WORKSHOP ON A RESEARCH ROADMAP FOR BRISTOL AND WESTERN CHANNEL HERRING (WKRRBWCH)

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WORKSHOP ON A RESEARCH ROADMAP FOR BRISTOL AND WESTERN CHANNEL HERRING (WKRRBWCH)

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Editors

Aaron Brazier • Afra Egan

Authors

Aaron Brazier • Afra Egan • Alexander Scorey • Campbell Pert • Charlotte Davies • Cormac Nolan • David R.K. Clarke • Edward Farrell • Frances Ratcliffe • Gus Caslake • Harriet Lincoln • James Stewart • Jaylene Mbararia • Jeroen van der Kooij • Lawrence Shephard • Louise Straker-Cox • Michael Gwilliam • Megan Elsmore • Paul Marchal • Pia Schuchert • Richard Joseph • Richard Nash • Rowan Cox • Susan Kenyon

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i Executive summary

Whilst ICES recognises three herring stocks in adjacent waters: North Sea autumn-spawners (her.27.3a47d), Celtic Sea (her.27.irls), and Irish Sea (her.27.nirs), there is no assessment and limited biological understanding of herring in the western Channel (Division 7.e) and Bristol Channel (Division 7.f). WKRRBWCH was convened to identify available data sources for assessment and management advice, review stock identity information and produce a roadmap for future research needs. Both fisheries-dependant and -independent data were evaluated, though there was only currently sufficient information to produce a landings-based assessment (ICES Category 5). However, WKRRBWCH noted discrepancies between landings data reported by ICES Statistical Rectangle directly to the Workshop compared to estimates presented in the annual herring assessment working group reports which require an additional data call to reconcile. This data call should include landings reported by metier, rectangle, quarter, and year. A new stock coordinator and assessor will be identified to carry out the assessment and draft the advice. Furthermore, WKRRBWCH documents the need to describe all herring populations throughout these divisions by means of genetic analysis (see WKSIDAC2), particularly in the western Channel, and analysis of physical samples currently held by external bodies (University of Swansea). These data are currently not available in sufficient detail or quantity to be considered for the basis of advice. Catch advice following the Category 5 method can be produced in time for HAWG (2025) with advice then given biennially.

ii Expert group information

Expert group name	Workshop on a Research Roadmap for Bristol and Western Channel Herring (WKRRB-WCH)
Expert group cycle	Fixed term
Year cycle started	2023
Reporting year in cycle	1/1
Chair(s)	Aaron Brazier (United Kingdom)
	Afra Egan (Ireland)
Meeting venue(s) and dates	4–6 December 2023, Swansea, United Kingdom (24 participants)

1   Introduction

1.1   Background

Atlantic herring (Clupea harengus, Linnaeus 1758) are a commercially-important, shoaling clupeid, typically measuring between 20–30cm and living to around 7 years of age (ICES, 2006), though there are differences between populations (Berg *et al*., 2017). Herring are demersal spawners, laying one batch of eggs on coarse substrata in high energy environments (Reid *et al*.,1999; Langård *et al*., 2014). Larvae are pelagic and are either retained near spawning areas or are transported by currents to more productive nursey grounds (Frost and Diele, 2022). Juveniles (aged 1–2) remain in shallow areas before joining adults in deeper, offshore waters after first maturation (Hay *et al*., 2001). Following maturation, adult herring undergo market annual cycles of feeding, reproduction, and overwintering (Creaser *et* al., 1984; Dragesund *et al*., 1997; Nash *et al*., 2009).

ICES currently recognise 11 herring stocks across the northeast Atlantic with annual advice: her.27.1-24a514a (Norwegian spring-spawning herring), her.27.20-24 (western Baltic spring-spawning herring), her.27.25-2932 (central Baltic herring, excluding the Gulf of Riga), her.27.28 (Gulf of Riga herring), her.27.3031 (Gulf of Bothnia herring), her.27.3a47d (North Sea autumn-spawning herring), her.27.5a (Icelandic summer spawning herring), her.27.6aN (6a North autumn-spawning herring), her.27.6aS7bc (herring north and west of Ireland), her.27.irls (Celtic Sea herring), and her.27.nirs (Irish Sea herring). The Herring Assessment Working Group (HAWG) also notes that there are herring stocks with limited data: Clyde herring (Forth of Clyde), herring in Divisions 7e and 7f (western Channel and Bristol Channel), herring in Subarea 8 (Bay of Biscay), and spring-spawning herring in 6aN. This, however, does not represent a complete list of herring populations which are known to exist.

Herring in 7e-f are not formally assessed and does not require annual advice at present, though this is now an ICES request. The stock structure of herring in these two Divisions is uncertain and the degree of mixing between herring in these Divisions and neighbouring areas is largely unknown. Catch data are collated for all ICES Divisions where herring are caught, either by targeted fisheries or as bycatch. Additionally, there are some surveys (acoustic and bottom trawl) across the two Divisions where catches of herring occur, though the levels of which are low.

Herring in both the western Channel (7.e) and Bristol Channel (7.f) are subject to a series of small-scale targeted fisheries or are taken as bycatch. Occasional years of high catches are reported, but low demand generally determines the minimal uptake by the fishery.

Currently, there is insufficient understanding of localised herring populations in either Division to produce robust, statistical advice. Whilst a relatively long time series of landings and catches are available, these data would need to be updated to account for differences between the current ICES landings estimates and the catch by rectangle statistics requested for use at this Workshop.

On request to provide catch advice for herring in both 7e and 7f, it was decided to hold this Workshop to develop a Research Roadmap for Bristol and Western Channel Herring (WKRRB-WCH). WKRRBWCH met on 4-5 December 2023 to discuss the possibility of giving advice with the following aims:

a) Identify methods and data available for the identification of herring stock structure in the western English Channel (7.e), Bristol Channel (7.f), and adjacent waters.

b) Identify potential and existing datasets (including environmental parameters) for the assessment and management advice on herring occurring in 7e and 7f.

c) Produce a roadmap for the delivery of future research needs for the scientific advice that underpins management of herring in the western English Channel and Bristol Channel, either together or independently.

1.2 Methods and approach

Other meetings, including HAWG (2023) and WKSIDAC2 (2023), identified a range of knowledge gaps regarding herring stock structure in Divisions 7.e-f. A Workshop proposal with ToRs (terms of reference) was submitted to ICES on completion of HAWG (2023) alongside the identification of Chairs: Aaron Brazier (Cefas) and Afra Egan (Marine Institute). Participants were identified and invited to contribute to the Workshop. A hybrid meeting was held on 4-5 December at the University of Swansea with 24 delegates attending in person or online.

1.3 ICES Code of Conduct/Conflict of Interest

WKRRBWCH is seen as a scoping Workshop and participants were expected and encouraged to speak from their own experiences and positions. Thus, this Workshop is considered to be covered by the code of conduct as *'ICES may run meetings which are intended to solicit stakeholder views. For these meetings, … participants will be asked to represent specific professional interests'*.

1.4 Nature of consensus in this report

The Workshop was tasked with developing a research roadmap for herring in the western Channel (7.e) and Bristol Channel (7.f) and the process for giving advice in these two Divisions. The level of consensus among all Workshop participants on the various issues discussed was very high. With such a range of experts in attendance, numerous aspects of the research needs were discussed in detail and the knowledge shared by invited speakers was imperative in sparking debate and coming to a common understanding. The roadmap presented in this report can therefore be considered broadly supported with the caveat that there may be views held by other stakeholders that were not involved in the meeting.

1.5 Scope of the Workshop

The Workshop focussed on the scientific research needs required to provide catch advice for herring in Divisions 7.e and 7.f. As such, whilst the methods of giving advice were discussed, and the issues of management and policy did arise from these discussions, these are not described in this report.

1.6 Invited statements and presentations

The following expert presentations were given during the meeting. Each presentation was followed by a question, answer, and discussion session.

Catch/landings of herring in 7.e and 7.f: Afra Egan (Marine Institute, Ireland).

The time series of landings data for herring in 7.e and 7.f currently available in the herring assessment working group report runs from 1974-2022 (ICES, 2023). Data are available by ICES division by year and following a data call data were also supplied by statistical rectangle

by quarter back to 2000. Data are taken from the ICES historical and official nominal databases and adjusted, where possible, with data supplied by working group members. Early in the time series there were several countries involved in the fisheries. Since 2000 the catch is mainly taken by the UK and France, with some landings also reported in some years by the Netherlands. Further detail is presented in Section 3.1.

Swansea/EMFF/AFBI/MI herring studies in West Wales and the Bristol Channel: Dave Clarke (University of Swansea, UK), Charlotte Davies (University of Swansea, UK), and Ed Farrell (Killybeg's Fisherman's Organisation, Ireland).

Data for this presentation have been drawn from four sources: SEACAMS (Sustainable Expansion of the Applied Coastal and Marine Sectors: 2018–19), EMFF (European Marine and Fisheries Fund: 2021–2023), AFBI (Agri-food and Biosciences Institute: 2022) and MI (Marine Institute) sampling. 4 655 morphological samples were collected from the SEACAMS and EMFF projects with 7 491 genetics samples collected across all four sources.

Morphological data included sex, spawning condition, length, weight (gutted and ungutted), vertebral count, and age. Ages were generally obtained by analyses of scales, although otoliths were collected from a majority of these fish also. Morphological data are available for samples across 39 sites covering 13 locations.

Spawning condition data demonstrate that autumn and winter spawners are found along the west Wales coast alongside the coasts of Somerset and north Devon. Spring spawners are found in Milford Haven and off the southwest coast of Wales. Age structure and length-at-age data were presented for different sites.

The genetic data included 4 344 baseline samples, 2 718 mixed samples, 260 larvae, and 169 archive samples. The genetic samples were genotyped by IdentiGEN, Dublin with the multispecies Axiom® SNP genotyping array (FSHSTK1D) yielding data for over 3 200 SNP (single-nucleotide polymorphism) markers for each fish. Samples were collected in the Celtic Sea, Irish Sea, Bristol Channel (Division 7.f), and at Mevagissey in 7.e. The analyses indicated a significant differentiation between spring and autumn spawners, with two spring-spawning groups identified in the Bristol Channel: low salinity spawners in Milford Haven and coastal spring spawners towards Freshwater East. The differentiation between the spring-spawning groups was evident in both the genetic and morphological data, with samples from Freshwater East exhibiting a significantly larger length at age than those from Milford Haven.

For the autumn and winter spawning herring, there was significant differentiation between the Irish and Celtic Sea(s) populations. There was also evidence of genetic differentiation between the Celtic Sea (Dunmore East and Knockadoon) samples and those from the Bristol Channel. The sample from Mevagissey was also differentiated from the Bristol Channel, Celtic Sea, and Irish Sea samples and was more genetically similar to winter spawning samples from division 6.a.S (northwest of Ireland) and division 7.d (Downs)

An exploratory assignment model was developed and used to assign mixed samples collected in the Irish Sea to population of origin (Irish Sea autumn spawners, Celtic Seas autumn and winter spawners, Milford Haven low salinity spring spawners. Coastal spring spawners). The analyses indicated that ~40% of the herring sampled during the 2021 and 2022 Irish Sea Herring Acoustic Survey were from the Celtic seas. Further work is needed to determine whether these are from the population that spawns off the south coast of Ireland or includes fish from west Wales and the Bristol Channel.

Data were also presented showing the spawning areas within Milford Haven. Data from Pembroke power station screen and ichthyoplankton sampling demonstrates a significant decline in population levels since 2012. Catch data were also presented from Minehead showing the seasonality of catches with a peak in December, though a decline in catch rate is seen since 2016.

Additionally, information was provided on the distribution of an acoustic tracking array in the Bristol Channel, which has the potential to be used for tracking herring, alongside a range of other species over the next two years.

Overall, the reports presented suggest significant gaps in knowledge and information needs. This includes the necessity of understanding the size of the autumn-winter spawning populations in the Bristol Channel, migration pathways of the different populations, and the need for resources to further analyse the genetic database which is already available.

Cefas surveys in the southwest: Louise Straker-Cox (Cefas, UK).

Herring data were presented from a collection of 5 Cefas bottom trawl surveys: DCRDC (Data Collection Regulation Survey; 2005–2010), SWBEAM (South Western Beam Trawl Survey; 2006–2023), WCGFS (Western Celtic Sea Groundfish Survey; 1982–2004), SWIBTS (South Western International Bottom Trawl Survey; 2003–2011), and SWOTTER (South Western Otter Trawl Survey; 2018–2020 and 2023). Herring were not a primary species for any survey; however, length data are recorded for all years. Biological and age data are available intermittently for each survey, though not in large numbers.

Herring data in French surveys and landings: Paul Marchal (Ifremer, France).

Herring in the English Channel, EC (ICES Divisions 7.d and 7.e) are sampled during the Q4 Channel Groundfish Survey (CGFS), and in the Celtic Sea (including ICES Division 7.f) during the Q4 EVHOE survey. The CGFS has operated with a GOV bottom trawl in Division 7.d since 1988, and in Division 7.e since 2015. Herring abundance is generally low in October, the period during which the CGFS operates, and is mostly concentrated in the eastern side of the EC (7.d), off the French Pas-de-Calais and Normandy coast and in the Dover Strait. In the western side of the EC (7.e), herring are sampled sporadically, and their spatial distribution is highly variable, although higher average densities are observed off the southwest of England. There were no obvious differences in herring size distributions between ICES Divisions 7.d and 7.e. EVHOE herring abundance data were made available over the period 1997–2019 in November-December when the survey operates. There was an apparent spatial continuity in herring distributions between ICES Divisions 7.f and 7.g. French herring landings in ICES Divisions 7.d–f were also examined (2011–2022) as these provide information on seasonal variability, in addition to the spatial and annual patterns revealed by the surveys. Landings in Division 7.e were mainly bycatches of the sardine pelagic fishery. They were much lower than in Division 7.d, and highly variable both spatially and inter-annually. When averaged over the period 2011–2022, the bulk of the landings in the western EC occurred in winter (similar to eastern EC herring landings), and close to the border between the western and the eastern EC. Herring landings in 7.f were negligible in all years and seasons.

Herring prey items in the Continuous Plankton Recorder: Lawrence Shephard (MBA, UK).

The continuous plankton recorder survey at the Marine Biological Association has performed methodologically consistent sampling (via Ships of Opportunity) and microscopic taxonomic analysis of plankton in UK seas since 1958. For 16 zooplankton taxa identified as being important to herring stocks, nominally monthly abundance values are available from several relevant survey routes (although three taxa have very limited data). This enables the construction of estimated monthly relative abundance time-series (for 2 by 2-degree areas/locations around the UK) and a corresponding mapping of each taxon's relative average abundances at these locations which may indicate their availability to herring.

Herring abundance in the MBA's long-term fish monitoring in the western Channel: Rachel Brittain (MBA, UK).

The Marine Biological Association (MBA) has had fisheries-independent surveys since 1911, representing some of the earliest surveys to take place in European waters. These data are recorded over a fine spatial scale and focusses on sites in the western Channel off the coast of Plymouth in depths of between 0–65m. Comparatively low herring analysis mean that only 10 397 individuals were recorded over the whole survey period between seasons: spring (7 314), summer (700), autumn (175), and winter (2 208). The demersal trawl method presents limitations for herring sampling and represents an incomplete data set (43-year gap in sampling effort). With a need for further analysis, there appears to be a correlation between local sea surface temperature (SST), primary productivity, and herring abundance.

Cornish sardine fishery and herring bycatch: Summary of a presentation by Gus Caslake (CSMA, UK).

The Cornwall Sardine Management Association (CSMA) was set up in 2004. Most vessels fish within about 200m of the shore with processors taking the majority of the catch. MSC status was awarded for sardine. In 2022, 7 500 tonnes of sardines were caught, mainly in Mounts Bay. Most sardines are sold as fresh or tinned. The CSMA has a Code of Conduct which encompasses an open access approach. They endeavour to participate and conduct science where possible. They have been involved in a Fishery Science Partnership since 2017. This involves collecting samples on vessels (length frequencies) and from processors as well, with the processors additionally recording weights and fat content. There are three vessels with cameras, note that skippers can add comments as well. All the CSMA vessels are under 15m.

Herring have not been caught by ring nets in last 2 years. The last catch was 26.2t in Feb 2021 in St. Ives Bay. Historically, catches were in Mounts Bay in November but poor quality, i.e. spent. Herring are not targeted by the larger vessels in the area. However, there was an incidental catch almost 200t in 2022. The traditional fishery was located out of Clovelly. There are no financial drivers for fishing during the winter and spring in the area. Fisheries in this area are largely driven by market demands, with no real interest in herring in the SW of England region.

Recreational herring catches in 7e-f: Aaron Brazier (Cefas, UK).

Catch by recreational fishers are beginning to be explored for their use as a data source to inform stock assessments, including for sea bass in the southern North Sea, Channel, and Celtic Sea. However, there is very limited reporting of such data, especially compared to commercial catches. Within the UK, data are submitted to the Sea Angling Diary where anglers are asked to record number and length of fish and noting whether these fish were kept or returned after capture. From this programme, it can be noted that recreational catches of herring in both 7.e and 7.f (by UK anglers) are to be of limited importance due to low catch both reported and estimated by the survey (10.4 tonnes total in 7.e and 0.6 tonnes total in 7.f). Whilst the survey errors are relatively large for herring in these areas (RSE 34% in 7.e and RSE 129% in 7.f, depending on year), the upper bounds of the catch estimates (highest 2.68 tonnes in 7.e and 0.442 tonnes in 7.f) still indicate limited mortality as a result of recreational fishing.

Pelagic Freezer Trawler Association (PFA) herring data: Susan Kenyon (Cefas, UK).

