NAFC Marine Centre
University of the Highlands and Islands

Trends in Scottish Fish Stocks 2019

Ian R. Napier

14th November 2019

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(ian.napier@uhi.ac.uk)

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www.nafc.uhi.ac.uk/fish-stats

NAFC Marine Centre
Port Arthur
Scalloway
Shetland ZE1 0UN
Tel: 01595 772000
Email: info@uhi.ac.uk
Web: www.nafc.ac.uk

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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 continues to be one of relatively high abundance, following increases over the last two decades, and of relatively low levels of exploitation following decreases over the same time period.

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), but 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 are available vary between stocks and areas. Long time-series, extending back to the 1960s or 1950s, are available for some species

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

(such as cod or plaice) but for others (such as monks or megrim) the available time series are much shorter.

Two parameters are commonly used to reflect the size of fish stocks and the level of exploitation:

The **Spawning Stock Biomass** (**SSB**) is the estimated biomass (weight) of sexually mature fish in a stock.

The **Fishing Mortality Rate (*F*)** is an index of the proportion of a fish stock that is removed (caught) each year and provides a measure of the level of exploitation. *F* is measured on a logarithmic scale, such that 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%.

For some species (including monks and ling) ICES uses other indices to reflect the size and level of exploitation of stocks.

The Gadoid Outburst

Starting in the 1960s – for reasons that are still unclear – there was an unprecedented increase in the abundances of some gadoid species (such as cod, haddock, saithe, whiting and Norway pout) in the North Sea, with five to six-fold increases in their biomasses[*]. This 'gadoid outburst' lasted into the 1970s and, in some cases, the early 1980s.

The available time-series of abundance of some of the gadoid fish stocks start during or shortly after the 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 from the 1970s to the early 1990s 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

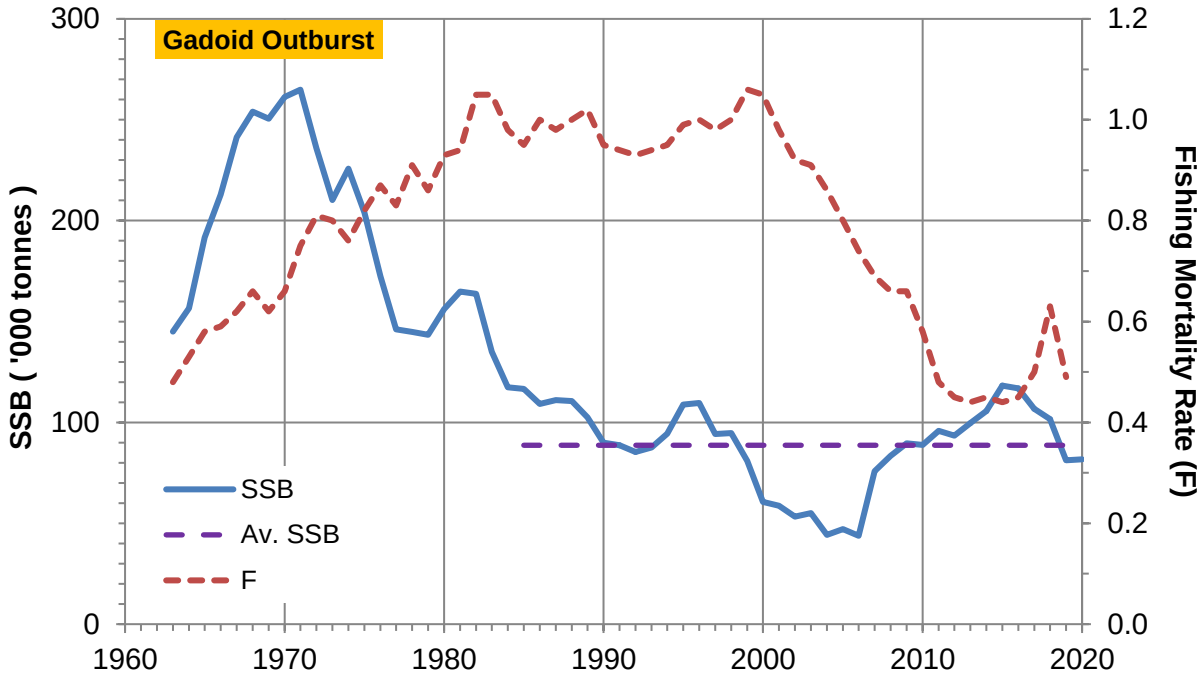

Figure 1 The spawning stock biomass (SSB) of North Sea cod from 1963 to 2019 and the projected SSB in 2020, and the fishing mortality rate (*F*) from 1963 to 2018 and the projected *F* in 2019. The horizontal dashed line shows the average SSB over the last 35 years (1985 – 2019). In the 1960s and 1970s 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) generally declined until the mid-2000s. From a low in 2006 the SSB increased, initially relatively rapidly, and has fluctuated since then.

Over the last 35 years (since the mid-1980s) the abundance of North Sea cod has fluctuated around an average of about 87,000 tonnes and has remained close to that size over the last couple of years.

The fishing mortality rate (*F*) increased during the period of the gadoid outburst and remained high during the 1980s and 1990s. After 2000 it fell rapidly, declining by two-thirds between 2000 and 2017. Despite an apparent increase in 2019, F is projected to fall again in 2020 and remains relatively low compared to the last 60 years.

