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1 **Photo-ID matches of Dutch bottlenose dolphins**

2 **Bottlenose dolphins in The Netherlands come from**
3 **two sides: across the North Sea and through the**
4 **English Channel**

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11

12 **ABSTRACT**

13 On July 19th 2019 an estimated 20 bottlenose dolphins (*Tursiops truncatus*) were observed in the
14 Marsdiep, a tidal inlet connecting the North Sea and the Dutch Wadden Sea, between Den Helder and the
15 island of Texel. Photographs and video recordings were made and nine individuals were matched with
16 known dolphins from the Moray Firth, NE Scotland. These are the first matches of this east coast of
17 Scotland population outside the UK and Ireland. Subsequent observations of individuals from this group
18 show that at least some of the animals have returned to Scottish waters, while others were photographed
19 in Danish waters. Furthermore, we report on a photo identification match of a solitary bottlenose dolphin
20 between France and The Netherlands. These matches suggest that bottlenose dolphins, in the Netherlands,
21 originate from two different genetically distinct populations: ‘Coastal South’ and ‘Coastal North’. This
22 evidence of previously unknown long-range movements may have important implications for the
23 conservation and management of this species in European waters.

24

25 **KEYWORDS**

26 Bottlenose dolphin, cetaceans, photo identification, The Netherlands, North Sea, Moray Firth, long-range
27 movement

28

29 **INTRODUCTION**

30 Bottlenose dolphins *Tursiops truncatus* (Montagu, 1821) were once common in the North Sea, but during
31 the last century numbers have declined (Evans, 1980) and they are now rarely observed here (Reid *et al.*,
32 2006). The exception is a small population of ca. 195 animals on the east coast of Scotland (Wilson *et al.*,
33 1997; Cheney *et al.*, 2013). Many historical reports of free ranging animals, stranded individuals and
34 catches show that bottlenose dolphins also used to inhabit Dutch waters (van Bree, 1977; Kompanje,
35 2001, 2005; Camphuysen & Peet, 2006). In the first half of the 20th century, groups of bottlenose dolphins
36 were observed yearly in spring in the Marsdiep, a tidal inlet connecting the North Sea and the Dutch
37 Wadden Sea, between Den Helder and the island of Texel. Here they foraged on herring migrating to the
38 Zuiderzee to spawn. After the completion of the dam ‘Afsluitdijk’ in 1932, the Zuiderzee was closed off

39 from the Wadden Sea and the local herring stock collapsed, with the dolphins disappearing soon after.
40 Since 1965 the sightings of dolphins have also decreased in other parts of The Netherlands and bottlenose
41 dolphins are now considered rare visitors (ter Pelkwijk, 1937; Verwey, 1975; Verwey & Wolff, 1981; van
42 Bree, 1977; Kompanje, 2001, 2005; Camphuysen & Peet, 2006). Most reports since then have been of
43 solitary individuals (Addink & Smeenk, 1990; Addink, 1991; van der Ham *et al.*, 1992; Camphuysen &
44 Peet, 2006). Most notably is a male identified as ‘Dony’ (also occasionally named ‘Randy’), that stayed in
45 The Netherlands for multiple weeks in November/December 2002. This individual yielded the first photo-
46 identification match of a “foreign” bottlenose dolphin in The Netherlands (Camphuysen & Peet, 2006).
47 He was first observed in Ireland (April 2001), and later in England and Belgium, before entering Dutch
48 waters. Currently (April 2021) he is residing off Brittany, France (Nunny & Simmonds, 2019; Facebook
49 page Dony, 2021). It is suggested that these solitary individuals came as a direct consequence of the
50 decimation of bottlenose dolphins in European waters (Müller & Bossley, 2002), as a dispersing dolphin
51 might not be able to find neighbouring populations and might socialize with people instead (Nunny &
52 Simmonds, 2019).

53 In contrast, a group of 50-100 bottlenose dolphins was observed in the morning of August 12th 2004,
54 swimming off Huisduinen (Figure 1), along the northwestern coastline of the Dutch mainland, until they
55 entered the Marsdiep (Supplementary Figures S1), all the way to the Afsluitdijk (Leopold, 2004;
56 Zeezoogdieren.org, 2004; Camphuysen & Peet, 2006). The animals returned to the North Sea in several
57 smaller groups in the afternoon and evening and disappeared from view. One month later, on September
58 9th, a group of approximately 60 animals was seen in the same area (Supplementary Figures S1). Again,
59 the dolphins were first observed in the morning, at 9:30 AM further south, off the Dutch mainland coast
60 (Camperduin), by an experienced seawatcher (*pers. comm.* Nick van der Ham). The animals moved north
61 and were picked up by other seawatchers at Callantsog and Huisduinen before they entered the Marsdiep
62 at approximately 12:30 PM. Here they swam eastwards up to the Den Helder-Texel ferry track line, where
63 they turned north and returned to the North Sea, following the coastline of Texel (Camphuysen & Peet,
64 2006; van Bemmelen, 2009). Unfortunately, none of the photographs taken during these two occasions
65 were suitable for photo-identification.

