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Trends in Scottish Fish Stocks 2017

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Summary

This paper summarises the most recently published data from the International Council for the Exploration of the Sea (ICES) on the state of commercially important fish stocks in the waters around Scotland. These data reveal trends in the sizes of these fish stocks and in the levels of exploitation. This information informs the scientific advice that ICES provides on the future management of these fish stocks.

The general overall picture is of increasing abundance and declining levels of exploitation.

Introduction

Published data have been collated and summarized to provide an overview of trends in the size of, and in the levels of exploitation of, commercially important Scottish fish stocks; in particular those that are of importance to the Shetland fishing fleet.

Data

Data were collated from the latest advice published by the International Council for the Exploration of the Sea (ICES)*. ICES is the inter-governmental organisation that coordinates and promotes marine research in the North-East Atlantic Ocean, including assessing the status of fish stocks and providing advice on their management. ICES stock assessments are based on the analysis of data from a variety of sources, including landings, fishermen's logbooks, scientific observers on-board fishing vessels, and research vessel surveys.

Fish species are divided into separate stocks in different areas. For some species ICES assesses stocks separately in the North Sea (ICES Sub-Area IV) and West of Scotland area (ICES Division VIa), while for others a single stock is assessed covering the North Sea and West of Scotland together. A few stocks are assessed across larger areas.

The time periods over which data stock data are available vary between stocks and area. For some species (such as cod or plaice) long-time series are available, stretching back to the 1960s or 1950s. For others (such as monks or megrim) the available time series are much shorter.

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* The latest ICES Advice is available online at:
www.ices.dk/community/advisory-process/Pages/Latest-advice.aspx

Two parameters are commonly used to reflect the state of a fish stock and the level of exploitation to which it is subject:

The **Spawning Stock Biomass** (**SSB**) is the estimated biomass (weight) of sexually mature fish in a stock and is commonly used as a measure of the size of the stock.

The **Fishing Mortality Rate (*F*)** is a measure of the proportion of a fish stock that is removed (caught) each year. *F* is measured on a logarithmic scale; thus a value of 1.0 ($F_{1.0}$) corresponds to 63% of the stock being removed each year, $F_{0.7}$ corresponds to 50% of the stock being removed and $F_{0.5}$ to 39%.

The Gadoid Outburst

Starting in the 1960s – for reasons that are still unclear – there was an unprecedented increase in the abundances of gadoid species (such as cod, haddock, saithe and whiting) in the North Sea, with a five to six-fold increase in their biomasses[*].

The available time-series of abundance of some of the gadoid fish stocks start around the time of gadoid outburst, and may thus give a misleading impression of the 'normal' size of these stocks. It has been suggested that the declines in the abundances of these gadoid species in the 1970s and into the 1980s should be regarded as a return to 'normal' levels of abundance.

[*] Hislop, J.R.G. (1996). Changes in North Sea gadoid Stocks. *ICES Journal of Marine Science* 53: 1146-1156. (Available at: https://doi.org/10.1006/jmsc.1996.0140)

Cod

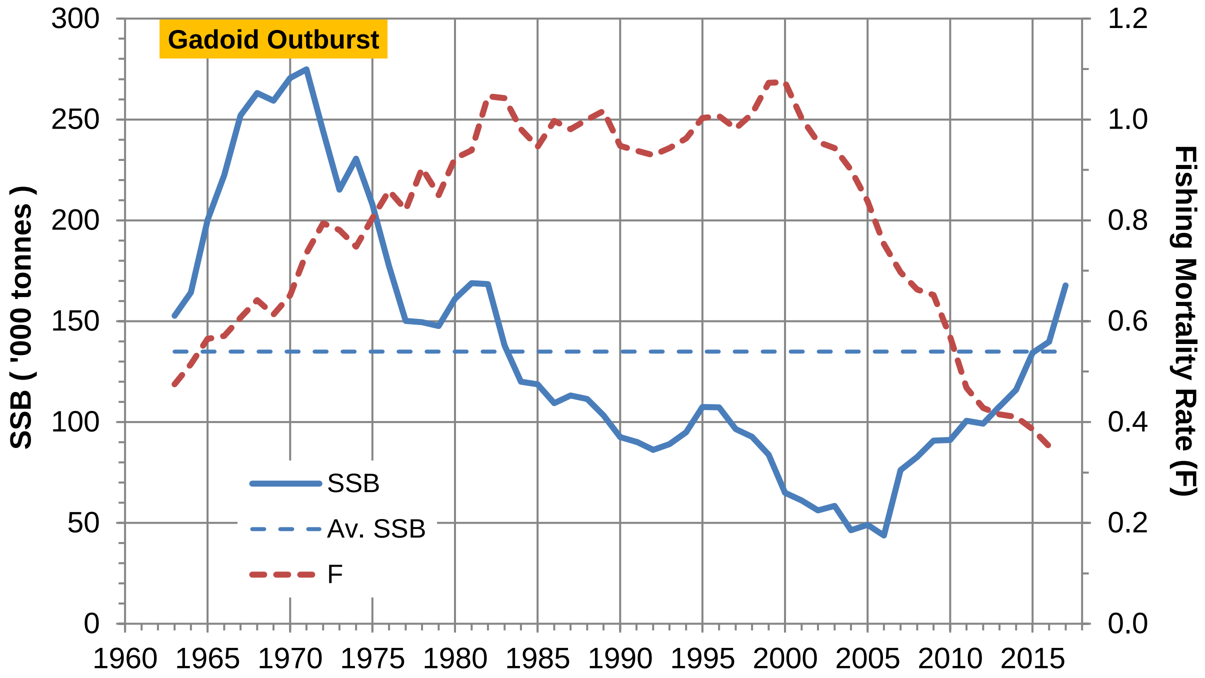

Figure 1 The spawning stock biomass (SSB) and fishing mortality rate (*F*) of North Sea cod from 1963 to 2017 (2016 for *F*). The horizontal dashed line shows the long-term average SSB over the whole period. (In the 1960s and 1970s the abundance of cod was enhanced by the 'gadoid outburst' - see p. 3.) (ICES Data; see p. 2.)

The abundance of cod in the North Sea peaked during the gadoid outburst in the 1960s and 1970s (see page 3). Following the outburst, the spawning stock biomass (SSB) declined steadily until the mid-2000s. From a low in 2006 the SSB has increased relatively rapidly, almost 4-fold by 2017.

The SSB of cod in the North Sea in 2017 was larger than its average size over the last 54 years (even including the gadoid outburst), larger than at any time in the last 35 years (since 1982), and larger than it was before the gadoid outburst.

The fishing mortality rate (*F*) increased during the period of the gadoid outburst and remained high during the 1980s and 1990s. Since about 2000 it has fallen steeply, declining by two-thirds between 2000 and 2017. The value of *F* in 2017 was lower than at any time since at least 1963.