Vessels belonging to member companies of the Pelagic Freezer Trawler Association (PFA) routinely collect biological data on herring during normal fishing operations. PFA vessels operate throughout the northeast Atlantic and a proportion of herring catches are taken within the English Channel which are relevant to populations occurring in ICES Divisions 7.e and 7.f. Data are collected for quality control purposes by trained personnel during catch processing in factories onboard vessels. Hauls are processed into production batches and the

average length, weight, and muscle fat content of approximately 23 kg of fish in each batch is calculated. Between 2014 and 2021, 1 028 batches of fish with an associated latitude and longitude were produced from Divisions 4.c, 7.d, 7.e, and 7.f. The median batch weight was approximately 30–40 t, with batches reaching between 100 and 150 t. The percentage of fat in the muscle tissue was relatively low compared to herring in the North Sea and gradually declined from approximately 10% to 2.5% between the beginning of November and mid-January. The relatively low and declining fat content combined with the nature of the fishery (targeted for roe) is consistent with the allocation of surplus energy reserves to gonads at the onset of spawning, implying these samples are from winter-spawning herring. Given the lack of samples from Division 7.e, the mixing of herring between these two areas is uncertain.

PELTIC survey: Jeroen van der Kooij (Cefas, UK).

The Pelagic Ecosystem survey of the western Channel and eastern Celtic Sea (PELTIC) has been monitoring the small pelagic fish community, including herring, in the autumn (Q4) since 2013. Survey coverage has expanded from covering UK waters of Division 7.e and f (2013–2016) only, to include French waters of the western Channel from 2017 and, from 2020, Cardigan Bay in the north. Although spatiotemporal coverage of the acoustic survey is optimised to monitor spat, sardine and anchovy, herring is found in mixed trawl catches with sprat in particularly the Bristol Channel, but also in smaller numbers in Lyme Bay and, more recently, Cardigan Bay. Total survey derived herring biomass between 2013 and 2021 (for which data were available) has fluctuated between 33 tonnes and 7 418 tonnes (in 2020 and 2018 respectively), with most of the biomass residing in the Bristol Channel (Division 7.f). Most fish were 0 or 1 year old and Bristol Channel fish were generally smaller than those in Lyme Bay (western English Channel). A one-off survey in Cardigan Bay in March (2023) found a larger range of sizes with fish ranging between 1 and 7 years old. Small numbers of herring larvae were also found during that survey.

Investigation into the decline of the Milford Haven herring: Frances Ratcliffe (Natural Resources Wales, UK).

Investigations into trends in Atlantic herring abundance in Milford Haven are being undertaken by Natural Resources Wales and Aberystwyth University. This work is part of a three-year programme funded by the Welsh government. The decline of species including maerl, sponges, horse mussels and herring will be included in this study. The work on herring will follow on from work carried out in the 1980s (Clark and King, 1985) and by Davies et al., (2020). This study aims to address questions such as

- Why have herring declined in Milford Haven?
- Have there been disturbances to the spawning beds?
- Has the water quality declined?
- Is there potential for recovery?
- Are there management measures that could be implemented to improve herring stocks in this area?

2 ToR A: Identify methods and data available for the identification of herring stock structure in the western Channel (Division 7.e), Bristol Channel (Division 7.f), and adjacent waters.

Herring samples have been repeatedly taken by projects associated with the University of Swansea (UK). These consist of length and weight records alongside limited age estimates (from scales). However, otoliths have been taken for a majority of samples and can be read and aged during future research projects. Comparatively, there are more samples taken in the Bristol Channel (Table 2) than the western Channel (Table 1). These data need further evaluation before use in advice methods.

Table 1. Biological data recorded from herring samples in Division 7.e (Western Channel).

	Length samples		Weight samples			
Year	Fork	Total	Gutted	Total	No. aged	Otoliths available
2019	100	100	100	100	0	100

Table 2. Biological data recorded from herring samples in Division 7.f (Bristol Channel).

	Length samples		Weight samples			
Year	Fork	Total	Gutted	Total	No. aged	Otoliths available
2018	1 014	1 195	969	1193	102	1 199
2019	1 200	1 221	878	878	7	1 080
2020	66	7	4	66	0	63
2021	369	369	367	369	0	369
2022	385	385	385	384	0	385
Total:	3 034	3 177	2 603	2 890	109	3 096

3 ToR B: Identify potential and existing data sets (including environmental parameters) for the assessment and management advice for herring occurring in Divisions 7.e and 7.f.

3.1 Landings data

The current time-series of landings runs from 1974–2022. Landings from Division 7.e (Western channel) and 7.f (Bristol Channel) are presented in Figure 1. Data are taken from the ICES historical and official nominal databases and adjusted, where possible, with data supplied by working group members. The highest landings in both areas were in the late 70s.

Since 2000, landings in Division 7.e and have fluctuated between a minimum of 6t in 2021 and 2022 and a maximum of over 1000 t in 2010. The average landing over the last ten years (2013–2022) is just under 300 t. Since 2000, landings in Division 7.f have ranged from 1t in 2020 to 231t in 2000. Landings are mainly reported by the UK. The average landings over the last ten years (2013–2022) is 82t.

Total landings from 2000 and the TAC since 2010 are shown in Figure 2. Every year the TAC is well in excess of the landings. Landings are mainly taken close to the UK coast with smaller amounts taken close to the coast of France.

Landings data by statistical rectangle by year from 2000-2022 are presented in Figure 3. There are some differences between total annual landings by rectangle and landings presented in the Herring assessment working group report. Further investigations are required to reconcile these data sets. A summary of the landings data submitted to the Workshop is presented in Table 3.

A full data call will be required before the landings data can be used for the provision of advice. Landings data at a finer resolution will be requested in order to determine if landings from all gears used in these fisheries are included in the total figures. Data will be required by ICES division, by month by metier. Whilst included in the official data calls for both France and the UK, additional work is also required to quantify landings by vessels less than 10m.
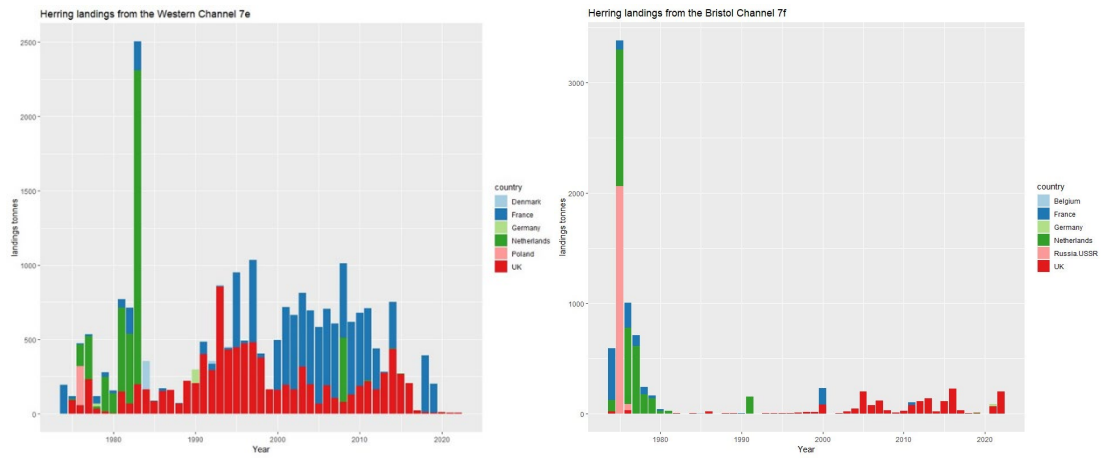
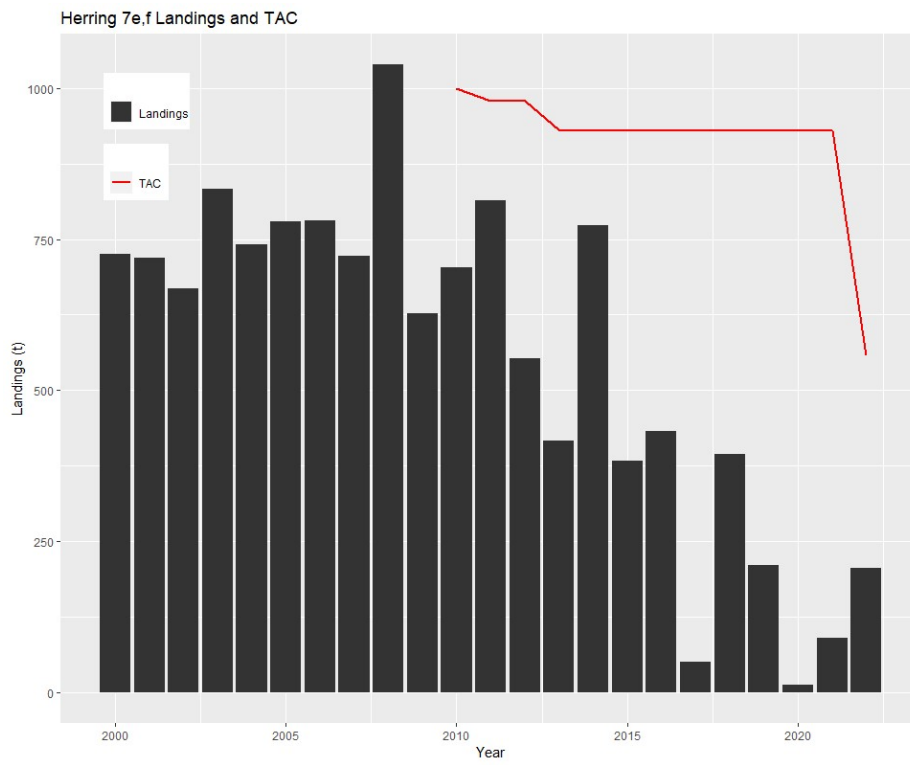**Figure 1. Time series of landings by country from ICES Division 7.e (left) and 7.f (right).**

Figure 2. Landings from ICES Divisions 7.e and 7.f between 2000–2022. TAC shown since 2010.

Figure 3. Landings (tonnes) of herring by ICES Statistical Rectangle from 2000–2022.

Figure 3 cont. Landings (tonnes) of herring by ICES Statistical Rectangle from 2000–2022.

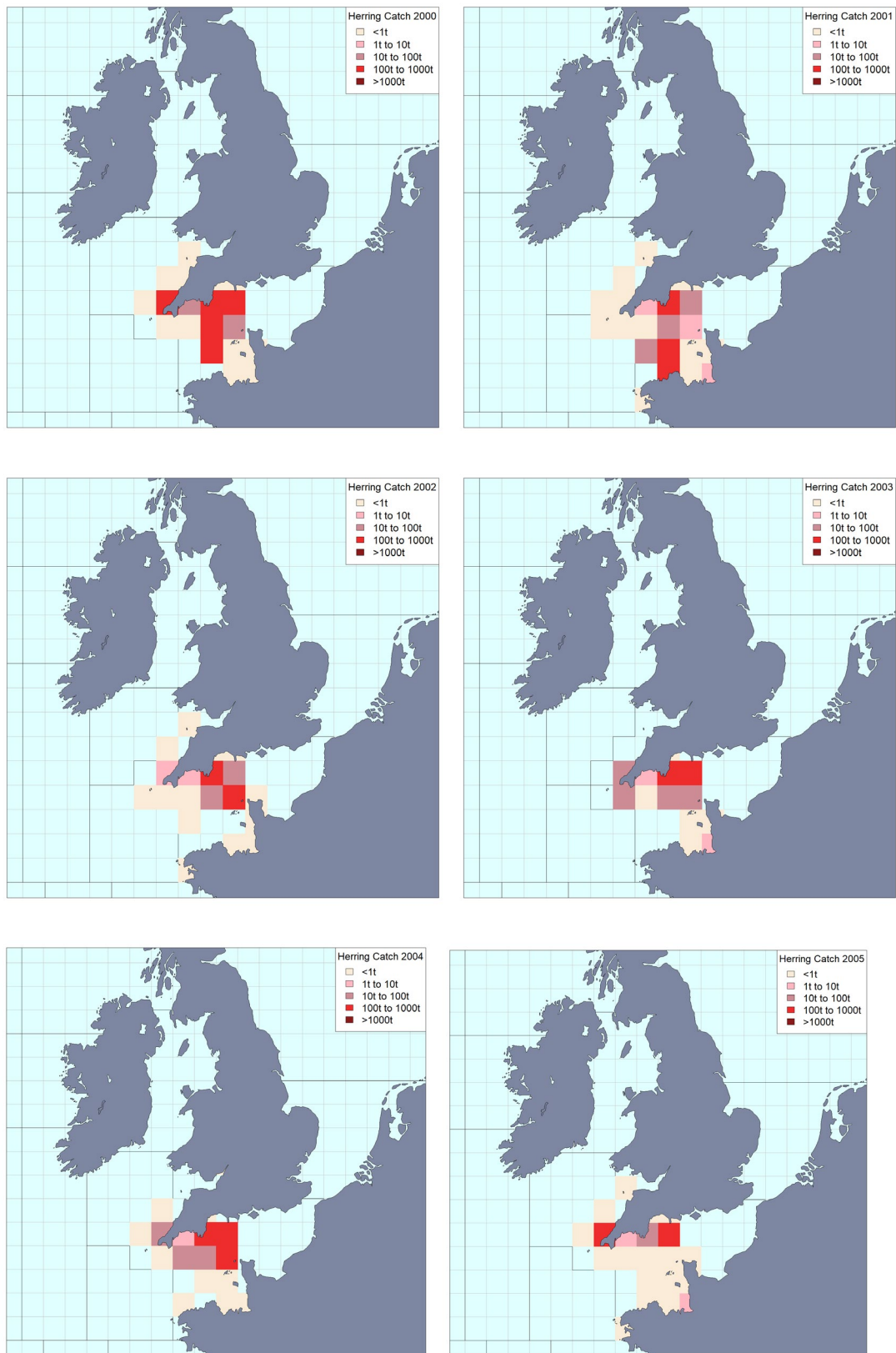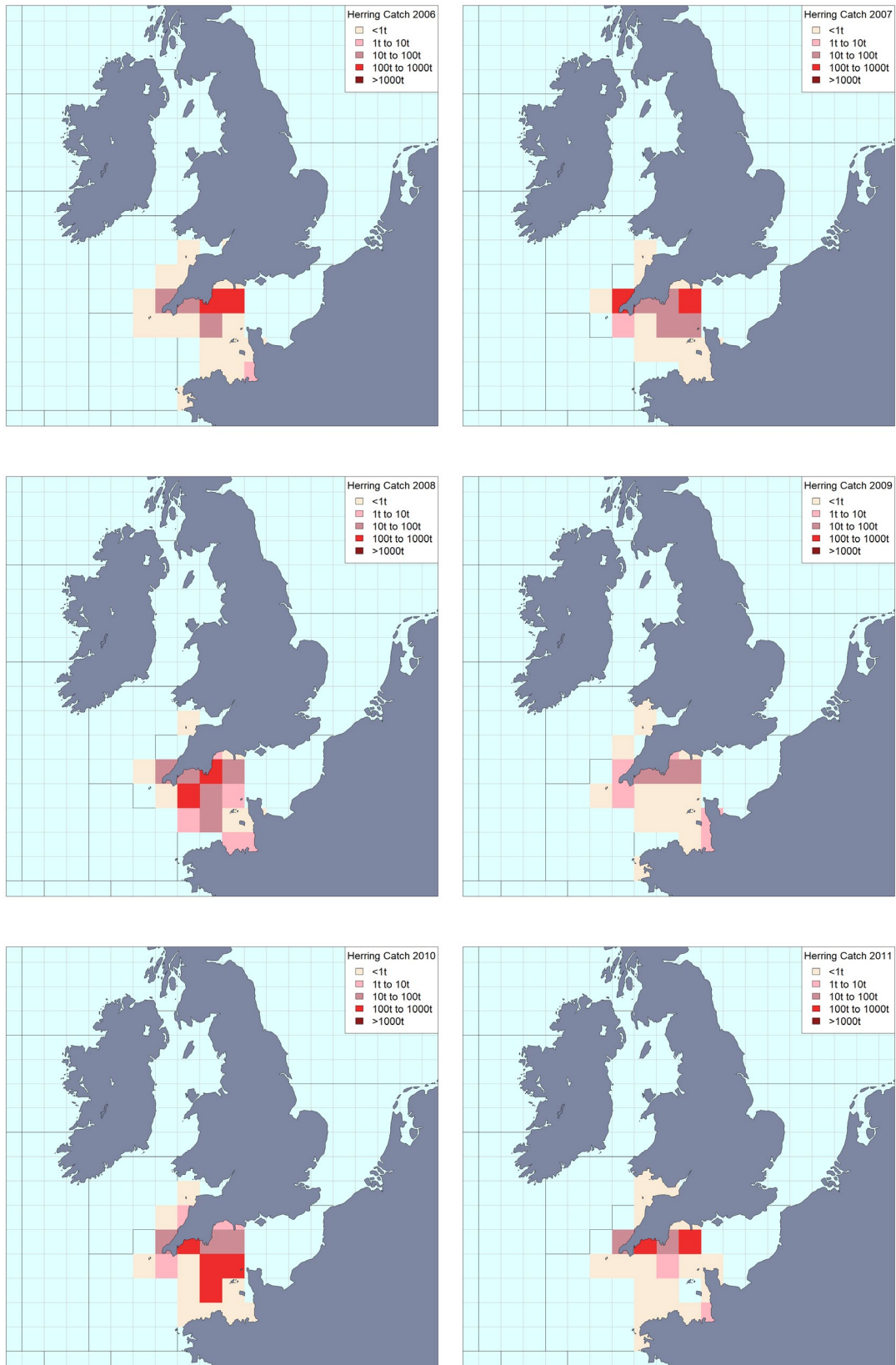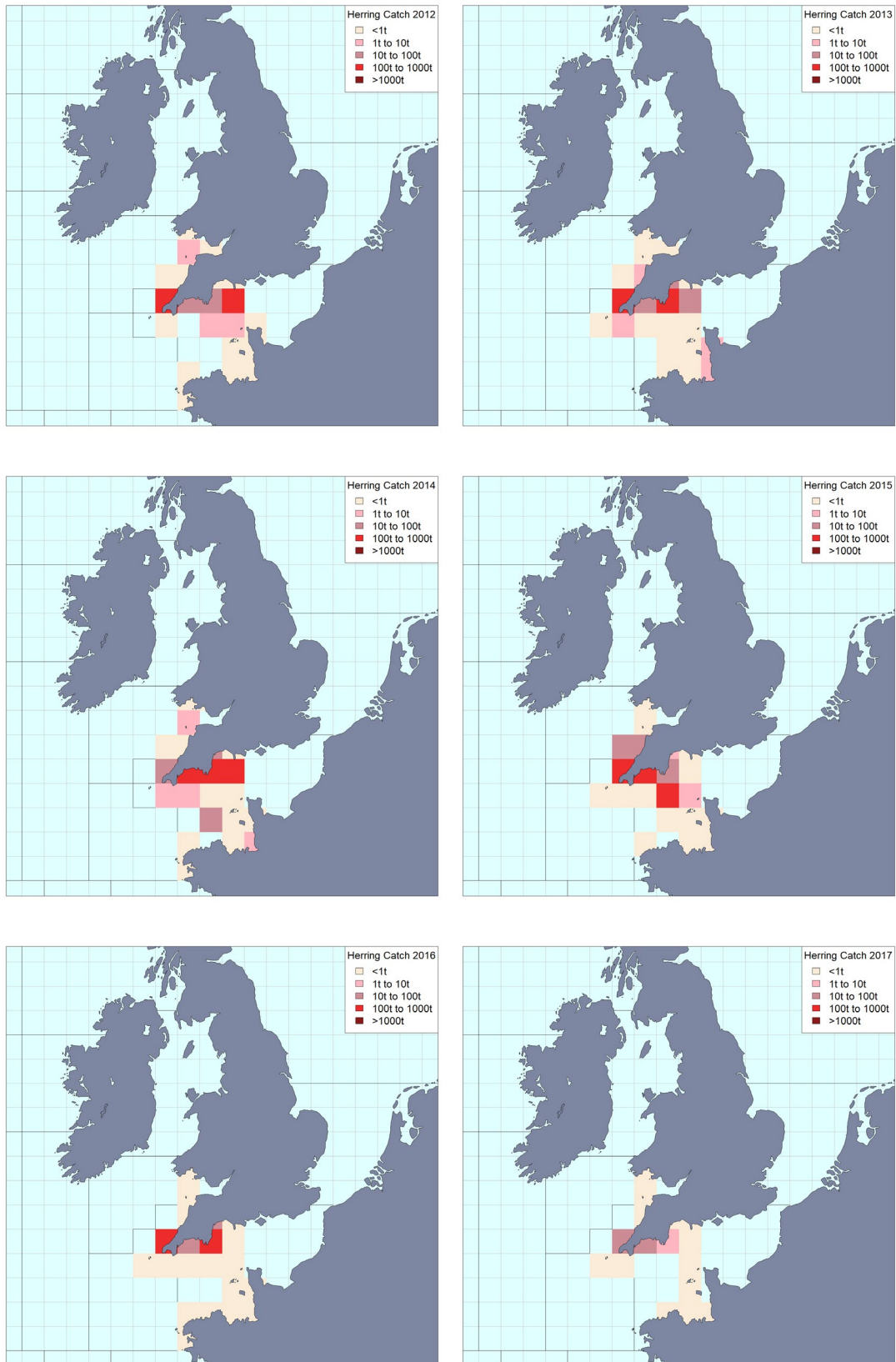**Figure 3 cont. Landings (tonnes) of herring by ICES Statistical Rectangle from 2000–2022.**
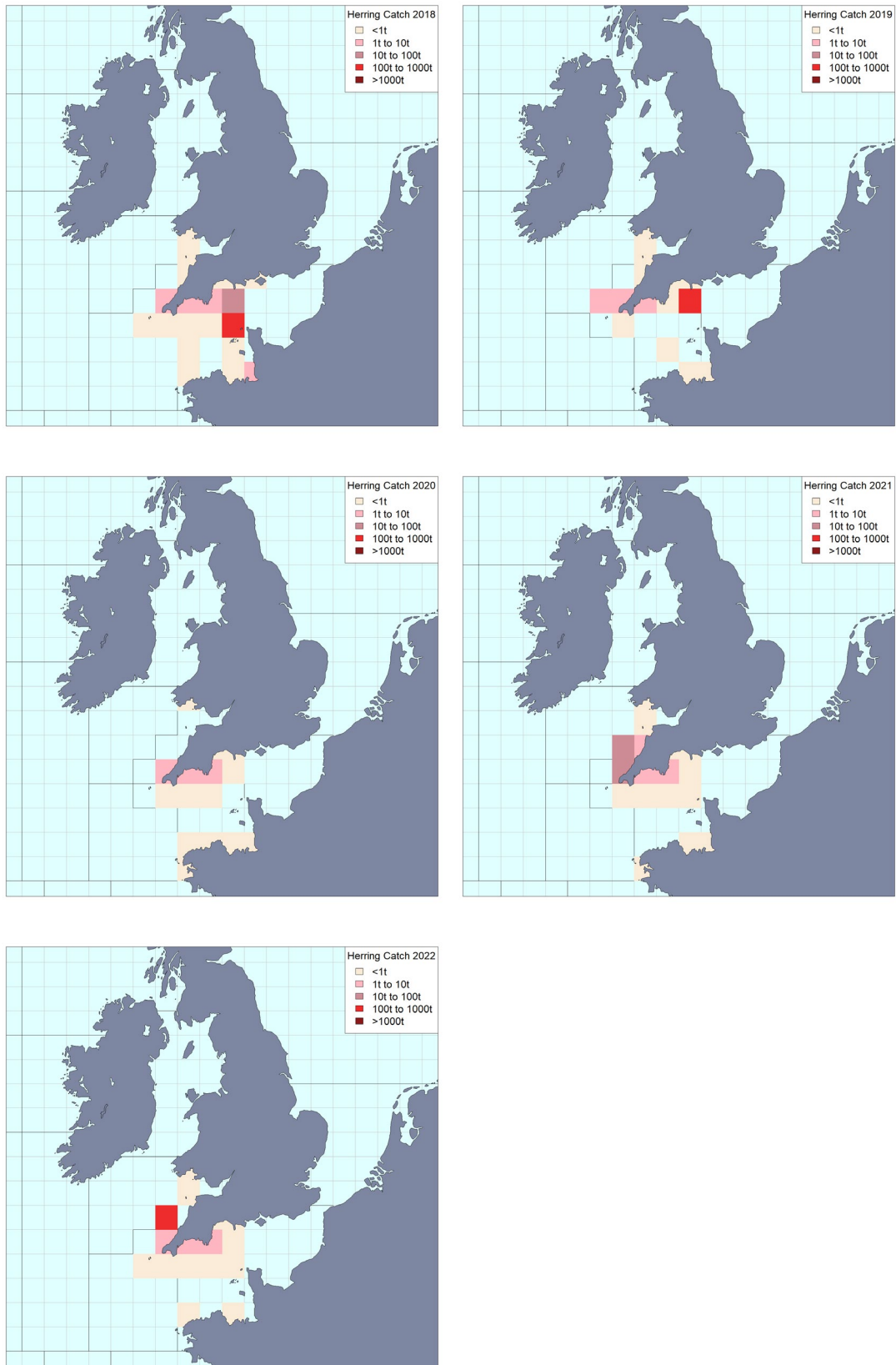
Figure 3 cont. Landings (tonnes) of herring by ICES Statistical Rectangle from 2000–2022.

