Scottish Wildlife Trust

Policy

Fisheries Management

October 2020

Policy Recommendations

1. Adopt an **ecosystem-based fisheries management** approach that truly places the environment at the core of decision-making and ensures all fishing activity occurs within environmental limits.
2. Improve data availability to ensure all fisheries management decisions are well informed and based on the most up-to-date **scientific evidence**.
3. Modernise the fishing industry through use of digital technology to improve **monitoring, compliance and enforcement** whilst increasing **transparency and accountability** in the supply chain.
4. Manage fish stocks and the wider marine environment in a way that is **inclusive of stakeholder views** at national and international scales.
5. Bring fisheries into the wider context of marine environmental management through improved **spatial planning** of fishing activities.
6. Ensure adequate **resourcing** is available to deliver long-term fisheries management and environmental impact mitigation.

Scope

The Scottish Wildlife Trust's views on the management of Scotland's fisheries supports the Trust's vision for "a connected network of healthy, resilient ecosystems supporting Scotland's wildlife and people". This policy focusses on management of Scotland's sea fisheries and marine assets, and should be considered alongside the Trust's Inshore Fisheries Policy.

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1. Executive Summary

Marine ecosystems are being degraded at an unprecedented rate, which compromises their ability to deliver essential goods and services to nature and society.[1] To improve the health of our seas, restore our natural capital assets, and preserve the essential ecosystem services they provide, action must be taken to mitigate the most impactful pressures. Although a number of human activities impact the health of the ocean[1], pressure from fishing activity has been highlighted as a significant and widespread driver of change at both national and global scales.[1,2,3] Fishing is an important industry to Scotland's society and economy, and it is important it is managed sustainably. However, in 2017, only 54% of Scottish stocks were fished at or below their maximum sustainable yield[4] and many of the practices used are damaging to marine ecosystems, threatening the long-term benefits they provide.

The Trust believes that by placing ecosystem and environmental health at the core of decision making, Scotland could become a world-leader in sustainable fisheries management. The Trust has identified six key areas it believes will improve the management of Scotland's fisheries and, ultimately, lead to healthier and more productive seas.

[1] IPBES Global Assessment Report on Biodiversity and Ecosystem Services (2019)
[2] DEFRA Marine Strategy Part One: UK updated assessment and Good Environmental Status (2019)
[3] Scottish Government Marine Atlas (2011)
[4] Scottish Government National Indicator Performance

2. Context

2.1 The Global Ocean: Importance and Threats

The ocean covers more than 70% of the surface of our planet, is home to more than 80% of life on Earth, and provides us with a wealth of benefits that directly and indirectly contribute towards our survival and well-being.

The natural capital assets of our seas – natural resources such as water, habitats, and living creatures – create the foundations for a range of services, known as ecosystem services, that society benefits from. For society to continue benefitting from ecosystem services, it is essential that marine natural capital is healthy, and the capacity for the environment to provide society is maintained, if not enhanced.

There are four types of ecosystem services: cultural services (e.g. education, recreation, and heritage); provisioning services (e.g. food, medicine, and energy); supporting services (e.g. primary production, nutrient cycling, and oxygen production); and regulating services (e.g. carbon sequestration, water purification, and coastal protection). Many habitats, such as salt marshes, sea grass beds, and kelp forests, provide many services (e.g. coastal protection, biodiversity, and nursery grounds) and, therefore, their protection can provide multiple benefits to society.

The marine environment plays an important role in regulating the Earth's atmosphere, by absorbing heat and sequestering carbon in marine organisms and habitats, known as 'blue carbon' stores.[5] Therefore, improving the health and productivity of the marine environment will also contribute towards mitigating the impacts of climate change.

Human activity and resource use have driven declines in the health of marine ecosystems across the globe and now, with just 3% of the global ocean free from human pressure[1], we are at a tipping point where the health of the marine environment could be irrecoverably damaged.[6,7,8] Direct exploitation of marine resources (such as fish and minerals), and changes in how we use the seas and coasts (e.g. coastal development, aquaculture, and bottom-trawl fishing) have had a significant impact on marine biodiversity.[1]

A diverse and abundant range of marine species and habitats is essential for healthy, functioning ecosystems[9], and, subsequently, maintaining the ecosystem services the marine environment provides.[10] By changing the diversity of marine life (both animals and habitats) in the sea, humans are altering the ability of marine ecosystems to absorb and adapt to disturbances and, therefore, provide the services we receive invaluable benefits from.[11,12,13]

In addition to biodiversity[14] loss, the ocean is affected by climate change. Increases in atmospheric CO_2 levels are making the marine environment warmer and more acidic, which in turn is reducing productivity, causing sea level rise, increasing the severity of storm events, and decreasing oxygen levels in the ocean.[8,15] Warming ocean temperatures are also modifying the range and distribution of marine organisms and increasing the risks associated with non-native invasive species. It is expected

[5] Scottish Wildlife Trust Blue Carbon Briefing
[6] IPBES Media Release: 'Nature's dangerous decline 'unprecedented'; species extinction rates 'accelerating'
[7] IPCC Special Report on Global Warming of 1.5C approved by governments
[8] IPCC Choices made now are critical for the future of our ocean and cryosphere
[9] Kearns C.A.(2010) *Conservation of Biodiversity*.
[10] Balvanera P. et al. (2016) Ecosystem Services. *GEO Handbook on Biodiversity Observation Networks*
[11] Cote I. M. & Darling, E.S. (2010) Rethinking Ecosystem Resilience in the face of climate change. PLOS Biology
[12] Elmqvist, T. et al. (2003) Response diversity, ecosystem change, and resilience. *Frontiers in Ecology and the Environment*
[13] Martin, S.L et al. (2016) An ecosystem service perspective for the oceanic eastern tropical Pacific: commercial fisheries, carbon storage, recreational fishing, and biodiversity. *Frontiers in Marine Science*
[14] Defined here as species diversity, abundance and genetic diversity.
[15] Huang, J. et al. (2018) The global oxygen budget and its future projection. *Science Bulletin*

that, by 2100, climate change will reduce net primary production in the ocean by 3-10%, and fish biomass by 3-25%.[1]

The cumulative effect of multiple direct and indirect pressures on the environment has significantly impacted its health. Biodiversity loss and climate change both pose significant threats to the functioning of marine ecosystems, and, subsequently, the provision of ecosystem services to society. The need for effective management of all human activities, on both local and national scales, is evident if we are to ensure future generations continue to benefit from the environment.

