et al. 2018 for Belgium, Kinze et al. 2018 for Denmark). A more valuable measure for common species however is to present the density, i.e. the average number of animals per unit of length (for instance kilometre; cf. Camphuysen et al. 2008, Keijl et al. 2016, 2021, Kinze et al. 2021), as this enables the comparison of the stranding intensity in a geographical as well as a temporal context. A prerequisite to do so is to know the observation intensity. Although the observation intensity at present is rarely mentioned and usually unknown, most parts of at least the Dutch beaches are visited nowadays by people probably at least once a week, and many stretches daily, by numerous people. Hence, on most parts, it seems hardly possible for a porpoise carcass to remain undetected. We could call this continuous censusing effort.

Between the 1930s and the early 1970s two Dutch naturalists, Fokko Niesen and Henk Kortekaas, regularly visited the beach. They both kept a diary in which they took detailed notes about their natural history adventures, and they included dead cetaceans. Together they have collected a unique set of data on dead porpoises from around the middle of the twentieth century, an important era in the history of porpoises in the southern North Sea, but a period neglected by Van Deinse regarding this species. Here, we describe this recently discovered dataset. It enables us to calculate densities of dead porpoises on the beach during these years. Although densities of stranded individuals have not been calculated in earlier studies (Van Deinse 1952, Addink & Smeenk 1999), they suggest a serious decline of porpoises in the Wadden Sea and adjacent estuaries from the early 1940s onwards. By analyzing the data of Niesen and Kortekaas, we expect to better pinpoint the drop in strandings, either '*during the war*' (the

early 1940s; cf. Verwey in Van Deinse 1952) or in '*the late 1950s/early 1960s*' (cf. Addink & Smeenk 1999). The densities of Niesen are also separately compared with those of Kortekaas, to check the validity of monthly and yearly strandings patterns. If they match, the calculated densities from Niesen and Kortekaas may be considered representative for the local situation at the time. The data can then also be compared with those from the national database, which are less systematically collected. Although the densities may differ between the Niesen/Kortekaas data on the one hand and the national database on the other, we expect to find similarity in patterns. The combined set can then be compared with the data of Addink & Smeenk (1999), who described the pattern of porpoise strandings in the Netherlands between 1920 and 1994, and, especially, with present day strandings. Hopefully, the results contribute to a better understanding of the sudden and steep increase in porpoise strandings in the south-eastern North Sea since 2006.

Methods

The study area considered spans the beach between Hoek van Holland and IJmuiden. The beach in this part of the North Sea is a fairly narrow sandy strip, on average about 90 metres wide. From the diaries of Kortekaas and Niesen, records of dead porpoise were extracted[1]. Niesen and Kortekaas visited the same parts of the Dutch coast, although never together, and their visits overlap in time. On most of their excursions they indicated which stretch of beach was visited, and they did so for decades. Although both men were interested in nature in general, their visits to the beach focused on birds. This resulted in a seasonal pattern of visits. Both Niesen and Kortekaas not only mentioned a dead porpoise in their diaries, but also wrote down their precise location (usually relative to the nearest numbered beach pole).

Fokko Niesen was born in Haarlem, Noord-Holland, in 1913 and lived there during his entire life. His diaries cover 1931-1975, a period of 45 years. When looking for birds along the sea shore, he usually entered the beach at Zandvoort, about six kilometres west of Haarlem. Later on, he worked in Katwijk, Zuid-Holland, and regularly traveled home from work on his bicycle along the beach from Katwijk to Zandvoort. He also visited the beach to look for birds during weekends. Niesen was very precise about his excursions. He specifically mentioned dead cetaceans on the beach and wrote down details such as the animals' sex and length. Niesen apparently carried a measuring device, as the measurements written down by him are very precise.

Henk L. Kortekaas was born in 1923 and lived in Den Haag, Zuid-Holland (Kortekaas & Peeters 2014). His diaries to our disposal span the years 1938-1958, a period of 21 years. Kortekaas's diaries contain less information on daily activities. He often merely wrote down the names of the birds he observed, without mentioning which part of an area was visited. Apart from the records from the diary of Kortekaas, we also have the list of cetaceans which he in 1978 sent to P.J.H. van Bree, then curator of mammals of the Zoological Museum of Amsterdam University, and compiler of reviews of dead cetaceans on the beach (e.g. Van Bree 1977). In this list there is sometimes more information than in the diaries, and the source containing most information was used.

Densities, i.e. the number of porpoises found per kilometre of beach, are calculated by dividing the total number of porpoises by the length of the trajectory visited. In a few cases, and only concerning the records of Kortekaas, the trajectory was not described in the diary nor in the letter to Van Bree, but could be inferred with near-certainty from the beach pole numbers noted during the visits. Only in two cases

[1] A few diaries of Kortekaas were missing from the archives of the Heimans en Thijsse Stichting during our visit to the library in July 2021.

dead porpoises found by Niesen are omitted because the trajectories are unknown. In their diaries Niesen and Kortekaas also mentioned the carcasses they had found during their earlier visits, so we are certain that the data do not include double counts.

