Environment Agency

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Economic evaluation of inland fisheries:

Welfare benefits of inland fisheries in England & Wales

Science Report – SC050026/SR1

SCHO1207BNNV-E-P

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Author(s):
Lawrence K. S.
Spurgeon J.

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Research Contractor:
Jacobs UK Ltd.
Jacobs House
427 London Rd.
Reading
RG6 1BC
0118 9635000

Environment Agency's Project Manager:
Guy Mawle
Rio House, Bristol

Collaborator(s):
Glasgow Caledonian University
CogentSi
Professor Ken Willis
Rainbow Research

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Steve Killeen

Head of Science

Executive Summary

This report covers Module A of the study, *Economic evaluation of inland fisheries*. Jacobs UK Ltd was commissioned to undertake this work by the Environment Agency and the Department for Environment, Food and Rural Affairs (Defra) in early 2006, in collaboration with Rainbow Research and the University of Newcastle upon Tyne.

A sister report on Module B, *The economic impact of freshwater angling in Engalnd & Wales* , was primarily authored by Glasgow Caledonian University and CogentSI Ltd.

Understanding the contribution of inland fisheries is vital for decisions on managing and investing in fisheries. Module A discusses the economic values of inland angling and fish stocks, exploring the positive health impacts of angling and the monetary value of salmon stock management to the general public. The report assesses the general public's willingness to pay (WTP) for salmon stocks across England and Wales.

This study carried out a survey of anglers to collect a range of data, including information on health and welfare. A second survey of the general public aimed to find out how much the public were willing to pay to help maintain salmon stocks.

An economic framework was established, splitting economic values into two main types. Economic impact analysis focused on the impact of angling on the local/regional economy in terms of expenditure, incomes and jobs. Economic welfare analysis focused on establishing the overall utility (enjoyment, satisfaction and health benefits)

The survey of anglers found no overall evidence of an increase in the level of physical exercise undertaken. Psychological and social benefits such as relaxation and a "break from everyday life" appeared to be much more important effects of angling.

The general public survey revealed a number of interesting points, such as:

- around 80 per cent of respondents said they "walked by rivers";
- respondents tended to perceive rivers as being in a substantially worse state than was necessarily the case, suggesting people are poorly informed, unaware or out-of-date in their knowledge of rivers;
- half of all respondents believed that their household "*would personally benefit if actions were taken to increase the number of fish in rivers*".

The mean WTP to prevent "severe decline in salmon populations across all of England and Wales", linked to a salmon specific disease rather than general river quality, was **£15.80 per household per year**, which aggregates to a total WTP of around **£350 million per year.**

This may be an overestimate of WTP for salmon alone if respondents were also thinking about their WTP for general river quality when deciding upon their response. So, at worst , WTP could be a third of these values.

WTP increased with respondent's usage of rivers, income, educational qualifications age and the fewer children they had. Gender, employment status, region of residence and fish welfare considerations did not appear to be important in determining the WTP stated[3].

A model was used to apportion the overall national value of preventing a 95 per cent decline in salmon numbers between individual salmon rivers. Average WTP was greater for longer rivers but was not affected by whether the river was urban or rural or whether it had protected status for salmon. The model found that:

- the **River Wye** contributes an estimated **£4.9 million per year;**
- the **River Thames** contributes an estimated **£3.2 million per year;**
- the **River Wyre** contributes an estimated **£2.2 million per year.**

The analysis separated out the WTP for three different attributes of rivers (salmon, other fish and river quality). These attributes had fairly similar WTP levels, implying that if river quality changed alongside a change in salmon stocks, then WTP would be two or three times higher than where salmon stocks changed independently.

The model also helped to establish relative WTP for changes between four levels of quality (good, moderate, poor and dead/none) for each of the three attributes. The model showed that moving from poor to moderate had a large effect on WTP, implying that policies maximising the numbers of rivers in a moderate state or better would have a large impact on welfare. Substantial "loss aversion" was also found, where people were significantly more willing to pay to prevent a loss in quality than to comparably improve it.

The report reaches the following conclusions:

- The mean WTP was **£15.80 per household per year**, which aggregates to a total WTP of around **£350 million per year**.
- It was difficult to separating out WTP for salmon abundance from WTP for other aspects of river quality. The **overall national WTP value may thus be an overestimate** though steps were taken to minimise the problem.
- Values calculated for individual rivers are useful as indicative values, but need to be used with some caution.
- The psychological and social benefits of angling need to be further explored, perhaps through case studies, as they are potentially important yet poorly understood.
- Further work could be conducted on **angling consumer surplus** values, either employing travel cost data from the angler survey undertaken here, or through a new survey (perhaps in conjunction with assessment of psychological and social benefits).
- The **distance decay effect** is of key importance when aggregating values to find an aggregated value for the population. This study has added significant new findings to the literature on this subject, but further investigation would be beneficial.

The results of this study will help the Environment Agency to achieve its aims of boosting the contribution of salmon and freshwater fisheries to the economy and fishing as healthy form of recreation. In particular, it will help us to monitor changes in the quality or levels of fish stocks; prioritise Salmon Action Plans; control outbreaks of fish disease; and find opportunities for external funding to improve fisheries.

Acknowledgements

This study was conducted by Jacobs UK Ltd, with the help of Professor Ken Willis of the University of Newcastle upon Tyne who acted as technical advisor to the project team, particularly on the design and analysis of stated preference elements.

The study was carried out in collaboration with Glasgow Caledonian University and with CogentSI Ltd, who are responsible for Module B and have provided input to areas such as Task 1, where the two modules overlap.

Rainbow Research conducted the fieldwork, provided helpful guidance on the methodology and commented on the results.

The project steering group provided data and guidance on all aspects of the report, including important contributions to Task 2. We would particularly like to thank Guy Mawle, the main contact at the Environment Agency, for this input, as well as Rob Curry, Clare Jackson, Graeme Peirson, Martin Stark and Martin Williams of the Environment Agency; Neil Auchterlonie and Andy Goodwin of Defra; and Mark James (on behalf of Defra).

Sincere thanks are also extended to Alex Coley of the Environment Agency, who went out of his way to provide Environment Agency data and to carry out GIS work.

Professor Nick Hanley provided a peer review (available on request from Guy Mawle, the Project Manager). We appreciated his helpful comments and accordingly made amendments to the report.

Finally, appreciation is due to the many members of the general public who participated in the survey.

Contents

1 Introduction

1.1 Purpose of the study

This report is a key output of the study, *Economic evaluation of inland fisheries*. Jacobs UK Ltd was commissioned to undertake this work by the Environment Agency and the Department for Environment, Food and Rural Affairs (Defra). The study was carried out in collaboration with Glasgow Caledonian University (and CogentSI Ltd), Rainbow Research and Professor Ken Willis from the University of Newcastle upon Tyne.

Understanding the contribution made by inland fisheries is vital for decisions on managing and investing in fisheries. This contribution includes both conventional economic inputs through angling expenditure, and less tangible impacts on the health and welfare of anglers and the general public.

This study builds upon previous work in this area. The results will help the Environment Agency to achieve its objectives[1] and will assist in evaluating:

- changes in environmental quality, such as during the Periodic Review 2009 (PR09) and under the Water Framework Directive (WFD);
- prioritisation in Salmon Action Plans;
- control programmes for outbreaks of fish disease;
- opportunities to secure external funding to improve fisheries.

A sister report, Module B (*An economic impact assessment of angling expenditure*), covers the findings of the angling survey and the resultant DREAM® modelling. Module B is authored by Glasgow Caledonian University..

1.1.1 Objectives

The study originally had six objectives and 16 tasks (see Table 1.1). However, the project board excluded two objectives before commissioning this study. The six original objectives are outlined below, along with reference as to the extent to which they are addressed and reported:

(i) provide estimates of the annual expenditure on different types of freshwater angling in each region of England and Wales (covered in Module B);

(ii) estimate the impact on regional economies of increases/decreases in different types of freshwater angling, identifying the contribution of tourism (in Module B);

(iii) provide updated estimates of the value of fishing rights for different types of freshwater fisheries (not commissioned at this stage);

[1] Most notably, to *'enhance the contribution salmon and freshwater fisheries make to the economy*' and also to *'enhance the social value of fishing as a widely available and healthy form of recreation*'

(iv) provide updated estimates of average anglers' consumer surplus for different types of freshwater angling, per day, regionally and nationally (not commissioned);

(v) provide national and regional estimates of the likely economic benefits from improved health and social welfare (briefly covered in Section 4 of this report);

(vi) provide national and regional estimates of the value of salmon and other selected species in urban and rural rivers, and evaluate marginal changes in their abundance - the main focus of this report: see Sections 5, 6 and 7.

The primary focus of Module A was to assess the general public's willingness to pay (WTP) for salmon stocks across England and Wales. In particular, the study was asked to assess:

- the value of salmon, with a scenario based on the anticipated effects of *Gyrodactylus salaris* if it were to arrive in England and Wales;
- WTP for marginal changes in fish stocks in a river;
- a way to distinguish between use and non-use values;
- a way to distinguish between values for ecosystem quality and values for fish stocks;
- an assessment of how results vary by the distance lived from the site;
- an indication of the value of individual rivers.

In addition, Module A carried out two associated tasks, namely to:

- explore different types of investment in maintaining and improving fisheries, and establish how economic values may be of use (Task 1);
- develop a fisheries economic framework that clarifies how the different values and impacts fit together (Task 2).

1.2 Approach

This study began in January 2006 and finished in March 2007. It contained a number of separate elements, some of which ran concurrently:

1.2.1 Audiences and uses of the report, and the economic framework

Tasks 1 and 2 were completed through deskwork, combining inputs from the project board, original work by the project team, material drawn from previous work by team members and a brief literature review.

1.2.2 Angler survey

The study included a survey of anglers by telephone (3,000 responses in February and March 2006) and via the internet (over 4,000 responses covering 10,000 combinations of region and species, from March to July 2006). This survey is described more fully in Module B, including the methodology used, a discussion of possible biases, the results obtained and the subsequent DREAM® modelling to assess economic impacts.

The angler survey included health and social welfare questions which are discussed in Section 4 of this report (Module A).

1.2.3 General public survey

A second survey was carried out in July and August 2006, this time a face-to-face survey of the general public managed by Rainbow Research.

The core of the survey was a set of stated preference questions aimed at quantifying the general public's willingness to pay (WTP) for salmon stocks and other aspects of river quality. The survey collected socio-demographic information, investigated the ways in which people use rivers and how they benefit from healthy rivers/fish stocks, and asked for people's perceptions of rivers.

The survey was designed using an iterative process of testing and modification, which included discussions with the project board, three focus groups, an in-office pilot and a full pilot of 20 interviews.

In total, 911 interviews were completed across 23 different locations, chosen to represent a variety of urban and rural locations, at a variety of distances from the named river being asked about. The questionnaires and associated materials are provided in Annex 1 of this report.

The stated preference questions included both a contingent valuation method (CVM) section and a choice experiments (CE) section.

1.2.4 Contingent valuation method

A CVM can be used to determine WTP for a specified environmental resource (such as a river) or a change in the resource, through use of a structured questionnaire in which respondents provide a willingness to pay response.

In this study, CVM questions investigated WTP for avoiding a severe decline in salmon (such as a decline that might occur if a salmon disease were to strike). As well as finding the overall WTP to avoid such a decline across England and Wales, an assessment was made of how this value would be apportioned between individual rivers. Adjustment factors were derived to show how WTP varied with factors such as household income, educational qualifications, the region lived in, levels of use of rivers, and distance lived from a specified river. These adjustment factors provide a richer set of results, by describing the kinds of people who value salmon stocks.

1.2.5 Choice experiments

Choice experiments (CE) can also be used to determine WTP. Their strength lies in their ability to assess a wider variety of ways in which a resource's quality might vary. They describe the resource in terms of its attributes (the river's characteristics) and the levels that these take (for example good, moderate or poor). Choice experiments can be used to assess the value associated with a change in any of these characteristics.

In this study, CE questions added two dimensions to the results:

1. A distinction between the value of salmon specifically, the value of fish more generally, and the value of the environmental quality of rivers as a whole.
2. An exploration of how WTP values vary with the extent of change in any of these three attributes: for example, how WTP alters for a change from “poor to moderate” compared to a change from “moderate to good” in an attribute.

The methodology for the general public survey is described in more detail in Section 5.1. The CVM and CE methodologies are described in Sections 6 and 7 respectively.

1.3 Previous WTP studies

Several recent studies have investigated willingness to pay for fisheries improvements.

In 2001, a survey of 650 people investigated WTP for increased flow along Hertfordshire’s River Mimram (Jacobs GIBB Ltd, 2002). Two-thirds of respondents would pay extra to ensure that the river ran dry only every 20 years rather than every four, and 82 per cent thought that preventing rivers from drying up was an important or very important environmental issue. Conservatively estimated, WTP was £3.22 per household per year within 500 m, £2.36 from there to three km, £0.46 to 12 km and £0.24 to 130 km (based on a six per cent discount rate and a 25-year horizon). Most people placed most importance on altruistic and bequest value motives, then existence values and only then personal use values; beyond 12 km from the river, most were non-users. The benefits to which respondents gave most weight were improved visual appearance, wildlife quantity, naturalness and way of life for local people.

A 2001 survey of 210 people living near the River Wear at Durham, and 210 near the River Clyde between Lanark and Cambuslang Bridge, showed that in-stream ecology, aesthetics (litter and so on) and bankside quality (vegetation and erosion control) are seen as the three most important aspects of river health, although interest in in-stream ecology showed a high variance (Hanley *et al*., 2006). Results were gained through both CVM and a ratings method, where respondents assigned 20 chips to various aspects according to their perceived importance. WTP for in-stream ecology: aesthetics: bankside quality was £12.19: £12.07: £12.67 per year (no significant differences between them) for the Wear and £38.70: £28.57: £42.99 per year (litter was significantly lower) for the Clyde. The significant difference between the two groups cannot be explained by known variables, demonstrating that benefits transfer is problematic in this field.

Crabtree and Willis (2004) questioned 900 sea anglers through chance face-to-face interviews at angling grounds and postal questioning of angling club members. They found that WTP increased by £0.22 for each one per cent increase in the size of fish and an additional WTP of £11.38 for the ability to catch new species; however, WTP did not increase with catch size.

A 2001 survey of both anglers and non-anglers showed that coarse anglers were willing to pay from £2.50 to £3.10 per visit to maintain the existing quality of fishing at their usual site and salmon and trout anglers had a WTP between £3.20 and £4.77 (Spurgeon *et al.*, 2001). Non-anglers were willing to pay £6.49 per household per annum to maintain or improve fish populations in their most familiar water body, and £3.63 to do so in the River Wye (although only 20 per cent of respondents were willing to pay for improvements to the Wye).

The study also gathered information on use and non-use motivations of the general public for valuing fish populations within England and Wales. As stated in the report:

> "*The first part concentrated on environmental attitudes of the interviewees ... It was also useful to assess the relative importance of fish populations compared to other environmental features.*
>
> *The second part introduced the respondent to two evaluation scenarios. The first of these scenarios concerned the nearest river that the respondent could recall during the interview ... Respondents were then asked to express their WTP for improving the fish population quality at this site, by means of unspecified payment mechanisms.*
>
> *The second scenario focused on the River Wye … In this case, the main purpose was to assess respondents' WTP for supporting a scheme that would improve salmon populations. Since only one river was considered for all, it meant that true non-use values could be assessed, as well as looking at effects of distance decay*."

Another 2001 survey of anglers visiting the River Teifi, and of those fishing around the Leeds urban area, revealed a WTP per person per trip for game fishing in the River Teifi of £7.10 (Peirson *et al.*, 2001). The equivalent WTP for coarse fishing in and around Leeds was £2.21. A linked survey of the general population, investigating WTP for the re-introduction of salmon populations into the River Thames, estimated the figure at £2.40 per household per year.

Simpson and Willis (2004) assessed the value of traditional salmon net fisheries (rather than the value of fish stocks themselves). The method used was of particular interest, as it employed a top-down approach to help to overcome issues with the embedding effect (see glossary). The authors initially asked respondents whether they would be willing to pay to maintain traditional salmon net fisheries at a minimum level of activity to preserve the practice, and then asked if they would pay an additional amount to maintain the current level of activity.

Respondents were asked how much they would be WTP (as a one-off donation) for each of these scenarios. This design provided an all-or-nothing value for fishing rivers, and a minimal amount of information on the benefits of improving the quality of the river beyond this. Respondents were then asked to allocate points to different management options and different locations, to indicate how they would like their donation to be spent.

1.4 Structure of this report

This report covers Module A of the study, *Economic evaluation of inland fisheries*, assessing the welfare benefits associated with inland fisheries. Table 1.1 shows the tasks outlined in the terms of reference and original proposal for this study.

This report starts with sections on 'Audiences and uses of the results' (Task 1) and '

An economic framework for fisheries' (Task 2), which provide the context for this study. In particular, the framework section explains the relationship between the 'total economic value' approach employed here and the 'economic impact assessment' approach used in Module B.

The report then covers four main areas of analysis:

- health and social welfare impacts;
- general public survey;
- contingent valuation method survey;
- choice experiment survey.

Note that this report's assessment of welfare benefits is in some ways incomplete; in particular, it does not include an explicit assessment of anglers' consumer surplus (see Section 3.1.4 for more details on consumer surplus).

Table 1.1: Tasks in the ToR and original proposal

Task	Location where results are reported
1: Audiences and uses of the results	This report, Section 2.
2: An economic framework for fisheries	This report, Section 3.
3: Design surveys of anglers	Module B; relevant to this report (health & social welfare sections).
4a: Field work for first survey (phone)	Module B; relevant to this report (health & social welfare sections).
4b: Field work for first survey (web)	Module B; relevant to this report (health & social welfare sections).
5: Analyse data from first survey	Module B.
6: Field work for second survey	Not commissioned at this stage.
7: Input survey results to regional economic model	Module B.
8: Estimate anglers' consumer surplus	Not commissioned at this stage.
9: Assess potential health and social benefits	Briefly considered in Section 4.
10: Recent sales of fisheries	Not commissioned at this stage.
11: Delphi technique on fishing rights	Not commissioned at this stage.
12: Review literature on non-use benefits	Not commissioned at this stage.
13: Design survey of general public's non-use values	This report, Sections 5.1, 6.1 and 7.1.
14a: Carry out non-use survey	This report, Sections 6 and 7.
14b: Analyse data on non-use	This report, Sections 6 and 7.
15: Draft final report and seminar	n/a
16: Finalise and deliver report	n/a

The project team has also provided the Environment Agency with a project record covering both modules, in electronic format. The project record includes all raw data, charts, figures, workings, equations and sources of information for the final report.

This report is divided into the following sections:

- Section 2 discusses the audience and uses of the results;
- Section 3 presents an economic framework for fisheries;
- Section 4 presents the health and social welfare methods, results and analysis;
- Section 5 presents the general public survey methods, results and analysis;
- Section 6 presents the contingent valuation methods, results and analysis;
- Section 7 presents the choice experiments methods, results and analysis;
- Section 8 summarises the conclusions drawn from the above;
- Section 9 outlines some recommendations.

2 Audiences and uses of the results

2.1.1 Introduction

The purpose of Task 1 is to clarify the objectives of this study, in particular the “types of investment in maintaining and improving fisheries that we are seeking to evaluate”. It answers questions such as:

- Who are the target audiences?
- How might they want to use the results?
- What measures to maintain and improve fisheries might we need to evaluate?

2.1.2 Methods

This task was primarily based on discussions with members of the project board at the project start-up meeting and on subsequent email submissions from Neil Auchterlonie (Defra) and Martin Stark, Martin Williams and Rob Curry (Environment Agency), along with a brief literature search.

2.1.3 Target audiences

The target audiences for this work include strategic decision-makers at national, regional and, in some cases, local level. As joint funders of this work, the Environment Agency and the Department for Environment, Food and Rural Affairs (Defra) are key audiences, but government departments and agencies with roles that touch upon inland fisheries management will also find the results useful. Other audiences include the nine regional development agencies in England, plus the Welsh Assembly Government, who are responsible for achieving sustainable economic growth in their regions.

Fisheries (commercial and recreational) are a devolved responsibility within the UK, with the administration of UK fisheries being carried out by Defra, the Scottish Executive Environment and Rural Affairs Department (SEERAD), the National Assembly for Wales Agriculture Department (NAWAD) and the Department of Agriculture and Rural Development for Northern Ireland (DARD).This study covers England and Wales.

Other potential audiences include:

- National Assembly for Wales;
- Natural England;
- Department for Culture, Media and Sport;
- Department of Health;
- Office of the Deputy Prime Minister;
- Home Office;
- Prime Minister's Strategy Unit;
- Sport England;
- Sports Council for Wales;
- local authorities;
- anglers;
- angling organisations, fishery owners and trade bodies;
- charities and NGOs;
- the general public;
- the media;
- water companies and OFWAT;
- tourist boards.

Annex 11 gives a more detailed description of the target audiences.

2.1.4 Uses of results

Periodic Review 2009

The environment programme of the Periodic Review (PR04, PR09 and so on) assesses which water quality improvements and environmental measures will be required from water companies, on a five-year cycle. PR09 will require an assessment of the costs and benefits of discretionary schemes in order to determine the appropriate programme of environmental improvements.

PR09 is likely to impact on inland fisheries through measures to improve river water quality or flows. Inland fisheries will benefit from the alleviation of a number of different pressures:

- water quality and flow problems, which may be due to natural causes but can be exacerbated by abstractions and river regulation;
- habitat damage caused, for example, by physical modifications to the water body locally and/or the connectivity of the system as a whole.

Benefits assessment guidance (BAG) was developed for PR04 (RPA, 2004b[1]). This guidance considers the assessment of a wide range of benefits relating to water quality and resource schemes, linking these benefits to changes in the river ecosystem (RE) classification of a river stretch or the frequency of low flow. As with the WFD, this process incorporates elements of cost effectiveness analysis (CEA) and cost-benefit analysis (CBA). Benefits are monetised as far as possible, leading to a ranking of schemes based on the

[1] *Benefits assessment guidance for water quality and water resources schemes*, RPA, 2004

ratio of benefits to costs, plus consideration of other, non-monetised factors. The analysis also assesses the benefits of the overall environmental programme at catchment level.

In this context, the results of the present study will be useful in assessments of water quality improvement schemes. PR09 assessments are likely to be concerned with marginal changes in the quality of fisheries, rather than all-or-nothing values.

Water Framework Directive

The Water Framework Directive (WFD) is a major EC directive aimed at bringing all EU water bodies up to "good ecological status". Economic appraisal is required under the WFD, to guide decisions on which measures to adopt to ensure that water bodies meet WFD requirements.

The WFD, like the PR09, is likely to benefit inland fisheries through the alleviation of a number of pressures such as:

- water quality problems caused by agricultural and industrial discharges;
- problematic land use such as afforestation of upland areas with inappropriate planting, resulting in acidification;
- water quality and flow problems (similar to PR09);
- habitat damage caused, for example, by physical modifications to the water body locally and/or the connectivity of the system as a whole (similar to PR09).

The first stage of assessment required under the WFD is cost effectiveness analysis (CEA), to help decide on the best combination of measures to achieve the aims of the WFD (RPA, 2004[2]).

Under the directive, it is possible to justify alternative objectives to good ecological status, if costs of achieving it are considered to be disproportionate. This process will in many cases involve cost-benefit analysis (CBA), which requires quantification and where possible, monetisation of the costs and benefits of proposed measures. If measures *are* found to be disproportionately costly, then either the deadline for achieving good ecological status can be put back, or a less stringent objective can be adopted. Results from this study may potentially feed into this assessment.

As in the case for PR09, WFD assessments are likely to be concerned with marginal changes in the quality of fisheries rather than all-or-nothing values. For the WFD, results will be most useful if they assess the benefit of moving from poor to moderate to good to high ecological status. However, a measure may only improve fish populations rather than the general quality of the river, in which case it would be inaccurate to use a value corresponding to ecological quality.

The WFD text defines each level of ecological status in terms of a number of different variables, one of which is fish fauna. This is listed separately for different types of water bodies; the relevant categories for this study are rivers; lakes; transitional waters; and heavily modified or artificial water bodies.

Definitions of the different levels of ecological status are the same for rivers and for lakes; these definitions are shown in Table 2.1. They differ slightly but not substantively for transitional waters. Definitions for heavily modified or artificial water bodies do not specifically mention fish fauna, but instead make comments about the overall biological quality elements of the water body.

[2] *CEA and developing a methodology for assessing disproportionate costs,* RPA, 2004

Estimates of total WTP for individual rivers may be used in impact assessments of works such as estuarine barrages, either within a WFD context or in standalone analysis. Care should be taken over the interpretation of the values presented in this report with relation to individual rivers, as outlined in Section 6.2.5.

Table 2.1: Definitions of high, good and moderate status for fish fauna in rivers and lakes

WFD status	Definition
High	Species composition and abundance correspond totally or nearly totally to undisturbed conditions. All the type-specific sensitive species are present. The age structures of the fish communities show little sign of anthropogenic disturbance and are not indicative of a failure in the reproduction or development of a particular species.
Good	There are slight changes in species composition and abundance from the type-specific communities attributable to anthropogenic impacts on physicochemical or hydromorphological quality elements. The age structures of the fish communities show signs of disturbance attributable to anthropogenic impacts on physicochemical or hydromorphological quality elements, and, in a few instances, are indicative of a failure in the reproduction or development of a particular species, to the extent that some age classes may be missing.
Moderate	The composition and abundance of fish species differ moderately from the type-specific communities attributable to anthropogenic impacts on physicochemical or hydromorphological quality elements. The age structure of the fish communities shows major signs of disturbance, attributable to anthropogenic impacts on physicochemical or hydromorphological quality elements, to the extent that a moderate proportion of the type-specific species are absent or of very low abundance.

Salmon Action Plans

Salmon Action Plans (SAPs) help the Environment Agency to meet the objectives of its National Salmon Management Strategy, which sets out four objectives for salmon fisheries:

1. Optimise the number of salmon returning to home water fisheries.
2. Maintain and improve fitness and diversity of salmon stocks.
3. Optimise the total economic value of surplus stocks.
4. Ensure beneficiaries meet necessary costs.

Objective 3 makes explicit reference to economic value and requires knowledge of how values vary with salmon abundance and how they are exploited. Objective 4 requires an understanding of the extent to which different beneficiaries gain from management measures. The results from this study should help to achieve these objectives.

SAPs aim to enhance salmon fisheries by setting spawning targets; improving water quality; protecting important habitats; reducing bird predation on young salmon; improving stock assessments; regulating the exploitation of salmon stocks; and maximising the effectiveness of stocking programmes.

There is a SAP for each of the principal salmon rivers in England and Wales. The plans are delivered locally in a collaborative approach with local interest groups, including consultation with fishery interests. Each SAP contains detailed costed action plans.

Fisheries Action Plans

Alongside the SAPs, a set of five Fisheries Action Plans (FAPs) have been launched to improve freshwater fisheries in England and Wales. Following the success of these schemes, another four FAPs will be set up and more are planned for the future.

FAPs involve the Environment Agency working in partnership with anglers, conservationists and other interest groups to increase public involvement in the management of local fisheries. Management measures might include studies on the impact of stocking of brown trout and improvements in juvenile coarse fish habitat. Each FAP group consists of about 12-15 members.

The FAP group compiles a list of key issues and sets targets and actions to resolve these issues. Although it is unlikely that FAP groups would undertake any economic analyses of their own, the results of this study could be used by FAP groups in prioritising their issues and targets.

Fish disease

Defra's requirements for data on fish disease are outlined in the project terms of reference:

> *"Information on the socio-economic value of recreational freshwater fisheries is of key importance in the development of comprehensive and effective disease outbreak contingency plans for Defra. Such a mechanism allows for the inclusion of the wider potential impacts of exotic notifiable disease beyond the immediate effects on farmed and wild fish stocks."*

The principal exotic fish diseases include those caused by the parasite *Gyrodactylus salaris* and the viruses infectious haematopoietic necrosis (IHN) and viral haemorrhagic septicaemia (VHS).

This use of the data may require all-or-nothing values for the presence of a given species (most notably salmon) in an individual water body, a region or nationally. Assessments of the impact of marginal changes in fish stocks might also be useful. Information on the potential economic impact and economic losses as a result of an outbreak of disease should help determine the level of response required.

Opportunities for applying for additional funding

Various opportunities exist for local, regional and national public bodies, private companies and charitable organisations to apply for funding to aid or complement the policy initiatives described above. Funding may be available for schemes to improve fisheries specifically, or the environment more generally, from sources at EU, national, regional and local levels.

Applications for funding generally need to present convincing cases for the benefits that can be obtained from the proposed schemes, to justify the investment. Different funding bodies are likely to be motivated by different agendas, but many will be interested in the potential economic benefits such as the employment created, local expenditure, the economic value added and the extent to which schemes target deprived areas or groups (the benefits from angling are particularly important for rural areas where there is relatively little other economic activity). This study should provide valuable results for such applications.

Funding applications might also be aided by including assessments of the health and social benefits of angling.

3 An economic framework for fisheries

3.1.1 Introduction

This section presents the results from Task 2 of the project, whose aim was to clarify how the different values and impacts fit together. This section summarises the various categories of value and economic impacts of angling in England and Wales. It includes a discussion of how the different values interact, answering questions such as "Which values can be added together, and when do we need to be concerned about double-counting?"

Historically, two kinds of economic evaluations have been applied to angling in the UK and elsewhere: economic impact analyses and total economic value assessments (TEV). These approaches adopt quite different viewpoints; they are discussed in Sections 3.1.3 and 3.1.4 in turn. Results from the two assessments generally cannot be added together.

Economic impact analyses assess the impact of angling on regional economies, for example in the form of total sales, incomes and employment generated as a result of angling activity. This is the approach employed in Module B of this study.

TEV assessments quantify the impact that angling has on national welfare, which is the sum of individual people's welfare values. Welfare values relate to the overall utility (enjoyment or satisfaction) derived by individuals from consuming goods and services. The values can feed into cost-benefit analyses and can be used to assess the merits of different policies and initiatives from a welfare standpoint. This approach, which helps us decide how to allocate scarce resources (such as government funding), is employed in this report (Module A).

Figure 3.1 shows how these two approaches relate to one another:

- The left-hand side shows how angling expenditure generates two types of welfare value (producer surplus and economic rent). These are complemented by a number of other types of welfare value derived from fish stocks, but not angling expenditure. In general, all these values can be added together to find TEV (although note caveats in Section 3.1.4). They are often measured by assessing willingness-to-pay (WTP). Note that people may hold multiple motives for being willing to to pay to protect a resource, meaning that it is not always possible to identify and separate out these different elements of value.
- The right-hand side shows how angling expenditure generates economic output, jobs and income within the regional economy. These are all valid ways of measuring what is essentially the same economic impact; they should not be added together.
- Impacts on the right-hand side should not be added to impacts on the left-hand side.
- This illustrative diagram is designed to assist the reader's understanding of the relationship between different impacts. Box sizes do not necessarily reflect the size of the impact in question; for example, economic income is unlikely to be of the same magnitude as economic output. At this stage, this diagram is a draft version.

We also consider the ways in which different audiences might interpret and use this framework (Table 3.1, at the end of this section). A selection of diagrams is provided to aid the reader.

