11 Sprat in the English Channel (divisions 7. de)

The stock structure of sprat populations in this region is not clear, despite evidence from acoustic surveys suggesting the stock is mainly confined to the UK side of 7.e. Further investigations and work are required to resolve this uncertainty.

11.1 The Fishery

11.1.1 ICES advice applicable for 2023

The advised catch for the English Channel (7.d and e) was set equal to 2473 tonnes.

11.1.2 Landings

The total sprat landings by country from 1986-2022 are provided in Table 11.1.1. Total landings from the international sprat fishery are available since 1950 (Figure 11.1.1.). Sprat landings prior to 1985 in 7.de were extracted from official catch statistics dataset (STATLANT27, Historical Nominal Catches 1950–2010, Official Nominal Catches 2006–2013), from 1985 onwards they come from WG estimates. Since 1985 sprat catch has been taken mainly by the UK (England, Wales and Northern Ireland). According to official catch statistics large catches were taken by Danish trawlers in the English Channel between the late 1970s and 1980s. The identity of these catches was not confirmed by the Danish data managers, raising the question of whether those reported catches were the result of species misreporting (i.e. herring misreported as sprat). Therefore, ICES cannot verify the quality of catch data prior to 1988.

The fishery starts in August and runs into February and sometimes March the following year. Most of the catch is taken in 7.e, in the Lyme Bay area. In the last decade catch from the UK covered about 93% of landed sprat, however in 2015 and 2016 this percentage diminished, with Netherlands, Denmark appearing, and taking a portion of the catch. Denmark and the Netherlands represent the two principle "transient fishing fleets" that appear occasionally in the time series and have been allocated a portion of the TAC under the common fisheries policy in previous years. In 2022, Landings were very low, with 8 tonnes caught by UK vessels and 4 tonnes caught by French vessels. Landings were also very low in 2021, 49 tonnes in total. Low landings in both years were attributed to inadequate large sprat in the catch, leading to a short season for the UK fleet.

Sprat is found by sonar search and sometimes the shoals are found too far offshore for sensible economic exploitation. This offshore/near shore shift may be related to environmental variability such as spatial and temporal changes in temperature and/or salinity.

11.1.3 Fleets

In the English Channel the primary gear used for the capture of sprat is midwater trawl. Within that gear type three vessels under 15 m have actively targeted sprat and have been responsible for the majority of landings. Since 2003 the UK fleet took on average 96% of the total landings. Sprat is also caught by driftnet, fixed nets, lines and pots and most of the landings are sold for human consumption.

11.1.4 Regulations and their effects

There is a TAC for sprat in ICES divisions 7.de, English Channel. Figure 11.1.2. shows the agreed TAC and the ICES catch from 2000-2023 and shows the catch is always below the agreed TAC.

11.1.5 Changes in fishing technology and fishing patterns

There is insufficient information available.

11.2 Biological Composition of the Catch

11.2.1 Catches in number and weight-at-age

In 2017/2018 fishing season a pilot self-sampling program started in the Southwest of UK, involving sprat fishers from Lyme bay. This program has continued through to 2022 however no sprat data were received in 2022 as fish were not of a marketable size. The graphs have therefore not been updated this year as the previous year's data better represents the stock, when taken by the fishery. The 2019-2020 data shown are raw numbers-at-length in the samples, and not raised to the total catches (Figure 11.2.1 and Figure 11.2.2).

The skippers have collected length measurements from the catches and recorded information on fishing trips since 2018. In 2019, the sprat lengths in the fishers' samples ranged from 7.5 to 15 cm (Figure 11.2.1). The main processors for the fishery were engaged in 2019 and have provided length and weight data from landings subsamples. The length distributions recorded by the processors was reasonably consistent in 2020 (Figure 11.2.2). Due to low uptake in the fishery during 2021, the fishery operated for only two months of the season (August and September) and the FSP program provided very little data.

Biomass estimates for 2021 showed a huge increase in Sprat biomass. The PELTIC survey reports that there was a very strong recruitment (0-group) (Figure 11.3.3). These small fish were very widespread throughout the survey area. Anecdotal evidence from the Fisheries (self) sampling program (FSP) program and fishers also support the survey findings, with the Pelagic fisheries noting difficulties in being able to fish because of too much "whitebait" everywhere, below marketable size. The demand in the fishery tied more to size and marketability than stock biomass, with the processors reluctant to take catches with small fish.

2022 saw a large reduction in the PELTIC biomass index for the western survey stratum, down from 107 kt in 2021 to 28 kt in 2022. The number of age 1 fish identified by the PELTIC survey in 2022 was an order of magnitude below the biomass of age 0 fish identified in 2021. This may indicate either high mortality or migration of sprat.

11.3 Fishery-independent information

PELTIC Acoustic Survey (A6259)

Cefas carried out the annual PELTIC survey (Pelagic Ecosystem Survey of the Celtic Sea and Western Channel) in autumn in the English Channel and the Celtic Sea to acoustically assess the biomass of the small pelagic fish community within this area (divisions 7.e–f), and sprat is one of the target species. This survey, conducted from the RV *Cefas Endeavour*, started in 2013, when it first focused only on UK waters but, from 2017, it expanded to also cover the southern area of division 7.e (French waters). In 2018 a one-off extension of the survey was conducted into division 7.d to investigate the presence of the stocks in the eastern channel, the survey found

almost no sprat present. This does not rule out the presence of the sprat in the eastern channel, but was used in the absence of other evidence.

As detailed in the ICES survey manual (Doray *et al.*, 2021), calibrated acoustic data were collected during daylight hours only at three frequencies (38, 120, 200 kHz) from transducers mounted on a lowered drop keel at 8.2 m below the surface. All non-fish acoustic targets were removed by creating a multi-frequency filter and only backscatter from swimbladder fish was retained for further analyses. The resulting echotraces were further partitioned by species based on the trawl catches and were converted into abundance and biomass estimates (plus Coefficient of Variation) in StoX software.

To convert acoustic biomass to abundance, a Target Strength (TS) equation is used. As no dedicated sprat specific TS equation is available for the area, the generic clupeid value of b20 = -71.2 dB is used. This was found to be an acceptable conversion and it was noted that more negatively values (leading to a higher biomass) have been used for sprat stocks in adjacent waters.

As part of the 2021 sprat inter benchmark process (IBP), the ability of the survey to capture the sprat stock (catchability) was evaluated, as this feeds heavily into assumptions of the management strategy evaluation (MSE). It was noted that the assessment is based on a biomass estimate from only a small area of the total management unit and is therefore likely to be a conservative estimate.

The survey also provides age and length structure for sprat aged 0–6 (Figure 11.3.2 and Figure 11.3.3). While there is high variability in the age distributions, this does not affect the overall estimate of biomass. However, it does preclude cohort tracking in the survey. The IBP found that the survey provided a robust estimate of biomass for application of a constant harvest rate (CHR) and is evaluated at two ICES working groups, WGIPS and WGACEGG each year."

Biological data

Biological information from trawl catches carried out during the 2021 PELTIC acoustic survey, identified 5 age classes from 0 to 4 contributing on average to 91.61%, 2.1%, 5.9%,0.32%, and 0.02% respectively in the samples collected. The age structure observed in 2021 is shown in Figure 11.3.2 and 11.3.3. This supports anecdotal information from the fishery and is linked to the reduced catch in 2021, citing a high volume of small fish. Biological information from trawl catches for the 2022 survey were not made available in time for HAWG in 2023.

11.4 Mean weight-at-age and maturity-at-age

No data on mean weight-at-age or maturity-at-age in the catch are available.

11.5 Recruitment

The acoustic surveys may provide an index of sprat recruitment in divisions 7.d–e.

