Seafish FMIG – 5th October 2023

Fishy Falsehoods

Debunking Myths About the Fishing Industry

Ian R. Napier (UHI Shetland)

“There will be no fish left by 2048”

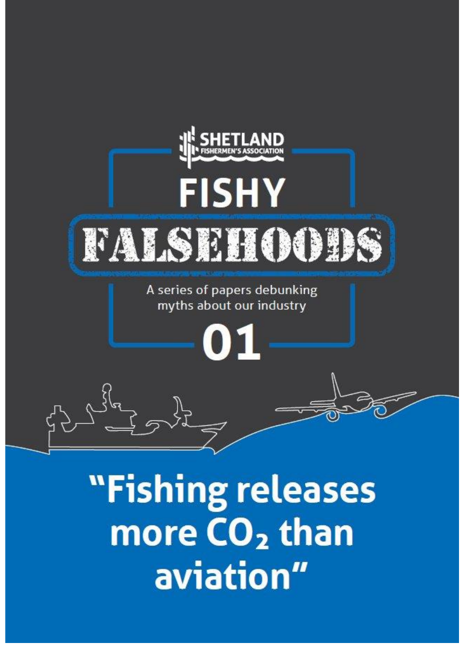
“Trawling produces more CO_2 than aviation”

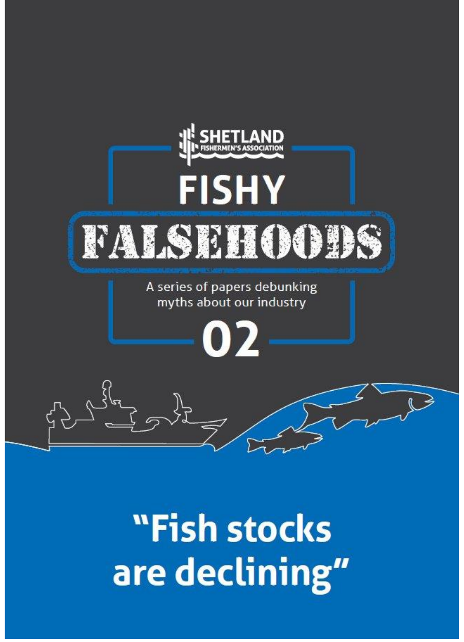
“Fish Stocks are declining”

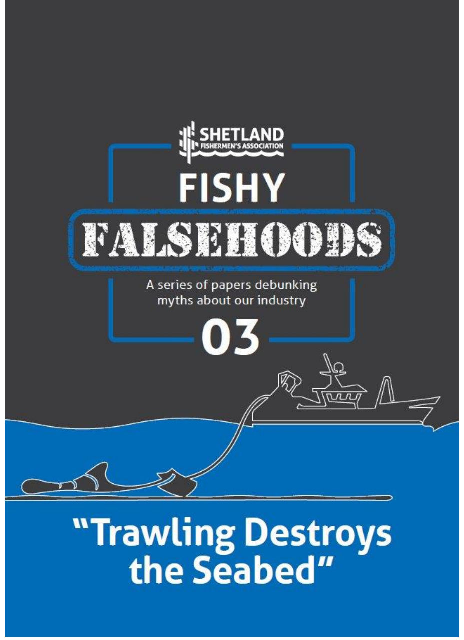
“Trawling destroys the sea-bed”

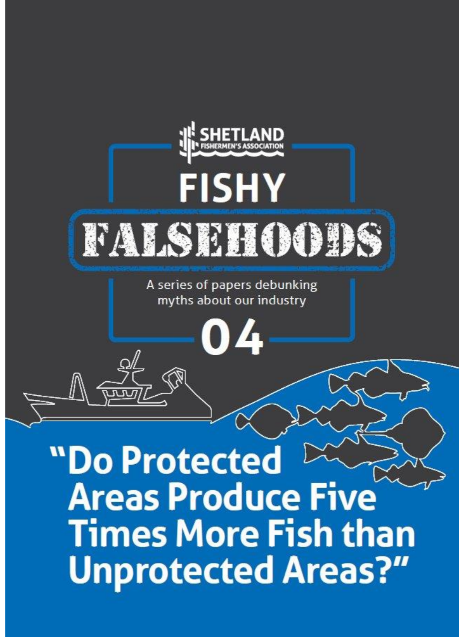
“Marine protected areas produce five times more fish than unprotected areas”

