

11. Biodiversity and ecosystem services: marine

Type: State/benefit indicator

Indicator Description

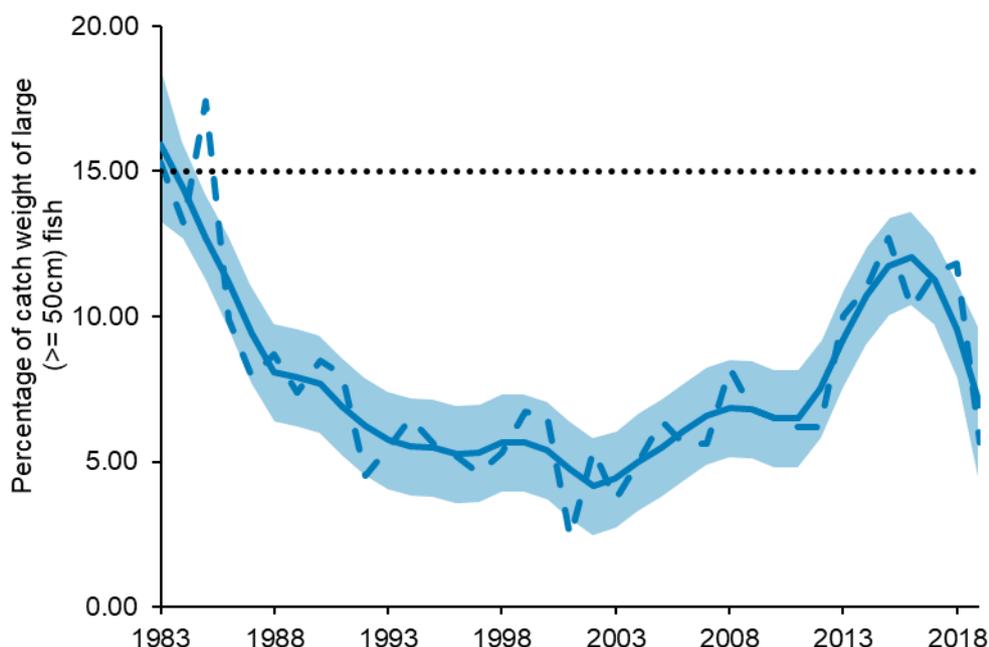
The indicator shows changes in the proportion, by weight, of large individuals equal to or over 50 cm in length in demersal (bottom-dwelling) fish populations in the North Sea. Changes in the size structure of fish populations and communities reflect changes in the state of the fish community. Fluctuations in values between years are expected given inter-annual fluctuations in the distribution and abundance of North Sea fish populations and sampling variation.

Fish size classes in the North Sea

Since the previous publication additional data have been provided for the North Sea. No updates have been provided for the Scottish Continental Shelf, Irish Sea and the Celtic Sea.

In 2019, large fish in the North Sea survey made up 6% of the weight of the fish community (Figure 11.1). This is below the value of 15% recorded in 1983 but above the low of 2% in 2001, followed by a rapid recovery to 13% in 2015 and dramatic fall between 2018 and 2019.

Figure 11.1: Percentage of large fish (equal to or larger than 50 cm), by weight, in the North Sea, 1983 to 2019



Notes:

1. The line graph shows the unsmoothed trend (dashed line) and a LOESS smoothed trend (solid line) with the shaded area showing the 95% confidence intervals around the smoothed trend.
2. The black horizontal dashed line shows the assessment target from OSPAR (2017).
3. LOESS is a non-parametric regression method; it may be understood as standing for "LOcal regrESSion".

Source: Centre for Environment, Fisheries and Aquaculture Science; Marine Scotland.

The indicator shows changes in the proportion, by weight, of large individuals equal to or over 50 cm in length in demersal fish populations in the North Sea. The indicator is based on standardised

trawls from international scientific surveys conducted annually. During the 1980s, large fish in the North Sea fish community included cod (*Gadus morhua*), ling (*Molva molva*), haddock (*Melanogrammus aeglefinus*), saithe (*Pollachius virens*), anglerfish (*Lophius piscatorius*) and rays (*Batoidea*). Recently, lesser spotted dogfish (*Scyliorhinus canicula*), hake (*Merluccius merluccius*) and smoothhounds (*Mustelus* spp.) have also formed a substantial part of the large fish catches in the North Sea. In 2019, a substantial reduction in large cod and saithe was evident in the survey along with an increase in small haddock, whiting (*Merlangius merlangus*), and dab (*Limanda limanda*).

The measure for the North Sea is used as the main indicator because it is based on the largest dataset that includes an assessment target period (early 1980s), and it is supported by publications, and therefore provides the most reliable indicator of change.

Figure 11.1 presents the LOESS smoothed trend that is used to assess both long-term and short-term trends in the proportion of large individuals in North Sea fish populations.