11.6 Stock Assessment

This stock is considered a category 3 stock with the assessment and advice based on survey trends (ICES Advice 2018).

The stock went through an interbenchmark in February 2021 to update the assessment method based on the new guidance issued by WKLIFEX and developed by WKDLSSSLS2. The IBP tested the available data against the updated guidelines and assessed the suitability of three data limited methods for the stock.

1. 1 over 2 ratio-based advice with a 20% and an 80% uncertainty cap
2. Constant Harvest Rate
3. Surplus Production model (SPiCT)

Three exploratory SPiCT assessments were performed:

- an annual model using calendar year (January–December)
- an annual model using fishing year (July–June);
- a model using quarterly data.

The IBP concluded that SPICT analysis of the stock was not viable at this point in time due to the limited time series available for the PELTIC survey (2014–2020). There is also a strong transient component to the fishery from Denmark and the Netherlands which has not been present in recent years. The IBP determined that SPICT should be re-examined in the future.

A constant harvest rate (CHR) was determined by management strategy evaluation (MSE). The CHR was tested alongside the 1o2 with 80% and 20% uncertainty caps. The MSE tested three survey catchability options, with an assumption of 0%, 50% and 100% over estimation of the underlying biomass from the PELTIC survey. Assuming that some overestimation may take place on the survey, the IBP determined that the 50% overestimation should be adopted. Three scenarios of fishing pressure, prior to implementation of the catch advice options, were simulated for 25 years to establish starting points for the stock.

This MSE was carried out on a seasonal time step due to limitations in the framework. The IBP recommended that the annual advice move to an annual-seasonal calendar toreduce the time lag between survey and advice, while keeping the stock within the HAWG. WKDLSSLS determined that the reduced lag between survey and advice was the key component of providing precautionary advice for short lived species. A CHR determined on a seasonal timestep will still be applicable to the stock and is more precautionary than the 1o2 rule.

The CHR was found to be more precautionary for the stock than the current 1o2 rule (with both UC values), supporting the findings of WKDLSSL1 & 2. The CHR of 12% was the maximum value estimated under the 50% survey catchability overestimation level that kept the risk <5% in the long term under all fishing histories while giving the highest yield. A correction factor to the CHR was applied to account for a mismatch between survey weight at age in the PELTIC biomass and the weight at age in survey biomass simulated in the MSE. This was done to account for in year growth and results in a correction factor of 0.714 equal to the ratio of the MSEindex/"PelticIndex", where PelticIndex equates to the weight-at-age structure present at the time of the survey. This time-step accounts for a seven-month growth period, comprising the months between spawning in March and the survey in October. The IBP concluded that an adjusted CHR to 8.57% was the most appropriate assessment method for the stock (ICES, 2021).

Further investigation of the CHR, specifically using sprat in 7.de, was conducted at WKDLSSLS3 in 2021. The group examined the effect of applying an 80% uncertainty cap (UC) to the CHRs. The conclusion from this was an UC resulted in minimal risk reduction for CHR's below the 5% risk threshold. It did reduce risk for CHR's that are too high but could not bring them below the ICES risk threshold. The only significant difference between CHR and CHR+UC was a decrease in interannual variability in the stock. This contrasts with work by other members of the WKDLSSLS group, who note that UC's may introduce unnecessary risks to the stock when requiring rapid reduction of catches. Alternatively following a drop of catch advice, may prevent recovery of yield (Fischer *et al*. 2020, 2021 and Sánchez-Maroño *et al*. 2021). The group found that unconstrained CHRs appear robust to past fishing history, initial stock status and advice schedule but are sensitive to survey catchability. No recommendations from the WKDLSSLS were made in regard to applying a UC to CHR's. Application of uncertainty cap is a current research topic and future guidelines may clarify how they are applied as part of a CHR.

11.6.1 Data exploration

Biomass Index

A 9-year time-series of biomass estimates from the PELTIC survey is shown in Table 11.6.1. The extension of the survey into ICES division 7.d and the southern part of 7.e suggests that the stock is mainly located in the more northerly part of division 7.e during October. The survey conducted in 2021 showed a very large concentration of age 0 sprat in Lyme bay, Figure 11.6.1 and 11.3.2. The survey also covered the area around the Channel Islands (Figure 11.6.1) and found a large quantity of sprat present off the coast of France. This biomass does not feed into the assessment, which looks only at the "core area" of Lyme Bay. The 2022 survey did not identify large amounts of age 1 or 2 sprat, indicating that these age 0 sprat either migrated or succumbed to high mortality between the 2021 and 2022 autumn surveys.

As in previous years, the greatest sprat biomass was found in the Lyme Bay region, however due to vessel issues the 2022 PELTIC survey extent was greatly reduced to an area of approximately 1/3 of the typical extent, covering only the Western Channel stratum.

In 2018, the PELTIC survey was extended into the eastern channel and found no discernible Sprat biomass, indicating a separation between 27.7.de and Sprat in the Eastern channel.

For more details on the survey design see Figure 11.3.1 and ICES 2022

A 2015 analysis of the age distribution of sprat in the survey area shows a marked distinction between the young fish (0 and 1) found in the Bristol Channel and the older age classes that occupy the Western English Channel (ICES 2015). Whether the two clusters belong to the same stock has yet to be proved: the circulation pattern of the area would allow sprat eggs/larvae to travel northward, from division 7.e to 7.g; however, the formation of a front in late spring/early summer seems to suggest these may be two different stocks.

The stock was examined using RAD-seq-derived SNPs (Restriction-site-associated DNA *sequencing* and single nucleotide polymorphisms) in 2020 (McKeown *et al*., 2020). This was part of a larger study of North Sea and Baltic sprat. The study found that amongst the North Sea population there was a lack of genetic differentiation between sampled stocks, indicating a high gene flow in the North Sea population. This would indicate that all sprat in the North Sea form one genetic unit, however the study suggests further work is needed. Specifically, for fisheries management, it should be noted that genetically connected stocks may still be isolated on the time scale of fisheries management.

11.7 State of the Stock

The acoustic estimates for 2017 (32 751t) saw a threefold increase compared to the all-time low value in 2016 (9826 t), although the biomass is still half of the high levels recorded in the period 2013–2015 (70680 t, 85184 t and 65219 t respectively), Table 11.6.1. The PELTIC biomass increased substantially from 36 798 tonnes in 2020 to 107355 tonnes in 2021, and reduced to 28439 tonnes in 2022. The harvest rate has been low for the past 2 years at 0.05% and 0.04% for 2021 and 2022 respectively. The low catch in 2021 which has been attributed to a large number small sprat mixed in with the catch and the low catch in 2022 has been attributed to a continued absence of large marketable sprat.

11.8 Catch Advice

Applying the constant harvest rate of 8.57% to the current estimate of PELTIC biomass gives an advised catch of 2437 tonnes.

11.9 Short-term projections

No projections are presented for this stock.

Reasons for change in advice

The decrease in advised catch this year is caused by the decreased PELTIC biomass index in 2022, as the advised catch is derived by multiplying the survey index in tonnes by 0.0857.

Survey year	Advice year	Western Channel stratum tonnage	Advice (surveyed tonnage x 0.0857)
2021	2022	107355	9200
2022	2023	28439	2437

11.10 Reference Points

The IBP suggested the use of the Istat value developed as part of WKDSLLS2 (ICES, 2021b) could be used as a proxy B_{lim} for the stock. The Istat is defined as:

Geomean(*Ihist*)*exp(-1.645*sd(log(*Ihist*))

Where *Ihist* refers to the biomass index, this gives a value of 11527.9 tonnes biomass for the stock. Note this should not be referred to as SSB or total biomass as SSB cannot be derived for the stock and the PELTIC does not capture the total biomass of the stock. Length based F (MSY) proxies were suggested by the ADG as being possibly applicable to the stock and providing useful information. They have not been explored to date but could be looked at in the future. The inclusion of the FSP sampling data (which includes length frequencies) could also be incorporated into these methods and provide interesting comparison between survey and fisheries derived data.

