Looking out for Whales and Dolphins

THE STATE OF EUROPEAN CETACEANS 2021

UNIVERSITY OF PLYMOUTH

FOREWORD

Reading this report, I'm struck by how much it reflects the constant challenges the conservation community faces – we make significant progress in key areas and then new problems and setbacks arise which tip the scales backwards again. So this is the kind of report which makes you ponder and wonder and worry all at the same time. For instance, it's great that more common dolphins are being observed around the glorious West coast of Scotland, opening up possibilities of a generation of people who will be entranced and engaged by the sight of such magnificent wildlife in our inshore waters. But then what impact will the planned offshore wind farms in that area have on these animals, just as they settle into their new found homes? It's like a giant game of 'Whack a Mole' . . . you solve one problem somewhere and it immediately pops back up somewhere else in a different guise.

But we must never get disheartened, and the wealth of detail and effort manifest in this report is a clear reminder to me of the whirring dynamo that is ORCA's army of fabulous citizen scientists. Kennedy once said that anyone can make a difference and everyone should try. So for every ORCA volunteer that has stood on a deck in the grimmest of weathers, recording sightings of whales and dolphins, I take my hat off to you. You and ORCA are making a difference and that is what whales and dolphins need most right now.

Chris Packham
ORCA patron, television presenter and wildlife expert

Common dolphins

KEY FINDINGS

'The State of European Cetaceans 2021' report is the latest milestone in ORCA's ongoing mission to use data collected by citizen scientists from platforms of opportunity (ferries and cruise ships) to improve the protection of whales, dolphins and porpoises (collectively known as cetaceans) within UK and European waters. Since 2001, trained volunteer Marine Mammal Surveyors have boarded ferries and cruise ships crossing the North-East Atlantic and beyond, recording the marine wildlife they observed. This is the fifth in a series of annual reports and builds on existing publications.

This report in particular looks at how citizen science can be used to better understand why in recent years more common dolphins have been observed inshore around the West coast of Scotland and the Hebrides. The aim of the study is to examine the environmental drivers causing this redistribution and the implications for the protection of these coastal common dolphins in light of ever increasing anthropogenic (man-made) pressures.

Another critical part of this report is an examination of the multiple threats facing whales, dolphins and porpoises within UK and European waters. The wide-ranging and cumulative threats that cetaceans face both on a regional and global scale are highlighted.

The State of European Cetaceans reports continue to demonstrate why ongoing, regular monitoring of cetaceans is vital. The compilation and analysis of real-time, long-term data are essential to make effective and informed decisions about the protection that our whales and dolphins so urgently need. Utilising ferry and cruise platforms is a highly effective tool to estimate the density, distribution and range of these animals in near real-time so that worrying patterns can be identified early.

Whilst citizen scientists can provide an army of watchful eyes thanks to the (extra) ordinary people who volunteer their free time in the name of science and conservation, we also need a commitment from governments to take swift and decisive action when evidence shows the growing threat to these animals and the habitats in which they live.

Common dolphin - Lisle Gwynn

Ferry and Cruise Survey Highlights (2019)

Record number of surveys conducted

- In 2019, ORCA conducted the highest number of effort-based cetacean surveys from platforms of opportunity to date, with 109 surveys aboard ferries and 27 surveys aboard cruise ships. The ferry surveys took place with seven ferry companies across 15 routes and the 27 cruise surveys were conducted in partnership with nine cruise companies.
- A total survey distance of 58,091 km was covered, an increase of 7,190 km of effort from 2018.
- Since 2006 ORCA has conducted 659 dedicated distance sampling surveys on 22 ferry routes and 116 effort-based surveys in partnership with 11 cruise companies, traversing 12 different sea regions.

First survey in the Southern Ocean and North Pacific Ocean

- ORCA regularly surveys nine sea regions: North Sea; English Channel; Celtic Sea; Bay of Biscay and Iberian Coast; Irish Sea; Minches and West Scotland; Arctic Waters; Wider Atlantic and the Mediterranean Sea. In 2019, surveys were conducted in the South Atlantic Ocean for the second year running and the Southern Ocean and North Pacific Ocean were surveyed for the very first time.

More than 14,000 cetaceans recorded

- ORCA surveyors reported a record number of cetacean encounters in 2019, with a total of 3,012 encounters across both ferry and cruise surveys, which amounted to 14,112 animals.

> An encounter refers to a single sighting, consisting of one individual or a group of animals of the same species

- The most frequently encountered species was the short-beaked common dolphin (490 encounters), followed by the harbour porpoise (457 encounters), humpback whale (397 encounters), fin whale (190 encounters), Dall's porpoise (160 encounters), common minke whale (138 encounters), striped dolphin (66 encounters), white-beaked dolphin (64 encounters), common bottlenose dolphin (50 encounters), beluga whale (46 encounters), and Pacific white-sided dolphin (39 encounters). All other cetacean species were recorded fewer than 30 times.

Four new species added to the ORCA database

- The bowhead whale, gray whale, Antarctic minke whale and Fraser's dolphin were all recorded for the first time on cruises in the Arctic Ocean, North Pacific Ocean, Southern Ocean and North Atlantic Ocean respectively.
- Twenty-nine different cetacean species were identified and recorded in 2019.

Over 3,000 cetaceans seen from UK ferry network

- There were 889 encounters of cetaceans from ferry surveys in 2019, consisting of 3,179 individuals, of which 661 encounters involved cetaceans identified as one of 11 species.
- Short-beaked common dolphins were the most numerous and frequently seen, with 293 encounters, followed closely by harbour porpoises (248 encounters).
- Most sightings were on the Penzance – St Mary's route in the Celtic Sea (125 encounters), closely followed by the Plymouth – Santander – Portsmouth route which traverses the English Channel, Celtic Sea and Bay of Biscay (122 encounters).

Common dolphins

Wildlife Officer Highlights (2019)

Greater than 75,000 km of survey effort

- Wildlife Officers covered 76,565 km of survey effort over five sea regions.
- The largest amount of effort was in the Bay of Biscay (31,293 km), followed by the North Sea (14,543 km), English Channel (14,114 km), Celtic Sea (11,115 km), and the Minches and West Scotland (5,500 km).

Over 17,000 whales, dolphins and porpoises spotted

- Wildlife Officers recorded 3,651 cetacean encounters, of which 2,662 were identified to species level, totalling 17,060 individual animals.
- Twenty different cetacean species were identified and recorded.
- Short-beaked common dolphins were most frequently recorded (1,075 encounters), followed by harbour porpoises (747 encounters), fin whales (370 encounters), common bottlenose dolphins (130 encounters), common minke whales (125 encounters), striped dolphins (88 encounters), and Cuvier's beaked whales (55 encounters), with the other 13 species seen 20 times or fewer.

North Sea and continental shelf edge with highest encounters

- Cetacean encounters were highest on the UK side of the North Sea ferry route, in proximity to the continental shelf edge in the Bay of Biscay, south of Ireland, and within the inner Minches and West Scotland, specifically inshore Hebridean waters.

Bottlenose dolphins recorded in all sea regions

- Common bottlenose dolphins were sighted in all sea regions and encountered throughout the Wildlife Officer season, with highest encounter rates between June and August.

Bottlenose dolphin - John Young

Modelling the Habitat Preferences of Common Dolphins in West Scotland

In recent years, with the ever increasing pressure for the UK Government to reach its net-zero carbon targets by 2050, offshore wind farm capability has expanded rapidly. Much of this proposed development is planned offshore around the West coast of Scotland and in the North Sea.

Over the last several years sightings of common dolphins around the coastline of West Scotland have also increased significantly, suggesting they are moving more to inshore areas. Despite their name, very little is known about the ecology of common dolphins. Understanding why this is happening and what environmental drivers are causing this redistribution is important in relation to current and potential commercial activity.

Habitat modelling provides an important analytical framework in the assessment and management of potential threats. The benefit of this type of modelling is that it is dynamic, allowing for continual investigation of species habitat preferences and monitoring the effectiveness of existing protection measures. Therefore, to understand why this redistribution of common dolphins is happening around West Scotland and to improve their protection, habitat modelling was used to help explain the association between range distribution of the species across space with both biological and physical environmental variables.

The environmental variables of depth, chlorophyll concentration, and sea surface temperature were all shown to be important explanatory variables of common dolphin presence. Results of this study show that common dolphins exhibit a high dependency on a well-defined habitat with a number of environmental variables contributing to the increased number of sightings observed for this species around West Scotland.

Further understanding of why this recent redistribution of common dolphins is happening is important, as fluctuations to their distribution and range as a result of mismanagement of human impacts can have a knock-on effect for the entire ecosystem.

Common dolphin - Glenn Overington

Threats to Cetaceans


Nisshin Maru, Japanese whaling vessel - IFAW

Whales, dolphins and porpoises depend upon the marine environment, but intensification of human activities has resulted in unprecedented changes to our seas and oceans, threatening the survival of cetaceans on a global scale. On a daily basis whales, dolphins and porpoises are faced with significant and emerging threats, but these do not occur in isolation and it is the cumulative impact of the wide-ranging and ever-increasing threats that is of paramount concern.

Over the past 200 years, industrial whaling decimated whale populations throughout the world's oceans. As the world's great whales were hunted to the point of extinction, and in recognition of this global overexploitation, the International Whaling Commission (IWC) in 1982 finally decided upon a global moratorium on commercial whaling. However, a number of commercial whaling countries have exploited loopholes in the IWC convention, allowing them to continue killing whales for commercial purposes. Norway, Iceland and Japan all conduct commercial whaling in defiance of the global ban. Norway continues to kill more whales each year than the other commercial whaling nations combined, with 503 whales killed during the 2020 whaling season under a self-allocated quota. Japan's 2020 whaling season killed 187 Bryde's whales, 25 sei whales and 95 minke whales. However, 2020 marked the second consecutive year that neither minke nor fin whaling had taken place in Iceland – the first step towards stopping this unsustainable and barbaric slaughter.

The world's oceans are busy places, with an abundance of human activities which can overlap with, and impact marine wildlife. With the increase in global marine traffic comes an increased risk of ships physically striking animals. This is commonly referred to as 'ship strike' which causes injury or death of the animal. The areas of greatest ship strike risk are where high densities of whales overlap with high intensity of shipping traffic. Injured animals may suffer long-term consequences such as a decrease in fitness which could also have welfare implications. Many of these whale strikes are under-reported. Furthermore, few studies have assessed the potential risk that smaller cetaceans face. It is clear that dolphins and porpoises are also victims of ship strike as individuals have stranded with evidence of collision related injuries.


Humpback whale

It is therefore vital that we further understand this global threat to cetaceans particularly for the smaller dolphins and porpoises. Much more detailed action and political will is required in regions where high density shipping traffic overlaps with high density cetacean areas to eliminate ship strike risk.

Marine mammals, and cetaceans in particular, have evolved to live in an underwater world of sound and as a result their auditory sense is highly developed. They use sound for all essential aspects of their lives including feeding, predator avoidance, navigation and communication. Anthropogenic noise has increased exponentially over the last 100 years, causing additional and increasing noise to be emitted into the marine environment. Anthropogenic noise can affect marine mammals in a variety of ways, depending upon the frequency and intensity of the noise source. In summary, underwater noise effects range from behavioural changes and displacement, through to masking of natural sounds (e.g. vocalisations), hearing loss at certain frequencies, physical injury and even death. Here in the UK, given the amount of offshore development required to meet net-zero targets and the wider government commitments to reduce the impacts of underwater noise, a collective effort by all industries that produce noise will be essential if development is to continue at pace. Effective and robust noise mitigation efforts are critical for the future offshore wind development planned in the North Sea, which is a particularly important habitat for harbour porpoises.


Entangled humpback whale Scotland - Andy Gilbert

Each year thousands of whales, dolphins and porpoises are incidentally caught and killed in fishing gear (commonly referred to as bycatch) around the world. Within European waters, bycatch continues to be a serious conservation and welfare issue with the majority of stranded animals' deaths attributed to bycatch. In UK waters, the most common victims of bycatch are the harbour porpoise and common dolphin; although the diversity of odontocete (or toothed cetaceans) species that become entangled also includes bottlenose dolphins, Risso's dolphins, striped dolphins, white-beaked dolphins, Atlantic white-sided dolphins and pilot whales. Baleen whales are also victims of bycatch; more commonly referred to as 'entanglement'. In the UK, minke whales and humpback whales are primarily affected. Despite international, national and regional regulatory policies to limit and reduce incidental capture in fishing gear, bycatch remains one of the foremost threats to marine mammals. We urge the UK Government to review fisheries management and practices, invest in new technologies that will reduce the incidence of bycatch and to phase out high-risk gear types such as set nets.

With human activity representing a key conservation threat for cetaceans, we have a responsibility to take action and safeguard our whales, dolphins and porpoises for future generations. Scientifically robust evidence is ever growing and for governments to not act upon current evidence in real-time and take meaningful, effective mitigation measures is wholly irresponsible.

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Acknowledgements

Shipping partners

We would like to extend our overwhelming gratitude to our shipping partners* without whom the survey data collection could not be possible.

*correct as of 2021

Corporate members

Supporters

We would like to thank the following for their generous support in helping ORCA to protect whales and dolphins: Heritage Lottery Fund, John Ellerman Foundation, John Spedan Lewis Foundation, Rickard Animal Company and Tesco Bags of Help.

Contributors

This report could not have been written without the help and support of other organisations: International Fund for Animal Welfare (IFAW), Natural England, University of Plymouth, University of Portsmouth, and Whale and Dolphin Conservation (WDC).

ORCA volunteers

ORCA's offshore monitoring programme is entirely reliant on our network of volunteer Marine Mammal Surveyors. Each one plays a role in this vital monitoring work – whether in the past, present or future.

These annual reports are a testament to their skill, time, effort and dedication.

Atlantic spotted dolphin - Ruth Coxon

About ORCA

ORCA is a UK whale and dolphin conservation charity dedicated to the long-term protection of whales, dolphins and porpoises (collectively known as cetaceans) and their habitats in UK and European waters. Founded in 2001, ORCA works to monitor vulnerable cetacean populations and helps to protect threatened marine habitats. Working with governments, research institutions and other conservation charities, ORCA's aim is to create safer places for cetaceans, ultimately promoting the health and well-being of the wider marine ecosystem.

Alongside its dedication to cetaceans, ORCA is passionate about people; the charity's work is as much about people as it is about whales and dolphins. What makes ORCA unique is the way we combine accessible marine education with our conservation activities, allowing us to give people from all walks of life the opportunity to take an active role in marine science and conservation. We are making science less exclusive and more accessible and tangible. We train volunteers to join our survey teams and recruit Wildlife Officers and Cruise Conservationists to support our educational programmes. ORCA's projects reach over 150,000 people of all ages each year, providing memorable educational activities and remarkable wildlife experiences both on and offshore. By doing so, we are empowering local communities to become stewards of whales and dolphins and the marine environment in which they live.

ORCA Wildlife Guides and guests

The Report and its Purpose

'The State of European Cetaceans 2021' report is the fifth in a series of annual reports published by ORCA. It summarises the distribution and range of cetacean populations, with a focus in and around UK and European waters using data collected on platforms of opportunity (namely ferries and cruise ships). This 2021 edition presents key survey findings from 2019. In normal circumstances the 2021 edition would be presenting findings of the previous year's survey season (2020), but at the time of writing the UK still remains in lockdown and the publication of the State of European Cetaceans 2020 edition along with the 2020 survey season were put on hold due to the global COVID-19 pandemic.