Haddock

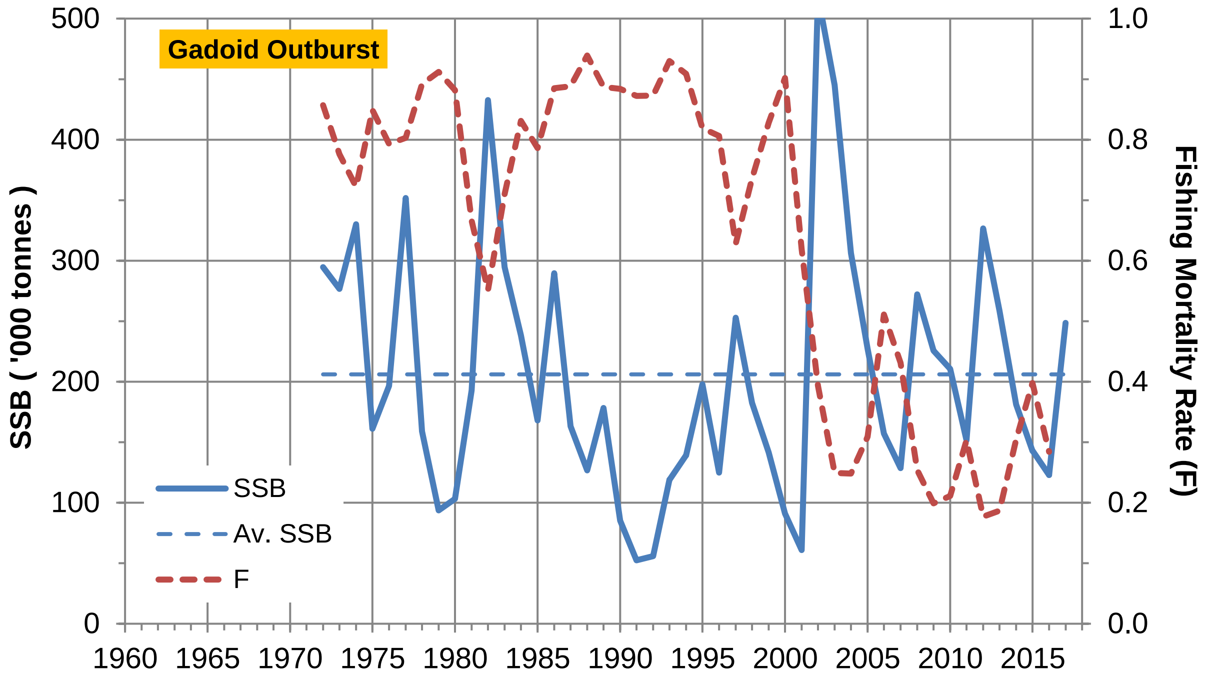

Figure 2 The spawning stock biomass (SSB) and fishing mortality rate (*F*) of the combined North Sea and West of Scotland haddock stock from 1972 to 2017 (2016 for *F*). The horizontal dashed line shows the long-term average SSB over the whole period. (ICES Data; see p. 2.)

Since 2015 haddock in the North Sea and West of Scotland areas have been assessed as a single stock.

The spawning stock biomass (SSB) of haddock in the North Sea and West of Scotland areas has experienced very large fluctuations over the last 40 years (reflecting the biology of the species). There was a general decline in the stock size until the early 1990s, since when there has been a general increase. The average haddock SSB in the years 2010 to 2017 was double that from 1990 to 1995, and the SSB in 2017 was above its average size over the last 45 years.

The fishing mortality rate (*F*) for haddock in the North Sea and West of Scotland areas remained generally relatively high until 2000, after which it fell sharply. The value of *F* in 2017 remained less than half of that in 2000, although it has increased in somewhat in recent years.

Saithe

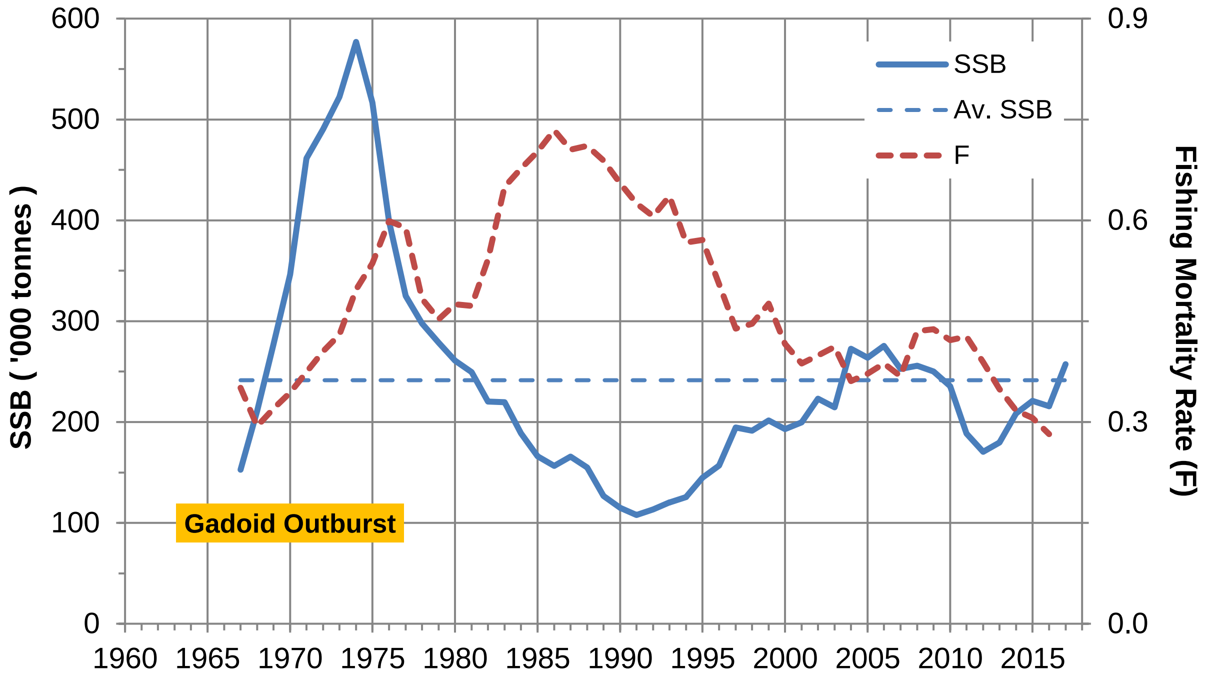

Figure 3 The spawning stock biomass (SSB) and fishing mortality rate (*F*) of the North Sea and West of Scotland saithe stock from 1967 to 2017 (2016 for *F*). The horizontal dashed line shows the long-term average SSB over the whole period. (In the 1960s and 1970s the abundance of saithe was enhanced by the 'gadoid outburst' - see p. 3.) (ICES Data; see p. 2.)

