

DATA ON THE LONG-TERM DEVELOPMENT  
IN THE NORTH ATLANTIC POPULATION OF  
THE SANDWICH TERN, *STERNA SANDVICENSIS*

Ed Buijsman

Nature Reserve De Beer Communication Series 25

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*Illustration frontpage*

Aerial view of the Sandwich Tern colony in Utopia, Texel, The Netherlands, 2016.

Counting the number of breeding pairs with a drone gives good results.

Photo Marc Plomp.

*Correspondence*

Bovencamp 57

3992 RX Houten

The Netherlands

☎ + 31 30 6373498

+ 31 6 36286096

✉ [natuurmonumentdebeer@inzichten.nl](mailto:natuurmonumentdebeer@inzichten.nl)

[ed.buijsman@xs4all.nl](mailto:ed.buijsman@xs4all.nl)

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# Contents

Abstract 4

Introduction 5

Methods 7

Area 7

Primary data 7

▣ Belgium 7

▣ Denmark 8

▣ Estonia 8

▣ France 9

▣ Germany 9

▣ Ireland 10

▣ Italy 10

▣ Poland 11

▣ Sweden 11

▣ The Netherlands 12

▣ United Kingdom 12

Data handling 13

Results 14

Discussion 16

Literature 18

Acknowledgements 22

About the author 23

Annex A – Number of breeding pairs of the Sandwich Tern 24

Annex B – Names of the Sandwich Tern 27

Annex C – The nature reserve De Beer in The Netherlands 28

Notes 33

## Abstract

This publication describes the results of a study into the numbers of breeding pairs of the Sandwich Tern, *Sterna sandvicensis*, in the North Atlantic population. The data was taken from publications and obtained from colleagues and ornithologists in Belgium, Estonia, France, Germany, Ireland, Italy, The Netherlands, Poland, Sweden, and the United Kingdom. For the period 1991-2020 the numbers of the entire population fluctuate with deviations of up to 15% around an average of approximately 52,000. These fluctuations can be even greater for individual countries, *i.e.* up to 50%. This phenomenological research has laid the foundation for future research for which a number of topics have been proposed.

## Keywords

Sandwich Tern, *Sterna sandvicensis*, beccapesci, Brandseeschwalbe, grote stern, Kentsk tärna, rybitwy czubatej, splitterne, Sterne caugek, tutt-tiir, North Atlantic population, trend.



## Introduction

The English medical doctor and ornithologist John Latham from Dartford, Kent, England was the first to describe the Sandwich Tern, *Sterna sandvicensis*, as a distinct species. In August 1784 Latham had received a shot specimen of the bird from his fellow physician Boys of Sandwich at the east coast of Kent. Latham named the bird Sandwich Tern in 1785, after the site of the Sandwich Bay where the bird was shot. He described *sandvicensis* in the last part of the six-volume 'A General Synopsis of Birds'.<sup>1</sup>

In the nineteenth century, ornithological fieldwork was not as common as it is today. As a result, only a limited number of Sandwich Tern colonies were known in this period (*figure 1*). For The Netherlands, for example, the number of known colonies was only two. In the early twentieth century, this grew to five, ten, and later on even more. In recent years, the number of colonies in The Netherlands has been between ten and fifteen. A similar development has occurred in other countries in Europe in the last century. The map by Glutz von Blotzheim & Bauer (1982) can serve as a comparison; this shows a much larger number of colonies throughout Europe (*figure 2*). Today, few Sandwich Terns will escape the attention of searching ornithologists.

In 2017, a book about the history of the Sandwich Tern in The Netherlands was published under the title 'Beautiful creatures' (Buijsman, 2017).<sup>2</sup> For a comparison with the size of the Dutch population of this bird the total number of breeding pairs of the North Atlantic population of the Sandwich Tern for the period 1900-2014 was given in an annex. Data for 1900 – 1990 were taken from Brenninkmeijer & Stienen (1992).<sup>3</sup> Later data was obtained from publications by and correspondence with various researchers throughout Europe. The present publication is intended to update and improve the estimate by Buijsman (2017) for the period 1991–2018. This also helps to gain a better insight into the numbers in the Atlantic population and the fluctuations therein.

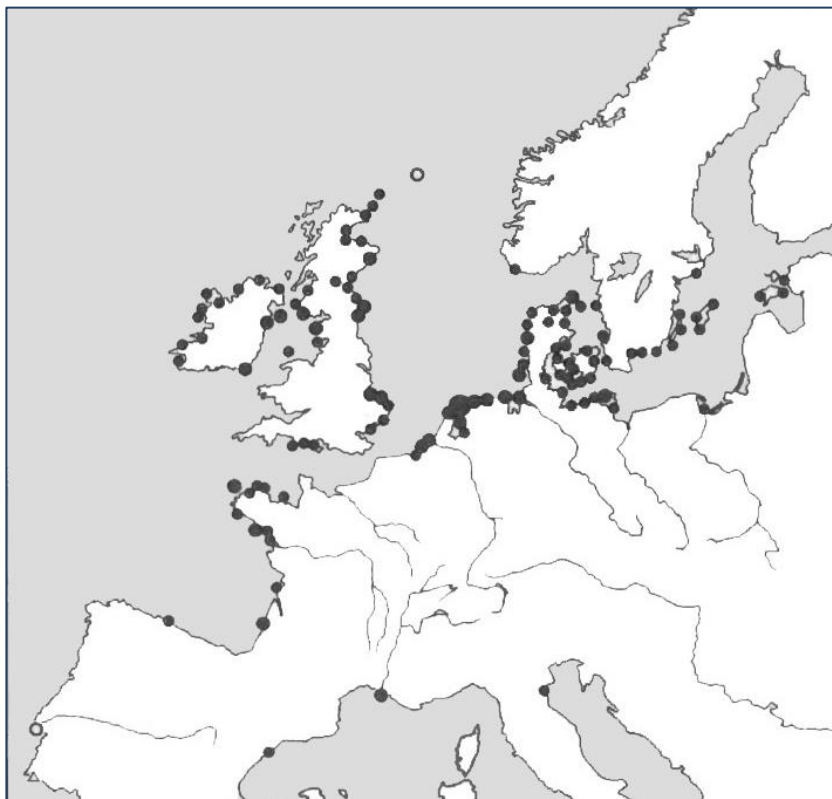
The Sandwich Tern is not endangered on a global scale. The size of the global population is estimated to be at least 500,000 individuals. The species consists of three very similar subspecies. The *Sterna sandvicensis sandvicensis* is the form that occurs in Europe. The *Sterna sandvicensis acufflavida*, also called Cabot's Tern, occurs from the eastern part of North America to the southern Caribbean and in winter from the south of Peru to Uruguay. The *Sterna sandvicensis eurygnatha*, also called the Cayenne Tern, is mainly found on islands near Venezuela, Guyana, Brazil, Argentina.<sup>4</sup> The Sandwich Tern does not occur in most of Asia and in Australia and New Zealand.<sup>5</sup>



[1.] Well-known, larger breeding grounds of the Sandwich Tern in north-western Europe in the 19<sup>th</sup> century. The locations have certainly not been occupied during the entire period. The number of breeding pairs in the colonies may have varied strongly over time. Please note that only one colony is shown for France. The number of colonies on the map is most probably an underestimate.<sup>6</sup>

The European sandwich tern population consists of three subpopulations. One subpopulation has its breeding grounds in the northwestern European coastal areas along the French, Atlantic coast, around the North Sea and along the Baltic Sea; this is what we call the North Atlantic population. The area extends to the west on the west coast of Ireland, from the north to the south Norway and Sweden and occasionally also on the Orkney and Shetland Islands, to the east to Estonia and on the south side to Italy and Spain. A second sub-population has the northern and western coast of the Black Sea as a breeding area. The third part resides around the Caspian Sea. Sandwich terns from the North Atlantic population most winter at the African west coast in the estuaries between Mauritania and Nigeria.<sup>7</sup>

The bird has the status 'least concern' on the Red List of Endangered Species of the International Union for Conservation of Nature (IUCN). The number of birds all over the world is labeled 'stable'.<sup>8</sup> Nevertheless, the population is under pressure in a number of European countries. Important pressures are: a) loss of natural habitats; b) disturbance; c) recreation and, especially in the past, d) environmental pollution.<sup>9</sup>



[2.] The North Atlantic population of the Sandwich Tern in Europe in the period 1960 – 1978. Colonies no longer occupied since 1960 are shown with open circles. Part of the map presented by Glutz von Blotzheim & Bauer (1982).



