March 2022

Gap analysis in geographical and environmental space

CetAMBICion

Coordinated Cetacean Assessment,
Monitoring and Management Strategy
in the Bay of Biscay and Iberian Coast sub-region

WP 2 - Task 2.1

CetAMBICion Deliverables 2.1a & 2.1b

Version of March 2022

Drafted by:

In the framework of the CetAMBICion project:

Coordinated Cetacean Assessment, Monitoring and Management Strategy in the Bay of Biscay and Iberian Coast sub-region (CetAMBICion).

The CetAMBICion project, coordinated by the Spanish National Research Council (CSIC) and which includes 15 partners from Spain, France and Portugal, aims to strengthen collaboration and scientific work between the three countries to estimate and reduce cetacean bycatch in the subregion “Bay of Biscay and Iberian Coast”, in close collaboration with the fishing industry. Until 2023, the project will work to improve scientific knowledge on population abundance, incidental bycatch and on mitigation measures of the latter.

The project is part of the European Commission's DG ENV/MSFD 2020 (Marine Strategy Framework Directive) call and the objectives are aligned with the Habitats Directive and the Common Fisheries Policy too.

Document Control Sheet

Project	CetAMBICion
Title	Coordinated Cetacean Assessment, Monitoring and Management strategy in the Bay of Biscay and Iberian Coast subregion
Reference	GA No. 110661/2020/839610/SUB/ENV.C2
Coordinator	CSIC
WP	WP2
WP Title	Proposal of coordinated subregional assessment, GES determination and monitoring strategy for cetaceans
Document Type	Deliverable
Document number	CetAMBICion D2.1_V1
Document Name	Gap analysis in geographical and environmental space
Date prepared	2022-02-09
Leader partner	LRUniv/ADERA/AZTI
Participants partners	DGRM; ICNF; IPMA; CHMAR, SEMA; IEO; CSIC; OFB

Executive summary

The three EU MS in the "Bay of Biscay and Iberian Coast" subregion have been involved in a number of projects addressing the abundance of marine mammals in their national waters, a parameter necessary to establish removals limits. There is yet no common methodological approach agreed among the three countries involved, which precludes meaningful comparisons among results on a sub-regional basis as required by the MSFD. In order to advance towards a more comprehensive assessment, the WP2 of CetAMBICion project aims to provide relevant data on descriptors D1C2 (abundance), D1C4 (distribution) and D1C5 (habitat use) of key cetacean species by analysing all together the data collected by the three countries.

To do so, data extracted from ship- and plane-based surveys, using a distance sampling protocol for recording cetacean sightings, were collated. This collation represents the first step to address the objective of WP2 and will be used for modelling cetacean distribution, abundance and habitat in the "Bay of Biscay and Iberian Coast" subregion in the next stage. Distance sampling protocols were selected because the methods allow to account for imperfect detection of cetaceans in the field, and thereby to obtain more accurate density and abundance estimates in modelling. A total of 242,646 km of ecosystemic/multidisciplinary survey effort accomplished between 2005 and 2020 were compiled for WP2: 145,929 km with ships and 96,717 km with planes corresponding to an approximate tally of 55,000 common dolphins; 7,000 bottlenose dolphins; 6,000 striped dolphins; 3,500 long-finned pilot whales; 1,400 fin whales; 500 harbour porpoises; 350 Risso's dolphins, 100 Cuvier's beaked whales; 100 sperm whales and 100 minke whales.

A gap analysis in space and time was carried out to highlight data that are missing for a complete assessment of cetacean distribution, abundance and habitat. There is a gap in data for winter months, and some imbalance between the first 5 years of data compared to the last 10 years. However, these temporal gaps appear moderate to small, and thus, the temporal coverage of the collated data is rather satisfactory. The gap analysis with respect to space reveals a large imbalance in sampling between inshore and offshore areas of the subregion. In addition, sampling in winter was largely biased towards the shelf areas of the Bay of Biscay.

A gap analysis in environmental space (potential habitat) further revealed that environmental coverage of the subregion is unbalanced, with shelf areas being relatively well covered for all months, including the winter months, but with offshore areas being less covered. In practice, most model-based predictions in offshore areas and winter are extrapolations (both in environmental and geographical space). Extrapolations are intrinsically more fragile because they are less informed by data and more model-dependent. As a result, assessments will be less robust.

Recommendations

- Improve geographically coherent sampling of the subregion with surveys also targeting offshore areas;
- Improve temporally coherent sampling of the subregion with surveys in all seasons, and especially in winter;
- Ensure that offshore areas are surveyed in winter at a representative scale for the subregion;
- Strengthen cooperation between France, Portugal and Spain, promoting the creation of regional groups and the use of the same protocols for data collection and analysis; and
- Encourage the participation of all European countries in national and international surveys to estimate the abundance of cetaceans, through the establishment of a European financing program (*e.g.* under DCF) and the creation of groups of experts for the collection and analysis of data (*e.g.* ICES Working Groups).

INDEX

Acronyms and Abbreviations

AZTI: Center of scientific research on marine ecosystems based in the Spanish Basque country (https://www.azti.es/).

BIOMAN: AZTI's ecosystemic survey taking place each year in spring in the MSFD subregion "Bay of Biscay and Iberian Coast".

CODA: Cetacean Offshore Distribution and Abundance, a large-scale ship survey to estimate the abundance and investigate the habitat use of cetacean species in European Atlantic waters beyond the continental shelf that took place in summer 2007.

DSM: Density Surface Model.

EEZ: Exclusive Economic Zone.

ES: Spain.

esw: effective strip width.

EU: European Union.

FR: France.

g(0) : detection probability on the transect line.

GAM: Generalized Additive Model.

GES: Good Environmental Status.

IBERAS: International Survey for the assessment of the strength of the sardine and anchovy recruitment in Atlantic Iberian Waters in autumn. IBERAS is a joint survey from IEO/IPMA.

ICES: International Council for the Exploration of the Sea (https://www.ices.dk/Pages/default.aspx).

Ifremer: 'Institut Français de Recherche pour l'Exploitation de la Mer' (https://wwz.ifremer.fr/).

IEO: Spanish Institute of Oceanography (http://www.ieo.es/es/).

IPMA: Portuguese Institute of Marine and Atmospheric Sciences (Instituto Português do Mar e da Atmosfera, https://www.ipma.pt/pt/index.html).

JUVENA: AZTI's ecosystemic survey taking place each year in autumn in the MSFD subregion "Bay of Biscay and Iberian Coast".

MarPro: Conservation of Marine Protected Species in Mainland Portugal. The MarPro project was a LIFE funded project that aimed to implement the NATURA 2000 network for cetacean and seabird species and their habitats throughout the EEZ of mainland Portugal.

MEGASCOPE: Set of surveys (*e.g.* PELGAS, EVHOE, etc.) of marine megafauna onboard Ifremer's research vessel "Thalassa".

MSFD: Marine Strategy Framework Directive.

ObSERVE: Irish survey of megafauna.

OSPAR: Oslo-Paris convention.

QSR: Quality Status Report.

PELACUS: IEO's ecosystemic survey taking place each year in spring in the north and northwest of the Spanish shelf.

PELAGO: one of the IPMA acoustic surveys for small pelagic fish taking place in spring.

PELGAS: 'Pelagiques Gascogne'; Ifremer's ecosystemic survey taking place each year in spring on the shelf area of the Bay of Biscay to assess stocks of small pelagic fishes such as anchovies and sardines.

PT: Portugal.

SAMM-I: 'Suivi Aérien de la Mégafaune Marine', a plane survey of marine megafauna in the Bay of Biscay that took place in winter 2011 and summer 2012.

SCANS: Small Cetaceans in the European Atlantic and North Sea, large-scale ship and aerial survey to study the distribution and abundance of cetaceans in European Atlantic waters that takes place in summer.

SDM: Species Distribution Model.

VAST: Vector Autoregressive Spatio-Temporal modeling.

WP2: Work package 2 of the CetAMBICion project.

List of Contents

Tables

Figures

Appendices

1. Introduction

The Work Package 2 (WP2) of the CetAMBICion project aims to propose a coordinated subregional assessment, Good Environmental Status (GES) determination and monitoring strategy for cetaceans in the MSFD subregion “Bay of Biscay and Iberian Coast”. Coordination between the three European Union (EU) Member States (MS) with waters belonging to this subregion (namely from South to North, Portugal (PT), Spain (ES), and France (FR)) is key to produce a consistent and coherent assessment of GES for highly mobile species such as cetaceans.

The three EU MS in the subregion have been involved in a number of projects addressing the occurrence and abundance of marine mammals in their national waters. These projects were organized according to scientific priorities and agendas defined at national level or launched as a national contribution to cooperative international studies covering wider marine areas. However, there is yet no common methodological approach agreed among the three countries involved, which precludes meaningful comparisons among results on a sub-regional basis as required by the MSFD.

The general objective of WP2 is to develop the necessary techniques and to implement a coordinated working structure for the regional assessment of cetacean species and their populations, suitable to provide key biological information for the species group ‘marine mammals’ under Descriptor 1, still missing on this subregional scale, thus enabling MSFD assessment under Art. 8 and OSPAR Quality Status Report (QSR 2023[1], appendix I). WP2 seeks to address concerns about lack of reliable data on D1C2 (abundance), D1C3 (demographic parameters), D1C4 (distribution) and D1C5 (habitat use) of key cetacean species. A coordinated assessment requires common data and a data stream that can be leveraged to inform GES, using a common methodology for the three MS.

This action seeks:

- to set up a working platform among the three EU Member States in the subregion (PT, ES, FR) to compare data on relevant cetacean species and shared populations;
- to share information on cetacean biology, habitat use, and both natural and anthropogenic threats;
- to identify current knowledge gaps in the area and to propose adequate solutions;
- to ensure regional consistency for abundance estimates and population studies; and to agree on common GES determination principles and to decide on a coordinated monitoring strategy for cetaceans in the sub-region.

The present report constitutes the first deliverable of WP2 and addresses to some extent the four points above. In particular, it reports on the collation of relevant data to inform MSFD criteria D1C2, D1C4 and D1C5; but also discusses briefly data for D1C3.

[1] https://www.ospar.org/work-areas/cross-cutting-issues/qsr2023

2. Data Call

In 2021, an OSPAR led data call was issued to contracting parties of the convention to collate national data on cetaceans from dedicated and/or multidisciplinary surveys (with cetacean observers) for common indicator M4[2] and the next QSR in 2023. The previous QSR report of 2011 considered the SCANS-I (1994) and SCANS-II/CODA surveys, and the QSR2023 will consider change from QSR 2011. The data provided by FR, ES and PT span the scope of both QSR and were further mobilized for the CetAMBIcion project to avoid duplication of effort. Data from the international SCANS and CODA surveys taking place in 2005, 2007 and 2016 were included in WP2: they cover the North-East Atlantic, including the MSFD subregion of interest (Appendix 0). The Irish ObSERVE surveys of 2015 and 2016 were also included (Appendix 0): despite covering another MSFD subregion, the high mobility of cetaceans in the North-East Atlantic justifies the inclusion of these data in model fitting to cover (i) the whole range of the currently recognized management units of cetaceans (Appendix 1), and (ii) as much as possible the potential habitats of some species, thereby avoiding gaps especially in environmental space (see **section 5.2**). The collated data from dedicated cetacean surveys and ecosystemic/multidisciplinary surveys since 2005 carried out in the North-East Atlantic are summarized in Table 1.

Table 1: Data from dedicated cetacean surveys and ecosystemic/multidisciplinary surveys since 2005 carried out in the North-East Atlantic.

Member States	Survey name	Year	Season	Platform	Bay Of Biscay and Iberian Coast
Portugal	MARPRO	2011-2015	Autumn	Plane	inside
Portugal/Spain	IBERAS	2019	Autumn	Ship	inside
Spain	PELACUS	2007-2020	Spring	Ship	inside
	JUVENA	2012-2020	Autumn	Ship	inside
	BIOMAN	2016-2020	Spring	Ship	inside
France	PELGAS	2005-2019	Spring	Ship	inside
	IBTS	2007-2020	Winter	Ship	outside
	EVHOE	2009-2020	Autumn	Ship	inside
	CAMANOC	2014	Autumn	Ship	outside
	CGFS	2015-2019	Autumn	Ship	outside
	SAMM-I	2011-2012	All	Plane	inside
	DUNKRISK	2017-2018	Winter-Summer	Plane	outside
	SPEE	2019-2020	All	Plane	inside
	CAPECET	2020	Winter-Spring	Plane	inside
Ireland	ObSERVE	2015-2016	All	Plane	outside
EU	SCANS-II	2005	Summer	Plane/Ship	partially inside
	CODA	2007	Summer	Ship	partially inside
	SCANS-III	2016	Summer	Plane/Ship	partially inside

[2] OSPAR common indicator M4, Abundance and distribution of cetaceans, is led by the Netherlands and co-led by France ; https://www.ospar.org/work-areas/bdc/biodiversity-monitoring-assessment-1/biodiversity-common-indicators

Ecosystemic/multidisciplinary survey effort data (transects) from surveys covering the subregion "Bay of Biscay and Iberian Coast" are depicted on Figure 1.

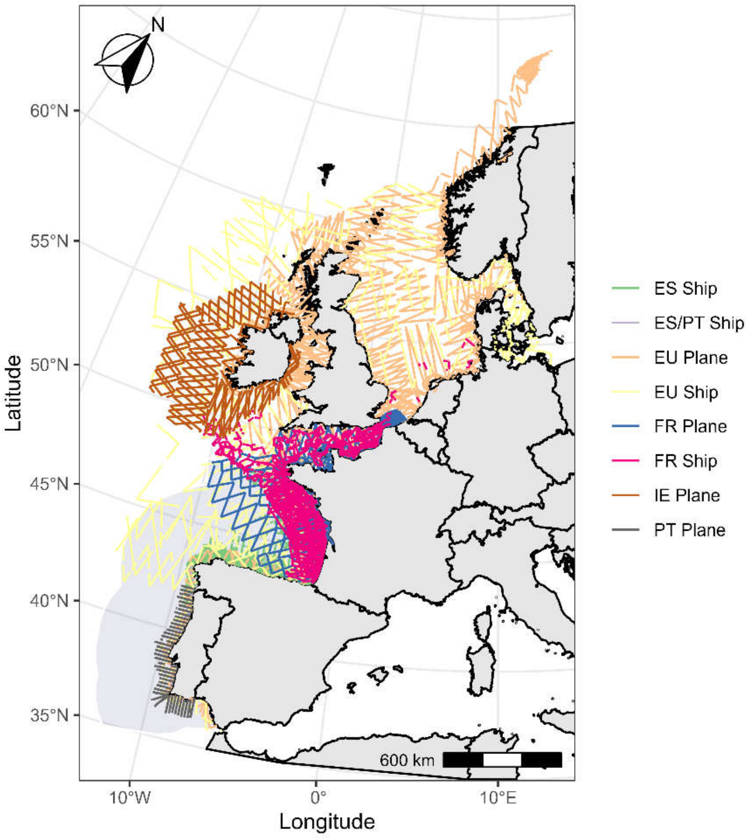


Figure 1: Data from dedicated cetacean surveys and ecosystemic/multidisciplinary surveys since 2005 carried out in the North-East Atlantic and included in the compiled dataset. EU surveys refer to the SCANS and CODA surveys. Surveys are either boat- or plane-based. The MSFD subregion "Bay of Biscay and Iberian Coast" is depicted in light blue.

Data snapshots per partners are detailed below:

Spain

Data from the PELACUS, JUVENA, and BIOMAN ecosystemic/multidisciplinary surveys were included (Table 1; Figure 2).

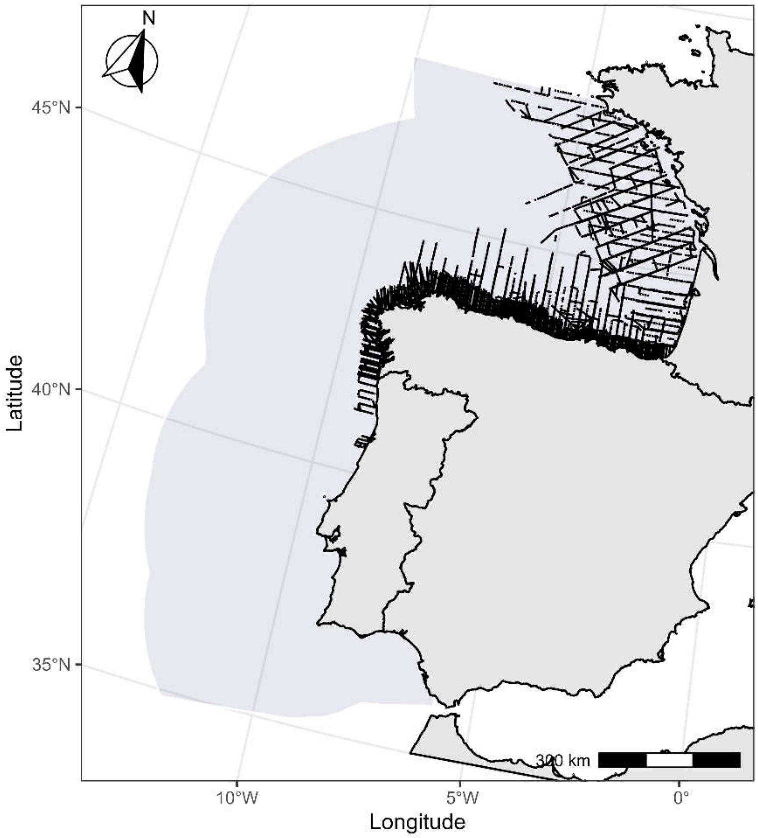


Figure 2: Ecosystemic/multidisciplinary survey data from the JUVENA, PELACUS and BIOMAN surveys in the MSFD subregion "Bay of Biscay and Iberian Coast".

Most of the data collected by Spanish partners are within ICES divisions 27.8.a, 27.8.b and 27.8.c. The shelf part of the Bay of Biscay and the Iberian Coast are the area most sampled by the JUVENA, PELACUS and BIOMAN[3] ecosystemic/multidisciplinary surveys, which are all boat-based and led by IEO (Saavedra et al., 2018) or AZTI (García-Barón et al., 2019). The IBERAS survey, although covering part of the Spanish EEZ in the "Bay of Biscay and Iberian Coast" is not depicted on Figure 2 (but see the paragraph below on Portuguese surveys).

[3] https://www.azti.es/en/proyectos/bioman-y-juvena/

France

Data from the MEGASCOPE program and SAMM-I surveys were included (Table 1; Figure 3).