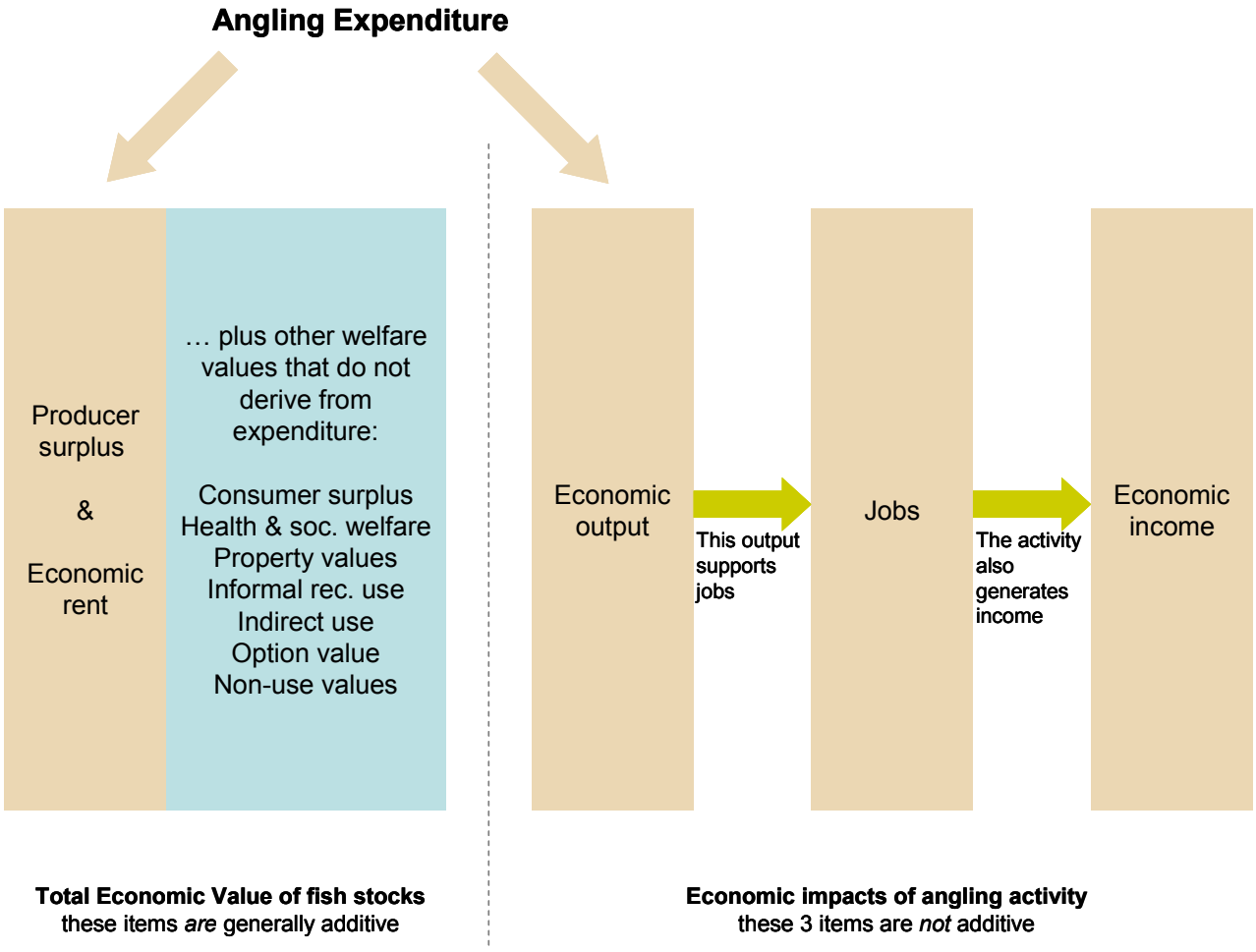


Figure 3.1: A comparison of the results from economic impact analyses and TEV assessments

3.1.2 Methods

Previous work by members of the project team was used in this task (Cappell and Lawrence, 2005; Spurgeon *et al*., 2001; Radford *et al*., 2004). Previous frameworks were combined and adapted to the needs of this study, with new elements and explanations added as required. The framework was also shaped by discussions with the project board at the start-up meeting.

3.1.3 Economic impact analyses

Economic impact analysis focuses on the impact of angling on local or regional economic activity. Anglers spend large amounts of money on their sport, generating jobs and income and within local and regional economies.

Annex 12 provides a more in-depth discussion of the economic impact of angling. This approach is used in Module B of this study.

3.1.4 Total economic value assessments

Assessments of total economic value (TEV) examine the economic value of a good by summing a variety of components of value. TEV is about assessing welfare values which relate to the utility (enjoyment or satisfaction) derived by individuals from consuming goods and services.

The welfare value approach helps us to carry out cost-benefit analyses that assess the merits of different initiatives. Initiatives that increase net welfare are deemed beneficial and vice versa. This approach helps us decide how to allocate scarce resources (such as government funding).

The figure below illustrates the total economic value components of fish stocks.

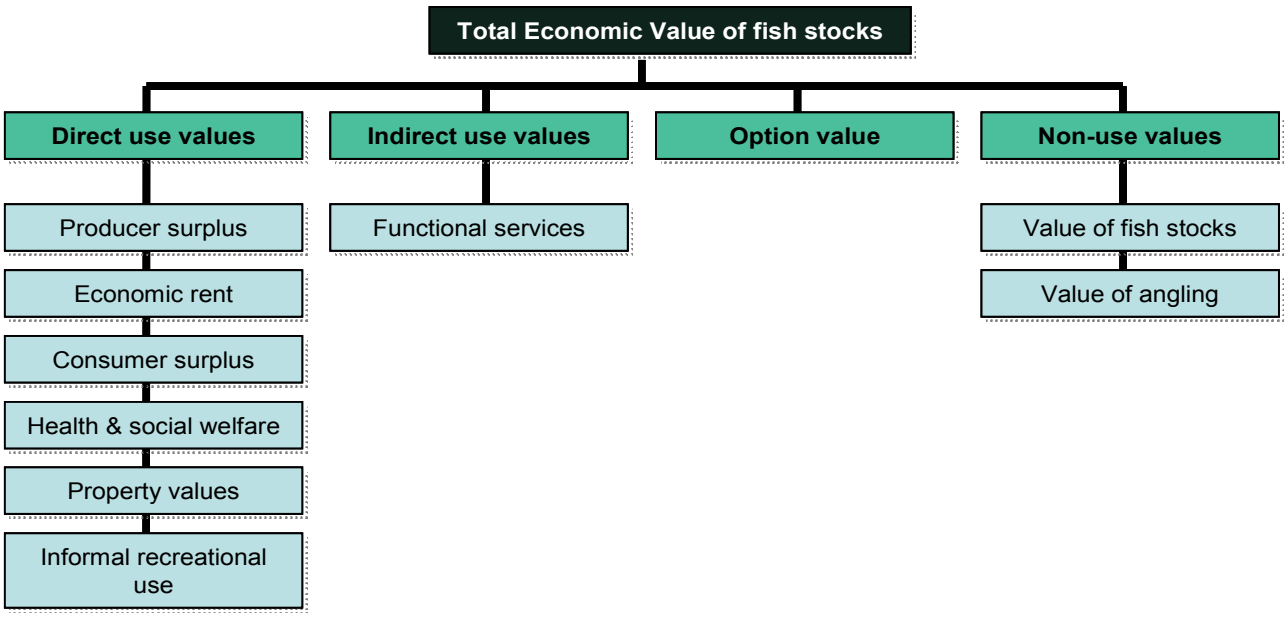


Figure 3.2: Values obtained from fish stocks

It is also possible to assess the sensitivity of TEV to changes in circumstances, such as changes in the use of a resource or in the quantity of fish present. The evaluation is not concerned with impacts on the regional economy or sectors of the economy, unlike economic impact analysis.

TEV assessment can be applied to different goods or services; for example, one can measure TEV of angling, fish stocks or healthy ecosystems, and the results are flexible enough to be put to use in a variety of situations by different users.

Examples of evaluations of angling activity include Willis and Garrod (1991), Foundation for Water Research (Anon, 1996), Davies and O'Neill (1992), Willis and Garrod (1999), [1]Gibb Environment (1999) and Spurgeon *et al*. (2001).

Producer surplus

Producers of goods and services such as angling equipment and accommodation receive economic benefits from angling, based on the profits from selling the goods/services.

[1] Now known as Jacobs UK Ltd.

Economic benefits to producers are known as producer surplus, defined as the excess of the revenue received by a producer of a commodity over the minimum amount they would be willing to accept to maintain supply..

Some businesses are directly dependent upon angling, such as tackle shops and angling journalism. Other industries derive income from angling, but are not wholly or largely dependent on it for their survival. These include hotels and other businesses selling food and drink, fuel and transport, and boat maintenance.

The market for angling equipment is reasonably competitive, with little inelasticity in the supply of fixed or variable factors. It may be reasonable to assume that competition entails low profit levels in the supply of angling goods and services, and therefore only incidental amounts of producers' surplus/economic rent will be generated in this sector.

Producer surplus can sometimes be measured through questionnaire surveys targeted at manufacturers and retailers, but this can be sensitive information to obtain.

Economic rent

As discussed above, anglers spend money that creates economic income and jobs in the area. In TEV analysis, we view these benefits as feeding into the total benefits brought about by angling activity, through the generation of economic rent and producer surplus (see below).

In England and Wales, recreational fisheries are generally privately owned and most owners of fishing rights charge anglers for access to the fishing site. The fishery is thus priced and operates within a market. One component of anglers' expenditure is payments to owners of fishing rights. Such payments are known as economic rent. Owners of fishing rights often incur relatively few costs in producing the fishing rights (although they may pay for marketing, stocking, maintenance and so on, they do not always pay directly for the resource itself). Economic rent is therefore often thought of as a direct source of value deriving from the fishery.

Owners of fisheries own the right to receive a net income flow by letting their fishing. Whether or not owners choose to let their fishing, an actual or potential income flow is available to them and the rights to this flow can be bought and sold in the market. The market value of fishing rights represents a capitalisation of the potential income from those rights. This market value also captures the option of exclusive use of the fishery and the status value of owning a fishery.

Anglers' consumer surplus

Willingness to pay (WTP) is a key concept in measuring TEV. In very simple terms, the economic value of a good, for example a fish, is measured by the maximum amount of other goods and services that a person is willing to give up to have that fish.

We express changes in people's welfare in monetary terms using WTP and willingness to accept compensation[2]. There are two different ways of conceptualising and measuring welfare changes: compensation variation and equivalent variation[3].

[2] There are practical problems in measuring WTA (see glossary for definition), so in general WTP is measured instead. It is recognised that this may be an underestimate of value in certain circumstances.

[3].Estimates of compensation variation and equivalent variation (see glossary for definitions) are very similar in theory, although they have been shown to differ considerably in applied studies. The choice of which measure to use depends on what the status quo is (the existing structure of property rights). If property rights reside with angling, then WTA (CV) is the theoretically appropriate basis for estimating the loss of welfare associated with an adverse change.

It is often incorrectly assumed that a good's market price measures its economic value. However, the market price only tells us the amount that people are *obliged* to pay for that good or service; not the amount of value that they place on it. People will purchase a good if their willingness to pay is equal to or greater than the price.

Consumer surplus is the difference between the maximum that anglers would be willing to pay, and the amount they actually do pay (the market price). This is illustrated in the figure in Annex 13. For example, consider an angler who has a WTP of £75 to goes on an angling trip. In reality, he only has to pay the market price for the trip, say £50 in this case. This angler would have a consumer surplus of £25.

Although it may seem an abstract concept, consumer surplus is a tangible economic benefit. One way to think of this is to consider what would happen if the market price for every angler's trip was set to WTP; anglers would still participate in the sport, but consumer surplus would be zero. In reality, the market price cannot usually be set this way and is lower than the WTP for most people. So most anglers save money compared to the maximum they would be prepared to pay. They can use the money saved to purchase other goods and services, thereby deriving a tangible economic benefit.

In economic terms, consumer surplus is analogous to the profits generated by a business activity, as it represents the surplus benefits generated above and beyond expenditure associated with the activity.

Consumer surplus will change if the price or quality of angling changes. For example, if the price of a good increases, but people's WTP remains the same, consumer surplus will be less than before. If the quality of a good increases, but price remains the same, then people's WTP may increase and thus consumer surplus will also increase.

Consumer surplus is a component of TEV representing a welfare value derived from fish stocks. It can be measured by finding WTP using stated preference methods such as contingent valuation surveys or choice experiments, and then subtracting actual expenditure or market prices.

Health and social welfare

Angling may be beneficial to participants' health as a result of the exercise, tranquillity and escape from everyday pressures. It could improve mental and physical health and might have impacts on social welfare, for example by keeping families together and keeping children out of trouble. These benefits may in turn have impacts on the economy, for example through reduced costs to health or social services. There is probably more evidence of benefit to mental welfare than to physical health. A recent Countryside Recreation Network report (Pretty *et al.*, 2005) concluded that "*green exercise has important implications for public and environmental health*", finding that green exercise resulted in significant improvements to self-esteem and to six 'mood measures'[4]. Ten projects were examined, covering a variety of outdoor pursuits; of the ten samples, anglers at Layer Pit fishing club, Essex had the second greatest increase in self-esteem and showed significant improvements in four of the six mood measures.

Whether angling offers a net benefit to the nation's health depends on alternative activities that anglers would have participated in had they not gone angling. Had they chosen a highly physical activity, angling could actually have had a net negative effect on physical health.

This is a relatively unknown area, with little research carried out. Only a basic level of analysis was possible in the present study; three questions were added to the angler survey.

[4] Anger, confusion, depression, tension, fatigue and vigour

Note that some benefits, such as the relaxing, enjoyable experience of angling, will already be captured in the assessment of consumer surplus. This topic is investigated further in Section 4.

Property values and regeneration

It is well established that residential property prices increase when the property is situated close to a river or other water body. This effect can be quantified through a hedonic pricing approach (a statistical method that disentangles the extent to which different parameters affect property values). The premium for living close to a river is likely to be significantly higher if the river is in a good state than if it is degraded. It is less clear whether the presence of fish in the river is an important contributor to this premium, or whether river quality alone is sufficient.

Care is required when assessing this benefit, as much of this premium may be included already under other sources of use and non-use value: if the premium is because the property owner enjoys visiting the river, this will be measured by passive use value; if it is because (s)he is happy simply to know there are fish in the river, it falls under non-use value. This value cannot simply be added to other sources of value without some careful effort to avoid double-counting.

Some policy measures aimed at improving angling will have side benefits by stimulating regeneration of the surrounding area. However, this regeneration can only be included as a benefit where the policy measure is an integral element of a wider regeneration scheme, none of which will go ahead (or which will go ahead at a much lower scale) without the measure. Regeneration benefits may be eligible to add as an indicator, but only where they go ahead purely as a result of the policy measure under consideration.

Such benefits are realistic in areas with high quality angling; for example, this was evidenced by the decision by pharmaceutical company Prostrakan to relocate to Galashiels due to "*the excellence of the fishing on Tweed; we would have located Prostrakan somewhere else if the fishing had not been so good here in the Borders*" (Berwickshire Today, 2007).

This value would likely to be of interest to RDAs, as it links strongly to economic growth.

Informal recreational use

Wildlife and natural resources such as fish stocks give rise to a range of informal recreational uses, where there is no *consumption* of the good in question. These values are sometimes referred to as 'passive use values'[5]. They come in two forms, which can both be measured through participants' WTP for the activities in question:

- Uses which are non-consumptive, but are still based on direct contact with natural resources, such as wildlife photography. Many species may be observed at particular locations, and riverside walking may be enhanced by the prospect of seeing fish.
- Activities such as reading about wildlife or watching TV nature programmes; when doing so, a person may derive enjoyment from the resource without having direct contact with it.

Indirect use values

Whereas direct use values assess the contribution that fish stocks make through direct use of the fish or fishery (for example, through recreation), indirect use values concentrate on the benefits derived from functional services that the fish stocks or fishery provide.

[5] Although this can be a confusing term, as it is used in different ways by different authors.

Indirect use values of fish stocks may be best thought of as the role that fish populations play in ensuring a healthy, interlinked, thriving ecosystem.

Option value

Option value is the value that people place on having the option to enjoy something in the future, even though they may not use it at present. Conserving a resource allows us to retain the option of using it in future; maintaining healthy fish stocks allows us more options for their future use. New uses may be found for fish stocks, or existing uses may become more valuable for reasons not anticipated. If fish stocks are lost, these opportunities are lost. This can be measured in WTP. Many economists do not consider option value to be a separable element of TEV with a predictable sign (i.e. it is not always positive), but prefer instead to talk about 'use values under uncertainty'.

Non-use values (bequest and existence values) of fish stocks

Non-use values refer to values that people hold for a resource existing, even though they do not use it. A recent report by Jacobs (formerly Jacobs Babtie) for the Environment Agency[6] outlines the latest thinking on non-use values. People have various motives for holding non-use values.

People may derive an existence value from simply knowing that the natural resource exists. This represents an explicit concern for the stock itself and is a non-use value of the stock. Existence value arises out of sympathy for the right of the species to continue to exist. For example, there may be significant WTP to preserve species such as salmon that have almost emblematic status. Existence value could be relevant for both the angling population and the general public.

Other types of existence value include knowing that other people have the opportunity to enjoy the resource, or the heritage and/or cultural aspects of fisheries; Simpson and Willis (2004) assessed the value of traditional net fisheries.

Some individuals may derive satisfaction from knowing that future generations will be able to enjoy fish stocks and are even willing to pay to ensure future generations' participation. This is the bequest value of fish stocks.

Care is required to distinguish between the non-use values people hold for fish stocks and the non-use values they hold for healthy ecosystems in general.

Non-use values can only be valued through stated preference methods such as contingent valuation method surveys or choice experiments, as used in this study.

Non-use values (bequest and existence values) of angling

In a similar way to fish stocks, there may be non-use values for angling as an activity.

Some individuals may derive satisfaction from knowing that future generations will be able to participate in angling and are even willing to pay to ensure future generations' participation. This is the bequest value of angling.

Some people may derive an 'existence value' from knowing the activity exists and is enjoyed by others. In other words, they would be willing to pay to preserve angling for the enjoyment of their contemporaries. This is the existence value of angling.

The common feature of these values is that an individual appreciates the consumptive use of a natural resource by others. Anglers in particular may have an altruistic concern for fellow

[6] Jacobs (2006) *Report on non-use benefits valuation*. Report for the Environment Agency

anglers that manifests itself in a willingness to pay. It is, however, difficult to separate this value from the use value of anglers.

If a sizeable proportion of the non-angling public has some explicit concern for anglers, then these two values might be significant for the general population. The study *Public attitudes to angling* (Simpson and Mawle, 2005) explored this subject.

Non-anthropocentric intrinsic value

Some people believe that natural resources also possess an intrinsic value, not merely one assigned by humans, but based on the notion that organisms have a right to exist. This is separate from TEV but indistinct from it; in fact, this value falls outside the realms of economic theory. Non-anthropocentric intrinsic value is not based on the anthropocentric concept of utility.[7] This category of value is not therefore assessed in this study.

3.1.5 Components of value included in WTP estimates

Module A employed stated preference surveys to assess the general public's WTP for salmon stocks and other aspects of river quality. Both users and non-users of rivers were interviewed. As the WTP scenario asked about an additional spend each year *on top of what respondents already pay*, WTP should include all components of TEV *not currently paid for*. It should therefore include all sources of value shown in Figure 3.1, except for producer surplus and economic rent − unless respondents were owners of businesses profiting from fish stocks and made allowance for these profits in their WTP, in which case total WTP would include producer surplus and economic rent. The motivations for giving a WTP amount are explored in Section 6.3.8; there was little or no evidence of producer surplus or economic rent being a motivation for WTP.

Module B estimated angling expenditure using an economic impact analysis rather than a TEV approach. It assessed the impacts of all items that anglers currently spend money on.

3.1.6 Caveats and health warnings

This section summarises some of the pitfalls facing users of this report. Potential misuses of results include articles in the media quoting the expenditure associated with angling as being the "value" of angling; results being taken out of context, for example at the wrong geographic scale; users employing inappropriate types of value for the use they are putting them to (such as using the existence value of healthy ecosystems to assess the impact of fish stocks dying out from a disease); users adding together values that are not additive, leading to double-counting.

Economic impact analyses measure the income and jobs resulting from angling expenditure. Some issues which might arise in the use of these results include:

- Angling expenditure itself is only an indicator of the *size* of angling as an activity; it does not measure the *value* of angling.
- Expenditure is a *gross* measure and so ignores what is foregone in choosing angling rather than some other activity.

[7] This is distinct from anthropocentric intrinsic value, which is value assigned by human judgment from a human viewpoint (arising from the belief that nature deserved to be conserved on moral grounds). Anthropocentric intrinsic value is likely to be captured within TEV through measuring existence value.

- Care is required to avoid double-counting between the jobs created and the income generated.
- An economic impact analysis at a national level would be far less interesting than a regional analysis.
- Other criteria may be important politically or to help meet government targets. Decision-makers might be interested in the extent to which investment in angling helps to reduce unemployment in the worst hit areas; or the extent to which angling programmes fit with urban regeneration schemes. Although these items may be flagged as useful indicators for decision-making purposes, they *cannot* be summed with welfare values.
- Economic impact analyses do not consider the wider benefits (or costs) of angling, such as consumer surplus, health and social welfare impacts or non-use values. Anglers' expenditure and these other components of value are not necessarily linked.

TEV is composed of a series of values that can generally be safely added together, since they are based on a common way of measuring value (WTP) and a common constituency (society as a whole). However, this is not always the case. Areas to be careful of include:

- Care is required over how values are measured, to be clear as to which types of values have been captured. For example, stated preference studies might capture some or all of angler's consumer surplus, existence value, bequest value and option values, depending on how the question is posed and who the audience is. This is discussed further under the design options for this study's stated preference survey.
- There is the potential for double-counting between property values and other use and non-use values, and between health benefits and consumer surplus. These issues must be carefully considered wherever property values and/or health and social welfare benefits are included in an assessment of TEV.
- Angling expenditure should be converted into producer surplus and economic rent before being include in any TEV analysis; expenditure itself is not a type of value.
- Analyses of jobs dependent on angling should not be considered an additional benefit that counts towards TEV; rather, this is another way of expressing benefits that have already been included within TEV (through producer surplus and economic rent).[8]

Finally, most decision-makers are primarily interested in incremental (or *marginal*) values, such as the impact on the regional economy or the change in national welfare if the extent or quality of angling changes. Marginal impacts are often more useful than absolute values.

However, the economic impact analysis described above only records the *current* economic significance of angling. The results need to be used sensitively in analysing the effect of *changes* in the current position. For example, a doubling of the returning salmon stock will not result in a doubling of the economic impact of salmon angling (Radford *et al*., 2001). Although it is interesting to quote the amount of income generated by a rod caught salmon, the causal chain between salmon stocks and output, income and employment is complicated and is not linear. Given this, crude averages need to be used with care.

It is sometimes possible to gain insights into incremental changes through a TEV assessment, depending upon the way in which component values are measured. For example, well-designed stated preference studies can tell us about the impact on consumer

[8] However, note that if the new jobs go to people who would otherwise be unemployed, then wage rates do not necessarily represent society's opportunity cost and there may be a net welfare gain from the employment created.

surplus and/or non-use values of incremental changes in water quality and/or fish stocks. However, care is required when applying values derived from all-or-nothing scenarios to scenarios involving marginal changes in quality or quantity of a resource. Again, non-linearities need to be allowed for. The CVM survey presented here essentially measures an all-or-nothing value, whereas the CE survey measures marginal values (changes between qualitative levels of environmental quality).

3.1.7 Different audiences, different perspectives

Each user should consider the use that they will put the results to, and choose the types of values to use accordingly. Table 3.1 lists the main uses that results could be put to and assesses the types of results that may be relevant in each case.

Some users (such as those assessing measures to prevent fish diseases) will be most interested in the value of fish stocks themselves, whereas other users (working on the WFD and PR09, for example) will be more interested in the value of improving the overall water quality of a given water body. These users should note such distinctions between the existence value of fish stocks, the existence value of high quality water bodies and the existence value of angling.

Users carrying out cost-benefit analyses of policies and measures should also allow for the costs associated with implementing the policies or measures.

Table 3.1: Potential uses of results

Type of use	Specific use	Audience(s)	Results needed		
			Change valued	**Area/species**	**Types of value**
Cost-benefit analysis of management measures and programmes.	Water Framework Directive.	Environment Agency; Defra; Welsh Assembly; Government; co-regulators.	The benefit of moving from poor to moderate to good ecological status; specifically, the changes in composition, abundance & age structure of fish fauna.	For a specific water body; differences between rivers, lakes, HMWB; major/minor rivers; by region etc.	TEV of ecosystem; expenditure; jobs.
	PR09.	Water companies; OFWAT; EA; Defra.	Marginal changes in water/river quality.	Similar to above.	TEV of ecosystem.
	Assessing measures to manage fisheries, inc. SAPs & FAPs actions.	All interested in salmon and salmon fisheries, inc. SAPs & FAPs.	All-or-nothing and marginal changes in fish abundance and diversity due to actions.	By fish type; for a specific water body.	TEV of stocks; expenditure; jobs.
	Contingency plans for fish disease outbreaks.	Defra.	All-or-nothing value; marginal changes in stocks.	By water body and species.	TEV of relevant stocks; expenditure; jobs.
	Measures to preserve endangered species.	Natural England; Environment Agency; CCW.	All-or-nothing values and marginal values for endangered species.	By water body/ national/global. For rare species.	TEV; mostly non-use value.
Cost-benefit analysis of policies.	Regulatory impact assessments (RIA).	Environment Agency; Defra; other government bodies.	Marginal change caused by policy.	Various.	TEV.
Demonstrating the importance of angling, fish stocks or healthy rivers to England and Wales, to the regions and at a local level.	To assist in funding applications.	Various (RDAs, local authorities, charities).	Marginal change caused by planned activity.	Area impacted by planned activity.	Expenditure; jobs; TEV.
	To raise awareness of angling's contributions to the economy and society	General public; media; angling organisations; government bodies.	All-or-nothing value.	National or regional.	Expenditure; jobs; TEV of angling.
	Setting a baseline for policies to enhance angling's contribution.	Environment Agency.	All-or-nothing value.	National and regional.	Expenditure; jobs; TEV of angling.
Setting priorities.	Prioritise angling as use of a river/fish stock, e.g. against other recreation,	Environment Agency; Defra; Countryside Agency; ODPM; Dept	Marginal changes; potential of angling; reference case.	Various.	Expenditure; jobs; TEV of angling.

Type of use	Specific use	Audience(s)	Results needed		
			Change valued	Area/species	Types of value
	commercial fisheries, industrial uses etc; prioritise spending on angling.	of Culture, Media & Sport; NAW; Sports Council Wales; Sport England; RDAs; LAs.			
Establishing the basis for a tax or charge.	Setting entrance charges to fishing sites.	Owners of fishing rights	Entrance charge compared to total expenditure.	By fishing site.	Expenditure.
	Setting the size of the licence fee.	Environment Agency.	Licence fee compared to total expenditure.	By category of licence.	Expenditure; TEV of angling.
	Taxing activities that damage ecosystems, or subsidising beneficial activities.	Government bodies such as Defra, the Treasury etc.	Marginal change caused by damaging/beneficial activity.	National.	TEV of ecosystem.
Green accounting.	Accounts that include environmental impacts, such as Defra green agricultural accounts.	Government bodies such as Defra, the Treasury etc; private sector.	Marginal change caused by sector/corporation. No great demand for information on fish stocks at present.	National or regional.	TEV of ecosystem.
Legal damage assessment.	Assessing compensation if rivers damaged or polluted; action under Environmental Liability Directive.	Environment Agency; ACA; polluters.	Marginal change caused by damage/pollution (compensation could be to owner of property rights or state/population affected).	Area damaged.	TEV of ecosystem.
Benefits transfer studies.	Applying the results to contexts other than setting for this study.	Various.	Marginal changes and all-or-nothing values.	As flexible as possible, with results split in many ways.	Various.

4 Health and social welfare

4.1 Methods

This study analysed responses to questions on the health and social welfare of angling in the telephone and internet angler surveys. These questions were removed from the internet survey after 857 people had responded to them, as part of a drive to cut back the length of the overall survey. This was deemed acceptable as the 857 responses were sufficient to provide statistically robust data on responses to these questions. Around 3,000 people responded to these questions through the telephone survey.

The study aimed to:

> "*Assess potential health and social benefits using information on activity levels from angler surveys and evaluate these using established techniques or developing new ones*."

The angler survey's treatment of health and social benefits was restricted to three questions. Nevertheless, the analysis reveals some interesting findings.

This is a relatively new area of economic analysis, but one of increasing focus. Few studies in the UK have determined quantitative values for health and social benefits, although there have been a number of literature reviews and scoping studies. Suggested benefits from angling include:

- the health benefits of the physical activity involved (especially for game fishing);
- psychological benefits associated with relaxation during angling;
- reducing crime and anti-social behaviour;
- increased social cohesion.

Our analysis concentrates on the first two, but does not assess the indirect economic benefits derived from the health benefits described above. Indirect economic benefits could, in theory, include reduced costs to the National Health Service from fewer treatments for physical and mental conditions in anglers, given that anglers' health may have improved directly due to angling. We have not produced any evidence of this.

Anglers would undertake alternative activities if they were not fishing. In order to understand net benefits attributable to angling, the benefits of angling should be compared to benefits that would have been obtained from these alternative activities.

4.1.1 Physical exercise obtained from angling

To test the extent to which angling is a source of physical activity, respondents were asked to characterize their angling activity in terms of how strenuous it was. Similarly, they were asked what alternative activity they might have undertaken were they unable to fish, and how strenuous this would have been.

These questions were used to investigate the net loss or gain in physical exercise obtained by anglers − the difference between exercise obtained from angling compared to the level of exercise obtained had they not gone angling. The questions were:

- If you were unable to fish at all, what activities are you most likely to have done instead? (If you would be working, please classify your work as a vigorous, moderate, light or sedentary activity).
    - Vigorous activities (activities like playing sports such as racket sports, running, swimming and cycling).
    - Moderate activities (activities like gardening, housework, walking for exercise, bowling, kayaking).
    - Light activities (activities like walking for pleasure, pleasure boating).
    - Inactive activities (activities like watching TV, reading, office work).
- Which of the above categories would you say your own angling activity falls into?
    - Vigorous activity.
    - Moderate activity.
    - Light activity.
    - Inactive activity.

4.1.2 Other benefits obtained from angling

Respondents were asked the following questions relating to other benefits, to generate information on the wider psychological or health-related benefits of angling:

- Please indicate how much you agree with the following statements about your most recent angling trip (rate these on the scale strongly disagree/slightly disagree/neither agree nor disagree/slightly agree/strongly agree):
    - I felt more relaxed after the trip.
    - I felt healthier after the trip.
    - I obtained physical exercise during the trip.
    - I enjoyed the trip.
    - I appreciated the solitude.
    - I enjoyed meeting other anglers.
    - I appreciated the break from my everyday life.

4.2 Results and analysis

4.2.1 Physical exercise obtained from angling

Table 4.1 presents results of the level of physical effort anglers considered their angling activity to involve, cross-tabulated against the level of physical effort associated with their most likely alternative activity.

Table 4.1: Level of physical effort involved in angling and alternative activities

	Angling				
Alternative	**Inactive**	**Light**	**Moderate**	**Vigorous**	**Total**
Inactive	97	350	289	26	**762** (19%)
Light	114	810	467	33	**1,424** (37%)
Moderate	69	400	362	24	**855** (22%)
Vigorous	78	351	273	137	**839** (22%)
Blank	2	9	5	-	**16** (0%)
Total	**360** (9%)	**1,920** (49%)	**1,396** (36%)	**220** (6%)	**3,896**

The mean rating given to the angling activity was 2.38 (using 1 = inactive, 2 = light, 3 = moderate, 4 = vigorous). All four ratings received sizeable numbers of answers, reflecting the variety of types of angling undertaken (standard deviation = 0.73).

The mean rating given to the alternative activity was 2.46. The variability of answers was higher here than for the angling activity (standard deviation = 1.04), with more respondents answering the extremes of 'inactive' or 'vigorous' here.

As these means are similar, on average anglers believe they gain a similar amount of physical exercise from angling as from the alternative activity they would undertake. This suggests that whilst angling involves physical activity, there is no net physical benefit obtained compared to the situation that would result if angling was unavailable.

However, a Wilcoxon signed ranks test showed that the physical activity gained from the alternative activity is significantly greater (albeit by a small amount) than that gained from the angling activity (asymptotic significance (two-tailed) = 0.000).

The results show that anglers who rate their angling activity as 'vigorous' are also the most likely group to select an alternative that is vigorous. For the other categories, the most likely alternative would be a 'light' level of physical effort. Overall, 30 per cent of anglers would gain more exercise from their angling, 33 per cent would gain more from their alternative activity and 36 per cent would gain the same from each.

4.2.2 Other benefits obtained from angling

Table 4.2 presents the mean rating given to each statement in the second question, ranked from the statement that was agreed with most to the one that was agreed with least (based on the combined sample). Answers were scored on a scale ranging from 'strongly disagree' (1) to 'strongly agree' (5).

Table 4.2: Health-related statements on angling

	Mean rating			Sample	Rank
	Web	Phone	Total	size	
I enjoyed the trip	4.74	4.93	4.89	3,870	1
I appreciated the break from my everyday life	4.74	4.87	4.84	3,890	2
I felt more relaxed after the trip	4.47	4.62	4.59	3,881	3
I enjoyed meeting other anglers	3.97	4.43	4.33	3,869	4
I felt healthier after the trip	4.05	4.25	4.21	3,871	5
I appreciated the solitude	4.42	4.13	4.19	3,880	6
I obtained physical exercise during the trip	4.10	3.90	3.94	3,874	7

The majority of anglers agreed with all of the statements given. It appears that anglers view *all* of these statements as important benefits of going angling[1].

The ranked frequency of these statements has interesting implications for the balance between physical and psychological benefits as sources of welfare from angling. Perhaps unsurprisingly, a large majority strongly agreed with "I enjoyed the trip" (the top answer). Other popular answers involved the "break from everyday life" and "I felt more relaxed", suggesting these are important motivations for anglers. This points to the psychological benefits of angling, as relaxation is connected to mental wellbeing.