# Methods

## Area

The North Atlantic population of the Sandwich Tern has been defined according to Glutz von Blotzheim und Bauer (1982) with breeding grounds in Belgium, Estonia, France, Germany, Ireland, Italy, The Netherlands, Poland, Sweden, and the United Kingdom. Breeding cases have been observed sporadically in southern Norway, Spain, and Portugal.<sup>10</sup> As a true coastal breeding bird, the Sandwich Tern occurs only in the coastal areas of the countries mentioned. As far as we know from literature, the North Atlantic population of the breeding of the Sandwich Tern does not (and never did) extend to Latvia, Lithuania and Finland in the past 200 years.<sup>11</sup> Occasionally the Sandwich Tern has been observed outside the breeding period in low numbers for instance in Croatia and The Netherlands. However, these are winterers. A phenomenon that occurs in many places in Europe, although the numbers are low (see for instance Møller, 1981; Ouweneel 1973, 1989; Stipcevic *et al.*, 1998).

## Primary data

### ▣ Belgium

Belgium once had a colony in the harbour of Zeebrugge. This colony has been abandoned because of rat and fox predation. As this location is close to the border of The Netherlands this colony can be considered as part of the metapopulation of the Delta area in The Netherlands.<sup>12</sup> Therefore, data for the Zeebrugge colony are included in those for The Netherlands. In the past, data for the Belgian colony have been provided by Eric Stienen from the Research Institute Nature and Forest in Brussels, Belgium. Data is included in the publications about the Sandwich Terns, by De Kraker (see for instance, 2020) and the annual overviews by SOVON.<sup>13</sup>



[3.] In 2008, a special island for coastal breeding birds was constructed in the outer harbour of Zeebrugge, Belgium. It was called Sterneneiland, the Tern Island. However, Sandwich Terns have not been breeding here since 2013, due to predation of rats and especially foxes. Photo Natura 2000 Vlaanderen.



#### ■ Denmark

Data for Denmark starting in 1920 have primarily been delivered by Thomas Bregnballe and Jens Gregersen of the Department of Bioscience, Aarhus University.<sup>14</sup> Recent data can also be found in Bregnballe & Gregersen. Some additional information is provided by the publications of Gregersen (2006) and Nyegaard et al. (2014). For an early publication see for instance Hagerup (1894).



[4.] Sandwich Tern colony on the island of Langli near Esbjerg, Denmark, May 2008. Photo Lars Maltha Rasmussen.

#### ■ Estonia

Meelis Levits of the Department of Wildlife of the Estonian Environment Agency in Tallinn provided the data for Estonia up to and including 2020. These data came with the remark that (probably) only data after 2015 are complete. Elts et al. (2019) give an estimate of 800-1.100 for the period 2013-2017, with an upward trend since 1980. In an earlier paper Elts et al. (2009) gave an estimate of 600-900 breeding pairs for the period 2003-2008.



[5.] The Kunnati lath/Laid nr. 10 colony in Estonia, May 2020. Photo Martin Vesberg.



#### ▣ France

Gwenaél Quaintenne of BirdLife France, League for the protection of birds, provided country totals up to and including 2017.<sup>a</sup> Data for 2018 and 2019 came from Yann Jacob of the Bretagne Vivante organization. Nathan Legroux of the Ornithological and naturalist group of the Nord – Pas-de-Calais supplied regional data for the colonies in North-western France.<sup>b</sup> Olivier Scher did the same for the Mediterranean colonies. An interesting development with the latter was that the first breeding case was found in 1948, in the Camarque. The numbers then steadily increased. In the early 1990s, numbers in the eastern half of the area decreased again, but numbers in the western area increased sharply. In the last ten years the number even doubled.<sup>15</sup>



[6.] Sandwich Terns in nature reserve Le platier d'Oye.<sup>c</sup>

#### ▣ Germany

Nowadays, data for Germany is collected per 'Bundesland'. In this case it means Hamburg, Mecklenburg-Vorpommern, Niedersachsen, and Schleswig-Holstein<sup>d</sup>. So, for Niedersachsen the data from the publication of Garthe & Flore (2007) was used. Later data was supplied by Thorsten Krüger, Staatliche Vogelschutzwarte im Niedersächsischen Landes-verwaltung für Wasserwirtschaft, Küsten- und Naturschutz. For Mecklenburg-Vorpommern Christof Herrmann of the Landesamt für Umwelt, Naturschutz und Geologie Mecklenburg proved to be indispensable.<sup>16</sup> The curious history of the German ornithologist Otto should not be left unmentioned here. There is a possibility that he saw the Sandwich Tern earlier than Latham.<sup>17</sup>



[7.] Panic flight of Sandwich Terns in the Norderoog colony, Germany. Photo Harro Müller, Hamburg.

<sup>a</sup> Ligue Pour la Protection des Oiseaux.

<sup>b</sup> Groupe ornithologique et naturaliste du Nord – Pas-de-Calais.

<sup>c</sup> Photo taken from the website platier.fr.

<sup>d</sup> Data for the Hamburg colonies are reported for Niedersachsen or Schleswig-Holstein.

#### ▣ Ireland

The Seabird Monitoring Programme (SMP) database of the Joint Nature Conservation Committee (JNCC) is a United Kingdom based database which contains data of a vast number of seabird colonies throughout the United Kingdom. It contains data from Ireland as well. Comparison with Irish publications, such as for instance Cummins *et al.* (2019), revealed differences with data in the SMP database being systematically lower. This suggests that the latter are not complete. On the other hand, country wide surveys in Ireland are done irregularly. So, apart from the publication by Cummins, the only other data is from Mavor (2003, 2004, 2005).<sup>18</sup> However, the only exception is Lady's Island Lake, where the colony is monitored annually.<sup>19</sup>



[8.] Lady's Island Lake in Southeast Ireland is the site of Ireland's largest Sandwich Tern breeding colony. Photo Tony Murray. Photo taken from Cummins *et al.* (2019).

#### ▣ Italy

Nesting in Italy was first recorded in Emilia-Romagna at the Valli di Comacchio, a lagoon and wetland complex at the Adriatic coast in northern Italy in 1979, about 80 kilometres south of Venice.<sup>20</sup> Subsequently, Sandwich Tern has become established as a regular breeding species in the Venice Lagoon since 1995. Sporadic nesting has also occurred at other sites in Veneto, in the Po Delta since 2004, Apulia at Margherita di Savoia Salt Pans since 1997 and Emilia-Romagna at Valle Bertuzzi since 1998. In Sicily, nesting was observed at Ognina, Province of Syracuse, in 2006. (Brichetti & Fracasso 2018). Country totals for the years 1979 up to and including 2004 were taken from Brichetti & Fracasso (2006). Thereafter, only data for the Lagoon of Venice are available; see Scarton & Valle (2015, 2017) and Scarton (2020).<sup>21</sup>



[9.] Sandwich colony in front of the Murano island, in the lagoon of Venice, Italy. Photo Francesco Scarton.



#### ▣ Poland

Breeding of the Sandwich Tern in Poland was for the first time observed in 1929 and thereafter from 1932 through 1936 with single pairs up to three. However, the numbers were rather low.<sup>22</sup> It was not until 1977 that the bird was seen again. Early data (1977–2004) were taken from Herrmann *et al.* (2008). Further data have been supplied by Herrmann *et al.* (s.a). Another source was Meissner *et al.* (2014). Valuable information about the past and current situation has been given by Meissner (2020).<sup>23</sup>



[10.] Former colony in the mouth of the Vistula, near Gdansk, Poland. Photo Mateusz Ściborski.

