Office for National Statistics

Statistical bulletin

Marine accounts, natural capital, UK: 2021

Natural capital accounts containing information on ecosystem services for marine and coastal areas in the UK.

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Release date:
6 April 2021

Next release:
To be announced

Notice

24 September 2025

The marine natural capital accounts have been updated as part of the Marine and coastal margins natural capital accounts, UK: 2025 publication.

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1 . Main points

- The UK marine natural capital assets for which we can estimate a value have an asset value of £211 billion.

- Marine carbon sequestration is significant and requires more research to fully understand it: it is estimated at between a little over one-third and more than double the carbon removed by terrestrial habitats.

- The value of marine renewable energy production grew in value by 37 times from 2008 to 2018.

- In 2018, there were over 400 million day trips to the coast.

- Since 2016, sustainable fishing has been more profitable per tonne than unsustainable fishing.

2 . Marine habitats

We are grateful to the Joint Nature Conservation Committee and Centre for Environment, Fisheries and Aquaculture Science for producing the initial research and methods that these accounts are based on. These accounts represent the ecosystem and abiotic services provided by the UK's waters. However, defining the UK's marine extent for the natural capital accounts is not straightforward.

For the outer or sea boundary, for most purposes, the UK's Exclusive Economic Zone (EEZ) is appropriate. This represents the UK's fishing area reasonably well. However, as minerals can be obtained from the whole continental shelf, this boundary is used for minerals purposes. The UK EEZ lies entirely within the continental shelf.

Similarly, for the inner boundary there is no single point at the shoreline that separates "marine" and terrestrial habitats. Ecosystems tend to interlink and overlap, which complicates natural habitat accounts as they do not meet to create a neat jigsaw across the UK, and so there can be some double counting between habitats. The spring high tide mark tends to be used, but the data themselves prevent such neat decision-making.

For instance, some shoreline habitats are clearly in scope, such as saltmarsh, which is difficult to remove from terrestrial accounts in respect to saltmarsh grazing sheep. Within the marine account saltmarsh provides: flood defence, carbon removal, coastal recreation, and amenity values which intrinsically tied to the sea and not included in other accounts. When people visit the coast, they may spend their time snorkelling or camping in a field on a cliff above the beach. There may be some double counting between habitats meaning care should be taken in habitat comparisons.

Table 1: The total area of selected European Nature Information System (EUNIS) (Level 2 and 3) habitat classes of interest, measured in hectares

EUNIS Class		Extent (Hectares)
A1	Littoral rock and other hard substrata	20,201
A2.1	Littoral coarse sediment	7,263
A2.2	Littoral sand and muddy sand	157,197
A2.3	Littoral mud	77,753
A2.4	Littoral mixed sediments	7,248
A2.5	Coastal saltmarshes and saline reedbeds	14,925
A2.6	Littoral sediments dominated by aquatic angiosperms	2,006
A2.7	Littoral biogenic reefs	4,502
A3	Infralittoral rock and other hard substrata	313,047
A4	Circalittoral rock and other hard substrata	1,476,680
A5.1	Sublittoral coarse sediment	15,724,915
A5.2	Sublittoral sand	25,931,054
A5.3	Sublittoral mud	6,415,298
A5.4	Sublittoral mixed sediments	1,942,240
A6.1	Deep-sea rock and artificial hard substrata	608,844
A6.2	Deep-sea mixed substrata	4,773,084
A6.3	Deep-sea sand	5,779,857
A6.4	Deep-sea muddy sand	3,175,492
A6.5	Deep-sea mud	18,015,486
	Total Area	84,447,094

Source: Joint Nature Conservation Committee EUNIS Level 3 Combined Map (2019)

3 . Condition metrics

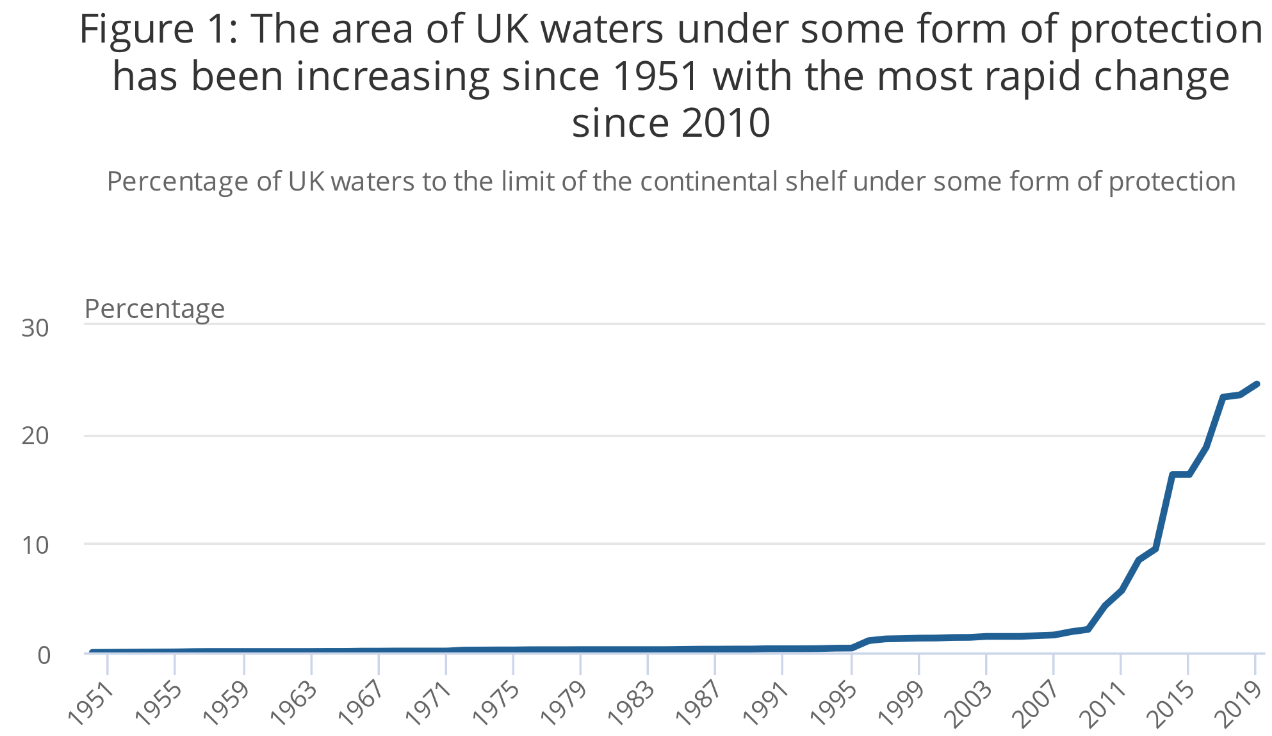
Marine protected areas

The UK has a range of marine protected areas of varying sizes and with varying protections. In 2019, [21.8 million hectares of UK waters are protected] to some degree, some 24.6% based on the UK's Exclusive Economic Zone (EEZ) and up to the UK Continental Shelf limit. This has increased since 1951, in particular since 2010, following ascent of The Marine and Coastal Access Act 2009, which committed the UK to the creation of Marine Conservation Zones.

For further detail on types and extents of different protected marine sites, visit the Joint Nature Conservation Committee (JNCC).

Figure 1: The area of UK waters under some form of protection has been increasing since 1951 with the most rapid change since 2010

Percentage of UK waters to the limit of the continental shelf under some form of protection



Source: Joint Nature Conservation Committee via UK Sustainable Development Goal Indicator 14.5.1

Water Framework Directive

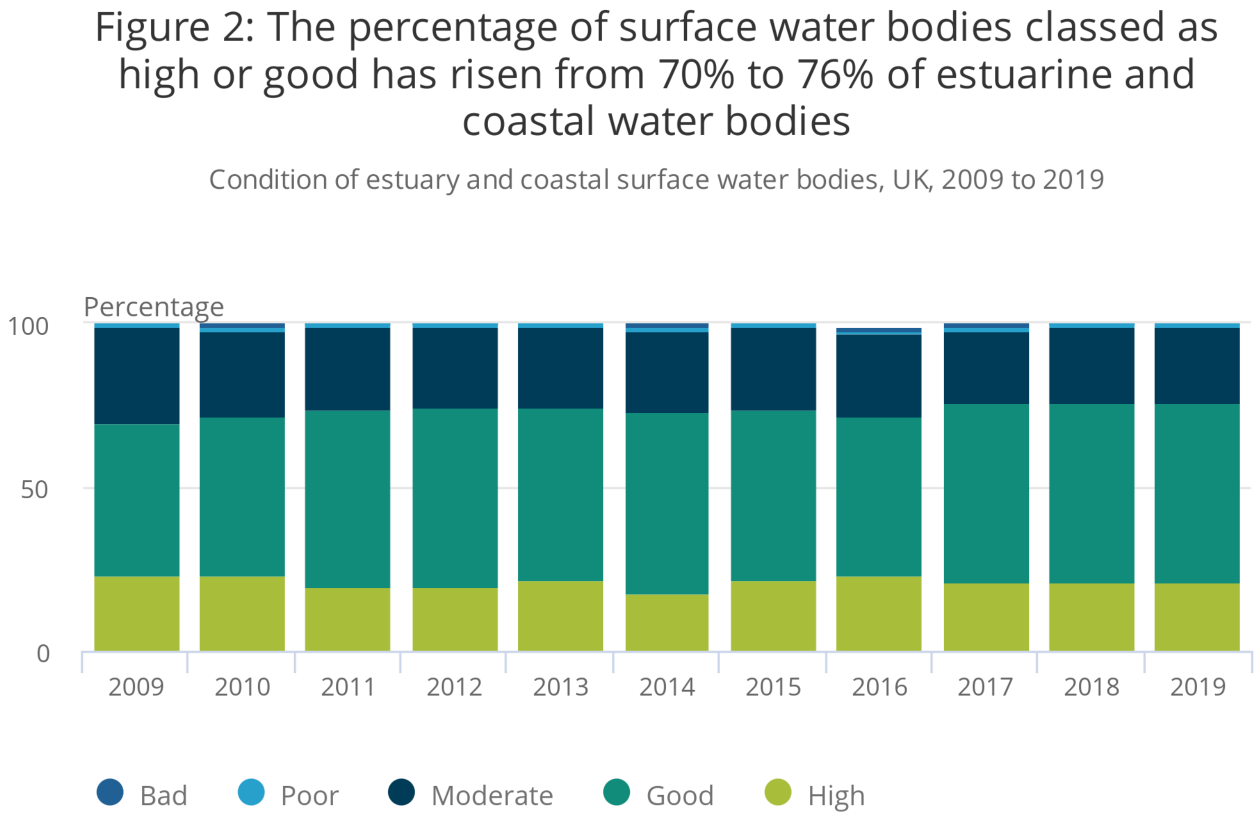
The Water Framework Directive (WFD) is an important tool for assessing the water environment across Europe for several types of water bodies, including rivers, lakes and canals. The overall condition of each body of water is examined and categorised into one of five classifications, ranging from "bad" to "high" condition status. The WFD operates in six-year cycles, with the second (2016 to 2021) cycle currently in effect. This framework helps to classify the quality of water bodies by measuring their ecological and chemical status.

