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AGREEMENT ON THE CONSERVATION OF SMALL CETACEANS OF THE BALTIC, NORTH EAST ATLANTIC, IRISH AND NORTH SEAS

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24 July 2026

30th MEETING OF THE ADVISORY COMMITTEE
Bonn, Germany, 1–3 September 2026
Agenda Item 3.5

ASSESSMENT OF WHITE-BEAKED DOLPHIN (*Lagenorhynchus albirostris*) STRANDINGS IN THE ASCOBANS AREA (1990–2025)

(Prepared by Lonneke IJsseldijk / the Netherlands)

Background

1. At AC28, the Advisory Committee established an intersessional Working Group on *Lagenorhynchus* species to review the conservation status of the Atlantic white-sided dolphin and white-beaked dolphin and to identify key knowledge gaps. The Working Group subsequently reported to MOP10 and highlighted evidence suggesting a northward shift in the distribution of white-beaked dolphins within the ASCOBANS area, potentially linked to climate-driven changes in habitat suitability and prey availability.

2. Building upon earlier work (IJsseldijk et al. 2018), the Working Group recommended an update incorporating more recent stranding records. At AC29, the Advisory Committee recognised that substantial data remained available through national stranding programmes but had not yet been integrated into a coordinated regional assessment. Through Action Point 18, Parties were invited to contribute available stranding data to support such an assessment.

3. The present document provides the preliminary results of that effort. Data have been compiled from nine countries and cover the period 1990–2025. The assessment examines spatial and temporal trends in strandings, demographic information, body condition indicators, and reports on available information on causes of mortality.

Status of the document

4. The report, available in Annex 1, should be regarded as preliminary. Some sections require additional information, validation, or further analyses before finalisation. In particular, the following components will be updated following AC review and additional input from Parties and national experts:

   - Validation of age-class, reproductive-state, and length-at-maturity analyses (Section 3.2).
   - Completion of preliminary analyses on body condition metrics, including BMI and blubber thickness (Section 3.3).
   - Final review of references, figures, captions, and supporting appendices.

5. The report is therefore submitted to facilitate discussion and obtain guidance from the Advisory Committee before preparation of a final assessment, including list of recommendations for endorsement at AC31.

Action requested:

6. The Advisory Committee is invited to:

a) Welcome the progress made in compiling and integrating regional white-beaked dolphin stranding data;

b) Provide comments on the preliminary findings and proposed analytical approach;

c) Take note of the preliminary recommendations and next steps identified in Section 4 of the report; and

d) Encourage Parties to provide any outstanding information on national stranding schemes, post-mortem investigations, and associated datasets to complete the AC29/AP18.

White-beaked dolphin strandings in the ASCOBANS region

Lonneke L. IJsseldijk[a], Simon Berrow[b], Andrew Brownlow[c], Linnea Cervin[d], Nick Davison[c], Rob Deaville[e], Noortje Derkx[a], Mariel ten Doeschate[c], Anders Galatius[f], Maria Garagouni[g], Jan Haelters[h], Thierry Jauniaux[i], Guido O. Keijl[j], Carl C. Kinze[k], Daniel Klingberg-Johansson[k], Natacha M. Kristensen[l], Moa Naalisvaara Engman[m], Aleksija Neimanis[m], Hélène Peltier[n], Eva Schotanus[a], Ursula Siebert[o], Charlotte Bie Thøstesen[l], Rosie Williams[e]

[a] Faculty of Veterinary Medicine, Utrecht University, The Netherlands

[b] Irish Whale and Dolphin Group, Ireland

[c] Scottish Marine Animal Stranding Scheme, United Kingdom

[d] Swedish Museum of Natural History

[e] Cetacean Strandings Investigation Programme, Institute of Zoology, Zoological Society of London, United Kingdom

[f] Aarhus University, Denmark

[g] North Atlantic Marine Mammal Commission, Norway

[h] Institute of Natural Sciences, Belgium

[i] University of Liege, Belgium

[j] Naturalis Biodiversity Centre, The Netherlands

[k] The Natural History Museum of Denmark

[l] Museum Vest, Denmark

[m] Swedish Veterinary Agency

[n] Observatoire PELAGIS, La Rochelle Universite-CNRS, France

[o] Institute of Terrestrial and Aquatic Wildlife Research, Germany

CSIP

Irish Whale and Dolphin Group

SMASS
Scottish Marine Animal Stranding Scheme

natural sciences .be

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Utrecht University

Naturalis Biodiversity Center

Cover photo: White-beaked dolphin at Dishoek, The Netherlands, 14-09-2025. Credit: Esmee Boenders

Faculty of Veterinary Medicine
Utrecht University
Yalelaan 1, 3484 CL, Utrecht
Tel: +31(0)624455698; E-mail: L.L.IJsseldijk@uu.nl

This report has been prepared for the ASCOBANS Advisory Committee. It was prepared in collaboration with the organisations listed above. The report will be discussed during the Advisory Committee meeting in Bonn in September 2026. The author list is ordered alphabetically after the primary author and may be subject to change if (part of) the results are submitted to a scientific journal, depending on the scope of the publication. The report will become available online on the ASCOBANS website once (part of) the results have been published in a scientific journal, or in September 2028.

This report is the result of a research assignment commissioned and funded by the Dutch Ministry of Agriculture, Fisheries, Food Security and Nature (LVVN) for Utrecht University, Dr. Lonneke IJsseldijk, under project number 201905130.

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1 Introduction

1.1 Background

The white-beaked dolphin (*Lagenorhynchus albirostris*) is a species endemic to cold temperate to subpolar waters across the North Atlantic and adjacent waters, including the North Sea. Within the North Sea, white-beaked dolphins are most prevalent in the northern part, although sightings are common as far south as the eastern English Channel (Reeves et al. 1999; Evans et al. 2003; Reid et al. 2003; Camphuysen & Peet 2006; Canning et al. 2008; Galatius & Kinze 2016; Kiszka & Braulik 2018).

A study published in 2018 investigated stranding frequencies of white-beaked dolphins within part of the ASCOBANS area, assessing potential spatiotemporal patterns between 1991 and 2017 (n = 407 records) (IJsseldijk et al. 2018). The study revealed a higher density of stranded animals in the southern region during earlier years, with slightly increased densities in the north-western area in more recent years. The findings highlighted the potential of stranding records as a means of collecting high-resolution spatiotemporal data, providing a valuable complement to surveys of live animals used to assess species distribution and abundance. Further research into metrics such as causes of mortality, life history, and body condition (all of which are currently largely unknown for this species) could provide additional insights into population status.

At the Advisory Committee meeting 28 (AC28, 2023), ASCOBANS established the intersessional working group (WG) on *Lagenorhynchus* species, covering the Atlantic white-sided dolphin *Leucopleurus acutus* and the white-beaked dolphin, to prepare a report on their conservation status and highlight knowledge gaps. The group was subsequently tasked with reporting to the 10th Meeting of the Parties (MOP10, 2024). The WG highlighted that the distribution of stranded white-beaked dolphins throughout the initial study period (1991–2017, IJsseldijk et al. 2018) could indicate a shift in habitat use and population distribution from southern to northern areas. As a potential explanation for this observed shift, climate change and its effects on prey distribution and availability were identified, consistent with previous findings by MacLeod et al. (2005) and Evans and Bjørge (2013).

The WG on *Lagenorhynchus* species recommended an update of more recent stranding records (2018–to date) to assess whether this trend has continued. Subsequently, in 2025 the Advisory Committee (AC29) recognised that substantial amounts of relevant data were still available through national monitoring programmes but had not yet been integrated into a comprehensive regional assessment of the species. In response to the need for an updated evaluation of white-beaked dolphin status across the North Sea, Action Point 18 invited parties to contribute available stranding records to support a further coordinated assessment (ASCOBANS Secretariat 2025).

Here, we report the preliminary results of this coordinated assessment.

1.2 Aims and approach

The aim of this assessment is to compile an overview of available white-beaked dolphin stranding data across the ASCOBANS area and to conduct a coordinated spatiotemporal assessment of all strandings from 1990-2025. The results will be evaluated in the context of previous findings to assess whether previously observed patterns in distribution and density of stranded animals have persisted, shifted, or changed more recently.

The assessment will focus on identifying temporal and spatial trends in white-beaked dolphin strandings, including seasonal patterns and potential differences between regions. Where data availability allows, patterns will be explored in relation to biological characteristics, including sex, age class or length, body mass, and reproductive status.

The availability of life history and body condition data will depend on the level of detail recorded within national stranding databases. Where sufficient information is available, analyses will be conducted to assess body condition metrics, and to investigate variation in body condition across regions, time periods, sex, age classes, or other relevant factors.

A further objective is to summarise available information on causes of death and identify current knowledge gaps. Where possible, mortality causes will be assessed in relation to demographic characteristics, spatial distribution, and temporal trends to provide insight into potential pressures affecting the species within the North Sea and wider ASCOBANS area.