2.2 Scotland's Marine Environment

Scotland is a maritime nation that has the largest coastline in the UK, stretching over 18,000 km.[16] Its sea area is 462,263 km^2 (six times larger than its land mass), which makes up more than 60% of the UK's seas.[17] Scotland's Territorial Seas[18] are larger in area than the combined area of the Scottish mainland and islands.[19]

Scotland's waters are highly productive, due to its location on the UK continental shelf, and contain a diverse range of habitats that provide the foundations for Scotland's marine life.[3] Scotland's seas support an impressive 8,000 plant and animal species[20], many of which are recognised as nationally and internationally important (e.g. breeding seabirds, bottlenose dolphin, and cold-water corals). Marine habitats found in Scotland's seas include:

Kelp Forests

Kelp are seaweeds that attach to hard surfaces and can form dense underwater forests. These habitats are highly productive and play a critical role in supporting biodiversity, nutrient cycling, coastal protection, carbon storage, and providing shelter for marine species, including commercially important stocks. Kelp forests are under pressure from harvesting, pollution, and fisheries.

Seagrass Meadows

Seagrasses form underwater meadows that stabilise marine sediments, provide shelter for small invertebrates, fish and other organisms, and food for intertidal birds. They are important nursery grounds for many commercially valuable species of fish and bivalves. Seagrasses are under pressure from dredging, anchoring, coastal development, and pollution.

Deep-sea Habitats

Marine environments below 200m are classed as the 'deep-sea' and are considered the largest, yet least explored, ecosystems on Earth. Deep-sea features, such as seamounts, play important roles in supporting biodiverse ecosystems, storing carbon, nutrient cycling, and providing nursery grounds for fish. Fishing and other extractive activities operating in the deep-sea can cause significant and long-term damage to the sensitive and slow-growing species and habitats found there.

Maerl Beds

Maerl is the collective term used for a species of coralline red algae that forms branched, nodular skeletons that grow down to around 30m depth and form extensive, gravel-like beds. Maerl beds are spatially complex habitats that are important for many species, including small fish, crustaceans (e.g. crabs and shrimps), and bivalves (e.g. scallops).[21] Maerl is slow growing and beds can take hundreds, if not thousands, of years to form, which makes them highly susceptible to environmental change and physical disturbance, most notably from pollution and bottom-contact fishing activity.

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[16] Scotland and the sustainable development goals: a national review to drive action (2020)
[17] Marine Scotland: Facts and figures about Scotland's sea area
[18] Measured from the mean low water mark to 12 nautical miles
[19] Scottish Natural Heritage: Coast and seas
[20] Scottish Natural Heritage: Priority Marine Features in Scotland's seas
[21] Barbera, C., et al. (2003) Conservation and management of northeast Atlantic and Mediterranean maerl beds. *Aquatic Conservation*

Burrowed Mud

Scotland contains the majority of the UK's burrowed mud habitats. Burrowed mud is home to a wide range of marine organisms, including sea pens, fireworks anemones, burrowing brittlestars, Fries' goby, and commercially valuable shellfish, including *Nephrops*.[22] Burrowed mud is vulnerable to physical disturbance and pollution, which can affect the quality of this habitat and, therefore, the marine life it contains.

2.3 Scotland's Marine Economy

Scottish seas support a variety of maritime industries, such as fishing (commercial and recreational), marine tourism, renewable energy, and oil and gas. In 2017, the Scottish marine economy[23] generated £5.2bn Gross Value Added (GVA)[24], of which most came from roles supporting the oil and gas sector (Table 1).[25] In the same year, 74,500 people were employed in roles related to the marine economy (mostly in marine tourism), which accounted for 3% of total employment in Scotland.

Table 1. Gross value added (GVA) and employment from marine economic sectors in Scotland in 2017

Sector	GVA (£M)	Employment Headcounts ('000s)
Aquaculture	436	2.2
Construction & water transport services	591	4.3
Fishing	316	4.8
Freight water transport	45	0.5
Marine tourism	594	28.3
Passenger water transport	90	1.1
Processing	392	7.7
Renting & leasing of water transport equipment	11	0.1
Ship building	572	7.7
Support for oil & gas	2176	17.8
Total	**5222**	**74.5**

Source: *Marine Scotland – Scotland's Marine Economic Statistics*

Despite their important economic role, the natural resources that support Scotland's marine industries are in a poor state of health. In 2011, the Scottish Government's Marine Atlas highlighted the denuded state of Scotland's seas, which identified human activity contributing to climate change and damage caused by fishing activity as the most widespread and significant pressures. In 2019, the UK Marine Strategy update reported that the UK was failing to meet 11 of the 15 indicators of Good Environmental Status (GES)[26], with commercial fishing identified as one of the key pressures preventing the UK from meeting this target.[2]

2.4 Scotland's Fishing Industry

The fishing industry plays a significant role in Scotland's maritime identity. Scottish fishers have harvested the natural resources of the North Sea, the west coast of Scotland, Norwegian and Faroese waters for centuries.[27] Historically, fishing was a subsistence activity, but throughout the 19th Century commercial fisheries developed into a commercial industry[28] that is now worth £316m to the

[22] Also known as langoustine, scampi or Norway lobster
[23] Defined as economic activity linked to the oceans, seas, bays, estuaries and other major water bodies, and the ecological and physical systems associated with them (Scottish Government)
[24] The Trust recognises that GVA is only a partial measure of the sector's economic contribution
[25] Scottish Government Marine Economic Statistics 2017
[26] European Commission: Good Environmental Status
[27] Royal Society of Edinburgh: Inquiry into the Future of the Scottish Fishing Industry (2004)
[28] Thurstan R.H. & Roberts C. M. 2010. Ecological Meltdown in the Firth of Clyde, Scotland: Two Centuries of Change in a Coastal Marine Ecosystem. *Plos One*

Scottish economy.[29] There are 4,800 people employed in the fishing industry (6% of the marine sector workforce), which accounts for 0.19% of Scotland's total workforce[20], although higher in island communities: 3% in Shetland, 2% in Orkney, 2% in Na h-Eileanan Siar, and 1% in Argyll and Bute.[30]

A significant amount of fishing activity in the UK's Exclusive Economic Zone (EEZ) occurs within Scottish waters.[31] In 2018, landings from Scottish vessels accounted for 58% of the value and 64% of the tonnage of the UK's total landings.[25] By tonnes of fish landed, Scotland is home to two of the top three ports in the UK.[25] The fish supply chain also plays an important socio-economic role in rural and coastal communities. In 2017, Scotland employed the majority of people in the UK's fish sector with 58% of the fishers and 50% of the fish processors (inclusive of aquaculture).[32]

Scotland has a diverse fishing fleet that targets a wide range of different species:

- Demersal fisheries: fish species close to the seabed (approximately 25% of landings by weight, with a value of approximately £200m);
- Pelagic fisheries: fish species in open waters at 20-400m depth (64% of landings by weight, with a value of approximately £200m); and
- Shellfish: crustaceans and molluscs (12% of landings by weight, with a value of approximately £170m).[25]

Although many commercial stocks are found in Scottish waters, the key species in terms of tonnage and value are cod, haddock, and monkfish (demersal); mackerel and herring (pelagic); and scallops and *Nephrops* (shellfish).[25]

In 2018, 2,089 vessels were active in Scotland (550 over 10m, and 1539 10m and under).[25] The composition of Scotland's fleet has changed over time, with an increase in under 10m and decrease in over 10m vessels. Overall, the number of vessels registered in Scotland has declined (a 4% drop was observed between 2009-2018); a trend observed across Europe and the rest of the globe.[25]

2.5 Why Do Fishing Activities Need Management?

Commercial fishing occurs in more than 55% of the World's oceans, illustrating the scale and distribution of pressures from this industry on the marine environment.[1] In the 1970s and 80s, it was recognised that many stocks were being fished beyond sustainable limits[33] and efforts have since been made to improve fisheries management by reducing fishing effort and using scientific evidence to determine fishing limits.