Poor ecological and chemical condition of a surface water body can cause a range of damage, including drinking and bathing water quality, biodiversity, and marine life health. One of the main aims of the WFD, across all surface water bodies in the European Union, is that all bodies of water should be in a "good" condition.

Figure 2 illustrates the percentage of estuary and coastal surface water bodies in the UK by their condition classification (excluding sites classified as "unassessed").

Figure 2: The percentage of surface water bodies classed as high or good has risen from 70% to 76% of estuarine and coastal water bodies

Condition of estuary and coastal surface water bodies, UK, 2009 to 2019



Source: Joint Nature Conservation Committee

Coastal bathing waters

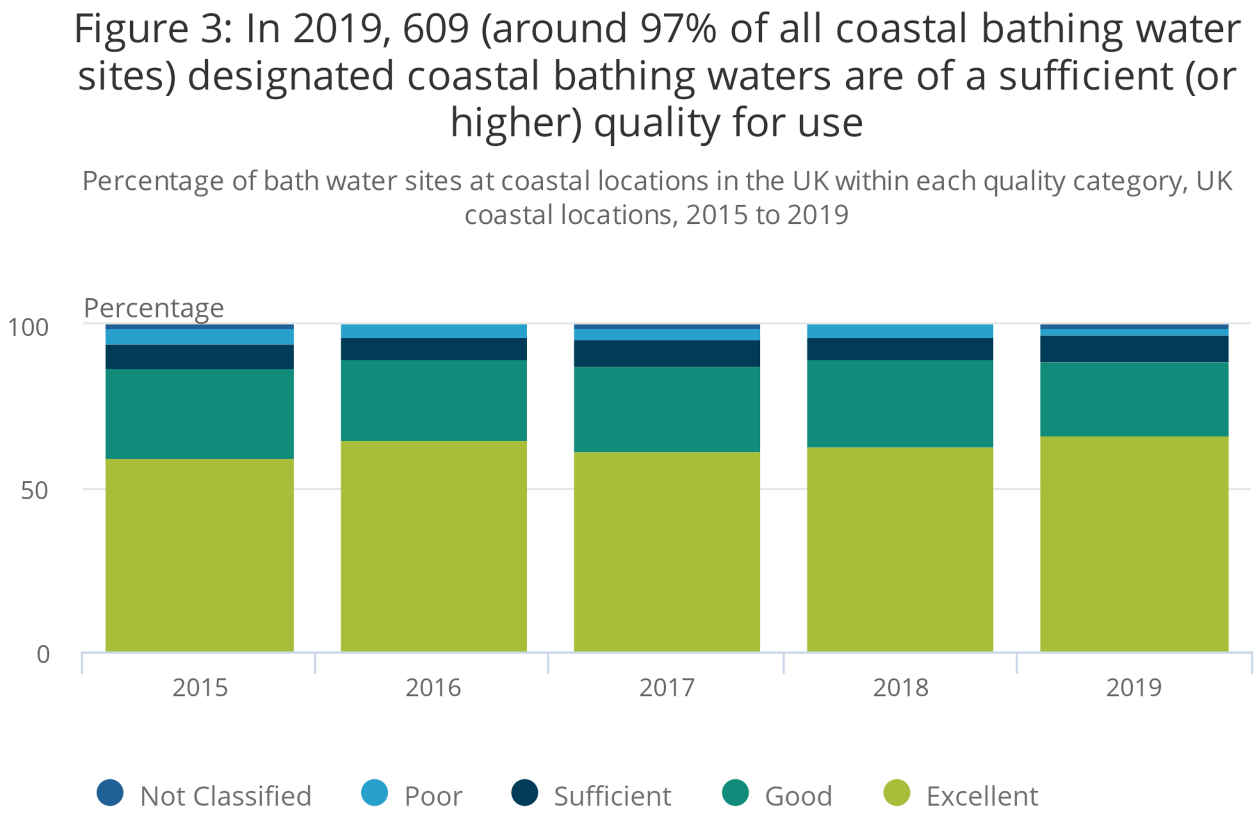
Clean waters are important for safe recreational bathing. Research by the Scottish Government on the [Value of bathing waters and influence of bathing water quality]() (2018) finds that access to clean bathing waters provide restorative physical and psychological benefits to users. It also suggests that there are positive impacts for local businesses through increased trade.

Safety and quality of bathing waters can be reduced by the presence of harmful bacteria. Escherichia coli and intestinal enterococci can cause illness if ingested, and they are used as indicators of faecal pollution from humans, livestock and wildlife. Poor livestock waste management and raw sewage discharge into water bodies contributes to the presence of these bacteria in bathing waters. EU Bathing Water Directive reports collates data on the conditions of UK bathing water sites, classifying each across four categories from excellent to poor, including on the presence of Escherichia coli and intestinal enterococci.

In 2019, the UK has 628 at coastal locations (sea and transitional waters). Between 2015 and 2019, the number of designated UK bathing water sites has increased by 11, all of which are at coastal locations. In 2019, 66.1% of coastal bathing waters were classed as "excellent", increasing by 6.2 percentage points since 2015.

Figure 3: In 2019, 609 (around 97% of all coastal bathing water sites) designated coastal bathing waters are of a sufficient (or higher) quality for use

Percentage of bath water sites at coastal locations in the UK within each quality category, UK coastal locations, 2015 to 2019



Source: EU Bathing Waters Directive

The data illustrated above includes bathing water sites in Gibraltar. In 2019, six of the designated coastal bathing sites are in Gibraltar.

4 . Provisioning services

Provisioning services are products from nature that meet human needs such as food, water, and materials.

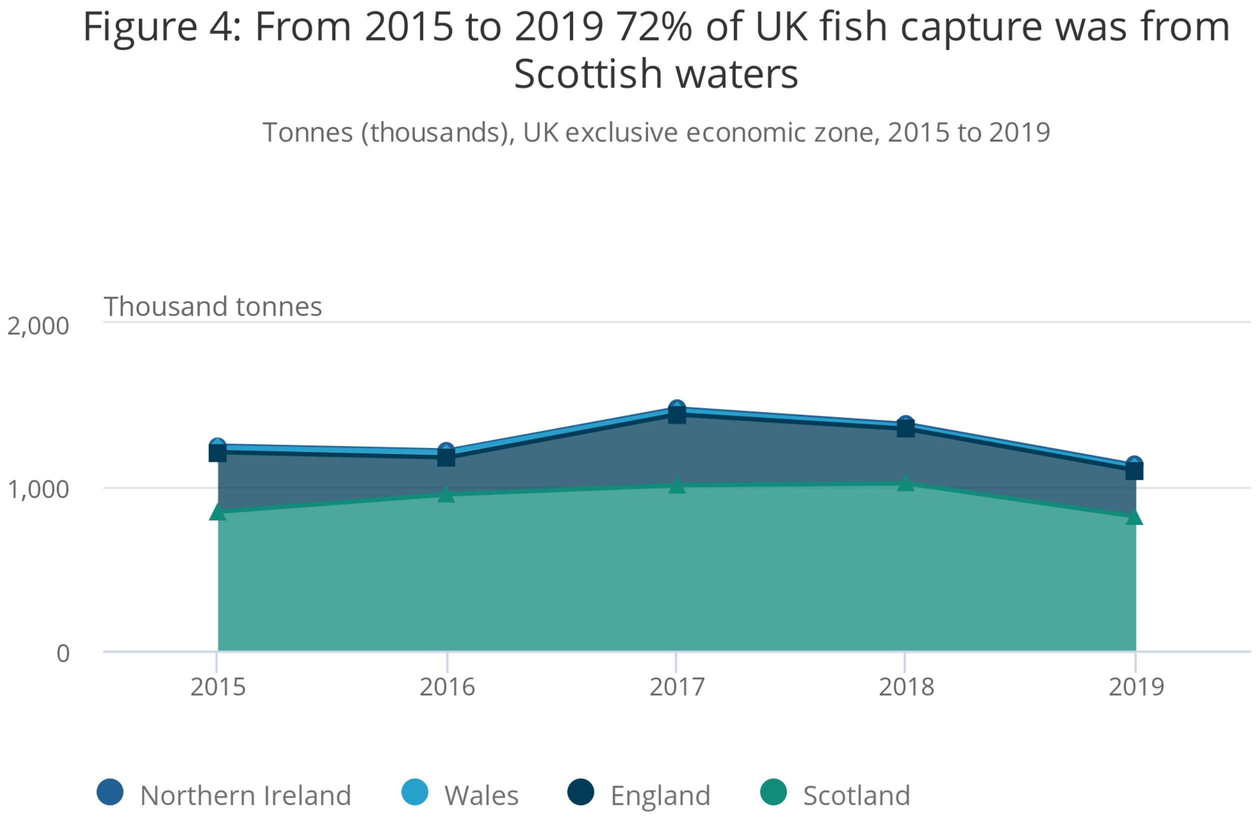
Fish capture

Fish capture includes the value of marine fish taken from UK waters (England, Scotland, Wales, and Northern Ireland). UK boundaries do not perfectly align with the geographical areas of fish capture statistics. For more detail on how fish capture in UK waters is estimated, see the Marine Management Organisation Exclusive Economic Zone Analysis and associated publications.