11.11 Quality of the Assessment

The coverage of the PELTIC acoustic survey was extended in 2017 towards the southern part of Division 7.e: this extension confirmed that the bulk of the sprat distribution in 7.e is located in Lyme Bay and surrounding areas, and it does not tend to extend outside the western channel stratum. The transects carried out off the French coast found very little sprat, mostly of ages 0 and 1. Sprat have since been recorded off the coast of France and around the channel island in 2018, 2019, whilst 2021 also saw sprat present off the coast of France. These fish do not feed into the advice, as they lie outside of the core Lyme bay area.

The extent to which the population migrates into Division 7.d was investigated during the 2018 survey. The survey showed that very little sprat was found on the eastern border of division 7.e and very little found in 7.d.

Concerns have been raised about the connection between the Western English Channel stock and the Bristol Channel, where large numbers of juveniles are found, it is currently believed the Bristol channel may represent a separate stock. See the data exploration section for details.

Material presented in 2023 to HAWG on the IBTS channel groundfish survey indicated that the amount of sprat in 7d should not be assumed to be negligible. Issues may exist with indices derived from this survey due to a vessel change in 2015, however it is advised that a comparison

is made with the peltic index once the RV change issue is addressed. The survey gear are not targeted to sprat, however they indicate a large presence of sprat on the French side of the channel around the Baie de la Seine (Figure 11.1.1; Figure 11.1.2). Also shown in IBTS data are a decreasing mean length of sprat over the last decade Seine (Figure 11.1.3; Figure 11.1.4). Considering the low fishing pressure in the stock area over the last decade, this is suspected to be ecologically (climate change) driven.

11.12 Management Considerations

Sprat is a short-lived species with large interannual fluctuations in stock biomass. The natural interannual variability of stock abundance, mainly driven by recruitment variability, is high and does not appear to be strongly influenced by the observed levels of fishing effort.

Sprat annual landings from 7.d–e over the past 20 years have been 2408 tonnes on average. The average harvest rate for the 10-year time-series is 7.4% however it has been close to 0.05% for two years.

The strong biomass fluctuations observed in the acoustic index and the relatively strong increase in biomass observed in 2017 and 2021 suggests that the low level of catch is not impairing the stock.

As of 2021, an agreement has been reached between the ICES members to move the advice to a seasonal calendar in line with the fishery for 2022/2023. The advice will now run across the fishing season (1 July–30 June) instead of on an annual basis.

The PELTIC survey takes place in October of the advice year minus 1, with the advice issued in March of the advice year for the fishing season. The fishing season runs from 1 July advice year, to 30 June advice year plus 1. Therefore, there is an 8-month delay between survey and advice. This is a weakness in the advice as Sprat can undergo rapid changes in biomass. The TAC issued separately to the ICES advice has been issue on a seasonal basis for 2022. A small delay is still present but has been greatly reduced. A further improvement to better respond to changing stock conditions would be a review mechanism at the time of the PELTIC in October to update the advice, if needed. However, this would present problems for issuing of the advice and there is currently little appetite to reopen advice mid-year for stocks in ICES or member states.

11.13 Ecosystem Considerations

Multispecies investigations have demonstrated that sprat is one of the important prey species in the North Sea ecosystem, for both fish and seabirds. At present, there are no analysis available on the total amount of sprat, and in general of other pelagic species, taken by seabirds, marine mammals, and large predators in the Celtic Seas Ecoregion. However, a wide spectrum of data that covers the whole trophic chain have been collected during the PELTIC acoustic survey: these data will in the future provide a substantial contribution to the knowledge base for the area.

11.14 Tables and Figures

Table 11.1.1 Sprat in 7.d-e. Landings of sprat, 1988–2022.

Country	Denmark	France	Germany	Netherlands	UK Eng+Wales+N.Irl.	UK Scotland	Total
1988	2529	2	0	1	2944	0	5476
1989	2092	10	0	0	1520	0	3622
1990	608	79	0	0	1562	0	2249
1991	0	0	0	0	2567	0	2567
1992	5389	35	0	0	1791	0	7215
1993	0	3	0	0	1798	0	1801
1994	3572	1	0	0	3176	40	6789
1995	2084	0	0	0	1516	0	3600
1996	0	2	0	0	1789	0	1791
1997	1245	1	0	0	1621	0	2867
1998	3741	0	0	0	1973	0	5714
1999	3064	0	0	1	3558	0	6623
2000	0	1	0	1	1693	0	1695
2001	0	0	0	0	1349	0	1349
2002	0	0	0	0	1196	0	1196
2003	0	2	0	72	1368	0	1442
2004	0	6	0	0	836	0	842
2005	0	0	0	0	1635	0	1635
2006	0	7	0	0	1969	0	1976
2007	0	0	0	0	2706	0	2706
2008	0	0	0	0	3367	0	3367
2009	0	2	0	0	2773	0	2776
2010	0	2	0	0	4408	0	4411
2011	0	1	0	37	3138	0	3176
2012	6	2	0	8	4458	0	4474
2013	0	2	0	0	3793	0	3795
2014	45	3	0	268	3357	0	3674

Country	Denmark	France	Germany	Netherlands	UK Eng+Wales+N.Irl.	UK Scotland	Total
2015	0	1	0	352	2659	0	3012
2016	185	7	49	227	2867	0	3334
2017	0	0	34	232	2496	0	2762
2018	474	1	0	0	1804	0	2279
2019	0	1	28	0	1544	0	1573
2020	0	1	0	0	873	0	873
2021	0	0.3	0	0	48.7	0	49
2022	0	4	0	0	8	0	12

Table 11.6.1. Sprat in 7.d–e. Annual sprat biomass in ICES Subdivision 7.e (Source: Cefas PELTIC acoustic survey)

Year	Western Channel stratum	Full survey area
2013	70680	96682.4
2014	85184	153126.9
2015	65219	286902.8
2016	9826	30788.8
2017	32751	198454.2
2018	21772	106431.2
2019	36789	111072.8
2020	33798	61222.1
2021	107355	265765.9
2022	28439	NA

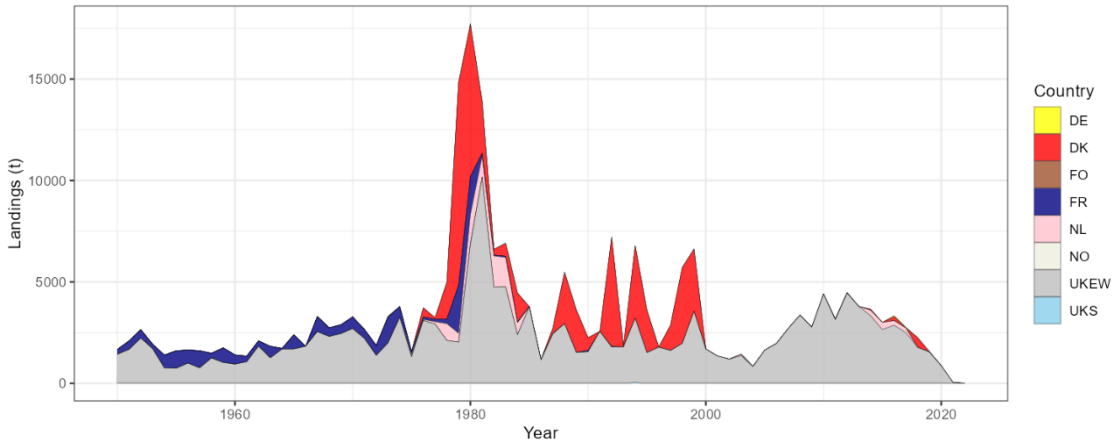

Figure 11.1.1. Sprat in 7.d-e. Landings of sprat 1950–2022.