Presently, the national strandings database, available at www.walvisstrandingen.nl[2], containing data on all cetaceans found in the Netherlands, is managed by Naturalis Biodiversity Center. The core is formed by strandings collected by A.B. van Deinse, and it has been extended by others after his death until present (e.g. Scheygrond 1964, Van Bree & Husson 1974, Keijl et al. 2021). The data rarely, if ever, provide information on which stretch of beach was searched for stranded cetaceans, hence the data of Niesen and Kortekaas, who usually visited a part of the beach between Hoek van Holland and IJmuiden, are not directly comparable. The beach in the area under consideration is narrow, flat and open, and a porpoise washed on the beach lies exposed and is very visible. As the beach in the study area is crowded nowadays, and most of it visited on a daily basis, the search effort can be considered continuous. Therefore, if data from the national database are used, the cumulative number of dead porpoises is divided by 62 (kilometres), which is the total length of the stretch of beach between Hoek van Holland and IJmuiden.

Results

The contributions of Niesen and Kortekaas

Between 1931-1973, Niesen found 216 porpoises on 127 trips in 28 years. Of these, 214 porpoises found on 125 trips in 28 years covering 909 kilometres are used for further analysis. Niesen's trips to the beach used for the analysis ranged between Scheveningen in the south to IJmuiden in the north. The stretch between Langevelderslag (north of Noordwijk) and Zandvoort was visited most by him (Table 1). Niesen went to the beach most frequently in the 1930s (Table 2), with a peak of 19 visits in 1934, and 5-10 visits in most of each of the following years. His average trip length was 7.3 km. This increased from 6 km in the 1930s to 11 km in the 1950s, after which it decreased to 5 km in the 1960s and 2 km in the 1970s. He found porpoises in every single year between 1931 up to and including 1942. His first visits to the beach after the Second World War were in 1945, but he reported his first post-war porpoise only in 1948. After the war the intervals during which he did not go to the beach increased, or he paid brief visits only. There were, for instance, no visits at all between July 1961 and October 1963. Still, he found porpoises in every single year between 1950 and 1958, and from then on intermittently until 1973.

Kortekaas found a total of 95 porpoises on 55 trips in 14 years between 1941-1961, of which 87 during 42 trips in 14 different years covering 411 kilometres are used here (Table 1). (The eight porpoises not used in the analysis were found elsewhere.) Most visited by him was the beach between Scheveningen and Katwijk, but his activities stretched between Hoek van Holland in the south to Bloemendaal in the north, so he has visited more different parts of the beach than Niesen. Kortekaas paid fewer visits to the beach (a maximum of six in both 1940 and 1954), but they were on average longer (9.9 km), especially in the 1940s (11 km). In the 1960s he only made a single trip (Table 2). He found his first porpoise on 14 September 1941, his second in 1947 and none in 1948. From 1949 until 1959 he reported porpoises in every year, and his last one dates from 1961.

During and immediately after the Second World War, between 1942 and 1946, vari-

[2] The website www.walvisstrandingen.nl will cease to exist early in 2024. From then on, dead cetaceans as well as other marine mammals will be recorded on www.stranding.nl

Table 1. Stretches of beach (and their length) visited by Niesen and Kortekaas between 1931-1973, arranged from south to north, the number of visits and the number of porpoises found. The total number of visits is lower than the accumulated number (142 instead of 125 for Niesen, 49 instead of 42 for Kortekaas) because on a single visit different stretches could have been visited.

Stretch	Length (km)	Niesen		Kortekaas	
		n visits	*n* porpoises	*n* visits	*n* porpoises
Hoek van Holland - Monster	6	0	0	3	3
Monster - Kijkduin	6	0	0	1	1
Kijkduin - Scheveningen	4	0	0	4	5
Scheveningen - Katwijk	16	2	2	31	57
Katwijk - Noordwijk	4	20	27	4	12
Noordwijk - Langevelderslag	7	20	30	3	6
Langevelderslag - Zandvoort	9	52	82	1	1
Zandvoort - Bloemendaal	6	37	52	2	2
Bloemendaal - IJmuiden	4	11	21	0	0
Total	62	125	214	42	87

Table 2. The number of porpoises (*n* porp) reported, the calculated average number of porpoises per kilometre, the total accumulated length surveyed, and the number of visits, for the whole observation period (All) and per decade, for Niesen and Kortekaas.

	Niesen				Kortekaas			
	n porp	Average porp / km	*n* km	*n* visits	*n* porp	Average porp / km	*n* km	*n* visits
All	214	0.24	909	121	87	0.21	406	41
1930-1939	118	0.29	413	70	-	-	-	-
1940-1949	27	0.19	143	15	20	0.17	119	11
1950-1959	57	0.19	306	28	66	0.23	284	29
1960-1969	9	0.21	42	9	1	0.29	3.5	1
1970-1979	3	0.50	6	3	-	-	-	-

ous parts of the beach, and finally the entire beach, were forbidden to enter (Figure 2). As a consequence, hardly any porpoises were reported during those years (Figure 3). Immediately after the war there was still unexploded ammunition on the beach or washing ashore and parts of the beach were still off limits to the public. These circumstances explain the gap in the sightings of Niesen and Kortekaas in these years: there are no data from 1943-1946.

