The Rivers Trust

Natural Capital of Freshwater Fisheries in England

Full report

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Catchment Based Approach

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1. Executive Summary

England's freshwater natural capital includes 47,600 km of rivers, 492 km^2 of lakes and standing waters and 178 km^2 of ponds and several thousand km of canals. The condition of our fisheries and the benefits we gain from them depend on the condition of these rivers, canals, lakes and ponds. These water bodies provide enjoyment for a million anglers with annual economic benefits in excess of £1.7 billion.

This report details the natural capital account that we have developed for freshwater fisheries in England. We include all freshwater fisheries (including salmon, trout, grayling and coarse fish), the ecosystem services they provide and the benefits to recreational anglers, the wider economy and commercial fisheries (excluding aquaculture). The natural capital approach is central to the government's 25 Year Environment Plan (HM Government, 2018) which states that:

> *"Natural capital is the sum of our ecosystems, species, freshwater, land, soils, minerals, our air and our seas…This value is not captured by traditional accounting methods and is too often ignored in management and policy decisions. But when we use a natural capital approach, we are more likely to take better and more efficient decisions that can support environmental enhancement and help deliver benefits such as reduced long-term flood risk, increases in wildlife, and a boost to long-term prosperity."*

We aim to develop natural capital accounts for freshwater fisheries at different scales (national, River Basin District, river etc). Our work will be consistent with Defra guidance on "enabling a natural capital approach" and will provide effective decision support as policy and decision makers at all levels, work to restore our natural capital.

Under the natural capital approach (Figure 1), we view the natural environment as a stock of assets. These assets provide a flow of ecosystem services to people, who benefit from them, and therefore value them.

The fisheries natural capital account (below) follows the same approach in presenting the key indicators for our ecosystem assets, ecosystems services and the benefits we gain from them. The account is fully explained and referenced in the body of this report and in the appendix.

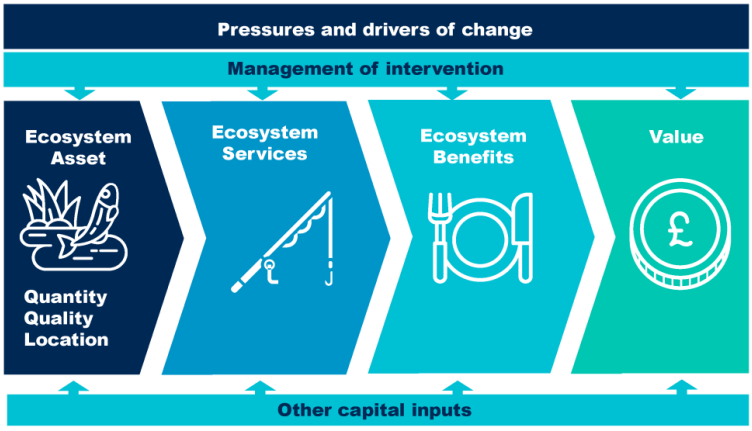


Figure 1 Based on Haines-Young and Potschin's ecosystem service cascade model (2011), reproduced from Sunderland, Waters, Marsh, Hudson, and Lusardi (2019).

Ecosystem assets

The 25 Year Environment Plan lays out clear goals for 'clean and plentiful' water and 'thriving plants and wildlife. It states that *"we will achieve clean and plentiful water by improving at least three quarters of our waters to be close to their natural state as soon as is practicable … and … we will achieve a growing and resilient network of land, water and sea that is richer in plants and wildlife."* But analysis of

Environment Agency (EA) data shows that only 15% of waterbodies were in good ecological health in 2019, with none meeting good chemical standards. Furthermore, there has been little change in the overall number of surface water bodies awarded high or good ecological status since 2009 (Department for Environment food and Rural Affairs, 2020c, pp., p. 23)

Natural Capital Account for Freshwater Fisheries in England (2019)

Ecosystem asset

Asset	Indicator	Indicator value	5-year trend
Extent	River length ('000 km)	47.6	=
	Lakes and standing waters (km^2)	492	=
	Ponds (km^2)	178	=
Asset Quality	River water quality; ecological status (% good, 2019) WFD	15%	=
	Canal water quality; ecological status (% good, 2019) WFD	51%	=
	Lake water quality; ecological status (% good, 2019) WFD	14%	=
	Surface water quality chemical status (% good, 2019) WFD	0%	=
Fish population	Ecological Quality Ratio - EQR (% 'good' or better)	23%	=
	Principal salmon rivers at risk (%)	93%	↑
Cultural	Indicators for assets supporting fishing		
	No suitable national level indicators identified		

Ecosystem services

Ecosystem Service	Indicator	Quantity	5-year trend	Confidence
Wild Fish and their outputs	- Eels and elvers caught (value £)	38020	↓	
	# of sea trout caught by rod (declared 2019)	25619	↓	
	# of salmon caught by rod (declared 2019)	7911	↓	
	- Trout and Grayling	*Not available*		
	- Coarse Fish	*Not available*		
Biodiversity/ thriving wildlife	*No comprehensive indicator selected*			
Cultural services: Experiential and physical use	Number of individual anglers (2019)	835,000	↓	
	Number of angling days (million/ year)	17.0	↓	
	Lakes, reservoirs and ponds	11.8		
	Rivers and streams	4.1		
	Canals	*1.1*		
	Coarse Fish	*15.1*		
	Trout and Grayling	*1.9*		
	Salmon and Sea Trout	*0.1*		
	Eels	*Not available*		

Notes: Confidence in values: Red is low, Amber is medium, Green is high. Benefit values are rounded to nearest 10 or 100 million. See the Appendix for sources, calculations and assumptions

Benefits and values

Benefit	Significance (1 low to 3 high)	Indicator	Annual benefit £ millions	Confidence
Benefits from provisioning services (Food)	1	Value of commercial catch	0.04	
Benefits from thriving wildlife	3	Benefits from thriving wildlife	*Not estimated*	
Cultural wellbeing	3	Total expenditure by anglers	1600	
	3	Income supported (GVA) from total expenditure by anglers	1400	
	GVA broken down by:-			
	3	Coarse fish	1210	
	3	Trout & Grayling	150	
	3	Salmon & Sea trout	10	
	3	Consumer surplus from fishing	250	
	3	Physical and mental health and other benefits of fishing	*Not estimated*	
Total benefits	3	**Total quantified benefits**	**1650**	
	3	**Significance of unquantified benefits**	**High**	

Ecosystem Services

Freshwater biodiversity has declined dramatically around the world; WWF reports an 83% decline in the freshwater living planet index since 1970[1]. This decline is also evident in England with many indicators for freshwater fisheries ecosystem services, giving major cause for concern.

- Fisheries statistics published annually by the Environment Agency show that salmon are 'at risk' in 93% of the rivers in England. Declining catches of salmon and sea trout show that the proportion of rivers at risk has increased over the last five years.

- The annual catch of eels and elvers is also declining and below the average for the last 5 years. Eels have been designated as a priority species under the UK Post-2010 Biodiversity Framework and are listed as Critically Endangered on the global IUCN Red List of Threatened Species.

- The Ecological Quality Ratio (EQR) provides an indication of the ecological state of England's freshwater assets. Data collected by the Environment Agency and processed by the Rivers Trust suggests that only 23% of sites have an EQR of good/high or above.

Benefits and Values

Despite these concerns, around 835,000 individuals enjoyed freshwater angling in 2019 with an increase of 15% during the pandemic in 2020. Recreational anglers fish for around 20 days per year and enjoy a total of 17 million angling days per year. Almost 70% of angling days take place on still waters (lakes, reservoirs and ponds), mainly for coarse fish. The remaining 30% takes place in rivers and streams (24%) and canals (6%).

We estimate the monetary value of benefits from freshwater fisheries in England is of the order of £1.7 billion per annum. This is comprised of household income gross value added (GVA) of ~£1.4 billion and consumer surplus of ~£250 million. GVA represents the level of economic activity supported by expenditure on fishing. In this case, annual expenditure by anglers of ~£1.6 billion supports ~£1.4 billion of additional economic activity.

