Environment Agency

Evidence

A survey of freshwater angling in England

Phase 2: non-market values associated with angling

We are the Environment Agency. We protect and improve the environment.

Acting to reduce the impacts of a changing climate on people and wildlife is at the heart of everything we do.

We reduce the risks to people, properties and businesses from flooding and coastal erosion.

We protect and improve the quality of water, making sure there is enough for people, businesses, agriculture and the environment. Our work helps to ensure people can enjoy the water environment through angling and navigation.

We look after land quality, promote sustainable land management and help protect and enhance wildlife habitats. And we work closely with businesses to help them comply with environmental regulations.

We can’t do this alone. We work with government, local councils, businesses, civil society groups and communities to make our environment a better place for people and wildlife.

Published by:
Environment Agency, Horizon House, Deanery Road, Bristol, BS1 5AH

http://www.gov.uk/government/organisations/environment-agency

ISBN: 978-1-84911-417-2

Further copies of this report are available from our publications catalogue:
http://www.gov.uk/government/publications

or our National Customer Contact Centre:
T: 03708 506506

Email: enquiries@environment-agency.gov.uk

Author(s):
Paul Metcalfe, Paulo Rui Anciaes and Antara Sen

Dissemination status:
Publicly available

Keywords:
valuation, angling, stated preference, revealed preference, angling appraisal tool

Research Contractors:
RPA Ltd, Farthing Green House, 1 Beccles Road, Loddon, Norfolk, NR14 6LT
Tel: 01508 528465

Dr Paul J Metcalfe, 1 Walford Close, Wimborne, Dorset, BH21 1PH
Tel: 01202 831316

Accent, Chiswick Gate, 598-608 Chiswick High Road, Chiswick, London W4 5RT
Tel: 020 8742 2211

Collaborator:
Dr Guy Mawle

Environment Agency’s Project Manager:
Graeme Peirson

Evidence at the Environment Agency

Scientific research and analysis underpins everything the Environment Agency does. It helps us to understand and manage the environment effectively. Our own experts work with leading scientific organisations, universities and other parts of the Defra group to bring the best knowledge to bear on the environmental problems that we face now and in the future. Our scientific work is published as summaries and reports, freely available to all.

This report is the result of research commissioned by the Environment Agency's Research, Analysis and Evaluation group.

You can find out more about our current science programmes at https://www.gov.uk/government/organisations/environment-agency/about/research

If you have any comments or questions about this report or the Environment Agency's other scientific work, please contact research@environment-agency.gov.uk.

Professor Doug Wilson
Director, Research, Analysis and Evaluation

Executive summary

Angling is one of the most popular participant sports in England. The aim of this two-phase project was to produce an up-to-date and comprehensive national-scale assessment of the economic value of freshwater angling in England. The first phase (reported separately) used the results of an expenditure survey to estimate annual spending by anglers on freshwater angling and angling-related products and services, and the impact of this expenditure on employment and business.

This report presents the findings of the second phase, which estimated the economic values of marginal changes in key variables of fishery quality and quantity. These values were derived by combining the findings of stated preference (SP) and revealed preference (RP) research into anglers' willingness to pay (WTP). The SP results (based on hypothetical scenarios) were obtained from a separate SP survey and the RP results (based on observed 'real world' behaviour) from data provided by the expenditure survey. A further objective was to combine the SP and RP analyses to develop an appraisal/simulator tool to enable managers to estimate robust economic values to anglers from changes in site characteristics.

Key findings from the SP research

WTP for increases in fish size, fish abundance and changes in fish species present at a site varies significantly by fishing type preferences, fishing trip frequencies, age, gender and household income group. This variation between anglers in their valuation of different these attributes indicates a fragmented angling market. This needs to be taken into account when considering the provision of angling opportunities.

The overall WTP values are indicative of the average preferences and preferences of different groups or segments of anglers for their trips and do not represent the WTP for improvement to any fishing site. This is because these values are not based on a full market model which includes the location of angling opportunities relative to the population and how people react to these different opportunities.

Key findings from the RP research

Anglers prefer sites that are close to their home as well as sites that offer good fishing facilities. In addition, anglers living near to large numbers of high quality fisheries will, on average, make a greater number of angling trips. Although the RP analysis had several limitations, the method was used because it was based on anglers' actual choices and hence could be used to ground hypothetical choices from the SP exercises with real choice behaviour to estimate robust and realistic WTP values.

Overall findings

Table 1 shows that changes in the type of fishery and increases in fish size and abundance are all predicted to cause substantial switching of visits to the site and the generation of new visits, on average. The finding that switching fishery type from coarse to either game or mixed is predicted to increase visits might be considered counterintuitive given that there are more coarse anglers than game anglers. However, the finding is consistent with the tendency for game anglers to travel further to fish than coarse anglers, making the catchment of potential game anglers larger.

Increasing the quantity of fish from low to medium has a much larger relative effect than increases from medium to high. This partly reflects the lower marginal value of increasing quantity beyond medium, but is also because the baseline number of visits is much higher for fisheries offering a medium quantity of fish, on average; further increases in visit numbers thus represent a much smaller rise in percentage terms per visit than for fisheries initially offering only a low quantity of fish.

Table 1 Predicted average impacts on numbers of visits to sites

Type of change	Average change in number of visits (as % of baseline number)		
	Switched visits	**New visits**	**Total**
Type of fishery			
Coarse to game	66	4	70
Coarse to mixed	130	8	138
Fish size			
Small to medium	146	9	155
Medium to large	104	6	110
Fish quantity			
Low to medium	331	18	349
Medium to high	31	2	33

Table 2 shows the predicted impacts of the same changes in fishery characteristics on consumer surplus – the principal economic measure of value to anglers. The values take into account the increases gained from those who continue to visit the site following the change, and the value gained by those who choose to switch their visits, or who make visits that they would not otherwise have made anywhere. Like Table 1, **Table 2** shows increases in value from changing fishery type from coarse to game or mixed, and higher values for increasing the size from small to medium than from medium to large, and for increasing the quantity of fish from low to medium than from medium to high. Additional findings from the research included that the specific site characteristics that anglers value the most are the availability of fishing spots and/or pegs, no visible pollution and a beautiful or attractive environment.

Table 2 Predicted average impacts on consumer surplus

Type of change	Average change in consumer surplus (per baseline visit)	
	Central estimate	**95% confidence intervals**
Type of fishery		
Coarse to game	£5.02	(£4.85, £5.19)
Coarse to mixed	£9.58	(£9.26, £9.91)
Fish size		
Small to medium	£10.63	(£10.27, £10.99)
Medium to large	£7.76	(£7.50, £8.02)
Fish quantity		
Low to medium	£22.27	(£21.52, £23.02)
Medium to high	£2.43	(£2.35, £2.51)

Appraisal tool

The values obtained from the research were incorporated into an appraisal spreadsheet tool (available to download alongside the report). The tool allows users to create bespoke scenarios of changes in angling quality at an individual fishery. Users can input alternative scenarios to obtain predicted impacts on visitor numbers, consumer surplus and revenue for the site in question. Results obtained from the tool were used to derive aggregated WTP estimates, both overall and by river basin district. Results are also used in a series of case studies presented in the report.

Contents

List of tables and figures

1 Introduction

Angling is one of the most popular participant sports currently practised in England, with estimates of the numbers of anglers in recent decades varying between 1 million and 4 million. Angling takes place in rivers, lakes, canals and ponds all over England as well as in estuaries and all around the coast.

The Environment Agency has legal duties to enhance the economic and social value of fishing, and to consider social and economic values in decision-making – as with implementation of the Water Framework Directive (WFD). The Environment Agency's Corporate Strategy (2011 to 2015) includes an objective to ensure that all sections of society can enjoy water and wetlands through angling and other recreational activities. Angling is therefore very relevant to the business of the Environment Agency. For the Environment Agency to work effectively with partner organisations to achieve this objective, up-to-date knowledge of the socioeconomic value of angling, and how it may be changing, is crucial.

1.1 Project objectives

The overall objective of this project was to produce an up-to-date and comprehensive national-scale assessment of the economic value of freshwater angling in England that:

- could be used as a baseline for future assessments
- could be deployed at local, catchment and project-specific scales

The project's specific objectives were to:

- use the results of an expenditure survey (ES) to estimate annual expenditure on freshwater angling and angling-related products and services, and the impact of this expenditure on employment and business
- evaluate the impact of marginal changes in key variables of fishery quality, such as access and the quantity and quality of fish present, on the economic value for fishing of anglers
- develop an appraisal tool that could be used by managers at local, catchment and project-specific scale to estimate the economic benefits to anglers from changes in site characteristics

The first of these objectives was addressed in Phase 1 of the project via a dedicated report on the ES and its findings (Environment Agency 2018).

This report focuses on the second and third objectives, that is:

- to present estimates of the economic values from marginal changes in key variables of fishery quality and quantity
- to describe the appraisal tool that has been developed

1.2 Valuation approach

The valuation approach consisted of estimating a revealed preference (RP) model and a stated preference (SP) model, and then linking the estimates from the RP and SP models together.

The main advantage of using an RP method is that the data are based on actual angling behaviour, namely the choice of which sites to visit and how often to participate in angling. However, the RP method relies solely on recent fishing activity and so is limited in its ability to derive predictions with respect to future improvements in water quality. In contrast, SP methods are based on choices made in hypothetical settings, but are well-suited to provide valuations of novel or future states of the world. Fortunately, SP data can be combined with RP data to exploit the strengths of both approaches while minimising their shortcomings (Adamowicz et al. 1997, Whitehead et al. 2008, Abildtrup et al. 2015, Whitehead and Lew 2015). The linking of estimates from the 2 models can result in more robust and realistic valuations of policy changes for relevant user groups than possible when using either method in isolation.

The values obtained from this research have been incorporated in a spreadsheet-based appraisal tool which accompanies this report. The tool allows users to create bespoke scenarios with respect to changes in angling quality at the level of the individual fishery (that is, rivers and transitional waters as well as private fishing sites on stillwater and canals). The tool allows the user to input alternative scenarios with respect to changes in angling quality to obtain predicted impacts on visitor numbers, consumer surplus and revenue for the site in question.

1.3 Structure of this report

Sections 2 and 3 describe the SP and RP research components respectively.

Section 4 brings the 2 sets of research outputs together in the form of a combined SP–RP model. It also describes the development and application of the appraisal tool.

Section 5 presents the conclusions from Phase 2 of the project.

The various appendices provide supplementary information, including:

- the questionnaires for the SP and ES surveys (Appendices A and B respectively)
- technical reports on the SP, RP and combined SP–RP analyses
- a user guide for the appraisal tool

2 Stated preference research

This section focuses on the design, administration and analysis of the SP survey, and the willingness to pay (WTP) findings resulting from this analysis. The survey objectives were to:

- obtain estimates of the value to anglers of changes in key characteristics of angling quality (for example, access, quantity and size of fish)
- ensure that these value estimates could be used in conjunction with results from the RP analysis to create a combined SP–RP appraisal tool for estimating the values to anglers from changes in angling-related characteristics such as fish size and fish abundance at specified fisheries

Section 2.1 describes the design and development of the SP survey.

Section 2.2 provides details of the survey administration, including characteristics of the data samples obtained.

Section 2.3 compares the SP survey sample and the larger ES sample in terms of important variables.

Section 2.4 presents the main results from the SP analysis.

Section 2.5 discusses the validity of the SP surveys.

Section 2.6 draws conclusions with respect to the SP analysis.

2.1 SP survey design and development

2.1.1 SP design overview

The development of the SP survey involved a number of stages.

In the first stage, the Environment Agency was consulted on the attributes of fisheries for which values were needed, ultimately arriving at a viable set for inclusion within the survey. The literature review carried out for this study (see Appendix C) contributed to this stage of the design.

Based on the required list of attributes, a format for the survey was developed based around 2 exercises:

- the SP1 exercise focused on choices between hypothetical site alternatives
- the SP2 exercise contained questions about most and least important features of a site when choosing where to go fishing

These 2 exercises could be linked because they included a common set of attributes.

The next stage of the design phase involved producing experimental designs for the 2 exercises. Finally, the designs were tested via a pilot survey before implementation in the main fieldwork phase.

The following sections describe each SP exercise in turn, including:

- the format of the questions
- the attributes and levels included

- the experimental design procedures
- the type of analysis performed on the resulting data

2.1.2 SP1: site choice exercise

SP1 choice format

The purpose of the SP1 choice exercise was to explore the trade-offs that anglers make between different characteristics of a site, including cost, when choosing where to go fishing. This type of choice was considered a natural way to measure anglers' values for different site features and could viably be linked to a comparable RP analysis of anglers' observed choices of sites to visit in the real world.

The SP1 choice exercise was displayed to respondents as a sequence of questions like the example shown in Figure 2.1. In each question, respondents were asked to consider which, if any, of the site alternatives shown they would choose in the case of an actual occasion when they had been fishing if these were the only sites available to choose from.

If these sites were the only options available to you when you decided where to go fishing on your recent trip, which would you be most likely to choose and which would you be least likely to choose? If you would be most likely not to have gone fishing at all if these were the only sites available, then please indicate this by ticking the relevant box.

Choice Card 1

Site Characteristics	Site A	Site B	Site C	Site D
Water body type	**River**	**River**	**River**	**River**
Method	**Multi-method**	**Fly fishing only**	**Multi-method**	**Multi-method**
Fish species 1	**Salmon/Sea trout**	**Salmon/Sea trout**	**Salmon/Sea trout**	**Mixed coarse fish**
Size	Small	Medium	Medium	Large (specimen)
Quantity	Medium abundance	High abundance	High abundance	High abundance
Fish species 2	**Trout (Wild)**	**Predators (pike/perch/zander)**	**Predators (pike/perch/zander)**	**Barbel**
Size	Medium	Large (specimen)	Large (specimen)	Large (specimen)
Quantity	Medium abundance	Low abundance	Low abundance	Low abundance
Fish species 3		**Mixed coarse fish**	**Mixed coarse fish**	**Trout (Wild)**
Size		Small	Medium	Small
Quantity		High abundance	High abundance	Low abundance
Distance of site from your home	**20 miles**	**5 miles**	**10 miles**	**50 miles**
Cost of a day's fishing	**£10**	**£50**	**£30**	**£150**

Most likely to choose

Least likely to choose

I would not choose any of the above sites

Figure 2.1 Example of SP1 question format

Prior to the SP1 choice questions, respondents were given some preliminary guidance on what to expect and how to answer the questions (see Appendix A for the SP survey questionnaire).

The SP1 exercise included 8 choice questions for each respondent of the kind shown in Figure 2.1. This number was chosen on the basis that more choice questions provide more data, but can also lead to respondent fatigue, particularly when the survey is lengthy and the choices are fairly complex.

In addition to asking for their most likely choice, respondents were also asked to state their least likely choice. This resulted in a substantial increase in data, and thus statistical precision, without much additional effort on the part of respondents. The outside option choice ‘I would not choose any of the above sites’ was also included in case respondents would choose not to visit any of the alternatives at the cost (of permission to fish) and distance indicated.

SP1 attributes and levels

The set of attributes and levels included in the experimental design for the SP1 exercise are listed in Table 2.1. These attributes and levels were developed following a literature review (see Appendix C) and discussions with the Environment Agency.

The first attribute included in the exercise was ‘Water body type’ with 3 levels*:* river, stillwater and canal.

The second attribute was ‘Fish species type’, with 9 species types. The levels were generally additive rather than mutually exclusive, with up to a maximum of 3 species types shown per site. All combinations of water body type and fish were considered for the design except for some infeasible combinations agreed with the Environment Agency and discussed below. ‘Mixed coarse fish’ included all species other than those specified elsewhere.

The third attribute was ‘Fish size’, with 3 levels: small, medium and large (specimen). When describing this attribute before the choice questions, respondents were instructed to consider that the given fish size was relative to the average for that species.

The fourth attribute was ‘Quantity of fish’ with 3 levels: low, medium and high. When describing this attribute, respondents were again instructed to consider that the given fish abundance was relative to the average for that species and of that size.

The fifth attribute was ‘Fishing method’ with 2 levels: multimethod and fly-fishing only.

The sixth attribute was ‘Distance of site from respondent’s home’, with the levels shown in Table 2.1. The distances were linked to respondents’ base trip,[1] as discussed in the section below on ‘SP1 experimental design’.

The final attribute was ‘Cost of a day’s fishing’, that is, the cost of obtaining permission to fish for a day. See Table 2.1 for the levels included in this attribute. Although season tickets are available for many waters, the choice construct was based on a single fishing trip and so season prices were not appropriate. When describing this attribute, it was explained to respondents that, where a season permit was in place, they would need to estimate the daily rate as season permit cost divided by total trips to waters covered by the permit.

The levels used to represent the cost of a day’s fishing at site were based on discussions with the Environment Agency and were restricted to reasonable ranges depending on water body type, fish species type, size and abundance level of fish species types. A skewed distribution for prices was assumed, with the bulk of fisheries in the low to middle price ranges, small numbers of fisheries in the very cheap price

[1] The most recent fishing trip for the respondent’s most frequent fishing type reported in the SP survey.

ranges and fewer fisheries in the more expensive categories (see Appendix D for details.)

Table 2.1 SP1 attributes and levels

Attribute	Levels
Water type	River, stillwater, canal
Fish species	Trout (wild) Trout (stocked) Grayling Salmon/sea trout Mixed coarse fish Predators (pike/perch/zander) Barbel Carp Catfish (stocked)
Size of fish	Small Medium Large (specimen)
Quantity of fish	Low abundance Medium abundance High abundance
Method	Fly-fishing only Multimethod
Distance from home	1, 2, 5, 10, 15, 20, 30, 50, 100, 200, 300 miles
Cost of a day's fishing	£0, £5, £10, £15, £20, £25, £30, £40, £50, £60, £75, £100, £125, £150, £200 and £250

SP1 experimental design

Levels were selected for each of these attributes for each alternative in each choice situation to create the sequences of choices put in front of respondents in the survey. The levels of all the attributes were varied across the alternatives according to an experimental design which was generated in several steps.

In the first step, a full profile dataset was created which consisted of all possible combinations of water body, fish species and levels of fish size, abundance and costs. A set of general restrictions relating to water body type, fish species, fishing method (see Table 2.2) and cost restrictions (see Appendix D) were applied to the full profile dataset to create a restricted profile dataset.

The restricted profile dataset was crossed with the distance levels to generate a 'short trips' dataset and a 'long trips' dataset. The reason for creating these 2 datasets was to avoid presenting site alternatives with excessively long/short distances to respondents who visited sites closer to or further off from their home during their base fishing trip respectively. The short trips dataset consisted of distance levels ≤100 miles and was created for respondents who travelled <30 miles for their base fishing trip. The long trips dataset consisted of distance levels ≥5 miles and was created for respondents who travelled >30 miles for their base fishing trip. This approach meant that respondents would only choose between site alternatives within a reasonable range of distances given the distance they travelled on their base trip.

The restricted profile dataset was used to create 18 versions of each of the 4 choice profiles. In each of these versions, a total of 240 choice sets was created, divided into 30 blocks, so that each respondent was presented with 8 choice questions.

Site alternatives A and B were linked to respondents' behaviour on their base fishing trip. Specifically:

- The water body types in A and B were always set equal to water body type visited on the respondent's base fishing trip.
- The fishing method in A and B were set equal to multimethod if the base species[2] was not trout, grayling or salmon/sea trout. If the base species was stocked trout, wild trout, grayling or salmon/sea trout, the fishing method was set equal to 60% fly-fishing and 40% multimethod.
- Species1 in A and B were set equal to the respondent's base species group.

For site alternatives C and D, the fishing method was set to be equal to 80% multimethod and 20% fly-fishing.

In the final step, the choice profiles were combined into choice situations ensuring that the species types in each of the 4 choice profiles were presented in a randomised order.

The dependencies and restrictions used for the design, which were agreed with Environment Agency, are shown in Table 2.2.

Table 2.2 SP design dependencies and restrictions

Dependency	Restriction
Water body type	IF 'River' THEN Species ≠ 'Catfish'
	IF 'River' AND Species = 'Salmon/Sea trout', 'Trout (stocked)', 'Trout (wild)' OR 'Grayling' THEN Species ≠ 'Carp'
	IF 'River' AND Species = 'Carp' THEN Quantity = 'Low abundance' AND Size= 'Medium/Large' AND present with 'Mixed Coarse'
	IF 'Still water', THEN Species ≠ 'Salmon/Sea trout' OR 'Grayling'
	IF 'Still water', AND Species = 'Trout (stocked)' OR 'Trout (wild)' THEN Species ≠ 'Catfish' OR 'Barbel' OR 'Carp'
	IF 'Still water' AND Species = 'Barbel' THEN Quantity = 'Low/Medium abundance'
	IF 'Canal' THEN Species ≠ 'Trout (wild)', 'Trout (stocked)', 'Grayling', 'Salmon/Sea trout', 'Barbel' OR 'Catfish'

[2] The type of fish species fished by the respondent during their base fishing trip

Dependency	Restriction
	IF ‘Canal’ AND Species = ‘Carp’ THEN Quantity =‘Low abundance’ AND Size = ‘Medium/Large’ IF ‘Canal’ THEN distance ≤30
Fish species	IF Species = ‘Catfish’ THEN Quantity = ‘Low abundance’ AND Size = ‘Medium/Large’ IF Species = ‘Barbel’ THEN ‘Mixed Coarse’ present IF Species=‘Trout (stocked)’ THEN Size=‘Medium/Large’ IF Species=‘Grayling’ THEN ‘Trout (wild)’ OR ‘Trout (stocked)’ present Species must be different in the same water body and must appear in a logical and random order. There should be at least 2 species except where ‘Stillwater’ AND ‘Mixed Coarse’ AND ‘Canal AND ‘Mixed Coarse’ Species 3 should be ‘Mixed Coarse’ OR Blank/Missing IF Species = Coarse (named) and base distance ≤30 THEN distance ≤30 IF Species = Coarse (named) and base distance>30 THEN distance ≤100 IF Species = Mixed coarse/any and base distance ≤30 THEN distance ≤20 IF Species = Mixed coarse/any and base distance >30 THEN distance ≤50
Fishing method	IF Species = (‘Trout’ OR ‘Salmon/Sea trout’ OR ‘Grayling’) THEN Method = 60% ‘Fly’ and 40% ‘Multimethod’ for site alternatives A and B IF Species ≠ (‘Trout’ OR ‘Salmon/Sea trout’ OR ‘Grayling’) THEN Method = ‘Multimethod’ for site alternatives A and B Method = 80% ‘Multimethod’ and 20% ‘Fly’ for site alternatives C and D
Distance	IF base distance <30: distance ≤100 IF base distance ≥30: distance ≥5
Cost of a day’s fishing	The cost of a day’s fishing was restricted to reasonable ranges depending on water body type, fish species type, size and abundance level of fish species types. See Appendix D for further details on price restrictions

Notes: Base distance is the one-way travel distance between the angler’s home the site visited during their base fishing trip.

2.1.3 SP2: MaxDiff exercise

SP2 choice format

The attributes included within the SP1 exercise were only a small subset of the total number of attributes that Environment Agency wished to obtain values for. For the additional attributes, use was made of the MaxDiff technique, otherwise known as best–worst scaling, which deals effectively with large numbers of attributes and which could be linked to the SP1 exercise via the inclusion of a common attribute.

An important feature of the MaxDiff format is that it requires attributes to be described in terms of 2 levels only. Hence, all the additional attributes were described in a single phrase, with an implied (or in some cases explicitly stated) counterfactual. An example of the type of MaxDiff question used in the survey is shown in Figure 2.2.

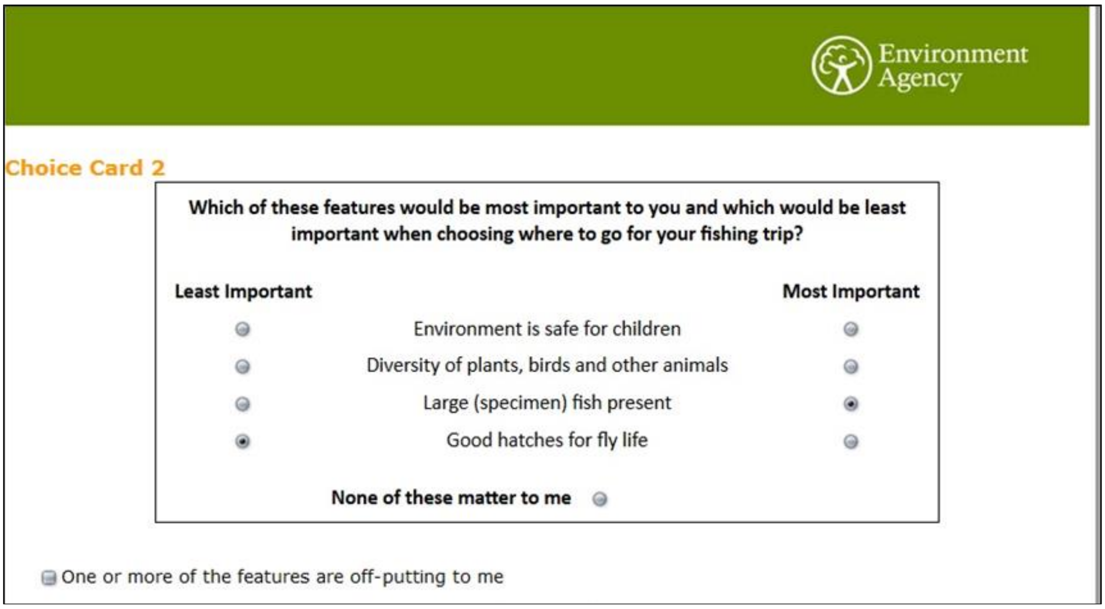

Figure 2.2 Example of SP2 question format

Respondents were shown 8 such questions and asked to indicate their most important and least important attribute choices. Questions were placed in the case of the same actual occasion when they had been fishing as asked about in the case of the SP1 exercise.

The choices included 2 additional options:

- ‘None of these matter’
- ‘One or more of the features are off-putting to me’

See Appendix E for an analysis of the responses for this latter option.

SP2 attributes

The set of attributes included in the experimental design for the SP2 exercise is shown in Table 2.3. The attributes ‘Abundance’ and ‘Size’ were included in the SP2 exercise to serve as linking attributes with the SP1 choice exercise. The reason for not using ‘Method’ as another linking attribute is discussed below.

Table 2.3 SP2 attributes

Attribute	Description
Abundance	High abundance of target species – exceptional catches common
Size	Large (specimen) fish present
Litter	Site is free of litter
Pollution	No visible pollution
Pegs	Good availability of fishing spots and/or pegs at site
Crowding	Very few other anglers
Disturbance	Lack of disturbance from other site users (for example, boating or cycling)
Accessibility	Good footpaths for easy access to fishing spot
Limited parking	Free car park available near the water, with maximum stay of 3 hours
Unlimited parking	Free car park available near the water, with no time limits
Toilets	Public toilet available at or near site
Plants and wildlife	Diversity of plants, birds and other animals
Methods	All legal fishing methods permitted (that is, no restrictions)
Flies	Good hatches of fly life
Take	(Limited) catch can be taken away, rather than catch and release
Safety	Environment is safe for children
Crime	A very low crime rate
Environment	A beautiful or attractive environment

SP2 experimental design

The experimental design for the SP2 exercise was created to generate all possible combinations of 4 different attributes for each choice occasion. These were then blocked into a design so that each respondent saw only a subset of the combinations (see example in Figure 2.2).

Taking the sample of responses, this approach provided a good quality dataset for understanding the relative importance of each of the attributes, including for segment analyses.

2.1.4 Pilot testing and refinement

The SP designs were pilot tested on a sample of 95 anglers. Overall, the SP exercises were judged as having worked well. However, 2 changes were recommended, namely:

- revising the price restrictions in the experimental design with the aim of lowering charges for the relevant fisheries

- amending the SP survey questions so that the focus was on a typical trip for the angler

These changes were made and incorporated in the main survey. The full pilot report was submitted to the Environment Agency on 27 November 2016.

2.2 SP survey administration

2.2.1 Target population

The target population for the research included all those aged more than 16 who were resident in England and held an Environment Agency rod licence (required for angling in England) at any time in 2016.

2.2.2 Survey mode

A mixed mode research design was adopted, including an online survey and a computer assisted telephone interview (CATI) component. This combined approach was chosen because:

- an online methodology offered a cost-effective way of obtaining a large sample
- a CATI approach would be able to correct for biases inherent in a pure online approach since not all anglers have easy access to the internet

2.2.3 Sampling and recruitment

The sample was obtained from the Environmental Agency's database of rod licence holders.

There were no quotas for the online elements or the CATI survey. The aim was to achieve a sample broadly matching the profile of the sample database large enough to analyse different trip types, in terms of target fish, separately.

Licence types varied in 2 dimensions:

- the fish species (T&C – trout and coarse; S&S – salmon and sea trout, in addition to trout and coarse)
- the length of the licence (short-term, annual)

Three different sample files were used for the survey:

- **ES sample (re-contacted)**. Anglers who had taken part in this earlier survey (Environment Agency 2018) and who had agreed to be contacted again for further research.
- **ES sample (unused)**. Anglers who were in the original sample but had not been previously contacted and so did not respond to the original survey.
- **Fresh sample of short-term licence holders**. A small number of anglers with a short-term licence were invited for the first time to participate in the SP survey.

The breakdown by sample type and survey mode is shown in Table 2.4.

Table 2.4 Breakdown of responses obtained by sample type and survey mode

Sample breakdown	Number of interviews		
	Online	CATI	Total
Previous sample – recontacts	2,381	57	2,438
Previous sample – unused	0	160	160
New short-term licence sample	593	33	626
Total	**2,974**	**250**	**3,224**

The ES had 10,000 online complete responses and 500 CATI complete responses. For the SP survey, the original intention had been to obtain a sample size of 50% of the original complete responses by re-contacting those who had not opted out (7,536 contacts). A target of 5,000 online and 250 CATI complete responses was therefore set.

A total of 7,536 online invitations were sent to previous participants, which yielded 2,381 completed surveys. As in the ES, only anglers who were resident in England were invited to participate. The invitation was by email and those who had not completed the survey within the required timeframe received a reminder.

The response rate (32%) was lower than had been anticipated. Accent, the company contracted to carry out the survey, believed this was due to:

- the long gap between the 2 surveys, which were originally meant to run nearly concurrently
- the survey being run very close to Christmas

The SP survey pilot showed that short-term licence holders were less likely to complete the second online survey than full licence holders, and tended to fall out of scope when contacted again to take part in the CATI survey. Again this was due to the gap between surveys (which meant that those who had previously held a short-term licence were either no longer in scope or had changed their fishing behaviour) and the consequent change in criteria; in the ES, participants had to have a licence in 2015, while in the SP survey it was a licence in 2016.

To obtain a sufficient number of complete responses, new short-term licence holders were invited to participate in the SP survey main stage. The Environment Agency provided a sample of new contacts who had purchased a short-term licence in 2016 and had not previously been contacted for the survey. A total of 30,391 invitations were sent to these contacts, which yielded 593 completed online surveys of which 314 were short-term licence holders. The remainder completed the survey as full licence holders. This was possible because participants can hold more than once licence type and were categorised in the survey according to the most expensive licence they held in 2016. Even though the response rate from the additional contacts was low (2%), a sample of over 300 short-term licence holders was achieved which would not have been possible without the fresh sample.

2.2.4 Fieldwork

CATI surveys were conducted using a phone–post/phone–email approach. Participants were first recruited over the telephone. If they were in scope and agreed to take part, questions that did not require 'show material' were asked first. Subsequently, participants were invited to take part in the next part of the survey requiring show material; the interviewer offered the choice of posting or emailing the show materials. If they agreed to take part using emailed show materials, participants were given a choice to carry on with the survey or complete it later. For those who requested show materials to be sent by post, an appointment was made for a later date to complete the survey.

Telephone fieldwork was conducted from Accent's dedicated telephone unit in Edinburgh. Pilot fieldwork was undertaken between 17 and 20 November 2016, with main stage following from 7 December 2016 to 8 January 2017. Telephone interviewers were briefed to ISO 20252:2012 standards.

Interviewers were provided with briefing notes which included information about the background and methodology of the project, as well as possible questions and suggested answers from the Environment Agency. The first half of the briefing was spent discussing these briefing notes. The second half of the briefing involved explaining the use of the questionnaire and the procedures for selection of respondents, followed by performing a mock interview so that interviewers could get a good feel for the structure and content of the questionnaire.

On average, the survey took 23 minutes to complete online and 26 minutes to complete over the telephone.

2.2.5 Sample characteristics

A total of 3,224 anglers with a current fishing rod licence were surveyed, of whom 2,974 completed the survey online and 250 took part in the CATI survey. Survey responses of pilot interviews (95) and main stage interviews (3,129) were combined, as no significant amendments were made after the pilot. The total number of achieved interviews by age and licence type is shown in Tables 2.5 and 2.6.

Overall, the older age groups (that is, 45–74) were overrepresented and the younger age groups were underrepresented. The latter could be due to the lower engagement of the younger age groups with angling and their availability to take part in the survey. The oldest age group (over 75s) was also underrepresented, which may be a result of them being less likely to have an email address and/or wish to complete an online survey.

The actual proportion of short-term licence holders in the SP survey was slightly lower than had been estimated based on the population database. This was due to several factors:

- The lower engagement of short-term licence holders in angling made them less likely to participate overall. This was also observed in the ES.
- The long gap in time between the ES and the SP survey, and the change in criteria from 2015 licence holders to 2016 licence holders, resulted in a response rate among the re-contacts being lower for short-term licence holders.
- Those who held both short-term and annual licences were categorised in the survey as full licence holders.

Even though in theory the new sample comprised short-term licence holders, almost half of those participants said they had also had an annual licence and were therefore recorded as such.

Table 2.5 Sample breakdown by age and survey mode

Age	CATI		Online		Total		Environment Agency population database[1]
	No. of interviews	% of total	No. of interviews	% of total	No. of interviews	% of total	% of total
17–24	16	6.4%	75	2.5%	91	2.8%	10.7%
25–34	22	8.8%	182	6.1%	204	6.3%	19.2%
35–44	22	8.8%	269	9.0%	291	9.0%	16.5%
45–54	56	22.4%	612	20.6%	668	20.7%	19.0%
55–64	59	23.6%	942	31.7%	1,001	31.0%	16.4%
65–74	48	19.2%	815	27.4%	863	26.8%	13.5%
75+	27	10.8%	79	2.7%	106	3.3%	4.5%
Prefer not to say							0.07%
TOTAL	**250**	**100.0%**	**2,974**	**100.0%**	**3,224**	**100.0%**	**100.0%**

Notes: [1] Population total excludes juniors (16 and under) and does include some duplicate licences. Source: Environment Agency database of licence sales April 2015 to March 2016

Table 2.6 Sample breakdown by licence type and survey mode

Licence type	CATI		Online		Total		Environment Agency Population database[1]
	No. of interviews	% of total	No. of interviews	% of total	No. of interviews	% of total	% of total
T&C annual	131	52.4%	2,457	82.6%	2,588	80.3%	76.8%
T&C short-term	39	15.6%	358	12.0%	397	12.3%	20.9%
S&S annual	54	21.6%	143	4.8%	197	6.1%	1.8%
S&S short-term	26	10.4%	16	0.5%	42	1.3%	0.5%
TOTAL	**250**	**100.0%**	**2,974**	**100.0%**	**3,224**	**100.0%**	**100.0%**

Notes: [1] Population total excludes juniors (16 and under) and does include some duplicate licences. Source: Environment Agency database of licence sales April 2015 to March 2016
Licences include over 65 and disabled licences but not junior licences.
T&C = trout and coarse; S&S = salmon and sea trout

2.2.6 Weights

As indicated in Tables 2.5 and 2.6, the sample was not representative with respect to some of the respondent characteristics measured in the survey. To correct for this, a set of calibrated survey weights was generated using an iterative proportional fitting, or raking, procedure. The raking procedure generated survey weights to match the sample weighted totals of age, gender, licence type and fishing licence type with the target population. The raked weights were trimmed so that the upper bound on the greatest value of the weights was set equal to 4, and the lower bound on the smallest value of the weights was set equal to 0.25. This adjustment was performed to ensure that the weights were not excessively small or large for any of the respondents.

2.3 Data from SP survey

This section presents a comparison of the characteristics of the expenditure and the weighted SP survey data (where possible). The ES sample provides the best estimates with respect to the population of all base fishing trips, whereas the SP sample used for modelling focused on a recent base trip of each of the respondents. It is therefore desirable that the samples should be consistent with one another which, in general, they are.

