

D1. Biodiversity and ecosystem services

D1a. Fish size classes in the North Sea

**Type:** State / Benefit Indicator

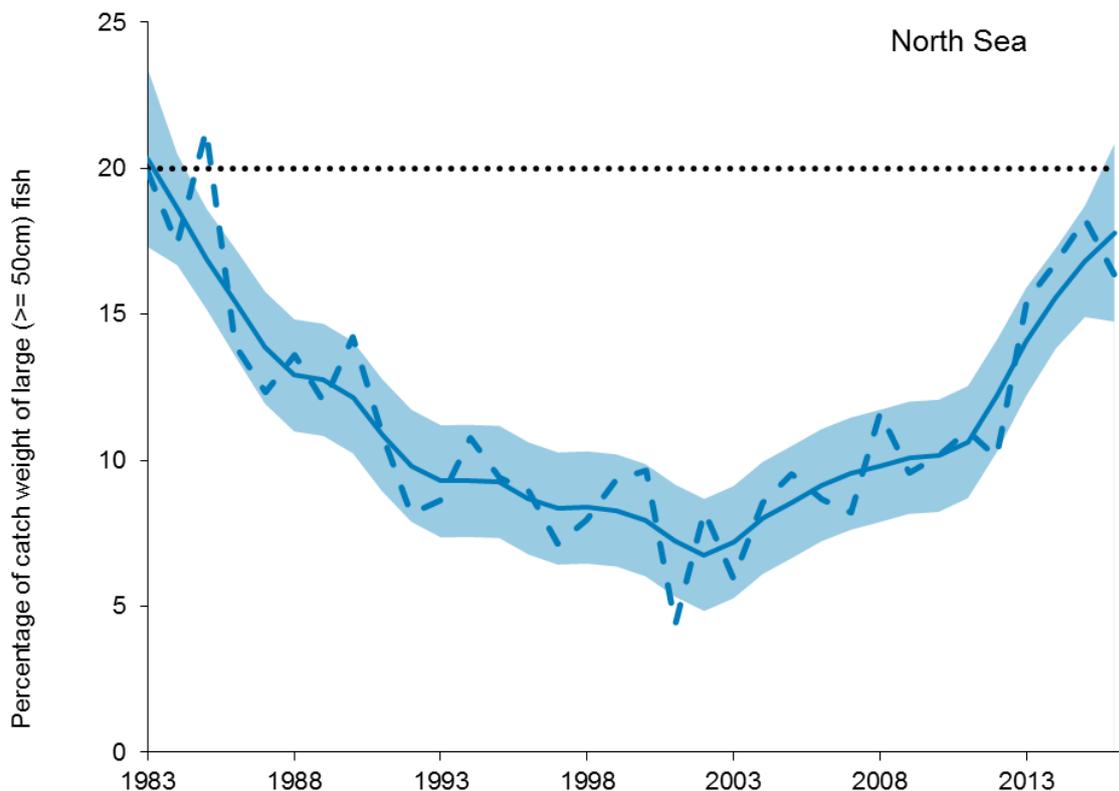
Since the previous publication additional data are provided for the North Sea and metrics for other regional seas have been restated. The size structure has also been changed from 40cm to 50cm.

**Indicator Description**

The indicator shows changes in the proportion, by weight, of large individuals equal to or over 50cm 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

In 2016, large fish in the North Sea survey made up 16% of the weight of the fish community. This is close to the value of 20% recorded in 1983 and a noticeable increase from a low of 4% in 2001. While there was a clear decline in the indicator from 1983 to 2001, there has been rapid recovery since and this pace of recovery accelerated after 2010.

**Figure D1ai. Proportion of large fish (equal to or larger than 50cm), by weight, in the North Sea, 1983 to 2016.**



**Notes:** The line graph shows the unsmoothed trend (dashed line) and a LOESS smoothed trend (solid line) with the shaded area showing the 95 per cent confidence intervals around the smoothed trend. The horizontal dashed line shows the assessment threshold.

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

Assessment of change in the proportion of large fish, by weight			
	Long term	Short term	Latest year
North Sea	 1983–2016	 2011–2016	Decreased (2016)

**Notes:** The long-term and short-term assessments have been made by the Centre for Environment, Fisheries and Aquaculture Science (Cefas) by fitting a LOESS smoothed trend to the index. LOESS is a non-parametric regression method; it may be understood as standing for "LOcal regrESSion".

### Indicator description

The indicator shows changes in the proportion, by weight, of large individuals equal to or over 50cm 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 (*Scylliorhinus canicula*), hake (*Merluccius merluccius*) and smoothhounds (*Mustelus* spp.) have also formed a substantial part of the large fish catches in the North Sea.

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

Figure D1ai 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.

