On the brink:

The most depleted fish stocks in the Northeast Atlantic

Contents

Credits

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Executive summary

School of Atlantic horse mackerels (*Trachurus trachurus*).

European countries have committed to restore and maintain populations of commercial fish species above sustainable levels. However, despite some progress made during recent years, the status of some fish stocks continues to be in a critical state. Thus, based on the latest available scientific information, Oceana has identified the over 20 depleted fish stocks in the Northeast Atlantic, to highlight their ongoing dire status and the urgent need for management measures aimed at their recovery.

The list of Northeast Atlantic depleted stocks covers a diverse group of species (including pelagic, demersal, and benthic species) and sea basins, from the Baltic Sea to the west of Scotland and from the Barents Sea to Iberian waters. Species like anchovy, eel, herring, horse mackerel, Norway lobster, sardine, and whiting, among others, have one or more stocks that are known or considered to be depleted. The most extreme case is that of cod, with the highest number of depleted stocks (nine) across the whole region.

The depletion of these stocks raises concerns not only about their status, but also about the possibility that their abundance may have fallen below tipping points that have negative biological and ecological implications, as well as adverse economic and social consequences, since the stocks cannot sustain direct exploitation. Their reproductive capacity and subsequent are impaired, and there is an increased risk of stock collapse. This situation also makes these stocks more vulnerable to anthropogenic pressures (such as habitat degradation and loss) and to environmental variation, including in relation to climate change.

Most depleted stocks in the Northeast Atlantic are managed jointly by different parties, mainly by the European Union and the United Kingdom, through a solid regulatory framework that, if well implemented, would facilitate the recovery and sustainable exploitation of depleted stocks. Nevertheless, only very limited attempts have been made to apply measures for their recovery (e.g., catch limits and technical measures). Indeed, depleted stocks are far from meeting the objectives set for their international and domestic management. For example, the abundance of the three most heavily depleted stocks, Irish Sea whiting, West of Scotland cod, and Celtic Sea cod, is only 8%,16%, and 21%, respectively, of the minimum target.

Overfishing is the main driver that has reduced the abundance of depleted stocks to unsustainable levels. Despite being clearly problematic, this excessive fishing pressure has been long ignored: for all of the most heavily depleted stocks, fishing mortality has exceeded sustainable levels for nearly the entire duration of the time series. The situation of the depleted stocks is so alarming that, in most cases, scientists advise that catches must be strongly reduced or stopped altogether (i.e., 'zero catch') to facilitate their recovery and sustainable exploitation. The need to implement such reductions is made more pressing by the fact that stock recovery is being hampered by other ongoing anthropogenic impacts and environmental changes, such as habitat degradation and climate change. Nevertheless, the scientific recommendations are regularly ignored by decision-makers.

A further complication arises because depleted stocks are typically captured as by-catch together with other fish stocks in mixed fisheries. Management decisions related to the exploitation rate and pattern of stocks caught in mixed fisheries typically take a stock-by-stock approach, and prioritise the catches of the most productive stocks, rather than securing the recovery of those stocks with the poorest conservation status. In addition, there are signs of non-compliance with the provisions of the landing obligation, such that illegal discarding continues to be a problem. As result, actual catches of depleted stocks may far exceed the levels that are scientifically advised for permitting them to recover.

Based on the findings of this report, any prospect of recovering these severely overexploited fish populations appears unlikely without decisive management action. Implementation of adequate policies and measures by Northeast Atlantic decision-makers, such as the EU and UK, is both crucial and urgent to recover depleted stocks above sustainable levels in the shortest possible time.

Oceana therefore recommends that these decision-makers act without delay to:

- **Adopt multi-year management strategies** for stock recovery;
- **Set catch limits** in line with scientific advice;
- **Prioritise the recovery needs** of depleted stocks in mixed fisheries;
- **Fully document fisheries** that target or catch depleted stocks as bycatch;
- **Implement the most effective by-catch** reduction measures;
- **Eliminate anthropogenic activities** that negatively affect depleted stocks;
- **Avoid any increase in fishing capacity** of fleets catching depleted stocks;
- **Protect essential fish habitats** (those habitats that are critical for the life cycle of exploited fish species); and
- **Safeguard food availability** for depleted stocks;

1. Introduction

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Unloading cod (*Gadus morhua*) from a longliner.

European countries have committed through different international agreements[1,2,3,4] and domestic regulations[5,6] to exploit fish resources at sustainable levels. However, despite the progress made during recent decades towards this goal, EU Member States and the UK have failed to meet the 2020 deadline established under UN Sustainable Development Goal 14 and the Common Fisheries Policy, which required them to restore and/or maintain all populations of harvested species above biomass levels that can produce the Maximum Sustainable Yield[a,7](MSY). Furthermore, the status of some fish stocks continues to be in a poor state, while the conservation and exploitation status of many others remains unknown.

Recent data published by the International Council for the Exploration of the Sea[8](ICES), an independent scientific institution that provides advice on fish stocks, indicate the ongoing depleted status of certain key fish stocks in the Northeast Atlantic, many of which are jointly managed by different parties (mainly by the EU and the UK). The situation of these stocks is so critical that for many of them, the ICES advice on appropriate levels of fishing to facilitate their recovery is a strong reduction in catches – or even a complete reduction in catches (i.e., 'zero catch'[8]).

[a] MSY is a theoretical maximum catch that can be taken from a stock in the long-term under constant environmental conditions.

> Despite the heavy depletion of stocks representing a major failing in the management of Northeast Atlantic fish resources, very limited effort has been made by the relevant parties to apply effective management and recovery measures.

Despite the heavy depletion of stocks representing a major failing in the management of Northeast Atlantic fish resources, very limited effort has been made by the relevant parties to apply effective management and recovery measures. However, such recovery efforts are needed more urgently than ever[9], given not only the poor status of the stocks, but also their lowered resilience to other anthropogenic impacts, such as habitat degradation and climate change[10].

This technical report provides an overview of the status, management, and exploitation of the most depleted stocks in the Northeast Atlantic and analyses the main reasons that may explain their condition. Based on the findings, Oceana sets out measures and recommendations for the recovery and sustainable exploitation of these stocks. Recovering depleted stocks is not only necessary for achieving healthy and resilient marine ecosystems, but also for thriving coastal communities that depend on fisheries.

2. Depleted stocks in the Northeast Atlantic

The most recent ICES annual advice covers 185 individual Northeast Atlantic fish stocks, representing over 60 species. To complement this single-stock advice[8], ICES also produces mixed-fisheries considerations, fisheries overviews by ecoregion[11], and ecosystem overviews[12]. Together, this information provides a good description of the status of the main fish populations in the Northeast Atlantic.

However, due to limitations in data and available knowledge, it is not possible for ICES to produce quantitative and analytical assessments for all 185 fish stocks. Thus, data for only 74 stocks are sufficient for estimating abundance (in the form of spawning stock biomass; SSB), fishing mortality rate (F), and reference points for these two indicators[b]. Comparing the biomass and fishing mortality estimates against their respective reference points allows for an assessment of the status and exploitation of the stocks, respectively.

[b] For the rest of stocks, commonly known as data-limited stocks, ICES usually provides advice on abundance and exploitation status, but without traditional analytical assessments and reference points. Therefore, in most of these cases the ICES assessments are based on trends.

Atlantic cod (*Gadus morhua*) among algae and bryozoans.