2.3.1 Comparison of ES and SP survey samples

A comparison of angling effort (that is, days spent fishing) by fishing and water body types is shown in Table 2.7. The figures in the second and third columns were calculated as a percentage of the total days fished (that is, total angling days). The results show that the distribution of days fished obtained from the SP sample reflects reasonably closely the population distribution of total angling days obtained from the ES sample except that the SP sample contains a greater number of trout and grayling days fished than the ES sample.

Table 2.7 Percentage of angling days by fish and water body types

	ES sample	SP sample
Coarse fish or eels		
Rivers or streams	19%	16%
Lakes/reservoirs/ponds	63%	59%
Canals	6%	4%
Brown trout, rainbow trout or grayling		
Rivers	4%	6%
Lakes/reservoirs/ponds	7%	14%
Salmon or sea trout		
Rivers or streams	1%	1%
Total	**100%**	**100%**

Notes: ES sample data taken from Environment Agency (2018, Table 3.5)

Figure 2.3 compares the average one-way distance travelled by anglers by fishing type from the ES and the SP samples. A significantly higher percentage of longer distances were travelled for salmon and sea trout angling, owing to the uneven geographical distribution of these fisheries.

There is a reasonably close match between the 2 samples in terms of the average distances travelled for the different fisheries, although there are somewhat higher distances travelled for salmon and sea trout fishing days in the SP survey than in the ES, and somewhat shorter distances travelled for trout fishing days.

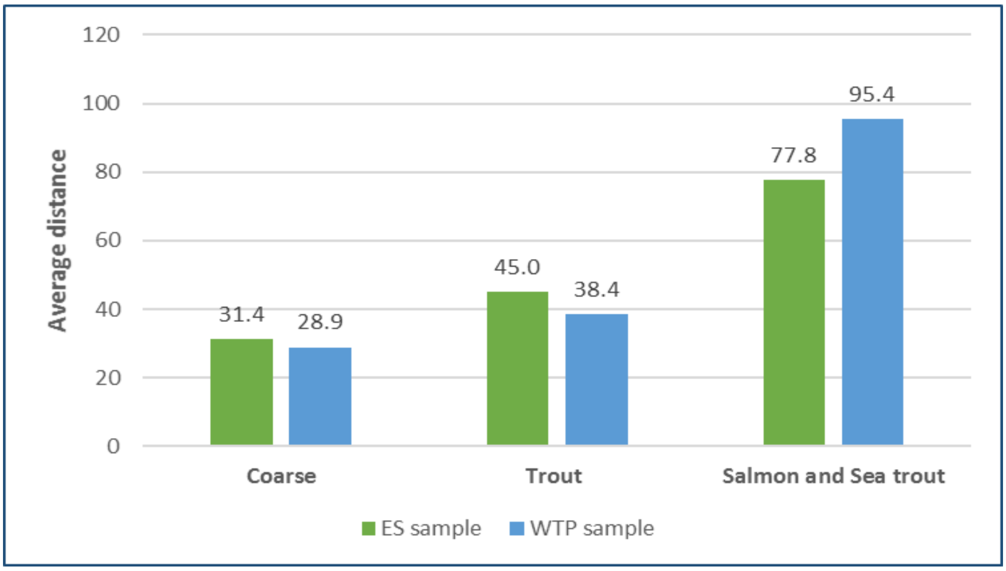

Figure 2.3 Average distance travelled by fishing type (miles)

Note: WTP sample refers to the sample used in the SP analysis

Tables 2.8 and 2.9 compare the 2 samples in terms of angler origins and destinations by river basin district (RBD) respectively.[3]

- Most anglers in both the samples originated from the Thames, Humber, Anglian and North West RBDs (in that order) (Table 2.8).
- Most of the fishing seemed to have taken place in the Humber, Thames, Anglian and Severn RBDs (Table 2.9).
- The SP sample distribution of angler origins and destinations seem to represent its population distribution quite well.

[3] The SP sample had data on the county of origin and county of destination of the CATI respondents. Since some county borders overlapped with the RBD borders, it was necessary to assign to these counties the RBD of the central point of these counties. This assumption affected 5 counties.

Table 2.8 Percentage of angling trip origins by RBD

RBD	ES sample	SP sample
Anglian	17.1%	18%
Dee	0.3%	0.1%
Humber	23.0%	21.4%
North West	10.8%	8.1%
Northumbria	3.0%	5.3%
Severn	8.4%	8.8%
Solway Tweed	0.3%	0.5%
South East	7.8%	7.8%
South West	5.5%	5.7%
Thames	23.8%	24.6%

Notes: SP data: 6 respondents whose home location was too far from any RBD were dropped from the sample.

Table 2.9 Percentage of angling trip destinations by RBD

RBD	ES sample	SP sample
Anglian	19.4%	21%
Dee	0.4%	0.3%
Humber	21.9%	20.1%
North West	9.9%	8.0%
Northumbria	2.2%	4.0%
Severn	10.1%	10.5%
Solway Tweed	0.6%	0.4%
South East	7.8%	8.7%
South West	7.1%	7.8%
Thames	20.7%	19.3%

Notes: SP data: 6 respondents whose home location was too far from any RBD were dropped from the sample.

Figure 2.4 compares the average cost per day's fishing for the ES and SP samples. For the ES sample, the estimated average cost per day's fishing per angler were obtained by adding the mean expenditure on angling permits (which included club membership, season tickets and syndicate fees) (Environment Agency 2018, Table 4.3) and the mean expenditure on day tickets that were available by type of Environment Agency licence held (Environment Agency 2018, Table 4.5). The data on average days fished for coarse and game species (Environment Agency 2018, Table 3.1) were then used to obtain the estimated average cost of day's fishing for the sample, dividing the mean expenditure by the mean days fished for each fish type. For the SP sample, cost figures were obtained by calculating the weighted average cost of a day's fishing based on anglers' base species. Figures 2.5 and 2.6 in Section 2.3.2 present some further descriptive statistics based on the base fishing trip of the SP sample respondents.

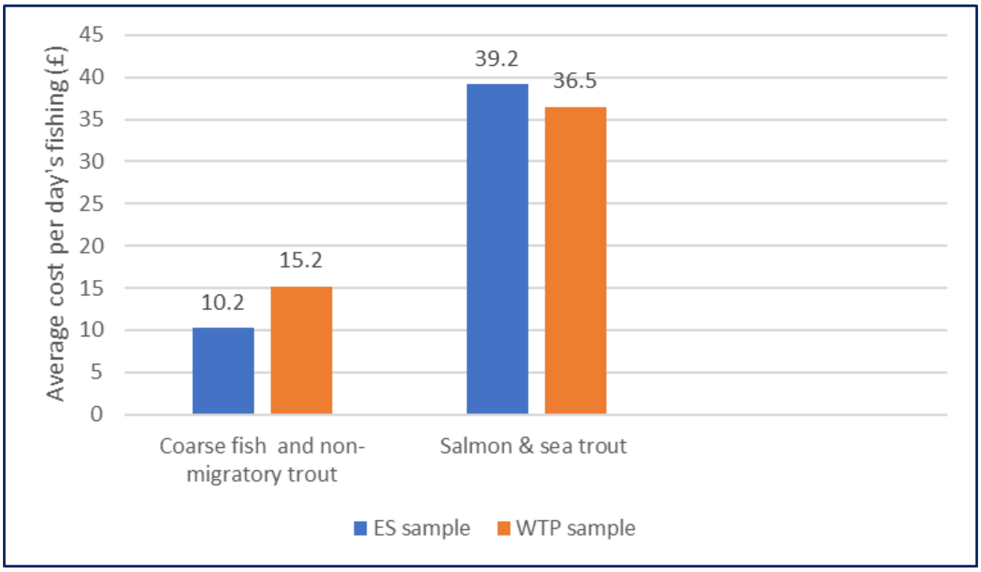

Figure 2.4 Average cost per day's fishing by type of fishing

Notes: The cost figures in both samples exclude travel costs to angling sites. WTP sample refers to the sample used in the SP analysis.

2.3.2 Other characteristics of respondents' base fishing trips

Figure 2.5 shows the distribution of fishing trip dates of the SP sample respondents in 2016. Most the respondents fished between the months of October and December. However, this finding does not represent the distribution of fishing dates in the population. The SP sample respondents were first asked to state their most frequent fishing type in 2016 (that is, whether they went for salmon and sea trout fishing or wild trout fishing or other types of fishing). Subsequently, they were asked about their most recent fishing trip of the type stated in the previous question. For the base trip, therefore, the focus was on the most recent fishing trip for their most frequent fishing type.[4]

The percentage of angling days by fish and water body types were similar across the ES and SP survey samples (Table 2.7). The distribution of angling days obtained from the SP sample is therefore a reasonably close reflection of the population distribution of total angling days obtained from the ES sample.

Figure 2.6 shows that 82% of the SP sample respondents chose to go on a day fishing trip, while only 18% went on a fishing trip that involved an overnight stay.

Overall, a reasonably close match was found between the ES and SP samples in terms of fishing trip characteristics. This provided confidence that the (weighted) SP dataset was not biased with regard to the types of trip asked about in comparison with the total population of anglers in England.

[4] Note that one respondent fished in 2015 and 3 respondents fished in January 2017.

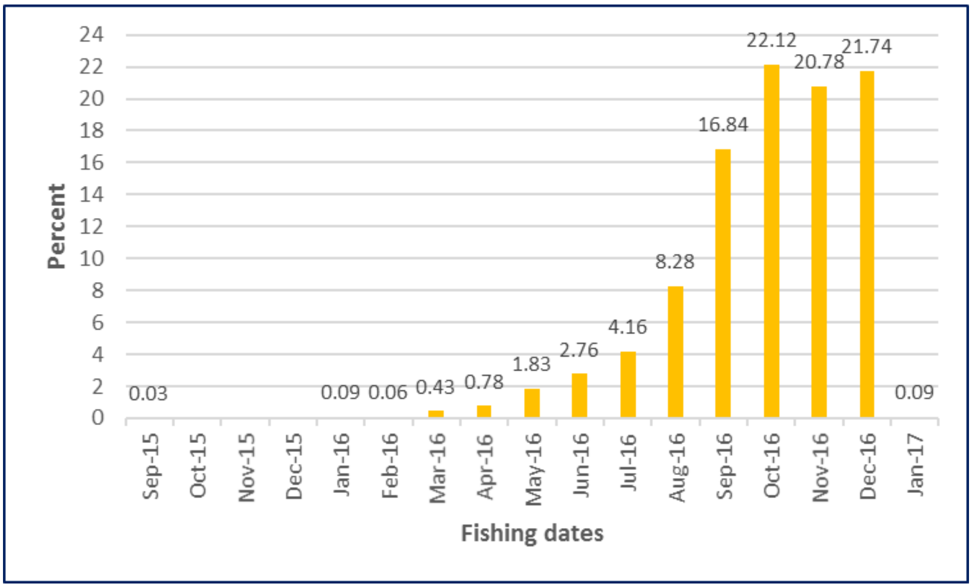

Figure 2.5 Percentage of base fishing trips by month of respondents to SP survey

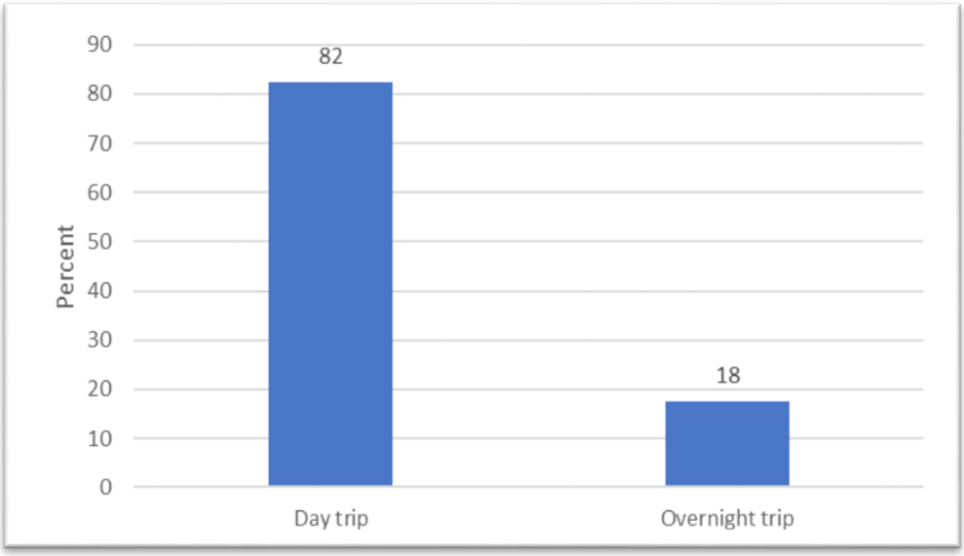

Figure 2.6 Base fishing trips: percentage of day versus overnight trips by respondents to SP survey

2.4 SP findings

2.4.1 SP1 model results

The SP1 choice data were examined using econometric models which explored the drivers of choice and could be used to derive WTP estimates on a £/ per trip basis for marginal changes in these variables. Technical details regarding the SP1 analysis methodology and estimates of the econometric models are given in Appendix E. This section focuses on the main findings.

Overall, the econometric model performed well, and no anomalous results were found. In general, the model yielded the following results.

- Anglers preferred sites closer to their homes than more distant sites, and sites with lower permit costs.
- Anglers preferred sites on water body types like the ones they chose for their base fishing trip. Similarly, anglers preferred sites offering fish species like the ones they chose for their base trip.
- Anglers preferred rivers and still waters more than canals.
- Anglers preferred sites with medium and large sized fish more than sites with small ones.
- Anglers preferred sites with medium and high abundance fish levels more than sites with low fish abundance.
- There were significant differences in preferences for water body types, fishing method types and fish species across anglers, with different anglers valuing different types of fishing.

All these results are consistent with expectation.

2.4.2 SP1 willingness to pay

A major purpose of the SP analysis was to estimate the utility[5] change due to an attribute change – with the aim of using this estimate in policy analysis.

The estimated utility change resulting from an attribute change, valued in monetary terms, is defined as the marginal willingness to pay (WTP). Thus, WTP is an estimate of the trade-offs that anglers make between different attribute levels and cost when choosing where to go fishing. The modelling methodology used in this study allowed for the estimation of marginal values of the different attributes to vary between anglers rather than being the same for every angler.

Marginal WTP (that is, the WTP for marginal changes in any attribute) can be positive or negative depending on how different anglers value the change in the attribute. The marginal WTP will be positive (negative) if the change in any attribute has a positive (negative) impact on the utility of anglers. For example, if a group of anglers prefer small-sized fish to medium sized fish, then a change from small to medium sized fish would have a negative WTP associated with it.

Note that these WTP values are indicative of average preferences and the preferences of different angler groups/segments for their trips, and do not represent the WTP for improvement to any fishing site. This is because the SP values are not based on a full market model that includes the supply side and the willingness of anglers to sort themselves into their preferred fisheries via their travel behaviour. In general, where a site characteristic (for example, the presence of large sized fish) is scarce there might be a WTP premium for this characteristic, but this will not be reflected in the average WTP for that characteristic as calculated below. This issue is partly addressed via the linking together of the SP and the RP estimates (see Section 4)

The WTP estimates for changes in fish size and fish abundance levels are presented in Table 2.10, together with the 95% confidence intervals around those estimates. The values are presented for the whole sample and then segmented by fishing type, annual visit frequency, age group, gender, annual household income and RBD.

---

[5] Utility is defined as the benefit provided by alternative sites to an angler, with each alternative site being a function of the angling attributes (including cost and travel distance).

The WTP estimates for the fish species present at a site corresponding to the segments selected for the analysis are presented in Table 2.11. The fishing type segments were based on the base trip characteristics of the respondents. For example, 'coarse/eels and river' referred to all respondents in the SP survey who fished for coarse fish in rivers during their base fishing trip.

Summary of findings on WTP from Table 2.10

Overall

- Average WTP for increases in size from small to medium fish was ~£4.20 per trip and average WTP for increases from medium to large was ~£3.30.
- Average WTP for increases in fish abundance from low to medium was ~£6.70 and average WTP for increases from medium to high was ~£1.00.

Fishing type segment

- Average WTP for increases in size from small to medium fish was fairly similar across all the base fishing type segments.
- Average WTP for increases in size from medium to large fish was less similar across the base fishing type segments, with a significant amount of variation in the WTP values, ranging from ~£0.00 per trip for salmon anglers to ~£3.70 for trout stillwater anglers.
- Average WTP for increases in fish abundance from low to medium was similar across all the base fishing type segments.
- Average WTP for increases in fish abundance from medium to high was similar across all segments, except for salmon anglers whose WTP was around half that of other anglers.

Annual visit frequency

- Average WTP for changes in fish size from medium to large was lower for anglers who made fewer than 5 fishing trips annually than that for anglers who made more than 5 annual angling trips.
- Average WTP for changes in fish abundance did not differ by annual visit frequency.

Age groups

- Average WTP for increases in size from small to medium fish was found to be similar across most age groups. However, anglers aged over 75 had a considerably lower WTP.
- Average WTP for increases in size from medium to large fish was more variable across the age groups. For example, average WTP was found to be ~£4.30 for anglers aged 25–34 but only ~£2.30 for anglers aged 64–75.
- Average WTP for changes in low to medium fish abundance levels was found to be similar across all age groups.
- Average WTP for increases in fish abundance from medium to high were found to be similar across age groups, but with smaller WTP for anglers aged over 75.

Gender

- Average WTP for increases in fish size from small to medium was found to be ~£4.50 for female anglers. This was slightly higher than that for male anglers (~£4.10 per trip).
- Average WTP for increases in medium sized to large sized fish was found to be ~£3.30 per trip for male anglers compared with ~£1.90 per trip for female anglers.
- Average WTP values for increases in fish abundance from low to medium were found to be the same for male and female anglers.
- Average WTP for increases in fish abundance from medium to high was found to be ~£0.90 per trip for male anglers compared with ~£1.20 per trip for female anglers.

Annual household income

- Average WTP values for increases in small to medium sized fish were found to be similar across income groups.
- Average WTP for increases in medium to large sized fish was found to be considerably higher for high income anglers than for low and medium income anglers.
- Average WTP values for increases in fish abundance from low to medium were found to be similar across income groups.
- Average WTP for increases in fish abundance from medium to high was also found to be similar across income groups.

RBD

- Anglers in the Severn RBD had the highest average WTP for increases from small to medium sized fish (~£4.40 per trip) and anglers in the South East RBD had the lowest WTP (~£3.80 per trip).
- Anglers in the South East RBD had the highest average WTP for increases in medium to large sized fish (~£4.50 per trip) and anglers in the Humber RBD had the lowest WTP (~£2.50 trip).
- Average WTP values for increases in fish abundance from low to medium were found to be similar across RBDs.
- Average WTP values for increases in fish abundance from medium to high were also found to be similar across RBDs.

Overall, some variation was found in all the cases above in the WTP values across some of the base segments in the sample. This suggests that the angling market is fragmented, with different anglers valuing different types of fishing.

Table 2.10 WTP (£ per trip) for marginal changes in fish size and fish abundance at site by sample segment

Sample segment	Number in sample	Fish size				Fish abundance			
		Small to medium		Medium to large		Low to medium		Medium to high	
		est.	CI	est.	CI	est.	CI	est.	CI
All	3,224	4.20	(4.1, 4.3)	3.30	(2.9, 3.6)	6.70	(6.7, 6.8)	1.00	(0.9, 1.0)
Fishing type									
Coarse river	559	4.00	(3.8, 4.3)	2.80	(2.1, 3.4)	6.70	(6.6, 6.8)	1.00	(0.9, 1.1)
Coarse stillwater	1,776	4.10	(3.9, 4.2)	3.40	(3.1, 3.8)	6.70	(6.7, 6.8)	1.00	(0.9, 1.0)
Coarse canal	115	4.30	(3.7, 4.8)	2.40	(1.0, 3.9)	6.70	(6.5, 6.9)	1.00	(0.7, 1.2)
Trout river	246	4.50	(3.9, 5.0)	2.90	(1.6, 4.3)	6.80	(6.6, 7.0)	1.00	(0.8, 1.2)
Trout stillwater	401	4.50	(4.2, 4.9)	3.70	(2.8, 4.6)	6.70	(6.5, 6.8)	0.90	(0.8, 1.1)
Salmon	127	4.80	(3.8, 5.7)	0.00	(-3.3, 3.2)	7.00	(6.6, 7.4)	0.50	(-0.1, 1.1)
Annual visit frequency									
<5 days	559	4.30	(4.1, 4.5)	2.80	(2.2, 3.4)	6.80	(6.7, 6.8)	1.00	(0.9, 1.1)
5–20 days	1,172	4.10	(3.9, 4.3)	3.60	(3.1, 4.1)	6.80	(6.7, 6.8)	0.90	(0.8, 1.0)
>20 days	1,493	4.10	(3.9, 4.3)	3.30	(2.8, 3.8)	6.70	(6.6, 6.7)	1.00	(0.9, 1.1)
Age									
17–24 years	91	4.30	(4.0, 4.7)	2.60	(1.4, 3.8)	6.70	(6.6, 6.8)	1.00	(0.8, 1.1)
25–34 years	204	4.30	(4,0, 4.6)	4.30	(3.5, 5.1)	6.70	(6.6, 6.8)	1.10	(0.9, 1.2)
35–44 years	291	4.10	(3.8, 4.3)	3.80	(3.0, 4.6)	6.70	(6.6, 6.8)	1.10	(0.9, 1.2)
45–54 years	668	4.10	(3.9, 4.4)	3.30	(2.6, 4.0)	6.70	(6.6, 6.8)	1.00	(0.9, 1.1)
55–64 years	1,001	4.50	(4.2, 4.7)	3.10	(2.3, 3.8)	6.70	(6.6, 6.8)	1.00	(0.8, 1.1)
64–75 years	863	4.30	(4.0, 4.6)	2.30	(1.6, 3.1)	6.70	(6.6, 6.8)	0.90	(0.8, 1.1)
>75 years	106	3.40	(3.0, 3.7)	3.20	(2.3, 4.1)	6.90	(6.7, 7.0)	0.60	(0.5, 0.8)

Sample segment	Number in sample	Fish size				Fish abundance			
		Small to medium		Medium to large		Low to medium		Medium to high	
		est.	CI	est.	CI	est.	CI	est.	CI
Gender									
Male	3,134	4.10	(4.0, 4.2)	3.30	(3.0, 3.6)	6.70	(6.7, 6.8)	0.90	(0.9, 1.0)
Female	81	4.50	(4.1, 5.0)	1.90	(0.3, 3.4)	6.70	(6.6, 6.9)	1.20	(0.9, 1.4)
Annual household income									
Low income	275	4.30	(4.0, 4.7)	3.40	(2.5, 4.3)	6.80	(6.6, 6.9)	0.80	(0.6, 1.0)
Medium income	1,623	4.20	(4.0, 4.3)	3.10	(2.7, 3.6)	6.70	(6.7, 6.8)	1.00	(0.9, 1.0)
High income	691	4.20	(4.0, 4.4)	4.10	(3.4, 4.8)	6.70	(6.7, 6.8)	0.90	(0.8, 1.0)
Don't know	73	4.20	(3.6, 4.8)	3.70	(2.2, 5.2)	6.90	(6.7, 7.1)	0.90	(0.6, 1.1)
Refused to say	562	4.00	(3.7, 4.3)	2.40	(1.7, 3.2)	6.70	(6.6, 6.8)	1.00	(0.9, 1.2)
RBD									
Anglian	527	4.00	(3.8, 4.3)	2.80	(2.1, 3.5)	6.70	(6.6, 6.8)	1.00	(0.8, 1.1)
Humber	689	4.30	(4.1, 4.5)	2.50	(1.8, 3.1)	6.70	(6.6, 6.8)	1.00	(0.9, 1.1)
North West	302	4.00	(3.7, 4.4)	3.10	(2.1, 4.1)	6.70	(6.6, 6.9)	0.90	(0.7, 1.1)
Northumbria	191	3.90	(3.4, 4.5)	4.30	(2.8, 5.8)	6.80	(6.6, 7.0)	0.80	(0.5, 1.1)
Severn	280	4.40	(4.1, 4.8)	3.90	(2.9, 5.0)	6.70	(6.6, 6.9)	0.90	(0.7, 1.1)
South East	256	3.80	(3.4, 4.2)	4.50	(3.5, 5.6)	6.70	(6.6, 6.9)	1.00	(0.8, 1.1)
South West	206	4.00	(3.5, 4.4)	3.40	(2.3, 4.5)	6.70	(6.5, 6.8)	1.00	(0.8, 1.1)
Thames	745	4.30	(4.1, 4.5)	3.30	(2.7, 3.9)	6.70	(6.6, 6.8)	1.00	(0.8, 1.1)

Notes: est. = central estimate, CI = 95% confidence interval

Table 2.11 WTP (£ per trip) for fish species present at site by fishing type segment

Fish species	Coarse river anglers		Coarse stillwater anglers		Coarse canal anglers		Trout river anglers		Trout stillwater anglers		Salmon anglers	
	est.	**CI**	**est.**	**CI**	**est.**	**CI**	**est.**	**CI**	**est.**	**CI**	**est.**	**CI**
Mixed coarse	8.80	(7.3, 10.2)	4.10	(3.3, 4.9)	12.10	(8.8, 15.3)	-6.80	(-9.4, -4.3)	-5.90	(-7.4, -4.3)	-10.20	(-15.0, -5.5)
Catfish	-37.70	(-39.2, -36.1)	-36.10	(-37.7, -34.5)	-39.10	(-42.3, -35.9)	-36.50	(-39.4, -33.7)	-38.10	(-39.8, -36.3)	-36.60	(-43.9, -29.3)
Predators	-6.50	(-8.7, -4.3)	-13.30	(-14.1, -12.5)	-5.00	(-9.1, -0.8)	-18.60	(-21.1, -16.2)	-11.40	(-13.3, -9.6)	-18.90	(-24.3, -13.5)
Barbel	7.10	(5.0, 9.3)	-3.80	(-4.4, -3.2)	-5.60	(-8.1, -3.1)	-4.80	(-7.1, -2.5)	-8.90	(-10.4, -7.4)	-8.30	(-13.5, -3.2)
Carp	2.70	(-0.3, 5.6)	33.60	(31.7, 35.6)	5.70	(0.8, 10.6)	-7.00	(-11.5, -2.5)	-8.40	(-11.7, -5.1)	-17.30	(-27.8, -6.9)
Stocked trout	-22.90	(-24.3, -21.5)	-23.70	(-24.5, -23.0)	-22.70	(-24.7, -20.7)	-18.70	(-21.3, -16.1)	26.80	(24.3, 29.2)	-23.00	(-28.5, -17.5)
Wild trout	-24.90	(-25.8, -24.1)	-25.90	(-26.4, -25.5)	-24.90	(-26.6, -23.2)	13.00	(9.4, 16.7)	-11.80	(-14.1, -9.5)	-20.50	(-23.5, -17.5)
Grayling	-13.10	(-14.4, -11.9)	-12.30	(-12.9, -11.7)	-12.90	(-15.0, -11.7)	-4.70	(-7.7, -1.6)	-10.70	(-12.2, -9.2)	-13.20	(-17.3, -9.1)
Salmon and sea trout	-30.00	(-30.4, -28.9)	-28.70	(-29.1, -28.3)	-29.20	(-30.7, -27.6)	-28.60	(-29.9, -27.3)	-28.00	(-29.0, -27.1)	83.30	(79.6, 87.0)
Number	**559**		**1,776**		**115**		**246**		**401**		**127**	

Notes: est. = central estimate; CI = confidence interval

Summary of findings on WTP from Table 2.11

A significant amount of variation WTP for presence of species at a site was found both within and between the fishing type segments.

- Average WTP for mixed coarse fish was found to be positive for coarse river, coarse stillwater and coarse canal anglers, and negative for trout and salmon anglers.
- Average WTP was found to be negative for catfish both within and across all segments, indicating that all anglers considered catfish to markedly reduce the value of their trip.
- Average WTP for predators was found to be negative across all segments, but varied substantially across segments, ranging from -£18.90 for salmon anglers to -£5.00 for coarse canal anglers.
- Average WTP for barbel was found to be positive for coarse river anglers only.
- Average WTP for carp was found to be positive for coarse river, coarse stillwater and coarse canal anglers.
- Average WTP for stocked trout was found to be positive for trout stillwater anglers only.
- Average WTP for wild trout was found to be positive for trout river anglers only.
- Average WTP for grayling was found to be negative across all segments.
- Average WTP for salmon and sea trout were found to be positive for only the salmon and sea trout anglers. All coarse and trout anglers had a negative WTP for salmon and sea trout, indicating that these anglers considered catching salmon and sea trout to reduce the value of their trip.

Table 2.11 shows evidence of strongly held preferences for particular species and a concomitant unwillingness to choose sites not offering the target species. This is indicated by the positive WTP for species generally fished by anglers in that species segment and negative WTP for all other fish species types.

These findings seem to imply that, on the surface, people would need to be paid compensation in the form of lower permit fees to accept the introduction of new species. A more accurate conclusion to draw from the results, however, is that anglers would be likely to switch fisheries when the range of species offered changes. This will include:

- anglers switching to start using a fishery who had not previously done so
- anglers switching away from a fishery to find somewhere else offering their desired species

The overall societal change in consumer surplus could be positive or negative in such cases. It will depend on:

- the relative abundance of different types of fisheries in the neighbourhood of the fishery undergoing the species change
- the relative numbers of anglers with different fishing preferences in the area

The overall change in consumer surplus cannot therefore be read directly from Table 2.11. It is also unfortunately not possible to derive an estimate of the change in consumer surplus by this method using the appraisal tool. This is because the site-level dataset used does not include a complete set of information on the species offered at each site. Additionally, data on angling licence holders are not sufficiently detailed to determine how prevalent different types of angling preferences are at the local level. For these reasons, the values in Table 2.11 should be considered as indicative only and not as measures of the changes in consumer surplus that would be expected given the introduction of new fish species.

2.4.3 SP2 model results

The SP2 choice data were also examined using a mixed logit model. Details on the SP2 analysis methodology and estimates of the mixed logit model, incorporating the main explanatory variables and their distributional assumptions, are presented in Appendix E.

Overall, the model performed well and no anomalous results were found. In general, the estimated model showed the following.

- Anglers preferred sites with ‘No visible pollution’ and ‘Good availability of fishing spots and/or pegs at site’ as their highest priority.
- In general, anglers preferred sites with a ‘Beautiful and attractive environment’ over sites with the remaining attributes (that is, fish abundance, fish size, litter, crowding, disturbance, toilets, accessibility, limited parking, unlimited parking, methods, flies, take, safety, plants and wildlife, and crime).
- There was significant variation in preferences for almost all the attributes, consistent with the findings from SP1.

Figure 2.7 shows the importance scores for the SP2 attributes, with the exception of ‘environment’ (that is, beautiful or attractive environment). This was assigned an importance index equal to 1, with the importance scores for the remaining attributes measured as a multiple of this attribute.[6]

All the attributes other than pegs (that is, good availability of fishing spots and/or pegs at site) and pollution (that is, no visible pollution) were less important than environment (that is, beautiful or attractive environment); pegs was around 1.3 times more important than environment as a factor influencing where anglers chose to go fishing on average.

[6] The choice of reference attribute was arbitrary and has no bearing on relative importance scores.

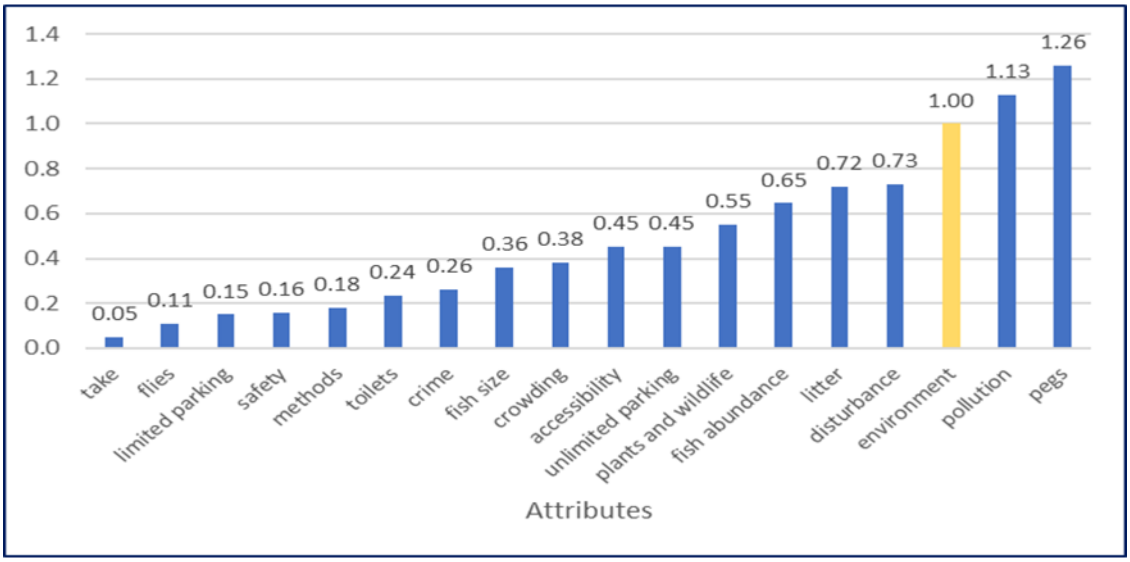

Figure 2.7 Relative importance of SP2 fishery attributes

Notes: See Table 2.3 for the full definitions of the attributes shown.

2.4.4 SP2 willingness to pay

The WTP estimates for the SP2 attributes were derived using the WTP estimates for the common attributes (that is, fish abundance and fish size) obtained from the SP1 analysis.[7]

To derive WTP using the fish abundance link with SP1, the estimated importance scores of each of the SP2 attributes was divided by the estimated importance score for 'high abundance of target species – exceptional catches common'. The results were then multiplied by the WTP estimate for medium to high fish abundance for each fishing type segment obtained from the SP1 analysis.

Similarly, to derive WTP using the fish size link with SP1, the estimated importance scores of each of the SP2 attributes was divided by the estimated importance score for 'large (specimen) fish present' with the WTP for medium to large sized fish for each fishing type segment obtained from the SP1 analysis.

For each SP2 attribute, 2 WTP values were therefore obtained for each fishing type segment:

- one based on the link between fish abundance attributes between SP1 and SP2
- one based on the link between fish size attributes between SP1 and SP2

These 2 estimates were taken as defining a range for WTP, and a central estimate was derived as the average of the 2 attributes.

Table 2.12 presents the WTP estimates and their 95% confidence intervals, for the overall sample and segmented by base fishing type.

[7] The fishing method variable was not used as another link between the SP1 and SP2 attributes because the inclusion of fishing method as a linking variable led to excessively large values for all the SP2 attributes.