#### ▣ Sweden

Data for the Blekinge province in southern Sweden came from Patrik Olofsson<sup>24</sup>. Data for Gotland was delivered by Kjell Larsson.<sup>25</sup> Herrmann *et al.* (2008) presented data as well. Some older data (<1973) were taken from Wallinn *et al.* (2009) and Gärdenfors (2005).<sup>26</sup>



[11.] Sandwich Tern colony near Tosteberga harbour in the province of Skåne, Sweden. The terns have been breeding here from 1999 to 2012. Photo Patrik Olofsson.

#### ■ The Netherlands

The first observation of the Sandwich Tern in The Netherlands was probably on the island of Rottum in 1817. However, the ornithologist Temminck already had a specimen - possibly shot by himself on Texel. - in his own collection in 1807.<sup>27</sup>

Most data for The Netherlands were supplied by SOVON, the Dutch Centre for Field Ornithology. This series goes back to 1900.<sup>28</sup> Literature provided very scarce data before 1900.<sup>29</sup> The most recent data (2019 and 2020) came from De Kraker (2020) and Buijsman (2020).<sup>30</sup>



[12.] Recently developed nature reserve, De Putten, in the province of North Holland, The Netherlands. It is an inland breeding area but surrounded by water to suppress predation. Photo Ruben Fijn/Bureau Waardenburg.

#### ■ United Kingdom

Data from 1969 up to and including 2104 for England, Scotland, Wales, and Northern Ireland were provided by Roddy Mavor and were taken from the Seabird Monitoring Programme (SMP) database of the Joint Nature Conservation Committee (JNCC). In the database numbers on colony level are available. Unfortunately, JNCC was unable to provide data for the years after 2014.<sup>31</sup> That is why these data were necessarily taken from a figure on the web page about the Sandwich Tern.<sup>32</sup> Data from before 1969 for a limited number of colonies were published by Cramp et al. (1964) for the period 1920–1969 and by Marples & Marples (1934) for the period 1920–1993.



[13.] Scolt Head Island National Nature Reserve is located on the northern coast of Norfolk, England. It is the main breeding ground for the Sandwich Tern in England. It has a very dynamic coastline and is steadily growing westward. Photo National Trust.



← [14.] Sandwich Tern colony in Forvie National Nature Reserve, Scotland. Forvie has long been the major breeding ground of the Sandwich Tern in Scotland. Photo Scottish Natural Heritage.



## Data handling

Data have been used as such. If relevant, in a few cases numbers will be presented for regions or areas instead of country totals. So, for Germany a distinction is made for the North Sea colonies and the Baltic Sea colonies. Likewise, for the United Kingdom: England, Scotland, Wales on one side and Northern Ireland on the other. In all these cases, the areas are geographically clearly far apart.

The first time series start in 1900; this is for The Netherlands. Data is available from 1960 onwards for most countries. Since older time series are very far from complete the total for the Atlantic population of the Sandwich Tern for the period 1900–1990 is taken from Brenninkmeijer & Stienen (1992).<sup>33</sup> For the years after that the total is the sum of the country totals.



## Results

Table 1 gives the results of the inventory. Year-on-year fluctuations in numbers are quite common to the Sandwich Tern. So, differences between the years of up to 8 percent are not uncommon (*figure 15*).<sup>34</sup> This is not the result of poor or good inventories but of the breeding success in the previous year, climatological conditions, and other factors like mass movements between colonies (and therefore countries).<sup>35</sup> The average over this period is 51,800. The lowest number being 43,800 (in 1997), the highest 60,400 (in 2017).<sup>e</sup>

Table 1 Number of breeding pairs of the Sandwich Tern (*Sterna sandvicensis*) in the North Atlantic population, total and in different countries, 1991 – 2020.<sup>f</sup>

Year	Total	Notes												
			Germany	Denmark	Estonia	France	Ireland	Italy	Netherlands	Poland	Sweden	United Kingdom		
			DE	DK	EE	FR	IR	IT	NL	PL	SE	UK		
			NS <sup>1)</sup>	BS <sup>2)</sup>								ESW <sup>3)</sup>	NI <sup>4)</sup>	
1991	51,333	5)	9,283	1,209	3,836	---	7,460	3,000	490	10,274	25	350	13,525	1,231
1992	48,099	5)	9,652	1,123	3,836	2	6,700	3,000	480	9,378	0	350	11,989	939
1993	46,603	5)	9,000	1,000	2,092	50	7,264	3,000	585	10,800	0	350	10,389	1,423
1994	46,150	5)	9,813	1,060	2,034	2	6,712	3,000	580	11,651	0	272	10,037	989
1995	46,739		8,800	251	2,473	202	6,500	3,716	700	13,110	0	315	9,580	1,092
1996	46,109	5)	10,138	597	1,948	61	7,500	3,000	725	10,697	0	235	9,684	1,524
1997	43,813	5)	8,119	782	1,861	4	5,890	3,000	850	11,962	0	450	8,879	2,016
1998	47,571	5)	7,670	670	3,702	15	6,831	3,000	640	13,550	0	498	9,212	1,783
1999	51,179	5)	8,858	693	4,407	1	6,638	3,000	700	14,150	0	482	10,415	1,835
2000	50,721	5)	7,780	711	4,314	2	6,938	3,000	615	14,455	0	394	10,558	1,954
2001	50,410		8,233	683	3,959	702	5,889	2,475	870	14,574	0	168	10,614	2,243
2002	56,965		9,685	607	4,560	1	5,676	3,260	1,381	17,312	0	184	12,092	2,207
2003	57,031		8,157	828	4,890	---	6,344	3,850	770	18,457	0	373	10,994	2,368
2004	52,976		7,306	772	3,174	5	7,175	4,070	810	16,319	0	171	10,554	2,620
2005	50,130	5)	4,747	765	4,286	9	6,435	3,000	560	16,690	0	106	10,213	3,319
2006	50,566	5)	5,234	551	6,084	168	6,534	3,000	390	17,313	140	261	8,150	2,741
2007	52,854	5)	6,667	650	4,899	32	5,935	3,000	485	18,818	400	366	8,626	2,976
2008	55,499	5)	6,783	403	6,286	200	7,554	3,000	585	19,528	300	495	7,930	2,435
2009	53,660	5)	4,542	390	5,419	218	7,036	3,000	805	19,179	570	460	9,081	2,960
2010	50,408	5)	5,215	317	6,050	162	6,575	3,000	815	17,086	100	330	8,524	2,234
2011	53,658	5)	5,639	238	5,306	765	5,728	3,000	605	19,980	112	493	10,133	1,659
2012	51,693	5)	7,349	426	3,868	118	7,840	3,000	635	16,373	276	549	9,438	1,821
2013	49,684	5)	6,646	240	3,931	787	7,237	3,000	641	14,831	415	529	9,878	1,549
2014	55,224	5)	7,392	235	4,358	638	8,408	3,000	1528	16,700	400	387	10,417	1,761
2015	59,008	5)	7,068	15	4,050	928	8,714	3,000	1511	18,175	670	577	14,300	
2016	54,726		7,265	3	4,513	655	9,385	2,550	1569	17,209	770	707	10,100	
2017	60,404		6,076	201	3,905	1,084	11,092	2,550	1878	19,050	0	768	13,800	
2018	57,669		7,301	190	3,829	886	9,578	2,550	1456	16,340	0	939	14,600	
2019		6)	---	282	3,393	1,342	9,859	---	---	19,450	0	1,234	---	---
2020		6)	---	---	3,385	1,000	---	---	---	18,600	0	1,255	---	---

1) North Sea

2) Baltic Sea

3) England, Scotland, Wales.

4) Northern Ireland.