This edition also provides an update on the threats that cetaceans face. These include the increasing risk of whales being hit by ships, the devastating consequences to both small and large cetaceans when they become victims of bycatch, the continued barbaric practice of commercial whaling, and the growing impact of noise pollution.

With ever-increasing concern over global warming and the growing commercial pressures impacting our oceans, justifiable concern is building about the health of our marine ecosystems. ORCA's cetacean monitoring programme helps to provide the year-round supporting evidence necessary to assess the health of our whale and dolphin populations in the face of these threats. ORCA's research highlights areas within our seas that are consistently utilised by a range of cetacean species. It is these hotspots that must be given more protection as a matter of urgency.

This report is the culmination of 14 years of sightings and environmental data collected between 2006 and 2019 during more than 750 surveys. It highlights observations recorded during the 2019 survey season and uses a long-term dataset collected by citizen scientists to explore why numbers of common dolphin sightings around the West coast of Scotland and the Hebrides have increased in recent years.

Pilot whale and calf

SURVEY OVERVIEW

Bottlenose dolphin - Catherine Clark

Survey Methodology

ORCA conducts dedicated, cetacean focussed surveys across line-transects according to distance sampling methodologies, a widely employed technique for estimating cetacean density and abundance. Surveys are conducted by a fully trained team of three or four volunteer ORCA Marine Mammal Surveyors from the vessel's bridge (or other forward-facing platform) aboard ferries. A standardised survey protocol is adhered to, ensuring data collection is rigorous and comparable.

Similar methodologies are followed aboard cruise ships by trained ORCA teams and by ORCA Wildlife Officers aboard ferries; however, survey effort is more variable due to different sized teams and often teams are located on the open decks with passengers and guests who can assist with surveying duties.

Survey areas

ORCA regularly surveys nine sea regions (Figure 1): North Sea, English Channel, Celtic Sea, Bay of Biscay and Iberian Coast, Irish Sea, Minches and West Scotland, Arctic Waters, Wider Atlantic and the Mediterranean Sea.

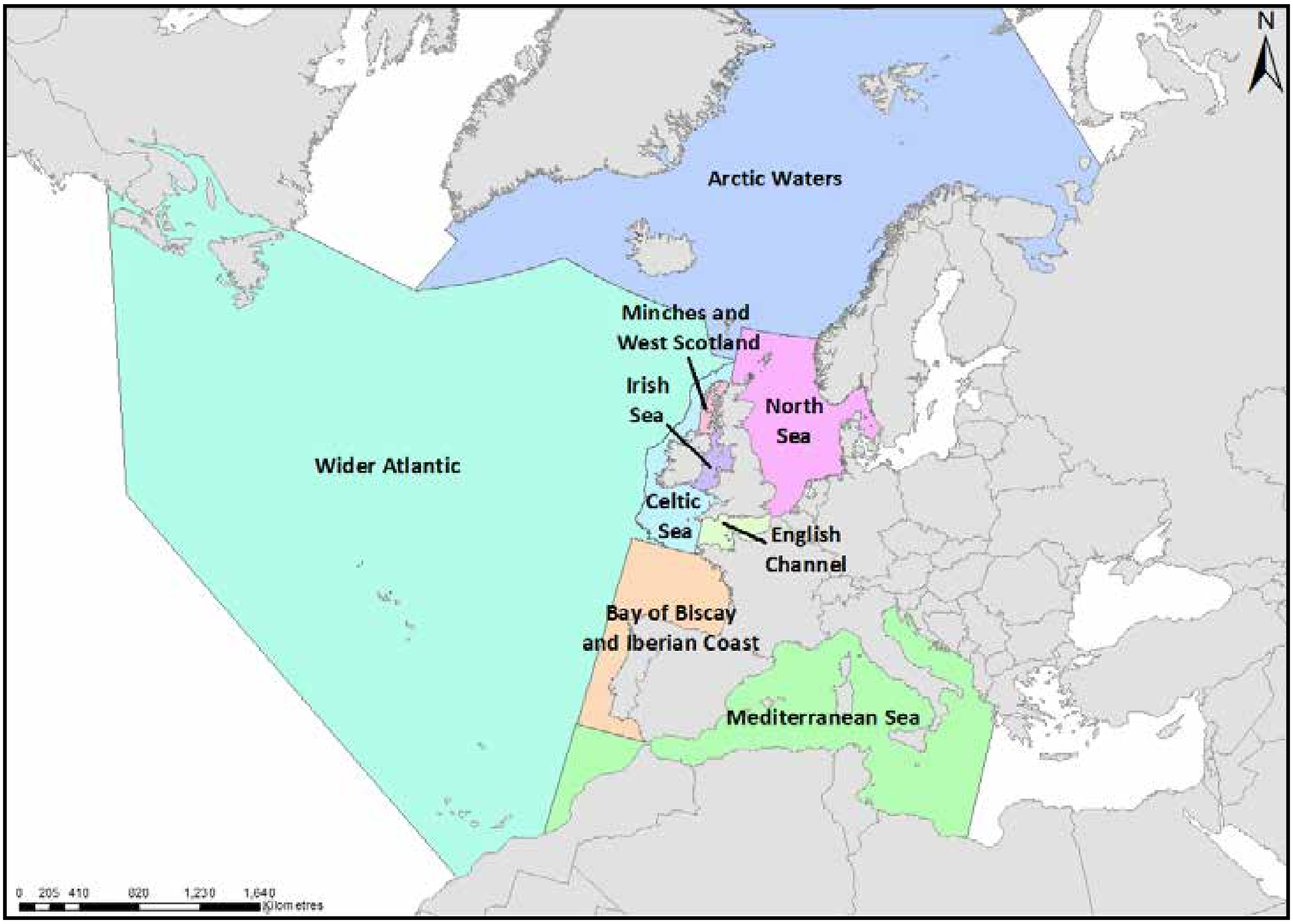


Figure 1: OSPAR regions regularly surveyed by ORCA.

Since 2006, ORCA has conducted 659 dedicated distance sampling surveys on 22 ferry routes in partnership with eight ferry companies. Additionally, 116 surveys following an effort-based survey methodology have been conducted in partnership with 11 cruise companies, traversing 12 different sea regions (Table 1).

Sea Region	Route Code	Route	Years Active	Company
North Sea	NsId	Newcastle – IJmuiden	2009, 2011 – 2019	DFDS
	NsBg	Newcastle – Bergen	2006 – 2008	DFDS
	HwEb	Harwich – Esbjerg	2008 – 2014	DFDS
	ImGoBvIm	Immingham – Gothenburg – Brevik	2015	DFDS
	AbLw	Aberdeen – Lerwick	2016 – 2019	NorthLink
	Cruise	Various cruises	2006, 2009 – 2019	Cunard, Fred.Olsen Cruise Lines, P&O Cruises, Saga, Silversea
English Channel	PlRc	Plymouth – Roscoff	2014 – 2019	Brittany Ferries
	PlRcCk	Plymouth – Roscoff – Cork	2017	Brittany Ferries
	PmCa	Portsmouth – Caen	2014 – 2019	Brittany Ferries
	PoCb	Poole – Cherbourg	2017 – 2019	Brittany Ferries
	DvCl	Dover – Calais	2016 – 2019	DFDS
	PmFb	Portsmouth – Fishbourne	2015 – 2019	Wightlink
	SoCo	Southampton – Cowes	2016 – 2019	Red Funnel
	LmYm	Lymington - Yarmouth	2015	Wightlink
	Cruise	Various cruises	2007, 2010 – 2019	Cunard, Fred.Olsen Cruise Lines, P&O Cruises, Saga, Silversea, Swan Hellenic
Celtic Sea	PzSm	Penzance – St Mary's	2009 – 2019	Isles of Scilly Travel
	Cruise	Various cruises	2007, 2009 – 2019	P&O Cruises, Saga, Silversea
Bay of Biscay and Iberian Coast	PlSt	Plymouth – Santander	2006 – 2008	Brittany Ferries
	PlStPm	Plymouth – Santander – Portsmouth	2009 – 2019	Brittany Ferries
	Cruise	Various cruises	2007, 2010, 2011, 2013, 2015 – 2019	P&O Cruises, Saga, Swan Hellenic
Irish Sea	HsPd	Heysham – Douglas	2011 – 2013, 2015, 2016	Isle of Man Steam Packet Company
	Cruise	Various cruises	2008 – 2019	P&O Cruises, Saga, Silversea
Minches and West Scotland	UlSw	Ullapool – Stornoway	2017 – 2019	Caledonian MacBrayne
	ObCs	Oban – Castlebay	2017 – 2019	Caledonian MacBrayne
	ObTiCo	Oban – Coll – Tiree – Colonsay	2017 – 2019	Caledonian MacBrayne
	UiTa	Uig – Lochmaddy – Uig – Tarbert – Uig	2019	Caledonian MacBrayne
	ArCp	Ardrossan – Campbeltown	2019	Caledonian MacBrayne
	Cruise	Various cruises	2009 – 2019	P&O Cruises, Saga
Arctic Waters	Cruise	Various cruises	2006, 2009, 2011, 2012, 2014 – 2019	Fred.Olsen Cruise Lines, Noble Caledonia, Oceanwide Expeditions, P&O Cruises, Saga, Silversea
Wider Atlantic	Cruise	Various cruises	2008, 2011, 2012, 2014 – 2019	Fred.Olsen Cruise Lines, P&O Cruises, Saga
Mediterranean Sea	Cruise	Various cruises	2007, 2008, 2010, 2011, 2012, 2015 – 2019	P&O Cruises, Saga
South Atlantic Ocean	Cruise	Various cruises	2018 – 2019	Hurtigruten, Oceanwide Expeditions
North Pacific Ocean	Cruise	Various cruises	2018 –2019	Celebrity Cruises, Crystal Cruises, Noble Caledonia, Silversea
Southern Ocean	Cruise	Various cruises	2019	Hurtigruten

Table 1: Routes surveyed by ORCA between 2006 and 2019.

Distance surveyed (effort)

In 2019, ORCA conducted 109 ferry surveys and 27 cruise surveys. The ferry surveys took place with seven ferry companies across 15 ferry routes. Two of these routes were in the North Sea (AbLw and NsId), six within the English Channel (DvCl, PmCa, PlRc, PoCb, PmFb and SoCo), one in the Celtic Sea (PzSm), one route traversed the English Channel, Celtic Sea and the Bay of Biscay (PlStPm) and five routes in the Minches and West Scotland (UlSw, ObCs, ObTiCo, UiTa and ArCp; Table 1 and Figure 2). The 27 cruises were conducted on board Celebrity Cruises, Crystal Cruises, Fred.Olsen Cruise Lines, Hurtigruten, Noble Caledonia, P&O Cruises, Oceanwide Expeditions, Saga and Silversea cruise ships across the North Atlantic Ocean, South Atlantic Ocean, North Pacific Ocean, Arctic Ocean, Southern Ocean and Mediterranean Sea (Table 1).

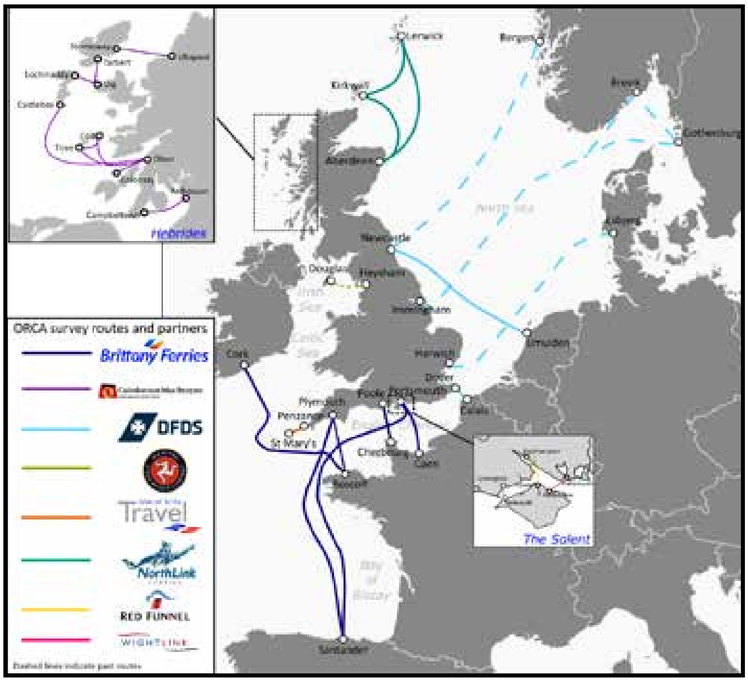


Figure 2: Ferry routes surveyed by ORCA in 2019.

The total surveyed distance in 2019 across all regions was 58,091 km (Figure 3). This consisted of 22,350 km of survey effort on board ferries, with dedicated distance sampling surveys, and 35,741 km of survey effort from cruise ships. This is an increase of 7,190 km of effort from 2018, resulting from more cruises conducted during the year.

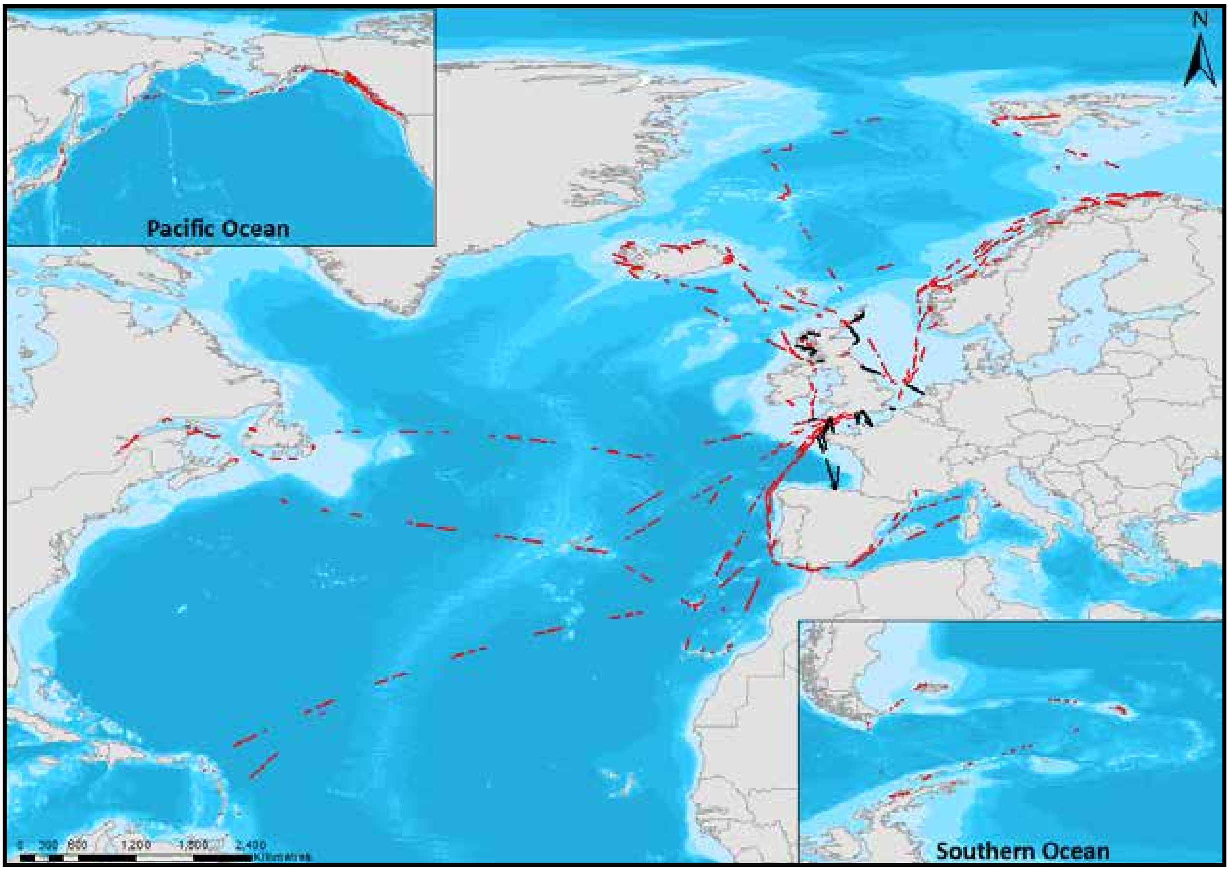


Figure 3: Ferry (black) and cruise (red) survey effort in 2019.