Table 2.12 WTP (£/trip) for SP2 attributes for whole sample and segmented by fishing type segment

SP2 attributes	All		Coarse river		Coarse stillwater		Coarse canal		Trout/grayling river		Trout/grayling stillwater		Salmon/sea trout river	
	est.	CI	est.	CI	est.	CI	est.	CI	est.	CI	est.	CI	est.	CI
Pegs	6.60	(6.1, 7.1)	5.80	(4.7, 7.0)	6.90	(6.3, 7.6)	5.20	(2.6, 7.7)	6.10	(3.7, 8.4)	7.30	(5.7, 8.9)	0.30	(-5.4, 6.1)
Pollution	5.90	(5.4, 6.4)	5.20	(4.2, 6.3)	6.20	(5.6, 6.8)	4.60	(2.4, 6.9)	5.40	(3.4, 7.5)	6.60	(5.1, 8.0)	0.30	(-4.8, 5.4)
Environment	5.20	(4.8, 5.7)	4.60	(3.7, 5.5)	5.50	(5.0, 6.0)	4.10	(2.1, 6.1)	4.80	(3.0, 6.7)	5.80	(4.5, 7.1)	0.30	(-4.3, 4.8)
Litter	3.80	(3.5, 4.1)	3.30	(2.7, 4.0)	4.00	(3.6, 4.4)	3.00	(1.5, 4.4)	3.50	(2.1, 4.8)	4.20	(3.3, 5.1)	0.20	(-3.1, 3.5)
Disturbance	3.80	(3.5, 4.1)	3.40	(2.7, 4.0)	4.00	(3.6, 4.4)	3.00	(1.5, 4.5)	3.50	(2.2, 4.9)	4.20	(3.3 5.2)	0.20	(-3.1, 3.5)
Plants and wildlife	2.90	(2.6, 3.1)	2.50	(2.0, 3.0)	3.00	(2.7, 3.3)	2.30	(1.1, 3.4)	2.60	(1.6, 3.7)	3.20	(2.5, 3.9)	0.10	(-2.4, 2.6)
Accessibility	2.40	(2.2, 2.6)	2.10	(1.7, 2.5)	2.50	(2.2, 2.7)	1.90	(0.9, 2.8)	2.20	(1.3, 3.0)	2.60	(2.0, 3.2)	0.10	(-1.9, 2.2)
Unlimited parking	2.40	(2.2, 2.6)	2.10	(1.7, 2.5)	2.50	(2.3, 2.7)	1.90	(0.9, 2.8)	2.20	(1.3, 3.0)	2.60	(2.1, 3.2)	0.10	(-1.9, 2.2)
Crowding	2.00	(1.8, 2.1)	1.80	(1.4, 2.1)	2.10	(1.9, 2.3)	1.60	(0.8, 2.3)	1.80	(1.1, 2.5)	2.20	(1.7, 2.7)	0.10	(-1.6, 1.8)
Crime	1.40	(1.3 1.5)	1.20	(1.0, 1.5)	1.40	(1.3, 1.6)	1.10	(0.5, 1.6)	1.30	(0.8, 1.7)	1.50	(1.2, 1.9)	0.10	(-1.1, 1.3)
Toilet	1.20	(1.1, 1.3)	1.10	(0.9, 1.3)	1.30	(1.2 1.4)	1.00	(0.5, 1.4)	1.10	(0.7, 1.6)	1.40	(1.1, 1.7)	0.10	(-1.0, 1.1)
Method	0.90	(0.9, 1.0)	0.80	(0.7, 1.0)	1.00	(0.9, 1.1)	0.70	(0.4, 1.1)	0.90	(0.5, 1.2)	1.00	(0.8, 1.3)	0.00	(-0.8, 0.9)
Limited parking	0.80	(0.7, 0.8)	0.70	(0.6, 0.8)	0.80	(0.7, 0.9)	0.60	(0.3, 0.9)	0.70	(0.4, 1.0)	0.90	(0.7, 1.1)	0.00	(-0.6, 0.7)
Safety	0.80	(0.8, 0.9)	0.70	(0.6, 0.9)	0.90	(0.8, 1.0)	0.60	(0.3, 1.0)	0.80	(0.5, 1.1)	0.90	(0.7, 1.1)	0.00	(-0.7, 0.7)
Flies	0.60	(0.5, 0.6)	0.50	(0.4, 0.6)	0.60	(0.5, 0.7)	0.40	(0.2, 0.7)	0.50	(0.3, 0.7)	0.60	(0.5, 0.8)	0.00	(-0.5, 0.5)
Take	0.30	(0.2, 0.3)	0.20	(0.2, 0.3)	0.30	(0.2, 0.3)	0.20	(0.1, 0.3)	0.20	(0.1, 0.3)	0.30	(0.2, 0.3)	0.00	(-0.2, 0.2)

Notes: Attributes are presented from highest to lowest WTP for all segments/
est. = central estimate; CI = confidence interval

The overall WTP estimates are in line with the importance scores presented in Figure 2.7: the highest WTP are for the pegs (£6.60), pollution (£5.90), and environment (£5.20) attributes. The lowest WTP are for flies (£0.60) and take (£0.30).

The average WTP values, as well as the corresponding range values for the various SP2 attributes, were found to be quite similar across the base segments. The WTP for pegs was also found to be the highest across all the fishing type segments.

2.5 SP validity assessment

Section 2.4 provides WTP estimates for marginal changes in attributes important to angling quality. However, it is vital to assess whether the results of the analysis meet the standard validity and reliability tests. This section presents a discussion of these validity tests.

2.5.1 SP1 feedback questions

A key test to undertake in relation to SP performance is to investigate the validity of the study, that is, the degree to which the study could measure the intended quantity. In general, there are 3 types of validity tests:

- **Content validity**. This assesses whether the SP survey questions based on which the WTP values are constructed were clearly understood by the respondents.
- **Convergent validity**. This typically compares the WTP values obtained from the study with WTP measures obtained from other comparable SP or RP studies.
- **Expectation-based validity**. This assesses whether the survey findings are in accordance with prior expectations based on economic theory and/or empirical results.

2.5.2 SP1 content validity

Studies with high content validity can be characterised as those in which:

> ‘the survey descriptions and questions are clear, reasonable and unbiased… [such] that respondents are put in a frame of mind that motivates them to answer seriously and thoughtfully’ (Schumann 1996).

This section discusses the content validity of the SP survey questions.

As indicated in Section 2.1, the SP1 choice exercise asked respondents to state their most likely choice and their least likely choice with an outside option provided, namely, ‘I would not choose any of the above sites’. The SP1 exercise included 8 such choice questions for each of the respondents. After the first SP1 choice card was shown, the respondents were asked their reasons for choosing an alternative as their most likely option to gain additional information on the site attributes that were particularly valued by them.

Most of the anglers chose alternatives as their most likely option based on the types of fish available at the sites, cost and distance considerations as well as fishing methods available at the sites (Table 2.13). Overall, most respondents gave reasons for their choices and all the reasons provided suggested valid expressions of preference.

Table 2.13 SP1: Why did you choose this option as the most likely?

Variable	Frequency	Percentage
Type of fish	937	34.8%
Cost of option	655	24.3%
Distance to site-nearer to home	538	20.0%
Fishing method	299	11.1%
Water body type	287	10.7%
Fish species variety	276	10.2%
Suits fishing needs	275	10.2%
Specimen fishing	211	7.8%
Fish abundance levels	198	7.4%
Site options are available locally	190	7.1%
Prefer catching large fish	181	6.7%
More likely to catch fish	162	6.0%
Cheaper/free	122	4.5%
Convenient for me	82	3.0%
Well stocked sites	78	2.9%
Fun for family	76	2.8%
Like site, locality and ambience	71	2.6%
Other reasons	45	1.7%
Natural environment	43	1.6%
Fishing quality	41	1.5%
Challenging and satisfying	37	1.4%
Match fishing	22	0.8%
Well managed site	16	0.6%
Short visits possible	16	0.6%
Other options were too expensive	14	0.5%
Prefer low stocked and less crowded sites	12	0.4%
Not interested in fish types offered in other options	8	0.3%
No reasons given	8	0.4%
Don’t know	3	0.1%

Notes: 531 respondents chose ‘I would not choose any of these sites’ and so the percentage is calculated on total of 2,693 respondents

Out of a total of 3,224 respondents, 356 faced difficulty in comparing the choice scenarios presented to them (Table 2.14). This is a reasonable proportion for an SP exercise and suggests that the exercise worked well overall.

Table 2.14 SP1: Did you feel able to make comparisons between options?

	Frequency	Percentage
Able to compare options	2,868	89%
Not able to compare options	356	11%
Total	**3,224**	**100%**

The reasons cited for having difficulty were mainly cost considerations, presence of many options and certain options being unrelated to the anglers' own fishing experiences. Although an attempt was made to restrict the design to include realistic charges for the relevant fishery types, some respondents still found many of the options to be too expensive for their liking. There were also several respondents who found the presence of too many options to be confusing.

Some 891 respondents considered the choice situations presented to them as being unrealistic (Table 2.15). This was mainly attributed to unrealistic pricing of the alternatives and an unrealistic mix of species presented to them as part of the alternatives. Both factors were considered in the design to try and create realistic choice situations. A certain degree of variability in attribute combinations was necessary, however, to be able to estimate efficient models.

Table 2.14 SP1: Did you find each of the options we described to be realistic?

	Frequency	Percentage
Found options realistic	2,333	72%
Found options unrealistic	891	28%
Total	**3,224**	**100%**

2.5.3 SP1 convergent validity

Convergent validity tests typically compare the WTP values obtained from a study with WTP measures obtained from other comparable SP or RP studies. Appendix C contains a literature review of studies based on the economic value of angling. As such, relevant angling studies conducted in the UK that valued the same attributes as this were not found.

Most of the studies detailed in the review provided estimates of expenditure relating to angling. The RP studies, in general, estimated the average WTP for improvements in river quality. Two studies (Crabtree and Willis 2004, Environment Agency 2007a) used SP data to estimate the value of sea angling and salmon respectively. Environment Agency (2007a) estimated the mean WTP to prevent 'severe decline in salmon populations across England and Wales' to be £23.88 per household per year. Crabtree and Willis (2004) used choice experiment data to estimate the marginal WTP for larger fish to be £0.22 per 1% increase in size and £11.38 for an increase in diversity of species caught.

2.5.4 SP1 expectation-based validity

Expectation-based validity tests are based on the existence of logical and significant relationships between the response variable in the model and the expected predictors.

The SP1 model estimation results (Table E.3 in appendix) indicate that, in general, the relationships between the explanatory variables and the choice of an alternative site conform to prior expectations. For example, as expected, coefficients on distance and cost were negative and statistically significant, implying that anglers prefer to visit sites that are closer to their homes and have cheaper fishing costs. Similarly, the interaction terms between base attributes and site attributes were all positive and significant, implying that in general anglers preferred sites that were characterised by their own base attribute types.

Overall, these findings for the SP1 choice exercise are very positive and provide assurance as to the validity of the WTP results from this exercise.

2.5.5 SP2 feedback questions

The SP2 choice exercise asked respondents to state their most important attribute and their least important attribute, with an outside option provided if they preferred none of the attributes (see Section 2.1). The SP2 exercise included 8 such choice questions for each of the respondents. After the first SP2 choice card was shown, respondents were asked their reasons for choosing an attribute as being most important to gain additional information on the attributes that were particularly valued by them.

Most of the anglers chose a beautiful environment, lack of disturbance from other site users, good parking facilities and lack of litter at sites as the most important attributes (Table 2.16). Overall, the vast majority of respondents gave reasons for their responses and these all indicated that their responses were valid expressions of preference.

Table 2.15 SP2: Why did you choose this attribute as the most important feature?

Variable	Frequency	Percentage
Want to relax while fishing and enjoy solitude	441	14.6%
Want to enjoy nature/wildlife/surroundings	345	11.5%
Easy access is important/car nearby	327	10.9%
Site should be litter/pollution free	221	7.3%
Want to catch lots of fish	168	5.6%
Carrying gear – with barrow etc.	161	5.3%
Availability of parking important	148	4.9%
Good availability/choice of fishing spots/pegs	134	4.5%
Mobility issues/disability	132	4.4%
Old age	126	4.2%
Pollution impacts ecosystem/quality of fishery	117	3.9%
Enjoy catching large (specimen) fish	108	3.6%

Variable	Frequency	Percentage
Personal safety is key – peace of mind	98	3.3%
Cost/keeping costs down	97	3.2%
Site should be well managed/maintained	94	3.1%
Good quality site/health of fishery important	85	2.8%
Need space to fish – if travelling long distance	81	2.7%
Children should feel safe	70	2.3%
Important to look after environment	69	2.3%
Need space to fish/move along bank	65	2.2%
Good chance of target species/quality fish	65	2.2%
Would not fish in polluted water	63	2.1%
Need a good peg for better fishing	53	1.8%
Concerns/worries about theft/vandalism	53	1.8%
Require access to amenities/toilet	51	1.7%
Don't want time limits/restrictions	50	1.7%
Most important feature	50	1.7%
Like to eat what I catch	46	1.5%
Good to have choice of fishing method	42	1.4%
Litter damages environment/affects fishery	37	1.2%
Like comfort when fishing – safer	37	1.2%
Not over-fished - more likely to catch	35	1.2%
Other reasons	35	1.2%
More food, more fish – healthier environment	25	0.8%
Good hatches help fly-fishing	23	0.8%
Good day out - enjoyment/fun/activity	22	0.7%
Litter gives fishery a bad reputation	19	0.6%
Pollution-free sites are well managed	19	0.6%
Some fisheries should allow legal methods	18	0.6%
No reasons given	18	0.6%
Time to fish is important	17	0.6%
Other site users ruin fishing – disturb fish	17	0.6%
Reasons obvious	13	0.4%
Want value for money	12	0.4%
Like choice of keeping or returning fish	10	0.3%

Variable	Frequency	Percentage
Against taking fish - stock gets low	9	0.3%
Fish within rules/fisheries should have rules	9	0.3%
Like fly-fishing	6	0.2%
Against catch/release -stresses fish	4	0.1%
Better policing of sites	4	0.1%
Taking/releasing fish depends on type of fish	3	0.1%

Notes: Percentage is calculated on a total of 3,011 respondents since 213 respondents chose the option 'None of these matters to me'.

Some 10% (327) out of a total of 3,224 respondents faced difficulty in comparing the choice scenarios presented to them (Table 2.17). This proportion is reasonably low for an SP exercise. Furthermore, only 108 respondents considered the choice situations presented to them as being difficult to understand (Table 2.18).

The reasons cited for having difficulty in comparing and comprehending the options were:

- the presence of so many options
- repetition of the options
- certain options being unrelated to the anglers' own fishing experiences

Overall, these findings for the SP2 choice exercise are very positive, providing further assurance as to the validity of the WTP results from this survey.

Table 2.16 SP2: Did you feel able to make comparisons between the options?

	Frequency	Percentage
Able to compare options	2,897	90%
Not able to compare options	327	10%
TOTAL	**3,224**	**100**%

Table 2.17 SP2-Did you find each of the options easy to understand?

	Frequency	Percentage
Easy to understand	3,116	97%
Not easy to understand	108	3%
TOTAL	**3,224**	**100**%

2.6 Conclusions

The focus of the SP survey was to:

- obtain estimates for how marginal changes in key variables of fishery quality would benefit anglers

- develop a model that could be combined with the RP analysis (see Section 3) to create a combined SP–RP appraisal tool for estimating the total value to anglers from changes in fishery characteristics such as fish size and fish abundance at specified fisheries

The SP survey was designed to include 2 stated preference choice exercises:

- a choice experiment focused on choices between hypothetical site alternatives
- a MaxDiff exercise containing questions about most and least important features of a site when choosing where to go fishing

These 2 exercises were linked together via the fact that they included an overlapping set of attributes.

Overall, the results showed substantial variation in WTP estimates resulting from increases in fish size, fish abundance and changes in fish species present at the site across all the segments. This variation between anglers in their valuation of different attributes in both parts of the SP survey is indicative of a fragmented angling market. Different anglers value attributes differently, a fact which should be taken into consideration in the provision of angling opportunities.

These findings should be considered indicative rather than conclusive in that they are based on choices made in hypothetical settings. Nonetheless, the results withstand a range of validity assessment analyses and hence can be considered as robust within the context of an SP approach.

However, the WTP values reported relate solely to changes in consumer surplus that would be experienced by anglers at a site improved without regard to any change in the number of visits to that site. The RP analysis in Section 3 is essential to the overall valuation approach adopted in this study as it includes an analysis of site choice and participation in angling based on real world data. This allows changes in visit numbers to be examined as well as changes in consumer surplus that would be experienced by anglers at the improved site.

3 Revealed preference research

This section describes the RP analysis. The most important difference between the RP and SP analysis is the type of data used to estimate values. The SP analysis was based on responses to hypothetical SP survey questions asking anglers what choices they would make for alternative levels of angling attributes. In contrast, the RP analysis is based on ES data on anglers' actual choices of fishing sites visited in 2015.

The objectives of the RP study were to:

- examine what determined anglers' choice of site and the frequency of their angling trips based on real world choice behaviour
- ensure that the analysis could be used in conjunction with results from the SP analysis to create a combined SP–RP appraisal tool for estimating the values to anglers from changes in angling-related characteristics such as fish size and fish abundance at specified fisheries

The data used to estimate the RP model are described in Section 3.1 and the main findings of the RP analysis in Section 3.2. Section 3.3 draws conclusions obtained from the RP analysis.

3.1 RP data

3.1.1 Data requirements

RP methods estimate values using data based on actual angling choices made by the angling population.

A commonly used RP method is the travel cost method, which is based on anglers' decisions to visit fishing sites that differ in trip costs and quality. In principle, 2 types of travel cost model can be used to value recreational uses of the environment:

- single site models
- multiple site models

Single site models are usually used when the purpose is to estimate the total use or 'access value' of a site. However, a multiple site model is preferred when the purpose is to estimate the value associated when changes in site characteristics at one or more sites.

One of the most widely used multiple site models is known as the random utility model (RUM), which is the one selected for this study. The RUM explains the choice of a site by an angler from a set of many possible sites on a single choice occasion as a function of the site characteristics. The choice of a site implicitly reveals how an angler trades off one site characteristic for another. Given that trip cost is always considered to be one of the site characteristics (that is, its 'price'), the travel cost RUM implicitly also reveals the trade-offs between money and the other site characteristics.

The key data inputs required to estimate the RUM include:

- **angler data** – including locations of sites visited over the season/year, frequency of visits and home location of anglers (see Section 3.1.2)

- **fishing site data –** including location, fishery type and other relevant characteristics for all fisheries in England potentially within the choice set of all the anglers resident in England (see Section 3.1.3)

3.1.2 Angler data

The source of angler data used was the expenditure survey conducted in Phase 1 of this study. The online survey element of the ES obtained responses from 10,468 licensed anglers in England and provided detailed information on their fishing trips in 2015.

The ES contained information on the total number of days fished in 2015 for each of 3 types of fish (coarse fish/eels, trout/grayling, and salmon and sea trout). In addition, it identified the locations of up to 20 visits for each of the 3 types of fish that the respondents fished for in 2015, as well as the number of days they fished in each of these. A total of 22,412 such visit records were identified in these data.

Out of the total 10,468 respondents, 31 visited sites outside England, 38 respondents indicated their home location to be outside England and 106 respondents had visited sites for which the water body type was unknown. These 175 respondents were therefore excluded from the study, resulting in a total of 21,845 visit records for 10,293 respondents being retained for the RP analysis.

The ES also provided information on the home location of the angler and various relevant angler characteristics including:

- age
- gender
- licence type (that is, full, senior, disabled, short)
- fishing licence type (for example, trout and coarse licence, and salmon and sea trout licence)

3.1.3 Fishing site data

The primary data source for fishing site characteristics was the FishingInfo (FI) dataset. The FI data are available from an interactive website (http://fishinginfo.co.uk) produced by the Angling Trust in partnership with the Environment Agency, Met Office and Post Office to increase participation in angling.

The FI website provided details of publicly accessible fisheries only and hence was not exhaustive. It was also not necessarily universally up-to-date or free from errors. However, given the absence of a complete and accurate national database showing all available fishing locations, along with details on at least some of their characteristics relevant to anglers, the FI dataset was the best available source for fishing site characteristics data for this study.

The FI database contained angling-related characteristics for 4,634 fishing sites across England.[8] It included the following fishing site data:

- type of water body (river/stillwater/canal)
- fishery type (for example, coarse, game, mixed (that is, coarse and game))

[8] Welsh sites were excluded from the analysis following Environment Agency guidance to focus solely on fisheries in England.

- whether the fishery is stocked or not (yes/no)
- whether a disabled fishing facility is available at the site or not (yes/no)
- whether a boat hire facility is available at the site or not (yes/no)

Details on each of these site characteristics variables are given in Table 3.1.

Table 3.1 Fishing site data from FI dataset

	Frequency	**Percentage**
Water body type		
River	1,356	29.3
Stillwater	2,713	58.6
Canal	302	6.5
Unspecified	263	5.6
Fishery type		
Coarse	3,922	84.6
Coarse and game	14	0.3
Game	572	12.3
Unspecified	126	2.7
Fishery stocked?		
No	1,575	33.9
Yes	2,571	55.4
Missing	488	10.7
Disabled facility available?		
No	2,130	45.9
Yes	2,191	47.3
Missing	313	6.8
Boat hire facility available?		
No	4,287	92.5
Yes	133	2.9
Missing	214	4.6
Total	**4,634**	**100**

Data on some of the site characteristics variables were missing in the FI database. For example, no data were available on water body type for 263 sites and no data on the type of fishery for 126 sites. Similarly, 488 sites were missing data on whether the fishery was stocked, 313 sites were missing data on whether a disability facility was available and 214 sites were missing data on whether a boat hire facility was available. In these cases, dummy variables were used to capture all sites with missing data on these variables.

An additional source of fishing site characteristics data used was a dataset supplied by the Environment Agency called the 'WFD Surface Water Bodies in England: Classification Status and Objectives – Cycle 2 data'; WFD classification data for 2015 were extracted for this study from this dataset. The dataset contained information on WFD classifications for all the water bodies under the jurisdiction of the Environment Agency and therefore excluded the private stillwater fisheries frequented by many anglers. Nonetheless, it allowed the study to capture the value to anglers of changing WFD water quality variables – an important objective for the Environment Agency in relation to its river basin management planning for the WFD.

The Environment Agency's WFD database included the following fishing site data:

- type of water body (river/stillwater/canal/transitional)
- fish class ecological status (high, good, moderate, poor and bad)

Table 3.2 gives details on the variables for water body type; 2,724 sites out of the total of 4,594 were missing data on fish class.

Table 3.2 Water body types of WFD sites

	Frequency	**Percentage**
Water body type		
River	3,767	82.0
Transitional	104	2.3
Stillwater	589	12.8
Canal	134	2.9
Fish class ecological status		
Bad	120	2.6
Good	529	11.5
High	268	5.8
Moderate	497	10.8
Poor	456	9.9
Total non-missing	1,870	40.7
Missing	2,724	59.3
Total	**4,594**	**100**

Table 3.3 shows the fish class data available by water body type from the WFD data. Fish class information was available only for rivers and transitional waters. In addition, fish class data were available for only 1,844 out of the total of 3,767 river water bodies, and for only 26 out of the total of 104 transitional waters.

Table 3.3 Fish class by WFD water body type

Water body type	Fish class (frequencies)					
	Bad	**Good**	**High**	**Moderate**	**Poor**	**Total with data available**
River	120	508	266	494	456	1,844
Transitional	0	21	2	3	0	26
Total	**120**	**529**	**268**	**497**	**456**	**1,870**

The National Fish Populations Database (NFPD) was also considered as an alternative source of fishing site data. The NFPD provides raw fish count data from the Environment Agency's electric fishing and netting surveys for over 14,000 site locations in England. However, its scope excluded many of the sites where anglers went fishing, including small private fishing ponds and lakes. In addition, site characteristics data in the NFPD was not comprehensive enough for use within an RP model.

3.1.4 Mapping the data sources

The ES identified the location of all fishing sites visited by anglers in 2015 using an interactive mapping facility. The recorded visit locations were used to identify sites that could be then used to define the choice set of an angler. The study exampled a total of 21,845 visit records (see Section 3.1.2).

GIS mapping was used to match the sites that anglers visited with the fishing site data. Each of the visited sites was matched to the closest FI site of the same water body type where this was within 1,000m. This led to 9,163 visits (that is, 42% of total visits) being matched to their nearest FI sites.

Where there were no FI sites of the same water body type within 1,000m (that is, visited sites that could not be mapped to their nearest FI site), the visit locations were treated as individual fishing sites. Several of these individual fishing sites were found to be located very close to each other. These sites were therefore defined as 'clusters', with the cluster centre being considered the 'real' site representing all those sites. A two-step procedure was used to identify these clusters.

1. Groups of sites of the same water body type (river, lake and so on) were identified where each site was <1,000m from at least one of the other sites.
2. The cluster centre was determined and the distances from all the sites in the cluster to its centre were calculated. If the calculated distances were >1,000m, the site was excluded. The sites matched to their nearest cluster centres were then described as a virtual fishery located at the centroid of their clusters.

Using this two-step procedure, 4,095 visits (that is, 18% of the total visits) were mapped to their nearest cluster centres.

The remaining visits (that is, 8,587 visits or 40% of the total visits) could not be mapped to either their nearest FI site or to any of the cluster centres. These visits were assumed to be made to 8,587 independent/isolated sites.

Details of the mapping of visit locations to all the sites are given in Table 3.4. None of the visit locations were mapped to their nearest WFD sites primarily because the WFD sites had no point location. Furthermore, the WFD database did not contain sufficiently comprehensive site characteristics data (for example, fishery type) for its use as a primary data source within the RP model.

Table 3.4 Mapping visits to sites

Sites	Total sites	Visit records	Percentage of total visits
FI sites	4,634	9,163	42%
Cluster centres	880	4,095	18%
Isolated sites	8,634	8,587	40%
Total	**14,148**	**21,845**	**100%**

To obtain fish class status data for the FI sites, the FI sites were matched to their nearest (1,000m) WFD site of the same water body type in the WFD data. A total of 1,564 out of 4,634 FI sites could be matched to their nearest WFD site of the same water body type. Of these 1,564 FI sites, 1,305 FI rivers were mapped to their nearest WFD river, 32 FI rivers were mapped to their nearest WFD transitional waters and 227 FI stillwater sites were mapped to their nearest WFD stillwater site (Table 3.5).

Table 3.5 Water body types of FI sites mapped to WFD sites

Water type	Frequency	Percentage
River	1,305	28.2%
Transitional	32	0.7%
Stillwater	227	4.9%
Not mapped to WFD sites	3,070	66.2%
Total	**4,634**	**100**%

As indicated in Section 3.1.3, fish class data were available only for WFD rivers and transitional waters. To obtain the fish class status data for the FI sites, only the FI rivers were matched to their nearest WFD rivers and transitional waters (Table 3.6).

Table 3.6 Fish class data for the FI sites mapped to WFD sites

Water body type	Fish class (frequencies)					
	Bad	**Good**	**High**	**Moderate**	**Poor**	**Total with data available**
River	19	290	194	198	98	799
Transitional	0	9	0	2	0	11
Total	**19**	**299**	**194**	**200**	**98**	**810**

Of the 1,356 FI rivers in the FI database (Table 3.1), 1,305 rivers could be mapped to their nearest WFD river and 32 FI rivers could be mapped to their nearest WFD transitional water (Table 3.5). Of the 1,305 FI rivers mapped to their nearest WFD river, only 799 rivers had fish class data available and of the 32 FI rivers mapped to their nearest WFD transitional water, only 11 had fish class data available in the WFD database (Table 3.6).

Based on the mapping of data sources described above, a total of 14,148 sites were identified that could be used to define an anger's choice set (Table 3.7).

Table 3.7 Choice set of each angler

Choice set of each angler	Total sites	Visited sites	Visit records
FI only sites[1]	3,070	1,756	6,153
FI sites mapped to WFD sites	1,564	905	3,010
Cluster centres	880	880	4,095
Isolated sites	8,634	8,587	8,587
Total	**14,148**	**12,128**	**21,845**

Notes: [1] 'FI only sites' refers to all the FI sites (that is, 4,634) less the 1,564 FI sites that could be mapped to the WFD sites.

The choice set of each angler (Table 3.7) consisted of:

- 3,070 FI sites that could not be mapped to their nearest WFD sites, of which there were 1,756 sites to which 6,153 visits were made
- 1,564 FI sites that could be mapped to their nearest WFD site of the same water body type, of which there were 905 sites to which a total of 3,010 visits were made
- 880 cluster centres to which 4,095 visits were made
- 8,634 isolated sites to which 8,587 visits were made[9]

The approach used to map meant that there were missing data on fishing site characteristics for many of the sites included in the choice set. Specifically, no fishing site characteristics data (that is, water body type, fishery type, fishery stocked, disabled facility available and boat hire facility) were available for all the cluster centres and the isolated sites. For these sites as well as FI sites that had missing data on any of these variables, dummy variables were used to capture the fact that data on these variables was missing for these sites.

The lack of data on fishing characteristics for many of the sites included in the choice set of an angler is not ideal and is a limitation of the analysis. However, the primary role of the RP analysis in the modelling framework adopted is to estimate the distance effect. It is also important that visits to all the sites could be matched to give as complete a set of angling locations as possible. The mapping approach allowed the locations of all the visited sites to be used to measure anglers' willingness to travel, while also providing a more complete set of angling locations in England (necessary for simulation modelling).

[9] The records for the 47 visits made to these isolated sites where the angler's home location was outside England were dropped from the analysis.

Travel distance

Travel distances were initially calculated in GIS. The spatial analysis used a road network model built from publicly available spatial data of the road network in Great Britain (Ordnance Survey Open Roads dataset). These data were integrated and cleaned in a GIS. A shortest route algorithm was then implemented using the ArcGIS 10.4TM Network Analyst extension to calculate the shortest distances from the residence locations of all the survey participants to all FI sites, cluster centres and isolated sites. Travel distances on the Isle of Wight ferry boat were modelled separately.

Permit cost

Data on permit costs incurred on the fishing trip were available for only some of the visited sites reported in the ES. Specifically, permit cost data were available only for up to a maximum of 6 visits (that is, most visited site and most distant site) per respondent for each of the 3 types of fish. In addition, the FI database had no data on the permit cost for the FI sites. Since these data were largely missing from both the ES data and the FI data for most sites, it was not possible to include the day permit cost variable in the model.

The exclusion of a permit cost variable is potentially a significant omission from the model. To the extent that permit costs are correlated with any of the explanatory variables, the estimated coefficients on those explanatory variables will be biased in the direction of the correlation. Of particular importance are the WFD fish class data. If, for example, permit costs are higher for sites with higher fish class status, then the coefficients on higher fish classes will be biased downwards since the coefficient will be capturing the negative impact of the higher permit cost, which will potentially offset some of the value attributable to the higher fish class itself.

Given that the permit cost was largely missing for the fishing sites and attributing values for permit cost was computationally infeasible given the large size of the dataset, it was necessary to exclude this variable from the model.

Comparison of visited sites with all sites

Table 3.8 presents a comparison of the site characteristics data for all sites in the choice set of each angler (that is, visited and non-visited) and all visited sites.

Overall, a high degree of correlation in site characteristics is found between the sites available to choose from and the set of site visits.

- Most of the fishing trips were made to coarse fisheries followed by game and mixed fisheries.
- Most of the fishing trips were made to stillwaters followed by trips to rivers, canals and transitional waters;
- Of the fishery sites for which WFD fish class data were available, most trips were made to good status waters, followed by sites with moderate and high fish class status.

Table 3.8 Site characteristics of all sites versus visited sites

Site characteristics	All sites[1]	Visited sites[2]
Fishery type		
Coarse fishery	27.7%	19.1%
Game fishery	4.0%	2.4%
Mixed fishery	0.1%	0.1%
Missing	68.2%	78.5%
Water body type		
River	9.3%	6%
Stillwater	19.1%	14.9%
Canal	2.1%	1%
Transitional	0.2%	0.1%
Missing	69.3%	78.1%
Fishery stocked		
No	11.1%	6.7%
Yes	18.2%	13.2%
Missing	70.7%	80.2%
Disabled facility available		
No	15.0%	9.2%
Yes	15.5%	11.5%
Missing	69.5%	79.3%
Boat hire facility available		
No	30.3%	20.4%
Yes	0.9%	0.8%
Missing	68.8%	78.8%
WFD fish class*		
High	1.4%	0.9%
Good	2.1%	1.2%
Moderate	1.4%	0.9%
Poor	0.7%	0.4%
Bad	0.1%	0.1%
All non-missing	5.7%	3.5%
Missing	94.3%	95.5%

Notes: No data are available for the cluster centres and the isolated sites.
[1] The data on all the variables are calculated as a percentage of the total number of all sites in the choice set (that is, 14,148 sites).
[2] The data on all the variables are calculated as a percentage of the total number of all visited sites (that is, 12,128 sites).

3.2 RP findings

3.2.1 RP model results

The RP data were examined using a model measuring 2 linked choices:

- the choice of which site to visit on any given choice occasion
- the choice of how many times to go fishing over the course of a year given the sites available for the angler to choose from

These choices are linked via the fact that the site choice model is used to assign an 'inclusive value' (also known as the logsum value) to the set of sites available to each angler, and this value is entered as an explanatory variable into the participation choice model. The inclusive value will be higher for those anglers living near to large numbers of high quality fisheries, and the expectation for the model is that the higher the inclusive value, the more often anglers will go fishing on average.

Full technical details regarding the analysis methodology and estimates of models, incorporating the main explanatory variables are presented in Appendix F. This section focuses on the main results from the analysis.

Overall, the model performed well in statistical terms, with a good degree of statistical significance on most of the coefficients. The estimated equation for the site choice model showed that:

- anglers preferred sites closer to their homes (as expected)
- overall, anglers preferred to fish in stillwaters more than in canals, rivers and transitional waters
- anglers preferred sites with higher fish class, as measured by the Environment Agency within its WFD data

In general, the estimated equation for the participation model showed the following.

- Anglers living near to high quality fisheries made more fishing trips over the course of 2015 than other anglers not so well served locally.
- Anglers aged 25–34 and 65–74 were likely to make significantly higher number of fishing trips than anglers aged 75+. Anglers aged 17–24, 35–44, 45–54 and 55–64 were also likely to make higher number of trips than anglers aged 75+. In these cases, however, the results were statistically insignificant.
- The coefficient on the fishing licence type variable (that is, trout/coarse licence) was positive and significant. This indicates that, on average, the trout/coarse licence type holders took more trips per person than the salmon/sea trout licence holders.

3.2.2 RP willingness to pay

This section uses the site choice component of the RP linked RUM to obtain WTP per trip estimates for changes in site characteristics for 'existing visits'. These estimates do not at this point take into account changes in numbers of visits; predictions on numbers of visits and overall consumer surplus changes are addressed in Section 4.

The WTP estimates below were calculated as the willingness to travel longer distances converted to monetary values via use of an estimated travel cost per mile.

The WTP to travel longer distances is the ratio of coefficient estimates of the attributes and the coefficient estimate of the travel distance variable in the RP linked RUM presented in Appendix F.

The travel cost per mile included 2 components:

- **Out-of-pocket travel cost**. This is the distance from the angler's home to the sites multiplied by unit costs of car travel. Following previous studies (Hang et al. 2016), the cost per mile obtained from the AA website for the UK (www.theaa.com) was used. According to the latest AA's motoring costs report available at the time of the study (2014), the average running cost for petrol cars was £0.145 per mile, while the average running cost for diesel cars was £0.125 per mile. The average of these 2 values (that is, £0.134 per mile) was used for the RP analysis.
- **Value of travel time**. This is the travel time from home to fishing sites multiplied by the unit value of travel time (that is, the opportunity cost of the time spent travelling). The unit value for non-work and non-commuting trips recommended by the Department for Transport of is £11.21 per hour (DfT 2015) was used. This was then converted to value of travel time per mile using average values of speed on single carriageway roads outside urban areas (48mph), also published by the Department for Transport. The estimated value of travel time is then £0.224 per mile.

The travel cost per mile is therefore £0.134 + £0.224 = £0.358.

WTP (£ per trip) estimates are presented in Table 3.9, together with the lower and upper confidence limits of the WTP estimates calculated from the site choice component of the RP linked RUM. The travel distance coefficient is converted into travel cost, using the method described above, with the result doubled to account for the fact that the angler's visit involves a return trip.

Table 3.9 WTP for marginal changes in angling attributes (£ per trip)

Change	WTP	Lower limit of CI	Upper limit of CI
Coarse to mixed fishing	7.78	4.66	10.84
Coarse to game fishing	4.08	3.23	4.95
Not stocked to stocked	2.31	1.63	3.06
Addition of boat hire facility	7.45	6.28	8.62
Addition of disabled facility	5.02	4.44	5.64
Fish class: bad/poor to moderate/good	2.29	-0.20	4.77
Fish class: bad/poor to high	4.23	1.36	7.07

Notes: The WTP values reported here are for existing trips only (that is, they do not take into account changes in the number of trips or switching between sites). Confidence intervals were obtained using the Krinsky and Robb parametric bootstrap method.

Overall, the following were found.

- Anglers' WTP was £7.78 per trip for a mixed fishery compared with a coarse fishery, and £4.08 per trip for a game fishery compared with a coarse fishery.
- Anglers', on average, were willing to pay an additional £2.31 to fish at stocked fisheries, £7.45 to fish at sites with boat hire facilities and £5.02 to fish at sites with disabled facilities.
- Anglers, on average, were willing to pay an additional £2.29 to fish at sites with a good or moderate fish class status and £4.23 to fish at sites with a high fish class status, in comparison with sites with a poor or bad fish class status.

3.2.3 Discussion of RP results

Notwithstanding the advantages of an RP model in respect of the fact that it is based on real world data, the analysis has several limitations.

Incomplete fishing site data

The fishing site data obtained from the FI database were missing for many of the sites included in the choice set of an angler (that is, the cluster centres and the isolated sites).

- The WFD classification data covered only a fraction of all fisheries and did not provide fish class data on private fisheries covering stillwater sites or canals. Hence, the RP model could only be used to provide value estimates for the WFD rivers and transitional waters resulting from changes in WFD-related attributes.
- No data were available on permit costs or any other factors such as aesthetic appeal and remoteness that influence site choice. If any of these factors are correlated with travel distance and/or fish class status, then the coefficients on these variables will potentially be biased.
- There were potentially measurement errors in the site characteristics variables included in the RP model. This was mainly because the FI website provided details of publicly accessible fisheries only and thus was not exhaustive. In addition, the FI database was also not necessarily universally up-to-date or free from errors.