By integrating available national stranding datasets, this assessment aims to improve the regional understanding of white-beaked dolphin status, identify remaining data gaps, and support future monitoring and conservation actions.

2 Material and methods

2.1 Stranding Schemes

White-beaked dolphin stranding records were compiled from nine European countries: Belgium, Denmark, Germany, France, Ireland, Norway, Sweden, the Netherlands, and the United Kingdom. The following section provides a detailed description of each national stranding scheme, including differences in data collection methods, reporting effort, coverage, and available information. This information is required to assess potential biases arising from variation in monitoring intensity, reporting practices, and the consistency of data collection among countries.

2.1.1 Belgium

A dedicated strandings scheme has been in place in Belgium since the early 1990s; it is coordinated by the Royal Belgian Institute of Natural Sciences (RBINS). For necropsies, assistance is provided by the universities of Liège and Ghent. Information on strandings, collected by volunteers, the press or by RBINS, are available, and RBINS holds a collection of skeletal remains, many of which dating back to the 19th century. RBINS manages a database with information on strandings and sightings.
The whole of the Belgian coastline is easily accessible, hence we consider the data on stranded white-beaked dolphins between 1990 and 2025 as complete.

2.1.2 Denmark

The National Contingency Plan concerning strandings of marine mammals in Denmark aims to record and collect dead stranded marine mammals along the Danish coastline and to contribute to monitoring the health status of seals and cetaceans, including the identification of possible causes of death.
At the same time, the Contingency Plan contributes to a greater understanding of marine mammals in Denmark, including the significance of changes in species diversity, abundance, and population parameters such as body size, sex, and age.

Since 1991, information on dead seals and cetaceans has been collected systematically in Denmark. This work is carried out through close cooperation between the Danish Environmental Protection Agency, the Danish Nature Agency, Museum Vest, the Natural History Museum of Denmark, the Department of Ecoscience at Aarhus University, and the Department of Veterinary and Animal Sciences at the University of Copenhagen.

A proportion of the stranded marine mammals that are in suitable for necropsy are collected to determine the cause of death and assess their health status. The necropsies are conducted as part of the Danish Wildlife Mortality Monitoring Programme, which is funded by the Agency for Green Transition and Aquatic (SGAV). The purpose of the programme is to investigate causes of death and monitor the health of Danish wildlife populations.

The stranded marine mammals are examined either on site by the Pathology Response Service or at the Department of Veterinary and Animal Sciences at the University of Copenhagen. During the necropsy, tissue samples are collected for further analyses and are subsequently used in research and monitoring activities carried out by the Department of Ecoscience at Aarhus University.
Skeletons from selected stranded marine mammals are preserved by Museum Vest and the Natural History Museum of Denmark. These specimens become part of the museums' scientific collections and contribute to both research and public outreach.

All information on recorded and collected marine mammals is compiled in a database administered by Museum Vest. Each year, records from the previous calendar year are summarized in an annual stranding response report. The records include only animals that were found dead, bycaught, euthanized, or shot with derogation shooting permits. Observations of live animals are therefore not included.

2.1.3 France

The French stranding network (Réseau National Echouages, named RNE), established in the 1970s and deemed stable since 1990 (Authier et al. 2014), consists of 400 members who participate in stranding interventions as part of their professional duties or voluntary efforts. The network comprises numerous agents of marine protected areas, veterinarians, biologists, and naturalists who have all been trained in accordance with standardised protocols (https://www.observatoire-pelagis.cnrs.fr/wp-content/uploads/2021/03/GuideEchouages2015.pdf).

Strandings are subject to regulatory oversight with regard to protected species, and there is an obligation to report them (Ministère de l'Environnement, de l'Énergie et de la Mer, 2017). They are usually reported by individuals who frequent the coastline, such as walkers or regular users, but also by local councils, fire brigades or police officers, when they are warned directly by the general public. Once the animal is transported to municipal facilities, correspondents from the stranding network or the Observatoire Pelagis can intervene based on the cetacean's level of decomposition. The intervention protocol is adjusted accordingly. The data is entered online, including measurements, external examinations and, where the condition of the specimen allows, internal examinations, as well as a set of detailed photographs.

All the information is validated by the Pelagis Observatory and stored in a PHPMyAdmin database.

A strategy to strengthen the monitoring of marine mammals' health status based on stranding data has been developed. It is broken down into four surveillance modalities: (1) general event-based surveillance ; (2) programmed surveillance; specific event-based surveillance ; (4) and in the longer term, syndromic surveillance (Wund et al. 2023).

2.1.4 Germany

The German stranding network at the North Sea coast was established in 1988/89 during the first Phocine Distemper Virus-Seal-die-off. National Park Rangers and "Seal hunters" (seals still belong the hunting law even as hunting was stopped in 1976) control the coastline regularity throughout the year so that a regular effort is secured. In Schleswig-Holstein marine mammal carcasses are collected and submitted for investigations, conducted at the Institute of Terrestrial and Aquatic Wildlife Research (ITAW), part of the University of Veterinary Medicine Hannover (TiHo).

2.1.5 Ireland

Records of stranded cetaceans in Ireland date back to the 18th century when Ireland was included in the Stranded Whale Scheme coordinated by the Natural History Museum, London but small cetaceans were very under-recorded. The earliest record of a stranded white-beaked dolphin in Ireland dates back to 1883. Since 1991 the Irish Whale and Dolphin Group (IWDG) have coordinated an All-Ireland stranding scheme and since 2000 recording effort has been quite consistent. This followed a series of programmes that funded the development of resources including, training, identification guides, database development and more recently reporting apps. Records of stranded cetaceans are submitted with enough information including images to assist validation. Once validated, records (including downgrades if species identification is not possible) are then posted on www.iwdg.ie and published each year in the Irish Naturalists Journal.

A network of trained volunteers, as well as IWDG staff, visit as many strandings as possible and record species, length, sex and typically take a skin sample for the Irish Cetacean Genetic Tissue Bank held by the National Museum of Ireland (Natural History). Over 80% of records are identified to species level, with over 50% visited by the IWDG stranding network. No long-term post-mortem scheme exists in Ireland but some strandings are recovered depending on the funded project objectives and white-beaked dolphins have been recovered since 2022 under the Deep Diving and Rare species Investigation Programme (DDRIP) through which two stranded individuals have been examined. The IWDG Cetacean Stranding Scheme is part-funded by the National Parks and Wildlife

Service of the Department of Housing, Local Government and Heritage. The last 12 months records are available online (https://report.iwdg.ie/strandings-archive?) with a Data Request to the IWDG required to access all records.

2.1.6 Norway

Prior to 2020, Norway lacked a central reporting system for marine mammal strandings. Observations were made opportunistically along the entire mainland coastline, i.e., not including Svalbard and Jan Mayen, and would have come from local reports or incidental findings, rather than a targeted monitoring effort. These incidental records were collated by the Directorate of Fisheries and reported to the North Atlantic Marine Mammal Commission (NAMMCO) on an annual basis. However, the records are likely not fully representative of reality, due to the lack of a dedicated effort to collect data. They have also not been regularly reported to NAMMCO since 2020. Existing data can be made available to the public upon request.

In 2020, the Institute of Marine Research (Havforskningsinstitut) initiated a citizen science–based reporting scheme, with a centralised online database (https://dugnadforhavet.no/). This covers the entire Norwegian EEZ. The actual extent and frequency of observations is likely skewed towards more populated/visited areas. Besides the location, number of animals, and likely or verified species ID, stranding records in this database can include key information such as sex, size, position and condition of the body, as well as photographs. Observations are checked and validated (to the extent that photos/videos and other information allow) on a regular basis. These records are publicly available to view on the database portal. However, no entries pertaining to white-beaked dolphins have been added between 2020 and the time of writing (09/07/2026).

Besides certain species-specific studies (e.g., on sperm whales, *Physeter macrocephalus*), there is no dedicated necropsy scheme for marine mammals. Those that are carried out are generally done so by the Institute of Marine Research. Necropsy findings are published in the Institute's Reports and, if pertinent for management decisions, are also presented at the annual Marine Mammal Advisory Board meeting (Sjøpattedyrutvalg).

2.1.7 Sweden

Swedish data on stranded marine mammals has been collected by the Swedish Museum of Natural History (NRM) since the 1970s with a full national scope except for uninhabited islands that are rarely visited. However, fewer reports are sent in from the Bothnian Bay and Bothnian Sea. Since 2020 the Swedish stranding network has been a joint effort between the Swedish Veterinary Agency (SVA) and the NRM. Reports of stranded cetaceans are received via various citizen-science reporting sites (https://marinadaggdjur.nrm.se/; valar.se; https://mobil.artportalen.se/eftersokta/rappen; https://rapporteravilt.sva.se/) where they are validated by experts. Occasionally, reports are received directly by telephone or email to NRM or SVA. Stranding report data are available upon request. Outreach activities to raise awareness about the stranding program have increased over time, particularly following the expansion of the program in 2020, leading to a probable increase in reporting effort.