We rely on a range of external sources that all involve known uncertainties. For instance, Norway and Faroese landings are excluded from this analysis. The economic data are based on UK fleet data, which we also apply to foreign vessels that may face different costs and prices.

Figure 4: From 2015 to 2019 72% of UK fish capture was from Scottish waters

Tonnes (thousands), UK exclusive economic zone, 2015 to 2019

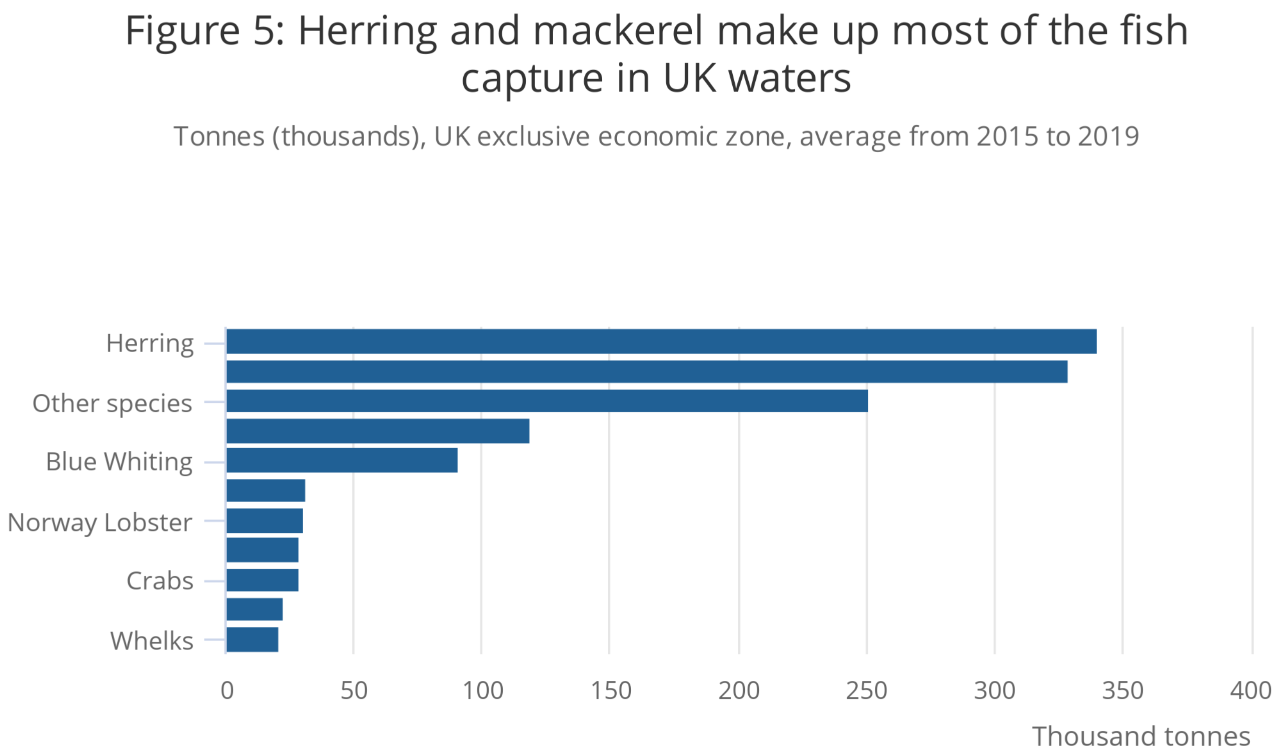


Source: Office for National Statistics, Marine Management Organisation, Seafish, Scientific, Technical and Economic Committee for Fisheries

A total of 395 different species of fish were caught in UK waters between 2015 and 2019. However, 51.8% of the tonnage was made up of just two species: Herring (26.3%) and Mackerel (25.5%). The top 10 species caught by tonnage represented 80.6% of the total catch.

Figure 5: Herring and mackerel make up most of the fish capture in UK waters

Tonnes (thousands), UK exclusive economic zone, average from 2015 to 2019



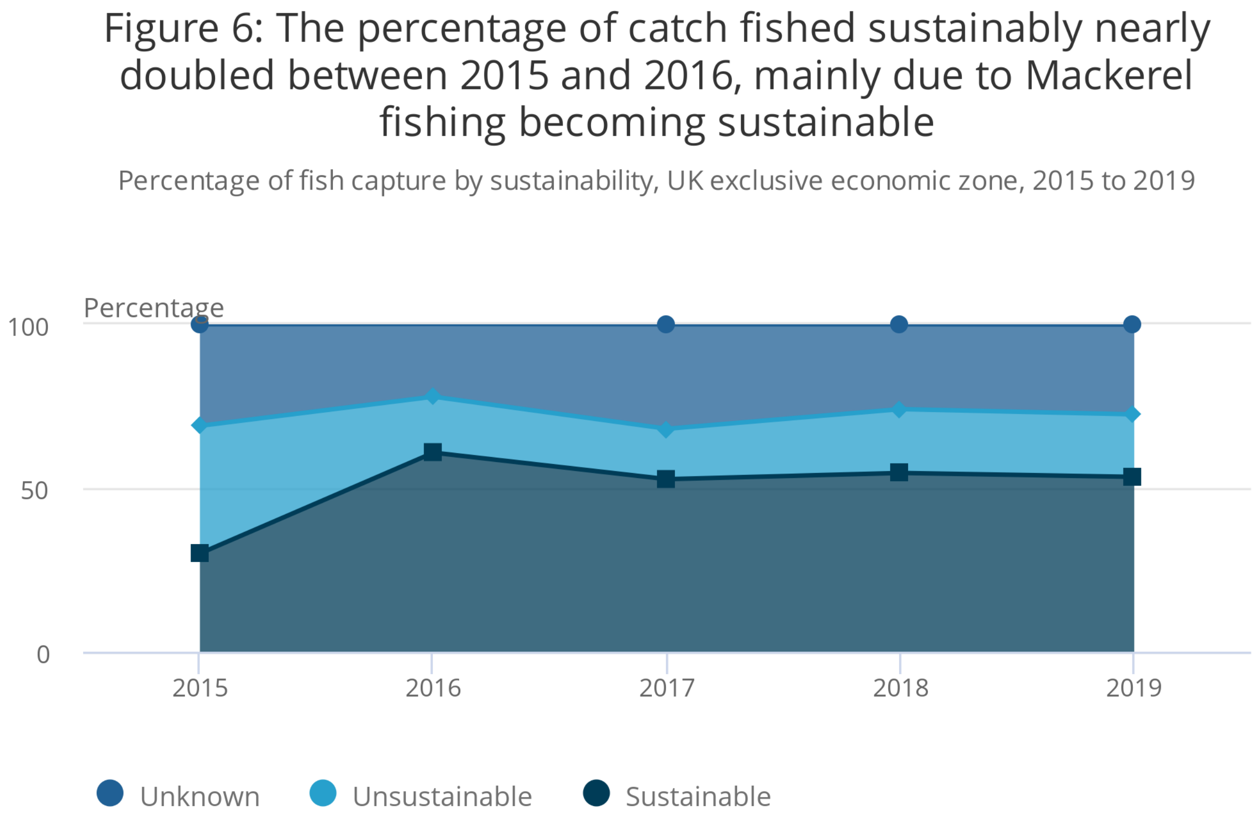
Source: Office for National Statistics, Marine Management Organisation, Seafish, Scientific, Technical and Economic Committee for Fisheries

For all the fish species, across different areas in UK waters, we estimate if fishing is sustainable using The International Council for the Exploration of the Sea stock assessments. This does not include wider externalities from fishing. For each stock we check that fishing pressure is at or below levels capable of producing maximum sustainable yield. We also check if each stock's spawning biomass is at or above the level capable of producing the maximum sustainable yield. Across the years we can determine stock sustainability for 72% of the fish capture tonnage, leaving 28% as unknown.

While we can determine if the level of fishing for a specific stock is sustainable, this approach does not consider the knock-on impacts of unsustainable fishing to the ecosystem. For instance, if a fish species which forms a significant part of other fish species diets is managed unsustainably it may impact the sustainability of other fish stocks higher up the food chain.

Figure 6: The percentage of catch fished sustainably nearly doubled between 2015 and 2016, mainly due to Mackerel fishing becoming sustainable

Percentage of fish capture by sustainability, UK exclusive economic zone, 2015 to 2019



Source: Office for National Statistics, Marine Management Organisation, Seafish, Scientific, Technical and Economic Committee for Fisheries and The International Council for the Exploration of the Sea

Overall, of the stocks assessed, more of the fish caught in UK waters is sustainably fished in 2019 than in 2015, driven largely by a significant shift in the sustainability of Mackerel fishing. In 2015, none of the Mackerel fishing in UK waters was sustainable, but from 2016 onwards all of the Mackerel in UK waters is fished at sustainable levels as fishing pressure fell below levels capable of producing maximum sustainable yield.

There have been significant improvements in fishing sustainability for other major species fished from UK waters. Haddock fishing sustainability has improved drastically. Just 3% of Haddock fish capture was sustainable in 2018, jumping to 70% in 2019. Herring fishing, the largest species in terms of tonnage, has been largely sustainable. Some 90% of Herring capture was sustainably fished in 2015, steadily increasing to 97% in 2019.