Model is not 'dynamic'

The model is not 'dynamic' in the sense that it does not allow for there to be any relationship between the site choices of the same anglers on different choice occasions. Although, ideally, the modelling would allow for such correlation, the approach adopted in this analysis is consistent with best practice in this area (Bockstael and McConnell 2007). This omission is not expected to materially bias the results.

Independence of irrelevant alternatives restriction

The model is subject to a restriction known as the independence of irrelevant alternatives (IIA). The IIA restriction implies that the relative odds of choosing between any 2 alternative sites is independent of changes that may occur in other alternative sites in the choice set of an angler. For example, if an improvement in angling quality at a specific site (site *i*) leads to a 5% increase in the probability of visiting that site, then the percentage change in the probability of visiting each of the remaining sites in the choice set of an angler must decrease by 5%. If some of the sites in the choice set of the angler are better substitutes for site *i*, then this property is quite unrealistic. This is because it would be expected the sites that are better substitutes for the one that was improved would have a larger percentage decrease in probability than the ones that are poorer substitutes. Although, the IIA is a restrictive assumption, it was computationally infeasible to apply estimators such as mixed logit which relax this assumption due to the large size of the anglers' choice set.

3.3 Conclusions

The primary focus of the RP analysis was to estimate an RP model that could be:

- linked to the SP model to obtain robust and realistic valuations of policy changes to anglers
- used to predict how visit numbers changed over a season/year due to changes in site attributes

The RP data were examined using a linked RUM, which was based around anglers' choices of where to go fishing and how many trips to make. In this approach, 2 models were estimated: a site choice model and a participation model.

In general, the estimation results for both the models were in line with expectations. For the site choice component of the linked RUM, anglers were found to prefer sites that were close to their home as well as sites that offered good fishing facilities. For the participation component of the linked RUM, it was found that an increase in the quality of local fisheries led to an increase the number of trips taken over the season/year by anglers.

As discussed in Section 3.2.3, the RP analysis was subject to a small number of limitations which included working with incomplete fishing site data and using a modelling approach that was subject to the IIA restriction and did not allow for there to be any relationship between the site choices of the same anglers on different choice occasions. Despite these limitations, however, the RP method was used because it was based on the actual choices of anglers and hence could be used to ground hypothetical choices made under the SP exercises with real choice behaviour to estimate robust and realistic WTP values.

The site choice component of the linked RUM was linked to the SP1 site choice model via the fact that they included a common attribute (that is, travel distance). The participation component of the linked RUM was used to predict visit number changes over a season/year due to changes in site attributes in the choice set of an angler. Note that these results relate only to the current licence holders. Extension of the analysis to include new licence holders was beyond the scope of this project.

Further details on how the SP and RP models were combined are given in Section 4.

4 Combined SP and RP analysis

This section focuses on combining the SP and the RP analysis which provide the study's main estimates of the use value to anglers of changes in key characteristics of angling quality such as fishery type, and the quantity and size of fish.

Section 4.1 provides a concise overview of the combined SP–RP valuation approach, including a discussion of how the results are used within the appraisal tool.

Section 4.2 contains the main results from the study on the economic values of marginal improvements to fisheries, both overall and by RBD. It also includes estimates for the change in visit numbers attributable to those same marginal improvements.

Section 4.3 presents a number of hypothetical case studies, which use the appraisal tool to derive values for potential improvements to individual sites. This section demonstrates how the appraisal tool can be used and comments on the reasonableness of the results obtained.

Section 4.4 draws overall conclusions with respect to the study.

Appendix G contains further technical details on the approach taken to develop the combined SP–RP model. Appendix H contains a user guide for the appraisal tool.

4.1 SP–RP valuation approach

4.1.1 Combining the SP and RP models

Combining SP and RP data within a model helps to achieve the benefits of both methodologies. The main advantage of using an SP model lies in its ability to derive predictions with respect to future improvements in the quality of the water environment. However, SP choices are made in hypothetical settings, which can limit their validity. The main advantage of using an RP method is that data are based on actual angling behaviour, but with the disadvantage being that the real world does not (usually) provide the experimental variation needed to explore the values of interest to the study.

The approach taken to combining the 2 models was to scale all the SP estimates by the ratio of the RP to the SP coefficients on travel distance. This approach maintained all the relative values from the SP research but calibrated the scale – the extent to which site choices are driven by observed characteristics versus unobserved factors – using the RP results.

The net effect of calibration of the 2 SP models using the RP model was to obtain a utility (preference) function containing all the SP1 and SP2 site attributes, including distance, but with a scale calibrated to the RP model.

The next step was to apply this utility function to the full set of sites available in England for the full population of angling licence holders in England.

4.1.2 Aggregation and calibration

For the purposes of the analysis, the Environment Agency provided the postcode, age and licence type records for every angling licence holder over 17 years of age in England (931,203 individuals).

The RP analysis had provided a detailed dataset on angling sites in England (4,634 sites). See Section 3.1 for details of this dataset.

In principle, every licence holder could be modelled as having a unique set of probabilities over which sites to visit on any given occasion due to the fact that the angler's location is unique and hence distances to all the available sites are also unique to that angler. In practice, however, this approach was considered computationally infeasible because that it would require calculations of distances and probabilities for 931,203 people × 4,634 sites.

To reduce the size of the task to manageable proportions, licence holders were grouped into catchment areas, of which there were 430 in England in the data provided by the Environment Agency. Although alternative spatial segmentations could have been used, the use of catchments was considered to be sufficiently granular while at the same time being computationally feasible.[10]

Shapefile data were obtained from the Environment Agency showing the locations of the catchments in England. GIS was used to group licence holders into catchments. This process gave data on the number of licence holders of each licence type and age band in each of the 430 catchments. Further use was made of GIS to calculate the travel distance (on the road network) of each site to the population centroid of each catchment.

Using the full linked participation and scaled site choice model, the resulting database allowed the calculation of:

- the predicted share of trips going to each site from each catchment
- the predicted number of trips from each segment (licence holder type and age band) in each catchment in total

However, the initially predicted shares of visits travelling to each site did not accurately represent the baseline shares. This was because the size of the RP site choice dataset precluded estimation of the site-specific constants that would be necessary to ensure that the predicted shares match the shares in the data. To further calibrate the model, the 'contraction algorithm' of Berry et al. (1995) was applied. Details of this procedure are described in Appendix G.

The output of this procedure was a calibrated site choice function that could be used to predict the change in the shares of visits from every catchment to every site on any given choice occasion.

4.1.3 Overview of the appraisal tool

An appraisal tool was created in Microsoft® Excel with the calibrated site choice utility function alongside the RP participation model at its core. The purpose of the tool is to:

- be able to simulate any change in any attribute for any site
- derive predicted changes to the number of visits, and the overall accompanying consumer surplus and revenue changes

Extracts from the simulator tool are shown in the screenshot illustrations below.

[10] At several stages of the analysis, computations would take several days to complete thus adding support to the justification for not pursuing an even more granular spatial segmentation.

Input sections of tool

Figure 4.1 shows the input sections of the tool. The user first chooses the site from a dropdown menu containing the names of the 4,634 fishing sites in the FI database. The user then inputs the initial (baseline) number of visits to the site (based on local knowledge of the site) and the average permit cost per day's fishing (in pounds) in the baseline and scenario cases.

Where the site is the sole holding of the controlling organisation, the average permit cost should be calculated as:

(day permit fee revenue + season permit fee revenue)/total number of day trips

In the case of sites run by organisations that hold a number of fisheries, members/season ticket holders may visit any number of other fisheries under the same permit. In this case, use of a nominal number of trips per year for anglers of a particular type is recommended (26 trips per year for coarse anglers, 12 for both categories of game angler), divided by the annual membership fee.

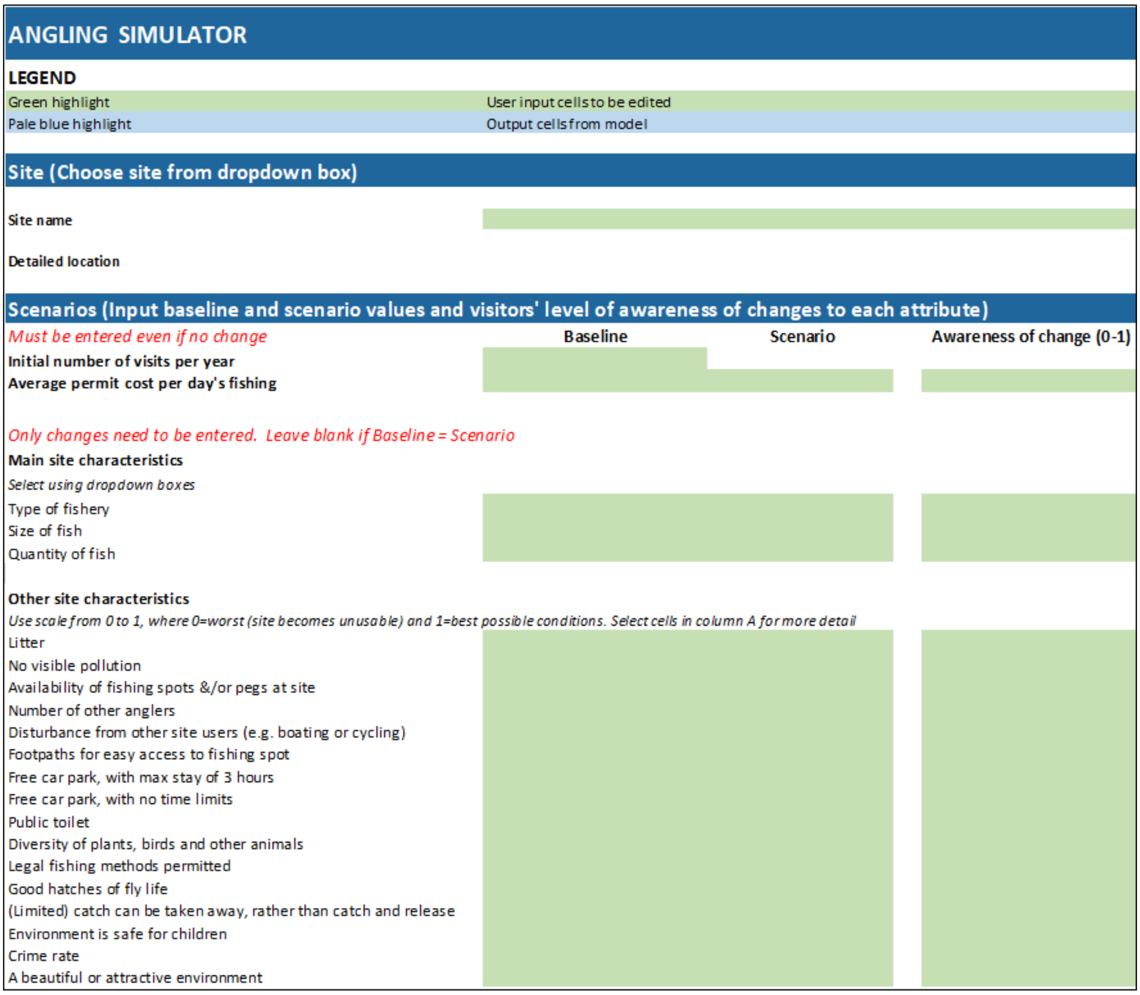

Figure 4.1 Input section of appraisal tool

It is then possible to choose from dropdown menus the baseline case and the desired scenarios for the type of fishery (coarse, game or mixed), fish size (small, medium or large) and fish quantity (low, medium or high)

The next step is to input the score of the site for 16 other features on a scale from 0 to 1, where 0 represents the worst possible conditions (the site becomes unusable) and 1 represents the best possible conditions.

The user also needs to specify the level of awareness of visitors to each type of change on a scale from 0 to 1, where 0 means that visitors are not aware of the change and 1 means that visitors are fully aware. Formally, the awareness scale should correspond to a weighted average of the full angler population's awareness levels, with weights corresponding to the probability of visiting the site under full awareness. It is assumed that the utility of visitors does not change when they are not aware of the change. When they are only partly aware, the utility changes are weighted by the awareness score. If there are no changes to an attribute, the awareness score assigned in the input cell corresponding to this attribute does not matter because there is no utility change with which to weight by awareness levels.

There is no precise way of assessing awareness. Users should use their best judgement. For guidance, however, Section 4.3 contains examples of case studies using different awareness levels for different types of changes.

Some of the values in the inputs section can be left blank, as the calculations are based only on the changes from the baseline and the desired scenario. This means that both the baseline and desired scenario of a feature need to be 'non-blank' for that feature to be included in the calculations.

Output sections of the tool

Figure 4.2 shows the output sections of the tool.

The first section shows the demand impacts of the changes defined in the inputs section. The relevant outputs are:

- visits switched from/to other sites in the desired scenario
- new visits (that is, visits that were not made in the baseline scenario but are made in the desired scenario) – this consists of additional visits by anglers who already use the site in question or another site, and new trips made by anglers who would not have visited any site prior to the improvement to the site in question
- total change in visit numbers to the site (that is, the sum of the visits switched from other sites and the new visits)

The second output section shows the consumer surplus, which is equal to WTP net of all trip costs (including permit fees) for the changes in the features of the site in the desired scenario. The relevant outputs are:

- total change in consumer surplus
- change in consumer surplus (per baseline visit)
- impact on revenue

Outcomes - Demand impact, Consumer Surplus (CS) (=WTP net of all trip costs), and Revenue	
Visits switched from other sites	0
New visits	0
Total change in visit numbers to site	**0**
Total change in CS for Scenario	**£0**
Change in CS (per baseline visit)	**£0.00**
Change in revenue	**£0**

Figure 4.2 Output section of appraisal tool

The spreadsheet tool includes 4 extra pages with data and calculations (Coeffs, Calcs, Atts and Sites). The user does not need to work with these 4 pages to use the tool.

4.1.4 Calculation of ‘utility changes’

The scaled utility coefficients derived as described above are embedded within the ‘Coeffs’ page of the appraisal tool. When the user specifies the features of a site in the baseline and desired scenarios, the difference between the baseline and desired scenario for each variable is first scaled for (i) the scope of improvement and (ii) the level of awareness of improvement, and then multiplied by the scaled coefficient corresponding to that variable in the Coeffs page to derive the utility change. The total utility change for the site is then the sum of scaled utility changes over all variables that differ between baseline and the desired scenario.

Both the scope of improvement and the level of awareness of improvement are measured in the range from 0 to 1. In the case of the scope of improvement, it is the difference in the level between the baseline and the desired scenario value that is used as the scaling factor, while in the case of awareness it is the [0,1] value representing awareness of the change that is the scaling factor. In both cases, these factors are implemented as linear scaling factors to utility. For example, an improvement from 0.2 to 0.6 in litter, with an awareness factor of 0.8, would lead to a utility change of:

$$b_{litter} \times (0.6 - 0.2) \times 0.8 = 0.32 \times b_{litter}.$$

4.1.5 Use of an approximation function to calculate impacts on visit numbers

In principle, the appraisal tool would calculate impacts on visit numbers given any change in any of the site attributes based on the full set of travel distances necessary to do so for each catchment. However, this approach would have led to a huge file size and an overly cumbersome user experience. An approximation function was therefore adopted to calculate these impacts.

The process involved calculating, for each site, the impact of utility changes on visit shares for that site only and on the change in the overall number of visits.

Impacts were evaluated for the following changes in utility (-10, -5, -2, -1, +1, +2, +5, +10) for each of the 4,634 sites individually. These impacts were then included in the appraisal tool’s Sites page and a linear approximation embedded to interpolate the impacts of utility changes within these cut points on site shares and overall visit numbers.

The highest individually valued change to site was an improvement in quantity of fish from ‘low’ to ‘medium’; this had a utility coefficient of 1.24. The expectation is that the majority of changes to be valued would lie within the range from -2 to +2; within this range, the error caused by the use of a piecewise linear approximation is small.

For larger changes in utility attributable to multiple simultaneous improvements, the approximation will lead to greater errors, which may be economically significant. In the appraisal tool, a warning is displayed above the output section (‘! scenario implies excessive increase in site utility – values maybe unreliable!’) in cases where the utility change exceeds 2 for this reason.

4.1.6 Final calculation of visit numbers and consumer surplus impacts

The impact on the overall number of visits and the share of visits associated with changes in the utility of a site are transferred in the spreadsheet to the Calcs page from the Sites page, which contains the results of the analysis described above.

The absolute number of new visits is calculated by multiplying the total utility change for the site by the interpolated impact of utility on visit numbers, multiplied by the baseline number of visits to the site, which is inputted by the user. The absolute number of visits switched from/to other sites is then calculated as the change in total utility multiplied by the interpolated impact of utility on share, multiplied by the baseline number of visits to the site.

The total change in consumer surplus is the sum of the change in expected consumer surplus for each individual, which is the difference between the product of the inclusive value and the predicted number of trips, before and after the policy changes. The inclusive value is an indicator of the maximum utility that the individual can expect to derive from the choice set of all available sites. Appendix G gives more detail about the estimation of the total change in consumer surplus.

4.2 Main results

This section presents the main results on anglers' WTP for marginal changes in fisheries' attributes both overall and by RBD. It also includes estimates for the change in visit numbers attributable to those same marginal improvements.

The results presented here give average changes in consumer surplus per baseline trip for given changes in site attributes. These numbers are calculated by first obtaining the total change in consumer surplus for each site for the change in question. The total change in consumer surplus values is then summed over sites and divided by the total number of visits to all sites in the baseline. In addition to showing overall average changes in consumer surplus per baseline trip for given changes in site attributes, the section also presents RBD-specific values. These calculations are equivalent to taking a weighted average of site-specific changes in consumer surplus per baseline trip, with weights equal to the number of baseline trips by site in each case.

4.2.1 Impacts on visit numbers

Tables 4.1 and 4.2 present the main estimates of the average impact of different types of change to fisheries on visit numbers as a percentage of the baseline number of visits. In each case, it is assumed that all potential users are fully aware of the changes.

Table 4.1 shows average impacts on numbers of visits per baseline visit due to the most important changes in type of fishery, fish size and fish quantity. For example, a switch from a coarse fishery to a game fishery would be expected to lead to 70% more visits than in the baseline, all other things being equal. The vast majority of these (66%) are 'switched' visits (that is, they consist of visits that would have been made to another site had the change in fishery type not occurred). In contrast, the number of altogether new visits – ones that would not otherwise have been made to any fishery – are only 4% out of the total change of 70% in visitor numbers.

The positive impact on visit numbers due to a change in fishery type is potentially somewhat counterintuitive given that there are many more coarse anglers than game anglers. However, the result can be explained by the fact that there are fewer game (and mixed) fisheries than coarse fisheries, and so game anglers travel further, on average, than coarse anglers. The switch from coarse to game for any one fishery thus potentially affects a larger catchment area and population.

An increase in fish quantity from low to medium has the largest expected impact in terms of the relative number of visitors of all the changes presented in Table 4.1. In this case, the change is expected to result in an almost 350% increase in the number of visits. However, such an increase might have impacts on crowding or the availability of pegs, which would dampen down demand.

Table 4.1 Average impact on number of visits due to changes in type of fishery, fish size and fish quantity

Type of change	**Average change in number of visits (as % of baseline number)**		
	Switched visits	**New visits**	**Total**
Type of fishery			
Coarse to game	66	4	70
Coarse to mixed	130	8	138
Fish size			
Small to medium	146	9	155
Medium to large	104	6	110
Fish quantity			
Low to medium	331	18	349
Medium to high	31	2	33

Table 4.2 shows the expected impacts on numbers of visits due to changes in site environment characteristics – the attributes that appeared in the SP2 exercise. All the expected impacts are shown again on the basis that all potential users are fully aware of the change. They are also shown for the case each of the attributes ranges from 0 = worst possible conditions to 1 = best possible conditions. This may represent an extreme degree of change in some cases.

For example, an improvement in litter would have a maximum impact of ~130% more visitors to the site, again with the majority drawing from visits that would otherwise have been made to different sites.

The results shown in Tables 4.1 and 4.2 are consistent in terms of the ordering of the attributes with the SP findings presented in Section 2.4. This should not be surprising as the behavioural model generating the predictions of switching and new visit generation is based on the SP findings. The overall scale of the predictions, however, is calibrated to the RP model results.

Table 4.2 Average impact on number of visits due to changes in site environment

Type of change	Change in number of visits (as % of baseline number)		
	Switched visits	**New visits**	**Total**
Litter	123	8	131
No visible pollution	222	13	234
Availability of fishing spots &/or pegs at site	294	17	310
Number of other anglers	63	4	67
Disturbance from other site users (for example, boating or cycling)	125	8	133
Public toilet	38	2	41
Footpaths for easy access to fishing spot	75	5	80
Free car park, with no time limits	76	5	80
Free car park, with maximum stay of 3 hours	24	2	26
All legal fishing methods permitted	29	2	31
Good hatches of fly life	17	1	18
(Limited) catch taken away, rather than catch and release	8	1	8
Environment is safe for children	26	2	27
Crime rate	43	3	46
Diversity of plants, birds and other animals	93	6	98
A beautiful or attractive environment	176	10	186

Notes: Values are for changes in each of the attributes from 0 = worst possible conditions to 1= best possible conditions.

4.2.2 Impacts on consumer surplus

Overall average values

Tables 4.3 and 4.4 show the average impacts on consumer surplus per baseline visit attributable to changes in fishery characteristics. These estimates represent the main measure of anglers' values for these changes. The tables also show 95% confidence intervals around the central estimates in each case. These represent the ranges within which estimates would be expected to lie in 95% of samples of a similar size and composition.

Table 4.3 shows average impacts on consumer surplus per baseline visit due to key changes in type of fishery, fish size and fish quantity. For example, estimates for moving from low to medium fish quantity are much bigger than the estimates for improvements from medium to high fish quantity.

Table 4.3 Average impact on consumer surplus due to changes in type of fishery, fish size and fish quantity

Type of change	Central	95% confidence intervals
Type of fishery		
Coarse to game	5.02	(4.85, 5.19)
Coarse to mixed	9.58	(9.26, 9.91)
Fish size		
Small to medium	10.63	(10.27, 10.99)
Medium to large	7.76	(7.50, 8.02)
Fish quantity		
Low to medium	22.27	(21.52, 23.02)
Medium to high	2.43	(2.35, 2.51)

Table 4.4 shows the average impacts on consumer surplus per baseline visit due to the changes in site environment characteristics. All the expected impacts are again shown on the basis that all potential users are fully aware of the change, and for the change entailing each of the attributes moving from 0 = worst possible conditions to 1 = best possible conditions. This may represent an extreme degree of change in some cases.

The estimates for improvements in the site environment for availability of pegs, no visible pollution and an attractive environment are the highest, suggesting that these attributes are crucial for the decision to visit a site.

Table 4.4 Average impact on consumer surplus due to changes in site environment

Type of change	Central	95% confidence intervals
Litter	9.08	(8.77, 9.39)
No visible pollution	15.58	(15.05, 16.11)
Availability of fishing spots and/or pegs at site	20.04	(19.36, 20.72)
Number of other anglers	4.80	(4.63, 4.96)
Disturbance from other site users (for example, boating or cycling)	9.22	(8.91, 9.54)
Public toilet	2.97	(2.87, 3.07)
Footpaths for easy access to fishing spot	5.71	(5.51, 5.90)
Free car park, with no time limits	5.73	(5.53, 5.92)
Free car park, with maximum stay of 3 hours	1.90	(1.83, 1.96)
All legal fishing methods permitted	2.28	(2.20, 2.36)
Good hatches of fly life	1.36	(1.32, 1.41)

Type of change	Central	95% confidence intervals
(Limited) catch can be taken away, rather than catch and release	0.62	(0.60, 0.64)
Environment is safe for children	2.00	(1.93, 2.07)
Crime rate	3.32	(3.20, 3.43)
Diversity of plants, birds and other animals	6.94	(6.70, 7.17)
A beautiful or attractive environment	12.62	(12.19, 13.04)

Notes: Values are for changes in each of the attributes from 0 = worst possible conditions to 1 = best possible conditions.

RBD values

Tables 4.5 and 4.6 show the average impacts on consumer surplus attributable to changes in fishery characteristics by RBD. The most important source of variation in these results is the variation in preferences over site attributes captured by the SP econometric models. Some additional variation across RBDs is driven by differences in the fisheries present in different regions. However, this additional variation is small compared with the variation attributable to the variation in preferences captured by the SP econometric models.

Table 4.5 shows the impact due to the key changes in fish size and fish quantity. The results do not vary very substantially between RBDs. No results are given comparing impacts due to changes in the type of fishery. This is because values for changes in the type of fishery were derived from the RP model which, for reasons of computational feasibility, were estimated with fixed parameters rather than parameters that vary between individuals. It was therefore not possible to derive robust estimates by RBD in this case.

Table 4.6 shows average consumer surplus impacts due to changes in the site environment by RBD. In general, values are lowest for the Northumbria RBD and highest for the South West RBD.

The aggregated welfare measures presented above can be used in generic, abstract or multi-site appraisals. For tailored appraisals specific to a known site, the appraisal tool will be more suitable. Section 4.3 contains case study examples illustrating how the tool can be applied in such cases.

Table 4.5 Average impact on consumer surplus due to changes in fish size, and fish quantity by RBD

Type of change	Average change in consumer surplus (£ per baseline visit)							
	Anglian	Humber	North West	Northumbria	Severn	South East	South West	Thames
Fish size								
Small to medium	10.64	10.39	10.22	10.19	10.69	10.84	11.20	10.80
Medium to large	7.77	7.58	7.46	7.44	7.80	7.91	8.18	7.88
Fish quantity								
Low to medium	22.30	21.80	21.41	21.19	22.40	22.69	23.33	22.64
Medium to high	2.43	2.37	2.33	2.33	2.44	2.47	2.56	2.47

Table 4.6 Average impact on consumer surplus due to changes in site environment by RBD

Type of change	Total change in consumer surplus (£ per baseline visit)							
	Anglian	Humber	North West	Northumbria	Severn	South East	South West	Thames
Litter	9.09	8.87	8.73	8.70	9.13	9.25	9.57	9.22
No visible pollution	15.60	15.23	14.98	14.90	15.67	15.88	16.38	15.83
Availability of fishing spots and/or pegs at site	20.06	19.61	19.26	19.09	20.15	20.41	21.01	20.37
Number of other anglers	4.80	4.69	4.61	4.60	4.82	4.89	5.05	4.87
Disturbance from other site users	9.23	9.01	8.86	8.84	9.27	9.40	9.72	9.37
Public toilet	2.98	2.90	2.86	2.85	2.99	3.03	3.13	3.02
Footpaths for easy access to fishing spot	5.71	5.58	5.48	5.47	5.74	5.82	6.01	5.79
Free car park, with maximum stay of 3 hours	5.73	5.60	5.51	5.49	5.76	5.84	6.04	5.82
Free car park, with no time limits	1.90	1.85	1.82	1.82	1.91	1.93	2.00	1.92
Legal fishing methods permitted	2.28	2.23	2.19	2.18	2.29	2.32	2.40	2.31
Good hatches of fly life	1.36	1.33	1.31	1.30	1.37	1.39	1.43	1.38
(Limited) catch can be taken away	0.62	0.61	0.60	0.60	0.62	0.63	0.65	0.63
Environment is safe for children	2.00	1.95	1.92	1.91	2.01	2.04	2.11	2.03
Crime rate	3.32	3.24	3.19	3.18	3.33	3.38	3.49	3.37
Diversity of plants, birds and other animals	6.95	6.78	6.67	6.65	6.98	7.07	7.31	7.05
A beautiful or attractive environment	12.63	12.33	12.12	12.09	12.68	12.86	13.29	12.81

4.3 Case studies

The appraisal tool was used by the Environment Agency to generate the following 4 case studies with the aim of trialling, developing and providing guidance for the tool.

- Case study 1 – a large reservoir in northern England
- Case study 2 – a commercial fishery complex in the Midlands
- Case study 3 – a club-controlled length of the River Severn in Shropshire
- Case study 4 – a recovering river in northern England

4.3.1 Case study 1 – a large reservoir in northern England

Current situation

The 67ha reservoir has a typical Pennine upland catchment and is operated by a private water company. The reservoir is located within 15 miles of major conurbations and is used extensively for leisure with angling, walking, running, birdwatching and so on. A large car park is available at the dam wall end of the lake, with a much smaller facility near the river inlet; public toilets are available in both car parks and there are good footpaths around the entire perimeter.

The reservoir is run as a stocked rainbow trout fishery with bag limits, but there is no compulsory retention (that is, anglers may fish purely catch and release). Rainbow trout stocked are small to medium in size (1–2lbs), with much larger fish also present very occasionally. A substantial stock of small wild brown trout is present along with small numbers of small perch.

The reservoir is open for fishing all the year round and the basic day ticket price is £20. No boats are allowed on the reservoir for angling or other leisure purposes, so all fishing is from the bank and fishing is strictly fly only. There are good hatches of fly including buzzers, with sedges and large Mayfly later in the spring.

Indicative visitor numbers per month are given in Table 4.7.

Table 4.7 Angler numbers per month (indicative only)

Month	Number
March	220
April	435
May	697
June	453
July	145
August	222
September	456
October	150
November	105
December	19
January	23
February	13

At present, the amount of bank space suitable for fly-fishing is quite limited – especially in spring when water levels are high; perhaps as little as a fifth of the perimeter is fishable at that time of the year. Trees, bushes and scrub severely limit the backcast and even access the water itself. Hence bank space is at a premium at weekends and Bank Holidays.

Suggested changes

It is suggested that some selective, targeted tree and vegetation management could be undertaken to significantly increase angling opportunities, particularly during the spring months when there are 3 Bank Holiday weekends and anglers are keen to fish again after the winter and the closure of coarse fishing in rivers. No other changes are proposed at this stage. Publicity about the change would be easy to achieve via a short article in a regional newspaper plus the fishery website.

Currently there are an estimated 2,500 visits per year (numbers are difficult to estimate from actual ticket sales even if these could be obtained since the ticket covers many reservoirs in the locality) and the average permit cost for a day’s fishing is assumed to be £20 under the baseline case and the desired scenario.

Suggested changes include:

- increasing peg availability from 0.2 to 0.7
- reducing angler crowding from 0.4 to 0.6

Results – demand impact and consumer surplus

Using the appraisal tool, it is predicted that the changes suggested above would result in an increase of around 2,500 visitors. This would, in turn, result in a total consumer surplus change of around £17,000 and an increase in revenue of around £51,000 (Figure 4.3). This corresponds to 7 anglers per day throughout the year, which is consistent with the size of the fly-fishing community in the catchment area.

ANGLING SIMULATOR

LEGEND

Green highlight	User input cells to be edited
Pale blue highlight	Output cells from model

Site (Choose site from dropdown box)

Site name	[redacted]
Detailed location	

Scenarios (Input baseline and scenario values and visitors' level of awareness of changes to each attribute)

Must be entered even if no change	**Baseline**	**Scenario**	**Awareness of change (0-1)**
Initial number of visits per year	2500		
Average permit cost per day's fishing	20	20	

Only changes need to be entered. Leave blank if Baseline = Scenario

Main site characteristics

Select using dropdown boxes

Type of fishery			
Size of fish			
Quantity of fish			

Other site characteristics

Use scale from 0 to 1, where 0=worst (site becomes unusable) and 1=best possible conditions. Select cells in column A for more detail

Litter			
No visible pollution			
Availability of fishing spots &/or pegs at site	0.2	0.7	0.8
Number of other anglers	0.4	0.6	0.8
Disturbance from other site users (e.g. boating or cycling)			
Footpaths for easy access to fishing spot			
Free car park, with max stay of 3 hours			
Free car park, with no time limits			
Public toilet			
Diversity of plants, birds and other animals			
Legal fishing methods permitted			
Good hatches of fly life			
(Limited) catch can be taken away, rather than catch and release			
Environment is safe for children			
Crime rate			
A beautiful or attractive environment			

Outcomes - Demand impact, Consumer Surplus (CS) (=WTP net of all trip costs), and Revenue

Visits switched from other sites	2385
New visits	148
Total change in visit numbers to site	**2533**
Total change in CS for Scenario	**£17,296**
Change in CS (per baseline visit)	**£7**
Change in revenue	**£50,664**

Figure 4.3 Case study 1: application of appraisal tool to large reservoir in northern England

4.3.2 Case study 2 – a commercial fishery complex in the Midlands

Current situation

The fishery consists of 4 small pools totalling just over a hectare in area, fed by a small stream via piped offtakes, set in a picturesque wooded valley around 20 miles from the main West Midlands conurbation.

The site is operated as a commercial coarse fishery catering primarily for general coarse fishing and match fishing, with a variety of fish species but predominantly carp, roach, bream and perch mostly small to medium in size. There is ample parking, toilets and a small café on site with good footpath access around all lakes. All the waters’ edge is accessible for angling via angling platforms and there are around 100 pegs in total.

The fishery is very popular with club members and for open matches at weekends and midweek, as well as with casual anglers. The fishery is open 52 weeks of the year and provides high or very high catch rates all year round.

The present number of visitors is probably around 200 anglers per week April to October and 50 anglers per week November to March, fairly evenly distributed around all the pools, and with an estimated total of ~6,000 per year. The basic day ticket price is £8, with other options for multiple rods, overnight stays and so on.

Suggested changes

It is suggested that the largest pool (~0.3ha, presently holding 30 angling pegs and with 1,900 visits per year) could be run as a specimen carp fishery; all the smaller carp and coarse fish would be removed and a small number of large specimens (20–30lbs) added to the few larger fish remaining from the original programme. The number of angling platforms would be reduced from 30 to 8 but each expanded to accommodate 2 anglers/6 rods per peg, and the unfished areas planted up with suitable vegetation to create a more secluded atmosphere. Overnight and weekend angling peg occupancy would be offered and the basic 24 hours ticket allowing 3 rods would cost £25.

Suggested changes therefore include:

- increasing size of fish from medium to large
- reducing the quantity of fish from high to medium
- reducing the availability of angling pegs from 1 to 0.5
- reducing angler crowding from 0.4 to 0.8
- increasing the diversity of wildlife from poor (0.2) to low–moderate (0.3)
- increasing the appeal of the environment from unappealing (0.2) to pleasanter environment (0.5)
- increasing the cost of the basic day permit from £8 to £25.

Awareness would be high for all these changes, except for improvement in wildlife which would be quite small and not noticeable immediately.

Results – demand impact and consumer surplus

Using the appraisal tool, it is predicted that these suggested changes would result in a reduction in the number of visitors and a decrease in total consumer surplus of around £13,000. There would also be a decrease in revenue, despite the premium charged for fishing for these larger carp (Figure 4.4).

Overall, this case study suggests that converting from a general match/pleasure scenario to an entry-level specimen carp water might not be a good business move. If the permit price is kept the same, however, the model predicts an overall increase in visit numbers, consumer surplus and revenue.

ANGLING SIMULATOR			
LEGEND			
Green highlight	User input cells to be edited		
Pale blue highlight	Output cells from model		
Site (Choose site from dropdown box)			
Site name	[redacted]		
Detailed location			
Scenarios (Input baseline and scenario values and visitors' level of awareness of changes to each attribute)			
Must be entered even if no change	**Baseline**	**Scenario**	**Awareness of change (0-1)**
Initial number of visits per year	1900		
Average permit cost per day's fishing	8	25	1
Only changes need to be entered. Leave blank if Baseline = Scenario			
Main site characteristics			
Select using dropdown boxes			
Type of fishery			
Size of fish	Medium	Large	1
Quantity of fish	High	Medium	1
Other site characteristics			
Use scale from 0 to 1, where 0=worst (site becomes unusable) and 1=best possible conditions. Select cells in column A for more detail			
Litter			
No visible pollution			
Availability of fishing spots &/or pegs at site	1	0.5	0.8
Number of other anglers	0.4	0.8	0.8
Disturbance from other site users (e.g. boating or cycling)			
Footpaths for easy access to fishing spot			
Free car park, with max stay of 3 hours			
Free car park, with no time limits			
Public toilet			
Diversity of plants, birds and other animals	0.2	0.3	0.2
Legal fishing methods permitted			
Good hatches of fly life			
(Limited) catch can be taken away, rather than catch and release			
Environment is safe for children			
Crime rate			
A beautiful or attractive environment	0.2	0.5	0.8
Outcomes - Demand impact, Consumer Surplus (CS) (=WTP net of all trip costs), and Revenue			
Visits switched from other sites	-1614		
New visits	-112		
Total change in visit numbers to site	**-1726**		
Total change in CS for Scenario	**-£13,366**		
Change in CS (per baseline visit)	**-£7.03**		
Change in revenue	**-£10,847**		

Figure 4.4 Case study 2: application of appraisal tool to a commercial fishery complex in the Midlands

4.3.3 Case study 3 – Middle reaches of a large river in the Midlands

Current situation

The fishery is an approximately 2 mile length on the right (west) bank of the middle reaches of the river, within 20–30 miles of the major West Midlands conurbation with smaller towns closer still.