The main reference points used by ICES to assess the conservation status of fish stocks are B_{lim}, B_{pa}, and MSY $B_{trigger}$. Stocks are classified in different conservation categories depending on whether their biomass is above or below these reference points. For a large majority of cases MSY $B_{trigger}$ is determined as B_{pa}, and therefore in practical terms there are three main possible states of conservation:

- Sustainable, if stock biomass is above MSY $B_{trigger}$
- Overexploited, if stock biomass is below MSY $B_{trigger}$
- Severely overexploited or depleted, if stock biomass is below B_{lim}

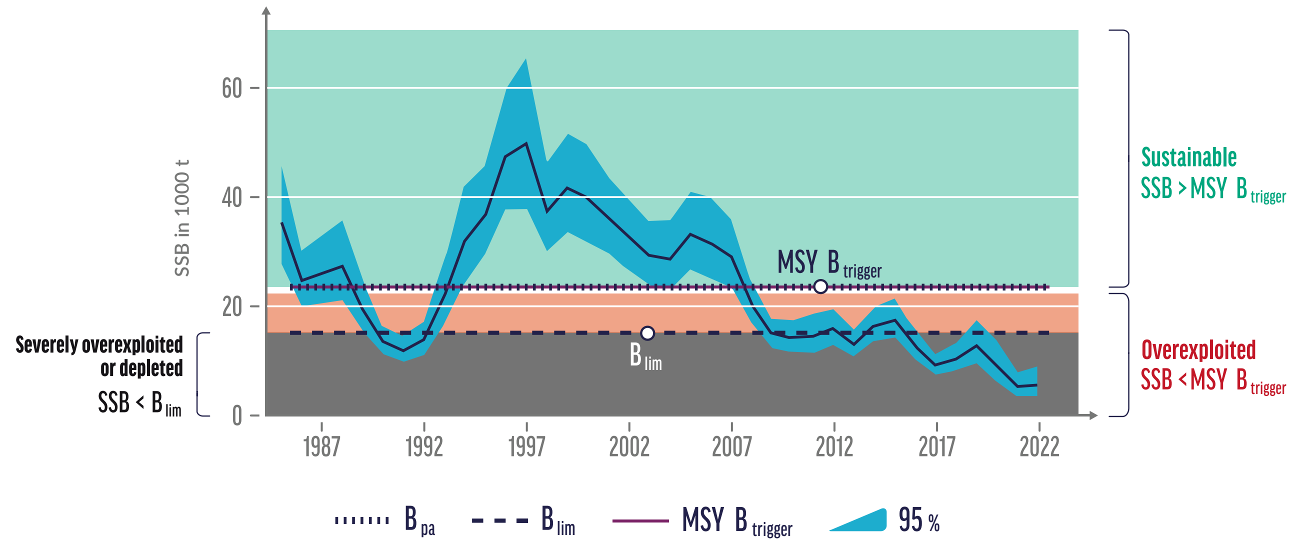


Figure 1. Categories of stock conservation status (sustainable, overexploited, and depleted) according to stock biomass (SSB) and the main biomass reference points (MSY $B_{trigger}$ and B_{lim}). The example shown is for the western Baltic cod stock. Data source: ICES[13].

B_{lim} is a biomass reference point below which the reproductive capacity and subsequent recruitment[c] of a stock are considered to be impaired and there is an increased risk of collapse[14]. This reduced level of biomass may also fall below levels associated with broader adverse ecological impacts, and with negative economic and social impacts[15], as reduced stocks are not able to support fisheries.

In addition, in some cases ICES is able to identify whether the abundance of a data-limited stock is below any possible biomass reference point (including B_{lim}), regardless of the fact that SSB and/or B_{lim} cannot be quantified. Any such stock is therefore classified as depleted[d].

[c] The process by which new individuals enter the exploitable stock and become susceptible to fishing.

[d] There are also examples of data-limited stocks that show very worrying trends, like: Rockall cod; Skagerrak, Kattegat, southern and central North Sea, and eastern English Channel horse mackerel; Celtic Seas, English Channel, and Bay of Biscay blackspot seabream; and Baltic Sea salmon (excluding Gulf of Finland).

Based on these criteria, the following Northeast Atlantic stocks are known or considered to be depleted:

- Atlantic Iberian waters **anchovy** (*Engraulis encrasicolus*), southern component, ane.27.9.a[16].
- Southeast Greenland **beaked redfish** (*Sebastes mentella*), demersal, reb.27.14b[17].
- Iceland and Faroes grounds, north of Azores, east of Greenland **beaked redfish**, shallow and deep pelagic stocks, reb.2127.sp[18] reb.2127.dp[19].
- Northeast Atlantic **blue ling** (*Molva dypterygia*), bli.27.nea[20].
- Western English Channel and southern Celtic Seas **cod** (*Gadus morhua*), cod.27.7.e–k[21].
- Eastern Baltic Sea **cod**, cod.27.24-32[22].
- Faroe Plateau **cod**, cod.27.5b1[23].
- Irish Sea **cod**, cod.27.7a[24].
- Kattegat **cod**, cod.27.21[25].
- North Sea, eastern English Channel and Skagerrak **cod**, cod.27.47d20[26].
- Northern Norwegian coastal **cod**, cod.27.1-2.coastN[27].
- West of Scotland **cod**, cod.27.6a[28].
- Western Baltic Sea **cod**, cod.27.22-24[13].
- Northeast Atlantic **eel** (*Anguilla anguilla*), ele.2737.nea[29].
- Northeast Atlantic **golden redfish** (*Sebastes norvegicus*), reg.27.1-2[30].
- Irish Sea, Celtic Sea and southwest of Ireland **herring** (*Clupea harengus*), her.27.irls[31].
- Skagerrak, Kattegat and western Baltic **herring**, her.27.20-24[32].
- Western **horse mackerel**, (*Trachurus trachurus*), hom.27.2a4a5b6a7a-ce-k8[33].
- Atlantic Iberian waters East, western Galicia, and northern Portugal **Norway lobster**, (*Nephrops norvegicus*), nep.fu.2627[34].
- Southern Bay of Biscay and northern Galicia **Norway lobster**, nep.fu.25[35].
- Northeast Atlantic and adjacent waters **orange roughy** (*Hoplostethus atlanticus*), ory.27.nea[36].
- Central and southern North Sea **sardine** (*Ammodytes* spp.), san.sa.2r[37].
- Bay of Biscay **sardine** (*Sardina pilchardus*), pil.27.8abd[38].
- Irish Sea **whiting** (*Merlangius merlangus*), whg.27.7a[39].
- Southern Celtic Seas and western English Channel **whiting**, whg.27.7b-ce-k[40].

This list of depleted fish stocks covers a diverse group of species (including pelagic, demersal, and benthic species) and sea basins, from the Baltic Sea to the west of Scotland, and from the Barents Sea to Iberian waters. As the abundance of all of these stocks is below B_{lim}, it also falls below the level of biomass that can support MSY, which is the primary binding management objective for stocks under current international[1,2,3,4] and domestic agreements[5,6] across Europe (see Section 3). It is important to note that to ensure their sustainable status and exploitation, depleted stocks should be restored and maintained not only above the B_{lim} reference point, but above levels that can produce MSY.