Within the North Atlantic, the highest total survey effort was undertaken in the North Sea (Figure 4). The relative amount of survey effort across the most frequently surveyed areas in the North Atlantic are depicted in Figure 5. The ferry survey route with the highest effort was Newcastle – Ijmuiden in the North Sea (3,920 km), closely followed by Portsmouth – Santander – Plymouth which traverses the English Channel, Celtic Sea and Bay of Biscay (3,686 km; Table 2).

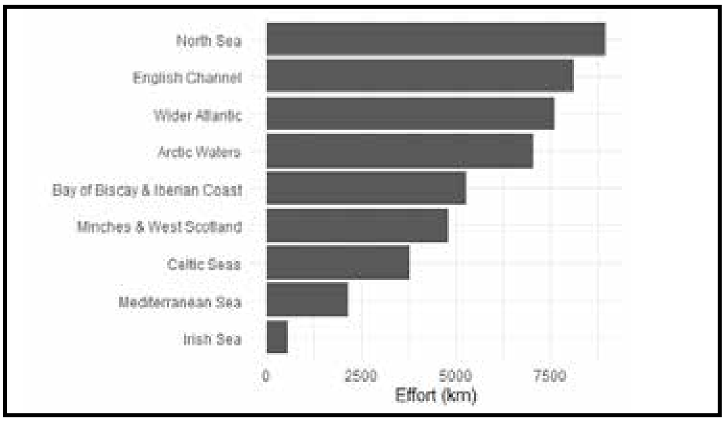


Figure 4: The total amount of effort (km) undertaken within each survey region in 2019.

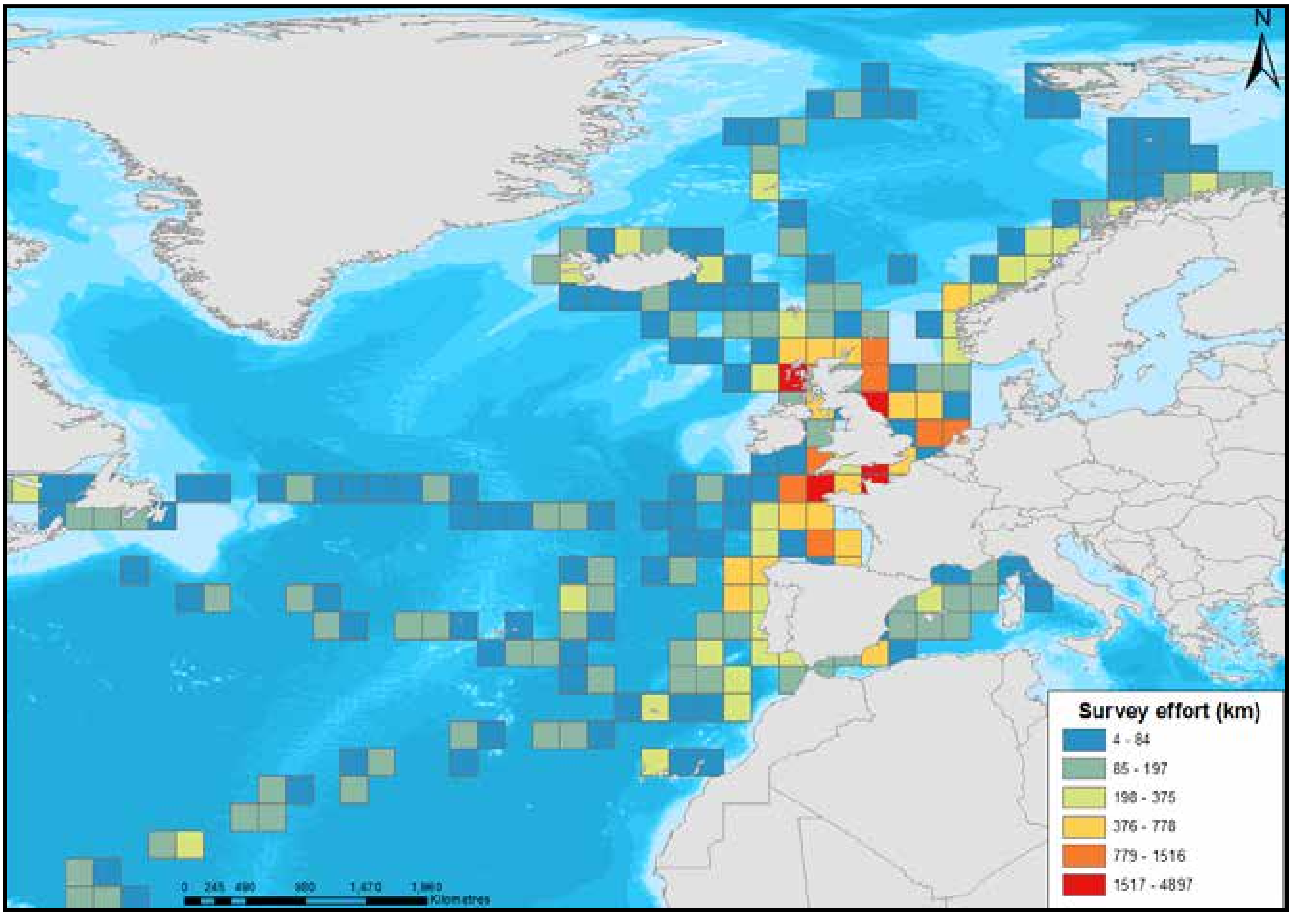


Figure 5: Relative amount of survey effort across the most frequently surveyed areas in the North Atlantic, calculated as a total effort in km across 200 km grid cells. Green cells indicate relatively low effort, in an increasing scale of warmer colours to red which indicates the highest amount of effort. Data are projected in Albers equal area conic to constrain proportions across Europe.

Year	NsBg	PlSt	HwEb	PlStPm	NsId	PzSm	HsPd	PlRc	PmCa	ImGoBv	LmYm	PmFb	DvCl	AbLw	SoCo	PlRcCk	PoCb	ObCs	ObTiCo	UlSw	UlTa	ArCp	Total
2006	8389	2115																					10504
2007	7522	3536																					11058
2008	7204	4453	333																				11990
2009			1770	5459	704	512																	8445
2010			163	4970		1622																	6755
2011			2544	5692	1855	1364	588																12043
2012			2882	4959	2210	1521	331																11903
2013			2903	4294	4087	1686	257																13227
2014			6168	5270	7532	1878		1420	212														22480
2015				4650	4706	2018	498	1123	1462	4297	45	95											18894
2016				3897	4107	1820	1219	1034	1694			110	382	916	111								15290
2017				6430	7282	4771		2708	2912			69	730	2109	50	385	891	210	122	188			28857
2018				5911	3612	2937		1184	1767			57	575	2632	67		983	1171	1003	590			22489
2019				3686	3920	2027		1339	2429			57	551	1971	67		1481	1682	869	984	839	348	22350
Total	23115	10104	16763	55218	40015	22156	2893	8808	10476	4297	45	388	2238	7628	295	385	3455	3063	1994	1762	839	348	216285

Table 2: Total effort (km) undertaken on ferry routes. See Table 1 for route code meanings.

Sightings

When compared with 2018, there was an increase in the number of cetacean encounters and animals recorded by ORCA surveyors on ferries and cruise ships in 2019. This continued year-on-year increase in sightings is likely due to increasing survey effort. In 2019, 14,112 animals were recorded across 3,012 encounters (Figure 6).

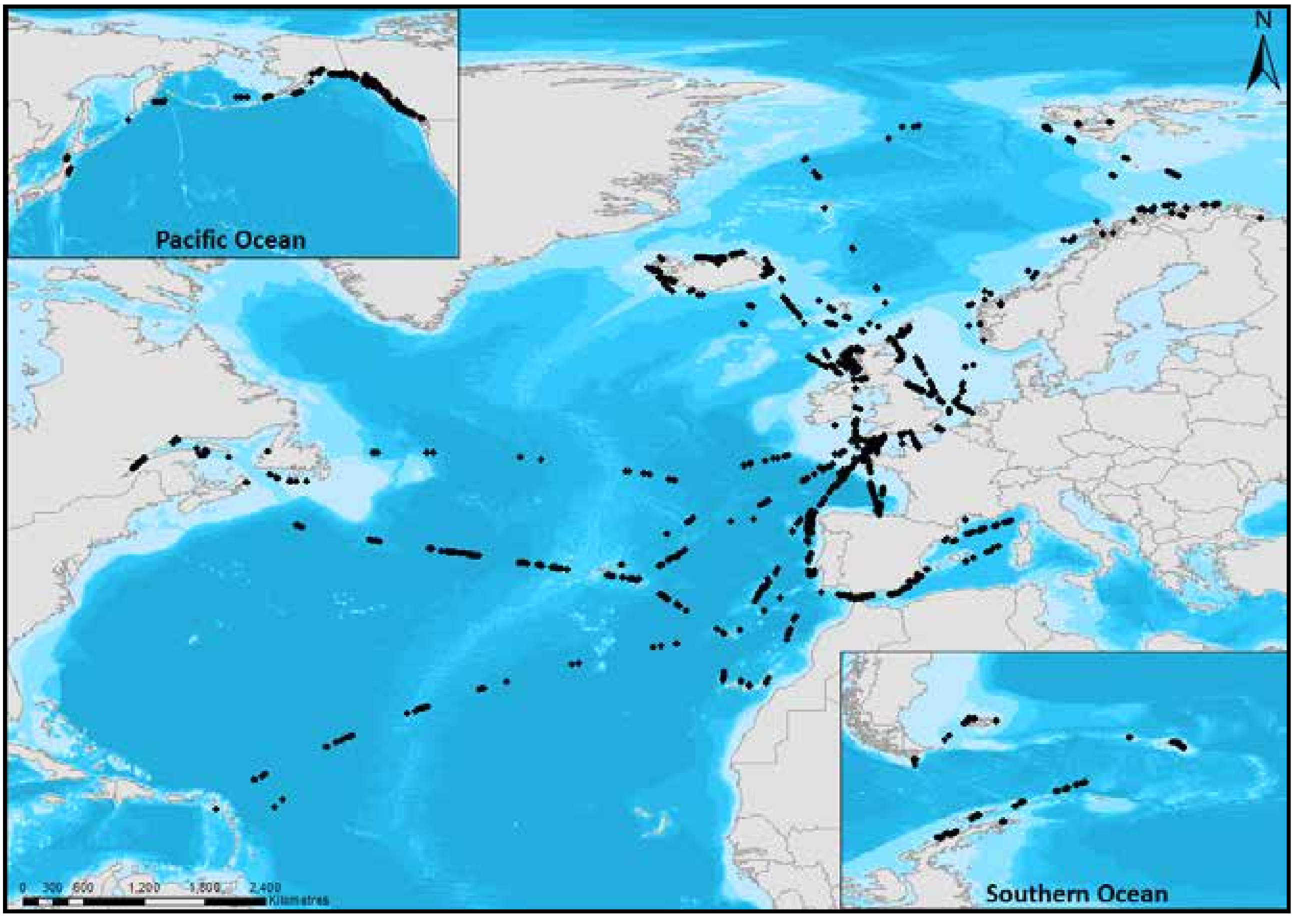


Figure 6: All cetacean sightings recorded by ORCA citizen scientists from ferries and cruise ships in 2019.

Of these 3,012 cetacean encounters, 2,310 were identified to species level, consisting of 10,708 individual animals (Table 3). Twenty-nine different cetacean species were identified, including four species that had previously never been recorded during ORCA surveys. The bowhead whale, gray whale and Fraser's dolphin were all recorded for the first time on cruises in the Arctic Ocean, North Pacific Ocean and North Atlantic Ocean respectively, and the Southern Ocean was surveyed for the first time in 2019 where Antarctic minke whales were sighted. This extended cruise coverage not only added new species to the ORCA database, but it also allowed data sharing with local research organisations, increasing the conservation value from these cruises.

The most frequently recorded species was the short-beaked common dolphin (490 encounters), followed by the harbour porpoise (457 encounters), humpback whale (397 encounters), fin whale (190 encounters), Dall's porpoise (160 encounters), common minke whale (138 encounters), striped dolphin (66 encounters), white-beaked dolphin (64 encounters), common bottlenose dolphin (50 encounters), beluga whale (46 encounters), and Pacific white-sided dolphin (39 encounters), with all other cetacean species recorded fewer than 30 times.

Overall, short-beaked common dolphins were the most numerous species recorded, with 4,274 animals sighted, followed by striped dolphins (1,059 animals), humpback whales (939 animals), harbour porpoises (902 animals), Dall's porpoises (745 animals), Pacific white-sided dolphins (500 animals), fin whales (361 animals), white-beaked dolphins (333 animals), common bottlenose dolphins (304 animals), long-finned pilot whales (233 animals), beluga whales (204 animals), common minke whales (171 animals), Atlantic spotted dolphins (113), and orcas (104 animals), with the total number of all animals from the remaining cetacean species being fewer than 100.