Table 3. Summary of landings data available and submitted to the Workshop for ICES Divisions 7.e and 7.f.

Country	Division	Landings data type	Landings by rectangle
France	7.e	Commercial data by quarter and year.	Yes, data since 2000 provided in Workshop data call (2023).
The Netherlands	7.e	Commercial data by quarter and year.	Yes, data since 2000 provided in Workshop data call (2023).
UK	7.e	Commercial data by quarter and year.	Yes, data since 2000 provided in Workshop data call (2023).
France	7.f	Commercial data by quarter and year.	Yes, data since 2000 provided in Workshop data call (2023).
Germany	7.f	Commercial data for 2021 only.	Yes, one record for 2021 provided.
The Netherlands	7.f	Commercial data by quarter and year.	Yes, data since 2000 provided in Workshop data call (2023).
UK	7.f	Commercial data by quarter and year.	Yes, data since 2000 provided in Workshop data call (2023).
France	7.e	Inshore (vessel <10m) catches.	Yes, included in data since 2000 provided in Workshop data call (2023).
The Netherlands	7.e	Inshore (vessel <10m) catches.	Yes, included in data from 2000–2018 provided in Workshop data call (2023).
UK	7.e	Inshore (vessel <10m) catches.	Yes, included in data since 2000 provided in Workshop data call (2023).
France	7.f	Inshore (vessel <10m) catches.	Yes, included in data since 2000 provided in Workshop data call (2023).
The Netherlands	7.f	Inshore (vessel <10m) catches.	Yes, included in data from 2000–2018 provided in Workshop data call (2023).
UK	7.f	Inshore (vessel <10m) catches.	Yes, included in data since 2000 provided in Workshop data call (2023).
UK	7.e	Recreational catches (numbers/weights, kept/returned).	No, data available by ICES Division only (2016–2022).
UK	7.f	Recreational catches (numbers/weights, kept/returned).	No, data available by ICES Division only (2016–2022).

3.2 Recreational catches

Catches by recreational fishers are beginning to be explored for their use as a data source to inform stock assessments, including sea bass (*Dicentrarchus labrax*) in the central and southern North Sea, Channel, Bristol Channel, and in the Irish and Celtic Sea (bss.27.4bc7ad-h). However, compared to commercial catches, there is very limited reporting of such data.

Within the UK, data are submitted to the Sea Angling Diary where anglers are asked to record number and length of fish and noting whether these fish were kept or returned after capture. Data has been submitted since 2016 and continues today. From this programme, it can be noted

that recreational catches of herring in both 7e and 7f (by UK anglers) are to be of limited importance due to low catch both reported and estimated by the survey (10.4 tonnes total in 7e and 0.6 tonnes total in 7f) (Figure 4). Whilst the survey errors are relatively large for herring in these areas (RSE 34% in 7e and RSE 129% in 7f, depending on year), the upper bounds of the catch estimates (highest 2.68 tonnes in 7e and 0.442 tonnes in 7f) still indicate limited mortality as a result of recreational fishing (Figure 5). A summary of the data provided for the Workshop is given in Table 3.
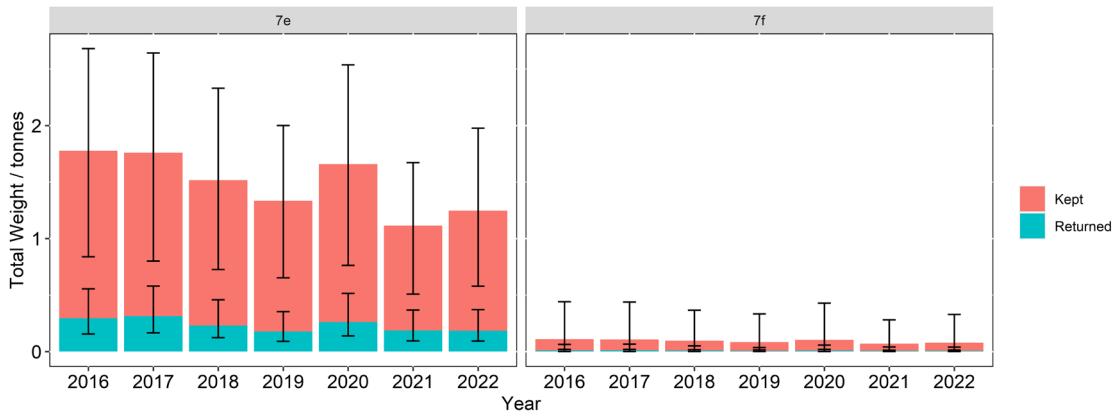

Figure 4. Catches of herring (*Clupea harengus*) by recreational fishers in the UK denoted into two categories: kept (fish retained) or returned (fish released) in ICES Divisions 7.e–f. Error bars represent the minimum and maximum estimates from the Sea Angling programme model.
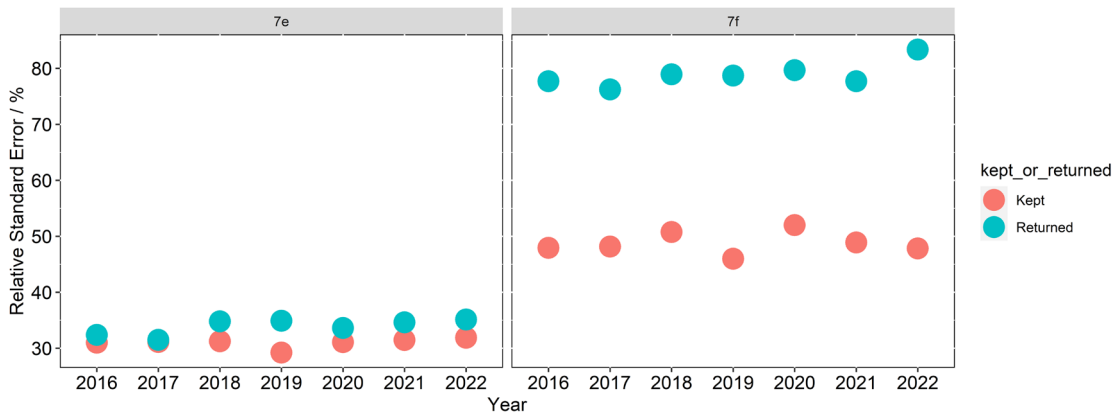

Figure 5. Relative standard error (RSE) of recreational catches of herring by UK fishers denoted into two categories: kept (fish retained) or returned (fish released) in ICES Divisions 7.e–f.

3.3 Survey data

3.3.1 DCRDC (Data Collection Regulation Survey)

The Data Collection Regulation Survey (DCRDC) was a combination of 6 individual surveys designed to collect biological data on fish stocks in support of the EU Data Collection Regulation (DCR) between 2006–2010 (Q1; February–March). The survey covered the Irish Sea, Celtic Sea, and western Channel but individual surveys targeted different areas in line with differing priorities, hence no fixed stations were sampled. Herring length data were recorded in each survey year whilst biological data was only recorded in 2010. Herring catch locations in the

western Channel and Bristol Channel are shown in Figure 6, whereas the length frequency of all surveys is shown in Figure 7 across all sampled areas.
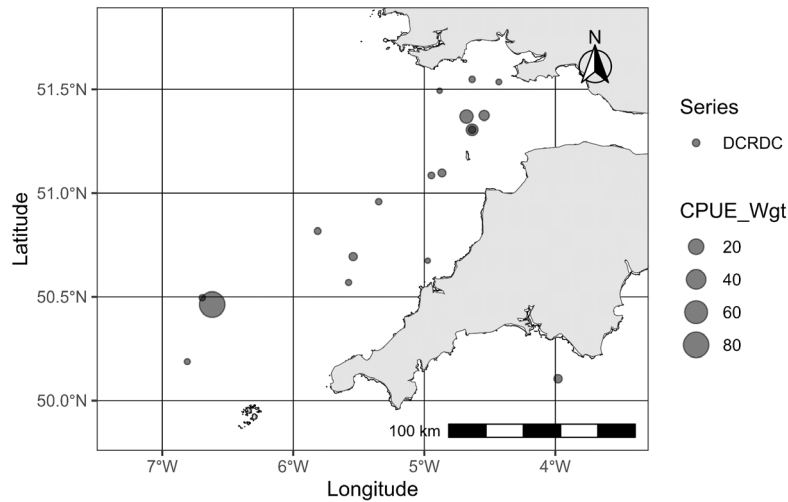

Figure 6. Catch locations of herring (*Clupea harengus*), scaled by CPUE, caught in the DCRDC survey (2005–2010; February–March).
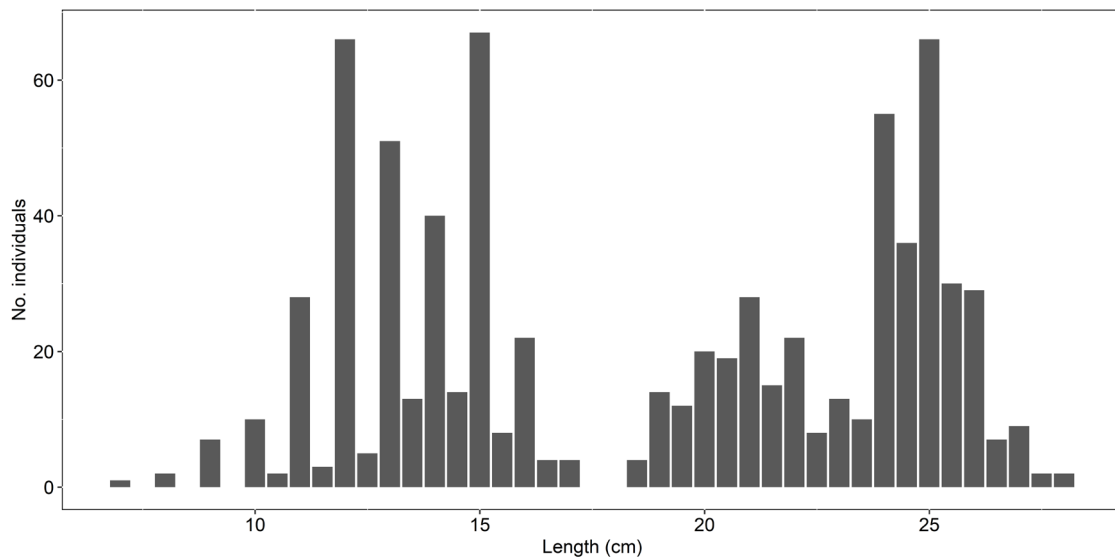

Figure 7. Length frequency of herring (*Clupea harengus*) caught in the DCRDC survey (2005–2010) across all sampled areas.