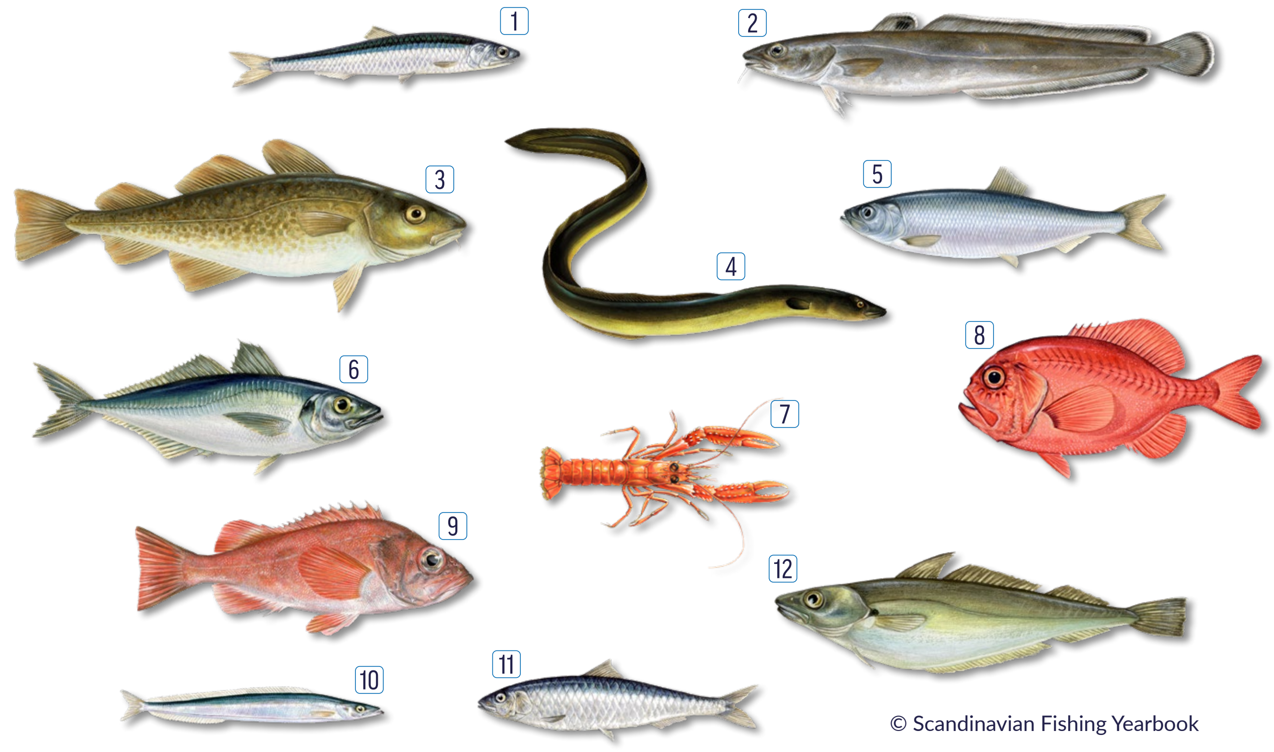


Figure 2. Species with at least one population (stock) known or considered to be depleted in the Northeast Atlantic: (1) **anchovy**; (2) **blue ling**; (3) **cod**; (4) **eel**; (5) **herring**; (6) **horse mackerel**; (7) **Norway lobster**; (8) **orange roughy**; (9) **beaked redfish**; (10) **sandeel**; (11) **sardine**; and (12) **whiting**.

3. Identification and status of the ten most heavily depleted stocks

The ten most heavily depleted stocks were identified and ranked by calculating the percentage difference between stocks' ICES-estimated SSB for 2022[e] and their respective B_{lim} reference points. In addition, to assess how far the most depleted stocks are from meeting their management objective, the same analysis was also conducted using the percentage difference between SSB and the MSY $B_{trigger}$ reference point[f].

The ten most heavily depleted stocks comprised three species (Table 1): whiting (two stocks), cod (six stocks) and herring (two stocks). It should be noted that, for the eel stock[29] and the two depleted Norway lobster stocks[34,35], ICES only provides relative values of biomass; therefore, they have not been included in this analysis. The status of these three stocks nevertheless seems to be among the most worrying of the list of depleted Northeast Atlantic stocks.

The most heavily depleted stocks are widely distributed across the Northeast Atlantic. They are found in sea basins such as the Baltic Sea, North Sea, West of Scotland, Irish Sea, and Celtic Sea, among others, although cod appears to be doing poorly across the whole Northeast Atlantic region.

Across the ten most heavily depleted stocks, there is a wide range of values relative to B_{lim} and MSY $B_{trigger}$ (Table 1). The SSB of Irish Sea whiting (ranked as the most heavily depleted stock) is only approximately 13% of its B_{lim}, whereas for

[e] In cases where 2022 biomass data were not available, 2021 data has been used.
[f] The biomass reference point, defined in ICES advice, which triggers the potential achievement of B_{MSY}. For a large majority of cases, MSY $B_{trigger}$ is determined as B_{pa}.

Celtic Sea whiting, SSB is about 88% of its B_{lim} (ranked tenth). The status of some of these stocks is so deplorable that they are not expected to recover above B_{lim} in the medium-term, even in the event of no fishing. It is important to note that, as MSY $B_{trigger}$ values are greater than B_{lim} values, all of the most heavily depleted stocks are at a significantly lower biomass level than the MSY objective. For example, the SSB of Irish Sea whiting is only about 8% of its MSY $B_{trigger}$ reference point, while the SSB of Celtic Sea whiting is approximately 64% of its MSY $B_{trigger}$.

Although trends in abundance (i.e., SSB) for the most heavily depleted stocks have been variable over the last 30-50 years (given the available data), most of them show an overall reduction trend during the time series, from sustainable levels (SSB > MSY $B_{trigger}$) to depletion (SSB < B_{lim}), with their lowest levels of abundance having been recorded in recent years (Figure 4). Many stocks have experienced steady declines in stock abundance, such as Irish Sea whiting, West of Scotland cod and western Baltic cod (the first two stocks have remained below B_{lim} for nearly the last 30 years), while others are far more variable (i.e., Irish Sea, Celtic Sea, and southwest of Ireland herring, eastern Baltic cod, and southern Celtic Seas and western English Channel whiting).

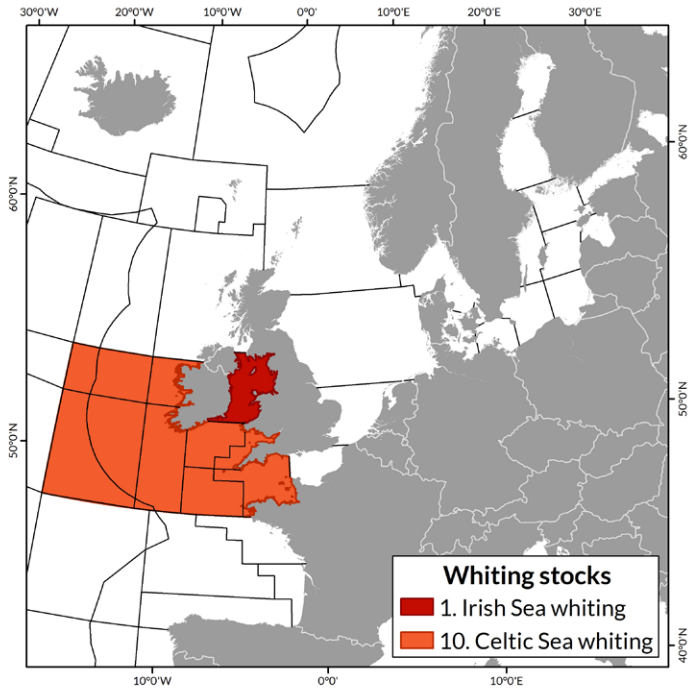
Table 1. Quantification of the conservation status of the ten most heavily depleted Northeast Atlantic fish stocks in relation to their respective B_{lim} and MSY $B_{trigger}$ reference points. Rankings reflect the relative size of stocks as a percentage of their B_{lim} reference point (SSB/B_{lim}), from the smallest to the largest. Values in the table for SSB, B_{lim}, and MSY $B_{trigger}$ refer to weight in tonnes. Data source: ICES.