Haddock

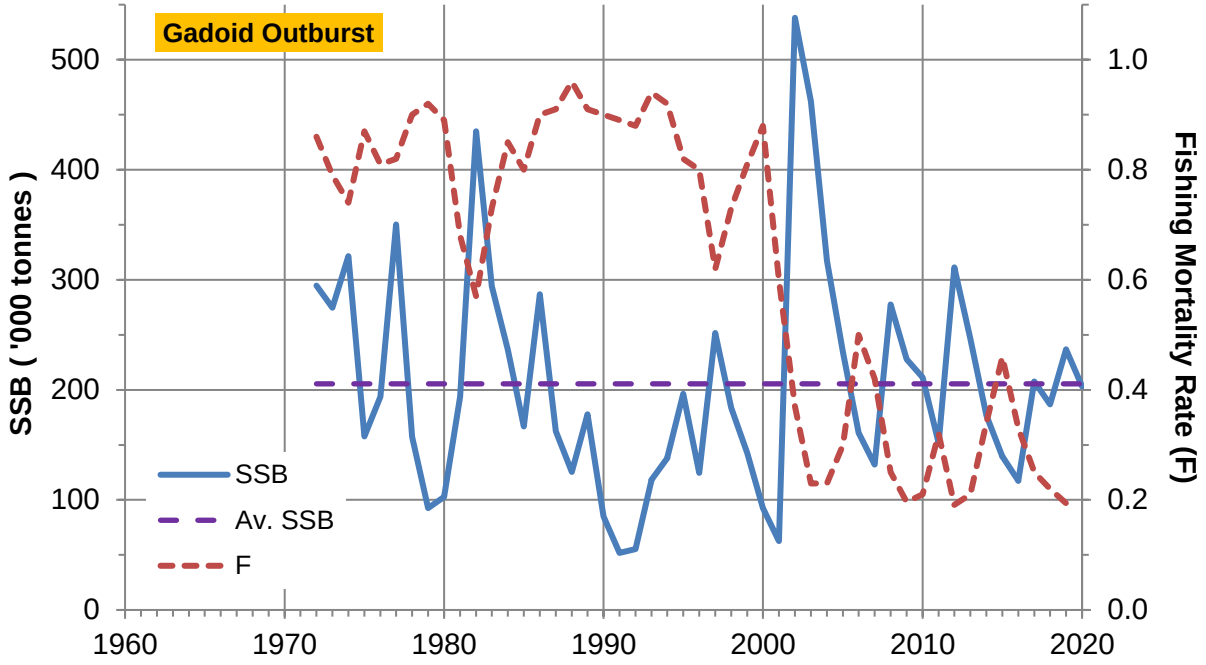

Figure 2 The spawning stock biomass (SSB) of the combined North Sea and West of Scotland haddock from 1972 to 2019 and the projected SSB in 2020, and the fishing mortality rate (*F*) from 1972 to 2018 and the projected *F* in 2019. The horizontal dashed line shows the average SSB over the whole time-series (1972 – 2019). In the 1960s and 1970s the abundance of haddock was enhanced by the 'gadoid outburst' (see p. 3). (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 has experienced very large fluctuations over the last 50 years (reflecting the biology of the species) and in 2019 was slightly above the long-term average.

The fishing mortality rate (*F*) for haddock remained generally relatively high until 2000, after which it fell sharply. Since the mid-2000s it has fluctuated, mirroring the fluctuations in biomass, and in 2019 was close to its lowest recorded level.

Saithe

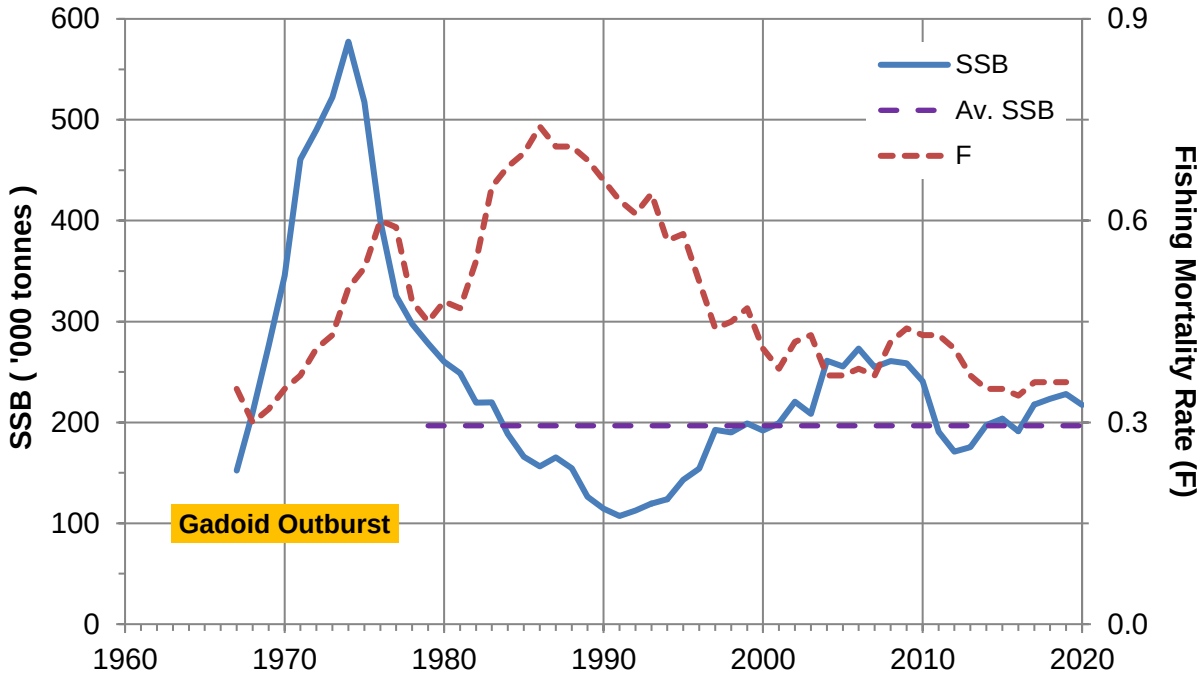

Figure 3 The spawning stock biomass (SSB) of the North Sea and West of Scotland saithe stock from 1967 to 2019 and the projected SSB in 2020, and the fishing mortality rate (*F*) from 1963 to 2018 and the projected *F* in 2019. The horizontal dashed line shows the average SSB over the last 40 years (1979 – 2019). 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), after which it declined to about 1990. Over the last 40 years the SSB has fluctuated with a general upwards trend.

The fishing mortality rate (*F*) for saithe has generally declined over the last 35 years, having increased during and after the gadoid outburst. It remains close to the lowest level recorded in the last 50 years.