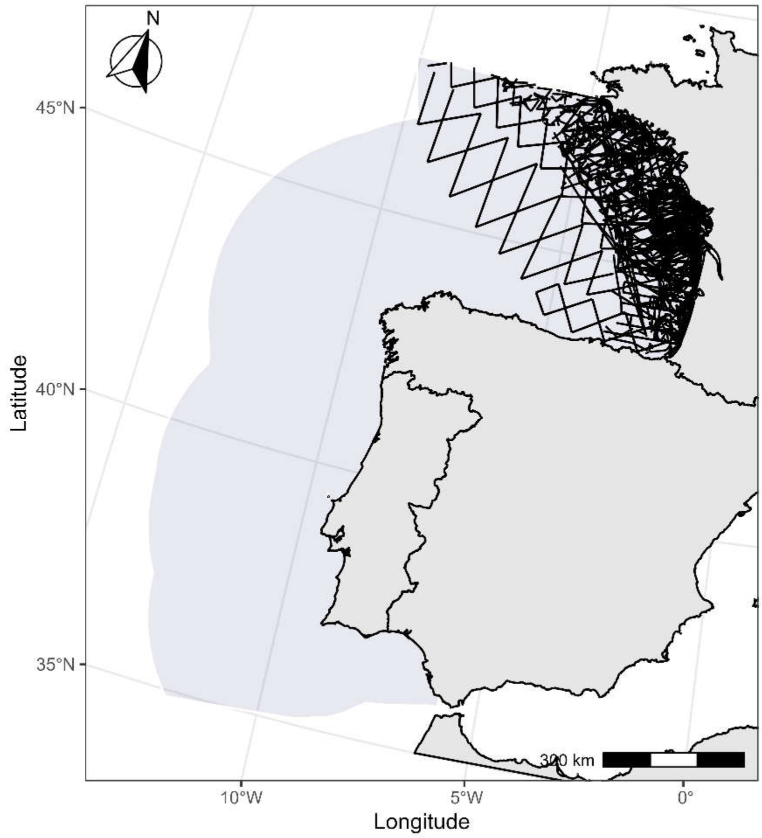


Figure 3: Ecosystemic/multidisciplinary survey data from the MEGASCOPE program and SAMM-I surveys in the MSFD subregion "Bay of Biscay and Iberian Coast".

Most of the data collected by French partners are within ICES divisions 27.8.a and 27.8.b. The shelf part of the Bay of Biscay is the area most sampled by the French surveys, in particular those that are part of the MEGASCOPE program (*e.g.* PELGAS, EVHOE): they are part of the Ifremer ecosystemic/multidisciplinary surveys (Doray et al. 2018). The few transects in the offshore areas of the Bay of Biscay were realized by plane during the SAMM surveys in 2011 and 2012 (Laran et al. 2017).

Portugal

Data from the IBERAS and MarPro surveys were included (Table 1; Figure 4).

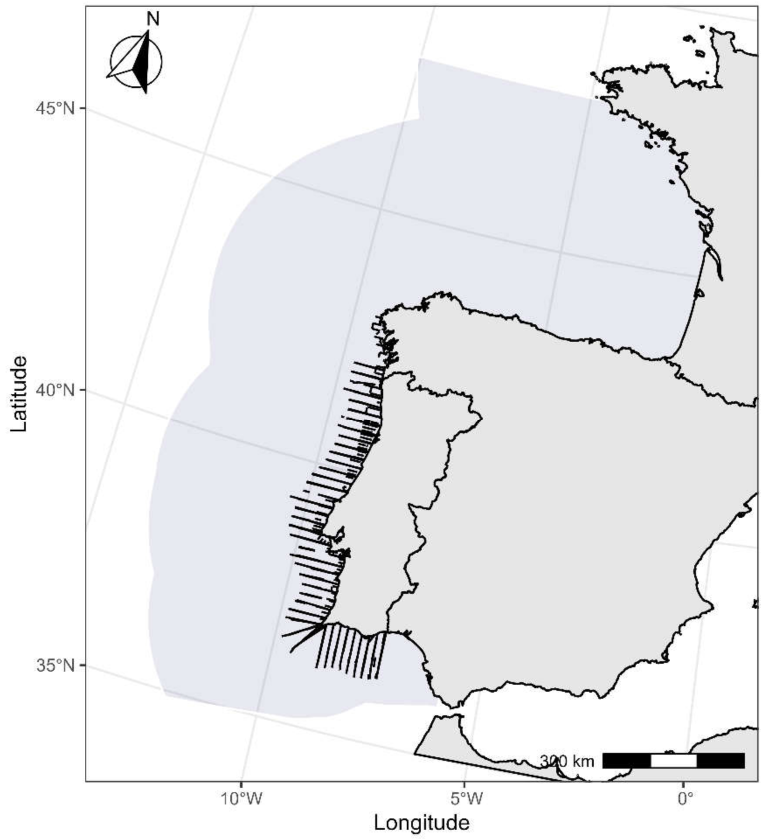


Figure 4: Ecosystemic/multidisciplinary survey data from the IBERAS and MarPro surveys in the MSFD subregion "Bay of Biscay and Iberian Coast".

IBERAS main objective is to get a recruitment index for both sardines and anchovies in Atlantic waters of the Iberian Peninsula. During daylight hours, a trained observer also recorded marine mammals. The MarPro surveys (Conservation of Marine Protected Species in Mainland Portugal[4]) were carried out between 2011 and 2015 (Table 1): they were plane surveys aimed to strengthen the knowledge on cetaceans and to inform the implementation of appropriate management measures.

[4] https://life.apambiente.pt/content/conservation-marine-protected-species-mainland-portugal

International Surveys

Data from the SCANS-II[5], CODA[6] and SCANS-III surveys[7] were included in the data collated for WP2 (Table 1; Figure 5). The SCANS-II survey covered the Belt Sea, North Sea, Western Scotland, the shelf area of the Celtic Seas, Bay of Biscay and Iberian Coast in 2005. The CODA survey covered the offshore areas of the Bay of Biscay in 2007. The SCANS-III survey covered the Belt Sea, North Sea, Western Scotland, the shelf area of the Bay of Biscay and Iberian Coast in 2016.

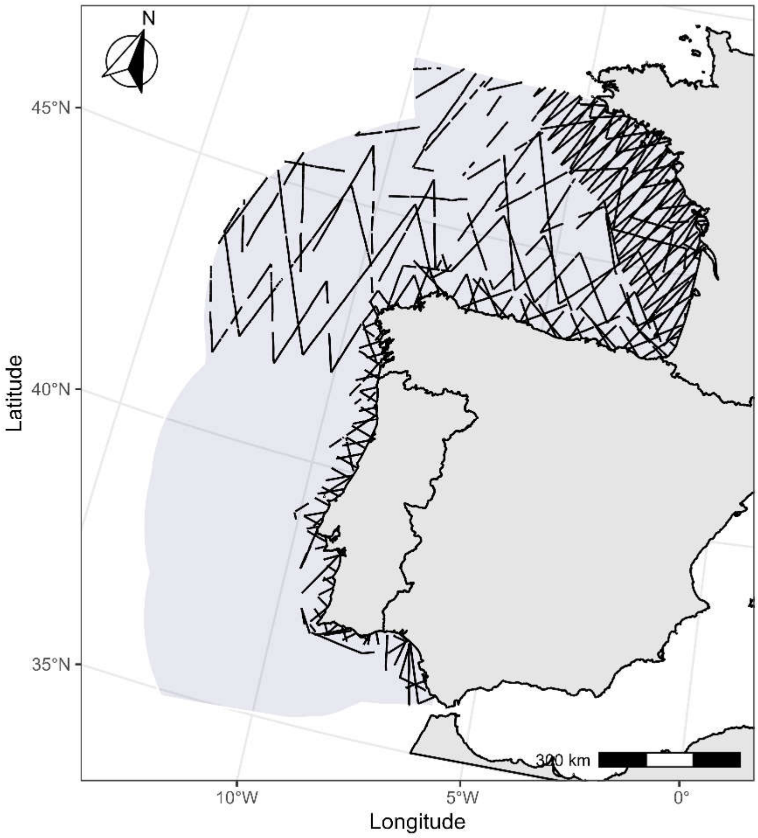


Figure 5: Dedicated cetacean survey data from the SCANS-II, CODA and SCANS-III surveys in the MSFD subregion "Bay of Biscay and Iberian Coast".

Figure 5 shows only the portion of survey effort from the international surveys (SCANS-II, CODA and SCANS-III) that fall within the MSFD subregion "Bay of Biscay and Iberian Coast". More data from these surveys are available though (Figure 1) and have been formatted for WP 2.

[5] https://biology.st-andrews.ac.uk/scans2/
[6] https://biology.st-andrews.ac.uk/coda/
[7] https://synergy.st-andrews.ac.uk/scans3/

3. Summary of the cetacean sighting and survey effort data

All the effort data collated for WP2 come for surveys (either ship- or plane-based, depending on the platform used) that share a common protocol for recording cetacean sightings, namely all these surveys implement distance sampling (Buckland et al. 1993). Distance sampling methods allow to account for imperfect detection of cetaceans in the field, and thereby to obtain more accurate density and abundance estimates. Including data collected on surveys that do not implement a distance sampling protocol to collect data is beyond the current scope of WP2 as it would require substantial time to prepare the data first and then to include it in a statistically sound way (but see Pacifici et al. 2017; Isaac et al. 2020; Martino et al. 2021). These data are further discussed in **Section 6** below.

Summary statistics for the ecosystemic/multidisciplinary survey effort and sightings are displayed below for ship and plane surveys respectively across a panel of 10 species of cetaceans, spanning the three recognized functional groups according to the Commission Decision (EU) 2017/848[8]. The ten species are in Table 2.

Table 2: Panel of the most commonly sighted cetacean species registered in the MSFD subregion "Bay of Biscay and Iberian Coast".

Functional group	Scientific name	Vernacular name
Small odontocetes	*Delphinus delphis*	Common dolphin
	Stenella coeruleoalba	Striped dolphin
	Tursiops truncatus	Bottlenose dolphin
	Phocoena phocoena	Harbour porpoise
Deep divers	*Globicephala melas*	Long-finned pilot whale
	Grampus griseus	Risso's dolphin
	Ziphius cavirostris	Cuvier's beaked whale
	Physeter macrocephalus	Sperm whale
Baleen whales	*Balaenoptera physalus*	Fin whale
	Balaenoptera acutorostrata	Minke whale

These summary statistics are further stratified by year and season for each platform (plane- or ship-based; Tables 3 and 4). These data, which include the international surveys, have been formatted into segments of approximatively 10km of length with homogenous detection conditions for Density Surface Modelling (Miller et al. 2013). Please note that these summary statistics refer to the data that belong strictly to the MSFD subregion "Bay of Biscay and Iberian Coast". More data are available for modelling at a larger scale (see Figure 1). These data may be used in fitting models in order to cover the whole possible range of habitats used by cetacean species.

[8] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32017D0848

Table 3: Number of segments with sightings of cetaceans (**_seg**) and number of cetaceans detected (**_ind**) for ship surveys in the collated WP2 dataset on MSFD subregion "Bay of Biscay and Iberian Coast". Data from both national and international surveys are included (see Table 1). Species codes are ddel: Common dolphin (*Delphinus delphis*); scoe: striped dolphin (*Stenella coeruleoalba*); ttru: bottlenose dolphin (*Tursiops truncatus*); gmel: long-finned pilot whale (*Globicephala melas*); ggri: Risso's dolphin (*Grampus griseus*); bphy: fin whale (*Balaenoptera physalus*); bacu: minke whale (*Balaenoptera acutorostrata*); zcav: Curvier's beaked whales (*Ziphius cavirostris*); ppho: harbour porpoises (*Phocoena phocoena*); pmac: sperm whale (*Physeter macrocephalus*). Table continues on next page.

Platform	Year	Season	Effort (km)	ddel seg	ddel ind	scoe seg	scoe ind	ttru seg	ttru ind	gmel seg	gmel ind	ggri seg	ggri ind	bphy seg	bphy ind	bacu seg	bacu ind	zcav seg	zcav ind	ppho seg	ppho ind	pmac seg	pmac ind
Ship	2005	spring	979	3	100	0	0	4	65	2	8	0	0	0	0	0	0	0	0	0	0	0	0
Ship	2005	summer	4108	42	953	3	69	7	43	6	28	2	3	1	1	0	0	4	10	4	8	0	0
Ship	2006	spring	3887	9	175	2	40	20	232	9	114	2	22	0	0	0	0	0	0	0	0	0	0
Ship	2007	spring	6121	12	199	1	10	15	307	8	104	0	0	1	1	2	2	0	0	0	0	0	0
Ship	2007	summer	4280	38	855	20	441	3	16	3	6	0	0	97	179	1	1	5	11	0	0	17	30
Ship	2008	spring	6929	38	869	7	292	11	229	12	233	3	8	0	0	3	4	0	0	0	0	1	1
Ship	2009	autumn	450	6	573	0	0	1	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Ship	2009	spring	7399	33	1367	1	20	21	471	20	467	1	1	0	0	1	1	0	0	0	0	3	6
Ship	2009	summer	490	0	0	0	0	5	350	6	115	0	0	1	3	0	0	0	0	0	0	0	0
Ship	2010	autumn	1058	19	806	0	0	2	75	3	21	0	0	0	0	0	0	0	0	0	0	0	0
Ship	2010	spring	7503	24	661	1	50	18	474	7	112	3	12	0	0	3	4	0	0	0	0	2	2
Ship	2010	summer	474	9	938	1	60	4	48	3	22	1	48	1	7	0	0	0	0	0	0	0	0
Ship	2011	autumn	1230	8	59	0	0	0	0	0	0	1	5	0	0	0	0	0	0	0	0	0	0
Ship	2011	spring	6254	28	877	2	60	4	74	11	239	0	0	0	0	0	0	0	0	0	0	0	0
Ship	2011	summer	386	2	60	0	0	2	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ship	2012	autumn	2804	37	815	5	121	8	236	6	112	0	0	3	6	0	0	0	0	0	0	1	14
Ship	2012	spring	6474	27	715	3	56	15	115	7	70	5	21	11	21	7	11	0	0	0	0	3	9

Table 3 (continued from previous page): Number of segments with sightings of cetaceans (**_seg**) and number of cetaceans detected (**_ind**) for ship surveys in the collated WP2 dataset on MSFD subregion "Bay of Biscay and Iberian Coast". Data from both national and international surveys are included (see Table 1). Species codes are ddel: Common dolphin (*Delphinus delphis*); scoe: striped dolphin (*Stenella coeruleoalba*); ttru: bottlenose dolphin (*Tursiops truncatus*); gmel: long-finned pilot whale (*Globicephala melas*); ggri: Risso's dolphin (*Grampus griseus*); bphy: fin whale (*Balaenoptera physalus*); bacu: minke whale (*Balaenoptera acutorostrata*); zcav: Curvier's beaked whales (*Ziphius cavirostris*); ppho: harbour porpoises (*Phocoena phocoena*); pmac: sperm whale (*Physeter macrocephalus*).

Platform	Year	Season	Effort (km)	ddel seg	ddel ind	scoe seg	scoe ind	ttru seg	ttru ind	gmel seg	gmel ind	ggri seg	ggri ind	bphy seg	bphy ind	bacu seg	bacu ind	zcav seg	zcav ind	ppho seg	ppho ind	pmac seg	pmac ind
Ship	2013	autumn	2784	40	862	15	171	8	78	6	36	0	0	6	16	2	3	0	0	0	0	1	1
Ship	2013	spring	6416	22	772	1	20	7	171	10	172	0	0	0	0	0	0	0	0	0	0	2	11
Ship	2014	autumn	4253	47	1349	19	546	8	227	13	65	1	3	17	26	2	2	5	9	0	0	0	0
Ship	2014	spring	6311	34	665	0	0	24	525	18	354	0	0	1	3	4	5	0	0	0	0	0	0
Ship	2015	autumn	3677	32	908	12	100	7	62	10	100	0	0	28	59	0	0	2	2	0	0	2	4
Ship	2015	spring	6176	17	580	0	0	16	222	14	64	0	0	2	2	1	1	0	0	0	0	0	0
Ship	2015	summer	184	3	53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ship	2016	autumn	3467	53	1819	17	308	6	108	4	13	4	10	31	75	0	0	0	0	0	0	0	0
Ship	2016	spring	7619	44	1113	4	104	23	695	12	116	1	5	8	12	3	3	0	0	0	0	0	0
Ship	2016	summer	6052	26	300	43	816	9	37	17	88	2	4	259	699	0	0	15	24	0	0	7	9
Ship	2017	autumn	2573	59	1479	2	19	8	125	1	2	0	0	17	28	0	0	2	2	0	0	0	0
Ship	2017	spring	8097	54	1380	11	122	19	266	8	90	0	0	0	0	1	1	0	0	0	0	0	0
Ship	2018	autumn	3605	37	1882	8	586	3	25	0	0	1	1	29	130	0	0	1	4	0	0	0	0
Ship	2018	spring	8173	66	879	4	68	14	180	11	96	2	12	8	12	4	4	0	0	0	0	0	0
Ship	2019	autumn	3817	73	1166	6	86	4	33	3	32	0	0	17	27	9	11	0	0	0	0	0	0
Ship	2019	spring	7588	48	2275	3	165	21	537	8	67	2	13	5	13	5	6	0	0	0	0	1	1
Ship	2020	autumn	2110	35	588	5	36	2	15	0	0	0	0	3	3	0	0	0	0	0	0	0	0
Ship	2020	spring	2204	33	1090	4	44	3	58	5	114	1	12	3	5	0	0	3	7	0	0	2	3

Table 4: Number of segments with sightings of cetaceans (**_seg**) and number of cetaceans detected (**_ind**) for plane surveys in the collated WP2 dataset on MSFD subregion "Bay of Biscay and Iberian Coast". Data from both national and international surveys are included (see Table 1). Species codes are ddel: Common dolphin (*Delphinus delphis*); scoe: striped dolphin (*Stenella coeruleoalba*); ttru: bottlenose dolphin (*Tursiops truncatus*); gmel: long-finned pilot whale (*Globicephala melas*); ggri: Risso's dolphin (*Grampus griseus*); bphy: fin whale (*Balaenoptera physalus*); bacu: minke whale (*Balaenoptera acutorostrata*); zcav: Curvier's beaked whales (*Ziphius cavirostris*); ppho: harbour porpoises (*Phocoena phocoena*); pmac: sperm whale (*Physeter macrocephalus*).

Platform	Year	Season	Effort (km)	ddel seg	ddel ind	scoe seg	scoe ind	ttru seg	ttru ind	gmel seg	gmel ind	ggri seg	ggri ind	bphy seg	bphy ind	bacu seg	bacu ind	zcav seg	zcav ind	ppho seg	ppho ind	pmac seg	pmac ind
Plane	2005	summer	1673	4	5	1	2	3	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plane	2011	autumn	5307	46	1011	5	657	10	102	4	30	3	15	5	5	5	7	2	6	19	46	0	0
Plane	2011	winter	2496	26	490	0	0	4	28	0	0	1	2	0	0	0	0	0	0	7	16	0	0
Plane	2012	autumn	1848	7	1362	5	230	1	20	1	15	0	0	3	8	4	5	0	0	1	3	0	0
Plane	2012	spring	3239	7	110	0	0	0	0	0	0	0	0	0	0	3	3	0	0	11	12	0	0
Plane	2012	summer	17546	188	11587	2	66	38	214	25	158	11	49	16	20	5	5	13	24	36	104	3	6
Plane	2012	winter	12983	69	1969	4	115	25	223	13	40	3	11	3	3	0	0	5	10	17	25	4	5
Plane	2013	autumn	1929	31	1372	4	233	4	139	0	0	1	2	3	3	6	7	0	0	9	25	0	0
Plane	2014	autumn	2056	43	3627	8	257	6	108	5	105	0	0	6	21	6	6	2	2	6	10	1	1
Plane	2015	autumn	1696	29	1104	3	78	4	21	3	72	4	16	3	4	3	3	0	0	7	15	1	2
Plane	2016	summer	12852	163	4162	8	272	22	175	8	48	7	37	2	2	2	2	5	11	16	21	0	0
Plane	2019	autumn	3204	4	47	0	0	2	8	0	0	2	20	0	0	0	0	0	0	10	29	0	0
Plane	2019	spring	1643	7	41	0	0	0	0	0	0	1	1	0	0	0	0	0	0	10	11	0	0
Plane	2019	summer	5002	19	188	1	14	10	33	0	0	0	0	0	0	1	1	0	0	8	12	0	0
Plane	2019	winter	3176	24	195	0	0	8	36	0	0	0	0	0	0	0	0	0	0	28	53	0	0
Plane	2020	autumn	3465	2	16	0	0	6	22	0	0	0	0	0	0	0	0	0	0	3	5	0	0
Plane	2020	spring	5044	12	389	0	0	5	47	1	3	1	2	0	0	0	0	0	0	17	39	0	0
Plane	2020	summer	3332	7	77	0	0	7	23	0	0	0	0	1	1	0	0	0	0	7	13	0	0
Plane	2020	winter	8225	24	250	0	0	1	1	0	0	1	19	0	0	0	0	0	0	20	51	0	0

A total of 242,646 km of ecosystemic/multidisciplinary survey effort accomplished between 2005 and 2020 were collated for WP2: 145,929 km with ships and 96,717 km with planes. These data include portion of international surveys that fall within MSFD subregion "Bay of Biscay and Iberian Coast". In terms of numbers of individuals per species (Table 2), these data represent:

- 57,184 common dolphins,
- 9,587 unidentified small delphinids (either common or striped dolphins),
- 7,372 bottlenose dolphins,
- 6,334 striped dolphins,
- 3,533 long-finned pilot whales,
- 1,395 fin whales,
- 498 harbour porpoises,
- 354 Risso's dolphins,
- 122 Cuvier's beaked whales,
- 105 sperm whales, and
- 98 minke whales.