There is a large overlap between the beach trips of Kortekaas and those of Niesen, in time as well as in geography. Still, from the date, the exact location, the state of the carcass, the length, and the sex, we were able to deduce whether different individuals were involved. Niesen and Kortekaas have added a total of at least 303 porpoises found between Hoek van Holland and IJmuiden in 1930-1975, which makes their contribution to the national strandings database considerable. Although it is difficult to be certain, because an individual porpoise may have been reported by various people while only the name of one of them was noted in yearly reports, Niesen and Kortekaas appear to have contributed almost half of all unique cases.

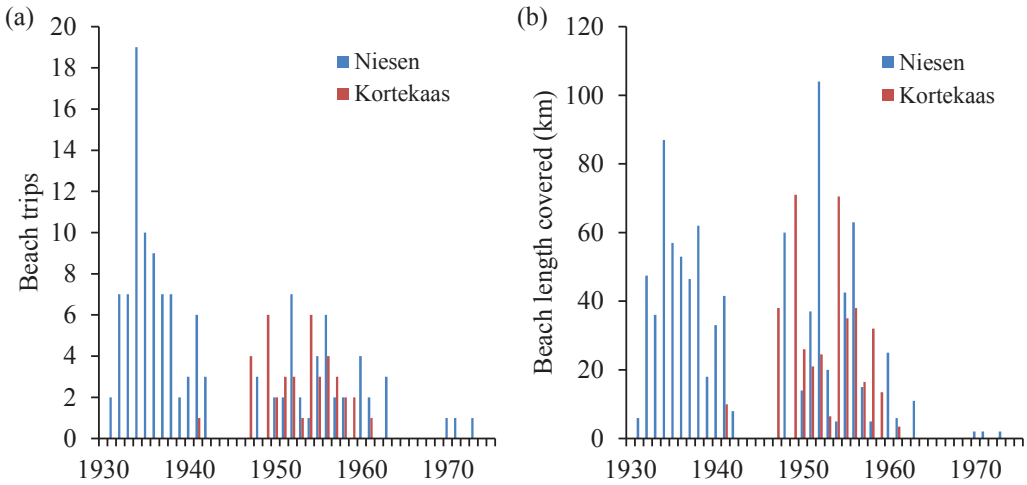

Figure 2. (a) The total number of beach trips per year by Fokko Niesen (blue, 125 trips between 1931-1973) and Henk Kortekaas (red, 42 trips between 1941-1961), and (b) the length of beach covered per year (in kilometres, blue - Niesen 909 km, red - Kortekaas 406 km) in the years during which they reported dead porpoises.

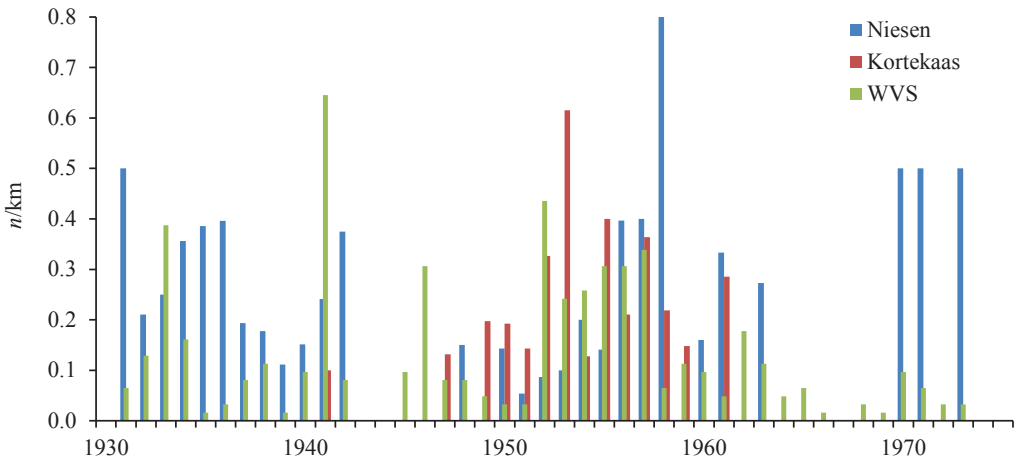

Figure 3. Average density of dead porpoises (*n*/kilometre/year) between Hoek van Holland and IJmuiden in 1930-1975 found by Fokko Niesen (blue, *n*=214) and Henk Kortekaas (red, *n*=88), and from the national database without the data of Niesen and Kortekaas (WVS, green, *n*=352). Although the data for WVS are calculated differently (see methods), the densities, and the resulting scale (y-axis), are the same.

Comparison between years

The average number of porpoises per visit found by Kortekaas was 2.1 and by Niesen 1.7. The small difference is possibly explained by the difference in average length of a visit, which was slightly longer for Kortekaas (9.9 versus 7.3 kilometre). The overall average porpoise numbers per kilometre per year are very close (0.24 by Niesen, 0.21 by Kortekaas), but fluctuate markedly in time (Figure 3). The average densities from Niesen show several peaks: in the mid-1930s, in the early 1940s, and in the late 1950s. The pattern from the data of Kortekaas, although it covers a shorter period, is comparable to that of Niesen. Unfor-