It is a mixed coarse fishery run by a large angling association, and although best known for its barbel fishing, it also produces good fishing (medium catch rate) for many other species including pike, perch, roach, dace and chub. Good-sized fish of all those species are caught, but the river rarely produces what would be regarded as 'specimen' sized fish. Salmon also pass through these reaches and have been caught by the dedicated angler. The environment is very attractive and wildlife is abundant. The river is used by canoes especially at weekends, and there are some houses and holiday homes in places on the east (left) bank.

The current number of visitor numbers is difficult to estimate but an annual picture might be as follows:

- 15 March to 15 June: no anglers (coarse fish closed season)
- mid-June to end October – weekends: 10 anglers per day, weekdays 5 per day (hence 45 anglers per week for 20 weeks)
- November to mid-March: 5 anglers per day weekends, 1 per day weekdays (hence 15 anglers per week for 20 weeks)

This yields a total of about 900 visits per year.

At present, fishing is restricted to club members only. Annual membership costs £40 for adults but the club controls many other fisheries. Using the figure of an average coarse angler fishing for 26 days per year, and if club members predominantly fish club waters, the 'permit' cost per day for a visit to this river fishery is only £1.54.

Access to the fishery is limited; there are around 5 car parking spaces in a pull-off about 200m from the upstream limit of the fishery and room for a further 5 car parking spaces part way down a lane situated about 300m from the middle part of the fishery.

The favoured pegs are towards the middle and lower parts of the two-mile stretch, meaning long walks from either of the 2 parking areas. Although there is a reasonable public footpath along the river, much of the fishery is under-utilised and overgrown. Matches are rarely held here nowadays and most visitors are specialist barbel anglers.

Suggested changes

The controlling club might consider improving parking and access to the fishery by:

- extending an existing rough track down towards the river and creating a small parking compound holding up to 8 vehicles, providing better (shorter) access to the middle part of the stretch
- negotiating with the owners of a small housing complex at the downstream limit of the fishery to allow a further 8 cars to park in the residents' car park for an annual fee

If these measures were implemented, potentially there would be parking spaces for up to 26 vehicles at various points along the stretch. Accompanying this change, the club would create another 20 pegs in selected areas along the two-mile stretch. Awareness of the changes would be via the club website and the printed venue guides issued by the club every 2–3 years.

Suggested changes therefore include:

- increasing availability of pegs from 0.2 to 0.5
- increasing angler crowding from 0.9 to 0.8
- increasing parking facility from 0.2 to 0.8

Results – demand impact and consumer surplus

The appraisal tool predicts an increase in the number of visits to the water with a consumer surplus of ~£4,000 and an increase in revenue of ~£800 (this would only accrue to the club if it gains new members) (Figure 4.5). This seems reasonable.

ANGLING SIMULATOR

LEGEND	
Green highlight	User input cells to be edited
Pale blue highlight	Output cells from model

Site (Choose site from dropdown box)

Site name	[redacted]
Detailed location	

Scenarios (Input baseline and scenario values and visitors' level of awareness of changes to each attribute)

Must be entered even if no change	Baseline	Scenario	Awareness of change (0-1)
Initial number of visits per year	900		
Average permit cost per day's fishing	1.54	1.54	
Only changes need to be entered. Leave blank if Baseline = Scenario			
Main site characteristics			
Select using dropdown boxes			
Type of fishery			
Size of fish			
Quantity of fish			
Other site characteristics			
Use scale from 0 to 1, where 0=worst (site becomes unusable) and 1=best possible conditions. Select cells in column A for more detail			
Litter			
No visible pollution			
Availability of fishing spots &/or pegs at site	0.2	0.5	0.8
Number of other anglers	0.9	0.8	0.8
Disturbance from other site users (e.g. boating or cycling)			
Footpaths for easy access to fishing spot			
Free car park, with max stay of 3 hours	0.2	0.8	0.8
Free car park, with no time limits			
Public toilet			
Diversity of plants, birds and other animals			
Legal fishing methods permitted			
Good hatches of fly life			
(Limited) catch can be taken away, rather than catch and release			
Environment is safe for children			
Crime rate			
A beautiful or attractive environment			

Outcomes - Demand impact, Consumer Surplus (CS) (=WTP net of all trip costs), and Revenue

Visits switched from other sites	515
New visits	33
Total change in visit numbers to site	**548**
Total change in CS for Scenario	**£3,872**
Change in CS (per baseline visit)	**£4.30**
Change in revenue	**£844**

Figure 4.5 Case study 3: application of appraisal tool to a club-controlled length in a Midlands river

4.3.4 Case study 4 – a recovering river in northern England

Current situation

The fishery is a five-mile stretch of an upland Pennine river in a well-populated, formerly heavily industrialised area. Much of the river was badly polluted and only since the middle of the 20th century have fish reappeared in the river, with some fish colonising from associated unpolluted water bodies and many being stocked by angling clubs and public bodies.

Formerly the reach provided modest coarse fishing but, since the turn of the century, it has supported a thriving trout and grayling fishery. Some coarse fish are still present, especially in the lower lengths in this river reach. Environmental quality is very variable, and the river remains festooned with litter and waste from former and present industrial and other activity. Nevertheless wildlife is fairly abundant in the quieter areas.

Current visitor numbers to this river reach is difficult to estimate since no records are kept. Despite the increase in interest in fly-fishing, the bulk of visitors still tend to be coarse anglers targeting chub and other coarse fish as well as the more numerous grayling, and several coarse fishing matches are held along this reach each summer. The river is, however, fished for the whole year except for 10 days in March after the coarse/grayling season closes and prior to the opening of the trout season. Focusing on the fly-fishers, the current numbers of visits is probably only about 500 a year.

Most of the reach is controlled by a large angling club, with some shorter lengths run by smaller clubs. The club controls lots of other fishing of a variety of types all over the region. Fishing is reserved for members only. The annual fee is £50 per year. Based on an assumption of an average of 12 days spent fishing for trout and grayling (from the report on angling activity in 2015) and that all those days are spent on club waters, each visit to this fishery costs members around £4.00.

Members fish for coarse fish and trout, but there is a growing constituency of anglers now specialising in fly-fishing for wild brown trout and grayling which are quite plentiful though generally small to medium sized individuals. Although the fishing for these is quite rewarding, there is little emergent fly life and fish are seen to rise relatively infrequently. The poor hatches of fly are thought to reflect the persistence of significant levels of toxic compounds that are a legacy of the textile and chemical industries which characterised the area in the past, and the continuing operation of storm sewer overflows.

Suggested changes

Levels of persistent toxic compounds in the river sediments are expected to continue to fall over coming decades due to natural decay but also gradual washout of contaminated sediments, which may be accelerated as some of the many weirs are removed or lowered. There are also ongoing programmes to reduce the incidence of operation of storm sewer overflows. These improvements are expected to result in many benefits including a reduction in sewage litter and greater diversity of invertebrate life including upwinged flies (Ephemeroptera, Trichoptera and Plecoptera), thus improving the overall experience for fly-fishing for trout and grayling on this river reach.

Suggested changes therefore include:

- decreasing visible pollution (sewage, litter and so on) from 0.4 to 0.8
- increasing the number of anglers/angler crowding from 0.8 to 0.7
- increasing wildlife diversity (expected to improve in line with overall habitat and water quality improvements) from current 0.5 to 0.7
- increasing good hatches of fly life from a poor 0.1 to moderate 0.7
- increasing attractiveness of environment from 0.4 to 0.5

Awareness of most of these changes would be quite low initially and would accrue gradually. Moderate scores were therefore inputted for the awareness changes in the appraisal tool.

Results – demand impact and consumer surplus

Using the appraisal tool, it is predicted that these suggested changes would result in an increase of around 400 visitors to this part of the river for grayling and trout fly-fishing. This would in turn result in a total consumer surplus change of ~£3,000 and an increase in revenue of ~£1,900 (Figure 4.6).

ANGLING SIMULATOR

LEGEND

Green highlight	User input cells to be edited
Pale blue highlight	Output cells from model

Site (Choose site from dropdown box)

Site name	[redacted]
Detailed location	

Scenarios (Input baseline and scenario values and visitors' level of awareness of changes to each attribute)

Must be entered even if no change	**Baseline**	**Scenario**	**Awareness of change (0-1)**
Initial number of visits per year	500		
Average permit cost per day's fishing	4	4	

Only changes need to be entered. Leave blank if Baseline = Scenario

Main site characteristics

Select using dropdown boxes

	Baseline	Scenario	Awareness of change (0-1)
Type of fishery			
Size of fish			
Quantity of fish			

Other site characteristics

Use scale from 0 to 1, where 0=worst (site becomes unusable) and 1=best possible conditions. Select cells in column A for more detail

	Baseline	Scenario	Awareness of change (0-1)
Litter			
No visible pollution	0.4	0.8	0.8
Availability of fishing spots &/or pegs at site			
Number of other anglers	0.8	0.7	0.8
Disturbance from other site users (e.g. boating or cycling)			
Footpaths for easy access to fishing spot			
Free car park, with max stay of 3 hours			
Free car park, with no time limits			
Public toilet			
Diversity of plants, birds and other animals	0.5	0.7	0.5
Legal fishing methods permitted			
Good hatches of fly life	0.1	0.7	0.8
(Limited) catch can be taken away, rather than catch and release			
Environment is safe for children			
Crime rate			
A beautiful or attractive environment	0.4	0.5	0.8

Outcomes - Demand impact, Consumer Surplus (CS) (=WTP net of all trip costs), and Revenue

Visits switched from other sites	438
New visits	27
Total change in visit numbers to site	**465**
Total change in CS for Scenario	**£3,169**
Change in CS (per baseline visit)	**£6.34**
Change in revenue	**£1,859**

Figure 4.6 Case study 4: application of appraisal tool to a recovering river in northern England

5 Conclusions

This report is concerned with the objective of Phase 2 of the research project, that is, to obtain estimates of the economic values for marginal changes in key variables of fishery quality and quantity. These values are derived by combining stated preference (SP) and revealed preference (RP) research into anglers' willingness to pay (WTP). The RP results were obtained from data obtained from the expenditure survey (ES) carried out in Phase 1 of the project, while the SP results were obtained from a separate SP survey. Both research components are presented in this report.

5.1 Overall findings from the SP research

- WTP for increases in fish size, fish abundance and changes in fish species present at site is variable across all the segments selected for the analysis – fishing type, fishing trip frequency, age, gender and household income groups.
- The variation between anglers in their valuation of different attributes is indicative of a fragmented angling market. This difference in how different anglers value attributes should be taken into consideration in the provision of angling opportunities.
- The overall WTP values are indicative of the average preferences and preferences of different angler groups/segments for their trips and do not represent the WTP for improvement to any fishing site. This is because these values are not based on a full market model that includes the supply side, that is, the location of angling opportunities relative to the population and how people react to these different opportunities.

5.2 Overall findings from the RP research

- Anglers prefer sites that are close to their home as well as sites that offer good fishing facilities.
- Anglers living near to large numbers of high quality fisheries will make a greater number of angling trips on average.

The RP analysis is subject to limitations that include using an incomplete fishing site dataset and the use of a modelling approach that does not allow for there to be any relationship between the site choices of the same anglers on different choice occasions. Furthermore, the RP model used is subject to a restriction known as the independence of irrelevant alternatives. This restriction implies that the relative odds of choosing between any 2 alternative sites is independent of changes that may occur in other alternative sites in the choice set of an angler.

Despite these limitations, the RP method was used because it was based on the actual choices of anglers and hence could be used to ground hypothetical choices made under the SP exercises with real choice behaviour to estimate robust and realistic WTP values.

5.3 Development of the appraisal tool

The final objective of Phase 2 of the project was to combine the SP and RP analyses to develop an angling appraisal/simulator tool to enable managers to estimate robust economic values to anglers from changes in site characteristics.

The appraisal tool was used to estimate the demand impact and the total consumer surplus change resulting from changes in site characteristics (for example, type of fishery, fish quality, fish quantity and other site characteristics) for a selected group of angling sites.

A limitation of the appraisal tool is that it can only be used for a selected group of angling sites, that is, the Fishing Info sites for which data were available on type of fishery and fish quality and quantity. However, taking these sites as example sites, managers can use the results from the appraisal tool to develop fisheries in other locations.

The results obtained from the tool were used to derive aggregated WTP estimates, overall and by river basin district. Overall, the aggregated consumer surplus changes resulting from improvements from small to medium fish size and improvements from low to medium fish quantity were found to be larger than the changes resulting from improvements from medium to large fish size and medium to high fish quantity, respectively. With respect to other site characteristics, the aggregated consumer surplus change estimates were found to be highest for availability of fishing spots and or pegs at a site, no visible pollution and a beautiful or attractive environment at a site.

References

ABILDTRUP, J., OLSEN, S.B. AND STENGER, A., 2015. Combining RP and SP data while accounting for large choice sets and travel mode – an application to forest recreation. *Journal of Environmental Economics and Policy*, 4 (2), 177-201.

ADAMOWICZ, W., SWAIT, J., BOXALL, P., LOUVIERE, J. AND WILLIAMS, M., 1997. Perceptions versus objective measures of environmental quality in combined revealed and stated preference models of environmental valuation. *Journal of Environmental Economics and Management*, 32 (1), 65-84.

BERRY, S., LEVINSOHN, J. AND PAKES, A., 1995. Automobile prices in market equilibrium. *Econometrica*, 63 (4), 841-890.

BOCKSTAEL, N.E. AND MCCONNELL, K.E., 2007. *Environmental and Resource Valuation with Revealed Preferences. A Theoretical Guide to Empirical Models.* Dordrecht, Netherlands: Springer.

BOCKSTAEL, N.E., HANEMANN, W.M. AND ING, C.L., 1987. Estimating the value of water quality improvements in a recreational demand framework. *Water Resources Research*, 23 (5), 951-960.

BROWN, A., MUNDAY, M., ROBERTS, A., ARMSTRONG, M., HYDER, K. AND OUGHTON, A., 2013. *Sea Angling 2012 – a survey of recreational sea angling activity and economic value in England (Annex 2: The economic and social value of recreational sea angling in England)*. London: Department for Environment, Food and Rural Affairs.

BROWN, A., 2014. *Realising the Eden's angling potential. Stage two: angler survey*. Final report. Penrith: Eden Rivers Trust. Available from: http://www.edenfishing.co.uk/documents.html [Accessed 17 July 2018].

CRABTREE, R. AND WILLIS, K., 2004. *Research into the economic contribution of sea angling in England and Wales.* Report prepared by Drew Associates for the Economic and Statistics Group of Defra.

CREEL, M. AND LOOMIS, J., 1992. Recreation value of water to wetlands in the San Joaquin Valley: linked multinomial logit and count data trip frequency models. *Water Resources Research*, 28 (10), 2597-2606.

DFT, 2015. *Provision of market research for value of travel time savings and reliability. Non-technical summary report.* London: Department for Transport.

ENVIRONMENT AGENCY, 2007a. *Economic evaluation of inland fisheries: welfare benefits of inland fisheries in England & Wales*. Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2007b. *Economic evaluation of inland fisheries: the economic impact of freshwater angling in England & Wales*. Science Report SC090026/SR2. Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2015. *The value of angling in Essex, Norfolk & Suffolk (ENS) area*. Bristol: Environment Agency.

ENVIRONMENT AGENCY, 2018. *A survey of freshwater angling in England: Phase 1 report: angling activity, expenditure and economic impact*. Bristol: Environment Agency.

FEATHER, P., 1994. Sampling and aggregation issues in random utility model estimation. *American Journal of Agricultural Economics*, 76 (4), 772-780.

FEATHER, P., HELLERSTEIN, D. AND TOMASI, T., 1995. A discrete-count model of recreational demand. *Journal of Environmental Economics and Management*, 29 (2), 214-227.

FREEMAN, A.M, 3rd, HERRIGES, J.A. AND KLING, C.L., 2014. *The Measurement of Environmental and Resource Values: Theory and Methods*, 3rd edition. New York: RFF Press.

GLASGOW CALEDONIAN UNIVERSITY, GRID ECONOMICS AND COGENT INTERNATIONAL, 2009. *Technical report. Economic impact of recreational sea angling in Scotland*. Edinburgh: Scottish Government.

HAAB, T. AND MCCONNELL, K.E., 1996. Count data models and the problem of zeros in recreation demand analysis. *American Journal of Agricultural Economics*, 78 (1), 89-102.

HANEMANN, M., 1984. Discrete/continuous models of consumer demand. *Econometrica*, 52 (3), 541-561.

HANG, D., MCFADDEN, D., TRAIN, K. AND WISE, K., 2016. Is vehicle depreciation a component of marginal travel cost? *Journal of Transport Economics and Policy*, 50 (2), 132-150.

HAUSMAN, J.A., LEONARD, G.K. AND MCFADDED, D., 1995. A utility-consistent, combined discrete choice and count data model Assessing recreational use losses due to natural resource damage. *Journal of Public Economics*, 56 (1), 1-30.

HYNES, S., O'REILLY, P. AND CORLESS, R., 2015. An on-site versus a household survey approach to modelling the demand for recreational angling: do welfare estimates differ? *Ecosystem Services*, 16, 136-145.

JOHNSTON, R., RANSON, M., BESEDIN, E. AND HELM, E., 2006. What determines willingness to pay per fish? A meta-analysis of recreational fishing values. *Marine Resource Economics*, 21 (1), 1-32.

JOHNSTONE, C. AND MARKANDYA, A., 2006. Valuing river characteristics using combined site choice and participation travel cost models. *Journal of Environmental Management*, 80 (3), 237-247.

LANCASTER, K.J., 1966. A new approach to consumer theory. *Journal of Political Economy*, 74 (2), 132-157.

LOUVIERE, J., HENSHER, D.A. AND SWAIT, J., 2000. *Stated Choice Methods: Analysis and Application*. Cambridge, MA: Cambridge University Press.

MCFADDEN, D., 1973. Conditional logit analysis of qualitative choice behaviour. In *Frontiers in Econometrics* (ed. P. Zarembka), pp. 105-142. New York: Academic Press.

MCFADDEN, D., 1978. Modelling the choice of residential location. In *Spatial Interaction and Planning Models* (ed. A. Karlqvist, L. Lundquist, F. Snickers and J.W. Weibull), pp. 75-96. Amsterdam: North-Holland Publishing Company.

PARSONS, G.R. AND KEALY, M.J., 1992. Randomly drawn opportunity sets in a random utility model of lake recreation. *Land Economics*, 68 (1), 93-106.

PARSONS, G.R. AND NEEDELMAN, M.S., 1992. Site aggregation in a random utility model of recreation. *Land Economics*, 68 (4), 418-433.

PARSONS, G.R., JAKUS, P.M. AND TOMASI, T., 1999. Comparison of welfare estimates from four models for linking seasonal recreational trips to multinomial logit models of site choice. *Journal of Environmental Economics and Management*. 38 (2), 143-157.

PRERA, A.J., THACHER, J.A., GRIMSRUD, K., HAND, M., MCCOLLUM, M. AND BERRENS, D., 2015. *Reauthorizing the Federal Lands Recreation Enhancement Act: impact to recreation demand of national forest in the southwest*. Working Paper WP 2015-13. Pullman, WA: Washington State University.

RADFORD, A., RIDDINGTON, G. AND GIBSON, H., 2009. *Economic impact of recreational sea angling in Scotland*. Edinburgh: Scottish Government.

REES, S., ATTRILL, M.J., AUSTEN, M.C., MANGI, S.C., RICHARDS, J. AND RODWELL, L.D., 2010. Is there a win-win scenario for marine nature conservation? A case study of Lyme Bay, England. *Ocean and Coastal Management*, 53 (3), 135-145.

SCHUMANN, H., 1996. The sensitivity to CV outcomes to CV survey methods. In *The Contingent Valuation of Environmental Resources: Methodological Issues and Research Needs* (ed. D.J. Bjornstad and J.R. Khan), pp. 75-96. Cheltenham: Edward Elgar Publishing.

SHONKWILER, J.S. AND DOUGLASS SHAW, W., 1996. Hurdle count-data models in recreation demand analysis. *Journal of Agricultural and Resource Economics*, 21 (2), 210-219.

SQW, 2015. *2015 update: Economic impact from angling on the Tweed river system. Final report.* Melrose: River Tweed Commission.

TOURISM DEVELOPMENT INTERNATIONAL, 2013. *Socio-economic study of recreational angling in Ireland*. Dublin: Inland Fisheries Ireland.

TRAIN, K.E., 2009. *Discrete Choice Methods with Simulation*, 2nd edition. New York: Cambridge University Press.

WHITEHEAD, J.C. AND LEW, D.K., 2016. *Estimating recreation benefits through joint estimation of revealed and stated preference discrete choice data.* Department of Economics Working Paper 16-22. Boone, NC: Appalachian State University.

WHITEHEAD, J.C., PATTANAYAK, S.K., VAN HOUTVEN, G.L. AND GELSO, B.R., 2008. Combining revealed and stated preference data to estimate the nonmarket value of ecological services: an assessment of the state of the science. *Journal of Economic Surveys*, 22 (5), 872-908.

ZANDERSEN, M., TERMANSEN, M. AND JENSEN, F.S., 2007. Evaluating approaches to predict recreation values of new forest sites. *Journal of Forest Economics*, 13 (2-3), 103-128.

List of abbreviations

CATI	computer assisted telephone interview
CS	consumer surplus
ES	expenditure survey
FI	Fishing Info
FTEs	full-time job equivalents
GIS	geographical information system
GVA	gross value added
IIA	independence of irrelevant alternatives
NFPD	National Fish Populations Database
RBD	river basin district
RP	revealed preference
RUM	random utility model
SP	stated preference
WFD	Water Framework Directive
WTP	willingness to pay

Glossary

Base trip	The most recent fishing trip for anglers' most frequent fishing type reported in the SP survey
Base water body type	Type of water body visited during base trip
Base species	Fish species that anglers fished for during their base trip
Base distance	One-way travel distance between anglers' home and site visited during their base trip
Base cost	Cost of a day's fishing (that is, day permit fees) to angler for site visited during their base trip
Choice experiment	A form of choice modelling in which respondents are presented with a series of alternatives and asked to choose their most preferred alternative
Consumer surplus	The difference (or the net gain) between the price paid when purchasing a good or service and the price that a consumer would have been willing to pay for the same good or service. This is a key measure of economic value.
Inclusive value	The expected consumer surplus obtainable from a given choice situation
Logsum	Another word for 'inclusive value'
Mixed logit model	A highly flexible discrete choice model that allows for random taste variation, unrestricted patterns of substitution and correlation in unobserved factors over time
Revealed preference (RP)	A research methodology involving the derivation of economic values from behavioural choices, as opposed to stated choices (see Stated preference below)
Random utility model (RUM)	A model that explains the choice of a site by an individual from a set of many possible sites on a single choice occasion, as a function of the site characteristics
Stated preference (SP)	A research methodology involving the use of choice experiments
Willingness to pay (WTP)	The monetary measure of the value of obtaining environmental (or other) gain or avoiding a loss

Appendix A: Phase 2 main survey questionnaire

2972
Environment Agency
Main WTP Questionnaire

Interviewer name: | **Date:** | **Time:**

Recruitment section

Intro for ONLINE interviews

Thank you for agreeing to take part in this survey. We are conducting research for the Environment Agency to provide a better understanding of what is important to anglers in relation to where they choose to fish. This survey is only about fishing in freshwater, that is, a pond, lake, reservoir, river, stream, drain or canal. The results will help ensure that our fisheries are appropriately managed and protected.

The questionnaire will take about 15 minutes to complete. You do not have to answer questions you do not wish to and you can terminate the interview at any point.

Intro for PHONE interviews [recontacts]

Hello, this is …. from Accent. You helped us earlier this year with a survey about angling we were conducting for the Environment Agency. At that time, you kindly said that we could contact you about our next survey which is about how anglers value the fisheries and their environment. Would it be convenient to ask you some questions now? Thank you. Any answer you give will be treated in confidence in accordance with the Code of Conduct of the Market Research Society. You do not have to answer questions you do not wish to, and you can end the interview at any point.

Intro for PHONE interviews [new contacts]

Hello, this is …. from Accent. We are conducting research for the Environment Agency to provide a better understanding of what is important to anglers in relation to where they choose to fish. The results will help ensure that our fisheries are appropriately managed and protected.

Would it be convenient to ask you a few questions now? Thank you. Any answer you give will be treated in confidence in accordance with the Code of Conduct of the Market Research Society. You do not have to answer questions you do not wish to, and you can end the interview at any point.

FOR ALL RECONTACTS

In our last survey, you told us about your fishing in 2015. These next few questions are about your fishing in 2016, so although they might be similar to questions you answered before, please update us with your current fishing activity.

Q1. Do you currently hold a rod licence for angling in England, or have you held one at any time in 2016?

Yes

No **THANK AND CLOSE**

Don't know **THANK AND CLOSE**

Q2. Have you fished for freshwater species in England in 2016?

Yes

No **THANK AND CLOSE**

Don't know **THANK AND CLOSE**

Q3. What type of rod licence do you hold? If you held more than one, please choose the most expensive type you have held in 2016

Licence type	**Coarse fish and non-migratory trout**	**Salmon and sea trout**
Full		
Senior (over 65) concession		
Disabled concession		
Junior (12–16) concession	THANK AND CLOSE	
8-day licence		
1-day licence		

HIDDEN QUESTION: LICENCE TYPE QUOTA **DP POPULATE FROM Q3**

1. Coarse – Full licence
2. Coarse – Short licence
3. Salmon – Full licence
4. Salmon – Short licence

HIDDEN QUESTION: AREA QUOTA FOR COARSE LICENCE HOLDERS **DP POPULATE FROM SAMPLE**

1. North East, North West and Yorkshire/Humber
2. East Midlands and West Midlands
3. South West, South East and East of England

HIDDEN QUESTION: AREA QUOTA FOR SALMON LICENCE HOLDERS **DP POPULATE FROM SAMPLE**

1. Non-salmonid
2. Salmonid

HIDDEN QUESTION: AGE **DP POPULATE FROM SAMPLE**

1. 17–24
2. 25–34
3. 35–44
4. 45–54
5. 55–64
6. 65–74
7. 75 or over

HIDDEN QUESTION: GENDER **DP POPULATE FROM SAMPLE**

1. Male
2. Female

Q4. What have you fished for in England in 2016? Select all that apply

I fished for coarse fish or eels.

I fished for rainbow or brown trout or grayling.

I fished for salmon or sea trout [ONLY SHOW THIS OPTION IF Q3=SALMON AND SEA TROUT]

[AT LEAST ONE MUST BE SELECTED]

Q5. ONLINE ONLY Where do you live? Please enter the first half of your postcode (for example, HP14) or click on the map to show the location of your home.

ADD MAP

TELEPHONE ONLY Please tell me the first half of your postcode.

PART 1: Your freshwater fishing in England in 2016

Q6. How many days, or part days, have you fished in England in 2016?

Less than 5 days

Between 5 and 20 days

More than 20 days

Q7. Have you competed in any fishing matches in 2016?

Yes

No

Q7a. Which of the following types of fishing did you do most often during 2016?

Salmon and sea trout

Wild trout

Other

[ONE MUST BE SELECTED]

PART 2: Your most recent fishing trip in England

[IF Q7a= Wild trout] For the remainder of this survey, the focus will now be on your most recent wild trout fishing trip in England.

[IF Q7a= Salmon and sea trout] For the remainder of this survey, the focus will now be on your most recent salmon and sea trout fishing trip in England.

[IF Q7a= Other or blank (not answered)] For the remainder of this survey, the focus will now be on your most recent fishing trip in England.

Q8. When did this fishing trip take place?

[DATE]

Q9. [IF ONLINE, SHOW MAP, OTHERS GO TO Q10] Where did you go on this occasion? Please place a marker on the map to mark the fishery.

[CAPTURE CO-ORDINATES]

GO TO Q11

Q10. [IF TELEPHONE] In which county was the place where you went fishing? [DP insert list of ceremonial counties (as previous)]

Q11. Approximately how far away from your home was this?

[MILES]

[basedistance=Q11]

Q12. What type of water was this (please select)? [ASK ALL EXCEPT IF Q7a= Salmon and sea trout]

River/stream/drain

Lake, pond or reservoir

Canal

[basewbtype=Q12]

Q13. What do you call this fishery?

RECORD VERBATIM

Q14. Was this a day trip, or did it involve an overnight stay?

Day trip

Overnight trip

Q15. Which of the following types of fish were you trying to catch on this trip, or were you fishing for anything? [ASK ALL EXCEPT IF Q7a=Wild trout OR IF Q7a=Salmon and sea trout]

Fishing for anything	
Carp	
Barbel	
Predators (pike, perch, zander)	
Catfish	
Other coarse fish	
Eels	
Trout (stocked)	
Trout (wild)	
Grayling	
Salmon or sea trout **[ONLY SHOW THIS OPTION IF Q3=SALMON AND SEA TROUT]**	

DP:

If Q12=1 AND basespecies = ‘Catfish’

OR

If Q12=2 AND basespecies = ‘Grayling’ OR ‘Salmon or sea trout’

OR

If Q12=3 AND basespecies = ‘Catfish’ OR ‘Barbel’ OR ‘Trout (stocked)’ OR ‘Trout (wild)’ OR ‘Grayling’ OR ‘Salmon or sea trout’

Show error message ‘Fish type <basespecies> cannot be selected for water type <Q12 answer>. Please either change the water type you fished or the types of fish you were trying to catch, or choose another recent trip to tell us about. To change the trip, click here [GO BACK TO Q8]

[basespecies=Q15**]**

If Q15 includes ‘Salmon or Sea trout’, then basespecies= ‘Salmon or Sea trout’
Else if Q15 includes Grayling, then basespecies= ‘Grayling’
Else if Q15 includes Trout (wild), then basespecies= ‘Trout (wild)’
Else if Q15 includes Trout (stocked), then basespecies= ‘Trout (stocked)’
Else if Q15 includes Carp’, then basespecies= ‘Carp’
Else if Q15 includes Barbel’, then basespecies= ‘Barbel’
Else if Q15 includes Predators’, then basespecies= ‘Predators’
Else if Q15 includes Catfish’, then basespecies= ‘Catfish’
Else basespecies= ‘Mixed coarse fish’

Q16. What fishing method(s) did you use on this occasion?

Fly-fishing

Other method

[IF Q16 = ‘Fly-fishing’, basemethod= ‘Fly only’; ELSE basemethod= ‘Multimethod’]

Q17. How much, if any, did it cost you for a day’s fishing at this site? If you pay a weekly or an annual fee to use the site, then please estimate the cost of a day by dividing the fee by the number of days you would expect to fish on that permit. For example, if it costs you £50 per year for a club membership which includes the site you visited, and you expect to fish that club’s waters 5 times per season on average, then the cost you should enter would be £10 per day.

[£AMOUNT] per day

[basecost=Q17]

RECRUIT TO SP EXERCISES – PHONE ONLY

Thank you for your answers so far. I would be very grateful if you could spare around 15 minutes – either now or at a more convenient time – to run through some more questions with me. You do need to have some materials in front of you for these next questions, which I can either email to you now and we can carry on, or I can email or post them to you and we can make an arrangement to talk later at a convenient time for you.

1. Email now – **Send email then and proceed**
2. Email later – **Send email then bring up appointment box**
3. Post – **Bring up appointment/address box**
4. No – **Attempt to reassure and persuade; if still no, thank and close**

Introduction to SP Exercises – PHONE ONLY

Thank you very much for agreeing to take part in this survey.

The rest of the questionnaire will take around 15 minutes.

Can I check you have your materials ready to refer to? These will have either been sent in the post or by email. And what is the reference number on the materials? **INTERVIEWER: CHECK THE NUMBER IS CORRECT AND PROCEED OR RE-SCHEDULE AS APPROPRIATE.**

1. Correct – **PROCEED**

2. Incorrect – **GO TO APPOINTMENTS SCREEN AND RE-SCHEDULE, RE-SENDING MATERIALS**

ASK ALL PART 3: SP1 Exercise

You will next be shown a sequence of cards each showing 4 hypothetical fishing sites.

IF TELEPHONE: CHECK THAT RESPONDENT HAS CHOICE CARD A1 IN FRONT OF THEM]

Each site is described by the following characteristics:

- the water type
- the fishing methods allowed
- the fish species available
- their size (relative to the average for that species)
- their abundance in the water (relative to the average for that species, of that size)
- the distance of the site from your home
- the cost to you of a day's fishing at the site (This could be a day permit fee or the annual fee divided by the number of trips you make to these waters. For the purposes of this exercise, please assume that there are no additional costs, for example, seasonal membership fees, other than your travel costs and the permit fee.)

<NEXT PAGE>

In each question, you will be asked to choose:

- which of the sites shown you would be most likely to visit for your fishing trip
- which you would be least likely to visit

The purpose of this exercise is to understand how important the different site characteristics are to you when deciding where to go fishing.

Please note that in this exercise, the order of species has been randomised, so you should make sure to look at all the species that are shown rather than just focus on the first one.

Please consider the occasion of your recent fishing trip we discussed earlier when answering these questions and imagine that these were the only sites available. For example, suppose that the sites currently available to you were all closed and that the sites shown in the choice questions had newly become available to you.

Please also assume that all other aspects relevant to your decision are the same across all sites.

You will see 8 choices in total in this exercise.

<NEXT PAGE>

IF TELEPHONE: **INTERVIEWER, CHECK THAT RESPONDENT UNDERSTANDS. IF LESS THAN 100% CLEAR, READ AGAIN. WHEN 100% CLEAR, CONTINUE.**

Q18. [CHOICE CARD A1] If these sites were the only options available to you when you decided where to go fishing on your recent trip, which would you be most likely to choose, and which would you be least likely to choose? If you would be most likely not to have gone fishing at all if these were the only sites available, then please indicate this by ticking the relevant box.

	A	B	C	D
Most likely				
Least likely				

I would not choose any of these sites.

Q19. Do not show if Q18 = 'I would not choose any of these sites', why did you choose this option as the most likely?

RECORD VERBATIM

Q20. CHOICE CARD A2

Q21. CHOICE CARD A3

Q22. CHOICE CARD A4

Q23. CHOICE CARD A5

Q24. CHOICE CARD A6

Q25. CHOICE CARD A7

Q26. CHOICE CARD A8

END OF SP1 EXERCISE

SP1 FOLLOW-UP
The next few questions are about the choices you have just made.

Q27. Did you generally feel able to make comparisons between the options presented to you?

1. Yes **GO TO Q29**
2. No

Q28. Why did you feel unable to make comparisons between options?

[RECORD VERBATIM]

Q29. In the choices, did you find each of the options we described to be realistic?

1. Yes **SKIP TO PART 4**
2. No

Q30. Which options did you feel were not realistic? [Please be specific in order to help us improve this survey for future participants.]

[RECORD VERBATIM]

PART 4: SP2 Exercise

The next set of questions will focus on features of fishing sites including aspects other than the fish themselves

IF TELEPHONE: CHECK THAT RESPONDENT HAS CHOICE CARD B1 IN FRONT OF THEM

At each question, you will be shown a list of 4 features relevant to an angling site, and you will be asked to choose which is the most important to you, and which is the least important when deciding where to go fishing for the type of trip you took most recently. You will also be able to say if none of these features matter to you or if one or more of the features are off-putting to you when choosing where to go fishing for this type of trip.

Please again consider your recent fishing trip when answering these questions.

You will see 8 choices in total in this exercise.

<NEXT PAGE>

IF TELEPHONE: **INTERVIEWER CHECK THAT RESPONDENT UNDERSTANDS. IF LESS THAN 100% CLEAR, READ AGAIN. WHEN 100% CLEAR, CONTINUE]**

Q31. CHOICE CARD B1

Most important

Least important

None of these matters to me

One or more of the features are off-putting to me

Q32. [IF Q31 <> 'None of these matter to me'] Why did you choose Q31[Most important] as the most important feature?

RECORD VERBATIM

Q33. [IF Q31 = 'one or more of the features are off-putting to me'] Which feature(s) in Q31 is/are off-putting to you when choosing where to go fishing?

DP – PLEASE SHOW THE OPTIONS FROM THE CHOICE CARD HERE WITH TICK BOXES

Q34. CHOICE CARD B2

Q35. CHOICE CARD B3

Q36. CHOICE CARD B4

Q37. CHOICE CARD B5

Q38. CHOICE CARD B6

Q39. CHOICE CARD B7

Q40. CHOICE CARD B8

FOR ANY OF THE ABOVE WHERE 'ONE OR MORE OF THE FEATURES ARE OFF-PUTTING TO ME' IS CHOSEN, REPEAT Q33

END OF SP2 EXERCISE

SP2 FOLLOW-UP

The next few questions are about the choices you have just made.