The spawning stock biomass (SSB) of saithe in the North Sea and West of Scotland areas peaked during the gadoid outburst (see page 3), but has otherwise remained at around the same size. The stock declined after the gadoid outburst to a low in the early 1990s, since when it has generally increased in size, albeit with some fluctuations).

The SSB of saithe in the North Sea in 2017 was larger than its average size over the last 50 years (including the gadoid outburst), more than double that in 1991, and larger than it was before the gadoid outburst.

The fishing mortality rate (*F*) for saithe in the North Sea and West of Scotland areas has generally declined over the last 30 years after increasing during the gadoid outburst. (*F* in 2017 was well below half of that in 1986).

Whiting

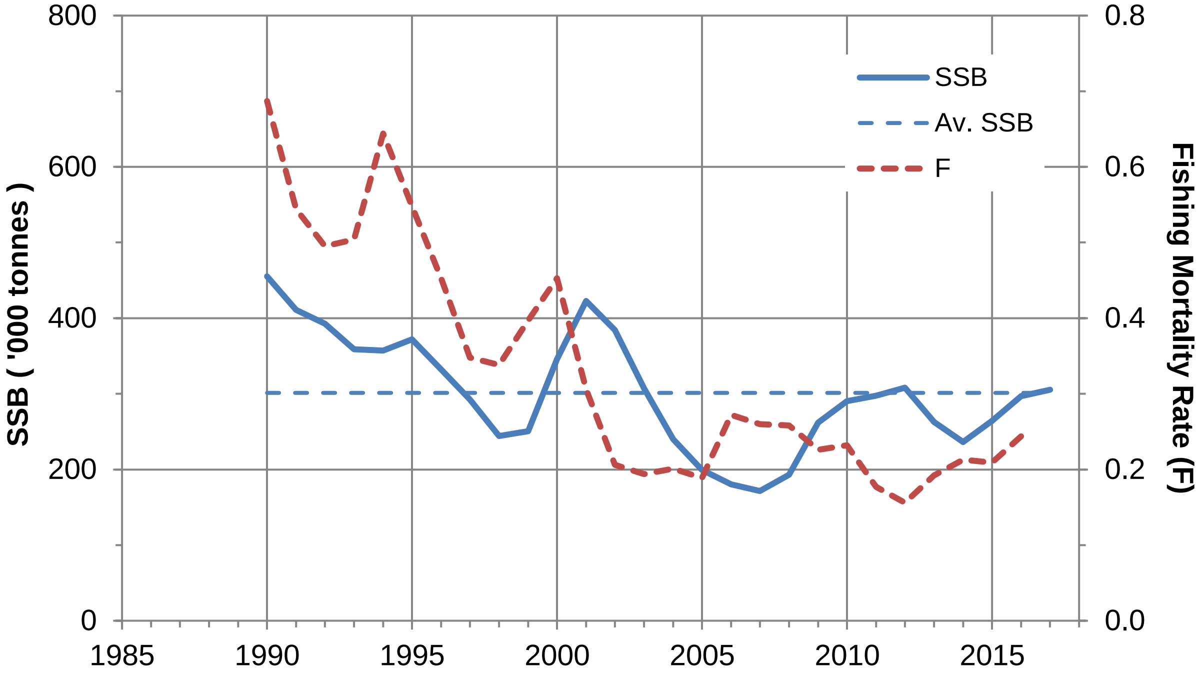

Figure 4 The spawning stock biomass (SSB) and fishing mortality rate (*F*) of North Sea whiting from 1990 to 2017 (2016 for *F*). The horizontal dashed line shows the long-term average SSB over the whole period. (ICES Data; see p. 2. Data for North Sea whiting are only available from 1990.)

Data for whiting in the North Sea are only available from 1990. Since then their spawning stock biomass (SSB) generally declined to about 2007, although with large fluctuations. Since 2007 the SSB has increased in size (by more than 50%), although again with large fluctuations, and the SSB in 2017 was close to its average for the last 27 years.

The fishing mortality rate (*F*) for whiting in the North Sea has also generally declined since 1990, though again with large fluctuations. The value of *F* in 2017 was about one-third of what it was in 1990.

Plaice

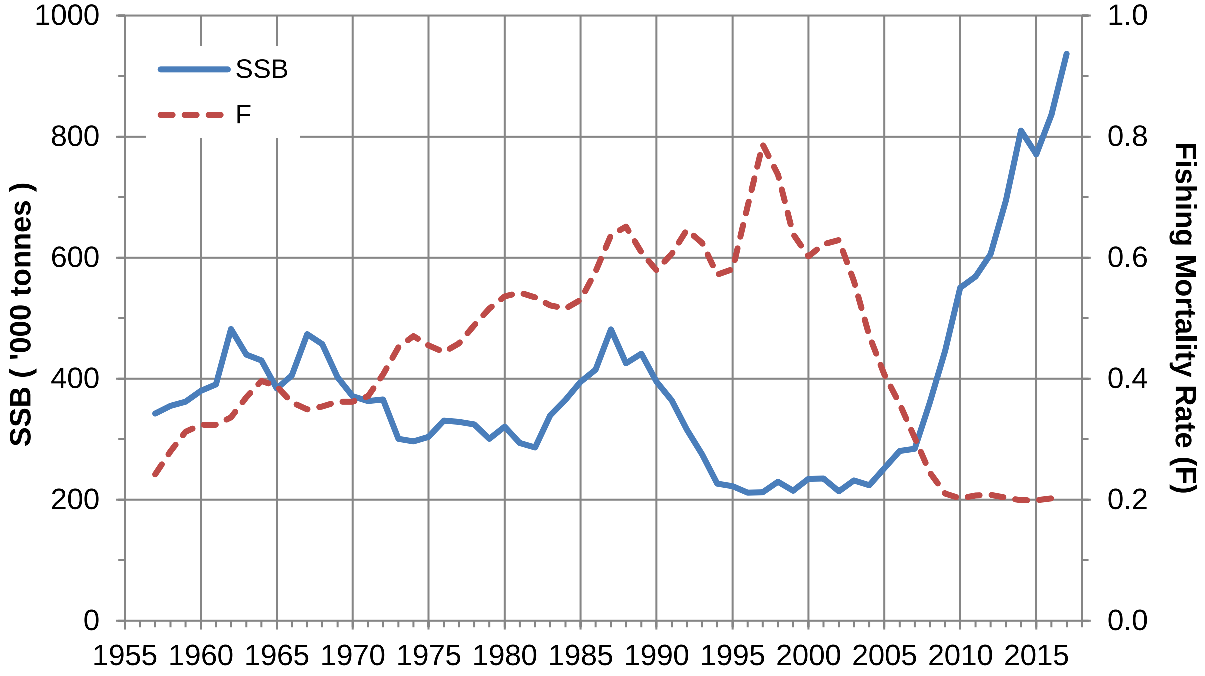

Figure 5 The spawning stock biomass (SSB) and fishing mortality rate (*F*) of North Sea plaice from 1957 to 2017 (2016 for *F*). (ICES Data; see p. 2.)