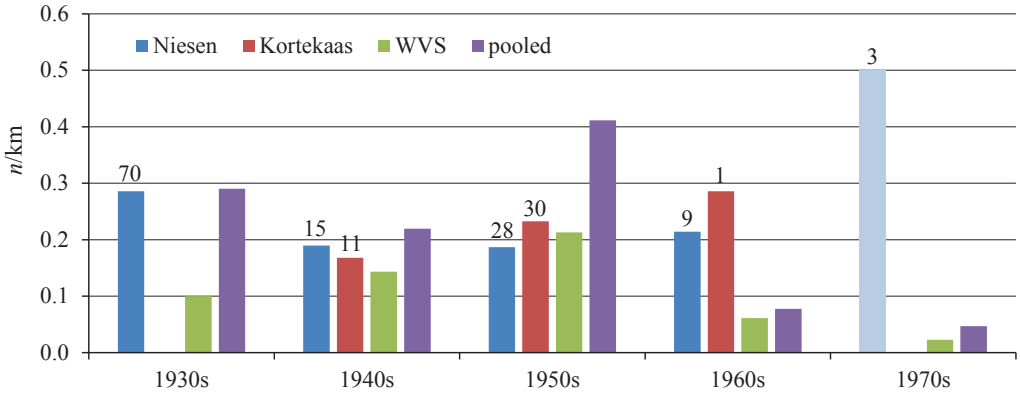

Figure 4. Average density of dead porpoises (*n*/kilometre) between Hoek van Holland and IJmuiden per decade in 1931-1973. Niesen: *n*=214; Kortekaas: *n*=88; the national database without data of Niesen and Kortekaas (WVS): *n*=352; and the three pooled: *n*=654. The bar for Niesen in the 1970s is made pale blue because it is based on only three counts of 2 km each. The number of trips of Niesen and Kortekaas are given above the bars.

tunately, neither reported any porpoises after 1961 (Kortekaas) or 1963 (Niesen). Although Niesen did find three more porpoises, in 1970, 1971 and 1973 respectively, they were found on just three trips, one in each year, with each trip covering two kilometres only, resulting in high densities. Surprisingly, the densities from the national database over the entire period, as well as the pattern, give the same result (Figure 3), even though the data are calculated differently (see Methods). Only in the years prior to the Second World War the more erratic pattern from the national database differs from that from Niesen.

If the data are displayed per decade, those of Niesen show a higher density in the 1930s, lower ones in the 1940s-1950s and a marginal increase in the 1960s (Figure 4, Table 2). The data of Kortekaas follow this pattern. The density from the national database now differs, with a lower average in the 1960s (Figure 4). This difference is caused by the data of Niesen and Kortekaas from this period onwards being less representative (Figure 2), as Kortekaas visited the beach in the 1960s only once (1961, one trip of 3.5 km, one porpoise), and Niesen only in three years (1960, 1961 and 1963; nine trips covering 42 km, nine porpoises). If the data of the three sources are pooled (purple bars in Figure 4), it shows an increase from the 1930s to the 1950s and a drop in the 1960s.

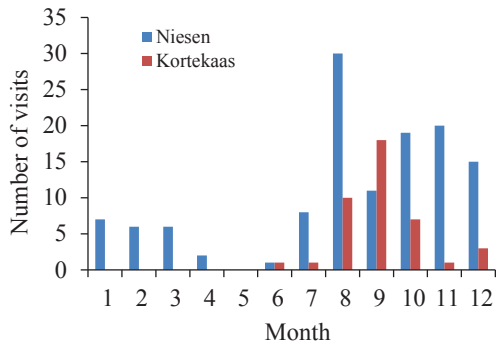

Figure 5. Number of visits per month by Fokko Niesen (*n*=125) and by Henk Kortekaas (*n*=45) during which they reported porpoises.

Monthly pattern

Being birdwatchers, for both observers dead porpoises on the beach were merely 'by-catch'. Although peculiarities such as sex and length were often noted by them, neither had the intention to perform research on porpoises. The fact that they were looking for birds is likely the main explanation for the absence

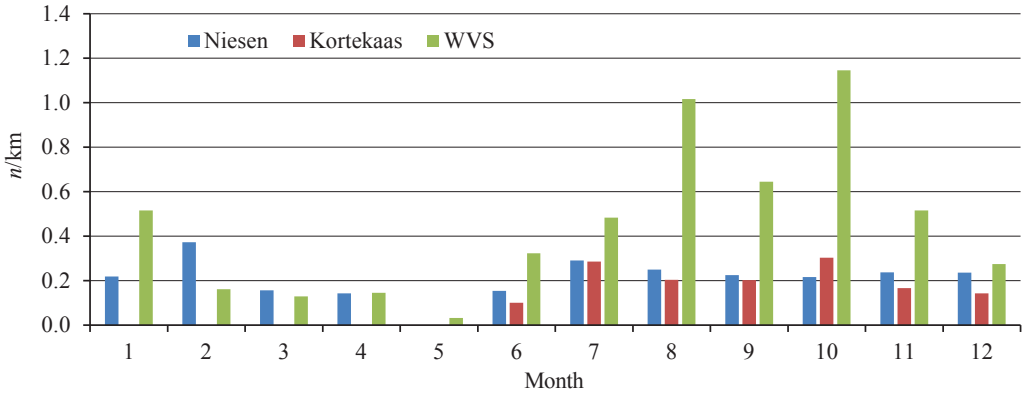

Figure 6. Average density of dead porpoises (*n*/kilometre) per month between Hoek van Holland and IJmuiden in 1931-1973 found by Fokko Niesen (*n*=214), by Henk Kortekaas (*n*=88) and from the national database (WVS, *n*=334, data of Niesen and Kortekaas excluded).