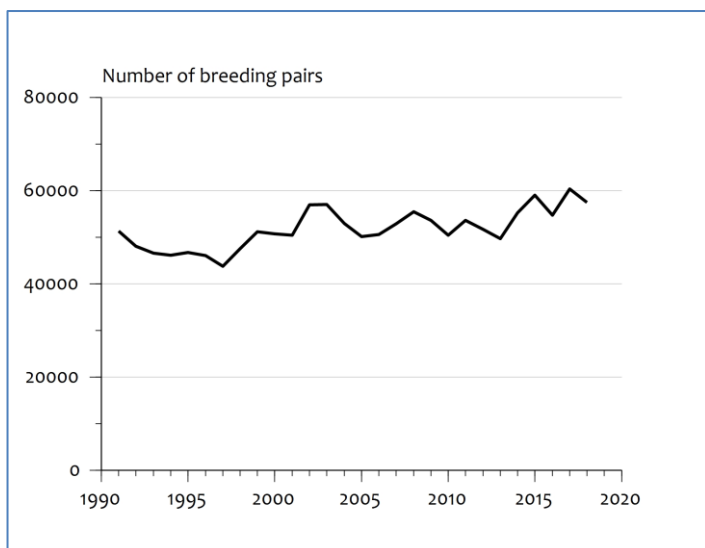
5) Total with an estimate for Ireland.

6) No total; too much data is missing.

	No data available for Sweden. Estimate by the author. <sup>36</sup>
	No countrywide inventory
	Preliminary data
	Conservative estimate by the author
---	No data

<sup>e</sup> Rounded numbers.

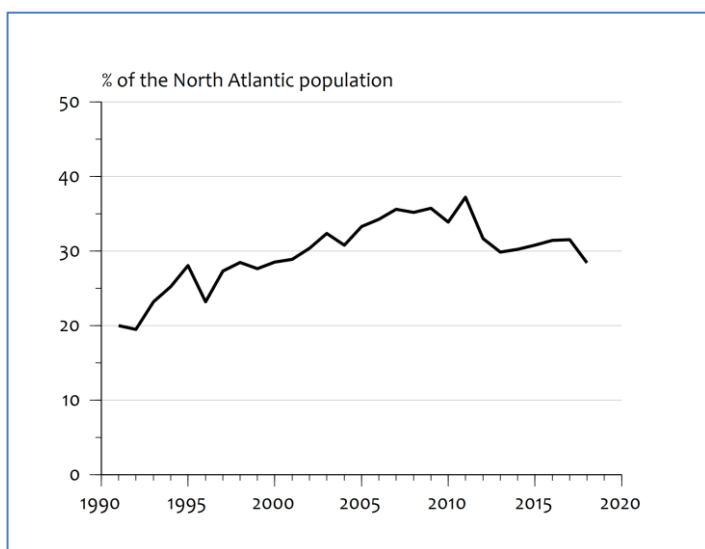
<sup>f</sup> For the years before 1991 see Annex A, table A2.



[14.] Number of breeding pairs of the Sandwich Tern (*Sterna sandvicensis*) in the North Atlantic population, 1991-2018.

There has been an gradual increase in numbers in The Netherlands in the period 1991-2020 (cf. table 1). The first decade starting 1991 showed an average of 12,000. For the next two decades, the average was just above 17,000. The previous ten years had an average level of just over 10,000.<sup>9</sup> It is tempting to apply some simple statistical analysis to estimate a trend.<sup>37</sup> However, a more sophisticated approach, which takes the fluctuations into account will certainly produce a much better result. Since such an analysis is not the purpose of this note, it will be left out.

Since 1993, The Netherlands has again had the largest share of the considered countries in the total of the North Atlantic population. This contribution amounts from about 20% in the beginning of the nineties to between 30 and 35% in later years (figure 16).



[15.] Number of breeding pairs of the Sandwich Tern in The Netherlands as a percentage of the total North Atlantic population, 1991-2018.

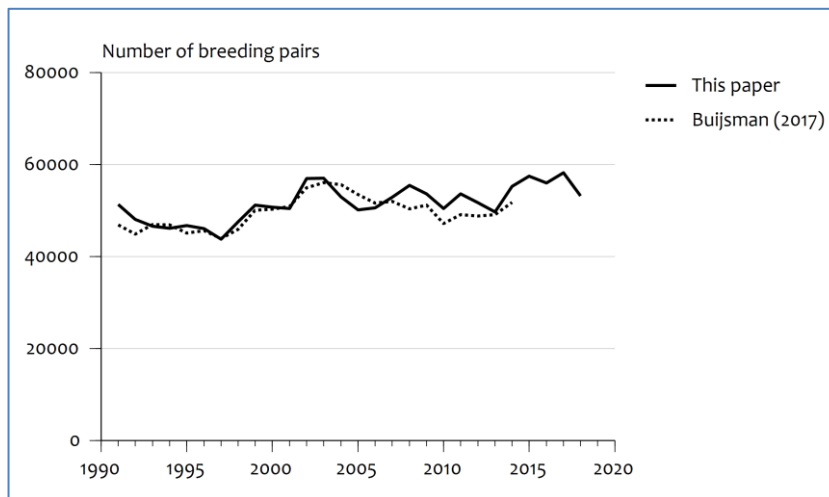


<sup>9</sup> See also Annex A, table A1.

## Discussion

The quality of the inventory can undoubtedly be improved. It is important to bear in mind that as a result of incomplete inventories country totals may be underestimated. This is especially true for Ireland and, to a lesser extent, Italy. This estimate of the total number of breeding pairs in the total North Atlantic population is on the average higher than the estimate of Buijsman (2017); see *figure 17*. The differences over the entire period lie in the range of -7 to +9% with an average of +2.<sup>h</sup> So, in general, the recent estimate is slightly higher than the previous one. Possible explanations are: a) use of incomplete datasets in the previous estimate, and b) later corrections or additions in datasets.

It is remarkable that there is so little attention for analysis of the long-term trend in the number of breeding pairs of the Sandwich Tern in the North Atlantic population. Apart from the publication by Herrmann et al. (2008) which focuses on the Baltic region and Garthe & Flore (2007) who have paid attention to the German North Sea coast, there is, to the best of my knowledge, apparently little interest in this subject. Of course, a long-term analysis will be complicated by missing data, especially for older time series. On the other hand, there is now a range of imputation techniques available to fill in missing data or for trend detection; see for instance Onkelinx et al. (2017) and Soldaat et al. (2007).



[16.] Estimates of the number breeding pairs of the Sandwich Tern (*Sterna sandvicensis*) in the North Atlantic population. For graph data see table A1.

Clearly, this research has only laid the groundwork for tackling the real scientific questions. Questions like: How stable are the colony settlements for this erratic species? How often are establishments given up and does the entire colony move? Can determining factors be distinguished? Are there long-term data on colony-level nesting success? Where do colonies become marginally relevant, that is, on the north or south side of the distribution area? What is the crucial factor in the population distribution across latitudes? However, further research into these questions is beyond the scope of this article, which was primarily intended to conduct a phenomenological analysis. So there is still a lot of research to be done.

<sup>h</sup> Difference is defined as:  $((\text{this estimate} - \text{previous estimate}) / \text{this estimate}) * 100\%$ .





[17.] Colonies of the Sandwich Tern (*Sterna sandvicensis*) in the North Atlantic population in the period 1991 – 2020. Only colonies with more than 100 breeding pairs are shown on the map. Not all locations have been occupied during the entire period. The number of breeding pairs in the colonies may have varied strongly over time.



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## About the author

Ed Buijsman (1948) was once trained as an analytical chemist in the Elemental Analysis department of the Analytical Chemistry Laboratory of the University of Utrecht. He was also trained as an atmospheric chemist at the Institute for Meteorology and Oceanography (IMOU) of the University of Utrecht, where he conducted modest research into the problem of acid rain. After graduating he worked there for several years as a researcher at the Analytical Chemistry Laboratory.

For most of his professional career, Buijsman has worked in various areas of air pollution. From 1979 to 1986 he worked at the Atmospheric Chemistry Group of the aforementioned IMOU. It was the time of acid rain research, chemical rainwater research and atmospheric ammonia as an evolving environmental problem. In addition, he was a chemistry teacher at the Foundation for Supplementary Education at the university from 1976 to 1986.