Whiting

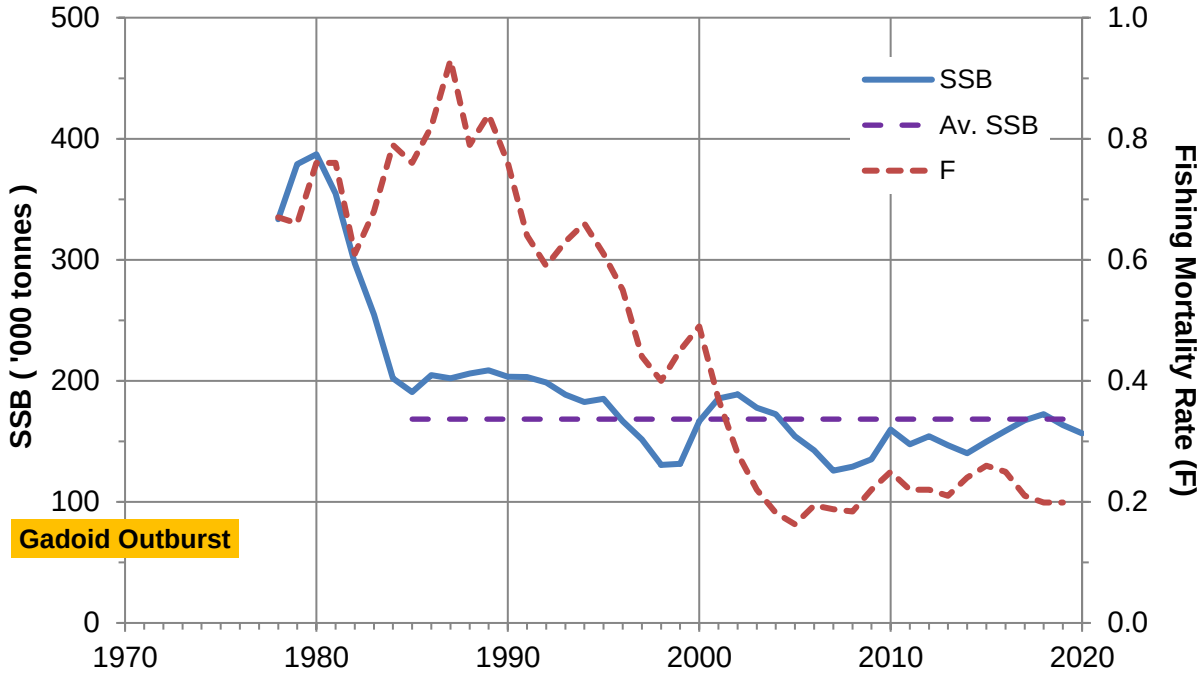

Figure 4 The spawning stock biomass (SSB) of North Sea whiting from 1978 to 2019 and the projected SSB in 2020, and the fishing mortality rate (*F*) from 1978 to 2018 and the projected *F* in 2019. The horizontal dashed line shows the average SSB over the last 35 years (1985 – 2019). In the 1960s and 1970s the abundance of whiting was enhanced by the 'gadoid outburst' (see p. 3). (ICES Data; see p. 2.)

Having declined from a peak in 1980, the spawning stock biomass (SSB) of whiting in the North Sea has fluctuated but remained generally fairly stable over the last 35 years.

The fishing mortality rate (*F*) for whiting in the North Sea also generally declined after the late-1980s, and has remained fairly stable at a relatively low level over the last decade or more.

Plaice

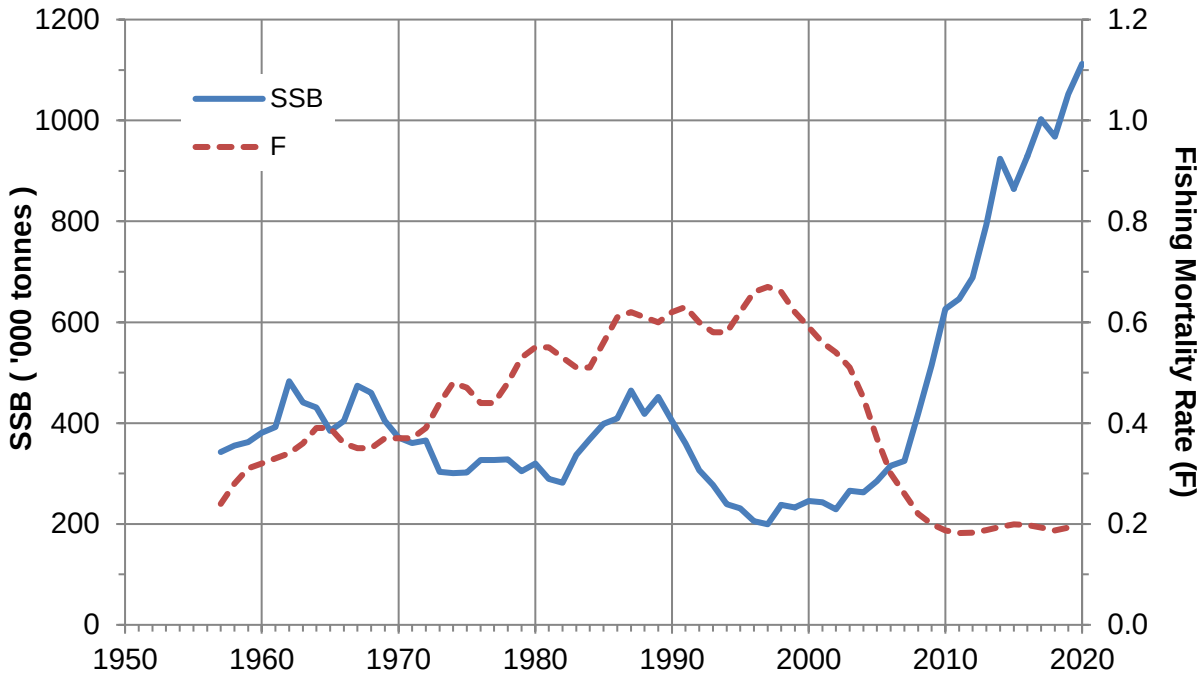

Figure 5 The spawning stock biomass (SSB) of North Sea plaice from 1957 to 2019 and the projected SSB in 2020, and the fishing mortality rate (*F*) from 1957 to 2018 and the projected *F* in 2019. (ICES Data; see p. 2.)

