12 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.

12.1 The Fishery

12.1.1 ICES advice applicable for 2021

The advised catch for the English Channel (7.d and e) was set equal to 1446 tonnes.

12.1.2 Landings

The total sprat landings by country are provided in Table 12.1.1. Total landings from the international sprat fishery are available since 1950 (Figure 12.1.1.). 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 UK, England and Wales. 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 particular in the Lyme Bay area. In the last decade catch from UK covered about 99% of landed sprat, however in 2015 and 2016 this percentage diminished, with Netherlands, Denmark, and for the first time in the whole time-series, Germany, contributing to about 11% of the reported landings. In 2020, 100% of the catches were by UK (England, Wales and Northern Ireland).

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.

12.1.3 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 they 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.

12.1.4 Regulations and their effects

There is a TAC for sprat in ICES divisions 7.de, English Channel. Up until recent years the TAC did not limit the sprat landings in this area (Figure 12.1.2).

12.1.5 Changes in fishing technology and fishing patterns

There is insufficient information available.

12.2 Biological Composition of the Catch

12.2.1 Catches in number and weight-at-age

Due to current restrictions from the COVID-19 pandemic in the UK, it has not been possible to recover the data collected by the fishers (self-sampling), but will be available at a later date. The length frequencies are not expected to differ substantially from those reported for 2019-2020

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 in 2020 and the participants in the fishery are keen to continue contributing data and are receptive to improving their sampling scheme and providing useful scientific data in the future. The data shown are raw numbers-at-length in the samples, and not raised to the total catches (Figure 12.2.1 and Figure 12.2.2).

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 12.2.1),. 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 again in 2020 (Figure 12.2.2).

12.3 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.

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.

As part of the 2021 sprat IBP, the ability of the survey to capture the sprat stock (catchability) was evaluated, as this feeds heavily into assumptions of the 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. 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. The survey also provides age and length structure for sprat aged 0-6. 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 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 PELTIC acoustic survey, identified 4 age classes from 0 to 3 contributing on average to 25%, 33%, 36%, and 6% respectively in the samples collected. The age structured observed in 2020 is shown in Figure 12.3.2.

12.4 Mean weight-at-age and maturity-at-age

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

12.5 Recruitment

The acoustic surveys may provide an index of sprat recruitment in divisions 7.d–e. However, further work is required.

12.6 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. I 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 notes that the current advice is given annually, however it is recommended to move to an annual- seasonal calendar. This will reduce 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 remained a risk <5% in the long term under all fishing histories, 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,2021b).

12.6.1 Data exploration

Biomass Index

A 9-year time-series of biomass estimates from the PELTIC survey is shown in Table 12.6.1. Despite being a short time-series, the acoustic survey covers a much wider area compared to the original survey, covering the core area, carried out in partnership with the fishery. A partial estimate of biomass from acoustic data collected by a fishing vessels is normally included in the table, due to COVID-19 this was not possible this year. 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 2020 showed a concentration of 0 age sprat in Lyme bay. This year the survey also covered the area around the Channel Islands (Figure 12.6.1).

Sprat was in general the dominant small pelagic species in the trawl samples, with highest densities in the eastern parts of the western Channel and the Bristol Channel, with the bulk of the biomass centered in Lyme bay (2020). As in previous years, large schools in the Bristol Channel appeared to consist mainly of juvenile sprat, whereas those in the English Channel also included larger size classes. For more details on the survey design see ICES 2015/SSGIEOM:05.

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. 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 samples 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 suggest further work is needed. Specifically for fisheries management, it should be noted that genetically connected stocks may still be isolated on a the time scale of fisheries management.

12.7 State of the Stock

The acoustic estimates for 2017 (32 751t) show a three-time 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 (70 680 t, 85 184 t and 65 219 t respectively). The PELTIC biomass has decreased to 33 798 tonnes in 2020 from 36 789 tonnes in 2019. The harvest rate has dropped from 4% to 2%. This is due low catches in 2020 which are attributed to the COVID-19 pandemic limiting fishing opportunities.

12.8 CATCH ADVICE

Applying the constant harvest rate of 8.57% to the current estimate of PELTIC biomass gives an advised catch of 2897 tonnes.

12.9 Short-term projections

No projections are presented for this stock.

12.10 Reference Points

The IBP suggested the use of the Istat value developed as part of WKDSLLS2 (ICES, 2021) 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.