Indicator assessment

Assessment of change in the proportion of large fish, by weight

Fish size in the North-western North Sea: Long term (1983 to 2019): Deteriorating; Short term (2014 to 2019): Deteriorating; Latest year (2019): Decreased

Note: The long-term and short-term assessments have been made by the Centre for Environment, Fisheries and Aquaculture Science (Cefas) by assessing change in the fitted LOESS smoothed trend.

Relevance

Change in the relative abundance of large fishes is likely to affect marine ecosystems in several ways. Fewer large fish will reduce the amount of predation on smaller prey species and allow increases in their abundance and biomass. In turn, this will affect the structure and stability of the ecosystem. The indicator responds to fishing impacts on the fish community because larger fish are more likely to be caught by trawls, and because larger species of fish are more likely to decline in number for a given rate of fishing (Engelhard *et al.*, 2015; Greenstreet *et al.*, 2011; 2012). When fish communities are more heavily fished the proportion of large fish is expected to fall, and when fishing is reduced the proportion of large fish is expected to rise, albeit with a multi-year delay. Some variation in the proportion of large fish will be driven by environmental variation and, in the long term, increases in temperature may lead to decreased body size of demersal fish in the North Sea (Queirós *et al.*, 2018). However, in the short term (over periods of a few years), environmental effects on this indicator are expected to be relatively small in relation to fishing effects.

The indicator is relevant to outcomes 2 and 2c in [Biodiversity 2020: A strategy for England's wildlife and ecosystem services](#) (see Annex A). The indicator is also relevant to international goals and targets (see Annex B of the aforementioned publication).

Background

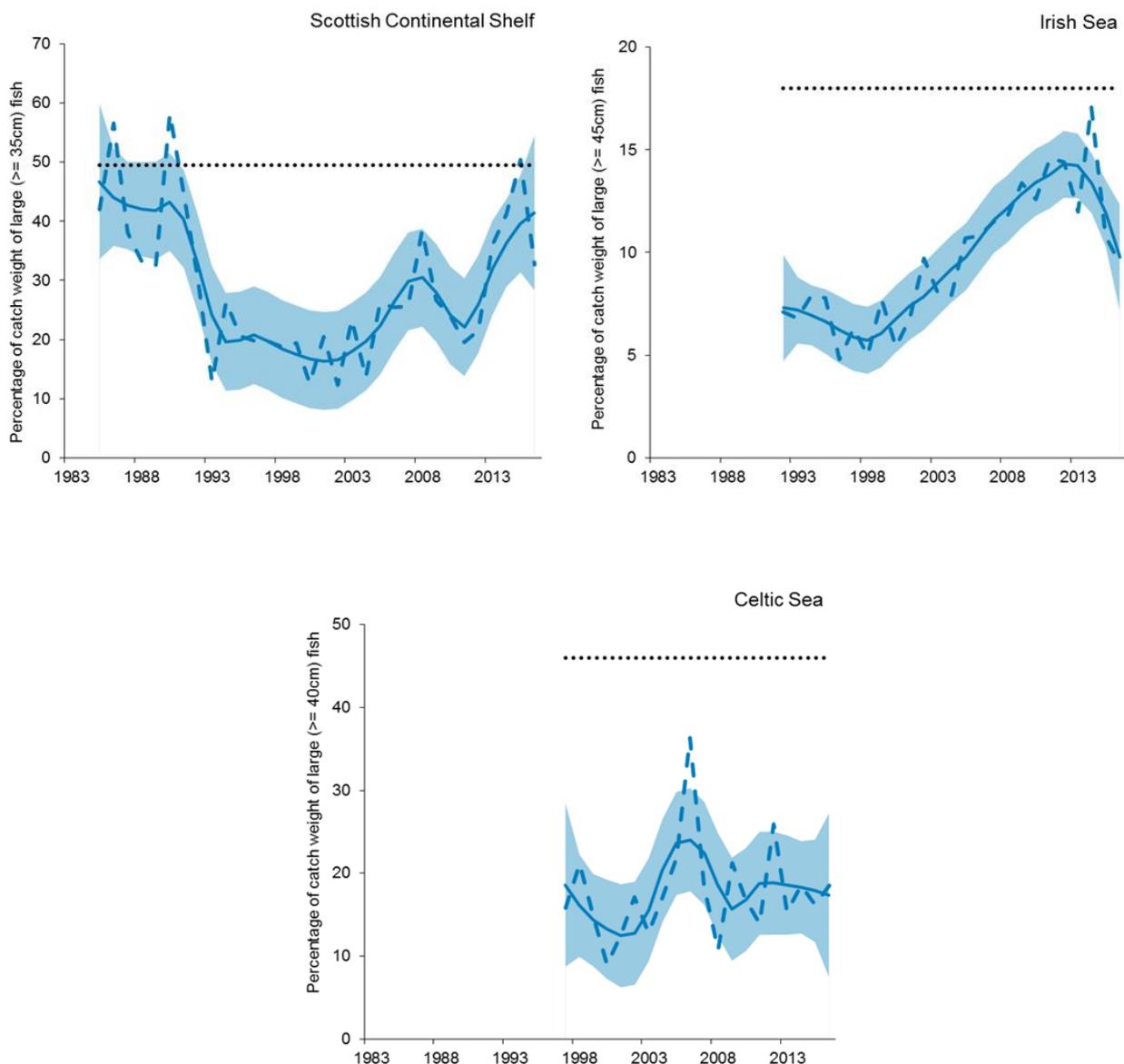
The indicator is compiled using methods based on those developed by the International Council for the Exploration of the Sea (ICES) for the analysis of International Bottom Trawl Survey data (ICES, 2007). These methods were further developed for the OSPAR Intermediate Assessment 2017, and have since been updated (Greenstreet and Moriarty, 2017; Moriarty *et al.*, 2017; Moriarty and Greenstreet, 2020). Data on fish length are taken from surveys carried out in the North Sea during the first quarter of each year. All fish are measured as part of the survey, but only demersal fish species are used in the indicator.