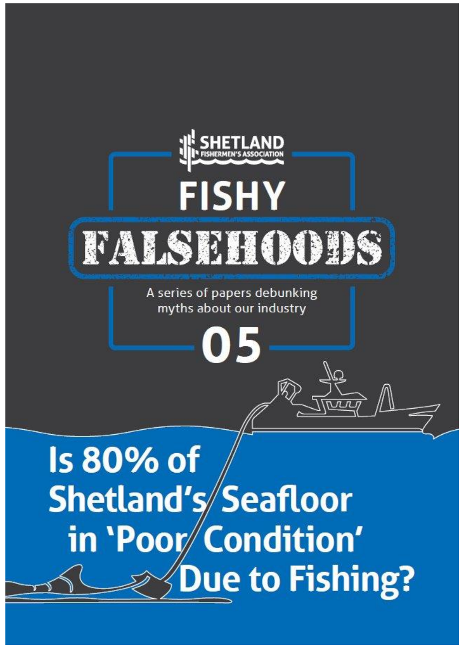
SHETLAND FISHERMEN'S ASSOCIATION

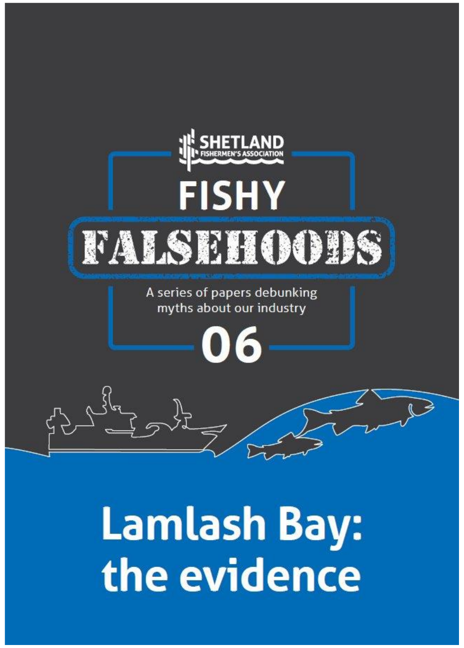


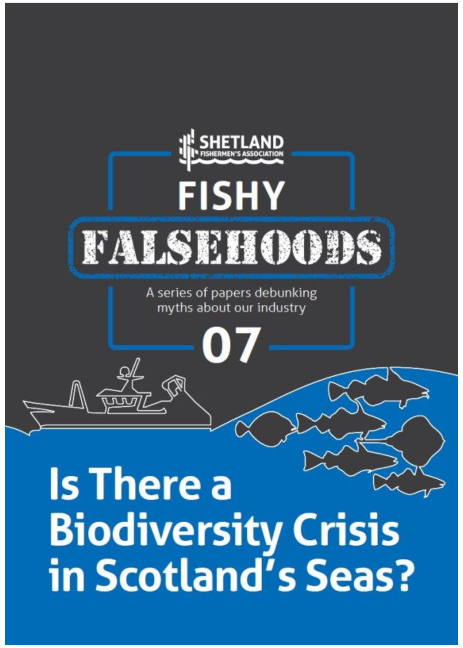




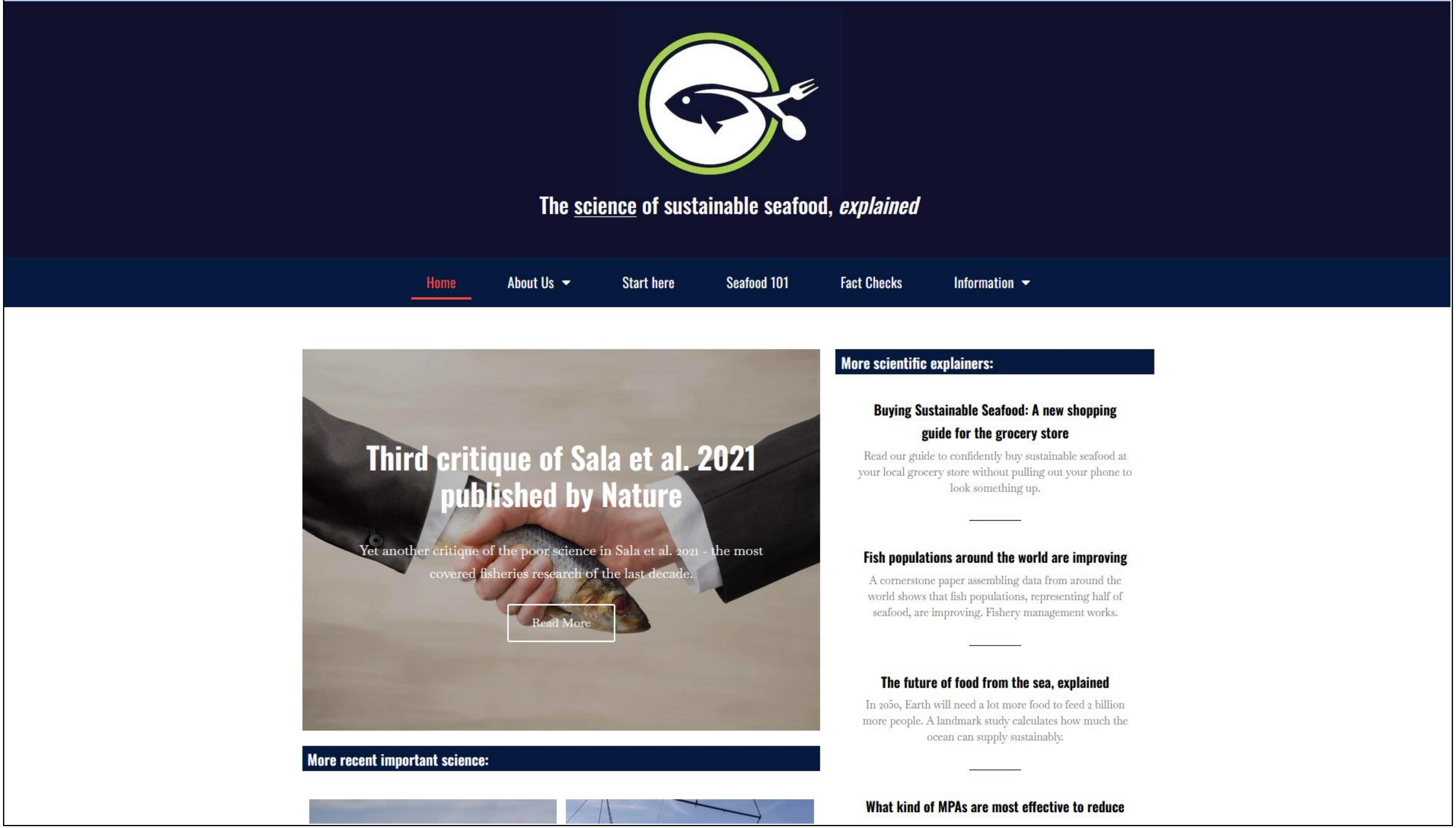








https://www.shetlandfishermen.com/papers/fishy-falsehoods



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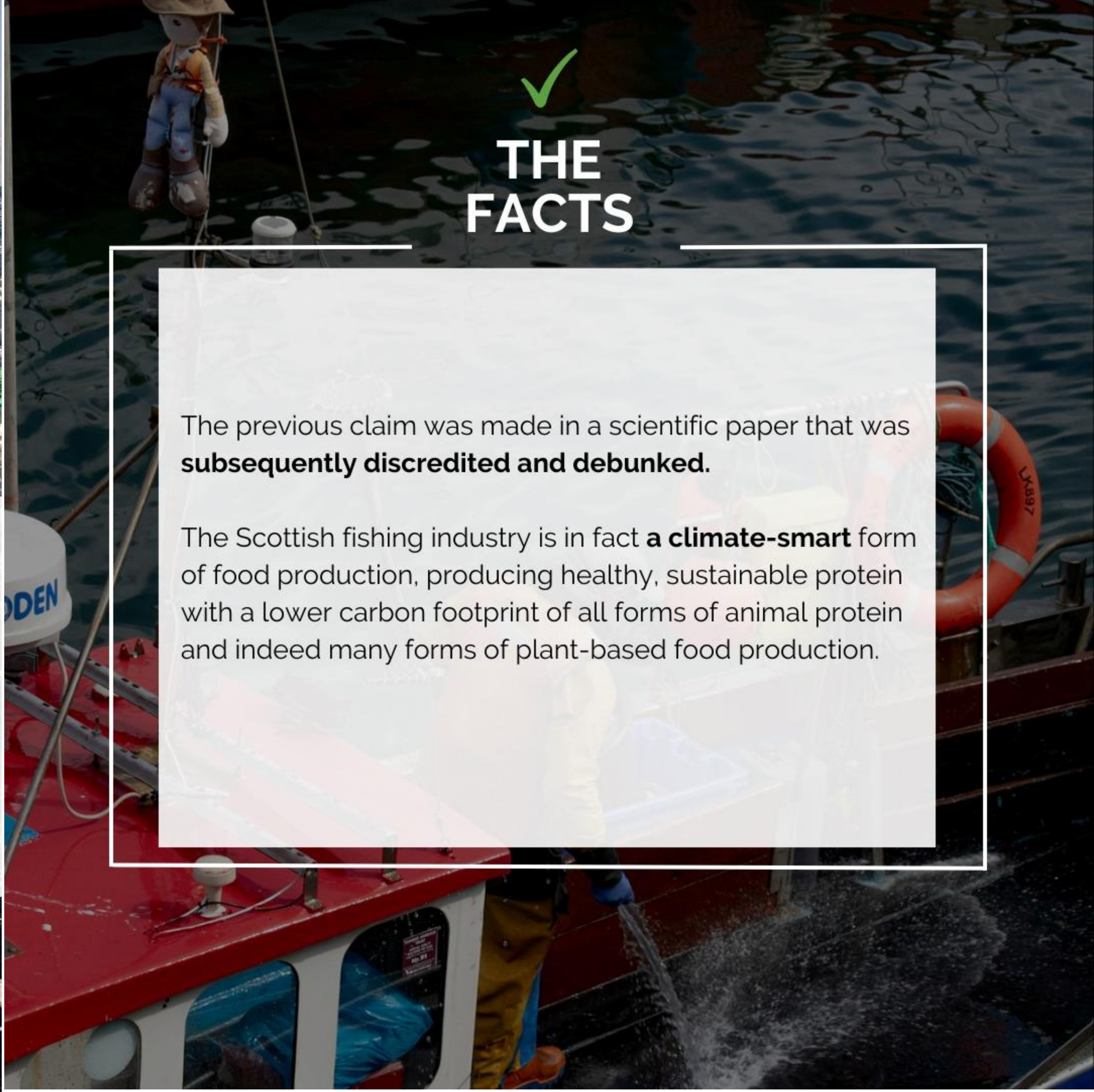

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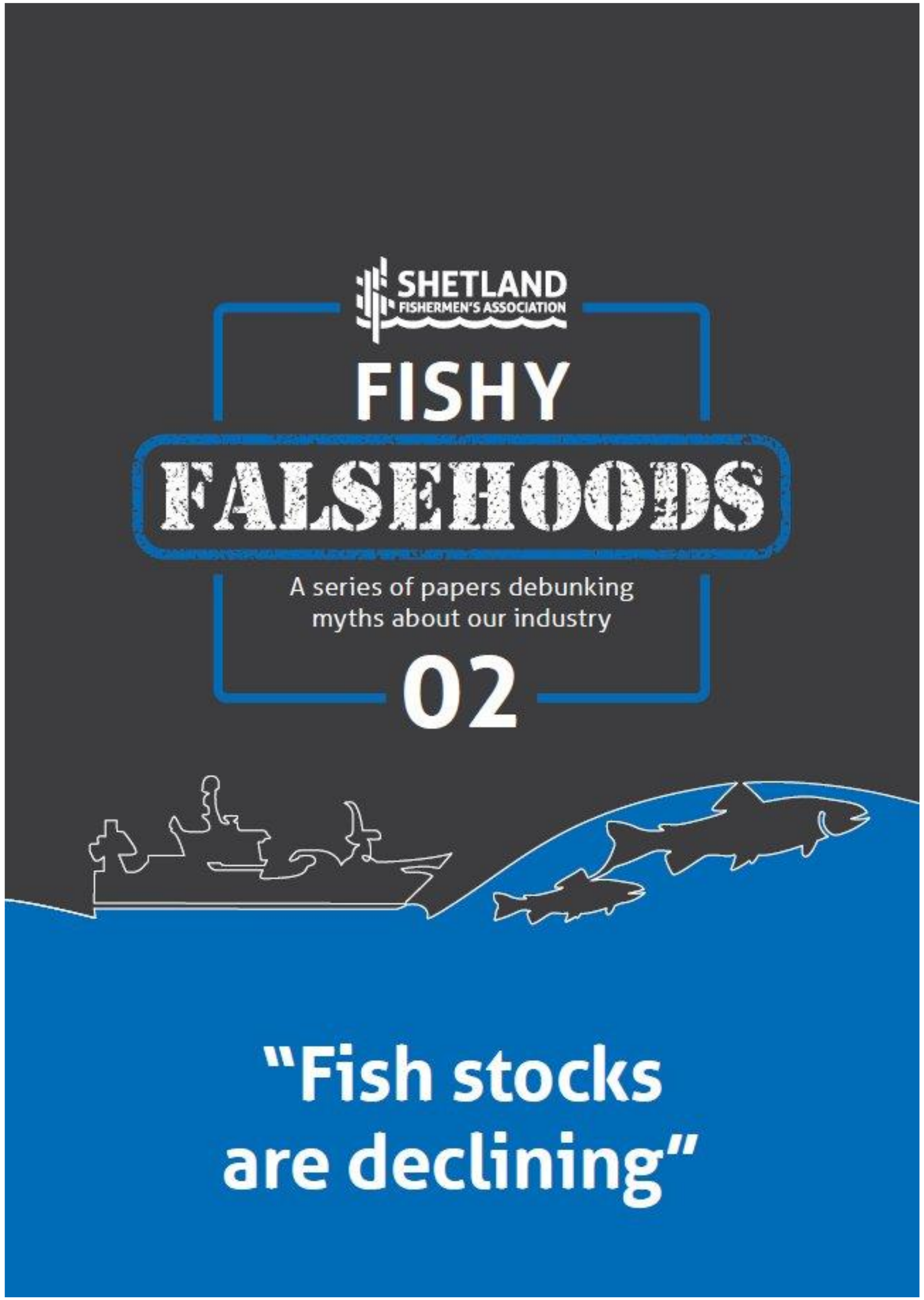
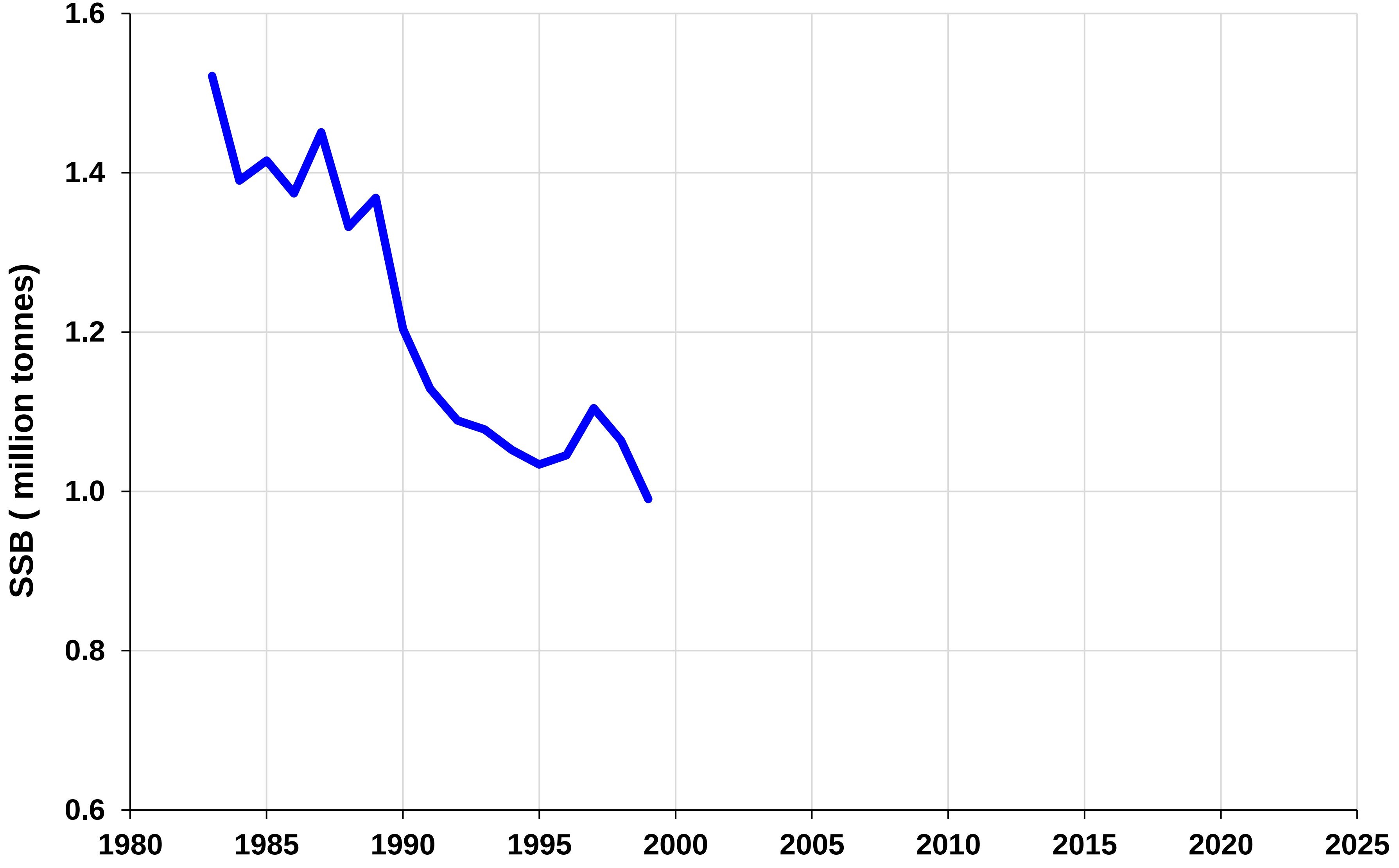
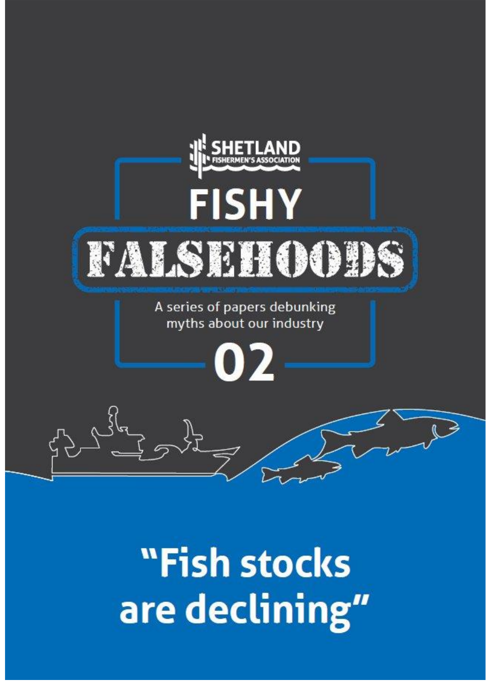