Dedicated post-mortem examinations of suitable stranded marine mammals have been performed by NRM and SVA. Since 2020, all cetacean necropsies are performed at the Department of Pathology and Wildlife Diseases, SVA together with NRM. Results are published openly in annual reports (https://www.sva.se/djurhaelsa/djurslag-a-oe/vilda-djur/marina-daeggdjur/) in Swedish and data are openly available (www.dataportal.se, keyword 'cetacean').

Funding for the stranding program has been provided by the Swedish Environmental Protection Agency and the Swedish Agency for Marine and Water Management.

2.1.8 The Netherlands

Until recently (1 January 2024), the Dutch stranding network consisted of a consortium of numerous organisations and volunteers involved in the detection, reporting, and documentation of stranded cetaceans. The network had provided particularly good coverage along the south-western and western coasts of the Netherlands, including the westernmost Frisian island of Texel, where coverage was estimated to approach 100%. Coverage was lower in the more remote areas of the Wadden Sea, including the remaining Frisian Islands, some of which are uninhabited. However, strandings of white-beaked dolphins are likely to receive greater attention than the average harbour porpoise (*Phocoena phocoena*) stranding, and therefore the majority of white-beaked dolphin strandings are expected to have been reported and registered for the present study.

A central digital stranding database was maintained by Naturalis Biodiversity Center (formerly the National Museum of Natural History Naturalis) in Leiden between 1990 and 31 January 2024. During this period, one dedicated validator reviewed incoming records to ensure that entries represented original stranding events and that key information, including species and sex were reliable. Associated data and photographs were made publicly available through the website www.walvisstrandingen.nl. From 1 February 2024 onwards, following a request from the Dutch Ministry of Agriculture, Fisheries, Food Security and Nature (LVVN), the database was transferred to the Observado platform (www.stranding.nl) and the website www.walvisstrandingen.nl was taken offline. Since this transition, the database has operated as a citizen-science-based platform without a dedicated validator.

Dedicated post-mortem examinations of stranded marine mammals have been conducted at the Division of Pathology, Faculty of Veterinary Medicine, Utrecht University since 2008, nowadays commissioned by the Dutch Ministery of LVVN. Results are presented in yearly reports which are shared online (www.uu.nl/strandingsonderzoek). Prior to this, dissections were performed opportunistically by seal rehabilitation centres and staff affiliated with Naturalis Biodiversity Center. Information from these earlier examinations was documented in published records (e.g., by Dr Chris Smeenk) and, where available, incorporated into the comments section of the stranding database.

2.1.9 United Kingdom

The Cetacean Strandings Investigation Programme (CSIP) has been running since 1990 and is funded by Defra and the Devolved Administrations. Several organisations are part of and contribute towards data collection for the CSIP, which is managed and coordinated by the Institute of Zoology (IoZ) in London. In England (excluding Cornwall), the reporting, retrieval and transportation of stranded animals is coordinated by the Natural History Museum (NHM) alongside IoZ. In Cornwall, the Cornwall Wildlife Trust Marine Strandings Network (CWTMSN) coordinate the stranding reporting, retrieval and transportation of carcases to postmortem facilities. These previously included the University of Exeter, and the Animal Health and Veterinary Laboratories Agency (AHVLA) in Truro, and currently the Cornwall Marine Pathology Team facilities in Falmouth. In Wales, the reporting, retrieval and transportation of stranded animals is coordinated by Marine Environmental Monitoring (MEM). In 1992, Scotland was also included in the CSIP remit, with the reporting, retrieval and postmortems of stranded animals being coordinated and executed by the Scottish Marine Animal Stranding Scheme (SMASS). In 2021, the CSIP separated into England and Wales, with Scotland continuing as a separate entity.

Since 2021 SMASS has been managed by the School of Biodiversity, One Health and Veterinary Medicine at the University of Glasgow and is funded by the Scottish Government (Marine Directorate). In Scotland strandings are reported opportunistically, most commonly by members of the public, and subsequentially validated by an experienced stranding coordinator. SMASS also operates a network of volunteers who assist with carcase retrieval and transport for postmortem, and who are trained to assess cases and systematically collect information, measurements, and a small tissue sample of skin, blubber, and muscle of cases that are not collected for postmortem.

2.2 Data collection

Data was obtained from collaborating organisations following a data request, led by Utrecht University. An Excel template was shared by email in Q3-Q4 of 2025. As most stranding schemes were established in the 90's, records from 1990 to 2025 were requested, together with, if available, additional data on body condition, life-history parameters and cause of death. The following variables were requested:

- National case ID
- Stranding date (day, month, year)
- Stranding location
  - Name
  - Area: North Sea, Baltic Sea, Atlantic, Other (specify)
  - Latitude, Longitude
- Decomposition condition code (DCC) on a five-point scale, with 1=very fresh, 2=fresh, 3=moderate decomposition, 4=advanced decomposition and 5=remnants
- Sex (three categories: male, female, unknown)
- Age class (four categories: neonate, juvenile, adult, not defined)
- Total length (in cm)
- Girth (in cm, at height of pectoral fins)
- Weight (in kg)
- Blubber thickness (in mm; the mean of dorsal (L11), lateral (L12) and ventral (L13) blubber thickness)
- Carcass completeness
- Age in years
- Post-mortem investigation (two categories: yes, no)
- Reproductive state
  - Males: immature / mature
  - Females: immature / pregnant / lactating / pregnant & lactating / resting
  - Unknown
- Cause of death – in categories, or by main findings
- Comments – e.g., if this was a live stranding and the animal was refloated, or other relevant stranding information

In total, 966 single-animal strandings were obtained.

2.3 Data preparation

Initial standardisation and data preparation was performed in Microsoft Excel. All stranding records were checked and the following entries were removed from further assessment:

1. Events occurring outside the study area (n = 3);
2. Events occurring outside the study period (1990-2025) (n = 6);
3. Events uncertain of species (n = 72);
4. Individuals found at sea (n = 13);
5. Individuals classified as foetus (n = 1);
6. Individuals that stranded alive and were successfully rehabilitated or directly released (n = 32).

This resulted in the total number of 839 individuals for the analyses. However, not all the requested variables were available from each stranding schemes database, and some variables (e.g., completeness and age) therefore had to be excluded from further reporting.

The variables that retained for analyses were: stranding date, latitude, longitude, region, DCC, sex, age class, total body length, body weight, blubber thickness, reported alive, post-mortem, and cause of death (CoD) category.

Three variables were added for spatiotemporal analyses: region, period and season. To assign region, the study area was subdivided into management regions defined under the Convention for the Protection of the Marine Environment of the North-East Atlantic (hereafter referred to as the OSPAR Convention (OSPAR Commission 2020)). Following Williamson et al. (2021), OSPAR Regions II and III were each split into northern and southern areas at 55°N, and in the present study we treated the English Channel as a separate region, which yielded a total of five geographical regions for the present study (Figure 1).