These data are geo-referenced and represent a total of 27,490 segments of ecosystemic/multidisciplinary survey effort (lines in a dataframe). These data are stored and are available to CetAMBICion partners as part of WP2 (Appendix 2).

For further analysis and estimation of abundance (D1C2), distribution (D1C4) and habitat (D1C5) of cetaceans, environmental covariates were extracted for each of these segments, including also ecosystemic/multidisciplinary survey effort and sighting data that were collected outside the MSFD subregion "Bay of Biscay and Iberian Coast" (*e.g.* the Irish ObSERVE surveys[9] in the MSFD subregion "Celtic Seas"). The added-value of considering these additional data is to calibrate statistical models with as much relevant data as possible to improve both accuracy and precision of outputs. The complete data amount to 52,005 segments of ecosystemic/multidisciplinary survey effort (Figure 1), of which 53% falls within the MSFD subregion "Bay of Biscay and Iberian Coast".

[9] https://www.gov.ie/en/publication/12374-observe-programme/

4. Environmental covariates

The use of physiographic and oceanographic variables to predict cetacean distribution or abundance has been explored in several previous studies. As marine mobile predators, cetaceans have a dynamic distribution integrating ecological processes across all levels of the trophic web (Croll et al. 1998, Barlow et al. 2020). Within their physiologic limits and needs, food availability play a major role in the habitat selection of cetacean species (Benoit-Bird & Au, 2003; Hastie et al., 2004; Frederiksen et al., 2006). The distribution of the prey of cetaceans, such as fish, is notoriously variable in both space and time (Hyrenbach et al. 2000). Prey distribution and abundances are hard to measure directly *in situ* (Guisan & Zimmermann, 2000) but can be correlated with other, easier to remotely sensed, environmental variables. The latter may be used as proxies, even if they are not always directly and causally related with animal presence (Redfern et al., 2006).

Oceanographic and physiographic predictors are relevant to predict cetacean distribution and abundance (Forney 2020). Physiographic features, such as depth, slope, aspect of the sea floor or substrate nature, can influence strongly the distribution of benthic or demersal prey species. For prey species, such as pelagic fish or cephalopods, physiography could influence indirectly their distribution via mechanisms such as topographically induced up-welling of nutrients, enhanced primary production and aggregation of zoo-plankton due to the enhanced secondary production or convergence of surface waters (Bakun 1997, Bakun 2006). Oceanographic predictors reveal fronts where mixing water masses enhance the nutrient supply to the euphotic zone, thus increasing primary production and prey aggregation. Bottom-up oceanographic processes that increase prey accessibility can be hotspots for marine megafauna (Vlietstra et al., 2005). Meso and submesoscale processes like fronts, upwelling or eddies enhance enrichment, concentration and retention of nutrients can also facilitate the development of trophic networks, from phytoplankton to zooplankton, fish, and finally apex predators (Bakun 1997, 2006). Many of these processes however occur in variable time intervals, and cetacean distribution across oceanographically dynamic areas may occur at variable temporal intervals, from bi-weekly to seasonally (Cox et al., 2017). Physiographic predictors are static and oceanographic predictors are dynamic, relating to water mass movements, prey availability and the presence of time-stable structures such as temperature gradients or eddies at a monthly resolution (Virgili et al., 2019).

A candidate set of predictors was selected from a literature review (Pigeault 2021) and considering the availability in EMODnet and Copernicus (Table 5, Figure 6). These covariates are to be used in modelling the distribution and abundance of cetaceans in the subregion of interest (Figure 6). A monthly resolution for dynamic covariates was chosen, partly out of convenience to limit the time consuming task of extracting these environmental data and matching them to cetacean sighting and ecosystemic/multidisciplinary survey effort data. The choice of a monthly resolution is also practical as it will allow, upon successful modelling, obtaining monthly maps.

<u>Table 5:</u> Candidate environmental predictors used for the cetacean distribution modelling. Source A: EMODnet DTM (https://www.emodnet-bathymetry.eu/). Slope, aspect and topography complexity index were derived from the bathymetry data with *terrain* function in package *raster* () in statistical software R. Source B: Copernicus database (https://resources.marine.copernicus.eu). SST gradients were calculated from SST means, using DetectFronts function (*grec* package; Lau-Medrano 2020).

Environmental variable		Original spatial resolution	Original temporal resolution	Spatial prediction resolution	Temporal prediction resolution	Source	Justification
Physiographic	Bathymetry (m)	1/16 arc minute	NA	10 km	NA	EMODnet DTM (A)	Deep-divers feed on squids and fish in the deep water column
	Slope (rad)						Associated with currents, high slopes induce enhanced primary production or prey aggregation
	Aspect (rad)						Describe currents and prominent structures such as canyons, seamounts or mountain chains, used as proxies for predator hotspots and useful in locations where access to biological data is limited
Oceanographic	Sea surface temperature (SST) mean (°C) and gradient (°C/m)	0.083 degree	Monthly	10 km	Monthly	Copernicus (B)	Variability over time and horizontal gradients of SST reveal front locations, mixing of water and is associated with enhanced primary production and prey aggregations
	Eddy kinetic Energy (EKE ; m/s)						High EKE relates to the development of eddies, upwelling of nutrients and enhanced primary production, which induce prey aggregation
	Net primary productivity (NPPV ; $mg.m^{-3}.day^{-1}$)	0.25 degree					Net primary production is a proxy of zooplankton distribution, feeding cetacean preys

5. Methods and results

Following data collation, a gap analysis in space and time has been carried out to highlight current gaps in the data on cetaceans (Figure 6).

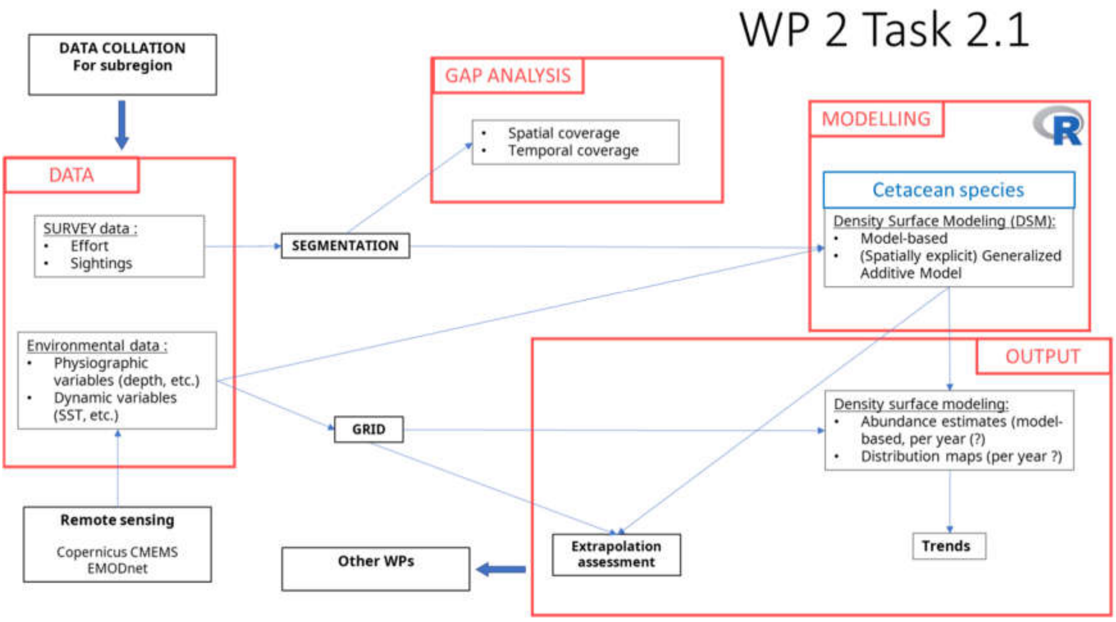


Figure 6: Flowchart of Task 2.1 within WP2. Question marks in the Output box flag standing questions to be discussed (among others) among partners.

5.1 Gap analysis in space and time

A gap analysis in space and time was carried out to assess data that may be missing for a complete assessment of cetacean distribution, abundance and habitat.

The temporal pattern in ecosystemic/multidisciplinary survey effort is displayed in Figure 7. The majority of ecosystemic/multidisciplinary survey effort is concentrated in spring: this is due to the timing of the PELGAS, PELACUS and BIOMAN surveys, which started in 2003, 2007 and 2016 respectively, to collect data on cetaceans (Table 1). Summer months, and July in particular, are also well covered. The peak in ecosystemic/multidisciplinary survey effort in July is due to the international surveys, such as SCANS and CODA. The month with the least ecosystemic/multidisciplinary survey effort is December. This may be easily explained with the difficult conditions for at sea observation in winter and with end of year celebrations which may deter from carrying out regular surveys at this time of the year. For all other month (and pooling all years), approx. 10,000 km of ecosystemic/multidisciplinary survey effort are available (Figure 7A). With respect to year, an overall increase in ecosystemic/multidisciplinary survey effort is manifest between 2005 and 2020 (Figure 7B). From 2010 onwards, at least 10,000 km of ecosystemic/multidisciplinary survey effort are available for each year, with peaks during 2012 and 2016 corresponding to the SAMM and SCANS-III surveys.

From this descriptive analysis, it can be concluded that there is a small gap in data for winter months, and some imbalance between the first 5 years of data compared to the last 10 years. However, these temporal gaps appear moderate to small. The temporal coverage of the collated data is rather satisfactory.

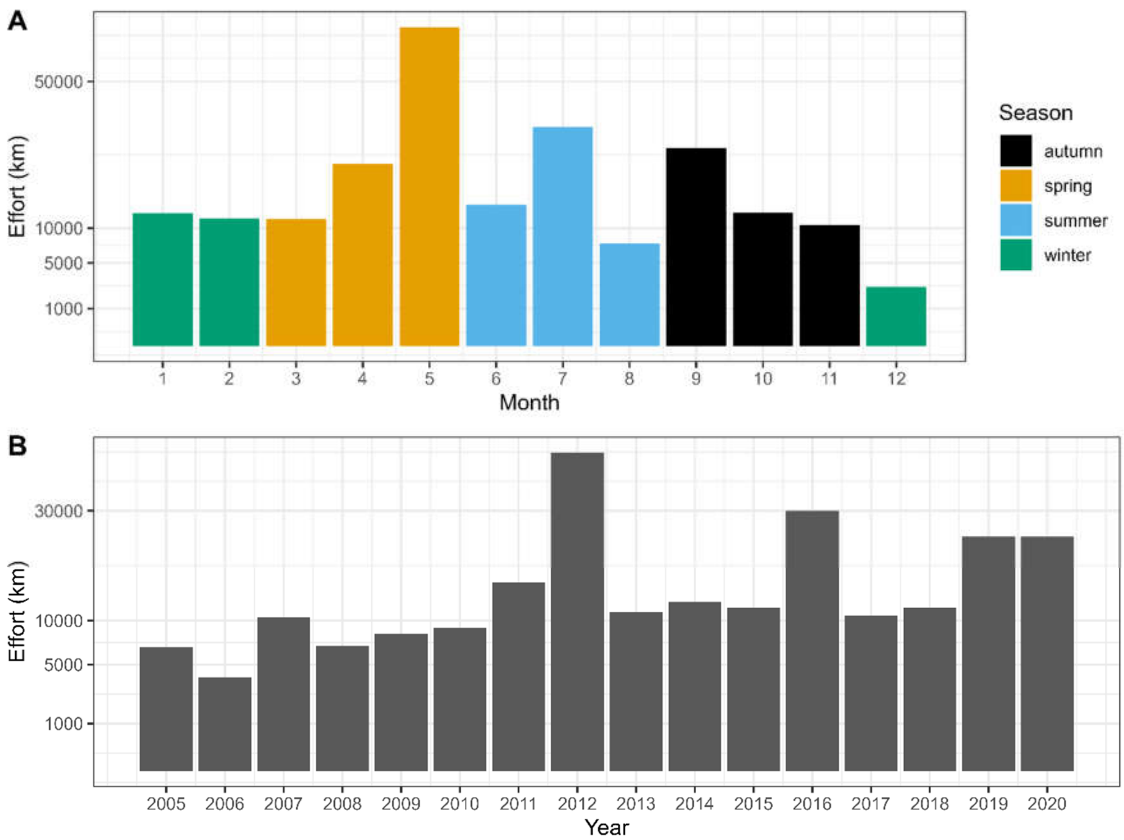


Figure 7: Temporal pattern in ecosystemic/multidisciplinary survey effort in the MSFD subregion "Bay of Biscay and Iberian Coast" for each season (A) and each year (B) between 2005 and 2020 in the collated dataset for WP2.

The gap analysis with respect to space reveals, on the other hand, a much more problematic imbalance in the collated data (Figure 8).

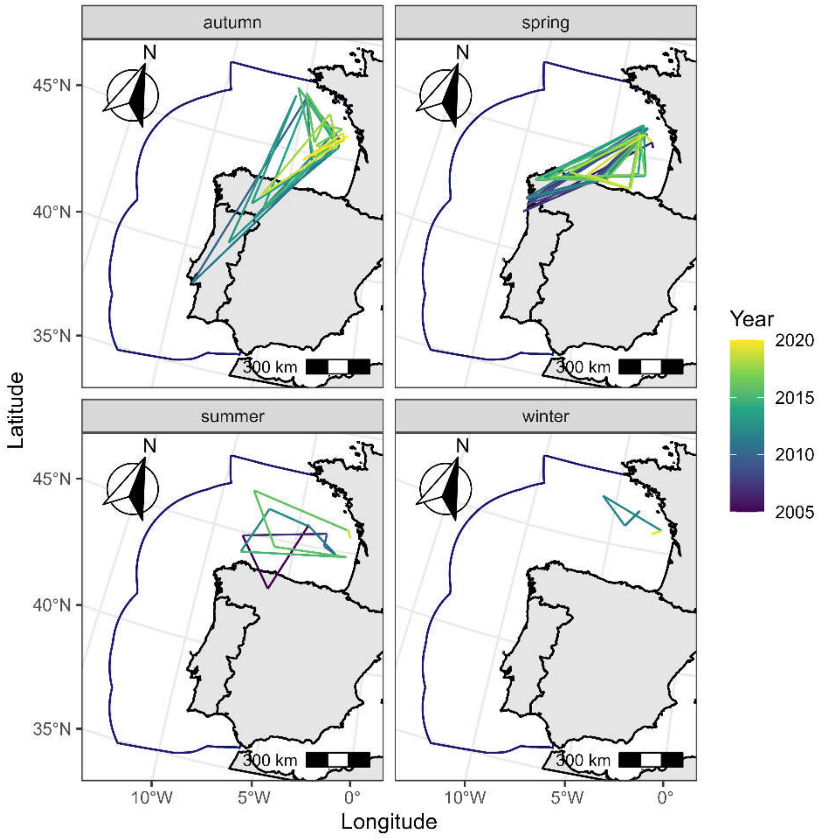


Figure 8: Centroids of ecosystemic/multidisciplinary survey effort in the MSFD subregion "Bay of Biscay and Iberian Coast" for each season and each year between 2005 and 2020 in the collated dataset for WP2.

For the gap analysis in geographical space, the centroids of all segments of effort in a given year and season were computed and mapped onto the MSFD subregion "Bay of Biscay and Iberian Coast" (Figure 8, see also Appendix 3). This map reveals a spatial coverage that is largely biased towards the shelf areas of the Bay of Biscay, especially in winter. In this season, there appears to have little ecosystemic/multidisciplinary survey effort on the Iberian Coast and in the area offshore PT. In general, the latter is not covered by surveys included the collated dataset for WP2. This spatial gap analysis reveals an imbalance between offshore and inshore areas within the MSFD subregion: the offshore areas are much less covered than the inshore areas. Only in summer are offshore areas in the Bay of Biscay more covered with the SCANS and CODA surveys. This spatial gap analysis reveals a lack of data for offshore areas, especially offshore PT.

5.2 Extrapolation in environmental space

The gap analysis focuses on spatio-temporal coverage, that is on data gaps in geographical space (Figure 8) and time (Figure 7). The MSFD subregion "Bay of Biscay and Iberian Coast", in which cetaceans spend their life cycles, or part thereof, is a dynamic and complex ecosystem (Tew Kai et al. 2020). This ecosystem can be described with environmental variables (Table 5) defining thereby a new topology, or environmental space, which can be studied with geometric tools such as distances (not necessarily Euclidean) and hulls. An extrapolation analysis in this environmental space can assess how the data is covering the environmental space (Authier et al. 2017; Bouchet et al. 2019). This analysis is informative on how pervasive extrapolation may be when predicting cetacean abundance, distribution and habitat from a DSM or SDM.

An extrapolation analysis involves comparing convex polygons in environmental space: a first polygon is obtained with the survey effort data by taking all segments of effort and their associated **environmental covariates** (hereafter the calibration data). A second polygon is obtained from environmental data collected in the whole area for which a distribution/abundance/habitat map is desired. It is important to note that this geographic area (*e.g.* the whole "Bay of Biscay and Iberian Coast") is usually much larger than the geographic area covered by surveys (*e.g.* Figures 2, 3 and 4). Figure 9 shows within the MSFD subregion "Bay of Biscay and Iberian Coast", geographical sampling imbalance. Maps covering the whole subregion are sought but some areas have not been surveyed in the collated data. Thus, the geographic area covering the whole subregion for which a prediction is sought is larger than the geographic area covered by the data.

