Stock Annex: Sprat (*Sprattus sprattus*) in divisions 7.d and 7.e (English Channel)

Stock specific documentation of standard assessment procedures used by ICES.

Stock: Sprat

Working Group: Herring Assessment Working Group for the Area South of 62ºN (HAWG)

Created: February 2013

Authors:

Last updated: 2013

Last updated by: Beatriz Roel (WKPELA)

A. General

A.1. Stock definition

Divisions 7.d and 7.e comprise a management unit for sprat, with an annual TAC being set by the EC. However it is not clear if sprat populations in this area constitute a unit stock; and if this is an appropriate management unit. Until more information is available, advice will be given for this unit, mainly based on information from the Lyme Bay (ICES statistical rectangles 29 and 30 E6, 7).

Most of the catch is taken in Lyme Bay in Subdivision 7.e, where 88% on average of landed sprat are caught.

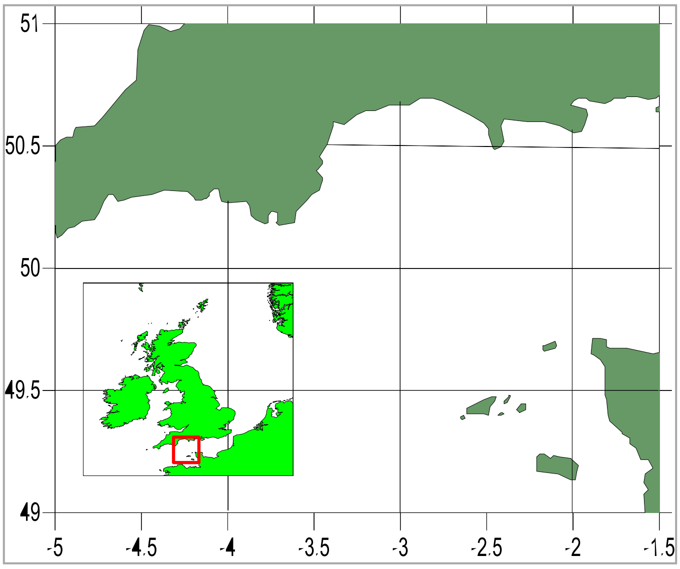


Figure 5.1.2. Sprat in 7.d,e, Lyme Bay. ICES statistical rectangles that constitute Lyme Bay are indicated.

A.2. Fishery

In Lyme Bay the primary gear used for sprat is midwater trawl. Within that gear type three vessels under 15 m actively target sprat and are responsible for the majority of landings (since 2003 they took on average 94% of the total landings). Sprat is also caught by driftnet, fixed nets, lines and pots. Most of the landings are sold for human consumption. The fishery starts in August and runs into the following year into February and sometimes March.

Sprat may also be caught in herring fisheries mixed shoals with herring. The level of discarding is unknown.

A.3. Ecosystem aspects

Fishermen find sprat by sonar search and sometimes the shoals have been too far offshore for sensible economic exploitation. Skippers then go back to other trawling activity. This offshore/ near shore shift may be related to environmental changes i. e. temperature and/or salinity.

B. Data

B.1. Commercial catch

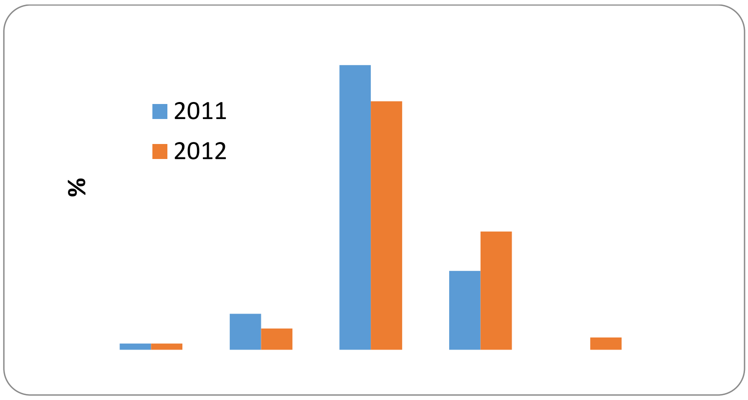
Sprat landings prior to 1985 in 7.d,e were extracted from STATLANT27 (Historical Nominal Catches 1950-2010), from 1985 onwards they are ICES estimates. Since 1985 sprat catch has been taken mainly by UK, England and Wales, with some substantial catches taken by Denmark in the late 1980s. Early landings from Denmark are being looked into as there may be some discrepancies between STATLANT27 and ICES data.

