EMFF Operational Programme 2014-2020

Marine Biodiversity Scheme

Marine Institute Cetacean Monitoring

During the Celtic Sea Herring Survey

4th - 24th October 2020

Lead Agency: Marine Institute

Lead Partners: National Parks and Wildlife Service,

Authors: Marine and Freshwater Research Centre, Galway-Mayo Institute of Technology, Galway

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An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

EUROPEAN UNION
This measure is part-financed by the European Maritime and Fisheries Fund

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Specific Objective	UP1 SO1 - Reduction of the impact of fisheries and aquaculture on the marine environment, including the avoidance and reduction, as far as possible, of unwanted catch. UP1 SO2 - Protection and restoration of aquatic biodiversity and ecosystems. UP6 SO1 - Development and implementation of the Integrated Maritime Policy
Measure	Marine Biodiversity Scheme
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1 Executive summary

The Celtic Sea Herring Acoustic Survey (CSHAS) took place from the 4th to the 24th of October, 2020 on board the Marine Institute's *R.V. Celtic Explorer*. The research survey covered an area along the south Irish coast, from counties Cork to Wexford and further offshore into the Celtic Sea. A cetacean-dedicated survey was carried out by an observer on board following a standard single platform line-transect methodology aiming to collect relative abundance and distribution of marine mammals in the area of interest.

The cetacean survey was conducted during 19 days, covering a distance of 3,001 km. The total amount of time the marine mammal observer spent on effort was 125 hours, 52 minutes and 57 seconds.

Environmental conditions varied between survey days. Visibility was overall good, with most time spent on effort (40.35% of the time) under visibility 5 conditions, *i.e.* from 16 to 20 km. On the other hand, sea state conditions were not as favourable, since most of the effort was carried out under sea state 4 (34.29% of the time). Swell height was recorded as 1 m during most of the time spent on effort (62.68% of the total time). Although with small interruptions when environmental conditions were nor suitable to keep the watch, and despite the sea conditions, marine mammal survey effort was carried out during all days while traveling, with the exception of the 19/10/2020, when effort had to be interrupted early in the morning due to adverse weather conditions.

A total of 270 sightings of marine mammal species were recorded over the course of the survey, with common dolphins accounting for 88.88% of these sightings. Common dolphins were recorded during every survey day in both, inshore and offshore areas. Fin whales were the most common species of baleen whales encountered (4.07% of the marine mammal sightings), with most of the sightings recorded off the coast of Co. Waterford.

2 Introduction

Starting in 2004, the Celtic Sea Herring Acoustic Surveys (CSHAS) has been carried out every year on board the Marine Institute's *R.V. Celtic Explorer* during the month of October.

This survey was divided into different groups of transects (Figure 1). Inshore transects were conducted along the south Irish coast, from counties Cork to Wexford. Offshore transects were conducted further south, into the Celtic Sea. During the first leg of the survey (*i.e.,* from 4th – 14th October), the predefined transects were surveyed from west to east and, throughout the second leg of the survey (*i.e.,* from 15th – 23rd October), interlaced transects to the previous ones were covered moving westwards. Additional transects were also carried out in areas identified as presenting high abundance of herring during the survey.

The main objectives of this research survey were to assess the current status of the herring stock, including age-composition and maturity stage within the study area, as well as to collect density and distribution data for this species (O'Donnell *et al.* 2019). Furthermore, the survey aimed to assess biomass and abundance of sprat. The methodology used was based on a combination of acoustic (echosounder EK60) and biological (pelagic trawl fishing) sampling techniques.

Using stable isotope models, Ryan *et al.* (2013) identified that herring and sprat represent a high percentage in the diet composition of fin (*Balaenoptera physalus*) and humpback (*Megaptera novaeangliae*) whales in the Celtic Sea. Furthermore, analysing time series data of baleen whales recorded during previous herring acoustic surveys in the Celtic Sea, Volkenandt *et al.* (2015) found a significant overlap between high densities of herring (*Clupea harengus*) and sprat (*Sprattus sprattus*) and the presence of minke (*Balaenoptera acutorostrata*), humpback and fin whales. Therefore, some areas of the Celtic Sea have been identified as important feeding grounds for these cetacean species during the autumn months.

Given the relevance of this waters for different cetacean species, the CSHAS survey provides a great opportunity to gather data on cetacean relative abundance and distribution within the study area. Data collected by the observer will be added to the ones from previous herring acoustic surveys carried out annually in the Celtic Sea.

3 Materials and methods

3.1 Data collection

The cetacean-dedicated survey was carried out by a Marine Mammal Observer (MMO) on board the *R.V. Celtic Explorer* during the Celtic Sea Herring Acoustic Survey 2020, from the 4th to the 24th of October, 2020.

Cetacean survey effort was conducted during daylight hours mainly from 08:00 to 17:30, with a small break every two hours in order to prevent fatigue and ensure high quality data collection. Watches were conducted from the crow's nest, located at 17 m above sea level, for most of the time spent on effort, only watching from the monkey island during the morning of the 23/10/2020, due to high swell conditions. The methodology followed was a standard single platform line-transect survey when travelling along transect and a point survey when oceanographic and biological sampling were taking place. The general approach was that, under unfavourable environmental conditions, *i.e.* sea state ≥ 6, swell > 2 m and/or visibility < 1km, the MMO should stop the effort. However, effort was carried out under these conditions when the observer deemed it appropriate.