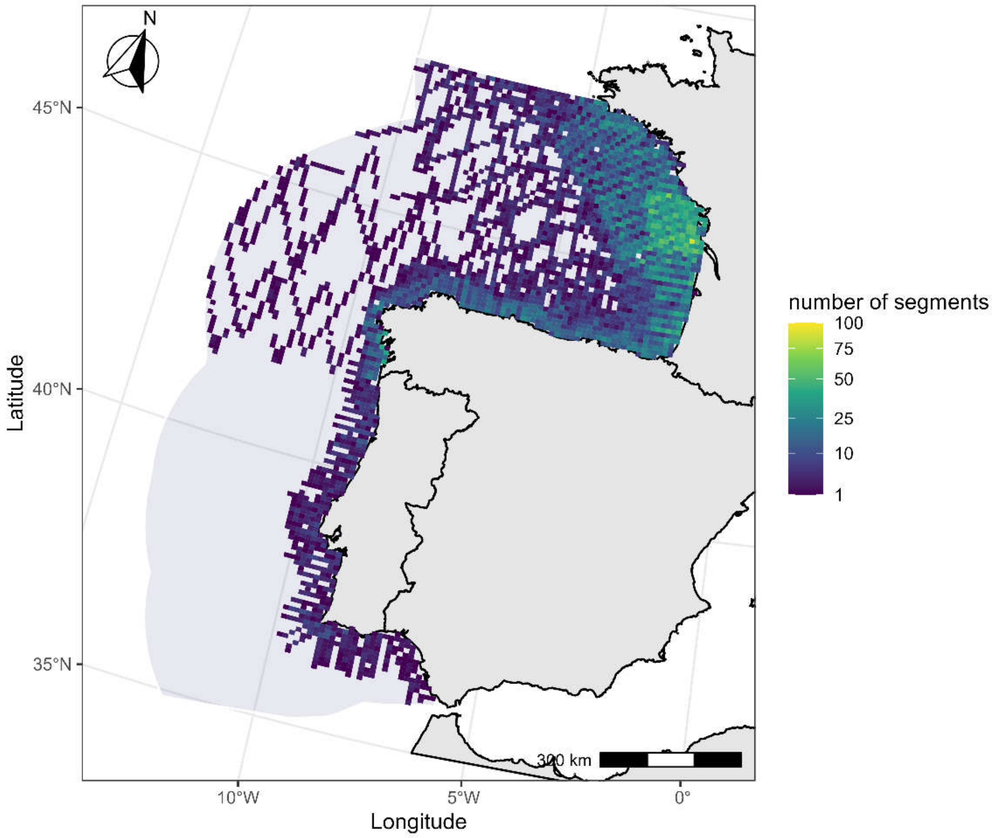


Figure 9: Predictions in the MSFD subregion "Bay of Biscay and Iberian Coast". The light blue area represents the extent of the subregion for which predicted abundance/distribution/habitat of cetacean species is the inferential target of Task 2.1 of WP2. The colour scale highlights ecosystemic/multidisciplinary survey effort (in number of segments) collated for this task.

Environmental data are to be used to predict cetacean distribution/abundance/habitat using both the environmental data and the model calibrated with the survey effort data. Each prediction is thus defined by a set of coordinates (values) that locate it in environmental space: it is possible to assess for each prediction whether it has neighbours in the calibration data that will inform the prediction (nearby data) and whether it falls within the convex hull defined by the calibration data (Figure 10; King & Zeng 2007, Authier et al. 2017, Bouchet et al. 2019). Extrapolation analysis allows to assess the robustness of model predictions without fitting a statistical model such as a DSM simply by assessing how much of the calibration data will be informing a prediction in the area of interest in environmental space (Authier et al. 2017; Bouchet et al. 2019; García-Barón et al., 2019).

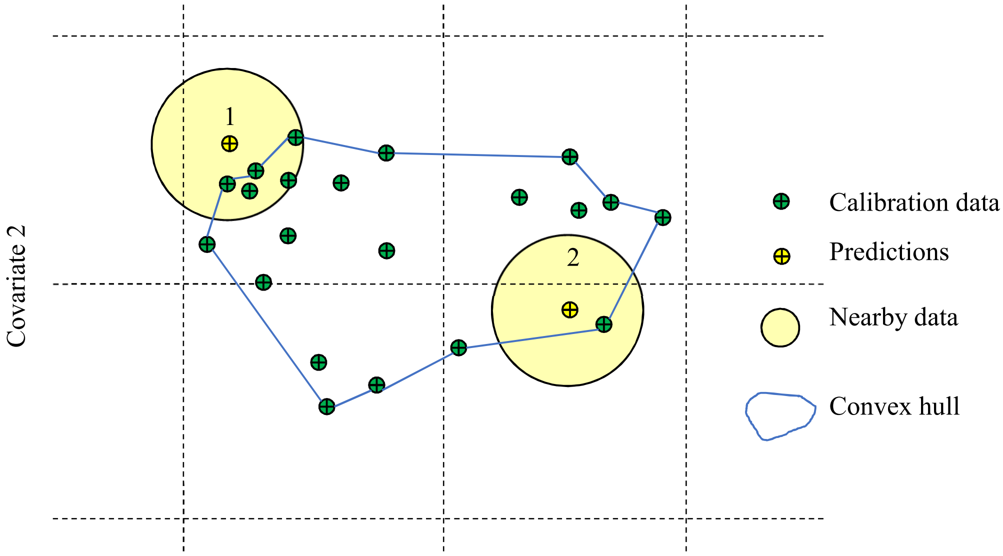


Figure 10: Conceptual representation of an environmental space defined by two environmental covariates. Prediction 1 is extrapolated (outside the convex hull defined by the calibration data) and prediction 2 is interpolated (inside the convex hull defined by the calibration data). Prediction 1 has, however, more nearby data and is hence more informed by calibration data than prediction 2. While prediction 1 is an extrapolation, it is less model-dependent because it has more calibration data in its immediate neighbourhood to inform it. Figure taken from Pigeault (2021).

Extrapolation analysis was undertaken to assess the robustness of model-based predictions of cetacean abundance/distribution/habitat in the MSFD subregion "Bay of Biscay and Iberian Coast" from the survey data collated for WP2. Results for predictions for all months in the year 2019 are presented on Figures 11 and 12. The year 2019 was selected as an example for all years since results were similar across years. This similarity may be due to the choice of a monthly resolution of oceanographic covariates: this monthly resolution smoothes out fine scale variation in oceanographic processes, hence reducing the volume of the convex hull in environmental spaces.

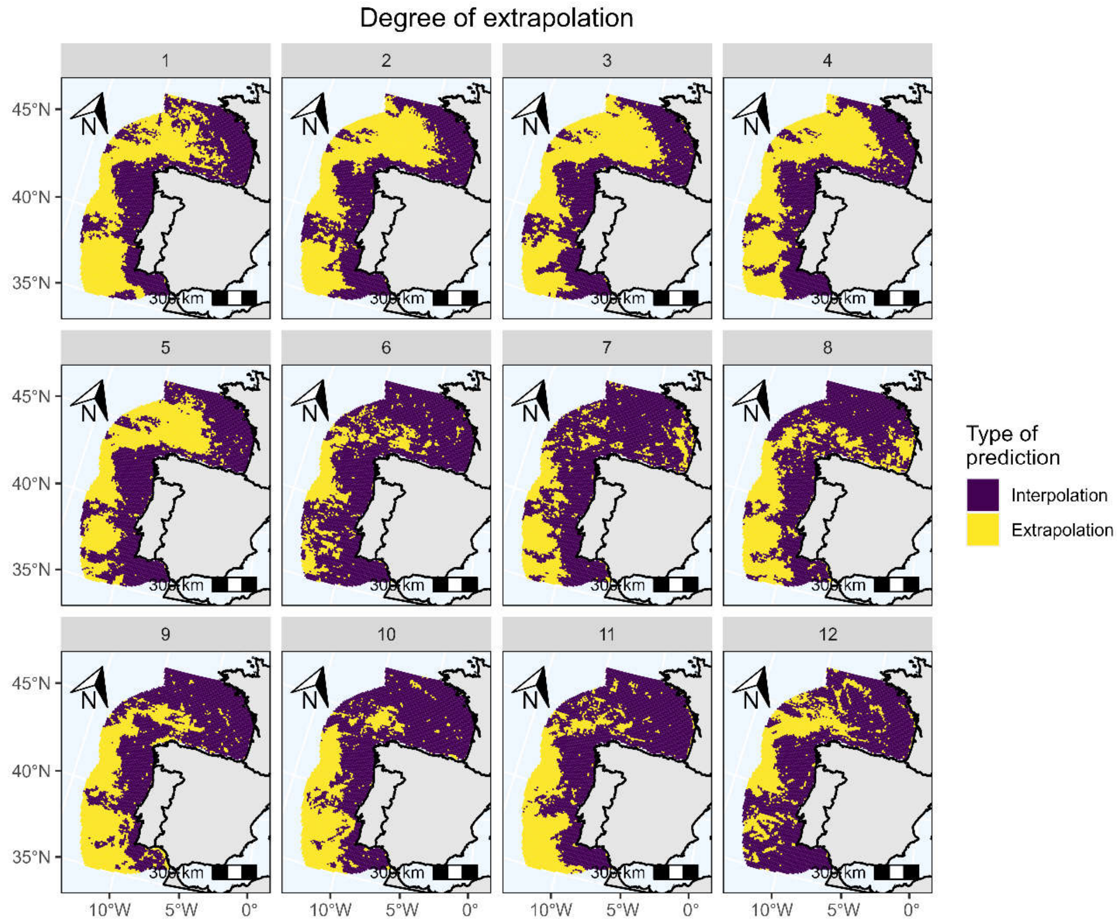


Figure 11: Extrapolation in predictions from a statistical model calibrated with the collated survey data for all months in year 2019 in the MSFD subregion "Bay of Biscay and Iberian Coast".

The extrapolation analysis reveals that environmental coverage of the subregion is unbalanced, with shelf areas being relatively well covered for all months, including the winter months (assuming that the model uses the 7 selected covariates from Table 5), but with offshore areas being less covered. In the latter case, this means in practice that most model-based predictions are extrapolations (both in environmental and geographical space; see Figures 2-5). Extrapolations are intrinsically more fragile because less informed by data and more model-dependent. A more fine-grained measure of model-dependence is provided in Figure 12, where the amount of survey data informing a specific prediction is displayed.

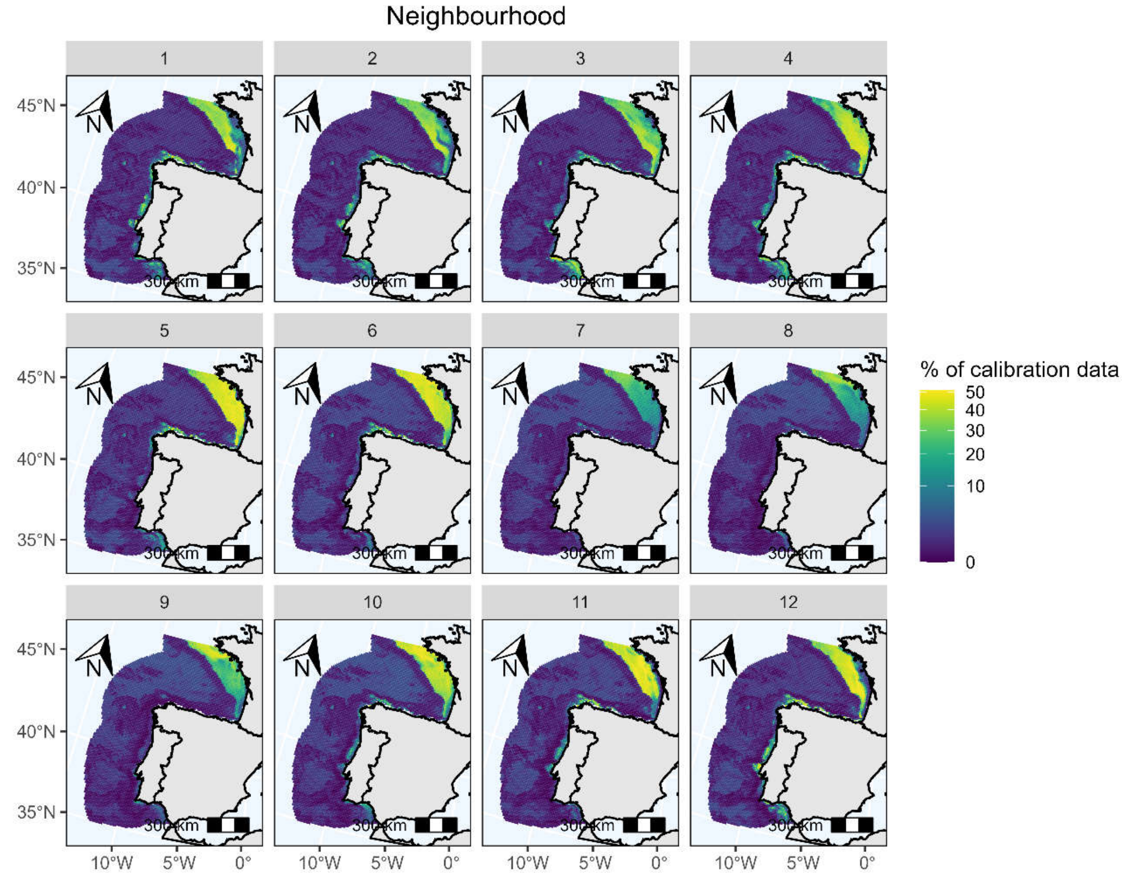


Figure 12: Percentage of the collated survey data for WP2 informing a specific prediction (in environmental space) in the whole MSFD subregion "Bay of Biscay and Iberian Coast" for each month in 2019. Note that the colour scale is square-root transformed to allow a better assessment of small values.

The patterns revealed in Figure 12 confirms largely those seen in Figure 11: predictions (from the environment) of cetacean abundance/distribution/habitat in offshore areas of the MSFD subregion "Bay of Biscay and Iberian Coast" are informed by less than 10% of the data collated for WP2. Some predictions that are interpolations (Figure 10) are nevertheless informed by very little data, and hence model-dependent. The shelf area in the MSFD subregion "Bay of Biscay and Iberian Coast" is that for which confidence in the predictions is highest as those predictions can be informed by as much as 40-50% of the calibration dataset.

6. Discussion and next steps

Data collation for WP2 focused on data collected onboard ecosystemic/multidisciplinary surveys in the MSFD subregion "Bay of Biscay and Iberian Coast" with a distance sampling protocol. These data share a comparable protocol, ensuring their commensurability and easing their analysis within the familiar framework of spatial Generalized Additive Modelling (Miller et al. 2013). This is precisely the next step in Task 2.1 that will seek to inform on several MSFD criteria (Table 6).

There are, however, other data sources on cetacean sightings in the subregion, either from platforms of opportunity (*e.g.* the CETUS data; Correia et al. 2019, 2021 or ORCA data[10]) or from acoustic surveys *e.g.* the PELAGO spring survey (which are part of the IPMA acoustic surveys for small pelagic fish; Massé et al. 2018; ICES 2020a) or the ECOCADIZ summer surveys (Massé et al. 2018). These are boat-based surveys within ICES division 27.9 and megafauna data are collected following the 'European Seabirds at Sea' methodology (Tasker et al. 1984), which is mostly used for studying seabirds but can also be adapted to cetaceans. Specifically, two observers carried out a visual search for cetaceans and seabirds within an angle of 180° ahead of the ship's bow. Upon detection, species identification is made with the aid of binoculars. Snapshot censuses of seabirds and marine mammal presence and activities are made every 5 min within a 300-m transect parallel to the ship's direction.

Including as much data as possible to carry out an integrated assessment is theoretically possible within a data fusion framework (Pacifici et al. 2017) using mathematical objects known as Inhomogeneous Poisson point processes (IPPP; Isaac et al. 2020, Martino et al. 2021). There are however several hurdles to overcome, most of which have to do with data and measurement rather than analysis *per se*. Data standardization may not be possible when data collection protocols are too different. A critical issue when combining any survey data sources is that correction factors to account for differences in detection probability (*i.e.* effective strip width and detection probability on the transect line, g(0)) are survey-specific. Estimating correction factors across groupings of data sources assumes that the covariates used to explain variability in the data can accurately reflect inter-survey differences (ICES 2020b). This is particularly important when incorporating non-systematic surveys (*e.g.* platform of opportunity), which are conducted in a wide range of different ways. Because non-systematic surveys typically do not use the full suite of methods necessary to meet the assumptions of line transect sampling, incorporating them often leads in effect to the coarsening of the data from systematic surveys in an attempt to ensure commensurability and comparability (coarsening the data does not mean that the analysis is less rigorous, *e.g.* Lauret et al. 2021). These issues preclude the estimation of absolute abundance which requires a careful treatment of detection probability (*e.g.* Hammond et al. 2021).

Assuming that data from different surveys can be combined, data fusion is the term used to describe the integration of these different data using of a joint likelihood (that of an IPPP, possibly thinned; Yuan et al. 2018; Isaac et al. 2020), whereby the different data may share latent (*i.e.* unobserved) parameters of interest. Data fusion requires the specification of several sub-models, each specific to a given dataset (Isaac et al. 2020). These sub-models are linked by shared parameters (*e.g.* a common spatial distribution of a cetacean species). Specification of these sub-models is a difficult task in itself (Jacobson et al. 2020), and their integration in a joint model is accurate if specification of each sub-model is correct (Hahn 2019). Granting that a

[10] https://www.orcaweb.org.uk/

correct model specification is possible, data formatting remains a time consuming step. While the data fusion is elegant and attractive, the complexity involved in using methods at the cutting-edge of current research is beyond the scope of the current task and of WP2 more broadly.

The data collated for Task 2.1 in WP 2 will be used to inform several MSFD descriptors, including D1C2, D1C4 and D1C5 (Table 6). The prepared data do not include all data on cetacean sightings that are available in the MSFD subregion "Bay of Biscay and Iberian Coast" (*e.g.* CETUS, PELAGO, ECOCADIZ). Some of these data were collated in other endeavours (*e.g.* the MERP project; Waggitt et al. 2020 but see also ICES 2020b page 32-33) or may be collated in the upcoming Joint Cetacean Data Programme (JCDP[11]) from JNCC but whose database will be hosted by ICES. Presence-only data can also be downloaded from OBIS-SEAMAP[12], but these data alone cannot inform on abundance. Integrating so-called presence-only[13] data in a data fusion framework is possible in theory but requires careful and proper weighing of survey effort. Unfortunately, with presence-only data, survey effort is often not explicitly recorded and substantial work must be devoted to finding good proxies of survey effort in order to tease apart the effect of biased sampling and the true distribution or abundance of cetaceans (Botella et al. 2020; Martino et al. 2021). Such work is beyond the scope of Task 2.1 in WP2 (and WP2 more broadly). Because Task 2.1 will endeavour to address D1C2 (abundance), priority was given to data that can inform on absolute abundance, that is data collected using a distance sampling protocol (Table 6).

This priority given to D1C2 (abundance) is justified on the ground that abundance is a primary MSFD criterion, a fundamental biodiversity variable, and is needed to inform other descriptors such as D1C4 (distribution) or D1C1 (bycatch). In particular, if absolute abundance can be estimated and spatialized, it is also possible to obtain distribution maps by a straightforward transformation of abundance in presence probability (Royle et al. 2005). Presence is the probability of at least one animal being present at a given location, which is the complement of no animal being present at said location. Such probability can be derived from a DSM or an SDM (Royle et al. 2005). Inferring the habitat of cetaceans (D1C5) is more difficult endeavour than predicting abundance or distribution (see Shmuéli 2010 for a discussion of predictive versus explanatory modelling). In particular, it assumes that all causally relevant environmental variables are included in the model, and that these provide an exhaustive description of the habitat including any change thereof through time, hence assuming stationarity of relationships between abundance/distribution of cetacean species and the marine environment. These are stringent assumptions, which may explain in part why the operationalisation of D1C5 is less advanced than that of other descriptors. For the present task, only 7 environmental variables have been extracted so far (Table 5), and it is unlikely that these represent a sufficient set to explain the habitats of all cetacean species in Table 2. However, these environmental variables were chosen because of their availability at the relevant scales (both in space and time) in the MSFD subregion "Bay of Biscay and Iberian Coast". They constitute a starting point, but it can already be acknowledged that some of chosen variables (*e.g.* bathymetry, slope) maybe correlated to cetacean habitat while not being in causal relationship: they may be crude proxies of other processes that explain habitat.