12.11 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 very little extend outside. In fact, the transects carried out off the French coast found very little sprat, mostly of ages 0 and 1. This pattern may have changed somewhat in recent years as sprat have been recorded off the coast of France and around the channel island in 2018 and 2019.

The extent to which the population migrate 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 suggesting no movements of sprat between the two areas and very little was 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.

12.12 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 2570 tonnes on average. The average harvest rate for the 9 year time-series is 9%, however if the 2016 value of 34% is removed this drop to 6% over the entire time-series. The average harvest rate is 6% over the last 3 years. In general, however, it seems that Lyme Bay, where most of the fishery occurs, consistently hosts quite a substantial part of the sprat stock: this is confirmed by the fact that even in 2016, when the estimated biomass was overall very low, Lyme Bay still contributed 50% of the total sprat population in the Western English Channel.

The strong biomass fluctuations observed in the acoustic index and the relatively strong increase in biomass observed in 2017, suggests that the low level of catch is not impairing the stock and that the reduced sprat biomass is not due to fishing mortality, but it is most likely caused by environmental factors.

The timing of the advice relative to the PELTIC survey should also be considered, currently the survey runs 1 year prior to the generation of the advice which is implemented 1 year later. This is a 2-year time-lag from data collection to advice and has been identified as a weakness in the advice especially for sprat which only live 3-4 years. The move to a CHR has improved the responsiveness of the advice, however the time lag between survey and advice remains an issue.

12.13 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.

Table 12.1.1 Sprat in 7.d-e. Landings of sprat, 1986–2020.

Country	Denmark	France	Netherlands	UK Eng+Wales+N.Irl.	UK Scotland	Other	Total
1986	15	0	0	1 163	0	0	1 178
1987	250	23	0	2 441	0	0	2 714
1988	2 529	2	1	2 944	0	0	5 476
1989	2 092	10	0	1 520	0	0	3 622
1990	608	79	0	1 562	0	0	2 249
1991	0	0	0	2 567	0	0	2 567
1992	5 389	35	0	1 791	0	0	7 215
1993	0	3	0	1 798	0	0	1 801
1994	3 572	1	0	3 176	40	0	6 789
1995	2 084	0	0	1 516	0	0	3 600
1996	0	2	0	1 789	0	0	1 791
1997	1 245	1	0	1 621	0	0	2 867
1998	3 741	0	0	1 973	0	0	5 714
1999	3 064	0	1	3 558	0	0	6 623
2000	0	1	1	1 693	0	0	1 695
2001	0	0	0	1 349	0	0	1 349
2002	0	0	0	1 196	0	0	1 196
2003	0	2	72	1 368	0	0	1 442
2004	0	6	0	836	0	0	842
2005	0	0	0	1 635	0	0	1 635
2006	0	7	0	1 969	0	0	1 976
2007	0	0	0	2 706	0	0	2 706
2008	0	0	0	3 367	0	0	3 367
2009	0	2	0	2 773	0	0	2 775
2010	0	2	0	4 408	0	0	4 410
2011	0	1	37	3 138	0	0	3 176
2012	6	2	8	4 458	0	0	4 474

Country	Denmark	France	Netherlands	UK Eng+Wales+N.Irl.	UK Scotland	Other	Total
2013	0	0	0	3 793	0	0	3 793
2014	45	0	275	3 338	0	0	3 658
2015	0	1	352	2 659	0	0	3 012
2016	185	7	231	2 867	0	49	3 339
2017	0	0	235	2 498	0	0	2 733
2018	474	1	0	1 776	0	0	2 252
2019	0	0.67	0	1544	0	28	1573
2020	0	0	0	873	0	0	873

Table 12.6.1. Sprat in 7.d–e. Annual sprat biomass in ICES Subdivision 7.e (Source: Cefas annual pelagic acoustic sur- vey and partial acoustic survey of Lyme bay from fishing vessel.).