The spawning stock biomass (SSB) of plaice in the North Sea remained relatively stable from the late 1950s until the mid-2000s, albeit with some large fluctuations (plaice was not affected by the gadoid outburst)). Since the mid-2000s the SSB has increased dramatically, quadrupling between 2004 and 2019. The SSB over the last decade has been larger than at any time since at least 1957.

The fishing mortality rate (*F*) for plaice in the North Sea generally increased until the late 1990s, after which it fell rapidly. Since 2010 it has remained relatively stable at its lowest level for more than 50 years.

Common (Dover) Sole

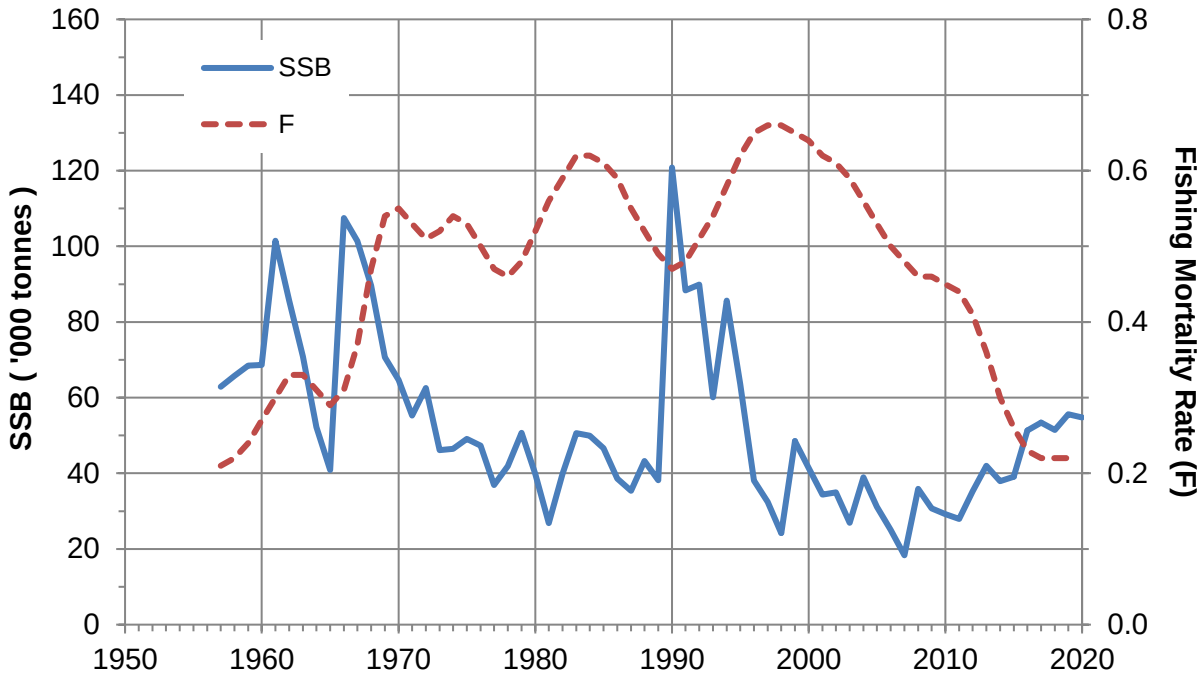

Figure 6 The spawning stock biomass (SSB) of North Sea common sole (Dover sole) from 1957 to 2019 and the projected SSB in 2020, and the fishing mortality rate (*F*) from 1957 to 2018 and the projected *F* in 2019. (ICES Data; see p. 2.)

The spawning stock biomass (SSB) of common (Dover) sole in the North Sea has remained relatively stable over the last 60 years, albeit with some very large fluctuations. The SSB has generally increased over the last decade and is 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 2019 was less than one-third of that in 1997 and lower than at any time since 1957.

Monks (Anglerfish)

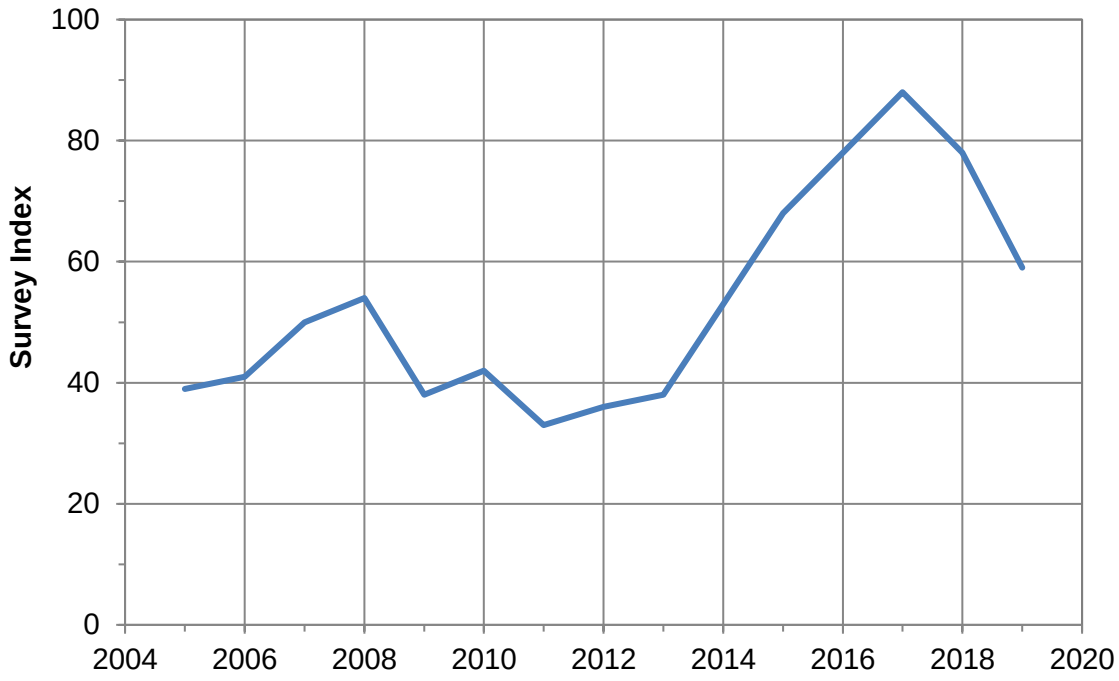

Figure 7 The abundance index (survey index) for Northern Shelf monks from 2005 to 2019. (No estimates of fishing mortality rate are available for monks.) (ICES Data; see p. 2.)