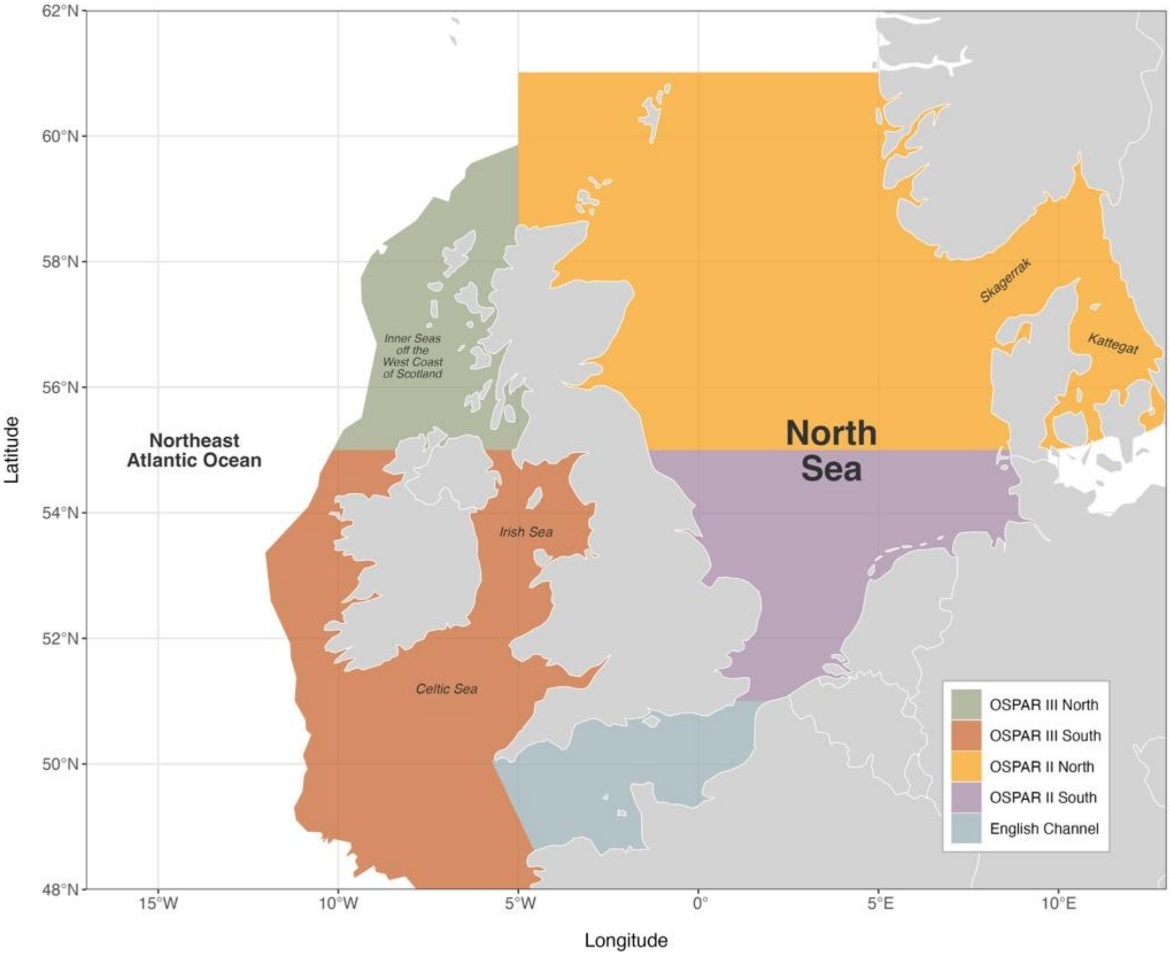

Figure 1. *Study area and regional subdivision used for the analysis of white-beaked dolphin strandings. Stranding locations were assigned to five geographical regions: OSPAR III North (green), OSPAR III South (red), OSPAR II North (yellow), OSPAR II South (purple), and English Channel (blue).*

To assess period, three equal multidecadal intervals of twelve years each (1990–2001, 2002–2013, and 2014–2025) were set, to which each stranding was assigned according to its year of stranding.

Season was assessed as: winter (December, January, February), spring (March, April, May), summer (June, July, August) and autumn (September, October, November).

2.4 Data analyses

Analyses were carried out in RStudio (version 2025.09.2+418) using R (version 4.5.2) (R Core Team 2024) with functions from the *tidyverse* package (Wickham 2023). Figures and maps were created using base R and the *ggplot2* (version 4.0.2; Wickham, 2016), *rnaturalearth* (version 1.2.0; Massicotte et al., 2026), and *MASS* (version 7.3–65; Ripley & Venables, 2025) packages. Data exploration was conducted following Zuur et al. (2010).

2.4.1 Spatiotemporal patterns

The spatial and temporal distribution of stranding events was explored using descriptive visualisations. Stranding locations (latitude and longitude, $n = 839$) were mapped for each period (1990–2001, 2002–2013, and 2014–2025) to assess changes in spatial distribution over time. Density heat maps were generated to assess stranding hotspots, using two-dimensional kernel density estimation (KDE; *kde2d* function, *MASS* package) applied to stranding coordinates. Each density surface used a bivariate Gaussian kernel with a fixed bandwidth of 2.5 decimal degrees in both longitude and latitude, applied identically across periods. To emphasise relative spatial concentrations rather than absolute stranding numbers, densities were normalised within each period (0 = most sparse, 1 = most dense). These maps were used descriptively and were not statistically tested. Temporal patterns in strandings were further examined by plotting stranding latitude against year, for regions separately and the full geographical range, and intra-annual variation by plotting monthly frequencies with regional trends overlaid.

Temporal trends in stranding frequency were quantified by linear regression of annual stranding counts per year, fitted separately for each region and the entire area, both over the whole study period and within each multidecadal period. The regression slope (β) was taken as the direction and magnitude of change and classified as increasing ($\beta > 0.01$ strandings yr^{-1}), stable ($-0.01 \le \beta \le 0.01$ strandings yr^{-1}), or decreasing ($\beta < -0.01$ strandings yr^{-1}).

To evaluate latitudinal shifts, the annual mean stranding latitude was calculated for each study region and for the complete dataset, regressed against year over the study period. The mean stranding latitudes were used for a linear regression across the entire study period. Annual means were used to minimise the influence of years with low stranding numbers and to account for temporal gaps in regional observations.

2.4.2 Demographic characteristics

The completeness and representation of biological information in the dataset was assessed to address data availability and determine the suitability of variables for describing demographic composition. Unfortunately, the limited available information on exact age, as well as reproductive state did not allow for further assessment of these variables. Given these constraints, we further focused on body length, age class and sex.

To characterise the relationship between body length and maturity, and to derive a length-based maturity threshold, sex-specific binomial generalised linear models (GLMs) with a logit link function were fitted. This was restricted to post-mortem-examined individuals with known age class, sex, and total body length (L1), ensuring that age class assignments were based on direct investigations of the reproductive organs and that the threshold for maturity could therefore be considered reliable (IJsseldijk, Brownlow, and Mazzariol 2019). Age class was recorded as a binary maturity variable (adult = mature, 1; juvenile = immature; 0, neonate = immature, 0), and maturity was modelled as a function of total body length separately. Predicted maturity probabilities were extracted on the response scale, as this ensured that confidence intervals remained bounded between 0 and 1 and provided biologically interpretable estimates of maturity probability. From each model, the length at 50% maturity (L50), the length at which the predicted probability of maturity equals 0.5, was extracted as the estimated length at sexual maturity.

NB Following missing data, there are varying total numbers (n=) reported in the result section, depending on the analysis conducted.

2.4.3 Post-mortem

Categorical variables describing the stranding event, like whether the stranded animal was reported alive, or dead (for which a DCC and CoD category was provided) were reviewed using frequency and proportional plots for their representation across regions (not further shown here). Temporal changes in CoD categories were additionally visualised using a cumulative frequency plot.

3 Results and discussion

3.1 Spatiotemporal patterns

White-beaked dolphin strandings occurred predominantly in the northwest and east coasts of Great Britain (OSPAR II & III North), the Belgian and Dutch coastlines (OSPAR II South), and western shores of Denmark (OSPAR II North) in the first assessment period (n = 294, 1990 – 2001), with similar frequencies observed in 2002–2013 (n = 311) (Figure 2). There were fewer strandings recorded in the most recent period (n = 234, 2014 - 2025). Stranding hotspots moved north, and centred around the British island of Orkney and Danish North Sea coast (Figure 3). Overall, strandings shifted from the south-eastern North Sea (OSPAR II South) towards the northern North Sea (OSPAR II North) over the study period. The previously observed patterns in north-wards distribution of stranded white-beaked dolphins (IJsseldijk et al. 2018) seems therefore persistent.

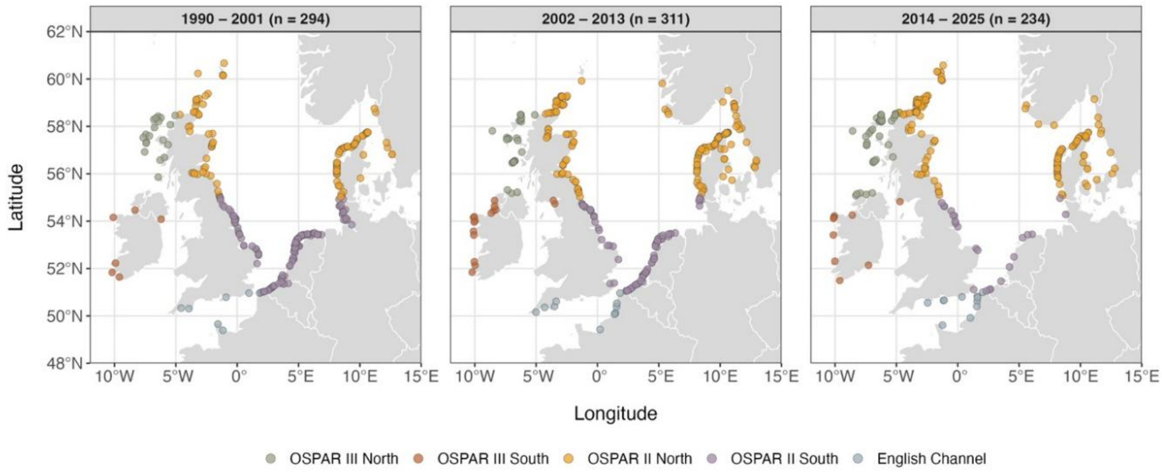

Figure 2. *Plotted locations of white-beaked dolphin strandings between 1990 and 2025 (n = 839). The colours represent the regions defined for this study with OSPAR III North (in green), OSPAR III South (in orange), OSPAR II North (in yellow), OSPAR II South (in purple) and the English Channel (in blue).*