Effort was focused in an arc of 60º at both sides of the vessel's track and up to 1 km distance in priority. However, sightings outside this arc and at further distance from the vessel were also logged. Watches were conducted with the naked eye and the help of high quality Opticron 10x42 binoculars when needed, to confirm species identification and/or group size as well as the behaviour of the animals encountered. Photographs of the sightings were taken when possible using a Canon 77D digital camera with Sigma 100-400mm telescopic lens, used to verify species identification when needed.

Distance and bearing of the animals encountered from the vessel were estimated using a range-finding stick (Heinemann 1981) and an angle board, respectively. Species identification, group size, age composition, heading and behaviour of the animals were also recorded for each sighting. All sightings were identified to species level when possible. However, whether the identification could not be confirmed, appropriate taxonomic levels and associated confidence levels were assigned to the animals observed. All cetacean sightings that occurred off effort and were reported to the MMO were also recorded as auxiliary sightings in an independent form within the database.

Environmental variables were also recorded every 15 minutes approximately and when a change in one of the parameters took place. These variables included sea state (from 0 to 6), visibility (with 1 = <1km, 2 = 1-5 km, 3 = 6-10 km, 4 = 11-15 km, 5 = 16-20 km, 6 = >20 km), cloud cover (from 1 to 8), swell height (with 0 = no swell, 1 = light 0-1 m, 2 = moderate 1-2 m, 3 = heavy >2 m), precipitation (type and intensity), wind speed and direction.

Information regarding CTD stations, fishing hauls, track lines surveyed and sun glare were also recorded as *Notes* in the environmental data form within the database.

Vessel position, sightings and environmental data were recorded by the MMO using the software IFAW Logger 2000 ™ (IFAW 2000), which logged the data into a Microsoft Access database. GPS position of the vessel was recorded every 10 seconds into the database using an

external GPS receiver with USB connection. All records were time-stamped and assigned a unique GPS index. The time recorded by the software corresponds to the Greenwich Mean Time (GMT).

At the end of the survey, the vessel track together with heading and speed data for the complete survey were obtained by the technician on board. These data were used to fill in gaps as well as to map the complete survey vessel track.

3.2 Data treatment

The GPS data recorded into the database was examined for potential gaps and these were completed manually when needed using the vessel's track provided by the technician at the end of the survey. Afterwards, the GPS index of all the sightings, as well as of the environmental stations recorded were verified prior to mapping.

The vessel track, together with the cetacean survey effort and the sightings recorded were mapped using ArcGIS 10.6.1 (ESRI 2018). For visual reasons, sightings were mapped separately, with odontocetes in a first map, mysticetes and pinnipeds together in a second map and bluefin tuna sightings in a third map. Total distance of the transects covered on effort was calculated using the Measure Tool in ArcGIS after projecting the data frame.

Photographs of some of the sightings submitted together with this report were coded using the following format: [Sighting No.][letter if more than one photograph of the same sighting]_[Date in yyyymmdd]_[SpeciesID] (*e.g.* 021a_20201006_FW).

4 Results

4.1 Marine mammal survey effort

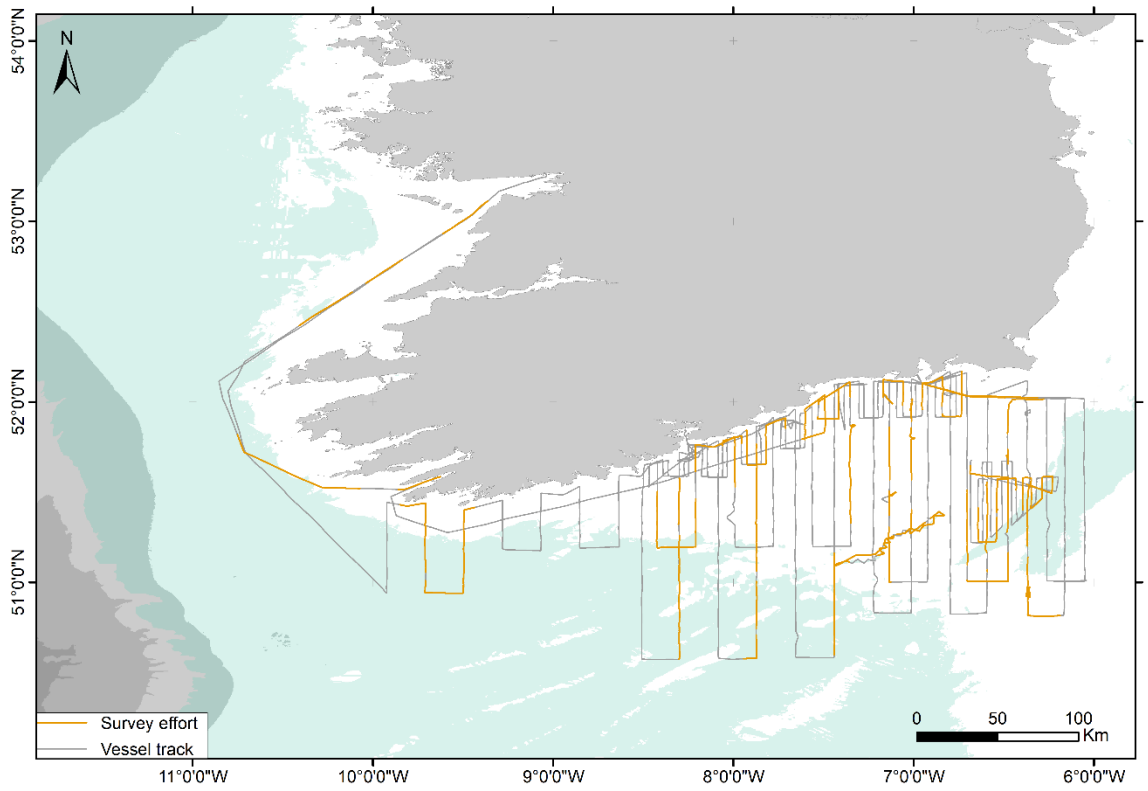

Figure 1. Vessel track and cetacean survey effort during the CSHAS 2020 survey. Bathymetry data was obtained from GEBCO Grid 2020.