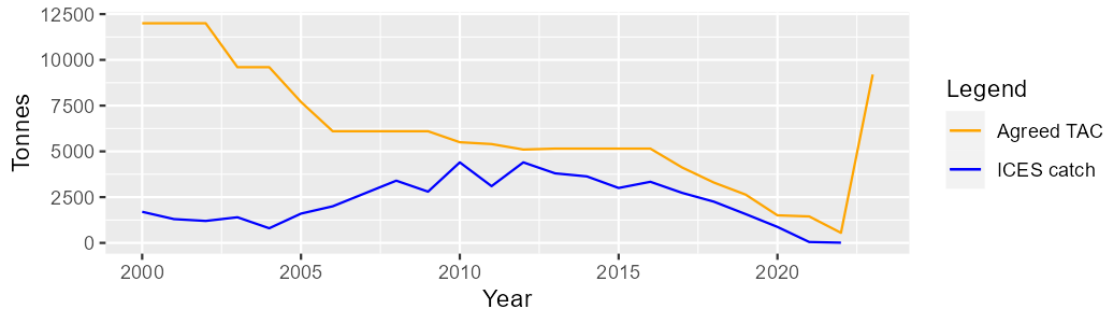

Figure 11.1.2. Sprat in 7.d-e. ICES catch (blue line) and agreed TAC (red line) from 2000 to 2022.

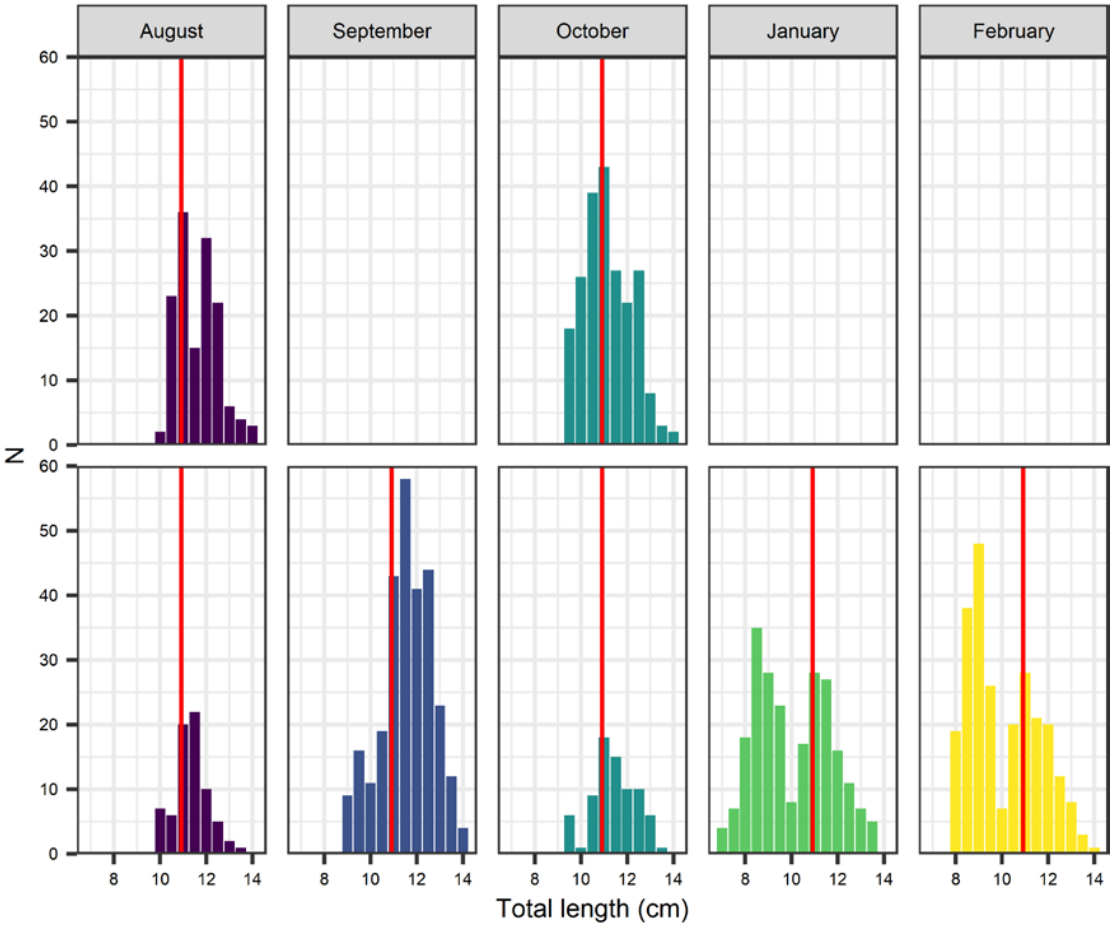

Figure 11.2.1. Length distribution collected by the fishers by month. Red line indicates weighted mean length at each month 2019, for the two boats supplying the FSP program.

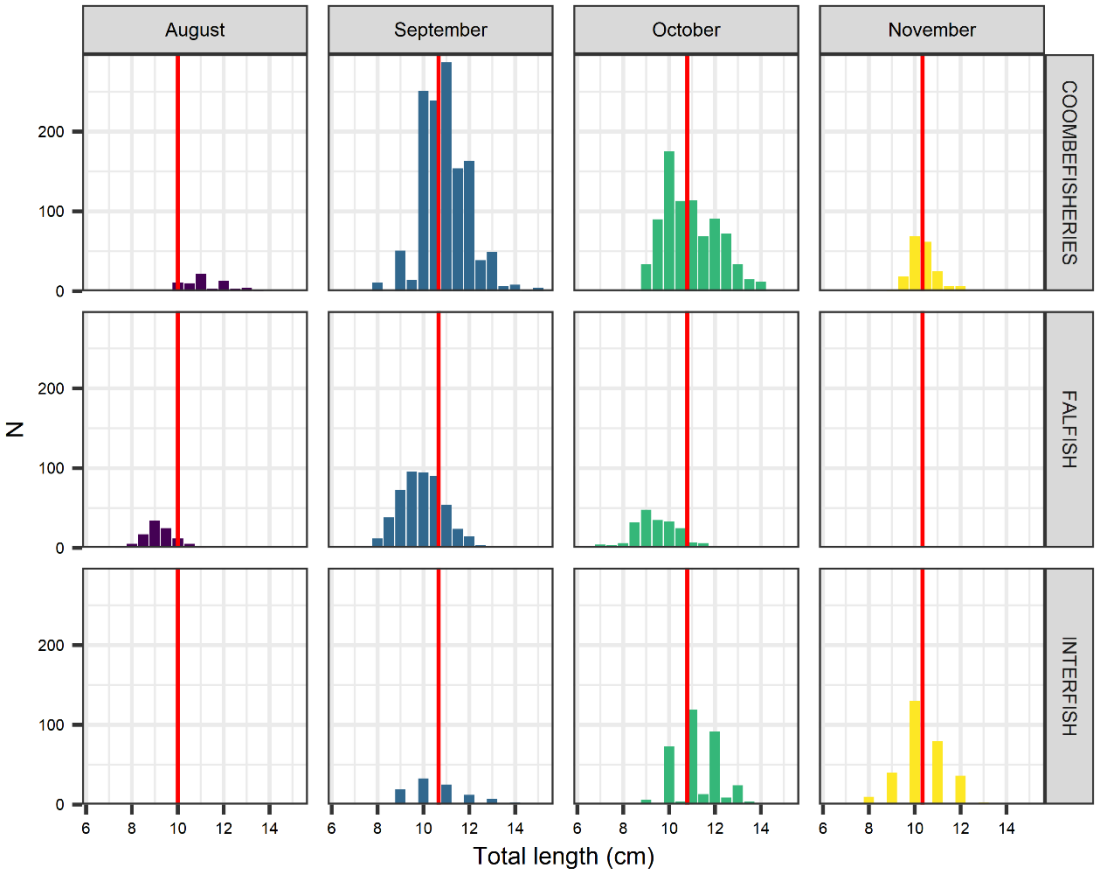

Figure 11.2.2. Monthly sprat total length distribution collected by the three processors in the 2020 season. Red line indicates weighted mean length at each month.