Are stocks declining?



Total spawning stock biomass (SSB) of seven stocks for which long-term time-series are available (ICES data).



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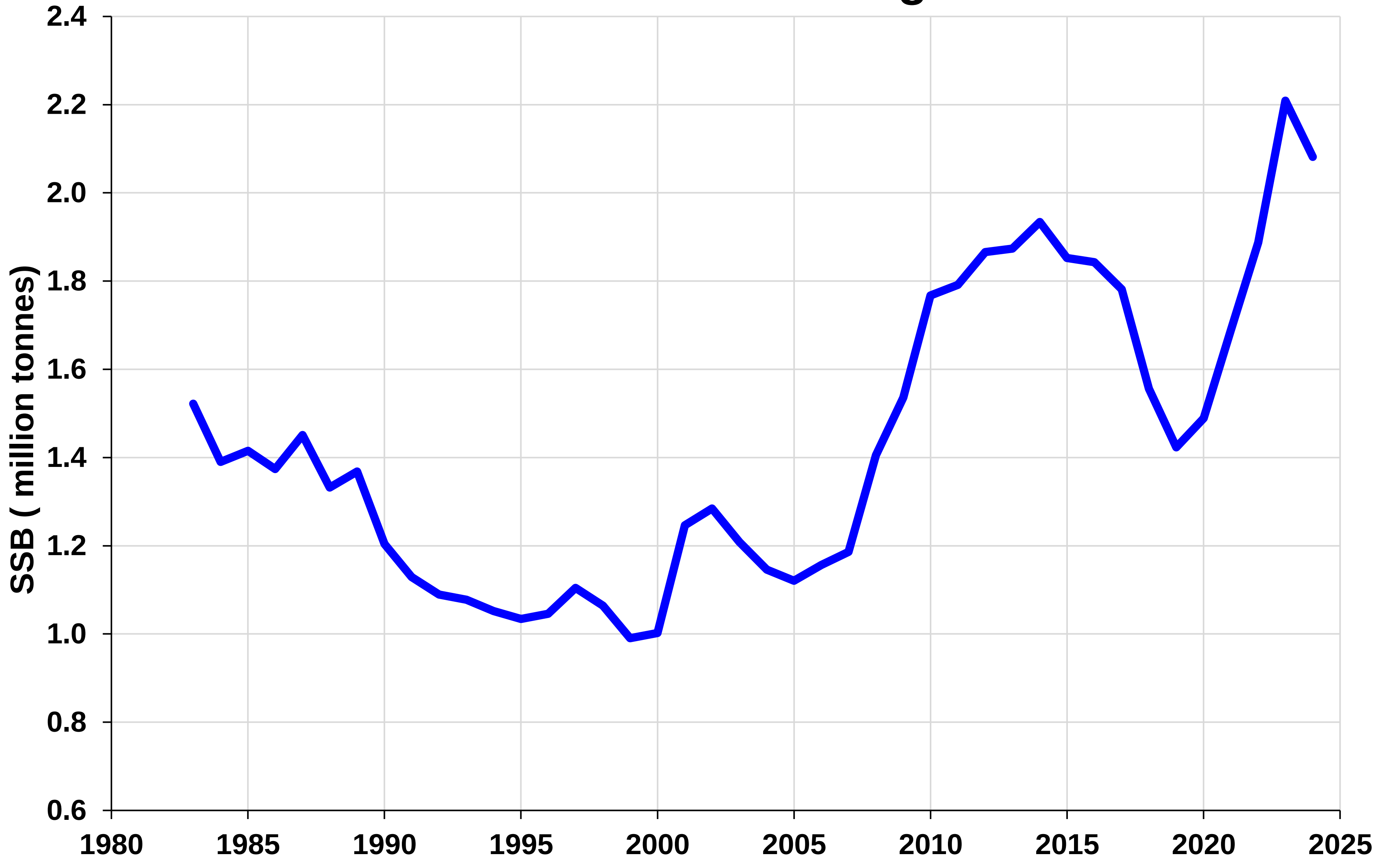

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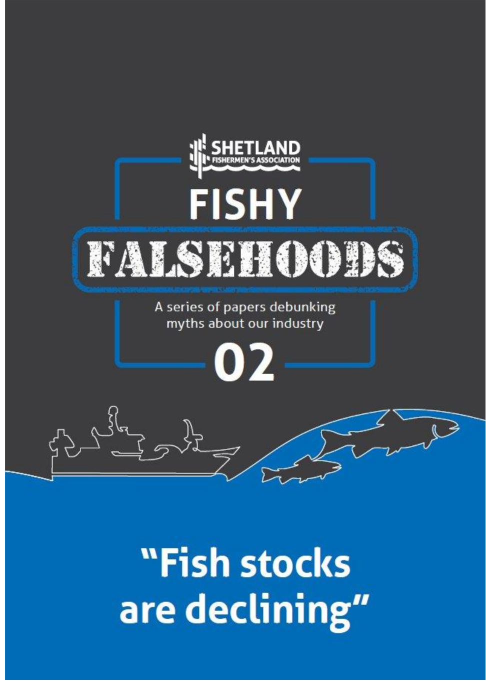