For the Northern Shelf monk stock an index of abundance is available only for the period from 2005 to 2019, providing a much shorter time-series than for other species. Following an increase to a peak in 2017 the index has decreased, but remains above the long-term average.

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

Megrim

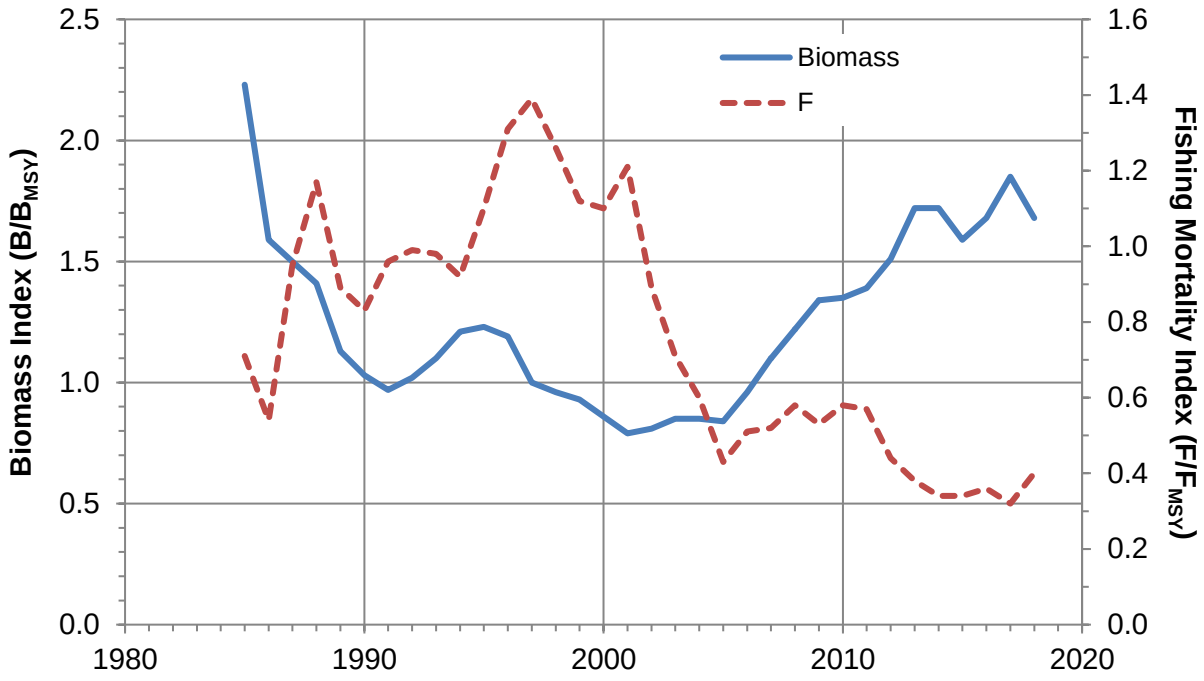

Figure 8 Indices of the biomass (B) and fishing mortality rate (*F*) of the North Sea and West of Scotland megrim stock from 1985 to 2018. (ICES Data; see p. 2.)

The biomass 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 substantially since then.

The fishing mortality rate (*F*) for megrim in the North Sea and West of Scotland areas generally increased until the mid-1990s but declined rapidly after that and has remained relatively low since the mid-2000s.

Hake

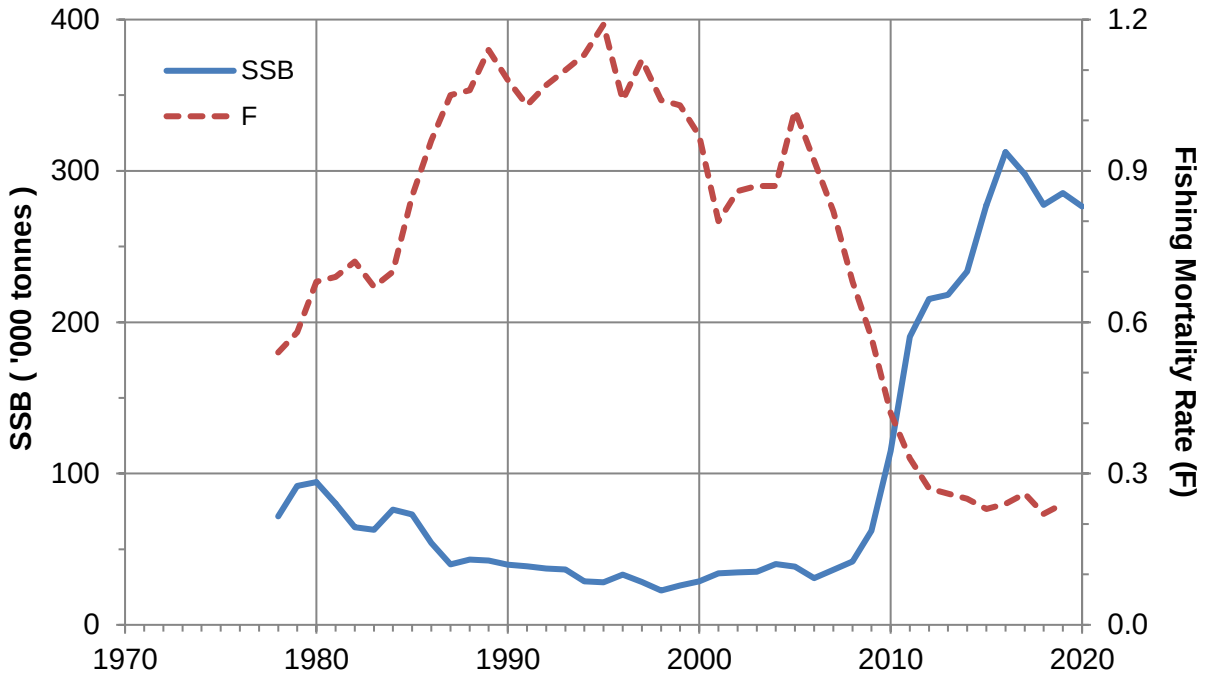

Figure 9 The spawning stock biomass (SSB) of the northern hake stock* from 1978 to 2019 and the projected SSB in 2020, and the fishing mortality rate (*F*) from 1978 to 2018 and the projected *F* in 2019. (ICES Data; see p. 2.)