Economists use the concept of consumer surplus to quantify welfare benefits that accrue directly to anglers. In this report, we use the benefit of an improvement of fishing quality from low to medium as an indication of the benefit of maintaining waterbody fishing quality at medium or better. This value (~£35/angler day), based on revealed and stated preference analysis conducted for the EA in 2015, includes benefits to existing anglers and the benefits resulting from an increase in angling. On this basis, we estimate that anglers enjoy around £250 million of consumer surplus per year.

Most (89%), of the £1.7 billion of benefits, is related to coarse angling, since this accounts for most angling days. The remainder is accounted for by brown & rainbow trout & grayling angling (11%) and salmon & sea trout angling (1%). Salmon and sea trout anglers spend more (per day and per angler) than coarse anglers and may also enjoy higher levels of consumer surplus from fishing; for example non-trip related expenditure per angler day is estimated to be ~ £43 across all types, but ~ £68 for salmon and sea trout.

The benefits from freshwater fisheries that we can value in money terms provide total annual benefits of £1.7 billion per year. This is equivalent to £300 of consumer surplus and £1,700 of GVA per year for the average angler. The GVA provides direct benefits to the economy and employment through angler expenditure on travel, food, accommodation, tackle, clothing, licences and fees etc.

[1] See the Living Planet Report here

Health and Wellbeing

In addition, there is increasing evidence of very significant physical, mental and other benefits from recreational activity and nature – which are closely associated with recreational fishing. The biodiversity benefits associated with freshwater fisheries are also highly significant.

2. Introduction

This Phase 1 report sets out our progress so far in assessing the natural capital value of freshwater fisheries in England in 2019[2]. A better understanding of the value of these fisheries should lead to better decision making as we work to restore our natural capital. A natural capital approach is central to the government's 25 Year Environment Plan. The following sections of the main report outline the main results with all details (sources, assumptions and calculations) being included in the Appendix.

The approach, data and indicators in the accounts are drawn from a variety of published sources and take account of recent UK developments. Sources and relevant documents include:-

- Defra's work on "enabling a natural capital approach" (Department for Environment food and Rural Affairs, 2020a);
- the outcome indicator framework for the 25-year environment (Department for Environment Food and Rural Affairs, 2020b);
- Fisheries statistics published by the Environment Agency and the surveys of freshwater angling commissioned by the agency;
- the UK natural capital: ecosystem accounts for freshwater, farmland and woodland (Office for National Statistics, 2017b) and semi-natural habitats (Office for National Statistics, 2021);
- the UK natural capital accounts for 2020 (Office for National Statistics, 2020);
- Natural England's natural capital accounts for National Nature Reserves; see Sunderland, Waters, Marsh, Hudson, and Lusardi (2019); and
- Natural England's national natural capital atlas (Natural England, 2019)

Comprehensive details of all source documents are included the References at the end of this report.

This report does not introduce the reader to natural capital accounting. Readers are referred to a range of excellent recent publications in this rapidly developing field (Bolt, Ausden, Williams, & Field, 2017; Helm, 2015; Natural Capital Committee, 2017; Office for National Statistics, 2017a; Özdemiroğlu, 2019; Sunderland et al., 2019; Tinch et al., 2019).

3. Natural capital accounts for freshwater and freshwater fisheries in England

[2] Wales is not included at this stage because it was not included in Environment Agency commissioned 2015 survey - Environment Agency. (2018b). *A survey of freshwater angling in England. Phase 1 Report*. Environment Agency. Retrieved from https://www.gov.uk/government/publications/a-survey-of-freshwater-angling-in-england. Our account is for the 2019 calendar year, since this was the last full year for which data was available during the data collection and analysis phase.

3.1 Overview of the freshwater and freshwater fisheries accounts

These natural capital accounts are part of the continuing effort by many parties to better identify and value the benefits that society gains from nature. The 25-year Environment Plan commits the government to "protecting and growing natural capital – leading the world in using this approach as a tool in decision-making" (HM Government, 2018).

It lays out clear goals for 'clean and plentiful' water and 'thriving plants and wildlife and states that *"we will achieve clean and plentiful water by improving at least three quarters of our waters to be close to their natural state as soon as is practicable … and … we will achieve a growing and resilient network of land, water and sea that is richer in plants and wildlife."*

Rivers, canals, lakes and ponds are vital components of our natural capital but their benefits are inadequately identified and valued. The UK National Ecosystem Assessment (2011) found that this "has resulted in habitat losses that are amongst the fastest in the UK".

We present the natural capital accounts as extended balance sheets detailing the full logic chain from ecosystem asset, services and benefits to values (Tables 3.1 & 3.2 below). We deliberately present all of this information together, so that benefits and values are considered at the same time as the state of the underlying assets, which support them. All sources, assumptions and calculations are detailed in the Appendix.

Under the natural capital approach, we view the natural environment as a stock of assets. These assets provide a flow of ecosystem services to people, who benefit from them, and therefore value them. Figure 1, shows this flow of services from natural capital assets to people and the flow from asset, to service, benefit and (natural capital) value.

Figure 1: Natural Capital Logic Chain

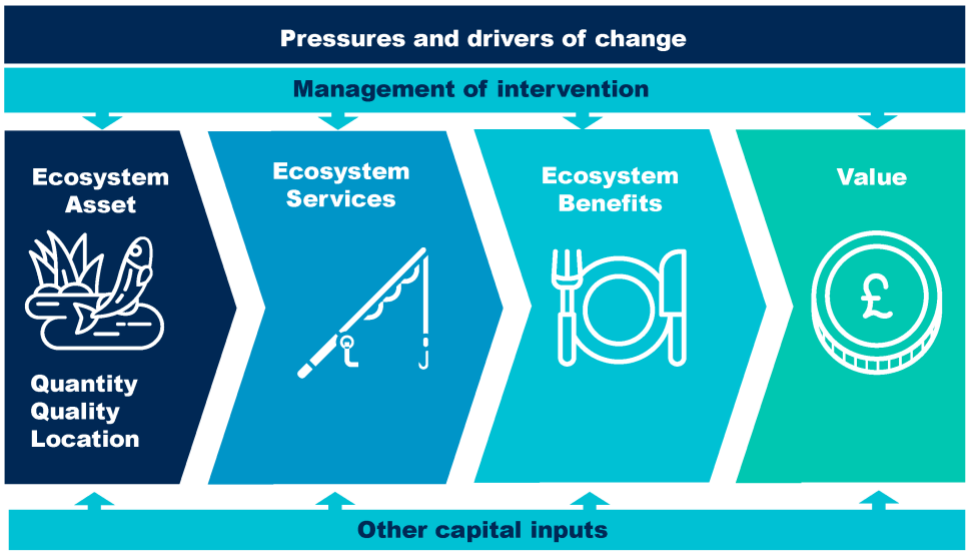


Figure 1 is based on Haines-Young and Potschin's ecosystem service cascade model (2011), reproduced from Sunderland et al. (2019).

The condition of our fisheries and the benefits we gain from them, are part of a wider picture; the overall condition of our rivers, canals, lakes and ponds. So, we start by sketching a natural capital account for freshwater (Table 3.2). This table clearly shows that the account categories for fisheries (in red) are but one vital part of the overall account. The overall account for fisheries is then presented as Table 3.3).

Guidance on interpreting the Natural Capital Account for Freshwater Fisheries (Table 3.3)

The *indicators* we have included in the fisheries account are necessarily a compromise between 'ideal' indicators and those for which suitable data is available. Further details on all of these indicators are included in the Appendix.

We include our assessment of *5-year trend*s; whether indicator values seem to be 'about the same' (=), improving (↑) or deteriorating (↓). These assessments are either for the last 5 years, where this data is available (e.g. EA annual fisheries statistics), or for the period since the (2015 e.g. Survey of Freshwater Angling).