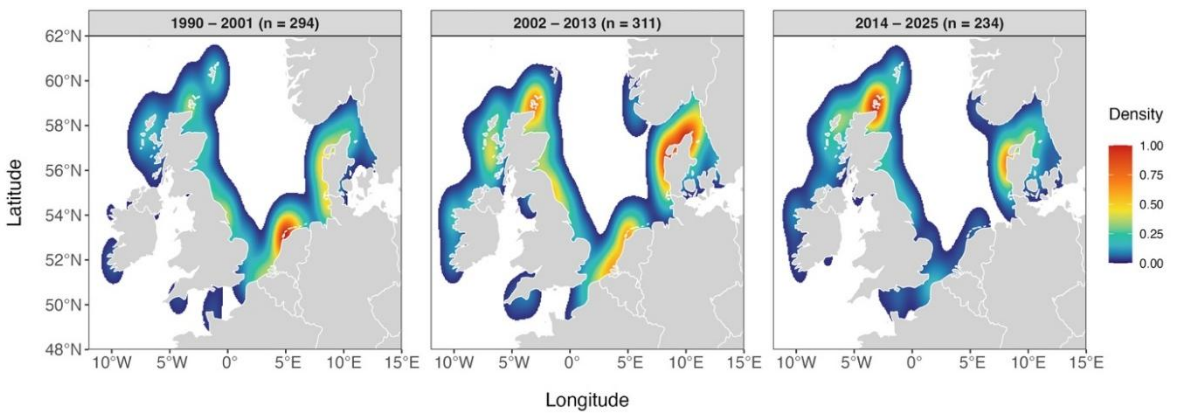

Figure 3. *Density heat maps of white-beaked dolphin strandings between 1990 and 2025 (n = 839). Hotpots were calculated using Kernel Density Estimation. Density values were normalised between 0 (minimum density; dark blue) and 1 (maximum density; red), with 0.5 (yellow) representing intermediate density.*

Consistent with a northward redistribution of stranding hotspots (Figure 3), the mean latitude of strandings increased significantly over the study period ($p < 0.001$). The fitted linear regression indicated a constant rise of +0.075 °N yr^{-1}, corresponding to a shift from 54.4°N in 1990 to 57.1°N in 2025 (Figure 4). Mean latitude showed little temporal change within four of the five regions, with regression slopes ranging from −0.004 to +0.007 °N yr^{-1} and no significant trends detected ($p \geq 0.73$). In contrast, OSPAR II North exhibited a significant increase in mean latitude (β = +0.031 °N yr⁻¹, p = 0.002), corresponding to an estimated northward shift of approximately 1.1°. Despite the limited change in mean latitude within some of the regions, the overall mean latitude of strandings increased by approximately 2.7° between 1990 and 2025. This resembles a northward shift of almost 300 kilometers.

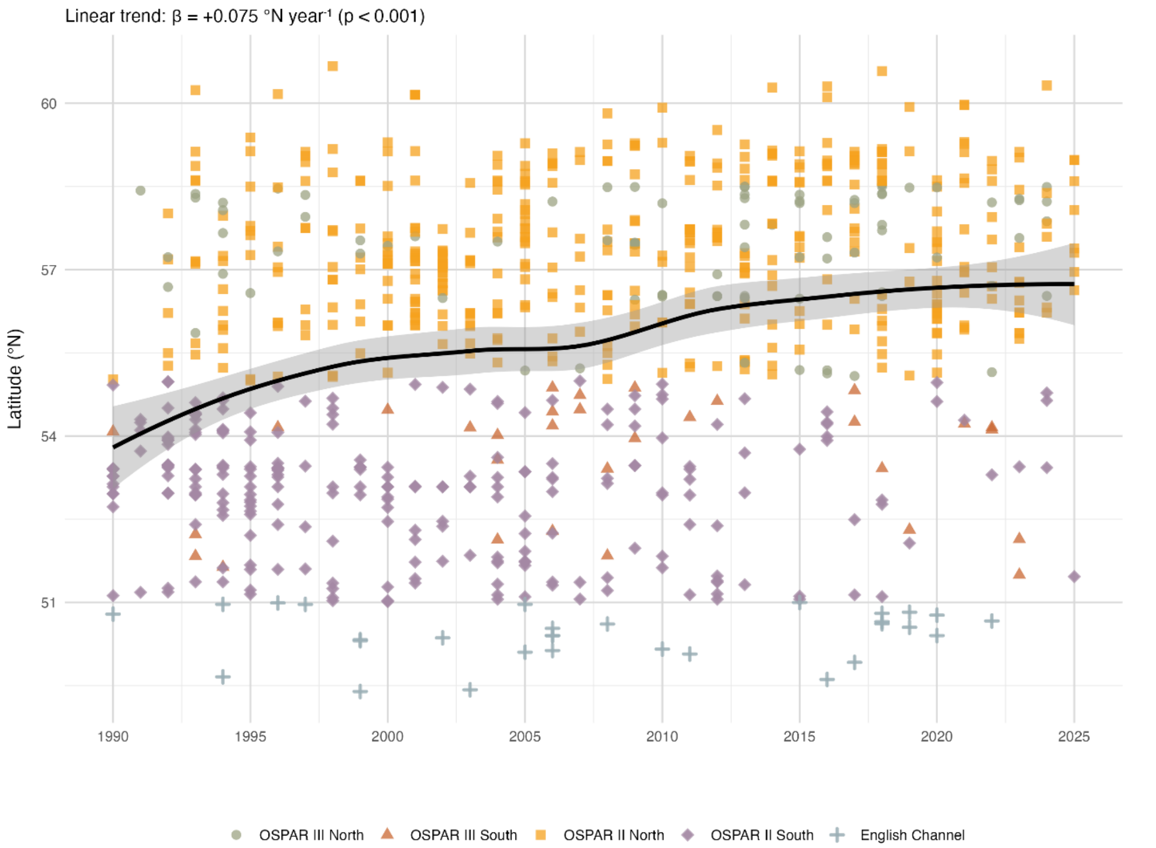

Figure 4. *Latitudinal (°N) distribution of white-beaked dolphin strandings over time (n = 839). Overall trend is indicated by the black line (linear regression: β = +0.075 °N yr⁻¹, p < 0.001); shaded area represents 95% confidence interval for fitted trend; points represent individual observations, with regions distinguished by symbol shape.*

Across the study period, annual strandings averaged 23.3 ± 8.0 strandings per year (mean ± SD), ranging from a minimum of 6 in 1991 to a maximum of 39 in 2001. Counts fluctuated from year to year, with above-average totals concentrated between the mid-1990s and early 2010s, and below-average totals dominating from 2014 onward, with the exceptions of 2017, 2018, and 2020. The underlying temporal trends, however, differed considerably between regions (Table 1).

Table 1. *Regional stranding trends across three periods (1990 – 2001, 2002 – 2013, 2014 – 2025; n = 839). For each region, the table reports the linear regression slope within each period, the total number of strandings (Total #), the slope across the full study period (Total slope), and the resulting trend direction (Trend); the bottom row (Total) summarises the entire study area. Slopes were estimated by linear regression of annual stranding frequencies on year and represent the rate of change in strandings per year (events yr^{-1}). Trend direction was classified from the long-term slope as increasing (slope > 0.01 events yr^{-1}; green), decreasing (slope < −0.01 events yr^{-1}; red), or stable (−0.01 ≤ slope ≤ 0.01 events yr^{-1}; blue).*

	1990 – 2001	2002 – 2013	2014 – 2025			
	Slope	Slope	Slope	Total #	Total slope	Trend
OSPAR III North	−0.097	0.652	−0.072	86	0.088	↑ *increase*
OSPAR III South	−0.029	−0.143	0.071	31	0.004	~ stable
OSPAR II North	1.677	−0.262	−0.657	446	0.091	↑ *increase*
OSPAR II South	−0.510	−0.206	−0.227	246	−0.390	↓ *decrease*
English Channel	0.137	−0.039	0.070	30	0.003	~ stable
Total	1.196	−0.115	−1.028	839	−0.183	↓ *decrease*

Seasonal variation in strandings was most evident for the three regions with most records (respectively OSPAR II North, OSPAR II South and OSPAR III North), but generally seemed to follow a similar pattern. OSPAR II North showed the most pronounced seasonal peak. Strandings started to peak in late spring, with overall highest numbers in June and July. Records decreased in or after August and numbers started to rise again in November and December. April had the lowest strandings frequencies in these regions.