of visits in May (Figure 5). April and May are an excellent time for observing birds in the Netherlands. During these months a variety of bird species may pop up in vegetated places like the dunes. Hence, the beach during those months was probably deemed less interesting by them. From the diaries we learn that they indeed paid multiple visits to the dunes and other places in April and May, especially after 1945, but not to the beach. A visit to the beach in June is least appealing for observing birds. Autumn and winter on the contrary are more rewarding, particularly during stormy weather, with the possibility to see seabirds such as skuas and auks, hence both observers paid numerous visits to the beach during those months.

The presence (density) of dead porpoises found by Niesen was highest in February (0.37 porpoises per kilometre, six trips) and July (0.29, eight trips). Kortekaas found the highest densities in July (0.29, one trip) and October (0.30, seven trips) (Figure 6). As far as counts are available (Kortekaas did not visit the beach in January-May), the monthly averages for both observers show the same pattern, with low densities in March-June, a notable increase in July and a more or less stable pattern from then on until December. Only in October 1949 and October 1955 Kortekaas found higher densities (0.40 and 0.83 respectively). It is likely that both observers were more prone to visit the beach during strong onshore winds, when the chance of observing seabirds – as well as finding a porpoise – is higher. Because the number of visits during January-June is low (14.1% of the total number of visits), it is uncertain whether the calculated averages for these months are representative. The monthly pattern from the national database excluding the data of Niesen and Kortekaas however shows a similar pattern (Figure 6), with the lowest density between late winter and early summer, a peak in July-October, and a decrease from then on until January. The density calculated from the national database is much higher, despite the difference in calculation. Possibly, this is caused by the chance of finding several porpoises being higher on a longer trajectory (62 km).

The Second World War has caused an important caesura in the data (Figure 3) and we have used it to compare densities before and after this period. Although Niesen paid almost twice as many visits to the beach prior to 1943 than later on (82 versus 43, Figure 2a), and the total distance covered was somewhat higher as well (495.5 versus 413.5 kilometres), the number of porpoises (136 versus 78) seems

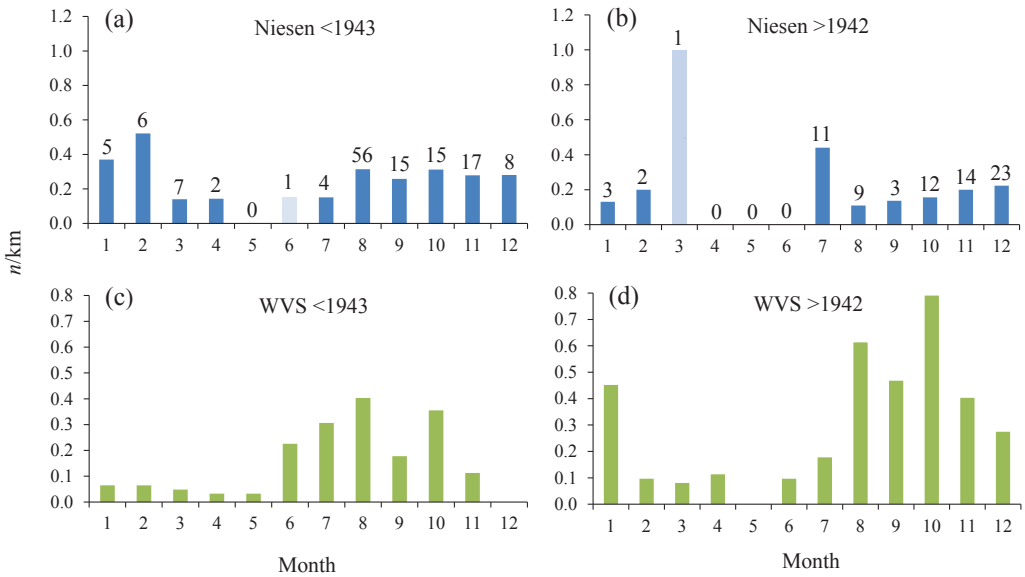

Figure 7. (a) Monthly pattern of dead porpoises (average/kilometre) found by Niesen before 1943 (1931-1942, *n*=136) and (b) after 1942 (1943-1973, *n*=78) compared to that in the national database (WVS) without the data of Niesen but including those of Kortekaas ((c): 1931-1942, *n*=113; (d): 1943-1973, *n*=221). The number of trips per month made by Niesen is indicated above the bars. The bar for Niesen in the 1970s is made pale blue because it is based on only three counts of 2 km each. Note the different scales.

large enough to allow for a comparison in monthly pattern between the two. The overall average density was lower during the second period (0.19 after 1942 *versus* 0.27 before 1943), while the density per month after 1942 was higher only in March and July (Figure 7a, b). The peak in March in the second period is based on a single trip on 23 March 1961, covering only one kilometre, during which Niesen found one porpoise (Figure 7b). (The peak in July after 1942 is based on five trips covering a total of 25 km.)