The spawning stock biomass (SSB) of plaice in the North Sea remained relatively stable from the 1960s to the mid-2000s, albeit with some large fluctuations. Since then there has been a substantial and rapid increase in the size of the stock, which more than quadrupled between 2004 and 2017. The SSB in 2017 was larger than at any time since at least 1957, and almost three times larger than the average prior to 2004.

The fishing mortality rate (*F*) for plaice in the North Sea generally increased from the 1960s through the 1990s. It fell steeply thereafter, declining by 75% between 2001 and 2011. The value of *F* in 2017 remained about one-quarter of that in 2001 and lower than at any time since at least 1957.

Common (Dover) Sole

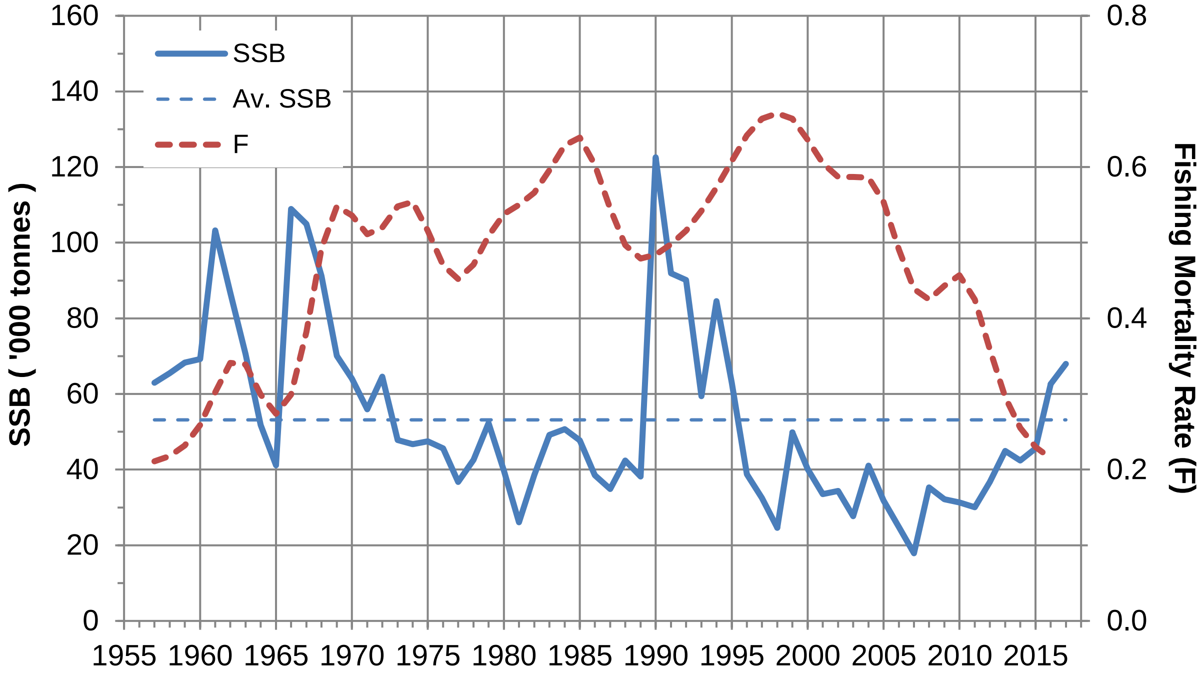

Figure 6 The spawning stock biomass (SSB) and fishing mortality rate (*F*) of North Sea common sole from 1957 to 2017 (2016 for *F*). The horizontal dashed line shows the long-term average SSB over the whole period. (ICES Data; see p. 2.)

The spawning stock biomass (SSB) of common sole in the North Sea has remained relatively stable over the last 60 years, albeit with some very large fluctuations. The last decade has seen an upward trend, with the size of the stock more than tripling from a low in 2007. The SSB in 2017 was above the long-term average over the last 60 years.

The fishing mortality rate (*F*) for common sole in the North Sea generally increased, though with large fluctuations, from the 1960s through the 1990s. It fell steeply thereafter, declining by 70% between 1997 and 2016. The value of *F* in 2015 was less than one-third of that in 1997 and lower than at any time since at least 1957.

Monks (Anglerfish)

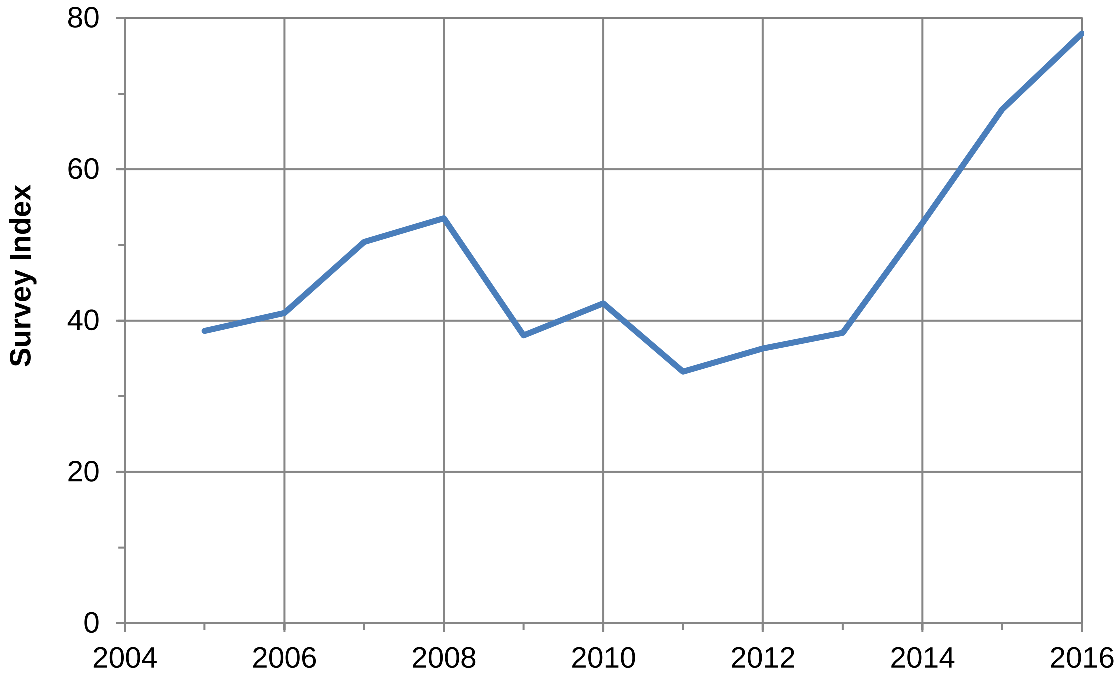

Figure 7 The abundance index (survey index) for Northern Shelf monks from 2005 to 2016. (No estimates of fishing mortality rate are available for monks.) (ICES Data; see p. 2.)