Species	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
Dall's porpoise *(Phocoenoides dalli)*													18	160	**178**
Harbour porpoise *(Phoceona phoceona)*	75	61	60	76	83	175	199	271	338	206	369	372	510	457	**3252**
Atlantic spotted dolphin *(Stenella frontalis)*												20	12	9	**41**
Atlantic white-sided dolphin *(Lagenorhynchus acutus)*	1	1				2	1	1	2	6		6	30	7	**57**
Bottlenose dolphin (common) *(Tursiops truncatus)*	8	9	19	18	8	33	12	24	25	16	30	60	68	50	**380**
Commerson's dolphin *(Cephalorhynchus commersonii)*													1	3	**4**
Common dolphin (short-beaked) *(Delphinus delphis)*	26	64	58	54	108	143	102	220	129	312	373	487	455	490	**3021**
Dusky dolphin *(Lagenoryhnchus obscurus)*													22		**22**
Fraser's dolphin *(Lagenodelphis hosei)*														1	**1**
Northern right whale dolphin *(Lissodelphis borealis)*													6		**6**
Pacific white-sided dolphin *(Lagenorhynchus obliquidens)*													12	39	**51**
Peale's dolphin *(Lagenorhynchus australis)*													13	7	**20**
Risso's dolphin *(Grampus griseus)*	1	2	1	2	1	5	4	6	10	3	9	26	20	13	**103**
Rough-toothed dolphin *(Steno bredanensis)*												1			**1**
Striped dolphin *(Stenella coeruleoalba)*	4	6	2	12	13	27	16	28	14	23	87	133	65	66	**496**
White-beaked dolphin *(Lagenorhynchus albirostris)*	4	11	3	3	1	28	19	46	79	21	54	43	70	64	**446**
False killer whale *(Pseudorca crassidens)*	1											2	1		**4**
Long-finned pilot whale *(Globicephala melas)*	2	13	7	10		6	20	2	3	8	6	20	25	22	**144**
Orca *(Orcinus orca)*	1		1	1		2	4	2	11	9	13	4	13	27	**88**
Short-finned pilot whale *(Globicephala macroorhynchus)*										3	2	4	3	1	**13**
Cuvier's beaked whale *(Ziphius cavirostris)*	2	2	3	8	3	10	12	6	8	12	9	15	8	16	**114**
Northern bottlenose whale *(Hyperoodon ampullatus)*	10	2	3		2	1	1		5	8	1	7	20	10	**70**
Sowerby's beaked whale *(Mesoplodon bidens)*		1		1	1	6	1	1	1	2	2	2	1	4	**23**
True's beaked whale *(Mesoplodon mirus)*		1								1					**2**
Beluga whale *(Delphinapterus leucas)*							6			3	2		9	46	**66**
Sperm whale *(Physeter macrocephalus)*	3	3	2	7	5	8	2	14	11	13	15	42	18	28	**171**
Blue whale *(Balaenoptera musculus)*							3	4	3	1	13	1	3	21	**49**
Bowhead whale *(Balaena mysticetus)*														2	**2**
Bryde's whale *(Balaenoptera brydei)*											1	3			**4**
Fin whale *(Balaenoptera physalus)*	6	14	74	11	6	42	27	28	49	35	95	105	189	190	**871**
Gray whale *(Eschrichtius robustus)*														2	**2**
Humpback whale *(Megaptera novaeangliae)*			1		1	3	7	10	31	25	32	89	292	397	**888**
Minke whale (Antarctic) *(Balaenoptera bonaerensis)*														20	**20**
Minke whale (common) *(Balaenoptera acutorostrata)*	6	9	9	15	16	36	52	43	79	44	50	102	109	138	**708**
North Atlantic right whale *(Eubalaena glacialis)*												1			**1**
Southern right whale *(Eubalaena australis)*													3		**3**
Sei whale *(Balaenoptera borealis)*		1			1		2	2	6		5	14	9	20	**60**
Total no. of encounters/No. of species	**150** 15	**200** 16	**243** 14	**218** 13	**249** 14	**527** 16	**490** 19	**708** 17	**804** 18	**751** 20	**1168** 20	**1559** 24	**2005** 29	**2310** 29	**11382** 37
Number of surveys per year	19	23	24	22	24	39	43	46	64	64	76	86	109	136	**775**
Average no. of encounters per survey	8	9	10	10	10	14	11	15	13	12	15	18	18	17	

Table 3: Number of encounters of each cetacean species 2006 – 2019.

Sightings by ferry route

There were 889 encounters of cetaceans from ferry surveys in 2019, consisting of 3,179 individuals, of which 661 encounters involved cetaceans identified as one of 11 cetacean species (Table 4). Short-beaked common dolphins were the most numerous and frequently seen, with 293 encounters. This was followed closely by harbour porpoises which were encountered 248 times.

Most sightings were recorded on the Penzance – St Mary's route in the Celtic Sea (125 encounters), with 91 short-beaked common dolphin encounters, 23 harbour porpoise encounters, five encounters with common minke whales and three encounters with common bottlenose dolphins and Risso's dolphins. This was closely followed by the Plymouth – Santander – Portsmouth route (122 encounters), consisting of the short-beaked common dolphin (95 encounters), fin whale (nine encounters), common bottlenose dolphin (seven encounters), striped dolphin (seven encounters), common minke whale (two encounters) and Cuvier's beaked whale (two encounters). There were 96 encounters on the third busiest route between Newcastle and Ijmuiden (Amsterdam), consisting of 66 harbour porpoise, nine white-beaked dolphin, nine common minke whale, eight common bottlenose dolphin and four short-beaked common dolphin encounters. The number of encounters on each route are outlined in Table 4.

Sea Region	North Sea		English Channel				Celtic Sea	Bay of Biscay	Minches and West Scotland					
Route Code	AbLw	NsId	DvCl	PmCa	PoCb	PlRc	PzSm	PlStPm	ArCp	ObCs	ObTiCo	UiTa	UlSw	
Species														Total
Harbour porpoise	27	66	6	12	1	3	23	0	6	23	36	14	31	248
Bottlenose dolphin (common)	10	8	0	4	1	1	3	7	0	1	0	0	0	35
Common dolphin (short-beaked)	0	4	0	1	1	40	91	95	0	23	2	8	28	293
Risso's dolphin	0	0	0	0	0	1	3	0	0	2	0	1	1	8
Striped dolphin	0	0	0	0	0	0	0	7	0	0	0	0	0	7
White-beaked dolphin	2	9	0	0	0	0	0	0	0	0	0	0	1	12
Orca	1	0	0	0	0	0	0	0	0	1	0	0	0	2
Cuvier's beaked whale	0	0	0	0	0	0	0	2	0	0	0	0	0	2
Fin whale	1	0	0	0	0	0	0	9	0	0	0	0	0	10
Minke whale (common)	2	9	0	0	0	0	5	2	0	9	7	1	8	43
Sei Whale	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Total	43	96	6	17	3	45	125	122	7	59	45	24	69	661

Table 4: Number of encounters for identified cetacean species in 2019.

Harbour porpoise - Andy Gilbert

Wildlife Officers

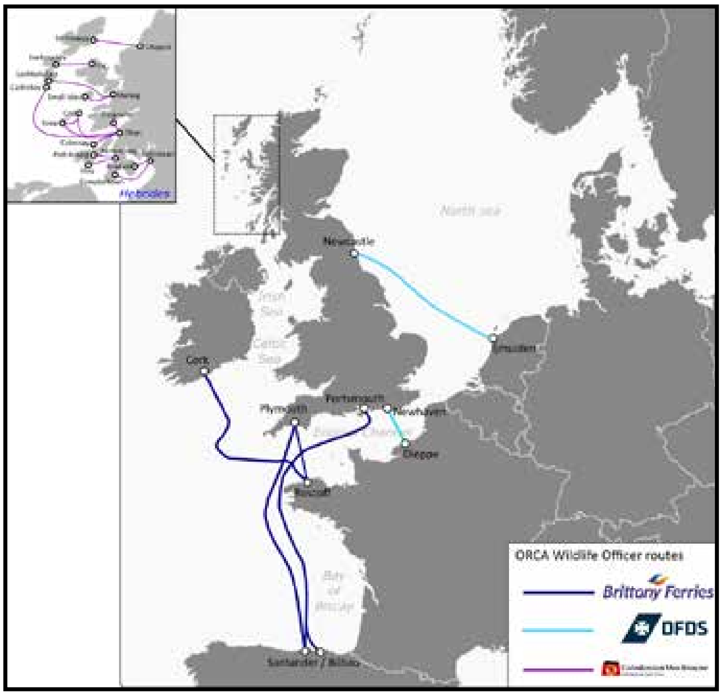


Figure 7: Ferry routes surveyed by Wildlife Officers in 2019.

In addition to the dedicated efforts of volunteer survey members, Wildlife Officers have been employed by ORCA, collecting standardised data since 2014. Wildlife Officers collect data from the open decks across a network of ferries, using the same survey protocol used on cruise ships. Operating for up to nine months of the year, Wildlife Officers live on board ferries, providing educational content to passengers and collecting scientific data, often every day for the entire season. This provides fine-scale temporal coverage that is unique for visual cetacean surveys.

Wildlife Officers have collected data on vessels operated by Brittany Ferries, Caledonian MacBrayne and DFDS, crossing the North Sea, English Channel, Celtic Sea, Bay of Biscay and Minches and West Scotland (Figure 7). A breakdown of the Wildlife Officer routes is shown in Table 5.

Company	Sea Region	Route	Vessel	Years Active
Brittany Ferries	English Channel, Celtic Sea, Bay of Biscay	Portsmouth – Santander – Plymouth – Roscoff – Cork – Roscoff – Plymouth – Santander – Portsmouth	Pont-Aven	2014 – 2019
	English Channel, Bay of Biscay	Portsmouth – Santander – Portsmouth – Bilbao – Portsmouth	Cap Finistère	2014 – 2019
Caledonian MacBrayne	Minches and West Scotland	Various routes	Various vessels	2018 – 2019
DFDS	North Sea	Newcastle – Ijmuiden	King Seaways	2014 – 2019
	English Channel	Newhaven – Dieppe	Seven Sisters, Cote d'Albatre	2018 – 2019

Table 5: Routes serviced by Wildlife Officers 2014 – 2019.

Wildlife Officer

Survey effort

In 2019 Wildlife Officers surveyed for cetaceans between March and October, with the largest amount of effort in the Bay of Biscay (31,293 km), followed by the North Sea (14,543 km), English Channel (14,114 km), Celtic Sea (11,115 km), and the Minches and West Scotland (5,500 km). Distances are summarised at ~100 km^2 grid cells in Figure 8.

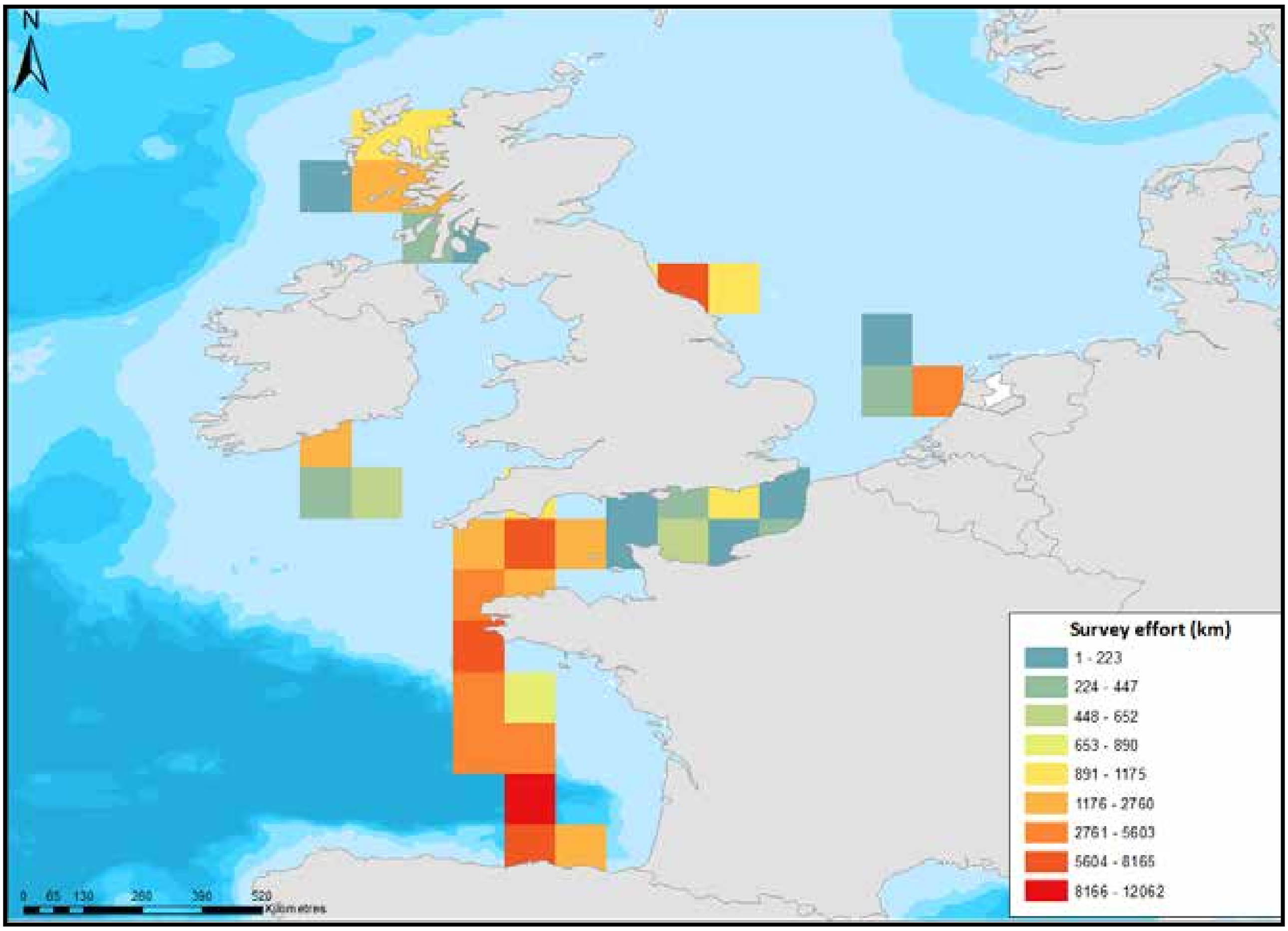


Figure 8: Wildlife Officer survey effort in 2019.

Common dolphins

Encounter rate

When considering variable survey effort across space to calculate the encounter rate of cetaceans (encounters per km of effort), there were more encounters on the UK side of the North Sea ferry route, south of Ireland, the Bay of Biscay in proximity to the continental shelf edge, and within the inner Minches and West Scotland waters, specifically inshore Hebridean waters (Figure 9).

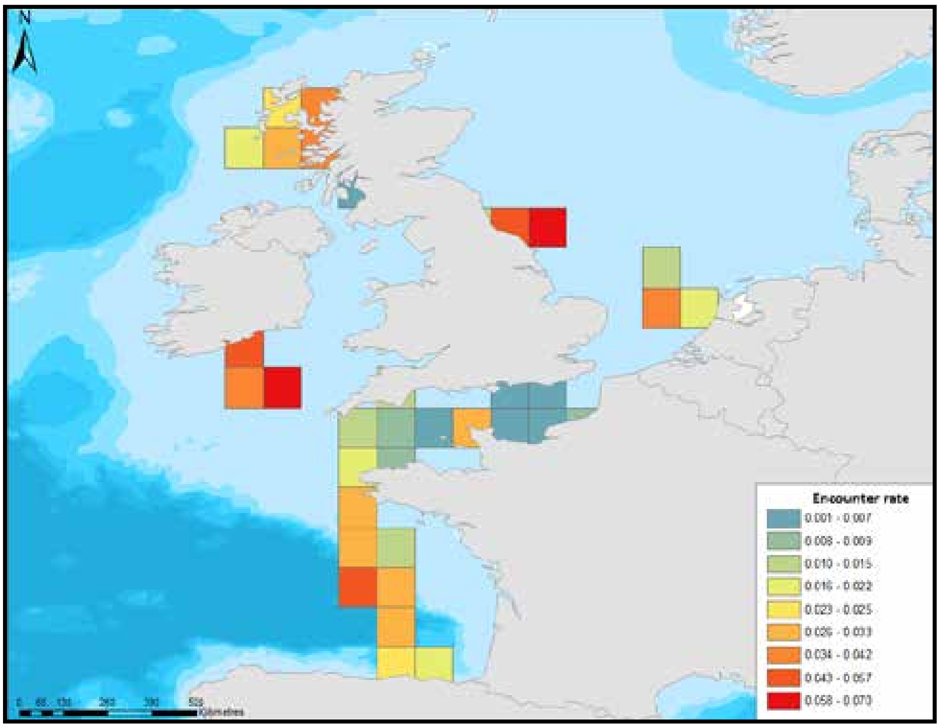


Figure 9: Mean encounter rate (cetacean encounters per km of survey effort) per grid cell, by Wildlife Officers in 2019.