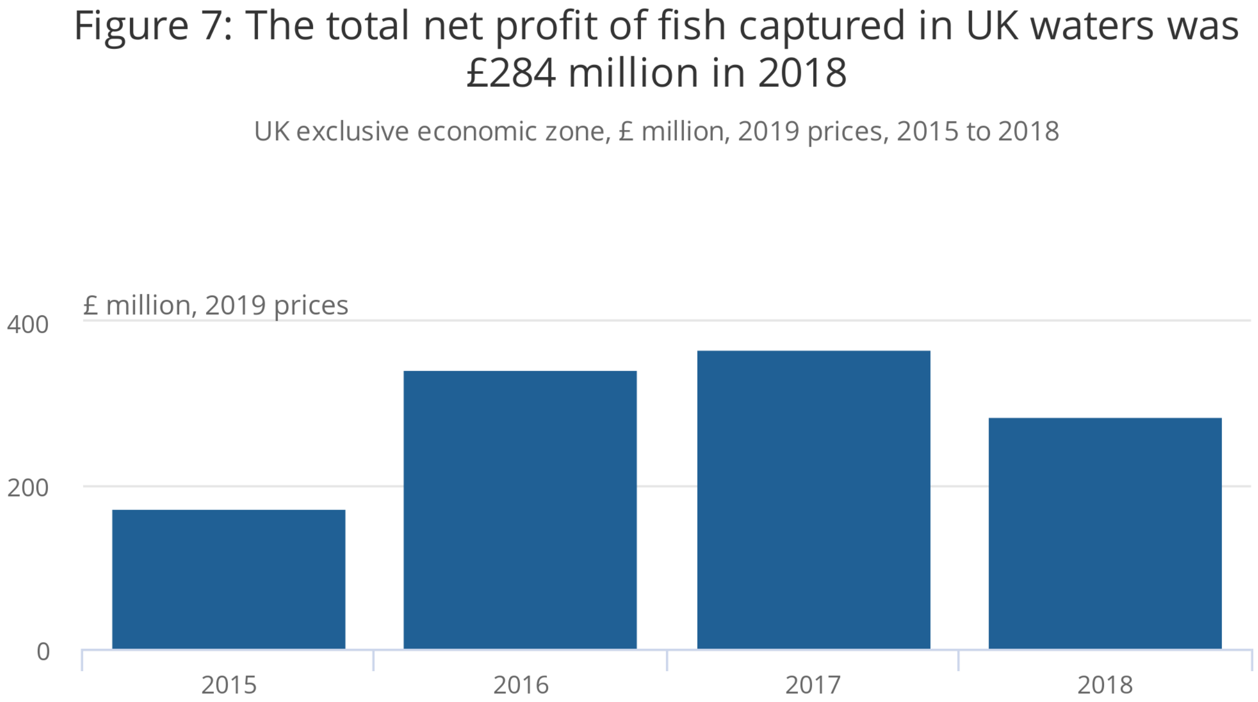
Unfortunately, not all fish stocks have improved sustainability over time. Blue Whiting is estimated to have been entirely unsustainably fished from 2015 to 2019 and Saithe fish capture were all estimated to be unsustainable from 2017. Sustainability of some major species, such as Sandeels, edible Crabs, Scallops, and Whelks is unknown by this method.

The value of fish capture is calculated using net profit per tonne (landed) estimates, provided by Seafish, for different marine species. Net profit per tonne is calculated using economic estimates for fleet segments and Marine Management Organisation data on landings by stocks. We only present the years 2015 to 2018 because of a lack of capital costing data after this period.

On average between 2015 and 2018, we can estimate a net profit valuation for 85% of the fish capture tonnage. The provisioning service valuation of fish capture from UK waters is likely to be an underestimate.

Figure 7: The total net profit of fish captured in UK waters was £284 million in 2018

UK exclusive economic zone, £ million, 2019 prices, 2015 to 2018

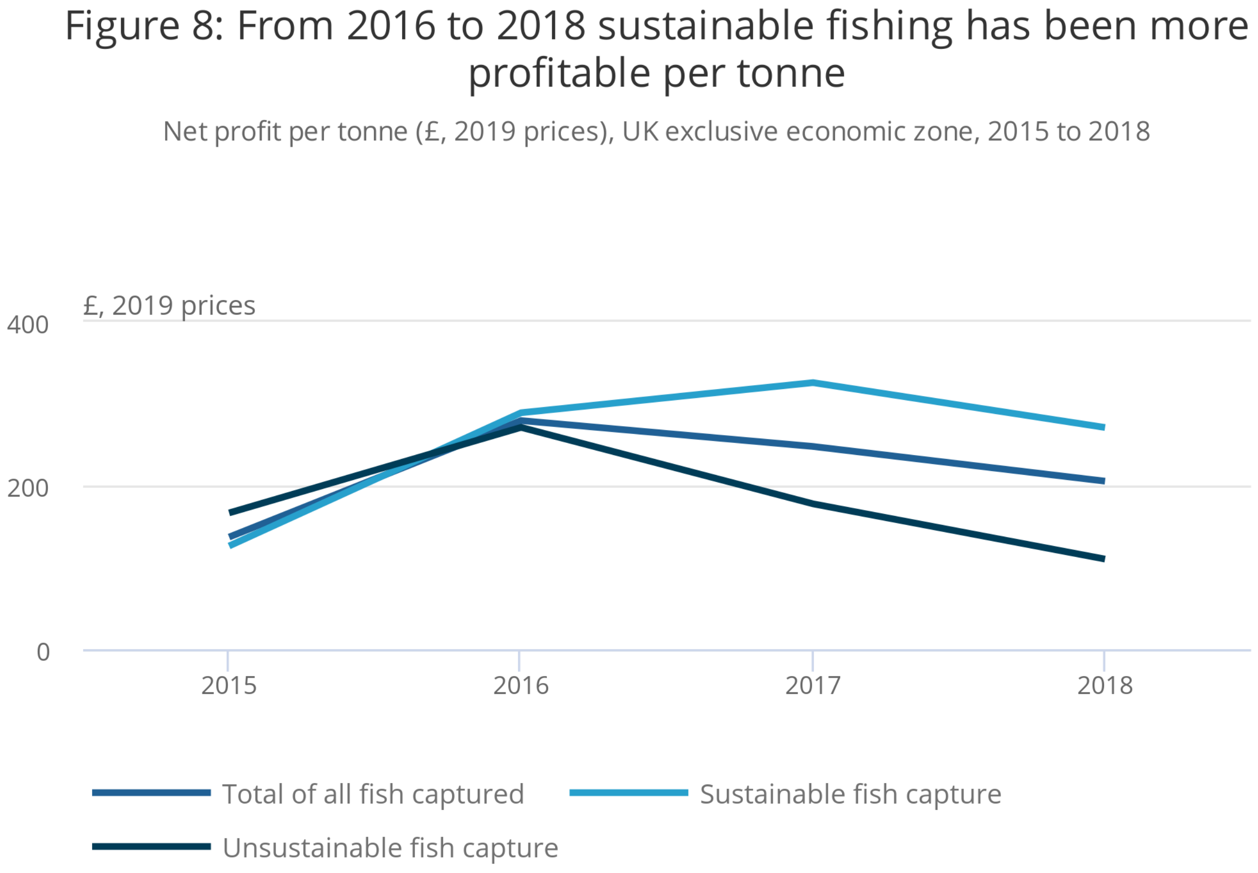


Source: Office for National Statistics, Marine Management Organisation, Seafish, Scientific, Technical and Economic Committee for Fisheries

The large shift in value from 2015 to 2016 can be attributed mainly to increase in the net profit per tonne of Mackerel and Herring. Between these years, Mackerel net profit per tonne increased 76% from £200 to £351 and Herring increased 147% from £88 to £217. Mackerel and Herring made up 62.1% of the total UK waters net profit, at 41.9% and 20.2% respectively. We have estimated valuations for 123 different species but the top 10 species by value make up 84.2 % of the overall value.

Figure 8: From 2016 to 2018 sustainable fishing has been more profitable per tonne

Net profit per tonne (£, 2019 prices), UK exclusive economic zone, 2015 to 2018



Source: Office for National Statistics, Marine Management Organisation, Seafish, Scientific, Technical and Economic Committee for Fisheries and The International Council for the Exploration of the Sea

Overall net profit per tonne rose sharply from 2015 to 2016, driven by the increases in Mackerel and Herring, then steadily declines in 2017 and 2018. Based on the available data on sustainability and net profit, fish stocks which we have estimated to be sustainable, have a higher net profit per tonne than unsustainable stocks. In 2018 on average, sustainable stocks were £161 per tonne more valuable than the unsustainable stocks.