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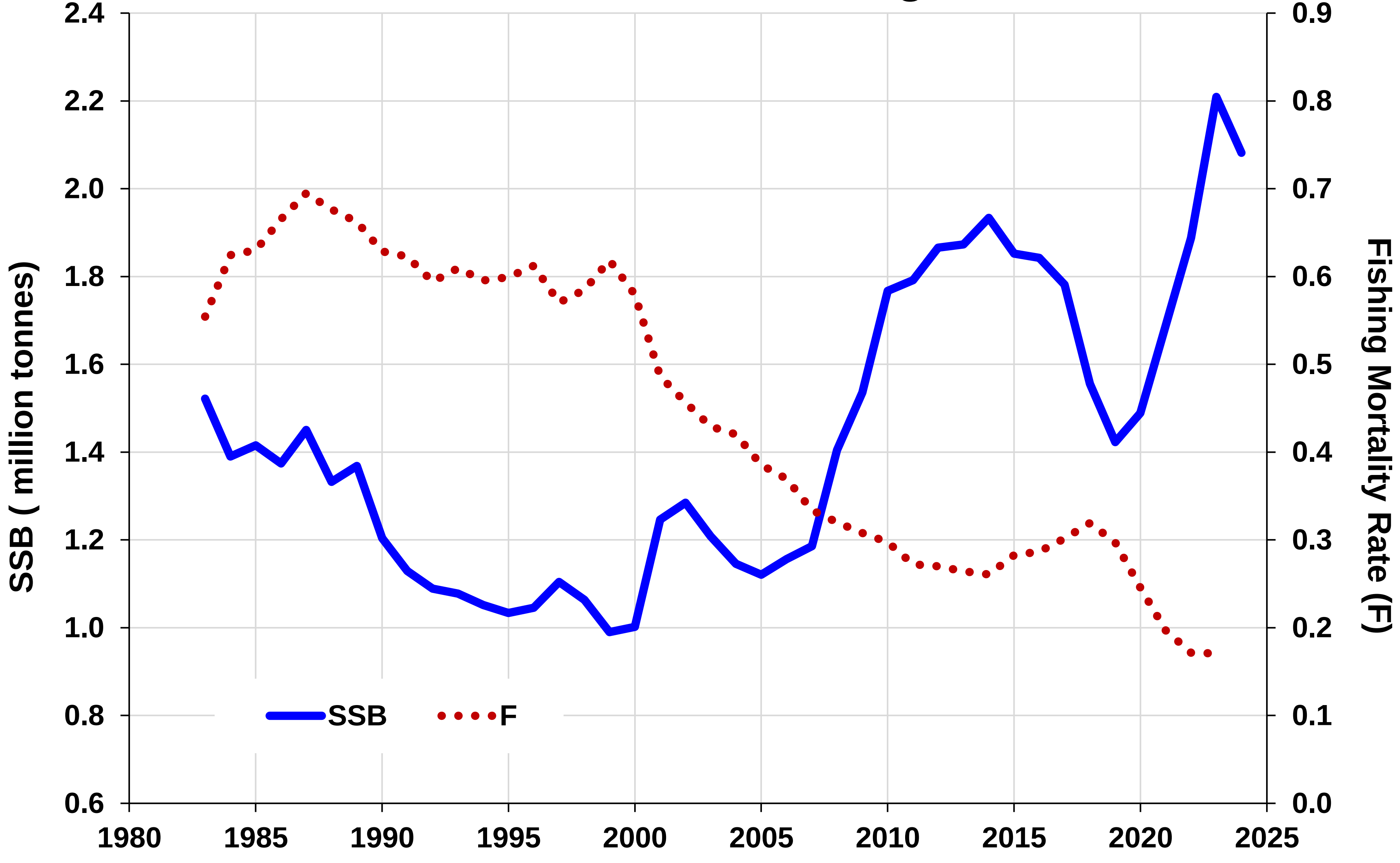
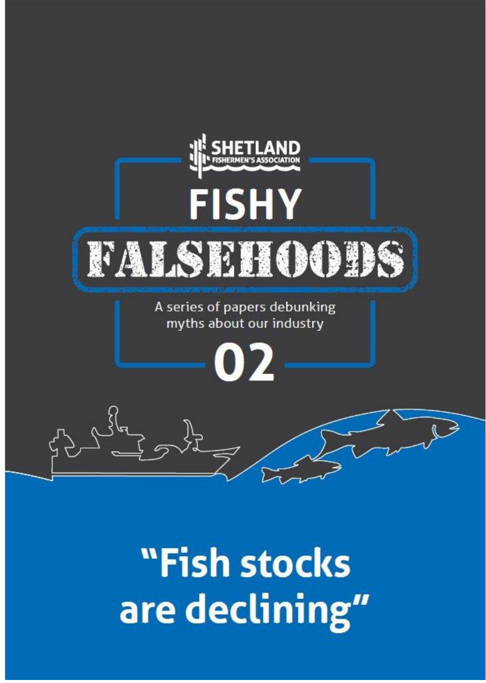


Total spawning stock biomass (SSB) and average fishing mortality rate (F)
of seven stocks for which long-term time-series are available.



Bottom trawling releases as much carbon as air travel, landmark study finds

Dragging heavy nets across seabed disturbs marine sediments, world's largest carbon sink, scientists report

An area of seabed damaged by trawling. Bottom trawling by fishing boats pumps out 1 gigaton of carbon every year. Photograph: Howard Wood/COAST

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About this content

Karen McVeigh

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Wed 17 Mar 2021 18.44 GMT

The New York Times SUBSCRIBE FOR

Trawling for Fish May Unleash as Much Carbon as Air Travel, Study Says

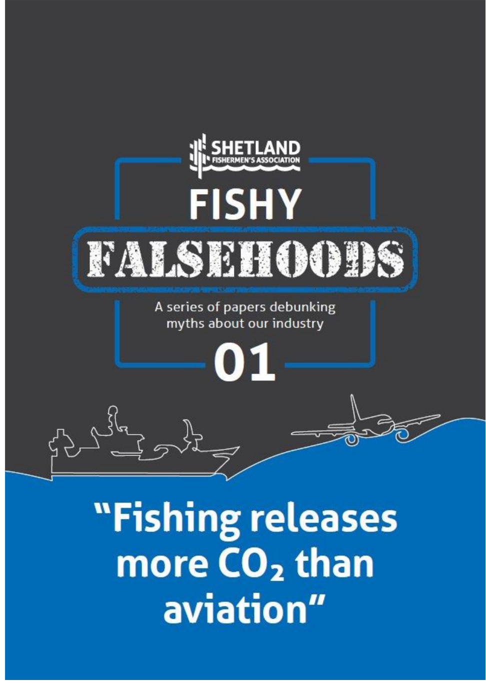
The report also found that strategically conserving some marine areas would not only safeguard imperiled species but sequester vast amounts planet-warming carbon dioxide, too.

Give this article 23

A trawler on Georges Bank, between Massachusetts and Nova Scotia. A new study found that bottom trawling accounts for as much carbon emissions as global aviation. Jeffrey Rotman/Alamy

By Catrin Einhorn

March 17, 2021



- Theoretical study
- Very general assumptions / guesses
- Crude global scale (50km rectangles)
- No comparison with air travel

The science of sustainable seafood, *explained*

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Officially bogus: Bottom trawling does not release as much carbon as airline travel

Max Mossler

June 14, 2023

Remember the headlines that claimed bottom trawling released as much carbon as all of air travel? We thought those claims were probably bogus when first reported, but Hiddink et al. 2023, a response paper published May 2023, now makes those claims Officially Bogus.

The original headlines came from Sala et al. 2021, a paper published in

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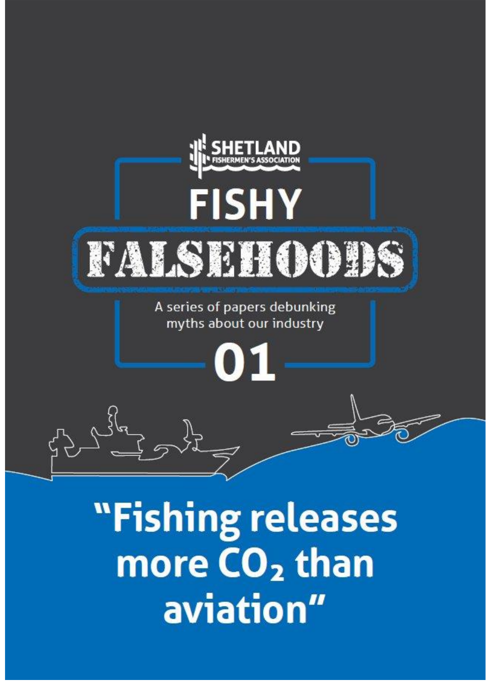

https://sustainablefisheries-uw.org/bottom-trawling-carbon-climate-change-debunked/

Article

Protecting the global ocean for biodiversity, food and climate

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Check for updates

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The ocean contains unique biodiversity, provides valuable food resources and is a major sink for anthropogenic carbon. Marine protected areas (MPAs) are an effective tool for restoring ocean biodiversity and ecosystem services[1,2], but at present only 2.7% of the ocean is highly protected[3]. This low level of ocean protection is due largely to conflicts with fisheries and other extractive uses. To address this issue, here we developed a conservation planning framework to prioritize highly protected MPAs in places that would result in multiple benefits today and in the future. We find that a substantial increase in ocean protection could have triple benefits, by protecting biodiversity, boosting the yield of fisheries and securing marine carbon stocks that are at risk from human activities. Our results show that most coastal nations contain priority areas that can contribute substantially to achieving these three objectives of biodiversity protection, food provision and carbon storage. A globally coordinated effort could be nearly twice as efficient as uncoordinated, national-level conservation planning. Our flexible prioritization framework could help to inform both national marine spatial plans[4] and global targets for marine conservation, food security and climate action.

The global ocean is a trove of biodiversity, containing unique life forms and genetic resources that provide ecosystem services of enormous value to humans[2,5]. However, increasing anthropogenic effects are compromising the ability of the ocean to provide these services[6,7] and have motivated a global discussion about expanding the world's system of MPAs.

MPAs—especially highly protected areas in which extractive and destructive activities are banned[8,9]—can be effective management tools to safeguard and restore ocean biodiversity and associated services[1,2,10], complement conventional fisheries management and contribute to the mitigation of climate change by protecting marine carbon stocks[11]. Yet as of March 2021, only around 7% of ocean area has been designated or proposed as MPAs, and only 2.7% is actually implemented as fully or highly protected[3]. This low level of ocean protection is explained in part by conflict between protection and extraction stemming from perceived trade-offs. Rather than viewing protection versus extraction as a zero-sum game, we ask whether strategic conservation planning can simultaneously yield benefits for biodiversity conservation, food provisioning and carbon storage.

Previous efforts to identify global conservation priorities in the ocean have primarily focused on narrow definitions of biodiversity and ignored other key facets such as functional roles, evolutionary histories of species and unique community assemblages[12,13]. Perhaps more importantly, focusing on a single objective in a multi-use ocean often results in strong trade-offs that hinder real-world conservation action. To overcome these problems, we developed a comprehensive conservation planning framework to achieve multiple objectives: biodiversity protection, food provisioning and carbon storage. The framework considers human impacts that are abatable through highly or fully protected MPAs (that is, protection from fishing, mining and habitat destruction) and those that are un-abatable with those tools[14] (for example, nutrient pollution, ocean warming and acidification), and it seeks to maximize the difference made by protection relative to a business-as-usual scenario (that is, a world without additional

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Difference in estimated CO_2 release = 2 – 3 orders of magnitude (x100 – x1,000)

Matters arising

Quantifying the carbon benefits of ending bottom trawling

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Check for updates

Jan Geert Hiddink[1]✉, Sebastiaan J. van de Velde[2,3], Robert A. McConnaughey[4], Emil De Borger[5], Justin Tiano[5,6,7], Michel J. Kaiser[8], Andrew K. Sweetman[9] & Marija Sciberras[8]

ARISING FROM E. Sala et al. *Nature* https://doi.org/10.1038/s41586-021-03371-z (2021)

Bottom trawling disrupts natural carbon flows in seabed ecosystems owing to sediment mixing, resuspension and changes in the biological community. Sala et al.[1] suggest that seafloor disturbance by industrial trawlers and dredgers results in 0.58–1.47 petagrams (Pg) of aqueous CO_2 release annually (equivalent to 0.16–0.4 Pg carbon (C) per year), owing to increased organic carbon (OC) mineralization, which occurs after trawling. We are concerned, however, that Sala et al.[1] overestimate trawl-induced CO_2 release, because their model uses a reactivity value (k, the first-order decay rate) estimated for highly reactive OC delivered recently to the sediment surface, and apply it to bulk sediment (typically composed of labile, recalcitrant and refractory C), which is known to have a much lower reactivity[2]. These assumptions result in an upward bias in the estimated CO_2 release by several orders of magnitude, overestimating the impact of trawling on global OC mineralization rates.