The *R.V. Celtic Explorer* departed Galway docks during the evening of the 04/10/2020, at 19:00 local time. The observer started her watch on the next morning while travelling south towards Dunmanus Bay, Co. Cork, where the calibration of the acoustic equipment was carried out from 13:00 to 20:00. After the calibration, the vessel left Dunmanus Bay and started heading to the first transect over the night. Inshore transects were carried out during the 06/10/2020 and the 10/10/2020, while longer offshore transects were conducted from the 07/10/2020 to the 09/10/2020 and from the 11/10/2020 to the 14/10/2020. At the end of transect during the 14/10/2020, the vessel travelled to Dunmore harbour, Co. Waterford for a scientist crew change.

After the scientists exchange, the vessel left Dunmore around 14:00 starting the second part of the survey and the MMO resumed the effort while traveling to transect. From the following day (15/10/2020), interlace offshore transects heading westwards were followed in the area previously covered during the first part of the survey. Interlace offshore transects were conducted until the 18/10/2020. Cetacean survey effort had to be interrupted on the 19/10/2020 due to adverse weather conditions. This same day, the vessel travelled for shelter to Cork harbour, where it remained until the 21/10/2020. After the storm, the MMO resumed the watch during the morning of the 21/10/2020. Inshore transects were covered during the last days of the survey. The survey finished on the 23/10/2020, with the vessel returning to Galway docks about 23:00.

For most of the days, effort was carried out form the crow's nest, approximately from 08:00 to 17:30. However, effort had to be interrupted in some occasions due to unfavourable weather conditions (*i.e.*, sea state > 6, visibility < 1 km and/or swell > 2m). Marine mammal survey effort amounted to 125 hours 52 minutes and 57 seconds, with a total distance surveyed of 3,001 km (Table 1).

Table 1. Daily details of MMO survey effort including start and end times, duration, transects, distance surveyed and platform from which watches were carried out. Times correspond to those entered via the software IFAW Logger 2000 in GMT. (CN = Crow's nest; MI = Monkey island).

Date	Start time	End time	Duration	Transects surveyed	Distance surveyed (km)	Platform
05/10/2020	07:44:09	12:51:35	04:21:02	Travelling + Calibration	128.431	CN
06/10/2020	07:23:35	16:22:19	07:32:10	Inshore transects	206.305	CN
07/10/2020	07:06:41	15:59:12	07:28:31	Offshore transects	166.601	CN
08/10/2020	07:17:41	17:01:41	08:41:28	Offshore transects	201.990	CN
09/10/2020	06:56:22	16:31:07	08:10:57	Offshore + additional transects	188.079	CN
10/10/2020	06:54:38	16:38:48	08:07:23	Inshore transects	181.674	CN
11/10/2020	07:01:54	16:43:48	08:08:17	Offshore + additional transects	168.353	CN
12/10/2020	07:09:14	16:55:44	07:35:28	Offshore + additional transects	192.534	CN
13/10/2020	07:12:21	16:48:44	08:11:28	Offshore transects	156.684	CN
14/10/2020	07:20:17	16:06:40	04:20:10	Travelling + scientists crew change	124.330	CN
15/10/2020	07:07:00	16:49:33	08:05:49	Offshore + additional transects	161.318	CN
16/10/2020	07:03:02	16:51:12	08:06:59	Offshore transects	211.611	CN
17/10/2020	07:03:18	16:28:42	07:31:54	Offshore transects	140.910	CN
18/10/2020	07:15:40	16:28:54	07:37:44	Offshore transects	188.343	CN
19/10/2020	07:10:22	08:11:44	01:01:22	Traveling for shelter	23.087	CN
20/10/2020	Storm	Storm	Storm	-	-	-
21/10/2020	07:29:56	16:49:25	08:06:08	Inshore transects	228.914	CN
22/10/2020	07:23:25	16:47:00	08:12:25	Inshore transects	206.901	CN
23/10/2020	07:45:00	14:25:51	04:32:25	Travelling	124.968	MI/CN
Total survey			**125:52:57**		**3,001**	

4.2 Environmental conditions

Environmental conditions encountered during the cetacean-dedicated survey effort were logged at 581 stations.

