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NSAC Advice on Climate Change and North Sea fisheries

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1 Background

Unlike other anthropogenic factors affecting fish stocks and their ecosystems, climate change is not directly and immediately controllable. Even when mitigation and adaptation measures are taken, changes come with delay and cumulative effects persist. The North Sea has been seeing measurable changes to stock distribution. This will need to be addressed by the management in order to avoid it becoming a source of dispute between the affected Member States and/or with third countries.

The NSAC Climate Change Focus Group was established in 2022 with the aim to address the challenges and opportunities posed by climate change. Blue food, decarbonisation, and the impacts of climate change on the fish stocks and fishing sector are only a few of the topics explored in this context.

The webinar[1] of December 2022 was organised against the backdrop of the EU Green Deal, the EU Climate Law, energy transition initiative, COP27, and UN Convention on Biodiversity (CBD). Furthermore, the EU Nature Restoration Law, which is pending an agreement between the co-legislators, aims to provide further impetus to tackle climate change and nature degradation. All these developments will require fisheries management to adapt.

On pages below we attempt to address several aspects of the climate-fisheries nexus: climate change impacts on North Sea fish stock migration and implications for management, influence of fishing and climate on emblematic North Sea cod stocks specifically, climate implications

[1] NSAC webinar on Climate Change and North Sea Fisheries – Report: https://www.nsrac.org/wp-content/uploads/2022/11/NSAC-Climate-Change-Webinar-Report_final_22-23-1.pdf

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for North Sea fisheries, industry efforts in ensuring compatibility of fisheries production with conservation objectives, and the political consideration of nature restoration against the objectives of food security. The webinar report and corresponding presentations can be accessed here. We invite you to read them for a more informed perspective.

2 Climate change impact on fisheries in the North Sea

2.1 Effects of climate change on fish stock migration in the North Sea and implications for management

The whole system, inclusive of all social and ecological elements, is being impacted by climate change. The ecological parts of the system are being affected by climate change drivers, with wide-ranging impacts across different temporal and spatial scales. In addition, the social parts of the system are being affected by climate change – from governance and management through to culture, economics, and technology.

There are three different approaches to climate change: (1) carbon mitigation to reduce the likelihood and/or severity of the effects of climate change; (2) the adaptation of processes or behaviours to reduce impact of climate change, and (3) both mitigation and adaptation, combined.

The main ways that fish stocks are impacted are through changes in productivity, distribution, or both. Productivity can either increase or decrease under the impacts of climate change. Changes in stock distribution (range) have important governance consequences, given that stocks may move between Exclusive Economic Zones (EEZ) and management regions. The impacts of climate change are occurring over different temporal and spatial scales, and flexibility in management doesn't yet exist at these same scales.

2.2 Sector observations concerning fish migration and management: opportunities for industry-science collaboration

Fishing in the North Sea may affect the climate through emissions and resuspension of sediment, while the climate affects fishing through changing fish distribution and growth, runoff into marine waters, and ocean acidification. While climate should be accounted for in fisheries management, currently it is not.

It is important to remind that associated carbon emissions per kilo of protein of landed seafood is lower than most animal proteins, meaning fishing's climate impact is manageable, in terms of ensuring future food security while keeping carbon emissions to a minimum. According to

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Hillborn (2023),[2] persistent concerns about bottom-trawling can be mitigated through appropriate management and technical measures that would result in fishing methods being less environmentally impactful than livestock or fed aquaculture – food production that would likely replace bottom-trawling, were it banned. At present, 83 bottom-trawl fisheries with 252 bottom-trawl-caught species/fisheries combinations, are certified by the Marine Stewardship Council (MSC), a standard that considers the status of the target stock as well as the environmental impacts of the fishing method and follows strict criteria for the management of bottom-trawl impacts on benthic communities (Monterey Bay Aquarium and MSC, in Hillborn, 2023).

The Common Fisheries Policy (CFP) has made commercial fisheries challenging over decades through closures, a preference for small-scale fisheries, and technical regulations. It is possible that fisheries displacement might have led to greater fuel consumption. A possible resuspension of sediment and CO2 in the North Sea through trawling, to the sea and to the atmosphere, is poorly understood and disputed among scientists. There has recently been a rebuttal of the widely cited Sala et al. paper on the benefits of MPAs closed to bottom-trawling in Nature. Sala's estimates on the amount of CO2 released in the atmosphere by bottom-trawling are deemed grossly overstated (Hiddink, 2023)[3], possibly leading to ill-informed management decisions.