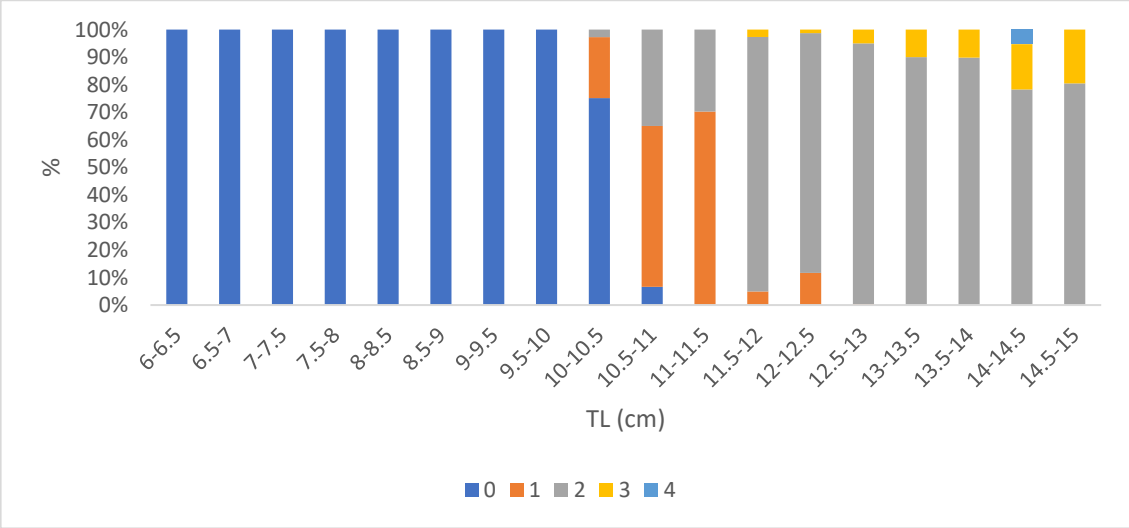

Figure 11.3.2. Sprat in 7.d-e. Proportion of numbers-at-age in the biological sample collected during the 2021 PELTIC acoustic survey.

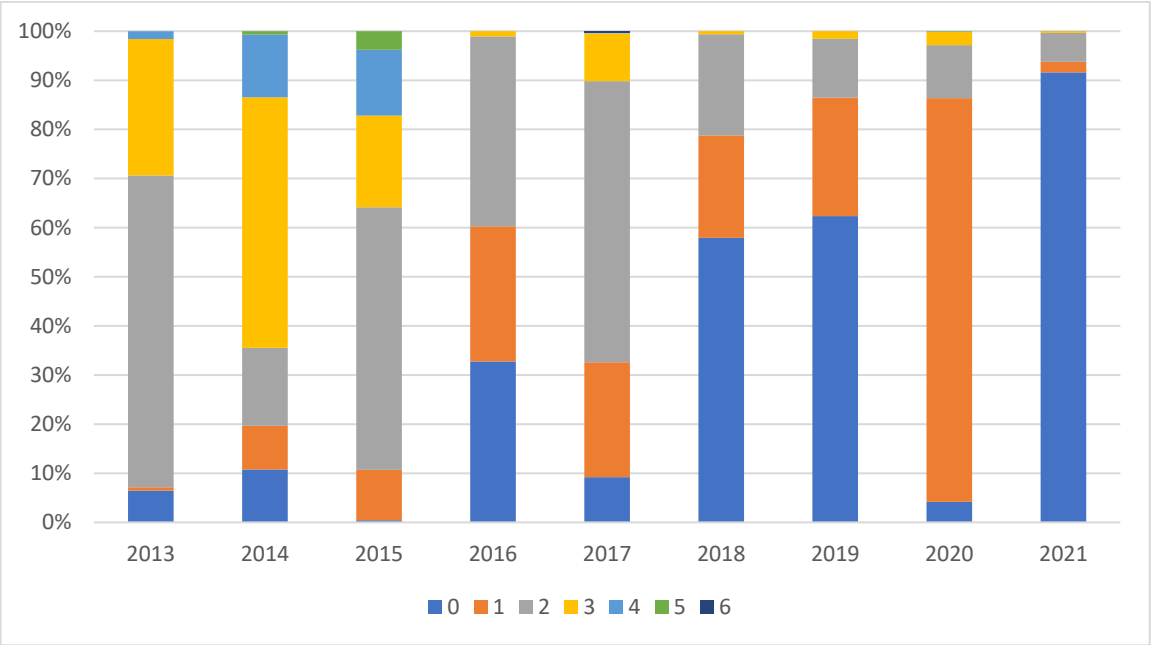

Figure 11.3.3. Sprat in 7.d-e. Proportion of numbers-at-age in the biological samples collected during the 2013–2021 PELTIC acoustic surveys.

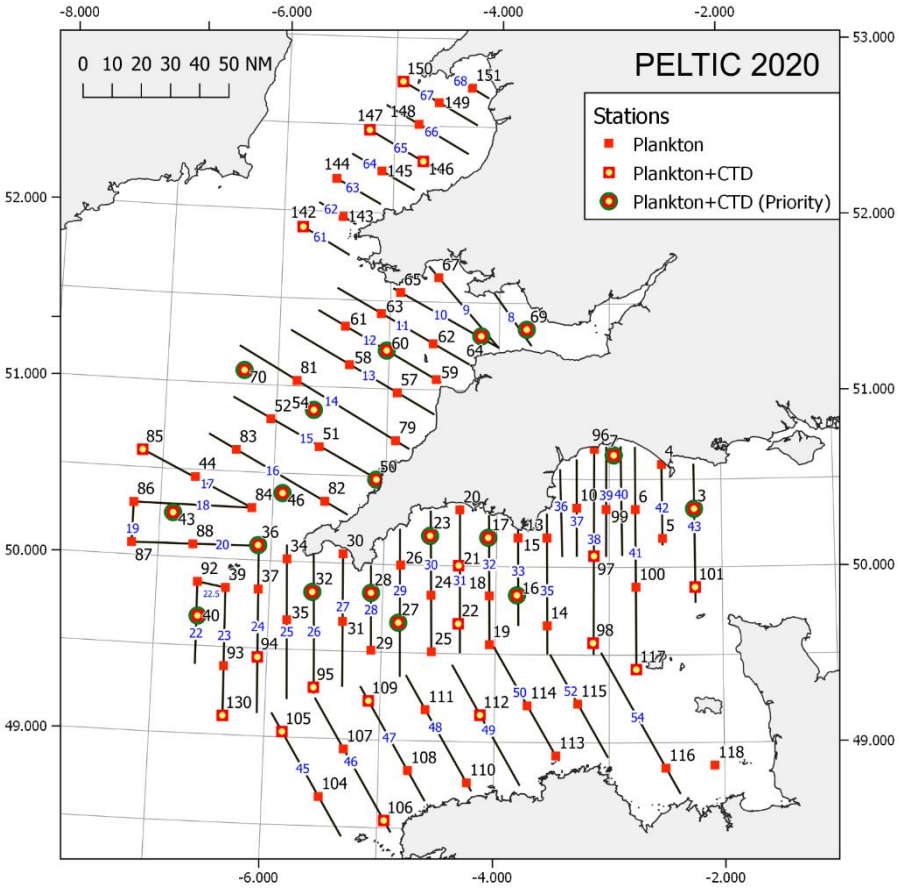

Figure 11.3.1. Sprat in 7.d–e. Survey design (2021) with acoustic transects (blue lines), zooplankton stations (red squares) and oceanographic stations (yellow circles).