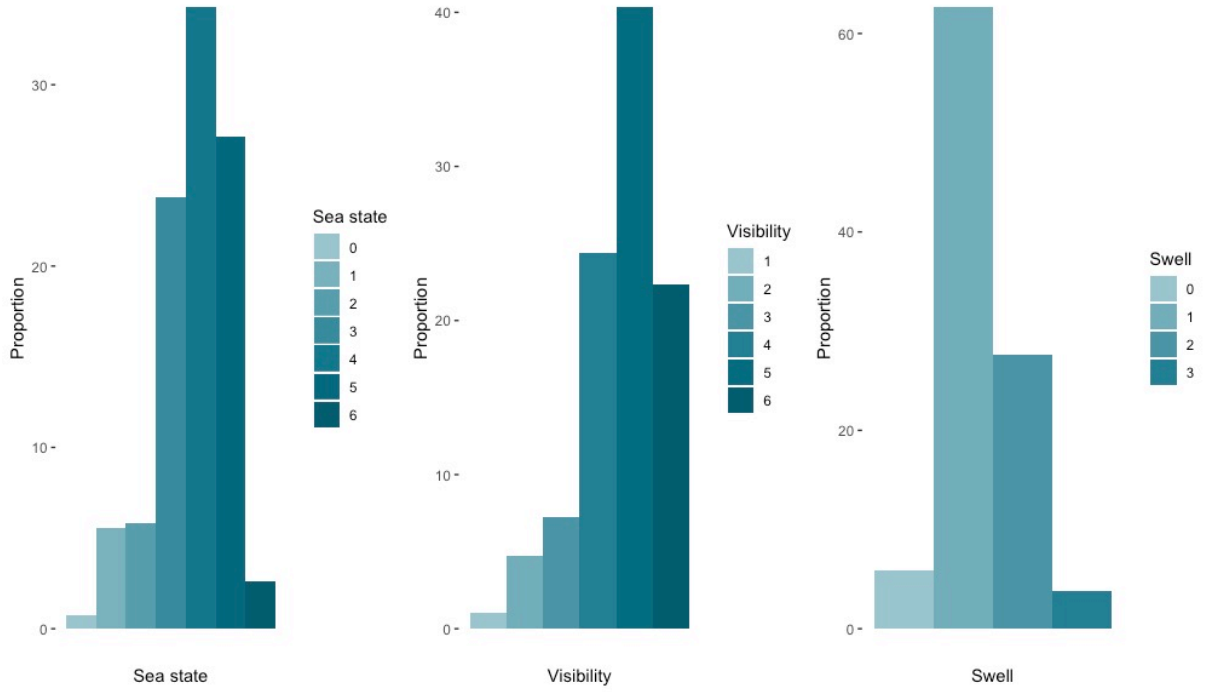

Figure 2. Overall environmental conditions: sea state, visibility and swell height encountered during the CSHAS 2020 survey. Data is presented as the proportion of time spent on effort under each sea state category for the entire survey.

Sea state conditions ranged from 0 to 6 during the survey (Figure 2 and 3), with most effort carried out under sea state 4 conditions, accounting for 34.29% of the total time spent on effort, followed by sea state 5 (27.12%) and 3 (23.82%). Effort was carried out under favourable sea conditions, *i.e.* sea states 2, 1 and 0 only during 5.85%, 5.59% and 0.74%, respectively. Sea state 6 was only recorded during 2.59% of the total time, since the general approach was that cetacean effort was conducted under sea states 0 to 5.

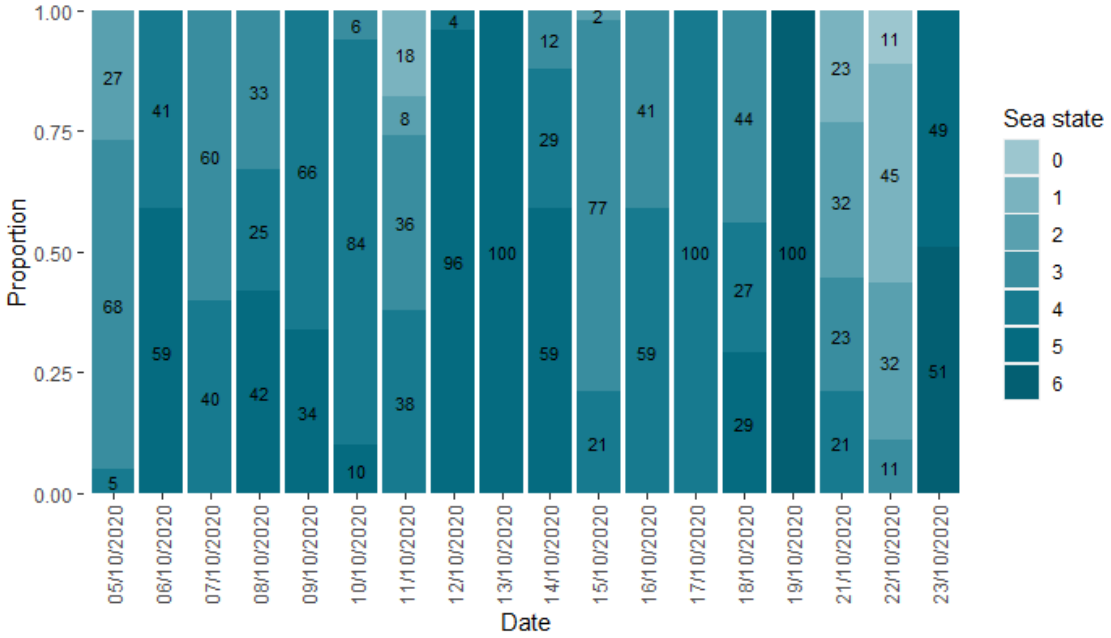

Figure 3. Daily sea state conditions encountered during the CSHAS 2020 survey. Data is presented as the proportion of time spent on effort under each sea state category for each day.

Visibility ranged from 1 (less than 1 km) to 6 (more than 20 km) during the course of the survey (Figure 2 and 4). Visibility conditions were overall favourable, recorded as less than 6 km only during 5.7% of the time. Most effort was conducted under visibility 5 (*i.e.* 16-20 km), accounting for 40.35% of the time. Although the general approach was that, effort would stop when visibility was less than 1 km, it was recorded for 1% of the time.