Q41. Did you generally feel able to make comparisons between the options presented to you?

1. Yes **GO TO Q42**
2. No

Q42. Why did you feel unable to make comparisons between options?

Q43. In the choices, did you find each of the options we described to be easy to understand?

1. Yes **SKIP TO PART 5**
2. No

Q44. Which options did you feel were not easy to understand? [Please be specific in order to help us improve this survey for future participants]

PART 5: BACKGROUND INFORMATION

In order to ensure that we survey people from all walks of life, I would now like to ask you some questions about you. I would like to reassure you that all responses will be kept strictly confidential.

ASK ALL

Q45. How would you describe the occupation of the chief income earner in your household? This could be you – the chief income earner is the person who has the highest earnings in the household.

SINGLE CODE

1	Senior managerial or professional	A
2	Intermediate managerial, administrative or professional	B
3	Supervisor; clerical; junior managerial, administrative or professional	C1
4	Manual worker (with industry qualifications)	C2
5	Manual worker (with no qualifications)	D
6	Unemployed	E
7	Retired	ASK Q46
8	Student	C1
9	Prefer not to say	

Q46. Does the chief income earner have a state pension, a private pension or both?

SINGLE CODE

1	State only	E
2	Private only	Ask Q47
3	Both	Ask Q47

Q47. How would you describe the chief income earner's occupation type before retirement?

SINGLE CODE

1	Senior managerial or professional	A
2	Intermediate managerial, administrative or professional	B
3	Supervisor; clerical; junior managerial, administrative or professional	C1
4	Manual worker (with industry qualifications)	C2
5	Manual worker (with no qualifications)	D
6	None of these	E
9	Prefer not to say	

Q48. DP: DUMMY QUESTION, DO NOT SHOW – summarise SEG

Q44=1 OR (Q44=7 AND Q46=1)	A	AB
Q44=2 OR (Q44=7 AND Q46=2)	B	
Q44=3 OR 8 OR (Q44=7 AND Q46=3)	C1	C1C2
Q44=4 OR (Q44Q45=7 AND Q46=4)	C2	
Q44=5 OR (Q44=7 AND Q46=5)	D	DE
Q44=6 OR Q45=1 OR (Q44=7 AND Q46=6)	E	

Q49. For classification purposes only, please indicate which category best describes the total income that you (and all other members of your household) earned during 2015 to 2016 before taxes. Please be sure to include each member's wages and salaries, as well as net income from any business, pensions, benefits dividends, interest, tips or other income.

Per week	**Per year**
Under £300	Under £15,600
£300 to £1,000	£15,600 to £52,000
Over £1,000	Over £52,000

Don't know

Rather not say

THAT WAS THE LAST QUESTION. THANK YOU VERY MUCH FOR YOUR HELP IN THIS RESEARCH

Please can I take a note of your name and telephone number for quality control purposes?

Respondent name:

Telephone: home:... work:

Thank you

I confirm that this interview was conducted under the terms of the MRS code of conduct and is completely confidential.

Interviewer's signature:

TELEPHONE ONLY: To be completed by the interviewer when interview is over

Q50. In your judgement, did the respondent understand what he/she was being asked to do in the questions?

Did not understand at all

Did not understand very much

Understood a little

Understood a great deal

Understood completely

Q51. Which of the following best describes the amount of thought the respondent put into making their choices?

Gave the questions very careful consideration

Gave the questions careful consideration

Gave the questions some consideration

Gave the questions little consideration

Gave the questions no consideration

Q52. Which of the following best describes the degree of fatigue shown by the respondent when doing the choice experiments?

Easily maintained concentration throughout the survey

Maintained concentration with some effort throughout the survey

Maintained concentration with a good deal of effort throughout the survey

Lessened concentration in the later stages

Lost concentration in the later stages

Appendix B: Phase 1 main survey questionnaire

2972
Valuation of Freshwater Angling in England

SYSTEM INFORMATION:
DELETE IF ONLINE: Interviewer number
DELETE IF ONLINE: Interviewer name
Date:
Time interview started:

Introduction

Thank you for taking part in this survey of the economic impact of freshwater angling in England.

The survey is commissioned by the Environment Agency to provide a better understanding of angling's economic significance. The results will help ensure that our fisheries are appropriately managed and protected. We can only do this with help from licensed anglers, like you. We need to know about the types of freshwater fishing you did in 2015, where you fished and how much you spent on angling.

This survey is only about fishing in freshwater, that is, a pond, lake, reservoir, river, stream or canal.

This survey will take about 15 minutes if you complete it in one go. You can always return to it at any time of your convenience by re-clicking on the link …………

The survey is divided into different parts as follows:

Part 1 asks you about your fishing in England in 2015.

Part 2 asks you about expenditure that is not related to any specific trip.

Part 3 asks some basic information about you (for use in the analysis only).

Part 4 asks you about specific fisheries that you visited in 2015.

Part 5 asks you about expenditure to those fisheries you visited in 2015.

Thank you for your help. If you have any queries about the survey, please telephone the Environment Agency's National Customer Contact Centre on 03708-506-506 as shown on your rod licence.

PART 1: Your freshwater fishing in England in 2015

Q1. What type of rod licence did you hold in 2015? If you held more than one, please choose the most expensive type you held between April and December 2015 (please select one).

DP allow one answer only

Licence type	**Coarse fish and non-migratory trout**	**Salmon and sea trout**
Full		
Senior (over 65) concession		
Disabled concession		
8-day licence		
1-day licence		

Q2. Did you fish for FRESHWATER species in England in 2015?

Yes

No **GO TO PART 2 (Q7)**

Don't know

Q3. **IF Q2=2 (NO) GO TO PART 2 (Q7), OTHERS ASK:** What did you fish for in England in 2015? Select all that apply

I fished for coarse fish or eels.

I fished for rainbow or brown trout or grayling.

I fished for salmon or sea trout (only allowed if have salmon/sea trout licence).

Q4. **IF Q3=1 ASK, OTHERS GO TO Q5:** How many days, or part days, did you fish for coarse fish or eels in 2015 on:

Rivers or streams: **DP ADD TEXT BOX**

Lakes/reservoirs/ponds: **DP ADD TEXT BOX**

Canals: **DP ADD TEXT BOX**

Q4.2 If you targeted particular species of coarse fish on some of your trips in 2015, on how many days were you trying to catch each species? You could target more than one species on the same day. There could be some trips where you just fish generally, not targeting particular species

Target species	**Number of days fished**
No particular species fished	
Carp	
Barbel	
Bream	
Catfish	
Chub	

Target species	Number of days fished
Crucian carp	
Dace	
Eel	
Perch	
Pike	
Roach	
Rudd	
Trench	
Zander	
Other (for example, bleak, dudgeon)	

Q4.3 How many coarse fishing matches did you compete in 2015?
None

Number of matches fished: ‘0’ not allowed

IF Q3≠2 or 3 GO TO PART 2 (Q7), OTHERS GO TO Q5

Q5. **IF Q3=2 ASK, OTHERS GO TO Q6:** How many days, or part days, did you fish for brown trout, rainbow trout or grayling in 2015 on:

Rivers: **DP ADD TEXT BOX**

Lakes/reservoirs/ponds: **DP ADD TEXT BOX**

Q5.2 On how many days were you trying to catch each species? You could target more than one species on the same day.

	No. of days on which I was specifically fishing for each species
Stocked rainbow trout	
Stocked brown trout	
Other types of stocked trout	
Wild trout	
Grayling	

Q5.3 How many trout and grayling competitions did you compete in 2015?

None

Number of competitions: **DP ADD TEXT BOX, ‘0’ not allowed**

IF Q3≠3 GO TO PART 2 (Q7), OTHERS GO TO Q6

Q6. **IF Q3=3 ASK, OTHERS GO TO Q7:** On how many days did you fish for salmon or sea trout in 2015?

Q6.2 On how many days were you trying to catch each species? You could target more than one species on the same day.

	No. of days on which I was specifically fishing for each species
Salmon	
Sea trout	

PART 2: Annual expenditure on tackle, clothing, books, magazines and club membership

Q7. **ASK ALL:** Please indicate your expenditure during 2015 on SPECIALIST CLOTHING INCLUDING WADERS AND OTHER FOOTWEAR FOR FRESHWATER ANGLING?

No spend

£1–£10

£11–£50

£51–£100

£101–£250

£251–£500

£501–£1,000

£1,001–£5,000

More than £5,000

Don’t know / Prefer not to say

Q8. Please indicate your expenditure during 2015 on TACKLE AND EQUIPMENT for each type of freshwater fishing (rods, poles, reels, floats, lures, hooks, weights, lines, flies, fly-tying equipment, nets and other fishing equipment, such as holdalls, boxes, umbrella, bivvy, seats, float tube, boats and engines).

Please DO NOT INCLUDE non-equipment items such as bait, accommodation, meals, transport, boat hire, day permits or licences.

	No spend	£1 – £10	£11 – £50	£51 – £100	£101 – £250	£251 – £500	£501 – £1,000	£1,001 – £5,000	£5,001 – £1,0000	More than £10,000 (please enter approximate amount) **DP ADD TEXT BOX**	Don’t know/ Prefer not to say
Coarse fish, eels											
Brown trout, rainbow trout, grayling											

Salmon and sea trout											

Q9. Please indicate your expenditure during 2015 on permits to fish for all types of freshwater fishing in England, including club membership, season tickets and syndicate fees. Please DO NOT INCLUDE YOUR ENVIRONMENT AGENCY ROD LICENCE and/or DAY TICKETS in this.

	No spend	£1–£10	£11–£50	£51–£100	£101–£250	£251–£500	£501–£1,000	£1,001–£5,000	More than £5,000 (please enter approximate amount) **DP ADD TEXT BOX**	Don't know/ Prefer not to say
Club membership/ season tickets/ syndicate fees										

Q10. Please indicate your expenditure during 2015 on books, magazines, DVDs or other media related specifically to angling. Please remember to include any items you may have bought by mail order or online.

No spend

£1–£10

£11–£50

£51–£100

£101–£250

£251–£500

£501–£1,000

More than £1,000 (please enter approximate amount) **DP ADD TEXT BOX**

Don't know / Prefer not to say

PART 3: About you

We need to ask a few questions about you to understand how different types of people choose to fish in different parts of the country.

Q11. Where you live. Please enter the first half of your postcode for example, HP14 or click on the map to show the location of your home

DP – ADD MAP

Q12. Your age (please select)

17–24

25–34

35–44

45–54

55–64

65–74

75 or over

Prefer not to say

Q13. Gender (please select one option)

~~Male~~

~~Female~~

DP - IF Q2=2 (NO) OR Q3=4 GO TO Q23

PART 4: Where you fished in England in 2015

Q14. **IF Q3=1 ASK, OTHERS GO TO Q15:** We need to know where you fished for coarse fish or eels. Please use the map and answer the questions to the right of the map for each fishery

ON FIRST MAP: Place a marker on the map to mark the fishery.

DP - SUB-QUESTIONS FOR THIS FISHERY TO APPEAR ALONGSIDE THE MAP:

Q14.2 What type of water was this (please select)?

River/stream

Lake, pond or reservoir

Canal

Q14.3 What do you call this fishery? **OPEN TEXT BOX**

Q14.4 How many days, or part days, did you fish here for coarse fish or eels in 2015?

DP ADD TEXT BOX – UPPER LIMIT OF 99

Q14.5 Did you fish for coarse fish or eels at any other fishery in England in 2015?

Yes **GO TO NEW MAP AND REPEAT QUESTIONS 14.1-14.4**

No

Q15. **IF Q3=2 ASK, OTHERS GO TO Q16:** Where did you fish for brown trout, rainbow trout or grayling in 2015? We need to know where you fished for trout or grayling. There is one map and a couple of questions for each fishery you visited last year. Please click here to go to the map.

ON FIRST MAP: Place a marker on the map to mark the fishery.

DP - SUB-QUESTIONS FOR THIS FISHERY TO APPEAR ALONGSIDE THE MAP:

Q15.2 What type of water was this (please select)?

River/ stream

Lake, pond or reservoir

Q15.3 What do you call this fishery?

Q15.4 How many days, or part days, did you fish here for trout or grayling in 2015?

DP ADD TEXT BOX – UPPER LIMIT OF 99

Q15.5 Did you fish for trout or grayling at any other fishery in England in 2015?

Yes **GO TO NEW MAP AND REPEAT QUESTIONS 15.1-15.4**

No

Q16. **IF Q3=3 ASK, OTHERS GO TO Q17:** Where did you fish for salmon or sea trout in 2015? We need to know where you fished for salmon or sea trout. There is one map and a couple of questions for each fishery you visited last year. Please click here to go to the first map.

ON FIRST MAP: Place a marker on the map to mark the fishery.

DP - SUB-QUESTIONS FOR THIS FISHERY TO APPEAR ALONGSIDE THE MAP:

Q16.2 What do you call this fishery?

Q16.3 How many days, or part days, did you fish here for salmon or sea trout in 2015?

DP ADD TEXT BOX – MAX UPPER LIMIT OF 99

Q16.4 Did you fish for salmon or sea trout at any other fishery in England in 2015?

Yes **GO TO NEW MAP AND REPEAT QUESTIONS 16.1-16.3**

No

PART 5: Your expenditure on trips to particular fisheries

This part is about your personal spending on angling trips to individual fisheries that you visited in 2015.

Q17. **IF Q3=3 ASK, OTHERS GO TO Q19:** You said that you fished for salmon or sea trout. ………………….. **(DP-INSERT THE NAME OF THE FISHERY THEY GAVE IN RESPONSE TO Q16.2 WHERE THEY FISHED THE MOST DAYS.)** On a typical trip from home to this fishery, how many days or part days, did you fish?

One, it was usually a day trip

I usually stayed for ___days **DP ADD TEXT BOX**

Q17.2 Please indicate the amount you spent on a typical trip to this fishery on the following items (including the amount you spent on other people): (please select)

	No spend	<£1	£1–£2	£3–£5	£6–£10	£11–£25	£26–£50	£51–£75	£76–£100	£101–£250	More than £250	Don't know / Prefer not to say
Accommodation including camping												

Meals and drinks served in pub, café etc.											
Food and drink from shop											
Public transport and vehicle hire											
Petrol, diesel, parking and tolls											
Hire of tackle and boats											
Fishing guide or ghillie											
Bait											
Day tickets											

Q18. **IF Q16.4=1 ASK, OTHERS GO TO Q19:** You also said that you fished for salmon or sea trout at **………………….. (DP-INSERT THE NAME OF THE FISHERY THEY GAVE IN RESPONSE TO Q16.2 THAT WAS FURTHEST AWAY FROM HOME. IF THIS IS THE SAME FISHERY AS FOR Q17, THEN SELECT THE SECOND FURTHEST.)** On a typical trip from home to this fishery, how many days or part days, did you fish?

One, it was usually a day trip

I usually stayed for ___days **DP ADD TEXT BOX**

Q18.2 Please indicate the amount you spent on a typical trip to this fishery on the following items (including the amount you spent on other people): (please select)

	No spend	<£1	£1–£2	£3–£5	£6–£10	£11–£25	£26–£50	£51–£75	£76–£100	£101–£250	More than £250	Don't know/ Prefer not to say
Accommodation (including camping)												
Meals and drinks served in pub, café etc.												
Food and drink from shop												
Public transport and vehicle hire												
Petrol, diesel, parking and tolls												
Hire of tackle and boats												
Fishing guide or ghillie												
Bait												
Day tickets												

Q19. **IF Q3=1 ASK, OTHERS GO TO Q21: You said that you fished for coarse fish or eels at DP-INSERT THE NAME OF THE FISHERY THEY GAVE IN RESPONSE TO Q14.2 WHERE THEY FISHED THE MOST DAYS.** On a typical trip from home to this fishery, how many days or part days, did you fish?

One, it was usually a day trip

I usually stayed for ___days **DP ADD TEXT BOX**

Q19.2 Please indicate the amount you spent on a typical trip to this fishery on the following items (including the amount you spent on other people): (please select)

	No spend	<£1	£1–£2	£3–£5	£6–£10	£11–£25	£26–£50	£51–£75	£76–£100	£101–£250	More than £250	Don't know/ Prefer not to say
Accommodation including camping												
Meals and drinks served in pub, café etc.												
Food and drink from shop												
Public transport and vehicle hire												
Petrol, diesel, parking and tolls												
Hire of tackle and boats												
Fishing guide												
Bait and ground bait												
Day tickets												
Match fees **(do not show if Q4.3 = None)**												

Q20. **IF Q14.5=1 ASK, OTHERS GO TO Q21:** You also said that you fished for coarse fish or eels at ………………….. **(DP-INSERT THE NAME OF THE FISHERY THEY GAVE IN RESPONSE TO Q14.2 THAT WAS FURTHEST AWAY FROM HOME. IF THIS IS THE SAME FISHERY AS FOR Q19, THEN SELECT THE SECOND FURTHEST.)** On a typical trip from home to this fishery, how many days or part days, did you fish?

One, it was usually a day trip

I usually stayed for ___days **DP ADD TEXT BOX**

Q20.2 Please indicate the amount you spent on a typical trip to this fishery on the following items (including the amount you spent on other people): (please select)

	No spend	<£1	£1–£2	£3–£5	£6–£10	£11–£25	£26–£50	£51–£75	£76–£100	£101–£250	More than £250	Don't know/ Prefer not to say

Accommodation including camping												
Meals and drinks served in pub, café etc.												
Food and drink from shop												
Public transport and vehicle hire												
Petrol, diesel, parking and tolls												
Hire of tackle and boats												
Fishing guide												
Bait and ground bait												
Day tickets												
Match fees **(do not show if Q4.3 = None)**												

Q21. **IF Q3=2 ASK, OTHERS GO TO Q22:** You said that you fished for trout or grayling at ………………….. **(DP-INSERT THE NAME OF THE FISHERY THEY GAVE IN RESPONSE TO Q15.3 WHERE THEY FISHED THE MOST DAYS.).** On a typical trip from home to this fishery, how many days or part days, did you fish?

One, it was usually a day trip

I usually stayed for ___days **DP ADD TEXT BOX**

Q21.2 Please indicate the amount you spent on a typical trip to this fishery on the following items (including the amount you spent on other people): (please select)

	No spend	<£1	£1–£2	£3–£5	£6–£10	£11–£25	£26–£50	£51–£75	£76–£100	£101–£250	More than £250	Don't know/ Prefer not to say
Accommodation including camping												
Meals and drinks served in pub, café etc.												
Food and drink from shop												
Public transport and vehicle hire												
Petrol, diesel, parking and tolls												

Hire of tackle and boats											
Fishing guide											
Bait											
Day tickets											
Competition fees (**do not show if Q5.3 = None)**											

Q22. **IF Q15.5=1 ASK, OTHERS GO TO Q23:** You also said that you fished for trout or grayling at **………………….. (insert the name of the fishery they gave in response to Q15.3 that was furthest away from home. If this is the same fishery as for Q21, then select the second furthest.)** On a typical trip from home to this fishery, how many days or part days, did you fish?

One, it was usually a day trip

I usually stayed for ___days **DP ADD TEXT BOX**

Q22.2 Please indicate the amount you spent on a typical trip to this fishery on the following items (including the amount you spent on other people): (please select)

	No spend	<£1	£1–£2	£3–£5	£6–£10	£11–£25	£26–£50	£51–£75	£76–£100	£101–£250	More than £250	Don't know/ Prefer not to say
Accommodation including camping												
Meals and drinks served in pub, café etc.												
Food and drink from shop												
Public transport and vehicle hire												
Petrol, diesel, parking and tolls												
Hire of tackle and boats												
Fishing guide												
Bait												
Day tickets												
Competition fees **(do not show if Q5.3 = None)**												

Q23. We will be conducting another survey about how anglers value the fisheries and their environment. Would you be happy to be contacted again for this?

Yes, I can be contacted again for a follow. If yes, please enter your email address and telephone number **DP ADD TEXT BOX**

No

Thanks for your help.

The results of this survey will be reported by the Environment Agency in emails to licence holders and to the angling press. This research was conducted under the terms of the MRS code of conduct and is completely confidential.

Appendix C: Literature review

Studies of the economic value of angling can be divided into 2 broad types according to the types of estimates they produce:

- economic impact studies
- economic valuation studies

Economic impact studies identify expenditure relating to angling, which are used to estimate the contribution of angling to the economy. Although economic impact analysis provides an indicator of the size of angling as an economic activity, it is not a measure of its value (Environment Agency 2007a). Estimating the value of angling involves identifying the willingness to pay (WTP) of anglers for recreational angling. This allows for the estimation of the 'consumer surplus' of angling – in other words, the net benefit that anglers receive from fishing.[11]

The review described in this appendix focuses mainly on studies conducted in the UK in the past 10 years. Studies conducted in Ireland and further afield are reviewed where necessary – as well as earlier studies – to provide a more complete picture of approaches used to estimate the economic impact and value of angling and the values produced.

Importantly, the studies include sea angling; the purpose of reviewing these is not so much on the findings but on the approaches to elicit the values. Table C.1 summarises the main studies reviewed.

For reviews of earlier studies, please refer to Crabtree and Willis (2004), Environment Agency (2007a) and Radford et al. (2009).

[11] Most of the economic valuation studies also collect expenditure data, which are used to calculate the consumer surplus.

Table C.1 Summary of recreational angling studies reviewed

Reference	Good/service being valued	Values produced	Methods	Sample	Economic estimates
Environment Agency (2015)	Recreational angling in Essex, Norfolk and Sussex area	Expenditure using secondary data	Secondary data	Not applicable	In 2013, freshwater angling activity contributed £149.4 million - £210.8 million direct expenditure to the local economy in 2013.
SQW (2015)	Recreational angling on River Tweed	Economic impact	Surveys and face-to-face interviews with river beat owners	n = 82 river beat owners	Angling contributes £24.0 million to the economy, (~30% increase on £17.9 million in 2006 report)
Hynes et al (2015)	Recreational fishing in Ireland	Consumer surplus (using TCM)	Angling travel behaviour survey (for TCM)	Anglers (n = 451), general public (n = 2,011)	Consumer surplus per trip: 1) €232 per trip for on-site model, 2) €49.97 per trip (for household model)
Brown (2014)	Recreational angling on River Eden	Expenditure and economic impact	Expenditure survey	Anglers (n = 2,465)	Average expenditure per angler in the Eden catchment: £803 (in 2013). With inclusion of indirect and induced effects: £951.84 (includes visitor and resident). Total economic output of £1,427,760 (= £613,936.80 of GVA)
Glasgow Caledonian University et al. (2009)	Sea angling in Scotland	Expenditure and economic impact	Expenditure surveys added to Omnibus	The sea angling questions were presented to a total of 15,037 Scottish individuals.	Estimates that sea angling in Scotland supported 3,148 jobs (FTEs) and contributed £69,670,000 to household income (including wages, self-employment income, rents and profits)

Reference	Good/service being valued	Values produced	Methods	Sample	Economic estimates
Tourism Development International (2013)	Fish stocks and recreational angling in Ireland	Expenditure and WTP (using CV)	Survey identifying angling travel behaviour (for TCM), expenditure and WTP for preservation of fish stocks (CV)	Anglers (n = 451) General public (n = 2,011)	Direct expenditure in 2012: €555 million With inclusion of indirect and induced effects: €755 million CV survey: mean WTP: €15.97 per person per year (general public) and €66.52 per person per year (anglers)
Brown et al. (2013)	Recreational sea angling in England	Expenditure and economic impact	Expenditure survey	Anglers (n = 340 on-site and n = 2,502 online survey)	Total resident sea angler spending in England: £1.23 billion With inclusion of indirect and induced effects: £2.1 billion
Radford et al. (2009)	Recreational sea angling in Scotland	Expenditure; economic impact	Omnibus, online angler and on-site youth angler surveys identifying angling behaviour and expenditure	Omnibus (n = 15,037 Scottish adults) Anglers (n = 501 online survey and n = 95 on-site survey)	Total expenditure on sea angling in Scotland: £140,868,000 If sea angling ceased, there would be annual income loss of £37 million.
Rees et al. (2010)	Recreational sea angling in Lyme Bay (Dorset, England)	Expenditure; economic impact	Expenditure survey	Sample group in hotspot areas (n = 40)	£1 million expenditure by divers through trips and total turnover for recreation estimated at £18 million
Environment Agency (2007a)	Salmon and other fish species in England and Wales	WTP (using CV and CE)	Survey with CV and CE Expenditure survey	SP survey: n = 911 members (general public)	Mean WTP among general public to prevent ‘severe decline in salmon populations across England and Wales’ (from disease): £15.80 per household per year (using CV) and £23.88 per household per year (using CE)

Reference	Good/service being valued	Values produced	Methods	Sample	Economic estimates
Environment Agency (2007b)	Freshwater angling in England and Wales	Expenditure; economic impact	Telephone, internet and postal expenditure surveys	Anglers (n = ~7,000)	Angler gross expenditure across the whole of England and Wales was £1.18 billion, with coarse angling responsible for £971 million of this. Household income of £980 million and 37,386 jobs were generated across England and Wales.
Johnstone and Markandya (2006)	Water quality changes in upland, lowland and chalk rivers in England	Consumer surplus (using TCM)	TCM. Survey eliciting site location and visitation frequency External data for classification of sites	Anglers (n = 421)	Estimated welfare gain per trip for a 10% increase in river quality: £47.31 for lowland sites, £19.27 for upland sites and £5.78 for chalk sites
Crabtree and Willis (2004)	Recreational sea angling in England and Wales	WTP (using CV, CE and TCM)	Survey with CE, angling behaviour questions (TCM) and expenditure questions	Omnibus household survey (n = 10,200) Anglers (n = 514 on-site and n = 383 postal surveys of angling clubs members)	Total expenditure by anglers in England and Wales: £538 million per year (residents) and £192 million per year (visitors). Choice experiments: marginal WTP for larger fish: £0.22 per 1% increase in size and £11.38 for increase in diversity of species caught

Notes: CE = choice experiment; CV = contingent valuation; TCM = travel cost method

C.1 Economic impact studies

Most economic impact studies in the UK have been conducted at a catchment or river level (for example, Brown et al. 2013, Brown 2014, Environment Agency 2015, SQW 2015).

The most recent economic impact study for the UK was conducted by the Environment Agency for the Essex, Norfolk and Suffolk area (Environment Agency 2015). Using secondary visitor data generated for the Broadland Rivers WFD catchment, which comprises 12% of the total Essex, Norfolk and Suffolk area, this study estimated that freshwater angling activity contributed between £149.4 million and £210.8 million direct expenditure to the local Essex, Norfolk and Suffolk economy in 2013. Secondary effects (indirect and induced effects) were not estimated in this report.

In the same year, SQW (2015) conducted a survey of fishing beat owners to update estimates from a 2006 report on the economic impact of angling in the River Tweed, which forms the border between England and Scotland. SQW found that fishing on the Tweed and its tributaries contributed £24.0 million to the economy, representing a significant increase from the estimated £17.9 million in the 2006 report. The report noted that this growth was a result of an increase in the number of days fished combined with an increase in fishing rents.

In another recent study, Brown (2014) used primary data on expenditure to estimate the economic impact of recreational angling in the Eden River catchment area in north-west England. Data from 2,465 anglers were collected via an online survey distributed to rod licence holders in 2013, and via angling clubs in the Environment Agency's North West and North East Regions. Results indicated that 26.4% of respondents had fished on the Eden catchment before, although 23.5% of these respondents had not fished there for over 5 years. The average expenditure in the Eden catchment in 2013 was estimated at £803 per respondent; with the inclusion of indirect and induced effects, this came to £951.84 per angler. The total economic output was estimated as £1,427,760, equating to £613,936.80 of gross value added (GVA), for the River Eden catchment area.

At a national level, Brown et al. (2013) estimated the economic impact of sea angling in England (Annex 2 of the Sea Angling 2012 study commissioned by Defra). Data for this study were collected via 340 face-to-face interviews with anglers in 5 locations and 2,502 online surveys targeted at sea anglers. Using the expenditure data generated by the survey, total resident sea angler spending in England was estimated at £1.23 billion, although this dropped to £831 million once account was taken of imports and taxes. With inclusion of indirect and induced effects, total spending came to £2.1 billion per year for all of England.

In the case of Lyme Bay in Dorset, Rees et al. (2010) revealed that the recreational angling-related industry was of economic significance to the local area. Of the recreational users studied (dive clubs, dive businesses, charter boat operators and anglers), anglers were found to be the most frequent users and had the highest estimated value of activity (at £3,034,138) in the Lyme Bay closed area.

Further afield, Radford et al. (2009) estimated the economic impact of sea angling in Scotland, using primary expenditure data generated from questions added to the Scottish Omnibus survey, as well as an online angler survey and an on-site angler survey targeted at younger anglers (<18years). They estimated that the total expenditure on sea angling across the whole of Scotland was £140,868,000 in 2008. Sea angling was found to support 3,148 full-time job equivalents (FTEs), and £69,67,000 annually of Scottish household income in the form of wages, self-employment income, rents and profits (that is, including indirect and induced effects). If sea angling ceased, they estimated that there would be a net loss of at least 1,675 FTEs and an annual income loss of £37 million.

A 2009 study found that sea angling in Scotland supported 3,148 jobs (FTEs) and contributed £69,670,000 to household income (including wages, self-employment income, rents and profits) (Glasgow Caledonian University et al. 2009). This report for the Scottish Government also estimated the jobs and household income that would be lost if sea angling ceased, and the economic contribution of sea angling to the Highlands and Islands Enterprise area. The report considered the future prospects for the sector and identified important sea angling centres, competing areas and the main characteristics and trends in the sector.

More recently, Tourism Development International (2013) conducted an evaluation of the economic impact of recreational angling in Ireland, as well its economic value (see below for a more detailed description of study). Using primary data generated from an Irish household survey (n = 2,011) and an on-site survey of anglers (n = 451), they estimated the direct expenditure on recreational angling at €555 million in 2012, of which €121 million was generated by out-of-state anglers. With the inclusion of indirect and induced effects, the economic impact of angling in Ireland came to €755 million in 2012.

Similarly, Crabtree and Willis (2004) provided estimates of the economic impact of angling as well as the consumer surplus (reviewed in greater detail below). Using data generated via mixed approaches (household survey, on-site angler survey, postal surveys distributed to members of angling clubs), the impact of recreational angling in England and Wales was estimated at as £538 million per year. Direct angling expenditure by visitors (travelling more than 50 miles from home) was £192 million (35% of the total). Indirect and induced effects were not accounted for in this study.

Overall, these studies used a diversity of approaches to estimate the economic impact of recreational angling in different locations, resulting in a range of values mostly produced for very specific locations. The present study contributes to this literature.

C.2 Economic valuation studies

There exists a large body of literature on the economic valuation of recreational fisheries, dating back to the 1970s. Most of this research has involved the application of revealed preference (RP) travel cost methods or stated preference (SP) methods to estimate consumer surplus related to recreational angling.

In a meta-analysis of 48 non-market valuation studies of recreational fishing benefits and values, Johnston et al. (2006) found that 55% of all values had been produced using discrete choice (also known as ‘random utility’) travel cost methods, 15% used individual travel cost methods and 30% used SP methods.

Only 2 recreational angling valuation studies have been conducted in the UK in the past 10 years and one in Ireland. Of these, Hynes et al. (2015) and Johnstone and Markandya (2006) used travel cost models to obtain consumer surplus estimates, while Tourism Development International (2013) and Environment Agency (2007a) used SP surveys.

The most recent study was that conducted by Tourism Development International (Tourism Development International 2013) for Inland Fisheries Ireland (also reviewed in previous section). Using data collected between March and November 2012 from a Irish household survey (n = 2,011, of which only n = 138 were anglers) and an on-site survey of anglers (n = 451) at 50 randomly selected angling locations in Ireland, they identified angling participation, expenditure by anglers and the WTP of all respondents for the preservation of fish stocks for recreational fishing in Ireland. Results indicated that mean WTP for the preservation of fish stocks for angling came to €15.97 per person per year (household survey) and €66.52 per person per year (on-site angler survey). The mean WTP of the subset of 138 anglers in the household survey was €36.99, that is, about €20 less than that of the on-site anglers. This is likely to be due to underlying differences between the on-site and household survey angler populations, as suggested by Hynes et al. (2015) – see below. The aggregate non-market value of preserving fisheries for angling was estimated at €57.6 million per year to the general Irish public and €27 million per year to the 406,000 registered anglers in Ireland.

Using expenditure and participation data generated by the Tourism Development International (2013) study, Hynes et al. (2015) produced per trip consumer surplus estimates for both the on-site survey and household survey angler samples using travel cost models. The consumer surplus associated with angling (estimated using a negative binomial model) came to €232 per trip using on-site survey data and €49.97 per trip for household survey data. Results suggested that the difference in values was explained by underlying differences between the 2 angler samples.

The most recent valuation study conducted in the UK was Environment Agency (2007a), which was commissioned as part of the 'Economic Evaluation of Inland Fisheries' study. SP surveys (n = 911) were conducted in-person with members of the public at 23 different locations around England and Wales. Using contingent valuation and choice experiments, the survey elicited peoples' WTP for salmon stocks across England and Wales. Mean WTP to prevent a 'severe decline in salmon populations across all of England and Wales' (from disease) was estimated at £15.80 per household per year (using contingent valuation), and £23.88 per household per year (using choice experiments). From the contingent valuation analysis, WTP was found to increase with respondent's usage of rivers, income, educational qualifications, age and the fewer children they had. Consumer surplus values were not estimated in this study, although the authors identified the importance of doing so in future studies.

Johnstone and Markandya (2006) estimated welfare changes to anglers from marginal changes in river water quality resulting from site characteristics and predicted number of trips. Using travel cost data generated via surveys with anglers across England (n = 421), combined with external data on site characteristics and the distance of sites from the respondent's home, 2 models were estimated and linked: a random utility (discrete choice) site choice model and a trip prediction (participation) model. Welfare gains from site attributes and from predicted trips could thereby be estimated jointly. Overall, they found that the consumer surplus associated with 10% increase in river quality was estimated at around £24 per trip (in 2001 £).

The present study adds to this literature in many ways.

- It is the first study to measure WTP for changes in freshwater angling quality in England. Whereas Environment Agency (2007a) did this for salmon stocks, the present study considers all freshwater fishery types.
- The present study examines marginal benefits from a wide range of attributes relating to angling. This information will provide more in-depth insight into precisely what anglers value and how much.
- By combining RP travel cost methods and SP methods to estimate consumer surplus related to recreational angling, the study allows the production of estimates of consumer surplus for hypothetical changes in fishery quality that are grounded in actual behaviour.

Appendix D: Cost restrictions for SP experimental design

The levels used to represent the cost of a day's fishing at site were based on discussions with the Environment Agency and were restricted to reasonable ranges depending on water body type, fish species type, size and abundance level of fish species types. Table D.1 shows the SP1 frequency of price categories and Table D.2 the cost levels included in the SP experimental design.

The first column in Table D.1 denotes the price categories assumed for each combination of water body type, fish species type, and fish size and abundance. The cells denote the frequencies assumed for each of the price levels contained in the price categories. For example, the price category assumed for the combination involving river, salmon/sea trout, small size and high abundance is 5 (that is, 5, 10, 15, 20, 25) and the corresponding frequencies for each of the 5 price levels are 0.15, 0.4, 0.3, 0.1 and 0.05 (see the first row of Table D.2 and the third row of Table D.1). This means that the full profile SP1 dataset was restricted such that, for the combination involving river, salmon/sea trout, small size and high abundance, 15% of the prices = £5; 40% of prices = £10; 30% of the prices = £15; 10% of the prices = £20 and 5% of the prices = £25.

Table D.1 SP1 frequency distribution of price categories

	Percentage in price category										
Price categories	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
3	25	50	25								100
4	20	40	30	10							100
5	15	40	30	10	5						100
6	12.5	35	30	15	5	2.5					100
7	7.5	25	25	20	15	5	2.5				100
8	5	25	20	17.5	15	10	5	2.5			100
9	5	25	20	15	12.5	10	7.5	2.5	2.5		100
10	5	22.5	20	15	12.5	10	7.5	3	2.5	2	100

Notes: Frequency distribution provided by the Environment Agency.