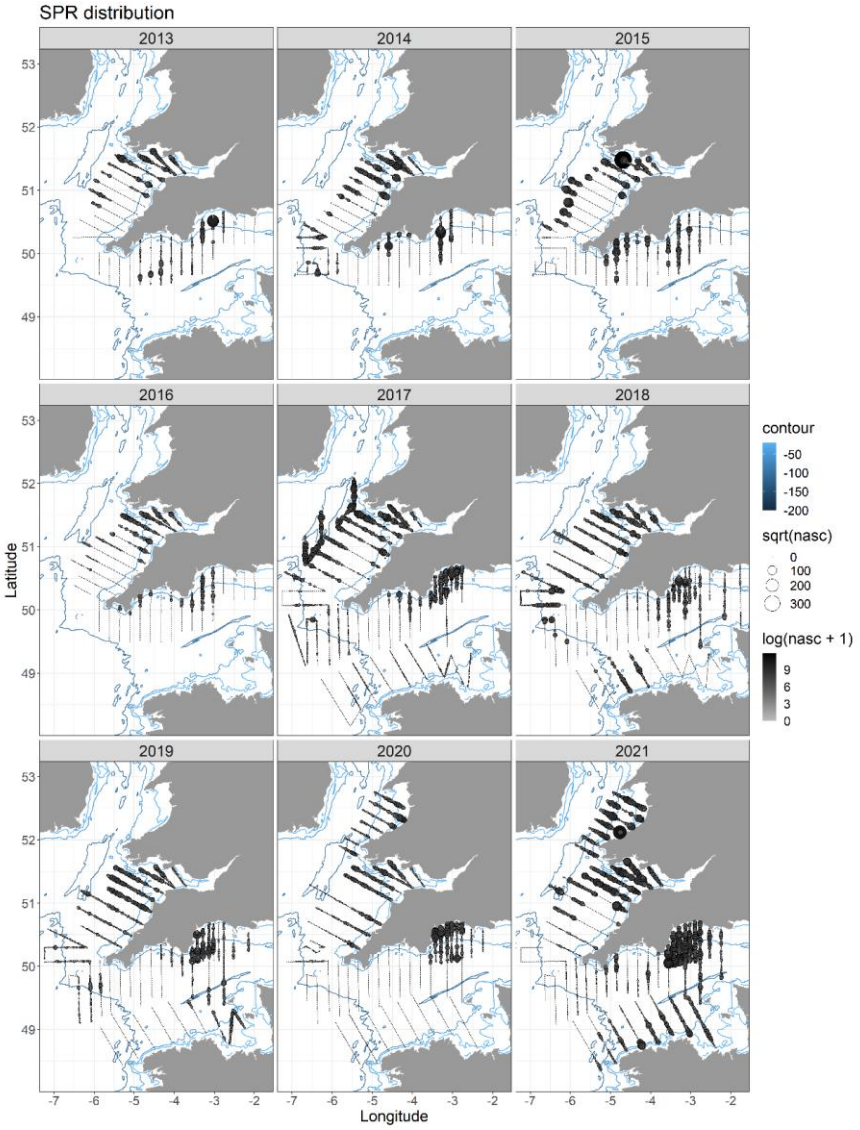

Figure 11.6.1. Sprat in 7.d–e. Acoustic backscatter attributed to sprat per 1 nmi equidistant sampling unit (EDSU) during October from the 2013–2021 PELTIC surveys.

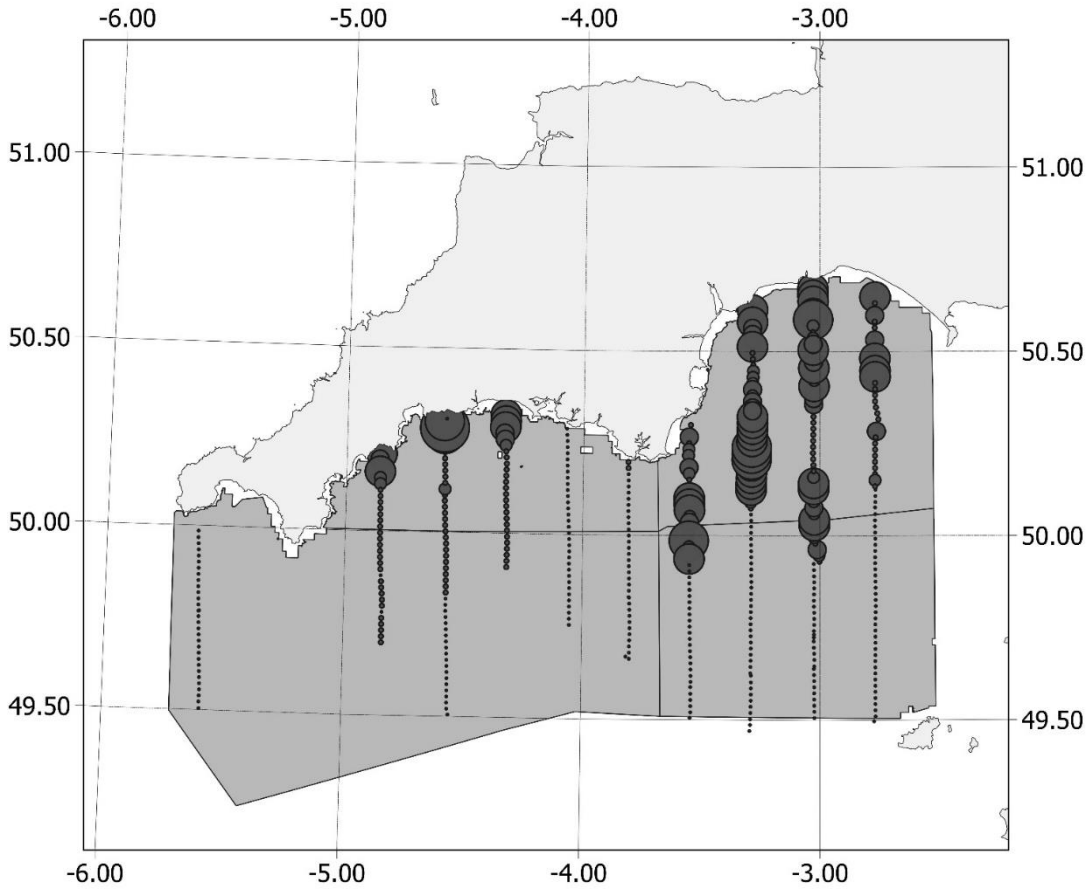

Figure 11.6.2. Sprat in 7.d–e. Acoustic backscatter attributed to sprat per 1 nmi equidistant sampling unit (EDSU) during October from the 2022 PELTIC survey, which reduced spatial coverage.