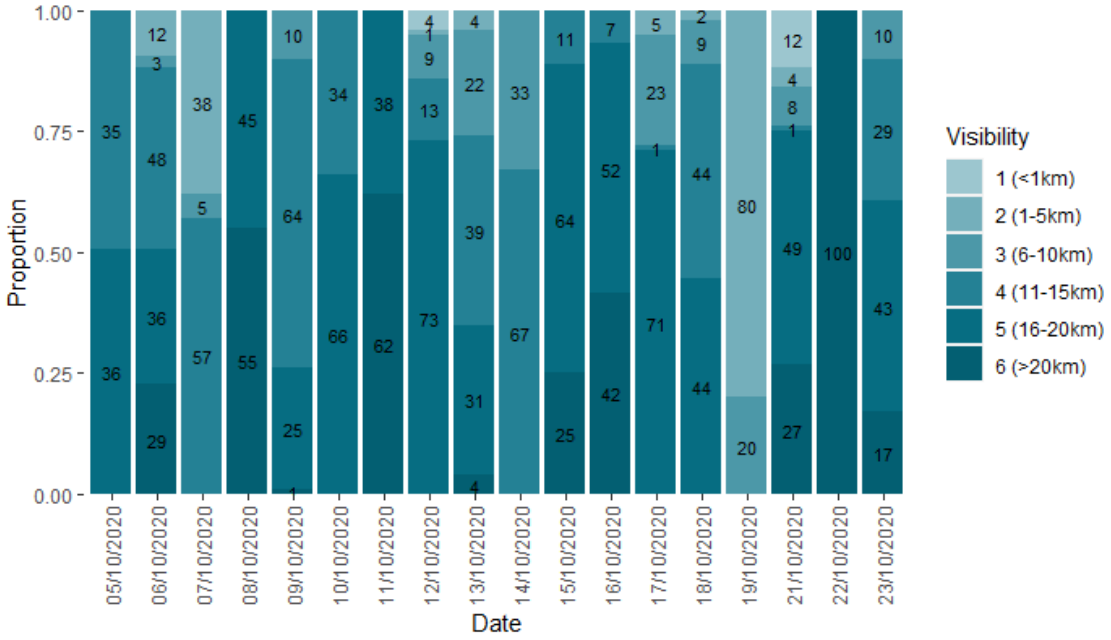

Figure 4. Daily visibility conditions encountered during the CSHAS 2020 survey. Data is presented as the proportion of time spent on effort under each visibility category for each day.

Swell height ranged from 0 to 3 (Figure 2 and 5) throughout the course of the survey, with most time spent on effort under swell 1, (*i.e.* from 0 to 1 m), accounting for 62.68% of the total time. Swell 2 was recorded during 27.62% of the time, followed by swell 0 and 3, recorded during 5.89 and 3.82% of the time, respectively.

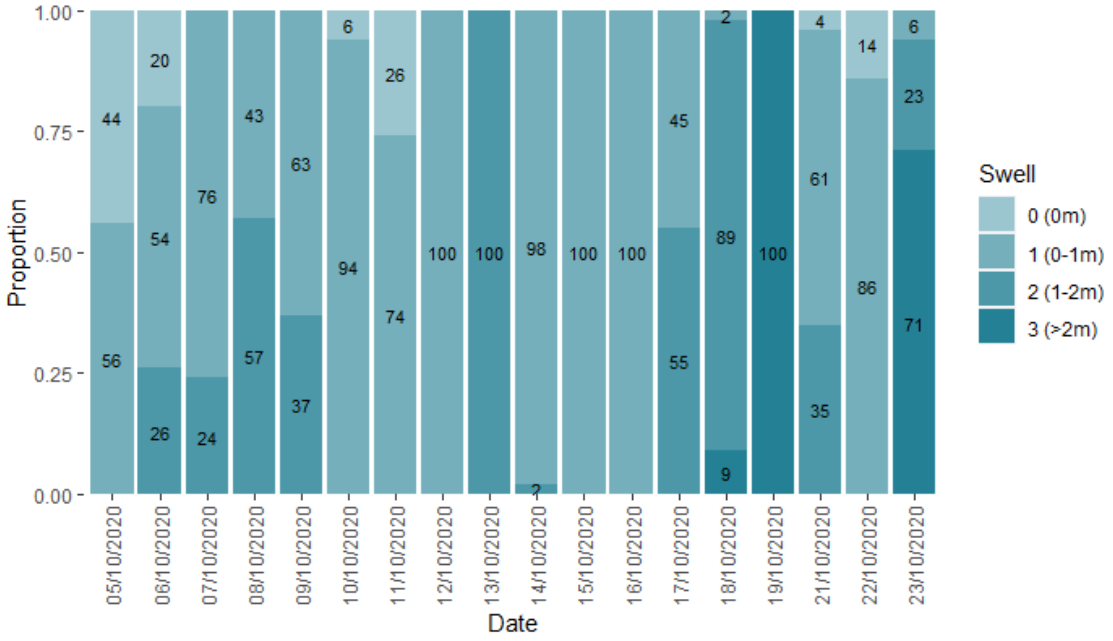

Figure 5. Daily swell height conditions encountered during the CSHAS 2020 survey. Data is presented as the proportion of time spent on effort under each swell height category for each day.