OSPAR III South (with 1–6 strandings per month) and the English Channel (with 0–7 strandings per month) had no apparent seasonal pattern (Figure 5).

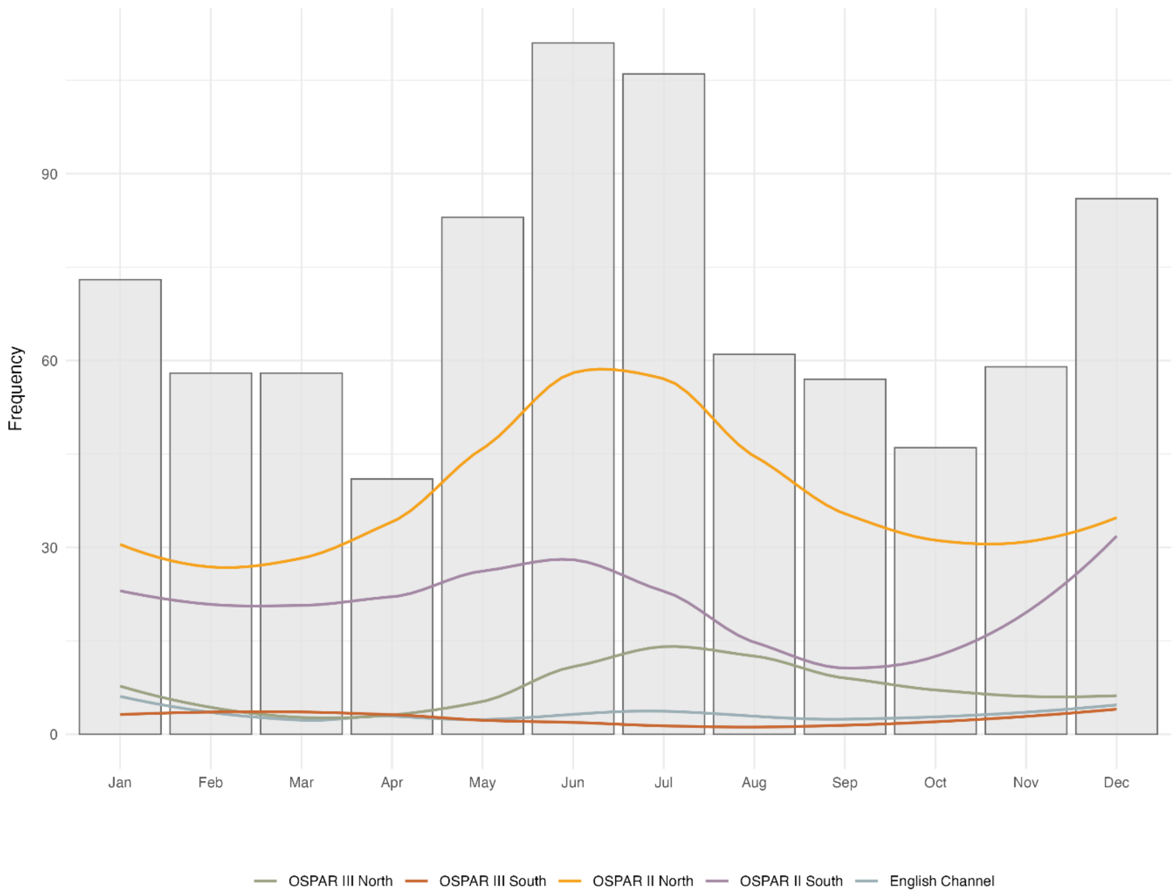

Figure 5. *Monthly distribution of white-beaked dolphin stranding frequencies (1990 – 2025; n = 839). Bars represent the total number of strandings per month aggregated across all regions, and lines indicate region-specific variability in monthly frequencies.*

3.2 Demographic characteristics

Sex was determined for two-thirds of stranded individuals (554/839, 66%), of which 46% were males (n = 254) and 54% were females (n = 300) (Figure 6). The proportion of unsexed individuals varied among regions and was highest in OSPAR II North (n = 164/285; 57.5%).

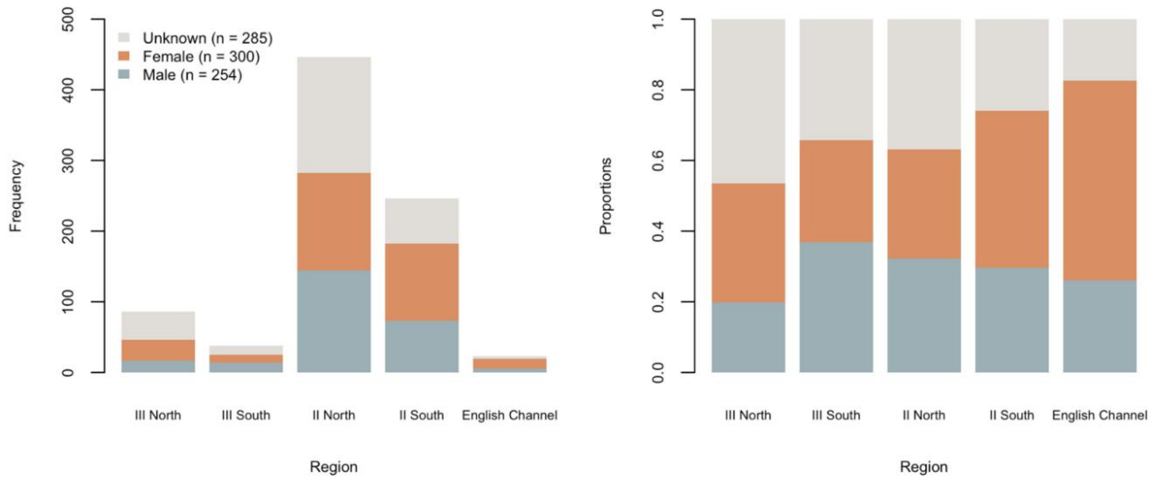

Figure 6. *Sex composition of white-beaked dolphin strandings by OSPAR region, shown as total counts (left) and proportions (right). Bars are stacked by sex: male (n = 254), female (n = 300), and undetermined (n = 285); total n = 839.*

Age class and total length were provided for 33.4% of all recorded stranded white-beaked dolphins. For those individuals sex was also recorded, the 50% length at maturity threshold was calculated. This included only animals which were post-mortem assessed. Sex-specific length-at-maturity thresholds were estimated 206 cm for females and 213 cm for males (Figure 7). The initial plan was to use these thresholds to assign maturity status to individuals of known sex and body length but unknown age class. However, these lengths do not correspond to lengths at sexual maturity reported in literature (Evans & Smeenk 2008; Galatius & Kinze 2016). Further outlier exploration and data verification is needed before continuing with age class analyses.

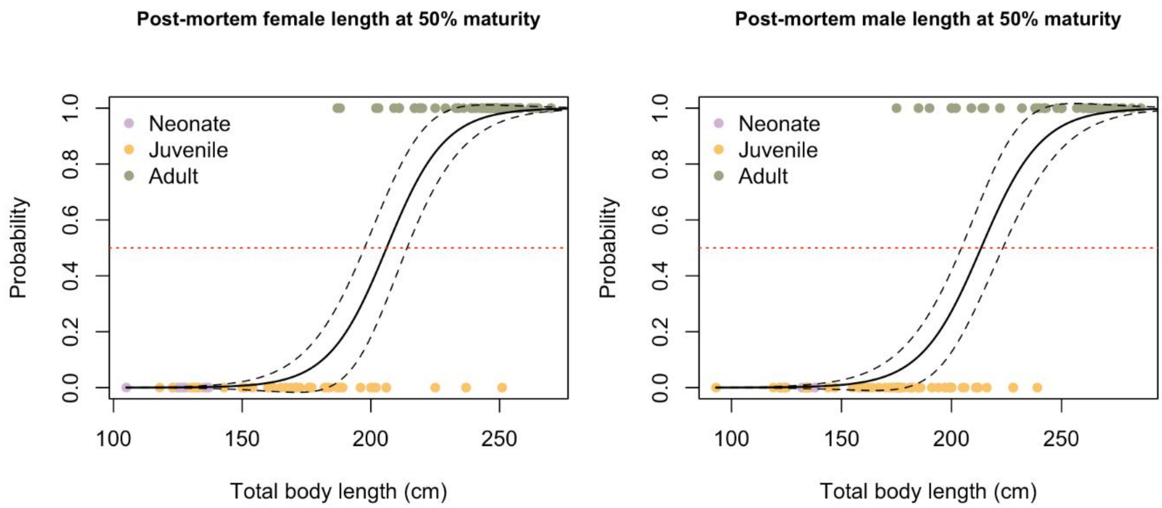

Figure 7. *Probability graph of 50% length at sexual maturity, per sex. L50% was 206 cm for females, and 213 cm for males, which does not correspond to literature and further assessment is needed before continuing with the age class variable.*

3.3 Post-mortem

Most individuals had no reported information about the stranding event (n= 805/839, 96%) and were considered to have been found dead. Six were reported dead at discovery (0.7%) and the others were reported alive (26 individuals 3.1%) or likely alive (two records, 0.2%) before they died. Reported live strandings occurred primarily in OSPAR II North and OSPAR II South, whereas no confirmed live strandings were recorded in OSPAR III North or OSPAR III South.