In 1986 Buijsman moved to the National Institute for Public Health and the Environment (RIVM), where he was first project manager of the Annual Air Quality Report and from 1990 to 1996 head of the National Air Quality Monitoring Network. Later he went to the newly established Environmental and Nature Planning Agency (Milieu- en Natuurplanbureau, MNP). Later, this was reorganised and named Netherlands Environmental Assessment Agency (Planbureau voor de Leefomgeving, PBL). Air pollution was also his work area at these organizations, including the position of editor of air quality of the Compendium for the Environment. In 2011 Buijsman was project leader of the report on a review of the problem of acid rain. Buijsman retired at the end of 2013. However, air pollution has kept his interest. The results of his new research appear in the LUVU Publication Series.

A person cannot live on air alone, so interest in nature was also added and, later, also interest in historical aspects of air quality and nature in the Netherlands. In 2007, he published a book about the history of the legendary natural reserve De Beer by publishing house Matrijs and in 2017 a book about the history of the Sandwich Tern in the Netherlands. New research on the nature reserve De Beer is published in the Natuurmonument De Beer Publication Series. In addition, he is founder of the magazines *Voortschrijdende Inzichten* (~Advancing Insights) and *PANORAMA* and the websites of *Advancing Insights*, about the nature reserve De Beer, about the Sandwich Tern, about Myeloproliferative Neoplasms and about changes in the Dutch landscape.

## Annex A – Number of breeding pairs of the Sandwich Tern

Table A1 Comparison of the present and previous estimate according to Buijsman (2017) of the number of breeding pairs of the Sandwich Tern, 1991 -2014.<sup>38</sup>

Year	This estimate	Previous estimate	Year	This estimate	Previous estimate
1991	51,333	46,900	2003	57,031	56,100
1992	48,099	44,900	2004	52,976	55,600
1993	46,603	47,000	2005	50,130	53,500
1994	46,150	46,900	2006	50,566	51,600
1995	46,739	45,100	2007	52,854	52,000
1996	46,109	45,600	2008	55,499	50,400
1997	43,813	43,900	2009	53,660	51,200
1998	47,571	45,900	2010	50,408	47,200
1999	51,179	50,100	2011	53,658	49,100
2000	50,721	50,300	2012	51,693	48,800
2001	50,410	50,900	2013	49,684	49,100
2002	56,965	55,000	2014	55,224	51,800

Table A2 Number of breeding pairs of the Sandwich Tern (*Sterna sandvicensis*) in the North Atlantic population, total and in different countries, 1900 – 1990.

Year	Total North Atlantic population	Sum of country totals	Germany North Sea	Germany Baltic Sea	Denmark	Estonia	France	Ireland	Italy	Netherlands	Poland	Sweden	United Kingdom England, Scotland, Wales	United Kingdom Northern Ireland
			DE	DE	DK	EE	FR	IR	IT	NL	PL	SE	UK	UK
1900	16,700	16,085								16,085				
1901	17,100	16,485								16,485				
1902	15,900	15,085								15,085				
1903	15,700	14,085								14,085				
1904	14,000	11,095								11,095				
1905	12,800	9,735	550							9,185				
1906	13,300	9,250	650							8,600				
1907	12,700	5,056	56							5,000				
1908	12,800	4,850	600							4,250				
1909	15,300	5,852	2,352							3,500				
1910	16,400	5,350	3,100							2,250				
1911	14,100	701	201							500				
1912	13,500	3,001	2,001							1,000				



Year	Total North Atlantic population	Sum of country totals												
			Germany North Sea	Germany Baltic Sea	Denmark	Estonia	France	Ireland	Italy	Netherlands	Poland	Sweden	United Kingdom England, Scotland, Wales	United Kingdom Northern Ireland
			DE	DE	DK	EE	FR	IR	IT	NL	PL	SE	UK	UK
1913	13,300	5,702	3,702							2,000				
1914	19,500	11,087	8,084							3,003				
1915	18,000	11,350	7,000							4,350				
1916	19,600	14,165	7,115							7,050				
1917	20,200	15,555	7,005							8,550				
1918	18,700	11,340	190							11,150				
1919	16,600	13,005	855							12,150				
1920	16,100	14,070	2,070							12,000				
1921	17,300	13,570	370							13,200				
1922	17,400	15,605	2,405							13,200				
1923	18,700	17,750	4,600							13,150				
1924	17,600	15,000	1,950							13,050				
1925	22,500	16,650	3,600							13,050				
1926	23,600	18,155	4,098							14,057				
1927	24,200	20,791	4,764							16,027				
1928	27,400	21,777	5,750							16,027				
1929	28,500	23,345	4,958							18,385	2			
1930	33,000	26,021	5,500							20,521				
1931	36,300	28,419	4,600							23,819				
1932	37,200	29,716	4,350							25,364	2			
1933	43,500	34,738	4,354							30,382	2			
1934	42,500	33,607	3,300							30,305	2			
1935	41,800	34,704	3,501							31,201	2			
1936	39,900	31,388	3,646							27,740	2			
1937	47,600	38,541	3,931							34,610				
1938	56,800	49,119	3,439							45,680				
1939	52,200	41,815	3,755							38,060				
1940	55,000	44,432	4,217							40,215				
1941	40,900	29,419	3,199							26,220				
1942	47,300	35,729	2,613							33,116				
1943	52,700	41,645	4,385							37,260				
1944	30,400	19,835	3,635							16,200				
1945	36,500	27,806	3,456				300			24,050				
1946	36,500	26,845	1,432							25,413				
1947	28,500	21,923	578							21,345				
1948	38,600	28,774	2,925							25,849				
1949	43,500	32,335	3,525							28,810				
1950	43,800	31,530	2,695							28,835				
1951	47,300	36,152	2,652							33,500				
1952	45,700	35,377	2,617							32,760				
1953	42,100	30,974	2,964							28,010				

Year	Total North Atlantic population	Sum of country totals	Germany North Sea	Germany Baltic Sea	Denmark	Estonia	France	Ireland	Italy	Netherlands	Poland	Sweden	United Kingdom England, Scotland, Wales	United Kingdom Northern Ireland
			DE	DE	DK	EE	FR	IR	IT	NL	PL	SE	UK	UK
1954	59,700	40,914	3,287				400			37,227				
1955	39,800	32,423	2,593				1,104			28,726				
1956	45,800	41,228	3,482				1,600			36,146				
1957	46,500	40,588	6,566	27			1,650			32,372				
1958	28,800	25,546	3,941	35			2,623			18,982				
1959	26,100	20,830	4,545	82			2,800			13,485				
1960	26,200	20,193	4,521	253	5,000					10,022	0	375		
1961	27,400	21,177	2,471	290	4,900		1,200			11,866	0	400		
1962	29,500	22,724	3,346	330	4,800		1,425			12,347	0	400		
1963	21,900	17,459	4,910	345	4,300		2,800			4,596	3	400		
1964	18,700	15,177	5,117	404	4,200		2,740			2,267	3	400		
1965	18,200	10,325	2,243	439	3,600		2,700			875	0	400		
1966	21,900	12,570	3,127	310	3,200		3,575			1,695	0	400		
1967	23,100	14,780	3,740	455	4,500		4,325			1,200	3	400		
1968	25,800	17,008	4,563	614	4,800	1	5,000			1,566	0	400		
1969	26,700	28,425	3,240	533	4,900		3,500	2,216		2,036	0	400	10,207	1,200
1970	29,400	30,130	4,152	649	3,900		5,275	2,216		2,418	0	350	9,696	1,378
1971	32,900	30,038	4,933	714	4,100			2,500		3,189	0	350	12,602	1,603
1972	32,000	29,587	5,497	710	3,100			2,500		3,976	0	300	11,921	1,573
1973	30,800	34,326	5,827	644	4,400		3,275	2,500		4,353	0	300	11,340	1,687
1974	31,700	33,683	6,670	934	5,300		1,824	2,500		5,324	0	250	9,487	1,394
1975	31,800	32,430	5,230	709	4,700	81	2,208	2,500		5,042	0	175	10,129	1,656
1976	34,600	36,690	7,726	818	4,200	76	2,808	2,500		5,554	0	175	11,171	1,652
1977	33,900	40,705	6,636	943	5,600	4	5,300	2,500		5,085	55	1,100	11,404	2,074
1978	39,900	40,719	6,857	1,006	3,600		6,191	2,500		6,106	60	1,000	11,540	1,832
1979	41,500	43,521	7,196	1,245	3,800	21	5,778	2,500	8	6,951	1	1,000	12,766	2,192
1980	42,400	42,527	7,640	1,081	3,532	26	5,900	2,500	40	8,016	190	1,000	10,689	1,839
1981	44,400	44,904	8,111	1,101	3,598	44	5,256	2,500	45	9,785	175	1,000	11,463	1,824
1982	43,900	45,055	6,743	1,003	2,705	57	6,627	2,500	75	9,356	300	1,000	12,760	1,764
1983	46,100	45,172	6,251	820	3,388	22	6,600	2,500	149	10,733	210	1,000	11,435	1,905
1984	44,700	44,968	6,987	927	3,396		5,348	3,467	144	8,855	200	1,000	12,327	2,195
1985	45,000	41,390	6,390	997	3,024		6,575	3,000	140	8,680	100	1,000	10,992	475
1986	47,800	44,899	6,702	1,024	3,144	55	4,104	3,000	195	12,100	50	1,000	11,887	1,623
1987	46,300	47,211	7,531	1,030	4,261	12	4,512	3,000	230	10,635	0	1,000	12,392	2,555
1988	47,400	53,389	8,250	988	5,816	265	6,372	3,000	350	11,862	0	630	13,234	2,520
1989	48,600	48,584	7,397	1,046	5,364	10	5,472	3,000	370	12,544	1	1,000	11,072	1,208
1990	47,000	47,776	9,319	1,160	3,664	231	5,568	3,000	500	10,505	0	1,000	11,198	1,616