Using the same encounter rate metric over time, we can see that common bottlenose dolphins were recorded by Wildlife Officers throughout the survey period in 2019, with highest encounter rates between June and August. Cuvier's beaked whales were not recorded in March, but encounter rates then increased until August. Patterns in short-beaked common dolphin encounter rates were less clear, with peaks in May and August. Fin whales were not recorded in March, with encounter rates rising from April to July, then reducing gradually until the end of the survey season in late September. Harbour porpoises were encountered throughout the season, with a rise in encounter rates in August and September. Common minke whales were not recorded in March, with a small gradual increase in encounter rates as the season progressed. Striped dolphins were not recorded in March or April, and encounter rates peaked in August. Encounter rates for each species across 2019 are shown in Figure 10.

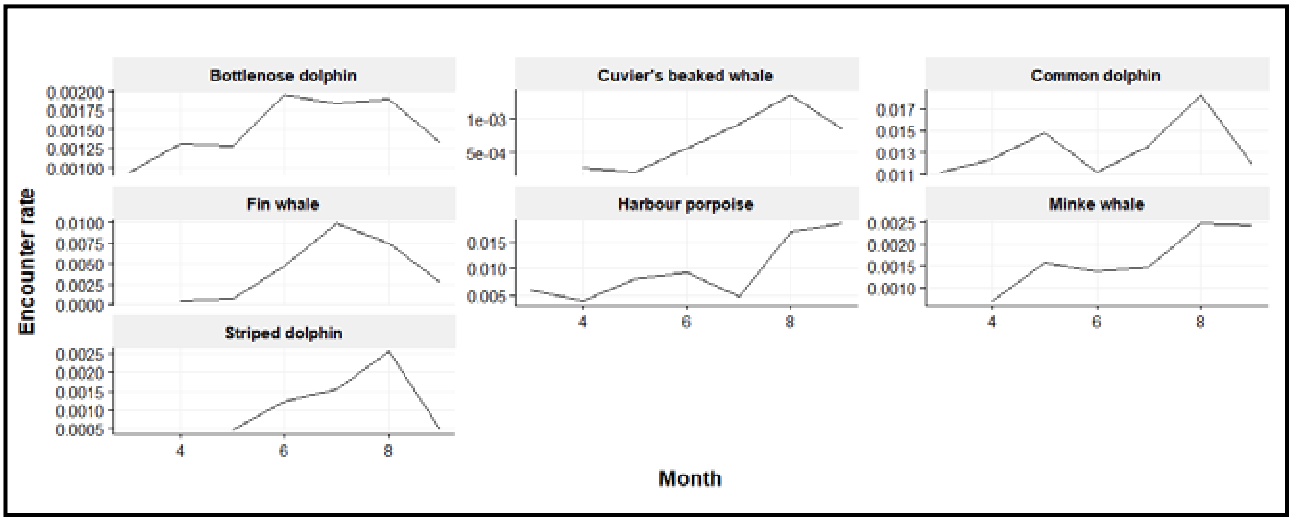


Figure 10: Temporal change in overall encounter rate for the seven most frequently recorded cetacean species by Wildlife Officers in 2019.

While the above encounter rates capture variation within each species over the course of 2019, patterns in occurrence also occur dependent on the location, with seasonal movements depending on the region. Region-specific seasonal encounter rates for each species are depicted in Figure 11, broadly showing that common bottlenose dolphins were only recorded in the Minches and West Scotland between March and June, when encounter rates also peaked in the Bay of Biscay; however, peaks were later in the Celtic Sea, English Channel, and North Sea. Cuvier's beaked whales were only recorded in the Bay of Biscay, where encounter rates increased throughout the season. Short-beaked common dolphin encounter rates were highest in the Celtic Sea in August, with lower but similar peaks in later summer in the English Channel and the Minches and West Scotland; however, in the Bay of Biscay, encounter rates were highest in the months preceding July. Fin whales were only recorded in the Bay of Biscay and Celtic Sea, and were encountered most frequently in July in the former, which also corresponds with their short period seen in the Celtic Sea. Harbour porpoises were present throughout the survey season in stable but low numbers in the English Channel, Celtic Sea and Bay of Biscay, with increases in the Minches and West Scotland around mid-summer, peaking in June, and peaks at the start and end of the survey season in the North Sea. Similarly, common minke whales were stable in low numbers throughout the Bay of Biscay, Celtic Sea, and English Channel, with slight increases throughout the season in the North Sea, and a peak in June in the Minches and West Scotland. Striped dolphins were consistently recorded in the Bay of Biscay from May, with a peak in August, and were recorded in low numbers in July and August in the Celtic Sea.

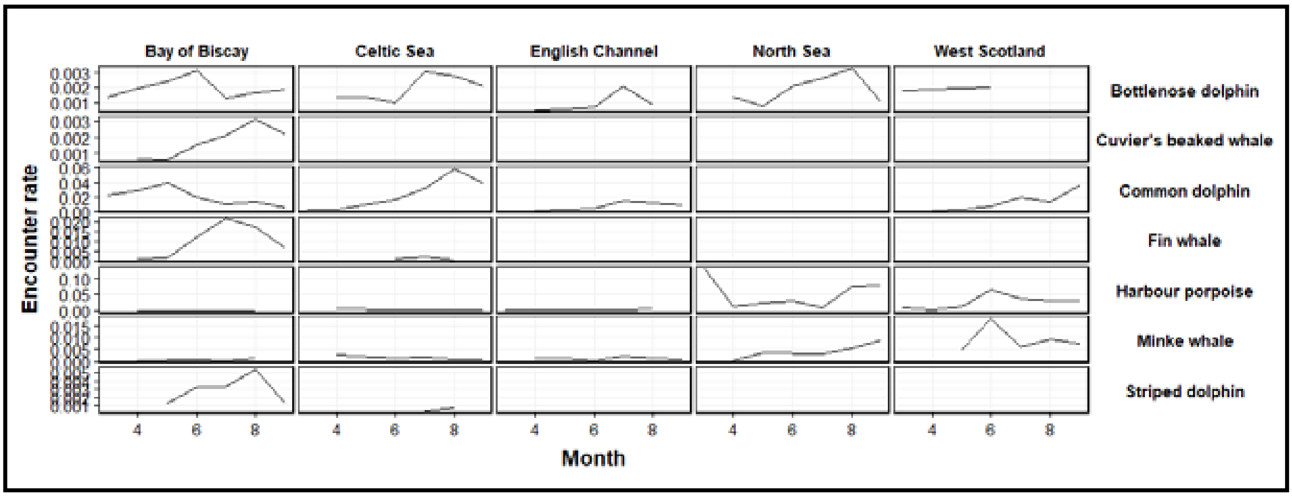


Figure 11: Encounter rates for the seven most commonly recorded cetacean species by Wildlife Officers in 2019. Encounter rates are presented for each month and each sea region. The sea region 'West Scotland' refers to the Minches and West Scotland.

Cuvier's beaked whale

CONTRIBUTING TO CETACEAN CONSERVATION

ORCA is committed to the conservation of cetaceans through evidence-based science. Long-term monitoring has accumulated a large dataset covering a wide area, allowing spatial and temporal trends to be investigated. These data are analysed in-house and by postgraduate students from a variety of universities to explore changes in distribution, population dynamics and densities. Results from these studies are disseminated in this report, in peer-reviewed publications, and through interfaces with scientific working groups and panels in order to affect policy and positive change.

Bottlenose dolphin - Catherine Clark

Modelling the habitat preferences of common dolphins in West Scotland

Contributors: *Hannah Thompson* (University of Plymouth), supervised by *Dr Clare Embling* (University of Plymouth) and *Katie Welsh* (ORCA, University of Plymouth)

Introduction

Short-beaked common dolphins *(Delphinus delphis)*

The short-beaked common dolphin *(Delphinus delphis)*, is a widespread species of common dolphin occurring in warm-temperate oceans. Being one of the most abundant species of cetacean, the common dolphin has a global population estimated to be around six million (Hammond *et al.*, 2008). Unlike other species of cetacean, this species presents a number of separate geographical populations (Heyning & Perrin, 1994; Jefferson & Van Waerebeek, 2002). As it stands there are two recognised species of common dolphin, the long-beaked common dolphin *D. capensis* and the short-beaked common dolphin *D. delphis* (Rosel *et al.*, 1994). Short-beaked common dolphins are the only common dolphin species to occur in the surveyed region of this study, therefore references to the 'common dolphin' hereafter is referring to *D. delphis*.

Despite the name 'common' dolphin there has been very little research into this species, considerably so when compared to the vast amount of literature published on bottlenose dolphins (*Tursiops spp.)*, a closely related species. The lack of data may be a result of their far reaching distribution and significant amount of time spent offshore, making surveying and accurately accounting for their numbers challenging. British and Irish waters are of particular ecological importance for the common dolphin, with it being one of the most abundant cetaceans in this region during the summer months, notably May to October (Hammond *et al.*, 2013; MacLeod *et al.*, 2008).

Threats to common dolphins

British waters are not only a hotspot for the rising numbers of common dolphins but also for a vast range of industrial, commercial and recreational activities. As a result, there can be a conflict of interest between the priorities of the parties involved in these activities and those focusing on the conservation and success of the UK's common dolphin population. Marine traffic, overfishing, bycatch, seismic exploration, habitat destruction and offshore construction are just a few examples of the anthropogenic threats facing common dolphins and other UK cetaceans.

Habitat Modelling

Upon the better understanding of the full extent of the threats posed to cetaceans by anthropogenic activities, efforts have increased by a number of authorities to better manage and preserve their marine resources and protect resident cetacean populations. Supporting management efforts calls for further and more accurate spatial and temporal data of species abundance for mapping purposes. Habitat modelling can be used in support of these efforts to ensure the success of a number of spatial management techniques such as MPAs/SACs, Environmental impact assessments (EIAs), spatial mapping, and threat assessments.

Common dolphin and calf - Shenaz Khimji

Common dolphin population in West Scotland

West Scotland is becoming an increasingly important region for British cetacean populations. To date there have been 24 species of cetacean reported in this region (Evans, 2000). Numbers of common dolphin sightings on the West coast of Scotland and around the Hebrides have increased in recent years. Common dolphins occur off West Scotland year-round, with sightings peaking in the summer months (Weir *et al.*, 2001). Local research groups monitoring cetacean population changes report record numbers of common dolphin sightings off the West coast of Scotland (HWDT, 2018). The clear and evident rise in numbers of this species in Scotland calls for further and more detailed investigation, for instance; where across the survey region are common dolphins frequenting most, when in the year are the highest numbers seen, and what environmental variables may be driving these changes?

This study models habitat usage of common dolphins in West Scotland. Investigating the consistency and significance of high use areas and associations with environmental variables, to include sea surface temperature, chlorophyll and depth, between 2017 and 2019.


Common dolphin

Methods

Study area

Data for this study were collected in the waters off the West coast of Scotland, specifically within 55°18 - 58˚64 N, -4˚63 -7˚42'W. Also referred to as 'The Minch', it is the Atlantic sea channel running through the Outer Hebrides, between 25 and 45 miles wide. This channel varies greatly in depth and rapid water flow running through a series of headlands and bays creates complex currents and hotspots for upwelling.

Data Collection

Data were collected both by ORCA Marine Mammal Surveyors aboard cruise ships and ferries and ORCA Wildlife Officers aboard regular ferry trips using effort-based survey methodologies. The time frame for these sightings were restricted to between March and October as there were no regular surveys carried out between November and February. Therefore, only sightings recorded from April to October were included in analyses, as there were sufficient numbers of surveys carried out in this time frame.

Data analyses

Data were organised by season and the seasons most surveyed were spring and summer; spring was categorised as March to June and summer as June to September. Seasonal satellite data for sea surface temperature and chlorophyll were sourced from NASA's database. These were seasonal composition maps at 4 km resolution (AQUA MODIS – LEVEL 3 MAPPED). Depth data was sourced and downloaded from GEBCO at a 1 km resolution (GEBCO Compilation Group (2020) GEBCO 2020 Grid).

Generalised Additive Models (GAMs) were chosen to represent the relationship between the environmental variables being investigated and the presence of common dolphins. Each variable was analysed individually, the GAMs were used to analyse the relationship between presence/absence of common dolphins per 1 km grid square on the survey tracks to the three environmental variables; sea surface temperature (SST), chlorophyll concentration and depth.

Results

Surveys and sightings

During the three years sampled, a total of 2,326 common dolphins were sighted over the 14,925 km surveyed. The total number of common dolphins sighted per season shows that consistently summer had the highest abundance of common dolphins, with 322 individuals sighted in 2017, 511 in 2018 and 1,493 in 2019. These results indicate that the number of common dolphins around West Scotland are increasing. Sightings increased by 59% between 2017 and 2018, and by 192% between 2018 and 2019. Mean group size was calculated by dividing the number of dolphins sighted by the number of sightings. Numbers in 2017 and 2018 were affected by a limited number of sightings with sightings of super pods leading to larger mean group sizes. Results for 2019 showed a seasonal response as group size increased from autumn through to spring and summer (Table 7).

	Summer 2017	Spring 2018	Summer 2018	Spring 2019	Summer 2019	Autumn 2019
Number of individual common dolphins	332	114	397	226	1193	74
Number of common dolphin sightings	7	5	49	25	81	14
Total survey effort (km)	865	2557	2836	4855	3158	654
Sightings per kilometre	0.008	0.0019	0.017	0.005	0.025	0.021
Mean group size	46	23	8	9	14	5

Table 7: Number of individual common dolphins, sightings, mean group size and the amount of survey effort per season in West Scotland between 2017 – 2019.

To account for the differing amount of survey lengths between years, sightings per km were calculated. 2019 showed a large increase in the number of sightings and individuals from the previous years and the most sightings per km were during the summer of 2019. In 2018 the summer season also had the highest number of sightings per km out of all seasons surveyed that year (Table 7).

Sightings were shown to be evenly distributed across all survey routes, with little spatial preference shown by the common dolphins. Sightings occurred near shore on both sides of the ferry survey routes and throughout the surveys also (Figure 12).