Our list of ecosystem services and benefits aims to include all significant potential services and benefits, not just those that we can quantify or place an economic value on. In order to make this clear we assign *significance ratings*, to draw decision-makers attention to the most significant services, which will not always be those we can quantify and value. Our ratings are based on our assessment of the social significance of each benefit ranging from 1 (small) to 3 (large)[3].

Additionally, we have used colour-coded *confidence level categories* to indicate the quality of the information behind the monetary value estimates (Table 3.1).

Table 3.1: Key to confidence level categories for monetary value estimates

Category definition	Colour
We may have used some assumptions or estimation but consider these figures uncontroversial. Accuracy is better than + or -10%.	Green
We have used some assumptions or estimation and some of these may be open to question. Accuracy is better than + or -50%.	Amber
We are confident that the number is in the right order of magnitude. Order of magnitude implies that for an estimate of 5 that we are confident that the real figure is within the range 0.5 to 50.	Red
We can't offer a number which is likely to be in the right order of magnitude. This is due to unquantifiable uncertainty in the science, the data, valuation or the relationship between them.	*Not estimated* *or* *Not available*

Table 1 and our approach to confidence levels is based on Sunderland et al. (2019).

Some examples of our assessments and the way in which this should be interpreted follow. Number of individual anglers is coded green, implying accuracy within plus or minus 10%. This is because we have reliable up to date license sales data and the number of unlicensed anglers is probably less than 10%. Most other data has been coded orange or red. For example, total number of angling days per year is coded orange because we do not know how average days per angler per year has changed since the last detailed survey in 2015. Our estimate of consumer surplus from fishing is coded red, given the various assumptions and uncertainties detailed in the Appendix.

[3] This follows the approach in Sunderland, T., Waters, R., Marsh, D., Hudson, C., & Lusardi, J. (2019). Accounting for National Nature Reserves: A Natural Capital Account of the National Nature Reserves managed by Natural England. Natural England. Retrieved from http://publications.naturalengland.org.uk/publication/4535403835293696. Ideally assessment of significance should be based on a wider expert consultation and/or stakeholder engagement.

Table 3.2 Natural capital account for freshwaters in England (2019)

Ecosystem asset

Natural capital asset baseline		
Asset Attribute	**Indicator**	**Indicator Value**
Extent	River length ('000 km)	47.6
	Lakes and Standing Waters (km^2)	492
	Ponds (km^2)	178
	other extent indicators may be added	
Asset Quality	Surface water quality ecological status (% good, 2019) WFD	15%
	Surface water quality chemical status (% good, 2019) WFD	0%
Cultural		

Ecosystem services

Ecosystem service (common name)	**Description**
Provisioning Services:-	
Wild animals & their outputs	Fisheries (crayfish, salmon, trout) based on rivers, lakes and ponds
Materials from plants, animals & algae	Wetland grasses provide grazing, silage and hay
Materials from plants, animals & algae	Reeds, osiers (for basket making) and watercress
Water supply	Plentiful water for drinking, domestic use, irrigation, livestock, industrial use & wildlife
Navigation	Navigable waterways of sufficient depth and suitable velocity
Regulating Services:-	
Global climate regulation	Equable climate e.g. reduced risk of drought, flood & extreme weather events etc
Flood protection	Reduced flood risk affecting health & safety, housing, businesses & infrastructure
Flow regulation	River flow, groundwater recharge influenced by landscape location, water storage
Water quality	Clean water & pollution regulation, underpinning water supply, ecosystems, cultural services & health
Regional & local climate regulation	Freshwaters can influence local climate
Fire regulation	Open water bodies can act as natural fire breaks
Human health regulation	Natural freshwater systems can increase well-being and quality of life
Biodiversity/thriving wildlife	Biodiversity, of itself, and underpinning all other services including recreation & tourism, research and education, flood protection & climate regulation
Cultural Services:-	
Science and education	
Religion	Freshwaters are sites of historical baptism and religious festivals
Tourism and recreation	Recreational fisheries, tourism & recreation require good habitat
Sense of place	Water defines specific landscape character and features strongly in art and local culture
History	Freshwaters have played a key role in human history since prehistoric times

Benefits and values

Benefit	**Significance** (1 low to 3 high)	**Indicator**	**Annual benefit (£ millions)**
Benefits from provisioning services:-			
Food		Value of commercial fisheries production	
Crops		Value of production from wetland grasses	
Food and other products		Value of production from reeds, osiers & watercress	
Water supply		Value of water abstracted	
Navigable waterways		Net benefits from navigation	
Benefits from regulating services:-			
Equable global climate		Net benefits from reduced emissions of CO_2 (equivalent)	
Flood protection		Net benefits from flood protection	
Flow regulation		Net benefits from flow regulation	
Water quality		Net benefits from water quality	
Equable local climate		Net benefits from more equable local climate	
Less damage from fires		Net benefits from reduced fire damage	
Improved human health		Net benefits from improved human helath	
Benefits from thriving wildlife		Benefits from thriving wildlife underping all other ecosystem services	
Cultural wellbeing:-			
Science and education		Social and cultural benefits including benefits from angling	
Religion		Social and cultural benefits	
Tourism and recreation		Social and cultural benefits including benefits from angling	
Sense of place		Social and cultural benefits including benefits from angling	
History		Social and cultural benefits including benefits from angling	

Notes: Ecosystem service descriptions/details above are mainly based on UK NEA (2011,Table 9.1) and Sunderland et al., (2019, Table 4). Inland fisheries services and benefits are shown in red.

Table 3.3 Natural capital account for freshwater fisheries in England (2019)

Ecosystem asset

Asset (extent & quality)	Indicator	Indicator Value	5 year trend
Extent	River length ('000 km)	47.6	=
	Lakes and Standing Waters (km^2)	492	=
	Ponds (km^2)	178	=
Asset Quality	**River** water quality; ecological status (% good, 2019) WFD	15%	=
	Canal water quality; ecological status (% good, 2019) WFD	51%	=
	Lake water quality; ecological status (% good, 2019) WFD	14%	=
	Surface water quality chemical status (% good, 2019) WFD	0	=
Fish populations	Ecological Quality Ratio - EQR (% 'good' or better)	23%	=
	Principal salmon rivers at risk (%)	93	⇧
Cultural	Indicators for assets supporting fishing		
	No suitable national level indicators identified		

Ecosystem services

Ecosystem service (common name)	Indicator	Quantity where available	5 year trend	Confid-ence
Wild fish and their outputs	- Eels and elvers caught (value £)	38020	⇩	
	# of sea trout caught by rod (declared 2019)	25619	⇩	
	# of salmon caught by rod (declared 2019)	7911	⇩	
	- Trout and Grayling	*Not available*		
	- Coarse Fish	*Not available*		
Biodiversity/thriving wildlife	*No comprehensive indicator selected*			
Cultural Services				
Experiential and physical use	Number of individual anglers (2019)	835,000	⇩	
	Number of angling days (million/year)	17.0	⇩	
	Lakes, reservoirs and ponds	11.8		
	Rivers and streams	4.1		
	Canals	1.1		
	Coarse Fish	15.1		
	Trout and Grayling	1.9		
	Salmon and Sea Trout	0.1		
	Eels	*Not available*		

Benefits and values

Benefit	Significance (1 low to 3 high)	Indicator	Annual benefit £ millions	Confid-ence
Benefits from provisioning services (Food)	1	Value of commercial catch	0.04	
Benefits from thriving wildlife	3	Benefits from thriving wildlife	*Not estimated*	
Cultural wellbeing	3	Total expenditure by anglers	1600	
	3	Income supported (GVA) from total expenditure by anglers	1400	
		GVA broken down by:-		
	3	*Coarse Fish*	1210	
	3	*Trout and Grayling*	150	
	3	*Salmon and Sea Trout*	10	
	3	Consumer surplus from fishing	250	
	3	Physical and mental health and other benefits of fishing	*Not estimated*	
	3	**Total quantified benefits**	**1650**	
	3	**Significance of unquantified benefits**	**High**	