The distribution of decomposition condition code (DCC) varied across the dataset, with DCC 4 being the most frequently recorded category (n = 191/839, 22.8%), followed by DCC 1 (n = 136/839, 16.2%), DCC 2 (n = 135/839, 16.1%), and DCC 3 (n = 112/839, 13.3%). DCC 5, representing the most advanced state of decomposition, was least frequently recorded (n = 79/839, 9.4%). A substantial proportion of individuals had an unknown DCC (n = 186/839, 22.2%). Variation in decomposition status was apparent among regions, although all regions contained at least one-quarter of stranded individuals in fresh to very fresh condition (DCC 1–2).

Post-mortem assessments, which varied between limited tissue sampling to a full necropsy, were conducted for 42% of all stranded individuals (Figure 8).

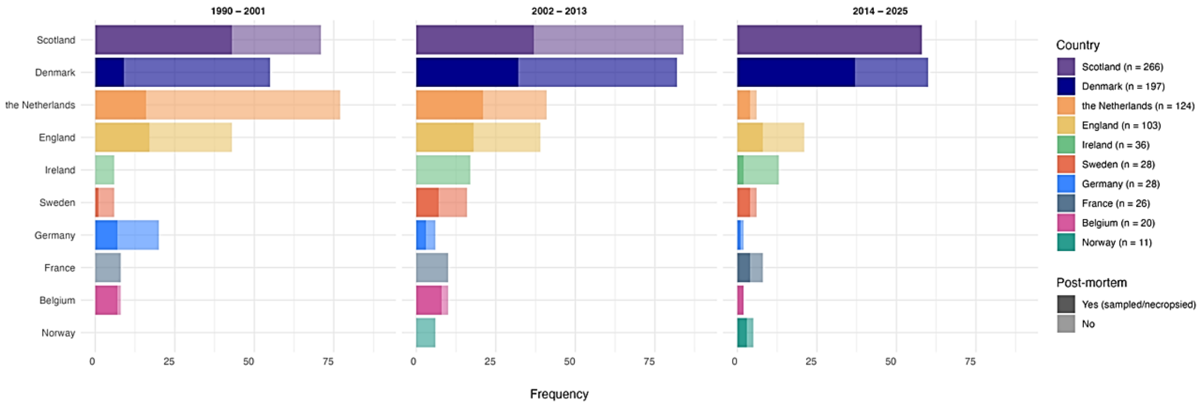

Figure 8. *Number of stranded white-beaked dolphins per country, per period (n = 839). Bars represent the frequency strandings with darker colour indicating proportion of post-mortem assessments, which could range from minimum tissue sampling up to a full necropsy.*

Cause of death was not investigated for the majority of stranded individuals (n = 490/839, 58.4%) or not established following a post-mortem investigation (n = 189, 22.5%). Where a cause of death category was provided (n = 160), live strandings represented the largest group (n = 51/160, 31.9%), followed by trauma (n = 49/160, 30.6%), non-trauma causes (n = 46/160, 28.8%), and other causes (n = 15/160, 9%) (Figure 8). Cumulative records of assessed causes increased steadily throughout the study period, with live strandings, trauma, and non-trauma causes contributing the largest proportions of classified events (Figure 9).

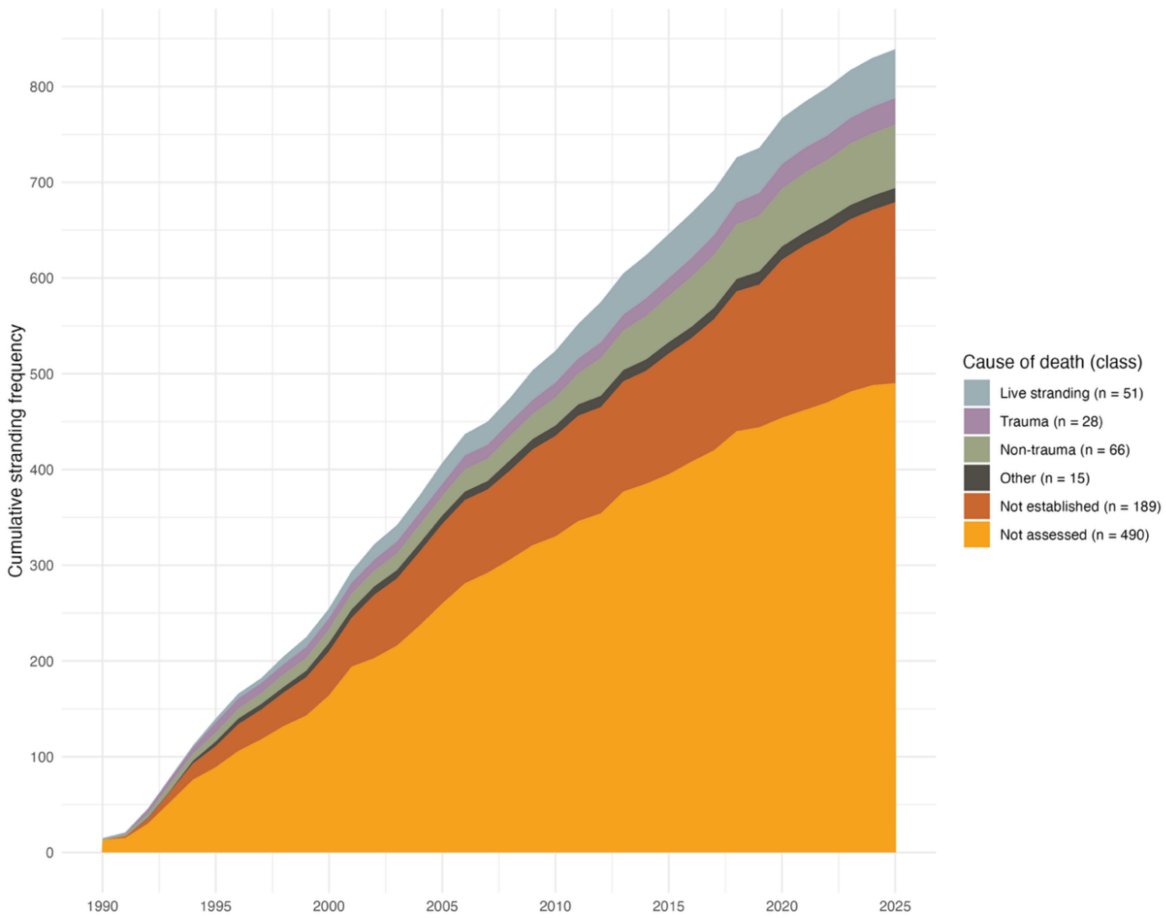

Figure 9. *Cumulative frequency graph of classes of causes of death over time (n = 839).*

4 Next steps and recommendation

This preliminary assessment indicates a persistent northward shift in the distribution of white-beaked dolphin strandings across the North Sea, consistent with patterns previously described for the period 1991–2017 (IJsseldijk et al. 2018). Further analyses should investigate the potential drivers of this shift, including changes in habitat use, environmental conditions, population dynamics, and differences in monitoring effort and reporting intensity among countries. These findings should also be interpreted alongside data from live-animal surveys, including aerial and ship-based surveys and, where available, surveys from more northern parts of the species' range. Combining these complementary datasets will help determine whether the observed patterns reflect a redistribution of the population, a change in overall abundance, or a combination of both.

The observed increase in mean stranding latitude and the concentration of recent stranding hotspots in the northern North Sea warrant further investigation through analyses of regional trends over time. These patterns should be evaluated in the context of environmental change, including previously suggested links between climate-driven shifts in sea temperature, prey distribution and availability, and cetacean occurrence (MacLeod et al. 2005; Evans and Bjørge 2013). Such analyses should also consider the documented northward expansion of warm-water delphinid species, including the striped dolphin (*Stenella coeruleoalba*) and the common dolphin (*Delphinus delphis*), into the ASCOBANS area (Evans & Waggitt 2020). Increased competition for habitat and prey resources resulting from these range expansions may represent an additional driver of the observed northward shift in white-beaked dolphins.

The demographic and life-history assessment should be completed through further validation and integration of available information on sex, length, age class, and reproductive status. Additional data checking is recommended before assigning maturity status based on length, to ensure that measurements and metadata are consistent and comparable. Once validated, these data can be used to assess demographic composition and investigate potential differences among regions and time periods.