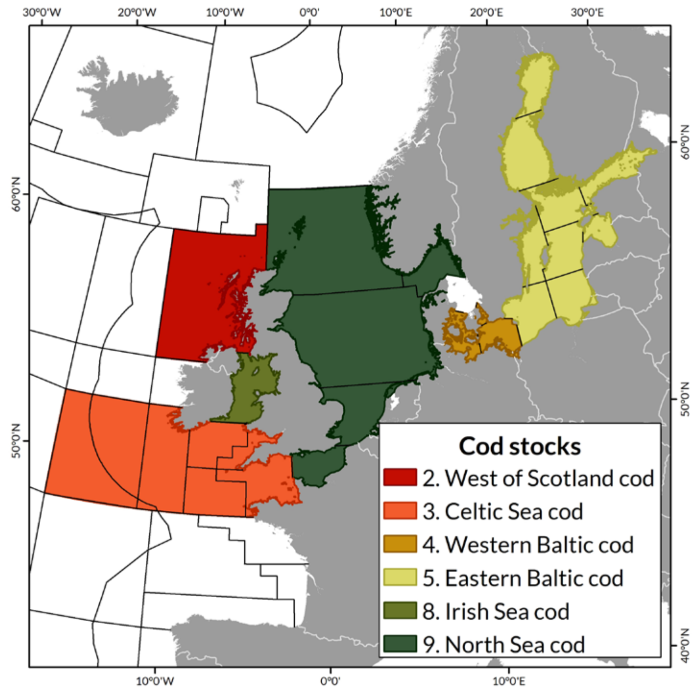
Ranking	Stock name	Stock code	SSB 2022	B_{lim}	SSB/ B_{lim} (%)	MSY $B_{trigger}$	SSB/ MSY $B_{trigger}$ (%)
1	**Irish Sea whiting**	whg.27.7a	1 326[g]	10 000	13.3	16 300	8.1
2	**West of Scotland cod**	cod.27.6a	3 288	14 376	22.9	20 126	16.3
3	**Celtic Sea cod[h]**	cod.27.7e-k	1 196	4200	28.5	5 800	20.6
4	**Western Baltic cod**	cod.27.22-24	5 661	15 067	37.6	23 492	24.1
5	**Eastern Baltic cod**	cod.27.24-32	60 979	108 036	56.4	Undefined	NA
6	**Irls herring[h]**	her.27.irls	19 349[i]	34 000	56.9	54 000	35.8
7	**Western Baltic herring[h]**	her.27.20-24	71 011[i]	120 000	59.2	150 000	47.3
8	**Irish Sea cod**	cod.27.7a	5 029	8 303	60.6	11 538	43.6
9	**North Sea cod[h]**	cod. 27.47d20	52 241	69 841	77.5	97 777	55.4
10	**Celtic Sea whiting[h]**	whg.27.7b-ce-k	32 346	36 571	88.4	50 818	63.7

[g] The ICES advice for Irish Sea whiting was not updated in 2022. SSB data refer to the short-term forecast for 2022 by ICES.

[h] Stock name has been simplified by naming only partially its area of distribution or using an ICES code. Details on the stock's full name can be found in the list of depleted stocks (Section 1 of this report).

[i] SSB data refer to the short-term forecast for 2022 by ICES.





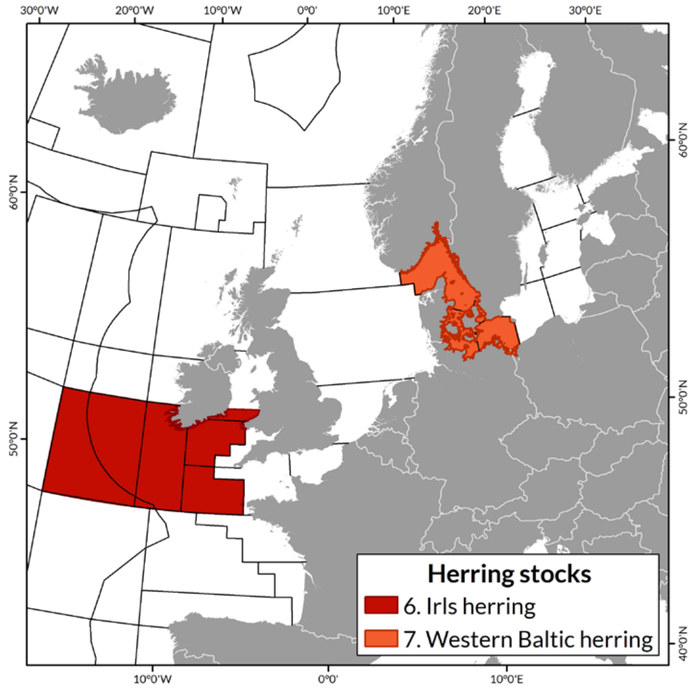


Figure 3. Distributions of the ten most heavily depleted stock. Numbers next to stock names indicate the ranking among these ten stocks, with 1 being the most heavily depleted stock. Polygons represent ICES subareas and divisions which are used to describe the location of assessed stocks. Polygons are shaded according to the distribution of the stocks, with colours as shown in the legend of each panel. Data source: ICES.

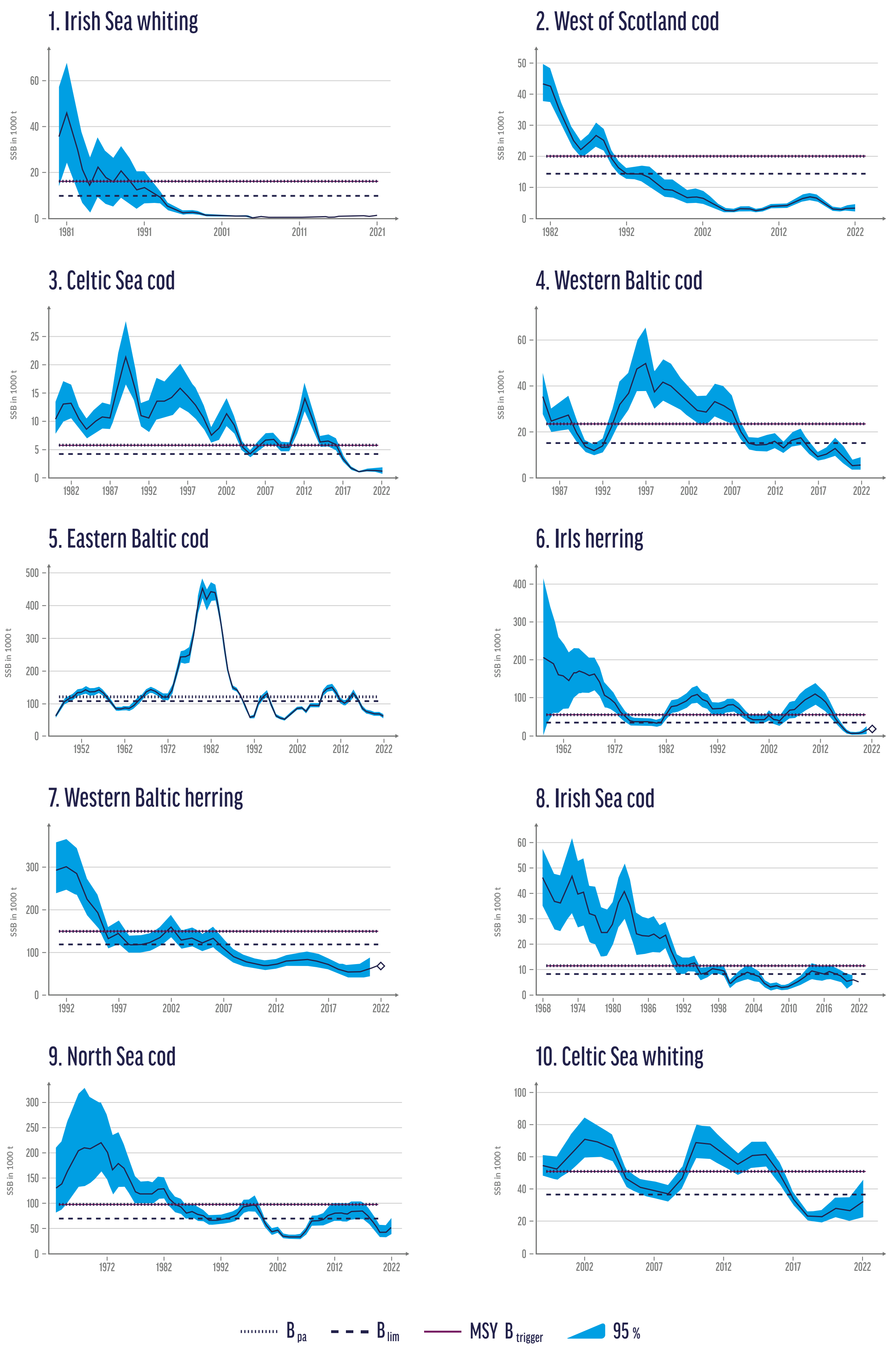
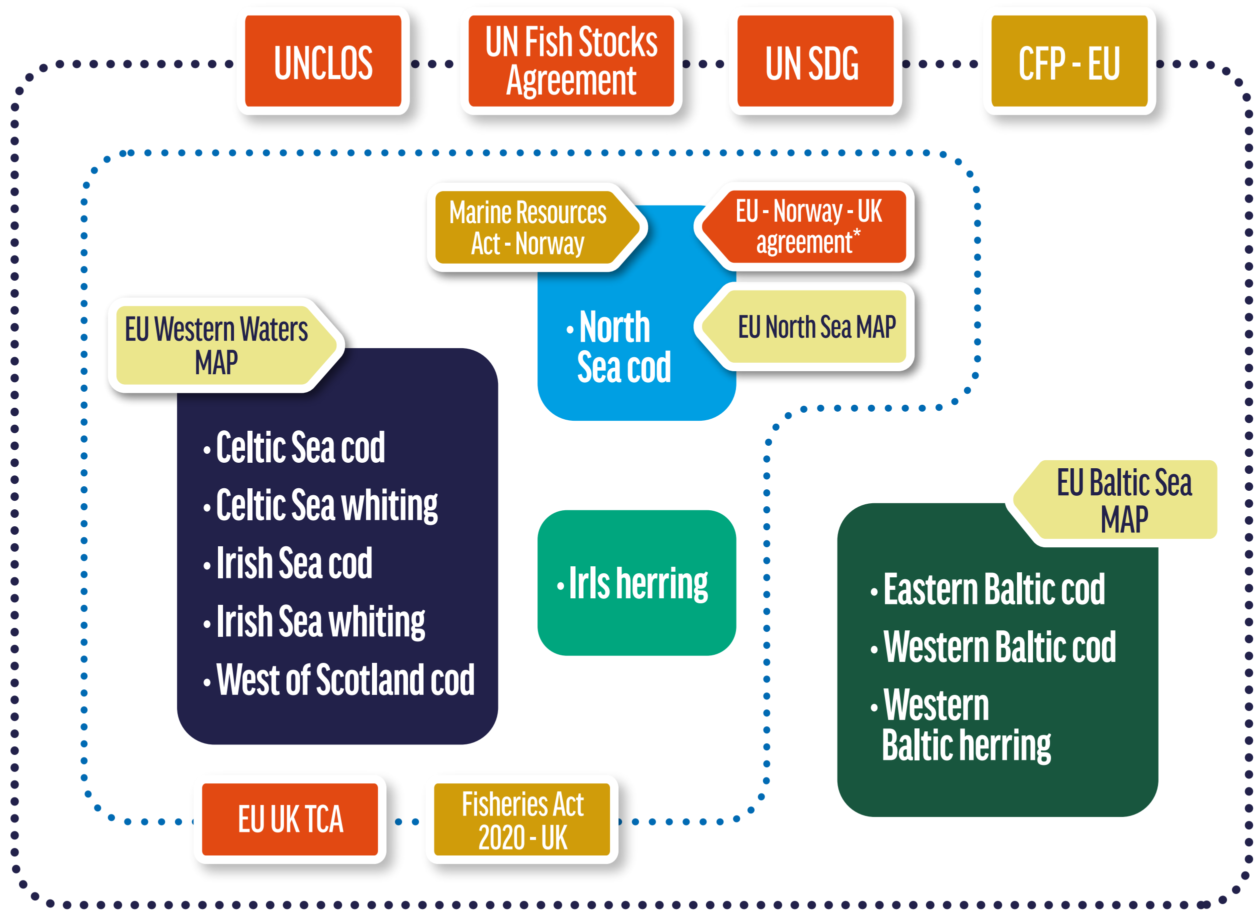