Survey	Area	Season	2013	2014	2015	2016	2017	2018	2019	2020
Partial	Lyme Bay	Oct	62 040	67 538	12 212	6 181	29 996	16 036	30 406	
PELTIC	W Eng Ch	Oct	70 680	85 184	65 219	9 826	32 751	21 772	36 789	33 798

*** ICES rectangles 29E6, 30E6**

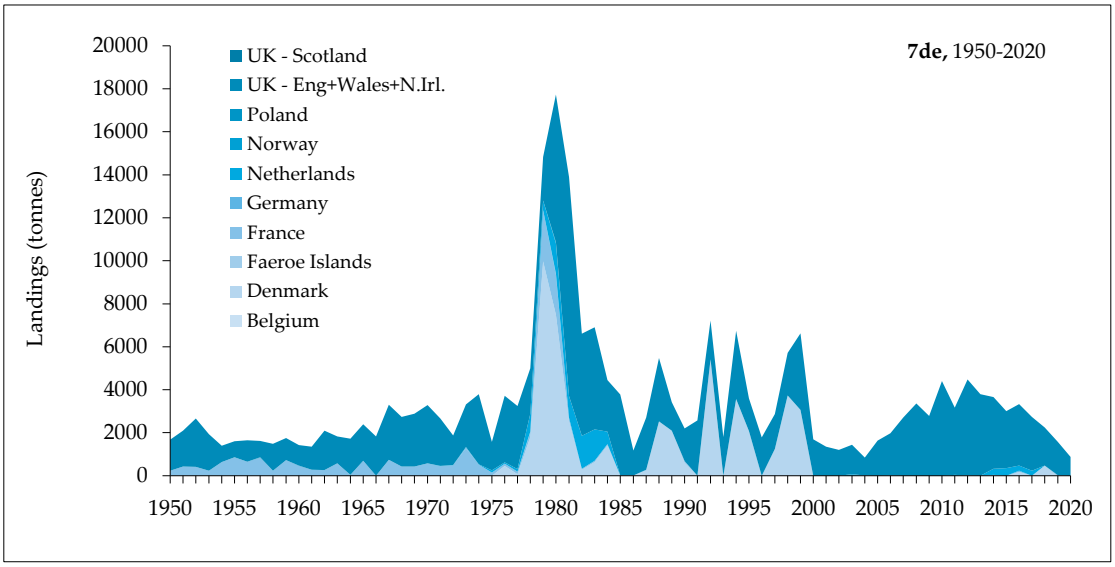

Figure 12.1.1. Sprat in 7.d-e. Landings of sprat 1950–2020.

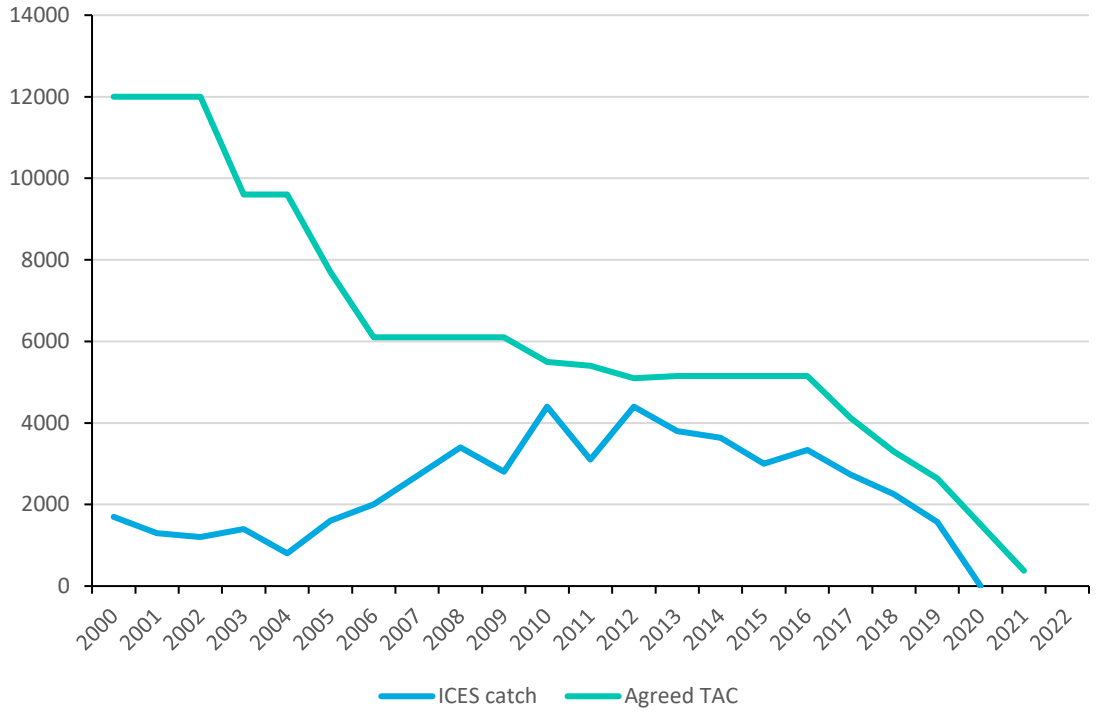

Figure 12.1.2. Sprat in 7.d-e. ICES catch (blue line) and agreed TAC (red line) from 2000 to 2021.