## Annex B – Names of the Sandwich Tern

This publication uses data from Belgium, Denmark, Estonia, France, Germany, Ireland, Italy, The Netherlands, Poland, Sweden, and the United Kingdom. The bird that this publication is about has in the different languages the following trivial names (in the order of the countries listed): grote stern/sterne caugek/Brandseeschwalbe, splitterne, tutt-tiir, sterne caugek, Brandsee-schwalbe, Sandwich Tern, beccapesci, grote stern, rybitwy czubatej, Kentsk tärna and Sandwich Tern.<sup>1</sup>

It is of course straightforward that the name Sandwich Tern has survived in English-speaking countries. The Swedish name, Kentsk tärna, refers directly to the name given by Gmelin, because it also means as much as Kentish Tern or the Tern from Kent. The names in some other languages are less easy to explain or understand. For instance: the name in Dutch, grote stern, has to do with the size of the bird. 'Groot' means big, large, tall. But bigger than what? The *Sterna albifrons*, the Little Tern, is in Dutch dwergstern, which can be roughly translated as Dwarf Tern, whereas the *Hydroprogne caspia*, Caspian Tern, in Dutch is called Reuzenster, the Giant Tern. It does not make much logic.

The names in Estonian and Polish, Tutt-tiir and Rybitwa czubata respectively, means translated into English, about the same: Crested Tern. The Italian name, beccapesci, refers to the characteristic feature, namely the way of catching fish: Fishpecker. However, one could of course argue that more birds could deserve such a name. Referring to another characteristic is the Danish name, Splitterne, referring to the forked tail, while flying. Strictly speaking the translation is Fork Tern.

After the foregoing, there are two more names left: the French and the German name. The French name, sterne caugek, goes all the way back to the name given by the 19<sup>th</sup> century Dutch ornithologist, Temminck. He used the name *Sterna caugek* in his publication 'Catalogue systématique du cabinet d'ornithologie et de la collection de Quadrumanes' from 1807. Temminck derived caugek from the characteristic sound the bird makes. So, it is an onomatopoeia, an imitation of the sound. The name caugek was traditionally used on the island of Texel in the north of The Netherlands. The Texel name therefore ended up in French via Temminck.<sup>m</sup> The name in German, Brandseeschwalbe, remains a bit of a mystery for the time being. Ruud Vlek, a historical ornithologist in The Netherlands, suggested that 'Brand' could be a shortened spelling of the German word 'Brandung', i.e. branding in English. A source to consult is 'Deutsche Vogelnamen, ihre Herkunft und Bedeutung' by Hugo Suolathi. In the 1909 edition of this book the following phrase can be found: 'Es ist eine ganz gewöhnliche Erscheinung, daß man schwarzgefärbte Tiere mit Russ, Kohle, Brand vergleicht und sie dann so benennt; so heißt der Fuchs *Brandfuchs*, die schwarzgezeichnete Meise *Brandmeise*, die schwarze Seeschwalbe und der Auerhahn *Brandvogel*, die Amsel *Kohlamsel*, der Rabe *Kohlrabe*' [It is quite a common occurrence to compare black-colored animals with soot, coal, fire and then name them; so the name of the fox is Brandfuchs, the black-drawn ant the Brandmeise, the black tern and the Auerhahn Brandvogel, the blackbird, the Kohlamsel, the raven, the Kohlrabe].<sup>39</sup> No doubt that this seems a reasonable explanation, although the Sandwich Tern is not mentioned as an example. Remember, however, that at the beginning of the twentieth century, so at the time of the book, the bird was still called Kentische Seeschwalbe (~Kentish Sea Swallow or just Kentish Tern) in German.



<sup>1</sup> Belgium is a country with three official languages, Dutch, French and German.

<sup>m</sup> Thanks Yann Jacob, Bretagne Vivante, who brought the book *L'étymologie des noms d'oiseaux* (LPO/Belin editions, 2003) by Pierre Cabard and Bernard Chauvet to my attention.

## Annex C – The nature reserve De Beer in The Netherlands

The name 'Nature Reserve De Beer Communication Series' refers to the former nature reserve De Beer in The Netherlands. There is a distinct possibility that readers from abroad never heard of this area. Therefore, a short explanation. De Beer was located on the island of Rozenburg near the coast of the North Sea on the south side of the mouth of the Nieuwe Waterweg (New Waterway) canal, opposite Hoek van Holland. It was until the end of the thirties of the twentieth century a wonderful example of a dynamic dune system where the sea had free rein. Vast beaches made it an ideal location for coastal breeding birds, such as Common Tern, Little Tern, Sandwich Tern, Avocet and Kentish Plover. De Beer developed into a nature reserve that, partly due to its size of 1300 hectares, was unique for The Netherlands. On the south side was a tidal marsh and muddy area of 300 ha.

'[...] if Rotterdam ever wanted to build on the Beer or otherwise disturb the peace, then in addition to the protests of countless Dutch people, those of the foreign connoisseurs and lovers would not fail to come. In twenty-five years from now, we will understand all these things even better than today. If it is not too late then.' These words were written by the famous Dutch environmentalist Thijssse in 1929 in the nature journal *De Levende Natuur* [Living Nature]. About 25 (!) years later, the first plans for a port at the head of Rozenburg were on the drawing boards of the Rotterdam harbour authority.

On November 7, 1957, the municipality of Rotterdam announced the Europoort [Port of Europe] plan to the world. It would mean a major expansion of the port of Rotterdam. This marked the beginning of the demise of De Beer. Natural reserve De Beer – once described by the same Thijssse as a 'first-class landscape' – closed on January 1, 1964. The destruction of De Beer can be described as one the major environmental scandals of the twentieth century in The Netherlands.

And indeed, unique it was. Before World War II, at the end of the thirties, de Beer housed 19,000 breeding pairs of the Common Tern (*Sterna hirundo*), 3,500 of the Sandwich Tern (*Sterna sandvicensis*), 500 or more of the Little Tern (*Sterna albifrons*), 500 of the Avocet (*Recurvirostra avosetta*) and about 100 of the Kentish Plover (*Charadrius alexandrinus*) and many other (breeding) birds.