The number of porpoises in the national database is lower prior to 1943 compared to the years thereafter (113 versus 221) and the overall density two times higher during the second period (0.14 versus 0.28). Thus, the trend emerging from the data of Niesen is the opposite to that from the national database (Figure 7). This can probably be attributed mainly to the fact that Van Deinse only started to systematically collect and report records of dead porpoises from the early 1950s onwards. The pattern emerging from the national database however, especially after 1942, with a peak in October and elevated numbers from August extending up to and including January, while the higher numbers in summer had disappeared, is probably more reliable than that of Niesen. The number of visits to the beach made by numerous people has obviously been higher than those made by a single person, especially in summer, when people were on holiday and many visited the beach. Also, the absolute number of porpoises after 1942 in the national database is almost three times higher.

Discussion

The systematically collected data of Niesen and Kortekaas on dead porpoises, together with the more incidental observations mentioned in the introduction and below, are solid prove that porpoises were common along the

Table 3. Percentage of new-born calves (<90 cm) and sex ratio (% males) prior to 1943 and after 1942, both for the data of Niesen and for the national database (WVS; excluding Niesen's data). The two data sets are pooled to enlarge the sample size, while after 1942 (last column) the data of Kortekaas are added as well.

	<1943			>1942		
	Niesen	WVS	Pooled	Niesen	WVS	Pooled
% <90 cm	14.4 (97)	29.2 (72)	20.7 (169)	3.9 (51)	3.3 (92)	4.6 (219)
% males	67.7 (68)	77.4 (93)	71.5 (171)	70.6 (17)	59.3 (81)	55.0 (109)

Dutch coast during the first half of the twentieth century. Until now however, the intensity and number of porpoise strandings prior to the early 1950s, i.e. the period during which Van Deinse did not systematically collect data on this species, have been obscure. The numbers indicated in publications were therefore deemed unreliable for a country-wide impression of presence and mortality of the harbour porpoise in the Netherlands (Smeenk 1987, Addink & Smeenk 1999), and therefore densities have never been presented. Nevertheless, *ad hoc* data from which densities could have been calculated were actually already available, such as those presented in the introduction (0.38/km in July 1924, Van Deinse 1924; 0.25/km in July 1932, Slijper 1936). And there were more. For instance, A. van Wijngaarden found seven porpoises on a single trip of 16 km in October 1933, giving a density of 0.44/km, and J.P. Strijbos found five porpoises on a trip of 21 km in November of the same year, a density of 0.24/km (Van Deinse 1946). Even though it is obvious that small sample sizes may yield deceiving results (Figure 4, Table 3), we know now that all these densities were representative for the local situation. The fact that the independently collected data sets by Niesen and Kortekaas, compared to that of the national database, reveal the same pattern, suggests that the three sets merged could be sufficiently robust for an analysis of stranded porpoises in the period 1930-1970, as far as the coastline between Hoek van Holland and IJmuiden is concerned. This enables us for the first time to compare densities from the past with those from the present (Figure 8).

For this study, the present-day stranding data between Hoek van Holland and IJmuiden were divided by the length of the total stretch (62 km), because historical systematic counts have long seemed to be absent, and densities could therefore not be calculated otherwise. Although the excellent database on the Dutch dead beached bird surveys (cf. Camphuysen 1995) could have been of help to compare with the densities from the national database, as corpses of marine mammals are included in the counts, it was not, because nowadays dead marine mammals are usually removed immediately from the beach after they are reported. Although the methods of the data sets of Niesen/Kortekaas and the national database differ, the *patterns* of strandings within years and between years can be compared. It is interesting to note that despite the difference in calculation methods, the densities are virtually the same.

The change in abundance of dead porpoises on the beach during the past century has been striking enough to be noted, not just by Verwey (1975) and Niesen, and it has intrigued researchers through time (e.g. Van Deinse 1960, Husson & Van Bree 1972, Smeenk 2003, Camphuysen & Siemensma 2011). Smeenk (1987) attributed the increase in porpoise strandings around the mid-1950s entirely to an increase in observers, although this was not corroborated with data. In their analysis of historical porpoise strandings, Addink & Smeenk (1999) divided their study period, 1920-1994, into five periods of about fifteen years each for the sake of statistics. By analysing discrete sets of time as a single unit, however, there is a risk that any changing pattern within a particular set will be obscured.

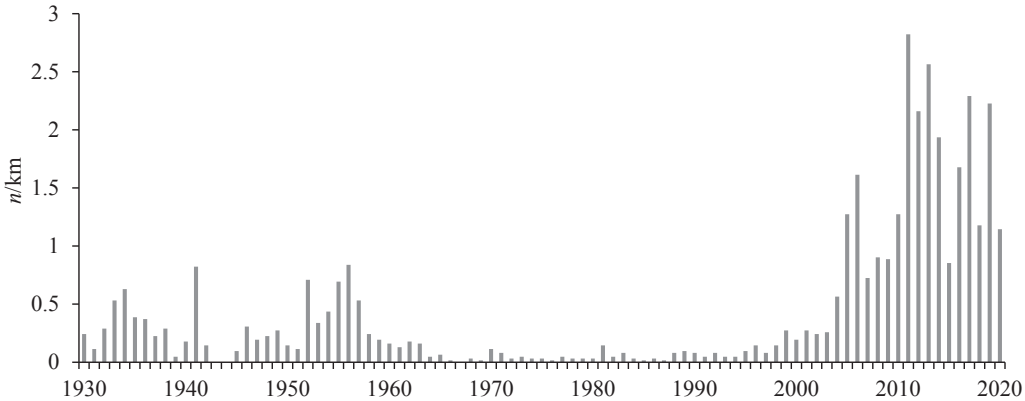

Figure 8. Density of stranded porpoises (*n*/kilometre) between Hoek van Holland and IJmuiden in 1930-2020 (*n*=2453), with the data from Niesen, Kortekaas and the national database combined.