Following a slight general decline during the 1980s and 1990s the spawning stock biomass (SSB) of the northern hake stock**Error! Bookmark not defined.** increased rapidly and dramatically after the mid-2000s, increasing almost 10-fold between 2006 and 2016.

Despite a small decrease since then, the hake SSB remains six times larger than the average prior to 2005.

The fishing mortality rate (*F*) for the northern hake stock rose during the 1980s but declined rapidly after the mid-2000s and over the last decade has been lower than at any time in the last 40 years.

* The 'northern' hake stock covers an area that extends from the northern Bay of Biscay to the west of Ireland and Scotland and to the North Sea.

Ling

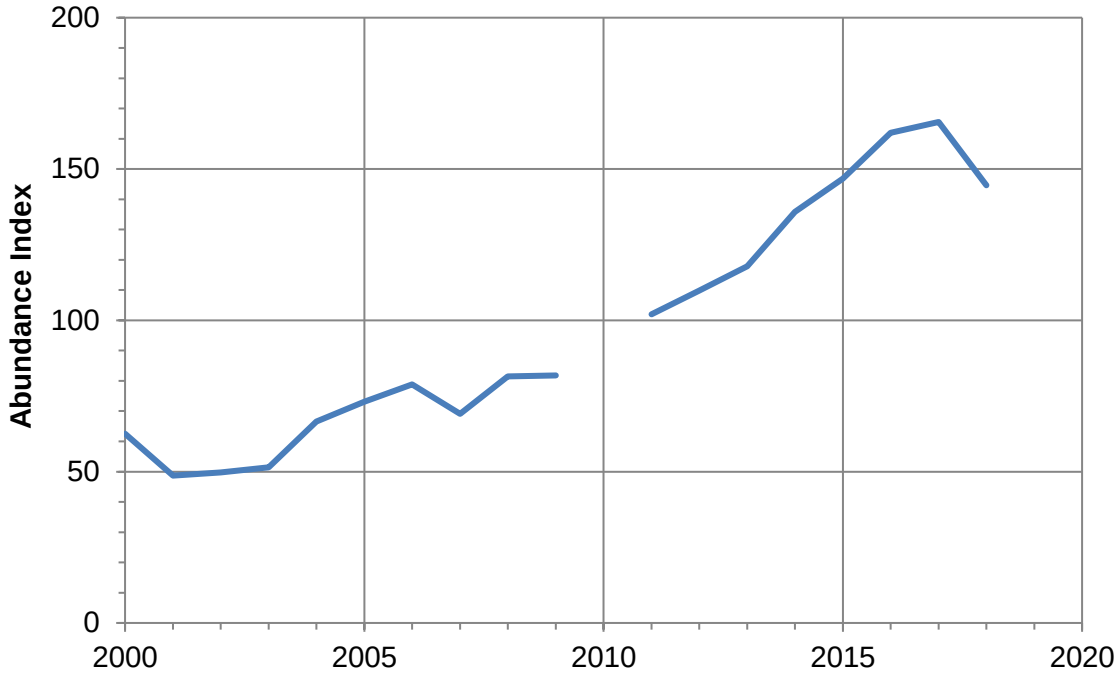

Figure 10 Index of the abundance of the North-East Atlantic ling stock* from 2000 to 2018. (No estimates of fishing mortality rate are available for ling.) (ICES Data; see p. 2.)

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 ling by Norwegian long-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 2017, although it fell slightly in 2018.

* 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).