The "physical exercise obtained during the trip" benefit came last, being the only statement to average less than four (slightly agree). This result is broadly consistent with respondents' answers to the questions about physical exercise above, which found that angling was generally considered to be a light or moderate activity.

Furthermore, anglers did in general agree that "I felt healthier after the trip". These findings support the notion that physical exercise and health benefits accrue from angling, but appear to be less important than other benefits (results from Question 1 suggest angling is no better or worse than the alternative activity for physical exercise).

Results showed that anglers both "enjoyed the solitude" and "enjoyed meeting other anglers". Although this may appear paradoxical, it is quite possible for both benefits to be important, either because some trips involve the social side of the sport while others do not, or because both elements can be obtained within a single trip.

A Wilcoxon rank-sum test showed that the differences between responses on the internet and by telephone were statistically significant for every statement (asymptotic significance (two-tailed) = 0.000 for all combinations), where internet respondents tended to appreciate the experience of solitude more and gave less importance to the opportunity of meeting other anglers. It may be that the younger, wealthier internet respondents engage in angling to pursue a relaxing activity rather than for social purposes. The difference could also be due to self-selection bias in the internet sample, perhaps biasing this sample towards serious anglers rather than those more interested in social aspects of the sport.

Results could be analysed separately for the two sampling methods. However, given that only a small amount of time was available for this task compared to other tasks prioritised by the client, it was not considered worthwhile pursuing this level of detail.

Data from these questions could potentially be examined further, such as splitting them by age, sex, income or other variables collected by the survey, for example to investigate any possible health benefits that might be attributable to older age groups. However, this analysis was not within the scope of this study.

We did not obtain information on the full range of benefits associated with alternative activities that anglers would have undertaken in the absence of angling. This would be required for a more thorough analysis of these results (but would be difficult to obtain from a survey). Alternative activities would be less likely to offer opportunities for solitude and quiet and the opportunity for contemplation/psychological benefits associated with these conditions; however, this hypothesis has not been tested here.

[1] Sample sizes differ slightly, in accordance with the number of valid answers received.

5 General public survey

5.1 Introduction

This section discusses the general public survey. Section 5.2 presents the methods used, 5.3 gives details of the respondents interviewed, 5.4 outlines the results obtained, and Section 5.5 provides an analysis and discussion.

5.2 Methods

The general public survey incorporated the contingent valuation method questions and the choice experiments, as well as questions about respondents' socio-demographic characteristics and their attitudes to, perceptions of, and uses of rivers and fish stocks. The contingent valuation method and choice experiments are discussed (including methodology) in Sections 6 and 7 respectively. This section covers the general method used for the survey, the sample interviewed and the results of the remaining aspects of the survey.

5.2.1 Results requested

This survey aimed to meet to main objective (i) from the terms of reference, namely to:

> *Provide national and regional estimates of the existence value of salmon and other selected species, in urban and rural rivers, and evaluate marginal changes in their abundance.*

The first task was to identify the most important requirements of likely audiences. The following were deemed essential outputs and methodological features of the study:

- a value for salmon, given a scenario of sudden decline due to disease, reducing stocks to very low levels for at least 25 years (this scenario mimics the anticipated effects of *Gyrodactylus salaris* if it were to arrive);
- WTP for marginal changes in fish stocks in a river (such as the benefit of moving at smaller increments from poor to moderate to good ecological status);
- presentation of results to distinguish between use and non-use values;
- a clear approach to distinguishing between non-use values for ecosystem quality and non-use values for fish stocks;
- how results vary by distance lived from the site (distance decay effects).

A number of other results were deemed useful but not essential. Many of these were built into the final survey design; three notable exceptions were "providing regional estimates" (as the survey design could not cope with assessing both a regional and national scenario; elements were, however, built into the design to assess the value of individual rivers); "all-or-nothing values for other species" (as this would have made the survey design excessively complex) and "comparing WTP for rivers that are heavily visited against those that are not visited" (as visits data were not available).

With client consultation, this assessment therefore amended the original objectives of the study (with a reduced emphasis on regional estimates).

5.2.2 Technical challenges

There are many issues facing stated preference studies attempting to quantify non-use values. These are discussed in detail in Jacobs' study for the Environment Agency, *Report on non-use benefits valuation* (2006),and in Bateman *et al*. (2002). The main technical challenges are listed in Annex 2, along with brief notes on how each issue was dealt with here. This list is not necessarily all-embracing, but picks out the most important issues. We addressed each of these in our survey design; many were removed or minimised, with residual issues clearly highlighted.

5.2.3 The sample

The survey was carried out face-to-face, which is ideal for stated preference surveys (particularly for choice experiments).

The target sample size was 850, sufficient to allow a relatively fine degree of analysis of variation within elicited values based on the interactions between attributes and with socio-demographic variables. It was sufficient to carry out the survey in four separate locations around England and Wales.

Choice experiment sample sizes can be slightly smaller than for CVM surveys, as they obtain data from each individual. The design of the CE is crucially important, where an effective design can substantially increase statistical efficiency.

'Quota sampling' was employed on age, gender and working status[2]; this process ensured that the sample obtained has the same characteristics as the overall population of England and Wales. The survey was thus representative. Section 5.3.4 presents the structure of the sample against other variables such as income.

5.2.4 Rivers selected

Respondents were asked about real rivers rather than hypothetical ones, to keep the task more conceptually manageable for respondents and to limit hypothetical bias.

Twelve rivers were selected in different parts of England and Wales. These were chosen through consultation with the Environment Agency to represent, as far as possible, the full diversity in each of the characteristics shown in Table 5.1. A map of these rivers is available in Annex 1.

Respondents were each assigned to a specific river (Table 5.2) and this was identified to them by the interviewer. Sampling locations were selected for each of the 12 rivers such that each river was represented by one location less than five km away; one location 5-20 km away; and one location 20-50 km away. In addition, for four rivers (the Thames, Itchen, Severn and Taff), three additional locations were selected at further distances from the river (50-150 km; 100-200 km; and above 150 km). The locations sampled for each river are summarised in Table 5.2. At locations which represented more than one river, respondents were assigned between these rivers at random.

Wherever the questionnaire states "[River X]", the interviewer inserted the name of the river being used for that particular respondent.

[2] Whether at least one adult aged over 16 years in the household is working

This approach has two important advantages:

(i) It allows an analysis of how WTP varies between different types of river, for example to test how WTP for fish in urban rivers compares to WTP for fish in rural rivers.

(ii) It captures information about the distance respondents live from the nominated river, which allows for assessment of the distance decay effect.

To keep the assignment of respondents to one of the twelve rivers manageable, the survey was restricted to three Government Office regions of England (North West, West Midlands and South East), plus Wales (these areas were chosen to represent the diversity of England and Wales as far as possible).

Investigation into the characteristics of each of these twelve rivers was limited in scope; we specified to the respondent what the current condition of each river was, but it was not possible to investigate the factors influencing each river. Instead, emphasis was placed on investigating whether certain characteristics of these rivers had a systematic impact on WTP values. The river characteristics to be tested were:

- length of river (length of main stem in km, provided by Environment Agency);
- whether in an urban or rural setting (using a simple scale: 0 = largely rural; 1 = mixed; 2 = largely urban);
- whether it was designated a Special Area of Conservation (SAC).

The characteristics of the 12 selected rivers are presented in Table 5.1.

Table 5.1: River characteristics

River	Main region[1]	Urban? (0-2)	Length of main stem (miles)	SAC status	General environmental quality[2]	Salmon level[2]	Other fish level[2]	Longer distances sampled?
Derwent[3]	NW	0	45	Yes	Good	Good	Good	
Dyfi	W	0	30		Good	Moderate	Good	
Itchen	SE	0	25	Yes	Good	Moderate	Moderate	Yes
Medway	SE	1	50		Moderate	No salmon	Moderate	
Mersey	NW	2	65		Poor	No salmon	Poor	
Ribble	NW	1	70		Moderate	Moderate	Moderate	
Severn	WM	0	180		Good	Good	Moderate	Yes
Taff	W	2	45		Moderate	Poor	Moderate	Yes
Teifi	W	0	70	Yes	Good	Good	Good	
Thames	SE	1	190		Moderate	No salmon	Moderate	Yes
Wye	W	0	160	Yes	Good	Moderate	Good	
Wyre	NW	1	30		Moderate	Poor	Poor	

[1] NW = North West; SE = South East; W = Wales; WM = West Midlands

[2] The rating scale is detailed in Annex 6

[3] The River Derwent in Cumbria.

5.2.5 Sampling locations

Twenty-three different locations were used for the survey. These were chosen to (a) represent the diversity of people in England and Wales; and (b) give a good spread of distances for each river, with some locations close to the river being asked about, and others a long way away. Table 5.2 shows the regional distribution of sampling locations, and the rivers that were asked about at each location.

5.2.6 Initial questions

A series of questions was asked to encourage respondents to think about the issues, before going on to the stated preference surveys. Results from these questions told us about the ways in which respondents used rivers and the split between use and non-use values in the WTP. Other questions asked about respondents' knowledge of the current state of rivers and their perception of river quality.

Interviewers recorded each respondent's postcode, which was used to calculate variables such as how far away from the river the respondent lived and the region lived in. A significant number of respondents provided partial postcodes; distances from the river were calculated for these, and this information was used where the error margin was not too great[1]; in cases where the error margin was too large, these data were discarded. Around 190 responses gave insufficient postcodes (see Table 5.3).

5.2.7 Stated preference instruments

The survey employed both the contingent valuation method (CVM) and a set of choice experiments (CE). Annex 3 summarises the advantages and disadvantages of each approach. As outlined in previous sections, we used CVM questions to assess all-or-nothing WTP amounts for a scenario where a disease hits salmon stocks across England and Wales. The CVM approach is probably the most robust way to generate such all-or-nothing values (see Section 7.4.1), and the results are the focus of the assessment of overall WTP levels.

Further questions (Q15b/c) asked respondents to nominate what proportion of their total WTP they would like to assign to a named river. These questions were used to assess how this total value would be split between individual rivers. This top-down approach to calculating WTP for individual rivers helped to overcome issues with the embedding effect (see glossary).

To overcome any potential issues over how well respondents understood percentage values, descriptions in plain English were used instead of percentages wherever possible. Jacobs (2003) tested the use of percentages with accompanying textual descriptions in a survey instrument and found that respondents were comfortable with this, so any remaining use of percentages was unlikely to be a major issue.

[1] Based on a ratio of the area of the known postcode district (at the most accurate level possible from the partial postcode given), compared to the distance away from the river. The error margin was said to be "not too great" when:

$$ratio = \frac{\sqrt{area}}{\text{distance from river}} < 0.5 .$$

The CE supplemented CVM results with additional information on how WTP varied as the magnitude of the improvement/degradation varied; information on loss aversion from respondents; and how WTP for changes in environmental quality compared to changes in salmon stocks or in other fish populations.

As the CE question asked respondents about their WTP for an individual river directly, it employed a bottom-up approach. Such an approach can encounter problems with the embedding effect. As such, although it provided useful information on the shape of WTP as characteristics varied, its results were not directly comparable with the CVM results (which were likely to be of significantly larger magnitude).

5.2.8 Final questions

At the end of the survey, additional questions were used to obtain socio-demographic information about respondents, to allow analysis of results by these variables and for the quota sampling process:

- gender;
- age;
- number of children living at home;
- number of adults (above16 years) living at home;
- level of educational qualification;
- household income before tax;
- membership of an environmental group or charity;
- home postcode (to enable region/country of residence to be calculated, as well as the distance from the place of residence to the nominated river);
- employment status (whether working or not working).

5.2.9 Quality checks

The dataset from the general public survey was received on 10th August 2006. An additional set of 25 responses was added on 24th August 2006, bringing the total to 911 responses. This compared to the target of 850 responses.

Checks by the Research Agency

The following checks were conducted by the Research Agency:

1) All questionnaires were manually checked for obvious errors − if a batch contained a high number of obvious errors, interviewers/respondents were re-contacted and asked to clarify responses.

2) Ten per cent of all respondents were re-contacted following the interviews (back-checks) to ensure they were interviewed, that they were happy with the format of the interview, that they were satisfied that the interview was conducted fairly and so on.

3) Ten per cent of all questionnaires were re-entered manually and a report was issued comparing original and re-entered responses for this sub-sample, that is, differently coded responses to each other, codes outside the coded responses on questionnaires

and so on. Any errors were then corrected. If a large number of errors were highlighted, an additional 10 per cent of questionnaires were checked, and so on.

4) A 'no reply' report was produced to highlight missing responses. There were no 'no replies' in this dataset except at Q11; some people struggled to give second and third responses (42 couldn't give a second response and 70 couldn't give a third response).

5) An 'error' report was produced highlighting any nonsensical responses.

6) The routing that interviews followed (the order of questions asked) was checked by comparing the numbers of responses received to each question against the number that would be expected.

In all cases, if concerns were highlighted, interviewers and/or respondents were re-contacted to verify/confirm responses or complete demographic questions. It was not necessary to contact interviewers/respondents for this dataset.

Checks by Jacobs UK Ltd

A lengthy survey design stage was undertaken before the survey started, including three focus groups, an in-office pilot and an on-street pilot, to ensure that the interview process worked. This is described in Section 5.2.10.

Two sets of sample data were examined at an early stage. Visual inspection of data, with some tabulation of responses, was used to check that responses looked sensible.

The checks showed that some respondents appeared to be giving surprisingly high WTP amounts – including some people who had answered a WTP of zero in the contingent valuation method, but had chosen cards with very large WTP in the choice experiments. This suggested that some respondents were failing to properly take into account the cost associated with the choices on each choice card.[2]

To respond to this concern, a clarification note was sent out on 20th July to all interviewers (see Box 1). Most (746 of the 911) interviews took place after the note was sent. Possible reasons for the high WTP bids are discussed in Section 7.4.1.

These issues are not unusual in stated preference studies, but it is important to take account of them in the analysis. A number of processes were used to help identify unusual responses; these included follow-up questions asking respondents about their reasons for making their choices. The results were tested with and without these outliers, to determine whether it was more appropriate to include or exclude them.

Responses were also checked to determine how many people had fallen for traps we set in the choice experiment (see Box 2). Results from these traps are discussed in Section 7.3.1 and Annex 14.

Finally, the data analysis was used to identify any surprising results within the dataset.

[2] This process also highlighted possible issues with respondents answering the same for all eight choice cards. However, further investigation showed that this was largely limited to people asked about the Derwent and that "always answering B" is actually a plausible and reasonable response for this river (as B is the only answer that guarantees the Derwent maintains its current good status).

BOX 1: Clarification note to interviewers

In some regions people answered "B" for EVERY case at Q16, raising the possibility that these people were failing to properly think through all the different options.

Also, some said they could not afford to pay anything at Q14, then saying a much higher amount on choice cards at Q16 to maintain river quality.

This suggests that some respondents are failing to properly take into account the cost of the choices on each choice card.

- Please re-emphasize how important it is that all respondents take the time to carefully consider all the choices on every choice card, and to take account of the cost of each choice to them.
- Respondents who give the same answer for every card (for example, answering B to all cards) should be questioned to ensure that these are genuine answers and not an attempt to cut corners.
- Additionally, if any respondents who answered “No” to Q13 then go on to make any choices on the cards (Q16) that involve paying a positive amount of money, please ask them to make sure they are genuinely prepared to pay this money.
- For any regions in which there are many tourists, please try to interview residents as a priority, however if you are struggling, it is OK to interview a minimum number of tourists.

BOX 2: Traps used in the choice experiment

1) Logic trap

On all rivers, Card 6 was set up so that it was always irrational to answer Choice C, because Choice B resulted in a better state of the river for a cheaper price. We assessed how many people fell for this trap, to determine the robustness of the data. The analysis could then be run with and without these people, to determine whether irrational answers were a problem.

2) Consistency trap

For four of the rivers, Card 1 was identical to Card 8. Rational respondents should therefore answer the same on both occasions. However, this might not be the case if:

- Respondents were not thinking carefully enough about their choices.
- A form of “anchoring effect” was taking place, whereby respondents’ choices were influenced by the other cards they had seen beforehand.

3) Order trap

For four of the rivers, Card 1 was the same as Card 4, with only the order of choices reversed. In theory, people should have chosen C for Card 4 if they had chosen A for Card 1, and vice versa. This tested whether the order of choices made any difference to people’s answers.

5.2.10 Survey testing and implementation

Focus groups

Three focus groups were held to help:

- identify which attributes are most important to people;
- explore attitudes to river quality and fish and the way in which people use them;
- find out about existing knowledge, comprehension of the task and so on;
- investigate the distinction between use and non-use values;
- test the wording of explanatory text and the use of maps and graphical information about the states of rivers;
- test the design of choice cards;
- examine the implications of using different payment vehicles.

The first two focus groups were held in Preston on 30 May 2006. The meetings were designed to be free-flowing discussions, to encourage a wide range of opinions and debate. To obtain a good cross-section of the general public, the first group comprised people who visited rivers regularly, whilst the second was people who did not. In order to obtain a range of ages, and to ensure that different age groups were able to express their opinions freely, the groups were split between those 45 years and older (Group 1) and those aged under 45 (Group 2). The summary report for these focus groups is presented in Annex 5 (authored by Rainbow Research).

The survey design was refined following these focus group meetings.

The third focus group meeting was held two weeks later, in Carlisle on 13 June 2006. This group included a full cross-section of the general public. It was used in a more structured way, testing the full survey design.

One key outcome was that respondents had difficulty understanding fully the task asked of them and identifying the different states of the river being described. This suggested a need to simplify further, so the experimental design was again refined.

Pilots

As the experimental design needed further modifications following the third meeting, it was decided to carry out in-office pilots of the simplified design, to ensure the above concerns had been addressed. These in-office pilots were successful, completing the survey within the target timescale and with a good level of comprehension.

In addition, a pilot of 20 interviews was carried out by the market research company (ten in Southampton, ten in Liverpool) before the survey commenced properly. These were completed successfully, so the survey was deemed ready to proceed.

Implementation

Rainbow Research arranged for interviewers to go to each of the 23 interview locations during July and August 2006. Each interview was carried out in person, taking around 20-25 minutes each.

5.3 Results and Analysis

The results given in this section relate to the entire sample of 911 respondents. A number of these were excluded from the analysis of CVM and CE data, for reasons outlined in Sections 6.3.1 and 7.3.1, so the sample size for those analyses was less.

5.3.1 Responses by river and interview location

Table 5.2 shows the number of responses for each river, in each interview location.

To keep the survey manageable, each river was assigned a number of specific interview locations, chosen so that a range of distances was achieved for each river; one of these locations was less than five km from the river, one was 5-20 km away and one 20-50 km away. For four of the rivers (Thames, Itchen, Severn and Taff), an additional three locations were added further from the river, to investigate distance decay at greater distances.

Many locations acted for more than one river; for example, Cardiff was the location for both “less than five km from the Taff” and “50-150 km from the Severn”. All locational quotas were achieved or exceeded (with two minor exceptions that fell just one response short of quota – these numbers were deemed acceptable to us).

Response levels were highest for the four rivers chosen to investigate WTP over long distances (see below).

As the information about regional locations of respondents presented in Table 5.2 shows, the sample was not representative of the overall regional distribution of the population of England and Wales, as it is concentrated in the North West, South East, West Midlands and Wales.

This split was chosen deliberately, to increase the practicality for interviewers and so that a good number of responses were achieved in each of four target regions (which were chosen to cover a variety of different types of region − high income/low income and so on), to increase the likelihood of generating statistically significant results.

5.3.2 Distance by river

In order to investigate the presence of distance decay in the results, it was important that a good spread of distances was achieved, with some respondents asked about rivers very close to where they lived and others asked about rivers a long way away.

For each river, Table 5.3 shows the number of respondents split by the distance between their place of residence and the nearest point on the river they were asked about. The longest distance was 459 km between the place of residence and the river.

Table 5.2: Responses by river

Sampling location		River												
Region	**Town**	Derwent	Dyfi	Itchen	Medway	Mersey	Ribble	Severn	Taff	Teifi	Thames	Wye	Wyre	***Total***
North West (***288***)	Blackburn					14	18						12	***44***
	Carlisle	15						25			30			***70***
	Chorley					12								***12***
	Fleetwood												24	***24***
	Keswick	24												***24***
	Liverpool					24	15							***39***
	Preston			24			23						13	***60***
	Whitehaven	15												***15***
South East (***247***)	London				12			24	24		25			***85***
	Rochester				24						12			***36***
	Salisbury			12					24		24			***60***
	Sevenoaks				12						12			***24***
	Southampton			28										***28***
	Winchester			14										***14***
Wales (***234***)	Aberystwyth		12						24	12				***48***
	Cardiff							24	24					***48***
	Cardigan									24				***24***
	Glynneath								15	15				***30***
	Machynlleth		24											***24***
	Monmouth			24					12			24		***60***
West Mids (***142***)	Leominster							11				13		***24***
	Shrewsbury		14	24				28			25			***91***
	Stratford Upon-Avon							15						***15***
	Worcester											12		***12***
Total		***54***	***50***	***126***	***48***	***50***	***56***	***127***	***123***	***51***	***128***	***49***	***49***	**911**

Table 5.3: Number of responses received at each distance from the river

Distance band	0-2 km	2-5 km	5-10 km	10-20 km	20-40 km	40-70 km	70-100 km	100-150 km	150-200 km	200-300 km	300-400 km	400-500 km	N/A	Total	Mean distance
Wye	20		2	5	8	1							13	49	9.0
Medway	1	2	18	10	11	4							2	48	17.4
Ribble	14	10	2	2	4	7			1	1			15	56	22.5
Wyre	1	2	8	18	8	1		1		1			9	49	24.4
Mersey	1	2	11	13	1					1	1		20	50	28.4
Teifi	6	5	5	5	1	14		1	1	1			12	51	33.1
Dyfi	13	2	2	2	2	12	4	2	1	2			8	50	42.4
Derwent	7		4	9	6	2	4	9	1	4	2	1	5	54	80.5
Severn[1]	16	2	5	2	9	17	1	25	1	14			35	127	81.2
Taff[1]		6	13	1	3	13	19	16	13	10		2	27	123	100.8
Thames[1]	6	13		2	15	22	3	18	1	2	23	2	21	128	120.4
Itchen[1]	15	11	5	3	8	4	2	2	6	25	23		22	126	140.2
Total	***100***	***55***	***75***	***72***	***76***	***97***	***33***	***74***	***25***	***61***	***49***	***5***	***189[2]***	***911***	***77.2***

[1] Rivers with extended distance decay built in.

[2] No distance could be calculated for these 189 respondents, as the postcode provided was either blank, too short or was not recognised in the GIS work. The river Derwent has a higher representation of long distances because the interviews in Keswick captured a significant number of people who were on holiday and who lived further away from the river. The river Wye is biased towards short distances, in part because Worcester, the location designated to be the location "20-50 km away from the Wye", had an unusually high number of people refusing to give a postcode.

5.3.3 The nations

A good sample of interviews was achieved in Wales, with a larger number in England. Twelve respondents lived elsewhere in the UK and were visiting the interview location.

Table 5.4: Interviews by country of residence

Nation of residence	Country river is in			*Total*
	England	**Wales**	**England & Wales[1]**	
England	383	*64*	87	***534***
Wales	*9*	99	34	***142***
Scotland	*9*	*2*		***11***
N. Ireland	*1*			***1***
None given	109	59	55	***223***
Total	***511***	***224***	***176***	***911***

[1] The River Severn and the River Wye cross the border between England and Wales.

Around 220 respondents' countries could not be determined[1].

Sixty-four people living in England were questioned about a river in Wales. Only nine people living in Wales were questioned about a river in England[2].

5.3.4 Demographics (QC-QI, QK)

The following tables reveal the socio-demographic profile of respondents by gender, age, household composition (children/adults), educational qualifications, household income, membership of an environmental group or charity and by working status.

As well as describing the people captured in sample, these variables can be included in the models used in Sections 6 and 7, to determine whether these factors affect WTP.

Table 5.5: Gender (QC)

Gender	Frequency	Percentage
Male	450	49.4
Female	461	50.6
Total	***911***	***100***

Quota sampling was employed on gender to ensure that the sample was well balanced. These quotas were achieved.

[1] The postcode provided was blank (a refusal or overseas visitor), too short or was not recognised by the GIS software. More postcodes were rejected than in the previous section, as more effort was put into using partial/short postcodes for determining the distance from the river (critical for the distance decay work) than for coding by country.

[2] A minimum of 24 interviews of this type were aimed for; however, over half of these respondents refused to give a postcode and some of the remainder actually lived in England, despite being interviewed in Wales.

Table 5.6: Age (QD)

Age	Sample frequency	Sample percentage	National percentage[3]
16-24	136	14.9	15.0
25-34	159	17.5	16.6
35-44	174	19.1	19.4
45-64	275	30.2	31.3
65+	166	18.2	17.7
Refused	1	0.1	N/A
Total	*911*	*100*	*100*

The age profile of survey respondents closely matched the national average, as quota sampling was employed on age. These quotas were achieved.

Table 5.7: Children living at home (QE)

Number of children	Frequency	Percentage
0	596	65.4
1	159	17.5
2	116	12.7
3	26	2.9
More than three	14	1.5
Total	***911***	***100***

Table 5.8: Adults living at home (QF)

Number of adults	Frequency	Percentage
0	7	0.8
1	209	22.9
2	504	55.3
3	126	13.8
More than three	65	7.1
Total	***911***	***100***

A good spread of household sizes was sampled. Around two-thirds of respondents had no children living at home. Over half of the respondents lived in two-adult households. A one-adult household was the next most common arrangement.

Table 5.9: Level of educational qualification (QG)

Educational qualification	Frequency	Percentage
No formal qualifications	219	24.0
O-level/GCSEs or equivalent	266	29.2
A-level or equivalent	153	16.8
Degree or equivalent	153	16.8
Professional or equivalent	114	12.5
Refused	6	0.7
Total	***911***	***100***

[3] Source: Office of National Statistics, 2006.

A good range of different educational levels was sampled. The biggest group was respondents with O-level/GCSEs or equivalent (29 per cent). Twenty-four per cent had no formal qualifications, while “A-level or equivalent” and “degree or equivalent” each characterised the same number of respondents (17 per cent).

Table 5.10: Pre-tax household income (QH)

Pre-tax household income (£ per year)	Sample frequency	Sample percentage (of those who replied)
Less than 5,000	42	6.5
5,000-9,999	90	14.1
10,000-14,999	96	14.9
15,000-24,999	138	21.5
25,000-39,999	154	24.0
40,000-59,999	76	11.8
60,000-99,999	30	4.7
Over 100,000	14	2.1
Refused/ Don't know	271	N/A
Total	***911***	***100***

England and Wales household income[4]	
Annual income (£)	**Percentage**
Less than 5,200	2.6
5,200 - 10,400	15.4
10,400 - 15,600	17.5
15,600 - 26,000	22.6
26,000 - 41,600	21.6
41,600 - 52,000	7.8
Over 52,000	12.4

As is usual with income-related questions, a large percentage (30 per cent) refused to give details of their income.

Our sample does not perfectly match the national pattern, as respondents were more likely to have annual household incomes of less than £5,000, and slightly less likely to have household incomes between £5,000 and £15,000. The two distributions are otherwise similar; these differences are considered minor and not a problem for the survey.

Table 5.11: Member of an environmental group or charity (QI)

Member of an environmental group or charity	Frequency	Percentage
Yes	121	13.3
No	790	86.7
Total	***911***	***100***

The majority of respondents (87 per cent) were not members of an environmental group or a charity.

[4] Source: Family Resources Survey, 2004-5.

Table 5.12: Working status (QK)

Working status	Sample frequency	Sample percentage	National percentage[5]
Working	575	63.1	61.6
Not working	332	36.4	38.4
Refused	4	0.4	N/A
Total	***911***	***100***	***100***

Around 63 per cent of respondents classified themselves as working; a little over one-third were not working. This matches the national situation quite closely; again, quota sampling was employed here.

5.4 Results: Attitudes, perceptions and uses

5.4.1 Levels of use

Walking was by far the most popular riverside activity, and a high proportion of walkers did so more than once a month. Jogging and horse riding were also popular. Watersports were less popular and less likely to be done more than once a month.

Table 5.13: How frequently have members of your household taken part in the following activities in the last 12 months? (Q2)

Riverside activity	More than once per month (%)	Less than once per month (%)	Never (%)
Walking by rivers	48.7	29.9	21.4
Jogging, cycling or horse riding by rivers	15.1	11	73.9
Birdwatching trips to rivers	8.8	8.7	82.5
Working alongside rivers	6.6	4.0	89.5
Freshwater angling	5.7	6.7	87.6
Canoeing/swimming in rivers	4.9	8.9	86.2
Boating/yachting on rivers	4.2	9.9	85.9

Twelve per cent of respondents said that a member of their household had been freshwater angling in the last 12 months. In contrast, the *Public attitudes to angling* 2005 survey (Simpson and Mawle, 2005) found that six per cent of the population had been freshwater fishing in the last year. However, the figures are not comparable; the current study asked whether any member of the interviewee's household had been freshwater angling in the last 12 months, rather than just the respondent themselves.

Just over 10 per cent of respondents worked near to rivers, with six per cent doing so more than once a month.

[5] Source: Office of National Statistics, 2006

5.4.2 Knowledge of rivers

Question 3 asked respondents if they had heard of the nominated river; Table 5.16 presents the results.

Overall, 84 per cent of people had heard about the river they were asked about. By percentage, the most well-known rivers were the Wye, Thames, Mersey, Medway and Severn; all of these were recognised by at least 95 per cent of those surveyed. The least well-known was the Itchen, which only 56 per cent of respondents recognised.

One factor influencing these results was that people who lived close to rivers were far more likely to have heard of the river than those living a long way away. This survey did not present a level playing field between the rivers in this regard; the average distance between respondents' place of residence and the river varied from one river to another.

For example, people questioned about the Wye lived an average of nine miles from the river, while those asked about the Itchen lived an average 140 miles away. This is likely to have influenced the figures in Table 5.14, making it more likely that people would have heard of the Wye than the Itchen for this reason alone.

Other factors influencing the results included the size of the river and its location; for example, rivers running through major urban centres (such as the Thames and the Mersey) were likely to be better known.

The final two columns in Table 5.14 show a ranking of how well-known the river was and a ranking of the average distance respondents lived from the river (from Table 5.3), for comparison. As expected, in general rivers with high distances tended to have lower recognition. Five rivers noticeably bucked this trend; the Thames, Severn and Mersey were well-known despite the distance of respondents from the river, and the Wyre and Ribble were poorly known despite respondents being relatively local. The Itchen was the least recognised river by a considerable margin.

There was a concern that respondents might confuse the Wyre with the Wye; however, as the Wyre had a relatively low recognition rate, this suggests that the level of confusion was also low.

Table 5.14: Have you ever heard of River X? (Q3)

River name	Heard of the river		% heard of river: rank	Average distance from river: rank
	Yes	No		
Wye	49 100%	- -	1	1
Thames	127 99.2%	1 0.8%	2	11
Mersey	49 98.0%	1 2.0%	3	5
Medway	46 95.8%	2 4.2%	4	2
Severn	121 95.3%	6 4.7%	5	9
Teifi	45 88.2%	6 11.8%	6	6
Dyfi	43 86.0%	7 14.0%	7	7
Wyre	41 83.7%	8 16.3%	8	4
Derwent	45 83.3%	9 16.7%	9	8
Ribble	43 76.8%	13 23.2%	10	3
Taff	87 70.7%	36 29.3%	11	10
Itchen	70 55.6%	56 44.4%	12	12
Total	***766*** **84.1%**	***911*** **15.9%**		

Note: Levels of knowledge will be influenced by the average distance lived from each river

5.4.3 Visits to rivers

Table 5.15 shows the numbers of people who had visited each river. This question was only asked of people who had heard of the river.

Of those who had heard of a river, roughly equal numbers had visited and not visited. The most visited rivers were the Wye (73 per cent visited) and the Medway (70 per cent); the least visited were the Taff and Ribble (less than 35 per cent for these rivers).

As with Table 5.14, these results will be affected by the “distance effect” – for some rivers. we sampled mostly people who lived close to the river, for others we tended to sample people from further away. The two highest-ranked rivers in Table 5.15 were the Wye and the Medway, and these are also the rivers where respondents lived nearest to the watercourse (an average nine miles from the Wye and 17 miles from the Medway). Conversely, the sample lived an average 101 miles away from the Taff.

The Thames, Ribble and Wyre were again anomalies; the Thames was visited more than the distance would suggest, and the Ribble and Wyre less visited. The Itchen was also more visited than would be expected.