3.3.2 EVHOE (French Southern Atlantic Bottom Trawl Survey)

Operated on the RV Thalassa each autumn (between October and December) and using a GOV demersal trawl, the EVHOE groundfish survey aims to collect data on the distribution, relative abundance and biological parameters of all fish and selected commercial invertebrates in Divisions 7.f–j and 8.a–b,d. The primary species are hake, anglerfish, megrim, cod, haddock and whiting. Data are also collected for all other demersal, pelagic fish and cephalopods as well as for the whole invertebrate megafauna. Since 2016, the sampling design has been fixed stations, based on a previously randomly selected set of points based on bathymetric and sedimentary strata. While herring is not part of the primary species being investigated, the EVHOE

survey still provides useful information on spatial patterns in herring densities. Data from 1997-2019 are presented in Figure 8 below.
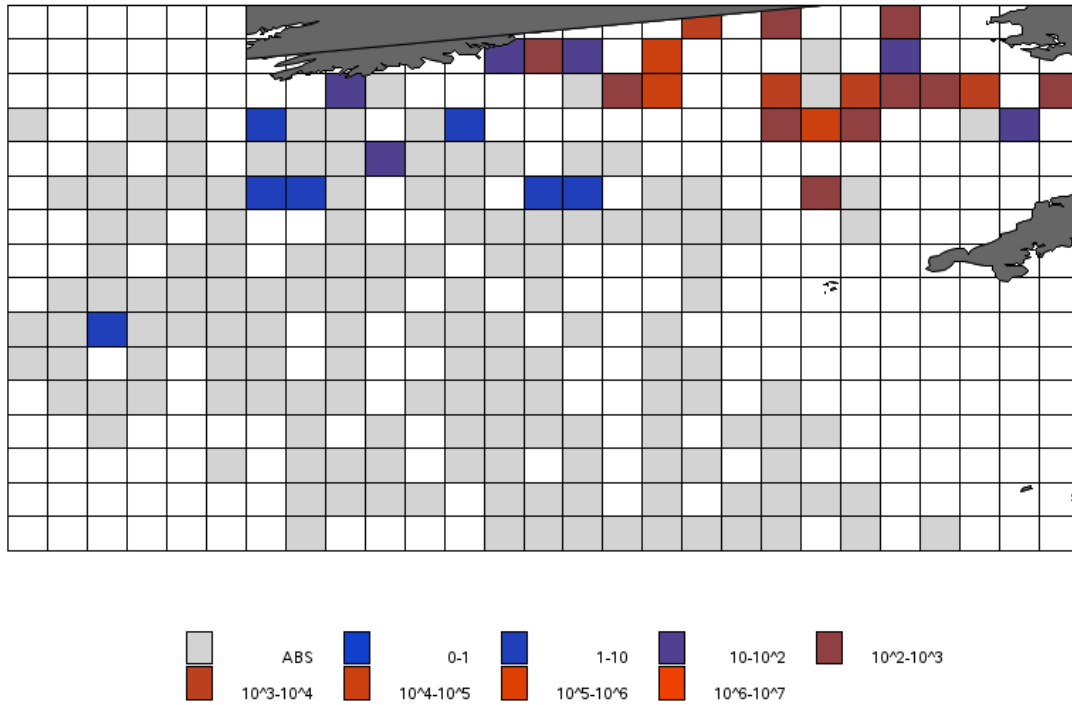

Figure 8. Herring spatial distributions (numbers per km² swept) in the Celtic Sea, as inferred from the EVHOE survey over the period 1997–2019. The grey squares represent areas where the EVHOE operated but where no herring were caught. The white squares were unsampled.

3.3.3 FR-CGFS (French Channel Ground Fish Survey)

The CGFS (Channel Ground Fish Survey), which operates in October using a GOV is part of the European Fisheries Monitoring Programme. The CGFS provides a set of data on exploited stocks (maturity, size/age structure, abundance and recruitment indices). The time series initiated in 1988 (on N/O Gwen-Drez) is used every year by ICES stock assessment working groups to infer the abundance of the main commercial species. Initially focused on the Eastern English Channel, the CGFS covers since 2018 the whole English Channel on a recurrent basis to be able to provide fishery-independent data in the Western area as well. Now operated onboard the N/O Thalassa, the CGFS allows for wider sampling and better knowledge of the entire ecosystem, meeting both the demands of marine ecosystem monitoring (MSFD) and the implementation of an ecosystem approach to fisheries at the EU level. Thus, the physio-chemical characteristics of the water, the phytoplankton and zooplankton communities, the abundance of fish eggs and the specific composition of the nekton communities are measured and analysed throughout the survey. Specific studies, which are used in dedicated projects, allow for a more detailed analysis of the structure of the food chain and its spatial variability. While October comes before the peak of abundance of herring in the English Channel, the CGFS still provides useful information on spatial patterns in herring densities and data from 2018–2023 are presented in Figure 9.
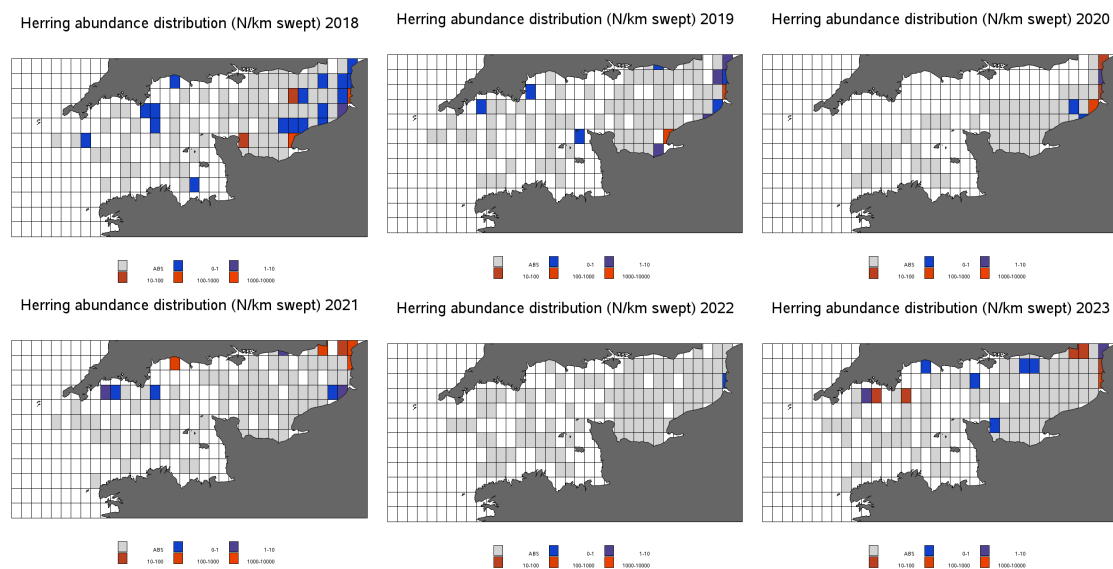

Figure 9. Herring spatial distributions (numbers per km² swept) in ICES Divisions 7d and 7e, as inferred from the CGFS over the period 2018–2023. The grey squares represent areas where the CGFS operated but where no herring were caught. The white squares were unsampled.

3.3.4   PELTIC (Pelagic Ecosystem Survey in the Western Channel and Celtic Sea)

The Pelagic ecosystem survey in the Western Channel and eastern Celtic Sea (PELTIC) operates in October, collecting data on the distribution, relative abundance, and biological parameters of the small pelagic fish community in ICES Division 7 e and f. The primary target species are sprat and sardine for which PELTIC provides the fisheries independent data, and anchovy. Although primarily a fisheries acoustic survey, the survey monitors different components of the ecosystem, from Physical oceanography, phyto-, meso- and ichthyoplankton to fish and top predators and as such helps underpin improved knowledge on the ecosystem functioning and contributes to monitoring ecosystem indictors (OSPAR). Little is known about the structure and delineation of the various herring stocks in the western Channel and particularly the eastern Celtic Sea, and it is likely that the survey timing is not necessarily optimised for herring monitoring. However, herring is routinely found, particularly in the Bristol Channel (Figure 10) and the coincidence with the CSHAS survey south of Ireland, means that the combined surveys can provide a large-scale overview of herring density distribution and abundance in October, –when fisheries independent data are limited.
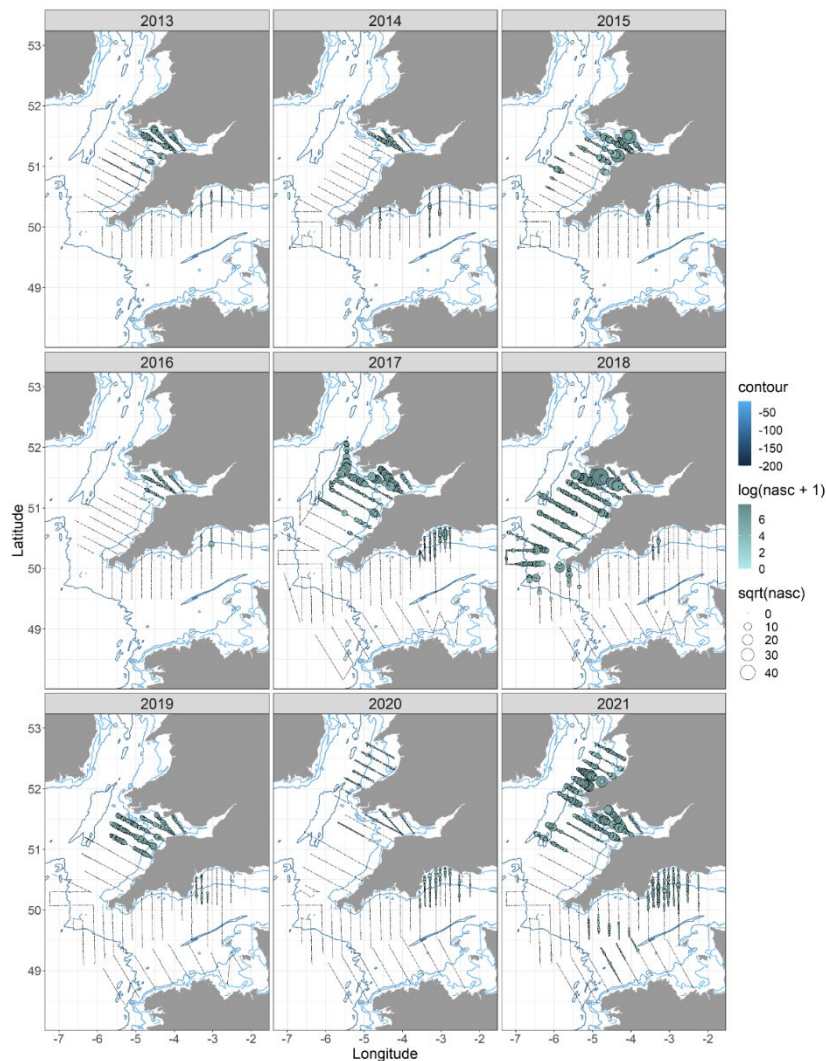

Figure 10. Overview map of acoustically derived herring density distribution during PELTIC in the western Channel and eastern Celtic Sea, between 2013 and 2021.

3.3.5 SWBEAM (South Western Beam Trawl Survey)

Operated aboard the Cefas Endeavour, the Q1/Q2 (February–April) South West Beam Trawl Survey (SWBEAM) supports annual EU Data regulations and targets sole (*Solea solea*), plaice (*Pleuronectes platessa*), and lemon sole (*Microstomus kitt*). The survey operates with a port and starboard deployed 4m beam trawl (commercial) with extended codend. Originally the survey only covered the western Channel, however this expanded to the Celtic Sea from 2013. Similarly, the survey initially sampled at fixed stations before moving to a randomly stratified sampling strategy.

Despite targeting flatfish species, herring are caught and recorded in each year the survey has taken place (2007–2010, 2013–2019, and 2021–) however biological data was only recorded in 2010 and 2013. Figure 11 provides a CPUE of herring catches in the western Channel and Bristol Channel, whilst the length frequency of biologically sampled fish is given in Figure 12.
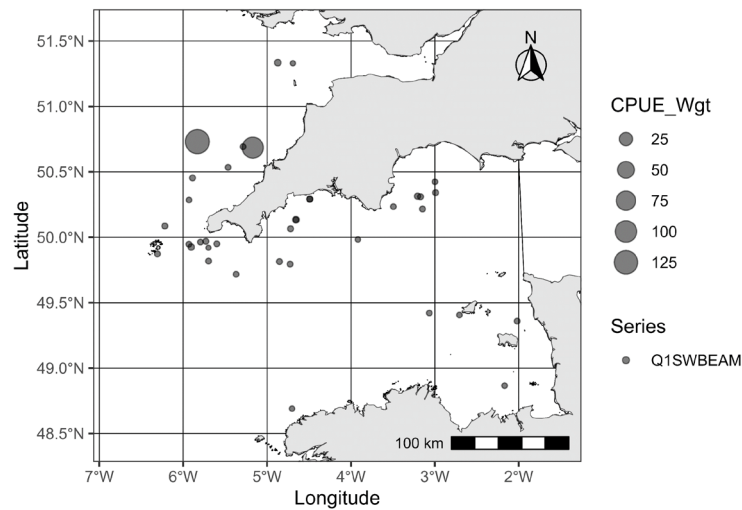

Figure 11. Haul locations where herring (*Clupea harengus*) are caught, scaled by CPUE, during the SWBEAM survey (February–April; intermittently between 2007–2023).
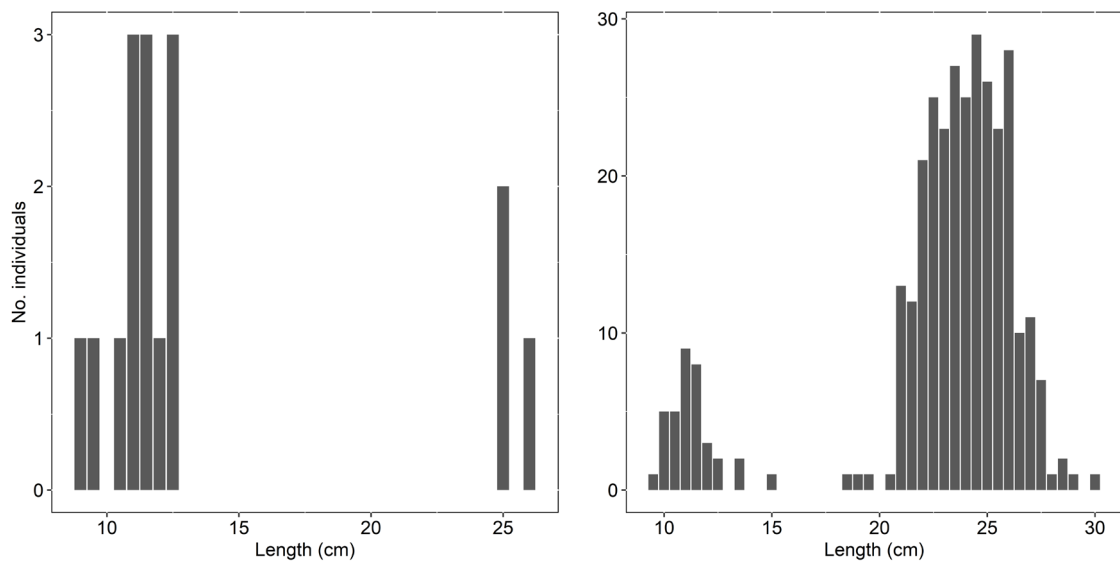

Figure 12. Length frequency of herring (*Clupea harengus*) caught and biologically sampled during the SWBEAM survey (2010 left, 2013 right).

3.3.6 SW-IBTS (South Western International Bottom Trawl Survey)

The South Western International Bottom Trawl Survey covered the Irish Sea, Celtic Sea, and western Channel (7a, 7e–k) during Q4 (November–December) between 2003–2011. The survey used a standard GOV trawl with rockhopper gear. Station, catch, length (all species) and biological data (select species) were recorded in each year of the survey. Herring length was taken in all survey years with biological data (age, maturity) available from 2004–2010. Haul locations where herring were caught are shown in Figure 13 with a full survey age-length key provided in Figure 14.

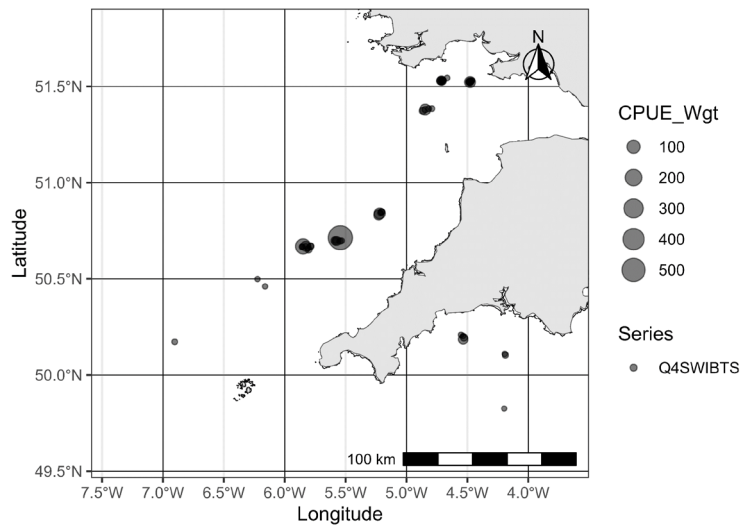**Figure 13. Haul locations where herring were caught, scaled by CPUE, in the Q4 SW-IBTS survey (2003–2011).**
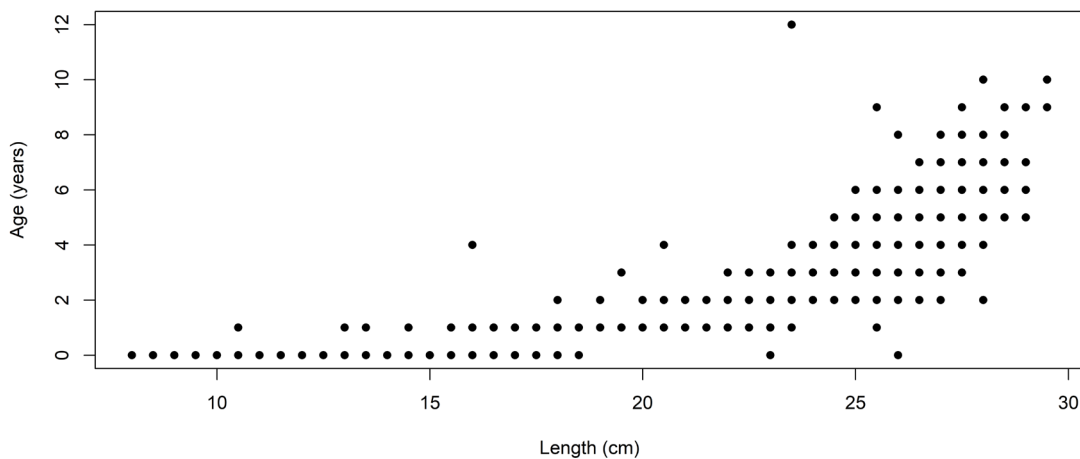

Figure 14. Age-length key of herring (*Clupea harengus*) caught during the full time series of the Q4 SW-IBTS survey (2003–2011).