Table D.2 Cost levels included in experimental design

Water body type	Fish species	Size	Abundance	Cost restrictions (£)
River	Salmon/sea trout	Small	High	5, 10, 15, 20, 25
River	Salmon/sea trout	Medium	High	30, 40, 50, 60, 75, 100
River	Salmon/sea trout	Large	High	75, 100, 125, 150, 200, 250
River	Salmon/sea trout	Small	Medium	5, 10, 15, 20
River	Salmon/sea trout	Medium	Medium	15, 20, 30, 40
River	Salmon/sea trout	Large	Medium	30, 40, 50, 60, 75, 100
River	Salmon/sea trout	Small	Low	0, 5, 10, 15
River	Salmon/sea trout	Medium	Low	15, 20, 30, 40
River	Salmon/sea trout	Large	Low	15, 20, 30, 40
River	Grayling	Small	High	5, 10, 15, 20
River	Grayling	Medium	High	10, 15, 20, 30, 40, 50, 60
River	Grayling	Large	High	15, 20, 30, 40, 60, 75, 100
River	Grayling	Small	Medium	5, 10, 15, 20
River	Grayling	Medium	Medium	10, 15, 20, 30, 40
River	Grayling	Large	Medium	15, 20, 30, 40, 50, 60, 75
River	Grayling	Small	Low	0, 5, 10
River	Grayling	Medium	Low	10, 15, 20
River	Grayling	Large	Low	10, 15, 20, 30
River	Wild trout	Small	High	5, 10, 15, 20
River	Wild trout	Medium	High	15, 20, 30, 40, 50, 60, 75, 100
River	Wild trout	Large	High	30, 40, 50, 75, 100, 150, 200, 250
River	Wild trout	Small	Medium	5, 10, 15, 20
River	Wild trout	Medium	Medium	10, 15, 20, 30, 40
River	Wild trout	Large	Medium	20, 30, 40, 50, 60, 75, 100
River	Wild trout	Small	Low	0, 5, 10
River	Wild trout	Medium	Low	10, 15, 20, 30, 40
River	Wild trout	Large	Low	15, 20, 30, 40
River	Stocked trout	Small	High	5, 10, 15, 20
River	Stocked trout	Medium	High	30, 40, 50, 60, 75, 100
River	Stocked trout	Large	High	75, 100 , 125 , 150 , 200, 250
River	Stocked trout	Small	Medium	5, 10, 15, 20

Water body type	Fish species	Size	Abundanc e	Cost restrictions (£)
River	Stocked trout	Medium	Medium	15, 20, 30, 40
River	Stocked trout	Large	Medium	20, 30, 40, 50, 60, 75, 100
River	Stocked trout	Small	Low	0, 5, 10
River	Stocked trout	Medium	Low	15, 20, 30, 40
River	Stocked trout	Large	Low	15, 20, 30, 40
River	Carp	Medium	High	5, 10, 15, 20, 30
River	Carp	Medium	Medium	5, 10, 15, 20, 30
River	Carp	Large	Medium	5, 10, 15, 20, 30
River	Carp	Medium	Low	5, 10, 15, 20, 30
River	Carp	Large	Low	5, 10, 15, 20, 30
River	Barbel	Small	High	5, 10, 15, 20
River	Barbel	Medium	High	5, 10, 15, 20, 25
River	Barbel	Large	High	10, 20, 30, 40
River	Barbel	Small	Medium	5, 10, 15, 20
River	Barbel	Medium	Medium	5, 10, 15, 20
River	Barbel	Large	Medium	5, 10, 15, 20, 30
River	Barbel	Small	Low	0, 5, 10
River	Barbel	Medium	Low	0, 5, 10, 15, 20
River	Barbel	Large	Low	10, 15, 20, 25
River	Predators	Small	High	0, 5, 10, 15, 20
River	Predators	Medium	High	5, 10, 15, 20
River	Predators	Large	High	10, 15, 20, 25, 30, 40
River	Predators	Small	Medium	5, 10, 15, 20
River	Predators	Medium	Medium	5, 10, 15, 20, 25
River	Predators	Large	Medium	5, 10, 15, 20, 30
River	Predators	Small	Low	0, 5, 10
River	Predators	Medium	Low	0, 5, 10, 15, 20
River	Predators	Large	Low	5, 10, 15, 20, 25
River	Catfish	Small	Low	0, 5, 10
River	Catfish	Medium	Low	5, 10, 20, 30
River	Catfish	Large	Low	10, 15, 20, 30, 40
River	Mixed coarse	Small	High	0, 5, 10

Water body type	Fish species	Size	Abundance	Cost restrictions (£)
River	Mixed coarse	Medium	High	5, 10, 15
River	Mixed coarse	Large	High	5, 10, 15, 20
River	Mixed coarse	Small	Medium	0, 5, 10
River	Mixed coarse	Medium	Medium	5, 10, 15
River	Mixed coarse	Large	Medium	5, 10, 15
River	Mixed coarse	Small	Low	0, 5, 10
River	Mixed coarse	Medium	Low	0, 5, 10
River	Mixed coarse	Large	Low	5, 10, 15
Stillwater	Wild trout	Small	High	5, 10, 15, 20
Stillwater	Wild trout	Medium	High	10, 15, 20, 25, 30
Stillwater	Wild trout	Large	High	15, 20, 30, 40
Stillwater	Wild trout	Small	Medium	5, 10, 15, 20
Stillwater	Wild trout	Medium	Medium	10, 15, 20, 25
Stillwater	Wild trout	Large	Medium	15, 20, 30
Stillwater	Wild trout	Small	Low	0, 5, 10
Stillwater	Wild trout	Medium	Low	10, 15, 20
Stillwater	Wild trout	Large	Low	10, 15, 20, 25
Stillwater	Stocked trout	Small	High	5, 10, 15, 20
Stillwater	Stocked trout	Medium	High	20, 30, 40, 50, 60, 75
Stillwater	Stocked trout	Large	High	40, 50, 75, 100
Stillwater	Stocked trout	Small	Medium	5, 10, 15, 20
Stillwater	Stocked trout	Medium	Medium	10, 15, 20, 30, 40
Stillwater	Stocked trout	Large	Medium	30, 40, 50, 60, 75, 100

Water body type	Fish species	Size	Abundance	Cost restrictions (£)
Stillwater	Stocked trout	Small	Low	0, 5, 10
Stillwater	Stocked trout	Medium	Low	10, 15, 20, 30
Stillwater	Stocked trout	Large	Low	15, 20, 30 40
Stillwater	Carp	Small	High	5, 10, 15
Stillwater	Carp	Medium	High	5, 10, 15, 20
Stillwater	Carp	Large	High	30, 40, 50, 60, 75, 100
Stillwater	Carp	Small	Medium	5, 10, 15
Stillwater	Carp	Medium	Medium	15, 20, 30, 40
Stillwater	Carp	Large	Medium	15, 20, 30, 40
Stillwater	Carp	Small	Low	0, 5, 10
Stillwater	Carp	Medium	Low	5, 10, 15, 20, 30, 40
Stillwater	Carp	Large	Low	15, 20, 30, 40
Stillwater	Barbel	Small	High	5, 10, 15
Stillwater	Barbel	Medium	High	5, 10, 15,
Stillwater	Barbel	Large	High	15, 20, 30, 40
Stillwater	Barbel	Small	Medium	5, 10, 15, 20
Stillwater	Barbel	Medium	Medium	5, 10, 15, 20
Stillwater	Barbel	Large	Medium	10, 15, 20, 30
Stillwater	Barbel	Small	Low	0, 5, 10
Stillwater	Barbel	Medium	Low	5, 10, 15, 20

Water body type	Fish species	Size	Abundance	Cost restrictions (£)
Stillwater	Barbel	Large	Low	10, 15, 20
Stillwater	Predators	Small	High	0, 5, 10, 15, 20
Stillwater	Predators	Medium	High	10, 15, 20, 30
Stillwater	Predators	Large	High	20, 30, 40, 50, 60, 75
Stillwater	Predators	Small	Medium	0, 5, 10, 15, 20
Stillwater	Predators	Medium	Medium	5, 10, 15, 20, 30
Stillwater	Predators	Large	Medium	10, 15, 20, 30
Stillwater	Predators	Small	Low	0, 5, 10
Stillwater	Predators	Medium	Low	0, 5, 10, 15, 20
Stillwater	Predators	Large	Low	5, 10, 15, 20, 30
Stillwater	Catfish	Small	Medium	5, 10, 15, 20
Stillwater	Catfish	Medium	Medium	15, 20, 30, 40
Stillwater	Catfish	Large	Medium	15, 20, 30, 40
Stillwater	Catfish	Small	Low	0, 5, 10
Stillwater	Catfish	Medium	Low	15, 20, 30, 40
Stillwater	Catfish	Large	Low	15, 20, 30, 40
Stillwater	Mixed coarse	Small	High	0, 5, 10
Stillwater	Mixed coarse	Medium	High	0, 5, 10, 15
Stillwater	Mixed coarse	Large	High	5, 10, 15, 20
Stillwater	Mixed coarse	Small	Medium	0, 5, 10

Water body type	Fish species	Size	Abundance	Cost restrictions (£)
Stillwater	Mixed coarse	Medium	Medium	5, 10, 15
Stillwater	Mixed coarse	Large	Medium	5, 10, 15, 20
Stillwater	Mixed coarse	Small	Low	0, 5, 10
Stillwater	Mixed coarse	Medium	Low	0, 5, 10, 15
Stillwater	Mixed coarse	Large	Low	5, 10, 15, 20
Canals	Carp	Medium	Medium	2, 5, 10
Canals	Carp	Large	Medium	2, 5, 10
Canals	Carp	Medium	Low	2, 5, 10
Canals	Carp	Large	Low	2, 5, 10
Canals	Predators	Small	High	2, 5, 10
Canals	Predators	Medium	High	2, 5, 10
Canals	Predators	Large	High	2, 5, 10
Canals	Predators	Small	Medium	2, 5, 10
Canals	Predators	Medium	Medium	2, 5, 10
Canals	Predators	Large	Medium	2, 5, 10
Canals	Predators	Small	Low	2, 5, 10
Canals	Predators	Medium	Low	2, 5, 10
Canals	Predators	Large	Low	2, 5, 10
Canals	Mixed coarse	Small	High	2, 5, 10
Canals	Mixed coarse	Medium	High	2, 5, 10
Canals	Mixed coarse	Large	High	2, 5, 10
Canals	Mixed coarse	Small	Medium	2, 5, 10
Canals	Mixed coarse	Medium	Medium	2, 5, 10
Canals	Mixed coarse	Large	Medium	2, 5, 10
Canals	Mixed coarse	Small	Low	2, 5, 10
Canals	Mixed coarse	Medium	Low	2, 5, 10
Canals	Mixed coarse	Large	Low	2, 5, 10

Notes: Cost restrictions provided by the Environment Agency.
Unreasonable combinations have been dropped from the table.

Appendix E: SP analysis

E.1 SP1 analysis

E.1.1 Methodology

The aim of the SP1 econometric analysis was to:

- explore the drivers of site choice
- use the results to derive willingness to pay (WTP) estimates on a £ per trip basis for marginal changes in these variables

The theoretical foundation for choice experiments lies in random utility theory and in Lancaster's characteristics theory of value (Lancaster 1966, Louviere et al. 2000). In the random utility model (RUM), the utility that an angler obtains by visiting a site, from among many possible fishing sites on any given choice occasion, consists mainly of 3 elements:

- cost of visiting the site
- a set of observable site attributes
- a random element that includes all the site characteristics which influence an angler's utility from fishing but are not observed by the researcher

In the RUM, the utility, *U*, for an angler *i* visiting site *j* is assumed to consist of a systematic part, *V* (consisting of observable characteristics) and a random error, that is:

$$U_{ij}=V_{ij}+\epsilon_{ij} \qquad \text{(C.1)}$$

The systematic component of the utility, *V*, which is a function of attributes for alternative *j* for angler *i,* is specified as:

$$V_{ij}=q_j\beta+z_iq_j\gamma+\mu p_{ij} \qquad \text{(C.2)}$$

where q_j includes the observed site characteristics, z_iq_j includes interactions between angler and site characteristics to account for preference heterogeneity, p_{ij} measures the cost/price of visiting the sites and ϵ_{ij} represents idiosyncratic tastes of an angler on a choice occasion for a location. β, γ and μ are the coefficients on the observed site characteristics, interaction terms (if any included) and the cost of visiting sites respectively.

Given that the utility includes a random error component, a probabilistic choice model can be estimated. The probability that an angler chooses to visit site *j* to any alternative site in their choice set *m* can be expressed as the probability that the utility associated with site *j* is greater than the utility associated with all other sites.

To derive an explicit expression for the choice probability, it is assumed that the random error terms are independently and identically distributed with a Type I extreme value distribution. According to McFadden (1973), this distributional assumption for the error term implies that the choice probability (that is, the probability that site *j* is chosen by an angler, given all other sites in their choice set) can be expressed in terms of a logistic distribution. This yields the standard conditional logit model, which can be estimated via maximum likelihood methods (that is, the model parameter estimates can be obtained such that the likelihood function, which specifies the probability that the sample makes the observed choices, is maximised).

The standard conditional logit model is subject to 2 limitations. It assumes that:

- everyone in the angler population has an identical preference structure
- the selections from the choice set of an angler must satisfy the independence of irrelevant alternatives (IIA) property

The IIA property implies that the relative probabilities of any 2 alternatives being chosen are not affected by the introduction or removal of other alternatives.

To relax these restrictive assumptions and allow for random taste variation among anglers, a mixed logit model specification was used for this study. The mixed logit model assumes that the model parameters are randomly distributed in the population, that is:

$$V_{ij}=q_j\beta_i + z_i q_j \gamma + \mu p_{ij} \qquad \text{(C.3)}$$

where β_i varies over the population of anglers with density f(β|δ) where δ is a vector of the true parameters of the taste variation and represents the mean and standard deviation of the βs in the population.

In the present context, it is assumed that the taste for all angling attributes, except the distance to site and cost attributes, have normally distributed random parameters. The heterogeneity in the sample can be then captured by the variance of the random parameter distribution. The mixed logit model parameters are estimated via maximum simulated likelihood (Train 2009).

Once the model parameters were estimated, the WTP associated with the changes in the angling quality variable is given as the ratio of coefficients as follows:

$$WTP_i = - b_A/b_Y \qquad \text{(C.4)}$$

where b_A is the coefficient estimate of any of the attributes and b_Y is the coefficient estimate of the cost variable in the model.

These ratios are known as implicit prices and show the WTP for a change in any of the attributes. Implicit prices are calculated by determining the marginal rates of substitution between the attributes, using the coefficient for cost as the ‘numeraire’ (Hanemann1984).

E.1.2 Analysis of trading behaviour

A key initial test to undertake in relation to SP performance is to investigate whether there was sufficient trading behaviour between alternatives within the experiments. If too many respondents were consistently choosing the same option regardless of the level of the attributes shown, then the econometric models would be poorly estimated and the results would be imprecise. For example, if a respondent chose Site A on each of the 8 choice occasions throughout the exercise then they would be deemed a ‘non-trader’.

The analysis of trading behaviour for the SP1 exercise found that only 2% of the respondents were persistent non-traders. This finding is an indicator that the exercise design was effective at generating preference revealing trade-offs.

E.1.3 Descriptive statistics

The dependent variable in the model used for this study was the choice of a hypothetical site – a dummy variable equal to 1 if the alternative was chosen by the respondent as their choice and equal to 0 otherwise.

The main explanatory variables that were included in the model are presented in Table E.1. These explanatory variables relate to:

- anglers' base trip characteristics (for example, base water body type and base fish species)
- angler characteristics (for example, annual household income)
- the SP1 site-specific characteristics (for example, water body type, fish species type, distance to fishing site and the cost of a day's fishing)

Table E.1 SP1 site choice model main explanatory variables

Variable	Definition	Mean	Standard deviation
distance	distance to site (in hundred miles)	0.3076	0.5395
basedistance	distance to site for base trip (in hundred miles)	0.3423	1.7187
cost	cost of a day's fishing/day permit fee (£ per visit)	23.9209	27.3645
river	=1 if site is river	0.4122	0.4922
baseriver	=1 if base trip was to river	0.2916	0.4545
stillwater	=1 if site is stillwater	0.4390	0.4963
basestillwater	=1 if base trip was to stillwater	0.6716	0.4696
canal	=1 if site is canal	0.0280	0.1649
basecanal	=1 if base trip was to canal	0.0368	0.1882
notstillwater	=1 if site is river/canal	0.5610	0.4963
catfish	=1 if catfish present at site	0.0151	0.1219
basecatfish	=1 if base species fished for was catfish	0.0003	0.0184
predators	=1 if predators present at site	0.3171	0.4653
basepredators	=1 if base species fished for was predators	0.0819	0.2743
barbel	=1 if barbel present at site	0.1028	0.3038
basebarbel	=1 if base species fished for was barbel	0.0464	0.2103
carp	=1 if carp present at site	0.1795	0.3837
basecarp	=1 if base species fished for was carp	0.3188	0.4660
stocked trout	=1 if stocked trout present at site	0.2443	0.4297
basestockedtrout	=1 if base species fished for was stocked trout	0.0997	0.2996
wild trout	=1 if wild trout present at site	0.2873	0.4525
basewildtrout	=1 if base species fished for was wild trout	0.0862	0.2806
grayling	=1 if grayling present at site	0.0540	0.2261
basegrayling	=1 if base species fished for was grayling	0.0173	0.1305

Variable	Definition	Mean	Standard deviation
salmonseatrout	=1 if salmon/sea trout present at site	0.1279	0.3340
basesalmonseatrout	=1 if base species fished for was salmon/sea trout	0.0414	0.1993
mixedcoarse	=1 if mixed coarse present at site	0.6827	0.4654
basemixedcoarse	=1 if base species fished for was mixed coarse	0.3079	0.4616
notmixedcoarse	=1 if mixed coarse fish not present at site	0.3173	0.4654
flyfishing	=1 if fly-fishing present at site	0.1608	0.3673
baseflyfishing	=1 if base method was fly-fishing	0.2134	0.4097
multimethod	=1 if multimethod fishing present at site	0.7183	0.4498
sizesmall	=1 if size of any species at site is small	0.5188	0.4996
sizemedium	=1 if size of any species at site is medium	0.5729	0.4947
sizelarge	=1 if size of any species at site is large	0.5670	0.4955
lowabundance	=1 if abundance of any species at site is low	0.6146	0.4867
mediumabundance	=1 if abundance of any species at site is medium	0.5081	0.4999
highabundance	=1 if abundance of any species at site is high	0.5203	0.4996
overnight	=1 if base trip was overnight	0.1769	0.3816
matchfishing	=1 if angler competed in matches	0.1238	0.3294
closedseason	=1 if fishing date between 15 March and 15 June	0.0027	0.0521
hhinclow	=1 if household income <£15,600 per year	0.0826	0.2753
hhincmed	=1 if household income is £15,600–£52,000 per year	0.5074	0.4999
hhinchigh	=1 if household income is >£52,000 per year	0.2207	0.4147
hhincdk	=1 if household income is unknown	0.0226	0.1485
hhincref	=1 if refused to report household income	0.1667	0.3727
nochoice	=1 if alt=‘ I would not choose any of the sites’	0.1209	0.3260

Notes: Fish size and fish abundance were specified to be relative to the average for the given species.

E.1.4 Econometric model

The variables for water body types, fishing method types, fish species types, fish size types and fish abundance levels were all treated as having random, normally distributed coefficients; while the coefficient on distance, cost and all the interaction terms were assumed to be fixed. The mixed logit model estimates the standard deviation of the parameter values across the population, assuming normal distributions, as well as the mean values of those coefficients.

Interaction terms were included in the model to provide some insight into the heterogeneity within the sample. This included the following interactions:

- Between distance of the site alternative and the base trip distance – to test whether an angler who travelled further on their base trip would tend to be less sensitive to distance when choosing between hypothetical site alternatives than an angler who travelled less far for their base trip
- Between distance and whether the base trip involved an overnight stay – to capture the expectation that those staying overnight would be less sensitive to distance than day-trippers
- Between distance and whether the respondent competed in matches – to test the hypothesis that those competing in matches would be less sensitive to distance
- Between cost of trip and household income levels (*hhinc*) – to capture the expectation that those on higher incomes will be less cost sensitive than those on lower incomes (omitted interaction here was the medium income level, *hhincmed*)
- Between cost and whether the respondent competed in matches – to test the hypothesis that those competing in matches would be less sensitive to cost
- Between water body type of the site alternative and the water body type visited by the angler on their base trip – to capture the hypothesis that anglers are more likely to choose a given water body type in the choice exercise if they also chose that water body type for their base trip
- Between species presence in the site alternative and whether that species was targeted by the angler at their base trip – to capture the hypothesis that anglers are more likely to choose sites with species that include those targeted on their base trip
- Between fly-fishing and base fly-fishing – to capture the hypothesis that those going fly-fishing on their base trip are more likely to choose sites with fly-fishing
- Between coarse fish and closed season for coarse fish in rivers (*closedseason*coarse*) – to test the hypothesis that the effect of having coarse fish at a river on site choice was different in the open season than in the closed season[12]

The selection of interactions between water body type and base trip water body type to include was considered carefully. There were 3 mutually exclusive water body types in

[12] Respondents whose base fishing trip date was during the river coarse fish closed season were not dropped from the analysis. They were simply identified as a separate group and an allowance made for there to be a negative utility effect since in reality they would not be legal options.

the data – river, canal and stillwater. Stillwater was chosen to be treated as the omitted reference category for the water body type dummies. Table E.2 shows the interactions included to capture the relative values for different water body types depending on base water body type.

In addition to *river* and *canal* dummy variables, *baseriver*river*, *basecanal*canal* and *basestillwater*notstillwater* were included to capture interaction effects. This approach embedded the expectation that positive values would be seen for *baseriver*river* and *basecanal*canal* and a negative coefficient for *basestillwater*notstillwater.*

Table E.2 Inclusion of dummy variables capturing relative values for different water body types

Base trip water body type	Site alternative water body type		
	River	**Stillwater**	**Canal**
River	*river+baseriver*river*		*canal*
Stillwater	*river+basestillwater*notstillwater*		*canal+basestillwater*notstillwater*
Canal	*river*		*canal+basecanal*canal*

Notes: The cells in the interior of the table show the names of the variables included in the model where, for example, *river* is a dummy variable indicating that the site alternative is a river, and *baseriver* is a dummy variable indicating that the respondent visited a river on their base trip.
* Indicates an interaction between variables.

Table E.3 shows 2 estimated models. 'Model with attributes only' includes only the choice attributes as explanatory variables in the model.

Table E.3 SP1 site choice: mixed logit model

Variable	Model with attributes only		Model with interactions	
	Coefficient	**Standard deviation**	**Coefficient**	**Standard deviation**
Distance	-0.8472****		-1.0555 ****	
basedistance*distance			0.0412 **	
overnight*distance			0.4826 ****	
matchfishing*distance			-0.0374	
Cost	-0.0240****		-0.0265 ****	
hhinclow*cost			-0.0017	
hhinchigh*cost			0.0097 ****	
hhincdk*cost			0.0052 ***	
hhincref*cost			-0.0024 **	
matchfishing*cost			0.0008	
River	-0.1581****	0.9737 ****	0.0444	0.8541 ****
baseriver*river			0.3830 ****	

Variable	Model with attributes only		Model with interactions	
	Coefficient	Standard deviation	Coefficient	Standard deviation
Canal	-0.4300****	1.4010 ****	-0.2356 ***	0.8010 ****
basecanal*canal			1.1690 ****	
basestillwater*notstillwater			-0.2867 ****	
Mixedcoarse	-0.0900****	0.6125 ****	-0.1476 ****	0.6140 ****
basemixedcoarse*mixedcoarse			0.3931 ****	
Catfish	-0.8944****	0.8317 ****	-0.6884 ****	0.5624 ****
basecatfish*catfish			21.0034	
Predators	-0.3332****	0.6305 ****	-0.3132 ****	0.6188 ****
basepredators*predators			0.6858 ****	
Barbel	-0.1006****	0.5872 ****	-0.0363	0.5124 ****
basebarbel*barbel			0.7961 ****	
Carp	0.1499 ****	1.1439 ****	-0.1394 ****	0.8599 ****
basecarp*carp			0.8273 ****	
stockedtrout	-0.4984****	0.6209 ****	-0.5464 ****	0.5872 ****
basestockedtrout*stockedtrout			1.1136 ****	
Wildtrout	-0.5850****	0.3883 ****	-0.5095 ****	0.4575 ****
basewildtrout*wildtrout			1.1266 ****	
Grayling	-0.2861****	0.5598 ****	-0.1846 ****	0.4252 ****
basegrayling*grayling			0.5823 ****	
salmonseatrout	-0.6746****	0.3513 ****	-0.5751 ****	0.5118 ****
basesalmon*salmonseatrout			2.5231 ****	
closedseason*coarse			-0.4843	
Flyfishing	-0.2595****	1.3591 ****	-0.8389 ****	0.8131 ****
baseflyfishing*flyfishing			1.7108 ****	
Sizemedium	0.1021 ****	0.1176 ****	0.1204 ****	0.1112 ****
Sizelarge	0.1767 ****	0.2837 ****	0.1988 ****	0.2942 ****
mediumabundance	0.1608 ****	0.0426 +	0.1591 ****	0.0553 *
highabundance	0.1841 ****	0.0351	0.1747 ****	0.0759
Nochoice	-1.4606****		-1.0094 ****	1.7512 ****
Number of respondents	3,224		3,224	
Number of choice situations	8		8	

Variable	Model with attributes only		Model with interactions	
	Coefficient	Standard deviation	Coefficient	Standard deviation
Pseudo R^2	0.21		0.25	

Notes: Significance levels: + p < 0.20, * p < 0.10, ** p < 0.05, *** p < 0.01, **** p < 0.001
Dependent variable is choice = 1 if alternative was chosen; = 0 otherwise.
See Table E.1 for the definitions of all the variables.
All attributes except cost and distance, and interactions with these variables, are modelled with random normally distributed coefficients.
Omitted categories in the model are Stillwater, sizesmall, lowabundance and multimethod.

In general, the estimated coefficients have the expected signs and are statistically significant. The standard deviations for the random parameters also show significant unobserved variation across angler choices for the attributes.

The attribute-only model indicates preference heterogeneity across respondents, but does not provide information about the sources of angler heterogeneity.

In the second estimated model, 'Model with interactions', interactions of several variables with the choice attributes were included. A comparison of the log-likelihoods and the pseudo R^2 goodness-of-fit measures between the 2 models indicated that the second model that accounted for sources of angler preference heterogeneity provided a better fit than the first model. This model was therefore used to derive the WTP values for marginal changes in the site attributes presented in the main body of this report.

E.2 SP2 analysis

E.2.1 Methodology

The attributes included within the SP1 exercise were only a small subset of the total number of attributes that Environment Agency wished to obtain values for. For the additional attributes, a method known as the MaxDiff technique (also known as best–worst scaling) was used. This deals effectively with large numbers of attributes and can be linked to the SP1 exercise via the inclusion of common attributes.

The MaxDiff technique requires that attributes are described in terms of 2 levels only. Hence, all the additional attributes were described in a single phrase, with an implied (or in some cases explicitly stated) counterfactual. The common attributes for the SP1 and SP2 choice exercises were fish abundance and fish size.

The SP2 econometric analysis sought to produce estimates of the value to anglers of changes in the non-fishery attributes covered in the SP2 choice exercise (for example, environment, litter and parking) as its main outputs.

E.2.2 Analysis of trading behaviour

The results of the SP2 exercise showed that there was a good degree of trading going on across the alternatives, with a negligible proportion (0.5%) of respondents choosing the same alternative every time.

E.2.3 Analysis of 'off-putting' attribute

As indicated in Section 2.1.3, the SP2 choice exercise included an option to state 'One or more of the features are off-putting to me' if one or more of the attributes were particularly unattractive for the respondents when choosing where to go fishing for their trip. Those that ticked this option were asked to state the attributes that were off-putting to them.

Figure E.1 presents the frequencies with which each of the attributes was chosen as being off-putting to the respondents. 'Limited parking' was most frequently chosen as off-putting, followed by 'limited catch' and 'very few other anglers nearby'. The attribute least frequently chosen as off-putting was 'a beautiful or attractive environment'.

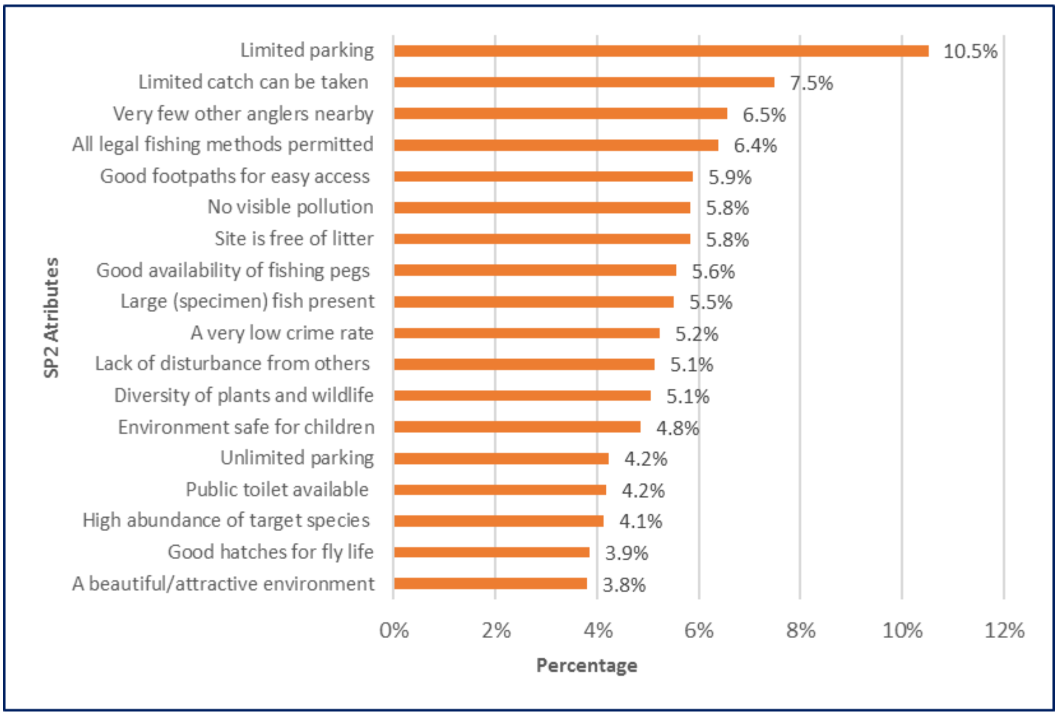

Figure E.1 SP2: frequency with which attributes were chosen as being off-putting

E.2.4 Econometric model

As in the case of SP1, the SP2 choice data were also examined using the mixed logit model specification. The dependent variable in the model was the choice of an attribute – a dummy variable equal to 1 if the attribute was chosen by the respondent as their choice and equal to 0 otherwise. The main explanatory variables included in this model are presented in Table E.4.

All the explanatory variables were treated as having random, normally distributed coefficients. This model estimates the standard deviation of the parameter values across the population, assuming normal distributions, as well as the mean values of those coefficients.

Table E.4 SP2: MaxDiff model explanatory variables

Variable	Definition
fish abundance	=1 if there is abundance of target species at site; 0 otherwise
fish size	=1 if availability of large specimen fish; 0 otherwise
litter	=1 if absence of litter at site; 0 otherwise

Variable	Definition
pollution	=1 if absence of visible pollution at site; 0 otherwise
pegs	=1 if availability of pegs/fishing spots/crowding; 0 otherwise
crowding	=1 if lack of crowding with very few other anglers nearby; 0 otherwise
disturbance	=1 if lack of disturbance from other site users; 0 otherwise
accessibility	=1 if accessibility (that is, physical ease of access to fishing spot); 0 otherwise
unlimited parking	=1 if availability of car parking facilities; 0 otherwise
limited parking	=1 if availability of car parking facilities; 0 otherwise
toilets	=1 if availability of toilets; 0 otherwise
plants & wildlife	=1 if plant and wildlife; 0 otherwise
methods	=1 if all legal fishing methods permitted (that is, no restrictions); 0 otherwise
flies	=1 if presence of good hatches for fly life; 0 otherwise
take	=1 if (limited) catch taken, rather than catch and release; 0 otherwise
safety	=1 if environment is safe for children; 0 otherwise
crime	=1 if a very low crime rate; 0 otherwise;
environment	=1 if a beautiful or attractive environment; 0 otherwise
none matters	=1 if option = 'None of these matters to me'

Estimates of the mixed logit model, incorporating the explanatory variables and distributional assumptions, are given in Table E.5. The model fits the data well and provided a good basis from which to derive the WTP values for marginal changes in the site attributes.

Table E.5 SP2: MaxDiff mixed logit model

Variables	Coefficient		Standard deviation		Importance index[1]
fish abundance	-0.4361	****	1.8990	****	0.65
fish size	-1.0176	****	1.9559	****	0.36
litter	-0.3288	****	0.3443	****	0.72
pollution	0.1219	****	0.2968	**	1.13
pegs	0.2319	****	0.8720	****	1.26
crowding	-0.9671	****	1.3752	****	0.38
disturbance	-0.3132	****	1.4204	****	0.73

Variables	Coefficient	Standard deviation	Importance index[1]
toilets	-1.4455 ****	1.0644 ****	0.24
accessibility	-0.7933 ****	0.8539 ****	0.45
unlimited parking	-0.7895 ****	0.8567 ****	0.45
limited parking	-1.8957 ****	0.4818	0.15
methods	-1.7109 ****	0.4919 ****	0.18
flies	-2.2266 ****	1.0862 ****	0.11
take	-3.0106 ****	0.0168	0.05
safety	-1.8427 ****	1.1891 ****	0.16
crime	-1.3362 ****	0.5629 ****	0.26
plants and wildlife	-0.5978 ****	0.7037 ****	0.55
environment	0	-	1.00
none matters	-2.8944 ****	1.7892 ****	
Number of respondents	3,224		
Choice situations per respondent	8		
Pseudo R^2	0.23		

Notes: Significance levels: + $p < 0.20$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$
[1] The importance index is computed by taking the exponential of the estimated model coefficients. It indicates the importance of each of the attributes in relation to the base attribute that is, environment. For example, the odds of choosing a site are found to be about 1.13 times greater if the site has no visible pollution than if the site has a beautiful or attractive environment.
Dependent variable is choice = 1 if attribute was chosen; = 0 otherwise.
See Table E.4 for definition of all the explanatory variables.
All attributes assumed to have normally distributed coefficients.
Omitted attribute in the model is environment which is =1 if the site has a beautiful or attractive environment and 0 otherwise.

Appendix F: RP analysis

F.1 Overview

The linked random utility model (RUM) (Bockstael et al. 1987) was used as the basis of the RP analysis. In this approach, 2 models are estimated.

- A **site choice model** explains anglers' choice of which angling site to visit as a function of angling site characteristics, including its distance from the angler's home.
- A **participation model** explains the total number of trips taken by anglers over the season/year as a function of angler characteristics and the expected value of a trip for the angler, where this expected value is derived from the site choice model and varies across anglers according to the quality of sites in the vicinity.

The linked RUM can be used to predict how visit numbers change over a season/year due to changes in site attributes in the choice set of an angler. For example, an increase in angling quality at one or more fishing sites would increase expected value from the site choice model which would, in turn, increase the total number of predicted trips in the participation model. Thus, welfare changes calculated using this approach would include both site substitution effects and changes in the total number of trips.

Linking the number of trips an angler takes over a season/year with the expected trip utility estimated in a site choice model ensures that changes in travel costs and site attributes access can alter the frequency of visits as well as the choice of sites.

This appendix sets out below the site choice and participation choice model specifications and presents the analysis results in full.

F.2 Model specification

F.2.1 Site choice model

A site choice model considers an angler's choice of a fishing site from among many possible fishing sites on any given choice occasion. The utility that an angler obtains by visiting the site consist mainly of 3 elements:

- cost of visiting the site
- a set of observable site attributes
- a random element that includes all the site characteristics not observed by the researcher

The utility index for an angler *i* visiting site *j* on any given choice occasion is specified as:

$$U_{ij} = q_j\beta + \mu p_{ij} + \epsilon_{ij} \qquad \text{(F.1)}$$

where q_j includes the observed site characteristics, p_{ij} measures the trip distance from an angler's residence to the fishing site and ϵ_{ij} represents the idiosyncratic tastes of an angler on any choice occasion for a fishing site.

Given that the utility function includes an error component, it is possible to estimate a probabilistic choice model. The probability that an angler chooses to visit site *j* to any alternative site in their choice set, m, can be expressed as the probability that the utility associated with site *j* is greater than the utility associated with any other site, that is:

$$P\ (U_{ij} > U_{im}) = P\ [(q_j\beta + \mu p_{ij} + \epsilon_{ij}) > [(q_m\beta + \mu p_{im} + \epsilon_{im})] \qquad \text{(F.2)}$$

To derive an explicit expression for the probability in Equation F.2, it is assumed that the random error terms are independently and identically distributed with a Type I extreme value distribution. Consistent with best practice in this area, the assumption that site choice is independent across choice occasions is included. According to Bockstael and McConnell (2007), for example, attempts to introduce dynamic aspects to site choice models have tended to fail and, as such, the modelling approach adopted for this study remains best practice.