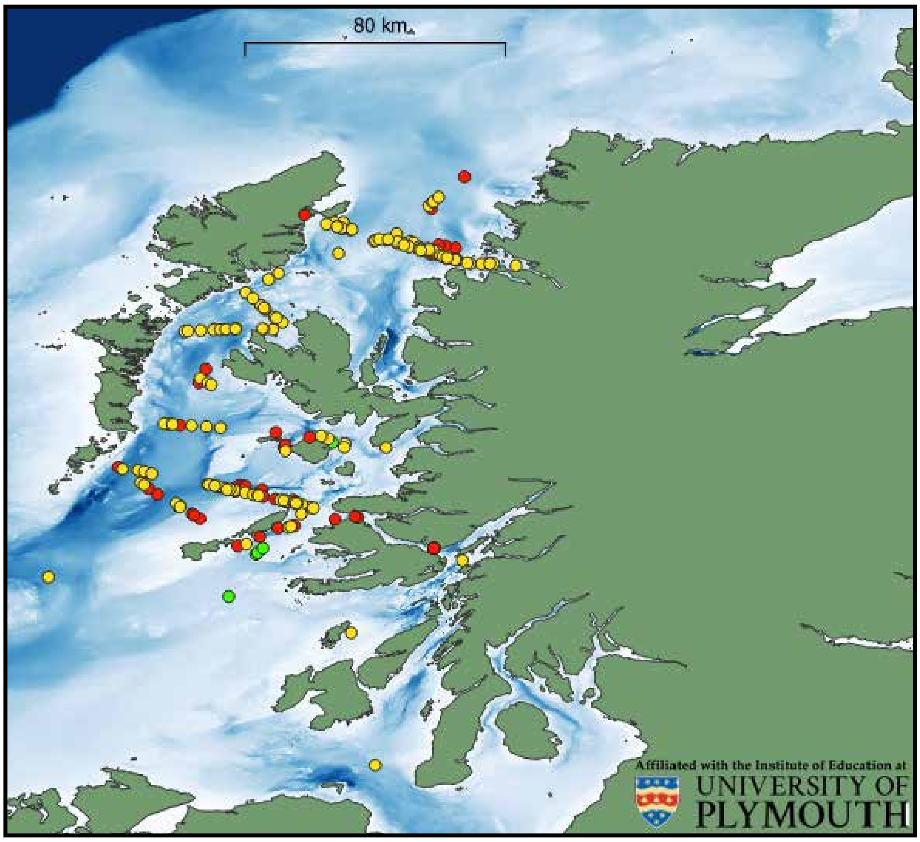


Figure 12: Common dolphin sightings in West Scotland between 2017 – 2019. Green dots show 2017 sightings, red dots show 2018 sightings and yellow dots represent sightings in 2019.

Habitat models

Three variables were tested for correlation with common dolphin presence; sea surface temperature (SST), chlorophyll concentration and depth. Of these three variables, depth was the most important predictor of common dolphin presence, results show that depth explained 2.99% of deviance in the model. Additionally, the UBRE (unbiased risk estimator) score is the lowest at -0.95, further explaining the importance of depth as a predictor of common dolphin abundance. Chlorophyll was the second most important environmental factor in explaining presence/absence in common dolphins and thirdly, SST was also found to be statistically significant. When these variables were combined in the model, the amount of deviance explained increased and the AIC score reduced (Table 8).

Model Variables	AIC	UBRE	% Deviance
Depth	2132.529	-0.95019	3.28
Sea surface temperature (SST)	2159.798	-0.94955	2.05
Chlorophyll concentration	2151.883	-0.94974	2.29
Depth + Chlorophyll concentration	2101.198	-0.95092	4.79
Depth + SST	2105.959	-0.95081	4.58
Depth + SST + Chlorophyll concentration	2082.59	-0.95136	5.88

Table 8: GAM results for depth, sea surface temperature (SST) and chlorophyll concentration as predictors of common dolphin presence.

Presence of common dolphins associated with depth ranged between -60 metres to -180 metres. Data for this variable was evenly distributed between 0 metres and -200 metres, therefore responses between this range can be considered reliable. The confidence intervals for depth are wider between -250 metres and -200 metres and between 0 metres and -50 metres, a lack of data for these depths is likely responsible for this response and means that absences at these depths cannot be inferred at this point (Figure 13a). Similarly, for SST common dolphin presence was shown between 12˚ C and 15˚ C, data was unevenly distributed with most data between 2-3˚ C and 8-10˚ C. Wide confidence intervals above 16˚ C mean that common dolphin absences may not be a result of higher temperatures but lack of data for these temperatures in the study region (Figure 13b). Finally, common dolphin presence showed a negative linear relationship with chlorophyll concentration, with preferences between 0 and 3 mg/m3 (Figure 13c).

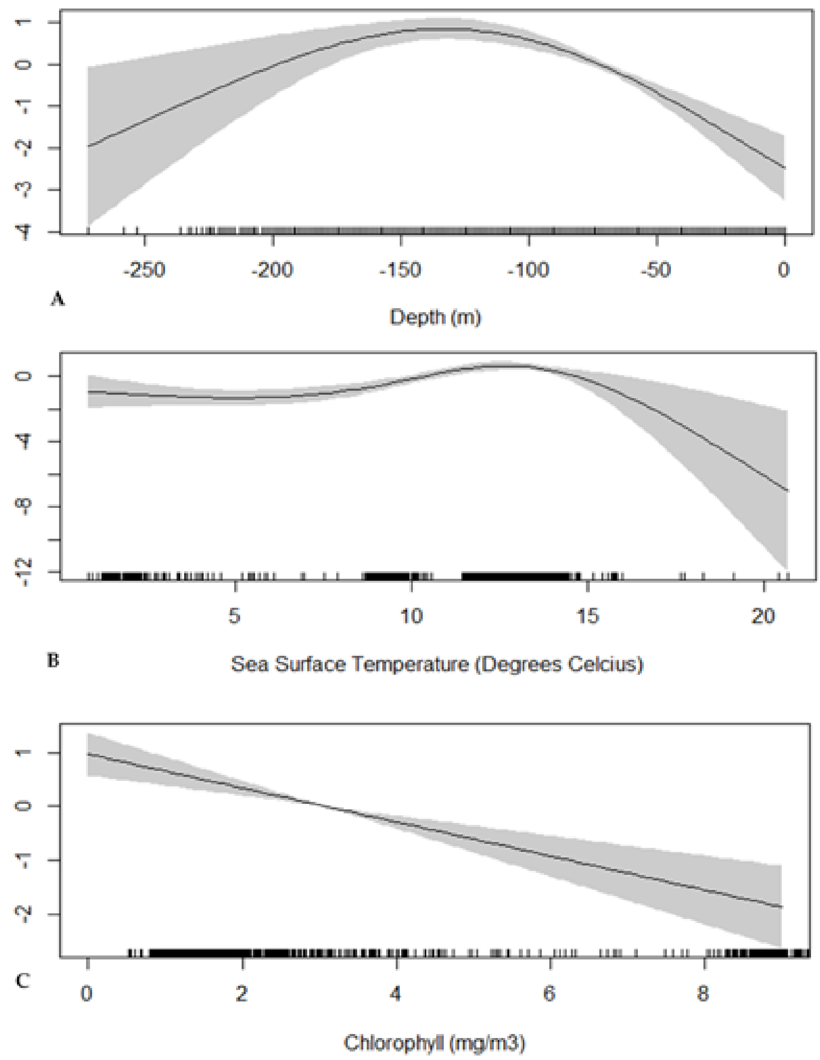


Figure 13: Relationship between presence/absence of common dolphins and (a) depth, (b) sea surface temperature, (c) chlorophyll concentration, for data collected around West Scotland between 2017 – 2019. Grey shaded area indicates approximate 95% confidence bounds.

Discussion

The coastal waters of West Scotland exhibit relatively high levels of marine mammal diversity and abundance (Reid *et al.*, 2003). Over the years there has been some question over the dynamics of the relationship between white-beaked dolphin and common dolphin abundance; the common dolphin is now one of the most abundant dolphin species off the coast of West Scotland (MacLeod *et al.*, 2008). This study has shown a clear rise in sightings of common dolphins over the past three years, with encounters throughout all areas of the study region and on all survey routes.

Common dolphins are considered a highly mobile species and around the UK are often found offshore and at some inshore locations around the South-West coast. The results of this study show that this species are increasingly utilising inshore areas in Scotland. Broadly, delphinids residency has been known to occur specifically in geographical locations where abundance of prey is predictably and consistently available (Gowans *et al.*, 2007). For marine mammals, the predictability of prey presence is important, even more so for females as a result of their further energy requirements. This may be one explanation for the rising number of common dolphin sightings seen over the survey period around West Scotland. However, a combination of biological factors in the environment is a better predictor of presence/absence of common dolphins, as suggested by the results in this study. SST, chlorophyll concentration and depth were all shown to be statistically significant and are therefore important explanatory variables of common dolphin presence.

Common dolphin

Presence/absence explained by depth

Depth was the most important environmental variable as an explanation for common dolphin presence/absence. This comes as no surprise, as a number of studies investigating other species, such as bottlenose dolphins, have shown depth to be a consistently important predictor of species distribution (Cañadas *et al.*, 2005; Cubero-Pardo, 2007; Azzellino *et al.*, 2008). Collectively, common dolphins and bottlenose dolphins have been grouped as shallow water species, both with strong associations with depths of less than 400 metres (MacLeod *et al.*, 2007). Much of these species' presence at shallower depths can broadly be explained by their feeding preferences. Despite these species being considered as very opportunistic feeders with a variety of target prey, they have shown preferential feeding on pelagic schooling fish over deeper water species such as squid (Young & Cockcroft, 1994). Dietary preferences to shallow water prey is one explanation for their significant associations with shallower waters.

Female common dolphins may also present a different response to habitat variables such as depth, as a result of their neonatal responsibilities. Movement inshore by groups of common dolphins with young have been documented by a number of studies, making this another plausible explanation for the significant depth response seen in this study (Neumann, 2001).

Presence/absence explained by chlorophyll concentration

Chlorophyll concentrations were significantly linked to presence/absence of common dolphins, with presence being highest at lower concentrations of chlorophyll. Previous studies have found chlorophyll concentrations to be the most important predictor of common dolphin presence, with patchy distributions in a population being explained by chlorophyll hotspots. Under these circumstances, the concentration of chlorophyll on its own is not responsible for the distribution of common dolphins, rather it acts as a proxy for other biological factors. Abundance of pelagic schooling fish, the dietary preference of common dolphins, can be determined by chlorophyll concentrations and therefore this is in itself a predictor of common dolphin abundance (Moura *et al.*, 2012). Research indicating chlorophyll to be the most significant predictor of common dolphin abundance has been focussed in warmer Mediterranean waters. While chlorophyll was a significant factor in this study it may not be the most important factor in predicting the presence of common dolphins in West Scotland due to the cooler water temperatures (Pietroluongo *et al*., 2020). Similar responses exist in other species of dolphin, such as bottlenose dolphins, which show an indirect link between chlorophyll and species presence. Under these circumstances the presence of the species is mediated by at least two or three separations in the food web.

Presence/absence explained by sea surface temperature

The presence of common dolphins was proven to be significantly linked to temperatures above 12˚ C. These findings support previous research suggesting that, during summer months, habitat partitioning exists between common dolphins and white-beaked dolphins in the Hebrides as a result of differing temperature preferences. As SST drops below 12˚ C in the transition to winter, common dolphin numbers also drop (MacLeod *et al*., 2007). Conversely, when considering worldwide distribution, common dolphins have shown association with a wide range of sea temperatures. Therefore, temperature alone is unlikely to have such a strong influence on the abundance of common dolphins. It is hypothesised that SST influences the distribution of common dolphin prey, which in turn affects their seasonal movements (Neumann, 2001). In support of this, studies have shown that in the instance of a dramatic drop in SST, particularly during the breeding season for prey species, there is a decline in the number of pelagic fish. For example, in the Mediterranean Sea off southern Spain in 1999, a scarcity of sardines occurred coupled with a drop in SST, which resulted in the displacement of common dolphins to deeper offshore areas during the summer months (Cañadas *et al*., 2002). The opposite response has also been shown, when SST spiked in summer months common dolphin populations showed a preference for warmer coastal waters as a result of the increased abundance of small pelagic fish (Pietroluongo *et al*., 2020).

Concluding remarks

The results of this study show that common dolphins exhibit a high dependency on a well-defined habitat, with a number of environmental variables contributing to the increased number of sightings observed around West Scotland. Prey availability has been shown in a number of other studies to be the most important factor in predicting cetacean presence and determining the activities of these species, therefore other behaviours exhibited are ‘secondary’ to prey availability as drivers of abundance.

Further research into this species and their habitat preferences around West Scotland is required. Year round surveys and predictive modelling would give sufficient evidence to advise potential MPAs and detect changes to anthropogenic activities and their associated threats in this area. Nonetheless, this study shows the importance of continual monitoring of the UK’s cetacean populations. In this case, the results here have been instrumental in updating the current knowledge gap of the redistribution of the common dolphin population around the coast of West Scotland.

Common dolphins - Glenn Overington

THREATS AND ISSUES

Our oceans are facing significant threats as a result of modern society and our interaction with the marine environment. Damage can be caused by a variety of threats and the combined pressure from these is devastating the unique wildlife in our waters. Urgent action is required to safeguard the biodiversity we enjoy for future generations.

This section outlines just a few of the anthropogenic threats facing cetaceans today, including commercial whaling, bycatch, underwater noise and ship strike. It is critical that policy-makers act quickly to mitigate the damage we have inflicted upon the marine environment and for effective measures to be put in place. Monitoring programmes are vital to investigate long-term changes in populations and acute impacts of more immediate threats.

Fin whale victim of Icelandic commercial whaling - IFAW

Commercial Whaling

Contributor: *Sharon Livermore* (International Fund for Animal Welfare)

Over the past 200 years, industrial whaling has decimated whale populations throughout the world's oceans. As ships increased in size and speed, and whaling techniques grew more sophisticated, the number of whales killed and the diversity of species targeted also grew rapidly. As whale numbers were depleted around the world, steam powered ships with explosive harpoons opened up hunting opportunities in the Antarctic where huge numbers of feeding whales could be targeted. Some populations, like the Antarctic blue whale, saw numbers reduced to just 1% of their previous population size as a result of commercial whaling (Clapham, *et al.*, 1999). Many populations today are still struggling to recover from this devastation.

As the world's great whales were hunted to the point of extinction, and in recognition of this global overexploitation, the International Whaling Commission (IWC) was established in 1946 to regulate whaling and conserve whale 'stocks'. Finally, in 1982 the IWC decided upon a global moratorium on commercial whaling - the first step towards stopping this unsustainable and barbaric slaughter.

However, a number of commercial whaling countries have exploited loopholes in the IWC convention, allowing them to continue killing whales for commercial purposes. Norway, Iceland and Japan all conduct commercial whaling in defiance of the global ban.

Iceland withdrew from the IWC in 1992 but re-joined in 2003 with a reservation against the moratorium. It then resumed commercial whaling of fin and minke whales in 2006 under this reservation. After lodging an official objection to the moratorium in 1982, Norway continues to hunt minke whales in the North Atlantic and sets its own catch limits. Japan carried out commercial whaling in both the Antarctic and North Pacific until 2019, exploiting an IWC loophole that allows 'scientific whaling' for 'research' purposes. Whale meat from these so-called scientific hunts was sold commercially in Japan, and a challenge against its Antarctic whaling led to a successful legal case by Australia and New Zealand against Japan at the International Court of Justice in 2014 (ICJ, 2014).