The parameter values in Sala et al.[1] ignore the important role of composition in driving OC mineralization in marine sediments. OC that reaches the sediment represents a mixture of compounds that range from highly reactive to very unreactive molecules[3]. Typically, around 70% (represented by the fraction of reactive material, p, of 0.70 for muddy sediment in the model of Sala et al.[1]) is highly reactive and mineralized by microorganisms within the first few centimetres of sediment, which translates into a high k value (reactivity of the OC pool, 1–10 per year (yr^{-1})). The remaining, less-reactive fractions are mineralized at a much slower rate, with typical k values below 0.1 yr^{-1} (ref. 4). Because of the preferential mineralization of the more-reactive fractions, the k value of the bulk OC decreases exponentially with sediment depth, generally from 1–10 yr^{-1} at the sediment–water interface to less than 0.01 yr^{-1} below a depth[4,5] of 5 cm (Fig. 1). The standing stock of OC in the sediment thus typically exhibits a k value of 0.01–0.1 yr^{-1}. Consequently, the approach Sala et al.[1] have taken—using a k value of 0.3–17 yr^{-1} and applying this to the bulk of the OC stock—may result in an overestimation of CO_2 release of historically buried OC by two to three orders of magnitude. We argue that incorporating the role of composition would require lowering the k value to around 0.01 yr^{-1}, which is representative of sub-surface sediment[5], and applying it to the bulk of the sediment (fraction of reactive material, $p = 1$) or, alternatively, using the original high k values ($k = 0.3$–$17\ yr^{-1}$) and applying them to the fraction of reactive material p present in historically buried OC ($p = 0.001$–0.01). More importantly, the calculations in Sala et al.[1] would have given only an estimate of OC remineralization independent of trawling—because these k and p values are representative of OC mineralization in marine sediments (Fig. 1 shows typical k values relative to sediment depth for a range of North Sea sediments).

Furthermore, the OC model presented by Sala et al.[1] does not differentiate between OC mineralization in undisturbed sediments and that induced by sediment disturbance. Instead, Sala et al.[1] implicitly assume that the OC mineralization rate calculated using their model results from trawling disturbance alone. As a result, their model assumptions imply that the OC in an area protected from trawling is unreactive and will not be mineralized. The 'carbon model validation' section in the methods of Sala et al.[1] clearly illustrates this issue. Sala et al.[1] compare the modelled CO_2 emissions that derive from only the trawl disturbance of historically buried OC with empirical estimates of CO_2 emissions from natural-plus-trawling mineralization of all sedimentary OC, and also do not compare the emissions with those of untrawled control sites. These fundamentally incomparable measures are not suitable for the validation of their model. The fact that these measures are of the same order of magnitude illustrates that CO_2 emissions by trawling are likely to be small compared with the emissions from natural mineralization[6] and much smaller than those modelled by Sala et al.[1].

The ultimate question is whether the reactivity of the OC stock is increased by trawling disturbance and resuspension, and thus whether the k value is higher after trawling. Unfortunately, this question is not adequately addressed by Sala et al.[1]. To date, our knowledge of the effects of the disturbance and resuspension of sediments induced by trawling on the reactivity of OC, and how this compares with the effects of natural resuspension events (such as storms and waves) is extremely limited. A recent review of 49 studies investigating OC stocks after trawling-induced disturbances revealed highly mixed results, with 61% of studies reporting no significant effect, 29% reporting lower OC stocks and 10% reporting higher stocks[6]. To robustly estimate the global impact of bottom trawling on OC mineralization, new experiments are needed that quantify the reactivity of disturbed OC in the sediment and in resuspension.

In conclusion, we currently do not know enough about the impact of trawling on seabed carbon to make robust global projections. Reliable estimates of sediment carbon loss should be based on models that use parameter estimates for the change in OC reactivity and that are tested against empirical measurements. Sala et al.[1] suggest that reducing CO_2 release through reducing trawling effort could generate carbon credits and provide an opportunity for financing marine protected areas. Although this is certainly an idea worth considering, we argue that the CO_2 release estimates of Sala et al.[1] create unrealistic expectations about

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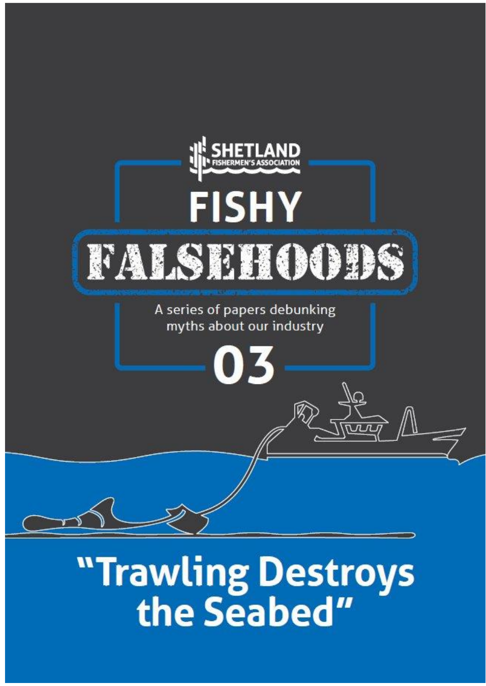
“Scottish Government data shows 80 per cent of Shetland’s seafloor is in ‘poor condition’ due to towed, bottom-contacting fishing.”



“58 per cent of [Scotland’s] seabed is highly disturbed.”

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Healthy and biologically diverse / Habitats / Deep sea / Predicted extent of physical disturbance to seafloor

Predicted extent of physical disturbance to seafloor

Sections

- Background
- Results
- Conclusion
- Knowledge gaps
- Status and trend assessment
- Links and resources

Key message

Disturbance of seafloor habitats from towed, bottom-contacting fishing activity is predicted to be widespread. The indicator predicts seafloor habitats are in poor condition across more than half of their area in nine out of 21 regions, and some level of damage is likely in all regions.

14 LIFE BELOW WATER

Broken shells, decaying material on recently dredged sea bed in Loch Carron © NatureScot/Ben James

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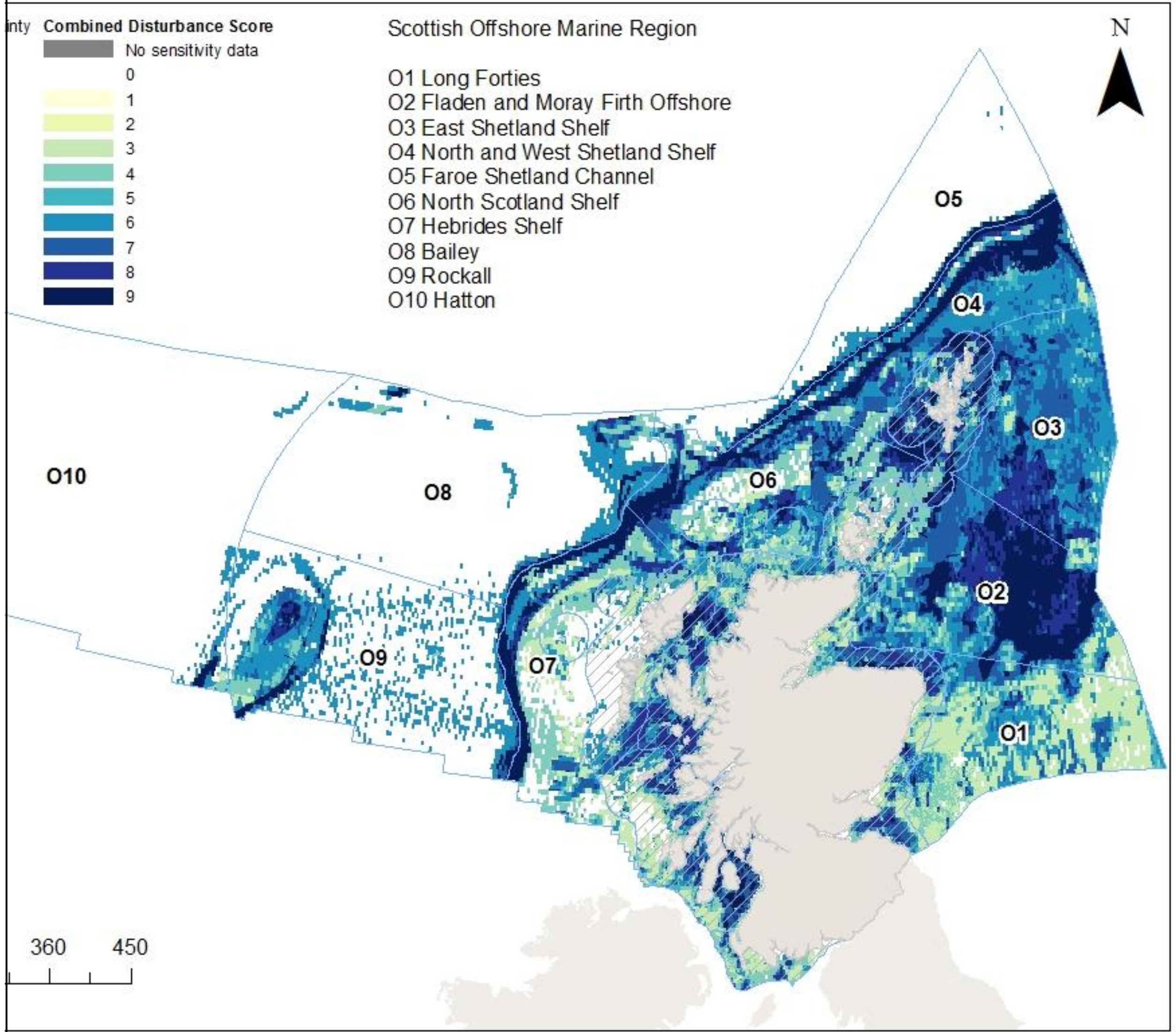
Background

Physical disturbance can damage seafloor habitats, especially those supporting larger and more fragile species and/or those with longer recovery time. The status of seafloor habitats can be assessed using monitoring data from surveys, ideally across a long time period. However, it is not feasible to monitor the whole seafloor: currently, monitoring data are mostly available from Marine Protected Areas. A modelled approach is necessary for large scale habitat assessments across all Scottish waters. Exposure to pressures associated with human activity can be used to devise a proxy for habitat condition.