3.3.7   SWOTTER (South Western Otter Trawl Survey)

The South Western Otter Trawl Survey (SWOTTER) is an annual survey led by Cefas covering the Celtic Sea and western Channel during Q1 (February–March; 2018–2020, 2023–). The survey is used to provide relevant, standardised data for the assessment of commercial de-mersal fish stocks and targets hake (*Merluccius merluccius*), haddock (*Melanogrammus aeglefinus*), whiting (*Merlangius merlangus*), and monkfish (*Lophius spp.*). Whilst the gear (originally monk trawl with rockhopper ground gear and 100mm codend, now a light hopper trawl with 20mm liner and heavy ground gear) and sampling method are not optimal for pelagic catch, some catch of herring are taken in all survey years (Figure 15).

Survey aims include recording age and length distributions of commercially important fish spe-cies including herring. A total of 405 herring were taken for biological sampling over the survey time series. Annual length frequencies (Figure 16), age frequencies (Figure 17), and an overall age-length key (Figure 18) are shown below.
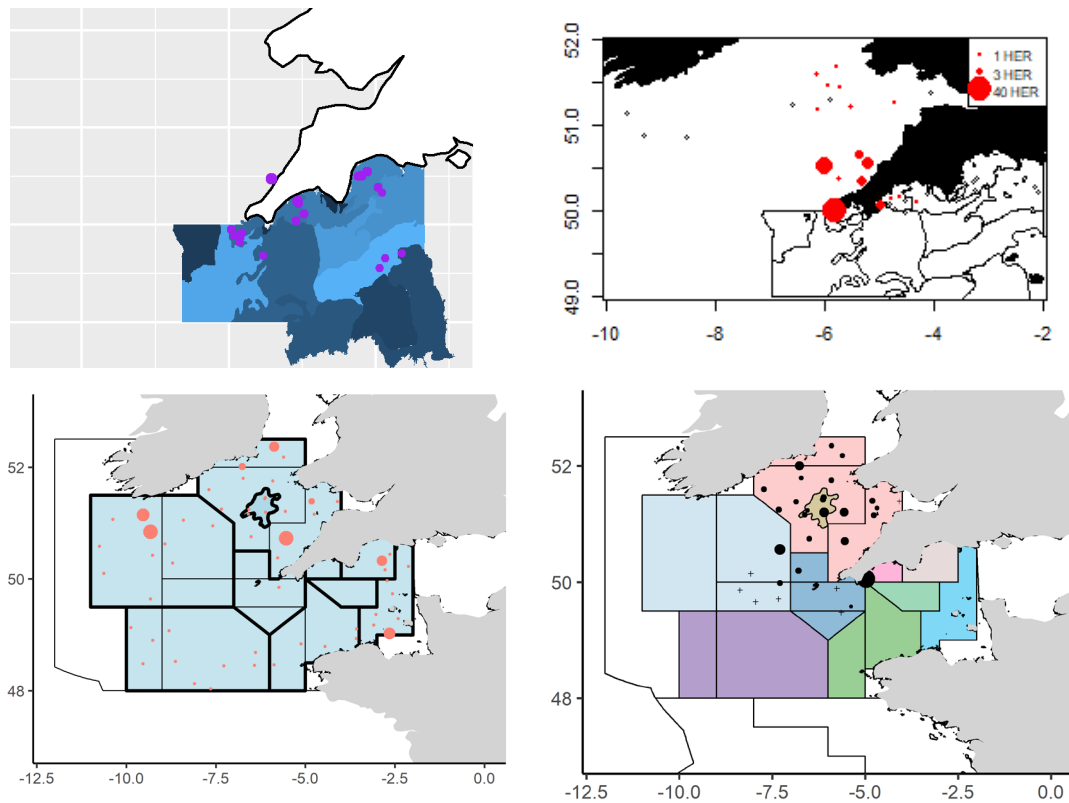
Figure 15. Haul locations during the Q1 SWOTTER survey where herring were caught per year: 2018 (top left), 2019 (top right), 2020 (bottom left), and 2023 (bottom right). Point sizes indicate CPUE but is not always reported.
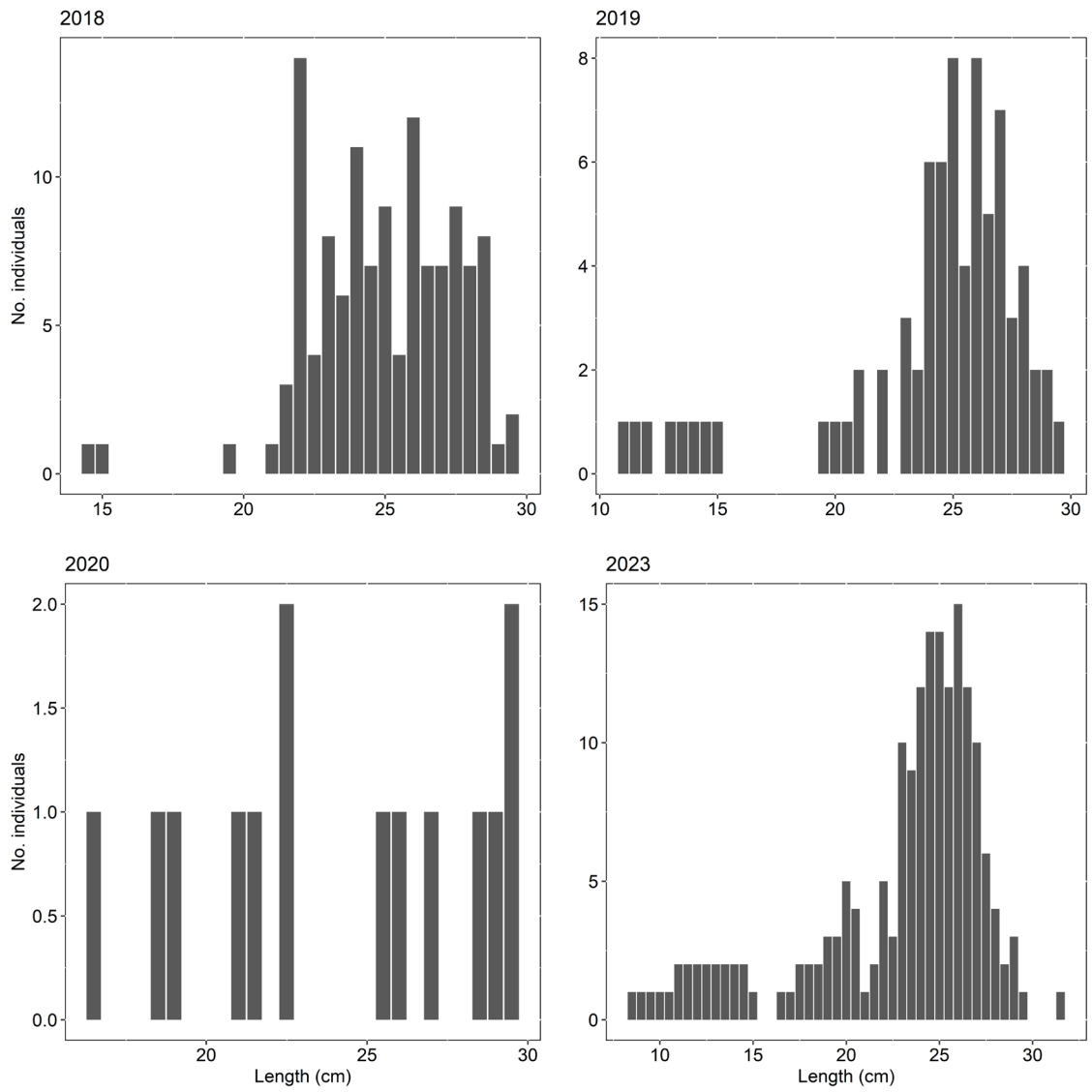
Figure 16. Annual length frequencies of herring (*Clupea harengus*) caught during the Q1 SWOTTER survey (2018–2020; 2023).
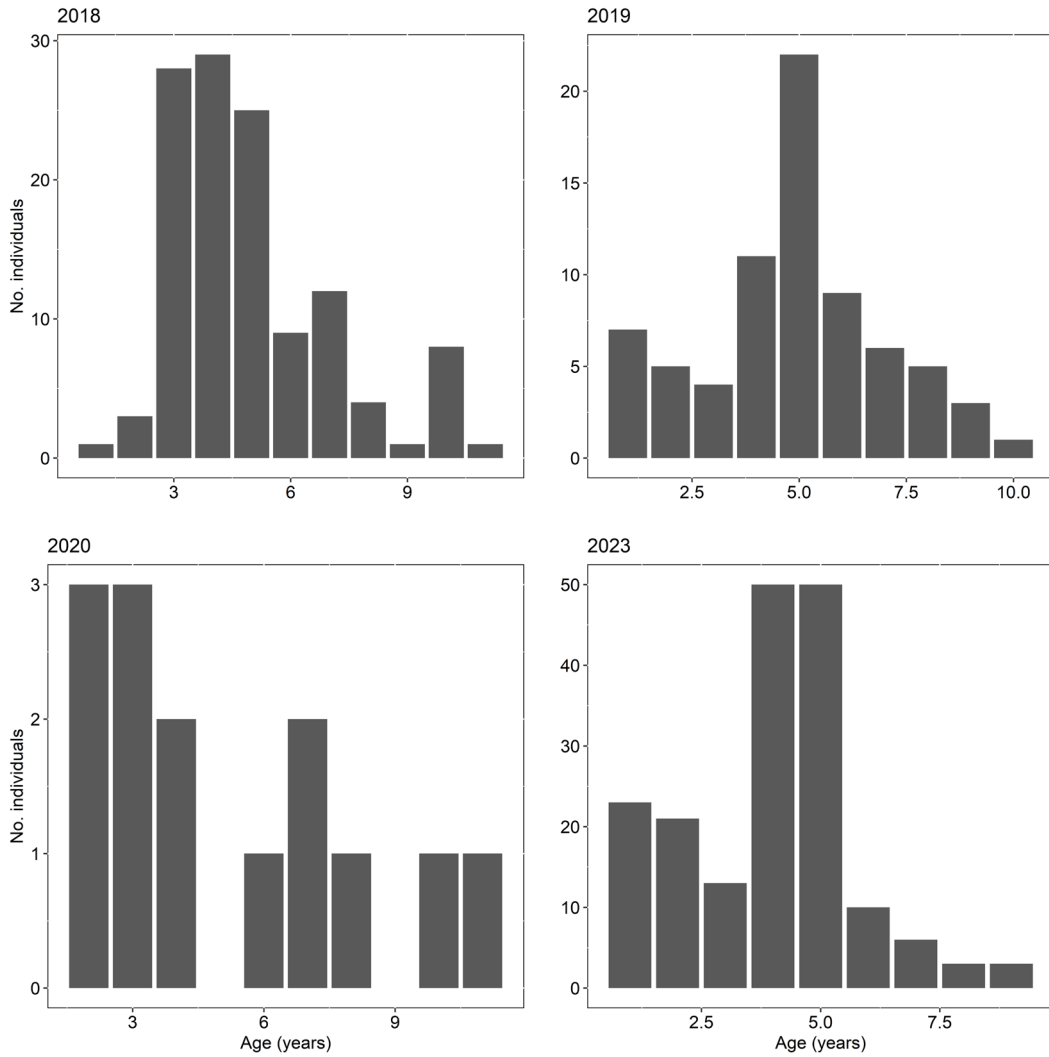
Figure 17. Annual length frequencies of herring (*Clupea harengus*) taken during the Q1 SWOTTER survey (2018–2020; 2023).
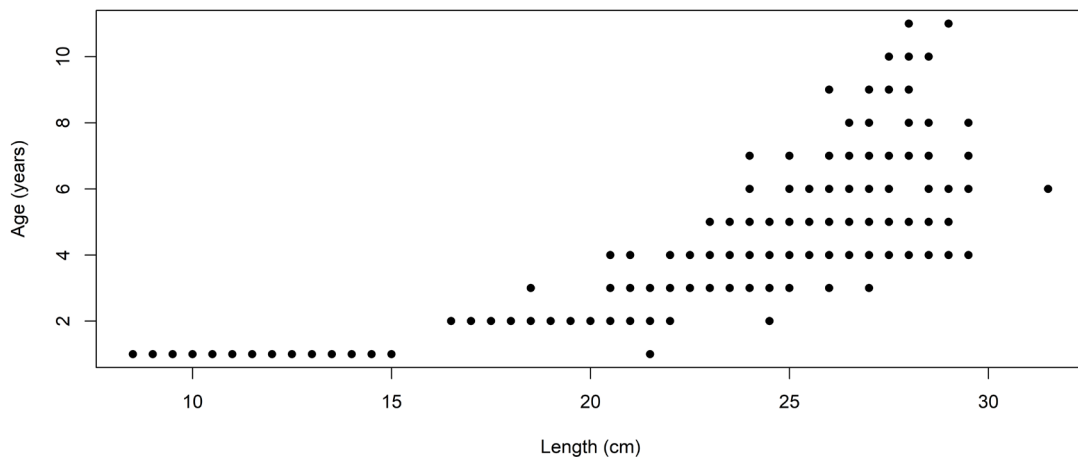
Figure 18. Age-length key of herring (*Clupea harengus*) caught during the full time series of the Q1 SWOTTER survey (2018–2020; 2023).

3.3.8   WCGFS (Western Celtic Sea Ground Fish Survey)

The Western Celtic Sea Ground Fish Survey (WCGFS) was a Cefas-led roundfish survey covering ICES Divisions 7e–k during Q1 (February–March; 1982–2004) and Q4 (November–December; 1982–1992). Each survey used a modified Portuguese high-headline trawl (PHHT) with heavier ground gear and a bunt tickler chain. The survey targeted mackerel (*Scomber scombrus*), horse mackerel (*Trachurus trachurus*), and sardine (*Sardina pilchardus*), though length data was recorded for all species caught. Comparatively, herring were caught in greater quantities in the Bristol Channel (7f; Figure 19). Biological and age data were recorded in 1993–1994, 1997–2002, and 2004. Number of aged herring samples for 7e–f combined are provided in Figure 20. Age-Length keys (ALK) for the two areas are provided in Figure 21.
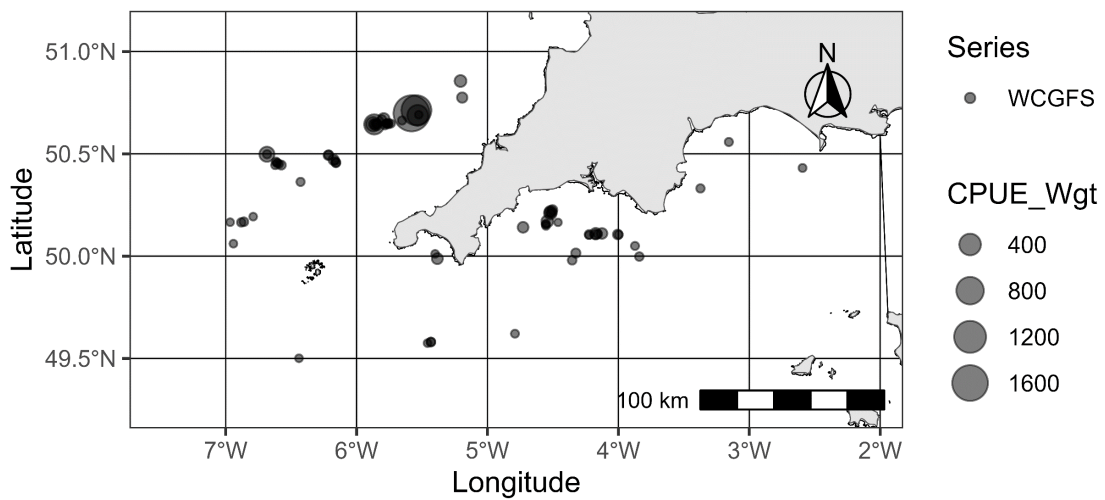
Figure 19. Haul locations where herring were caught, scaled by CPUE, in the Q1 and Q4 WCGFS survey (1982–2004).

Figure 20. Number of aged herring samples by year caught during the Q1/Q4 WCGFS (1982–2004).

Figure 20 cont. Number of aged herring samples by year caught during the Q1/Q4 WCGFS (1982–2004).