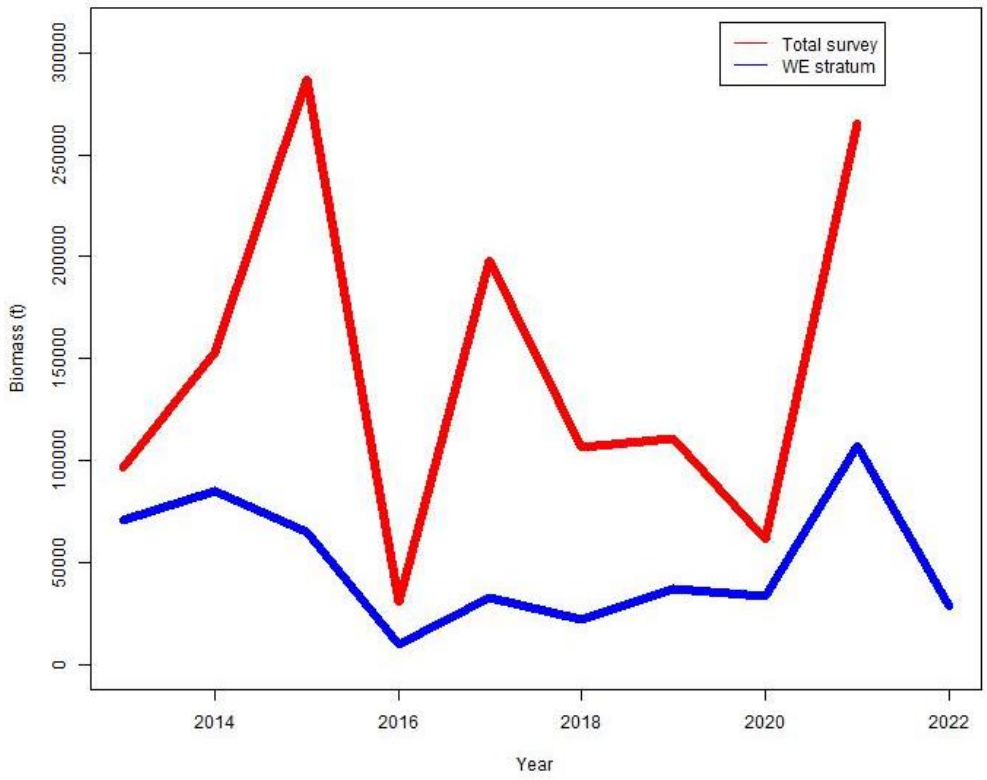

Figure 11.6.3. Sprat in 7.d-e. Biomass of sprat estimated from the PELTIC acoustic survey from 2013 to 2022 for Division 7.e (red line) and the Lyme Bay area (blue line). The Partial survey has not been run since 2019.

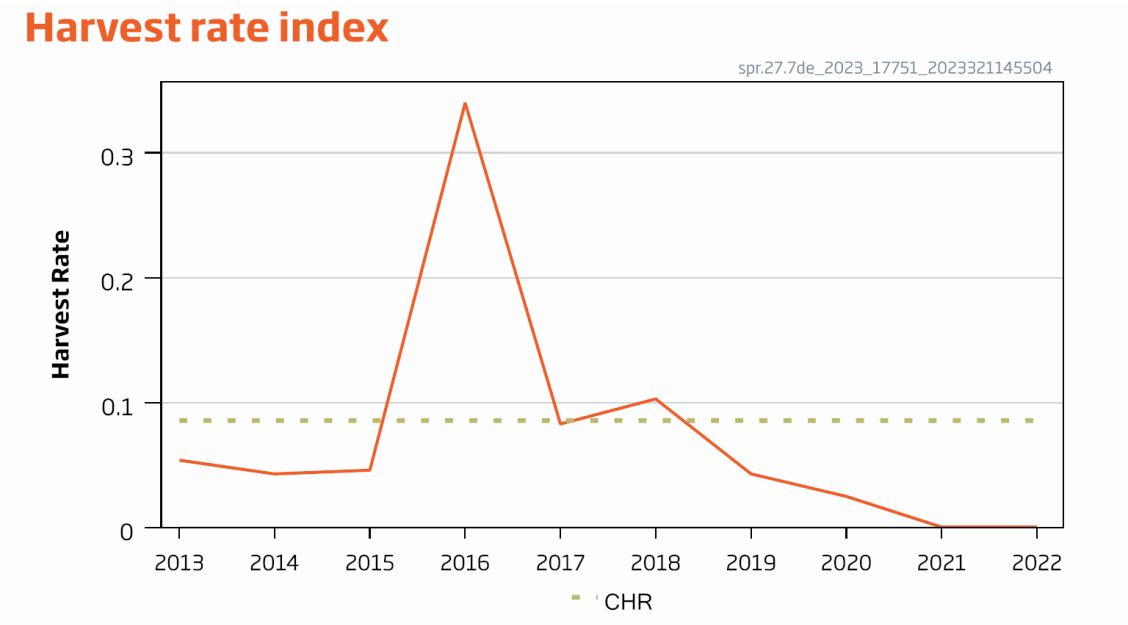

Figure 11.7.1. Sprat in 7.d-e. Constant Harvest rate index (ratio between landings and PELTIC acoustic survey biomass estimate).

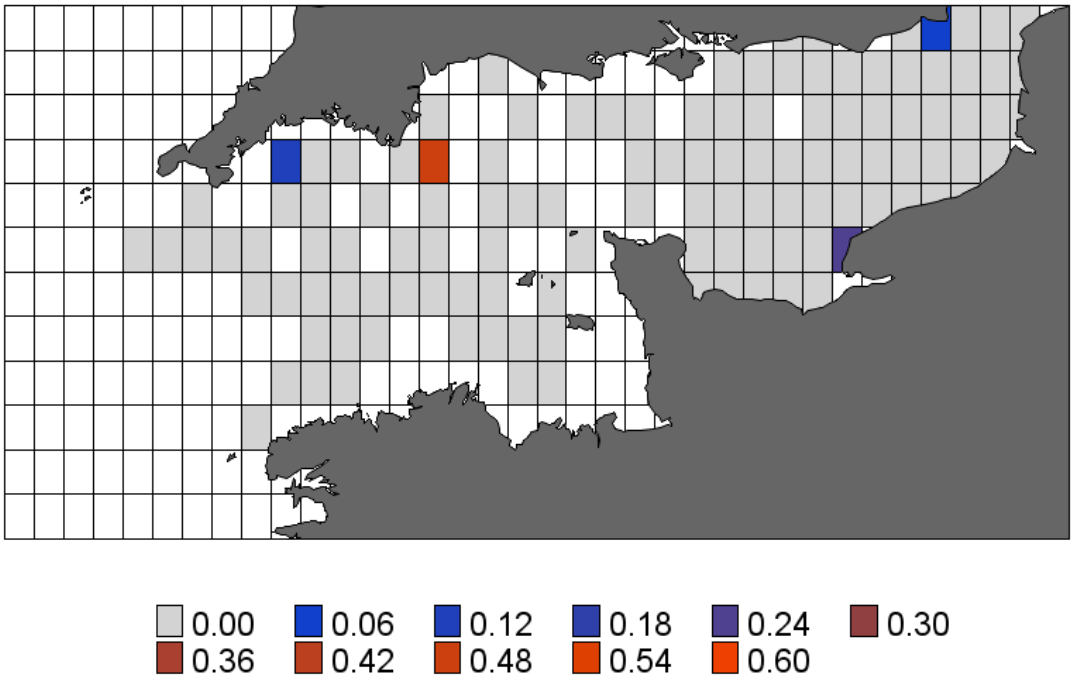

Figure 11.11.1. Proportions of summed sprat distribution in 7.d-e from the 2015-2022 from the IBTS groundfish survey. All rectangles add to 1. Grey rectangles indicate a proportion of between 0 and 0.06. All grey rectangles add to approximately 20%, and the remaining 80% is within 4 coloured rectangles. White cells have not been sampled.