Notes: Confidence in values: Red is low, Amber is medium, Green is high. Benefit values are rounded to nearest 10 or 100 million. See the Appendix for sources, calculations and assumptions

3.2 Ecosystem assets

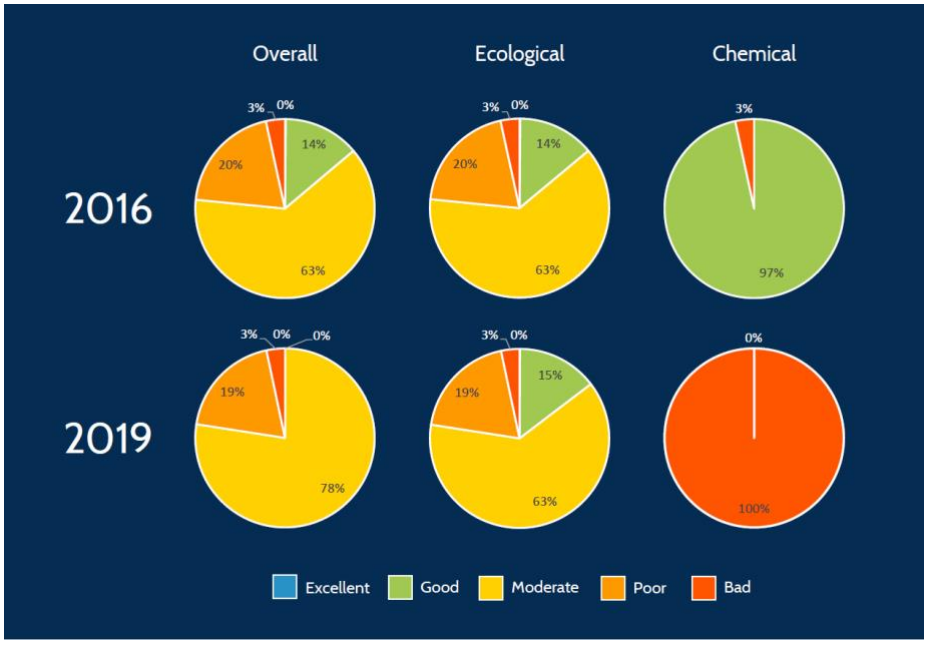
England's freshwater assets include 47,600 km of rivers, 492 km^2 of lakes and standing waters and 178 km^2 of ponds (Natural England, 2019) and several thousand km of canals[4]. While we do not have comprehensive data on the proportion of these assets that provide habitat for fish, we note that this proportion has increased in recent decades[5]. Improvements in chemical water quality and removal of obstructions to fish passage, have allowed fish to return to many rivers

UK's national ecosystem assessment (2011) found that:

> **…Overall freshwater quality has improved as a result of controls of industrial pollution and domestic sanitation, and reductions in the use of agricultural fertilisers have reduced the costs of providing potable water, as well as having direct health benefits. However, locally there are still issues with excessive abstraction and diffuse pollution of water bodies…**
> **(UK National Ecosystem Assessment, 2011, p. 34)**

Water Quality

Unfortunately, the rate of improvement has slowed since 2011. Analysis of Environment Agency data shows that only 15% of waterways – rivers, lakes and streams –were in ecological good health in 2019, about the same as 2016. In 2019, several chemicals were measured for the first time resulting in no waterways being assessed as meeting good chemical standards[6]. Figure 2 is based on analysis of EA data downloaded from the catchment data explorer[7].



[4] According to the Inland Waterways Association "there are 4,700 miles of canals and rivers that are navigable in the UK".
[5] Fish populations and angling effort are very heterogeneous across these assets, so use of per km or per ha indicators will generally be inappropriate.
[6] The change between 2016 and 2019 is largely related to an improvement in assessment methods with several chemicals being measured for the first time.
[7] Catchment data explorer is available here

Figure 2: Results of EA water status 2016 and 2019 (Rivers Trust, 2020)

The above assessment is supported by JNCC[8], which oversees the collection and publication of data on selected biodiversity indicators, including surface water status. According to the latest biodiversity indicators report "There has been little change in the overall number of surface water bodies in the UK awarded high or good ecological status since … 2009, and … little change … between 2014 and 2019" (Department for Environment food and Rural Affairs, 2020c, pp., p. 23). This data is summarised in Figure 3, below.

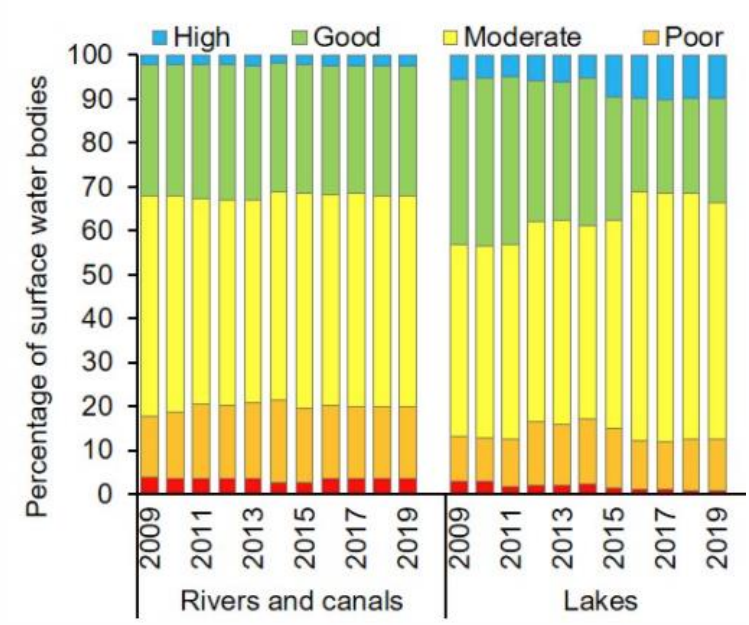


Figure 3: WFD overall water status classification 2009-2019
(reproduced from Defra (2020c, pp., p. 23)

[8] https://jncc.gov.uk/our-work/ukbi-b7-surface-water-status/

Fisheries

Salmonid and fisheries statistics published annually by EA, indicate that salmon are 'at risk' in 93% of the rivers in England (Environment Agency, 2020). Declining catches show that the proportion of rivers at risk has increased over the last five years.

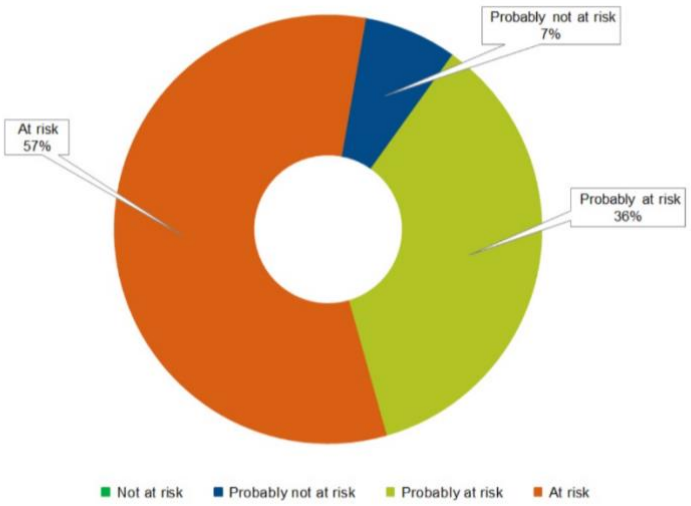


Figure 4: Salmon stock status in England, 2019
Reproduced from Environment Agency (2020)

Eels have been designated as a priority species under the UK Post-2010 Biodiversity Framework and are listed as Critically Endangered on the global IUCN Red List of Threatened Species. Eel management plans were developed in 2010 to set out actions to ensure at least 40% of potential adult eels will return to the sea to spawn (reproduce)[9]. It is believed that only one of the ten RBD's is meeting the silver eel escapement target[10].