Figure 21. Age-length key of herring (*Clupea harengus*) caught during the full time series of the Q1/Q4 WCGFS survey (1982–2004).
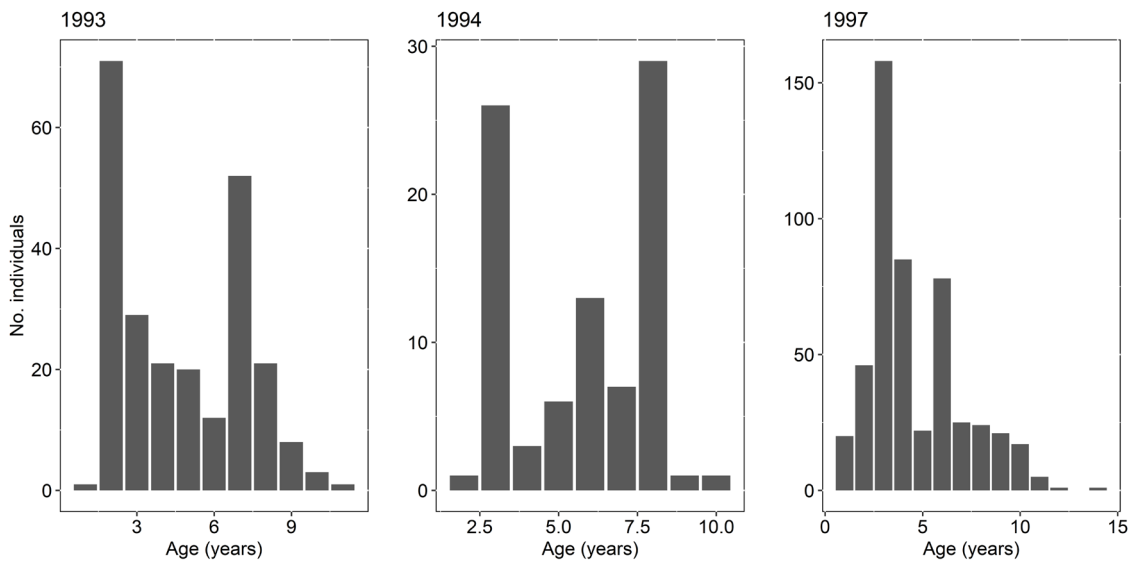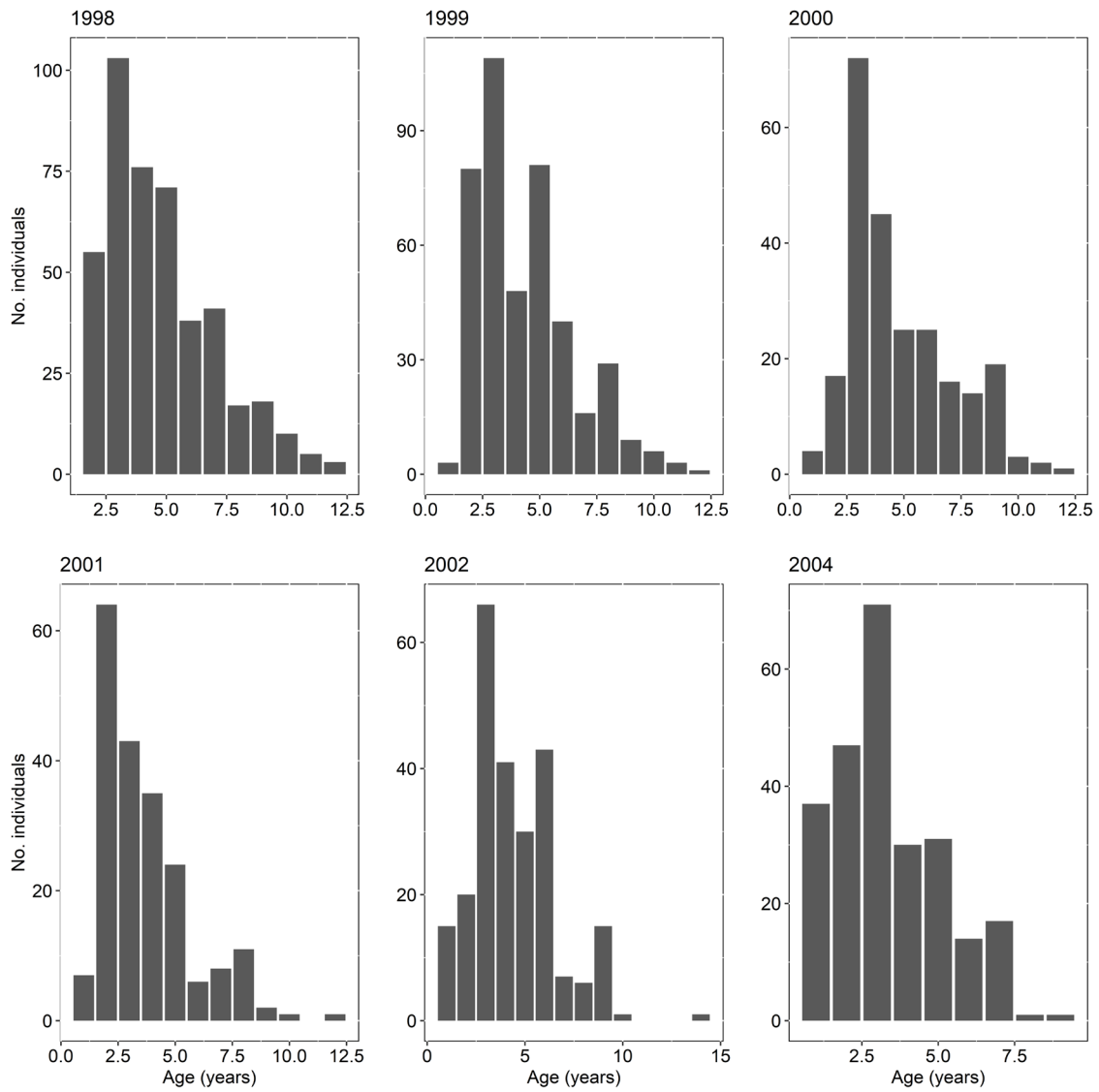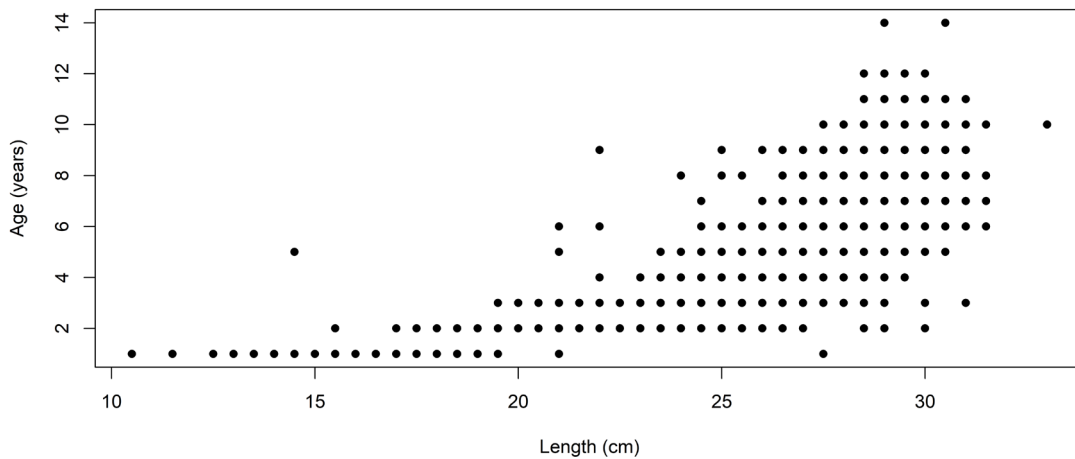
3.3.9   Survey overview

Table 4 summarises the details of individual fisheries-independent surveys covered in Section 3.3.

Table 4. Summary of surveys in ICES Divisions 7.e and 7.f where herring are encountered.

Survey	Institute	Division	Timing	Duration	Vessel	Target spp.
DCRDC	Cefas	7a, 7e–j	Q1	2005–2010	Cefas Endeavour	All
EVHOE	Ifremer	7f–k, 8a–c	Q4	1997–	Thalassa	All
FRCGFS	Ifremer	7d–e	Q4	1988–	Thalassa	All
PELTIC	Cefas	7d–f	Q3	2011–	Cefas Endeavour	SPR/PIL/HER/ HOM/ANE
SWBEAM	Cefas	7e–h	Q1–2	2006–2023	Cefas Endeavour	SOL/PLE/LEM
SWIBTS	Cefas	7a, 7e–k	Q4	2003–2011	Cefas Endeavour	COD/HKE/HAD/ WHG/ANF/ANK
SWOTTER	Cefas	7e–h	Q1	2018–2020, 2023	Cefas Endeavour	HKE/HAD/WHG/ ANF/ANK
WCGFS	Cefas	7e–k	Q1/Q4	1982–2004	Cirolana/Corystes/ Cefas Endeavour	MAC/HOM/PIL

3.4   Additional data sources

3.4.1   Herring abundance in the Marine Biological Association's long-term fish monitoring in the western Channel

The Marine Biological Association (MBA) has had fisheries-independent surveys since 1911, representing some of the earliest surveys to take place in European waters. These surveys record data over a fine spatial scale, focussing effort off the coast of Plymouth in the western Channels in waters up to 65m depth. A total of 4,253 trawls have taken place with 3,023,321 individual fish sampled, comprising 143 distinct species.

Trawls targeting demersal fish species are carried out using a *Channel Hunter* box trawl using an 80mm cod-end mesh i.e., otter trawl with a fine (~2mm) cod-end cover. On average, trawls last 82.43 minutes. Abundance of species are recorded in all years, whilst length (millimetres) and weight (grammes) measurements are recorded from 2001 onwards. The highest concentration of sampling effort (>100 trawls) occurs at ICES Station L4 (Figure 22), sampled between 1913–2017. Notably, there was no sampling effort for 43-years (1912, 1915–1918, 1923–1949, 1959–1966, 1980–1982, and 1999).

From these surveys, there has been limited herring-specific analysis. However, CPUE (catch per unit effort) has been recorded for all years where herring was caught. The greatest CPUE was in 1993 where it reached >80 individuals. There are few years where CPUE exceeded 10 individuals

with more years recording less than 5 herring in the study area (Figure 23). In total, 10,397 herring were caught in 4,209 trawls. The greatest abundance, and CPUE by association, was taken in spring, followed by winter, summer, and autumn. Sample and CPUE estimates per season are presented in Table 5.

Length frequency information is recorded in MBA surveys between 2001–2021 with 1,875 individual herring records. Lengths range between 65–363mm with a mean total length of 262.9mm (± 35.3mm standard deviation). Mean length is relatively consistent between 2001–2018 (>250mm), however in recent years the mean length has reduced to >100mm (Figure 24).

In summary, the data from MBA surveys presents limitation for herring study as the sampling method (demersal trawl) is less effective for catching this species. Furthermore, great consideration is needed considering the lack of continuous sampling effort. However, whilst further analysis would be required, preliminary evidence suggests that greater herring abundance is correlated with cooler temperatures and changes in primary productivity, though this would need to be verified. These data sources are open access and available through direct contact with the MBA with some held on through MEDIN (Marine Environmental Data and Information Network) and BODC (British Oceanographic Data Centre) data centres. Additional datasets can also be accessed through the Western Channel Observatory.
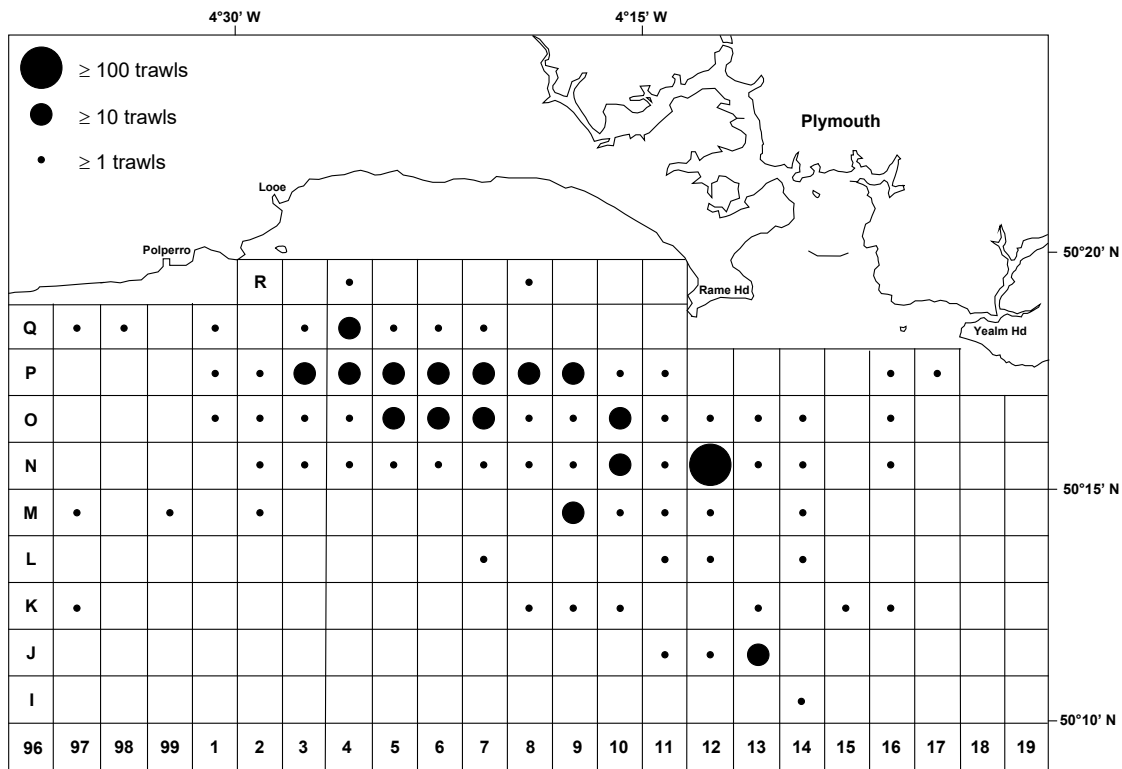
Figure 22. Trawl locations and frequency (total number) at ICES L4 station in the western Channel by MBA demersal surveys (1913–2017).
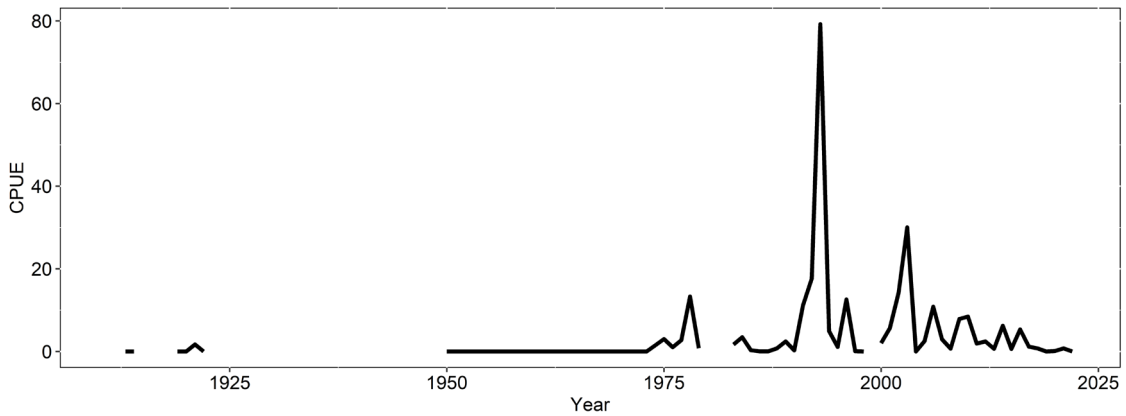
Figure 23. Annual catch per unit effort (CPUE), defined as number of individuals per trawl, of herring (*Clupea harengus*) recorded in MBA (Marine Biological Association, UK) trawl surveys between 1911–2022 with data collected for 63 years over that period.
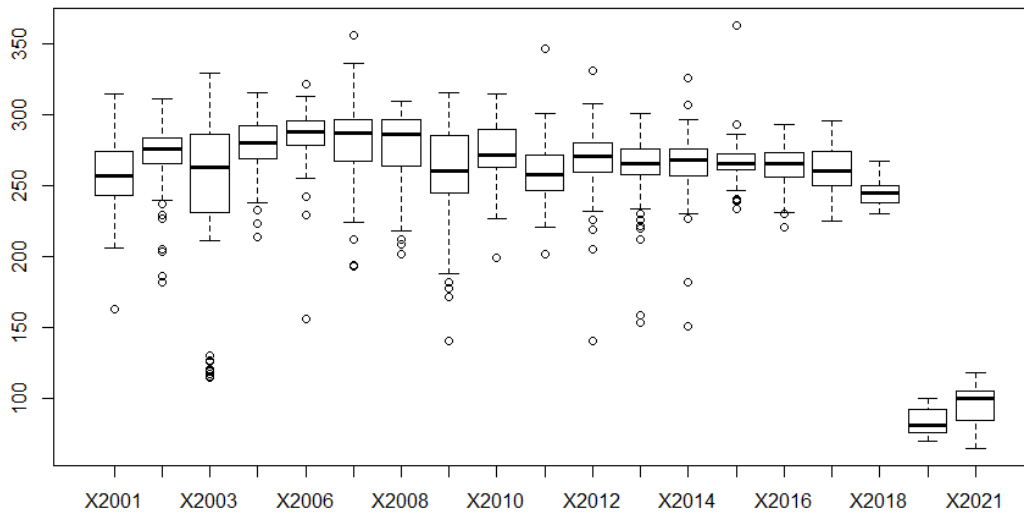
Figure 24. Mean total length (mm) of herring (*Clupea harengus*) in MBA demersal trawls (2001–2021). Standard deviation around the mean is shown along with all outliers.

Table 5. All herring data from MBA surveys (1911–2022) divided into individual seasons: spring (March–May), summer (June–August), autumn (September–November), and winter (December–February). CPUE was calculated by dividing total abundance per season by the number of trawls in the same season. CPUE values are edited to reflect ICES rounding rules.