Renewable energy

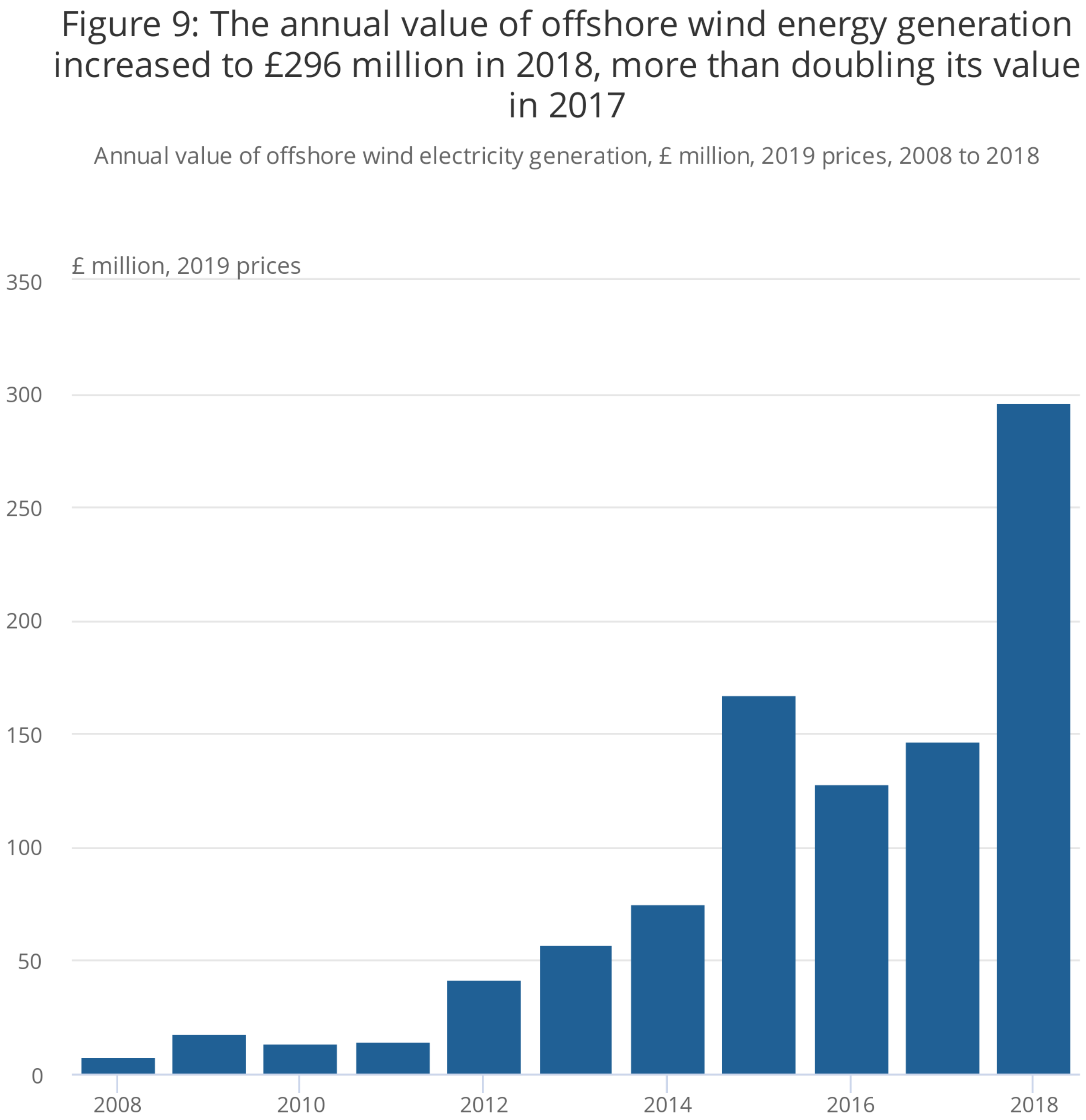
In 2019, 27% of total renewable electricity generation in 2019 was produced by offshore wind farms (Department for Business, Energy and Industrial Strategy). Between 2018 and 2019, offshore wind generation increased by 5.5 TWh to 32 TWh, an increase of around 20%. This is the largest increase in power output by any renewable energy source in the UK in that year.

By comparison, while onshore wind made a similar contribution to electricity generation in 2019, this increased by 2.0 TWh - approximately 6.5% - compared with 2018. As the cost per unit of energy generated of offshore wind continues to fall, this energy source is increasingly competitive. The development of larger wind farms and larger turbines may further reduce the costs of producing offshore electricity.

Using a resource rent residual value, the annual value of offshore electricity generation fluctuates across the time series shown. The peak value in this time series is in 2018, where offshore wind is valued annually at £296 million. The value of marine renewable energy production grew in value by 3,612% from 2008 to 2018.

Figure 9: The annual value of offshore wind energy generation increased to £296 million in 2018, more than doubling its value in 2017

Annual value of offshore wind electricity generation, £ million, 2019 prices, 2008 to 2018



Source: Office for National Statistics

"Load factors", such as weather, wind speeds and hours of sunshine, affect the total generation produced by renewable energy sources. Wind speeds affect the generation of electricity by onshore and offshore wind turbines. The load factor is a ratio of the energy generated as a proportion that could be generated, and was 39.6% in 2019 for offshore wind (more detail can be found in Renewable Energy Statistics).

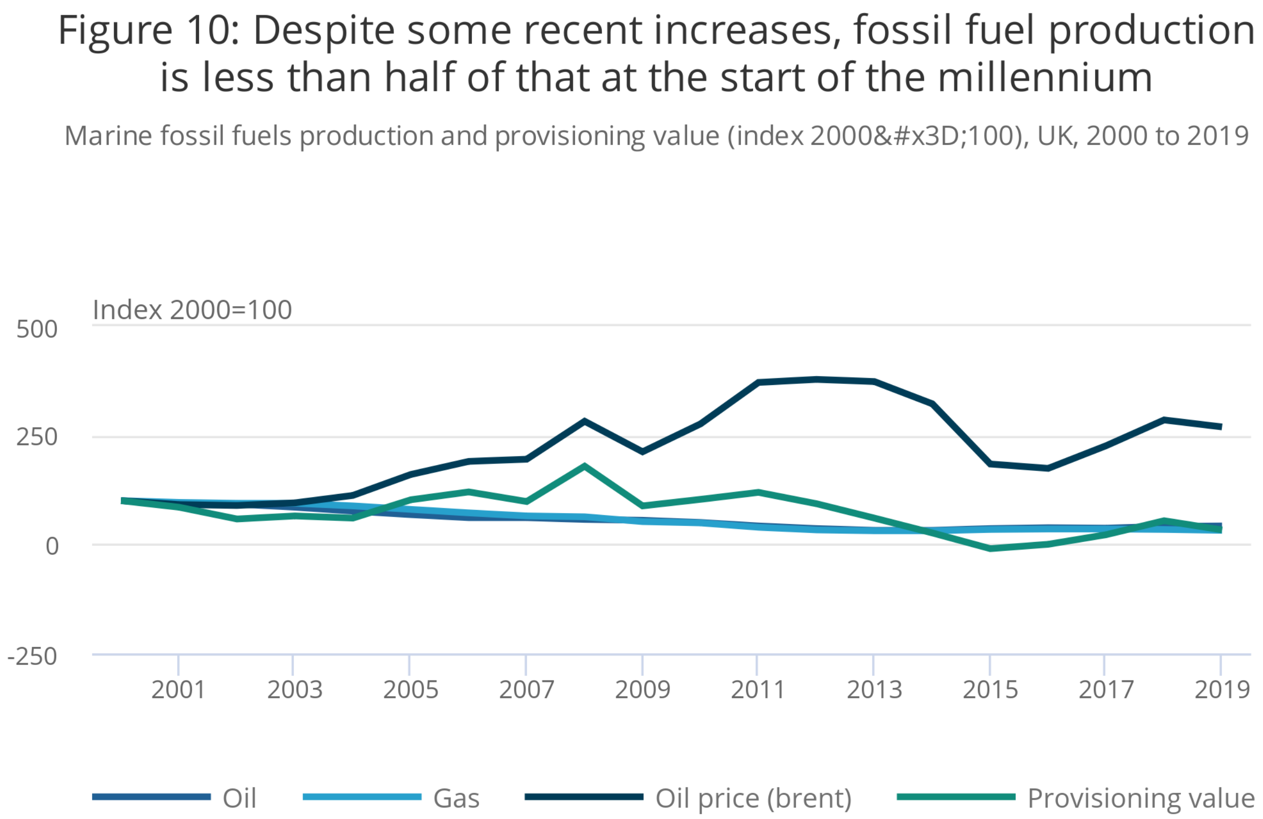
Fossil fuels

The annual value estimate of fossil fuels has varied, driven largely by oil and gas price changes and production trends.

Marine fossil fuels have accounted for around 99% of UK oil production, and marine gas 98% of production. Marine oil and gas production peaked around 2000 and then gradually declined before levelling off in recent years.

Figure 10: Despite some recent increases, fossil fuel production is less than half of that at the start of the millennium

Marine fossil fuels production and provisioning value (index 2000=100), UK, 2000 to 2019



Source: Office for National Statistics and Oil and Gas Authority

Between 2007 and 2008, oil and gas prices increased by 41% and 69% respectively. These spikes are reflected in the annual valuation. In 2019, the annual value decreased to £6.5 billion, as oil and gas prices fell by 6% and 41% respectively.

Since 2005, UK fossil fuel demand has exceeded domestic production and so the UK has been a net importer of fossil fuels. Consumption of fossil fuels has a carbon cost. This is estimated on the cost of the carbon removal required to meet an emission reduction target. We make a very approximate estimate of that cost here purely to provide context. In 2019, the carbon cost of using just the UK marine fossil fuels extracted was estimated at £16.6 billion based on UK non-traded carbon prices.

Minerals

Over the last decade, between 15 and 20 million tonnes of marine aggregates were extracted from the UK seabed each year, averaging annual extraction in recent years has been around 17.81 tonnes.

Marine aggregates are sand and gravel resources from the seabed largely used for house building, transport infrastructure, beach replenishment and coastal defence improvement. In 2019, 18% of marine aggregate removal was used for beach nourishment, replenishing beaches and protecting coastal areas, and to mitigate coastal erosion, which is likely to increase as sea levels rise and storms become more frequent due to climate change.

This service is valued at £19.1 million. As of 2020, the estimated primary reserves of primary marine aggregates totalled 356 million tonnes, giving around 22 years of permitted production.

5 . Regulating services

As well as tangible provisioning services, natural assets provide several less visible services known as regulating services. These include sequestering carbon and regulating water flows to prevent flooding.

Flood protection

Many habitats in our coastal and marine environments provide us with a range of services, often invisible to the human eye. For example, saltmarshes provide crucial regulating ecosystem services through flood mitigation. They help to absorb the energy carried by coastal waves, potentially reducing the need for built structures, such as concrete flood walls. Saltmarshes sequester carbon and remediate nutrients, and they can also be used for livestock grazing.

The total extent of natural saltmarshes in the UK has declined, in particular over the last 50 or 60 years. For example, research suggests that saltmarshes in South East England have been lost at a continuous rate of 40 hectares a year for the last 50 years.

The importance of saltmarshes is being increasingly recognised, with restoration and rebuilding. Hesketh Out Marsh was completed in 2008 and recreated 322 hectares of managed saltmarsh. This project aimed to protect 130 residential properties and three commercial buildings from the risk of a 1-in-200-year flood event. This has also likely increased the economic value of the flood-protected land.

Our experimental approach uses geographic mapping to estimate the economic value of land in the UK protected in this way. We look at five land types: urban, suburban, neutral grassland, improved grassland, and arable and horticulture land. We aim to include other types of land and infrastructure protected by saltmarsh in future analysis.

Table 2 presents the total hectares of land potentially affected areas by coastal flooding. The estimates account for topographical heights and discount areas in England and Wales where built structures are providing coastal flood protection. Built flood defence structures in Scotland and Northern Ireland are not yet excluded, so these figures likely overestimate the total UK hectares of saltmash-protected land.