The Ecological Quality Ratio - Fish (EQR)[11] provides an indication of the ecological state of England's freshwater assets. Data collected by the Environment Agency and processed by the Rivers Trust suggests that only 23% of sites have an EQR of high (0.7) or above.

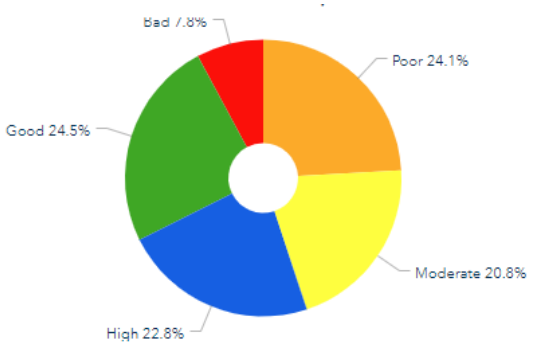


Figure 5: Ecological Quality Ratio (Fish) of freshwater sites in England
Based on Environment Agency data and analysis by the Rivers Trust here

[9] See Defra (2010) Eel Management plans for the United Kingdom here
[10] Personal Communication with EA Fisheries Staff.
[11] The ratio between the value of the observed parameter for a given surface water body and the expected value under reference conditions.

3.3 Ecosystem Services

England's freshwater natural capital (assets) deliver a wide range of ecosystem services (Table 3.1). Fisheries deliver a vital part of these services. We have (where possible) identified indicators, quantities and trends for ecosystem service as detailed in Tables 3.3 and 3.4.

Table 3.4 Freshwater fisheries, ecosystem services; indicators, quantities and trends

Ecosystem service (common name)	Indicator	Quantity where available	5 year trend
Wild fish and their outputs	# of sea trout caught by rod (declared 2019)	25,619	↓
	# of salmon caught by rod (declared 2019)	7,911	↓
	- Trout and Grayling	*Not Available*	
	- Coarse Fish	*Not Available*	
	- Eels and elvers caught (value £)	38,020	↓
Biodiversity/thriving wildlife	*No indicator*		
Cultural Services			
Experiential and physical use	Number of individual anglers (2019)	835,000	↓
	Number of angling days (million/year)	17.0	↓
	Lakes, reservoirs and ponds	11.8	
	Rivers and streams	4.1	
	Canals	1.1	
	Coarse Fish	15.1	
	Trout and Grayling	1.9	
	Salmon and Sea Trout	0.1	
	Eels	*Not Available*	

At national level, most ecosystems services are in decline. Catches of salmon, sea trout, eels and elvers in 2019, were below the average for the last five years. At the same time, the number of individuals who engage in angling is falling, as is the total number of days fished each year.

The different categories of ecosystem service were well summarised in the national ecosystem assessment (UK National Ecosystem Assessment, 2011, Table 9.1):-

- Provisioning services include fisheries based on rivers, lakes and ponds, wetland grasses, reeds & osiers, water for drinking, irrigation, livestock & industry and navigable waterways;
- Regulating services include climate regulation, flow regulation, flood protection and water quality; and
- Cultural services include tourism and recreation (including recreational fisheries) as well as important services related to sense of place, religion and history.

The quantity, quality and location of assets influences the delivery of these ecosystem services, as does management and external pressures. We are able to quantify only a proportion of these ecosystem services. Where we are able to quantify the ecosystem services we do so based on a combination of evidence and assumptions. For example

number of fishing days (an indicator of cultural services) is estimated based on a survey conducted by the Environment Agency in 2015, data on the number of individual licensed anglers in 2019 and an assumption about the average number of days fished by each angler.

Data on the status of fish populations and the number of salmon caught each year is likely to be reasonably accurate at national level. Population status data may be less accurate at local level and we do not have a reliable way of assessing annual catches of trout, grayling and coarse fish. There are also a number of important ecosystem services, which we are unable to quantify. These include biodiversity/thriving wildlife, global climate regulation, flow regulation and local climate regulation.

3.4 Value and significance of benefits

Society values natural capital for the enjoyment people gain from these assets and the benefits they provide. We have noted all important categories of benefits and where possible have estimated their monetary value.

The commercial fishing in freshwater is very limited and its benefits are assessed as being of 'low' significance overall. It comprises eel and elver catches and historically a char fishery in some Lake District lakes. Environment Agency (2020) reported the value of eels and elvers caught as £38,020. Salmon and Sea Trout net and trap, marine and estuarine fisheries depend on the health of the freshwater environment but are not included in this account. Aquaculture and rainbow trout harvested for food from some reservoirs are also not included in this analysis.

Around 835,000 individuals enjoyed freshwater angling in 2019[12]. This number, based on licence sales is conservative, since family members who benefit from the 'angling experience' often accompany anglers. In addition, there may be 40-80,000 people who benefit from angling but do not buy a licence[13]. We provide a breakdown by type of fishing and type of water body. Almost 70% of angling days take place on stillwaters (lakes, reservoirs and ponds), mainly for coarse fish. The remaining 30% takes place in rivers and streams (24%) and canals (6%), see Table 3.4 below.

Recent trends suggest that anglers fish for an average of ~20 days per year and so enjoy ~ 17 million angling days per year, in total[14]. We estimate the monetary value of benefits to society from freshwater fisheries in England is, of the order of, £1.7 billion per annum. This is comprised of gross value added (GVA) of ~£1.4 billion and consumer surplus of ~£250 million.

Table 3.5 Angling effort by water body and type of fish (% of total angling days)

	Stillwaters	Rivers	Canals	All
Coarse	62.6%	19.4%	6%	88.4%
Trout & Grayling	6.7%	4.2%		11.0%
Salmon & Sea Trout		0.6%		0.6%
All	69.4%	24.2%	6.5%	100.0%

Note: The data in this Table is based on Environment Agency (2018b)

[12] In 2020, the first year of the Covid pandemic, the number of licensed anglers increased by 15% to 960,000.

[13] We assume 5-10% of anglers are unlicensed. The authors of the Environment Agency 2007 report (EA, 2007, Appendix B) provide a 'best guess' that there were 2 million unlicensed angler days in 2005; equivalent to 7% of licensed angler days. EA (2018, p.5) referred to estimates in EA (2007) and reported that the impacts of unlicensed anglers are "expected to be negligible".

[14] If average days per angler have remained at 2015 levels then our estimate of total angling days would increase to ~ 19 million.

Most (89%), of this £1.7 billion is related to coarse angling, since they account for most angling days. The remainder is accounted for by brown & rainbow trout & grayling angling (11%) and salmon & sea trout angling (1%). Salmon and sea trout anglers spend more (per day or per angler) than coarse anglers and may also enjoy higher levels of consumer surplus from fishing; for example non-trip related expenditure per angler day is estimated to be ~ £43 across all types, but ~ £68 for salmon and sea trout[15].

We estimate the monetary benefits of angling based on three main indicators; angling expenditure, angling GVA and consumer surplus. The first two indicators are compatible with conventional. national accounting methods, while consumer surplus captures some of the benefits of fishing that are not included in national accounts

Table 3.6 Annual benefits from freshwater fisheries

Benefit category	Indicator	Quantity where available (£ millions)
Food	Total value of commercial catch	0.04
Benefits from thriving wildlife	*No indicator*	*Highly significant*
Cultural wellbeing	Total expenditure by anglers	1600
	Income supported (GVA) from total expenditure by anglers	1400
	GVA broken down by:-	
	Coarse Fish	1210
	Trout and Grayling	150
	Salmon and Sea Trout	10
	Consumer surplus from fishing	250
	Other physical and mental health and other benefits of fishing	*Highly significant*
	Total quantified monetary benefits	**1650**

Estimates of household income gross value-added (GVA) represent the level of economic activity supported by expenditure on fishing. In this case, annual expenditure by anglers of ~£1.6 billion supports ~£1.4 billion of additional economic activity. Anglers and others gain significant benefits *in addition* to this expenditure related benefit of ~£1.4 billion.