UK landings data are available by gear type from 1981 to date. For trawlers, associated effort was recorded both as number of days and hours fishing. In the case of driftnets effort corresponds to number of hauls times the total number of nets and for gillnet the length of the gear (m) times the number of days fishing. Technological improvements in the fishery such as high technology sonars (such as CH 32), were put in place in the early 1980s.

There is a TAC for sprat for 7.d,e, English Channel.

B.2. Biological

Catch sampling information was not available for ICES. Biological information was collected in the acoustic surveys. Age composition data suggested a majority of age 2 in the survey area. Ages 0, 1, 3 and 4 were also represented. Percentages at age by survey are compared in the plot below.



B.3. Surveys

Acoustic surveys covering the area where the fishery operates were conducted in 2011 and 2012. The surveys are carried out in October, coinciding with the early months of the sprat fishing season, which runs from September to February. The survey included a series of pre-designed parallel, equidistant (10 nautical mile, nmi) transects perpendicular to the coast, covering the ICES rectangles where most of the annual sprat catches in the past decade (Roel *et al.*, 2011) have been made, with particular focus on the western part of Lyme Bay. The pre-designed transects covered a larger area than was feasible, but based on previous experience, it was anticipated that the main sprat concentrations were likely to be found in a relatively small part of the whole area. Given that the location and extent of the sprat distribution was not known in advance of the survey, an adaptive design was adopted, with transects being dropped as the biomass dropped progressively from earlier transects.

A local sprat fishing vessel was chartered for the survey: the 11.98 m FV *Mary Anne*. Although its size restricted its range and speed to some extent, it was imperative to the programme that the survey be conducted using a local fishing vessel experienced in fishing for the target species, i.e. sprat. Also, the aim of the project was to quantify the sprat population targeted by the inshore fishery, and we were confident that the vessel could cover the area of interest adequately.

Acoustic surveying took place during daylight, because sprat disperse into loose aggregations at night (Plirú *et al.*, 2011), so would be more difficult to detect acoustically then. Where possible, the transects were completed from east to west because anecdotal information suggested that sprat move in from the west. Surveying the transects in the opposite direction, therefore, would have increased the likelihood of double counting.

Fisheries acoustic data

Scientific quality acoustic data were collected using a portable EK60 Simrad echosounder operating at 120 kHz, connected to a Furuno GPS. Ping rate was set to 0.4 s^{-1} and pulse duration to 0.256 µs, to collect high-resolution data. The transducer was attached to an over-the-side mount on the port side of the vessel. The mount consisted of a vertically orientated aluminium pole that, when deployed, protruded 2 m below the surface, so that the transducer remained clear of the bubbles formed by the hull during steaming. A 5 inch fin was attached to the aft side of the pole to prevent vortices developing as a result of the drag through the water; they would cause the pole to vibrate during steaming (see van der Kooij *et al.*, 2011, for more detail).

Prior to the survey, the echosounder was successfully calibrated outside Torquay harbour using a 23 mm copper sphere following standard methods (Foote *et al.*, 1987). Depending on weather, the vessel speed during the acoustic transects was a constant 7 knots. Faster than that and in adverse weather, noise would have reduced the quality of the acoustic data.

Acoustic data were recorded continuously. A scanning sonar, traditionally used by the fishery to search for sprat schools, was switched off while running the acoustic transects because it interfered with the acoustic data. When marks were encountered on-transect and a decision made to fish, the vessel would come off-transect and use the sonar to track the schools that had been seen on the echosounder. After completion of the haul, the sonar was switched off again, and the transect resumed where it had been interrupted.