Season	No. trawls	No. herring	CPUE
Spring	1 120	175	0.156
Summer	988	7 314	7.4
Autumn	1 088	700	0.64
Winter	1 013	2 208	2.2

3.4.2 Herring prey items from the Continuous Plankton Recorder (CPR)

The continuous plankton recorder survey at the Marine Biological Association has performed methodologically consistent sampling (via Ships of Opportunity) and microscopic taxonomic analysis of plankton in UK seas since 1958. The CPR sampler is a rugged mechanical device that traps plankton on a roll of silk. A silk sample corresponds to about 10 nautical miles of filtered seawater. and a microscopic count performed of various important plankton taxa in each of these samples, including those which may be food available for herring. For a given taxon, the counts for all samples in a month in a given 2x2 degree grid square can be averaged to give a time-series value for that grid square for that month and year, and the median value (averaged over years) can be determined for each month to give a typical seasonal profile (associated with the annual 'plankton bloom') for that grid square. The data available for Calanus spp. stage I-IV is presented in Figure 25. In the upper plot the all-time average of the values for each grid square is presented as a colour value to give a map of relative abundance/availability of Calanus spp. stage I-IV around the Southern UK (Calanus below stage V is not identified to species level). In the lower plot the typical seasonal profile found in each grid square (identified by its lower-left boundary corner coordinates) is presented (median monthly value against month-of-year) showing the one or more peaks in abundance typically recorded each year. Note that the median is zero in some locations, and values are unavailable in others (plot blank). Overall, the coverage of the CPR survey appears to be better in the Northern North Sea than in the Southern area with only a few routes covering the area of interest.
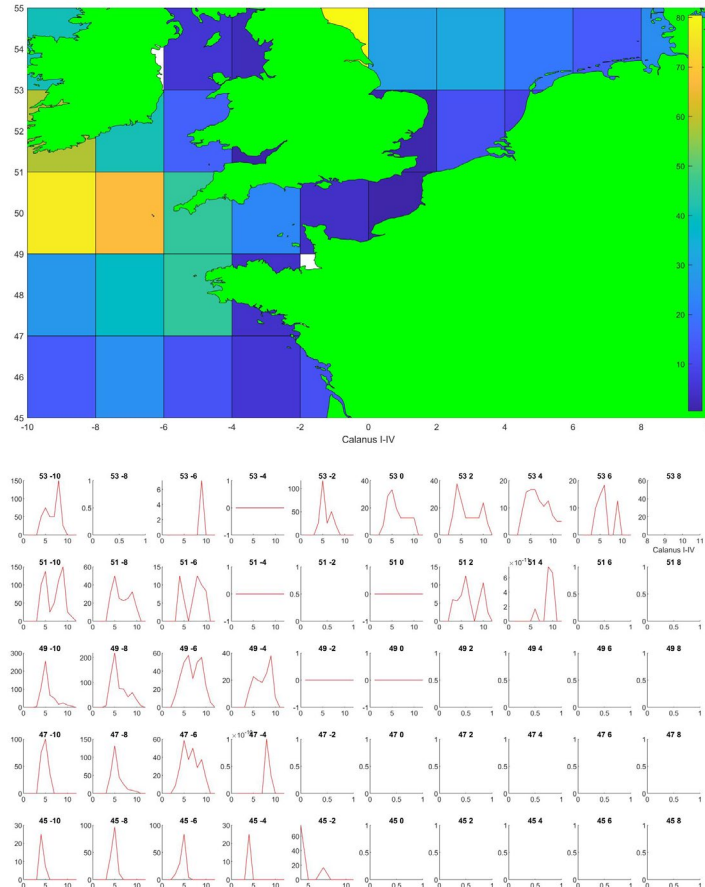

Figure 25. Calanus spp. stage I-IV from the CPR survey.

3.4.3 Pelagic Freezer Trawler Association (PFA) herring data

The Pelagic Freezer Trawler Association (PFA) is a member association comprised of eight pelagic freezer trawler companies, operating a combined fleet of eighteen vessels registered across six European countries. The PFA routinely collects herring data during catch processing in factories onboard vessels. A winter herring fishery occurs in the southern North Sea and Channel from November to February and, as such, data collected by the PFA during this fishery are relevant to herring stock structure in ICES Divisions 7.e, 7.f and adjacent areas.

Data are collected by trained personnel for quality control and commercial purposes as part of standard operating procedures. Hauls are processed into production batches which comprise any number of boxes of fish each weighing approximately 23 kg. The number of fish, average weight, and average fat content of herring in one box per batch is calculated and recorded. In some cases, the average length of fish is also estimated. There were 1 028 samples collected between 2014 and 2021 on herring caught in relevant areas (Figure 26). A further 1 365 samples from Divisions 4c and 7d were collected without an associated latitude and longitude of origin.

The median weight of batches (calculated as the average weight of fish in one box multiplied by the number of boxes in a batch) ranged between 30-40 t (Figure 27). Occasionally, batches weighed up to 150 t, however, in later years, large batches were considered outliers.

Between the beginning of November to mid-January, the percentage of fat within herring muscle tissue declined from approximately 10% to 3%. This gradual but significant decline is consistent with both the utilisation of fat reserves for gonad development at the onset of spawning and the reliance on stored energy overwinter when food availability is low. Given the location of the samples and that the fishery is targets herring for roe content, it is likely these samples originate from the Down's winter-spawning component of the North Sea herring stock.
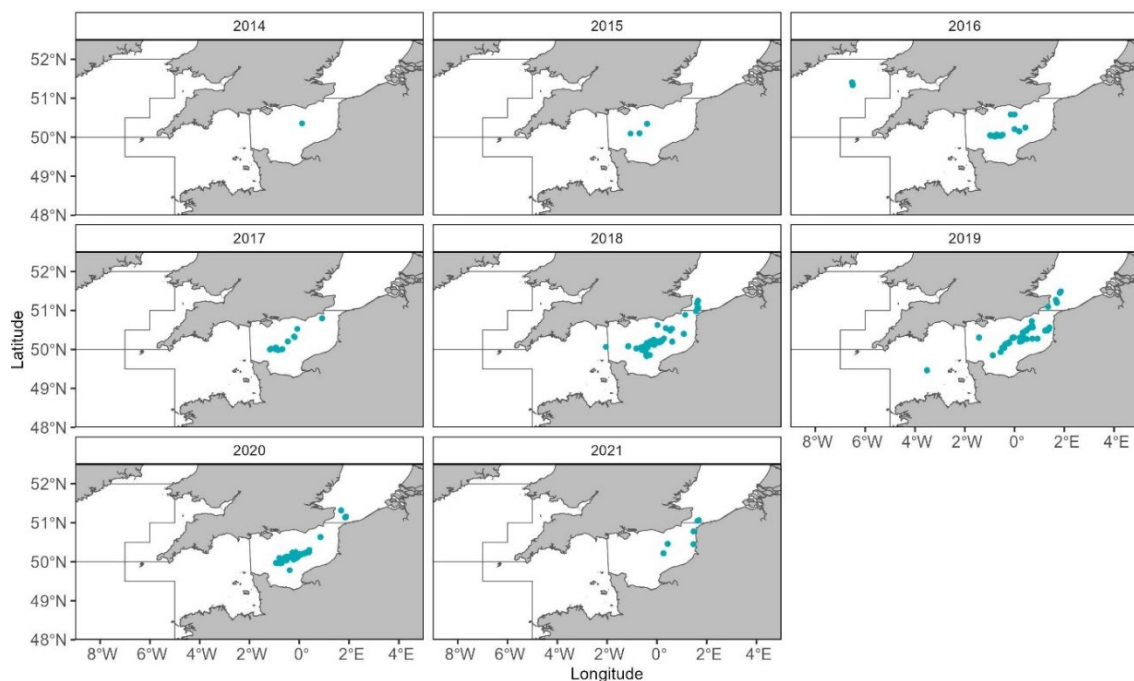
Figure 26. Spatiotemporal distribution of herring samples in ICES Divisions 7.d, 7.e, 7.f, and 4.c collected by the Pelagic Freezer Trawler Association from 2014 to 2021.
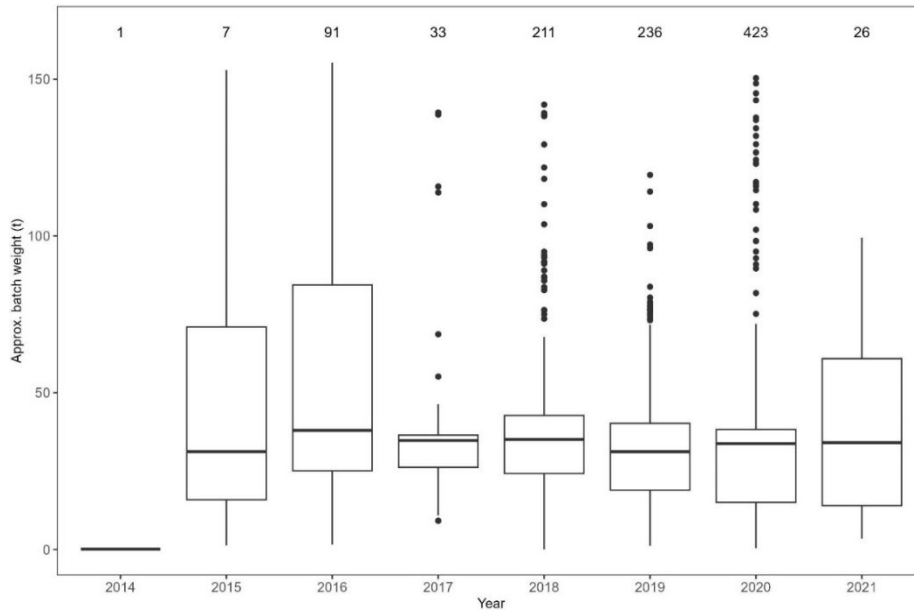
Figure 27. Boxplot of herring batch weights produced by the Pelagic Freezer Trawler Association (PFA) from ICES Divisions 7.d, 7.e, 7.f., and 4.c each year from 2014 to 2021. Numbers along the top indicate numbers of batches produced.

3.4.4 Minehead catch series

Based on Swansea University sampling data, catches in the Bristol Channel and West Wales begin in late September and continue until January, with some spawning fish seen throughout. This can be illustrated using catch and effort data provided by Paul Date and Michael Martin from a beach net in Minehead Bay. These data are available for 2016 onwards and demonstrate increasing catches to a peak in December (Figure 28) and an apparent decline in catches since 2016 (Figure 29). Data from 2020 were excluded because only two fishing operations were undertaken because of covid restrictions.
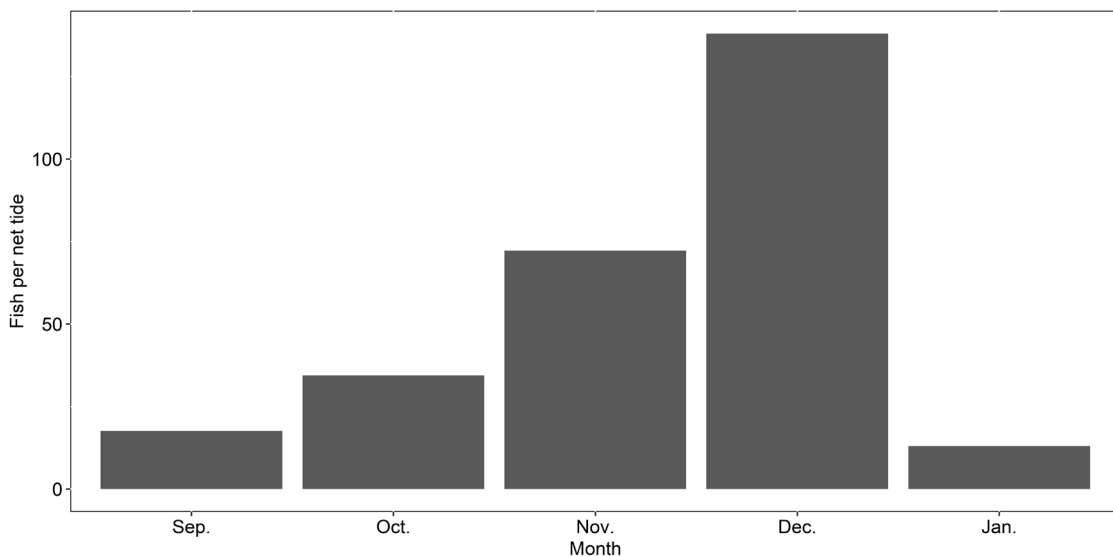
Figure 28. Average number of herring caught by month at Minehead (2016–2023).
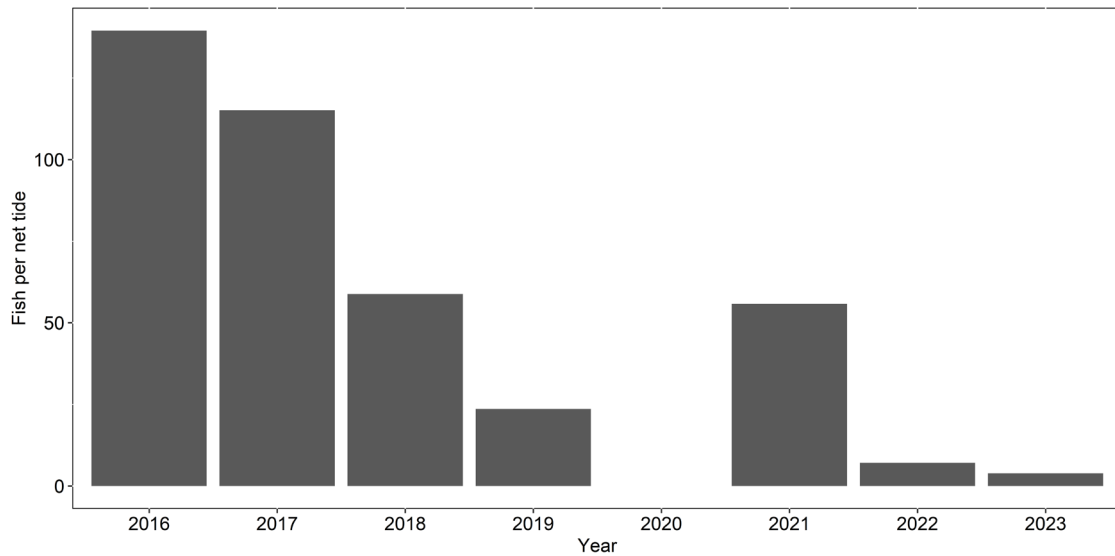
Figure 29. Average number of herring caught per net tide annually at Minehead (2016–2023).

3.4.5   Pembroke Power Station herring data series

There is a spring spawning population which spawn in Milford Haven between February and April, on spawning grounds in Castle Reach and at Burton (Figure 30; see Clarke and King, 1985). Historically this has supported fixed net catches of 80-100 tonnes per annum, but the fishery is now largely extinct due to low demand and poor catches in recent years, with only a handful of boats fishing.

Within Milford Haven, ichthyoplankton summer survey data have been collected by Pembroke Power station since 2009, with both impingement data on screens (fish which do not pass through 6mm screens), and entrainment data (eggs and larvae which do pass through) available since 2012 (Figures 31 and 32). Both impingement and entrainment data appear to show a considerable decline over the period, though it is important to recognise that both datasets may include Autumn spawners as well as spring spawners; genetic testing of impinged fish suggested that 42% were of spring origin (Gwilliam *et al.*, 2020).

Figure 30. Map showing location of spawning grounds in Milford Haven.
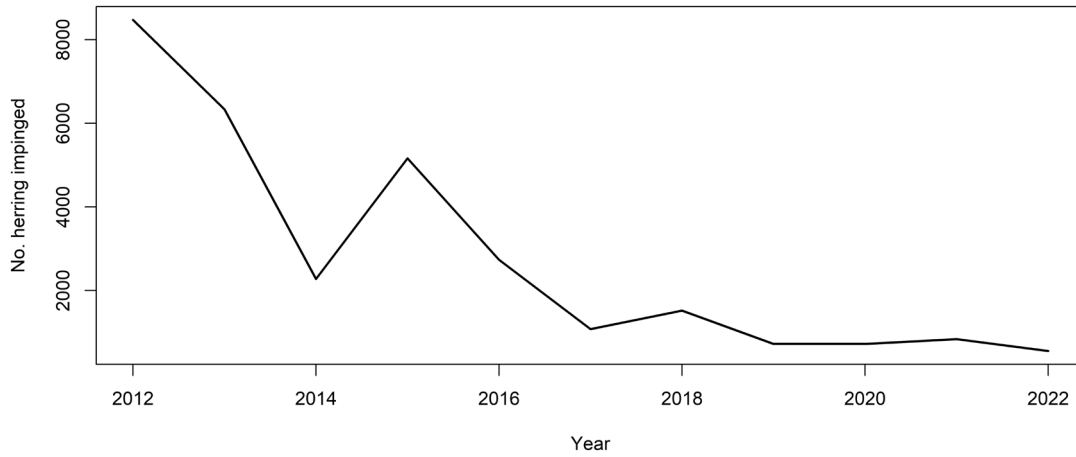
Figure 31. Impingement numbers of herring at Pembroke Power Station (2012–2022). Source: Jacobs (2023).
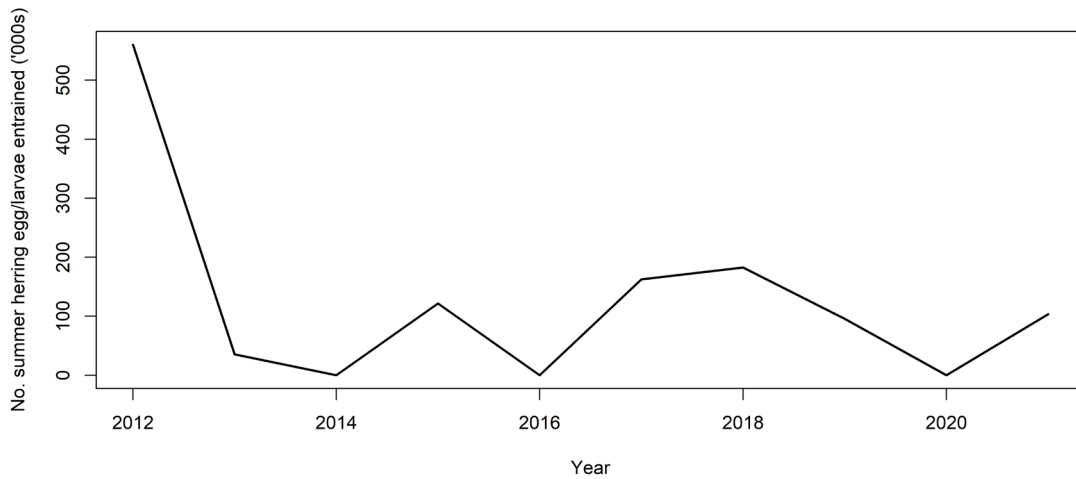
Figure 32. Entrainment numbers of herring at Pembroke Power Station (2012–2021). Source: Jacobs (2023).