These benefits include the physical and mental health benefits, over and above what anglers spend. Economists use the concept of consumer surplus to quantify the benefits that accrue directly to anglers. In this report, we use the benefit of an improvement of fishing quality from low to medium as an indication of the benefit of maintaining waterbody fishing quality at medium or better. This value (~£35/angler day), based on stated and revealed preference analysis conducted for the EA in 2015 (Environment Agency, 2018c), it includes benefits to existing anglers and the benefits resulting from an increase in angling. We use data on the Ecological Quality Ratio (EQR) of multiple sites across England to apply this benefit to 44% of angling days; this produces an estimate of ~£250 million of consumer surplus to anglers, per year[16].

[15] These are updated estimates based on Environment Agency (2018b)

[16] Ideally we would relate direct estimates of the benefit of maintaining fishing quality to data on fishing quality at the sites where anglers fish. Our figure is based on an estimate of the benefit of improving fishing quality and is applied pro rata to the percentage of waterways with EQR above 0.4.

We are not able to fully estimate the magnitude of all of the benefits people gain from angling (e.g. physical, mental health and other benefits). There is increasing evidence of very significant physical, mental and other benefits from recreational activity and nature – which are closely associated with recreational fishing. Some of these are noted in the appendix. The biodiversity benefits associated with freshwater fisheries are also highly significant.

The benefits from freshwater fisheries that we can value in money terms [income supported GVA plus consumer surplus] provide total annual benefits of ~ £1.7 billion per year.

The benefits provided by freshwater natural capital are far greater and are only briefly indicated here[17]. They include the benefits of water abstraction, navigable waterways, flood protection, water quality, biodiversity, and recreation, physical and mental health[18]. The Environment Agency launched a natural capital register and account tool in early 2021, which will assist with valuation of some of the benefits provided by freshwater.

Given this approximation, this estimate is speculative as indicated by a red confidence colour code in Table 3.2.

[17] The Office for National Statistics (2017b) estimated the annual value of freshwater ecosystems as £1.4 billion in 2014. This was based on £1 billion for water abstraction, £18 million for pollution removal and £322 million for recreation. Benefits for water quality, flood control and many other highly valuable services are not included. In addition the benefits from recreation are based on estimated travel costs and do not include the non-trip associated expenditure of anglers or the wider social benefits of angling and recreation associated with freshwater.

[18] There is a growing literature on physical and mental health benefits, see Appendix A4.6.

Appendix Data sources, assumptions and calculations for the fisheries accounts

4. Asset extent

4.1 Asset extent indicators	
Indicators	River length ('000 km) Lakes and standing waters (km^2) Ponds (km2)
Data sources	Data on the national extent of freshwater assets is drawn from Natural England's National Natural Capital Atlas (Natural England, 2019). - Length of rivers is mapped using EA's Water Framework Directive (WFD) river waterbodies dataset (cycle 1, to include coastal streams) - Area of lakes and reservoirs mapped using the Centre for Ecology and Hydrology (CEH)'s UK Lakes Portal dataset
Values for England	River length ('000 km) 47.6 Lakes and standing waters (km^2) 492 Ponds (km^2) 178
Five-year trend	Not available
Data sources for local estimates	Similar data is available for 44 local areas in local natural capital atlases available here, also reproduced in section 4.8 below.

5. Asset quality

5.1 Water Framework Directive indicators	
Indicators	Surface water quantity status (WFD), % good Surface water quality ecological status (WFD), % good Surface water quality chemical status (WFD), % good
Data sources	WFD data downloaded from EA, available on RT Fisheries Hub – Beta, can be analysed at different levels of aggregation.
Values for England	Surface water quality ecological status (WFD), % good 15% Surface water quality chemical status (WFD), % good 0%
Five-year trend	= *'About the same'* Little change in the overall number of surface water bodies in the UK awarded high or good ecological status between 2014 and 2019 " (Department for Environment food and Rural Affairs, 2020c, pp., p. 23).

	Chemical status is also thought to be 'about the same', overall. This is harder to assess because the criteria used to report chemical status changed over the period.
Data sources for local estimates	See Data sources, above.

5.2 Salmon rivers at risk

Indicator	Percentage of principal salmon rivers at risk
Data sources	This value is provided in the salmonid and fisheries statistics published annually by EA. The report for 2019 published on 28 July 2020 is available here Our indicator is for England only, and includes rivers at risk plus rivers probably at risk. Data from Figure 1 in the supplementary tables. Figure 1 - England salmon stock status 2019 Risk Value — Number of rivers — Percentage of total Not at risk — 0 — 0% Probably not at risk — 3 — 7% Probably at risk — 15 — 36% At risk — 24 — 57%
Value for England	Percentage of principal salmon rivers at risk 93%
Five-year trend	↓ % of rivers at risk is increasing Current format of reporting % of salmon rivers at risk started in 2018 with 91% of principal salmon rivers probably at risk. Clear trend of declining salmon catches.
Data sources for local estimates	EA provides estimates for each river in the supplementary data tables. Also see (ICES, 2020, pp., p.66)

5.3 Ecological quality ratio

Indicators	Percentage of waters with Ecological Quality Ratio (EQR) of moderate (0.4) or high (0.7) or above.
Data sources	EQR data downloaded from EA, available on RT Fisheries Hub – Beta, can be analysed at different levels of aggregation. Further information on EQR is available on the Catchment Based Approach website here and as part of the ToolHab decision support system here
Value for England	EQR moderate (0.4) or above: 44% EQR good (0.7) or above: 23%
Five-year trend	Advice from EA suggests "little change in recent years"
Data sources for local estimates	See Data sources, above.

6. Ecosystem services

6.1 Ecosystem service categories and names

We adopt 'plain English' ecosystem service category names – mainly based on UK NEA (2011, Table 9.1) and Sunderland et al., (2019, Table 4). These categories are mainly based on the Common International Classification of Ecosystem Services (CICES v. 4.3) to ensure consistency with work by the Office for National Statistics (ONS) and international approaches. We follow Natural England in renaming some of the CICES categories to increase accessibility for a non-specialist audience.

Table 6-1: Ecosystem services and associated benefits included in the fisheries accounts

Ecosystem service	Common name adopted in natural capital accounts	Description of services	Benefits
Wild animals & their outputs	Wild animals & their outputs *Wild fish & their outputs*	Production of wild fish & their outputs	Net benefits from commercial wild fisheries
Maintenance of nursery populations and habitats	Thriving wildlife/Biodiversity	Biodiversity, in of itself, and underpinning all other services such as recreation (including wildlife watching), tourism, research and education, food from wild populations & aquaculture, flood protection (sea grass beds, dunes), climate regulation	Benefits from thriving wildlife
Cultural services	Cultural Services (recreation, tourism and volunteering)	Cultural wellbeing. This includes: Capabilities e.g. knowledge, health, dexterity, judgement Experiences e.g. tranquillity, inspiration, escape, discovery Identities e.g. belonging, sense of place, rootedness, spirituality, sense of history Non-use values: existence, bequest, altruistic, option	Benefits from recreation, tourism and volunteering
	Cultural Services (scientific and educational)		Benefits from scientific and educational services
	Cultural Services (appreciation of nature)		Benefits from other aspects of nature/fisheries

6.2 Ecosystem service indicators

This section provides estimates of ecosystem service flows, as well as the methodology followed.

As noted in section 3.3 of the main report, there are a number of important ecosystem services that we are unable to quantify using currently available data.