66 A similarly large group was seen offshore, on October 3rd 2014 near the Dutch/Belgium border
67 (51°30’00”N, 03°07’48”E, Figure 1), from the fishing vessel BRA5 (Natuurpunt, 2014). Animals
68 accompanying the ship were videoed, but the image quality did not allow matching.

69 In this study we report on new sightings and photo-identification matches of bottlenose dolphins in Dutch
70 waters (i.e. the Marsdiep and Amsterdam). Additionally, we present images of two bottlenose dolphins
71 that were stranded in the Netherlands that could not be matched with previously known individuals.

72

73 MATERIALS AND METHODS

74 Photographs and videos of bottlenose dolphins in Dutch waters were opportunistically collected, both of
75 stranded (dead) and free ranging individuals. We compared these images manually (i.e. by eye) with
76 photo-identification catalogues and pictures taken by the public, available on the internet, to examine the
77 origins of these Dutch sightings.

78

79 RESULTS

80 **Bottlenose dolphins in the Marsdiep**

81 On Friday July 19th 2019, at 5:30 AM, a group of bottlenose dolphins was spotted off Egmond aan Zee
82 (Dutch mainland coast) (Figure 1) (*pers. comm.* Jasper Rautenberg). The group travelled north and was
83 observed off Camperduin (*pers. comm.* Bert de Haan and Nick van der Ham) and then photographed off
84 Petten (*pers. comm.* Nils van Duivendijk) later that morning. At 10:32 AM the group swam past
85 Huisduinen (*pers. obs.* JH), 30 km north of the first sighting location. At this point two groups were
86 observed. Within each group, the animals were swimming closely together and both adults and juveniles
87 were present. The first group swam northwards parallel to shore at 500-1000 m and consisted of
88 approximately 10 individuals. The second group was swimming in the same direction, but closer to shore
89 (50-100 m) and consisted of nine individuals. Whenever a boat passed close by, the animals dived longer
90 and appeared to increase their swimming speed. Occasionally the dolphins were lobtailing. The first
91 group continued to move northwards towards Texel, crossing the Marsdiep, and soon disappeared from
92 sight, while the second group followed the coastline eastwards, deeper into the Marsdiep towards the
93 Wadden Sea, where the animals were continuously seen until noon by multiple observers (*pers. obs.* ML).
94 The last sighting was made from the vessel TX 10 at 15:27 PM in the Wadden Sea east off Texel, close to
95 Oudeschild (Figure 1).

96 The first group was too far from shore to collect any images that could be used for photo-identification.
97 The second group however, swam closer to shore and photos (Figure 2, Supplementary Figures S2) and
98 video recordings (Supplementary Video S3) were made, both from shore and from seal watching boat
99 'Het Sop'. These images were compared to the East Coast Scotland Bottlenose Dolphin Photo-
100 Identification Catalogue (Cheney *et al.*, 2014), curated by the University of Aberdeen and the University
101 of St. Andrews. Eight individuals were positively identified, while one other individual was highly likely
102 a match to the same population (Figure 2, Supplementary Figures S2, Table 1). Matches were made using
103 multiple photographs from the Netherlands (see supplementary information) to individuals observed
104 almost annually by the University of Aberdeen since at least 2006. The adult dolphins were matched
105 using nicks (three dolphins) and/or tooth rakes and skin lesions (six dolphins), and the two juveniles were
106 matched on observed association with their mothers and dorsal fin shape (Table 1). The group consisted
107 of an adult and a juvenile male, 6 adult females and 1 juvenile of unknown sex (Table 1). None of these
108 dolphins were observed by the University of Aberdeen in the Moray Firth Special Area of Conservation
109 during their approximately weekly photo-identification surveys between May and September 2019,
110 although all the adults had previously been photographed in this area every year since at least 2009.