It is worth noting that, even in areas with built flood defences, saltmarshes are part of the flood defence process, meaning that saltmarshes do provide a degree of natural hazard protection alongside flood walls and structures.

Table 2: Total area of land that receive protection from saltmarshes, hectares, UK, 2015

Land Type	Affected Areas (Hectares)
Improved Grassland	13,328
Arable and Horticulture	7,567
Neutral Grassland	1,001
Suburban	623
Urban	461

Source: UK Centre for Ecology and Hydrology Land Cover Map 2015, Ordinance Survey, Natural Resources Wales, and Environment Agency

This approach finds 23,885 properties in suburban areas and 16,671 properties in urban areas receive flood protection from saltmarshes.

We measure the economic value of flood damage to agricultural land by assessing the cost of raw inputs to a field of crop or livestock and the potential loss of profit. We assume that flooded agricultural land becomes unproductive for one year and recognise that livestock is mobile such that valuations for improved and neutral grassland may be overestimates. However, as land may suffer longer-term damage through saltwater inundation this may be an underestimate. These economic values do not capture the wider impacts of flooding, such as on mental health and ability to work.

We are continuing to develop this approach to understand the baseline risk of flooding with and without saltmarsh. At present, we provide illustrative valuations assuming a 1-in-50-year flood risk across all sites and limiting our estimate to land behind saltmarsh, which lacks topographic protection and excluding sites in England and Wales only that have built coastal flood defences. Moving to a 1-in-60-year risk across all sites provides an estimated service value of around £4.5 million. This can be thought of as the amount we might be willing to pay to replace the services that our saltmarshes provide. The asset value of this service is equal to approximately £131 million. Using a 1-in-100-year risk, the service value rises to approximately £13.5 million, and the asset value rises to approximately £393.5 million.

Carbon sequestration

Living organisms, such as seagrass species, can capture, process and bury carbon. Abiotic (physical and non-living) services, such as the carbon sequestration service provided by subtidal muds and sands, can also contribute. Regulation of carbon stocks helps to reduce the flows of carbon, a greenhouse gas, in the atmosphere.

Carbon sequestration in the coastal environment does not just occur in aquatic habitats, sand dunes and machair also can capture carbon from the air, meaning coastal habitats provide several means of carbon sequestration and burial. Restoration projects, such as the seagrass restoration project undertaken by Swansea University, may aid the future carbon capture and storage.

Saltmarsh ecosystems are intertidal coastal ecosystems with populations of vascular plant species, a range of sequestrating sediments, and are highly efficient "blue carbon" sinks. Additionally, the high levels of sulphates found in coastal soils mitigate the transformation of stored carbon into methane, another greenhouse gas.

We first estimate the extent of saltmarsh (EUNIS 2.5), sublittoral (sub-tidal) sands (EUNIS A5.2) and sublittoral muds (EUNIS A5.3) in the UK.

Table 3:Extent of Blue Carbon sequestering habitats in UK waters, 2019

EUNIS Habitat	Extent (Hectares)	Lower CO2e	Higher CO2e
Sublittoral Sands (EUNIS A5.2)	25,931,054	7,606,449	48,110,793
Sublittoral Muds (EUNIS A5.3)	6,415,298	2,822,734	11,902,527
Saltmarsh (EUNIS 2.5)	14,925	47,064	114,923
Total	32,361,277	10,476,247	60,128,243

Source: Joint Nature Conservation Committee EUNIS Level 3 ‘Combined Map’ (2019)

There is a wide spectrum of carbon sequestration rates across the three habitat types identified. We therefore provide a range of values. In 2018, we estimate a range that between 10.5 and 60.1 million tonnes of carbon dioxide equivalent were sequestrated in UK waters by these three habitats, with an estimated value of between £742 million and £4,259 million (in 2019 prices). This compares with gross carbon sequestration from terrestrial habitats of 28 million tonnes per year.

Lower bounded estimates are likely to underestimate the full value of carbon sequestration services, as not all carbon sequestrating plants, organisms and habitat types are captured in this measurement. The extent estimation for UK saltmarsh is conservative when compared to other values referenced in the literature.

Wastewater remediation

The sea can regulate pollution from nutrients released into it from human populations. Effluent that we eject into the seas no longer needs to be dealt with (though there are clear implications which we discuss later) and we can value that service in terms of what it would cost us to clean that water.

How much do we pour into the seas?

Daily discharge of wastewater, measured on a population equivalent basis, increased by 1.7 million units between 2016 and 2018, from 25 million units to 26.7 million units. The total daily quantity of Nitrogen discharged at coastal and estuarine locations increases from 193 tonnes in 2016 to 206 tonnes in 2018. The daily discharge of Phosphorous also increased from 56 tonnes in 2016 to 60 tonnes in 2018.

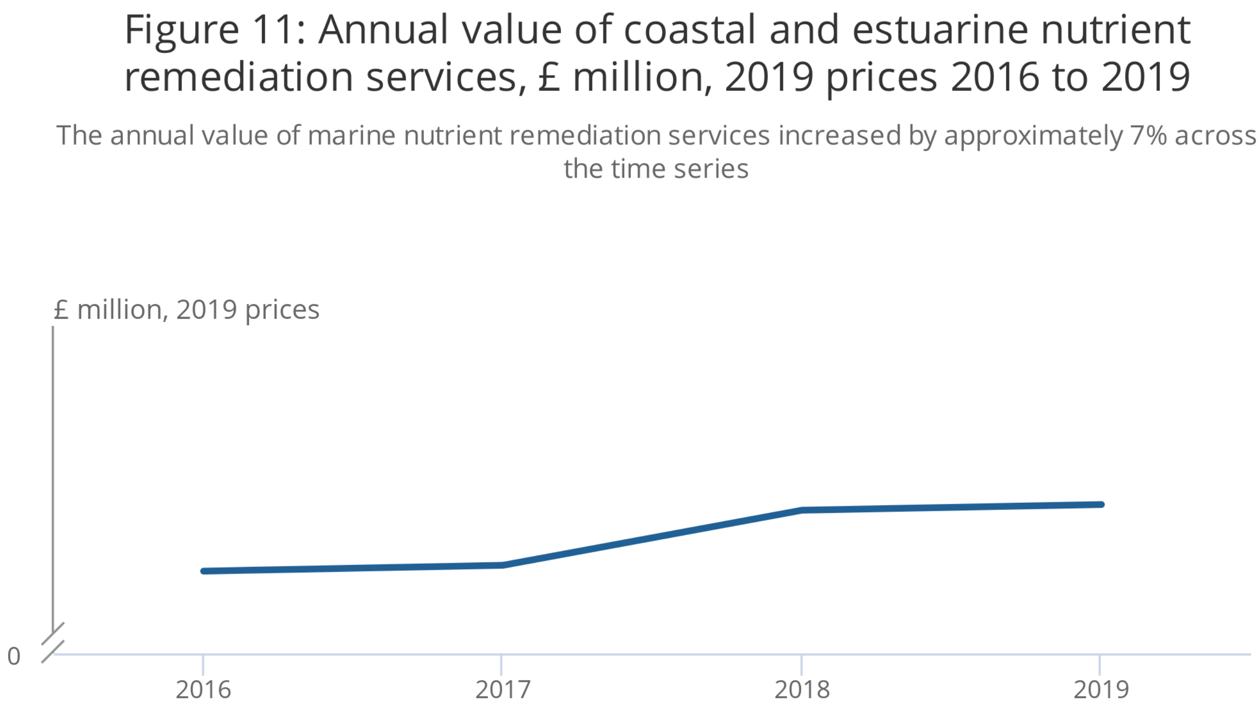
Population equivalent is a measure of the equivalent flow of wastewater per capita per day, based on one individual producing 60 grams of Biological Oxygen Demand (BOD) per day. Biological Oxygen Demand refers to the amount of oxygen consumed by micro-organisms as they break down organic matter. We hold daily per capita flows of BOD constant to allow a standardised measurement of daily per capita Nitrogen and Phosphorus into wastewater. The increase in wastewater flows could be attributed to the growth of the UK population over the time series.

Cost of cleaning

Coastal and estuarine nutrient remediation services for human input of Nitrogen and Phosphorous from urban wastewater rises across the time series shown. In 2016, the annual value of this regulating service was £640 million, and this increased to £683 million in 2019, assuming that the per kilogram cost of removing either Nitrogen or Phosphorous remains constant. The increase in annual value can be attributed to increased flows of wastewater and the quantity of nutrients flowing from them.

Figure 11: Annual value of coastal and estuarine nutrient remediation services, £ million, 2019 prices 2016 to 2019

The annual value of marine nutrient remediation services increased by approximately 7% across the time series



Source: EU Urban Wastewater Treatment Directive and Environment Agency

It should be noted that our estimate of the total human input of pollutants into the UK coastline is likely a significant underestimate. Furthermore, we assume that the demand for nutrient remediation services is met by the marine environment, although in reality this may not occur. Inputs of nitrates from wastewater into surface water bodies, including coastal waters, estuaries, lakes, rivers, and canals, account for around 25% to 30% of the total level of nitrates found in these waters. The major contributor to nitrates in surface water bodies is "run-off" from agricultural processes, such as the use of fertiliser which we do not fully capture. Atmospheric deposition of pollutants also contributes to the concentrations of nutrients in surface water bodies.

What is the impact on the sea of releasing these pollutants?

Excessive flows of human population nutrients into the sea can damage those habitats. An important issue for coastal and transitional waters, such as estuaries, is potential growth of micro-algae. Coastal, estuarine and freshwater bodies of water are considered as sensitive areas. This is because these water bodies are potentially eutrophic and are rich in nutrients. This means that excessive flows of inorganic nutrients, from humans, from wastewater into these water bodies may cause unwanted algal growth. Although algal blooms in English coastal waters are rare, some algae types can be toxic and can affect the health of fish.