[11] https://jncc.gov.uk/our-work/joint-cetacean-data-programme/

[12] OBIS-SEAMAP http://seamap.env.duke.edu/

[13] A better description would be 'detected-only' as these data usually do not address the problem of imperfect detection

Table 6: MSFD criteria to be potentially informed by the collated data. v indicates that the data can inform the criterion. * Absolute abundance if g(0) taken into account. ** Relative abundance can reveal trends if biases are assumed time-invariant. *** Vital rates can be used in a Management Strategy Evaluation framework to set limits to anthropogenic removals (Genu et al. accepted).

Data	Data protocol	Sample representativeness	Methods	WP	Task	D1C1	D1C2	D1C3	D1C4	D1C5	Example (references)
Ecosystemic / multidisciplinary surveys	Distance sampling	should ideally include g(0) correction	DSM	2	2.1	v*	v*		v	v	Garcia-Baron et al. 2019, Lacey et al. 2021
	other (*e.g.* ESAS, *etc.*)	depends on data standardization	SDM				v**		v	v	Waggitt et al. 2020
Platform of opportunity	various	Usually biased due to non-equiprobability coverage	SDM						v	v	Matear et al. 2020, Correia et al. 2021
Surveys	various	depends on data standardization	SDM, VAST				v**		v	v	Waggitt et al. 2020, Astarloa et al. 2021
Strandings	Stranding networks	Potentially biased due to drift, reporting etc.	Reverse Drift	3	3.4.2	v					Peltier et al. 2016
			Survival models using age at death			v***		v			Read 2016, Saavedra 2018, Rouby et al. 2021
Photo-capture	Capture-Mark-Recapture	limited to resident (and often small) populations	Capture-Mark-Recapture			v***	v	v	v	v	Gaspar 2003, Ludwig et al. 2021

Note on D1C1 and D1C3:

Table 6 mentions other descriptors than those that WP will inform. In particular, demographic parameters (D1C3); although secondary, are also of paramount importance. In particular survival rates and fecundity rates are key vital rates that can reveal early warnings of likely decline, and allows timely corrective measures to prevent degradation of Good Environmental Status (GES). For cetaceans, detecting trends in abundance is a difficult task (Taylor et al. 2007, Authier et al. 2020), and usually statistical significance is evidenced only for large decline, defeating the purpose of preventing non-GES or restoring GES rapidly since for slow-paced species such as cetaceans, population recovery may take a long time. Data that may inform D1C3 include strandings (*e.g.* Read 2016, Saavedra 2018) and photographic capture-recapture using natural marks on the dorsal/caudal fin of cetaceans (*e.g.* Ludwig et al. 2021).

The ICES working group on Marine Mammal Ecology provided in 2021 an extensive survey of national stranding networks in the North-East Atlantic, including those operating in the MSFD subregion 'Bay of Biscay and Iberian Coast" (ICES 2021, pages 113-138). These networks collect data on stranded animals, including biological samples of tissues such as teeth, which can be used to age specimen using cementochronology; or gonads, which can be analysed to assess sexual maturity. For a limited number of answers received so far[14], it appears, that these analyses may not routinely be carried out by strandings networks in the MSFD subregion 'Bay of Biscay and Iberian Coast", but more on an *ad hoc* basis.

The other source of data for D1C3 are capture-recapture data, but such study may only be carried out on resident or localized populations of cetaceans (*e.g.* common bottlenose dolphins in the Sado estuary: Gaspar 2003). Collecting capture-recapture data is very demanding, but very informative as these data have the potential to inform all criteria. However, the localized scale at which capture-recapture methods can be usually implemented limits the geographic scope of an assessment.

These caveats notwithstanding, these data are crucial to inform on vital rates and demographic parameters (D1C3), and should be leveraged, for example, to inform also on D1C1 (bycatch; the focus of WP3 in the CetAMBICion project) in setting removals limit to bycatch (Genu et al. accepted). Computing removals limits require in any case knowledge on absolute abundance (Wade 1998).

The collated data for WP2 are available, along with the first scripts to perform the extrapolation analysis, in private Gitlab hosted by La Rochelle University: https://gitlab.univ-lr.fr/mauthier/cetambicionwp2

This gitlab project is CETAMBICION WP2 D2.1b.

[14] As of the 13th of December 2021. We are indebted to Marie Petitguyot and Andrea Fariñas Bermejo for designing the questionnaire and collecting answers on stranding networks.

7. Acknowledgements

We are indebted to all data providers and all the participants involved in the data collection. We thank OMMEG members, Chris Moulton and Lena Avellan from the OSPAR secretariat, Phil Hammond (University of Saint Andrews) and Anita Gilles (TiHO, Hannover) for providing the SCANS and CODA data, Laurena Leacy for the ObSERVE data. Rémi Pigeault provided invaluable help with scripts and data formatting. Marie Petitguyot and Andrea Fariñas Bermejo provided information on stranding networks and analysed the questionnaire (including its follow-up questions). We thank all partners of the CetAMBICion project for feedback and critical comments.

8. References

Authier, M., Saraux, C., & Péron, C. (2017). Variable selection and accurate predictions in habitat modelling: A shrinkage approach. Ecography, 40(4), 549–560.

Authier, M.; Galatius, A.; Gilles, A. & Spitz, J. (2020) Of Power and Despair in Cetacean Conservation: Estimation and Detection of Trend in Abundance with Noisy and Short Time-Series. PeerJ, 8:e9436

Bakun, A. (1997) Patterns in the ocean: ocean processes and marine population dynamics. Oceanographic Literature Review, 5(44), 530.

Bakun, A. (2006) Fronts and eddies as key structures in the habitat of marine fish larvae: Opportunity, adaptive response and competitive advantage. Scientia Marina, 70(S2), 105–122.

Barlow, D., Bernard, K., Escobar-Flores, P., Palacios, D., Torres, L. (2020) Links in the trophic chain: Modeling functional relationships between *in situ* oceanography, krill, and blue whale distribution under different oceanographic regimes. Marine Ecology Progress Series, 642, 207–225.

Benoit-Bird, K. J., & Au, W. W. L. (2003). Prey dynamics affect foraging by a pelagic predator (*Stenella longirostris*) over a range of spatial and temporal scales. Behavioral Ecology and Sociobiology, 53(6), 364–373.

Botella, C.; Joly, A.; Monestiez, P.; Bonnet, P. & Munoz, F. (2020) Bias in Presence-Only Niche Models Related to Sampling Effort and Species Niches: Lessons for Background Point Selection. PLoS One, 15, e0232078

Bouchet, P. J.; Miller, D. L.; Roberts, J. J.; Mannocci, L.; Harris, C. M. & Thomas, L. (2019) From Here and Now to There and Then: Practical Recommendations for Extrapolating Cetacean Density Surface Models to Novel Conditions. University of Saint Andrews

Buckland, S. T.; Anderson, D. R.; Burnham, K. P. & Laake, J. L. (1993) Distance Sampling - Estimating Abundance of Biological Populations. Chapman & Hall, 1st Edition.

Correia, A. M.; Gandra, M.; Liberal, M.; Valente, R.; Gil, A.; Rosso, M.; Pierce, G. J. & Sousa-Pinto, I. (2019) A Dataset of Cetacean Occurrences in the Eastern North Atlantic. Scientific Data, 6, 177

Correia, A. M., Sousa-Guedes, D., Gil, Á., Valente, R., Rosso, M., Sousa-Pinto, I., Sillero, N. and Pierce, G. J. (2021) Predicting Cetacean Distributions in the Eastern North Atlantic to Support Marine Management. Frontiers in Marine Science, 8:643569. doi: 10.3389/fmars.2021.643569

Cox, S. L., Witt, M. J., Embling, C. B., Godley, B. J., Hosegood, P. J., Miller, P. I., Votier, S. C., & Ingram, S. N. (2017). Temporal patterns in habitat use by small cetaceans at an oceanographically dynamic marine renewable energy test site in the Celtic Sea. Deep Sea Research Part II: Topical Studies in Oceanography, 141, 178–190.

Croll, D. A., Tershy, B. R., Hewitt, R. P., Demer, D. A., Fiedler, P. C., Smith, S. E., Armstrong, W., Popp, J. M., Kiekhefer, T., Lopez, V. R., Urban, J., Gendron, D. (1998) An integrated approch to the foraging ecology of marine birds and mammals. Deep-Sea Research Part II: Topical Studies in Oceanography, 45(7), 1353–1371.

Doray, M.; Petitgas, P.; Romagnan, J-B.; Huret, M.; Duhamel, E.; Dupuy, C.; Spitz, J.; Authier, M.; Sanchez, F.; Berger, L.; Dorémus, G.; Bourriau, P.; Grellier, P. & Massé, J. (2018) The PELGAS survey: Ship-based integrated monitoring of the Bay of Biscay pelagic ecosystem. Progress in Oceanography, 166, 15-29.

Forney KA (2000) Environmental Models of Cetacean Abundance: Reducing Uncertainty in Population Trends. Conservation Biology, 14(5), 1271–1286.

Frederiksen, M., Edwards, M., Richardson, A. J., Halliday, N. C., & Wanless, S. (2006). From plankton to top predators: Bottom-up control of a marine food web across four trophic levels. Journal of Animal Ecology, 75(6), 1259–1268.

García-Barón, I.; Authier, M.; Caballero, A.; Vázquez Bonales, A. J.; Santos, M. B.; Murcia, J. L. & Louzao, M. (2019) Modelling the Spatial Abundance of a Migratory Predator: A Call for Transboundary Marine Protected Areas. Diversity and Distributions, 25, 346-360

Gaspar, R. (2003) Status of the resident bottlenose dolphin population in the Sado estuary: past, present and future. PhD Thesis.

Genu, M.; Gilles, A.; Hammond, P.; Macleod, K.; Paillé, J.; Paradinas, I. A.; Smout, S.; Winship, A. & Authier, M. (accepted) Evaluating Strategies for Managing Anthropogenic Mortality on Marine Mammals: an R Implementation with the Package RLA. Frontiers in Marine Science

Guisan, A., & Zimmermann, N. E. (2000). Predictive habitat distribution models in ecology. Ecological Modelling, 135(2–3), 147–186.

Hahn, R. P. (2019) An Illustration of the Risk of Borrowing Information via a Shared Likelihood. Arizon State University. https://arxiv.org/abs/1905.09715

Hammond, P. S.; Lacey, C.; Gilles, A.; Viquerat, S.; Börjesson, P.; Herr, H.; MacLeod, K.; Ridoux, V.; Santos, M. B.; Scheidat, M.; Teilmann, J.; Vingada, J. & Øien, N. (2021) Estimates of Cetacean Abundance in European Atlantic Waters in Summer 2016 from the SCANS-III Aerial and Shipboard Surveys. Sea Mammal Research Unit, University of Saint Andrews, UK.

Hastie, G. D., Wilson, B., Wilson, L. J., Parsons, K. M., & Thompson, P. M. (2004). Functional mechanisms underlying cetacean distribution patterns: Hotspots for bottlenose dolphins are linked to foraging. Marine Biology, 144(2), 397–403.

Hijmans, R. J. (2021). raster: Geographic Data Analysis and Modeling. R package version 3.5-2. https://CRAN.R-project.org/package=raster

Hyrenbach, D. K., Forney, K. A., Dayton, P. K. (2000) Viewpoint: Marine protected areas and ocean basin management. Aquatic Conservation: Marine and Freshwater Ecosystems, 10(6), 437–458.

ICES (2020a) Working Group on Southern Horse Mackerel, Anchovy and Sardine (WGHANSA). ICES Scientific Reports. 2:41. 655 pp. http://doi.org/10.17895/ices.pub.5977

ICES (2020b) Working Group on Marine Mammal Ecology (WGMME). ICES Scientific Reports. 2:39. 85 pp. http://doi.org/10.17895/ices.pub.5975

ICES (2021) Working Group on Marine Mammal Ecology (WGMME). ICES Scientific Reports. 3:19. 155 pp. https://doi.org/10.17895/ices.pub.8141

Isaac, N. J. B.; Jarzyna, M. A.; Keil, P.; Dambly, L. I.; Boersch-Supan, P. H.; Browning, E.; Freeman, S. N.; Golding, N.; Guillera-Arroita, G.; Henrys, P. A.; Jarvis, S.; Lahoz-Monfort, J.; Pagel, J.; Pescott, O. L.; Schmucki, R.; Simmonds, E. G. & O'Hara, R. B. (2020) Data Integration for Large-Scale Models of Species Distributions. Trends in Ecology and Evolution, 35, 56-65

Jacobson, E. K.; Boyd, C.; McGuire, T. L.; Shelden, K. E. W.; Boor, G. K. H. & Punt, A. E. (2020) Assessing Cetacean Populations Using Integrated Population Models: an Example with Cook Inlet Beluga Whales. Ecological Applications, 30, e2114

King, G., & Zeng, L. (2007). When Can History Be Our Guide? The Pitfalls of Counterfactual Inference. International Studies Quarterly, 51(1), 183–210.

Lacey, C. , Hammond, P. S., Gilles, A., Börjesson, P., Herr, H., Macleod, K., Ridoux, V., Santos, M. B., Scheidat, M., Teilmann, J., Vingada, J., Viquerat, S., Øien, N. (2021) Modelled density surfaces of cetaceans in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. 20 pages

Laran, S., Authier, M., Blanck, A., Doremus, G., Falchetto, H., Monestiez, P., Pettex, E., Stephan, E., Van Canneyt, O., & Ridoux, V. (2017). Seasonal distribution and abundance of cetaceans within French waters- Part II: The Bay of Biscay and the English Channel. Deep Sea Research Part II: Topical Studies in Oceanography, 141.

Lau-Medrano, W. (2020). grec: Gradient-Based Recognition of Spatial Patterns in Environmental Data. R package version 1.4.1. https://CRAN.R-project.org/package=grec

Lauret, V.; Labach, H.; Authier, M. & Gimenez, O. (2021) Using Single Visits into Integrated Occupancy Models to Make the Most of Existing Monitoring Programs. Ecology, https://doi.org/10.1002/ecy.3535

Ludwig, K. E., Daly, M, Levesque S. and Berrow, S. D. (2021) Survival Rates and Capture Heterogeneity of Bottlenose Dolphins (*Tursiops truncatus*) in the Shannon Estuary, Ireland. Frontiers in Marine Science 8:611219. doi: 10.3389/fmars.2021.611219

Martino, S.; Pace, D. S.; Moro, S.; Casoli, E.; Ventura, D.; Frachea, A.; Silvestri, M.; Arcangeli, A.; Giacomini, G.; Ardizzone, G. & Lasinio, G. J. (2021) Integration of Presence-Only Data from Several Sources. A Case Study on Dolphins' Spatial Distribution. Ecography, 2021, 44, 1533-1543

Massé, J., Uriarte, A., Angélico, M. M., and Carrera, P. (Eds.) 2018. Pelagic survey series for sardine and anchovy in ICES subareas 8 and 9 – Towards an ecosystem approach. ICES Cooperative Research Report No. 332. 268 pp. https://doi.org/10.17895/ices.pub.4599

Matear, L., Robbins, J. R., Hale, M., Potts, J. (2019) Cetacean biodiversity in the Bay of Biscay: Suggestions for environmental protection derived from citizen science data. Marine Policy, 109, 103672

Miller, D.; Burt, M.; Rexstad, E. & Thomas, L. (2013) Spatial Models for Distance Sampling Data: Recent Developments and Future Directions. Methods in Ecology and Evolution 4, 1001-1010

Pacifici, K.; Reich, B. J.; Miller, D. A.; Gardner, B.; Stauffer, G.; Singh, S.; McKerrow, A. & Collazo, J. A. (2017) Integrating Multiple Data Sources in Species Distribution Modeling: a Framework for Data Fusion. Ecology, 98, 840-850

Peltier, H.; Authier, M.; Deaville, R.; Dabin, W.; Jepson, P.; van Canneyt, O.; Daniel, P. & Ridoux, V. (2016) Small Cetacean Bycatch as Estimated from Stranding Schemes: the Common Dolphin Case in the Northeast Atlantic. Environmental Science & Policy, 63, 7-18

Pigeault, R. (2021) Assessing Model Transferability by Gap Analysis in Environmental Space: a Case Study on Cetaceans in the North East Atlantic. Master Écologie & Évolution, Université Paul Sabatier, Toulouse, France.

Read, F. L. (2016) Understanding cetacean and fisheries interactions in the North-West Iberian Peninsula, University of Vigo.

Redfern, J. V., Ferguson, M., Becker, E. A., Hyrenbach, K. D., Good, C., Barlow, J., Kaschner, K., … & Werner, F. (2006) Techniques for Cetacean–Habitat Modelling. Marine Ecology Progress Series, 310, 271-295

Rouby, E.; Ridoux, V. & Authier, M. (2021) Flexible Parametric Modeling of Survival from Age at Death Data: a Mixed Linear Regression Framework. Population Ecology, 63, 108-122

Saavedra, C. (2018) strandCet: R package for Estimating Natural and Non-Natural Mortality-at-Age of Cetaceans from Age-Structured Strandings. PeerJ, 6, e5768

Saavedra, C.; Gerrodette, T.; Louzao, M.; Valeiras, J.; García, S.; Cerviñoa, S.; Pierce, G. J. & Santos, M. B. (2018) Assessing the Environmental Status of the Short-Beaked Common Dolphin (*Delphinus delphis*) in North-western Spanish Waters using Abundance Trends and Safe Removal Limits. Progress in Oceanography, 166, 65-75

Shmuéli, G. (2010). To Explain or to Predict? Statistical Science, 25(3), 289–310.

Tasker, M. L., Jones, P.H., Dixon, T. J., Blake, B. F. (1984) Counting seabirds at sea from ships: a review of methods employed and a suggestion for a standardized approach. Auk, 101, 567-577

Taylor, B.; Martinez, M.; Gerrodette, T.; Barlow, J. & Hrovat, Y. (2007) Lessons from Monitoring Trends in Abundance of Marine Mammals. Marine Mammal Science, 23, 157-175

Tew-Kai E, Quilfen V, Cachera M, Boutet M (2020) Dynamic Coastal-Shelf Seascapes to Support Marine Policies Using Operational Coastal Oceanography: The French Example. Journal of Marine Science and Engineering, 8(8), 585.

Virgili, A., Authier, M., Boisseau, O., Cañadas, A., Claridge, D., Cole, T., Corkeron, P., Dorémus, G., David, L., Di-Méglio, N., Dunn, C., Dunn, T. E., García-Barón, I., Laran, S., Lauriano, G., Lewis, M., Louzao, M., Mannocci, L., Martínez-Cedeira, J., … Ridoux, V. (2019). Combining multiple visual surveys to model the habitat of deep-diving cetaceans at the basin scale: Large-scale modelling of deep-diving cetacean habitats. Global Ecology and Biogeography, 28(3), 300–314.

Vlietstra, L. S., Coyle, K. O., Kachel, N. B., & Hunt, G. L. (2005). Tidal front affects the size of prey used by a top marine predator, the short-tailed shearwater (*Puffinus tenuirostris*). Fisheries Oceanography, 14(s1), 196–211.