Fin whale being caught by commercial whalers in Iceland - IFAW

Iceland

Since resuming commercial whaling in 2006 after a 13-year hiatus, over 1,500 minke and fin whales have been slaughtered by whalers in Icelandic waters. However, 2020 marked the second consecutive year that neither minke nor fin whaling had taken place.

In spring of 2020, the last remaining minke whaling company made a public statement confirming the cessation of all its whaling operations, citing economic inefficiency and the extended whale sanctuary in Faxaflói Bay, off Reykjavík, as the main reasons for ending the hunt (Alberts, 2020). Minke whales were being harpooned in direct proximity to the whale watching area in Faxaflói Bay, so the sanctuary extension protects these whales from hunting and they can now be appreciated as part of Iceland's successful whale watching industry, without the threat of harpoons.

Despite killing no endangered fin whales in either 2019 or 2020, Iceland's lone fin whaling company, Hvalur hf., is yet to make an official announcement about the future of its enterprise. Kristján Loftsson, the CEO and owner of Hvalur hf., stated that the hunt would not take place during 2020 as exporting fin whale products from Iceland to Japan would be uneconomic, as the prices cannot compete with Japan's own government-subsidised whale meat. Loftsson also said Japan now has strict requirements for imported whale meat, which has made exports even more challenging (Bjarnason, 2020). However, the current five-year licence and quota issued by the Icelandic Government runs until 2023, so the possibility still exists that Loftsson will decide to reinstate the hunt before it expires.

In-country efforts, such as IFAW's *Meet Us Don't Eat Us* campaign, which educates tourists about the realities of tasting whale meat during their visit, and work to drive attitudinal shifts away from whaling and towards whale watching in Iceland, have helped contribute to this sea change in Iceland. A shifting political landscape internationally could provide the final straw needed to end Icelandic whaling forever – for example, the UK Government has the opportunity to raise whaling as part of its trade deals with Iceland following Brexit. Furthermore, Iceland has been certified under the USA's Pelly Amendment since 2014 on account of its whaling and international trade in whale meat. Opportunities to strengthen ties between these two countries with a new US administration in place could be hampered while Iceland still has fin whaling permits in place.

Fin whale victim of commercial whaling in Iceland - IFAW

Norway

Norway continues to kill more whales each year than the other commercial whaling nations combined. The target species of these hunts is the minke whale, and 503 whales were killed during the 2020 whaling season under a self-allocated quota.

A highly concerning development in Norway this year was the announcement of new government regulations aimed at increasing participation in whaling. The changes mean that now only the owner of the whaling vessel or one person on board must have had experience of killing minke whales in the last six years in order to go whaling. These relaxed restrictions raise major welfare questions, as whales are not killed instantaneously or painlessly even with the most 'advanced' whaling techniques, and inexperienced hunters will not have the precision needed to minimise the suffering of these animals.

After years of falling demand, domestic whale meat sales have reportedly increased during the COVID-19 pandemic, with reduced international travel resulting in more domestic trips to areas of Norway serving whale meat and encouraging Norwegians to sample products for the first time (Devlin, 2020). As was the case in 2019, records for 2020 show shipments of whale meat and products to the Faroe Islands and Japan from Norway. In 2019, whale meat was transported from Norway to Japan via the Port of Rotterdam, despite past commitments from both the port and the Dutch State Secretary for Foreign Affairs to prevent such shipments. As part of its Brexit promises, the UK's Secretary of Environment declared that the passage of whale meat through British ports will be outlawed after the UK exits the EU. Confirmation of these commitments by both the UK and Netherlands will help to tighten the noose on Norwegian whale meat exports.

Whale meat products in a Japanese market - IFAW

Japan

Following its exit from the IWC and cessation of its high seas whaling activities in the Antarctic and North Pacific, Japan resumed commercial whaling within its own coastal waters and Exclusive Economic Zone (EEZ) last year. During Japan's 2020 whaling season within these waters, the factory fleet killed its full quota of 187 Bryde's whales and 25 sei whales, and 95 minke whales were also taken as part of Japan's Small-Type Coastal Whaling (STCW) from a quota of 100 minke whales and 12 in reserve.

The whaling quotas set by the Japan Fisheries Agency (JFA) for 2021 are not substantially different from those set for 2020, and include a factory fleet quota of 25 sei whales and 150 Bryde's whales (with 37 in reserve) and a coastal whaling quota of 120 minke whales (with 14 in reserve).

While the whaling carried out by Japan in its own waters means fewer whales are killed each year than were during its high seas operations, some whale populations now being targeted are already very depleted and the relationship between different populations (so-called stock structure) is not clear. Sei whales in this region are of particular concern from a conservation perspective, as Japanese catches within its EEZ come from the most depleted western population. Likewise, the coastal minke whales targeted are from an unusual and possibly unique population called the 'J-stock', which is also considered to be in a depleted state (IWC, 2004). So even these reduced quota numbers are unlikely to be sustainable.

In addition to these serious conservation questions, Japanese whaling faces a number of domestic challenges that may soon see the end of this outdated and inherently cruel industry. Firstly, huge Japanese Government subsidies of around five billion yen (about £35 million) have been essential to financially support factory fleet whaling operations each year, but from this year on, one billion yen (approximately £7 million) of the subsidy will become a loan in an effort to drive the industry towards financial independence. Secondly, with reduced subsidies, the price of whale meat has had to increase by up to 30% and there is still very little demand for whale meat and products in Japan. Lastly, whaling company Kyodo Senpaku say limited quotas and the increasing price of whale meat, reduce the possibilities of sustaining whaling as a commercial enterprise. This dying, inhumane industry should be replaced by proper investment in responsible, sustainable whale watching.

Bycatch

Contributor: *Sarah Dolman* (Whale and Dolphin Conservation)

Each year hundreds of thousands of sea mammals are incidentally caught and killed in fishing gear around the world. Commonly referred to as bycatch, this represents a growing threat to marine life and one of the biggest challenges faced by global sea mammal populations.

The issue is complex as a result of a range of equipment used and the species affected. There is also a significant lack of understanding of the true scale of the issue since so many incidents are currently unreported.

Within UK waters, the most common victims of bycatch are harbour porpoises and common dolphins (Northridge *et al.*, 2018); although the diversity of odontocete (or toothed cetaceans) species that become entangled also includes bottlenose dolphins, Risso's dolphins, striped dolphins, white-beaked dolphins, Atlantic white-sided dolphins and pilot whales. Baleen whales are also victims of bycatch, more commonly referred to as 'entanglement' and in the UK, minke whales and humpback whales are primarily affected (Ryan *et al.*, 2016). Despite international, national and regional regulatory policies to limit and reduce incidental capture in fishing gear, bycatch remains one of the foremost threats to marine mammals.

Gill nets are the highest risk gear category globally for cetaceans and other species sensitive to bycatch. There are also serious bycatch problems associated with trawl fisheries and with fisheries using pots and traps. The different characteristics of these gear types and the types of and size of vessels involved require different solutions.

Gill nets

Gill nets are a very small proportion of the total UK fisheries (2% of value), but cause most of the cetacean bycatch. Recent research has shown that hundreds of porpoises and dolphins can be saved from asphyxiation by replacing gill nets with alternative gear types that are shown to be safer for cetaceans (Leaper & Calderan, 2018). Acoustic deterrent devices (ADDs), such as 'pingers', have been shown to be effective at reducing harbour porpoise bycatch in gill nets (Omeyer *et al.*, 2020), but the reduction achieved so far has been small. They may cause unwanted disturbance or displacement, and are not always used properly and may not be effective for other species (Kyhn *et al.*, 2015). Hence there should be increased attention to moving away from gill nets towards alternative gears by prioritising more funded trials and then fleet roll out of new safer gear types. This offers a practical step forward for the fisheries industry to engage with and adopt alternative gears.

Trawl fisheries

There is a very large bycatch problem for common dolphins associated with trawl fisheries in the Bay of Biscay (Peltier *et al*, 2020). Although this is apparently occurring in adjacent rather than UK waters, adequate monitoring of similar trawl fisheries in UK waters is needed to enable a rapid response to any changes in dolphin distribution or fishing effort that might result in bycatch. Mitigation plans that can be put into action as soon as there is any evidence that bycatch is occurring should be developed for all trawl fisheries that may pose a risk, together with adequate, independent, at sea monitoring. Such plans could include testing strategies such as a moving on procedure, where fishing activity moves away from areas where bycatch is occurring or may occur.

Entangled humpback whale Scotland - Andy Gilbert

Pot and creel fisheries

Pot and creel fisheries pose a particular entanglement risk to larger species such as minke and humpback whales (MacLennan *et al.*, 2020). Unlike gill nets which are often designed to catch fish species of similar size to a small cetacean, entanglements in creel gear involve interactions with parts of the gear that are not related to catching the target species. Thus, there is much greater scope for technical modifications to creel gears to reduce entanglement risk without affecting the target catch than there is for other gears such as gill nets.

With the vast number of UK fishers not wanting to catch whales and dolphins in their nets and with viable fishing gear alternatives which can dramatically reduce deaths, large scale bycatch within UK waters can be largely eliminated. What is lacking is a coordinated and prioritised action from the UK and devolved Governments as significant progress is taking too long.

Action plan for change

Back in 2017, George Eustice MP, the then Fisheries Minister, declared that he wanted to see a significant reduction in the number of dolphins and porpoises caught and killed in UK fisheries. The UK Government established the UK Bycatch Focus Group, a coalition of NGOs, fisheries industries and government to try and tackle bycatch. Four years on however, progress has been slow despite George Eustice MP, now Secretary State of the Environment, promising that after Brexit the UK will be a global leader, inspiring others to protect cetaceans. The NGO community and other interested parties are still waiting to see a government led action plan on how dolphin and porpoise deaths from bycatch will be stopped.

Fortunately, the recently enacted UK Fisheries Act (renegotiated because of Brexit) now includes a requirement that "incidental catches of sensitive species are minimised and where possible eliminated'. A requirement within this Act also includes the production of a Joint Fisheries Statement. This statement sets out the policies that all four UK nations will have to employ to ensure they are meeting their objectives in the Fisheries Act; including how they minimise and where possible eliminate dolphin, porpoise and whale entanglements and death. All it needs now is political action.

Whale and Dolphin Conservation is leading a campaign along with other NGO partners asking the UK Government to:

- Set clear ambitious annual targets to reduce bycatch every year until it is stopped.
- Invest in bycatch solutions for the UK fleets, including trails and roll-out of alternative gears, effective technical and spatial solutions on fishing gear and independent at sea monitoring to track progress.
- Develop mitigation plans that can be put into action as soon as there is any evidence that bycatch is occurring for all trawl fisheries that may pose a risk, together with adequate independent at sea monitoring.
- Employ modifications for pot and creel gears together with ongoing trials of better management practices.

Anthropogenic Noise

Contributor: *Rebecca Walker* (Natural England)

Marine mammals, and cetaceans in particular, have evolved to live in an underwater world of sound and as a result their auditory sense is highly developed. They use sound for all essential aspects of their lives including feeding, predator avoidance, navigation and communication (Weilgart, 2007). Anthropogenic (man-made) noise has increased over the last 100 years, causing additional and increasing noise to be emitted into the marine environment. Man-made noise can range in frequency and intensity and be categorised into two types: impulsive and non-impulsive (continuous). Impulsive noise is produced by activities such as seismic air gun surveys for oil and gas, pile-driving in marine constructions, underwater blasting or detonation of unexploded ordnance, and navy sonar. Non-impulsive noise is predominantly caused by shipping (NRC, 2003; Götz *et al.*, 2009). Anthropogenic noise can affect marine mammals in a variety of ways, depending on the frequency and intensity of the noise source. ORCA's State of European Cetaceans 2019 report fully details these potential impacts, but in summary, underwater noise effects range from behavioural changes and displacement, through to masking of natural sounds (e.g. vocalisations), hearing loss at certain frequencies, physical injury and even death (Götz *et al.*, 2009).

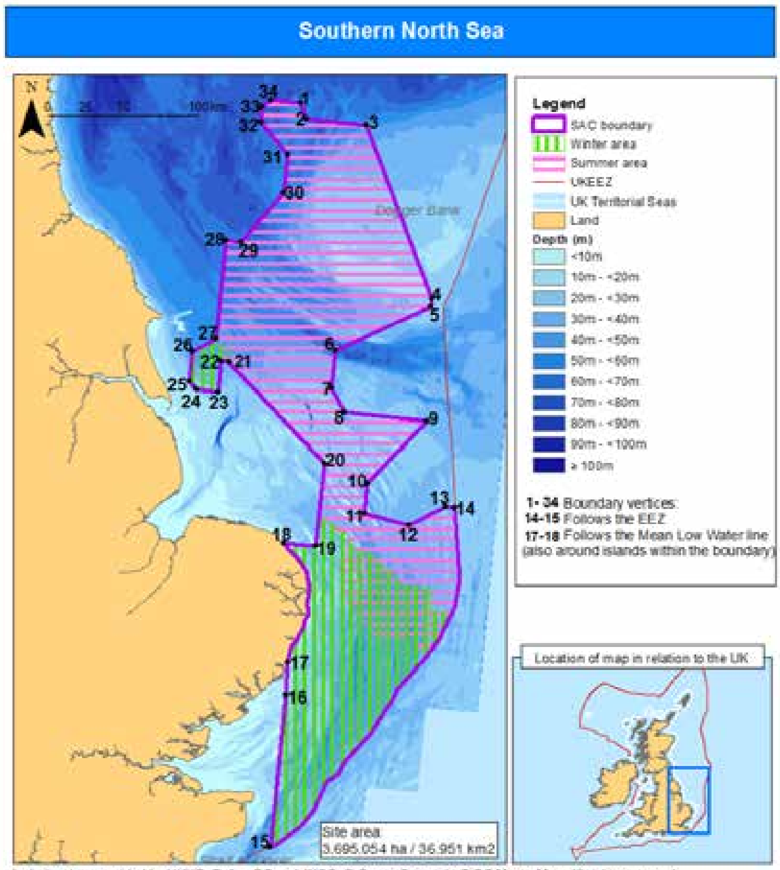
The UK Government has agreed a number of international commitments and obligations (such as those agreed under the OSPAR Agreement) to ensure underwater noise does not adversely affect marine life. These commitments are often transposed into UK legislation (e.g. the UK Marine Strategy and achieving Good Environmental Status), requiring the UK Government to monitor and, if necessary, manage underwater noise, and requiring developers to assess and measure the impacts of proposed marine constructions. Should there be potential significant impacts on marine mammals then mitigation is required to decrease these impacts before the project can proceed. The UK also has obligations under the 2016 Paris Agreement on climate change to reduce greenhouse gas emissions and limit the global temperature increase this century to below 2°C. This obligation led to the UK becoming the first major country to legislate to achieve net-zero carbon emissions by 2050 in June 2019. Reaching this target will be a challenge, but a major contributor will be the renewable energy provided by offshore wind.