De Beer was heavily damaged during the war since it was part of the infamous Atlantik Wall built by the German occupying force during World War II. A vast number of fortifications and artillery positions mutilated the landscape. Moreover, in the west and south of De Beer massive dikes were built. The swamp area was diked in and converted into agricultural land. Nevertheless, after the war De Beer was partly restored to its former glory by the return of large numbers of coastal breeding birds. In the first half of the fifties, there were 8,000 to 10,000 (!) breeding pairs of the Sandwich Tern and 5,000 to 10,000 of the Common Tern (*Sterna hirundo*); on the other hand, the numbers of the Avocet and Kentish Plover never again reached pre-war levels. As the work to construct the harbour facilities progressed the number of birds steadily declined. Nowadays, there is nothing in the landscape of Europoort that reminds us of the famous nature reserve that was once here. What in the end remains is an ever-fading memory of an incredibly beautiful and unique nature reserve.<sup>n</sup>

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<sup>n</sup> In 2007, after ten years of research, the author of this paper published a book about the history of nature reserve De Beer. It is not only about nature and birds, but it also pays extensive attention to the origin and the landscape development of this area, war time events, and political processes leading to the loss of De Beer. See also 'Literature'.

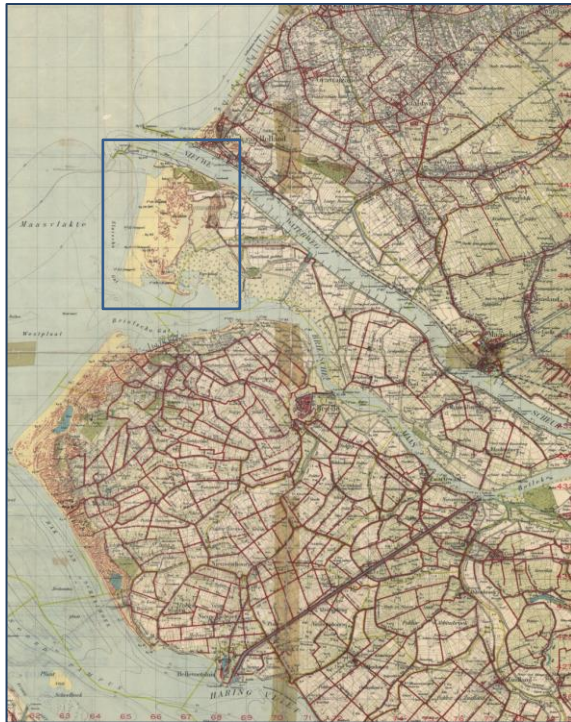




[18.] Southern part of nature reserve De Beer, 1927. Photo Frans Kooijmans, collection Roald Kooijmans.



[19.] View on the beach of nature reserve De Beer, 1930. Photo Frans Kooijmans, collection Roald Kooijmans.



[20.] *Left* In the blue rectangle the nature reserve De Beer in the thirties of the 20<sup>th</sup> century. It was sandwiched between the Nieuwe Waterweg canal in the north and the Brielsche Maas river in the south. To the left of De Beer the North Sea; In the north the densely built-up greenhouse area south of The Hague. In this period, the harbour of Rotterdam is still located about 25 kilometres inland to the east. [21.] *Right* Enlarged view of the area in the blue square on the left image. The thin grey lines make areas of one square kilometre. In the southeast the marsh of 300 hectares with a tidal effect that was reclaimed during the Second World War. The not connected row of dunes on the beach (indicated in reddish brown) is clearly visible, which meant that the hinterland could flood at high tide. Maps: Topographic Service of The Netherlands.

## DE BEER AFTER WORLD WAR II



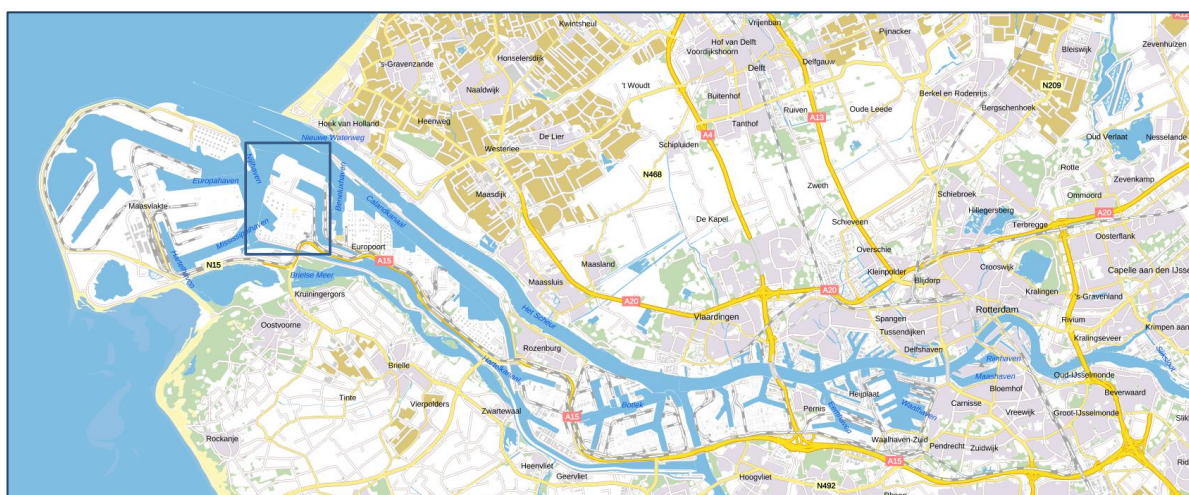
[22.] Sandwich Tern colony on the so-called Groene Strand [Green Beach] of nature reserve de Beer in The Netherlands, ~1950. Photo Simon de Waard.





[23.] *Left* The Netherlands, ~1950. The red square indicates the location of nature reserve De Beer. To the left the North Sea. The blue shapes indicate the two main areas in The Netherlands where Sandwich Tern nesting took place. The total area of The Netherlands is approximately 40,000 square kilometres. [24.] *Right* In the polygon, nature reserve De Beer south of the Nieuwe Waterweg canal in the fifties of the 20<sup>th</sup> century. The squares measure one by one kilometre.

## PRESENT SITUATION



[25.] Nowadays, the harbour of Rotterdam lies like an elongated wide ribbon on the south side along the rivers Nieuwe Maas and het Scheur and the Nieuwe Waterweg canal. The total length is about 40 kilometers. In the blue square the location of the former nature reserve De Beer, now Europoort. 1 cm = approximately two kilometres. Map: Topographic Service of The Netherlands, 2019.



[26.] The industrial landscape of Europoort, part of the harbour of Rotterdam, where nature reserve De Beer was once located. Photo Ed Buijsman, 2014.





# Notes

<sup>1</sup> – a) Latham was the first to describe the Sandwich Tern, but he gave no further name to the bird. The reason for this was that Latham like many English researchers at the time, initially declined to use the binominal naming introduced by Linnaeus in 1758. Therefore, the first official name in accordance with the Linnaeus system was given by Gmelin in a publication from 1788: *Sterna cantiaca*, something liked the tern from Kent. Latham attempted to correct what he soon saw as a mistake in 1787 (Latham 1787), so before the publication by Gmelin, by publishing a supplement to his original writings. He now came with the Latin name *Sterna sandvicensis*. But it was too late, the name given by Gmelin had already been adopted. In the early twentieth century, the case was rectified and *Sterna sandvicensis* became the official name after all.

– b) Some in the Netherlands often affectionately call the Sandwich Tern simply *sandvicensis*. The author is not aware of whether this is also the case in other countries.

<sup>2</sup> See Buijsman 2017.

<sup>3</sup> References on which the trend figure in Brenninkmeijer & Stienen (1992) is based, are given in the caption; see figure 6, p. 16. Unfortunately, the underlying data are not available anymore; Eric Stienen, personal communication of January 20, 2015.

<sup>4</sup> And in a sense also in the Netherlands, namely on islands of Bonaire and Aruba in the Caribbean.