Table 5.15: Has anyone in your household visited River X in the last 12 months? (Q5)

River	Of those who had heard of the river		% visited: rank	Average distance of respondent from river: rank
	Visited	Not visited		
Wye	36 73.5%	13 26.5%	1	1
Medway	32 69.6%	14 30.4%	2	2
Teifi	26 57.8%	19 42.2%	3	6
Thames	73 57.5%	54 42.5%	4	11
Mersey	25 51.0%	24 49.0%	5	5
Dyfi	21 48.8%	22 51.2%	6	7
Itchen	34 48.6%	36 51.4%	7	12
Derwent	21 46.7%	24 53.3%	8	8
Severn	54 44.6%	67 55.4%	9	9
Wyre	17 41.5%	24 58.5%	10	4
Ribble	15 34.9%	28 65.1%	11	3
Taff	28 32.2%	59 67.8%	12	10
Total	***382*** ***49.9%***	***384*** ***50.1%***		

Note: Levels of visits will be influenced by the average distance lived from each river

5.4.4 Perceptions of river quality

Question 4 asked respondents to state what condition they thought the nominated river was currently in, on the same scale used later in the questionnaire (good; moderate; poor; or dead). Overall, there was a good correspondence between respondents' perceptions and the ratings assigned to the rivers in this study (based on data provided by the Environment Agency; see Annex 6), with the cleanest rivers receiving the best responses.

Outliers include the Derwent and the Teifi, which ranked only fourth and sixth by perceptions, despite having the best ratings; and the Mersey, which ranked ninth (and above the Ribble) by perceptions, despite being the lowest ranked river based on Environment Agency data.

The most striking result is that there was a consistent tendency for respondents to perceive rivers as being in a worse state than their ratings would suggest. For example, although six of these rivers were rated as of good environmental quality, the Wye was the only river which more than half of respondents believed to be of good quality.

Fifty-five per cent of respondents said that their river was of moderate quality, and this was the most common response for every river except the Wye.

Table 5.16: What is the current quality of River X, in your opinion? (Q4)

River name	Respondents' perceptions of river[1]				Perceived quality: rank[2]	River ratings used in survey[3]		
	Good	Moderate	Poor	Dead		Env quality	Salmon	Other fish
Wye	23 53.5%	15 34.9%	5 11.6%	0 0.0%	1	Good	Moderate	Good
Dyfi	12 36.4%	19 57.6%	2 6.1%	0 0.0%	2	Good	Moderate	Good
Severn	28 30.4%	47 51.1%	16 17.4%	1 1.1%	3	Good	Good	Moderate
Derwent	7 25.0%	16 57.1%	5 17.9%	0 0.0%	4	Good	Good	Good
Itchen	11 22.4%	27 55.1%	11 22.4%	0 0.0%	5	Good	Moderate	Moderate
Teifi	7 24.1%	14 48.3%	8 27.6%	0 0.0%	6	Good	Good	Good
Wyre	5 22.7%	11 50.0%	6 27.3%	0 0.0%	7	Moderate	Poor	Poor
Taff	6 10.7%	41 73.2%	9 16.1%	0 0.0%	8	Moderate	Poor	Moderate
Mersey	6 15.4%	24 61.5%	7 17.9%	2 5.1%	9	Poor	No salmon	Poor
Ribble	3 8.8%	20 58.8%	11 32.4%	0 0.0%	10	Moderate	Moderate	Moderate
Medway	1 2.6%	26 66.7%	12 30.8%	0 0.0%	11	Moderate	No salmon	Moderate
Thames	11 11.5%	47 49.0%	36 37.5%	2 2.1%	12	Moderate	No salmon	Moderate
Total	***120*** ***21.4%***	***307*** ***54.8%***	***128*** ***22.9%***	***5*** ***0.9%***				

[1] Percentages given are proportions of those respondents who gave an answer; some respondents did not answer this question.
[2] The ranking is based on a rating calculated as: (3 * % saying good + 2 * % saying moderate + 1 * % saying poor).
[3] Ratings derived from Environment Agency quality data (see Annex 6).

Possible explanations for the discrepancy between perceptions and ratings include:

- The two scales may simply be calibrated differently; for example, respondents may have a more demanding interpretation of what is meant by "good" river quality than that of the ratings assigned (which are based on scientific data).
- Respondents appeared to find it difficult to judge the level of river quality, and there was a tendency towards answering "moderate" rather than the more extreme responses. However, this explanation cannot fully explain why perceptions were consistently lower than the ratings assigned.
- Respondents may have been underestimating the quality of rivers in England and Wales; many rivers (particularly in industrial areas) have improved substantially over the past decade, and respondents may be reflecting an out-of-date opinion of river quality. This explanation is backed by discussions in the focus group, which followed a similar course. This is considered the most likely explanation.

5.4.5 Opinions about rivers

Question 7 gave three statements on the nominated river, but only to those who had visited the river. For those who did answer, anglers were seen more commonly than fish, although over half of respondents claimed to have seen fish in the nominated river. Almost a third were unsure how many fish their river contained. More than two-thirds of those who *were* able to answer believed the nominated river was well-stocked.

Table 5.17: Opinions on statements related to fish (Q7)

	There are a lot of fish in the river	I have seen fish in the river	I have seen anglers fishing in the river
True	176 46%	209 55%	273 71%
False	86 23%	122 32%	71 19%
Don't know	120 31%	51 13%	38 10%
Total	***382*** ***100***	***382*** ***100***	***382*** ***100***

5.4.6 Benefiting from changes in fish population

Questions 8 and 9 asked whether the respondent felt that they or their household would personally benefit from an increase in the number of fish stocks in England and Wales in general; and in the nominated river specifically.

Table 5.18: Do you think members of your household would personally benefit in any way if actions were taken to increase the number of fish in rivers across England and Wales? (Q8)

	Frequency	Percentage
Yes	392	51.2
No	374	48.8
Total	766	100

Table 5.19: Do you think members of your household would personally benefit in any way if actions were taken to increase the number of fish in River X specifically? (Q9)

	Frequency	Percentage
Yes	312	79.6
No	80	20.4
Total	392	100

Roughly half of respondents thought they would benefit from having more fish across the country. Of those people who *did* believe they would benefit, around 80 per cent felt that they would also benefit from having more fish in the nominated river. This result may be influenced by the fact that the sample was biased towards people living relatively close to the nominated river (although it also included people who lived a long distance away).

6 Contingent valuation method: impact of severe salmon decline

6.1 Introduction

This section covers the contingent valuation method used in the GENERAL PUBLIC SURVEY. Section 6.2 discusses the method used, 6.3 presents the results together with a brief commentary, and Section 6.4 covers the interpretation of these results.

6.2 Method

The CVM section was designed to keep the questionnaire manageable for respondents. The question asked is shown in Box 3 and in Annex 1, along with the explanatory text that was provided.

6.2.1 The scenario being valued

The scenario presented to respondents referred to a 95 per cent loss rather than a total loss of salmon, as this was believed to be a more realistic scenario for a potential disease outbreak. The scenario stated that salmon would be lost for 25 years, again as this was believed to be realistic, and also as a timeframe that respondents could relate to. The payment period was spelled out unambiguously; respondents were asked to pay annually for 25 years, to be consistent with the period of the disease outbreak.

This scenario was chosen for two reasons:

- it is quite a close representation of the potential impact of *Gyrodactylus salaris*;
- to concentrate respondents' minds on a scenario which only affected salmon and not other aspects of river/environmental quality.

6.2.2 Payment vehicle

The 'payment vehicle' is the means by which the respondent would make his or her payment for the river improvements. Possibilities include an increase in water bills; an increase in council tax; an increase in general tax; or a single donation to a trust fund.

In general, it is usually best to select the payment vehicle which would actually be used in practice. In this case, this was problematic as different payment vehicles might be required for different policy measures; for example, improvements under the water industry's Periodic Review 2009 (PR09) might result in increased water bills, whereas measures to avoid fish diseases might be paid for through taxation.

Crucially, the payment vehicle needs to be 'incentive-compatible'; it needs to encourage respondents to act truthfully with respect to their actual WTP, rather than acting strategically to further their own interests. For example, if respondents are asked

about paying one-off donations, but perceive that they will never have to pay that amount in reality, they are likely to answer a higher amount than is realistic.

Q12 of the questionnaire asked respondents whether anyone in their household pays income tax. For both the CVM and CE questions, respondents who answered "yes" to Q12 were asked about their willingness to pay *an extra amount of income tax*. Respondents who answered no to Q12 were instead asked about their willingness to pay *an extra amount on their water bill*. Results were tested to determine whether the payment vehicle used affected the findings.

Box 3: Contingent valuation method questions

Firstly, the map (see Annex 1) was shown to the respondent. The following text was then read out:

"This map shows the major rivers in England and Wales that have salmon in them – there are 78 salmon rivers in total. Salmon are one of the largest of the many different types of fish found in our rivers. Unfortunately, there is a strong possibility that a viral disease might infect ALL of these rivers, causing a severe decline in all salmon populations across the country, with 95 per cent of salmon being lost for at least 25 years. Implementing strict management measures would prevent this from happening. These measures would have to be funded by the public through income tax/water bills* (delete according to Q12). If we don't all contribute financially, then salmon populations will definitely decline".

Q13. To ensure these actions go ahead, would your household be prepared to pay any additional amount in income tax/on your water bill* (delete according to Q12)?

"Past surveys have shown that it is common for people to state higher amounts in this type of survey than they would be prepared to pay in reality. It is important that you state an amount you would really be prepared to pay, bearing in mind your financial constraints and all the other things you would like to spend your money on."

The payment card (see Annex 1) was then shown.

Q14. Which of the amounts on the card would be the MAXIMUM amount that your household would be willing to pay EVERY YEAR in income tax/ on your water bill* (*delete according to Q12*) for the next 25 years, over and above what you currently pay, to ensure that the measures go ahead to protect all salmon?

"We would now like to find out more about your attitudes towards the [River X]".

Text relating to the nominated river was then read out (see Annex 1).

Q15b. If the money were split equally between the 78 salmon rivers in England and Wales, each river would receive 1.3 per cent of the total. What proportion of your own payment would you want to be spent on measures to protect the salmon in [River X] specifically?

6.2.3 Follow-up questions

A number of additional questions were included to help clarify the context of the WTP results received:

Q15a. Why are you not prepared to pay an additional income tax/water bill[6] payment? (to those who answered No to Q12 only)
This question helps to identify 'protest votes' (see Annex 2).

Q18. How well did you understand everything in this survey using a scale of one to five, where one means "you did not understand what was being asked of you" and five means "you understood everything fully"?
This question helps determine the reliability of the WTP responses.

Q19. At the start of this survey we discussed a disease that could cause severe declines in ALL salmon stocks across the country. You said that you would pay up to £[X] (insert highest amount stated in Q14) extra in income tax/on your water bill* each year for 25 years to ensure that this does not occur. On reflection, how likely would you be to pay this?
This question, asked towards the end of the survey, checks to see whether the WTP bids given were genuine or not.

Q20. Can you tell me why you would you be willing to make this payment?
Investigates the motivations behind WTP.

Q21. Did you consider the possible suffering of diseased fish when deciding on how much you would pay?
Investigates whether fish welfare affects WTP.

6.2.4 Analysis

Basic frequency analyses and significance testing was undertaken using SPSS 14.0 (© SPSS Inc, 2005).

Analysis of the CVM data was carried out for two reasons. Firstly, the analysis helped to understand the variables that influenced the amount people were willing to pay for fish stocks (including characteristics of individuals, such as income; characteristics of the river, such as length; and location of the river/interview). Secondly, the outputs could be converted into a tool to help value specific rivers, or possibly other scenarios through a benefits transfer approach (note that the usual caveats on the use of benefits transfer would apply here, such as ensuring the context of the two studies was similar).

This was achieved through a two-stage process. Firstly, the factors influencing whether an individual had a positive WTP or a zero WTP were assessed, using a binomial logit model, estimated in LIMDEP 8.0 (© Econometric Software Inc.). Various socio-demographic and location variables were added, to establish which factors had significant influences on the WTP response. Modelling began with the construction of a general model that included *all* potentially relevant variables. The most insignificant variables were removed and the model was re-run; this process was repeated until only significant variables remained. The resulting parsimonious model could help explain whether individuals were willing to pay anything or not.

Secondly, a linear regression model (ordinary least squares (OLS)), estimated in LIMDEP 8.0, was used to investigate which variables had a significant impact on the

[6] Selected according to whether anyone in the household pays income tax or not.

magnitude of WTP; this was again achieved by adding socio-demographic and location variables to the model.

Various functional forms of this model were tested. In particular, a Box-Cox test was employed to test logarithmic and standard forms of the model. The logarithmic form of the model was selected, as this provided the best fit to the data. The dependent variable was therefore log(WTP+1).

With this functional form, each coefficient was interpreted as "the estimated percentage change in (WTP+1) for a unit change in the regressor, with other quantities constant".

As before, modelling started with the construction of a general model that included *all* potentially relevant variables; insignificant variables were removed in turn until only significant variables remained. This resulted in a model that explained the magnitude of the WTP amounts provided. This analysis was restricted to only those respondents who gave a positive WTP amount (zero bids were excluded).

The results of both stages were then combined to give adjustment factors for each significant variable. These factors summarised the variables that significantly influenced WTP, allowing for both (i) the probability of giving a positive WTP amount and (ii) the size of this amount. The adjustment factors describe the kinds of people who value salmon stocks and add a spatial dimension to the results.

Both models contain continuous variables (such as income, age); categorical variables (such as frequency of walking by rivers); and discrete variables (payment vehicle used; location and so on). Discrete variables were modelled by including 'dummy variables' in the model. It is quite usual to employ regression models to test the significant of discrete variables.

Other technical issues and assumptions are outlined below.

Heterogeneity of variance (heteroscedasticity)

Use of OLS assumes that the error terms (residuals) have constant variance across all observations (that is, that there is no heteroscedasticity). A Breusch-Pagan test showed that the final model used for stage 2, with ln(WTP+1) as the dependent variable, did not exhibit heteroscedasticity (statistic = 8.31, p = 0.8226).

Multicollinearity between predictor variables

If regressor variables are highly correlated, this can result in high standard errors (which reduces the level of confidence in estimated coefficients), as it becomes difficult to disentangle the effects of each variable.

However, this is not always a problem. As Maddala (2001) explains, *"high intercorrelations among the explanatory variables need not necessarily cause a problem and some solutions often suggested … can often lead us on a wrong track. The suggested cures are sometimes worse than the disease"*.

Correlations between the variables in the final stage 2 model are shown in Annex 8. These results show which variables are highly correlated, providing a rough indication of which variables could be subject to multicollinearity, if any.

As expected, there were some correlations within the location and regional variables. Few other pairs of variables in this dataset were closely correlated. Perhaps unsurprisingly, INCOME was slightly correlated with several variables: with BOATFREQ ~ 0.15; with EDUC ~ 0.15; with ENVCON ~ 0.11; with KESWICK ~ -0.10. These levels of correlation were unlikely to cause problems in the model.

This study benefited from a relatively large sample size. As a result, coefficients were calculated with sufficient accuracy to allow a good level of confidence in choosing variables to include in the final model (all individual coefficients in our final model had small enough t-ratios that we could be confident (at the five per cent significance level) of including them. Multicollinearity between variables did not cause a problem here.

Nevertheless, care was taken over interpretation of the coefficients for variables that were likely to be correlated; for example, it was important to note the "ceteris paribus"[7] condition when interpreting these coefficients.

Where variables were clearly linked (such as "region of residence" and "location interviewed in"), models were tried with both variables included, and also with each variable on its own. This helped investigate the impact each variable had on the other's coefficient and the ways in which they inter-related.

Normality of distribution of error terms

Using OLS also assumes that error terms of the regression are normally distributed. Annex 9 shows a plot of residuals from the stage 2 model against the dependent variable (ln(WTP)). Residuals appear to be normally distributed on this chart.

6.2.5 Calculating WTP for individual rivers

In the CVM, we generated a value for an individual river by first asking for WTP to avoid a loss of salmon across the whole country, and then asking what portion of this should be attributed to a specific river (Questions 15b/c). This information could be used to split the total WTP between the 75 salmon rivers in England and Wales, to find "each river's portion of the overall WTP".

The crudest way to find the contribution to WTP made by an average individual river was to simply divide the total WTP for all salmon rivers by the number of rivers (75).

This top-down approach has the advantage of minimising the impact of the embedding effect (see glossary). The alternative, bottom-up approach (first asking for the value for a specific river, then summing to find an aggregated value) would almost certainly have resulted in much higher WTP values (if people did not take account of the full range of alternative demands on their expenditure). It is unlikely that these higher values would have been realistic or defensible.

However, a number of issues are associated with this calculation. Firstly, substitution effects mean that the value may not be appropriate if we want to find the "WTP to avoid loss of salmon in one river only". Secondly, the value will vary from one river to the next, according to the river's characteristics and its location (in particular, the number of people living close to it – note that people were not told of the quality of existing salmon stocks in the river they were asked to value, which could otherwise affect WTP). Results from this survey could be used to adjust for these variations, to obtain a value for certain rivers; however, these results should be treated with caution, as they are dependent on responses given to Questions 15b/c, and on a number of assumptions.

Substitution effects and the impact of scale

The calculation above could overstate the "WTP to avoid loss in one river only".

For the use value component of WTP, if salmon were lost from the named river but remained in a neighbouring one, some anglers currently using the named river would

[7] "Holding all other things equal".

simply relocate to the neighbouring one, so little value would be lost. This substitution effect would be reduced if opportunities for salmon fishing in the neighbouring river were already fully exploited, or if the rivers were not perfect substitutes[8].

It may be the case that most opportunities to fish for salmon are fully taken already (personal communication, Environment Agency), implying that this type of substitution effect may be minimal, and the value calculated may not be a significant overestimate.

For the non-use value component, values will be influenced by the *scale* of scenario presented to respondents. The value attributed to "losing salmon in one river" could be quite different (probably smaller) than 1/75th of the value attributed to "losing salmon in all 75 rivers", as these scenarios have quite different implications for the species.

Adjusting for framing bias

When prompted, respondents assigned an average of 21 per cent of their total WTP to the river named to them in Q15b. However, this was an overestimate of the contribution actually made by a typical individual river, for two reasons:

- Named rivers were selected with a bias towards those rivers closest to where respondents lived[9], so this proportion was greater than the portion that would be given to "any randomly chosen named river", due to the distance decay effect.
- Respondents also appeared to be biased towards the specific river being asled about over and above other similar rivers not specified to them. This is a familiar phenomenon in stated preference studies; it is a type of framing bias[10].

If these proportions were taken at face value, and total WTP calculated for each river on this basis, the sum of WTP for all 75 salmon rivers would then be higher than the overall WTP for all rivers in England and Wales. This could be adjusted for by applying a pro-rata factor to the WTP calculated for individual rivers, to ensure that the sum of all 75 individual rivers equalled the overall WTP for all rivers in England and Wales.

The steps required to find the pro-rata factor are:

a) Estimate how many salmon rivers each respondent has within each distance band of their residence. This will vary from region to region.

Twelve residences were selected at random from the sample (choosing three in each of the four regions used), and the number of salmon rivers in each distance band from each of these residences was estimated, by visual inspection of a map of all salmon rivers in England and Wales. The results were then averaged.

b) Multiply the WTP that respondents would assign to named rivers in different distances bands from their residence (from answers to Q15b/c) by the actual number of rivers located in each distance band from a typical respondent (from (a)).

This gives the "implied total WTP" that would result if they were actually allowed to assign this high a value to all 75 individual rivers.

[8] The rivers would not be perfect substitutes if anglers had a preference for fishing in the named river over the neighbouring river for any reason (for example, if it was closer to home, or had a different type of fishing in it).

[9] Although this was not always the closest river, the rivers chosen tended to be closer to the place of residence than would have occurred by chance.

[10] A phenomenon where people tend to overstate the importance of the issue/resource that they are being asked about at that specific moment.

Here, this turned out to be 13.2 times higher than the WTP stated for all rivers in England and Wales, largely due to the framing bias. The pro-rata factor was thus 13.2.

The raw responses given for the amount to be assigned to individual rivers must therefore be divided by 13.2, to correct for framing bias.

Allowing for variability between rivers

Our estimate of an individual river's contribution to WTP could be improved by allowing for some rivers to be more valuable than others, because of i) the number of people living within specified distances of the river; and ii) river characteristics that have a significant influence on WTP in the CVM regression (such as size, protected status, current salmon stocks). Ideally, we should also have allowed for variations in the characteristics of the population near the river. However, this was deemed likely to have only a minor impact on the results, so was not carried out.

Section 6.3.7 estimates the value of three named rivers: Thames, Wye and Wyre. These were chosen to represent a variety of rivers by size, region and current quality.

The steps taken were as follows:

1. Find the mean WTP for an individual river, after applying the pro-rata factor to adjust for framing bias (see above).

2. Assess how WTP varies by river characteristics (Section 6.2.6). Express these results as adjustment factors to be applied to individual rivers' characteristics and find the factors for the Thames, Wye and Wyre.

3. Assess how WTP varies by distance lived from the river (Section 6.2.6).

4. Assess the number of households located in specified distance bands from the three rivers. Distance bands (0-10 km; 10-20 km; 20-40 km; 40-70 km; above 70 km) were created in ArcMap 8.1 (© ESRI Inc., 1999-2001), and are shown in Figure 6.1.

These distance bands were then cross-referenced against county boundaries, to assess which counties the households were in. The results were multiplied by population density data at county level (Office of National Statistics, 2004) and converted into number of households by dividing by the average household size of 2.38 people/household in England and Wales[11] (Office of National Statistics *et al*, 2003). This technique separates out (and hence accounts for) most large cities, as these are generally specified as separate counties in the data set.

5. Generate population density adjustment factors for each river: multiply the number of households (from Step 4) by WTP estimates by distance band (from Step 3). Compare the results to equivalent results from a river with average population density in each distance band.

6. Obtain adjusted WTP values for the Thames, Wye and Wyre: multiply the mean WTP (from Step 1) by the river characteristic factors (from Step 2) and population density factors (from Step 5).

[11] Checks were carried out to investigate possible regional variation in the average household size, but very little variation was found, so a national figure was used.

6.2.6 Assessing distance decay

The results derived above were used to investigate distance decay using another linear regression model, this time regressing the logarithm of the WTP for an individual river on the distance between the place of residence and the nearest point of the river in question. As before, sociodemographic and location variables were added to the model, to ensure that these were not confounding the impact of distance on WTP.

In addition, the river characteristics discussed in Section 5.2.4 were added to the model, to test whether WTP varied according to the type or size of river asked about.

A model was created to test for significant differences between individual rivers, but no such differences were found; the best fit was found with river characteristics (primarily river length) as explanatory variables, but without dummy variables for specific rivers.

The pro-rata factor calculated above was applied to these results to ensure they were consistent with the total WTP given for England and Wales. This did not affect the shape of the distance decay curve.

6.2.7 Calculating WTP by region

Estimating the value of a region again runs into the issue of substitutes and the difficulty of scaling values from one spatial scale to another. One possibility would be to split the total WTP between the ten regions, based on the numbers and lengths of the salmon rivers in each region. This estimate could be refined to allow for the size of the population in the vicinity of the river. However, this would be an onerous task. Ideally, one should adjust for the different characteristics of the rivers in each region (and perhaps the characteristics of the population); however, suitable data may not be readily available. It was not possible to do this as part of this study.

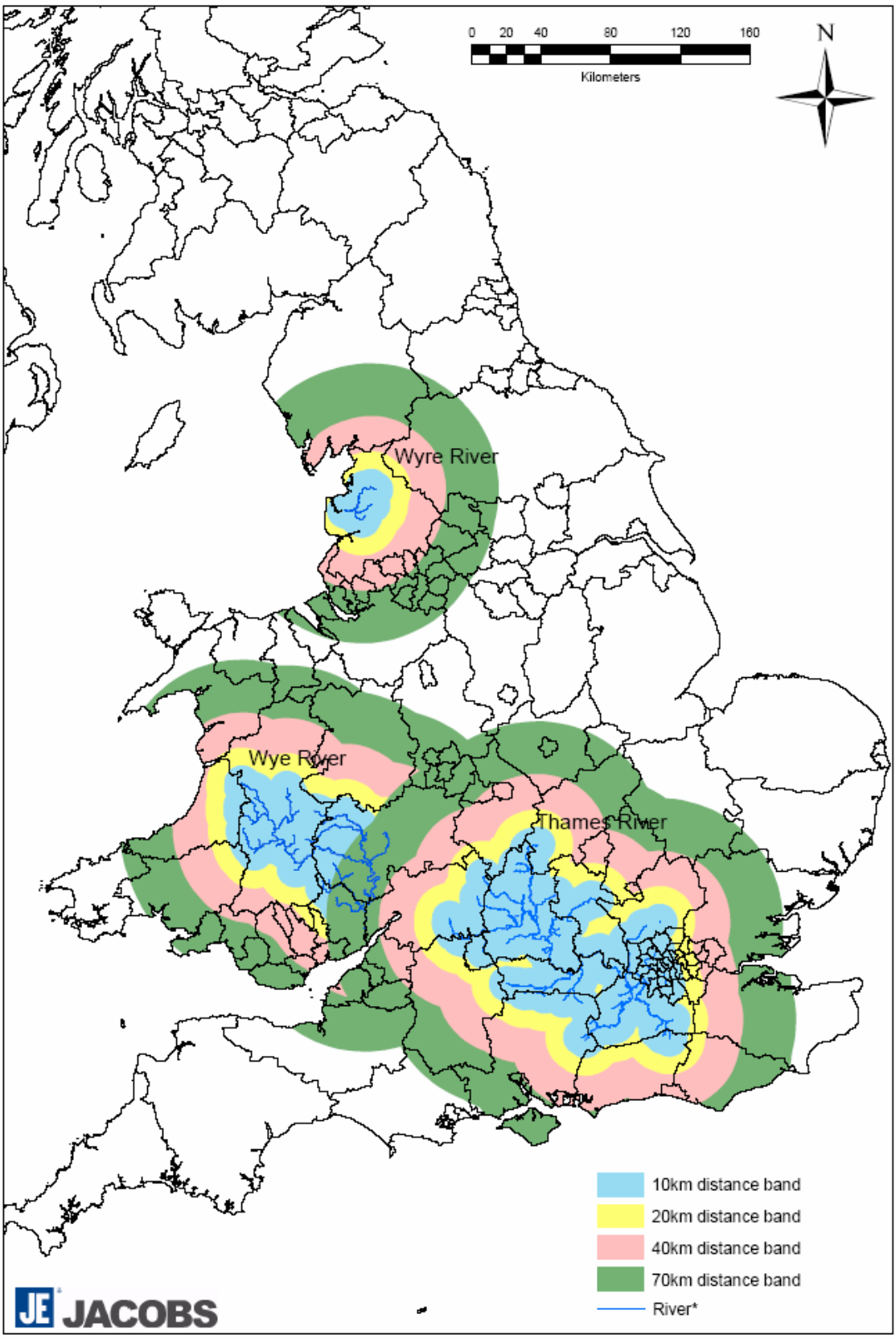


Figure 6.1: Map of the distance bands for the three named rivers

6.3 Results

6.3.1 The contingent valuation method question

The CVM began by determining which payment vehicle to use for each respondent. Respondents were asked whether they would be willing to pay an extra amount in either income tax or on their water bill, according to the answer given to Q12, in order to prevent a serious decline in salmon stocks across England and Wales. As shown in the table below, a large majority of respondents paid income tax.

Table 6.1: Do you or any other members of your household pay income tax at present? (Q12)

Pay income tax?	Frequency	Percentage
Yes	725	79.6
No	173	19.0
No answer	13	1.4
Total	***911***	***100***

Respondents who answered no to Q12 were subsequently asked about their willingness to pay an extra amount on their water bill instead of in income tax.

All respondents were shown a map (Annex 1) and told:

> "*This map shows the major rivers in England and Wales that have salmon in them – there are 78 salmon rivers in total. Salmon are one of the largest of the many different types of fish found in our rivers. Unfortunately, there is a strong possibility that a viral disease might infect ALL of these rivers, causing a severe decline in all salmon populations across the country, with 95 per cent of salmon being lost for at least 25 years. Implementing strict management measures would prevent this from happening. These measures would have to be funded by the public through income tax/water bills. If we don't all contribute financially, then salmon populations will definitely decline*."

They were then asked:

Q13. *To ensure these actions go ahead, would your household be prepared to pay any additional amount in income tax/on your water bill*?

As shown in Table 6.2, just over half of respondents said that they would not be prepared to pay any additional amount**.** These are referred to as "zero bids".

Table 6.2: Additional payment – zero bids (Q13)

Additional payment	Frequency	Percentage
Yes	444	48.7
No	467	51.3
Total	***911***	***100***

There were a variety of reasons for this answer, which were investigated in Q15/15a:

Table 6.3: Why are you not prepared to pay an additional income tax/water bill payment? (Q15/15a)

Reason	Frequency	Protest bid?
Rather pay by a different method	10	Protest
The Government/other should pay	192	Protest
Concern over how the money would be spent	31	Protest
Not convinced the measures would make any difference	16	Protest
Complaint about paying higher taxes	101	Protest
Complaint about paying higher water bills	58	Protest
Depends on how much it is	16	Protest
It's not that important an issue/don't care about it	20	Non-protest
Cannot afford to pay anything	100	Non-protest
There are more important things to spend money on	46	Non-protest
Don't know	12	Non-protest
Other answers (specified by respondent):		
Many salmon farms	3	Non-protest
Already pay salmon income	4	Non-protest
Killed before get here	1	Non-protest
Mismanaged by Government	2	Protest
We have not damaged them	1	Protest
Rivers are too clean-no food for fish	1	Non-protest
Pay enough tax already	11	Non-protest
Don't pay water rates (self-sufficient)	1	Protest
Water company should do it	8	Protest
No personal benefit	1	Non-protest
Don't like fish	4	Non-protest
Do not live in location	2	Non-protest
Waste a lot of money	5	Non-protest
Spend it all on the river-not fish	2	Protest
People who personally benefit should pay	3	Non-protest
Polluters should pay	10	Protest
Don't know enough about it	1	Non-protest
Should not be based on income tax/water rates	3	Protest
Councils should pay	2	Protest
Fishing community should pay	2	Protest
River authority should pay	1	Protest
Total	***670***	

The responses in this table sum to 670, as multiple responses were allowed.

The last column shows that some of these zero bids can be regarded as ‘protest bids’. Protest bids are respondents who refuse to offer a WTP value, but are in reality likely to have a WTP value for the fish.

For example, a respondent who refuses to offer a value because they would “rather pay by a different method” is likely to have a positive WTP for salmon, and has only

answered “No” to Q13 because of the way this payment was phrased. This should not be treated as a genuine zero bid.

The following table categorises respondents who answered “No” to Q13 into protests and non-protests:

Table 6.4: Protest versus non-protest bids

Protest bid?	Frequency	Percentage
Non-protest bid	124	26.6
Protest bid	274	58.7
Both protest and non-protest	69	14.8
Total	***467***	***100***

Out of the 467 zero bids, 274 were classified as protest bids. These responses were removed from the sample, following the most authoritative UK guidance on this subject (Bateman *et al.*, 2002). Around 120 people gave non-protest bids, so their answers were treated as genuine zero bids and included in the sample.

Around 70 respondents gave both a ‘protest bid’ answer and a ‘non-protest bid’ answer to Q15a. It was not clear whether these represented genuine zero bids or not. To be conservative, it was assumed that these were genuine zero bids, and they were included in the sample. This will have reduced the average WTP result.

A follow-up question was employed towards the end of the survey, to test the robustness of respondents’ WTP amounts. Respondents were asked to re-examine the amount they were WTP for this scenario:

Q19: *At the start of this survey we discussed a disease that could cause severe declines in* ALL *salmon stocks across the country. You said that you would pay up to £[x] extra in income tax/on your water bill each year for 25 years to ensure that this does not occur. On reflection, how likely would you be to pay this?*

Table 6.5: Likelihood of paying sum stated (Q19)

Probability	Frequency	Percent
Very likely	203	45.8
Fairly likely	202	45.6
Fairly unlikely	14	3.2
Very unlikely	4	0.9
I would pay a different amount	1	0.2
I would not pay anything	19	4.3
Total	***443***	***100***

The vast majority (91 per cent) of respondents answered “very likely” or “fairly likely” (Table 6.5). It was assumed that the answers these respondents gave to Q13 were valid. However, 37 respondents gave answers that implied less confidence in their original responses. As this left some uncertainty over whether their original bid was valid, these respondents were excluded from the sample. Including the “I would not pay anything” answers as zero bids would have slightly reduced the average WTP result.

On closer inspection, it emerged that nine of the 19 people who changed their mind to “I would not pay anything” in Q19 were interviewed at Stratford-upon-Avon; furthermore, this constituted all nine respondents from Stratford who had given a

positive answer to Q13. This raised serious questions about the quality of data from Stratford. As a result, these data (15 people) were excluded from the final sample.