Precipitation was recorded for a total of 6 hours, 29 minutes and 57 seconds while on effort. Intermittent light rain accounted for most of this time, recorded for 3 hours, 9 minutes and 3 seconds. Continuous light rain was recorded for 2 hours, 55 minutes and 3 seconds and continuous high rain for 25 minutes and 53 seconds.

Unfavourable sea conditions were encountered during some parts of the days. Effort had to be interrupted early in the morning during the 19/10/2020 until the 21/10/2020 and again during the last day (23/10/2020), when the vessel was travelling back to Galway at the end of the survey.

4.3 Sightings

A total of 277 sightings and 6 auxiliary sightings, on effort and off effort, respectively were recorded over the course of the CSHAS with a total of 2,255 individuals. Five cetacean species (two odontocetes and three mysticetes), one pinniped and a fish species were identified (Table 2; Figures 7, 8 and 9).

Figure 6. Sighting of two fin whales during the CSHAS 2020 survey.

Table 2. Species of cetaceans, pinnipeds and fish encountered during the CSHAS 2020 survey (recorded on and off effort). Number of sightings, individuals and group size (minimum, maximum and average values) are included.

	Species	Sightings	Individuals	Group size
Odontocetes	Common dolphin	240	2,174	1-40 (9)
	Harbour porpoise	4	9	2-3 (2)
	Unidentified dolphin	2	8	2-6 (4)
	Total odontocetes	**246**	**2,191**	**-**
Mysticetes	Fin whale	11	12	1-2 (1)
	Humpback whale	1	1	1
	Minke whale	4	4	1
	Unidentified whale	5	6	1-2 (1)
	Total mysticetes	**21**	**23**	**-**
Pinnipeds	Grey seal	3	3	1
	Total marine mammals	**270**	**2,217**	**-**
Other sightings	Bluefin tuna	13	38	2-5 (3)
	TOTAL	**283**	**2,255**	**-**

The two odontocete species encountered during the survey were common dolphin (*Delphinus delphis*) and harbour porpoise (*Phocoena phocoena*) (Table 2, Figure 7). Common dolphins were by far the most abundant species encountered, being recorded every day, with 240 sightings of a total of 2,174 individuals (84.8% of the total sightings and 97.16% of all the animals). Common dolphins also presented the largest group size, ranging from one to 40 individuals observed. Four sightings of harbour porpoises (1.41% of the sightings) were recorded of a total of 9 individuals. Two sightings of unidentified dolphins were also recorded.

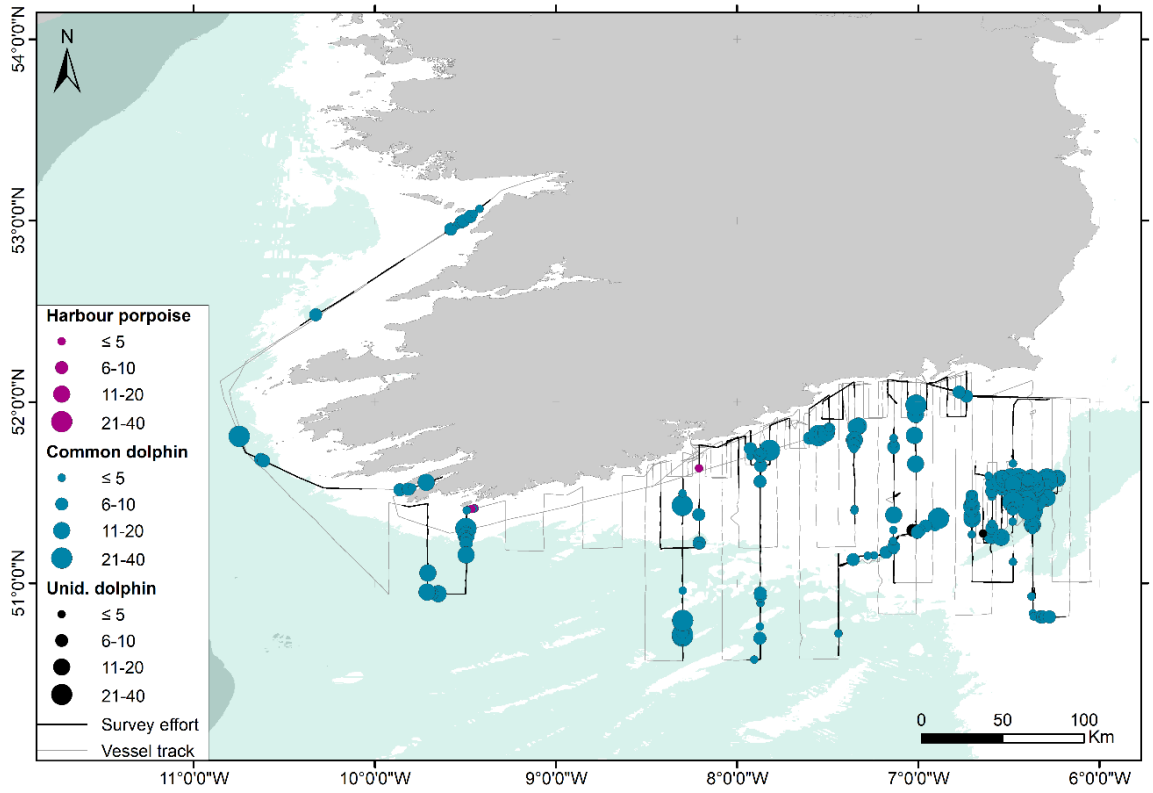

Figure 7. Sightings and group size of odontocete species (harbour porpoise, common dolphin and unidentified dolphin) recorded during the CSHAS 2020 survey. Marine mammal survey effort and vessel's track are also represented.