OSPAR (2017) identify there are "small problem areas" of eutrophication along the coast of the UK in the Great North Sea. Further "small problem areas" are also identified at coastal and inshore locations in the Celtic Seas. While the spatial extent of eutrophic areas in UK waters has decreased over the period between 2008 and 2017, they remain an issue: 213 square kilometres (km^2) of UK coastal waters from the sample group above were identified as "problem areas". The UK uses a range of tools to assess the overall health of marine ecosystems, including the Water Framework Directive.

This analysis focuses on the flows of Nitrogen and Phosphorus that are discharged into coastal and estuarine water bodies from urban wastewater treatment plants. This is to observe where and how nutrient flows contribute to problems of eutrophication in coastal waters. By observing the physical flows of Nitrogen and Phosphorous into coastal and estuarine waters, we estimate the cost of removing these nutrients based on the capital and operating costs of a wastewater treatment plant. This provides an estimated replacement cost for the value of the marine nutrient remediation service.

6 . Cultural services

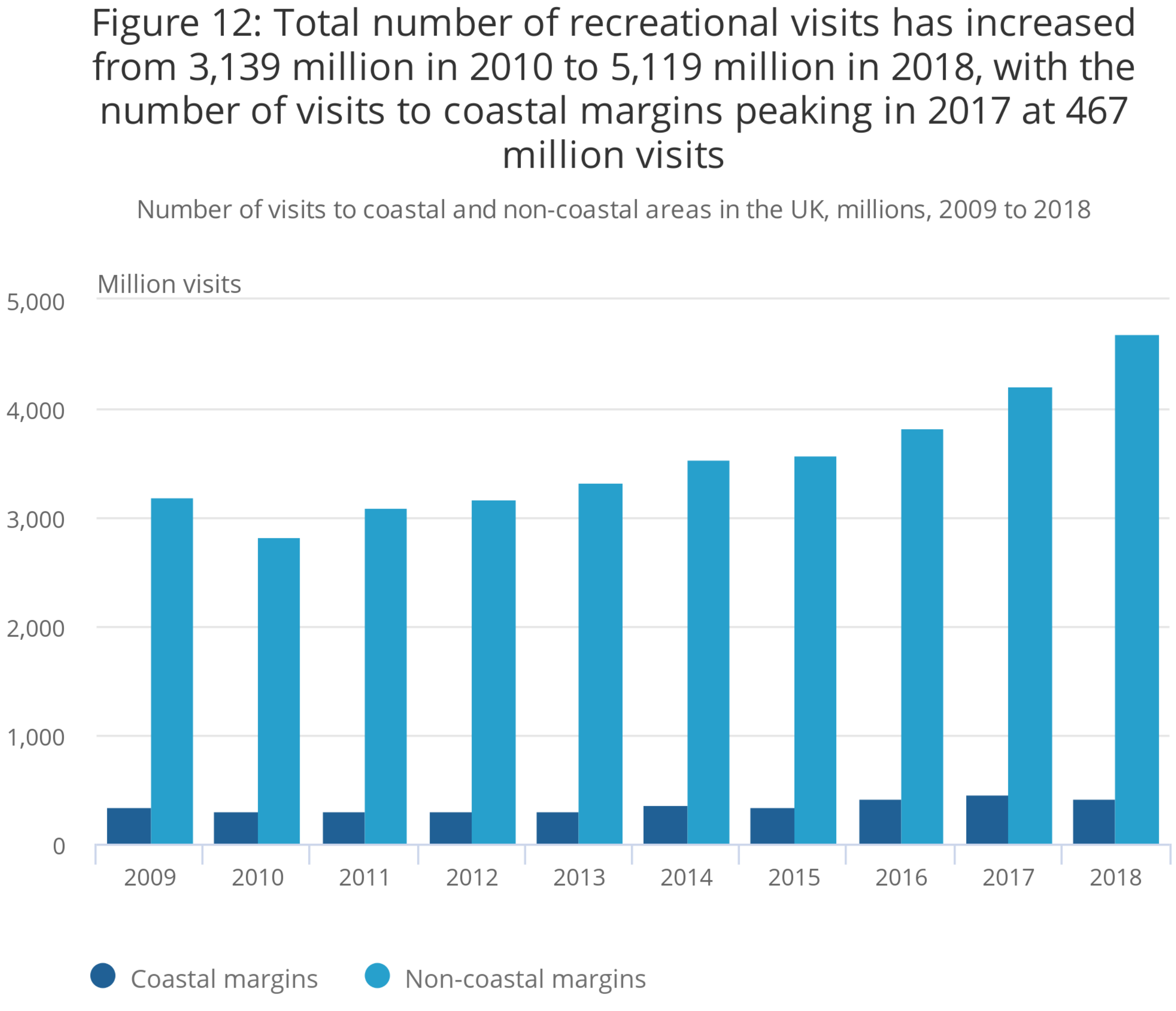
Cultural services are the non-material benefits people obtain from natural capital, such as recreation, and aesthetic experience.

Recreation

Coastal margins, or more commonly and largely "the beach", are one of several habitats people in the UK visit for leisure purposes. In 2018, 423 million trips were made to coastal margin, around 8% of all visits to nature in that year. By comparison, most nature visits in 2018 were made to urban green space (64%). These outdoor recreation estimates cover people aged 16 years and over and excludes most tourism, including any overnight stays.

Figure 12: Total number of recreational visits has increased from 3,139 million in 2010 to 5,119 million in 2018, with the number of visits to coastal margins peaking in 2017 at 467 million visits

Number of visits to coastal and non-coastal areas in the UK, millions, 2009 to 2018



Source: Monitor of Engagement with the Natural Environment Survey, National Survey for Wales, Scotland's People and Nature Survey

In 2018, over 1 billion hours were spent collectively at coastal margin areas for recreation and this represents approximately 10% of total hours spent on outdoor recreation. On average in 2018, individuals travelled to coastal margin areas for around one hour and spent an average of approximately 1.5 hours there per trip and spent 19 hours visiting coastal margins over the year.

In 2018, visitors' expenditure during trips to coastal margins was £1,726 million, made up of running costs (private transport cost), car parking costs, public transport costs, equipment hire, maps and guides, and admission fees. This was approximately 21% of total spending on visits to nature in that year, with the average individual spending £4.08 per trip. The recent peak in expenditure during trips to coastal margins was £2,171 (million) in 2010. In 2018, running costs were the single largest element of expenditure and equalled around 76% of total expenditure when visiting coastal margins.

Amenity value of sea views

In the UK, between 2009 and 2016, a sea view added an average of £8,100 (in 2019 prices) to house prices.

This is based on analysis of the variables that affect house prices, including the presence of a sea view (including estuaries and channels), known as a hedonic pricing approach. Other environmental variables that may affect house prices such as air pollution and noise pollution are also included. For more information, please see the detailed methodology article.

The estimated effect of having a sea view was £6,885 on average in 2016 equivalent to 2.65% of the average property price in the sample used of properties with a sea view.

Table 4: In 2016 UK properties with a sea view benefited from an additional £95 billion in value from having a sea view

Year	Properties in sample	Properties with a sea view	Average property price (£)	Average sea view value (£)	Average sea view value (%)	Aesthetic asset value (£m)	Aesthetic annual value (£m)
2009	4,101.0	55.0	297,300.0	9,365.0	3.2	4,420.0	108.8
2010	26,759.0	451.0	322,803.0	8,763.0	2.7	4,164.0	93.3
2011	44,523.0	735.0	311,841.0	8,662.0	2.8	4,140.0	94.6
2012	69,821.0	1,190.0	308,240.0	8,622.0	2.8	4,144.0	97.0
2013	84,069.0	1,518.0	306,294.0	8,631.0	2.8	4,170.0	99.2
2014	108,006.0	2,026.0	296,054.0	6,986.0	2.4	3,395.0	84.6
2015	87,131.0	1,441.0	264,994.0	7,258.0	2.7	3,551.0	101.4
2016	57,170.0	920.0	260,033.0	6,885.0	2.7	3,395.0	101.1

Source: Office for National Statistics

Over this time period, an average of 1.73% of properties sold had a sea view. We apply this sample average to the number of UK residential properties each year to estimate the total number of UK residential properties with a sea view. In 2016, there were 28.49 million residential properties in the UK, with 0.49 million assumed to have a sea view. To estimate the total stock (asset) value we multiply this by the average annual effect of having a sea view (£6,885) to get £3,395 million.

To estimate annual service values, we calculate a rental value of having a sea view. This is calculated using the Office for National Statistics (ONS) imputed annual rental estimates multiplied by the 1.73% of properties with a sea view, in turn multiplied by the annual percentage increase in property prices caused by having a sea view. Therefore, the annual value of having a view of the sea was £101 million in 2016.

7 . Asset valuation

The asset value of natural resources, such as our waters and beaches, refers to the long-term stream of services that we get from them. Examples of this include fish stocks where our marine environment provides us with food. Furthermore, our coastal habitats provide several services that we benefit from, such as recreation at beaches, views for us to enjoy from our homes, and saltmarshes help keep flood water at bay.