111 In June 2020, two of these individuals (#1028 and #440) were observed and photographed in the Moray
112 Firth, providing proof of the animals' return to their normal range after their excursion across the North
113 Sea. However, three other individuals (#23, #578 and #732) were photographed in autumn 2020 on the
114 west coast of Denmark (*pers. comm.* Carl Kinze). Whether this means that these three individuals stayed
115 in the eastern part of North Sea, or returned to Scotland before traveling to Denmark remains unclear.
116 However, in January 2020 one of these dolphins (#23) was sighted in the Moray Firth by a regular
117 seawatcher familiar with this individual (*pers. comm.* Alan Airey). Unfortunately, this animal was not
118 photographed, and the identification could not be confirmed.

119

120 **Solitary bottlenose dolphin in Amsterdam**

121 A solitary bottlenose dolphin was observed on Saturday May 2nd 2020, swimming with the sailing vessel
122 'Tres Hombres'. The crew first observed the dolphin off France 3 days earlier. The animal followed the
123 ship to The Netherlands, into the Noordzeekanaal (North Sea Canal), passing the sluices in IJmuiden
124 (Figure 1), up to the Suezhaven in Amsterdam where the ship docked. The dolphin appeared to be

125 healthy, and was observed defecating. The dolphin stayed with the ship, and detailed photographs could
126 be made. Comparison of the dorsal fin and facial features (Genov *et al.*, 2018) with images of known
127 individuals from the French coast showed that this individual is known as ‘Zafar’ (Figure 3,
128 Supplementary Figures S2), a male solitary-social dolphin that shows atypical behaviour seeking out
129 human company (Nunny & Simmonds, 2019). This individual might have been observed as early as
130 2002, but the first confirmed sighting dates back to 2017, when he was seen off Lomener, Brittany,
131 France (Zafar le dauphin blogspot, 2018). Since then, he was repeatedly observed off Brittany, mostly off
132 Brest, until mid-February 2020. On May 3rd the dolphin was escorted back through the sluices, after
133 which he resided in the Seaport of IJmuiden for two days. Here he interacted with various small boats,
134 buoys and people, but was also observed foraging. The last confirmed sighting was from a fishing vessel
135 off Callantsoog on May 5th, which he followed for multiple hours (Observation.org, 2020). Unfortunately,
136 the dolphin was found dead with its tail amputated on May 12th, probably after a ship strike (IJsseldijk *et*
137 *al.*, 2020).

138

139 **Recent strandings**

140 Bottlenose dolphin strandings in The Netherlands over the last two decades were examined to look for
141 other potential matches with the east coast of Scotland. An extensive overview of strandings and catches
142 of bottlenose dolphins in the North Sea between 1534 and 2000 can be found in Kompanje (2001, 2005),
143 but these do not show photographs of recent cases that might be matched with dolphins from other
144 regions. Since 2000, 10 new strandings have been reported (Table 2). These records mostly concerned
145 single bones, but there were two individuals found dead and photographed in the Eastern Scheldt, both of
146 which were first observed alive in the same area.

147 The first of these two dolphins was a female (262 cm, 221 kg), found on September 12th 2007 (Figure 4),
148 floating in the Eastern Scheldt, between buoys LG10 and LG12 (Figure 1). This animal had been
149 observed alive days before stranding in this semi-enclosed tidal bay. A necropsy, performed by Dr
150 Thierry Jauniaux, indicated the cause of death was an infectious disease, specifically lung edema
151 associated with pyemia/septicemia. Stomach content analysis found remains of (amongst others) 12
152 Atlantic cods *Gadus morhua*, six saithes *Pollachius virens* and two black gobies *Gobius niger*, a locally
153 abundant goby species, indicating that the animal had been feeding locally, until shortly before her death.

154 A second female (266 cm, 196.5 kg) was found dead in the Eastern Scheldt near Krabbendijke (Figure 1)
155 on June 27th 2013 (Figure 5), after she had been observed alive in the area since June 18th 2013. The
156 stranded animal had died very recently (the body was still warm) and was necropsied the same day at
157 Utrecht University. The stomach was empty, except for some tiny fish eye lenses and jaws of marine
158 worms, both probably from small secondary prey, suggesting this dolphin had not eaten recently. Parasitic
159 nematodes *Anisakis simplex* found in the fore stomach were still alive. All these findings suggest the
160 animal live stranded following starvation and subsequently died (van Beurden *et al.*, 2015).

161 Neither of these dolphins from the Eastern Scheldt could be matched to the NE Scotland population, nor
162 with solitary individuals documented online.