Three species of mysticetes were encountered during the survey: Fin (*Balaenoptera physalus*), minke (*Balaenoptera acutorostrata*) and humpback (*Megaptera novaeangliae*) whale (Table 2, Figure 8). Fin whales were the most commonly recorded species of baleen whales, with 11 sightings of 12 individuals. These were followed by four sightings of four minke whale individuals and one only sighting of a humpback whale. Most mysticetes were sighted alone, but a sighting of two fin whale individuals was recorded (Figure 6) and another sighting of two unidentified whales. Five sightings of unidentified whales were also recorded.

Grey seal (*Halichoerus grypus*) was the only species of pinnipeds observed during the survey, with a total of three sightings recorded of one individual each (Table 2, Figure 8).

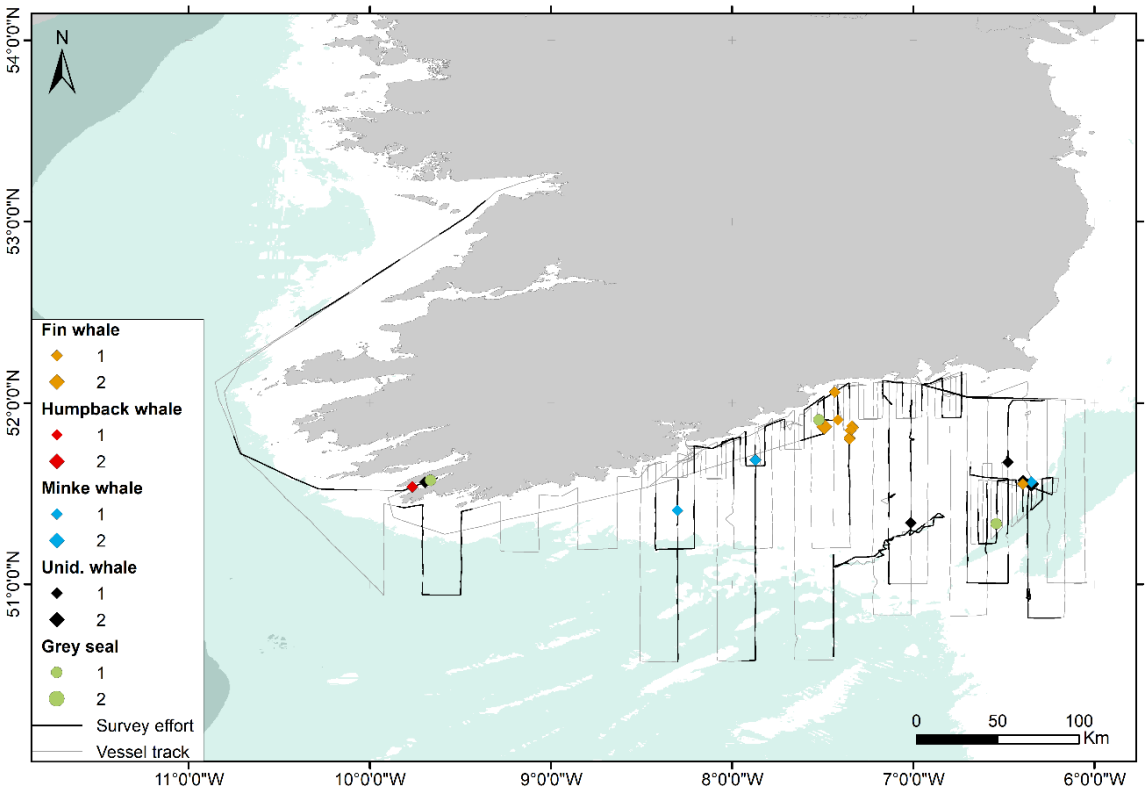

Figure 8. Sightings and group size of mysticetes (fin, humpback, minke and unidentified whales) and pinnipeds (grey seal) recorded during the CSHAS 2020 survey. Marine mammal survey effort and vessel's track are also represented.

Apart from marine mammals, 13 sightings of 38 individuals of bluefin tuna (*Thunnus thynnus*) were recorded, accounting for 4.59% of all the sightings (Table 2, Figure 9).