Aggregate Whitefish Biomass

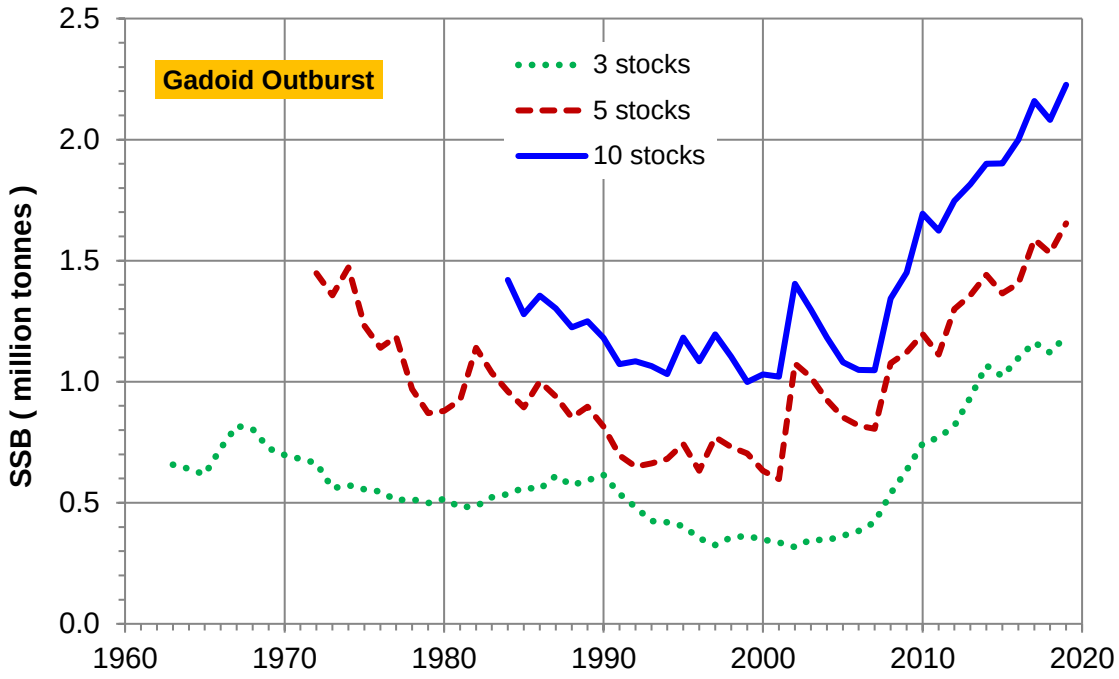

Figure 11 The total combined spawning stock biomasses (SSB) of three, five and 10 fish stocks for which long-term time-series are available (see table below for stocks). (Based on analysis of ICES Data; see p. 2.)

	3 stocks 1963-2019	**5 stocks** 1972-2019	**10 stocks** 1984-2019
NS Cod	X	X	X
NS Plaice	X	X	X
NS Pout			X
NS Dover Sole	X	X	X
NS Whiting			X
WoS Cod			X
WoS Whiting			X
NS & WoS Haddock		X	X
NS & WoS Saithe		X	X
Hake			X

Despite the fluctuations in the abundances of individual whitefish stocks, the total biomass of fish in the North Sea and West of Scotland area has more than doubled over the last two decades and is higher now than ever previously recorded (Figure 11).

Aggregate Whitefish Fishing Mortality Rate

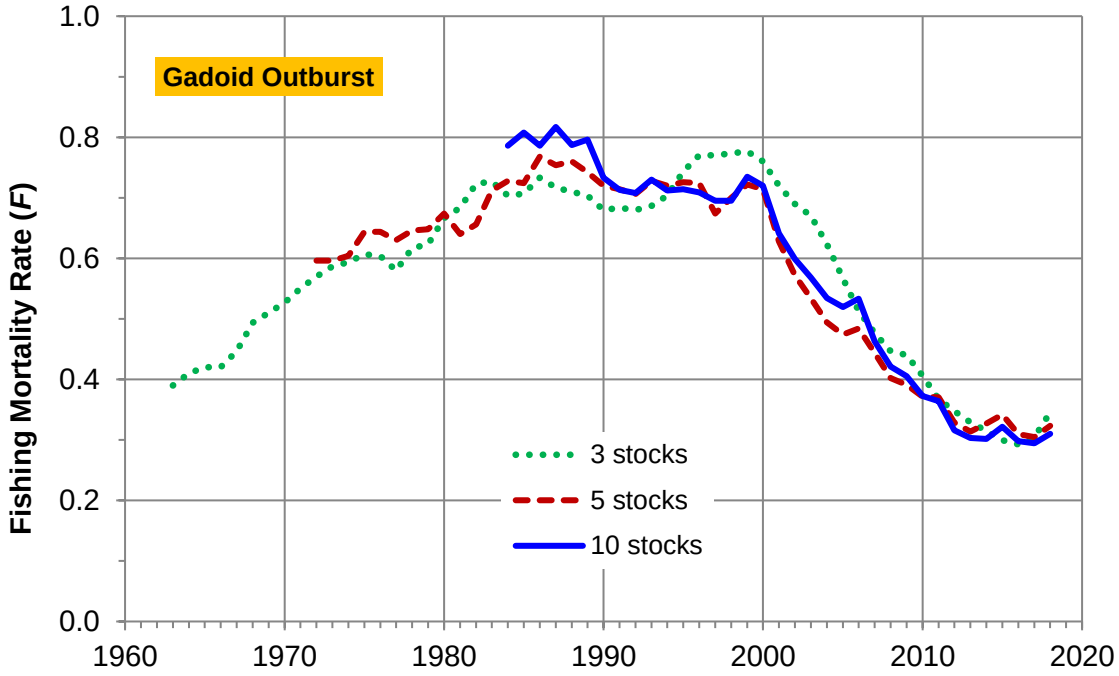

Figure 12 The overall average fishing mortality rate (*F*) of three, five and 10 fish stocks for which long-term time-series are available (see table below for stocks). (Based on analysis of ICES Data; see p. 2.)

	3 stocks 1963-2019	**5 stocks** 1972-2019	**10 stocks** 1984-2019
NS Cod	X	X	X
NS Plaice	X	X	X
NS Pout			X
NS Dover Sole	X	X	X
NS Whiting			X
WoS Cod			X
WoS Whiting			X
NS & WoS Haddock		X	X
NS & WoS Saithe		X	X
Hake			X

The overall average fishing mortality rate (*F*) of whitefish stocks in the North Sea and West of Scotland area has more than halved over the last two decades and is lower now than ever previously recorded (Figure 12).