To compile the indicator, the proportions of fish in the North Sea greater than or equal to 50 cm are estimated by weight. For other seas, a different target for 'large' is selected based on signal-to-noise analyses. Technical documentation for the indicator is available from <https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/fish-and-food-webs/proportion-large-fish-large-fish-index/>. The method involves additional

averaging of catch densities across hauls within ICES rectangles, prior to summation of the large and total fish components for the large fish indicator (LFI) ratio calculation.

The background to this indicator previously included information from sub-divisional assessments within the North Sea, but current assessments (last updated in 2016) are only available at the regional sea level (Figures 11.2 and 11.3). From the previous extensive OSPAR assessment, 3 otter trawl surveys were selected to provide the key data for each regional sea area, considering the length of the time-series, spatial coverage and quality of data. These surveys are: the Scottish otter trawl survey in Quarter 1 for the Scottish Continental Shelf, the Northern Irish otter trawl survey in Quarter 1 for the Irish Sea, and the northern part of the French otter trawl survey in quarter 4 for the Celtic Sea.

Figure 11.2: Proportion of large fish (survey specific threshold for 'large' size), by weight, in the Scottish Continental Shelf (1985 to 2016), Irish Sea (1992 to 2016) and Celtic Sea (1997 to 2016)



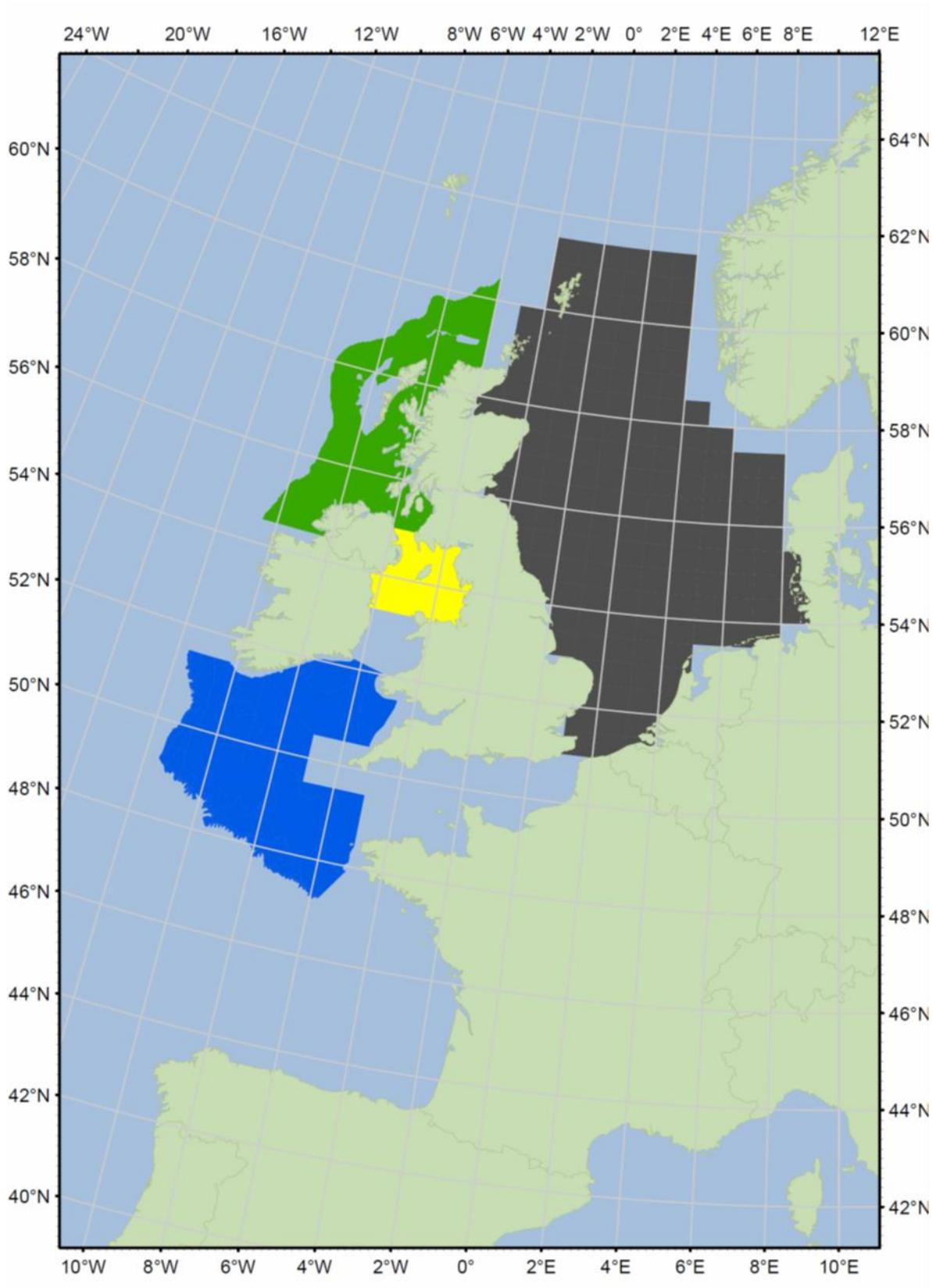
Notes:

1. Each line graph shows the unsmoothed trend (dashed line) and the LOESS smoothed trend (solid line) with the shaded area showing the 95% confidence intervals around the smoothed trend.
2. The black horizontal dashed line show the assessment target from OSPAR (2017).

3. LOESS is a non-parametric regression method; it may be understood as standing for "LOcal regrESSion".

Source: Centre for Environment, Fisheries and Aquaculture Science; Marine Scotland.

Figure 11.3: Areas surveyed to generate the fish size class indicator for the seas around the UK: North Sea – dark grey, Scottish Continental Shelf – dark green, Irish Sea – yellow and Celtic Sea – dark blue



Source: Centre for Environment, Fisheries and Aquaculture Science.

Key findings for the 3 survey areas (see Figure 11.2) are:

Scottish Continental Shelf

In 2016, large fish (≥ 35 cm) made up approximately 33% of the weight of the surveyed demersal fish community. This was lower than the 42% observed in 1985 and lower than the 50% target, but there are signs of recovery in the data. While there was a clear decline in the indicator during the 1990s to 12% in 2002, the smoothed trend has shown increases with fluctuations since that time.

Irish Sea

In 2016, large fish (≥ 45 cm) made up approximately 10% of the weight of the surveyed demersal fish community. This was higher than the 7% recorded in 1992, but lower than the peak of 17% recorded in 2014 of 17%. Although recovery was prominent until 2014, a subsequent fall was observed in 2015 and 2016. This fall is due to a rapid increase in the biomass of small fish, predominately whiting (*Merlangius merlangus*) that do not contribute to the large fish component. The surveyed biomass of large fish has, in fact, continued to increase since 2014 but at a slower rate than the biomass of small fish.

Celtic Sea

In 2016, large fish (≥ 40 cm) made up approximately 19% of the weight of the surveyed demersal fish community. This was slightly higher than the 16% recorded in 1997 but below the target of 46%, and lower than the 36% recorded in 2006. Although the long-term smoothed trend has been largely stable there was a fluctuation to higher values in the mid-2000s.

Web links for further information

Defra Science: [Development of a Marine Trophic Index for UK waters and recommendations for further indicator development. Project code: WC0604](#)

International Council for the Exploration of the Sea: [ICES home page](#)

OSPAR Intermediate Assessment 2017: [Proportion of large fish \(large fish index\)](#)

UK Marine Strategy Assessment 2019: Proportion of Large Fish (Large Fish Index), UK Marine Online Assessment Tool 2019. Available at <https://moat.cefas.co.uk/biodiversity-food-webs-and-marine-protected-areas/fish/large-fish-index/>

References

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Queirós A.M., Fernandes J., Genevier L. & Lynam C.P. (2018) Climate change alters fish community size-structure, requiring adaptive policy targets. *Fish and Fisheries*. 2018; 00:1–9. <https://doi.org/10.1111/faf.12278>

Last updated: October 2020

Latest data available:

Proportion of large fish by weight in the North Sea – 2019;

Proportion of large fish by weight in the Scottish Continental Shelf – 2016;

Proportion of large fish by weight in the Irish Sea – 2016;

Proportion of large fish by weight in the Celtic Sea – 2016