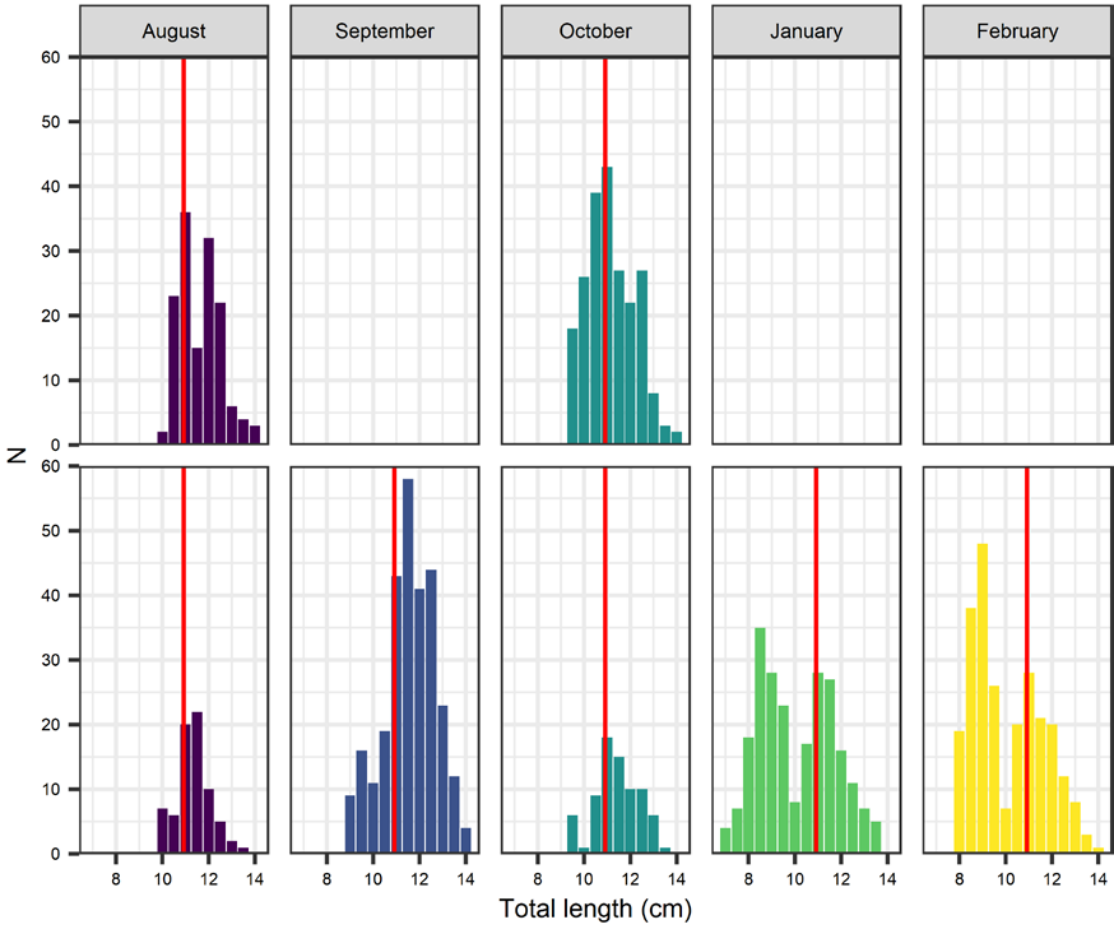

Figure 12.2.1. Length distribution collected by the fishers by month. Red line indicates weighted mean length at each month 2019–2020.