Figure 4. Trends in abundance (SSB) of the ten most heavily depleted fish stocks in the Northeast Atlantic. Data source: ICES.

4. Management and exploitation of the most heavily depleted stocks

Management of all of the ten most heavily depleted stocks occurs within the context of a solid international and domestic fisheries regulatory framework (Figure 5), with management objectives and principles that, if well implemented, would ensure their recovery and sustainable exploitation. Other relevant environmental agreements and regulations, such as the Convention on Biological Diversity[41] (CBD), the Marine Strategy Framework Directive[42] (MSFD) and the Sustainable Development Goals (SDG), also include targets and objectives related to the conservation and sustainable exploitation of fish populations.



*The EU-Norway-UK fisheries agreement is in the process of being adopted.

Figure 5. International and domestic fisheries regulatory framework for the exploitation and conservation of the most heavily depleted stocks.

- Red boxes refer to international agreements
- Golden boxes refer to main domestic framework regulations
- Yellow boxes refer to EU multiannual plans (MAPs)

Aside from the main global agreements for the management of fish stocks[1,2,3], the EU Common Fisheries Policy (CFP)[5] is the legal framework that covers all of the most heavily depleted stocks. All ten of them are also of commercial interest to the EU. In addition, the EU has multiannual management plans in place for stocks fished in the Baltic Sea[43], North Sea[44], and in western waters[45], which cover nine of the ten most heavily depleted stocks (Figure 5).

On the UK side, the 2020 Fisheries Act[6] covers the majority of the most heavily depleted stocks, except for those in the Baltic Sea. Although the Fisheries Act requires the development of Fisheries Management Plans (to replace the EU multiannual plans), these plans have not yet been developed. Both the EU and the UK have also established a specific regulatory framework for shared stocks under the EU-UK Trade and Cooperation Agreement (TCA)[4,j]. Finally, the Norway Marine Resources Act[46] applies to one of the most heavily depleted stocks: North Sea cod. As a result of Brexit, the three parties that are responsible for managing this stock – the EU, Norway, and the UK - are in negotiations to adopt a fisheries agreement for the management of their shared fish stocks[k], which will cover North Sea cod, among other fish stocks.

The fundamental and shared objective in the regulatory framework of the most heavily depleted stocks is to restore and maintain fish populations above biomass levels that can produce the MSY (see, for example, CFP Article 2.2, UK Fisheries Act 1.(3).(b), EU-UK TCA Fish.2.2, or SDG target 14.4). Parties involved in the exploitation of these stocks adopt measures, such as annual catch limits and technical measures, to make progress towards the agreed management objectives.

However, the measures adopted by decision-makers to date are insufficient and/or inefficient, not only to achieve their commitments[7] (e.g., MSY) for the depleted stocks, but even to recover them.

Stocks managed by the EU and the UK:

1. Irish Sea whiting
2. West of Scotland cod
3. Celtic Sea cod
6. Irish Sea, Celtic Sea, and southwest of Ireland herring
8. Irish Sea cod
10. Southern Celtic Seas and western English Channel whiting

Stocks managed by the EU:

4. Western Baltic cod
5. Eastern Baltic cod[l],
7. Western Baltic herring

Stocks managed by the EU, Norway, and the UK:

9. North Sea cod

[j] Fisheries agreements for shared stocks usually also include mutual access to each other's waters and the exchange of fish quotas.

[k] Before Brexit, the EU-Norway agreement covered the fish stocks that now are shared among the three parties (EU, Norway, and UK). The EU-Norway agreement is still in place for the stocks shared between those two parties, but it is in the process of being reformed.

[l] Russia accounts also for a small quota of eastern Baltic cod.

The setting of catch limits is the most important tool to control the exploitation rate of commercial fish stocks. All of the most heavily depleted stocks are managed through annual catch limits (Total Allowable Catches; TACs), expressed in weight (tonnes), and with quotas assigned to the relevant parties (Table 2). Decisions on TACs are adopted by different decision-makers depending on the stock and based on scientific advice provided by ICES. However, scientific recommendations on the fishing mortality levels that would be consistent with achieving sustainable fisheries are rarely followed[47,48]. This is particularly pronounced in the case of the depleted stocks (see Section 5), for which actual catches even exceed agreed catch limits.