Scotland's proximity to other maritime nations (both inside and outside the European Union (EU)) requires a joint management approach for many fish stocks in Scottish waters. In 2018, UK vessels landed just 29% of all fish and shellfish caught from its EEZ, with EU members (44%), Norway (24%) and the Faroe Islands (3%) catching the rest.[34] The high level of international interest in the UK's EEZ demonstrates the need for effective information sharing and management.

Successful fishing industries rely on productive marine ecosystems. Therefore, it is in the interest of the industry to ensure the marine environment is in a good state of health and exploited sustainably. However, fishing activity directly affects the health of fish stocks and the wider marine environment, causing habitat and biodiversity loss, which can disrupt food web structure and functioning.[13,35]

The environmental impacts of fishing activity are described below:

[29] Marine Scotland – Scotland's Marine Economic Statistics
[30] Scottish Government: Scottish Sea Fisheries Statistics 2018
[31] Marine Management Organisation: UK Commercial Sea Fisheries Landings by Exclusive Economic Zone of Capture: 2012-2018
[32] House of Commons: The Fisheries Bill 2017-19
[33] Hilborn R. et al. (2020) Effective fisheries management instrumental in improving fish stock status. *PNAS*
[34] Napier, I.R. (2020) Fish landings from the UK EEZ 2015-2018. NAFC Marine Centre, University of the Highlands and Islands
[35] Zhou S. et al. (2010) Ecosystem-based fisheries management requires a change to the selective fihing philosophy. *PNAS*

- **Physical damage –** Bottom trawling and dredging have been identified as the most widespread source of physical disturbance on the seabed.[36] Damage from mobile bottom contact fishing gear can result in the mortality of benthic[37] species, increased sediment suspension, and physical disturbance to biogenic habitats, which can affect species composition and productivity, reduce habitat complexity[38], and affect biodiversity.[39]
- **Marine litter –** Lost or discarded fishing gear contributes to the growing problem of plastic pollution in the oceans and poses a threat to both marine life and human health. If lost, fishing gear can continue to catch marine life indiscriminately and unsupervised, known as 'ghost fishing'. Marine litter can also be ingested by marine organisms, from plankton to cetaceans, and smother or damage species on the sea floor. Data deficiencies make quantifying the amount of marine litter from the fishing industry difficult, but it has been estimated that, in Scotland, the fishing industry releases approximately 20 tonnes of plastic into the sea (approximately 2% of the total plastic released).[40]
- **Overfishing –** Overfishing can lead to the depletion of target species, which can subsequently lead to fishermen targeting low trophic species, a process known as 'fishing down the food chain'. Targeting low trophic species can affect the overall productivity and stability of marine ecosystems.[41,42] For example, environmental degradation and overfishing in the Firth of Clyde resulted in a decline in demersal fisheries, resulting in lower trophic species dominating the area and fishers moving towards *Nephrops* fishing.[43]
- **Bycatch –** Bycatch is the unintentional capture of non-target species (e.g. fish, sharks, seabirds and cetaceans), undersized catch, or over-quota species. Unreported information on the amount, composition, and size classes of bycatch restricts our understanding of the scale of the impact and our ability to manage this pressure effectively.
- **Climate change –** Fishing activity can contribute to climate change by reducing the oceans' capacity to sequester (capture and store) carbon. 'Blue carbon' habitats, such as maerl beds, seagrass beds, and flameshell beds, are capable of storing both organic (e.g. living tissue) and inorganic (e.g. shells) carbon, and support communities of marine species, which are also considerable carbon stores. Damage to blue carbon habitats can reduce, if not eliminate, their ability to sequester carbon and lock it away, in some cases, for thousands of years.[13]

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[36] Hiddink J.G. et al. (2017) Global analysis of depletion and recovery of seabed biota after bottom trawling disturbance. *PNAS*

[37] Relating to, or occurring at the bottom of a body of water

[38] Eigaard O.R. et al. (2015) Estimating seabed pressure from demersal trawls, seines, and dredges based on gear design and dimensions. *ICES Journal of Marine Science*

[39] Effects of Trawling and Dredging on Seafloor Habitat (2002). Ocean Studies Board. The National Academies of Sciences, Engineering and Medicine

[40] Turrell W.R. (2020) Estimating a regional budget of marine plastic litter in order to advise on marine management measures. *Marine Pollution Bulletin*

[41] Molfese C. et al. (2014) Overfishing and the replacement of demersal finfish by shellfish: an example from the English Channel. *Plos One*

[42] Shannon L. et al. (2014) Trophic level-based indicators to track fishing impacts across marine ecosystems. *Marine Ecology Progress Series*

[43] Scottish Government: Scottish Marine and Freshwater Science Volume 3 Number 3: Clyde Ecosystem Review

3 Managing Scotland's Fishing Industry: Recommendations

The Scottish Government has a vision for 'clean, healthy, safe, productive and biologically diverse marine and coastal environments, managed to meet the long-term needs of nature and people'.[44] To ensure that fishing activity is managed in accordance with this vision, environmental health and sustainability must be at the core of decision-making. It is the Trust's view that the current approach to managing wild capture fisheries is inadequate and that a new, innovative approach that focusses on improving the health of the wider marine ecosystem is required.

The Trust has identified six key recommendations that, if implemented, could ensure Scotland's fishing industry operates within environmental limits and contributes towards improving the health and productivity of Scotland's seas. These recommendations apply to the management of all types of fishing across Scotland's seas.

Recommendation 1

> Adopt an **ecosystem-based fisheries management** approach that truly places the environment at the core of decision-making and ensures all fishing activity occurs within environmental limits.