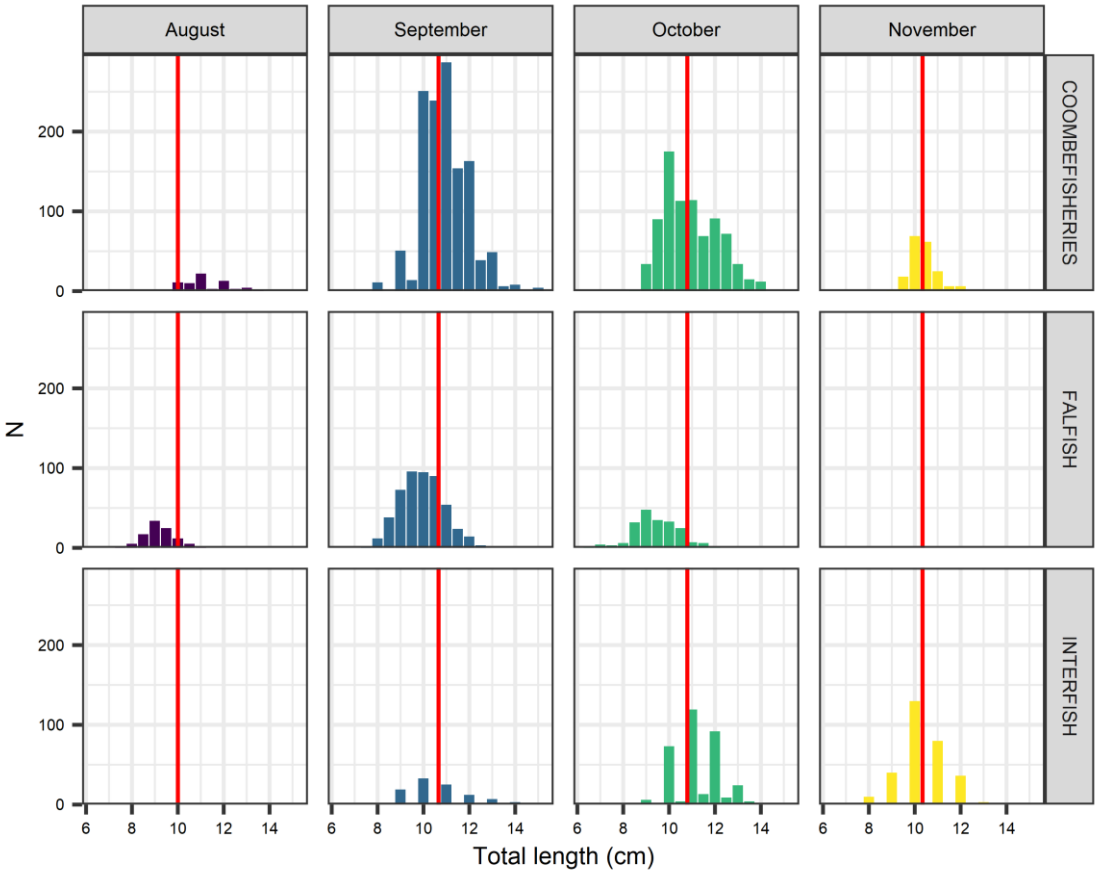

Figure 12.2.2. Monthly collected sprat total length distribution by all processors (3) in season 2019-2020. Red line indicates weighted mean length at each month.