Due to the critical status of the most heavily depleted stocks, TACs that permit directed fisheries are only in place for two of the ten stocks (southern Celtic Seas and western English Channel whiting; and North Sea, eastern English Channel and Skagerrak cod). For the remainder of stocks, the agreed TACs are exclusively for accidental catches (i.e., "by-catch TACs"), and so they are no longer considered target stocks. In the specific case of Irish Sea, Celtic Sea, and southwest of Ireland herring, the TAC is only allocated to vessels participating in a sentinel fishery.

Like other Northeast Atlantic stocks managed through TACs, the most heavily depleted stocks are included under the landing obligation, which is also known as the 'discard ban'. This means that during fishing activities, all catches of these stocks must be retained on board, recorded, landed, and counted against the quotas[m]. Despite efforts to implement the landing obligation, it is broadly recognised that non-compliance is widespread across fishing fleets, unreported discarding continues, and the landing obligation is not effectively controlled[49,50], posing significant risk to the sustainable exploitation of fish stocks (see Section 5).

Unloading cod (*Gadus morhua*) from a gillnetter in the beach.

The demersal fishes that are among the most heavily depleted stocks, like cod and whiting stocks, are regularly caught together with other fish stocks in mixed fisheries. For example, most catches of Irish Sea whiting are made by the Norway lobster fleets, and almost all fleets targeting Celtic Sea demersal species, like haddock, catch cod to a greater or lesser extent. Therefore, management decisions for individual stocks included in mixed fisheries have consequences for the rest of stocks in these fisheries, including those that are depleted. For

[m] Note that there are some exemptions to the landing obligation when catches are used as live bait, for prohibited species, for high survivability species, and catches falling under de minimis exemptions. See CFP Article 15 for details.

example, a sustainable TAC for Nephrops in the Irish Sea can lead to the excessive by-catch of whiting, or a modification of the mesh size for targeting haddock in the Celtic Sea can have implications on the selectivity pattern for cod.

European countries also adopt technical measures to regulate the operation of fishing fleets, in particular the exploitation pattern of fishing activity (i.e., how fishing mortality is distributed across different fish species and their age compositions). This exploitation pattern is related to selectivity and determined by the characteristics of fishing gear (e.g., mesh size), area, and the seasonal distribution of fishing. With the aim of ensuring the protection of juveniles, countries set species-specific minimum conservation reference sizes or minimum landing sizes, below which individuals cannot be sold for direct human consumption.

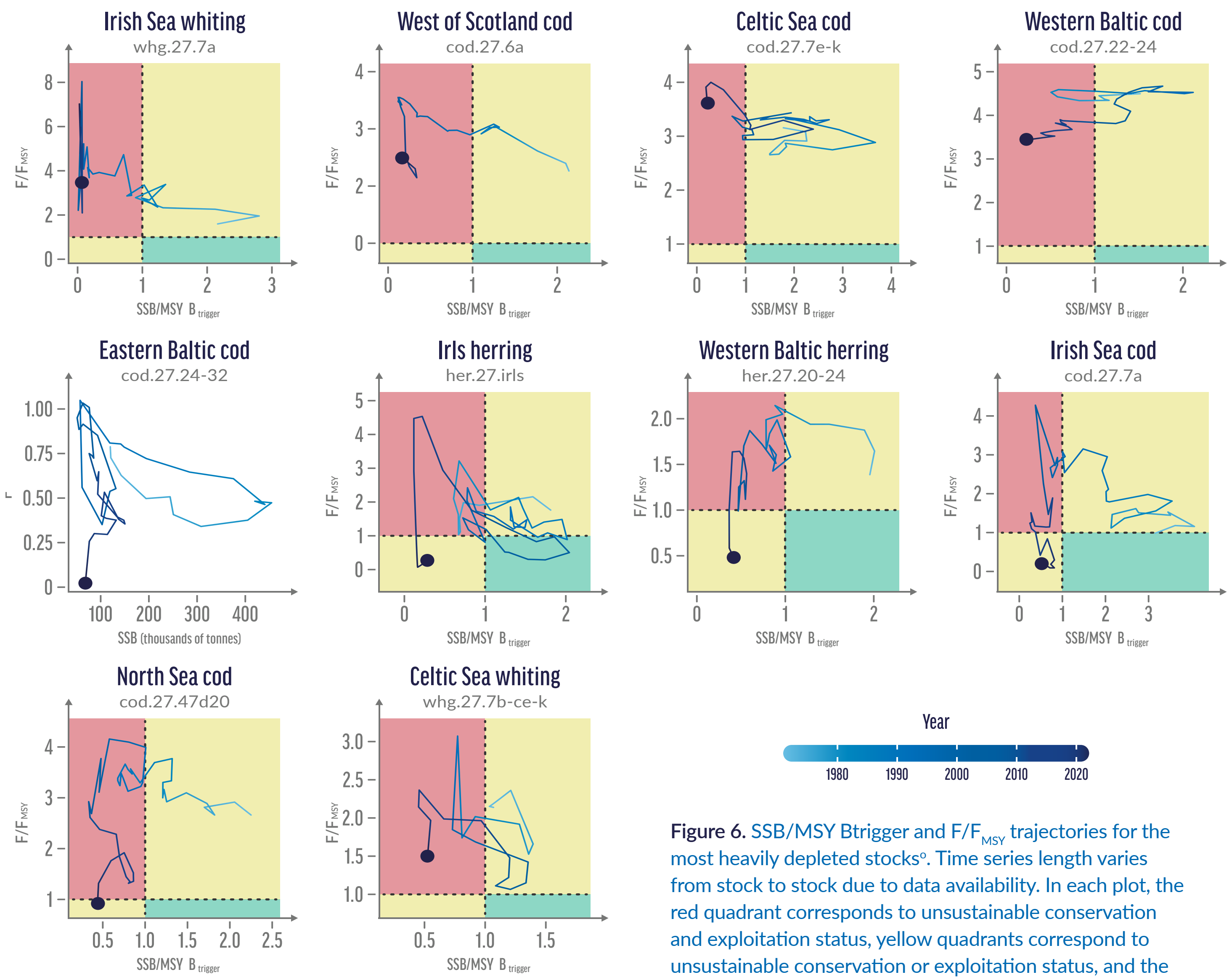
Table 2. Catch shares for the most heavily depleted stocks in 2022. Countries are indicated by the following abbreviations: BE: Belgium; DE: Germany; DK: Denmark; EE: Estonia; FI: Finland; FR: France; IE: Ireland; LV: Latvia; LT: Lithuania; NL: Netherlands; NO: Norway; PL: Poland; SE: Sweden. Data sources: EU-UK TCA and EU fishing opportunities regulations for 2022.

Ranking	Stock name	TAC code	TAC share for 2022	
1	Irish Sea whiting	WHG/07A	EU 41.4% UK 58,6%	(IE 38%, FR 3%, BE <1%, NL <1%)
2	West of Scotland cod	COD/5BE6A	EU 27.4% UK 72.6%	(IE 17%, FR 9%, DE 1%, BE <1%)
3	Celtic Sea cod	COD/7XAD34	EU 90.5% UK 9.5%	(IE 52%, FR 36%, BE 2%, NL <1%)
4	Western Baltic cod	COD/3BC+24	EU 100%	(DK 44%, DE 21%, SE 15%, PL 12%, LV 4%, LT 2%, EE 1%, FI <1%)
5	Eastern Baltic cod	COD/3DX32	EU 100%	(PL 27%, SE 23%, DK 23%, DE 9%, LV 9%, LT 5%, EE 2%, FI 2%)
6	Irls herring	HER/7G-K	EU 99.9% UK 0.1%	(IE 86%, FR 6%, NL 6%, DE 1%)
7	Western Baltic herring	HER/3BC+24	EU 100%	(DE 55%, SE 18%, DK 14%, PL 13%, FI <1%))
8	Irish Sea cod	COD/07A	EU 55.8% UK 44.2%	(IE 50%, FR 3%, BE 2%, NL <1%)
9	North Sea cod	COD/2A3AX4	EU 38.2% NO 17.0% UK 44.8%	(DK 15%, DE 9%, NL 8%, FR 3%, BE 3%, SE <1%)
		COD/07D	EU 90.7% UK 9.3%	(FR 84%, BE 4%, NL 2%)
		COD/03AN	EU 100%	(DK 83%, SE 14%, DE 2%, NL <1%, BE <1%)
10	Celtic Sea whiting	WHG/7X7A-C[n]	EU 88.9% UK 11.1%	(FR 48%, IE 39%, BE <1%, NL<1%)

[n] This TAC also includes the eastern English Channel (ICES Division 7d) which is part of the North Sea whiting stock (whg.27.47d).