Ecosystem-based fisheries management focuses on achieving sustainable fisheries and healthy marine ecosystems simultaneously.[45] It recognises that fishing activity effects broader ecosystem health, beyond the target fish stock, and also that fishing is one of many marine activities that need to be considered in management decisions.[46]

Objective 1.1

Establishment of a fisheries management approach that prioritises the health of the environment at the core of decision-making and ensures all fishing occurs within environmental limits.

Challenges

To date, fisheries management prioritises the regulation of catch levels of commercially valuable fish stocks, which has failed to deliver healthy fish stocks or minimise environmental impacts. Ecosystem-based fisheries management would provide strategic direction on broader ecosystem impacts, other marine users, and ecosystem services. The protection and enhancement of marine ecosystems is a challenge for conservation, and, despite their interdependence, are often decoupled from fisheries management decisions.[47]

Suggested actions

- Define what an ecosystem-based fisheries management approach for Scotland would look like, assess whether current fisheries management objectives are: fit for purpose; will deliver ocean recovery; promote ecosystem-based management, and develop an implementation plan that will ensure fisheries management in Scotland will deliver sustainable and nature friendly fisheries, in light of the biodiversity and climate crises.

[44] Scottish Government: Making the Most of Scotland's seas: turning our marine vision into reality
[45] Trochta J.T. et al. (2018) Ecosystem-based fisheries management: perception on definitions, implementations, and aspirations. *Plos One*
[46] Link J.S. (2010) Ecosystem-based Fisheries Management. *Cambridge University Press.*
[47] Rees S.E. et al. (2020) Emerging themes to support ambitious UK marine biodiversity conservation. *Marine Policy*

- Integrate into and prioritise ecosystem health in fisheries management plans and policies, and move away from managing stocks in isolation (particularly of single species).
- Include ecosystem health within measures designed to promote stock recovery (in addition to limiting mortality of targeted stock), as well as protection, and enhancement, of marine features that the stock depends on.
- Integrate the protection and enhancement of natural capital and ecosystem services into fisheries management decisions to ensure the impacts of fishing on the wider environment, society and economy are addressed.
- Develop and implement licencing conditions that promote sustainable and low-impact fishing activity.
- Prioritise environmental recovery through incentivising sustainable fishing activity. For example, fishermen who adopt the most sustainable fishing practices are prioritised when allocating any additional quota resulting from the UK exiting the EU.
- Identify opportunities for incorporating the EU's four environmental principles (the precautionary principle, polluter pays principle, rectification at source, and prevention principle[48]) into fisheries management decisions.
- Support innovation in the catching process aimed at reducing the environmental impact of fishing, such as square mesh panels, rope-less creels, single buoys for static gear, electronic gear tagging, sensors, and on-board cameras (see Recommendation 3), and identify opportunities (and barriers) for their widespread adoption throughout Scotland's fishing industry. Existing work from groups, such as Fisheries Innovation Scotland and The Gear Innovation and Technology Advisory Group, should be supported and the integration of their findings into fisheries practice and management should be incentivised.

Benefits

- Natural capital assets and ecosystem services are protected and sustainably used, resulting in more resilient and stable marine ecosystems and a productive marine economy (including fishing).
- Fisheries are better integrated with wider marine management, allowing for cumulative and in-combination environmental impacts of multiple sectors to be assessed and managed.
- A robust and inclusive management approach that considers the effects, interactions, and trade-off decisions have on social, economic and environmental variables across different fisheries, habitats, and industries.[49]
- Healthy, productive and biologically diverse marine ecosystems capable of adapting to and mitigating the effects of climate change.[50]

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[48] Articles 11 and 191(2) of the Treaty for the Functioning of the European Union (TFEU).
[49] NOAA Fisheries (2017): Understanding Ecosystem-based Fisheries Management
[50] European Commission (2009): Nature's role in climate change

Recommendation 2

> Improve data availability to ensure all fisheries management decisions are well informed and based on the most up-to-date **scientific evidence**.

It is vital that data on fishing behaviour, methods, and catch (including bycatch) are collected in a standardised, robust way, and made available to ensure fisheries management decisions are transparent, informed, fit for purpose, and effective.

Objective 2.1

Establishment of measurable, time-bound targets and objectives for collecting data, and increased data availability to inform decision-making.

Challenges

The baseline health of the marine environment is poorly understood. Without reliable historical data or reference points, such as fully protected marine areas[51], the accepted threshold for a healthy environment decreases with each generation, making it challenging to identify appropriate management measures and conservation targets – a syndrome known as shifting baselines.[52] Data deficiencies in areas such as stock status, environmental impacts, the distribution of fishing activity, gear type, catch levels, selectivity measures, bycatch, and carbon footprint can compromise actions that address marine protection, overfishing, biodiversity loss, and climate change.

Suggested actions

- Establish a baseline health for the marine environment that accounts for shifting baselines, informs management decisions, and can be measured against to assess the effectiveness of management measures.
- Identify priority areas for data collection, monitoring, and research with input from stakeholders. Information of interest could include:
    - fish mortality and catch composition (biomass, target and non-target species);
    - spatial data on vessel activity;
    - the relative impacts of each fleet segment on the marine environment (including carbon footprint);
    - the cumulative environmental impact of all fishing activity;
    - the cumulative impact of all marine activity (including fishing);
    - the interactions between pressures introduced by fishing activities and other marine industries on different ecological components[53]; and
    - distribution and population health of all stocks (e.g. stock assessments).
- Implement measures to increase fishers' capacity to contribute to data collection, including projects such as:
    - Scottish Inshore Fisheries Integrated Data System (SIFIDS), which engaged fishers in research and explored cost-effective digital tools for data collection;

[51] For example, IUCN MPA Category 1a Strict nature reserve - Strictly protected for biodiversity and also possibly geological/ geomorphological features, where human visitation, use and impacts are controlled and limited to ensure protection of the conservation values

[52] 'the way in which significant changes to an ecosystem are measured against previous baseline states, which themselves are significantly different from the original state of the system'. Jackson J.B.C. et al. (2011) *Shifting Baselines: The Past and the Future of Ocean Fisheries*, Island Press

[53] See the ODEMM Linkage Framework for further information on pressure assessments

    - Fisheries Innovation Scotland (FIS032) project for a real-time reporting app to avoid unwanted catches; and
    - Paradigm for Novel and Dynamic Oceanic Resource Assessments (PANDORA) project, which uses biological data collected by pelagic fishers to inform assessments.
- Promote the use and reuse of biological data[54] to inform management decisions and encourage information sharing between stakeholders to increase the real-world applicability of research projects (by government, industry and academics) in fisheries science.
- Collect information on projects and trials that fishers have proactively engaged with.

Objective 2.2

Increased transparency in fisheries management decisions, with a statutory responsibility on UK Fisheries Administrations[55] to make decisions affecting Scottish waters based on robust scientific evidence, and to apply the precautionary approach[56] where data deficiencies remain.