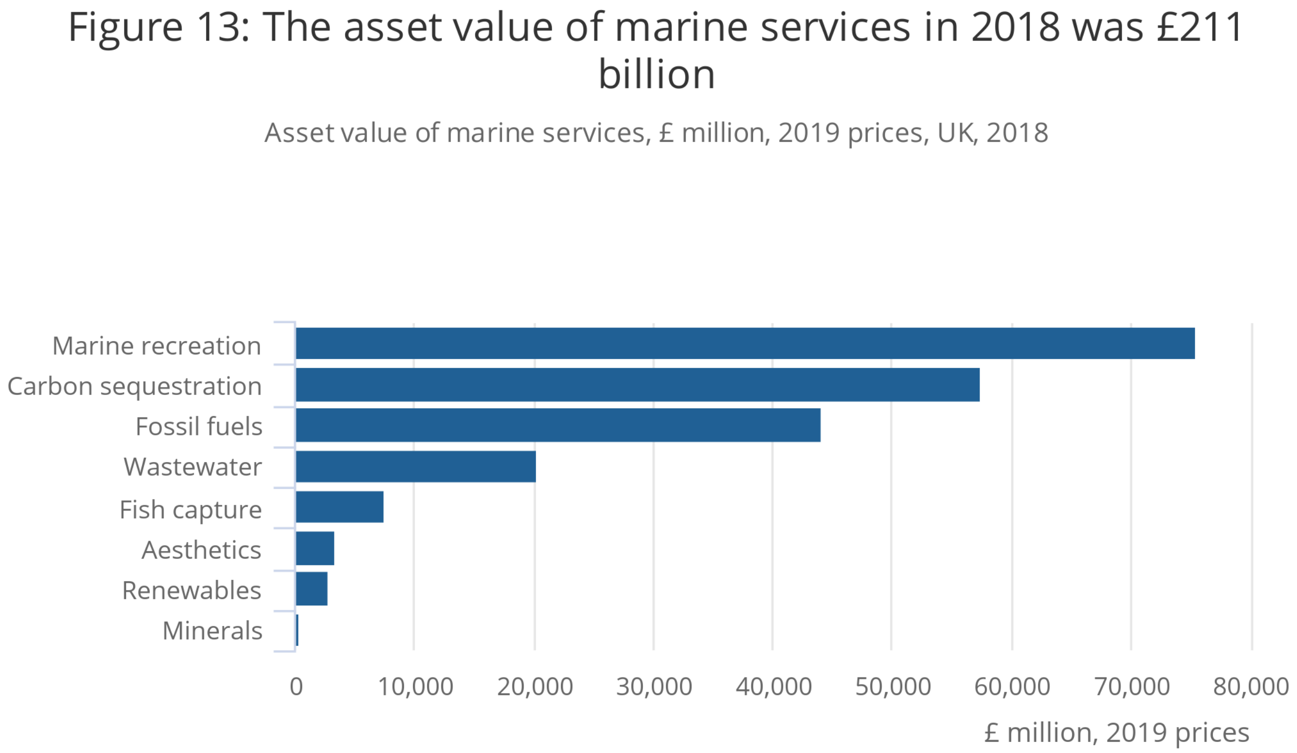
To calculate an asset value, we need to estimate the flow of services that will be provided by our natural marine resource over its lifetime. This is known as the asset life. In order to do this, we use the net present value (NPV) approach, taking annual service flows as a basis and then projecting these across the asset life.

Renewable services are those that can continuously create benefits for us. For these services, we assume an asset life of 100 years, and for non-renewable services, we assume a 25-year asset life. In our marine accounts, non-renewable services would include fossil fuels, minerals and stocks of fish that are fished unsustainably or have unknown levels of sustainability.

Once an asset life been determined, the projected future value of a service is discounted back to the current period, providing an estimate of its capital value at present. For a more detailed explanation of this, see the methodology guide.

Figure 13: The asset value of marine services in 2018 was £211 billion

Asset value of marine services, £ million, 2019 prices, UK, 2018



Source: Office for National Statistics

Notes:

1. The asset value for carbon sequestration is based on a 2019 annual valuation
2. The asset value for aesthetics is based on a 2016 annual valuation.

The largest asset value in 2018 is that of marine recreation, a cultural service, valued at £75,428 million (2019 prices). This is followed by carbon sequestration, a regulating service, and fossil fuels, a provisioning service, valued at £57,466 million and £44,041 million, respectively. The total asset value of UK marine account ecosystem services is £211 billion.

8 . Marine habitats, natural capital data

Marine accounts, natural capital, UK: 2021 summary tables Dataset | 06 April 2021
Estimates of the value of marine natural capital to people in the UK.

9 . Glossary

Abiotic services

Abiotic services are the non-living components of the natural environment that provide services to humans, such as fossil fuels.

Asset

A natural asset is a resource that can generate goods or services to humans into the future. Asset valuation estimates the stream of services that are expected to be produced by the natural resource over a reasonably predictable time horizon.

Ecosystem services

Ecosystem services are the living (biotic) components of the Earth that provide services to humans, such as woodland.

Physical flow

The physical flow of a natural asset is the measure of its output in units appropriate to the good or service. This differs from the annual value and asset value, which measure the monetary value of a natural resource.

10 . Measuring the data

Initial research and methods on which this work were based were produced by The Joint Nature Conservation Committee and Centre for Environment, Fisheries and Aquaculture Science.

Thornton, A., Luisetti, T., Grilli, G., Donovan, D., Phillips, R. and Hawker, J., 2019. Initial natural capital accounts for the UK marine and coastal environment. Final Report. Report prepared for the Department for Environment Food and Rural Affairs.

The Office for National Statistics (ONS) natural capital accounts are produced in partnership with the Department for Environment, Food and Rural Affairs (Defra). Further details about the natural capital accounting project are also available.

The methodology used to develop these estimates remains under development; the estimates reported in this article are experimental and should be interpreted in this context. Experimental Statistics are those that are in the testing phase, are not yet fully developed and have not been submitted for assessment to the UK Statistics Authority. Experimental Statistics are published to involve customers and stakeholders in their development and as a means of building in quality at an early stage.

The Natural Capital Marine Account: Methodology provides a detailed summary of the methodology used to develop the Natural Capital Accounts. This summarises the broad approach to valuation and the overarching assumptions made, as well as giving a more detailed description of the methods used to value the individual components of natural capital and physical and monetary data sources.

We have used a wide variety of sources for estimates of natural capital, which have been compiled in line with the guidelines recommended by the United Nations (UN) System of Environmental-Economic Accounting Central Framework and System of Environmental-Economic Accounting Experimental Ecosystem Accounting principles, which are in turn part of the wider framework of the system of national accounts.

As the UN guidance is currently still under development, the Office for National Statistics (ONS) and the Department for Environment, Food and Rural Affairs (Defra) published a summary of the principles underlying the accounts.

We welcome discussion regarding any of the approaches presented via email at natural.capital.team@ons.gov.uk.

Department
for Environment
Food & Rural Affairs

11 . Strengths and limitations

Fish capture

UK boundaries do not perfectly align with the geographical areas of fish capture statistics. For more detail on how fish capture in UK waters is estimated, see the [Marine Management Organisation Exclusive Economic Zone Analysis] and associated publications.

We rely on a range of external sources which all involve known uncertainties. For instance, Norway and Faroese landings are excluded from this analysis. The economic data are based on UK fleet data which we also apply to foreign vessels that may face different costs and prices.

Whilst we can determine if the level of fishing for a specific stock is sustainable, this approach does not consider the knock-on impacts of unsustainable fishing to the ecosystem. For instance, if a fish species which forms a significant part of other fish species diets is managed unsustainably it may impact the sustainability of other fish stocks higher up the food chain. The stock assessments we use are the best available to us for those stocks but are imperfect since in a given year being slightly over (or under) the trigger for extraction does not necessarily mean an individual stock is fished unsustainably (sustainably). There are also several species which are not assessed in this way but may have sustainable management plans in place and we will try to capture some of these species better in later publications.

On average between 2015 and 2018 we can estimate a net profit valuation for 85% of the fish capture tonnage. The provisioning service valuation of fish capture from UK waters is likely to be an underestimate.

Renewable energy

The resource rent approach is not appropriate for this service long term as we cannot disaggregate renewables from the wider power sector.

One option would be to use data on subsidies and levilised costs of operation to estimate the overall income for the renewable energy providers. The direction of the change would be uncertain. Another option might be to develop supply and use tables for the renewables sector in the UK.

Fossil fuels

High quality data. No planned change.

Minerals

The value of marine aggregates provisioning is apportioned from the resource rent residual value of the minerals industry as a whole. This apportioning is based upon relative total output of the marine aggregates sector and the total output of the minerals industry.

Flood protection

This method is at an early stage of development. This analysis does not yet incorporate coastal flood defences for Scotland and Northern Ireland. We have also predicted where flooding may occur by setting a 200-metre buffer from UK saltmarshes. We hope to improve the accuracy of this assumption in the future. Furthermore, our calculations of the number of properties are based on an average footprint of English homes. This does not account for differences in property types and the estimated flood damage to housing cost does not account for different property types. We aim to develop the precision of this analysis in the future to include a larger number of land types and infrastructure.

The key missing part of the analysis as it stands is the baseline flood risk and the expected impact of the saltmarsh itself. Without this we can only provide illustrative ranges of potential figures. Further work will be done to estimate the scale of the flood risk benefits to the land sheltered by saltmarsh.

Carbon sequestration

We present a wide range of carbon sequestration values. This is due to a wide range of values being reported in the literature. We also only report on three marine habitat types when many other habitat types may provide carbon sequestration services.

Wastewater remediation

This analysis only incudes urban wastewater that is discharged at coastal and estuarine locations. It does not include the flows of nutrients from farmland. This analysis uses an assumption on the quantity of nutrients in each unit of wastewater (as measured in population equivalent). There is likely to be variation in the quantity of nutrients within wastewater geographically. A main assumption is that the marine environment can remediate the full quantity of nutrients being discharged.

Recreation

There are unlikely to be any significant methodology changes in the basic travel cost work. However, we do hope to start including tourism spend estimates in addition to short day trips. This may significantly increase the value of recreation.

Amenity value of sea views

The original data source for advertised house prices is no longer readily available. We will therefore move to actual recorded sale prices. In addition, we would need to change the basis on which a "view" is identified. The overall impacts of these changes are unknown but could be significant.

12 . Related links

Initial natural capital accounts for the UK marine and coastal environment
Report | Released in June 2019
Initial marine natural capital report prepared by the Joint Nature Conservation Committee and the Centre for Environment, Fisheries and Aquaculture Science for the Department for Environment Food and Rural Affairs.

UK natural capital accounts: 2020
Statistical Bulletin | Released on 19 November 2020
Estimates of the financial and societal value of natural resources to people in the UK.

United Nations System of Environmental Economic Accounting Experimental Ecosystem Accounting
Website | Updated as necessary
The SEEA Experimental Ecosystem Accounting constitutes an integrated statistical framework for organizing biophysical data, measuring ecosystem services, tracking changes in ecosystem assets and linking this information to economic and other human activity.

Principles of Natural Capital Accounting
Methodology article | Released 24 February 2017
A background article for those wanting to understand the concepts and methodology underlying the UK natural capital accounts being developed by the ONS and Defra.