6.2.1 Fish and fish products

Indicator	Value of fish caught commercially (in freshwater)
Data sources	Environment Agency (2020)
Value for England	Eels, elvers & lamprey value ~ £38,000 Salmon net and trap fisheries in estuaries are small and declining and many are due to be phased out. Total catch (in estuaries) in 2019 was 579 kg from salmon net fisheries and 541 kg[19] net catches of sea trout. These marine fisheries depend on the health of the freshwater environment but are **not** included in this account. Aquaculture and rainbow trout harvested for food from some reservoirs are also **not** included in this analysis. Annual salmonid and fisheries statistics e.g. Environment Agency (2020), provide the following data for 2019:- Salmon net catches (England) excluding Drift, T and J nets – not freshwater: 135 Salmon 579kg (Table 15) Sea trout net catches (England) excluding Drift, T and J nets: 415 541 kg # of Salmon and sea trout caught 548
Five-year trend	↓
Data sources for local estimates	As above

6.2.2 Wild fish and their outputs

Indicator	Number of fish caught
Data sources	Individuals who purchase licenses to fish for salmon or sea trout are required to provide catch returns to the Environment Agency (EA). Anglers reporting their catch returns online need to know:- - "your fishing licence number

[19] Catches from drift, T and J nets are excluded since these are taken from the sea. These catches in estuaries and are not included in this freshwater account.

	- your postcode - the rivers where you fished - the number of days you fished before and after 16 June - the species of fish you caught - how you caught the fish - how many fish you released - the weight of the fish" See "Report a catch return" This data is then used to a provide "a summary of the declared catches of salmon, sea trout, eels, smelt and lamprey by rods, nets and other fishing instruments" The report for 2019 published on 28 July 2020 is available here Data for England is extracted from Tables 9 to 12. *For the 2019 season, EA received returns for 76% of the total licences issued. The accuracy of these catch statistics (as indicators of the total numbers of fish caught) has not been assessed.* An additional indicator is catch per unit effort (CPUE). Data is published annually; see Cefas (2019). The 2019 CPUE for net fisheries was significantly lower than in recent years. "Rod CPUE in 2019 decreased on 2018 in all regions, except the North East and Southern, and was below the previous 5-year mean in all regions, except the North East (Table 21)".
Value for England (2019)	Salmon caught (rod) 7,647 Salmon caught (net) 264 Sea trout caught (rod) 11,531 Sea trout caught (net) 14,088 Eels and elvers £38,020 (value caught) Estimates for the number of trout, grayling and coarse fish caught are not available.
5-year trend	↓ Salmon catch was 8% below the 5-year mean in 2019 Sea trout catch (rod) was 13% below the 5-year mean the net and fixed engine catch was 98% below Eel and Elver catch also below 5-year average
Data sources for local estimates	Annual salmonid and fisheries statistics include catch data by area and by river.

6.2.3 Biodiversity/thriving wildlife

Indicator	We have not identified a single indicator that would usefully provide data on this service
Data sources	None identified

Value for England	No comprehensive indicator selected
Data sources for local estimates	None identified

6.2.4 Cultural services – number of anglers

Indicator	Number of individual anglers
Data sources	Our estimate of the number of individual anglers is based on data provided by EA on the number of individual/unique anglers who purchase licences to fish on freshwater waterways each calendar year. For consistency with previous estimates (EA, 2008,2018) we do not include the 40 - 80,000 people who benefit from angling but do not buy a licence[20].
Value for England	835,000 (2019), 958,000 (2020)
5-year trend	↓ Number of individual anglers has fallen by 15% since 2015 (984,708). In 2020, the first year of the Covid pandemic, the number of individual anglers buying licenses increased by 15% to 958,000.
Data sources for local estimates	Not estimated at local level. Many anglers fish at different locations, so we cannot estimate the number of individual anglers at local level, without double counting.

6.2.5 Cultural services – angling effort

Indicator	Number of angling days
Data sources	Our estimate of the number of angling days is calculated from *Number of unique anglers x average angling days per angler* We assume that average days per angler continues to fall at 2.6% per annum (the annualised rate for 2005 to 2015). This gives average days per angler in 2019 of 20.4 compared to 22.7 in 2015.

[20] We assume 5-10% of anglers are unlicensed. The authors of the Environment Agency 2007 report (EA, 2007, Appendix B) provide a 'best guess' that there were 2 million unlicensed angler days in 2005; equivalent to 7% of licensed angler days. EA (2018, p.5) referred to estimates in EA (2007) and reported that the impacts of unlicensed anglers are "expected to be negligible".

	A 2018 survey by the Angling Trust (2019) found "35.6% of respondents said that they had done less angling in the last 12 months, 21.4% said that they had done more". *If average days per angler have remained at 2015 levels then our estimate of total angling days would increase to ~ 19 million.* Care should be taken in assessing angling effort via "angling days per angler" since participation is often varied & irregular, sporadic & episodic, often of long duration and highly seasonal (Brown, Dash, Harrison, & Tarpey, 2016).
Value for England	17 million (2019)
5-year trend	↓ Number of angling days is estimated to have fallen by 24% since 2015 (22.3 million)
Data sources for local estimates	Angling days by area are estimated based on the share of angling days by water body type, fishing type and RBD in 2015 and projected total angling days in 2019.

6.2.6 Angling days by fishing type, water body type and area

The following data is included in the fisheries natural capital accounts spreadsheet (Tab 4 Angling days by fishing type)

Angling days by fishing type										
Summary (% of total angling days)		Based on EA (2018)								
	Stillwaters	**Rivers**	**Canals**	**All**						
Coarse	62.6%	19.4%	6%	**88.4%**						
Trout & Grayling	6.7%	4.2%		**11.0%**						
Salmon & Sea Trout		0.6%		**0.6%**						
All	**69.4%**	**24.2%**	**6.5%**	**100.0%**						
Notes:										
Angling days (2019) are estimated based on the share of angling days by water body type, fishing type and RBD in 2015 and projected total angling days in 2019										
Total Angling Days (2019)	*rounded to nearest hundred days*									
Water Body type	**Rivers**	**Rivers**	**All water bodies**	**Stillwaters**	**Stillwaters**	**Canals**	**All water bodies**	**All water bodies**	**All water bodies**	
Fishing type	**Coarse**	**Trout & Grayling**	**Salmon & Sea Trout**	**Coarse**	**Trout & Grayling**	**Coarse**	**Coarse**	**Trout & Grayling**	**All fishing types**	
Anglian	672,000	99,400	100	2,177,300	152,900	228,600	3,077,900	252,300	3,330,200	
Dee (England only)	12,200	7,600	1,700	39,800	7,600	3,800	55,800	15,300	72,800	
Humber	732,400	145,300	1,800	2,370,000	237,000	249,200	3,351,600	382,300	3,735,700	
North West	321,100	76,500	19,300	1,037,400	122,300	108,600	1,467,100	198,800	1,685,200	
Northumbria	42,800	53,500	29,700	139,100	84,100	-	182,000	137,600	349,300	
Severn (England only)	328,700	76,500	12,800	1,066,500	122,300	112,400	1,507,600	198,800	1,719,100	
Solway, Tweed (England onl	13,800	7,600	10,700	44,300	15,300	-	58,100	22,900	91,700	
Sout East	246,200	68,800	2,700	795,800	114,700	83,300	1,125,300	183,500	1,311,500	
South West	204,900	84,100	22,900	662,100	137,600	69,600	936,500	221,700	1,181,200	
Thames	720,900	99,400	200	2,332,500	152,900	244,600	3,298,100	252,300	3,550,500	
Total by destination	**3,295,000**	**718,700**	**101,900**	**10,664,800**	**1,146,700**	**1,100,100**	**15,060,000**	**1,865,500**	**17,027,200**	
All adjusted to reflect estimate for total angling days (2019)	EA, 2018, Table 3.13	EA, 2018, Table 3.16	EA, 2018, Table 3.12	EA, 2018, Table 3.14	EA, 2018, Table 3.17	EA, 2018, Table 3.15	Calc (3.13+3.14+3.15)	Calc (3.16+3.17)	Calc (sum of 3.12 to 3.17)	

Data on angling days for salmon and sea trout is also collected via catch returns and reported in the annual salmonid and fisheries statistics available here.

Anglers submitting catch returns declared ~84,000 days[21] fished for salmon and sea trout, by rod and net, in England and Wales in 2019. While this is around 20% lower than the estimate of 101,900 detailed above, some of the discrepancy may be explained by anglers not submitting returns.