Challenges

There is a disconnect between scientific advice on sustainable fishing levels and agreed fishing quotas, with fishing quotas often exceeding advised levels. For example, in 2017, just 54% of Scotland's stocks were fished at or below maximum sustainable yield[4], and in 2019, the UK's overall Total Allowable Catch (TAC) was set 24.3% above scientific advice.[57] When scientific evidence is overlooked, and a precautionary approach is not applied, unsustainable levels of fishing can occur.

On a practical level, there is a lack of transparency in the decision-making process for introducing management measures, which prevents interested stakeholders with expertise from providing input and denies State representatives from being held to account.[58]

Suggested actions

- Introduce a legal obligation to fish at sustainable levels.
- Decision makers follow the best scientific advice available to ensure harvesting activities are sustainable. Management decisions that do not follow the science must be justified and evidence for the decision(s) to be provided (similar to the publication of Scientific, Technical and Economic Committee for Fisheries (STECF) advice[59]).
- Establish an independent body to evaluate and scrutinise the application of scientific evidence to decision-making, and monitor the progress of Fisheries Administrations towards meeting environmental targets.
- Establish an annual report on data availability, collection, and analysis to increase transparency in decision making, similar to the FAO's General Fisheries Commission for the Mediterranean (GFCM).[60]

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[54] Scottish Government: Open Data Strategy

[55] UK Fisheries Administrations are responsible for management of their respective commercial fishing fleets. They are:
- Marine Scotland (Scotland),
- The Department for Environment, Food and Rural Affairs (Defra) (England),
- The Welsh Government (Wales), and
- The Department of Agriculture, Environment and Rural Affairs (DAERA) (Northern Ireland).

UKFAs are required to cooperate closely due to the shared nature of fisheries and marine resources particularly in relation to reserved functions that affect fisheries such as foreign affairs and international relations.

[56] EUR-Lex: The Precautionary Principle

[57] Landing the blame: Overfishing in the Northeast Atlantic 2019. New Economics Foundation

[58] The importance of transparency in the decision-making process is being increasingly recognised. For example, the European Ombudsman case 640/2019/FP on transparency of the EU Council's decision-making process led to the adoption of annual regulations setting fishing quotas (Total Allowable Catches)

[59] European Commission: Scientific, Technical and Economic Committee for Fisheries

[60] Government Europa: Mediterranean fisheries transparency boosted in new package

Benefits

- Fishing activity occurs within environmental limits and fisheries resources are exploited sustainably.
- Improved economic performance of the fishing fleet (as seen in Europe[61]).
- Improved quality and quantity of data available for decision-making to ensure decisions are accountable, robust and more reflective of what is happening at sea.
- Increased buy-in to data collection.
- Improved information sharing and open data available for use and reuse.
- Transparency in the decision-making process.
- Improved health of natural capital assets (i.e. fish stocks and other environmental resources) with knock on benefits for provision of ecosystem services.
- A guarantee that short-term benefits do not take priority over long-term stability.
- Greater security and consistency in future fishing opportunities as the stock(s) begin to recover and increase in abundance, and the health of the environment begins to improve and stabilise
- Improved availability of biological data to inform and guide research, which can lead to better management.

Recommendation 3

Modernise the fishing industry through use of digital technology to improve **monitoring, compliance and enforcement** whilst increasing **transparency and accountability** in the supply chain.

For management measures to achieve their objectives, it is essential that they are monitored, complied with, and enforced. Monitoring is essential for assessing the impact of management measures and, when necessary, adapting them. Compliance with legislation and regulations is necessary for achieving management objectives. Enforcement is critical for ensuring management measures are complied with.

Digital technology can play an important role in tackling the challenges associated with fisheries management. As well as improving monitoring, compliance, and enforcement, digital technology can assist with identifying and mitigating the impact of fishing on the marine environment, enhancing data collection, business planning, and increasing safety.

Objective 3.1

Increased presence and integration of digital technology on fishing vessels (and throughout the supply chain) to support the delivery of effective management, promote sustainable fishing practices, and increase the industry's contribution to data collection and scientific research.

Challenges

The challenges associated with monitoring, compliance, and enforcement vary depending on, for example, gear type, location, flag state, vessel size, and fleet segment. A key challenge in fisheries management and activity is a general lack of transparency and accountability.

[61] World Fishing and Aquaculture: Sustainable fishing key to high EU profits

Digital tools could help overcome this challenge but are often not utilised, with labour-intensive tools, such as self-reporting and observations, relied upon instead. Advancements in technology used by the fishing industry have meant that fishers have become more effective at catching fish over time[62], but the monitoring of catches has not advanced at the same pace.

Although the technology to improve the sustainability of catching activities exists, unsustainably sourced seafood remains available to consumers, and current fishing activity is affecting the health of the marine environment. Currently, opportunities for fishers to contribute to data collection have not been optimised, resulting in large amounts of uncollected information.

Suggested actions

- Require all vessels operating in Scottish waters (and Scottish vessels fishing elsewhere) to be equipped with accurate, up-to-date Vessel Monitoring Systems (VMS) with GPS, to ensure the location of fishing activity can be monitored, and fishing pressure can be mapped and managed.
- Build on the 2019/20 Programme for Government commitment to introduce remote electronic monitoring (REM) to inshore scallop vessels[63] by committing to use REM with cameras as the principle method for monitoring and ensuring compliance with regulations.
- Phase in a requirement for REM on-board all vessels fishing in Scottish waters, enshrining this commitment in the appropriate legal framework(s) (e.g. licencing conditions and access agreements) and ensuring the data collected can be used in decision-making and prosecutions.
- Identify priority vessels for digital transformation[64] and determine a timescale for phased implementation, starting with high-risk vessels and fisheries with large ecological footprints.
- Undertake an assessment of existing methods/tools for monitoring fishing activity, facilitated by knowledge sharing and collaboration with stakeholders, to identifying any gaps and inform the introduction of REM.
- Compliment new technologies with existing and traditional tools, such as accreditation schemes, observers, enforcement vessels, port inspections, aerial monitoring and increased frequency of VMS pings (for over 10m vessels).
- Deliver smart-boats and encourage climate-smart fishing through the use of innovative digital technology, such as:
    - **Blockchain** – a 'decentralised electronic ledger system that records any transaction of value whether it be money, goods, property, work or votes'.[65] Blockchain technology can address the issue of transparency in the supply chain and has been used by WWF-New Zealand, Fishcoin, Traceregister, Thisfish, and Provenance to improve traceability in the fishing industry.
    - **The Internet of Things (IoT)** – 'a world where sensors and actuators are embedded into physical objects and are linked through the wireless and wired networks that all live and interact with one another'.[66] The IoT would allow fishers to monitor the contents of their nets in real time to maximise their quota, minimise bycatch, and ensure compliance with relevant regulations. In addition, these sensors can be used for long-range tracking and to monitor a fleet's activity and fuel use. SmartCatch and BlueTraker use the IoT to collect and share information about fishing activities.
    - **Artificial Intelligence (AI)** – the use of computer systems to perform tasks that usually require human intelligence allows for data analysis to be faster, cheaper, and more accurate. AI is already used by Global Fishing Watch and Smartfish-H2020 for

[62] Science Daily: New technology allows fleets to double fishing capacity and deplete fish stocks faster
[63] Scottish Government: Protecting Scotland's Future: The Government's Programme for Scotland 2019-2020
[64] Digital transformation refers to increased use of technology to enhance management and decision-making
[65] World Economic Forum: Building Block(chain)s for a Better Planet (2018)
[66] Kipper G. (2013) Chapter 6 – Visions of the Future. *Augmented Reality*

analysing large datasets on fishing activity, and shows potential for improving decision-making.