163

164 **DISCUSSION**

165 The photo-identification matches presented here show that bottlenose dolphins in The Netherlands
166 originate from different locations. The Marsdiep group of 2019 comprised the first photo-identification

167 match of bottlenose dolphins in The Netherlands with the NE Scotland population. Furthermore, this
168 sighting provided the first matches of bottlenose dolphins from the east coast of Scotland population
169 outside the UK and Ireland. The sightings of two individuals (#1028 and #440) from this group in 2020
170 back in the Moray Firth show that these dolphins made a round trip. Individual #23 may have returned to
171 the Moray Firth before he was re-sighted in Danish waters, although without photographs or video
172 footage this could not be confirmed. It is unknown whether individuals #578 and #732 also returned to
173 the Moray Firth or stayed in eastern parts of the North Sea, before they were re-sighted with #23 in
174 Danish waters. The fate of the other identified individuals is not presently known. Unfortunately, there is
175 no high-resolution imagery available of the bottlenose dolphins sighted in 2004 in the Marsdiep, so their
176 origin remains unknown.

177 In contrast to the group of dolphins photographed in the Marsdiep in 2019, two solitary bottlenose
178 dolphins may have entered the North Sea from the south. The Amsterdam dolphin of 2020 ('Zafar') was
179 matched with previous sightings off Brittany, which is close to a nearby population residing off
180 Normandy, France, consisting of approximately 420 individuals (Louis *et al.*, 2015). The behaviour of
181 'Zafar' allowed for confirmation that this dolphin entered the North Sea from the South via the English
182 Channel, as he was seen by the crew of the 'Tres Hombres' for three consecutive days as they sailed
183 through the Channel. The dolphin that resided in the SW of The Netherlands in 2002 ('Dony') was first
184 observed in Ireland (Camphuysen & Peet, 2006), close to a genetically distinct population residing in the
185 Shannon Estuary (Mirimin *et al.*, 2011). It is likely that 'Dony' entered the North Sea via the English
186 Channel as well. The two other solitary dolphins, observed and later found dead in the SW of The
187 Netherlands in 2007 and 2013, did not match with any individuals from the east coast of Scotland
188 population. Comparisons were also made with pictures of solitary individuals and groups sighted along
189 the Belgium coast (Haelters & Kerckhof, 2010; Haelters *et al.*, 2018), but no match could be established.

190 Based on the genetic population structure, the North-East Atlantic coastal bottlenose dolphin ecotype can
191 be divided in two populations, a 'Coastal South' (comprising the English Channel, Arcachon estuary and
192 South Galicia resident groups) and a 'Coastal North' population (comprising the UK and Ireland resident
193 or mobile coastal groups) (Louis *et al.*, 2014). It is currently unclear to which populations 'Zafar', 'Dony'
194 and the two stranded individuals belong, but this can potentially be resolved by future genetic analysis.

195 The results presented here could only be collected due to the (opportunistic) collaboration between land
196 based 'seawatchers', observers at sea and marine scientists, augmented by public outreach in (social)
197 media. This is indicative of the importance of long-term research and photo-identification catalogues such
198 as the East Coast Scotland Bottlenose Dolphin Photo-Identification Catalogue, and also of publicly
199 available platforms such as Observation.org (2020).

200 Small coastal populations that are relatively isolated are vulnerable to extinction (Louis *et al.*, 2014).
201 Already a population of North Sea bottlenose dolphins became extinct, namely the genetically distinct
202 population in the Humber Estuary, East England (Nichols *et al.*, 2007). The bottlenose dolphins that
203 visited the Marsdiep/Zuiderzee seasonally have disappeared from that area as well. As it remains unclear
204 whether these animals were genetically differentiated from neighbouring populations, it is unknown
205 whether they changed their distribution or that this population became extinct as well.

206 In Europe there are two key conservation measures for bottlenose dolphins. Firstly, the designation of
207 Special Areas of Conservation (SAC) under Annex II of the EU Habitats Directive (92/43/EEC), although
208 the use of these static protection measures for mobile species has been debated (Hooker *et al.*, 2011;
209 Wilson, 2016). Secondly, bottlenose dolphins are European Protected Species under Annex IV which is
210 dynamic and protects bottlenose dolphins "across their entire natural range" within the EU, although

211 unlike Annex II, this does not provide habitat protection. In Scotland, following EU exit, the
212 Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) continues to deliver these two
213 conservation measures for territorial waters and provides that the population of bottlenose dolphins that
214 use the Moray Firth SAC are protected across their known Scottish range. However, whether this same
215 level of protection extends internationally is debatable, especially in areas this population was not known
216 to frequent. The dolphins in Normandy live in an “Area of Special Interest.” that is being upgraded into a
217 marine protected area, under the IUCN (category V: “protected seascape”) (Louis *et al.*, 2015) and is
218 being listed under Annex II of the Habitats Directive.