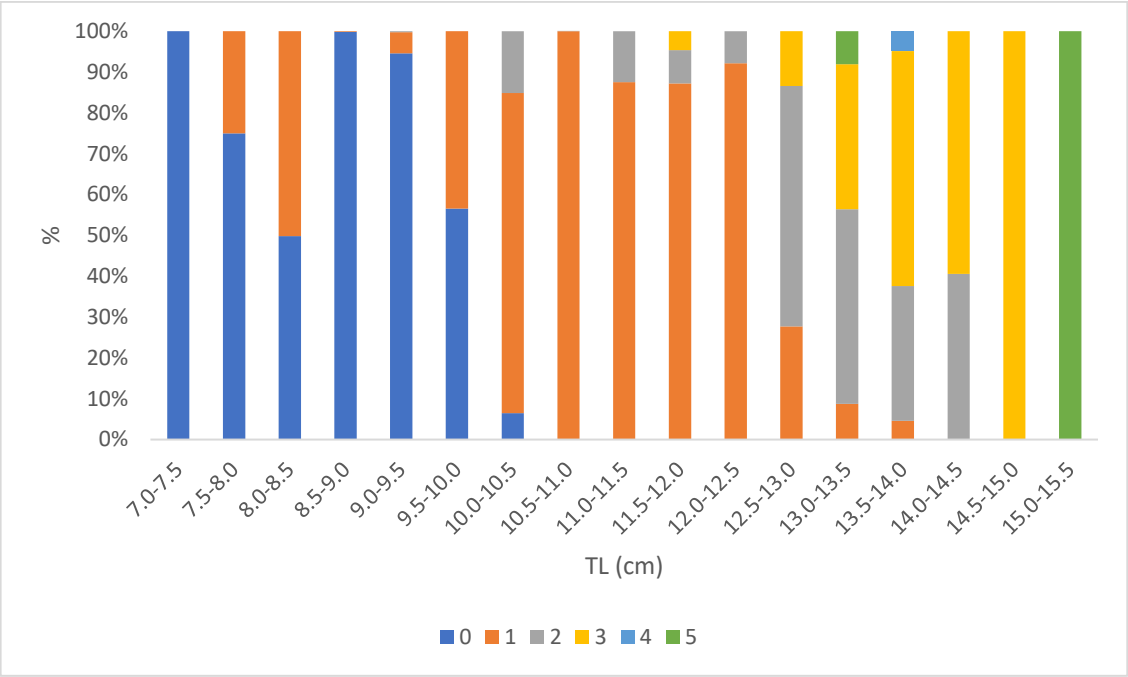

Figure 12.3.2. Sprat in 7.d-e. Proportion of numbers-at-age in the biological sample collected during the 2020 PELTIC acoustic survey.

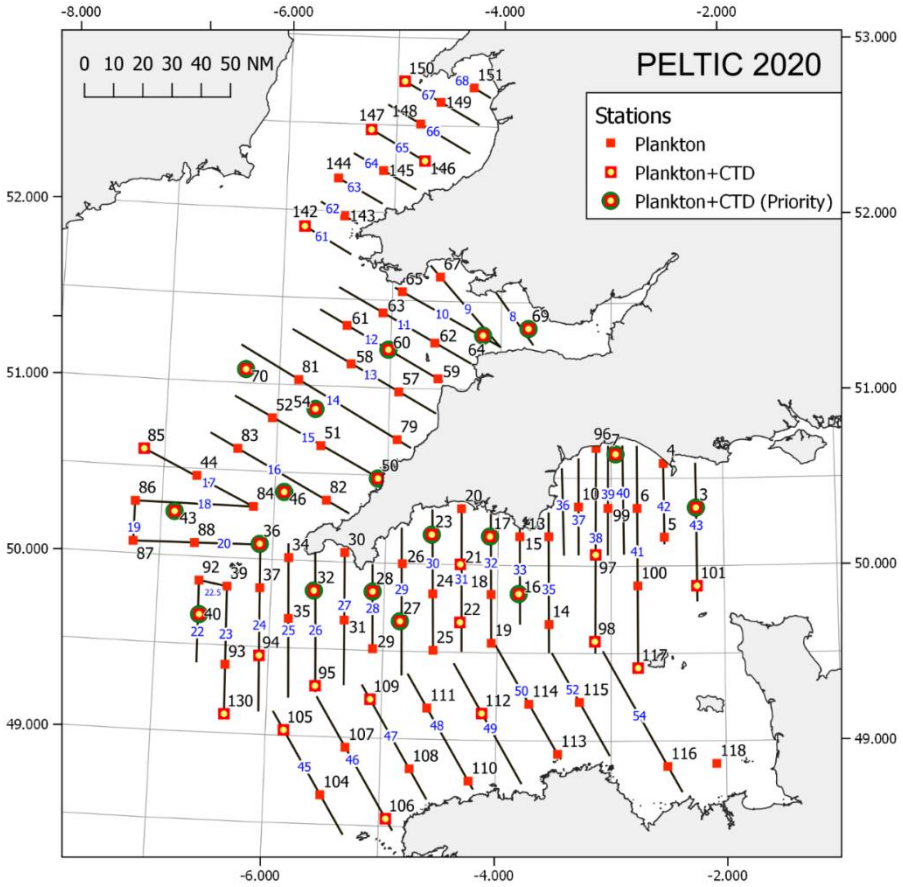

Figure 12.3.1. Sprat in 7.d–e. Survey design (2020) with acoustic transects (blue lines), zooplankton stations (red squares) and oceanographic stations (yellow circles).