After protest bids, respondents who changed their mind in Q19 and responses from Stratford were excluded, the sample size had reduced to **594**.

These exclusions could introduce a risk of non-response bias. Bateman *et al*. (2002) advise "*the main concern ... is that this may have some systematic bias on the results of the analysis*", and "*analysts should examine the distribution of key characteristics of households in the sample ... and ensure that it does not differ significantly from the distribution of these characteristics in the population*". Accordingly, checks were carried out on key variables that influence WTP[2], and it was concluded that these exclusions introduced no worrying sources of bias (see Annex 10).

Level of understanding of the survey

Towards the end of the survey, respondents were asked to indicate their level of understanding of the survey. Around 520 people (57 per cent) stated that they understood everything fully and another 190 (21 per cent) affirmed a high level of understanding. This was an encouraging finding for both the CVM and CE results.

Table 6.6: How well did you understand everything in this survey? (Q18)

Level of understanding	Frequency	Percentage
1 – Did not understand	8	0.9
2	34	3.7
3	156	17.1
4	189	20.7
5 – Understood everything fully	524	57.5

6.3.2 Willingness to pay

Respondents were asked for their WTP to prevent "a severe decline in all salmon populations across the country[3], with 95 per cent of salmon being lost for at least 25 years". The full CVM question is shown in Box 3 and in Annex 1.

The mean WTP of all valid responses (including people offering zero WTP) was **£15.80 per household per year**. As is usual in CVM surveys, there was a high degree of variance within the WTP bids; the standard deviation is 27.

Figure 6.2 shows the distribution of WTP bids.

[2] Income; education; age; children; boating frequency; and walking frequency (based on the results in Section 6.3.5).

[3] Defined as all salmon rivers across England and Wales.

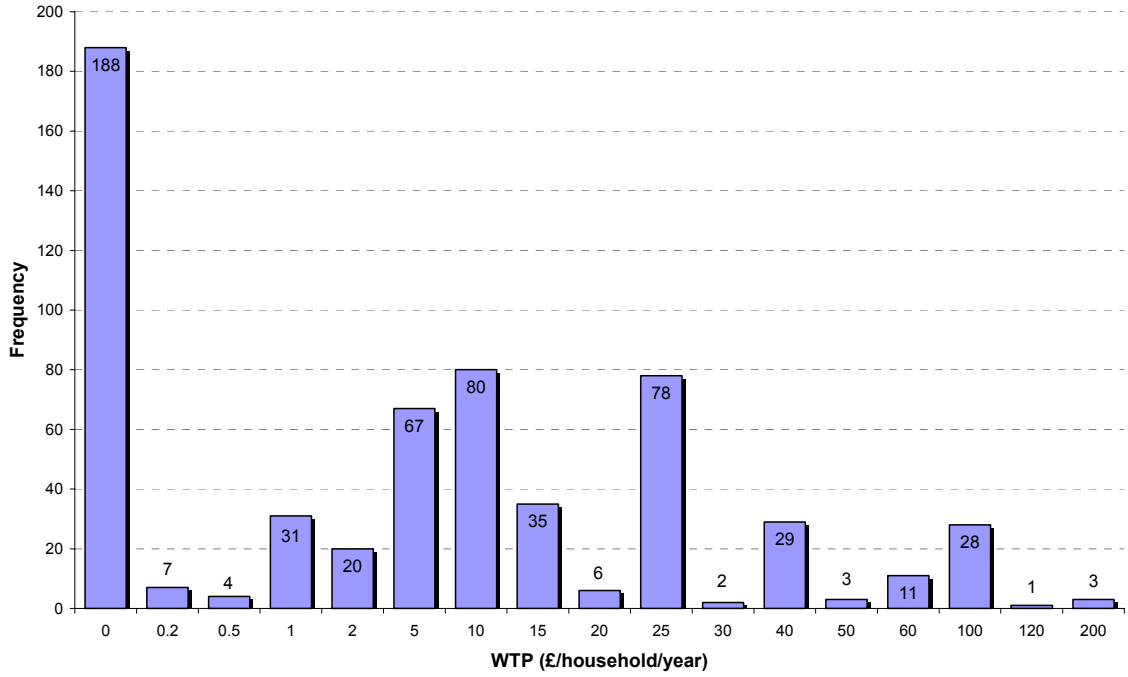


Figure 6.2: Number of respondents stating each WTP amount

In 2004, there were an estimated 22,310,000 households in England and Wales (Office of National Statistics, 2004). This can be multiplied by £15.80 to give a total WTP to prevent a severe decline in all salmon populations across all of England and Wales of around **£350 million per year**.

For those who find it useful to capitalise this result, this can be converted into a capitalised 'present value' by following the guidance in the Treasury's Green Book (HM Treasury, 2003). Values are capitalised using a 25-year time horizon, to be consistent with the scenario posed to respondents. The Green Book recommends using a discount rate of 3.5 per cent per year for all years in our assessment period. On this basis, the present value of WTP to prevent a severe decline in all salmon populations across all of England and Wales is in the order of **£6 billion**.

Potential biases

The total WTP value may be biased for a number of reasons:

1. Non-response bias could arise if excluded individuals had a different mean WTP from those providing a valid WTP. In line with accepted guidance (Bateman *et al.*, 2002), the sociodemographic characteristics of the reduced sample were compared to those of the original sample, revealing no substantive differences (Section 6.3.1). Non-response bias was therefore considered to be of minor concern.

2. The sample was taken from only four areas/regions (North West, West Midlands, South East and Wales). Although chosen to represent a variety of region types (such as high and low income areas), these four regions may not be representative of the entire country. In particular, all of the selected areas contained salmon rivers, whereas at least two other regions contain virtually no salmon rivers (East Midlands and East of England). Three sets of checks were carried out to reduce the level of concern here:

- Checks were carried out on the sociodemographic profile of the sample, revealing no worrying differences from the overall profile of the population of England and Wales (Section 5.3.4).
- No intrinsic differences were found in WTP between the four regions (Section 6.4.4; it was not possible to test for regions outwith the sample).
- Distance from place of residence to the nearest river did not have a significant impact on WTP (Section 6.4.5), possibly implying that an absence of salmon rivers may not have a significant impact on the results in other regions.

Although it was impossible to be certain, it was not considered likely that this regional bias would have a large impact on the overall WTP.

3. The sample may have been biased towards people living close to salmon rivers. However, as mentioned above, distance from place of residence to the nearest river was not a significant influence on WTP. This potential bias was thus not of concern.

4. The sample may have been biased towards rural sampling locations as opposed to urban ones. The sample did include interviews held in major cities such as London and Liverpool, but probably underrepresented the overall urban population of England and Wales. The impact of sampling location is discussed in Section 6.4.4; no evidence was found of urban areas having a systematically different WTP to rural areas. This potential bias was not therefore considered to be a significant concern.

5. WTP values might include an element of WTP for general environmental quality, rather than exclusively representing WTP for salmon stocks. This possibility was minimised by asking respondents for their WTP to prevent a disease hitting salmon stocks, to concentrate respondents' minds on a scenario which only affected salmon and not other aspects of river/environmental quality. However, it was not explicitly stated to respondents that other aspects would not be affected if the disease struck.

As witnessed in the focus groups, many people do associate fish stocks with general environmental quality, and may find it difficult to separate the two in their minds. Thus, some respondents might have made allowance for protecting other aspects of river quality within their stated WTP. Responses may therefore represent an overestimate of the real WTP for salmon stocks.

Based on the outputs of the CE (see Section 7.4.3), the worst case scenario was that the true WTP for salmon could be as little as a third of the stated value[4]. As steps were taken to concentrate respondents' minds on salmon exclusively, it was thought likely that true WTP would be greater than this worst case scenario.

However, despite efforts to minimise this issue, this was the most serious of the potential biases.

Outliers

Average WTP could have been heavily influenced by a small number of outliers. Thirty-two respondents gave a WTP bid of between £100 and £200.

Removing both the five per cent of responses with the highest WTP and the five per cent with the lowest WTP generated a 'trimmed mean' WTP of **£11.47 per household**

[4] The CE found roughly similar WTP for each of three attributes, one of which was the number of salmon, the others representing different aspects of river quality. This approach models WTP for *a simultaneous change in all aspects of river quality* as the sum of WTP for each of the three separate attributes. WTP for salmon would therefore represent roughly a third of stated WTP *if* this stated WTP included consideration of a change in all aspects of river quality.

per year, a reduction of 27 per cent compared to the mean WTP. This suggests that unusually high responses (in the range £100-£200) have a substantial influence on the mean result. The present value would decline to the same extent, to £4.5 billion. However, the high values may be entirely valid responses.

6.3.3 Factors influencing whether respondent is willing to pay anything

A total of 68 per cent of respondents answered "Yes" to Question 13, stating that they were willing to pay an amount to prevent the disease scenario[5]. This section gives the results of an analysis to identify the factors which influenced the "Yes" or "No" reply.

The analysis helped to answer questions such as "Do responses vary as income or other socio-demographic variables vary? As levels of use of the river vary? Or as the region of residence, or the location interviewed in, varies?" A large number of candidate variables were tested, including measures of respondents' attitudes, perceptions, activity levels, socio-demographics and locations. This analysis employed a binomial logit model.

The final model (after insignificant variables had been removed) is presented in Annex 7. The pseudo-R^2 statistic for this model was 0.195, which is acceptable for a CVM study of this nature, where there is a high degree of variability in the WTP bids received.

These results were then converted into adjustment factors that represented the extent to which the probability of having a WTP varied as the value of each variable changed.

Table 6.7 presents the adjustment factors for each variable.

An adjustment factor greater than 100 per cent indicates that if the variable takes this value, then the likelihood of the respondent being willing to pay an amount increases; conversely, a factor less than 100 per cent indicates that the likelihood of paying something decreases.

The adjustment factors were applied to the overall probability (68.2 per cent) of answering "Yes", to give the estimated probability of having a positive WTP for individuals in that category. For example, if an individual goes walking more than once a month, an adjustment factor of 111.9 per cent should be applied, where her estimated probability of being willing to pay something increases by a factor of 11.9 per cent (to 68.2 x 111.9 = 76.4%).[6]

[5] After excluding protest votes, respondents who changed their mind in Q19 and Stratford respondents from the sample (Section 6.4.5).

[6] More than one adjustment factor can be applied at the same time if desired; for example, for an individual who does not go walking near rivers, but is educated to at least GCSE level, the estimated probability of having a positive WTP is: 68.2 x 73.0 x 106.7 = 53.1%.

Table 6.7: Variables influencing whether WTP or not

		Adjustment factors (%)		
Variable	**Description of variable**	**Value = 0**	**Value = 1**	**Value = 2**
WALKFREQ[7]	= 0 if never goes walking on rivers, = 1 if goes less than once per month, = 2 if goes more than once per month [Q2]	73.0	94.7	111.9
INCTAX	= 1 if payment vehicle was income tax, = 0 if water bills [based on Q12]	86.4	103.1	n/a
EDUC	= 1 if educated to at least O-level/GCSE, 0 otherwise [QG]	74.7	106.7	n/a
GLYNNE	= 1 if interview was in Glynneath, 0 otherwise	103.2	13.5	n/a
SALISBU	= 1 if interview was in Salisbury, 0 otherwise	102.1	42.8	n/a
SEVENOA	= 1 if interview was in Sevenoaks, 0 otherwise	97.8	133.8	n/a
WHITEHA	= 1 if interview was in Whitehaven, 0 otherwise	100.8	59.9	n/a
UNDSTAND	How well respondent understood the survey (from 1-5) [Q18]	From 76.0 (did not understand) to 104.4 (understood fully)		
AGE	Respondent age [QD]	From 87.2 (age 20) to 112.0 (age 75)		
CHILDREN	Number of children living at home[8] [QE]	From 103.5 (no children) to 74.9 (>3 children)		
INCOME	Household income [QH]	From 89.8 (£0 per year) to 128.5 (£150,000 per year)		

Dependent variable = PAY (= 1 if answered "Yes" to Q13, 0 otherwise).
Protest bids, respondents who changed their mind in Q19 and Stratford respondents have been removed from the sample.
Number of observations = 594
Pseudo-R^2 = 0.195

Briefly, the results showed that the probability of having a positive WTP went up for:

- people who walked by rivers;
- interviews where income tax was used as the payment vehicle;
- people educated to at least GCSE level;
- those who understood the survey well;
- wealthier respondents;
- households with no children.

There also appeared to be effects specific to some individual sampling locations. Care should be taken over interpreting these results, however.

[7] Variables indicating levels of usage were included as interval variables, taking the value 0, 1 or 2 depending on the degree of usage. This constrained results more than the alternative of including two dummy variables to code each level of use separately, but was necessary to keep the model manageable in size.

[8] "More than three" was coded as 4.25 .

6.3.4 Factors influencing the magnitude of WTP

Of those respondents who *were* willing to pay something to prevent the disease scenario, the mean WTP amount was £23.15 (excluding zero bids).

A linear regression model was employed to examine which factors influenced the magnitude of the WTP bid stated. Again, a large number of candidate variables were tested, including measures of respondents' attitudes, perceptions, activity levels, socio-demographics and locations.

The final model (after insignificant variables had been removed) is presented in Annex 7. The adjusted R^2 statistic for this model was 0.150, which is again acceptable for a CVM study of this nature.

As before, the results were converted into adjustment factors. This time the factors represented the extent to which the magnitude of WTP varied as the value of each variable changed. The formula for finding the adjustment factor for variable j taking value z is:

$$Adjustment\_factor_j = (1+\beta_j)^{(z-\overline{x_j})}$$ *, where* β_j *is the coefficient on variable j*

$\overline{x_j}$ *is the mean value taken by variable j*

Table 6.8 summarises the main results of this model, showing the adjustment factors to be applied to the mean WTP amount (£23.15).

An adjustment factor greater than 100 per cent indicates that, if the variable takes this value, the mean WTP amount increases. For example, if an individual is educated to at least GCSE level, an adjustment factor of 104.8 per cent should be applied, where the mean willingness to pay increases by a factor of 4.8 per cent (£23.15 x 104.8% = £24.25).

Briefly, the results showed that the probability of having a positive WTP went up for:

- people who went boating on rivers;
- people educated to at least GCSE level;
- respondents with certain motivations for having a WTP (environmental concern; anglers; and those who want to eat fish);
- wealthier respondents.

Again, there appeared to be some effects specific to certain sampling locations. There was also some variation by region of residence (note that as region interacts with location, care should be taken when interpreting these results).

Table 6.8: Variables influencing magnitude of WTP

		Adjustment factors (%)		
Variable	**Description of variable**	**Value = 0**	**Value = 1**	**Value = 2**
BOATFREQ	= 0 if never goes boating/yachting on rivers, = 1 if goes less than once per month, = 2 if goes more than once per month [Q2]	94.4	126.3	169.1
EDUC	= 1 if educated to at least O-level/GCSE, 0 otherwise [QG]	84.0	104.8	n/a
ENVCONC	= 1 if reasons for having WTP included "the environment is important", 0 otherwise [Q20]	81.0	109.6	n/a
ANGLING	= 1 if reasons for having WTP included "I go angling", 0 otherwise [Q20]	97.6	140.9	n/a
EATFISH	= 1 if reasons for WTP included "I want to be able to eat fish", 0 otherwise [Q20]	97.6	161.1	n/a
W	= 1 if interview was in Wales, 0 otherwise	105.7	72.6	n/a
W_MID	= 1 if interview was in the West Midlands, 0 otherwise	109.5	50.5	n/a
ABERYST	= 1 if interview was in Aberystwyth, 0 otherwise	97.6	145.9	n/a
BLACKBU	= 1 if interview was in Blackburn, 0 otherwise	105.7	32.0	n/a
KESWICK	= 1 if interview was in Keswick, 0 otherwise	102.4	42.8	n/a
SALISBU	= 1 if interview was in Salisbury, 0 otherwise	102.0*	27.6*	n/a
SOUTHAM	= 1 if interview was in Southampton, 0 otherwise	102.3	52.8	n/a
INCOME	Household income [QH]	From 92.6 (£0 per year) to 159.0 (£150,000 per year)		

Dependent variable = LNWTP (logarithm of WTP amount given in Q14).
Protest bids, respondents who changed their mind in Q19 and Stratford respondents have been removed from the sample.
Number of observations = 403
Adjusted R^2 = 0.150

6.3.5 Combined results

The adjustment factors from stage 1 can be multiplied by the equivalent factors from stage 2, to give combined adjustment factors that account for both the likelihood of the respondent giving a WTP at all, and the expected magnitude of that amount.

Table 6.9 summarises these combined results. By applying these combined adjustment factors to the mean WTP amount of all valid responses (£15.80), users can assess what the expected mean WTP would be for different types of user (such as the mean WTP for a respondent aged 30 with an income of £20,000 per year). This is useful to better understand who values salmon stocks most highly, and hence what kinds of people are affected by policies to enhance stocks. It also provides a richer set of results for use in future benefits transfer exercises.

These results are discussed and interpreted in Sections 6.4.2 to 6.4.5.

Table 6.9: Combined factors: influences on WTP

		Adjustment factors (%)		
Variable	**Description of variable**	**Value = 0**	**Value = 1**	**Value = 2**
WALKFREQ	= 0 if never goes walking on rivers, = 1 if goes less than once per month, = 2 if goes more than once per month [Q2]	73.0	94.7	111.9
BOATFREQ	= 0 if never goes boating/yachting on rivers, = 1 if goes less than once per month, = 2 if goes more than once per month [Q2]	94.4	126.3	169.1
INCTAX	= 1 if payment vehicle was income tax, = 0 if water bills [based on Q12]	86.4	103.1	n/a
EDUC	= 1 if educated to at least O-level/GCSE, 0 otherwise [QG]	62.7	111.8	n/a
ENVCONC	= 1 if reasons for having WTP included "the environment is important", 0 otherwise [Q20]	81.0	109.6	n/a
ANGLING	= 1 if reasons for having WTP included "I go angling", 0 otherwise [Q20]	97.6	140.9	n/a
EATFISH	= 1 if reasons for WTP included "I want to be able to eat fish", 0 otherwise [Q20]	97.6	161.1	n/a
W	= 1 if interview was in Wales, 0 otherwise	105.7	72.6	n/a
W_MID	= 1 if interview was in the West Midlands, 0 otherwise	109.5	50.5	n/a
ABERYST	= 1 if interview was in Aberystwyth, 0 otherwise	97.6	145.9	n/a
BLACKBU	= 1 if interview was in Blackburn, 0 otherwise	105.7	32.0	n/a
GLYNNE	= 1 if interview was in Glynneath, 0 otherwise	103.2	13.5	n/a
KESWICK	= 1 if interview was in Keswick, 0 otherwise	102.4	42.8	n/a
SALISBU	= 1 if interview was in Salisbury, 0 otherwise	104.2	11.8	n/a
SEVENOA	= 1 if interview was in Sevenoaks, 0 otherwise	97.8	133.8	n/a
SOUTHAM	= 1 if interview was in Southampton, 0 otherwise	102.3	52.8	n/a
WHITEHA	= 1 if interview was in Whitehaven, 0 otherwise	100.8	59.9	n/a
UNDSTAND	How well respondent understood the survey (from 1-5) [Q18]	From 76.0 (did not understand) to 104.4 (understood fully)		
AGE	Respondent age [QD]	From 87.2 (age 20) to 112.0 (age 75)		
CHILDREN	Number of children living at home[9] [QE]	From 103.5 (no children) to 74.9 (>3 children)		
INCOME	Household income [QH]	From 83.1 (£0 per year) to 204.3 (£150,000 per year)		

[9] "More than three" was coded as 4.25.

6.3.6 WTP for individual rivers/distance decay

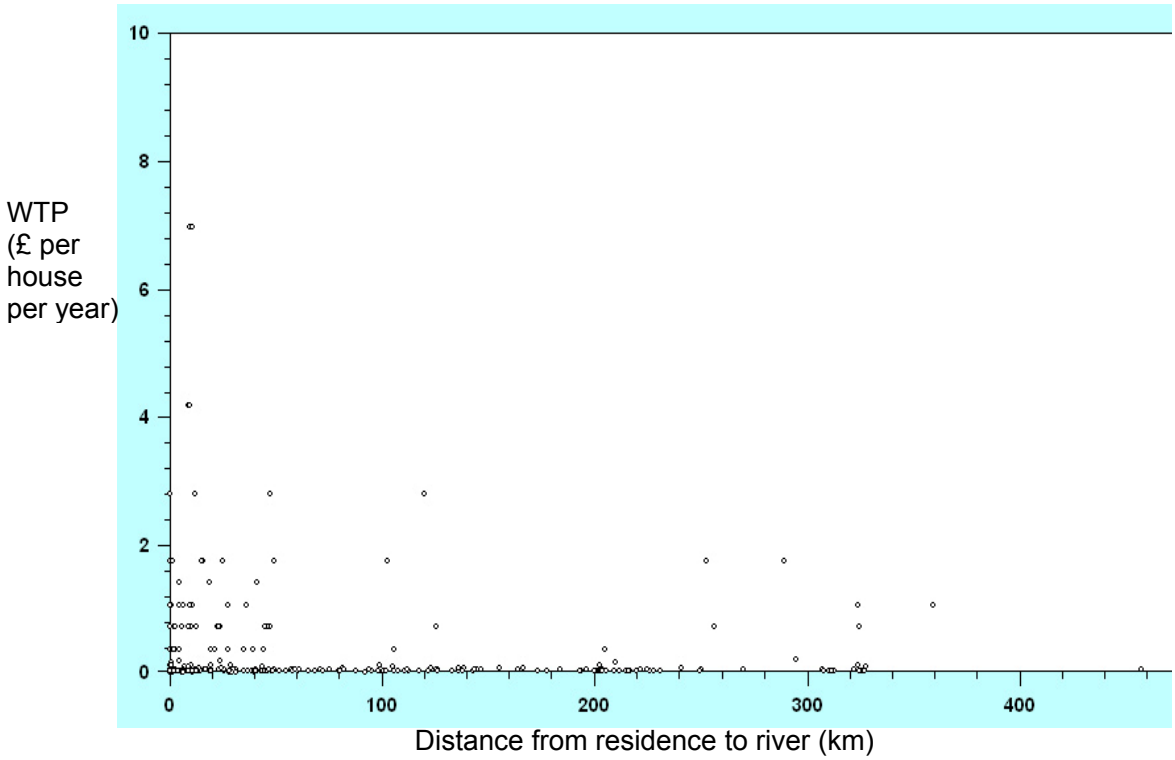
On average, each river contributed £0.21 per household per annum towards the overall mean WTP for salmon stocks - this was calculated by dividing the mean WTP (£15.80) by the number of salmon rivers (75). Aggregated across all households, this equated to each river contributing £4.7 million per year[10].

The warnings given in Section 3.1.6 should be borne in mind here, in particular the substitution effects, so this figure is likely to be an overestimate of the "WTP to avoid loss of salmon in one river only".

As discussed in Section 6.2.5, respondents assigned an average of 21 per cent of their total WTP to the river named to them in Q15b. These responses must then be adjusted to allow for framing bias, by applying the pro-rata factor calculated earlier (13.2).

Average WTP amounts might be expected to vary according to how close the respondent lived to the River X. Figure 6.3 is a scatter-plot showing all WTP bids plotted against the distance between the respondent's residence and the closest point on the river. WTP results are shown after adjusting for framing bias. Although the trend is somewhat obscured by the high variability of the WTP bids, a possible downwards tendency may be discernable.

Figure 6.3: Scatter-plot of WTP bids against distance from the river



[10] Equivalent to a present value of around £80 million, again following HM Treasury (2003) guidance.

This distance decay effect can be quantified by fitting a regression model. Various functional forms were tried for this relationship, including a simple linear relationship and a quadratic form. However, the best fit was found using a capped linear form, where WTP decreased linearly up to a certain point, and was then level at a constant value for all distances greater than the cut-off point. The best fit was found when this cut-off point was 70 km (43.5 miles).

The model was run with various socio-demographic variables, to ensure these did not confound the distance decay results. Only two individual characteristics were found to be significant: the frequency of going boating and of going walking by rivers; both were indicators of higher WTP amounts.

Furthermore, the model included various river characteristics as described in Section 5.2.4. One river characteristic, the length, proved to be a significant influence on WTP.

The model is presented below in Table 6.10 and shown graphically in Figure 6.4.

Table 6.10: Regression of WTP for a specific river against distance from the river

Variable	Description of variable	Parameter value	P-value
ONE	Constant	0.38	0.00
BOATFREQ	= 0 if never goes boating/yachting on rivers, = 1 if goes less than once per month, = 2 if goes more than once per month [Q2]	0.27	0.03
WALKFREQ	= 0 if never goes walking by rivers, = 1 if goes less than once per month, = 2 if goes more than once per month [Q2]	0.12	0.02
LENGRIV	The length of the river in km	0.0017	0.01
RIVDISTL	Distance between residence and River X, for first 70 km only	- 0.0061	0.00

Dependent variable = LNWTPX (logarithm of WTP amount given in Q14).
Protest bids, respondents who changed their mind in Q19 and Stratford respondents have been removed from the sample.
Number of observations = 466
Adjusted R^2 = 0.081

Distance decay

For the first 70 km away from the river, WTP declined as the distance between the place of residence and the nominated river increased**.**

After adjusting for the framing bias, the mean WTP for a river immediately next to the respondent's household was £0.31 per year. The mean WTP for a river 70 km or more away from the respondent's household was £0.20 per year.

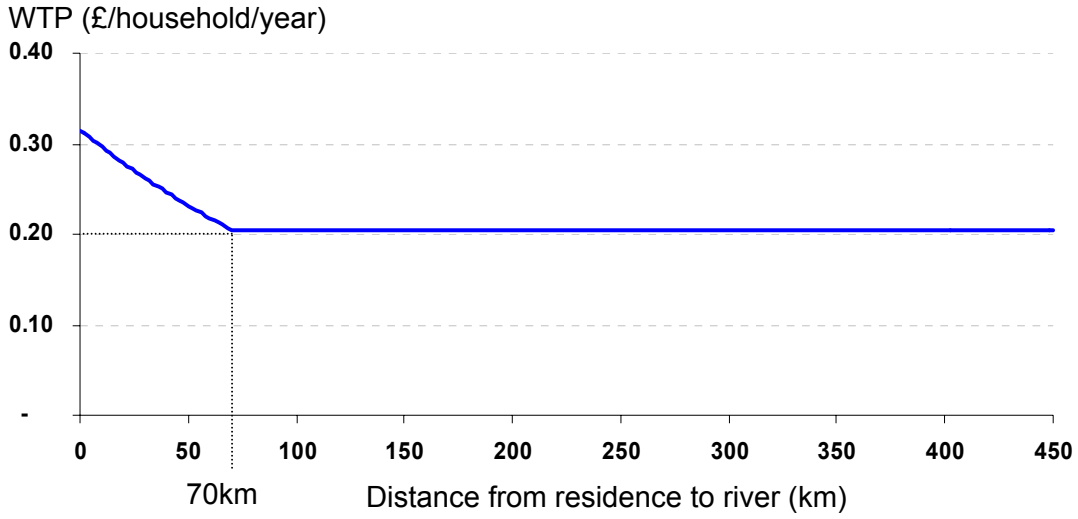


Figure 6.4: Distance decay function for WTP to prevent a serious decline in salmon populations in the nominated river

Table 6.11 shows WTP by distance band, with WTP based on the mid-point of the band.

Table 6.11: WTP by distance band

Band (km)	WTP (£/household/year)
0-10	0.31
10-20	0.29
20-40	0.26
40-70	0.22
70+	0.20

Note that this distance decay relationship was derived using a top-down approach, which was different to that used in two previous studies on this issue. This is discussed in Section 6.4.8.

The distance decay effect was found to make a relatively modest difference to the values presented for individual rivers (Section 6.3.7)[11].

[11] Note that this effect does not influence the headline figure of £350 million per annum WTP for all rivers in England and Wales.

River length

WTP tended to be higher for longer rivers than for shorter ones, as seen in Figure 6.5.

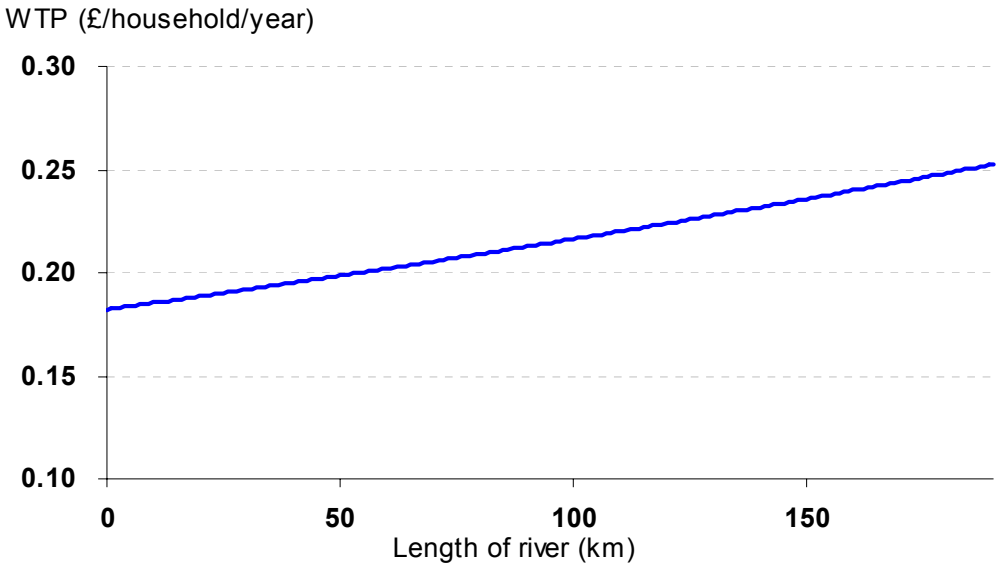


Figure 6.5: Effect of river length on WTP for an individual river

6.3.7 WTP for specific individual rivers

A rough estimate of the value of individual rivers can be derived with adjustment factors to allow for how WTP varies by (i) length of river; (ii) number of people living at different distances from the river; and (iii) current state of salmon stocks in the river. This section follows this process to estimate values for the rivers Wye, Thames and Wyre.

However, caution is required when interpreting these results for two reasons. Firstly, substitution effects can arise, so this figure can only be interpreted as "the contribution made by the named river to overall WTP for all rivers in England and Wales" and not "WTP to avoid loss of salmon in the named river only", which is likely to be lower. Secondly, results are dependent on the adjustment factors, so will not take account of any factors that were not analysed, such as factors specific to the river in question.

i) Length of river

The model (Table 6.10) illustrated how the mean amount contributed to WTP by individual rivers (£4.7 million per year) varied by river characteristics; WTP increased as river length increased, but was unaffected by other river characteristics. Applying the results on river length to the three selected rivers gave the adjustment factors to apply: Wye (113.7%); Thames (119.7%); and Wyre (90.9%).

ii) Number of people living at different distances from the river

The results also showed how WTP varied by distance lived from the river. This information was then combined with data on the population living in different bands from each river, to give a second set of adjustment factors to allow for the population density around each river: Wye (99.9%); Thames (111.4%); and Wyre (99.9%).

Table 6.12: Numbers of households in each distance band from each river (thousands, England and Wales only)

Distance band	Wye	Thames	Wyre
0-10 km	192	3,401	170
10-20 km	240	1,626	167
20-40 km	940	2,218	1,036
40-70 km	1,626	3,003	1,745
>70 km	19,311	12,062	19,192
Total	22,310	22,310	22,310

Note that as the distance decay function shown in Figure 6.4 levels off at longer distances, this implies that all households in England and Wales will hold a significant WTP value for every individual river; hence, distance decay does not have as radical an impact on the results as might be expected.

iii) Current state of salmon stocks in the river

As respondents were not told of the current status of the named river before being asked how much they would assign to that river, it was not possible within the CVM to test for whether WTP varies as salmon stocks vary. This was instead derived from the CE results, which showed how WTP varies with the level of salmon (Section 7.4.2).

These results were used to find the relative size of WTP for rivers currently in each state, assuming that the scenario presented to respondents (a "severe decline" in salmon) corresponded to a decline to a "poor" salmon state; unless the river was already in a "poor" state, in which case the scenario was assumed to correspond to a decline to "no salmon". Note that this is quite a strong assumption, as the scenarios presented were different in a number of ways.

Adjustment factors were then calculated from these results, to ensure that contributions made by each of the 75 salmon rivers would sum to the headline figure of £350 million per year for all rivers in England and Wales[12]. These factors are shown in Table 6.13.