<sup>5</sup> Buijsman 2017, p. 91.

<sup>6</sup> The colonies shown on the map are based on information taken from Latham (1824), Taylor (1837), Naumann & Naumann (1840), Schlegel (1854-1858), Dresser (1871-1881), Saunders (1889) and Marples & Marples (1934). Taken from Buijsman (2017). The map is by Cornell, dated 1864.

<sup>7</sup> Del Hoyo et al. 1996, p. 647; Cramp et al 1985, p. 48-53.

<sup>8</sup> See <https://www.iucnredlist.org/>.

<sup>9</sup> See for the Mediterranean area for instance Gadolin et al, 2018, for the Netherlands Buijsman 2017, p.164 and following. For the serious environmental pollution in the sixties that almost led to the extinction of Sandwich Tern in the Netherlands, see Buijsman 2017, p. 127 and following.

<sup>10</sup> Glutz von Blotzheim & Bauer 1982, p. 870.

<sup>11</sup> In Mitchell et al. 2004 it has been suggested that the Sandwich Tern is a breeding bird in Finland as well. This information was derived from Lloyd et al. 1991. According to Aleksi Llehikoinen, Helsinki Institute of Sustainability Science and National delegate for Finland for the European Bird Census Council, the Sandwich Tern the bird never brooded in Finland. There may have been a confusion with the Caspian Tern, *Hydroprogne caspia*. Personal communication of July 9, 2020.

<sup>12</sup> The concept of metapopulation was provided by Andrewartha and Birch introduced in 1954. It holds in this publication in that the breeding colonies throughout Northwestern Europe as a great whole, the metapopulation, can be seen which in turn consists of a number of subcolonies. Levin's 1970 formulated the concept mathematically. For practical implications see Newton 1998, p. 124 et seq. Hagemeyer & Blair 1997 use the term "metapopulation" for the entirety of colonies in northwestern Europe.

<sup>13</sup> See for instance De Kraker 2020.

<sup>14</sup> Thomas Bregnalle, personal communication of June 15, 2020.

<sup>15</sup> Olivier Scher, personal communication of October 1, 2020.

<sup>16</sup> Data for 1972-2014, personal communication of November 5, 2014; also published in various 'Jahresberichte', see below. Data for 2015-2017 Jahresberichte der AG Küstenvogelschutz Mecklenburg Vorpommern 2015, 2016, and 2017. Data for 2018-2020 (zero breeding pairs!) personal communication C. Herrmann.

<sup>17</sup> Otto gave in an article in the journal 'Neue Mannigfaltigkeiten' in 1777 an overview of the birds in then Swedish Pomerania, a region on the north coast of present-day Germany and Poland. Otto described in his article, among other things, the 'kleine Stübbersche Kirke' or, as he officially called the bird, the *Sterna stübberica* that would occur on the small island Stubber south of the island of Rügen in the Greifswalder Bodden in the Baltic Sea (see next page for an illustration). The name *Sterna stübberica* would, according to Naumann & Naumann ('Naturgeschichte der Vögel Deutschlands, nach eigenen Erfahrungen entworfen', volume 10, 1840, p.50), be one of the alternative names of the *Sterna cantiaca*. Bechstein noted about this in 1804 in his 'Gemeinnützige Naturgeschichte Deutschlands' at: 'Auch Herr Otto, der vorher diese Meerschwalbe auf der Insel Stübber allein einheimlich glaubte (...) hält sie jetzt mit der Kentischen für einerlen.' And much later, in 1982, would Glutz von Blotzheim and Bauer (1982, p. 872) – not the least – nevertheless without blushing about it write: 'Um 1775 befand sich eine Kolonie auf dem Großen Stubber im Greifswalder Bodden.' This would make that Otto earlier than Latham had observed the Sandwich Tern. However, as has been argued by Christof Herrmann, Otto does not describe the distinctive yellow tip of the bill (see Herrmann 2015). Moreover, the Gull-billed Tern (*Gelochelidon nilotica*) which resembles the Sandwich Tern to some extent, at least from a distance, has been described as a breeding bird in the Rügen area around 1820 whereas there are no other records of the Sandwich Tern in this area.

<sup>18</sup> The author has attempted to contact researchers in Ireland, but all attempts, despite repeated requests, have failed.

<sup>19</sup> See <https://birdwatchireland.ie/birds/sandwich-tern/>, accessed September 1, 2020.

<sup>20</sup> Brichetti 1979.

<sup>21</sup> F. Scarton, personal communication of August 11, 2020.

<sup>22</sup> Schulz 1947.

<sup>23</sup> W. Meissner, personal communication of June 24, 2020.

<sup>24</sup> Data for 1960-2018: Olofsson & Larsson 2018. Data for 2019 and 2020: P. Olofsson, personal communication of August 6, 2020

<sup>25</sup> K. Larsson, data via ResearchGate on June 24, 2020.

<sup>26</sup> U. Gärdenfors, *The 2005 Redlist of Swedish Species*, SLU, Uppsala as cited in Herrmann 2008.

<sup>27</sup> Buijsman 2017, p. 31; Temminck 1807.

<sup>28</sup> One might wonder how this is possible. Were the observations in The Netherlands so good and intensive long ago? No, none of that. As in other countries, going back in time, the observations are becoming increasingly scarce. There are gaps in The Netherlands data in the

period 1900-1930, especially from 1907-1913 and in the 1920s. More important is in general, that numbers from this period indicate that the species was less numerous compared to later periods. It was of great influence when data from the island of Griend, for a long time the most important breeding ground in The Netherlands, was missing. How was the missing data problem solved? The publication by Kwint (1992; unfortunately in Dutch), states: 'Interpolation has "corrected" the trend in numbers for the whole of The Netherlands, especially for the period 1900-1940.' However, the report does not provide any further explanation of the interpolation technique used. So one could assume that it has been a simple linear interpolation.

<sup>29</sup> Taken from Buijsman 2017.

<sup>30</sup> For 2019: De Kraker 2020. For 2020: preliminary estimate by Ed Buijsman based on the information exchange in the Contact Group Sandwich Tern in The Netherlands.

<sup>31</sup> Unfortunately, the YNCC was unwilling to provide more detailed data. The reasoning for this was that a publication on the long-term development is in preparation.

<sup>32</sup> See <https://jncc.gov.uk/our-work/sandwich-tern-sterina-sandvicensis/>; figure 1 on this page was used. Given the presentation, these data can not be estimated very accurate.

<sup>33</sup> See note 21; in stead of The Netherlands read Europe.

<sup>34</sup> JNCC 2020 speaks of 'the most erratic population trends and distribution of any seabird breeding in the UK'.

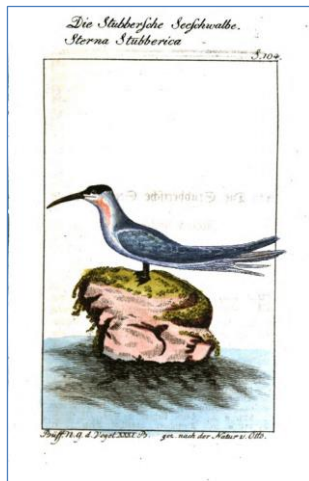
<sup>35</sup> It shows that a country-by-country approach is not very fruitful for the Sandwich Tern if we want to understand fluctuations in the population.

<sup>36</sup> Brenninkmeijer & Stienen (1992) give a number of 1,000 for these years.

<sup>37</sup> A simple linear regression for example. This yields a explained variance ( $R^2$ ) of a poor 0,53.

<sup>38</sup> Buijsman 2017, p. 181.

<sup>39</sup> H. Suolahti, *Die deutschen Vogelnamen - eine wortgeschichtliche Untersuchung*, Strassburg [The German bird names - a verbal study], 1909, p.45, consulted on Biodiversity Heritage Library.



The *Sterna Stübberica*, illustration taken from 'Herrn von Buffons Naturgeschichte der Vögel', Band 31, by B.C. Otto, Berlin 1804.





Keep the thought of nature  
reserve De Beer alive