Data for monks in 2017 have not yet been published.

For the Northern Shelf monk stock an index of abundance is available for the period from 2005 to 2016, providing a much shorter time-series than for other species. Over this period the size of the stock has fluctuated, but has increased since 2011. According to the survey index the stock has more than doubled in size since 2011.

No estimates of fishing mortality rate (*F*) are available for monks.

Megrim

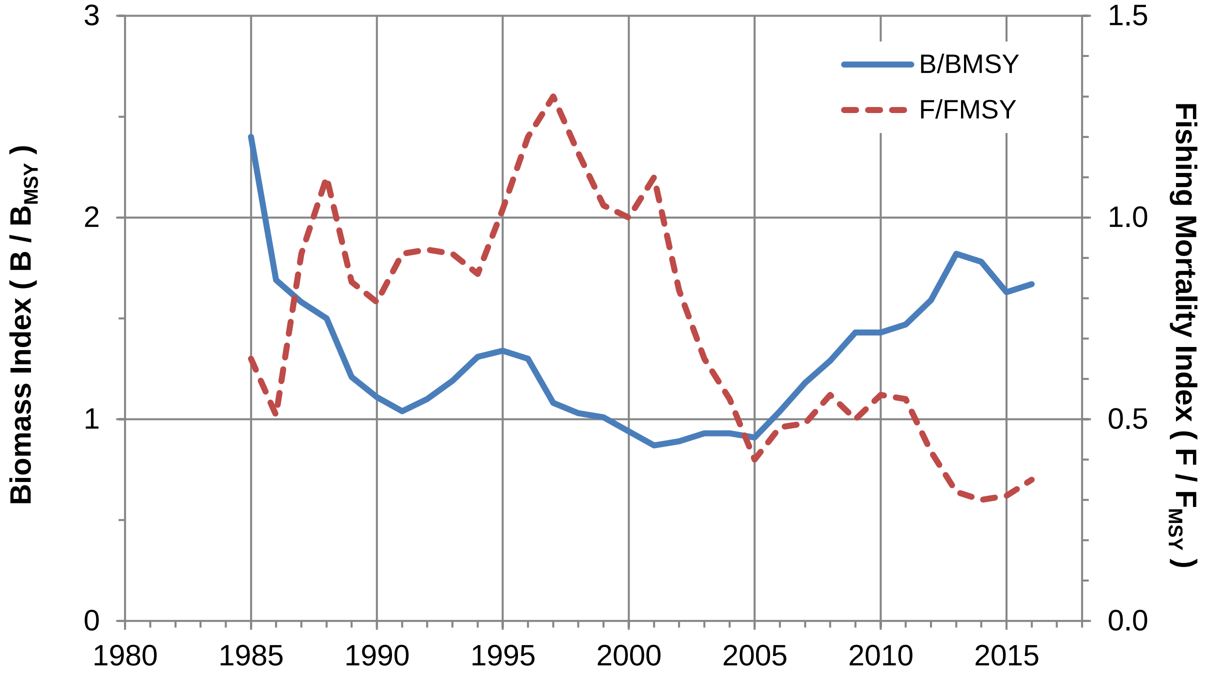

Figure 8 Indices of the biomass and fishing mortality rate of the North Sea and West of Scotland megrim stock from 1985 to 2016. (ICES Data; see p. 2.)

Data for megrim in 2017 have not yet been published.

The biomass index of the North Sea and West of Scotland megrim stock declined during the late 1980s, remained fairly stable through the 1990s to the mid-2000s, and has increased since then. The index in 2016 (the last year for which data are available) was almost double that in 2005.

The fishing mortality index for North Sea and West of Scotland megrim has generally declined over the last 20 years. The value of the index in 2016 was about one-third of the average in the 1990s.

Hake

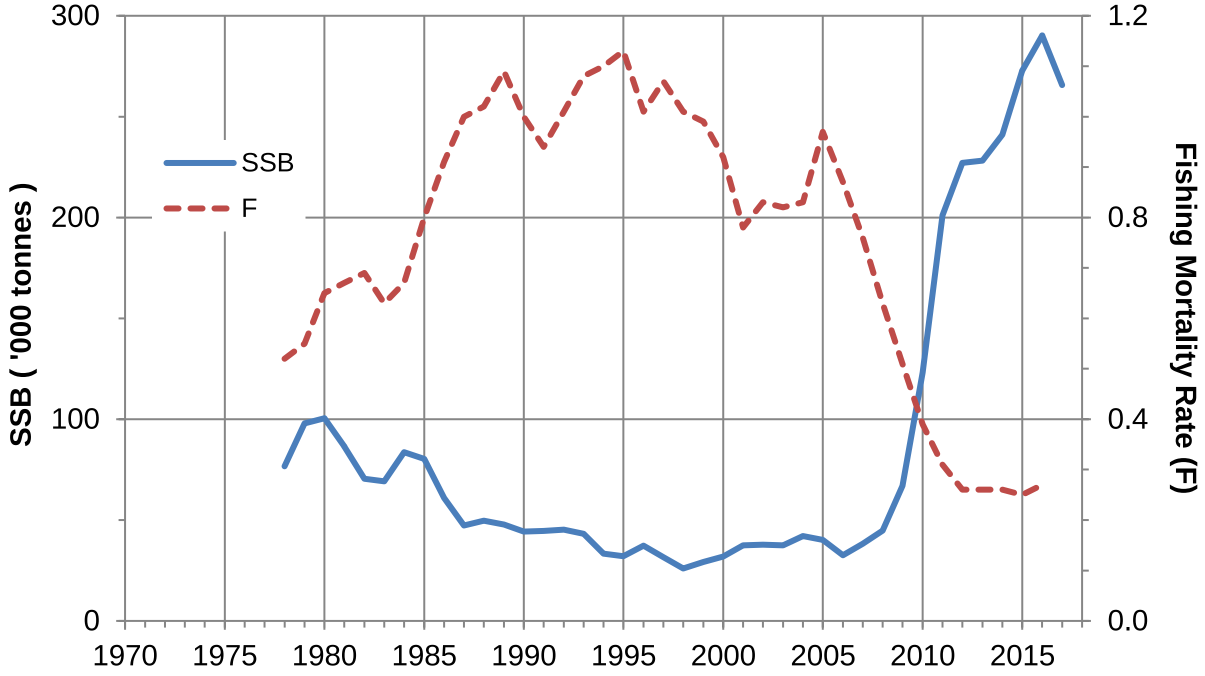

Figure 9 The spawning stock biomass (SSB) and fishing mortality rate (*F*) of the northern hake stock* from 1978 to 2017 (2016 for *F*). (ICES Data; see p. 2.)