Table 6.13: Adjustment factors by current salmon level

Level	Change valued	Adjustment factor
Good	Good to poor	146.7
Moderate	Moderate to poor	91.4
Poor	Poor to no salmon	51.5
No salmon	n/a	0.0

The Wye was rated as "moderate"; the Thames[13] and Wyre were both rated as "poor".

[12] This required an estimate of the number of rivers in each quality category; this was estimated as 27 "good", 29 "moderate", 17 "poor" and two "no salmon" (the Bristol Avon and the Medway), broadly based on data in CEFAS & Environment Agency (2006).

Results

Multiplying the three sets of adjustment factors together and applying these to the overall mean contribution to WTP made by an individual river (£4.7 million per year) gave the contribution made to aggregate WTP by each of the three named rivers:

- the **River Wye** contributes **£4.9 million per year**[14] to the overall total (equivalent to a present value (PV) of around £85 million);
- the **River Thames** contributes **£3.2 million per year**[15] (PV around £55 million);
- the **River Wyre** contributes **£2.2 million per year**[16] (PV of around £40 million).

Similar calculations could be carried out for any river (real or hypothetical) for which the length, population density and current salmon stocks were known. For example, a hypothetical river with "good" salmon stocks, average population density nearby and average length (85 km) would contribute £6.9 million per year.

6.3.8 Reasons for having a WTP value

A number of questions asked about the reasons why people value rivers/fish stocks; the ways in which respondents use rivers in England and Wales (Q2); the benefits which they receive from rivers (Q10/11); and the reasons why they would be willing to pay something to avoid the stated decline in salmon (Q20).

Each of these questions informed us about the reasons for people having a positive WTP to avoid the stated decline in salmon and about the way the total WTP value was split between use values and non-use values (see Task 2).

Question 10 asked people how they thought that members of their household would personally benefit from an increase in the number of fish in River X. Potential responses were not read out loud, but were encoded in the categories below (Table 6.14).

Table 6.14: In what way, or ways, do you think members of your household would personally benefit from an increase in the number of fish in River X? (Q10)

Type of benefit	Frequency	Use or non-use?
Happy to know that environmental quality has improved	117	Non-use
Nicer place to visit	113	Use
More wildlife to see	99	Use
More fish to see	76	Use
River will be nicer for future generations to enjoy	63	Non-use

[13] The Thames was rated as "no salmon" for the purposes of the choice experiment. However, a zero value was considered inappropriate for the Thames for three reasons: the river does in reality have some salmon in it; there was evidence that respondents *perceived* the Thames as being either poor or moderate in quality (Section 5.3.1); and many respondents supplied a positive WTP value for the Thames. A rating of "poor" was therefore felt to represent both the real quality and respondents' perceptions more accurately.

[14] £4.7 million x 113.7 x 99.9 x 91.4 = £4.9 million

[15] £4.7 million x 119.7 x 111.4 x 51.5 = £3.2 million

[16] £4.7 million x 90.9 x 99.9 x 51.5 = £2.2 million

Type of benefit	Frequency	Use or non-use?
Might want to fish there in the future	45	Option[17]
Angling improved for us	44	Use
Angling has improved for others	44	"Non-use"[18]
Happy to know there are more fish, even if we don't see them	40	Non-use
More fish to eat	36	Use
Other	8	-

The most common answer was "happy to know that environmental quality has improved", which is not associated with use of the resource; it is a non-use value. Other types of non-use value received fewer responses.

Collectively, more people put forward use values as the reason for having a positive WTP value (368 gave use value-related benefits, compared to for 264 non-use value-related benefits).

Question 11 asked the same question, but this time the suggested categories of benefit were read out aloud. Respondents were asked to rank the three top ways in which they thought their household would benefit from increased fish in the River X. The results were as follows (Table 6.15):

Table 6.15: Top three ways to personally benefit (Q11)

Benefits	Number of responses	Use or non-use?
Happy to know that environmental quality has improved	512	Non-use
River will be nicer for future generations to enjoy	454	Non-use
More wildlife to see	417	Use
Nicer place to visit	395	Use
Happy to know there are more fish, even if we don't see them	227	Non-use
More fish to see	135	Use
Happy that angling has improved for others	125	"Non-use"
We might want to fish there in the future	114	Option
More fish to eat	87	Use
Angling improved for us	53	Use

Responses related to non-use values ranked higher in the responses given here than in Q10; categories connected with non-use received a total of 1,318 votes, compared to 1,087 votes for categories connected with use of the river and 114 votes connected with a type of option value.

Question 20 was a follow-up question, with the CVM survey asking respondents for the reasons for being prepared to pay something to avoid a severe decline in salmon (Table 6.16).

[17] The value people place on having the option to enjoy something in the future, although they may not currently use it. This is sometimes categorised as a type of use value, but here it is classified as a separate category of its own.

[18] This category is related to other people's use of the river. As it is not connected with any use by the respondent, it is probably best thought of as "the non-use value of angling".

Table 6.16: Can you tell me why you would you be willing to make this payment? (Q20)

Reason	Frequency	Use or non-use?
The environment is important/rivers are important	283	?
It is important that fish/salmon exist	79	Non-use
I enjoy visiting rivers	72	Use
It would benefit me/my family	40	Use
I enjoy seeing fish	36	Use
I go angling	27	Use
I don't want fish to suffer	22	Non-use
I want to be able to eat fish	20	Use
I can afford it/it was not very much money	19	?
Angling creates jobs	14	Use
I don't know	3	?
I don't believe I would ever have to pay this money in reality	1	?
Others		
For future generations	5	Non-use
Improved wildlife	3	?
Member of family fishes	2	Use
Health of country as a whole	2	Non-use?
I work beside them	1	Use
Improve river quality	1	?
Would like to help	1	Non-use
No difference	1	?
Will create jobs	1	Use

Note: Multiple answers were allowed

It was harder to categorise these answers as relating to use or non-use values; in particular, the top answer “the environment is important/rivers are important” was somewhat vague, although it was likely to include at least some non-use component. However, it was certainly clear that both use and non-use values were important.

6.4 Analysis and discussion

6.4.1 WTP to prevent a serious decline in salmon populations

Results show that WTP for salmon stocks in England and Wales is substantial. The mean WTP to prevent the “severe decline in salmon populations across all of England and Wales” found by the survey was **£15.80 per household per year.** This aggregates to a total WTP of around **£350 million per year**, equivalent to a present value of around £6 billion**.**

These results were then analysed, through an econometric modelling exercise, to help explain which variables influenced the amount that people were willing to pay for fish stocks. For example, the analysis investigated whether individual characteristics (such as income), river characteristics (such as length) and location of the river/interview influenced the size of WTP. It also investigated whether use or non-use benefits were likely to be the major motivations for WTP.

The results from this analysis also provide useful information for valuing other scenarios through a *benefits transfer* approach, allowing the analyst to adjust WTP results according to differences in individual characteristics, river characteristics and location between the new study site and the sample assessed in the current study (note that the usual caveats on the use of benefits transfer would apply).

Unless otherwise stated, the analysis presented in the sections below is based upon the results of the combined model in Section 6.3.5.

6.4.2 Use values or non-use values?

The survey collected evidence on the motivations for WTP from a variety of sources.

i) Findings from the questionnaire

The results presented in Section 5.4 showed that when respondents were asked about the ways in which members of their household would personally benefit from an increase in the number of fish in the River X, more people put forward use values (368) than non-use values (264) as their reason for having a positive WTP value.

However, when respondents were prompted with suggested reasons for benefiting, responses related to non-use values increased in importance and slightly outnumbered use value responses. This suggests that non-use values probably were important to respondents, but that they perhaps underestimated this source of value until they were reminded about it.

ii) Results from the CVM analysis

Several variables that were significant in the combined model (Section 6.3.5) indicate that use values play a role in determining WTP:

- **People who went boating or yachting** tended to have a higher WTP than those who did not. The adjustment factors were amongst the highest in the combined model, with an individual who went boating more than once a month having a WTP that was 69 per cent higher than an average respondent.
- **People who went walking near rivers** also had an increased WTP, although this was a less marked effect. This variable influenced the likelihood of paying something rather than the magnitude of this amount.
- **Angling as a motivation for WTP:** although the frequency of going angling did not turn out to be a significant influence on WTP, stating that "I go angling" as a reason for being WTP proved to be significant, increasing WTP by 41 per cent.
- **Eating fish as a motivation for WTP**: this also increased WTP. However, only 20 people gave this response, so caution is required when interpreting these results. There may be a link with angling here, as anglers are more likely to eat fish from rivers than other respondents.

Only one variable relating to a non-use value was included in the final model:

- **Environmental concern as a motivation for WTP**: again this increased WTP, but only by 10 per cent. Although this appeared to indicate the presence of non-use values, it was not clear whether this was entirely the case, as "environmental concern" may also be exhibited by users of a resource.

The lack of other significant variables indicating non-use motivations should not necessarily be interpreted as evidence that non-use issues are minor influences of

WTP, as identifying which respondents hold non-use values is more difficult than identifying users of the resource.

The following variables were removed from the final model because their influence was found to be insignificant (Table 6.17):

Table 6.17: Usage variables found to have insignificant impact on WTP

Variable	Description of variable
JOGFREQ; BIRDFREQ; ANGLFREQ; SWIMFREQ; WORKFREQ	The frequency with which the respondent goes jogging, cycling or horse riding; bird-watching; angling; canoeing/swimming in/on rivers.
ENVGROUP	Whether respondent is a member of an environmental group.
(WHY_WTP)	The remaining reasons given in Q20 for why respondent is willing to pay something to avoid the stated decline in salmon (other than the three described above).

WTP was unaffected by the remaining reasons given in Q20 for why the respondent had a positive WTP. These included both use and non-use related motivations. WTP was also unaffected by whether the respondent was a member of an environmental group or not.

Variables indicating the amount of angling, bird-watching, jogging or swimming undertaken were found to have positive values of estimated coefficients for these variables; however, these results were not significant at the five per cent level. This suggests that WTP does increase for respondents who use rivers for bird-watching, jogging or swimming, but this effect appears to be quite weak and there is insufficient evidence to conclude this for certain.

In summary, **both use values and non-use values appear to be significant contributors to WTP to maintain salmon across England and Wales**.

6.4.3 Socio-demographic factors

This section further discusses and analyses results presented in Section 6.3, particularly the combined factors in Table 6.9.

Income

As expected, **WTP for salmon increased as household income increased**. The adjustment factors were amongst the highest in the combined model. Conversely, a household with an income of £50,000 would be WTP nearly 20 per cent more than a household with the mean income (£24,053), whilst a household earning £150,000 per year would pay more than double the overall average.

Income was collected as a categorical variable and was expressed in bands: below £5,000 per year; £5,000 - £9,999; £10,000 - £14,999; £15,000 - £24,999; £25,000 - £39,999; £40,000 - £59,999; £60,000 - £99,999; above £100,000). For ease of analysis, the results were converted to a numerical variable by taking the mid-point of each band (the final band was assigned the value £150,000). This approach will have introduced a degree of inaccuracy into the results and might have slightly overstated income, which could lead to the estimated coefficient on income being slightly understated. The level of inaccuracy was considered to be small.

Other functional forms (quadratic and logarithmic) were tested for the relationship between WTP and household income, but these were not found to be significantly better than a linear model.

Some respondents (165 out of 594) refused to provide their income level. Rather than discarding these respondents, the model first tested whether they had a significantly different WTP to those who did provide an income level, and then assigned a proxy income[19] to this group, to enable these data to be used. This approach is similar to that recommended in Department of Transport guidance (Bateman *et al.*, 2002).

Educational qualifications

On average, **respondents with at least some educational qualifications had higher WTP than those without.** Respondents with at least a GCSE qualification had a mean WTP that was 12 per cent higher than the average. Conversely, respondents without this level of educational qualification had a mean WTP that was 37 per cent lower than the average. There was no significant difference between the different levels of educational qualification tested ("O-level/GCSE", "A-level", "degree", "professional"). This was again an expected and logical result consistent with previous studies.

Number of children

Respondents with children tended to have lower WTP than those without. For example, respondents with more than three children had a mean WTP that was 25 per cent lower than the average[20]. This may be because these people had different priorities (their families) and less disposable income than respondents without children. This seems to reject the notion of parents holding a "bequest value" (value that people place on knowing that future generations will have the option to enjoy something).

Age

Older respondents tended to have higher WTP than younger people. This effect was not as strong as some of the other variables mentioned, with respondents aged 75 offering 12 per cent more than the average. This effect occurred "ceteris paribus", after removing the effect of all other variables in the model; this means that the age effect was not simply due to older respondents being wealthier, for example (although it may have been influenced by greater levels of *disposable* income).

As with income, age was collected as a categorical variable and for ease of analysis, results were converted to a numerical variable by taking the mid-point of each band (the final band, 65+, was assigned the value 75). Again, this induced a small degree of inaccuracy, which could lead to estimated coefficient on age being slightly understated.

The following variables were removed from both stages of the model, because their influence was found to be insignificant in both cases (Table 6.18):

Table 6.18: Socio-economic variables found to have insignificant impact on WTP

Insignificant variable	Description of variable
GENDER	Gender of respondent.
ADULTS	Number of adults living at home (above or equal to 16 years of age).
WORKING	Whether respondent is working or not working.
SQINC	Household income squared; included to test whether relationship with income was quadratic.
LNINC	Natural logarithm of household income; used to test different form of relationship with income.

[19] The proxy level was determined endogenously by each of the Stage 1 and Stage 2 models, to model responses from this group as accurately as possible.

[20] Respondents who said they had "more than three" children were coded as having on average 4.25 children.

WTP was not affected by the respondent's gender, number of adults in the household or whether the respondent was working or not.

6.4.4 The impact of region and location

The model explored whether WTP for salmon was affected by the region the respondent lived in, or alternatively by the location the interview was carried out in.

Regions

Sufficient data were available to test the difference between respondents in the North West; South East; West Midlands; the rest of England; and Wales.

The final econometric model (Table 6.9) included negative coefficients on the variables WALES and W_MID, which appeared to suggest that region of residence had a significant impact on WTP.

However, this was somewhat misleading, as these results were a construct of multicollinearity between these regional variables and location variables in the final model (see below). This was tested by running a variant of the model with the location dummy variables excluded; in this model, regional effects were no longer significant.

It was therefore concluded that *there was no clear evidence of the region of residence having any intrinsic influence on WTP for salmon, nor was there evidence of Welsh respondents having an intrinsically different WTP to English respondents.*

However, it was likely that WTP for salmon would vary between government regions, due to differences in other variables between the regions. For example, regions with high average incomes (such as the South East and London) would be likely to have high mean WTP, as WTP for salmon increases with household income (see above). A similar effect could occur for educational qualification levels.

In summary, any difference in WTP between regions would likely be due to the influence of variables such as income or educational qualification, and not due to an intrinsic difference in WTP between government regions.

Locations

Certain locations had significantly different results to the remainder of the sample: Salisbury, Glynneath, Blackburn, Southampton and Whitehaven had unusually low WTP bids; conversely, Aberystwyth and Sevenoaks had significantly higher WTP bids than average.

These differences did not appear to be caused by factors such as differences in income or educational qualification, as these factors were separated out in the final model, or indeed by the region lived in (as the region lived in was found to have no significant impact on WTP). These results were therefore surprising.

There are four possible explanations for the unusual results in these locations:

- Firstly, factors specific to each location could have influenced the results. For example, Machynlleth may have a disproportionate amount of residents who are environmentally aware or involved in environmental industries, as the small town hosts a renowned environmental centre (Centre for Alternative Technology), environmental retail spaces, and other environmental events. The area is also home to the New Dyfi Fishery Association, an active angling association offering fishing on much of the Dyfi to locals and tourists alike.

- Secondly, these results may simply reflect random variability in the data; for example, in Machynlleth three individual responses had very high WTP, which pushed the average up for that location.
- Thirdly, it is possible that interviewer bias affected the results at these locations. This phenomenon is quite common in SP studies; even the way that interviewers are dressed can influence WTP. However. there is no evidence that this necessarily occurred in this instance, as there were several other possible explanations for why the results varied by location.
- Finally, the differences could have been caused by differences in the types of people interviewed compared with the rest of the sample, in terms of *hidden variables* that were not measured by this survey (which could be anything from pet ownership to whether the residence was a second home).

One approach to these unusual results would be to treat data from these locations as unreliable and remove them from the sample. However, as there are several potentially valid explanations for these results, it was not considered appropriate to remove them.

The following variables were removed from the final model because their influence was found to be insignificant (Table 6.19). No significant differences were found between the remaining 18 interview locations.

Table 6.19: Location variables found to have insignificant impact on WTP

Insignificant variable	Description of variable
[14 other locations]	Which location interview was carried out in; 22 locations were tested, eight found to be significant (in final model).
NW; SE	Which region the respondent lives in.
NEAR_RIV	Distance respondent lives from the nearest river.
COASDIST	Distance respondent lives from the coast.

Distance lived from the coast/nearest river

Results showed that WTP was not affected by either the distance the respondent lived from the coast (a proxy variable for whether they lived nearer to a river's headwaters or its estuary), or the distance the respondent lived from the nearest river.

6.4.5 Other factors

Understanding the survey

Q18 asked respondents how well they understood everything in the survey using a scale of one to five, where one meant they did not understand what was being asked of them and five meant they understood everything fully. Respondents who replied that they understood the survey well gave higher WTP bids than those who did not.

Payment vehicle used

Respondents who were presented with an increase in income tax as the payment vehicle gave significantly higher WTP bids than those who were presented with an increase in their water bill. This suggests that incentive compatibility differed between payment vehicles. Alternatively, it may simply be that households where no-one paid income tax (the group who were presented with a water bill increase) had a lower WTP than other households, for reasons unconnected to the payment vehicle given.

Animal welfare

The following variables were removed from the final model because their influence was found to be insignificant (Table 6.20):

Table 6.20: Other variables found to have insignificant impact on WTP

Insignificant variable	Description of variable
CONS_SUF	Whether respondent considered the possible suffering of diseased fish when deciding on how much they would pay.

The impact of animal welfare considerations was also tested in other questions in the survey. Just over half of respondents who gave a positive WTP bid in Q14 answered "No" to Q21: *Did you consider the possible suffering of diseased fish when deciding on how much you would pay?*

Table 6.21: Consideration of fish suffering (Q21)

	Frequency	Percentage	Mean WTP
Yes	183	43.2	£21.57
No	241	56.8	£23.73
Total	424	100	

Subsequently, the 183 respondents who answered "Yes" to Q21 were asked how much their WTP would have reduced if they had known for certain that *no salmon would suffer* (although salmon would still die); in other words, they were asked to remove fish suffering from their assessment of WTP.

As shown in Table 6.22, only 28 people (15.3 per cent) would have changed their WTP.

Table 6.22: If you knew that no fish would suffer, but that fish would still die with this disease, how much less would you have paid to prevent the disease arriving? (Q22)

	Frequency	Percentage
No change	155	84.7
A bit less	12	6.6
A lot less - a quarter of what I stated	1	0.5
About half of what I stated	10	5.5
I would not have paid anything	5	2.7
Total	183	100

These results imply that 2.6 per cent of the total WTP (of all 424 respondents) could be attributed to fish welfare issues.

Similarly, respondents who answered "No" to Q21 were asked how much their WTP would have increased if they had been told that fish *would* suffer; that is, they were asked to now consider fish welfare, where they had not done so initially. Around 70 people (29.4 per cent) would have increased their WTP (Table 6.23).

Table 6.23: If you knew that this particular disease caused fish to suffer as they died, how much more would you have paid to prevent the disease arriving? (Q23)

	Frequency	Percentage
No change	168	69.7
A bit more – 25 per cent more than I stated	50	20.7
About 50 per cent more	12	5.0
A lot more - at least double what I stated	9	3.7
Don't know	1	0.4
I would not have paid anything	1	0.4
Total	241	100

This implies that the total WTP (of all 424 respondents) would have gone up by at least 6.8 per cent if all respondents had been informed that fish would suffer as a result of the disease[21].

These results suggest that fish welfare had only a fairly minor impact on WTP, but was more likely to lead to the WTP amount being an underestimate than an overestimate.

As the extent to which fish suffer during a disease outbreak is not entirely clear, it cannot be said for certain whether 2.6 per cent should be subtracted from the calculated WTP or 6.8 per cent added. It would seem reasonable to ignore this impact on WTP until more evidence on fish suffering becomes available.

Furthermore, the CVM model found that CONS_SUF was not a significant influence on WTP. **The suffering of diseased fish did not appear to be a significant motivation for the WTP bids given** and could be safely ignored.

6.4.6 WTP for individual rivers / distance decay

On average, each river contributed £0.21 per household per year towards the overall mean WTP for salmon stocks.

Distance decay

As Section 6.3.6 shows, **WTP declined as the distance between the place of residence and the nominated river increased for the first 70 km** away from the river; from £0.31 per household per year for a river immediately next to the respondent's household, to £0.20 per household per year for a river 70 km or more away from the respondent's household.

This implies that WTP remained positive for all distances tested (the longest distance tested was 459 km). In other words, people in England and Wales care about salmon in all rivers in England and Wales, wherever in the country they are located; however they place more importance on rivers close to where they live.

River characteristics

This section discusses the ways in which WTP for an individual river varied as the characteristics of that river varied. The only variable that was found to be significant

[21] This assumes that WTP of respondents who answered "Yes "to Q21would not have been affected if they were told that fish *would* suffer; in reality, their WTP might have increased, raising total WTP by more than 6.8 per cent.

was river length; **WTP tended to be higher for longer rivers than for shorter ones**. For example, a river that is only 25 km long would have an expected WTP ten per cent lower than the overall average. Conversely, a river that is 150 km long would have an expected WTP 12 per cent higher than the overall average. This result is presented graphically in Section 6.3.6.

The following variables were removed from both stages of the model because their influence was found to be insignificant in both cases (Table 6.24).

Table 6.24: River characteristics found to have insignificant impact on WTP

Insignificant variable	Description of variable
URBANRIV	0 = largely rural; 1 = mixed; 2 = largely urban
SACRIVER	= 1 if the river is a Special Area of Conservation (SAC), = 0 otherwise
RIVERQ	General river quality, on the scale used in the rest of the report: 0 = dead; 1 = poor; 2 = moderate; 3 = good
SALM	Number of salmon, on the scale used in the rest of the report: 0 = no salmon; 1 = poor; 2 = moderate; 3 = good
OTHFISH	Populations of other fish, on the scale used in the rest of the report: 0 = no fish; 1 = poor; 2 = moderate; 3 = good

WTP was not affected by whether the river was in an urban or rural setting. It was also unaffected by whether the river had protected status for salmon or not.

There was some evidence that WTP to prevent loss of salmon in a river tended to increase as the state of salmon stocks in the river improved. Such a result might well be expected intuitively. However this finding was not significant, so was not included in the final model. Instead, results from the CE were used to assess how WTP varied as the level of salmon varied (see Section 6.3.7).

There was no evidence that WTP was affected by river quality or the state of other fish stocks.

6.4.7 WTP for named individual rivers

The contribution made by individual rivers was found to vary according to river length, population living near the river and level of salmon[22]. Based on this, the contribution made to aggregate WTP by each of three named rivers was estimated as follows:

- the **River Wye** contributes **£4.9 million per year;**
- the **River Thames** contributes **£3.2 million per year;**
- the **River Wyre** contributes **£2.2 million per year.**

The Wye makes the largest contribution, as it has a larger salmon population than the other two rivers and is a long river. The Thames and Wyre have smaller values than the average river, as there are few salmon at present; the Thames has a higher value than the Wyre as it is a bigger river and also has the greatest number of people living close to it (over 3.4 million households are located within 10 km of the Thames).

[22] Using results from the choice experiment in Section 7.

These estimates should be treated with caution for two reasons: firstly, substitution effects mean that this is likely to be an overestimate of "WTP to avoid loss of salmon in the named river only". Secondly, the results do not take account of any factors that were not analysed, such as local factors specific to the river in question.

6.4.8 Comparisons to previous results

WTP amounts

The WTP found here for an individual river *before adjusting for framing bias* was £3.28 per household per year. This closely matched the result in Spurgeon *et al*. (2001), who found a mean WTP of £3.73 to improve/maintain fish stocks at the respondent's nearest site. However, after adjusting for framing bias, the result in this study was reduced to £0.21 per household per year.

In fact, the two results are not directly comparable, as the current study assessed a *severe decline in salmon only within a specified river* potentially many miles away from the household in question. The 2001 result related to improvements of all fish at their nearest water body.

Distance decay

Few studies have attempted to quantify the strength of the distance decay effect for environmental goods; this is a significant weakness in the literature, as distance decay can have a major effect on aggregated WTP estimates, where it affects the size of the population to aggregate over. Two studies have assessed this issue for rivers; Jacobs (2003) on the River Mimram and Georgiou *et al.* (2000) on the River Tame.

The River Tame study (Georgiou *et al.*, 2000) found evidence of the distance decay effect. The authors emphasised the need for care in identifying the relevant population when aggregating WTP, to avoid overestimating benefits. This study only tested a linear form of the distance decay function; the resulting model showed that WTP reached zero for respondents living more than 17-36[23] miles away from the river. This result implies that one only needs to consider those living within this boundary as being potential beneficiaries of any river improvement schemes. In contrast, the present study found that WTP remained positive at all distances tested, implying that such a boundary should not be drawn.

The River Mimram study (Jacobs, 2003) explored distance decay of WTP for the river Mimram. It found distance decay with a similar shape to that found here; WTP decreased for the first 12 km and then levelled off (remaining positive) at longer distances. The study captured less evidence about long distances, as it only interviewed respondents up to 60 km away. Note that the River Mimram is not a well known river, and this is likely to have influenced the results.

As discussed previously, the WTP presented here includes both use and non-use values. Distance decay is likely to act quite differently on these different components of value. For use values, we might expect a strong distance decay effect, with respondents living beyond a reasonable travel distance to the river holding a very low use value for the river (only visiting if the river has a particular attraction to them, or if on holiday). On the other hand, it might be quite reasonable to hold a substantial non-use value for a river that is a long distance away from where you live.

[23] Depending on the degree of improvement under consideration.

Overall, the strength of the distance decay effect found here looked quite modest compared to previous studies. A top-down approach was used to find the distance decay effect, starting with establishing WTP for all rivers, then asking how much of this total contribution should be assigned to a specific river, and finally assessing whether this portion was higher for nearby rivers than for far away rivers. In contrast, both Georgiou *et al.* (2000) and Jacobs (2003) asked respondents directly about their WTP for a specific river. It is possible that this difference in methodology influenced the strength of the distance decay effect found here.

Further investigations into this effect would be useful.

Influences on WTP

This study found no clear evidence that the region of residence had an influence on WTP for salmon, and no clear evidence t**hat Welsh respondents had a different WTP to English respondents.** Any difference between regions appeared to be due to the influence of other variables such as income or educational qualification, and not due to an intrinsic difference in WTP between government regions.

The 2001 inland fisheries study (Spurgeon *et al*., 2001, p100) generated adjustment factors to show how WTP for improvements to fisheries varied by region[24], and found substantial differences between regions. For example, WTP increased by a factor of 135 per cent for people in the South/South East, and decreased by a factor of 80 per cent for Wales, 77 per cent for the Midlands and 44 per cent for the North West. This implies a large degree of variation by region. However, as discussed in their report, differences between regions predominantly related to differences in key explanatory variables such as income and educational qualifications that varied between regions (that is, the variation was due to confounding variables, rather than an intrinsic difference in WTP between the regions).

[24] Based on Environment Agency regions, rather than the government office regions used here.

7 Choice experiments: Value of different types of change

7.1 Introduction

This section discusses the choice experiment aspect of the general public survey. Section 7.2 presents the methods used, 7.3 outlines the results obtained, and Section 7.4 provides an analysis and discussion.

7.2 Methods

7.2.1 Information and explanations provided

Explanatory text was provided to clarify any likely sources of confusion and to ensure that respondents understood the choices they were being asked to make. This was accompanied by a sample choice card and visual information.

Visual materials were chosen carefully, to ensure the information was informative but not emotive, and hence did not bias results. Including pictures of actual rivers, edited to show the river in different states, would have run a serious risk of biasing the results, as it would be hard to control aspects of the pictures which might influence people's responses.

Providing information was particularly important in this survey, as it was questionable how much respondents knew about their local rivers beforehand; levels of knowledge varied between locations and between respondents. A balance was required between keeping the survey manageable in length (and not deluging respondents with too much to deal with) and providing enough information to allow an informed response.

"Cheap talk" was used to reduce hypothetical bias; this is further discussed in Annex 14.

7.2.2 Payment vehicle

The same payment vehicle was used as in the CVM survey: *either an extra amount of income tax* or *an extra amount on their water bill*, depending on the response to Q12.

7.2.3 Attributes and levels

In choice cards, various different hypothetical states of the river were described to respondents, who were asked to choose between them. These states were defined in terms of various attributes of the river, such as its environmental quality. In each state, each attribute took one out of a "menu" of possible levels for that attribute.

Table 7.1 shows the attributes chosen to describe the states of the river. It also lists the menu of levels for each attribute. Each state was made up of one level chosen from the menu of river quality attribute, one from the menu of salmon attribute, one from the

menu of other fish attribute and one from the payment attribute. These are also shown in the graphic in Annex 1, which was presented to respondents to help explain what each attribute and level meant.

Table 7.1: Attributes and levels

River quality	Salmon	Other fish	Payment each year	
Good	Good	Good	£0	£15
Moderate	Moderate	Moderate	£1	£25
Poor	Poor	Poor	£2	£40
Dead	No salmon	No fish	£5	£70
			£10	

The number of attributes used in a CE study should be limited to a maximum of five. Increasing the number of attributes would increase the amount of results, but would be more confusing for respondents, as the task becomes conceptually more difficult. It also reduces the statistical significance of the results, as the number of ways of splitting the results increases. Taking these problems into account, focus groups for our survey suggested that four attributes was the most wieldy number. These were:

- the payment attribute, which was essential to convert results for other attributes into WTP amounts;
- the river quality attribute, which told us about the value held for healthy ecosystems, that is, it informed us about whether people were interested in the fish themselves, or in the general quality of the river environment;
- the other fish attribute, which allowed us to separate out the value held for fish stocks in general from the value held for general environmental quality;
- salmon attribute, which enabled us to separate out the value held for salmon specifically from the value held for fish in general.

The levels were chosen to provide results in a form useful to report users and to be readily understood by respondents. A colour coding system was employed, with levels broadly consistent with Environment Agency classifications of river quality and fish stocks (see Annex 6).

Proposed levels considered both improvements to the status quo and declines in quality. This was important for our purposes, as some uses (such as WFD, PR09) consider improvements in quality, whereas others (dealing with fish diseases) are concerned with degradations. However, technical issues may arise[25]. In general, people tend to display “loss aversion”, where they will pay more to avoid a loss than they would to gain in equivalent magnitude. Our survey design encountered this phenomenon, and was able to produce a simple measure of it.

We chose to give each quality attribute four levels. Evidence has shown that respondents tend to be biased towards giving greater importance to attributes with higher numbers of levels; thus, there were advantages to giving all attributes the same number of levels.

[25] Such as the distinction between WTP/WTA and between equivalent variation/compensating variation, yet given the theoretical equivalence between WTP/WTA at the margin, this should not be a major problem.

Other attributes were also considered; these were explored in the focus groups, to see if they were important influences on the choices made. These attributes were not included in the final design. Some of the possibilities considered are listed in Annex 4.

Levels were expressed in qualitative terms, using words like “good”, “moderate” and “poor”. For a discussion of this, see Annex 14.

7.2.4 Combining levels to form choice cards

Attributes and levels were then combined to describe different hypothetical states of the river being asked about. Figure 7.1 shows an example choice card, showing three of the 576 possible ways that the above levels could be combined. Each card shows three states, with state B representing the status quo option.

Each respondent was presented with eight choice cards (making eight separate decisions).

The design of the choice card experiment is detailed in Annex 14.

7.2.5 Follow-up question

One additional question was added to help clarify the context of the results received:

Q17. What did you base your choices on?

Some of the follow-up questions used for the CVM survey are also of interest here.

7.2.6 Analysis

Basic frequency analyses and significance testing was undertaken using SPSS 14.0 (© SPSS Inc. 2005).

The CE model was estimated in NLOGIT 3.0 (© Econometric Software Inc.) using a Random Parameters Model, as described in Annex 14.

The steps taken during the analysis process are described in the results and analysis presented below.