Addink & Smeenk (1999) found '*a serious decline in numbers in the late 1950s/early 1960s*', which they attributed mainly to the disappearance of neonates. They also found a shift in strandings from summer to winter between the period prior to 1950 compared to that after 1970. (They did not include 1965-1969 because of a lack of data.) Despite their thorough analysis, they did not present densities, as data on search intensity from their area of study, i.e. the whole country, were not available, even though those of Kortekaas were included. Also, they did not especially focus on changing patterns, but rather tried to establish the cause of the decline in strandings. Their '*late 1950s/early 1960s*' fell within their single defined study period 1950-1964. The stranding data from the national database only covering the coast between Hoek van Holland and IJmuiden, now boosted with the data of Niesen, unveil that there was no decline in strandings during these years (Figure 8), at least not in this part of the country. The decline mentioned by Addink & Smeenk (1999) appears to have occurred after a period of six years with elevated numbers. It was not until 1964 when the density fell dramatically, and the total number of dead porpoises reported in that entire year along Hoek van Holland and IJmuiden was only three, the resulting density being 0.05 per kilometre. The undulating pattern in strandings density appears to continue even after 1970, with peaks, albeit marginal ones, around the early 1980s, early 1990s and around 2000, after which the numbers rise steeply. Also, the density of stranded porpoises from the late 1990s appears not to have been unusual up to and including 2004 compared to that prior to the Second World War. In 2005-2006 extremely high densities were reached. From 2010 onwards mortality along the Dutch coast has been excessive, especially in 2011-2013. Sighting rates of live porpoises from the coast show a comparable trend (IJsseldijk et al. 2021), although there are also some remarkable differences between the two data sets, for instance in timing.

If porpoise stranding density reflects population size, it is possible that numbers decreased because of the acts of war in the early 1940s, for instance because of underwater explosions or increased ship movements. This remains unknown, especially because survey data from the war are lacking, but the number of dead porpoises on the beach increased again immediately after the war. Establishing the population size of an elusive cetacean like the harbour porpoise is a challenge, but it makes sense to assume that in a larger population more animals die than in a smaller one. There are no estimates whatsoever for the historical North Sea porpoise population, and also nowadays

science is struggling to estimate the present population size (Hiby & Hammond 1989, Northridge et al. 1995, Hammond et al. 2002). Between the 1990s and mid-2000s, and possibly irrespective of the population size, there seems to have been a shift in porpoise distribution within the North Sea from the north to the south (Geelhoed et al. 2022). The reason for this remains obscure, but the increase in strandings on the Dutch coast from the late 1990s onwards seems to support the assumption that when there are more porpoises, more will wash ashore (cf. Camphuysen & Siemensma 2011).

From the late 1950s onwards populations of piscivorous marine species such as common seal (*Phoca vitulina*) and sandwich tern (*Thalasseus sandvicensis*) in the southern North Sea crashed due to pollution by PCBs (Van Haaften 1974, Reijnders 1986, Brenninkmeijer & Stienen 1992). The decrease of the piscivorous porpoise partly preceded and partly coincided with that of these species. However, a link of a diet consisting of fish polluted with orchanochlorines as an explanation for increased mortality, decreased fertility, and the near-disappearance of a large part or most of the porpoise population, though likely, has yet to be proven. The recent findings of Van den Heuvel-Greve et al. (2021) suggest that increased mortality may especially have hit unborn porpoises, which in turn may be an explanation for the near-absence of neonates on the beach after the 1950s. On the other hand, if there would have been a rise in prematurely born – i.e. aborted, hence not viable – porpoises, the question rises why they were not encountered on the beach. Although the recent increase in porpoise abundance in the southern North Sea since the late 1980s could be explained by a cleaner environment, climate change, a southward shift of (part of the) North Sea population, or a difference in availability of preferred fish species, further analysis to unravel this phenomenon is beyond the scope of this paper.