Following a general decline during the 1980s and 1990s the spawning stock biomass (SSB) of the northern hake stock* increased rapidly and dramatically after the mid-2000s. The SSB increased almost 10-fold between 2006 and 2016. Despite a small decrease in size in 2017 the SSB remains more than five times larger than the average prior to 2005.

The fishing mortality rate (*F*) for the northern hake stock rose during the 1980s but has generally declined since then, especially after 2005. The value of *F* in 2015 was less than one quarter of that in 2005, and over the last few years has been lower than at any time in the last 40 years.

* The 'northern' hake stock covers an area that includes the North Sea and West of Scotland areas, as well as the areas around Rockall, to the west and south of Ireland and into the northern Bay of Biscay.

Ling

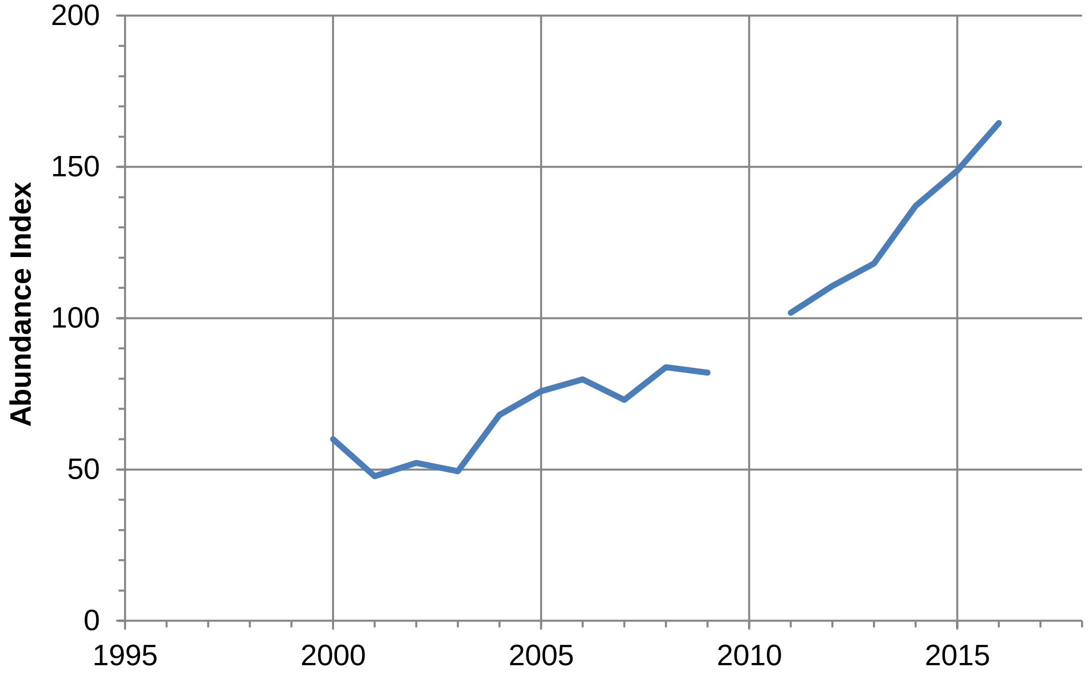

Figure 10 Index of the abundance of the North-East Atlantic ling stock* from 2000 to 2016. (No estimates of fishing mortality rate are available for ling.) (ICES Data; see p. 2.)

Data for ling in 2017 have not yet been published.

The spawning stock biomass (SSB) and fishing mortality rate (*F*) of ling are not known directly. Instead, ICES uses an index of ling abundance based on the catch rate of Norwegian ling-line fishing vessels.

This index indicates that the size of the ling stock has increased steadily over the last 13 years, more than tripling in size between 2003 and 2016.

* The 'North-East Atlantic' ling stock covers an area that extends from southern Spain to the North Sea and West of Scotland areas and to the coast of Greenland (but not the Norwegian Sea or the waters around Iceland or Faroe).

Whitefish Aggregate - North Sea

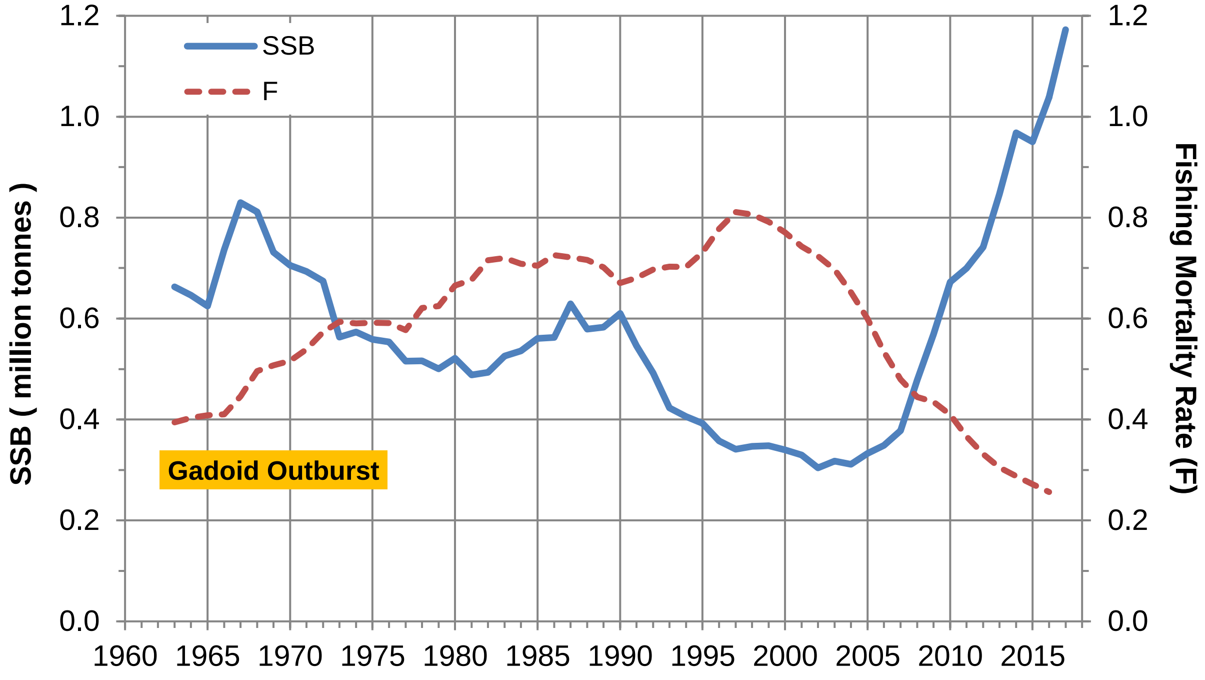

Figure 11 The total spawning stock biomass (SSB) and average fishing mortality rate (*F*) of North Sea cod, plaice and common sole* from 1963 to 2017 (2016 for *F*). (Based on analysis of ICES Data; see p. 2.)