- Create and develop multi-stakeholder partnerships to drive innovation, roll-out trials, and facilitate partnership working, similar to existing groups such as Clyde 2020, Fisheries Innovation Scotland, GITAG, MASTS, PANDORA and SIFIDS.

Objective 3.2

A better understanding of how fisheries interact with the marine environment delivered through traceable, fully-documented fisheries that account for all fish, shellfish and bycatch species caught in Scottish waters.

Challenges

A lack of transparency in catch data has made it difficult to assess the effectiveness of management measures, which has, subsequently, limited our understanding of the full impact fishing activity has on fish stocks and the marine environment.

Suggested actions

- Introduce a requirement for all fisheries (irrespective of nationality) to provide complete transparency in catch data (including bycatch), and develop a process for delivering fully-documented fisheries.
- Begin continuous monitoring to determine the scale of impact fishing activity has, and to ensure management measures are complied with by all gear types.
- Identify priority vessels for full documentation and determine a timescale for implementation.

Objective 3.3

All vessels fishing in Scottish waters adhere to management measures, including requirements for the use of digital technology, and share information required to ensure fisheries management measures are effective.

Challenges

Many of Scotland's fish stocks are shared with other countries. Fish and other marine resources that are shared are at risk if subject to inconsistent regulation, low levels of monitoring, poor compliance, and a lack of information sharing between nations.

Suggested actions

- Legislate to ensure equivalence, transparency and accountability for high environmental standards and use of digital technology as a prerequisite of access to Scottish waters, irrespective of nationality.
- Ensure efficient and transparent information sharing between countries to inform appropriate resource and environmental management (particularly in relation to data on full documentation and bycatch).
- Establish measures to ensure compliance, irrespective of nationality of the vessel.

Benefits

- Simplified, more efficient fisheries management with improved knowledge, understanding and flow of information on fishing activities and interactions the wider marine environment.
- Reduced pressure on human, financial and environmental resources.
- Trust in the fisheries supply chain, created through transparency and accountability, and opportunities for fishers to demonstrate best practice.

- Real-time reporting in the supply chain that can improve traceability, inform consumer decisions, and allow the market to support sustainable practices.
- Electronic reporting increases the opportunity for adaptive management (and enforcement) and enables regulators to respond to challenges in real-time.
- Scotland has a world-leading, adaptable, and sustainable fishing industry that reduces pressure on human, financial and environmental resources.
- The adoption of digital technology can improve the monitoring of MPAs, increase safety (e.g. emergency response), and virtualise supply chains.
- Ensure all seafood products caught in Scottish waters are traceable, contribute towards achieving zero bycatch, and help identify illegal, unregulated and unreported (IUU) fishing.
- Full documentation on fisheries catch data and activity would provide regulators with the following:
    - Information on where vessels are operating;
    - Compliance with regulations (e.g. bycatch, landings, fish size, catch limits, selectivity measures, and spatial restrictions);
    - Catch composition and mortality;
    - Behaviour change in line with regulations (e.g. what methods have been used to comply with management measures);
    - Impacts of climate change on the fishing industry (e.g. data on species distribution); and
    - the contribution of fishing activity to climate change (e.g. fuel emissions[67], impacts on the blue carbon habitats).

Recommendation 4

> Manage fish stocks and the wider marine environment in a way that is **inclusive of stakeholder views** at national and international scales.

Fisheries management decisions affect many people, due to the implications they have to the broader health of the marine environment. To ensure fisheries management decisions are in line with public interests[68], knowledge from fishers, scientists, environmental groups, academics, community groups, regulators and other stakeholders must be included.

Objective 4.1

Fisheries management decisions that are informed by a streamlined, effective and inclusive stakeholder engagement process.

Challenges

The large number of stakeholders with vested interests in fishing, makes balancing the demands of each difficult. Stakeholders often have competing visions for fisheries and environmental management, which can be observed between different fishing sectors, across different marine users, and between countries.

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[67] Greer K. et al. (2019) Global trends in carbon dioxide (CO_2) emissions from fuel combustion in marine fisheries from 1950 to 2016. *Marine Policy*

[68] Mikalsen K.H. & Jentoft S. (2001) From user-groups to stakeholders? The public interest in fisheries management. *Marine Policy*

Political considerations and/or short-term gains can often be prioritised over environmental challenges. However, unless resources are managed in a way that maintains or, where appropriate, recovers marine natural capital assets, ecosystem services will continue to be at risk, threatening the societal benefits for current and future generations.

Suggested actions

- Identify key stakeholders in Scottish fisheries and their role in decision-making.
- Recognise and consider the impacts on often-overlooked stakeholders, such as future generations, the general public (including coastal communities), and consumers.
- Assess whether the existing systems for stakeholder engagement and co-management of fisheries is representative and fit for purpose. Establish new forums for co-management if gaps are identified.
- Identify stakeholder priorities for fisheries management (building on existing studies[69,70,71]) and ensure stakeholder opinion is effectively incorporated in decision-making.
- Consider opportunities for co-management of inshore waters through existing groups such as Marine Planning Partnerships (MPPs) and Inshore Fisheries Groups (IFGs), akin to the Inshore Fisheries Conservation Authorities (IFCAs) in England.
- Identify new stakeholder engagement opportunities in offshore waters.
- Increase information sharing across stakeholders to ensure scientific evidence, socio-economic concerns/benefits, and local knowledge inform management decisions.

Objective 4.2

Good collaboration with the rest of the UK and other coastal states to ensure effective management of shared resources and widespread pressures, with ecological concerns given greater weight in negotiations.

Challenges

Co-management has an extra layer of complexity in Scotland as many of the UK's stocks are shared with other non-UK countries, both within and outside the EU. Biodiversity loss, climate change, and the pressures that drive these challenges span political boundaries and are caused by multiple industries. To avoid the risks poor management poses to society, the economy and environmental sustainability, a collaborative, multi-national and cross-sectoral approach is required.