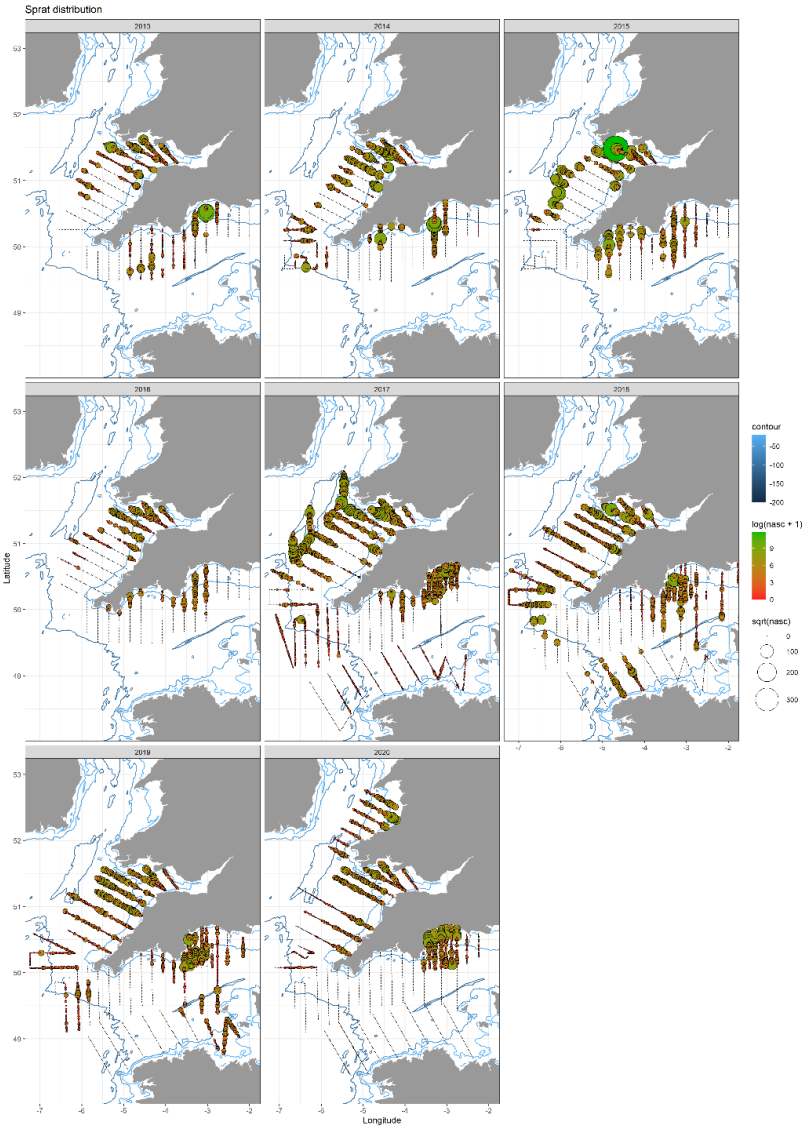

Figure 12.6.1. Sprat in 7.d–e. Acoustic backscatter attributed to sprat per 1 nmi equidistant sampling unit (EDSU) during October from the 2013-2020 PELTIC surveys.