The combined spawning stock biomass (SSB) of cod, plaice and common sole* in the North Sea generally declined through the 1970s, 80s and 90s, following the peak associated with the gadoid outburst (see page 3), during which the abundances of cod was enhanced (plaice and sole are not gadoid species).

From about the mid-2000s the combined SSB has increased rapidly, due to the increasing abundances of all three species (but especially plaice). The combined SSB almost quadrupled between 2004 and 2017, reaching a size greater than at any time since at least 1963.

The average fishing mortality rate (*F*) for cod, plaice and common sole in the North Sea generally increased until the mid-1990s but has fallen since about 2000. The average value of *F* in 2015 was about one-third of that in 2001 and at its lowest since at least 1963.

* Cod, plaice and common sole are the only North Sea whitefish species for which long-term time-series of abundance are available.

Whitefish Aggregate – North Sea & West of Scotland

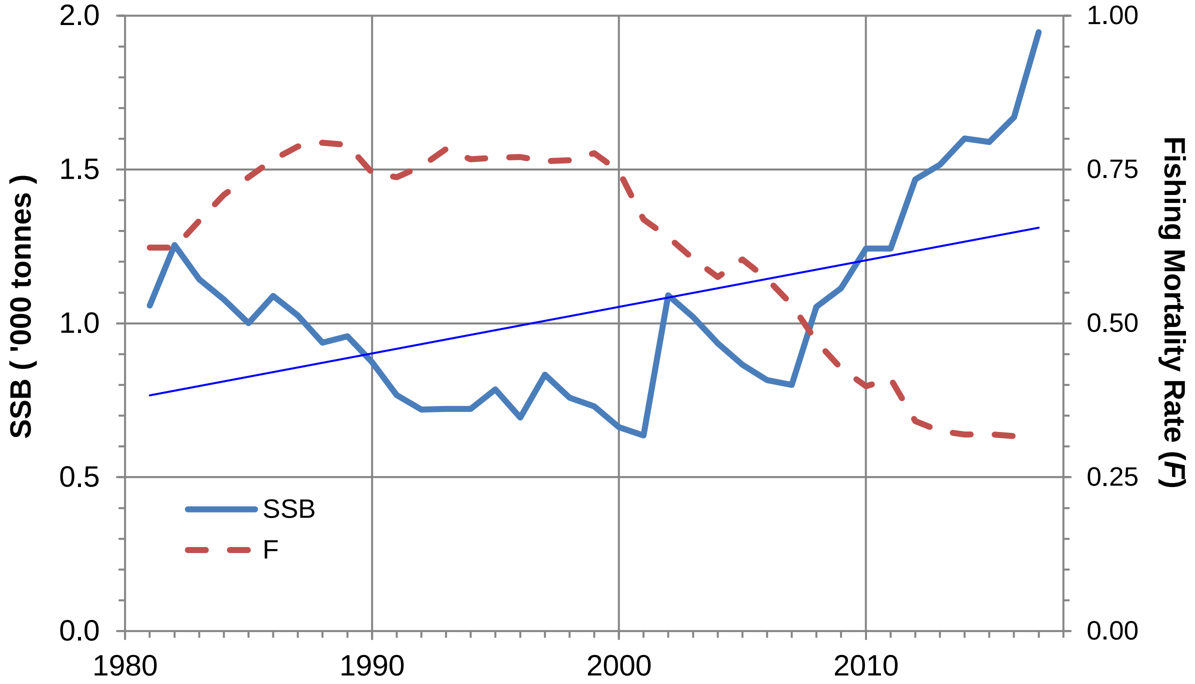

Figure 12 The total spawning stock biomass (SSB) and the average fishing mortality rate (*F*) of North Sea and West of Scotland cod, haddock, hake, plaice, saithe and common sole* from 1981 to 2017 (2016 for *F*). A straight trend-line is fitted through the biomass data. (Based on analysis of ICES Data; see p. 2.)

The combined spawning stock biomass (SSB) of cod, haddock, hake, plaice, saithe, and common sole* in the North Sea and to the West of Scotland generally declined during the 1980s, remained relatively stable during the 1990s and has generally increased since then, particularly over the last 10 years.

The combined SSB more than tripled between 2001 and 2017. The SSB in 2017 was more than 90% larger than the average over the preceding 35 years, and larger than at any time since at least 1981. A straight trend-line fitted through the SSB data shows a marked overall upward trend over the last 35 years.

The average fishing mortality rate (*F*) for cod, haddock, hake, plaice, saithe, and common sole in the North Sea and to the West of Scotland has declined steadily since the late 1990s. The average value of *F* in 2017 was less than half that in the 1990s.

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* These six whitefish species have the longest available time-series in the North Sea and West of Scotland areas.

Herring

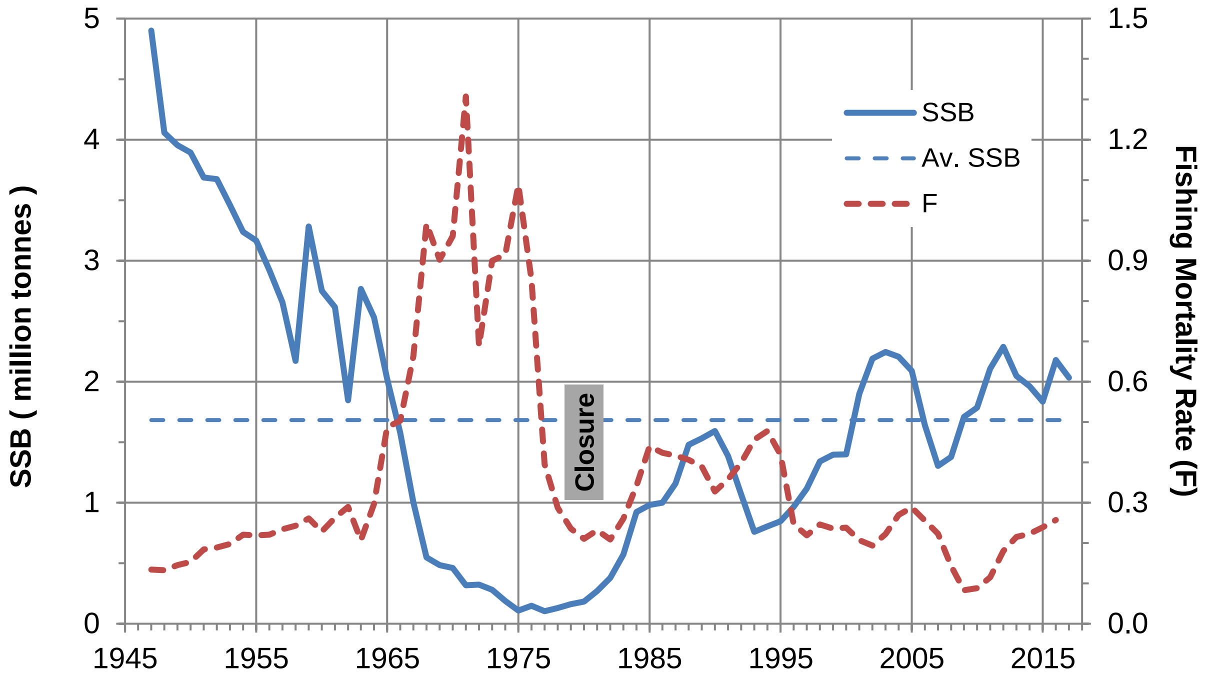

Figure 13 The spawning stock biomass (SSB) and fishing mortality rate (*F*) of North Sea herring from 1947 to 2017 (2016 for *F*). The horizontal dashed line shows the long-term average SSB over the whole period. (The North Sea herring fishery was closed from 1977 to 1983.) (ICES Data; see p. 2.)