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Samenvatting

Een tipje van de sluier – bruinvisstrandingen in Nederland rond het midden van de twintigste eeuw

Het monitoren van walvissen op zee is ingewikkeld en omgeven met onzekerheden. Bovendien gaat het gepaard met hoge kosten. Tellingen van gestrande walvissen leveren geen kennis op omtrent de omvang van de populatie, maar kunnen wel worden gezien als een relatieve maat voor aanwezigheid. Bovendien kan onderzoek aan dode dieren kennis opleveren die niet op andere wijze kan worden verzameld, zoals sekseverdeling of dieet. De bruinvis (*Phocoena phocoena*) komt al lang in Nederlandse kustwateren voor en in de eerste helft van de twintigste eeuw was hij algemeen. Hoewel er al sinds 1915 een registratiesysteem voor dode walvissen in Nederland bestaat, zijn bruinvissen daarin aanvankelijk niet meegenomen, juist omdat ze zo algemeen waren. Het is daarom lastig om bijvoorbeeld de toename sinds de jaren 1990 en de schommelingen in aanspoelpatronen in context te plaatsen: betekent deze toename dat de populatie weer terugkeert naar de omvang van weleer, of is er wat anders aan de hand? In het begin van de jaren 1950 leken bruinvissen in aantal af te nemen, zowel levend in de kustwateren als dood op het strand. Vanaf die periode zijn dode dieren meegenomen in de strandingsregistratie, maar

het was aan de late kant, want bruinvissen bleken toen al erg schaars te zijn geworden. De aantallen die zowel uit de periode voor 1950 als de periode tot de jaren 1970 circuleren, en de schommelingen daarin, zijn in de literatuur als onvolledig en onbetrouwbaar benoemd. Zo is een toename van aangespoelde bruinvissen in de jaren 1950 toegeschreven aan een toename van dagjesmensen op het strand, en aan de extra aandacht voor de soort, niet aan een werkelijke verandering in talrijkheid. De dagboeken van vogelaars Fokko Niesen en Henk L. Kortekaas, die de periodes van respectievelijk 1931-1975 en 1938-1958 omspannen, blijken een belangrijke bron van informatie te zijn omtrent dode bruinvissen tussen Hoek van Holland en IJmuiden. Deze gegevens zijn hier verder uitgewerkt. Zowel Niesen als Kortekaas kwamen regelmatig aan het strand op zoek naar levende en aangespoelde vogels en noteerden niet alleen dode bruinvissen, maar ook waar precies ze het strand betraden en weer verlieten. Met hun gegevens is het gemiddelde aantal bruinvissen per kilometer te berekenen, een getal dat belangrijker wordt geacht dan een totaal aantal dode bruinvissen op een stuk kust van onbekende lengte, omdat gemiddelden beter met elkaar kunnen worden vergeleken. Niesen legde op 125 strandbezoeken in 28 verschillende jaren in totaal 909 kilometer af en vond daarbij 214 bruinvissen; Kortekaas bezocht het strand in 14 verschillende jaren 55 keer, legde daarbij 411 kilometer af en vond 95 bruinvissen. De gemiddelden van Niesen en Kortekaas worden hier onderling vergeleken, maar ook met die uit de nationale database uit dezelfde periode, en met die uit de jaren vanaf 1970 tot en met 2020. Het strandingspatroon per maand tussen beide waarnemers komt overeen, maar verschilt met de landelijke gegevens. Dit komt waarschijnlijk door de belangrijkste interesse (vogels) van de twee waarnemers, waardoor er weinig strandbezoeken in het voorjaar waren. Ook het aantal strandbezoeken per waarnemer per jaar, of de afgelegde afstand per bezoek, zijn van invloed op de gevonden patronen: hoe minder bezoeken per jaar, des te grilliger het verloop tussen jaren, en hoe kleiner de afgelegde afstand per bezoek, des te groter de schommelingen. Dat de gegevens uit de nationale database van voor 1950 lager uitkomen dan die van Niesen en Kortekaas komt doordat van Deinse, op wiens gegevens de database is gebaseerd, vóór dat jaar alleen bruinvissen noteerde als er iets bijzonders over te vermelden viel. De soort werd te algemeen geacht om alle gegevens te verzamelen. Toch liggen de kilometergemiddelden uit de drie bronnen (Niesen, Kortekaas, nationale bestand) dicht bij elkaar en geven de sterk vergelijkbare schommelingen in de tijd vertrouwen dat de gevonden patronen reëel zijn. Daarmee is een belangrijk instrument gevonden om de strandingspatronen door de tijd in een breder daglicht te plaatsen. Als de dichtheden van aangespoelde bruinvissen op de kust tussen Hoek van Holland en IJmuiden over de hele periode 1930-2020 wordt beschouwd, zien we een golvend patroon. Er is geen afname in strandingen na de Tweede Wereldoorlog, en hoewel er rond 1950 lagere dichtheden zijn geconstateerd, heeft een voortdurende afname van de bruinvis in de jaren 1950, zoals die bij eerder onderzoek is gevonden, niet plaatsgevonden: in de tweede helft van de jaren 1950 waren de aangespoelde aantallen juist hoog. De grootste afname vond plaats vanaf 1964, hoewel in de dertig jaar daarna, toen er hooguit enkele bruinvissen per jaar werden gevonden, nog altijd een golvend strandingspatroon zichtbaar is. Deze 'magere' periode komt overeen met de afname van andere mariene viseters zoals de grote stern (*Thalasseus sandvicensis*) en de gewone zeehond (*Phoca vitulina*), soorten waarvan is aangetoond dat ze te lijden hebben gehad van PCB-vergiftiging. Of dat ook de achteruitgang van de bruinvis in Nederland heeft bespoedigd, valt buiten het bestek van deze studie, net als de sterke toename van zowel levende als aangespoelde dieren sinds de jaren 1990.

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