5. Overfishing and other reasons that may explain the status of heavily depleted stocks

To assess the effect of fishing mortality on the stock biomass, Oceana analysed the trajectories of fishing mortality relative to sustainable exploitation levels (F/F_{MSY}) and abundance relative to sustainable levels (SSB/MSY $B_{trigger}$) over time for the most heavily depleted stocks° (Figure 6). The resulting trajectories show that excessive fishing pressure (F/F_{MSY} > 1) over many years has reduced the biomass of these stocks from sustainable levels (SSB/MSY $B_{trigger}$ >1) at the beginning of the time series to well below overexploited levels (SSB/MSY $B_{trigger}$< 1). Indeed, for all of the most heavily depleted stocks, fishing mortality has exceeded sustainable levels for nearly the entire duration of the time series. For the four most heavily depleted stocks, fishing mortality remains at around 2.5-3.8 times greater than sustainable levels.



° In the case of eastern Baltic cod, because FMSY and MSY $B_{trigger}$ reference points are not defined, SSB and F trajectories have been analysed instead.

Figure 6. SSB/MSY Btrigger and F/F_{MSY} trajectories for the most heavily depleted stocks°. Time series length varies from stock to stock due to data availability. In each plot, the red quadrant corresponds to unsustainable conservation and exploitation status, yellow quadrants correspond to unsustainable conservation or exploitation status, and the green quadrant corresponds to sustainable conservation and exploitation status consistent with the management objective. Figure produced by MarFishEco. Data source: ICES.

The trajectories for stocks show that, in some cases (e.g., stocks ranked 5th–9th), despite substantial reductions in fishing mortality in recent years, these reductions have not yet resulted in increased biomass. This lack of recovery may be due to two main reasons. First, as noted in Section 1, when the abundance of a stock falls below B_{lim}, the stock is so depleted that recruitment is compromised. Second, the critical status of depleted stocks makes them more vulnerable to other types of anthropogenic and environmental impacts, further affecting their capacity to recover.

In stark contrast to the agreed management objectives, annual decisions on catch limits (TACs) for fish stocks are rarely set in line with scientific advice[p,47,48]. This particularly applies to the depleted stocks for which, due to their critical status, scientific advice from ICES usually recommends either a major reduction in catches or no catches at all. Despite these expert recommendations, decision-makers often adopt catch limits for the most heavily depleted stocks that merely roll-over the previous year's agreed catch limits, rather than adopting restrictive limits in line with the scientific advice (Table 3). Setting TACs above scientific advice clearly not only hinders the recovery of depleted stocks, but in some cases may even worsen their decline.

Furthermore, despite signs of illegal discarding[49,50], countries currently adopt TACs under the false assumption that all catches are landed and counted against respective quotas. This poses significant risks for these stocks, as setting TACs for depleted stocks whilst continuing to ineffectively control discarding results in catches that likely exceed both the scientific advice and agreed limits[51].

Moreover, heavily depleted stocks that are captured as by-catch in mixed fisheries are rarely prioritised in management decisions for those fisheries. Catch limits set for target stocks of such fisheries often result in incidental catches of heavily depleted stocks that are too high to permit their recovery. ICES assesses and provides information about the potential implications of single-stock advice on catches of stocks in mixed fisheries, for the main sea basins of the Northeast Atlantic, including the Greater North Sea[52], Irish Sea[53], Celtic Sea[54], Bay of Biscay[55] and Atlantic Iberian waters[56]. Despite this advice, management decisions for mixed fisheries stocks are not driven by the need to recover and/or sustainably exploit the less productive stocks, including those that are depleted or heavily depleted.

[p] A 2022 CEFAS report on "Assessing the sustainability of fisheries catch limits negotiated by the UK for 2020 to 2022", stated that only around one third of the TACs agreed during the last three years with parties like the EU or Norway have been consistent with scientific advice.

Atlantic cod (*Gadus morhua*).

Table 3. Summary of ICES headline advice on catch limits for 2022 and 2023 for the most heavily depleted stocks, with subsequent agreed 2022 catch limits. Values refer to weight in tonnes, while number in parentheses indicate the percentage difference in 2022 TACs compared to 2021 TACs (e.g., a difference of 0% indicates that the 2022 TAC was identical to the 2021 TAC).

Ranking	Stock name	TAC code	ICES 2022 advice	2022 agreed TAC	ICES 2023 advice
1	**Irish Sea whiting**	WHG/07A	0	721 (0%)	0
2	**West of Scotland cod**	COD/5BE6A	0	1279 (0%)	0
3	**Celtic Sea cod**	COD/7XAD34	0	644 (-20%)	0
4	**Western Baltic cod**	COD/3BC+24	698[q]	489 (-87%)	943[q]
5	**Eastern Baltic cod**	COD/3DX32	0	595 (0%)	0
6	**Irls herring**	HER/7G-K	0	869 (0%)	0
7	**Western Baltic herring**	HER/3BC+24	0	788 (-50%)	0
8	**Irish Sea cod**	COD/07A	74	206 (0%)	0
9	**North Sea cod**	COD/2A3AX4	14 276[r]	13 246 (0%)	26 008
		COD/07D		772 (0%)	
		COD/03AN		1893 (0%)	
10	**Celtic Sea whiting**	WHG/7X7A-C[s]	3435-4029[t]	10 696 (+4%)	1715

[q] This advice applies to the sum of commercial and recreational catches. According to ICES, recreational fisheries constitute 46% of all catches of western Baltic cod. It is worth noting that the Baltic Fisheries Assessment Working Group (WGBFAS) recommended zero catches of this stock. See p. 132 of the following report: ICES. (2022). Baltic Fisheries Assessment Working Group (WGBFAS). *ICES Scientific Reports*, 4(44). http://doi.org/10.17895/ices.pub.19793014.

[r] Other catch scenarios were provided by ICES to consider six alternative TAC overshoot assumptions for 2021 ranging from 5% to 40%: ICES Technical Service. 2021. https://doi.org/10.17895/ices.advice.8938.

[s] This TAC also includes the eastern English Channel (ICES Division 7d), which is part of the North Sea whiting stock (whg.27.47d).

[t] ICES headline advice is provided in the form of a range in response to the EU multiannual plan (MAP) for the Western Waters and adjacent waters.

Beyond the direct impacts of fisheries, depleted stocks are also affected by an array of other factors. It has long been known that fish stocks are responsive to climate conditions, with impacts ranging from changes in distribution patterns to variation in the success of annual recruitment[57]. Thus, fish populations fluctuate in terms of distribution and abundance even in the absence of fishing activity. In the case of depleted or heavily depleted stocks, their lowered resilience means that population responses to environmental variation may have significant impacts on stock recovery. This added stress should be taken into account by decision-makers, based on scientific understanding of the sensitivity of individual species and stocks to environmental drivers, and predicted climate impacts.

In the Northeast Atlantic, current climate scenarios project ongoing increases in temperature[58], and therefore changes in species' distribution. Species like cod and herring have been already identified as "big movers" in the Northeast Atlantic region, with observed changes in distribution in response to environmental conditions (mainly temperature)[59]. The main potential ecological implications for these species include, for example, limited areas of suitable habitat (e.g., for cod), isolation between habitats for different life stages (e.g., for herring), and altered predator-prey interactions and subsequent competition between predators[59].