### Relevance

Change in relative abundance of large fishes is likely to affect marine ecosystems in a number of ways. Fewer large fishes 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 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), but in the short term (over periods of a few years) available evidence suggests environmental effects on this indicator are relatively small in relation to fishing effects.

### 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) and further developed for the OSPAR Intermediate Assessment 2017 (Greenstreet and Moriarty, 2017). Data on fish length are taken from the North Sea during the first quarter of each year. All fish are measured as part of the survey.

To compile the indicator, the proportions of fish greater than or equal to 50cm are estimated by weight. The technical paper that accompanies this indicator outlines the background to the development of the 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 Index (LFI) ratio calculation. In addition, corrections have been made to the underlying data as part of an ongoing process to improve quality control. For these reasons, absolute values of the indicator differ slightly from those reported in previous years.

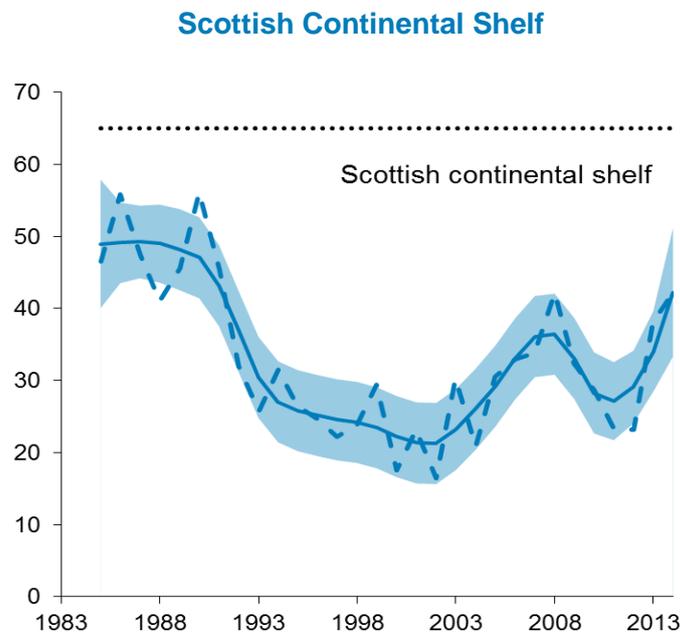
The background to this indicator previously included information from sub-divisional assessments within the North Sea, but current assessments are only available at regional sea level (Figure D1aii and D1aiii). From the extensive OSPAR assessment, 3 otter trawl surveys were selected here to provide the key data per UK sea area given length of 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. Key findings for these areas are as follows:

**Scottish Continental Shelf.** In 2014, large fish ( $\geq 35$  cm) made up approximately 42% of the weight of the surveyed demersal fish community. This was lower than the 47% observed in 1983 and lower than the 65% target, but there are signs of recovery in the data. While there was a clear decline in the indicator during the 1990s to 16% in 2002, the smoothed trend has shown increases with great fluctuations since that time.

**Irish Sea.** In 2015, large fish ( $\geq 45$  cm) made up approximately 19% of the weight of the surveyed demersal fish community. This was higher than the 7% in 1992 demonstrating recoveries in the community and the trend is approaching the 23% target.

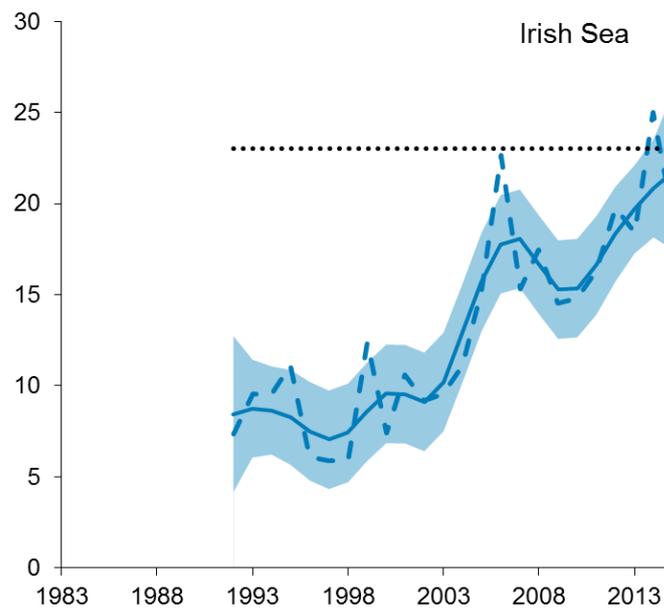
**Celtic Sea.** In 2015, large fish ( $\geq 40$  cm) made up approximately 26% of the weight of the surveyed demersal fish community. This was slightly lower than the 29% recorded in 1997 and below the 67% target. The smoothed trend has been largely stable throughout the survey period.