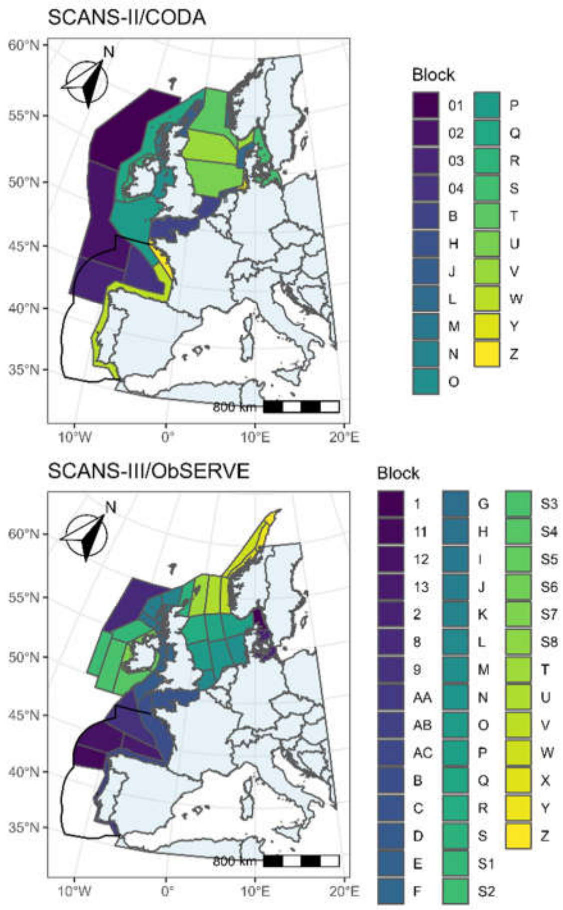
Wade, P. R. (1998) Calculating Limits To the Total Allowable Human-Caused Mortality of Cetaceans and Pinnipeds. Marine Mammal Science, 14, 1-37

Waggitt, J. J., et al. (2020) Distribution maps of cetacean and seabird populations in the North-East Atlantic. Journal of Applied Ecology, 57, 253-269. https://besjournals.onlinelibrary.wiley.com/doi/abs/10.1111/1365-2664.13525.

Yuan, Y.; Bachl, F. E.; Lindgren, F.; Borchers, D. L.; Illian, J. B.; Buckland, S.; T.; Rue, H. & Gerrodette, T. (2018) Point Process Models for Spatio-Temporal Distance Sampling Data from a Large-Scale Survey of Blue Whales. Statistical Science, 11, 2270-2297

APPENDIX 0. Spatial coverage of the SCANS-II, CODA, SCANS-III and ObSERVE in the North-East Atlantic

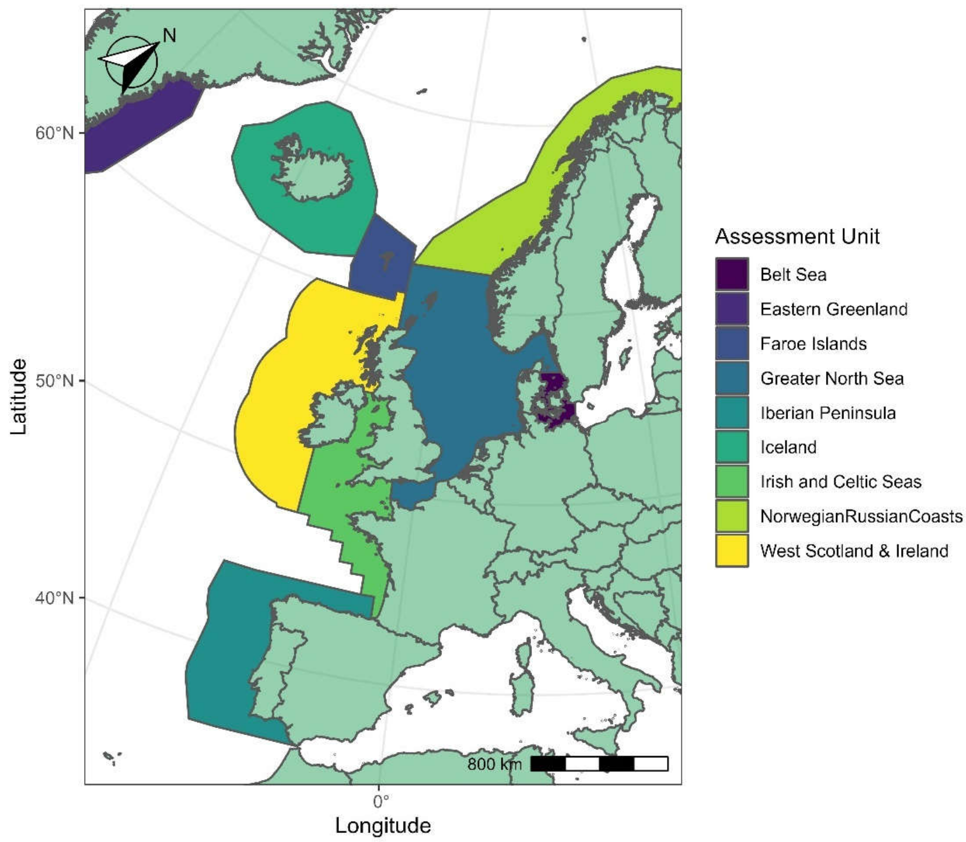
The two maps below show the spatial coverage of SCANS-II/CODA and SCANS-III/ObSERVE surveys. The black line delineates the MSFD subregion "Bay of Biscay and Iberian Coast".



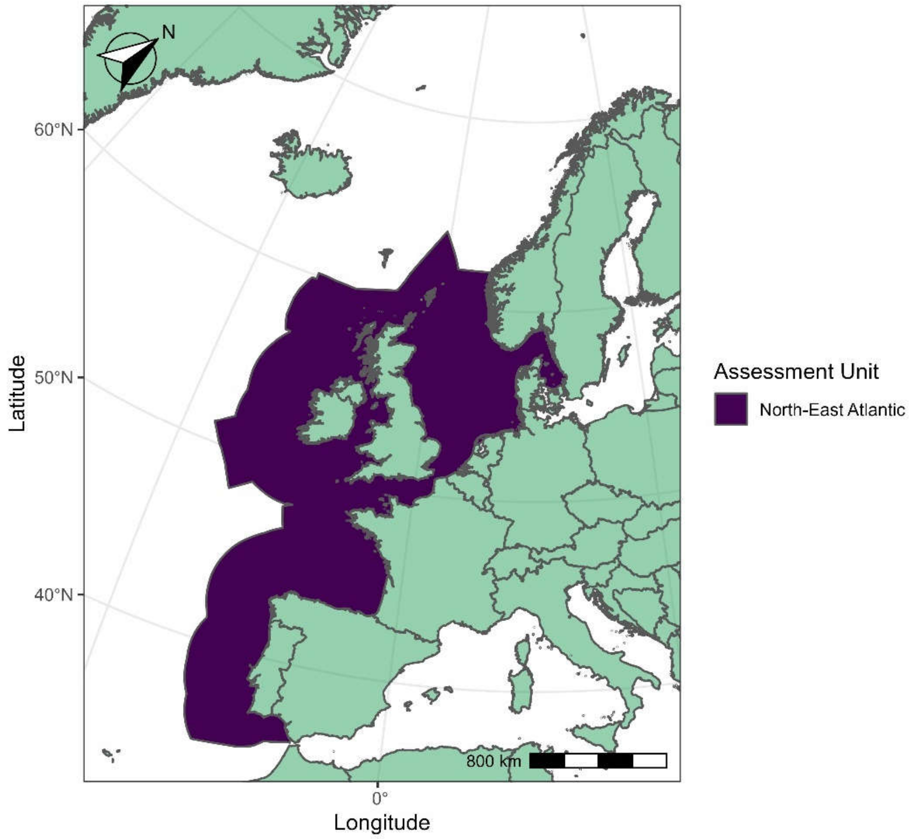
APPENDIX 1. Cetacean Assessment Units in the North-East Atlantic (OSPAR)

Maps below show the OSPAR Assessment Units for OSPAR common indicator M4 'Cetacean abundance and distribution'. All Assessment Units are available as geopackages for use in GIS softwares.

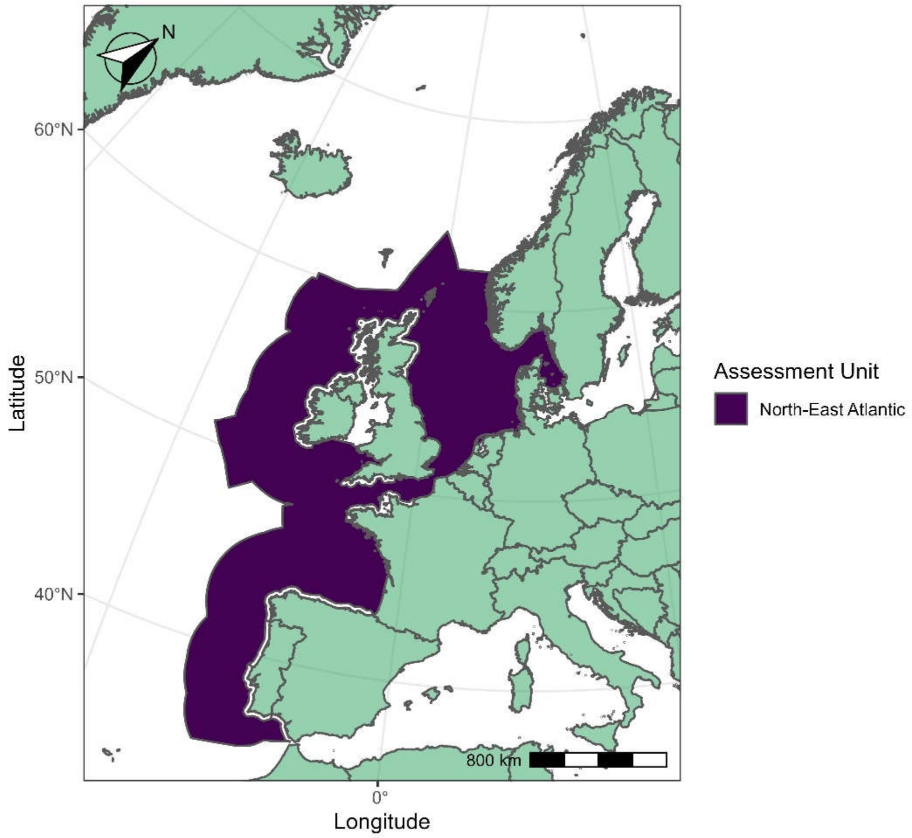
Harbour Porpoise (*Phocoena phocoena*)



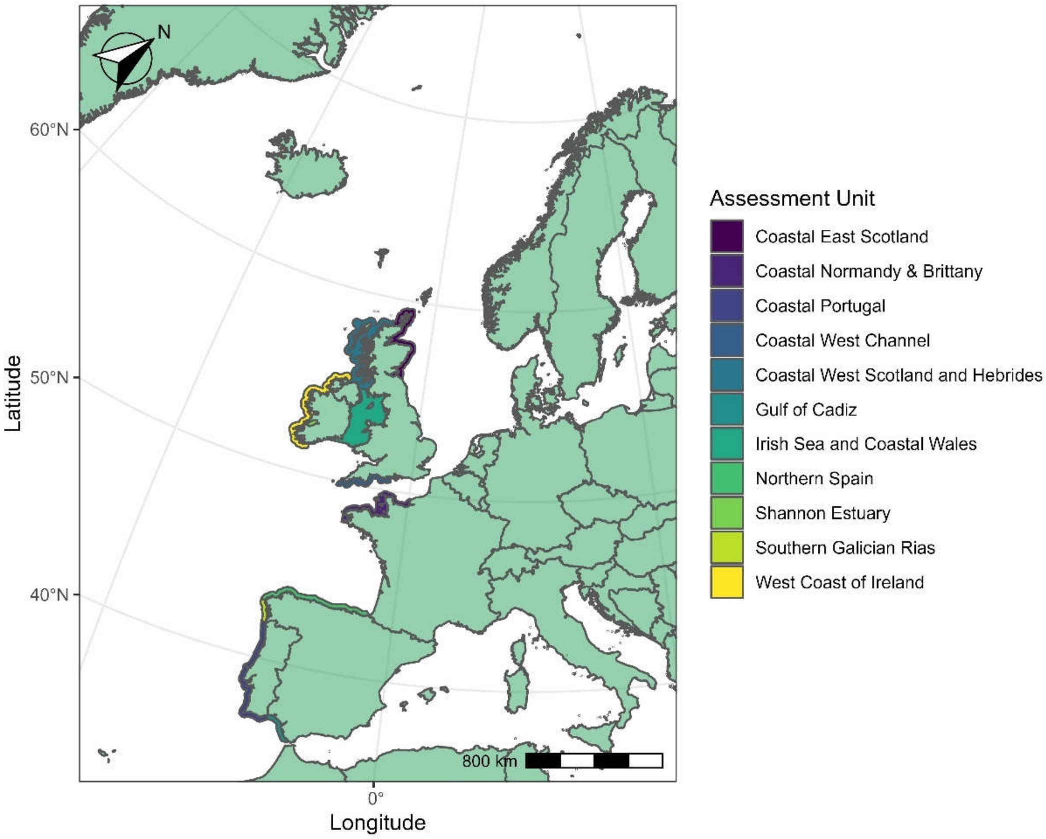
Common Dolphin (*Delphinus delphis*)



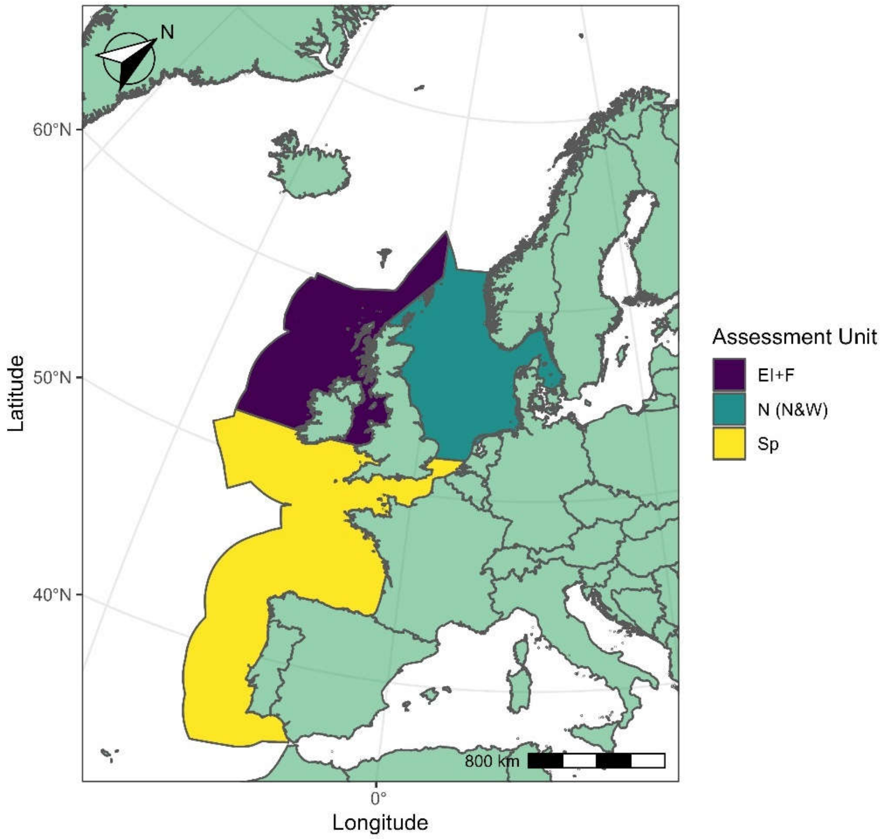
Offshore Bottlenose Dolphin (*Tursiops truncatus*)



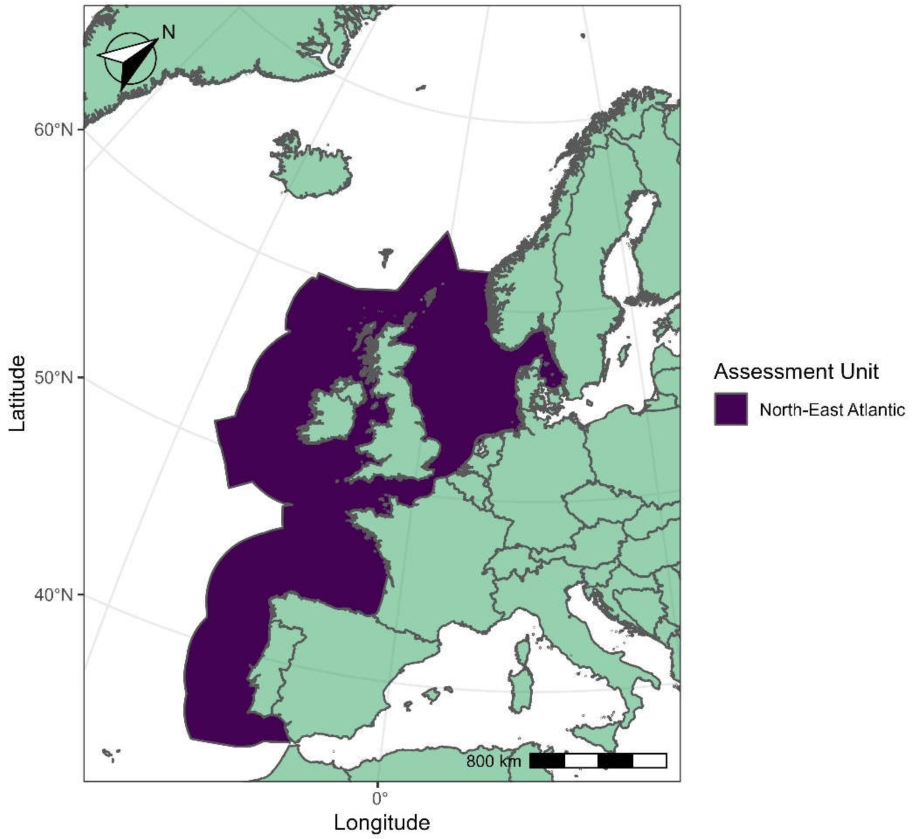
Coastal Bottlenose Dolphin (*Tursiops truncatus*)



Fin Whales (*Balaenoptera physalus*)



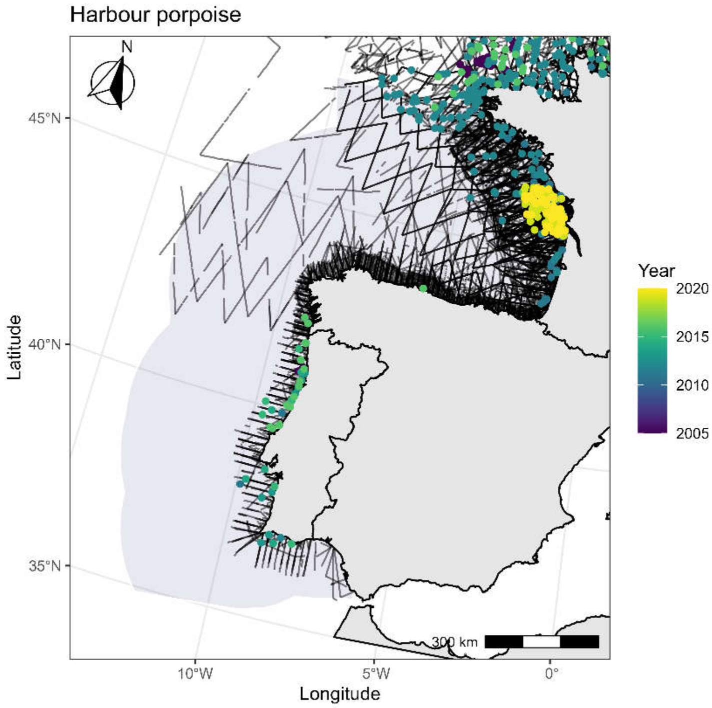
Minke Whales (*Balaneoptera acutus*)