In view of the NSAC, it is paramount that any policy proposals are based upon robust scientific evidence with solid peer review. This is especially important in industries that are essential for ensuring food security and that are already subject to severe adverse effects from climate change and ensuing measures. In our view, appropriate management measures would make bottom trawling more environmentally friendly than animal agriculture or fed aquaculture, sectors that would likely replace bottom-fisheries. Instead of singling-out bottom-trawling, the policy-makers should work, together with the sector, towards its re-imagining. This should be done by encouraging and fostering the restructuring of the industry towards carbon-neutral, lower-impact commercial fisheries, while at the same time understanding that all food production will inevitably have an impact and that trade-offs are an inherent part of this industry.

Climate change induces changes in species distribution, including for example the northward movement of cod and halibut. While some species of fish are moving out of areas of fishing and management interest, new species - such as bass, squid, mullet, and anchovy - are moving in. This is a slow process, and many of these species may have existed there for some time, but the populations are slowly increasing as species move poleward.

[2] Hillborn et al. (2023). Evaluating the sustainability and environmental impacts of trawling compared to other food production systems. ICES Journal of Marine Science. Accessible at: https://doi.org/10.1093/icesjms/fsad115

[3] Hiddink et al. (2023). Quantifying the carbon benefits of ending bottom trawling. Accessible at: https://www.researchgate.net/publication/370656000_Quantifying_the_carbon_benefits_of_ending_bottom_trawling

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Climate affects stock size, with cod being a notable example. A new reference point was introduced for cod in 2021, a possible 'new normal' trend for cod. Fishers feel they are being hit by climate change, through inefficient fisheries that require more fuel expenditure, and inefficient management measures with demands that are difficult to deliver. In order to have true ecosystem-based fisheries management (EBFM), there needs to be an openness to new and more flexible approaches, such as industry input into scientific advice. As noted in one of the upcoming NSAC advice papers on stakeholder engagement in ICES advice requests, co-management should start with assumptions implied in the managers' requests for scientific advice, as these importantly affect the end result.

2.3 Other considerations in the impacts of climate change on fisheries in the North Sea

There are several complex mechanisms at play in the climate change effects on ecosystems. In some cases, climate change impacts small animals, such as plankton, and target species for fisheries follow their food northward in response to these changes. Changes in small animal distributions will affect animals further up the food chain. There is a plankton index that reveals that larval cod survival is highly correlated with planktonic changes in the North Sea. On the other hand, the example of anchovy and sole show that target species may die in the winter if they have not grown to a sufficient size, or if the winter is too cold. The effects of climate change are very complex, with impacts occurring across the whole ecosystem and involving many interactions between species. There are also direct effects on target species through effects on metabolism as well as the food web.

In terms of MSY as a management measure against the backdrop of climate change, there is insufficient information to understand the impacts of following MSY under climate change in the North Sea. In general, there is a need to assess MSY year on year in response to climate change, as well as to adapt fisheries management accordingly.

In relation to an increased rollout of MPAs to reduce the effects of climate change on fish stocks, by providing areas of reduced stress to increase the ability of marine organisms to adapt, the effect on the fishery will depend on where the MPAs are situated. If they are placed in traditional fishing areas, then the displacement effect will have a negative impact through the increased usage of fuel to attain more remote grounds.

3 Fisheries role in climate change: North Sea perspective

3.1 Good fisheries management for good carbon management

The ocean produces approximately 50% of global oxygen, absorbs 93% of global heat, and stores 30% of the world's sequestered carbon. Fish stocks are the 'lifeblood' of oceans and diverse populations (types, ages, structures, etc.) are essential. Humanities most important

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action is to reduce CO2 emissions and in this, EBFM is an important part of the suite of necessary actions.

The ocean acts as biological pump, moving energy and carbon through the ocean system. Fish contribute to the 16% of the total ocean carbon flux. Fishing's impacts on ocean carbon are not just through potential impacts on the seabed, but also through extraction of fish from that system. Fish help to move carbon up and down the water column and the carbon pumping capacity of whales alone has been valued at around 1 trillion dollars in terms of ecosystem services offered.

The scale of carbon release through bottom trawling is an area in need of further investigation. Whether or not this carbon returns to the atmosphere, its entry into the water column will have an effect on ocean acidification. The jury is still out on the quantities of released carbon through bottom-trawling, but the latest work by Hiddink et al. (2023) establishes that the current estimates are grossly overstated.

A 2022 paper from Cheung et al.[4] highlights the impact of climate on the management's capacity to restore biomass. There is a range in the possible extremity of impact on fisheries, however the impact is high even in low-emissions scenarios; even in the best-case scenario, with 1.5 °C of warming and conservation-focused fisheries management, will still see stock biomass at around two-thirds of the pre-industrial levels. In this sense, it seems prudent to accept a more realistic, new 'normal' state of the stocks instead of holding them to an unrealistic standard or pre-industrial era.