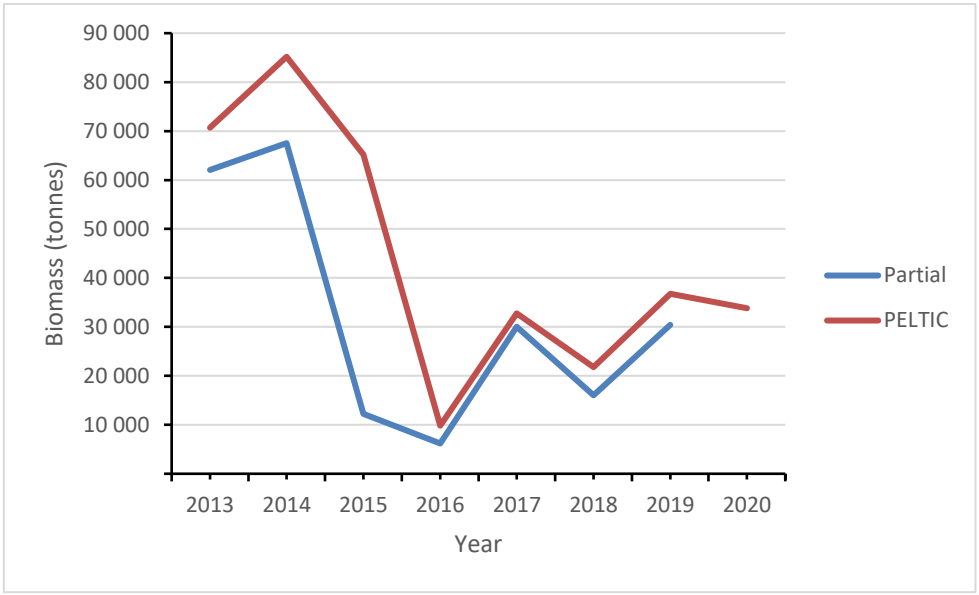

Figure 12.6.2. Sprat in 7.d-e. Biomass of sprat estimated from the PELTIC acoustic survey from 2013 to 2020 for Division 7.e (red line) and the Lyme Bay area (blue line).

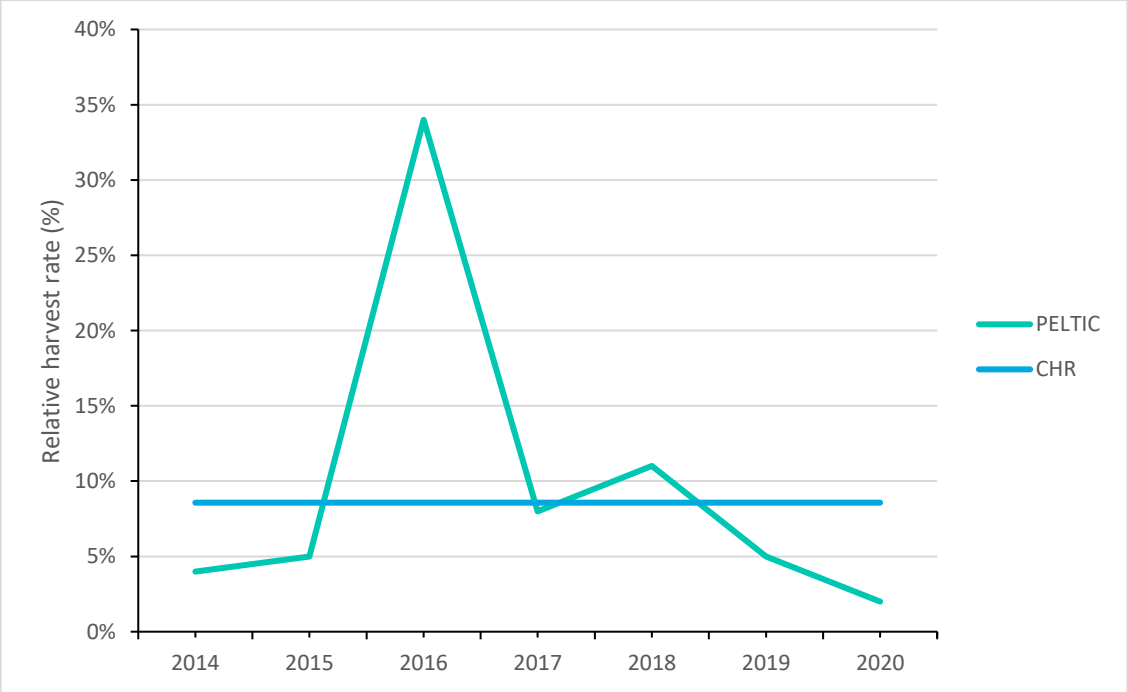

Figure 12.7.1. Sprat in 7.d-e. Constant Harvest rate index (ratio between landings and PELTIC acoustic survey biomass estimate).

12.14 References

Doray, M., Boyra, G., and van der Kooij, J. (Eds.). 2021. ICES Survey Protocols – Manual for acoustic surveys coordinated under the ICES Working Group on Acoustic and Egg Surveys for Small Pelagic Fish (WGACEGG). 1st Edition. ICES Techniques in Marine Environmental Sciences Vol. 64. 100 pp. https://doi. org/10.17895/ices.pub.7462

ICES. 2021. Inter-benchmark to revise the advice framework for the Sprat stock in 7.de based on the most recent changes to data-limited short-lived species assessments (IBPSprat). ICES Scientific Reports. 3:23. 42 pp. https://doi.org/10.17895/ices.pub.7918

McKeown, N. J, Carpi, P., Silva, J. F, Healey, A. J E, Shaw, P. W, and van der Kooij, J. Genetic population structure and tools for the management of European sprat (*Sprattus sprattus*). – ICES Journal of Marine Science, doi:10.1093/icesjms/fsaa113.