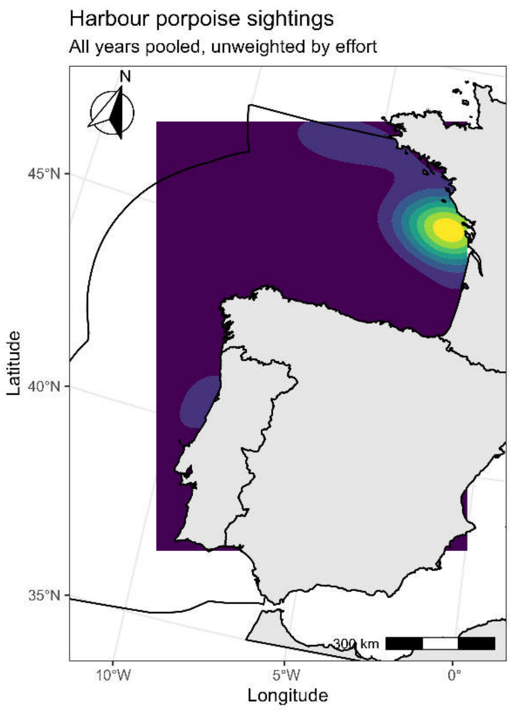


APPENDIX 3. Cetacean sightings in the MSFD subregion "Bay of Biscay and Iberian Coast"

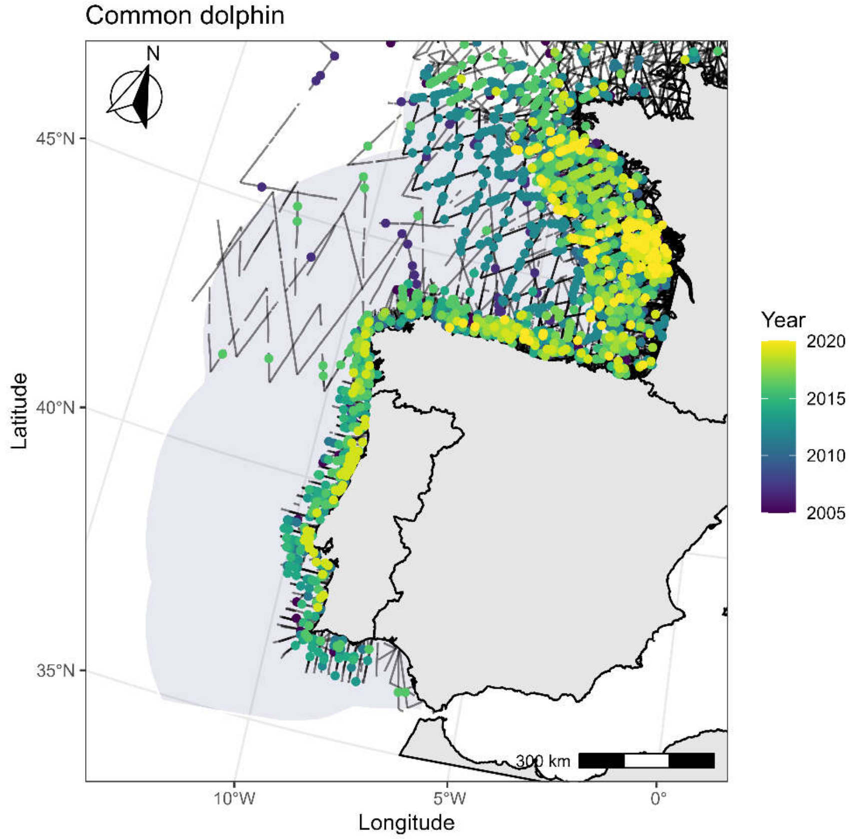
Maps below show the cetaceans sightings collated for further analysis in WP2. Data are available as geopackage for use in GIS and statistical softwares. A plot of the raw and smooth sightings data are shown. **The smoothed plot was obtained by pooling all years and discarding segment with no sighting. It does NOT take into account ecosystemic/multidisciplinary survey effort and is NOT a distribution map of the species of interest, but a map of where the species was sighted by observers.**

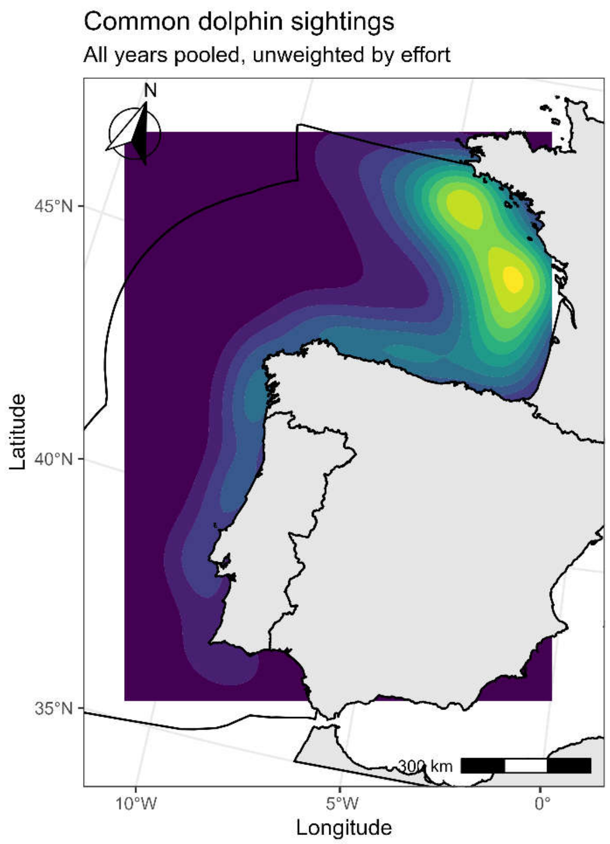
Harbour Porpoise (*Phocoena phocoena*): raw data (top) and smoothed data (bottom)



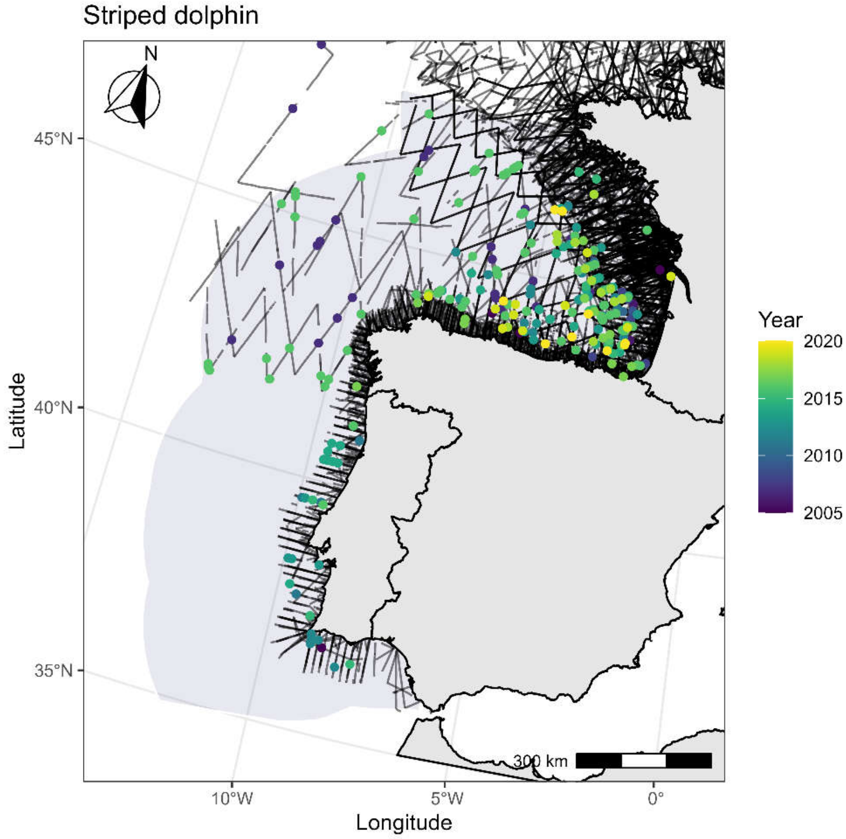


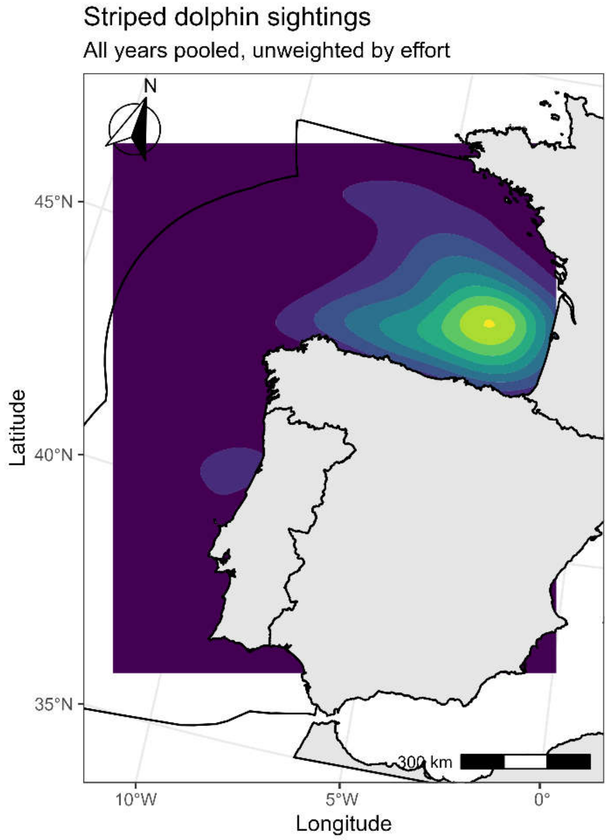
Common Dolphin (*Delphinus delphis*): raw data (top) and smoothed data (bottom)



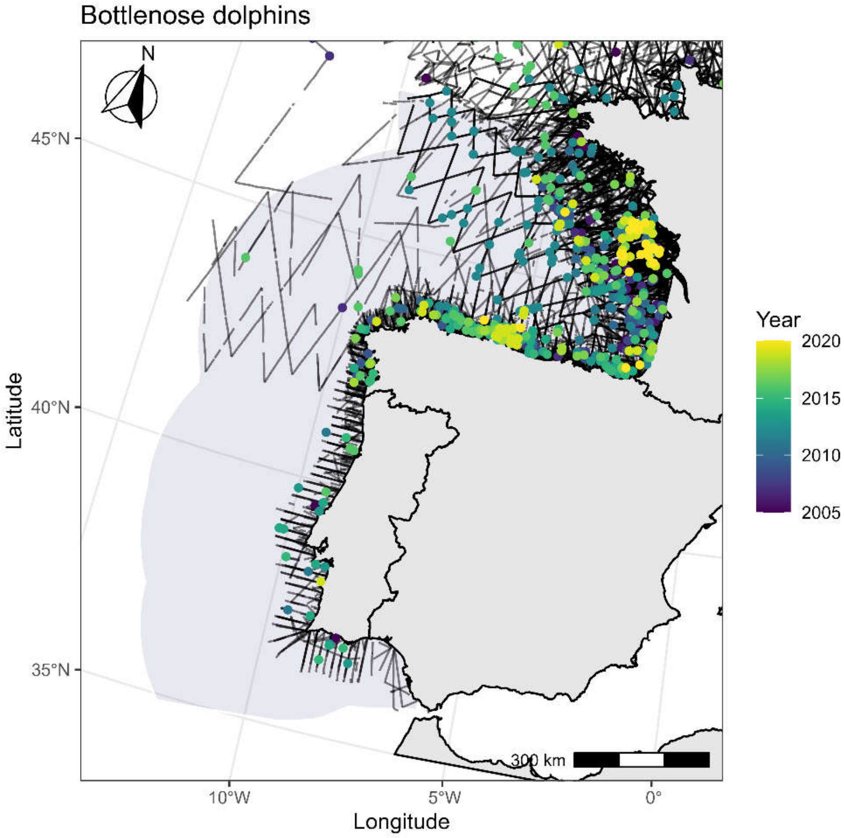


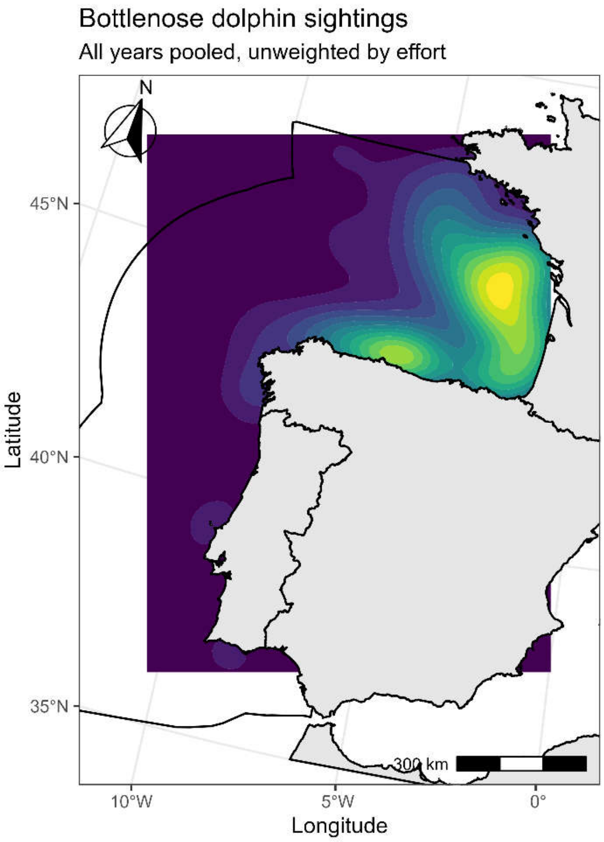
Striped Dolphin (*Stenela coeruleoalba*): raw data (top) and smoothed data (bottom)



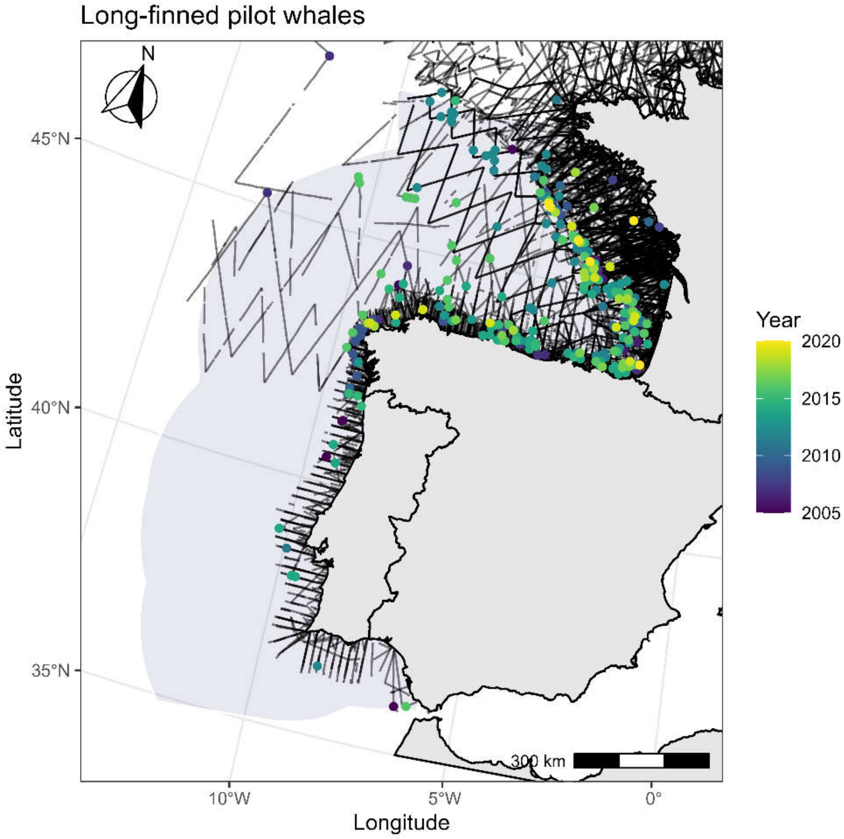


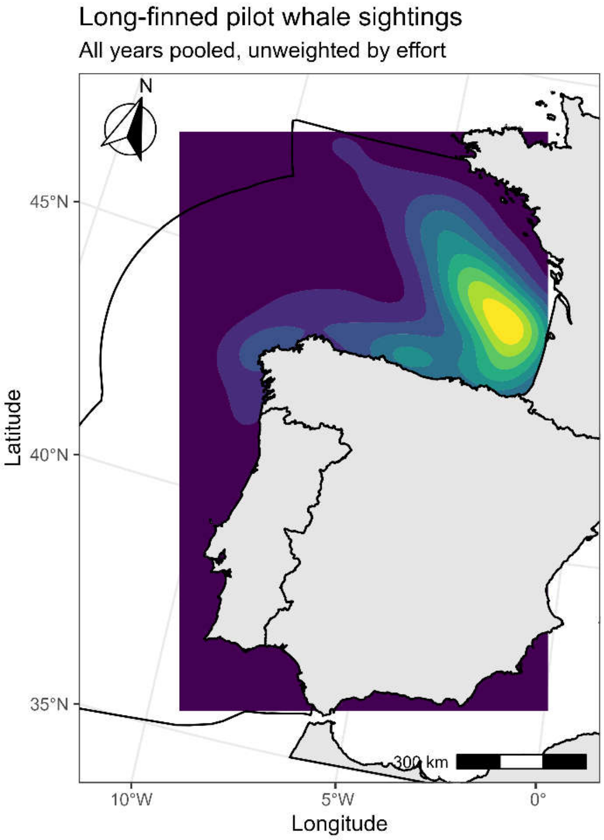
Bottlenose Dolphin (*Tursiops truncatus*): raw data (top) and smoothed data (bottom)