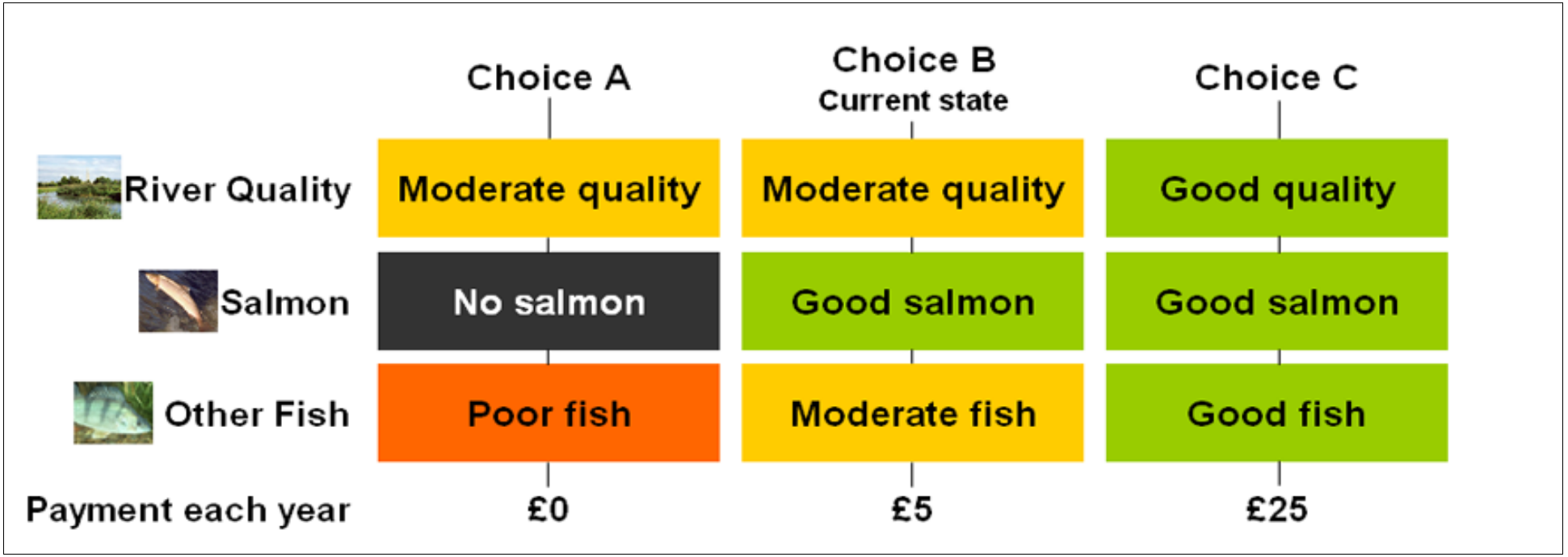


Figure 7.1: An example choice card

7.3 Results

7.3.1 Sample

CE questions were presented to the same sample as the CVM. Most interviews (746 out of the 911) took place after the clarification note outlined in Box 1 was sent.

After the choice cards were presented, respondents were asked to provide the reasons underlying their choices. The most common answer given was river quality, which was closely followed by cost. Achieving a balance between cost and quality was another common answer, which was encouraging.

Percentages in Table 7.2 do not sum to 100, because multiple answers were allowed.

Table 7.2: What did you base your choices on? (Q17)

Reason given	Freq.	Per cent	Protest bid?
I was most interested in river quality (rather than fish)	180	19.8	Non-protest
Minimising the cost to me	177	19.4	Possibly
It was a balance of cost to me and improving the rivers	163	17.9	Non-protest
The government/other should pay	136	14.9	Protest
I was prepared to pay a certain amount but no more than that	129	14.2	Non-protest
I wanted a variety of fish	101	11.1	Non-protest
I wanted as many fish as possible	100	11.0	Possibly
Mainly based on the cost, but avoiding really bad states of the river	92	10.1	Non-protest
Complaint about paying higher taxes/water bill	64	7.0	Protest
I was most interested in salmon	59	6.5	Non-protest
Cannot afford to pay anything	56	6.1	Non-protest
Not convinced the measures would make a difference	44	4.8	Protest
Concern over how the money would be spent	37	4.1	Protest
I was just guessing/I did not understand the questions/ I don't know	17	1.9	Exclude
Other	59		

The last column shows that some of these zero bids could be regarded as protest bids. Protest bids identify respondents who are likely to have not answered in an economically consistent manner, and should probably be excluded from the sample.

Two answers, “minimising the cost to me” and “I wanted as many fish as possible”, were harder to interpret. They could imply that the respondent was only considering one of the attributes, and hence ignoring the others, making a trade-off between the attributes impossible; such respondents should be excluded. However, these responses could alternatively represent a genuine preference for just one attribute.

The following table (Table 7.3) categorises respondents into protests and non-protests.

Table 7.3: Protest versus non-protest

Protest bid?	Frequency	Percentage	Exclude?
Non-protest OR Non-protest + possible protest	667	73.2	Include
Protest bid + Non-protest bid	51	5.6	Include
Protest bid	146	16.0	Exclude
Protest bid + Possible protest bid	47	5.2	Exclude
Total	***911***	***100***	

In total, 193 out of the 911 respondents were classified as protest bids. These responses were removed, including the 47 respondents who gave one of the "possible" protest bids as well as a definite protest bid.

In contrast, respondents who answered with a possible protest bid as well as a non-protest bid were treated as valid answers and were included in the sample.

Around 50 respondents gave both a protest bid answer and a non-protest bid answer to Q17. It was not clear whether these represented valid responses or not. As in the CVM survey, to be conservative it was assumed that these were valid responses, and they were included in the sample.

Respondents excluded from the sample

As highlighted under the CVM section, the responses from Stratford upon Avon were questionable, so these were excluded as well.

Thirty-seven respondents refused to answer at least one of the eight cards. It was necessary to exclude all data from these respondents[1].

The decision was taken to exclude E_MANY from the sample; all those who made protest bids or refused cards, failed the logic trap or made protest bids in the CVM survey, as well as those who failed *more than one* of the other traps (the consistency and order traps, and giving the same answer for each card). This reduced the sample size to **429**. Just over half of the original respondents were excluded from the sample; this was a very high level of exclusion.

Annex 14 discusses the rationale and justification for these exclusions.

The impact of the clarifying note (sent out to CE interviewers; see Box1 in 5.2.9) was examined. It had no significant impact on WTP. Consequently, we did not exclude responses obtained before the note was sent out.

7.3.2 Model

This section presents the results from the CE survey, modelled using a Random Parameters Logit model (RPL). The results provide information about relative preferences for the three attributes of rivers that were tested and for different levels of the attributes. The full model output is included in Annex 7 including the output for an MNL model.

These models were arrived at by starting with a model that included the full set of levels for each attribute, and removing insignificant variables one at a time. NEGTAX

[1] Because of the way NLOGIT reads the data, it expects all respondents to have made eight choices.

was specified as the random parameter, taking a lognormal distribution. The model was run using 100 repetitions, and Halton draws to improve model efficiency.

The adjusted R^2 statistic was 0.170, which is satisfactory for a CE study of this nature. CE model results are shown in Table 7.4.

Table 7.4: CE RPL model results

		Parameter value	Standard error	P-value
NEGTAX	*Value of the payment attribute on each choice (as a negative: NEGTAX = - TAX)*	*- 4.608*	*0.392*	*0.000*
RGOOD	= 1 if the choice has river quality = good; 0 otherwise	1.303	0.115	0.000
RMOD	= 1 if the choice has river quality = moderate; 0 otherwise	0.968	0.098	0.000
SGOOD	= 1 if the choice has salmon = good; 0 otherwise	1.520	0.092	0.000
SMOD	= 1 if the choice has salmon = moderate; 0 otherwise	1.096	0.080	0.000
SPOOR	= 1 if the choice has salmon = poor; 0 otherwise	0.395	0.065	0.000
FGOOD	= 1 if the choice has other fish = good; 0 otherwise	1.606	0.097	0.000
FMOD	= 1 if the choice has other fish = moderate; 0 otherwise	0.727	0.065	0.000
B	= 1 for choice B (the status quo); 0 otherwise	1.249	0.049	0.000
LsNEGTAX	*A variable indicating the extent of heterogeneity in individual's responses*	*3.148*	*0.254*	*0.000*

The variables RPOOR and FPOOR were not included in the base model, as the estimated coefficients were not significantly different to zero.

The final variable, LsNEGTAX represents the random component of the RPM. It was highly statistically significant here, indicating that employing an RPL will substantially improve the goodness-of-fit of the model compared to an equivalent CLM. This result suggests a high level of underlying randomness in the general public's preferences for healthy rivers and fish stocks (which was captured by the RPL, but not by the CLM).

The interpretation of these results is discussed in Section 7.4.

7.4 Analysis and discussion

7.4.1 Magnitude of WTP

WTP for a change in a single attribute varied from zero (for example, for a change from "dead" to "poor" in the river quality attribute) to £44.98 per household per year (for a change from "dead" to "good" in the other fish attribute).

On average, these WTP values (representing a change in an individual river) were of similar magnitude to the WTP found in the CVM survey for preventing the loss of

salmon in *all* rivers across England and Wales. Remaining consistent with the methodology in Section 6.3.7[2], the mean WTP derived from the CE for "a severe decline in salmon stocks in a randomly chosen individual river," would have been £23.88 per year. Mean WTP from the CVM for "a severe decline in salmon stocks in all rivers" was £15.80 per year.

However, WTP values here were much higher than the WTP found in the CVM for preventing the loss of salmon in an *individual* river. As anticipated in Section 5.2.7, the most likely explanation for this difference was the embedding effect.

Respondents did not appear to have properly adjusted their responses to allow for the fact that only one river was being asked about, rather than all rivers. Explanations for this effect include the "warm glow" effect; offering a WTP amount may give a good feeling to the respondent, irrespective of whether they have taken account of what the change actually is.

The CVM survey used a top-down approach (starting by asking about WTP for the all-embracing good and then breaking this down into its constituent parts), whereas the CE survey used a bottom-up approach (asking about WTP for one individual element). These two approaches commonly result in quite different WTP values (Jacobs, 2007).

Another possibility is that respondents may have been overloaded with too much information (there may have been a greater conceptual complexity than they could cope with, leading to a form of information bias). This may have led to certain details being overlooked, such as which river was being asked about (or even the fact that the question focused on an individual river rather than *all* rivers).

It is also possible that people's answers to the CE question were influenced by the preceding CVM questions on salmon. For example, the change from asking about all rivers (in the CVM) to a specific river (in the CE) could have confused respondents.

These problems did not affect (or were much less severe for) the CVM results, because the good being valued was clearly described, a top-down approach was used, and the survey design was considerably simpler than for CE. CVM results looked more intuitively reasonable and were more comparable with previous studies. Importantly, they also provided rational results when the dataset was analysed in more detail, which added confidence in their validity. They were also more conservative than CE results.

However, it is possible that CVM values were significant underestimates of the overall value, due to issues such as hypothetical bias, fear that any money spent would not be used appropriately, or fear that attempts to recover salmon populations would be futile.

Another possibility is that, in the CE study, we do not know what respondents were assuming about changes in water quality/fish numbers on other rivers when they made their particular choices for one river. They may have assumed that in paying for a given improvement on one river they were also producing equivalent improvements on other rivers.

No consistent pictures exists in the literature with regard to this comparison of values obtained by CE and CVM (N. Hanley; pers. comm.). On balance, in this study, the analysis and write-up of CVM results was prioritised over CE results. Nevertheless, the CE model did add value; in particular, it told us about:

[2] And assuming that there are 27 "good"; 29 "moderate", 17 "poor" and two "no salmon" rivers in England and Wales.

- the shape of the WTP curve, that is, how WTP for moving from dead to poor compared to WTP for moving from poor to moderate, and so on (Section 7.4.2);
- how preferences for salmon/other fish/general river quality compared to one another (Section 7.4.3);
- whether loss aversion was present (Section 7.4.4).

7.4.2 The shape of the WTP curve

This section concentrates on the shape of the WTP curve; it considers the marginal WTP for moving between different levels of an attribute (from dead to poor, dead to moderate and so on).

Table 7.5 and Figures 7.2 to 7.4 show the shape of WTP for improvements in river quality, increases in salmon stocks and increases in other fish populations, as derived from the RPM model. Each graph displays WTP for moving from dead/none to good[3]. The coloured bars represent the WTP for moving between each of the interim levels within this larger change (dead/none to poor; poor to moderate; moderate to good).

In order to concentrate on the shape of the results (relative sizes of movements between different levels and attributes) rather than their magnitude, WTP for each change was expressed as the proportion of total WTP given for moving between dead/none and good.

Table 7.5 presents these proportions numerically. For example, the table shows that moving from no salmon to poor salmon would yield 26 per cent of the WTP for moving from no salmon to good salmon. Moving from poor salmon to moderate salmon would yield a further 46 per cent (26-72 per cent) of the total; moving from moderate salmon to good salmon would yield the remaining 28 per cent.

Table 7.5: WTP for moving between different levels of each attribute (expressed as percentage of WTP for moving between dead/none and good)

Change	River quality	Salmon	Other fish
Dead/none ←→ Good	100	100	100
Dead/none ←→ Moderate	74	72	45
Dead/none ←→ Poor	0	26	0

[3] Or WTP to avoid a movement in the opposite direction – the two scenarios are not distinguished between here; see discussion of loss aversion in Section 7.4.4.

Figure 7.2: WTP to move between different levels of river quality

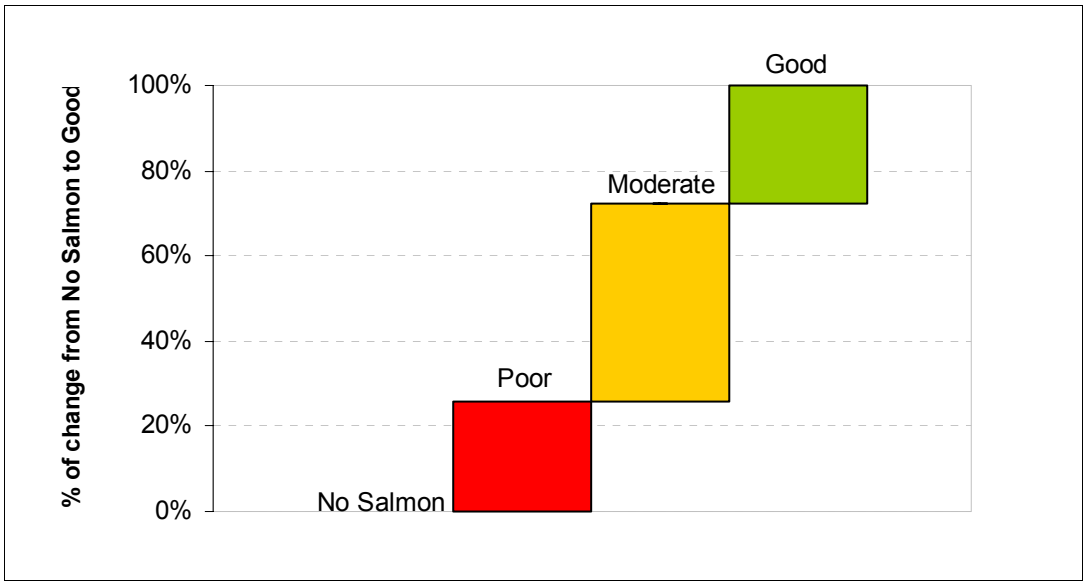


Figure 7.3: WTP to move between different levels of salmon

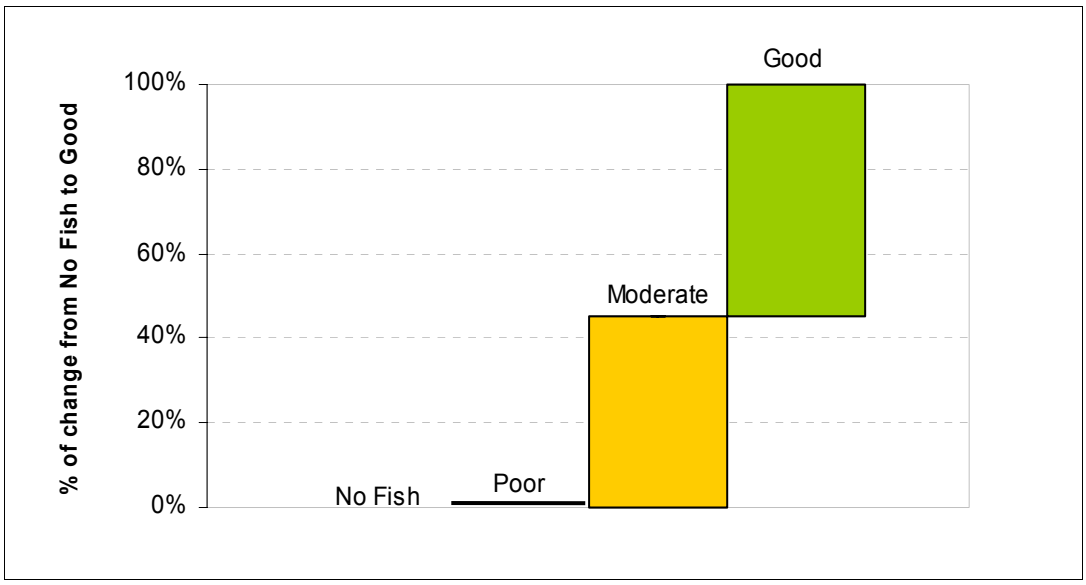


Figure 7.4: WTP to move between different levels of other dish

In general, the results exhibited a classic S-shaped curve.

There was no significant difference between preferences for a dead river and a poor quality river. This implies that **policies that aim to improve rivers from a dead state to a poor state will have no significant impact on total welfare**. Similarly, there was no significant difference between preferences for no fish and poor other fish. There was a small but statistically significant WTP for moving from no salmon to poor salmon.

It might be thought that the difference between no fish and poor fish would be valued highly, due to rarity value; however, this effect was not seen. These values relate to a change in one river, rather than across the whole country; although the species may be rare in this particular river, respondents were not told about stocks elsewhere in the country, which could be healthy.

The most likely explanation was that respondents were only prepared to pay money if they felt that this investment would achieve some worthwhile results; they did not feel that it was worth improving rivers from a dead state to a poor state. This type of response is fairly common in SP studies.

An alternative explanation would be that respondents did not fully appreciate the difference between a river in a dead state and a poor state. The states were explained in the images shown in Annex 1 and in the choice card itself (Figure 7.1; a dead river was coloured in black, poor was coloured in red).

Moving from poor to moderate had a large WTP effect. This may be because improvements to the river/fish stocks were clearly visible here; respondents felt that achieving a moderate state was a worthwhile outcome. This implies that **policies maximising the number of rivers in a moderate state or better would have the greatest impact on welfare**.

For both the river quality and salmon attributes, declining marginal utility set in between moderate and good states, with this change being valued less highly than the change from poor to moderate. This effect was not seen for other fish.

This implies that **improving rivers from a moderate state to a good state would have an additional positive impact on welfare.**

These percentage values or factors can be used in a variety of ways, to adjust results to allow for the magnitude of the change under consideration. For example, they were used in Section 6.3.7 to adjust individual river valuations to allow for levels of salmon stocks in those rivers.

7.4.3 Relative preferences for salmon, other fish and river quality

Survey techniques (including CVM) often struggle to separate out the WTP for salmon from WTP for other aspects of river quality/fish stocks. One of the strengths of this CE design is that these other effects were separated out, leaving the derived WTP for salmon as a value that specifically related to preferences for this species alone.

Results imply that if river quality declined (improved) alongside a decrease (increase) in salmon stocks, then WTP would be two or three times higher than where salmon stocks decreased (increased) without any corresponding change in river quality[4].

An initial inspection of the results in Table 7.4 suggests that the three attributes had fairly similar WTP levels, but that WTP for changes in river quality was slightly lower than for the other two attributes.

A more detailed analysis[5] revealed statistically significant differences between the attributes at some but not all levels. There was some evidence that an improvement to a poor or moderate level of salmon was preferred to an equivalent improvement in other fish[6]. However, no clear picture emerged of one attribute being more important than the others.

Note that use of the CE approach implies accepting the implicit assumption that 'the value of the whole equals the sum of the parts'.

7.4.4 Loss aversion

The substantial positive coefficient on B (Table 7.4) reflects a preference for the status quo. As expected, this preference suggests that respondents exhibited *loss aversion*, where they were willing to pay more to prevent a loss in quality than they were to achieve an improvement in quality.

Loss aversion was modelled assuming that WTP to avoid environmental degradation was higher than WTP for an improvement by a *constant* amount; that is, we assumed that the shape of the WTP curve (as shown in Section 7.4.2) was the same in both cases. This simplification was required as the model became too complex (and would not converge) if the shape of the curve was allowed to vary between the two scenarios.

[4] This has implications for interpretation of the CVM results; if respondents correctly understood the scenario, then WTP related only to a decline in salmon stocks (due to a disease); WTP for a decline in river quality would be additional to this. If, however, respondents failed to differentiate between changes in salmon stocks and river quality, then the "real" WTP for salmon alone could be as little as a third to half of the WTP stated. As discussed in Section 6, efforts were taken to emphasise that respondents only valued salmon and not general river quality.

[5] Using the WALD command in NLogit.

[6] The coefficient on SMOD was significantly higher than FMOD, whilst there was no significant difference between SGOOD and FGOOD. WTP for a good level of other fish was significantly higher than WTP for a good level of river quality; conversely, WTP for a moderate level of other fish was significantly *lower* than WTP for a moderate level of river quality.

Loss aversion was substantial here; the example below gives an idea of the likely scale of this effect[7].

WTP to prevent a river deteriorating *from* moderate status on all three attributes *to* dead (with no fish at all) [£83.90]	is **2.6 x**	WTP to improve a river *from* dead (with no fish at all) *to* moderate status on all three attributes [£32.03]

[7] As this effect was modelled as a constant addition, the model calculated the ratio between WTP to avoid environmental degradation and WTP for an equivalent improvement to be greater than 2.6:1 for more modest changes in quality and smaller than 2.6:1 for more substantial changes. However, this result was a construct of the form of the model and the dynamics of the loss aversion effect were not investigated further.

8 Conclusions

8.1 Audiences and uses of the results

Target audiences for this work include strategic decision-makers at national, regional and, in some cases, local level. Key organisations include: the Environment Agency, Department for Environment, Food and Rural Affairs (Defra), National Assembly for Wales, Natural England, Office of the Deputy Prime Minister, Department for Culture, Media and Sport, Department of Health, regional development agencies, OFWAT, water companies, angling organisations, anglers, Sport England, Sports Council for Wales and tourist boards.

The results of this study may be of use for the following purposes:

- cost-benefit analysis of fishery management measures, programmes and policies;
- setting priorities for angling activities and fish stocking;
- establishing appropriate levels of environmental quality (associated with Water Company Periodic Review 2009 and the Water Framework Directive);
- Salmon Action Plans;
- establishing the basis for taxes and charges;
- green accounting;
- damage assessments (such as under the Environmental Liability Directive);
- managing fish disease;
- opportunities for applying for additional funding.

8.2 An economic framework for inland fisheries

An economic framework was established that split economic values into two main types. **Economic impact analysis** focused on the impact of angling on local or regional economic activity in terms of expenditure, incomes and associated jobs. Angling expenditure and associated employment are not particularly useful measures of economic impact, although such figures are often used for advocacy purposes. Assessing changes in expenditure at a regional level and investigating how this affects incomes and jobs was thought to be of more value (and was the focus of Module B).

Economic welfare analysis focuses on establishing the overall utility (enjoyment or satisfaction) derived by individuals from consuming goods and services. Total economic value (TEV) examines the economic value of a good by summing a variety of different components of value. Using a welfare value approach enables decision-makers to allocate scarce resources (such as government funding) in the most efficient manner using cost-benefit analysis. Initiatives that increase net welfare measures (where total benefits outweigh total costs) are deemed beneficial.

Several types of welfare value contribute to the TEV of fisheries in England and Wales, including:

- **Producer surplus:** This is the profit producers of goods and services such as angling equipment and accommodation receive (as a result of angling).

- **Economic rent:** This is the payment made by anglers to owners of fishing rights over and above the cost of providing the fishing.

- **Anglers' consumer surplus:** This is the difference between the maximum that anglers would be WTP, and the amount they actually pay (the market price).

- **Health and social welfare benefits:** Angling may be beneficial to participants' health as a result of the exercise, tranquillity and escape from everyday pressures. It could result in improved mental and physical health and it might have impacts on social welfare, for example by keeping families together and young people out of trouble. These impacts may in turn benefit the economy, for example through reduced costs to health and social services.

- **Option value:** This is the value that people are potentially willing to pay to maintain the option of enjoying something in the future, even though they may not use it at present.

- **Non-use value of fish stocks:** Values referring to enjoyment and WTP that people may have for a resource existing, even though they do not use the resource in any way. It may be for maintaining something for future generations (bequest value) or simply for their personal benefit (existence value).

- **Non-use value of angling:** Values individuals may derive from knowing that others and future generations will be able to participate in angling.

WTP estimates presented here are likely to include elements of all of the above, with the possible exception of producer surplus and economic rents.

Economic impacts such as expenditure and jobs cannot be added to welfare benefits such as producer and consumer surplus, as they approach the assessment from different viewpoints.

8.3 Health and social welfare

The survey of anglers revealed that on average, anglers believe they gain the same physical exercise from angling as from an alternative activity if they could not fish: 31 per cent of anglers would gain more exercise from angling, 36 per cent would gain the same amount of exercise, and 33 per cent would gain more from an alternative activity.

Although it could be argued that angling probably is beneficial for some anglers as a physical activity, overall there does not appear to be any obvious increase in the level of physical exercise in angling rather than in an alternative activity (if anything, the alternative would involve slightly more physical activity).

Anglers obtain a variety of other benefits from their angling. Relaxation and a "break from everyday life" appear to be amongst the most important ones. This suggests a range of psychological benefits associated with angling, which may be substantially more important than physical benefits. However, psychological benefits from alternative

activities were not explored in this assessment. Further work on the psychological and social benefits of angling would be required to confirm this tentative conclusion.

8.4 Survey of the general public

8.4.1 Attitudes, perceptions and uses of rivers

Initial questions in the general public survey revealed a number of interesting points on the ways in which respondents use rivers, and their attitudes towards and perceptions of rivers. For example, 79 per cent of respondents said they "walked by rivers". Perhaps unsurprisingly, the Thames, Mersey and Severn were particularly well-known and heavily visited. The Wyre, Itchen and Ribble were less well-known and visited.

There was a tendency for respondents to perceive rivers as being in a substantially worse state than the rating assigned to them in this study would suggest. This could indicate that people are poorly informed, simply unaware, or out-of-date in their knowledge of rivers. In particular, the Derwent and Teifi were perceived as being of lower quality than their ratings, whereas the Mersey received surprisingly positive responses relative to its (bottom) rating.

Just over half (51 per cent) of respondents believed that members of their household "*would personally benefit if actions were taken to increase the number of fish in rivers across England and Wales*".

8.4.2 Contingent valuation method: impact of a severe decline in salmon

Results showed that the potential value of maintaining salmon stocks in England and Wales was substantial. The mean WTP to prevent the "severe decline in salmon populations across all of England and Wales" was £15.80 per household per year. This aggregates to a total WTP of around £350 million per year, equivalent to a present value of around £6 billion. Removing the highest and lowest five per cent of WTP values gave a "trimmed mean" WTP of £11.47 (a reduction of 27 per cent).

Various relationships were found to help explain which types of people were willing to pay the most (or least) for fish stocks. Notably:

- boat users, walkers and anglers had a higher WTP than non-users of rivers;
- WTP for salmon increased as household income increased;
- respondents with at least some educational qualifications had a higher WTP;
- respondents with children tended to have lower WTP than those without;
- older respondents tended to have higher WTP than younger people;
- respondents who stated that they understood the survey well had higher WTP;
- WTP was higher for income tax payment rather than water bill rates.

The negative results from this analysis are also interesting; the following variables had no significant influence on WTP:

- other uses of rivers (such as jogging, bird-watching);
- membership of an environmental group (although expressing a concern for the environment *did* have an impact);
- gender;
- employment status;
- region of residence;
- distance to nearest river.

Fish welfare considerations did not appear to be important in determining WTP.

Given that there are 75 salmon rivers, one could say that maintaining salmon on each river has, on average, a value of £0.21 per household per year. This aggregates to a national WTP value for England and Wales of around £4.7 million per year per river, equivalent to a present value of around £80 million.

However, household WTP for a nominated salmon river was found to decline as the distance from the river increased. As shown in Figure 8.1, on average it declined from £0.31 per household per year for those living immediately next to a river, to £0.20 per household per year for households living 70 km or more from the river. Households were found to be willing to pay for rivers up to 459 km from where they lived, the longest distance tested.

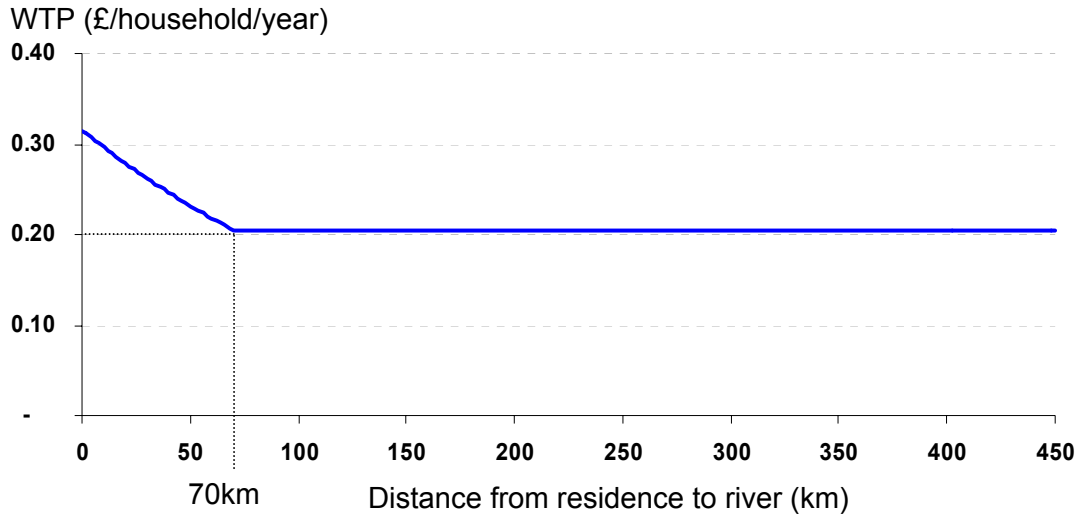


Figure 8.1: Distance decay function for WTP to prevent a serious decline in salmon populations in the nominated river

WTP also appeared to be affected by river length. WTP tended to be higher for longer rivers than for shorter ones. For example, a river that is only 25 km long would have an expected WTP ten per cent lower than the overall average. Conversely, a river that is 150 km long would have an expected WTP 12 per cent higher than the overall average. WTP did *not* appear to be affected by whether the river was in an urban or rural setting, or whether it had protected status for salmon.

8.4.3 WTP for named individual rivers

As part of the study, a model was established to help apportion the overall national value of preventing a 95 per cent decline in salmon numbers between individual salmon rivers. The model was based on WTP values for households at different distances from the rivers, adjusted by a factor for river length. Rough estimates of the contributions made by three named rivers were as follows:

- rhe River Wye is estimated to contribute £4.9 million per year;
- the River Thames is estimated to contribute £3.2 million per year;
- the River Wyre is estimated to contribute £2.2 million per year.

Care should be taken when interpreting and using these results (see Section 6.3.7).

8.4.4 Choice experiments: Relative value of different changes

WTP values derived from CE for *individual rivers* were of similar magnitude to WTP value found in the CVM survey for preventing the loss of salmon in *all rivers* across England and Wales. Possible explanations for this apparent anomaly include the embedding effect, whereby respondents may not have properly adjusted their responses to allow for the fact that only one river was being asked about rather than all rivers, and the warm glow effect whereby respondents were simply willing to pay an amount, regardless of the specific benefit they would derive.

Alternatively, this discrepancy could suggest that CVM results were underestimates of true WTP for some reason.

It was decided that CVM WTP values should be adopted and focused on in this study (rather than WTP derived from CE) because: they appeared more intuitively reasonable; they maintained their rationality when analysed in more detail; and they were more conservative.

The CE model yielded a reasonably reliable set of factors to establish the relative difference in WTP values between four levels (good, moderate, poor and dead/none), for three attributes (salmon, other fish and river quality).

This technique explicitly separated WTP for salmon from WTP for other aspects of river quality/fish stocks. The three attributes had fairly similar WTP levels, implying that if river quality changed alongside a change in salmon stocks, WTP would be around two to three times higher than where salmon stocks changed independently.

Figure 8.2 illustrates WTP for a change between the lowest level of each attribute (dead/none) and the highest level (good), standardised so that the largest possible change is represented as 100 per cent. Coloured bars represent WTP for moving between each of the interim levels within this larger change (dead/none to poor; poor to moderate; moderate to good).

Results broadly exhibited an S-shaped curve.

There was no little or no difference between preferences for the lowest two levels (dead/none and poor). Respondents may have only been prepared to pay if they felt that investment would achieve worthwhile results. This implies that policies aimed at improving rivers from a dead state to a poor state would have little or no impact on welfare. Policies to improve salmon stocks from a no salmon state to a poor state would have a modest positive impact on welfare.