The acoustic data were cleaned and processed after the survey using the processing software Echoview version 5.3 (Myriax). Acoustic data collected during fishing operations and the steam to and from the transect were discarded, retaining only on-transect data. Surface aeration caused by bad weather was removed, setting a surface exclusion line, and acoustic data from closer to the seabed than 0.5 m were also removed, to exclude the strong signals from the seabed. Owing to the presence of occasional noise, interference and weaker scatterings caused by other organisms, several algorithms were applied so that only sprat schools were extracted from the raw data. This included a filter to remove all non-clupeid backscatter and a backscatter threshold (of -60 dB; Figure 2). Sprat schools were identified based on a combination of expert knowledge and trawl catches.

As small numbers of other species were caught in the trawl, acoustic energy was partitioned by species, based on the weight ratios obtained from the trawl catches. Mackerel, however, were not considered because they only give a weak signal at 120 kHz and were automatically filtered out using the algorithm mentioned above.

Trawling

Trawling is conducted using the vessel's standard commercial midwater gear designed to catch sprat. As sprat biomass was calculated from the acoustic data, trawl catches were used only to establish the species composition of the acoustic marks, and to collect biological material on the pelagic fish community, in particular length frequency, and age and maturity information. This meant that only relatively small catches were required, so the skipper ensured this by carefully monitoring the trawl procedure using a combination of the sonar and the netsonde.

Once on board, the catch was sorted by species. Fish were counted and measured to the nearest 0.5 cm or 1.0 cm, depending on species. When catches of a species were very large, a subsample of that species was taken. At every station, however, five sprat from each length category were collected and retained on ice, then once ashore, were frozen and taken on board the RV Cefas Endeavour for further analysis: length, weight, sex and maturity were recorded, and otoliths were extracted for age determination.

Biomass calculation

The acoustic density attributed to sprat (s_A or Nautical Area Scattering Coefficient) was converted into numbers according to standard procedures. First, the TS was calculated for each sprat length group:

$$TS = 20 \text{Log} L + b_{20}, \quad (1)$$

where b_{20} was -74.2 dB at 120 kHz (Saunders *et al.*, 2012), and *L* was the fish length group. This was converted into the backscattering cross section for each length group:

$$\sigma = 4\pi 10^{(TS/10)}, \quad (2)$$

This in turn provided the weighted average backscattering cross section per individual fish. Dividing the s_A or the NASC (mean acoustic energy attributed to sprat) per nmi by this number yielded the mean number of sprat per nmi, which was converted into biomass by multiplying by the mean weight of sprat. Because fish weight could not be determined accurately on board the commercial fishing vessel, the mean weight was derived as follows: a length–weight relationship was calculated based on trawl samples in the area obtained from the international bottom trawl survey which takes place in November. The calculated weight of a sprat at a mean length of 13.27 cm was 16.57 g. The biomass was calculated separately for each of the four ICES rectangles covered in the survey.

B.4. Commercial lpue

A midwater trawl landings per unit of effort (lpue) series were constructed based on the three vessels that take most of the catch around Lyme Bay. Lpue is calculated based on the landings per hour away from port. Annual lpue is presented per hour and by fishing season, which runs from August to February–March depending on the year but referred to by the year when the season started.

Communication with fishermen that target sprat in the Channel has indicated that the fish may not be found on occasions so, if lpue was to be used as an indicator of stock abundance it may be preferable to include all effort spent which would include searching time. If there were no landings in August or March the effort in those months was excluded when computing lpue.

C. Assessment: data and method

For Lyme Bay sprat there is information that can be put forward to inform advice. For the rest of Divisions 7.d,e there is insufficient information to assess the state of the stock. The majority of sprat caught in 7.d, e is taken in the Lyme Bay area. The proportion of landings between Lyme Bay and the rest of the area should be monitored to ensure that the assessment covers the main part of the fisheries.

Lyme Bay

Relevant information to inform the advice for the Lyme Bay area are:

- trends in the lpue since 1988;
- trends in the acoustic survey index since 2011.