219 While movements of individual or groups of bottlenose dolphins outside their known range may facilitate
220 gene flow between isolated populations, there is also the risk that individuals, from these already small,
221 vulnerable populations (Louis *et al.*, 2014) move into areas with different levels of protection. Evidence
222 of long-range movements and/or confirmed presence in an area is required to ensure the correct
223 implementation of existing EU conservation and management initiatives by member states to protect both
224 individuals and their habitats. This previously unobserved connectivity of bottlenose dolphins between
225 territorial waters exposes these individuals to widespread and persistent threats such as bycatch and
226 anthropogenic noise (Nelms *et al.*, 2021), highlighting the need for adaptive and integrated conservation
227 and management of these mobile cetaceans.

228

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239

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243

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344 FIGURE LEGENDS

345 **Fig. 1.** Maps of The Netherlands showing the locations mentioned in the main text. **Left panel:** The
346 locations of the two stranded bottlenose dolphins (2007 top and 2013 bottom) in the Eastern Scheldt and
347 the sightings from fishing vessel BRA5 (2014). **Right panel:** Map of the province North-Holland. The
348 arrow depicts the estimated route of the bottlenose dolphins, sighted on July 19th, 2019.

349 **Fig. 2.** Photo identification of the Dutch bottlenose dolphins, sighted on July 19th, 2019. Pictures on the
350 left are from the East Coast Scotland Bottlenose Dolphin Photo-ID Catalogue, pictures on the right are
351 taken in the Marsdiep (by Tobias Brüggling, JH and ML). High resolution versions and additional photos
352 and video that were used to identify individuals can be found in Supplementary Figures S2 and
353 Supplementary Video S3.

354 **Fig. 3.** Photo identification of the Amsterdam bottlenose dolphin. The top images (A and B) were taken in
355 Amsterdam (May 2nd 2020, by JH), the bottom images (C and D) were taken in France (Facebook page
356 Zafar, 2019).

357 **Fig. 4.** Bottlenose dolphin, retrieved from the Eastern Scheldt, SW Netherlands, Sept 12th 2007. Photo by
358 Alfons Wijdeveld, provided by EHBZ Zuidwest (Walvisstrandingen, 2020).

359 **Fig. 5.** Bottlenose dolphin stranded near Krabbendijke, Eastern Scheldt, SW Netherlands, June 27th 2013.
360 Photos by Liliane Solé (Walvisstrandingen, 2020).

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362 TABLES

363 **Table 1.** Overview of bottlenose dolphins photographed in the Marsdiep (The Netherlands) that are
364 matched with the East Coast Scotland Bottlenose Dolphin Photo-ID Catalogue.

#	Name	Sex	Ageclass	Confidence	First seen	Matched using
23	Mischief	Male	Adult	Certain	1989	Multiple nicks
440	Sickle	Female	Adult	Certain	1994	Tooth rake and skin lesions
578	Chewbacca	Female	Adult	Certain	1996	Multiple nicks and skin lesions on body
732	Tall Fin	Female	Adult	Certain	1998	Fin shape and tooth rakes
1023	Sparkle	Female	Adult	Certain	2007	Skin lesions
1028	Lilith	Female	Adult	Certain	2006	Large nick
1020	Idris	Female	Adult	Probable	2007	Fin shape and association with known individuals
1201	Skywalker	Male	Juvenile	Certain	2015	Fin shape and association with mother (#578)
1239	Ruby	Unknown	Juvenile	Certain	2017	Fin shape and association with mother (#1028)