This assessment, developed for use in OSPAR and UK Marine Strategy assessments (known as 'Extent of Physical Damage' indicator (OSPAR, 2017), predicts the spatial extent and level of physical disturbance by mapping areas where pressures overlap with sensitive habitats. Currently, it only considers disturbance from surface and sub-surface abrasion caused by vessels over 12 m in length using Vessel Monitoring System (VMS) (reporting vessels) fishing with bottom contacting gears. This is considered to be the most significant pressure (Foden, 2011). The corresponding pressure maps produced using these data aggregate pressure across a large grid cell. It is assumed that fishing occurs evenly across the whole grid cell which may not be the case.

The indicator categorises disturbance at the seabed from 0 (none) to 9 (very high). Categories 5 to 9 represent higher levels of disturbance. Areas with a score of 5 and above are considered highly disturbed and, therefore, potentially in poor condition. Habitats may have a high disturbance score if they are heavily fished or, if they are fished less frequently but are highly particularly sensitive to the associated pressures.



"…predicts seafloor habitats are in poor condition across more than half of their area in nine out of 21 regions…"

Scotland's Marine Assessment 2020

https://marine.gov.scot/sma/assessment/predicted-extent-physical-disturbance-seafloor

Trawl impacts on the relative status of biotic communities of seabed sedimentary habitats in 24 regions worldwide

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Bottom trawling is widespread globally and impacts seabed habitats. However, risks from trawling remain unquantified at large scales in most regions. We address these issues by synthesizing evidence on the impacts of different trawl-gear types, seabed recovery rates, and spatial distributions of trawling intensity in a quantitative indicator of biotic status (relative amount of pretrawling biota) for sedimentary habitats, where most bottom-trawling occurs, in 24 regions worldwide. Regional average status relative to an untrawled state (=1) was high (>0.9) in 15 regions, but <0.7 in three (European) regions and only 0.25 in the Adriatic Sea. Across all regions, 66% of seabed area was not trawled (status = 1), 1.5% was depleted (status = 0), and 93% had status > 0.8. These assessments are first order, based on parameters estimated with uncertainty from meta-analyses; we recommend regional analyses to refine parameters for local specificity. Nevertheless, our results are sufficiently robust to highlight regions needing more effective management to reduce exploitation and improve stock sustainability and seabed environmental status—while also showing seabed status was high (>0.95) in regions where catches of trawled fish stocks meet accepted benchmarks for sustainable exploitation, demonstrating that environmental benefits accrue from effective fisheries management. Furthermore, regional seabed status was related to the proportional area swept by trawling, enabling preliminary predictions of regional status when only the total amount of trawling is known. This research advances seascape-scale understanding of trawl impacts in regions around the world, enables quantitative assessment of sustainability risks, and facilitates implementation of an ecosystem approach to trawl fisheries management globally.

trawl impacts | trawl footprints | recovery | habitat sensitivity | spatial upscaling

Bottom-trawl fishing occurs worldwide and is the most extensive anthropogenic direct physical disturbance to seabed habitats (1, 2). Towing trawl gear such as otter or beam trawls or dredges along the seabed has a wide range of direct and indirect impacts on habitats, the broader ecosystem, and the services they provide (3–8) and often is portrayed as a destructive fishing practice by some environmental nongovernmental organizations. However, bottom-trawl fisheries provide about a quarter of marine catch (9), making substantial contributions to global food supply and livelihoods (10). Recognition of the wider environmental consequences of fishing, including seabed impacts of trawling, has contributed to the development of an "ecosystem approach to fisheries" [EAF (11)] that considers broader ecosystem sustainability in balance with fishery production when managing fisheries. EAF principles are being adopted widely into international and national policy commitments, fishery management plans, and sustainable-seafood certifications (12).

Balancing fishery production and ecosystem sustainability, however, remains a globally challenging issue—partly because the required indicators of ecosystem state often are unavailable or cost prohibitive to acquire at management scales.

Significance

We estimated the biological state of seabed sedimentary habitats, with specified uncertainty, in 24 trawled regions worldwide. Seabed status differed greatly among regions (from 0.25 to 0.999, relative to an untrawled state of 1); 15 regions had average status > 0.9. Two-thirds of all assessed seabed area was untrawled with status = 1, 93% had status > 0.8, but 1.5% had status = 0. The total area swept by trawling was a strong driver of regional status, providing a relationship to predict status from the regional estimated total amount of trawling. Seabed status is high in regions where fisheries are exploited sustainably—emphasizing that good fishery management contributes to better ecosystem outcomes—and, conversely, low status highlights regions needing improved management.

Author contributions: C.R.P., S.J., M.J.K., and R.H. designed research; C.R.P., R.A., T.M., R.A.M., and A.D.R. performed research; C.R.P., J.C., and A.M.P. contributed new analytic tools; C.R.P., J.G.H., R.A., and M.S. analyzed data; and C.R.P., J.G.H., S.J., J.C., A.M.P., R.A., T.M., M.S., R.A.M., A.D.R., M.J.K., P.S., and R.H. wrote the paper.

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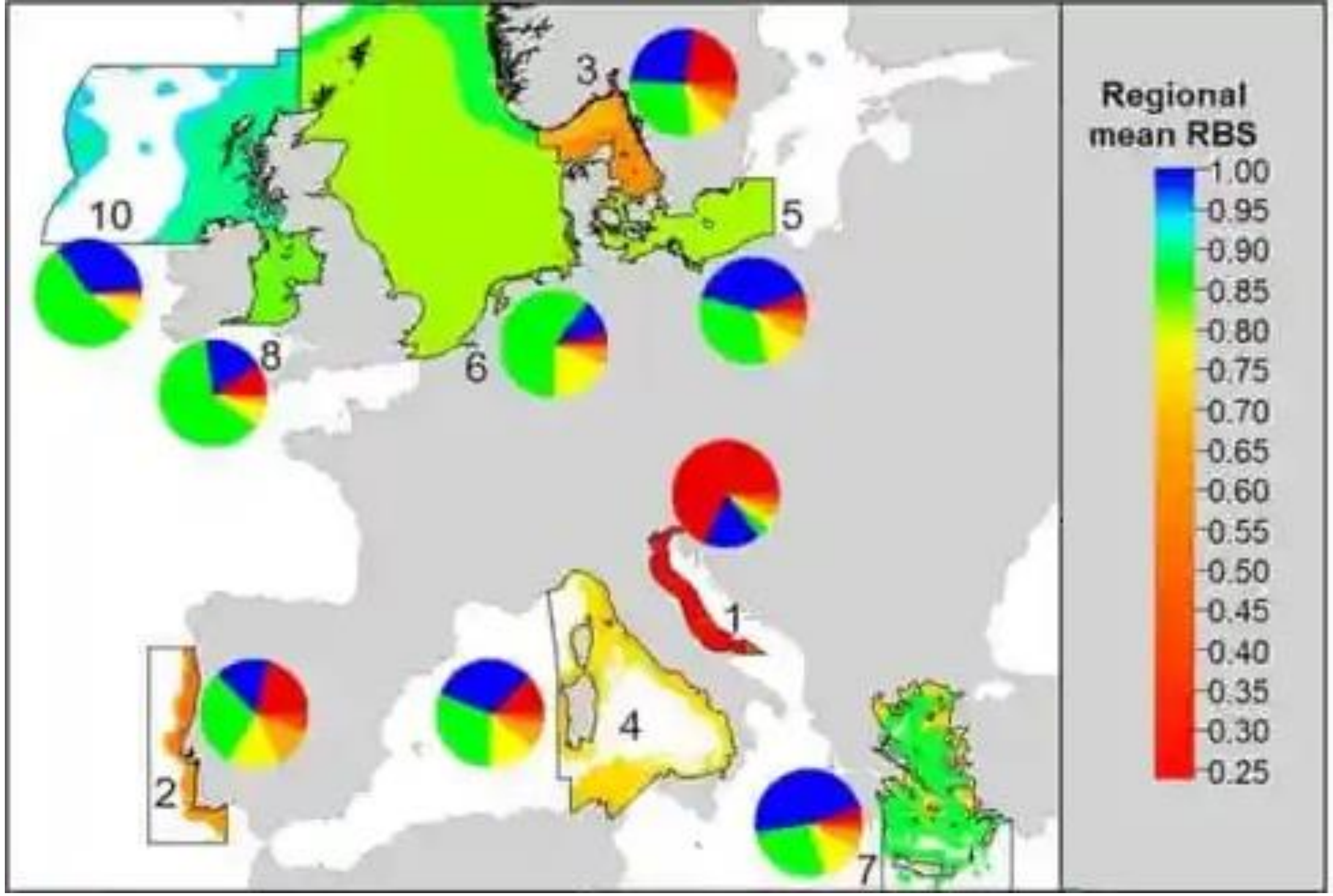
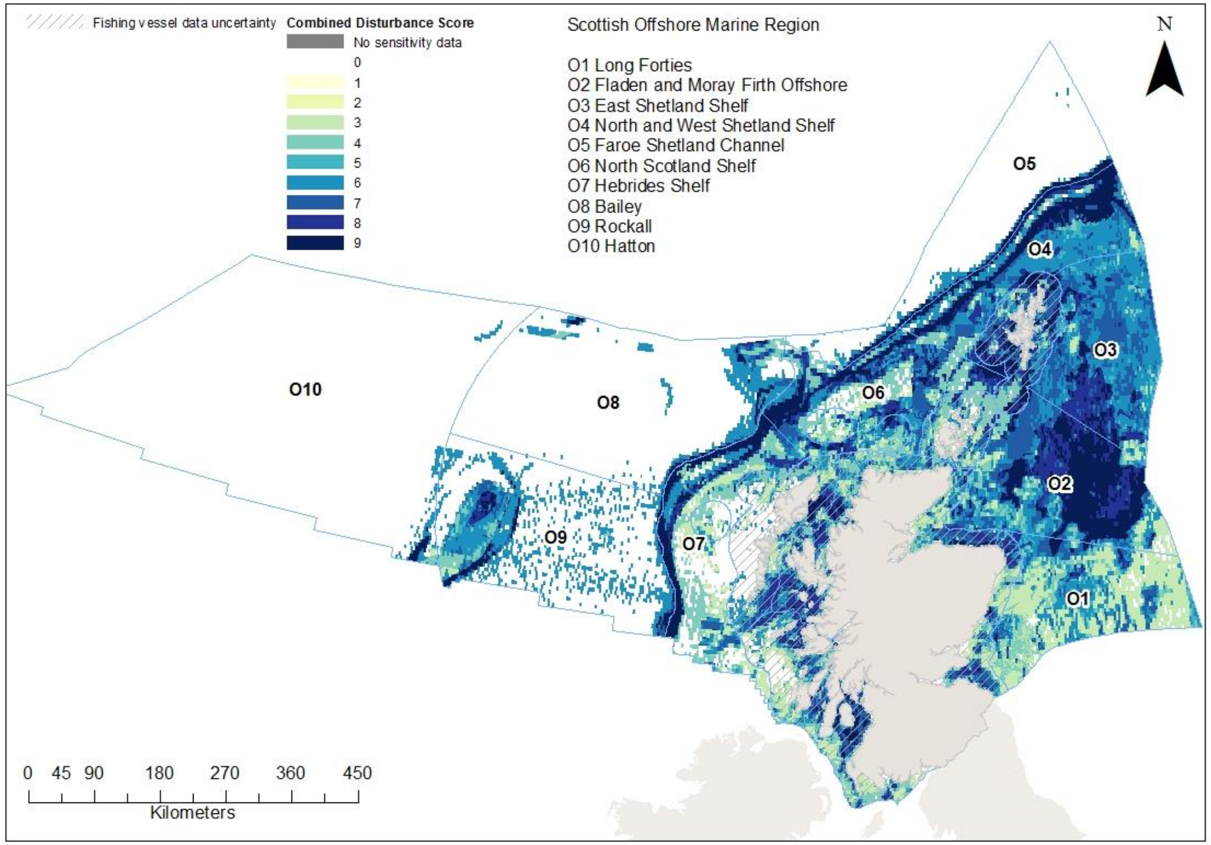