Herring

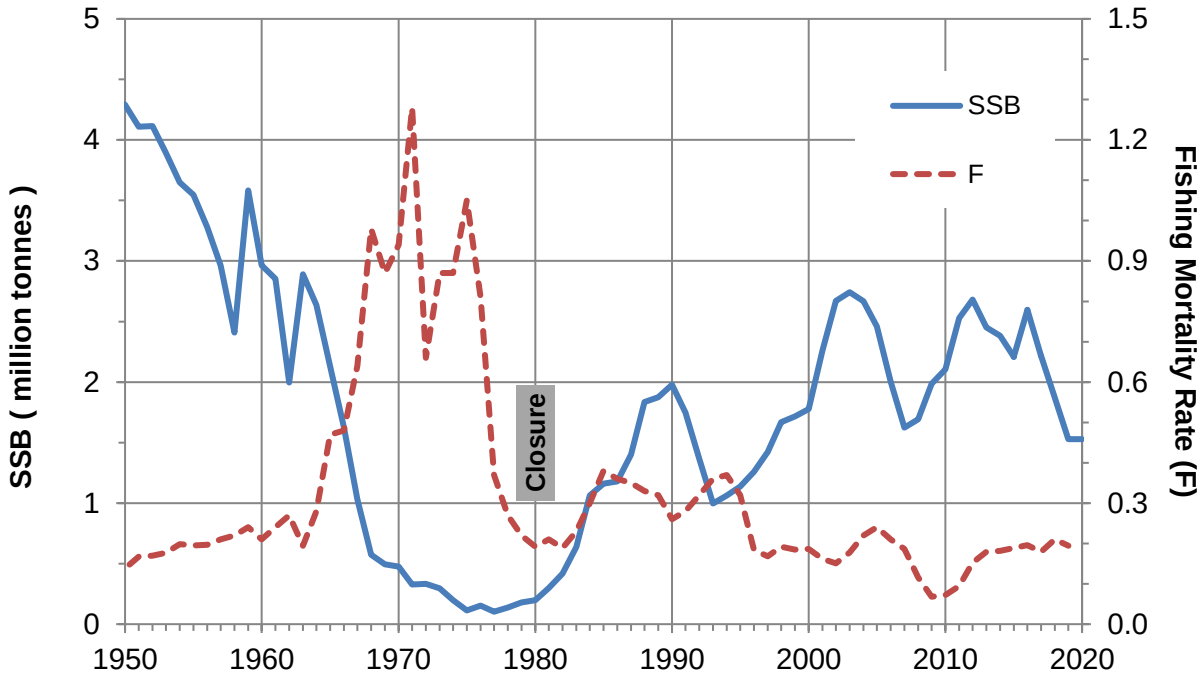

Figure 13 The spawning stock biomass (SSB) of North Sea herring from 1950 to 2019 and the projected SSB in 2020, and the fishing mortality rate (*F*) from 1950 to 2018 and the projected *F* in 2019. (ICES Data; see p. 2.)

The spawning stock biomass (SSB) of herring in the North Sea generally declined from the mid-1940s until the mid-1970s, leading to the closure of the fishery from 1977 to 1983. Following a recovery the biomass has generally fluctuated over the last two decades.

The fishing mortality rate (*F*) for herring in the North Sea peaked in the early 1970s, before declining rapidly during the closure of the fishery. Since the fishery re-opened the fishing mortality rate has generally declined, especially since the mid-1990s, albeit with some large fluctuations.

Mackerel

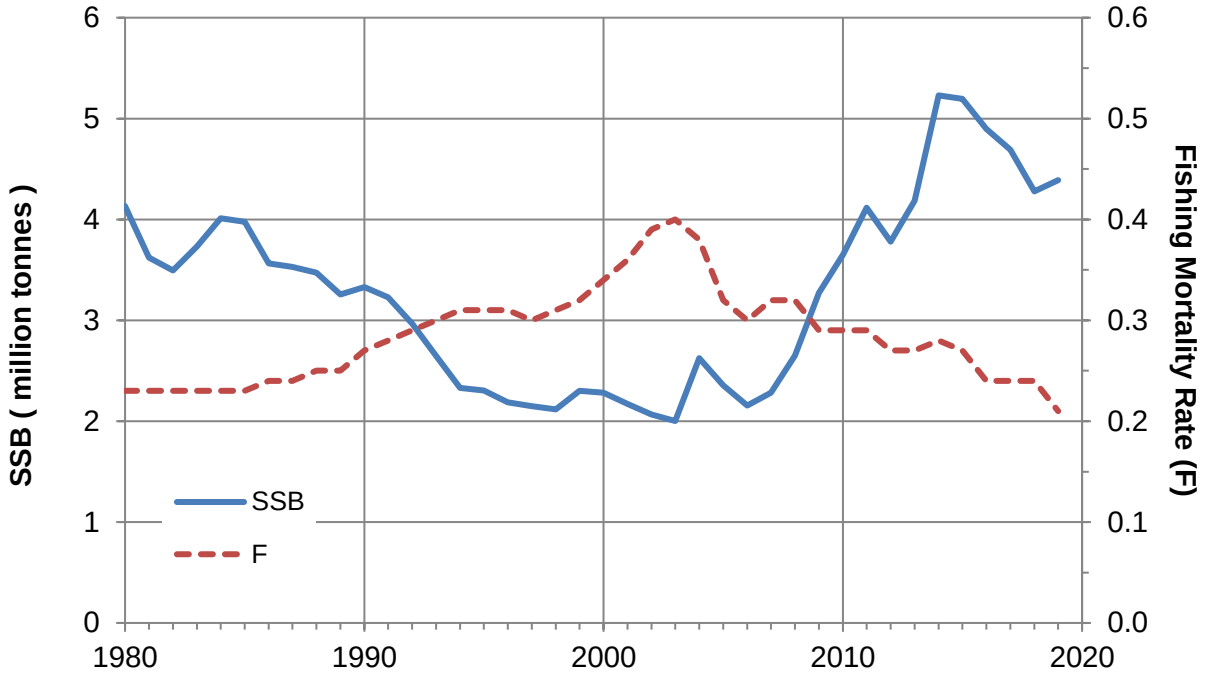

Figure 14 The spawning stock biomass (SSB) of the North-East Atlantic mackerel stock* from 1980 to 2019 and the projected SSB in 2020, and the fishing mortality rate (*F*) from 1980 to 2018 and the projected *F* in 2019. (ICES Data; see p. 2.)

The spawning stock biomass (SSB) of the North-East Atlantic mackerel stock* declined during the 1980s and early 1990s, but increased rapidly after the mid- 2000s. Although there has been a decrease in the last few years the mackerel SSB remains relatively high.

The fishing mortality rate (*F*) for the North-East Atlantic mackerel stock generally increased prior to about 2003, but generally declined since then.

* 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, those 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 has increased dramatically over the last two decades (Figure 11) and is now at a record high level. Over much the same period the average level of fishing mortality of whitefish stocks has fallen substantially to record-low levels (Figure 12).

Research carried out by ICES on the interactions between different fish species in the North Sea* has 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). This interaction implies that it is impossible for all fish stocks to be abundant at the same time.

The overall picture of whitefish stocks provided by these data is of relatively high levels of abundance and relatively low levels of fishing mortality. 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).