Offshore windfarm in the North Sea

The UK has the largest installed offshore wind capacity in the world, with 10.4 gigawatts (GW) installed by the end of 2020, helping renewable energy sources to provide over 40% of the UK's electricity. However, meeting net-zero targets requires a much greater development of offshore wind than previously envisaged. As a result, the Government released their 10-point plan for a Green Industrial Revolution in November 2020. Offshore wind was action point number one, with a commitment to produce 40GW of offshore wind by 2030, quadrupling the existing capacity. The UK therefore must balance the need to develop a significant amount of offshore wind with the protection of the marine environment.

For marine mammals, the main impact of offshore wind is the underwater noise generated by the installation of the turbines (Thomsen *et al.*, 2006). The most common method of installation is by pile-driving; using a large hammer to drive the foundation of the turbine into the seabed. Pile-driving is very loud, with the potential to cause physical or auditory injury if a marine mammal is too close (Thomsen *et al.*, 2006; Bailey *et al.*, 2010). Another concern with offshore wind farm development is the requirement to remove unexploded ordnance (UXOs) from the development area. For safety reasons they are usually detonated in the location where they are found, causing a large explosive shockwave and high sound levels that can injure or even kill marine mammals (von Benda-Beckmann *et al.*, 2015). To predict at what distances from a noise source injury could develop, noise exposure criteria were developed by Southall *et al.*, in 2007. These criteria were updated in 2019 and are a key piece of literature used by wind farm developers in their environmental impact assessments (EIAs). The results of which are used to develop a marine mammal mitigation plan, to reduce the risk of injury to marine mammals as a result of underwater noise.

UK nature conservation agencies have developed mitigation guidelines for several industries to prevent marine mammal injury (e.g. using observers to make sure no animals are in the injury zone, the slow ramp up of pile-driving and by using acoustic deterrent devices (ADDs) to deter an animal from the location shortly before pile-driving or UXO detonation takes place). However, while the prevention of injury can be addressed, the issue of disturbance is still of concern. To add another layer of complexity (but more importantly, protection), in 2019 a large part of the southern North Sea was designated as a harbour porpoise Special Area of Conservation (SAC; a marine protected area under European legislation). This site stretches from the central North Sea (north of Dogger Bank) to the Straits of Dover in the south, covering an area of 36,951 km^2 (JNCC, 2020a) (Figure 14).



Includes data provided by UKHO, Defra, OS and JNCC. © Crown Copyright © OS MasterMap. All rights reserved.
Not to be used for navigation. © JNCC 02/2019. Coordinates displayed in WGS84 geographic coordinate system.
Site area calculated using modified Europe_Albers_Equal_Area_Conic_UK projection.

ID	Latitude	Longitude	ID	Latitude	Longitude	ID	Latitude	Longitude	ID	Latitude	Longitude
1	55° 28' 53.1" N	01° 02' 24.8" E	10	53° 17' 32.9" N	02° 11' 31.6" E	19	52° 53' 06.4" N	01° 45' 21.9" E	28	54° 37' 0.5" N	00° 27' 44.8" E
2	55° 23' 34.2" N	01° 07' 24.8" E	11	53° 06' 45.7" N	02° 11' 43.8" E	20	53° 22' 42.4" N	01° 44' 22.2" E	29	54° 37' 11.8" N	00° 37' 01.8" E
3	55° 24' 03.2" N	01° 45' 17.6" E	12	53° 04' 11.8" N	02° 38' 38.6" E	21	53° 54' 06.6" N	00° 39' 29.7" E	30	54° 56' 28.6" N	00° 59' 18.7" E
4	54° 25' 05.4" N	02° 37' 56.9" E	13	53° 12' 19.1" N	02° 59' 22.3" E	22	53° 54' 0.3" N	00° 35' 04.2" E	31	55° 09' 56.9" N	00° 58' 38.1" E
5	54° 22' 23.6" N	02° 37' 58.3" E	14	53° 12' 19.0" N	03° 04' 57.1" E	23	53° 48' 17.2" N	00° 35' 41.1" E	32	55° 20' 23.2" N	00° 39' 10.7" E
6	54° 03' 07.5" N	01° 43' 06.7" E	15	51° 04' 38.9" N	01° 39' 44.1" E	24	53° 42' 60.0" N	00° 22' 03.6" E	33	55° 25' 46.4" N	00° 38' 51.5" E
7	53° 49' 40.4" N	01° 43' 32.5" E	16	51° 59' 04.9" N	01° 38' 08.0" E	25	53° 45' 35.5" N	00° 17' 20.7" E	34	55° 28' 33.4" N	00° 43' 26.4" E
8	53° 41' 38.9" N	01° 52' 54.2" E	17	52° 10' 54.3" N	01° 37' 11.0" E	26	53° 56' 22.0" N	00° 16' 38.8" E			
9	53° 41' 57.7" N	02° 42' 50.7" E	18	52° 52' 51.4" N	01° 26' 06.8" E	27	54° 02' 03.1" N	00° 30' 01.3" E			

Figure 14: Southern North Sea Special Area of Conservation (SAC) - JNCC.

Conservation objectives have been produced for the site, one of which states that there should be no significant disturbance of harbour porpoises. Guidance for assessing the significance of noise disturbance in harbour porpoise SACs was published in July 2020 by the Joint Nature Conservation Committee (JNCC), and all industries (e.g. oil and gas, offshore wind, pipelines) must now ensure that their development, in-combination with other plans and projects, does not exceed thresholds of disturbance within the site (JNCC, 2020b) monitored via site integrity plans.

There has been a considerable amount of research undertaken over the last 15 years both to understand the impacts of underwater noise on marine mammals and look at ways of reducing the noise produced by marine activities and the detonation of UXOs. As a result, despite large knowledge gaps remaining, there are mitigation and management options that can be put into place now, should significant impacts be predicted in an EIA or if the SAC noise disturbance thresholds are predicted to be exceeded. Management can include the planning and phasing of noisy activities, the use of alternative foundations, the use of alternative methods of installation, and/or the use of noise abatement technology, such as bubble curtains or resonators. Two recent reports (NIRAS & SMRU, 2019 and Verfuss *et al.*, 2019) have reviewed these options for use in UK waters. Robinson *et al.*, (2020) also present the results of an alternative method to neutralise UXOs, using a process called deflagration, which burns out the explosive rather than detonating it. Initial experiments have suggested this method could be significantly quieter, hugely reducing the area of impact and therefore the effect on marine mammals.

Given the amount of development needed to meet net-zero targets and the wider Government commitments to reduce the impacts of underwater noise, a collective effort by all industries that produce noise will be essential if development is to continue at pace, especially given the offshore wind development planned or which could focus in future in the Southern North Sea SAC. Considering these commitments as well as the protection and general welfare of animals, there is a shared responsibility to manage and reduce the ever-increasing amounts of noise emitted into the marine environment, which will be additive with other stressors on populations such as climate change or contaminants. Efforts to avoid, reduce and mitigate noise impacts should be encouraged across marine industries and could include ship greening and quieting measures and noise reduction mitigation implemented as standard/best practice.

Offshore windfarm

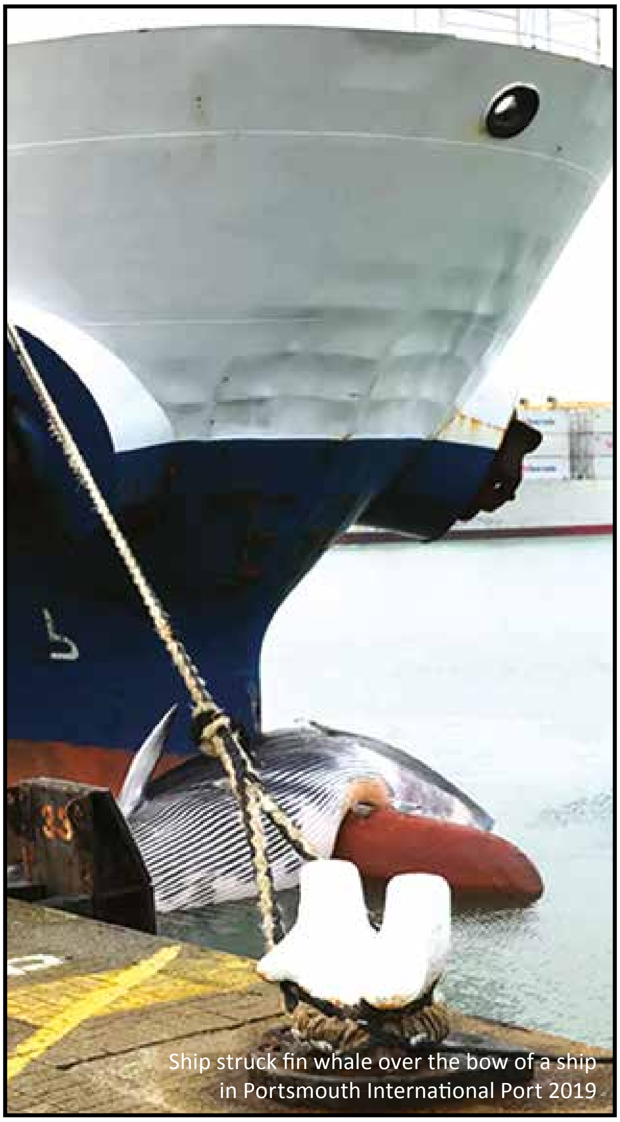
Ship Strike

Contributor: *James R. Robbins* (University of Portsmouth)

The world's oceans are a busy place, with an abundance of human activities which can overlap with, and impact marine wildlife. Ship traffic is one such activity (Erbe *et al.*, 2020). We rely on vessels to transport our goods (90% of which are transported by sea), service structures and support offshore industries, and ferry people between locations. Vessels are clearly important and serve a purpose, but how do they affect marine life? Shipping activity is on the rise globally (Pirotta *et al.*, 2019), so awareness of and research into the impacts is increasingly important. Vessels not only produce sound energy, contributing to ambient noise levels which can impact cetaceans as outlined in the previous section; they can also physically strike animals, termed 'ship strikes' which cause injury or death of the animal. Injured animals may suffer long-term consequences such as a decrease in fitness which could also have welfare implications.

Collisions between cetaceans and vessels have been documented globally, with areas of greatest risk expected to be where high densities of animals' overlap with high intensity of shipping traffic (Bezamat *et al.*, 2015). Collisions are more likely to be fatal if the vessel is travelling at higher speeds (David *et al.*, 2011; Conn & Silber, 2013). As a result, speed restrictions can be implemented to reduce the risk of a fatal collision in high-risk areas, with speeds over 10 knots banned. However, new biophysical models found that large vessels travelling slower than this limit can still exert excessive mechanical stresses that could cause lethal injuries (Kelley *et al.*, 2020). Alternatively, areas can be delineated that are closed to vessels at certain times of the year to protect animals during seasonal movements. If areas requiring management fall within territorial waters, measures can be implemented by coastal states, or otherwise can be recommended or mandated by the International Maritime Organization.

It is thought that ship strikes are under-reported (Van Waerebeek *et al.*, 2007), although available evidence suggests that large whales are most at risk from collisions with vessels (Laist *et al.*, 2001; Schoeman *et al.*, 2020), likely due to their reduced mobility, and periods spent at the surface between dives (Parks *et al.*, 2012; Owen *et al.*, 2016). However, few studies assess the potential risk that smaller cetaceans face, and the scarcity of recorded collisions with smaller species is likely due to reporting bias (Schoeman *et al.*, 2020). It is clear that dolphins and porpoises are also victims of ship strike as individuals have stranded with evidence of collision related injuries (Van Waerebeek *et al.*, 2007). A recent review by Schoeman *et al.*, 2020 found that at least 75 marine species have been struck by vessels, including non-cetacean species such as turtles, seals, sharks and seabirds; however the majority of research has focussed on large whales. The study recommended that more work on smaller species is required, as a multi-species approach to management will hopefully minimize the risk of traffic management schemes being implemented to save large whales, while unknowingly moving vessels into greater overlap with other species also at risk.



Ship struck fin whale over the bow of a ship in Portsmouth International Port 2019

The risk to animals has been well discussed in previous reports and referenced literature; however, collisions can also damage vessels, leading to costly repairs and lost ship time, and even the injury of crew and passengers. There have even been reports of human deaths as a result of collisions. New research estimates that ships are damaged in one out of 10 collisions with whales, and suggests safety and economic factors should be taken into account when assessing proposed mitigation measures, with the hope that these additions would lead to greater stakeholder acceptance and compliance (Sèbe *et al.*, 2020). Further, understanding the practicalities of mitigation measures for vessel crews is important, with recent findings suggesting that crews preferred to avoid an area rather than reducing speed (Sèbe *et al.*, 2021).

As the issue of ship strikes gathers more attention and research focus, policy-makers will be better informed to make appropriate management decisions to help reduce this risk to cetaceans and other sensitive marine species.

Fin whale - Paul Soulby

Recent occurrences and on-going research

Although many carcasses of ship-struck animals will be lost at sea, a proportion are washed ashore. The study of these animals affords an important opportunity to garner information about their history and the threats that they face. While stranded animals may have drifted a considerable distance, and details of the cause of death may be obscured by decomposition, these individuals can often provide an insight into often little-known threats such as ship strike.

In the UK, there have been several recent collisions which gathered considerable interest in the media, and which allowed scientists at Cetacean Strandings Investigation Programme to investigate the cases. In October 2019, a humpback whale was spotted in the Thames, and soon was discovered dead with a head injury caused by a vessel in this busy waterway. This individual was in an atypical area, and already in poor condition; however, it does highlight the pressures that these animals face. In December 2019, a fin whale was brought into Portsmouth International Port on the bow of a container ship, with the cause of death thought to be a collision, likely offshore where this species is distributed.

These incidences, and published stranding records elsewhere in the region (e.g. Peltier *et al.*, 2019), make it clear that ship strikes occur in the North-East Atlantic, and may be a significant conservation concern. For appropriate conservation management to be possible, baseline and up-to-date information are critical; however, little dedicated work has been conducted on ship strike in the contiguous North-East Atlantic. In an attempt to change this, a University of Portsmouth funded PhD in collaboration with Bangor University, University of St Andrews, Instituto do Mar-Azores, Cardiff University, and ORCA is investigating the overlap between cetaceans and vessels between Portugal and Norway. Assessing the risk of collisions between animals and vessels is a vital step toward the implementation of appropriate mitigation measures, which do not currently exist in this area.

The first step being undertaken in this PhD is to analyse shipping traffic in the area, to determine how vessel densities change across space and time. This work includes looking at how patterns vary between vessel types of different function and size and speeds. After understanding shipping traffic variations, the two-dimensional relative overlap between vessels and cetaceans will be investigated – including twelve different species, not only large whales. This will help to identify areas and months with greatest overlap, which may indicate higher risk for animals. As fin whales are thought to be the most widely ship-struck cetacean species globally, further focus on this species will occur by analysing their dive patterns in relation to depths occupied by vessel draughts to create three-dimensional risk models and estimate the number of fin whales hit and killed each year. Finally, it is hoped that engagement with vessel crews to understand their experience and knowledge of ship strikes will take place, enabling the opportunity to gain insights into their opinions of appropriate mitigation measures and their practicalities. By pulling together all of these aspects and results, we hope to gain a better understanding of the state of cetaceans in this region, and recommend areas, times and species which require further research and potential mitigation measures to minimise ship strike occurrences.


Fin whale victim of ship strike

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