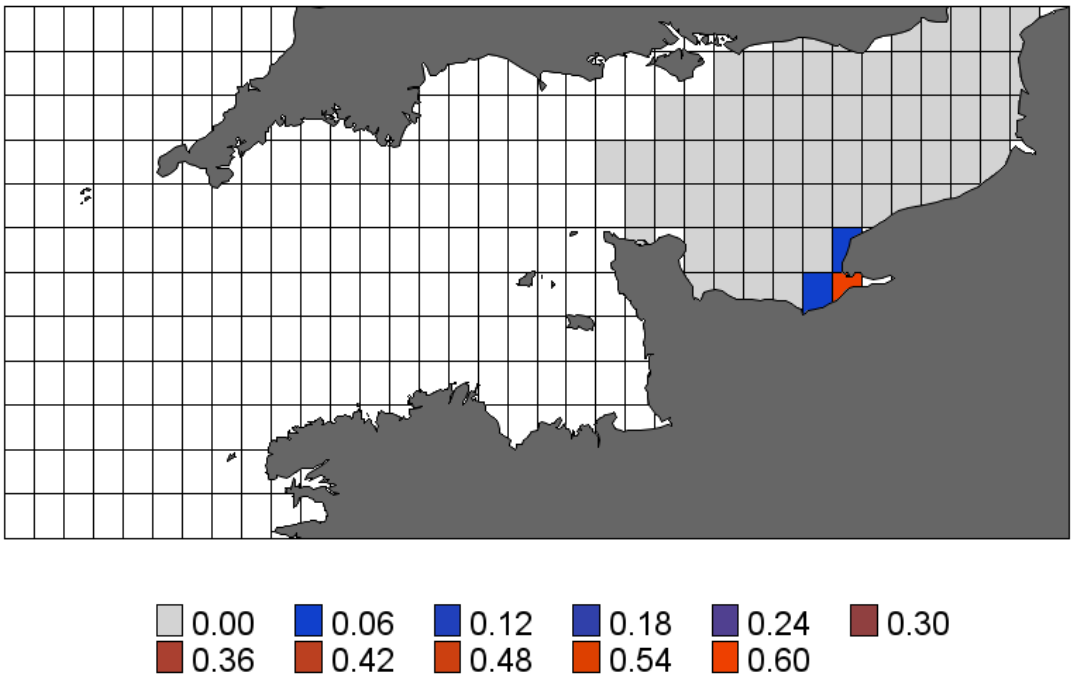

Figure 11.11.2. Proportions of summed sprat distribution from the 1988-2014 from the IBTS groundfish survey, a period when only 7.d was sampled by the survey. All rectangles add to 1. Grey rectangles indicate a proportion of between 0 and 0.06. All grey rectangles add to approximately 10%, and the remaining 90% is within 4 coloured rectangles.

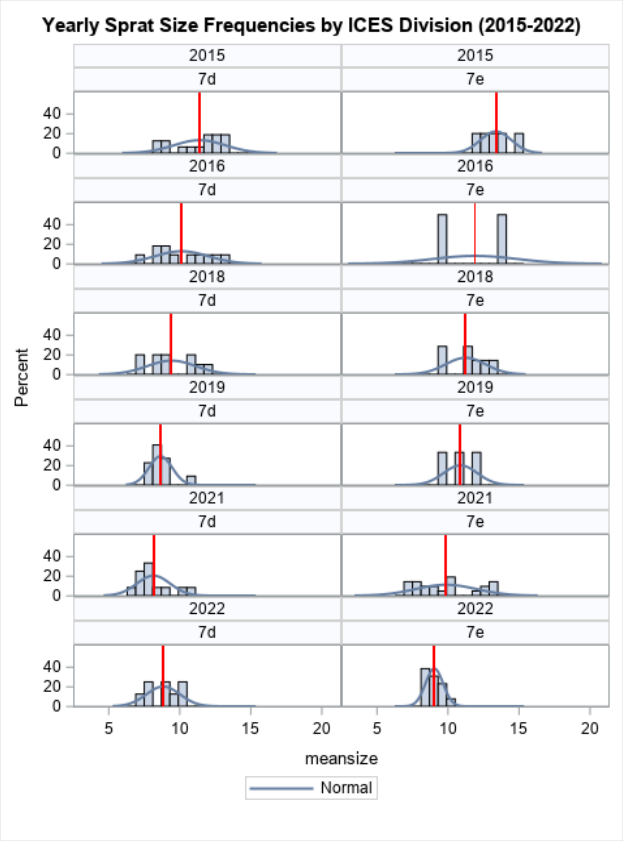

Figure 11.11.3. Length frequency (%) plots for 7d and 7e from the IBTS groundfish survey between 2015-2022. Red vertical line indicates mean length.

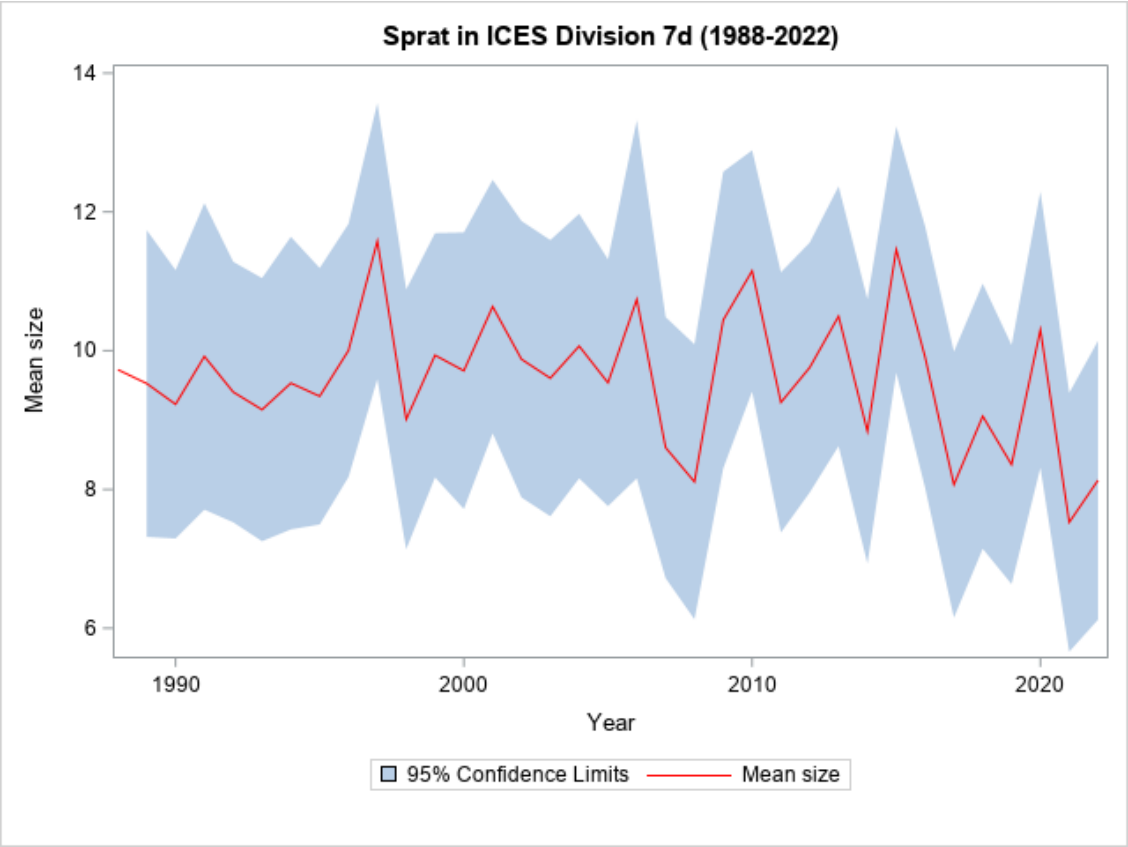

Figure 11.11.4. Mean length (cm) in 7d from the IBTS groundfish survey between 1988-2022. Note the survey vessel changed in 2015.

11.15 References

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