Finnish trawler fishing after having hauling the net.

Warming temperatures caused by climate change can also drive changes in terms of the reproductive capacity of stocks, with clear implications for recruitment success and for the size structure of fish populations[60,61]. Indeed, for cod, the species with the largest number of depleted stocks, rising temperatures have been shown to affect its spawning phenology[62] and have resulted in a new low productivity state of some cod stocks, which is likely to continue[15]. Such temperature effects can be amplified when stocks are faced with increased fishing pressure[61]. Furthermore, some southern cod populations, such as in the Baltic Sea, appear to be at their upper limit of temperature tolerance[63].

Species' interactions, primarily through predator-prey relations, also appear to be major drivers of stock distribution and status[64]. Food availability and predation are often intertwined, as prey and predator species switch roles depending on their respective life stages. For example, North Sea cod is preyed upon by a variety of species throughout its life cycle. Species like grey gurnard, whiting, harbour porpoise, and various seabirds contribute to predation mortality of juvenile (i.e., 0-group) cod[65]. High abundance of herring, which also preys on early life stages of cod, has been found to lead to significant declines in cod[66]. Lastly, predation by harbour porpoise and grey seal (and also cannibalism) seem to have a significant impact on the mortality of cod aged 1-2 years, whilst grey seals are the main influence on mortality of cod aged 3-4 years[67]. At the same time, cod is a top predator that feeds and depends on various species, like sprat, herring, and sandeel, among others[68].Fishing pressure can exacerbate or modify these various predator-prey interactions, making it difficult for struggling stocks to recover by altering the ecological state of the system[69].

Essential fish habitats, such as spawning and nursery grounds, are also vulnerable to anthropogenic impacts. For example, gravel substratum is an essential habitat for spawning herring, and activities such as dredging, sand and gravel extraction, dumping of dredge spoil, waste from fish cages, or the construction of structures such as wind turbines in the vicinity of spawning grounds negatively affect these habitats and, ultimately, stock status. Scientists have consistently advised that those activities that disturb herring spawning grounds should be avoided[31].

In addition to this direct damage to key habitats, other human activities and impacts affect depleted stocks. For example, levels of nutrients, pollutants, and deoxygenation are higher in the Baltic Sea than in most other European seas. Some Baltic Sea stocks also face high levels of recreational fishing pressure. These pressures affect both the status and recovery of depleted Baltic cod stocks[70] and western Baltic herring. The overall environmental situation in the Baltic also affects the functioning of the food web and reduces ecosystem resilience and resistance to additional environmental changes.

Recovery of depleted stocks is complex but is nevertheless possible. Experience has shown how, with strong political will, appropriate management decisions, and stakeholder collaboration, it is possible to recover depleted stocks to sustainable levels. In the Northeast Atlantic there are strong examples of recovery success, covering different species categories and sea basins. Good examples of recovery are illustrated by the cases of Cantabrian Sea and Atlantic Iberian waters sardine (*Sardina pilchardus*)[71], Irish Sea sole (*Solea solea*)[72], and northern hake (*Merluccius merluccius*)[73].

6. Conclusions and management recommendations

Depleted stocks in the Northeast Atlantic have been systematically subjected to overfishing for many years. As a result of this excessive fishing, these stocks have suffered major declines in biomass, bringing them beyond tipping points that have severe biological and ecological consequences, with associated socio-economic impacts.

Until now, European countries have adopted management measures that are insufficient to recover these stocks, creating a situation in which they are also more vulnerable to other anthropogenic pressures and environmental changes, such as habitat degradation and climate change. Any prospect of recovering depleted fish populations appears unlikely under the current status quo approach to management.

It is imperative and urgent that decision-makers adopt and implement adequate policies and measures that are firmly in line with science-based management, in order for overexploited stocks to recover. They must reduce fishing pressure, including unwanted catches that occur in mixed fisheries, and take into account other anthropogenic pressures and environmental conditions, which also impact the status of many depleted stocks.

Depleted stocks are a public resource and recovering them is not only a necessity to achieve agreed fisheries management objectives and contribute to healthy and resilient marine ecosystems, but will also provide long-term benefits for coastal communities that depend upon them.

In line with previous joint NGO recommendations for the setting of fishing opportunities in the Northeast Atlantic to recover and sustainably exploit depleted stocks[74,75,76], Oceana urges European countries to:

1. **Adopt multi-year management strategies to recover depleted stocks** as the basis for setting management measures (i.e., catch limits). To ensure progress in the recovery of depleted stocks, countries should ensure that these multi-year management strategies include specific conservation objectives, with concrete targets and timeframes for recovery, bycatch reduction plans, and safeguard measures that should be implemented in the event that objectives and targets are missed. Management strategies should also incorporate:
   - Provisions to implement Remote Electronic Monitoring (REM), to support data collection and improve transparency and accountability.
   - Precautionary measures to allow depleted stocks to adapt to anthropogenic and environmental drivers that affect their conservation.
   - Shared multilateral strategies among all parties exploiting depleted stocks, which extend beyond the boundaries of individual management units, to align and harmonise stock management objectives and measures.

2. **Set catch limits for depleted stocks in line with scientific advice** to ensure that stocks recover to sustainable levels in the shortest possible time. These limits should also be set in accordance with the following points:
   - Where possible, countries should set catch limits below the levels recommended in the ICES headline advice, to buffer against other pressures or ecosystem dynamics, such as habitat degradation and climate change.
   - Since the biomass of depleted stocks is critically low, countries should not allow interannual and interarea flexibilities in catch limits for these stocks.
   - Exploitation of shared depleted stocks should be conditional on agreeing catch limits and shares.

3. **Prioritise the recovery of depleted stocks in mixed fisheries, in which depleted stocks are caught either as the target or as bycatch,** rather than aiming to fully exploit the most productive stocks. This requires setting certain catch limits for the more abundant stocks caught in mixed fisheries below the levels recommended in their respective single-stock advice, in order to safeguard other stocks and ensure that the by-catch of depleted stocks does not exceed unsafe levels.

4. **Ensure that fisheries catching depleted stocks as a target stock or as bycatch are fully documented** using Remote Electronic Monitoring and/or a reliable and independent catch documentation scheme. This is particularly crucial for countries to monitor and enforce adopted management measures, in view of long-standing concerns about the lack of compliance with the landing obligation, as well as the fact that fisheries regularly overshoot agreed catch limits for certain depleted stocks. Fully documented fisheries will also contribute to improving the quality of stock assessments, providing a stronger basis for management.

5. **Mandate the implementation of the most effective by-catch reduction measures.** Being granted access to fishing grounds where depleted stocks are known to occur should be conditional on using the best available technology and practices for selectivity to minimise the by-catch of these stocks. This also includes applying measures such as temporary and permanent area restrictions.

6. **Eliminate** and, where not possible, minimise **anthropogenic activities and impacts that have a negative effect on depleted fish stocks** and habitats associated with them. Examples of such activities include the dumping of dredge spoil and the extraction of marine aggregates in herring spawning grounds; and recreational fishing, pollution, and eutrophication, which all affect Baltic cod. Countries should continue to restrict damaging activities until it has been scientifically proven that their effects are not detrimental to the conservation of stocks.

7. **Avoid any increase in fishing capacity of fleets catching depleted stocks,** and reduce it where possible. Countries should not grant any reallocation of fishing capacity or new authorisations for these fleet segments until the depleted stocks concerned have recovered.

8. **Protect essential fish habitats for depleted stocks,** like nursery and spawning grounds, by adopting spatial and/or temporal restrictions for any fishing activity that has, or is likely to have, an adverse impact on these habitats. Where possible, restore degraded essential fish habitats so they can fulfil their ecological role.

9. **Safeguard food availability for depleted stocks.** Countries should exercise precautionary management of prey species of depleted stocks, by setting catch limits below levels recommended in single-stock scientific advice. Ensuring that depleted stocks have sufficient food available is a key requirement to facilitate their recovery.

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