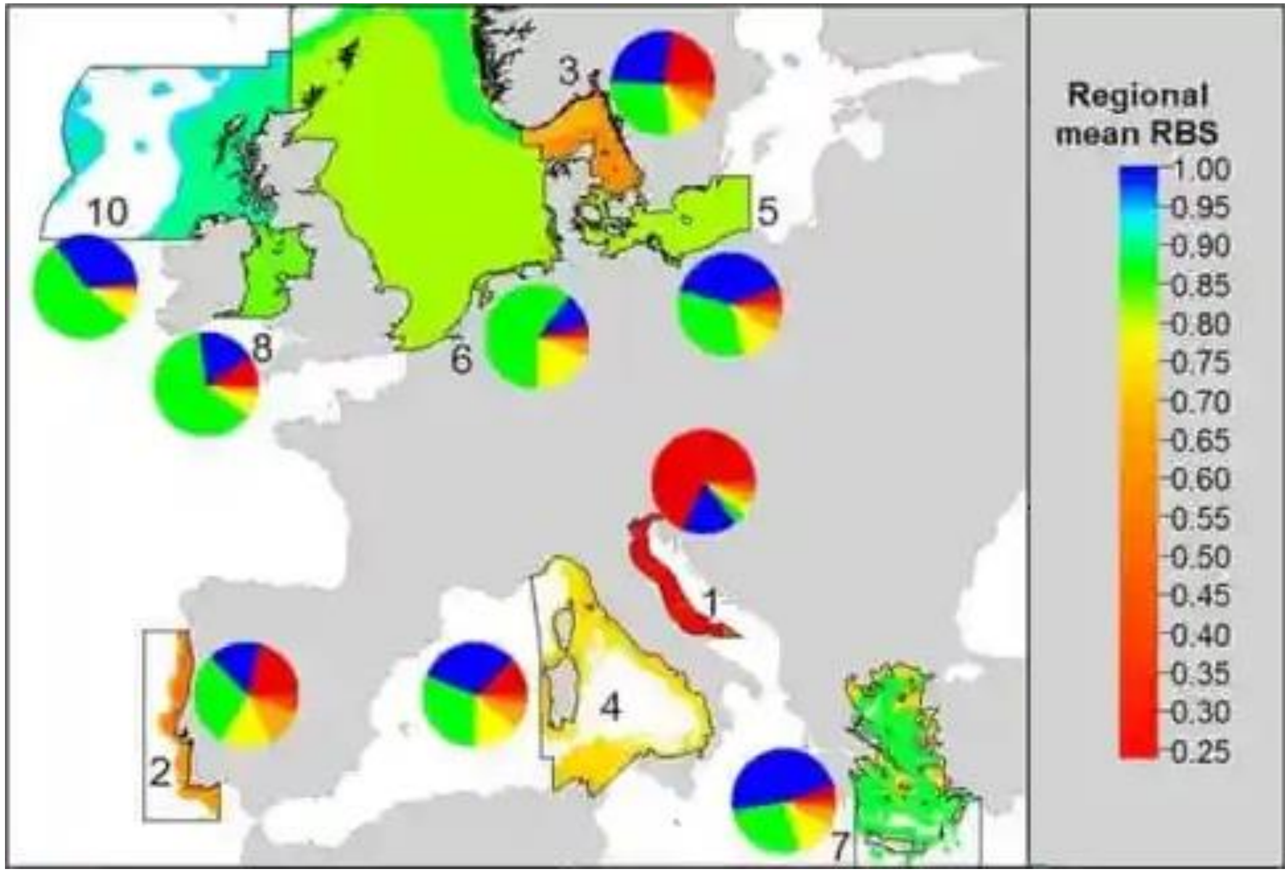
North Sea RBS Scores:

11% - 1.0 (no depletion)

72% - 0.8 (20% depletion)

3% - 0.0 (total depletion)