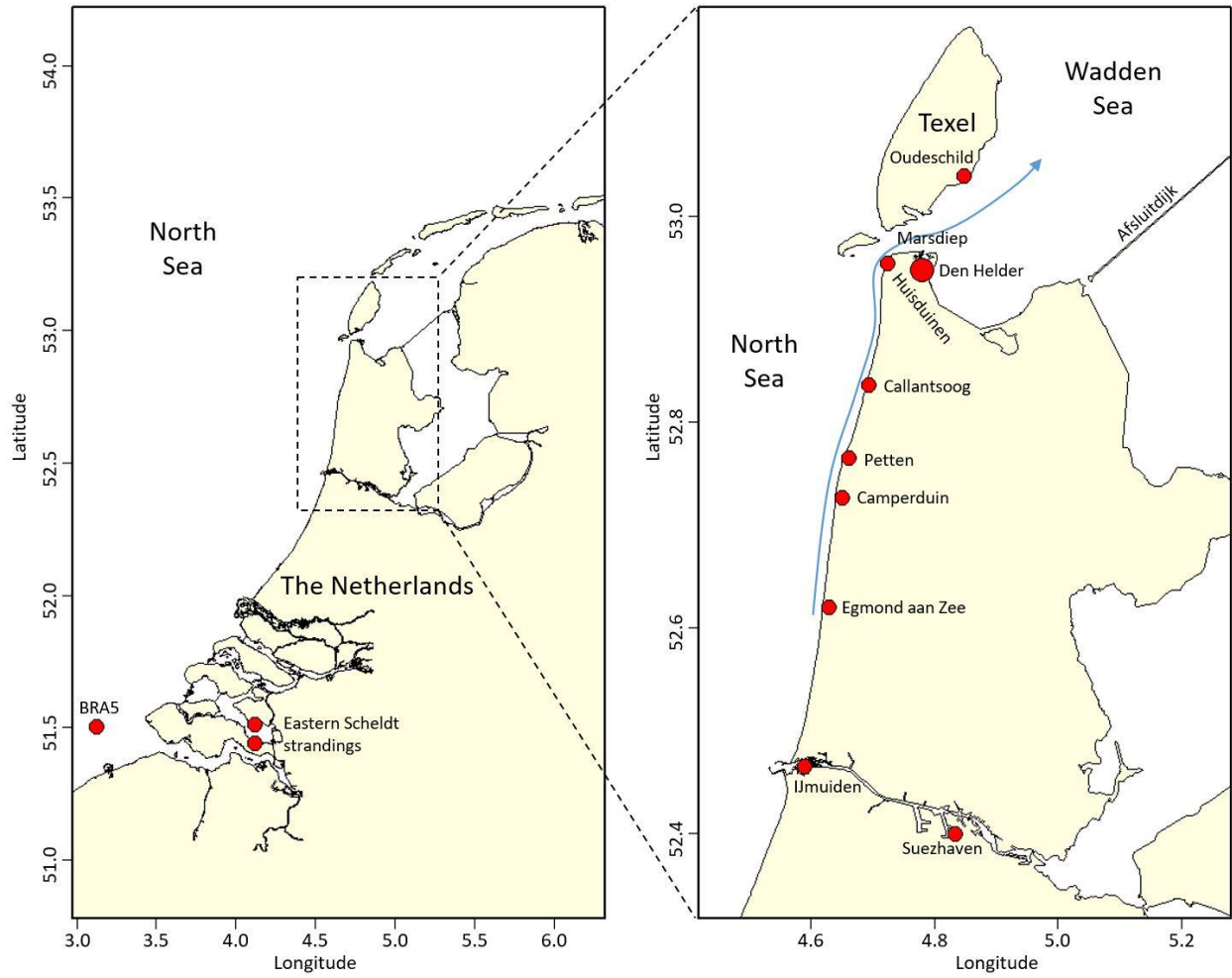
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366 **Table 2.** Summary of stranded bottlenose dolphins in The Netherlands since 2000 (Walvisstrandigen,
367 2020).

Date	Location	Description
September 12, 2007	Eastern Scheldt	Complete animal, see text
November 26, 2008	Wadden Sea, near Ameland	(Sub)fossil skull
April 14, 2012	Vliehors, Vlieland	Left lower jawbone
April 20, 2013	Hors, Texel	Vertebra
June 27, 2013	Krabbendijke (Eastern Scheldt)	Complete animal, see text
August, 2014	Terschelling	Right lower jawbone, 42.5 cm
January 4, 2015	Terschelling	Right lower jawbone
May 13, 2015	Noordwijk	Left lower jawbone, ~40 cm
December 18, 2015	Schiermonnikoog	(Sub)fossil vertebra



















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#	Catalog (2018)	Marsdiep (July 19, 2019)
23	 13 Jul	
440	 18 Jul	
578	 11 Jun	
732	 13 Jul	
1020	 20 Aug	
1023	 13 Jul	
1028	 18 Sep	
1201	 8 May	
1239	 27 Aug	

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