To summarise, good fisheries management is good carbon management because it (1) protects/increases fishes' status as carbon engineers and builds resilience; (2) protects food webs and the biological pump; (3) avoids habitat disturbance and destruction (including carbon-rich habitats); (4) decreases CO2 emissions, and (5) increases CO2 sequestration. In this sense, fisheries management in the North Sea can be seen as an exemplary model of good management, and stakeholders continue to work on points of improvement.

4. Reconciling sovereign food supply with nature conservation

4.1 Resilience of the EU common fisheries policy towards climate change and fuel efficiency

A set of published studies have been used in a report delivered to the Commission entitled 'Ten lessons on the resilience of the EU common fisheries policy towards climate change and fuel efficiency - A call for adaptive, flexible and well-informed fisheries management'. There is the challenge of fishing as a variable and uncertain occupation, and the interest of fishing businesses in securing a more stable and improved income. Additionally, climate change affects marine ecosystems and fish stock populations, which in turn can lead to unsatisfactory

[4] Cheung et al. (2022). Rebuilding fish biomass for the world's marine ecoregions under climate change. Accessible at: https://doi.org/10.1111/gcb.16368

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outcomes with fisheries management if it does not account for these changes. A precautionary approach is needed to address this issue; in the North Sea, this could involve fishing in the lower range of MSY for some species.

Decarbonisation of the fishing sector will offer a suite of benefits and opportunities, where fishing less could mean earning more - for instance, lower fishing effort or larger mesh sizes use less fuel, or improved abundance translating to less effort needed for larger catches. Through protection of sensitive species and habitats through an ecosystem approach, biodiversity tipping points can be avoided. Less effective fishing techniques should be re-imagined, and focus should be placed on designing more effective techniques. With its upcoming symposium on innovative gear in Spring 2024, the NSAC aims to take stock of existing solutions, trialled gear and factors playing into their implementation.

Overview of plausible scenarios and the number of factors to be considered, inclusive of environmental effects, future climate, and socio-economic context leads to ten core lessons. The three relevant ones are:

1. Healthy and well-assessed stocks are resilient to short-term stress, as seen in the recovery of North Sea cod. This leads to the recommendation of following low MSY and regular revision of biological reference points.

2. Many technologies exist to reduce fuel use in fisheries, but many are not yet implemented. This includes retrofitting vessels, changing gears, and switching fishing strategies to reduce fuel consumption.

3. Management should anticipate and respond to changes with adaptive, flexible approach. Key allocations should be revised to align fishing opportunities with shifting stocks and stock assemblages.

There is a need to think ahead in terms of meeting strong policy commitments to reduce energy usage, while aiming to make energy costs more affordable and for the sector to be carbon neutral by 2050.

Uptake of energy-efficient solutions by the fishing industry has been low to date. Addressing this involves improving knowledge transfer and implementation, removing regulatory barriers, reducing costs for transition, and finding solutions for inertia. Providing positive incentives, training for new practices or technologies, and avoiding fuel tax subsidies are possible solutions for this.

5 Conclusion and NSAC Advice

The global demand for seafood is increasing, which puts pressure on the wider ecosystem in the North Sea. There is a need to regulate actions to address and respond to the challenges of climate change.

With this, the NSAC advice is as follows:

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Management and governance

1. There is a need to, urgently and explicitly, consider the impacts of rapid climate change in the context of fisheries management. Incorporating **climate considerations within fisheries management** will allow stocks to be exploited for longer and optimise pooled catch.
2. One-size-fits-all approach' would not be appropriate and there is a need for **tailored solutions.** Both science and stakeholder input are needed, together, to craft policies that are fit for purpose. Industry-science collaboration will be essential for future management that is inclusive, transparent, and legitimate.
3. The North Sea has been seeing measurable **changes to stock distribution** These discrepancies will need to be addressed by the management in order to avoid conflicting situations.
4. **Fisheries management** will need to be adapted in light of the EU Green Deal, the EU Climate Law, energy transition initiative, COP27, the Nature Restoration Law and the proceedings of the UN Convention on Biodiversity (CBD). It is important that the management reflects and is reflected in other **EU and international governance initiatives**. So far, the consequences of these climate-related initiatives/legislation on fisheries management are unclear and adaptive management is needed.
5. When considering results of projects on climate change impacts on fish stocks, specifically CERES, managers should consider the findings with caution and be **mindful of assumptions** put into the model. To ensure robust model assumptions that reflected and determine the outcome of the scientific endeavour, the scientific community and policy-makers should consider strengthening the **involvement of stakeholders** in the early stages of project management and research.
6. **Resilient and sustainable fisheries** are a common goal for many stakeholders. To achieve this, in addition to healthy stocks and limited environmental impact, there is a need for **flexible governance and management**, and for well-developed **participatory mechanisms** that are flexible and inclusive.
7. Management should anticipate and respond to changes with **adaptive, flexible approach**. Any reform must **cross jurisdictions** and account for impacts in the wider system.
8. Policy-makers should be mindful that the potential absence of extreme climate events does not have the **unintended consequence** of sidelining climate change in the policy agenda.
9. It is important to assess the climate risks and see how those impact all parts of the sector, from fisheries and fisheries governance structures to the supply chain and the market. Climate mitigation and adaptation measures **impacting the risk profile** should be considered across ecological, social, economic and governance components.