[21] See Tables 17 and 18 Supplementary Data Tables: Salmonid and Freshwater Fisheries Statistics for England and Wales, 2019 available here

7. Benefit indicators

7.1 Food	
Indicator	Value of commercial catch
Data sources	Annual salmonid and fisheries statistics e.g. Environment Agency (2020), provide the following data for 2019:- Drift, T and J net catches occur in the sea and so are excluded Salmon net catches (England) 541kg, Sea trout net catches (England) 541 kg. Environment Agency (2018a, p. 31) provides average 2018 prices of £11.20/kg for salmon and £6.92 for trout giving total of ~ £10,000 after adjusting for inflation Eels, elvers & lamprey value ~ £38,000
Value for England	~£50,000
Data sources for local estimates	As above

7.2 Benefits of biodiversity/thriving wildlife	
Indicator	We have not identified a single indicator that would usefully provide data on benefits of this service
Data sources	None identified
Value for England	No comprehensive indicator selected
Data sources for local estimates	None identified

7.3 Total expenditure by anglers	
Indicator	Total expenditure by anglers
Data sources	EA (2018) estimated total expenditure by anglers in 2015 based on a large sample survey. Our estimate for 2019 assumes that total non-trip expenditure and trip related expenditure per day have remained about the same as in 2015 (in real terms). Myrvold, Mawle, Andersen, and Aas (2019) provide a mean expenditure estimate of Euro 100 per day on Salmon angling in 2017, for England and Wales based on (Environment Agency, 2018b) and Mawle (2018). Also see Marine Scotland (2017). Environment Agency (2018a) provides more detailed data on expenditure by salmon and sea trout anglers.
Value for England	£1.6 billion (2019)
5-year trend	↓

	Expenditure is estimated to have fallen from £1.9 billion (CPI adjusted) in 2015. This is consistent with reduction in the number of individual anglers.
Data sources for local estimates	Expenditure estimates have been broken down at RBD level.

7.4 Income supported GVA

Indicator	Income supported GVA by anglers
Data sources	EA (2018) estimated total expenditure by anglers in 2015 based on a large sample survey. The detailed method used in estimation of Gross Value Added (GVA) is provided the EA (2018) report. We estimate GVA based on the same overall multiplier as in EA (2018).
Value for England	£1.4 billion (2019)
5-year trend	↓ GVA is estimated to have fallen consistent with reduction in expenditure by anglers.
Data sources for local estimates	GVA estimates can be broken down at RBD level.

7.5 Consumer surplus from fishing

Indicator	Consumer surplus from fishing
Data sources	We use the benefit of an improvement of fishing quality from low to medium as an indication of the benefit of maintaining waterbody fishing quality at medium or better. This value (~£35/angler day) is based on stated and revealed preference analysis conducted for the EA in 2015 (Environment Agency, 2018c) and data on the Ecological Quality Ratio (EQR) of multiple sites across England. 17 million angling days x 44% of fishing days, experience fishing quality of moderate or better x £35 = £266 million. Alternative approach using estimate by Marine Scotland 17 million angling days x £14.12 = £240 million We adopt £250 million (rounded to the nearest £50 million)
Value for England	~ £250 million
Data sources for local estimates	See Data sources, above.

7.6 Additional information on the consumer surplus from fishing

EA (2018) use combined stated and revealed preference data to estimate the increase in consumer surplus per day from an improvement in fishing quality from size small to medium and quantity low to medium, of £35.47 after adjusting for inflation. Benefit for an improvement from size medium to large and quantity medium to high, is £10.98. These benefits are per baseline fishing day and include the additional benefit resulting from additional fishing days (because of increase in fishing quality).

The Environment Agency uses data from the National Water Environment Benefits Survey (NWEBS) as an indication of the benefit of maintaining waterbodies in good condition or higher. The NWEBS value for a status change from moderate to good is used as an indication of the benefit of maintaining the waterbody in good status or better. In effect, the benefit flow is valued in terms of avoided deterioration in water quality (EA, pers com, 2020).

Marine Scotland (2017) estimated anglers' consumer surplus e.g. "the benefit that anglers obtain from their angling, over and above their financial cost". Their estimate of £17 million from annual angling days in Scotland of 1.3 million, equates to £13.08 per angler day (£14.12/day after adjusting for inflation).

7.7 Physical and mental health benefits

Estimates of the physical and mental health benefits angling would require specialist input to develop and are outside the scope of this report. According to the Department for Environment food and Rural Affairs (2020a) the valuation evidence for 'supporting physical health' is "some evidence, but incomplete or uncertain".

Relevant recent work includes the following:

Physical health benefits for UK urban areas are included in ONS Urban Natural Capital Accounts (Office for National Statistics, 2019).

ONS (2019) does not include physical and mental health benefits, beyond those that may be indicated by willingness to pay for recreational visits and housing with access to green/blue space. This avoids double counting, since at least some of these benefits will already have been included in the benefits of recreational visits.

Dickie, Boshoff, Gianferrara, and Porter (2018) estimate the increase in quality of life resulting from increased physical activity associated with recreational visits to greenspace. They note that these welfare gains may double count the welfare value of recreational visits (above) and so do not include them in aggregate values.

Dickie et al. (2018) also estimate health costs per inactive person to be around £650 and avoided direct and indirect clinical health costs of inactivity to be nearly £56 million per year in Greater Manchester. Mental health benefits are estimated to be approx. 5% of all mental health related spending – totalling £264 million per year.

A recent review by Public Health England (2020) found that "£2.1 billion per year could be saved in health costs if everyone in England had good access to greenspace, due to increased physical activity in those spaces".

Rogerson, Barton, Bragg, and Pretty (2019) provide evidence that

"Wildlife Trust projects are successfully accessing individuals with low levels of personal wellbeing; and that project attendance was associated with statistically significant improvements in individuals' mental wellbeing. The percentage of participants reporting low wellbeing scores (defined by UK norms) declined from 39% at baseline to only 19% at 12-weeks"

7.8 Climate regulation

Estimation of carbon emission/sequestration attributable to freshwater or fisheries is a very complex[22] area. **I recommend** that this indicator is not included in these accounts

[22] One approach would be to base emission factors for freshwater on median values reported in Bolt et al., (2017), the RSPBs natural capital account of their estate in England, which used values derived from a review of scientific literature. Values are included for 'open water' ranging from +3.07 to +7.65 tonnes of CO_2 equivalent per hectare per year, based on papers by Casper et al. (2000), Stets et al. (2009) & Finlay et al. (2010). These estimated values depend on the productivity and nutrient content of the water. In general less productive lakes with lower nutrient status emit less CO_2 equivalent – so typical values for oligotrophic (low nutrient) lakes are +3.07 to + 8.8, while values for eutrophic or mesotrophic lakes are + 6.07 to + 7.65.

On this basis, we might estimate total emissions from lakes and ponds in England of ~460,000 tonnes CO_2 equiv per year *(492 km^2 lakes + 178 km^2 ponds) x 100 x 6.86 = 459,620.* This does not include an estimate of emissions/sequestration from rivers.

"One of the most recent estimates of global GHG emissions from lakes and impoundments found that … about 72% of the climatic impact of GHG emissions (in CO_2-equivalents) from lakes and impounded waters is due to CH_4." Beaulieu, J. J., DelSontro, T., & Downing, J. A. (2019). Eutrophication will increase methane emissions from lakes and impoundments during the 21st century. *Nature Communications, 10*(1), 1375. doi:10.1038/s41467-019-09100-5

Accordingly, the assessment reports of the Intergovernmental Panel of Climate Change moved from conceptualizing freshwater waters as a passive channel of carbon from the continents to the ocean in previous assessment reports, into a model that acknowledges that freshwater waters simultaneously act as conduits from land to sea, sediment carbon sinks, and sources of atmospheric CO2 and CH4 (IPCC 2013).

8. References

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