**Figure D1aii. Proportion of large fish (survey specific threshold for “large” size), by weight, in the Scottish Continental Shelf, Irish Sea and Celtic Sea.**

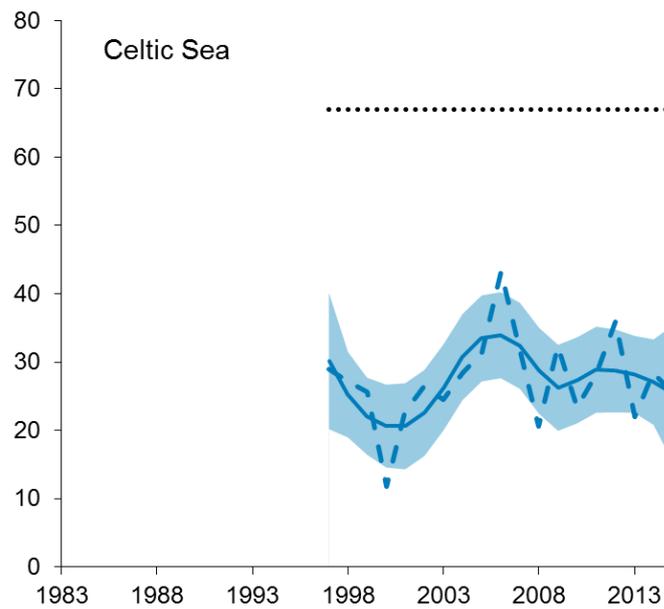


## D1a. Fish size classes in the North Sea

### Irish Sea



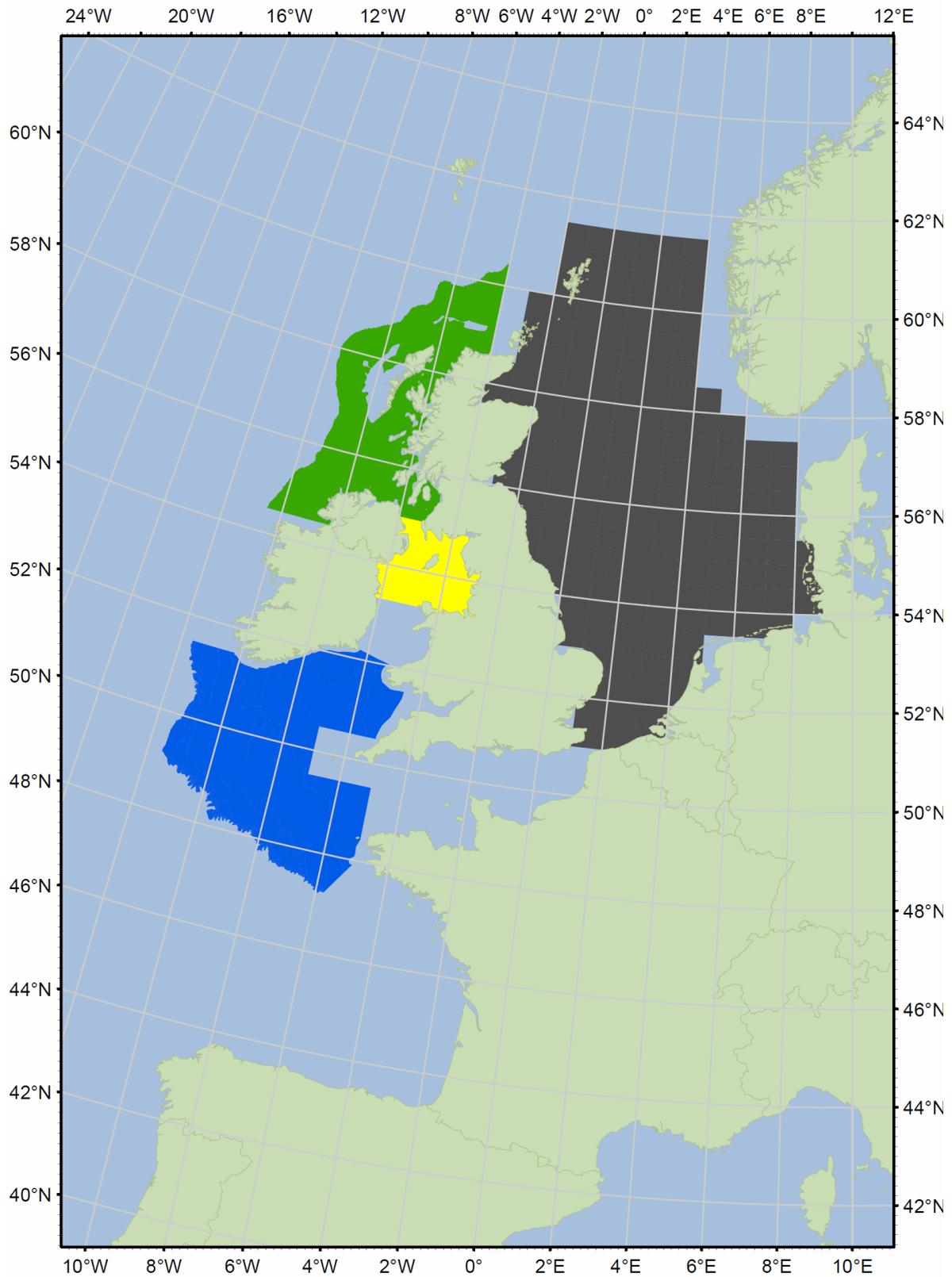
### Celtic Sea



**Notes:** The line graphs show the unsmoothed trend (dashed line) and a LOESS smoothed trend (solid line) with the shaded area showing the 95 per cent confidence intervals around the smoothed trend. The horizontal dashed line shows the assessment thresholds.

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

Figure D1aiii. Areas surveyed to generate the fish size class indicator for the seas around the UK: North Sea - dark grey, Scottish Continental Shelf – green, Irish Sea – yellow and Celtic Sea – dark blue.



Source: Centre for Environment, Fisheries and Aquaculture Science.

## Goals and targets

### Aichi Targets for which this is a primary indicator

**Strategic Goal B.** Reduce the direct pressures on biodiversity and promote sustainable use.



**Target 6:** By 2020, all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.

**Strategic Goal D.** Enhance the benefits to all from biodiversity and ecosystems.



**Target 14:** By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.

### Aichi Targets for which this is a relevant indicator

**Strategic Goal A.** Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society.



**Target 4:** By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.

**Strategic Goal D.** Enhance the benefits to all from biodiversity and ecosystems.



**Target 15:** By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

### Web links for further information

Reference	Title	Website
OSPAR Intermediate Assessment 2017	Proportion of Large Fish (Large Fish Index)	<a href="https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/fish-and-food-webs/proportion-large-fish-large-fish-index/">https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/fish-and-food-webs/proportion-large-fish-large-fish-index/</a>
Defra Science	Cotter <i>et al.</i> 2008. Development of a Marine Trophic Index for UK waters	<a href="http://randd.defra.gov.uk/Document.aspx?Document=WC0604_7255_FRP.pdf">http://randd.defra.gov.uk/Document.aspx?Document=WC0604_7255_FRP.pdf</a> (PDF, 1.36Mb)

Reference	Title	Website