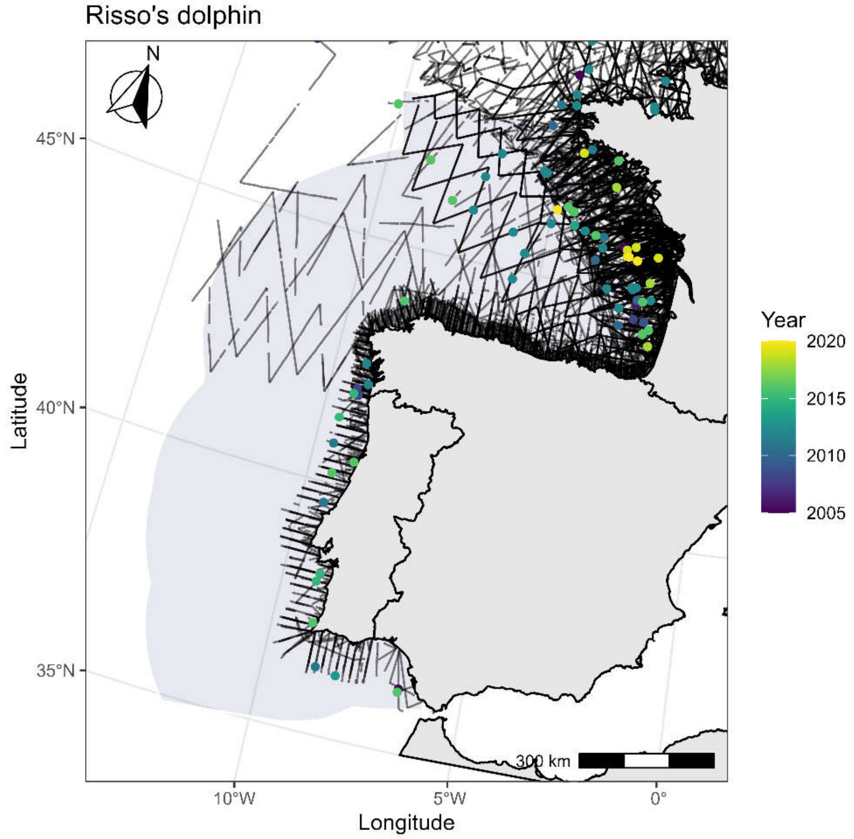


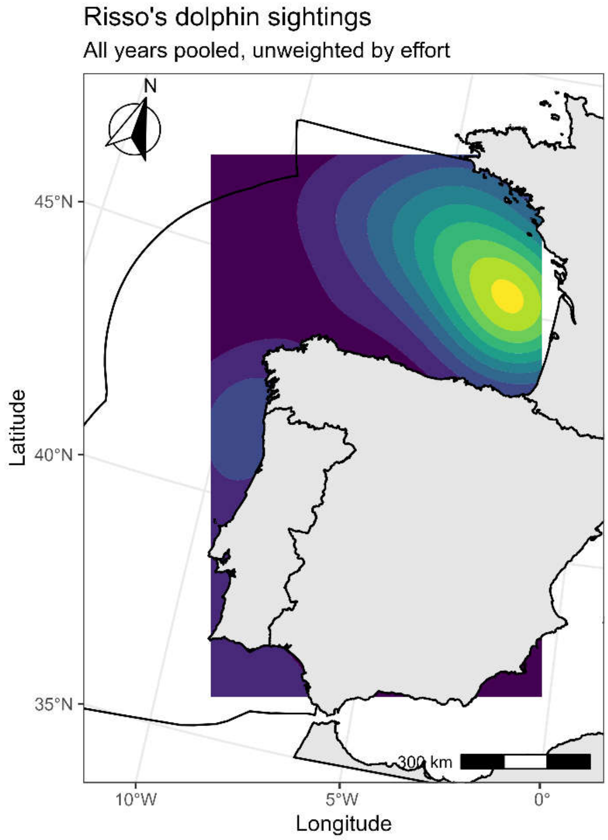
Long-finned Pilot Whales (*Globicephala melas*): raw data (top) and smoothed data (bottom)



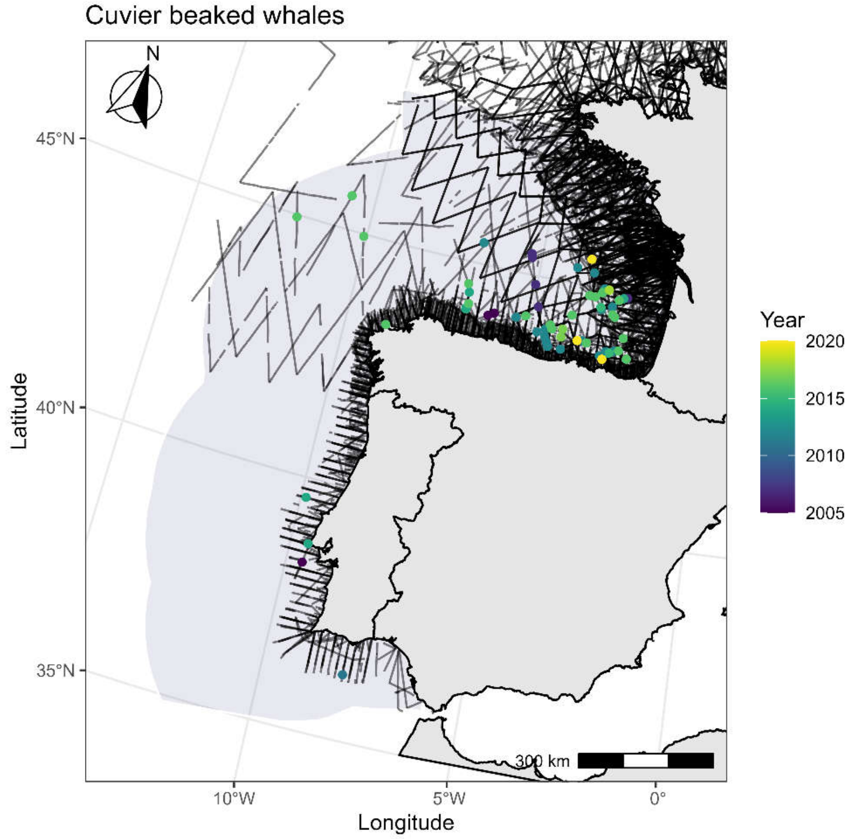


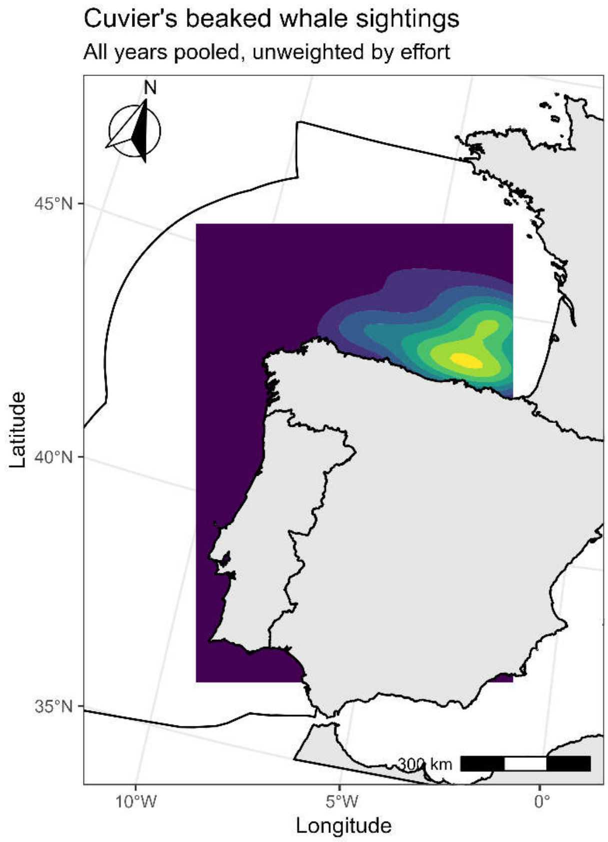
Risso's dolphins (***Grampus griseus***): raw data (top) and smoothed data (bottom)



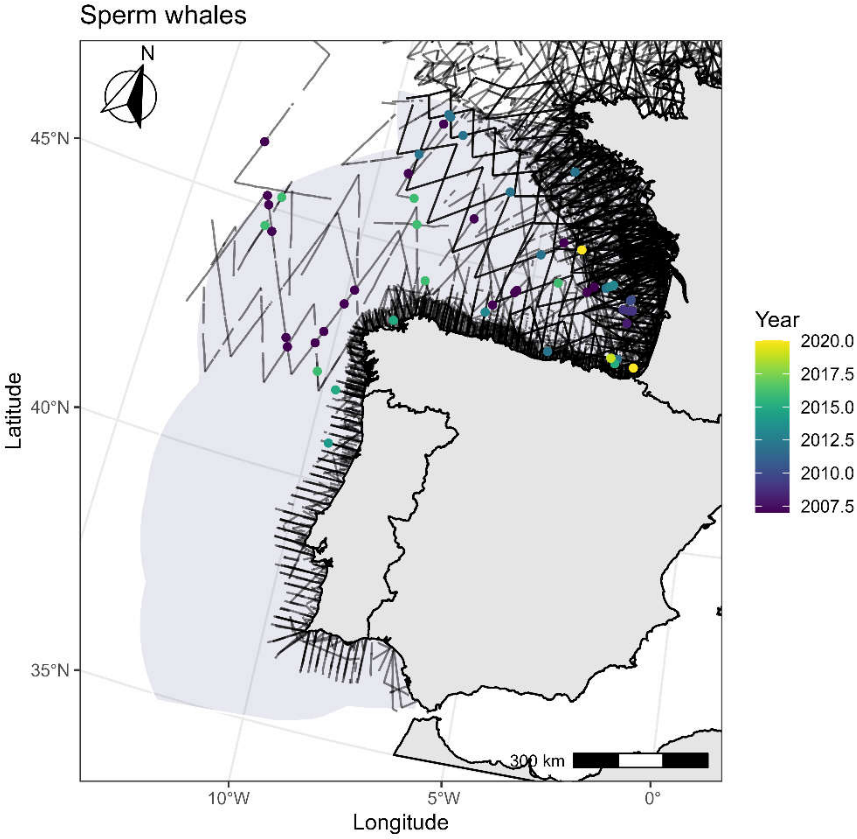


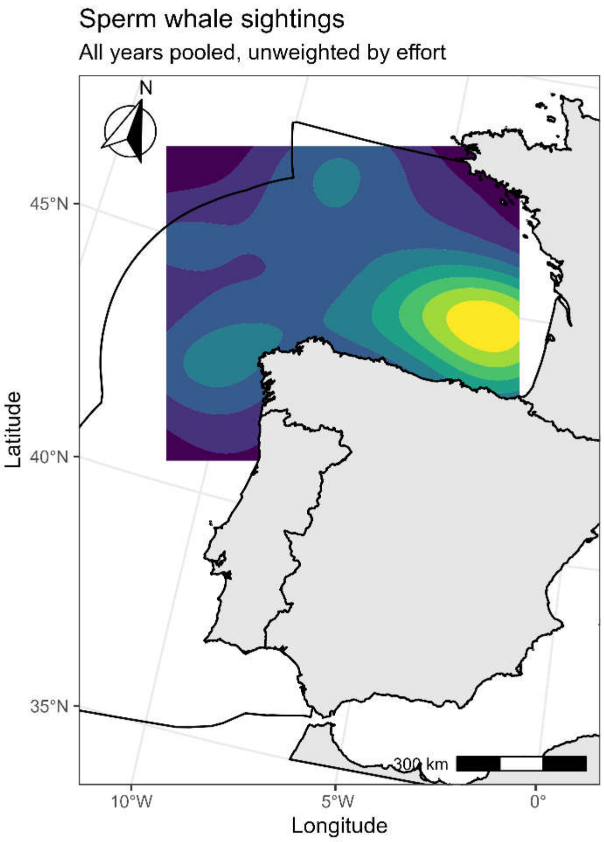
Cuvier's Beaked whales (*Ziphius cavirostris*): raw data (top) and smoothed data (bottom)



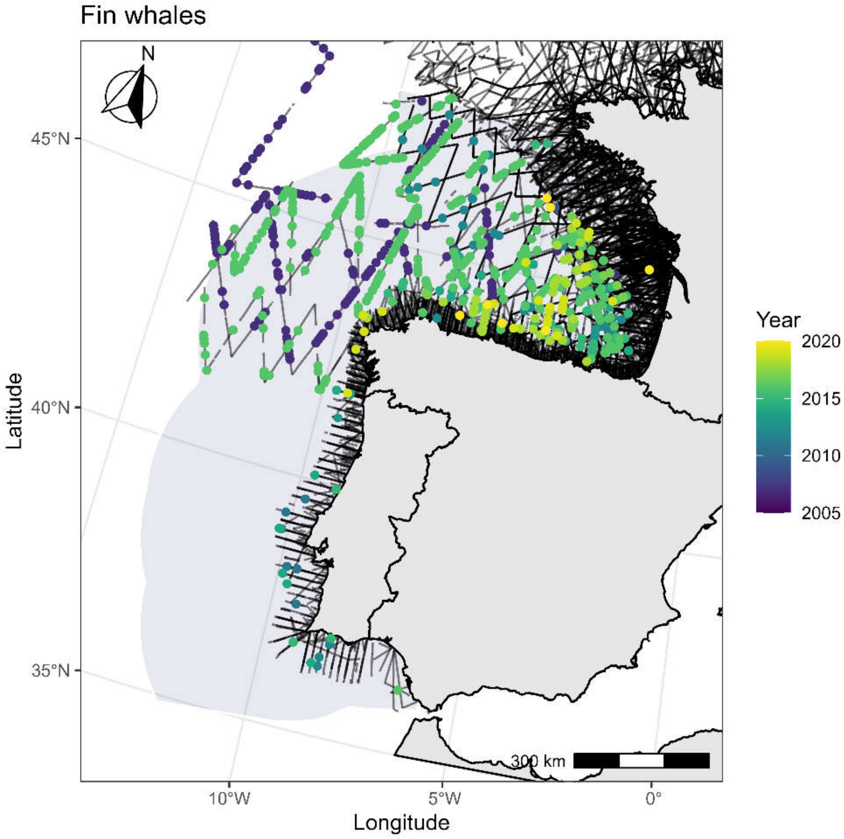


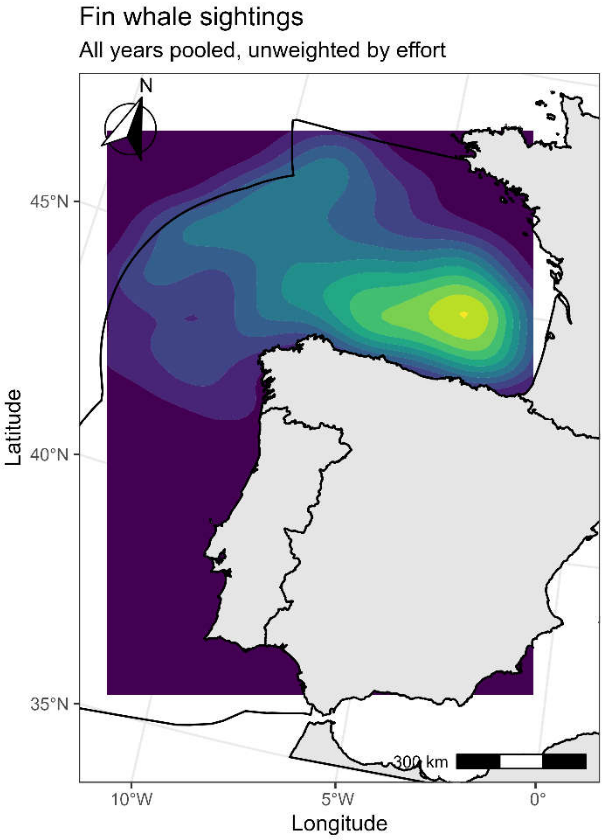
Sperm whales (*Physeter macrocephalus*): raw data (top) and smoothed data (bottom)



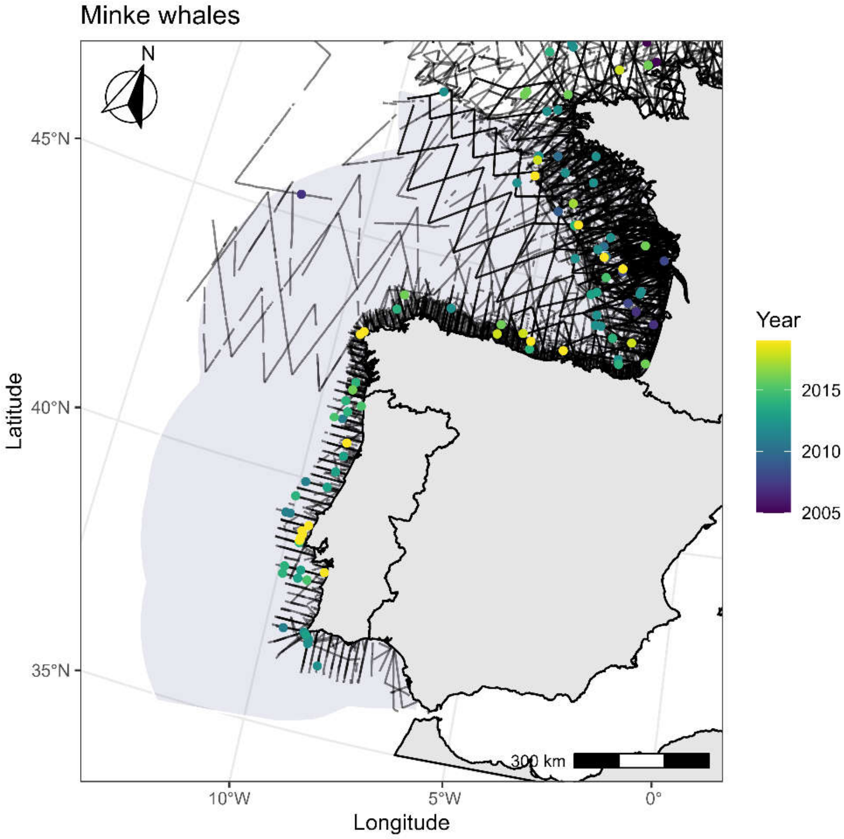


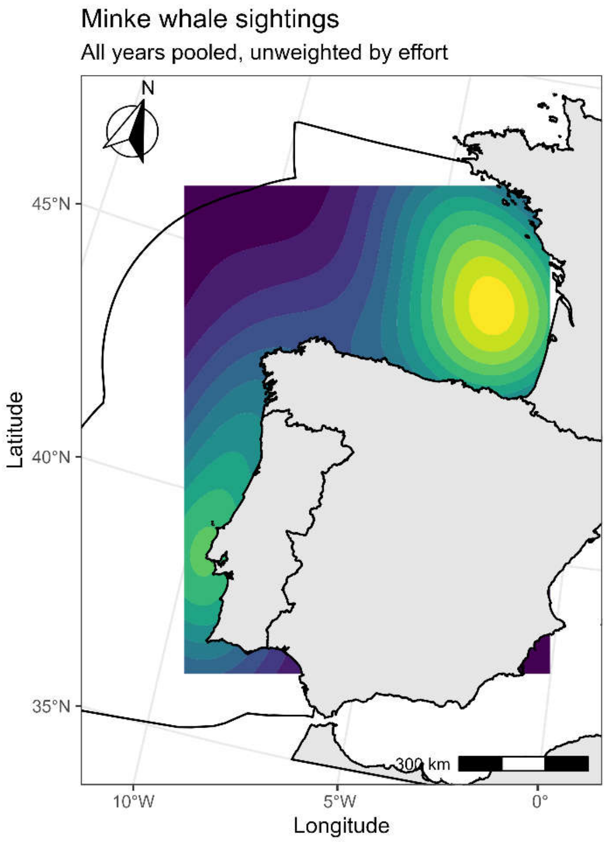
Fin Whales (*Balaenoptera physalus*): raw data (top) and smoothed data (bottom)





Minke Whales (*Balaneoptera acutus*): raw data (top) and smoothed data (bottom)





APPENDIX 3. Survey effort in the MSFD subregion "Bay of Biscay and Iberian Coast"

The maps below show output from a bivariate smooth of ecosystemic/multidisciplinary survey effort in the MSFD subregion "Bay of Biscay and Iberian Coast" collated for WP2. Each subpanel represents a year. The geographic extent varies from year to year, and so does the scale: subpanels can be compared on a relative scale, with cold colours showing little survey effort and bright colours highlighting areas of concentrated survey effort. For example, in 2019 and 2020, the SPEE surveys (see Table 1) were carried out each season on a small scale off the French Atlantic board. This accrued effort on a small area clearly pops.

This map further illustrates the coverage imbalance with a clear concentration of bright colours (higher effort) on the shelf part of the MSFD subregion "Bay of Biscay and Iberian Coast", especially in the Bay of Biscay proper.