The assessment of body condition should be conducted when sufficient data are available. Analyses of body mass index (BMI) and blubber thickness can be used and compared as indicators of nutritional condition. These metrics could provide important insight into whether changes in environmental conditions or prey availability are reflected in individual health. Future monitoring efforts should aim to standardise the collection of body condition measurements to improve comparability between countries.

The assessment of mortality patterns highlights an important knowledge gap. The majority of strandings lacked a (confirmed) cause of death, even if full necropsies were performed. Available post-mortem information could be further evaluated and samples further analysed. A recommended next step is to compile and re-assess the available post-mortem reports collectively, including the 160 records with assigned cause-of-death categories, using a harmonised pathology framework. This would allow a more detailed evaluation of health status, pathological findings, and potential changes in mortality patterns that cannot be captured through broad cause-of-death categories alone. This might also include monitoring of pathogens, such as morbillivirus, and contaminant screening.

The relatively high number of reported live strandings could also be considered in future analyses. While some individuals were excluded from the main assessment because they entered rehabilitation and were therefore not directly comparable with fatal strandings, these records may provide important additional information on health state and condition of white-beaked dolphins. A separate evaluation of live-stranding cases could assess spatial and temporal patterns, rehabilitation outcomes, and potential differences between animals surviving initial stranding and those found dead (see also Appendix A).

Together, these additional analyses will allow completion of the current assessment and provide a stronger evidence base for evaluating white-beaked dolphin status across the North Sea. Continued coordination between national stranding networks is recommended, including harmonisation of data collection, improved recording of post-mortem findings, and integration of biological and pathological information to support future regional assessments.

5 Literature

ASCOBANS Secretariat. (2025). Report of the 29th Meeting of the ASCOBANS Advisory Committee. https://www.ascobans.org/sites/default/files/document/2025-12/ascobans_ac29_report_1.pdf (March 2, 2026).

Authier, M., Peltier, H., Dorémus, G., Dabin, W., Van Canneyt, O., & Ridoux, V. (2014). How much are stranding records affected by variation in reporting rates? A case study of small delphinids in the Bay of Biscay. Biodiversity and Conservation, 23(10), 2591-2612.

Camphuysen, K., & Peet, G. (2006). Whales and dolphins of the North Sea. Fontaine Uitgevers [in cooperation with: The North Sea Foundation].

Canning, S. J., Santos, M. B., Reid, R. J., Evans, P. G., Sabin, R. C., Bailey, N., & Pierce, G. J. (2008). Seasonal distribution of white-beaked dolphins (*Lagenorhynchus albirostris*) in UK waters with new information on diet and habitat use. Journal of the Marine Biological Association of the United Kingdom, 88(6), 1159-1166.

Evans, P.G.H., Anderwald, P., & Baines, M.E. (2003). UK Cetacean Status Review. Report to English Nature and the Countryside Council for Wales. Sea Watch Foundation, Oxford, UK.

Evans, P.G.H., & Smeenk, C. (2008). White-beaked dolphin *Lagenorhynchus albirostris*. In: S. Harris & D.W. Yalden (eds). Mammals of the British Isles. Handbook. 4th Edition: 724-727. The Mammal Society, Southampton, UK.

Evans, P.G.H., & Bjørge, A. (2013). Impacts of climate change on marine mammals. Marine Climate Change Impacts Partnership (MCCIP) Science Review 2013: 134-148.

Evans, P.G.H., & Waggit, J. (2020). Impacts of climate change on marine mammals, relevant to the coastal and marine environment around the UK. Marine Climate Change Impacts Partnership (MCCIP) Science Review 2020: 421-455.

Galatius, A., & Kinze, C. C. (2016). *Lagenorhynchus albirostris* (Cetacea: *Delphinidae*). Mammalian Species, 48(933), 35-47.

IJsseldijk, L. L., Brownlow, A., Davison, N., Deaville, R., Haelters, J., Keijl, G., ... & ten Doeschate, M. T. (2018). Spatiotemporal analysis in white-beaked dolphin strandings along the North Sea coast from 1991-2017. Lutra, 61(1), 153-163.

IJsseldijk, L. L., Brownlow, A. C., & Mazzariol, S. (Eds.) (2019). Best practice on cetacean post-mortem investigation and tissue sampling. Joint ACCOBAMS and ASCOBANS document. Available at: https://osf.io/zh4ra.

Kiszka, J. & Braulik, G. (2018). *Lagenorhynchus albirostris*. The IUCN Red List of Threatened Species 2018: e.T11142A50361346. http://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T11142A50361346.en

MacLeod, C. D., Bannon, S. M., Pierce, G. J., Schweder, C., Learmonth, J. A., Herman, J. S., & Reid, R. J. (2005). Climate change and the cetacean community of north-west Scotland. Biological Conservation, 124(4), 477-483.

Massicotte, P., South, A., & Hufkens, K. (2026). "Rnaturalearth: World Map Data from Natural Earth." https://cran.r-project.org/web/packages/rnaturalearth/index.html.

OSPAR Commission. (2020). The OSPAR Maritime Area and Its Regions. OSPAR Commission. https://www.ospar.org/documents?v=57731.

R Core Team. (2024). "R: A Language and Environment for Statistical Computing." https://www.r-project.org/.

Reeves, R. R., Smeenk, C., Kinze, C. C., Brownell, R. L., Lien, J., Ridgway, S. H., & Harrison, R. (1999). White-beaked dolphin *Lagenorhynchus albirostris* Gray, 1846. Handbook of marine mammals: the second book of dolphins and the porpoises, 6, 1-30.

Reid, J. B., Evans, P. G., & Northridge, S. P. (2003). Atlas of cetacean distribution in north-west European waters. Joint Nature Conservation Committee, Peterborough, UK.

Ripley, B, & Venables, B. (2025). "MASS: Support Functions and Datasets for Venables and Ripley's MASS." https://cran.r-project.org/web/packages/MASS/index.html.

Wickham, H. (2016). Ggplot2: Elegant Graphics for Data Analysis. New York: Springer.

Wickham, H. (2023). "Tidyverse: Easily Install and Load the 'Tidyverse.'" https://cran.r-project.org/web/packages/tidyverse/index.html.

Williamson, M. J., ten Doeschate, M. T., Deaville, R., Brownlow, A. C., & Taylor, N. L. (2021). Cetaceans as sentinels for informing climate change policy in UK waters. Marine Policy, 131, 104634.

Wund, S., Méheust, E., Dars, C., Dabin, W., Demaret, F., Guichard, B., ... & Caurant, F. (2023). Strengthening the health surveillance of marine mammals in the waters of metropolitan France by monitoring strandings. Frontiers in Marine Science, 10, 1116819.

Zuur, A. F., Ieno, E.N., & Elphick, S. C. (2010). "A Protocol for Data Exploration to Avoid Common Statistical Problems." Methods in Ecology and Evolution 1(1): 3–14.

6 Appendix A: proposal 'Information derived from stranded rehabilitated animals'

SEAMARCO (Sea Mammal Research Company)
Applied research for marine conservation

SEAMARCO proposal 2026-03

For ASCOBANS

The biology of White-beaked dolphins (*Lagenorhynchus albirostris*)

Information derived from stranded rehabilitated animals

March 2026

Background
Between 1991 and 1995, four stranded white-beaked dolphins (WBDs) arrived at the rehab center of Dolfinarium Harderwijk. During the rehabilitation and between recovery and return to sea, a large amount of biological data was gathered (some daily, some weekly, and some monthly) which is unique, as since that time no similar data has been gathered. SEAMARCO would like to analyze and publish this information, but needs funding to do so.

The potential topics are:

- Introduction.
- Historic strandings of WBDs on the Dutch coast.
- Rehabilitation and release.
- Food consumption.
- Growth (length and weight).
- Detailed external body measurements relative to body weight.
- Blubber thickness at several locations via ultrasound scanning.
- Initial passage time of food through the digestive tracts.
- Respiration rate.
- Behavior towards conspecifics and harbor porpoises.
- Vocalizations.

Team
Ron Kastelein PhD. SEAMARCO, Nancy Jennings Ph.D., UK, John Terhune, PhD. University of New Brunswick, Canada, Wim Verboom (JunoBioacoustics), and potential other specialists may be consulted.

Relevance of the information
ASCOBANS is focusing on the conservation of the genus *Lagenorhynchus*.

The White-beaked dolphin is also a species included in the Netherlands' National Protection Program.

Dr. Ir. Ron A. Kastelein
Director & owner
SEAMARCO B.V.
Julianalaan 46
3843 CC Harderwijk

Tel: 06.46.11.38.72
rk@seamarco.nl

ABN/AMRO Bank Harderwijk no. 47.71.87.188
IBAN: NL12ABNA0477187188
BIC: ABNANL2A
BTW no: NL 1801.74.733.B01
KvK: Harderwijk no. 53444868
EORI-number: NL180174733