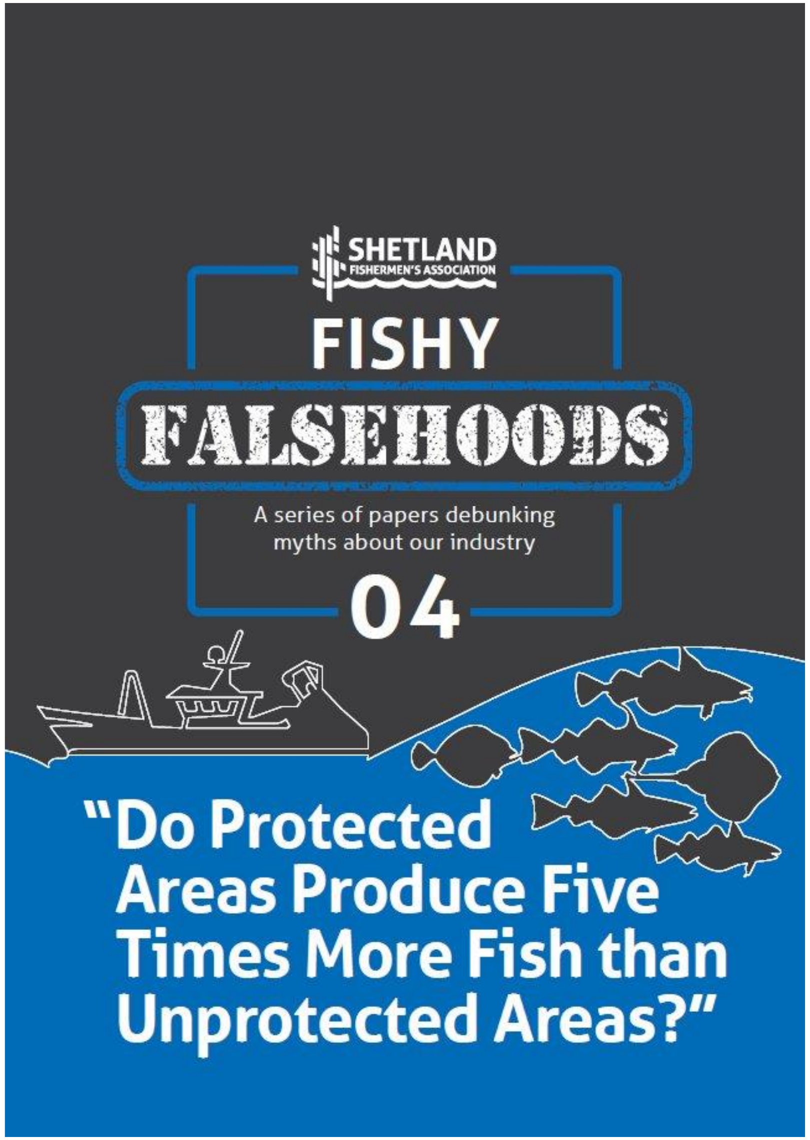


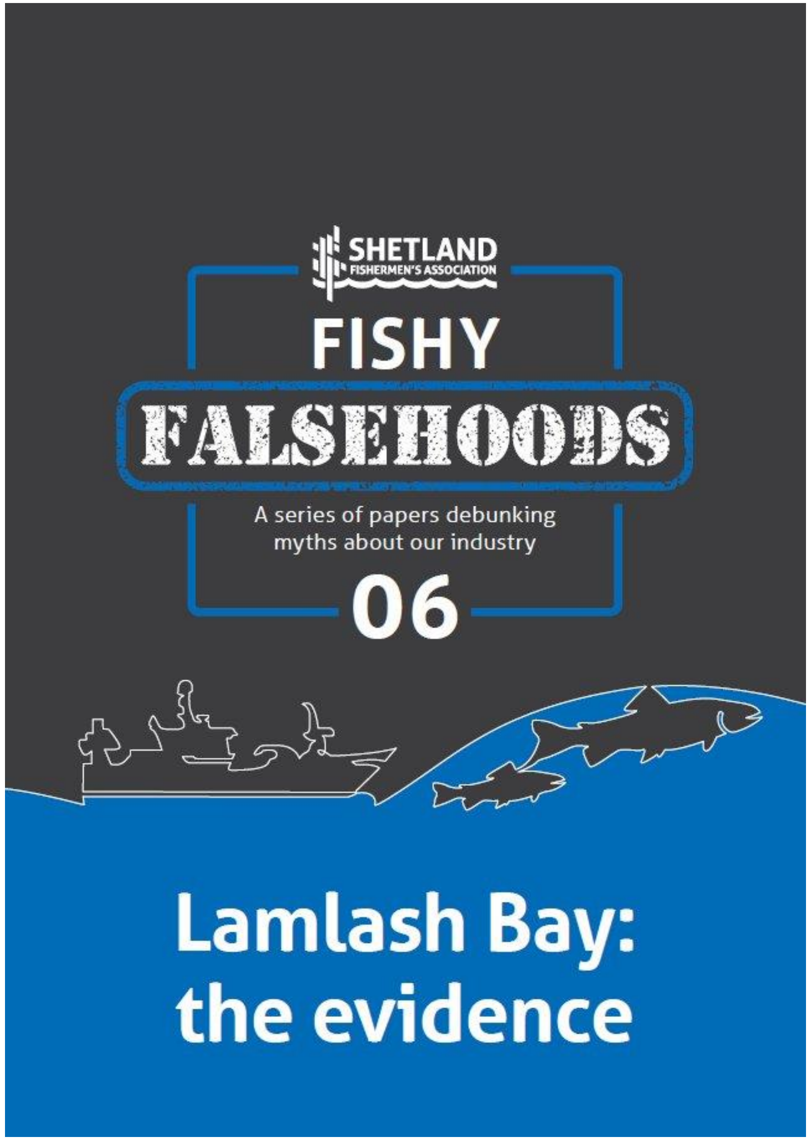


- 30 km² squares
- 2-point scale (‘low’ or ‘high’ disturbance)
- 58% of [Scotland’s] seabed is highly disturbed

- 1 km² squares
- Numerical scale
- 72% of North Sea has RBS score >0.8

SHETLAND FISHERMEN'S ASSOCIATION






VALENTIA
LK21


LK-470


SERENE


DEFIANT


LERWICK
4

~~Fishing v. Not Fishing~~

Fishing v. Other Means of Food Production

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Net gains

Eating wild-caught fish is better for the environment and biodiversity than consuming meat or even crops, argues RAY HILBORN.

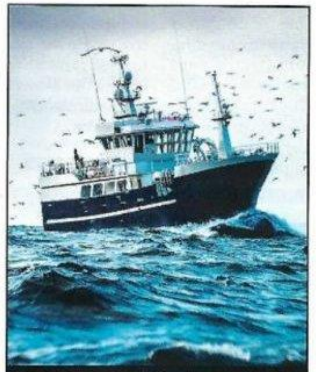
In 2010, a friend said to me: "I'm an environmentalist, should I stop eating fish?" I responded: "If you don't eat fish, what are you going to eat?" He replied that as he wasn't a vegetarian, he would eat more meat. This led me to start exploring the environmental cost of fishing, compared with other ways of producing food.

All types of food production require resources such as fuel, energy, land, water, fertiliser, antibiotics and equipment. This produces environmental impacts such as greenhouse gases, water shortage, soil erosion, nutrient and acid pollution, antibiotic-resistant bacteria and loss of native biodiversity. The impact of different food production systems differs greatly, and has increasingly been the subject of scientific research.

In his 2013 book *The Perfect Protein*, Andy Sharpless, CEO of the ocean conservation organisation Oceana, wrote: "But what if there was a healthy, animal-sourced protein that [could be enjoyed] without draining the life from the soil, without drying up our rivers, without polluting the air and water, without causing our planet to warm even more, without plaguing communities with diabetes, heart disease and cancer." That perfect protein is, of course, wild-caught fish. Fish can be caught with almost no water, no herbicides or pesticides, no antibiotics, and no soil erosion. The two major environmental impacts of fishing are greenhouse gases primarily from fuel use, and impacts on biodiversity.

The greenhouse gas footprint of fisheries varies enormously and depends almost totally on fuel use. Globally, most fish are caught from motorised vessels. Fuel use can range from as little as 50 litres per tonne of product, to more than 4000 litres. The most fuel-efficient fisheries are those that go after dense schools of fish such as mackerel, herring, whiting and pollock, but the large salmon fisheries in Alaska and a host of other fisheries can use as little as 100 litres per tonne. These fuel-efficient fisheries have a much lower greenhouse gas footprint than livestock, and can be as low as some crops.

We have all heard that the oceans are being emptied of fish, and many people think fishing has more biodiversity impact than livestock or crops. Nothing could be further from the truth. A key difference between fisheries and crops is that fisheries target specific species and leave the base of the marine food chain (phytoplankton and zooplankton) alone. Fisheries certainly affect the abundance of the target species, and some non-target species, but usually affect only a small portion of the species in the seas.



Targeted: wild-caught fisheries have an impact only on certain species.

Fisheries target specific species and leave the base of the marine food chain alone.

Several studies (published in the journals *Conservation Letters*, *Marine Ecology Progress Series* and *Scientific Reports*, and including two by myself and co-authors) have shown that the total abundance of fish in the sea is either unchanged or actually higher because of fishing. This is because fisheries tend to target predatory fish. Because the small "forage fish" are naturally far more abundant than their predators, their increase more than compensates for the reduction of the predators.

All crops, and almost all non-grazing livestock production, depend on eliminating natural ecosystems and replacing them with fields of monoculture crops. Biodiversity is largely eliminated. Certainly, most crops have a lower greenhouse gas footprint than capture fisheries, but that is the only environmental metric where crops outperform fishing.

A recent study by myself and colleagues, published in the *Proceedings of the National Academy of Sciences*, found that the two major threats to ocean ecosystems were climate change and coastal impacts from sediment, pollution and habitat loss. Fisheries were the impact of least concern.

Many people believe that a vegan diet has the lowest environmental impact. While that is probably true for greenhouse gases, it is certainly not true for other effects, especially for loss of biodiversity. Growing soy requires transforming land from natural habitat to crops. A vegan diet also causes the direct mortality of sentient animals. Anyone who has harvested a field of grain knows that plenty of wildlife gets caught in the harvesting machines.

In summary, then, wild-capture fisheries, across almost all environmental impacts, are more environmentally friendly than livestock or crops. ▮

Ray Hilborn is professor of aquatic and fishery science at the University of Washington. He is the keynote speaker at a seafood seminar in Wellington on February 16.

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The science of sustainable seafood, *explained*

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New review shows bottom trawling is sustainable (when well-managed)

Max Mossler

Seafood produced by bottom trawling can have
impact than chicken or pork, according to a ne
yesterday. Writing in the ICES Journal of Mari
2023 argues that banning bottom trawling wou
environmental impacts by increasing terrestria

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Food for Thought

ICES CIEM International Council for the Exploration of the Sea / Conseil International pour l'Exploration de la Mer

Evaluating the sustainability and environmental impacts of trawling compared to other food production systems

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Mobile bottom contact gear such as trawls is widely considered to have the highest environmental impact of commonly used fishing gears, with concern about impact on benthic communities, bycatch, and carbon footprint frequently highlighted as much higher than other forms of fishing. As a result, the use of such gears has been banned or severely restricted in some countries, and there are many proposals to implement such restrictions elsewhere. In this paper, we review the sustainability of bottom trawling with respect to target-species sustainability, impact on benthic communities, bycatch and discards, carbon footprint from fuel use, and impact on carbon sequestration. We compare the impact to other forms of fishing and other food production systems. We show that bottom-trawl and dredge fisheries have been sustained, and where well managed, stocks are increasing. Benthic sedimentary habitats remain in good condition where fishing pressure is well managed and where VME and species of concern can be protected by spatial management. Bycatch is intrinsically high because of the mixed-species nature of benthic communities. The carbon footprint is on average higher than chicken or pork, but much less than beef, and can be much lower than chicken or pork. The impact on carbon sequestration remains highly uncertain. Overall, the concerns about trawling impacts can be significantly mitigated when existing technical gear and management measures (e.g. gear design changes and spatial controls) are adopted by industry and regulatory bodies and the race-to-fish eliminated. When these management measures are implemented, it appears that bottom trawling would have a lower environmental impact than livestock or fed aquaculture, which would likely replace trawl-caught fish if trawling was banned. A total of 83 bottom-trawl fisheries are currently certified by the Marine Stewardship Council, which is the most widely accepted measure of overall sustainability.

Keywords: Bottom trawling, bycatch, carbon footprint, discards, environmental impacts of fishing.

Introduction

Bottom trawls (such as beam trawls, otter trawls, and shellfish dredges, which we will refer to as bottom trawls) are designed to catch target species that live close to, in, and on the seabed. The use of bottom trawls as a means of catching fish has met with increasing opposition due to its impact on seafloor habitats and biological communities (Watling and Norse, 1998; Watling, 2013), its high bycatch rates (Pérez Roda *et al.*, 2019; Gilman *et al.*, 2020), CO_2 release from fuel use (Tyedmers, 2004; Sala *et al.*, 2022), and, lately, its potential contribution to greenhouse emissions through the release of stored carbon from disturbed seabed sediments (Sala *et al.*, 2021). Although the magnitude of those impacts remains the subject of intense scientific debate (Pitcher *et al.*, 2022), concerns about the environmental impacts of trawling have fueled strong public campaigns, resulting in bottom trawling being demonized (Willer *et al.*, 2022), severely restricted, or effectively banned in some countries and regions (McConnaughey *et al.*, 2020).

However, bottom trawling accounts for 26% of global marine fisheries catches (Steadman *et al.*, 2022), providing food and employment for millions of people at a time when the contributions of marine fisheries towards the United Nations Sustainable Development Goals (United Nations, 2002) and, specifically, to meet the food and nutrient needs of a growing population, are increasingly recognized. While alternative fishing gears and methods may be available and economically viable in some cases, many benthic and demersal target species would be difficult to catch without some form of bottom trawling (Ziegler and Valentinsson, 2008; Suuronen *et al.*, 2012).

From this perspective, bottom trawling needs to be considered as one form of food production, and its sustainability and environmental footprint should be compared to footprints of other ways of producing food, including other capture fisheries, aquaculture, livestock, and crop production.

The purpose of this paper is to summarize the current knowledge about the sustainability and environmental

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"…trawling impacts are well below most animal-source foods… banning bottom trawling… would actually increase negative global environmental impacts."

https://sustainablefisheries-uw.org/bottom-trawling-review-sustainable-management/

https://doi.org/10.1093/icesjms/fsad115

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It’s Complicated!

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Thank You