Suggested actions

- Prioritise long-term environmental sustainability in joint management decisions. For example, the Shetland Regional Marine Plan aims to ensure that use of the marine environment is sustainable, does not cause biodiversity loss, change ecology, effect resource availability for future generations, and maintains or enhances the marine environment to support 'a prosperous community'.[72]
- Maintain and develop good working relationships with other nations to address the management of shared stocks, widespread pressures, and global challenges.
- Establish effective routes of communication and collaboration between UK Fisheries Administrations to ensure the UK, and Scottish, marine environments are utilised sustainably.

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[69] Stewart, B.D. & O'Leary, B.C. (2017) 'Post-Brexit Policy in the UK: A new dawn? Fisheries, Seafood and the Marine Environment'.

[70] Agnisola G. et al. (2019) The voices that matter: a narrative approach to understanding Scottish fishers' perspectives of Brexit. *Marine Policy*

[71] Stewart B. et al. (2019) Making Brexit work for the environment and livelihoods: delivering a stakeholder informed vision for agriculture and fisheries. *British Ecological Society*

[72] Shetland Islands Marine Planning Partnership (2019) Draft Shetland Islands Regional Marine Plan. NAFC Marine Centre UHI pp 158.

- Ensure that annual fishing negotiations do not undermine the environment and that Fisheries Administrations are transparent (e.g. scientific advice and Government proposals are published in advance of negotiations) both within the UK and with other coastal states.
- Ensure management approaches by all coastal states are complementary and do not result in unilateral setting of catch limits in relation to shared stocks.

Benefits

- Collaborative management that includes a diversity of stakeholders and transparency in decision-making.
- Coastal States collaborate to manage shared resources and pressures that have widespread impacts.
- Natural assets are managed as commodities with shared ownership, rather than owned by individuals, with those harvesting the assets considered as stewards of a public resource.
- Stakeholders are better represented with effective, streamlined stakeholder groups.
- Valuable local knowledge and expertise within the fishing industry incorporated into management and decision-making.

Recommendation 5

Bring fisheries into the wider context of marine environmental management through improved **spatial planning** of fishing activities.

Human activities introduce pressures that can alter and degrade marine ecosystems. It is essential that how, when, and where human activities occur is determined through effective spatial management. Historically, there has been little regulation directly managing where fisheries can operate in Scottish seas, which has led to conflicts between fishers, other marine users, and conservation objectives.

A key consideration in spatial planning is the allocation of space to different uses, which has become more important as the scale, intensity and range of human activities in the ocean has increased. Competition for space and resources is a challenge that requires the needs of all users to be balanced and resource use to be sustainable.

Objective 5.1

Inshore fishing activity is fully integrated with and managed through Regional Marine Plans.

Challenges

Fishing activity is not managed in the same spatial way other marine industries are, and progress on development of Regional Marine Plans for inshore waters (that would incorporate fisheries into wider marine planning) has been slow since the adoption of the National Marine Plan in 2015.

Suggested actions

- Further develop, progress and fund the establishment of Marine Planning Partnerships and Regional Marine Plans throughout Scotland.
- Identify clear environmental conservation objectives for the Marine Region and identify how each industry within the Region can contribute towards their achievement.
- Undertake cumulative impact assessments/strategic environmental assessments for Regional Marine Plans that encompass all marine activity, including fisheries.
- Integrate spatial management of fishing activity into Regional Marine Plans.

Objective 5.2

Spatial management of fishing activity in ecologically important areas, including 'whole-site' approaches to MPA management and effective area-based conservation measures.

Challenges

The degree of impact of fishing activity has on the environment is influenced by a number of factors, such as gear type, location, spatial footprint, and sensitivity of species or habitats damaged. Information on key fishing grounds and areas of importance to fishers is generally poor, which has made spatial management of fishing activity challenging.

Although some conservation and stock management measures restrict where and when certain types of fishing can take place, fishing licences currently do not control where fishing activity can occur within the licenced zone.

Scotland's MPA Network currently places some restrictions on fishing activity, but, with the exception of the Lamlash Bay no-take zone, provides little more than partial protection, as all MPAs continue to allow some level of resource extraction.

Suggested actions

- Trial a low impact zone in Scottish inshore waters that encourages environmentally sustainable fishing practices and protects inshore habitats. Space should be allocated for MPAs, important fish and shellfish habitats (e.g. spawning and nursery grounds), no take zones, and static gear. Mobile bottom contacting gear should only be granted access if an EIA of the proposed method is undertaken and suitable sites can be identified.
- Indiscriminate fishing practices should be tightly controlled, reduced where possible, and banned in fragile habitats. When such practices are used, management measures, such as technical measures, spatial controls, impact quota, and effort controls[73], should be in place.
- Commit to a minimum of 30% of Scottish seas being highly protected, of which at least a third is fully protected[74], by 2030. To support delivery, establish an independent commission to advise on the transformation of MPA management in Scottish seas. The commission should also provide advice on the condition and ecological coherence of the existing network and consider new sites to deliver nature's recovery, including protection of features important for climate resilience.
- Introduce a whole-site approach to MPA management that provides protection to all habitats and species within the site boundary, and move away from feature-based management that protects particular species or habitats.

[73] McConnaughey R.A. et al. (2019) Choosing best practice for managing impacts of trawl fishing on seabed habitats and biota. *Fish and Fisheries*

[74] The Marine Protected Area Guide defines Fully protected as: no extractive or destructive activities are allowed, and all impacts are minimized. Highly protected is defined as: only light extractive activities are allowed, and other impacts are minimized to the extent possible. Oregon State University, IUCN World Commission on Protected Areas, Marine Conservation Institute, National Geographic Society, and UNEP World Conservation Monitoring Centre (2019). An Introduction to The MPA Guide. Available at: https://www. protectedplanet.net/c/mpa-guide

- Utilise adaptive management approaches (e.g. spawning and real-time closures) as standard practice to manage the impacts of fishing activity.
- Trial innovative and novel approaches to fisheries management, such as co-location of activities and utilisation of Demonstration and Research MPAs.[75]
- Assess whether the current spatial management of fishing activity and the marine environment is effective for protecting seafloor integrity.[76]
- In light of scientific advice, assess whether existing protection measures are adequate for delivering the enhancement, and recovery, of marine assets within and outside the MPA network. This assessment should include all Priority Marine Features and blue carbon habitats, due to their role in climate change mitigation[77], vulnerability to fishing activity (i.e. removal or damage[78]), the benefits they provide for fisheries stock enhancement[79,80], and coastal protection.
- Ensure that deep-sea habitats and features are effectively protected through a prohibition of fishing activity below 600m, in line with scientific advice[81], and with appropriate regulation, monitoring, and reporting.
- Implement legislation to ensure equivalence for spatial management measures and accountability as a prerequisite for access to Scottish waters, irrespective of nationality.