According to McFadden (1973), this distributional assumption for the error term implies that the probability that site *j* is chosen by an angler, given all other sites in their choice set (that is, *k* = 1, 2 … *J*), can be expressed in terms of a logistic distribution as follows:

$$P_i(j) = \exp(V_{ij}) / \sum_{k=1}^{J} \exp(V_{ik}) \qquad \text{(F.3)}$$

where $V_{ij} = q_j\beta + \mu p_{ij}$.

This is the standard conditional logit model, which can be estimated via maximum likelihood methods. The likelihood function, which specifies the probability that the sample makes the observed choices, is as follows:

$$L = \sum_{i=1} N \sum_{j=1}^{J} y_{ij} \ln(P_i(j)) \qquad \text{(F.4)}$$

where y_{ij} =1 if site *j* chosen by individual *i* on any choice occasion and =0 otherwise; and *N* is the total number of anglers in the sample and *J* is the set of sites in each angler's choice set.

An important assumption of the conditional logit model is that selections from the choice set must satisfy the independence of irrelevant alternatives (IIA) property. This implies that the relative probabilities of any 2 alternatives being chosen are not affected by the introduction or removal of other alternatives. Although this is a restrictive assumption, it was computationally infeasible to apply estimators such as mixed logit which relax this assumption. It is difficult to estimate in this context what impact this restriction might have on the results. However, there is not clearly any bias a priori that might be expected with respect to estimates of willingness to travel to higher quality sites.

The estimated site choice model can be used to obtain the expected maximum utility of an angler for a trip (also known as the inclusive value) to the fishing site as follows:

$$IV = \ln\left(\sum_{k=1}^{J} \exp(V_{ik})\right) \qquad \text{(F.5)}$$

This is the natural logarithm of the denominator of the logit function in Equation F.3.

The inclusive or the logsum value represents the value of different alternative sites weighted by their probabilities of being chosen (Bockstael et al. 1987).

One of the key issues involved in modelling a recreation demand model is to obtain data on the real world choice set available to anglers. The visits recorded in the expenditure survey were used to identify sites. These were then used to define the choice set of an angler.

A potential issue with the choice set definition for this study was that there were too many fishing sites to feasibly include every one of them within the choice set for each angler for estimation. Instead, for each angler, the universal choice set, consisting of the 14,148 sites, was randomly sampled to generate a choice set of 500 alternatives. The choice set for each angler included the visited sites with the remaining sites randomly sampled to form a choice set size equal to 500. A 'nochoice' alternative was also included in the choice set of each angler to capture the option of not visiting any of the sites. Therefore, the final choice set of each angler consisted of a total of 501 alternatives. The site choice model was then estimated based on this final choice set.

The random sampling approach has been widely used throughout the literature (for example, Parsons and Kealy 1992, Parsons and Needelman 1992, Feather 1994). According to McFadden (1978), such random sampling satisfies the uniform conditioning property, thereby providing consistent parameter estimates – if the model meets the IIA property. Since the standard conditional logit model specification for the site choice component of the linked RUM model was used, pruning of the choice set using random sampling leads to consistent parameter estimates (Train 2009).

F.2.2 Participation model

The participation component of the linked RUM focuses on the total number of trips taken by an angler *i*:

$$t_i = f\,(I_i,\, b_i) + \zeta_i \tag{F.6}$$

where $t_i = \sum_{j=1}^{J} t_{ij}$ is the total number of trips taken by the angler *i*, I_i is the variable that links the participation component to the site choice component, b_i denotes the set of angler-specific variables that influence the number of trips taken and ζ_i is the random error term.

Bockstael et al. (1987) used the inclusive value term (in Equation F.5) as the linking variable I_i in Equation F.6. Hausman et.al (1995) suggested a slight variant of the Bockstael approach and replaced the inclusive value with its monetised counterpart (that is, IV/ μ), so that it could be viewed as a price index for recreation demand (Freeman et al. 2014). Parsons et al. (1999) compared 4 different ways of linking the site choice and the participation models, and found that when applying the Bockstael et al. method, all 4 approaches give similar results (Zandersen et al. 2007). Hence, the analysis here follows the Bockstael et al (1987) approach and uses the inclusive value index from the site choice model as an explanatory variable in the participation model.

Early applications of linked RUMs treated trips in the participation model as a continuous variable. More recent variants improved the model by treating the number of trips as a count variable and use count data models (Creel and Loomis 1992, Feather et al. 1995, Hausman et al.1995) or even hurdle count models (Haab and McConnell 1996, Shonkwiler and Douglass Shaw 1996) for estimation.

Following recent research (Prera et al. 2015), the participation component in this study was estimated using a negative binomial model. The negative binomial model is a generalisation of the standard Poisson model and can be used for overdispersed count data (that is, when the conditional variance exceeds the conditional mean for the count variable). In practice, the standard Poisson model underfits the amount of dispersion in the outcome leading to inefficient estimates, downward-biased standard errors and hence spuriously small *p* values. The negative binomial model extends the Poisson model to include an additional parameter that allows for overdispersion and reflects unobserved heterogeneity among the observations.

In a standard Poisson regression model, if *y* is a random variable indicating the number of times an event has occurred, then *y* has a Poisson distribution with parameter $\mu > 0$ if:

$P(y|\mu) = [\exp(-\mu) * \mu^{y}]/y!$ (F.7)

where y = 0, 1, 2, 3 and $\mu_i = E(y_i|x_i) = \exp(x_i\beta)$ (that is, the conditional mean depends on individual characteristics).

One of the main assumptions of the Poisson distribution is that the conditional mean equals the conditional variance; this is known as the equidispersion property. In practice, however, count variables usually have a variance greater than the mean, which is known as overdispersion. The negative binomial model extends the Poisson model to allow for such overdispersion by modelling the conditional mean as follows:

$\tilde{\mu_i} = \exp(x_i\beta + \eta_i)$ (F.8)

where η_i is the random error term which captures all unobserved factors that have been omitted from the model and is assumed to be uncorrelated with the individual characteristics.

If it is assumed that $\exp(\eta_i) = \delta_i$ and that the mean of the error term $\eta_i = 1$, then the conditional mean in the negative binomial model equals the conditional mean of the Poisson model, that is:

$\tilde{\mu_i} = \exp(x_i\beta + \eta_i) = \mu_i \times \exp(\eta_i) = \mu_i \times \delta_i = \mu_i$ (F.8)

that is, both the Poisson and the negative binomial models have the same mean structure.

The assumption that δ ~ Gamma (v) such that E(δ) =1 and Var (δ) = 1/v implies that the conditional variance in the negative binomial model is given as follows:

$Var(y_i|x_i) = \mu_i(1 + \mu_i/v_i)$ (F.9)

If it is assumed that $v_i = v = 1/\alpha$ for all individuals and for $\alpha > 0$, then this implies that the conditional variance is given as:

$Var(y_i|x_i) = \mu_i(1 + \mu_i/v_i) = \mu_i(1 + \alpha\mu_i)$ (F.10)

Note that since μ_i and v are positive, the conditional variance in a negative binomial model is greater than its conditional mean.

α is known as the dispersion parameter since an increase in α leads to an increase in the conditional variance. If α = 0, then the conditional variance equals the conditional mean and the negative binomial model reduces to the standard Poisson model.

F.2.3 Welfare effect

The estimated linked RUM is used to derive consumer surplus estimates on a £ per trip basis for marginal changes in fishing quality variables. The indirect utility function is the basis for welfare calculations in RUMs and is used to estimate the welfare impacts of changes in site characteristics or access.

In this study, the logsum approach is used to calculate the consumer surplus associated with the changes in the angling quality variables from the RUM site choice model. Under this approach, the total welfare that each angler gains from each site under a hypothetical improved condition is compared with the total welfare from the original condition.

An estimate of the compensating variation per choice occasion associated with a change in prices or site attributes can be obtained by dividing the difference by the marginal utility of money.

$CV_i = [\ln(\sum_{j=1}^{J} \exp(V_{ij}^{*})) - \ln(\sum_{j=1}^{J} \exp(V_{ij}))]/\mu$ (F.11) where $V_{ij}^* = q_j\beta + \mu p_{ij}$ is an estimate of the indirect utility function under the improved/altered condition, V_{ij} is an estimate of the indirect utility function under the original condition, and μ which is the coefficient estimate of the trip cost variable is the marginal utility of money.

To obtain annual or seasonal benefit estimates, Equation F.11 (obtained from the site choice model) is multiplied by the predicted number of trips the angler takes per season, computed at new level of prices/site qualities obtained from the participation model. A variation to calculating the estimated annual welfare change is to define it as the difference between the product of the inclusive value and the predicted number of trips, before and after the policy changes, that is:

$$W_i = \{[\ln (\textstyle\sum_{j=1}^{J} \exp(V_{ij}^*)) * t_i^*] - [\ln (\textstyle\sum_{j=1}^{J} \exp(V_{ij})) * ti]\} / \mu \qquad \text{(F.12)}$$

To obtain total welfare changes for the angler population, the full licence holder database held by the Environment Agency can be interrogated to:

- examine the spatial distribution of licence holders
- derive data on the number of licence holders within different distance bands of each fishing site

These data can be multiplied with the annual/seasonal benefit estimate for an angler obtained from Equation F.11 or Equation F.12 to derive the total welfare change for the angler population for marginal changes in each variable for each fishing site.

F.3 Descriptive statistics

F.3.1 Site choice model

The site choice model was estimated based on data obtained from the expenditure survey, the Fishing Info (FI) data and the WFD classification data.

Table F.1 presents descriptive statistics relating to the travel distance and site characteristics variables included in the site choice model.

Table F.1 RP site choice model variables

Variable	Description	Mean	Standard deviation
travel distance[1]	distance from angler's home to fishing sites	114.82	64.99
river	=1 if site is river	0.09	0.44
canal	=1 if site is canal	0.02	0.15
transitional	=1 if site is transitional water	0.002	0.09
stillwater	=1 if site is stillwater	0.19	0.37
missingwbtype	=1 if water body type is unknown at site	0.69	0.50
mixed fishery	=1 if fishery type at site is coarse and game	0.001	0.03
game fishery	=1 if fishery type at site is game	0.04	0.17

Variable	Description	Mean	Standard deviation
coarse fishery	=1 if fishery type at site is coarse	0.28	0.41
missingfisherytype	=1 if fishery type is unknown at site	0.68	0.43
fish class: high	=1 if fish class was high at site	0.01	0.15
fish class: good	=1 if fish class was good at site	0.02	0.19
fish class: moderate	=1 if fish class was moderate at site	0.01	0.18
fish class: bad	=1 if fish class was bad at site	0.001	0.08
fish class: poor	=1 if fish class was poor at site	0.007	0.16
fish class: missing	=1 if fish class is unknown at site	0.94	0.34
fisherystocked	=1 if fishery is stocked	0.18	0.35
missingfisherystocked	=1 if fisherystocked is unknown at site	0.71	0.42
disabled facility	=1 if disabled facility is available at site	0.15	0.32
missingdisabilityfacility	=1 if disabled facility unknown at site	0.69	0.42
boathire facility	=1 if boat hire facility is available at site	0.01	0.08
missingboathirefacility	=1 if boat hire facility unknown at site	0.68	0.43

Notes: [1] Travel distance is the one-way distance (in miles) from the angler's home to all visited and unvisited fishing sites in their choice set.
The average travel distance is high since the estimation dataset is based on distances from anglers' home to all visited as well as non-visited sites.
The descriptive statistics have been calculated based on the dataset used to estimate the model.
The choice set of each angler consists of 3,070 FI only sites, 1,564 FI sites mapped to WFD sites, 880 clusters of unmatched visit locations and ,634 individual unmatched visit locations.

In the estimation dataset, the average travel distance from the angler's home to fishing sites was ~114 miles. This mean distance is based on distances from the angler's home to all visited as well as non-visited sites.

Most the sites included in the sample were coarse fisheries (28%), followed by game and mixed (coarse and game) fisheries. Similarly, most of the sites were stillwaters (19%) followed by rivers, canals and transitional waters. Furthermore, 18% of the fisheries were on average stocked, with about 71% having missing data on whether the fishery was stocked at these sites (Table F.1).

Around 15% of the fisheries had, on average, disability facilities available while 69% fisheries had missing data on whether such facilities were available at these sites.

Only about 1% of the sites included in the sample had boat hiring facilities available and no information was available for 68% of the sites on whether such facilities were available.

Finally, data on fish quality was missing for about 94% of the sites (see Section 3.1.4). Of the remaining sites that had non-missing fish quality data, 1% had high fish class quality, 2% had a good fish class quality, 1% had moderate fish class quality, 0.7% had poor fish class quality and 0.1% had bad fish class quality.

F.3.2 Participation model

The participation model was estimated based on data obtained from the expenditure survey. As indicated in Section 3, the participation model was based on visits by all anglers resident in England who were older than 16 and held an Environment Agency rod licence (required for angling in England) at any time in 2016.

Table F.2 presents descriptive statistics relating to the angler characteristics variables included in the participation model.

Table F.2 RP participation model variables

Variable	Description	Mean	Standard deviation
total number of trips	Total count of trips by an angler over a year	27.18	33.70
age1	=1 if angler is aged 17–24	0.02	0.15
age2	=1 if angler is aged 25–34	0.07	0.26
age3	=1 if angler is aged 35–44	0.12	0.33
age4	=1 if angler is aged 45–54	0.22	0.42
age5	=1 if angler is aged 55–64	0.29	0.45
age6	=1 if angler is aged 65–74	0.24	0.43
age7	=1 if angler is aged >75 years	0.03	0.16
trout/coarse licence	=1 if angler holds a trout/coarse licence	0.96	0.20
salmon licence	=1 if angler holds a salmon/sea trout licence	0.04	0.20

The average number of trips taken by anglers over the season/year was about 27. Most of the anglers in the sample were aged 45–74 years (Table F.2).

As noted in the ES report (Environment Agency 2018), the ES sample was not representative with respect to some of the respondent characteristics measured in the survey. To correct for this, a set of calibrated survey weights was generated using an iterative proportional fitting or raking procedure. The raking procedure generated survey weights such that the sample weighted totals of control variables (that is, categorical variables that are available for both the population and the sample) matched the known population totals. Age, gender, licence type and fishing licence types were used as control variables to generate the raked weights. These weights were used in the estimation of the RP model, the details of which are discussed in the next section.

F.4 RP econometric model

Table F.3 presents the estimated linked RUM. Both parts of the model are well estimated, as indicated by the significance levels on the coefficients.

Table F.3 RP linked RUM

	Site choice model	
travel distance: distance from home to sites (in miles)	-0.0655	****
river =1 if site is river	-0.1040	**
canal =1 if site is canal	-1.2861	****
transitional =1 if site is transitional water	-0.8913	****
missingwbtype =1 if water type of site is unknown	-1.6452	****
mixed fishery =1 if fishery type is coarse and game	0.7118	****
game fishery =1 if fishery type at site is game	0.3729	****
missingfisherytype =1 if fishery type of site is unknown	0.6787	****
fish class: high	0.3869	***
fish class: good and moderate	0.2093	*
fish class: missing	0.6585	****
fisherystocked =1 if fishery is stocked	0.2116	****
missingfisherystocked =1 if fishery stocked data unknown	0.2096	****
boathire facility =1 if boat hire facility is available at site	0.6815	****
missingboathirefacility =1 if boat hire facility unknown for site	0.5572	****
disabled facility =1 if disabled facility is available at site	0.4598	****
missingdisabledfacility =1 if disabled facility unknown for site	0.1300	+
nochoice =1 if alt = 501 (that is, no site is visited)	-0.7736	****
N(visits)	21,845	
N(people)	10,293	
N(alternatives)	501	
Pseudo R^2	0.33	
Total observations (10,293 anglers × 501 alternatives)	**5,156,793**	
	Participation model	
logsum value	0.0623	**
angler aged 17–24	0.0155	
angler aged 25–34	0.1451	**
angler aged 35–44	0.0364	
angler aged 45–54	0.0037	
angler aged 55–64	0.0063	
angler aged 65–74	0.1094	*
angler holds trout/coarse licence	0.3126	****

	Site choice model	
constant	2.536	****
alpha	1.0617	****
Total observations	**10,293**	

Notes: Significance levels: + $p < 0.20$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

For the **site choice model:**

- Dependent variable is choice = 1 if site was visited; = 0 otherwise.
- *Travel distance* is one-way distance from the angler's home to fishing sites.
- Omitted categories for water body, fishery type and fish class variables are stillwater, coarse fishery, and fish class poor and fish class bad combined respectively.
- Full choice set for each respondent consists of 14,148 sites and the no choice alternative.
- Randomly sampled choice set size of sites for each respondent = 500 sites; with the 'no choice' alternative, there are 501 alternatives in the choice set for each respondent.
- Total respondents included in model estimation = 10,293 [10,468 (total) –38 (living outside England) –31 (visits outside of England) – 106 (water type unknown)]. Therefore, site choice estimation dataset consists of 10,293 × 501= 5,156,793 observations.

For the **participation model:**

- Dependent variable is the total count of fishing trips taken over the season/year by an angler.
- The logsum/inclusive value represents a measure of the expected maximum utility from the site characteristics.
- Omitted categories for age and fish licence type are age>75 years and salmon and sea trout licence respectively.
- alpha is the estimate of the dispersion parameter. If the dispersion parameter = 0, the model reduces to the Poisson model. If alpha is significantly greater than zero then the data are overdispersed and are better estimated using a negative binomial model than a Poisson model. Furthermore, the likelihood ratio test comparing the negative binomial model with a Poisson model gave a chi-squared value of 356.19.
- The large value of the test statistic with a p value of <0.0001 indicates that the negative binomial model is more appropriate than the standard Poisson model.

F.4.1 Site choice model results

- People tended to prefer sites that were closer to their home (the distance coefficient is negative and highly significant).
- Rivers, canals and transitional waters were preferred less than stillwaters (the omitted water body category) as indicated by the negative coefficients on river, canal and transitional.
- Mixed and game fisheries were preferred to coarse only fisheries (the omitted fishery type category). This is consistent with the fact that game anglers travel further, on average, than coarse anglers.
- Fish class = high was preferred to Fish class = medium, which was itself preferred to Fish class = low (the omitted category).
- Fisheries that were stocked and/or had boat hire available and/or had disabled facilities were preferred to those that did not have these features.

F.4.2 Results for the participation component of the model

- Anglers in areas with a good selection of quality fisheries to choose from locally had higher rates of participation than others. This is revealed through the positive and significant coefficient on the logsum variable, which captures the inclusive value of the choice set of available sites as described above. This positive coefficient ensures that improvements to a site have a positive impact on participation generally, in addition to their impact on the share of visits going to the site in question.
- Anglers aged 25–34 make the most trips, followed by those aged 65–74. These 2 age groups make substantially more trips per person than any other age groups.
- Anglers holding a trout/coarse licence make significantly more trips per person than anglers holding salmon/sea trout licences.

Appendix G: Combined SP–RP analysis

G.1 Overview of approach

The estimated RP, SP1 and SP2 models are linked together in the analysis via the inclusion of overlapping attributes in each case.

Both the RP and the SP1 site choice models included the distance of the angler to the site in question as key determinants of site choice. The marginal utilities of all the SP1 variables are included in the combined model's site utility function in scaled form, after multiplying the original coefficients by the ratio of the RP distance coefficient to the SP1 distance coefficient. In this way, the scale of the combined utility function is calibrated to the scale of the RP utility function.

The SP2 marginal utilities were then included after scaling to the scaled SP1 utility function via the fact that abundance and fish size were included as variables in both the SP1 and SP2 models. The scaling factor used in this case was the average of the ratio of the abundance coefficients and the ratio of the size coefficients. (This is the same method as described in Appendix E in the context of the SP analysis.)

The net effect of these transformations was to obtain a utility function containing all the SP1 and SP2 site attributes, but with a scale calibrated to the RP analysis.

Distance plays an essential role in determining site choice. To take account of distance effects in aggregation, the population of licence holders was grouped into catchment areas, of which there were 430 in England in the data provided by the Environment Agency.

The Environment Agency data provides the postcode of every licence holder in England, as well as their age and licence type. Shapefile data showing the locations of the catchments in England were also obtained from the Environment Agency.

GIS was used to group licence holders into catchments and thus obtain data on the number of licence holders of each licence type and age band in each of the 430 catchments.

GIS was also used to calculate the travel distance (on the road network) of each site to the population centroid of each catchment. This provided a database that allowed the calculation of the predicted share of trips going to each site from each catchment, and the predicted number of trips from each segment (licence holder type and age band) in each catchment in total using the full linked participation and scaled site choice model.

However, the initially predicted shares of each site within the total number of visits (that is, the estimated probabilities that a site is visited) were different from the real world shares, and so the model was calibrated to the true baseline as far as possible.

Full details of the various steps in the process of developing the combined SP–RP model, including this calibration procedure, are outlined below. Figure G.1 illustrates the procedures used derive the final calibrated model – the appraisal tool.

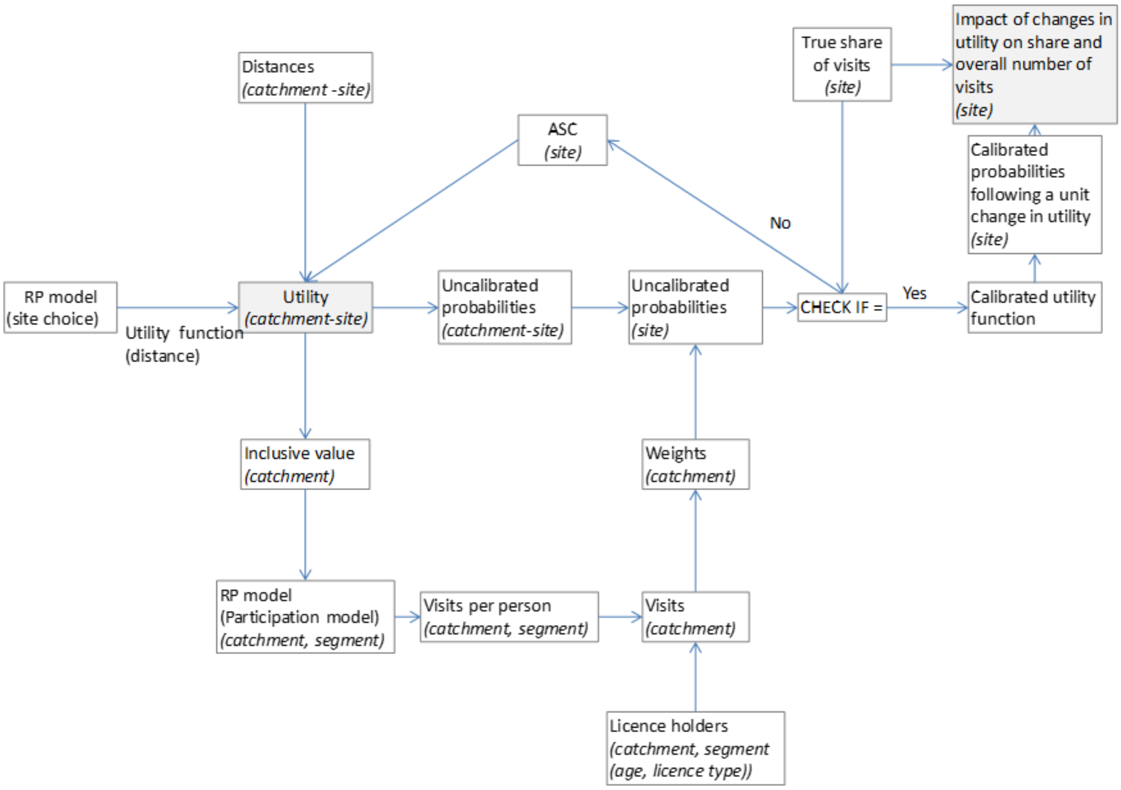

Figure G.1 Schematic representation of development of the appraisal tool

G.2 Calculation of total number of visits and share of each site

The utility of a site for an angler can be broken down into an effect based on its distance and a site fixed effect, which accounts for all the features specific to each site. The utility U_{ij} of site *j* to anglers living in catchment *i* and visiting that site can thus be written as:

$$U_{i,j} = ASC_j + \delta dist_{i,j} \tag{G.1}$$

where $dist_{i,j}$ is the distance from catchment *i* to site *j*, δ is a parameter measuring how utility varies with distance, and ASC_j is the fixed effect for site *j* which captures everything that matters to anglers about that site, including both observed (and modelled) and unobserved features, except for the distance which is captured separately, and which varies over catchments.

The data on the distances between catchments and sites were obtained using a GIS. The parameter δ is taken from the revealed preference (RP) model (Table F.3). The α parameters are initially set to 0, but are later calibrated to adjust the model to observed data on visits to sites (see Section G.4).

Given a logit model specification, the predicted probability that an angler in catchment *i* visits site *j* is calculated as the exponential of the utility of that site for that angler divided by the sum of the exponentials of the utilities of all the sites:

$$P_{i,j} = \frac{e^{U_{i,j}}}{\sum_k e^{U_{i,k}}} \tag{G.2}$$

The predicted probability of an angler (in any catchment) visiting site *j* is then the weighted sum of the probabilities of anglers in each catchment visiting that site. The calculation of the catchment weights is explained in Section G.3.

$$P_j = \sum_i w_i \, P_{i,j} \tag{G.3}$$

G.3 Weighting

The maximum utility that an angler in catchment *i* can expect from the set of sites available (known as the 'inclusive value') can be calculated as the log of the sum of the exponential of the utilities the angler potentially derives from all the available sites.

$$IV_i = \log(\sum_k e^{U_{i,k}}) \tag{G.4}$$

The inclusive value then enters the participation model, which predicts the number of visits per person to all sites over a season/year.

For each population segment q in catchment i, the participation model predicts the number of visits per person made by anglers in that segment ($T_{i,q}$), based on the inclusive value of the catchment (IV_i), a parameter γ measuring how the number of visits changes with the inclusive value, and a fixed effect ($X_{i,q}$) accounting for the characteristics of that segment that are independent of the set of sites available. There are 28 segments in each catchment (the combination of 7 age groups and 4 licence types).

$$T_{i,q} = X_{i,q} + \gamma_q IV_i \tag{G.5}$$

The fixed effect terms come from the RP model.

The total number of visits to all sites from catchment i is N_iT_i, which is the sum for all segments q of the number of visits per person from anglers in segment q in catchment i multiplied by the number of licence holders in that segment in that catchment ($N_{i,q}$).

$$N_iT_i = \sum_q N_{i,q} \, T_{i,q} \tag{G.6}$$

The data on the number of licence holders come from a dataset supplied by Environment Agency with information about all the licence holders including postcode, age and licence type.

The total number of visits from all catchments to all sites (NT) is then the sum of the visits from each catchment.

$$NT = \sum_i N_i \, T_i \tag{G.7}$$

Finally, the weight w_i of catchment i is the ratio between the visits from that catchment and the total number of visits.

$$w_i = \frac{N_iT_i}{NT} \tag{G.8}$$

G.4 Calibration

The initially predicted shares of each site within the total number of visits (that is, the estimated probabilities that a site is visited) were different from the real world shares, and so it is important that the model is calibrated to the true baseline as far as possible. Although actual population level data on visits to all individual sites do not exist, it was possible to derive estimates of these shares from data obtained from the expenditure survey. For the purposes of calibration, 'true shares' were calculated as the share of total visits made by expenditure survey respondents to each site identified in the dataset.

The predicted shares could then be calibrated to the true shares by adjusting the alternative-specific constants in the utility function.[13] This was an iterative process that successively added to the site fixed effects until the predicted and true shares were equalised. In each iteration, the quantity added was the log of the ratio of real share (s_j) and predicted share (p_j):

$$ASC_j^{t+1} = ASC_j^t + \log(s_j/p_j) \quad \text{(G.9)}$$

After adding this value, all the calculations described in Section G.3 were run again and the predicted share compared with the real share. This process continued until the 2 shares were equal.

The output of this process was a calibrated utility function, with a new alternative-specific constant for each site (each was 0 before the calibration process).

The calibrated utility function was used to re-estimate – using the methods described above – the total number of visits and the shares of each site when changing the utility of each of the 4,634 sites separately. A range of possible values was assumed for the utility change (-10, -5, -2, -1, 1, 2, 5, 10). This re-estimation was performed 4,634 times to estimate the impacts of changes in the utility of each site. The results were then integrated into the appraisal tool.

G.5 Integration of calculations in the appraisal tool

When the user specifies the features of a site in the baseline and desired scenarios, these inputs are transformed in the Calcs page of the appraisal tool (an Excel spreadsheet) into changes in utility. This is done using the results of the SP models (SP1 and SP2) (see Section 2). The model coefficients were previously scaled to use the same units as the RP model. This scaling was done by linking the distance coefficient in the SP1 and RP model, and then the fish quantity and fish size coefficients in the SP2 and SP1 models.

The changes in utility are also scaled to account for the levels of awareness about changes in each type of attribute among current and potential users. This should be inputted by the user using a scale from 0 (no awareness) to 1 (full awareness) as described in Section 4.1.3.

The impact on the overall number of visits and the relative impact on the share of visits associated with changes in the utility of a site are transferred in the spreadsheet to the Calcs page from the Sites page, which contains the results of the analysis described in the previous sections. The impacts are calculated by interpolating the impacts of fixed changes in utility (-10, -5, -2, -1, 1, 2, 5).

The absolute number of visits shifted from/to other site is then the product of the change in utility with the relative number of visits shifted.

The total change in consumer surplus is the sum of the changes in consumer surplus for each individual. This is the difference between the product of the inclusive value and the predicted number of trips, before and after the policy changes. For an individual in catchment i, this is:

$$CS_i = \{[\ln(\textstyle\sum_{j=1}^{J} \exp(IV_{i,j}^*) * NT_i^*] - [\ln(\textstyle\sum_{j=1}^{J} \exp(IV_{i,j}) * NT_i \;]\}/\mu \quad \text{(G.10)}$$

where μ is the coefficient of the cost of the visit in the SP1 model, scaled by the ratio of RP to SP1 distance coefficients, to be consistent with the RP model.

[13] See, for example, Train (2003, p. 37).

To be clear, consumer surplus equates to the willingness to pay (WTP) of anglers after accounting for changes in the permit cost.

Appendix H: Appraisal tool user guide

The appraisal tool developed during this project allows users to input alternative scenarios with respect to the attributes of specific fisheries sites including:

- type of fishery
- fish quality and quantity
- other features of the sites
- average permit cost per day's fishing

The outputs give predictions for willingness to pay (WTP) and demand impacts associated with those scenarios.

Extracts from the appraisal tool are shown in the screenshot illustrations below.

H1 Input sections of the tool

Figure H.1 shows the input sections of the tool.

The user first chooses the site from a dropdown menu containing the names of the 4,634 fishing sites in the Fishing Info database. The user then inputs the initial number of visits to the site and the average permit cost per day's fishing (in pounds) in the baseline and (desired) scenario cases.

Where the site is the sole holding of the controlling organisation, the average permit cost average should be calculated as:

$$\frac{\text{(day permit fee revenue + season permit fee revenue)}}{\text{total number of day trips}}$$

In the case of sites run by organisations that have a number of fisheries, members/season ticket holders may visit any number of other fisheries under the same permit. In this case, use of a nominal number of trips per year is recommended for anglers of a particular type (26 trips per year for coarse anglers, 12 for both categories of game angler) divided by the annual membership fee.

It is then possible to choose, from dropdown menus, the baseline case and the desired scenarios for the type of fishery (coarse, game or mixed), fish size (small, medium or large) and fish quantity (low, medium or high)

The next step is to input the score of the site for 16 other features on a scale from 0 to 1, where 0 represents the worst possible conditions (the site becomes unusable) and 1 the best possible conditions

The user also needed to specify the level of awareness of visitors to each type of change on a scale from 0 to 1. In this scale, 0 means that visitors are not aware of the change and 1 means that visitors are fully aware. Formally, the awareness scale should correspond to a weighted average of the full angler population's awareness levels, with weights corresponding to the probability of visiting the site under full awareness. It is assumed that the utility of visitors does not change when they are not aware of the change. When they are only partly aware, the utility changes are weighted by the awareness score. If there are no changes to an attribute, the awareness score assigned in the input cell corresponding to this attribute has no consequence. This is because there is no utility change with which to weight by awareness levels.

There is no precise way of assessing awareness and users should use their best judgement. See Section 4.3 for examples of case studies using different awareness levels for different types of changes.

Some of the values in the inputs section can be left blank as the calculations are based only on the changes from the baseline and the desired scenario. This means that both baseline and desired scenario of a feature need to be 'non-blank' for that feature to be included in the calculations.

H.2 Output sections of the tool

Figure H.2 shows the output sections of the tool.

The first section shows the demand impacts of the changes defined in the inputs section. The relevant outputs are:

- the visits switched from/to other sites in the (desired) scenario
- the new visits (visits that were not made in the baseline scenario but are made in the desired scenario) – this consists of additional visits by anglers who already use the site in question or another site, and new trips made by anglers who would not have visited any site prior to the improvement to the site in question
- the total change in visit numbers to the site (that is, the sum of the visits switched from other sites and the new visits)

The second output section shows the consumer surplus, which is equal to WTP net of all trip costs including permit fees, for the changes in the features of the site in the desired scenario. The relevant outputs are:

- total change in consumer surplus
- change in consumer surplus per baseline visit
- impact on revenue

The tool includes 4 extra pages with data and calculations (Coeffs, Calcs, Atts and Sites). The user does not need to work with these 4 pages to use the tool.

Note that if the scenarios defined in the input sections correspond to substantial improvements in many of the attributes of a site and the awareness of these improvements is defined as close to 1, the tool will generate unrealistically high numbers of new and switched visits and a consequent increase in consumer surplus. In these cases, a warning is displayed above the output section ('! scenario implies excessive increase in site utility - values maybe unreliable!'). The excessive predicted numbers of new and switched visits are due to the large number of possible sites in the choice set for each angler, coupled with the fact that there is no 'habit' element in the model which might cause there to be more inertia in reality than it is possible to find when using stated preference models to make predictions, even when these predictions are calibrated using revealed preference data.

ANGLING SIMULATOR

LEGEND

Green highlight	User input cells to be edited
Pale blue highlight	Output cells from model

Site (Choose site from dropdown box)

Site name	
Detailed location	

Scenarios (Input baseline and scenario values and visitors' level of awareness of changes to each attribute)

Must be entered even if no change	Baseline	Scenario	Awareness of change (0-1)
Initial number of visits per year			
Average permit cost per day's fishing			

Only changes need to be entered. Leave blank if Baseline = Scenario

Main site characteristics

Select using dropdown boxes

	Baseline	Scenario	Awareness of change (0-1)
Type of fishery			
Size of fish			
Quantity of fish			

Other site characteristics

Use scale from 0 to 1, where 0=worst (site becomes unusable) and 1=best possible conditions. Select cells in column A for more detail

	Baseline	Scenario	Awareness of change (0-1)
Litter			
No visible pollution			
Availability of fishing spots &/or pegs at site			
Number of other anglers			
Disturbance from other site users (e.g. boating or cycling)			
Footpaths for easy access to fishing spot			
Free car park, with max stay of 3 hours			
Free car park, with no time limits			
Public toilet			
Diversity of plants, birds and other animals			
Legal fishing methods permitted			
Good hatches of fly life			
(Limited) catch can be taken away, rather than catch and release			
Environment is safe for children			
Crime rate			
A beautiful or attractive environment			

Figure H.1 Inputs to appraisal tool

Outcomes - Demand impact, Consumer Surplus (CS) (=WTP net of all trip costs), and Revenue

Visits switched from other sites	0
New visits	0
Total change in visit numbers to site	**0**
Total change in CS for Scenario	**£0**
Change in CS (per baseline visit)	**£0.00**
Change in revenue	**£0**

Figure H.2 Outputs from appraisal tool

Would you like to find out more about us or about your environment?

Then call us on
03708 506 506 (Monday to Friday, 8am to 6pm)

email
enquiries@environment-agency.gov.uk

or visit our website
www.gov.uk/environment-agency

incident hotline 0800 807060 (24 hours)
floodline 0345 988 1188 / 0845 988 1188 (24 hours)

Find out about call charges: www.gov.uk/call-charges

Environment first: Are you viewing this on screen? Please consider the environment and only print if absolutely recessary. If you are reading a paper copy, please don’t forget to reuse and recycle if possible.