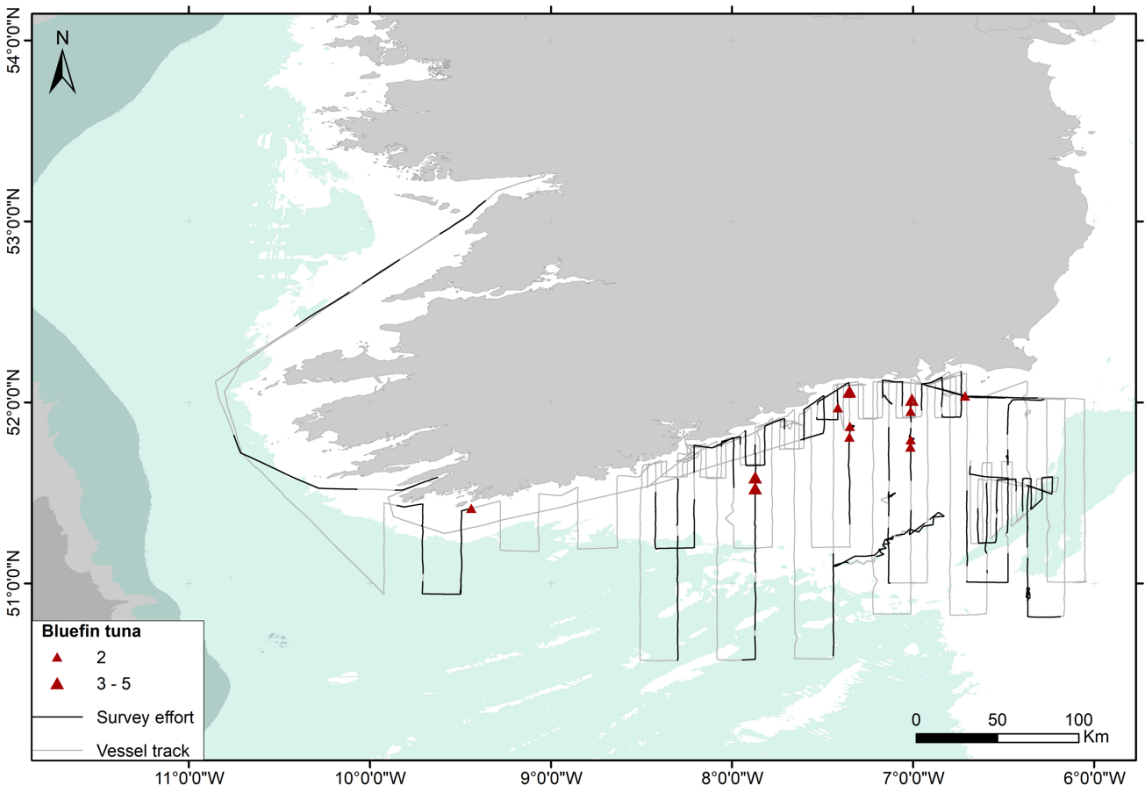

Figure 9. Sightings and group size of bluefin tuna recorded during the CSHAS 2020 survey. Marine mammal survey effort and vessel's track are also represented.

5 Discussion

During the CSHAS 2020 survey, common dolphins were observed every day that cetacean effort was carried out and were recorded in both, inshore and offshore areas. The largest number of sightings was concentrated along additional offshore transects conducted in the eastern part of the study area. This species was by far the most frequently observed and the most abundant, accounting for 84.8% of the total sightings and 97.16% of all individuals recorded. Common dolphins also presented the largest group size, with up to 40 individuals, with an average group size of 9 individuals. Some groups presented bow riding behaviour while the vessel was travelling. Harbour porpoise was the other odontocete species recorded accounting for 1.41% of the total sightings. Sightings of this species were of two or three individuals.

Three species of baleen whales were recorded, with fin whales being the second most frequently recorded cetacean species, accounting for 3.88% of the total sightings. Most fin whale sightings were recorded in inshore areas off the coast of Co. Waterford. The only humpback whale individual encountered was recorded in Dunmanus Bay. Also in this location, a minke whale was observed lunge feeding. Four sightings of single individuals of minke whales were recorded (1.41% of all the sightings), scattered over the surveyed area.

Bluefin tuna were spotted in 13 different occasions, accounting for 4.59% of all the sightings, always associated with feeding activity of large flocks of birds.

These observations are in accordance with cetacean species recorded in the area (Wall *et al.* 2013) as well as with previous CSHAS surveys during which common dolphins were also reported as the most frequently sighted species and individuals were encountered all around the study area (O'Donnell *et al.* 2011, 2012, 2013, 2015, 2016, 2017, 2018 and 2019; Nolan *et al.* 2014). Likewise, several sightings of fin whales were also reported in previous surveys (O'Donnell *et al.* 2017, 2018, 1019) being this the second most frequently recorded species of cetaceans. Sightings of fin whales were previously reported around the same area as the ones encountered during the present survey, off the coast of Co. Waterford (O'Donnell *et al.* 2011, 2012, 2015, 2016 and 2018; Nolan *et al.* 2014). Like in previous surveys, small number of harbour porpoise sightings were recorded. These could be due to sea state conditions, which were higher than 3 for most of the time spent on effort.

Although Risso's dolphins were reported during the 2014, 2017 and 2018 CSHAS surveys (Nolan *et al.* 2014; O'Donnell *et al.* 2017 and 2018), sightings were mainly recorded around the Blasket Islands, area travelled at night during this year's survey.

As in previous years, grey seals were the only species of pinnipeds encountered, with three sightings of one individual each. The low number of sightings are consistent with most surveys. However, high numbers of grey seals including pups were reported during the 2015 CSHAS survey around the Blasket Islands (O'Donnell *et al.* 2015), which is an Special Area of Conservation (SAC) for this species (Ó Cadhla *et al.,* 2013).

In addition to marine mammals, sightings of tuna species were also frequently recorded during this and previous herring acoustic surveys (O'Donnell *et al.* 2013, 2015, 2017, 2018 and 2019; Nolan *et al.* 2014) over the area of interest.

Some areas of the Celtic Sea have been previously identified as important feeding grounds for cetaceans, specifically for minke, fin and humpback whales (Volkenandt *et al.* 2015), which were the species of baleen whales encountered during the survey.

All sightings recorded during the course of the CSHAS 2020 by the observer are consistent with the ones reported during previous herring acoustic surveys in the Celtic Sea. These data collected on relative abundance and distribution of the species encountered in the Celtic Sea will be added to time-series data from previous surveys.

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Further details available on www.emff.marine.ie

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