Exploratory (Schaefer, Bayesian) assessments will be further developed before they can be benchmarked.

CATCH ADVICE

Catch advice was based on category 3 (WKLIFE 2012) according to the data and analysis that were available. This category includes stocks for which survey indices (or other indicators of stock size such as reliable fishery-dependent indices are available that provide reliable indications of trends in stock metrics such as mortality, recruitment and biomass. Those are a time-series of lpue (1988- 2012) and two acoustic surveys (2011 and 2012) performed in the area where the fishery takes place in the vicinity of Lyme Bay.

A Depletion-Corrected Average Catch (DCAC) procedure was implemented but based on the data available it was not considered appropriate.

Data and computations

Catch and lpue data and, predicted lpue based on the surplus production model for 2008 – 2012 were used. The period chosen was based on common practice.

	Catch	lpue	pred lpue
2008		1029.26	938.008
2009		773.19	896.942
2010	4404.294	1526.95	898.397
2011	3136	1047.41	827.981
2012	4434	1988.61	835.466
C(2010-2012)	3991.431		
Unc Cap +	4789.718		
Unc cap -	3193.145		
lpue(2011-12)		1518.01	831.7235
lpue(2008-10)		1109.8	911.1157

Catch advice in 2014 is computed according to the following equation:

$$C_{y+1} = C_{y-1}\left(\frac{\sum_{i=y-x}^{y-1} I_i/x}{\sum_{i=y-z}^{y-x-1} I_i/(z-x)}\right)$$

Where I is the survey index, x is the number of years in the survey average, and $z > x$. For example, $x = 2$ would be a two year survey average, and $x = 2$ $z = 5$, which is analogous to the five steps in the ICES MSY transition from 2010 to 2015 (ICES Introduction 1.2);

An Uncertainty Cap and the Precautionary buffer were also applied. The catch advice was based on the observed lpue as the surplus production model is exploratory and not an accepted assessment at present.

D. Short-term projection

No short-term projections are put forward.

E. Medium-term projections

No medium-term projections are put forward.

F. Long-term projections

No long-term projections are put forward.

G. Biological reference points

No precautionary reference points are defined for sprat populations in this region.

H. Other issues

The advice for sprat in Lyme Bay can be better informed if in time the acoustic survey is long enough to be able to tune this with other tuning data such as the lpue and landing statistics such as number or weight in the landings, mean weight-at-age or maturity-at-age. When this is will be the case depends on the length of the time-series (at least five years) and the consistency with other information.

H.1. Historical overview of previous assessment methods

ICES has started to give quantitative advice for this datalimited stock in 2012.

I. References

Foote KG, Knudsen HP, Vestnes G, MacLennan DN, Simmonds E.J. 1987. Calibration of acoustic instruments for fish density estimation: a practical guide. Report No. 144. ICES, Copenhagen.

Historical Nominal Catches 1950-2010. Version 30-11-2011. Accessed 13-03-2015 via http://ices.dk/marine-data/dataset-collections/Pages/Fish-catch-and-stock-assessment.aspx. ICES, Copenhagen.

Official Nominal Catches 2006-2013. Version 12-02-2015. Accessed 13-03-2015 via http://ices.dk/marine-data/dataset-collections/Pages/Fish-catch-and-stock-assessment.aspx. ICES, Copenhagen.

Plirú A, van der Kooij J, Engelhard GH, Fox CJ, Milligan SP, Hunter E. 2011. Is recruitment of plaice in the Irish Sea constrained by predation of eggs by sprat? Report No. ICES CM 2011/H: 33.

Roel, B. A., Readdy, L., and van der Kooij, J. 2011. Review of UK data for sprat in the English Channel (VIId, e). Working Document presented to the Herring Assessment Working Group 2011, Copenhagen.

Van der Kooij, J., Brown, D., and Roel, B. A. 2011. Western Channel sprat (*Sprattus sprattus* L.) population assessment. FSP Programme Report, 32. 16 pp. Available at: http://www.cefas.defra.gov.uk/media/585780/mf050_report2011_vfinal2.pdf.