3.4.6 Milford Haven larval herring and grab sampling

During 2018 and 2019 Swansea University undertook fishing and both grab and larval sampling to try and establish the current status of the spring spawning population in Milford Haven. Spawning adults were caught in the Castle reach area, demonstrating that a spawning population still exists. However, grab and plankton sampling on the historic grounds where 259 grab samples and 20 larval hauls were taken during March and April 2018 yielded no eggs and very few larvae. In 2019 a more systematic survey was undertaken, with 8 sets of grab sampling per month on the spawning areas (twice per week) and larval surveys at 12 sites (triplicate hauls at each site, every 10 days) (Figure 33). Again, few larvae and no eggs were found. This is consistent with both anecdotal reports from fishers and the apparent decline seen since 2012 in power station impingement and entrainment.
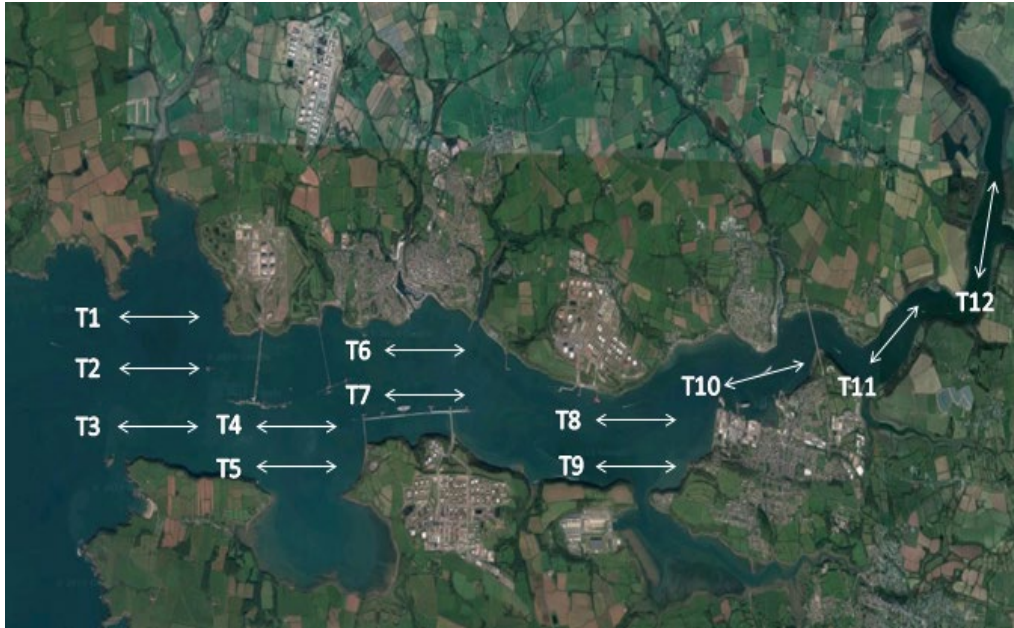
Figure 33. Larval survey sites (2019).

4   ToR C: Produce a roadmap for the delivery of future research needs for the scientific advice that underpins management of fisheries that target herring in the western Channel and Bristol Channel, either together or independently.

A roadmap on research aims is summarised in Table 6 following discussions during the Workshop focussing on six main themes, see below.

4.1   Catch and landings data

Data are available by statistical rectangle by quarter from 2000-2022. This data differs from the landings presented in the herring assessment working group report. A data call will be required where landings by ICES division, by metier, by quarter will be requested. This will revise the current time series of landings data and clear up any discrepancies with the landings data supplied by statistical rectangle. The availability of data by metier will also help to improve our knowledge about the fishery and the fleets participating in it.

4.2   Survey data

Three surveys currently sample Divisions 7.e and 7.f: two bottom trawl surveys (FRCGFS and EVHOE) and one acoustic survey (PELTIC). A particular research need is to describe abundance indices of herring from these surveys (length, age etc). The Workshop believes that a HAWG led request to other relevant ICES Working Groups would be beneficial to this understanding. As a suite of data is available from bottom trawl surveys, Workshop participants shall evaluate herring data held on the ICES Database for Trawl Surveys (DATRAS). Once compiled, a request may be sent to IBTSWG (International Bottom Trawl Survey Working Group) to advise on whether these data and developed indices are appropriate to use in future assessments. Furthermore, a request can be made to WGIPS (Working Group on International Pelagic Surveys) to advise on using PELTIC data to develop indices, along with whether there is the scope and possibility to have of a geographically continuous, synoptic view (via research survey or through chartered vessels) of the Celtic Sea, Irish Sea, Bristol Channel, and western Channel for full spatial coverage. At minimum, the request should ask to cover both 7.e and 7.f to assess its use and when this survey should take place.

4.3   Biological understanding of herring in 7.e and 7.f

To accurately identify areas where further data collection is needed, a full literature review should be completed including on spawning areas and potential small-scale populations. Focus may be best placed on the western Channel with this area being the least studied, however a broadscale view of both 7.e and 7.f would be beneficial. The University of Swansea currently holds 3 196 otoliths that need to be analysed, collected from both areas during genetic research projects. Analysis of these otoliths can provide insight into the age structure of herring populations, if these can be correctly assigned, and then to produce catch curves.

4.4   Genetic analysis

The Second ICES Workshop on Stock Identification and Allocation of Catches of Herring to Stocks (WKSIDAC2; ICES, 2024), concluded that the analysis of genetic markers is becoming a widely applied and cost-effective tool for separating herring into biological populations and potential management units at accuracies greatly surpassing previously applied methods. WKSIDAC2 considered analyses including genetic samples from both the western Channel and Bristol Channel where four genetically distinct populations have been described. However, this may not be an exhaustive list and there may remain undescribed genetic structure or populations within the areas that should be the focus of further study; in particular, one sample has been collected and analysed in the western Channel. Further analyses are also required to refine the discrimination of the herring populations that spawns off the south coast of Ireland (Celtic Sea herring) and the populations that spawn off the west coast of Wales and in the Bristol Channel. This should include the collection of additional baseline spawning samples from the Celtic Sea (Irish waters) to ensure temporal and spatial coverage of the spawning season in this area.

4.5   Additional data and information sources

Whilst a wide range of additional data sources were analysed during the Workshop, two further sources were identified which may be useful. These include data collected at a second Power Station (Hinkley Point B) which has a >20-year times series. The second is a potential future source surrounding tagging studies. Acoustic arrays are currently in place in the western Channel and Bristol Channel for other species, including twaite shad (*Alosa fallax*). It is possible, if herring are successfully tagged, to use these arrays to observe whether herring, from either 7.e or 7.f, are exploited in adjacent waters.

4.6   Catch advice

The only option for the provision of advice for herring in 7.e and 7.f in the short-term would be Category 5 (ICES, 2012), which is for stocks with only landings data available. To provide advice based on landings a data call is required to revise and correct the current time series of landings data and to make sure that all available landings data are included in this time series. A stock coordinator and a stock assessor are required to collate this data, produce an advice sheet, and update the data annually and the advice biennially.

Table 6. Roadmap of research aims needs to underpin future management of herring in the western Channel and Bristol Channel.

Item	Description	Who	Timeline Milestone	Completion	Notes
1	Landings data				
1.1	ICES Data Call	ICES (DK)	2025	2025	Report catches/landings at metier level. ICES, alongside the stock coordinator, needs to initiate data call to produce advice in 2025.
1.2	<10m vessel catches	ICES (DK)	2024	2024	Catches made by smaller (<10m) vessels are included in data submitted to both the Workshop and HAWG.
2	Survey data				
2.1	Abundance indices	Cefas (UK), Ifremer (FR)	2024	2024	Describe abundance indices (length, age etc) from fisheries independent surveys.
2.2	WGIPS request	ICES (DK)	2024	2025	A recommendation from HAWG (2024) to WGIPS requests the group to evaluate the possibility of a geographically continuous, synoptic acoustic survey to cover the Celtic Sea, Irish Sea, Bristol Channel, and western Channel for full coverage.
2.3	IBTSWG request	Cefas (UK)	2024	2025	Evaluate DATRAS data and decide whether they are effective enough to develop indices. Ask IBTSWG for QA on our results.
3	Biological understanding				
3.1	Literature review	Cefas (UK)	2024	2024	Collate all available information on herring in 7.e and 7.f to highlight whether further data collection is required.
3.2	Otolith reading	Cefas (UK), University of Swansea (UK)	Ongoing		Otoliths are currently held by the University of Swansea for fish used in genetic studies. When read, these can be used to compare catch curves. Cefas likely to read otoliths.

Table 6 cont. Roadmap of research aims needs to underpin future management of herring in the western Channel and Bristol Channel.

Item	Description	Who	Timeline		Notes
			Milestone	Completion	
4	Genetics				
4.1	Baseline spawning samples	AFBI (UK), Cefas (UK), Marine Institute (IE)	Ongoing		Collection of additional samples from the western Channel, Irish Sea, and Celtic Sea. Samples may be taken during research surveys or through chartering independent vessels provided they are collected at appropriate times and areas.
4.2	Genetic database	ICES (DK)	Ongoing		Look into the required resources needed to maintain/extend the current genetic database. All institutes taking genetic samples are now using the same SNP panel.
4.3	Additional resources required to advance genetic classification work	University of Swansea (UK)	Ongoing		Look at the possibility of employing a post-doc for 12 months to analyse and select the best markers and to work on the assignment model for CS/IS/BC/WC. Opportunities for funding need to be evaluated. All relevant institutes may provide support for future projects.
5	Additional data sources				
5.1	Hinkley Point B data	Cefas (UK)	Ongoing		Evaluate the use of data collected at the Hinkley Point B site (>20-year time series). Availability of data needs to be evaluated.
5.2	Tagging studies	University of Swansea (UK)	Ongoing		Acoustic tagging arrays are in place in the Bristol and western Channel. These would aid in seeing whether fish are exploited in adjacent waters. While in place for other species, application for herring has not yet been attempted.

Table 6 cont. Roadmap of research aims needs to underpin future management of herring in the western Channel and Bristol Channel.

			Timeline		
Item	Description	Who	Milestone	Completion	Notes
6	Catch advice				
6.1	Advice request	ICES (DK)	2024	2024	ICES (ACOM) confirm that catch advice for 7.e–f is required as soon as it is possible and available.
6.2	Stock assessment and advice	Cefas (UK), Ifremer (FR), ICES (DK)	2024	2025	A stock coordinator and stock assessor are required to produce category 5 advice. This advice can be drafted and reviewed at HAWG (2025).

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Annex 1: List of participants

Name	Institute	Country (of institute)	Email
Aaron Brazier (Chair)	Cefas	UK	aaron.brazier@cefas.gov.uk
Afra Egan (Chair)	Marine Institute	Ireland	afra.egan@marine.ie
Alexander Scorey	Natural Resources Wales	UK	alexander.scorey@cyfoethnatu-riolcymru.gov.uk
Campbell Pert	Marine Directorate	UK	campbell.pert@gov.scot
Charlotte Davies	University of Swansea	UK	c.e.davies@swansea.ac.uk
Cormac Nolan	Marine Institute	Ireland	cormac.nolan@marine.ie
David R.K. Clarke	University of Swansea	UK	d.r.k.clarke@swansea.ac.uk
Edward Farrell	Killybegs Fisherman's Organisation	Ireland	edward@kfo.ie
Frances Radcliffe	Natural Resources Wales	UK	frances.radcliffe@cyfoethnatu-riolcymru.gov.uk
Gus Caslake	Seafish/CSMA	UK	gus.caslake@seafish.co.uk
Harriet Lincoln	Natural Resources Wales	UK	harriet.m.lincoln@cyfoethnatu-riolcymru.gov.uk
James Stewart	Devon & Severn IFCA	UK	j.stewart@devo-nandsevernifca.gov.uk
Jaylene Mbararia	ICES Secretariat	Denmark	jaylene.mbararia@ices.dk
Jeroen van der Kooij	Cefas	UK	jeroen.vanderkooij@cefas.gov.uk
Lawrence Shephard	Marine Biological Association	UK	lawshe@mba.ac.uk
Louise Straker-Cox	Cefas	UK	louise.strakercox@cefas.gov.uk
Michael Gwilliam	University of Swansea	UK	m.p.s.gwilliam@swansea.ac.uk
Megan Elsmore	Aberystwyth University	UK	mee16@aber.ac.uk
Paul Marchal	Ifremer	France	paul.marchal@ifremer.fr
Pia Schuchert	AFBI	UK	pia.schuchert@afbini.gov.uk
Richard Joseph	Fisher	UK	richard.jo-seph@marinespace.co.uk
Richard Nash	Cefas	UK	richard.nash@cefas.gov.uk
Rowan Cox	Aberystwyth University	UK	roc60@aber.ac.uk
Susan Kenyon	Cefas	UK	susan.kenyon@cefas.gov.uk

Annex 2:   Resolutions

A **Workshop on a Research Roadmap for Bristol and Western Channel Herring** [WKRRBWCH] will be established (Aaron Brazier, UK and Afra Egan, Ireland) and will meet at the University of Swansea, from 4th – 6th December 2023 to:

a) Identify methods and data available for the identification of herring stock structure in the western English Channel (Division 7e), Bristol Channel (Division 7f), and adjacent waters.

b) Identify potential and existing data sets (including environmental parameters) for the assessment and management advice for herring occurring in Divisions 7 e and f.

c) Produce a roadmap for the delivery of future research needs for the scientific advice that underpins management of fisheries that target herring in the western English Channel and Bristol Channel, either together or independently.

WKRRBWCH will report by date (February 2024) for the attention of ACOM and HAWG.

Supporting information

Currently, ICES does not recognise herring (*Clupea harengus*) occurring in the western English Channel (ICES Division 7e) and Bristol Channel (ICES Division 7f) as a single stock, nor provide advice for these combined Divisions. However, there are three herring stocks in adjacent waters: herring in 3a, 4, and 7d (North Sea; Category 1 SAM assessment), 7aN (Irish Sea; Category 1 SAM assessment), and 7aS, 7g–j (Celtic Sea; Category 1 ASAP assessment). The Herring Assessment Working Group (HAWG) lists herring in ICES Division 7e–f as a stock with limited data (not to be confused with a data limited stock) with catch records reported since 1974. The stock structure is uncertain in these two Divisions. Catch data are collated for each Division from either targeted fisheries or as bycatch. Additionally, there are a number of surveys (both acoustic and bottom trawl) where herring are recorded and in some cases the abundance is estimated.

Herring is subject to small-scale targeted fisheries in Divisions 7e–f in the Bristol Channel along the south Wales and north Devon coasts. In the past there were fisheries in the western English Channel. The latest catch records of herring in 7e since 2000 have varied between 12 and 1010t with catches from 7f fluctuating between 1 and 231t over the same time period. Preliminary landings (2022) were 6 and 200 tonnes for Divisions 7e and 7f respectively (HAWG, 2023 *in prep*).

At present, there is insufficient understanding, information, and data on the herring population structure in the western English Channel and Bristol Channel to be able to provide robust advice or on any potential changes in productivity in the short to medium term. Herring are a key forage fish in adjacent ecosystems, forming an important trophic level in the food chain for key predatory species.

Details/overview

Priority:	The identification of stock boundaries and the logical definition of management units is vitally important for the sustainable exploitation of fish stocks. In addition, the acquisition of appropriate data on which herring occur in the Bristol Channel and western English Channel is necessary for providing scientific advice in selected areas where fisheries are occurring. A workshop is needed to collate all available information on herring in the Bristol Channel (ICES Division 7f) and western English Channel (ICES Division 7e) to identify knowledge gaps and provide a roadmap on research necessary to be able to provide robust advice to management.
Scientific justification and relation to action plan:	The aim for the workshop is to collate all available information on herring in the Bristol Channel (ICES Division 7f) and western English Channel (ICES Division 7e) with a view to determine stock structure (boundaries), data on biological characteristic and abundance, the ecological role of herring in this ecosystem, where data are missing, and a roadmap for research to underpin the advice and management of the herring in this area.
Resource requirements:	No specific resource requirements beyond the need for members to prepare for and participate in preparatory and final meetings.
Participants:	In view of its relevance to the EU Data Collection Framework (DCF) and the UK, the Workshop is expected to attract interest from ICES Member States.
Secretariat facilities:	None.
Financial:	Some additional funding will be required for attendance of personnel at the final workshop. Attendance at other meetings at the use of Microsoft Teams (or equivalent) will be used for the preparatory work to minimise any financial requests. Potential expertise by invitation?
Linkages to advisory committees:	ACOM.
Linkages to other committees or groups:	ACOM, HAWG.
Linkages to other organisations:	

Annex 3:   Agenda

Key			
Introductions	Group discussion	Presentations	Breaks

Monday 4th December 2023

10:00–11:00 Introductory session.

- Welcome to WKRRBWCH (Aaron & Afra).
- Introductions by all participants.
- Practical arrangements (Chairs and ICES Secretariat).
- ToRs and aims of the meeting
- Assign rapporteurs.

11:00–11:15 Tea break.

11:15–12:30 ToR A/B presentations session.

- Herring stocks overview and commercial catch data (Afra Egan).
- Genetics (Dave Clarke & Ed Farrell).
- Spawning/sampling/morphology (Charlotte Davies).
- SWOTTER & Cefas surveys (Louise Straker-Cox).

12:30–13:00 ToR A/B Discussion.

- Local and industry perception discussion.

13:00–14:00 Lunch.

14:00–15:30 ToR A/B presentations continued.

- French survey data (Paul Marchal).
- CPR herring and prey items (Lawrence Sheppard).
- Sardine fishery & herring bycatch (Gus Caslake).
- Recreational herring catches (Aaron Brazier).
- PFA herring data (Susan Kenyon).

15:30–15:45 Tea break.

15:45–17:00 ToR A/B dataset discussion.

- PELTIC survey (Jeroen van der Kooij).
- Potential datasets going forward?
- Sampling needs?

17:00 Meeting closed.

Tuesday 5th December 2023

10:00–11:30 ToR C (Roadmap creation).

- Future projects (Frances Ratcliffe & students).
- Research needs and focus.
- Timeline for management measures.

11:30–11:45 Tea break.

11:45–13:00 ToR C continued.

13:00–14:00 Lunch.

14:00–15:30 Report writing.

- Authors and section planning.

15:30–15:45 Tea break.

15:45–17:00 Report writing.

17:00 Meeting closed.