Benefits

- Marine industries, including fishing, operate sustainably in Scottish seas and fragile, vulnerable, and threatened habitats are identified and adequately protected.
- Formal agreements on spatial management can assist with conflict resolution and ensure ecological, economic and social objectives are achieved.
- Marine spatial planning contributes towards the implementation of Scotland's existing high-level marine objectives, such as those within the National Marine Plan.
- Better management of blue carbon habitats increases their contribution to combatting climate change as 'natural climate solutions'.[82]
- Conservation, and enhancement, of important and sensitive marine features and improved ecosystem integrity.

Recommendation 6

Ensure adequate **resourcing** is available to deliver long-term fisheries management and environmental impact mitigation.

To deliver lasting change and improve fisheries management, it is essential that adequate resources are available for the long-term. Appropriate resourcing is needed for data collection, technological

[75] Scottish Government Demonstration and Research MPAs
[76] Hopkins C. & Bailey D. (2018) Seafloor Integrity. Scottish Environment LINK
[77] Macreadie P.I. et al. (2019) The future of Blue Carbon science. *Nature Communications*
[78] Luisetti T. et al. (2019) Quantifying and valuing carbon flows and stores in coastal and shelf ecosystems in the UK. *Ecosystem Services*
[79] Blowes S.A. et al. (2020) Mediterranean marine protected areas have higher biodiversity via increased evenness, not abundance. *Journal of Applied Ecology*
[80] Herr D. et al. (2017) Pathways for implementation of blue carbon initiatives. *Aquatic Conservation*
[81] Clarke J. et al. (2015) A scientific basis for regulating deep-sea fishing by depth. *Current Biology*
[82] Scottish Wildlife Trust: Natural solutions are essential to meeting net-zero emissions.

development, monitoring, enforcement, innovation and diversification. As part of this, consideration should be given to 'who funds what' in the current system.

Objective 6.1

Resources are made available to support the delivery of long-term fisheries management, promote sustainable resource use, meet conservation objectives, and improve data collection and monitoring.

Challenges

Long-term financing is required to support work streams that address, manage and remediate the environmental impacts of fishing activity. Funding for key management areas, such as behaviour change, innovation, research (and trials), and novel approaches, are already limited and risk being reduced further with the loss of the European Maritime and Fisheries Fund (EMFF).

Suggested actions

- Assess whether resourcing is currently sufficient for data collection, monitoring and enforcement required to deliver a sustainable and world-leading fishing industry in Scotland.
- Establish funding streams and/or partnerships (similar to the Seafood Innovation Fund) that can provide resourcing for research, trials, data collection, diversification, remediation of environmental impacts, and investment in digital transformation.
- Progress the establishment of the Scottish Marine Environmental Enhancement Fund, to ensure marine conservation action is financially supported through contributions from marine industries, including the fishing industry.
- Support and advance the phasing out of environmentally harmful subsidies, e.g. those that contribute to overcapacity, overfishing, IUU fishing[83], and promote unsustainable human activity (e.g. fuel tax exemptions[84]).
- Redirect any available funds, resulting from phasing out harmful subsidies, to support sustainable fishing and improved management.
- Review the potential benefits and challenges for establishing statutory regulators at a regional level, similar to Inshore Fisheries and Conservation Authorities[85], that can generate funds for fisheries management and contribute towards spatial management, issuing of permits and licences, determination of infringements, and implementation of robust sanctions.
- Require evidence of environmental sustainability as a precondition for grant schemes that support long-term, sustainable fisheries.

Objective 6.2

Fishers operating in Scottish waters contribute appropriately towards management costs and improving the health of the marine environment.

Challenges

Fish are a public resource that should be managed for the public good. However, fisheries management comes at a significant public cost and the environmental impact of current fishing activity has negative consequences for wider societal benefits. Fishing opportunities are dependent on healthy marine ecosystems, but fishers do not directly pay for access to fisheries resources or for marine protection and enhancement measures. As commercial fishers are the principle beneficiaries

[83] DEFRA: Sustainable fisheries for future generations (2018)
[84] New Economics Foundation: Fisheries Management Costs (2018)
[85] Association of IFCA

of fisheries management, they should contribute towards the financing required to deliver fisheries management.

Suggested actions

- Assess whether current spending on fisheries management accounts for the polluter pays principle, beneficiary pays principle, and principal-agent problem.[86]
- Research different mechanisms for implementing cost recovery within Scottish fisheries, with the aim of raising revenue from the fishing industry to pay for management costs.
- Research options for fishers paying a 'resource rent' to ensure that the costs of management and conservation are included in the price of exploiting the resource.
- Identify opportunities for using existing mechanisms, such as licences and access to quota, to create funds and drive behaviour change.

Benefits

- Better resourcing for core, but often under-funded, management areas that deliver effective fish stock recovery.
- Increased resources for data collection, monitoring, and research to inform and improve fisheries management decisions, ensure fish stocks are sustainably exploited, and secure long-term benefits for fishers and the wider community.
- Increased collaborative working as fishers can be compensated for their involvement in data collection, trials and research.
- The costs of fisheries management are reduced and distributed proportionally depending on level of impact.
- Public money is spent more effectively and delivers the greatest public benefit.

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4. Conclusion

Effective, long-term management of Scottish sea fisheries has the potential to deliver benefits that extend beyond the industry, by improving the health of the marine environment, increasing the flow of ecosystem service to society, and strengthening the marine economy. The continued degradation of the marine environment by the fishing industry risks the many recreational, cultural and economic services that support the wellbeing and identity of coastal communities[87], and Scotland as a whole.

The Scottish Government must take transformative action to limit and reverse the deterioration of the marine environment. The proposed actions within this policy are wide ranging, but it is the Trust's view that their implementation could create a world-leading fisheries management framework and ensure the Scottish fishing industry is truly sustainable and operates within environmental limits.

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[86] Polluter pays principle: 'those responsible for the costs bearing the costs'.
Beneficiary pays principle: 'those who benefit from management bearing the costs of the management'.
Principal-agent problem refers to there being 'no real link between the value of the services provided and the cost of providing them'. See NEF: Fisheries Management Costs

[87] IPCC Special Report on the Ocean and Cryosphere in a Changing Climate (2019)

5. How the Scottish Wildlife Trust will use this policy

The Trust will use this policy to advocate for the protection, enhancement and sustainable use of the marine environment and promote ecosystem-based principles for management of Scottish seas.

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6. Other related documents

- Inshore Fisheries Policy
- Sea Fisheries Discussion Paper response