	and recommendations for further indicator development	
International Council for the Exploration of the Sea	ICES home page	<a href="http://www.ices.dk/Pages/default.aspx">http://www.ices.dk/Pages/default.aspx</a>

## References

- Cotter, J., Rogers, S., Ellis, J., Mackinson, S., Dulvy, N., Pinnegar, J., Jennings, S. & Greenstreet, S. (2008) *Marine Ecosystem Integrity: Development of a Marine Trophic Index for UK waters and recommendations for further indicator development*. Final report for Defra, Centre for Environment, Fisheries and Aquaculture Science (Cefas).
- Engelhard G.H., Lynam C.P., Garcia-Carreras B., Dolder P.J. & Mackinson S. (2015) *Effort reduction and the large fish indicator: spatial trends reveal positive impacts of recent European fleet reduction schemes*. *Environmental Conservation* 42: 227-236  
<https://doi.org/10.1017/S0376892915000077>
- Greenstreet, S.P.R., Rogers, S.I., Rice, J.C., Piet, G.J., Guirey, E.J., Fraser, H.M., Fryer, R.J. 2011. Development of the EcoQO for fish communities in the North Sea. *ICES Journal of Marine Science*, 68, 1-11.
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- Greenstreet, S. P. R., and Moriarty, M. 2017. OSPAR interim assessment fish indicator data manual (relating to version 2 of the groundfish survey monitoring and assessment data product). *Scottish Marine and Freshwater Science*, 8: 83.
- International Council for the Exploration of the Seas (ICES). (2007) *Development of EcoQO on changes in the proportion of large fish and evaluation of size-based indicators*. International Council for the Exploration of the Sea, Copenhagen. ICES ACE Report 2007.
- Queirós A.M., Fernandes J., Genevier L. & Lynam C.P. (2018) Climate change alters fish community size-structure, requiring adaptive policy targets. *Fish Fish*. 2018;00:1–9.  
<https://doi.org/10.1111/faf.12278>

**Full details of this indicator, including a datasheet and technical documentation are available at:** <http://jncc.defra.gov.uk/page-4248> and <https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/fish-and-food-webs/proportion-large-fish-large-fish-index/>

**Last updated:** July 2018

**Latest data:** Proportion of large fish by weight in the North Sea – 2016  
 Proportion of large fish by weight in the Scottish Continental Shelf – 2014  
 Proportion of large fish by weight in the Irish Sea – 2015  
 Proportion of large fish by weight in the Celtic Sea – 2015