The spawning stock biomass (SSB) of herring in the North Sea generally declined until the mid-1970s, especially during the mid-1960s, which led to the closure of the fishery from 1977 to 1983. Since the low point in the mid-1970s the stock has generally increased in size, albeit with large fluctuations.

The SSB of North Sea herring in 2017 was almost 20 times larger than in 1975, and although it has fluctuated in recent years the stock remains relatively large (similar to its size in the late 1950s and early 1960s, prior to the collapse of the stock) and above the long-term average size.

The fishing mortality rate (*F*) for herring in the North Sea peaked in the early 1970s. Since the increase following the re-opening of the fishery in 1983, the fishing mortality rate has generally declined, especially since the mid-1990s. Although the value of *F* has increased in the last few years it remains about half what was in 1994.

Mackerel

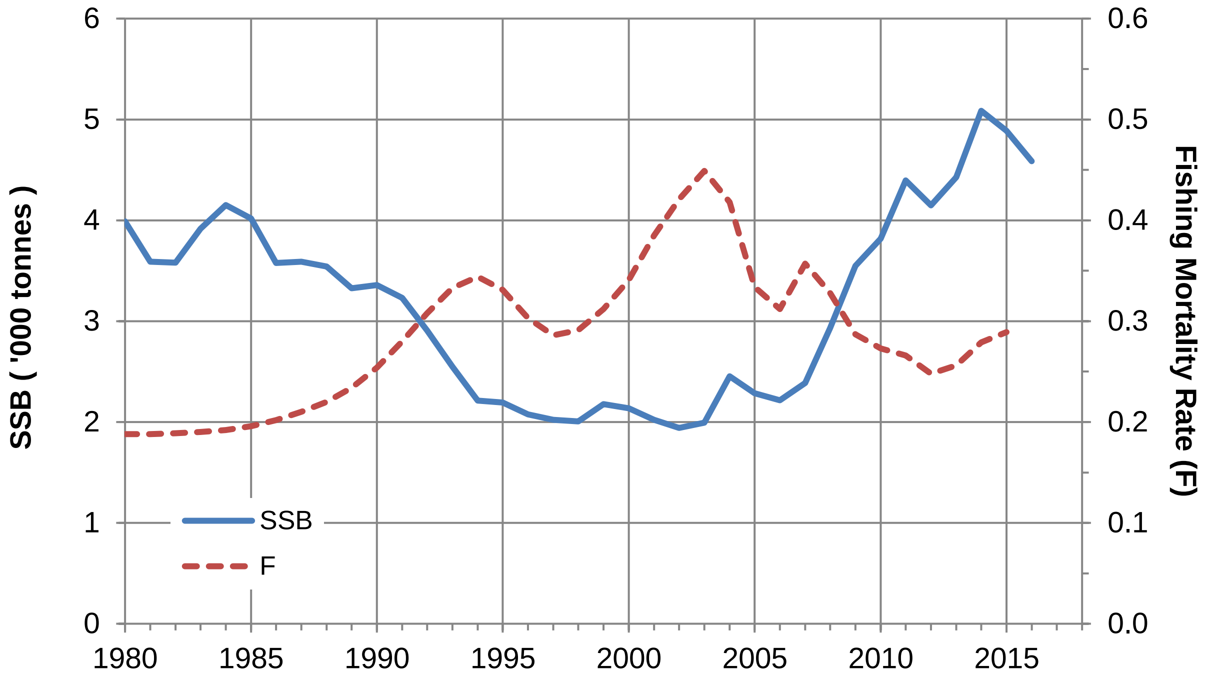

Figure 14 The spawning stock biomass (SSB) and fishing mortality rate (*F*) of the North-East Atlantic mackerel stock* from 1980 to 2016 (2015 for *F*). (ICES Data; see p. 2.)

Data for mackerel in 2017 have not yet been published.

The spawning stock biomass (SSB) of the North-East Atlantic mackerel stock* declined during the 1980s and early 1990s, but increased rapidly after the early 2000s. Although there has been a small decline in the last couple of years the mackerel SSB remained higher in 2017 than at any time prior to 2014, and more than double its size around 2000.

The fishing mortality rate (*F*) for the North-East Atlantic mackerel stock generally increased prior to about 2003, but has declined since then. Although the mortality rate has increased in the last few years it remains well below its peak value.

* The North-East Atlantic mackerel stock extends from the coasts of Portugal and Spain to the Norwegian Sea and Iceland, including the North Sea.

General Remarks

Two general trends are apparent from the whitefish data:

- ♦ The spawning stock biomasses (SSB) of most whitefish stocks have increased since the mid-2000s, in some cases by substantial amounts.
- ♦ The fishing mortality rates (*F*) of all the species have declined since the mid-2000s, again by substantial amounts in some cases.

Although the sizes of some stocks (such as cod and haddock) remain below levels seen in the past, stocks of others (such as plaice and hake) are at historic highs. (As is discussed on page 3, past abundances of some species were enhanced by the gadoid outburst).

It is notable that the aggregate whitefish spawning stock biomass for the North Sea has remained relatively constant, albeit with some fluctuations, over the last four decades and has increased dramatically in recent years (Figure 11). A similar pattern is evident for North Sea and West of Scotland stocks combined (Figure 12), although the time-series is shorter. This suggests that fluctuations in the abundances of the different species may – to some extent at least – cancel each other out.

Research carried out by ICES on the interactions between different fish species in the North Sea[*] has also suggested that there are links between the abundances of different species of fish. In particular, increases in the abundance of cod and saithe may result in declines in the abundance of haddock and whiting (which they eat), but also to increases in the abundance of species such as herring, sandeels and pout (which haddock and whiting eat).

The overall picture of whitefish stocks provided by these data is of generally increasing stock sizes and decreasing (and relatively low) fishing mortality rates. These data also suggest that focussing attention on a single species may give an incomplete impression of the general state of Scottish fish stocks.

[*] Anon. (2013). Multispecies considerations in the North Sea. *ICES Advice 2013*, Book 6, Section 6.3.1. (available online at: www.ices.dk/sites/pub/Publication%20Reports/Advice/2013/2013/mult-NS.pdf).