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Fisheries science

10. It is important for the managers to consider how **climate change** impacts the risks of achieving **Ecosystem-Based Fisheries Management (EBFM)** in the context of political, ecological, and human wellbeing. In order to have true EBFM, there needs to be an openness to new or more flexible approaches, such as **industry input into scientific advice**. EBFM should be implemented as early as possible and incorporate ecosystem considerations in the setting of fishing opportunities.
11. It is important for the policy-makers to consider the **effects offshore wind industries** have on wider ecosystems, including fisheries and scientists, who are being excluded from wind farm development sites. This impacts the **veracity of the long-term datasets** that are used in fisheries science.
12. For actionable strategies and approaches that could support advice for fisheries management through considering climate effects, see **ICES WKCLIMAD** report.
13. Where there is high risk posed by climate change, **precaution is needed** particularly when there is **high uncertainty** when assessing the state of stocks. **Precautionary approach** is advised in the management of some species to account for climate change-induced changes to productivity.
14. There is a need to recognise that **some stocks will disappear** under climate change, regardless of fishing effort. It is possible to scientifically **anticipate stock disappearance** and the establishment of new stocks to inform new management models.
15. It is vital to **improve data collection** to feed into models such as the FishClim. **Industry-science collaboration** will prove essential to this end.
16. In terms of MSY as a management measure against the backdrop of climate change, there is **insufficient information** to understand the impacts of **following MSY** under climate change in the North Sea.
17. **Healthy and well-assessed stocks** are resilient to short-term stress, as seen in the recovery of North Sea cod. We need to increase efforts to reduce the number of data poor stocks and work towards implementing sustainable management across stocks.

Carbon footprint and mitigation

18. It is important to keep in mind that associated carbon emissions per kilo of protein of landed seafood is lower than most animal proteins. It stems from this that fishing's climate impact is manageable, ensuring future food security while **keeping carbon emissions to a minimum**.
19. **Good fisheries management means good carbon management** because it (1) protects/increases fishes' status as carbon engineers and builds resilience; (2) protects food webs and the biological pump; (3) avoids habitat disturbance and destruction (including carbon-rich habitats); (4) decreases CO2 emissions, and (5) increases CO2 sequestration. To this end, overfishing should be eliminated, and bycatch minimised.

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20. Any policy proposals must be based upon robust scientific evidence with solid peer review. Instead of singling-out **bottom-trawling**, the policy-makers together with stakeholders should work towards its **re-imagining** by encouraging restructuring of the industry towards a carbon-neutral, lower-impact fisheries, while understanding that all food production involves trade-offs.
21. Support projects on **life-cycle assessment (LCA) models** contributing to better understanding of **carbon dynamics** involved to inform future policies and advice and include approaches to influence and enable **consumer behaviour** towards buying more sustainable products.
22. **Improve data collection** to inform LCAs, including **modelling of future scenarios** that include the implementation **new energy-efficient technologies and gears**.
23. To foster a speedy and just transition to net-zero emissions in fishing, a **supporting environment is needed** for the industry, as well as meaningful stakeholder engagement from the outset. Energy Transition Partnership should include Advisory Councils for solutions that are harmonised yet tailored to the region and specific fishery.
24. Addressing inertia in the adoption of new low-carbon technologies and gears involves improving **knowledge transfer** and implementation, removing **regulatory barriers**, **reducing costs** for transition, and providing **positive incentives**. The NSAC will continue to deliver on these objectives by hosting talks with leading experts in the form of iterative events.

The NSAC thanks the Commission and the North Sea Member States for supporting our efforts in achieving environmentally, socially, and economically sustainable fisheries in the region. Should further exchange be required on the above recommendations, we remain available to your services.

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