Moving from poor to moderate had a large impact on WTP. This implies that policies maximising the number of rivers in a moderate state or better would have a large impact on welfare.

For both the river quality and salmon attributes, declining marginal utility set in between moderate and good, with this change being valued less highly than the change from poor to moderate. Policies and actions that improve rivers from a moderate state to a good state should nevertheless have an additional positive impact on welfare.

Figure 8.2: Relative WTP to move between different levels of each attribute

These results can be used in a variety of ways; for example, to adjust the values attributed to individual rivers to allow for current levels of salmon in those rivers, or in benefits transfer exercises (see below).

Substantial loss aversion was also found, meaning that respondents were WTP significantly more (perhaps two to three times as much) to prevent a loss in quality than they would to achieve a comparable improvement in quality.

8.5 Using the results for benefits transfer

Outputs from both the CVM and CE analyses could also provide useful information for valuing other salmon, fish and river quality scenarios through a benefits transfer approach, allowing the analyst to adjust WTP results according to differences in individual characteristics, river characteristics and location between the new study site and the sample assessed in the current study (note that the usual caveats on the use of benefits transfer would apply). In particular:

- Table 6.9 presents adjustment factors that could be used to adjust WTP estimates to allow for different types of user (for example, to indicate how WTP might differ in a sample with lower average income than the sample used here);
- Table 7.5 provides a useful and relatively robust set of adjustment factors that could be used to adjust WTP to allow for different degrees of changes in the status of salmon stocks, other fish and general river quality.

9 Recommendations

9.1 Use of results

The overall results of this study including their potential uses, the economic framework, and the valuation results should be disseminated to interested and affected groups, to make them aware of the diverse and significant value of inland fisheries. This is likely to require the production of a summary report.

Results can be used for cost-benefit analysis and prioritisation of fishery management measures in a number of policy areas, including the Water Company Periodic Review 2009, the Water Framework Directive, Salmon Action Plans and policies to tackle potential fish diseases such as *Gyrodactylus salaris*. Results may also be useful for applications for additional funding for fisheries management.

However, results may only be used to evaluate situations where the scenario under valuation is similar to that assessed here (in terms of the nature, magnitude and context of the environmental change being assessed), and where the population under assessment has similar characteristics to the sample here. In some cases, it may be possible to use the adjustment factors derived from the CVM and CE to adjust for differences in these aspects, through a benefits transfer approach.

The overall national value determined using the CVM approach for preventing a serious decline in salmon numbers (£350 million per year) can be used with relative confidence. If there were difficulties in separating WTP for salmon from WTP for other aspects of river quality, this would be an overestimate of WTP for salmon. However, the scenario for evaluation was designed to avoid such difficulties.

Values calculated for individual rivers are useful as indicative values, but need to be used with some caution, as there may be inaccuracies and possible overestimates given that the stated preference survey was not designed for this purpose; for example, substitution effects may have led to these being overestimates.

Similar values for other individual salmon rivers could be calculated using the method developed in this study, based on the distance decay relationship found, the way in which WTP varies by river length, and the relationship between WTP and current salmon stocks as derived from the CE. The top-down approach used to derive these figures should be borne in mind when interpreting these findings.

As well as potentially feeding into a benefits transfer approach, the econometric modelling undertaken in the CVM also provides information on the types of people with a high WTP and factors affecting the size of WTP. Together with the initial and follow-up questions, this provides insights into the balance between use and non-use motivations for holding values. Initial questions also provide information about the ways in which people use rivers, and their attitudes towards and perceptions of rivers. These results are all considered to be relatively robust.

The CE approach provides information on the relative magnitudes of values associated with different levels of salmon stocks, other fish populations and general river quality. These factors can also be used with some confidence. However, consideration of loss aversion was relatively simplistic. With some cases, these could be combined with the CVM headline results to determine ballpark estimates of WTP for other scenarios involving changes in the level of provision of salmon, other fish and river quality. CE results have implications for the management targets that should be set for rivers.

9.2 Areas for further research

The psychological, mental health and social benefits associated with angling need to be further explored, perhaps through case studies, as they are potentially important yet poorly understood values.

Further work to establish more up-to-date angling consumer surplus values could be usefully conducted. This could potentially be achieved using travel cost data from the angler questionnaire survey described in Module B, or through a new survey, perhaps in conjunction with an assessment of psychological and social benefits.

The distance decay effect is of key importance when aggregating values to find an aggregated value for the population. This study has added to the literature on this subject, but further investigation would be beneficial.

Given the difficulties in separating WTP for salmon from WTP for other aspects of river quality, additional investigation may be useful to feed into policy decisions that relate to fish stocks independently of general environmental quality (such as assessing the welfare impacts of fish disease).

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List of abbreviations

ACA	-	Anglers' Conservation Association
BAG	-	Benefits assessment guidance
CBA	-	Cost-benefit analysis
CE	-	Choice experiments
CEA	-	Cost effectiveness analysis
CLM	-	Conditional Logit Model
CV	-	Compensation variation
CVM	-	Contingent valuation method
DARD	-	Department of Agriculture and Rural Development for Northern Ireland
Defra	-	Department of Environment, Food and Rural Affairs
EA	-	Environment Agency
EqV	-	Equivalent valuation
FAP	-	Fisheries Action Plan
GES	-	Good ecological status
IHN	-	Infectious haematopoietic necrosis
LA	-	Local authority
NASCO	-	North Atlantic Salmon Conservation Organisation
NAWAD	-	National Assembly for Wales Agriculture Department
NGO	-	Non-governmental organisation
ODPM	-	Office of the Deputy Prime Minister
OFWAT	-	Water Services Regulation Authority
OLS		Ordinary least squares
PRO9	-	Periodic Review Process 2009
RDA	-	Regional development agency
RE	-	The river ecosystem classification system, which uses levels of chemical indicators (oxygen, ammonia, copper and zinc, as well as pH and biochemical oxygen demand) to classify the status of inland freshwaters
RPM	-	Random Parameters Model
SAC	-	Special Area of Conservation
SAP	-	Salmon Action Plan
SEERAD	-	Scottish Executive Environment and Rural Affairs Department
SSSI	-	Site of Special Scientific Interest

TEV	-	Total economic value
ToR	-	Terms of reference
VHS	-	Viral haemorrhagic septicaemia
WAG	-	Welsh Assembly Government
WFD	-	Water Framework Directive
WTA	-	Willingness to accept compensation
WTB	-	Wales Tourist Board
WTP	-	Willingness to pay

Glossary

All-or-nothing value	The entire value of a resource in its current state (as contrasted with a marginal value).
Benefits transfer	The method of transferring benefit or value estimates from past valuation studies to the present study, in order to reduce appraisal costs.
Bequest value	The value that people place on knowing that future generations will have the option to enjoy something.
Cheap talk	A means of obtaining unbiased responses to a survey, by explicitly highlighting the hypothetical bias before participants make any decisions.
Choice experiments	Used to determine WTP. Their strength is their ability to provide a rich set of results by assessing a variety of different ways in which a resource's quality might vary. They describe the resource in terms of its attributes (or characteristics) and the levels that these take (such as good, moderate or poor). They can be used to assess the value associated with a change in any of these characteristics.
Compensation variation	Considers what is financially required to restore the individual to his/her original welfare position after a change has occurred. For a change that leaves individuals worse off, CV measures the financial compensation that is required to restore the original position. For example, the compensation an individual would demand to be content to allow a fish disease outbreak to occur is their WTA for the outbreak, which corresponds to the CV measure of the change in their wellbeing.
Consumer surplus	The difference between the amount currently paid for a good or service and the maximum amount that an individual would be willing to pay.
Contingent valuation	Determination of WTP for a specified environmental resource or a change in the resource, through use of structured questionnaire in which respondents answer "yes/no" to suggested prices (dichotomous choice or payment ladder) or provide a WTP number themselves (open-ended).
Direct use value	Determined by the contribution an environmental asset makes to current production or consumption through direct use of the site (such as recreation and wood harvesting).
Economic appraisal	Appraisal which seeks to quantify and where possible estimate the welfare impacts from the costs and benefits of a project or policy.
Embedding effect	The embedding effect is a phenomenon of contingent valuation studies, whereby the value of a good decreases when it is offered together with several other goods, compared to when it is offered alone.
Equivalent variation	Considers what is financially required to leave the individual as well off without the change as he/she would be with the change.

	If a change decreases wellbeing, the EqV measure is the maximum amount the individual would be willing to pay to prevent the adverse change from occurring. For example, WTP to avoid a fish disease outbreak corresponds to the EqV measure of the change in their wellbeing.
Existence value	The non-use value that people place on simply knowing that something exists, even if they will never see it or use it.
Hypothetical bias	People's tendency to cite higher WTP in hypothetical scenarios than they would actually pay in real life.
Marginal value	The value of a specified change in the quantity or quality of a resource.
Net present value	Present value (PV) is the capitalised value of a stream of future costs or benefits, that is, the discounted value of future costs and benefits. NPV is the discounted benefits minus the discounted costs.
Non-anthropocentric intrinsic value	The intrinsic value of the environment, in and of itself and not as assigned by human judgment. This falls outside the realms of economic theory.
Non-use value	Effectively the change in satisfaction or enjoyment derived by an individual associated with changes in the quality or quantity of an environmental asset, despite that person not necessarily visiting or using the asset.
Option value	The value that people place on having the option to enjoy something in the future, although they may not currently use it.
Present value	The capitalised value of a stream of future costs or benefits, that is, the discounted value of future costs and benefits.
Stated preference studies	Methods of putting dollar values on something (e.g. air quality) that relies on asking people to reveal their values through some type of survey or questionnaire.
Total economic value	The sum of all the relevant use and non-use values for a good or service.
Use value	The value derived from the actual use of a good or service, such as hunting, fishing, bird-watching or hiking.
Warm glow	Offering a WTP amount may give a good feeling to the respondent, irrespective of whether they are genuinely concerned with what the change actually is.
Willingness to accept	A similar concept to willingness to pay, measuring the minimum amount of compensation consumers would be willing to accept for foregoing units of consumption.
Willingness to pay	The amount that someone is willing to give up or pay to acquire a good or service.

Annex 1: General public questionnaire

See following 13 pages (labelled A1-A13).

Annex 2: Issues facing stated preference surveys

This annex summarises some of the main technical issues facing stated preference surveys and includes brief notes on how they have been dealt with here:

1. **Effect of substitutes**
   Respondents need to consider the presence of substitute sites when deciding on their WTP. They are not always good at doing this. This was a much less serious issue for CE than for CVM.

2. **Scope effects and marginal/incremental changes**
   Respondents are often WTP for a minimal amount of environmental improvement, but then unwilling to pay for additional improvements beyond this. CE tackled the issue of incremental changes more effectively than CVM.

3. **Embedding and part-whole effects**
   The embedding effect occurs when respondents become confused between a good and a larger embracing good (such as an individual river and an entire catchment area). Part-whole effects occur where the sum of respondents' values for a number of individual goods is higher than their value for a bundle of the same goods. This was tested for using a CVM survey on the whole of England and Wales and a question to ask how much of this WTP was attributable to the nominated river.

4. **Distinguishing between non-use values for ecosystem quality and non-use values for fish stocks**
   There is potential for overlap between the non-use value of a general improvement in environmental quality and the non-use value of fish stocks specifically (or, thirdly, the non-use value of angling as an activity). There is a danger of a form of embedding effect; in attempting to quantify the non-use value of fish stocks, this was likely to become confused in respondents' minds with the non-use value of environmental quality (a larger, embracing concept).

5. **Income constraints**
   Household income constraints can become an issue when summing WTP for a number of different improvements. However, it is unlikely that this was a major issue for this survey, as the WTP amounts were a very small proportion of household income. Checks were run at the end of the survey, to ensure that respondents were really WTP what they said they were.

6. **Warm glow effects**
   Some people's WTP might relate to the positive feeling they obtain from answering the question, rather than representing a genuine concern for the environmental issue in question. This problem is hard to avoid and links to the embedding effect described above. The explanatory text reminded people that the payment they would make would impact upon their ability to buy other goods and services, so that their responses were more realistic. We also tested for the embedding effect.

7. **Sequencing effects/path dependency**
   These issues occur where scheme benefits occur in sequence over a period of time, and the timing impacts on the WTP stated.

8. **Estimating the number of beneficiaries/distance decay effects**
   After we estimated WTP per person, we needed to know how many

beneficiaries to multiply this figure by, for example, over how wide a geographical area did WTP apply? This linked to the concept of distance decay, which occurs when WTP declines as distance from the river in question increases. The survey design allowed an explicit test for distance decay.

9. **Respondents' understanding and perception**
   Respondents were not familiar with the environmental changes under discussion, and they were extremely unlikely to be able to relate to the specific changes being assessed for specific policy measures (such as the definition of "good ecological status" under the WFD). This is sometimes called "information bias". This was a serious issue here, and was highlighted in the focus groups. To help with this, respondents were presented with information about the river and graphical information on its different states. In addition, the survey design was kept as simple as possible to ease the conceptual requirements of respondents. The analysis included testing for whether WTP varied according to how well people understood the survey. The survey also included a number of "traps" to identify respondents who gave illogical or inconsistent responses, so that these could be removed if necessary.

10. **Payment vehicles and how projects are delivered**
    The payment vehicle (water bills or tax) needs to be relevant and credible. It also needs to be incentive compatible; for example, voluntary donations may not be incentive compatible if respondents do not believe that they would ever have to pay the sum stated, which may prompt them to answer a higher amount (also known as hypothetical bias).

11. **Ethical protests and zero bids**
    Respondents may refuse to give a WTP value or give a bid of zero, not because they have no value for the change, but because they are protesting or feel that it is impossible to put an actual sum on such a value. Q15/15a and Q17 of the questionnaire asked respondents for the reasons for their choices, so that protest votes could be identified and removed if appropriate.

12. **Accounting for socio-economic composition/variety**
    There is a need to ensure that respondents are representative of those affected. Quota sampling was employed on age, gender and working status.

13. **Conversion of non-users to users**
    SP studies could convert some non-users into users, either because the proposed improvements in the river persuade more people to use the river, or because telling people about a site they were not aware of makes them more likely to use it in future. This problem is difficult to avoid or to quantify. However, this survey measured both use and non-use values, so both types of value were valid and hence any "conversions" were less of a worry.

Annex 3: Comparison of CVM and CE methods

	Contingent valuation method	Choice experiment
Advantages	Well-suited for finding WTP for all-or-nothing values. Concentrates on a single question; can be made incentive compatible though choice of payment vehicle. Can provide information in a way that respondents can relate to. Can include follow-up questions to check whether people are really WTP the amount they state they will. Long pedigree, thousands of applications.	Assesses people's trade-offs between attributes; a more natural decision for respondents than asking about WTP directly (as in CVM). Can avoid ethical protests on payments. Ideal for finding WTP for incremental changes, and hence for finding the impacts of policies on welfare (see Adamowicz *et al.*, 1994) Can cope with a number of different attributes and levels. Gives flexibility to model complex scenarios and multiple trade-offs simultaneously. More suitable for use in benefits transfer because handles variations in characteristics better and assesses a wider range of policy options (Environment Agency, 2006). Can explicitly include substitution possibilities in the choice set. Obtains more data per respondent, so generates more results for given sample size, with better statistical significance.
Dis-advantages	Questions over the robustness of CVM results, given information bias, embedding effect etc.; the task is conceptually alien to respondents. Less detail over the value of incremental changes; although it can be used to model trade-offs between attributes, it is not ideal for this, or for generating results that can be applied to different situations in benefits transfer. Relies on respondents allowing for substitution possibilities on basis of information provided – studies have shown this is a problem (see Boxall *et al.*, 1996). Requires large sample sizes. Possible bias from anchoring/ starting point and other biases.	Not ideal for calculating WTP for all-or-nothing scenarios. Respondents may engage in strategic behaviour as they progress through long CE instruments (Bateman *et al*., 2004) Suffers from information bias; may be more or less serious than for CVM (CE is conceptually more familiar, so less knowledge is needed; but it is harder to provide user-friendly information on the scenario being considered, e.g. it is harder to use graphical devices). The CE format may induce spurious preferences if responses are "obvious". Difficult to do follow-up questions to check whether WTP is genuine as do not know WTP until analysis done. There is a limit to number of options respondents can handle, especially when comparing tangible/non-tangible items.
Example studies	Radford, Spurgeon *et al.* (2001): Economic evaluation of inland fisheries. Simpson and Willis (2004): Heritage value of fisheries.	Hanley *et al.* (2003): Economic value of improvements in river ecology for the WFD. Carlsson *et al.* (2003): Valuing wetland attributes.

Annex 4: Other attributes considered for CE, but not used

(i) **Overall salmon stocks in England & Wales:** Would distinguish WTP for the local river from WTP for fish in England & Wales in general. Not required, as the CVM survey deals with this.

(ii) **Overall stocks of other fish in England & Wales:** Similar to above.

(iii) **The size of fish:** Previous studies have shown this to be an important determinant of anglers' WTP (see Lawrence, 2005). However, was thought unlikely to be a major influence on the size of non-use values.

(iv) **Access/facilities** at the site. This is only relevant for use values and was likely to confuse or bias our estimates of non-use values.

(v) **The number of fish in a specific river a long distance away** from the respondent's home. Not required, as the distance decay effect was dealt with by sampling at a variety of distances from the river.

(vi) **Angling in [River X]:** Would tell us about the non-use value of angling as an activity, that is, whether people were interested in the fish themselves, or in the ability of people to go angling for these fish. This would be interesting, but was decided not to be a key result for this study. There was also a danger of confusion between use and non-use values.

(vii) **Presence or absence of rare/endangered species**: Non-use values for preserving rare species might potentially be considerably higher than non-use values for ensuring that stocks of angling species were kept at a healthy level. This was examined further in the focus groups, but no clear preference for rare species emerged; respondents appeared confused when asked about species they had not heard of.

Annex 5: Focus group summary report

Rainbow Research, Preston, 30th May 2006

Group 1

Six respondents:

- two anglers;
- five people who visit rivers regularly (five or more times in the last six months);
- all respondents 45 years or older (mix above this age);
- mix of gender.

Group 2

Seven respondents:

- all non-anglers;
- all people who do not visit any rivers frequently (less than five times in the last six months) and do not live near a river;
- all respondents 45 years or younger (mix below this age);
- mix of gender.

Rivers/fish in general:

- rivers are an important part of anglers lives, less so for non-anglers;
- anglers are concerned with the quality and number of fish in the Ribble;
- anglers commented on increasing number of fishermen over recent years on the Ribble, improved fish stock, more cormorants and wildlife in general indicating increasing numbers of fish;
- non-anglers (general public) are concerned with the look of the river area for walking etc.; they have less knowledge of fish, rivers and wildlife, although good fish stock and environmental quality is still important to them due to the 'feel good factor' and food chain;
- all respondents stated good environmental quality is an indicator that the river contains high numbers of quality fish.

Maps:

- anglers are more aware of the Ribble/have local knowledge; they read *Angling Times* and watch local match reports, compared to rivers further a field;

- respondents would prefer a honed-in map of the local area, the North West, to identify their local river (rather than UK map) – provides more information on the size, location and so on of river;
- rivers in areas further afield are relatively foreign – little/no knowledge – difficult to answer detailed questions on these (all seen as 'other' rivers to local one); consider questioning on local river and 'other' rivers in the UK as a whole, depending on the importance of 'distance' mapping;
- important to include place names next to rivers for geographical identification;
- coloured map more preferable – clearer!
- howeve,r consider questioning the purpose of a map and what it is trying to achieve during the interviews, given respondents categorise 'local' river and 'other' rivers;
- River Ribble differs environmentally/in fish stock at different parts, so respondents would have difficulty in answering questions on whole river catchments and all its tributaries;
- they can more easily identify with (and have more knowledge of) the length of river in their immediate residential vicinity.

Fish:

- currently respondents perceive there to be few salmon in the River Ribble, mainly trout;
- anglers were able to name different species such as barbel, salmon, trout, however general members of the public see fish as fish, although most agreed that to see salmon jumping from the river would be 'something special'!
- anglers are aware of disease in Carp (F1 & F2) – now bred to be resistant to disease;
- all would prefer to see healthy fish, and good quality environment - feel good factor;
- number and quality of fish are important to all – anglers for fishing and feel good factor and non-anglers for general environment (such as for walking);
- respondents see the quality of the environment (including wildlife) and fish stock as linked attributes – one indicates the other;
- elimination of all fish from rivers across the UK due to a viral disease is believable by all respondents. Reactions include – sad, awful, believable;
- fish in rivers is not something that is at the forefront of the general public's minds. If informed of problems, they will believe and listen, but not currently an unprompted concern;
- most (particularly anglers) would be concerned if there was any reduction in fish stock from UK rivers (even down to 25 per cent) – reduced feel good factor, less fishing, loss of revenue;
- 100 per cent loss is a disaster – no going back; whereas 25 or 50 per cent provides an opportunity to breed – this needs explaining;
- one respondent commented that fish stocks declining to him represent fish in the sea (trawlers) and not fish in rivers (single anglers);

- more concerned about reductions in local rivers than rest of the UK, however most would like to see healthy rivers/fish throughout ;
- benefits of the presence of salmon include tourism (leaping salmon), attracts walkers, indication of healthy environment, more wildlife, peace of mind, education for children.

Payment:

- respondents see the Environment Agency as responsible for funding such issues as fish disease in UK rivers;
- they initially felt fishing licence charges should contribute to such issues (pay £24 per year), and some questioned 'why more taxes?' saying others (members of the public) should not be forced to pay;
- farmers (and other industries) were thought to contribute to problems with fish stock (e.g. insecticide) and were therefore also thought to be responsible for contributing financially;
- however, most (both anglers and non-anglers) stated they would be willing to pay extra to prevent fish disease in local rivers and rivers throughout the UK − acceptable as most use the river for one reason or another and agree that improvements cost financially;
- additions to water bills were not perceived as being as bad as additional tax charges – perceived wastage of government taxes, lack of trust in spending;
- however, some felt it would be hypocritical of water companies to charge more, given recent publicity relating to wastage via leaks;
- Government would need to be accountable for the charge, with breakdown of proposed spend, reasons for charge, eventual improvements shown, guarantee taxes would be spent on proposed cause (cynical government spending);
- suggestion that taxes paid should go to the local area, rather than nationwide;
- if the public were aware of noticeable difference/improvements over time, for example with illustrations in local paper of salmon jumping out of the river, all stated they would be happy to pay;
- however, some (minimal) concern that different people in different circumstances would have to pay the same amount;
- amounts up to around the £50 mark were stated as acceptable, anything upwards from here would cause problems for the general public.

Illustrated rating scales:

- both pictures and textual explanations of rating scales required;
- in the main, current proposals illustrate the required rating scales successfully;
- some, however, suggested including wildlife such as kingfishers in environmental pictures to illustrate a healthy environment;
- pictures need to be a true reflection, for example for salmon illustration of 'moderate' shows one salmon – respondents suggest showing higher numbers; for other fish, illustration of 'good' fish shows two fish and 'moderate' shows two fish also – respondents suggest there should be more of a difference here;

- the scales state the number of salmon, however for other fish no numbers are shown – consistency is required;
- it is not clear as to whether the numbers of salmon stated represent the whole river or part of the local catchment area – clarity required;
- the picture illustrating the 'river beyond repair' for environmental quality is perceived to look like a tide – consider using an alternative shot;
- it is acceptable that illustrations are not specific to the Ribble but representative of rivers in general;
- numbers of fish stated should be believable − the example suggests the Ribble currently contains a 'moderate' number of salmon, that is, 1,700. Respondents, particularly anglers who have some knowledge of the current state of the river find this difficult to believe – this needs some consideration, otherwise respondents will be cynical about other facts on the questionnaire.

Choice cards:

- when provided with choice cards, respondents questioned many aspects of the fish stock and fish disease issues such as disease origin, disease form, culls, cures, spend, management plans. All should be clarified where possible;
- should respondents receive more information on the proposed spend in this area, for example £40 = £10 on banks, £10 on birds, £10 on fish, £10 on bridges, they seem more willing to agree to an increase in tax/water charges;
- however, guarantees of spend in the 'fish stock' area and not for example on Iraq, would also provide peace of mind and willingness to pay;
- most stated they would be willing to contribute due to their concern for potentially diminished rivers/fish stock;
- respondents stated it was clear that choice card questions related to the Ribble only and not rivers in the UK;
- choice cards are clear, choices could be easily made;
- majority of discussions around choice cards related to issues about payment amounts;
- need to know how long payments would need to be made (for ever). They believe unless otherwise told, they perceive it will be for ever;
- concern that anglers may object due to current licence payment, and public may object due to not using the river;
- concern over industry contribution to problems, some perceive they should contribute to payment;
- one comment "*Environment Agency taken to court and prosecuted for polluting rivers*" – PR issues for some, mainly anglers;
- as said earlier, with proof, guarantees, explanations, most stated they would be willing to pay up to £50/year/household, beyond which there would be issues!
- scenario relating to 'no additional payment = decline in environmental quality, maintaining additional tax = current state, larger increase = enhancing river above its current state' is more believable than getting a tax rebate (less/not believable), otherwise most believe what they're told, as long as it's convincing.

Annex 6: Data used to categorise current river quality

This annex outlines the data used to determine the current ratings of the 12 rivers.

Other fish rating

Source: *Water Framework Directive: FAME output, England & Wales indices* (Class Statistics and GIS Group: National Fisheries Technical Team, 2004).

FAME rating	Rating used here
Mostly 1 (high) or 2 (good):	Good
Mostly 3 (moderate):	Moderate
Mostly 4 (poor), could have some points that are five (bad)	Poor
Mostly 5 (bad)	No fish

River quality rating

Source: *General quality assessment (GQA): Biological river quality* (Environment Agency, 2005).

GQA rating	Rating used here
Mostly a (very good) & b (good)	Good
Mostly c (fairly good) & d (fair)	Moderate
Mostly e (poor) & f (bad)	Poor
No rivers were categorised “dead”	Dead

Salmon rating

Source: CEFAS and Environment Agency (2006).

Current salmon ratings were based on CEFAS and Environment Agency data on the number of eggs in each river in 2005, as compared to the management target. Rivers were generally classified as being “good” if they had more than 80 per cent of the management target in 2005 (some had considerably more); “moderate” if they had 25-80 per cent of the target; “poor” if they had significant eggs but less than 25 per cent of the target; and “no salmon” if they had only nominal numbers of eggs. However, as stock levels can vary substantially from one year to the next, adjustments were made to classifications in some cases according to expert judgement. Most notably, the Taff was classified as having “poor” salmon despite reaching 73 per cent of its target in 2005, as its stock levels were considerably lower in all previous years and 2005 was considered exceptional for this river (Environment Agency, personal communication).

Annex 7: Final model outputs

This annex provides the output from NLogit (© Econometric Software Inc.) of the main models used in this report, including diagnostic information where relevant.

Stage 1: Final model (Ref A20)

```
--> LOGIT ; Lhs = PAY
          ; Rhs = ONE, _LOCATI2, WalkFreq, INCTAX, UNDSTAND,
          AGE, CHILDREN, EDUC, INCOME
          ; HET
          ; Marginal effects $
Normal exit from iterations. Exit status=0.

+--------------------------------------------+
| Multinomial Logit Model                    |
| Maximum Likelihood Estimates               |
| Model estimated: Jan 15, 2007 at 10:00:15PM.|
| Dependent variable                  PAY    |
| Weighting variable                 None    |
| Number of observations              594    |
| Iterations completed                  6    |
| Log likelihood function       -298.4833    |
| Restricted log likelihood     -370.7758    |
| Chi squared                    144.5851    |
| Degrees of freedom                   11    |
| Prob[ChiSqd > value] =          .0000000    |
| Hosmer-Lemeshow chi-squared =   6.77073    |
| P-value=  .56156 with deg.fr. =       8    |
+--------------------------------------------+

+---------+--------------+----------------+--------+---------+---------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]|Mean ofX|
+---------+--------------+----------------+--------+---------+---------+
          Characteristics in numerator of Prob[Y = 1]
 Constant     -2.93451899      .64887322    -4.522   .0000
 GLYNNE       -3.28648759      .78440781    -4.190   .0000   .03535354
 SALISBU      -1.82769815      .45992378    -3.974   .0001   .04208754
 SEVENOA       2.38012354     1.05600118     2.254   .0242   .03198653
 WHITEHA      -1.24759741      .59945083    -2.081   .0374   .02188552
 WALKFREQ       .65777621      .13136353     5.007   .0000   .27609428
 INCTAX         .55847798      .25718350     2.172   .0299   .79797980
 UNDSTAND       .22860483      .10547521     2.167   .0302   .29461279
 AGE            .01636643      .00606274     2.700   .0069  5.7424242
 CHILDREN      -.22864681      .11164253    -2.048   .0406   .56397306
 EDUC          1.04577964      .24865667     4.206   .0000   .75757576
 INCOME       .127062D-04    .675116D-05     1.882   .0598  26871.8138
```

```
+---------------------------------------------------------------------+
| Information Statistics for Discrete Choice Model.                   |
|                            M=Model MC=Constants Only   M0=No Model  |
| Criterion F (log L)     -298.48327        -370.77584    -411.72943 |
| LR Statistic vs. MC      144.58514            .00000        .00000 |
| Degrees of Freedom        11.00000            .00000        .00000 |
| Prob. Value for LR           .00000            .00000        .00000 |
| Entropy for probs.       298.48328         370.77584     411.72943 |
| Normalized Entropy           .72495            .90053       1.00000 |
| Entropy Ratio Stat.      226.49230          81.90716        .00000 |
| Bayes Info Criterion     667.22222         811.80736     893.71452 |
| BIC - BIC(no model)      226.49230          81.90716        .00000 |
| Pseudo R-squared             .19498            .00000        .00000 |
| Pct. Correct Prec.        76.26263            .00000      50.00000 |
| Means:       y=0    y=1    y=2    y=3    yu=4   y=5,    y=6   y>=7 |
| Outcome     .3165  .6835  .0000  .0000  .0000  .0000  .0000  .0000 |
| Pred.Pr     .3165  .6835  .0000  .0000  .0000  .0000  .0000  .0000 |
| Notes: Entropy computed as Sum(i)Sum(j)Pfit(i,j)*logPfit(i,j).      |
|        Normalized entropy is computed against M0.                   |
|        Entropy ratio statistic is computed against M0.              |
|        BIC = 2*criterion - log(N)*degrees of freedom.               |
|        If the model has only constants or if it has no constants,   |
|        the statistics reported here are not useable.                |
+---------------------------------------------------------------------+

+----------------------------------------+
| Fit Measures for Binomial Choice Model |
| Logit    model for variable PAY        |
+----------------------------------------+
| Proportions P0= .316498   P1= .683502  |
| N =     594 N0=     188   N1=     406  |
| LogL =  -298.48327 LogL0 =  -370.7758  |
| Estrella = 1-(L/L0)^(-2L0/n) = .23720  |
+----------------------------------------+
|     Efron |  McFadden  |  Ben./Lerman  |
|    .24134 |    .19498  |       .67014  |
|    Cramer | Veall/Zim. |     Rsqrd_ML  |
|    .23759 |    .35257  |       .21605  |
+----------------------------------------+
| Information  Akaike I.C. Schwarz I.C.  |
| Criteria        1.04540     673.60910  |
+----------------------------------------+
Frequencies of actual & predicted outcomes. Predicted outcome has
maximum probability. Threshold value for predicting Y=1 = .5000
            Predicted
------  ----------  +  -----
Actual       0    1  |  Total
------  ----------  +  -----
  0         78  110  |    188
  1         31  375  |    406
------  ----------  +  -----
Total      109  485  |    594

======================================================================
Analysis of Binary Choice Model Predictions Based on Threshold = .5000
----------------------------------------------------------------------
Prediction Success
----------------------------------------------------------------------
Sensitivity = actual 1s correctly predicted                    92.365%
Specificity = actual 0s correctly predicted                    41.489%
Positive predictive value = predicted 1s that were actual 1s   77.320%
Negative predictive value = predicted 0s that were actual 0s   71.560%
Correct prediction = actual 1s and 0s correctly predicted      76.263%
----------------------------------------------------------------------
Prediction Failure
----------------------------------------------------------------------
False pos. for true neg. = actual 0s predicted as 1s           58.511%
False neg. for true pos. = actual 1s predicted as 0s            7.635%
False pos. for predicted pos. = predicted 1s actual 0s         22.680%
False neg. for predicted neg. = predicted 0s actual 1s         28.440%
False predictions = actual 1s and 0s incorrectly predicted     23.737%
```

Stage 2: Final model (Ref M26)

```
--> REGRESS ; Lhs = LNWTP
            ; Rhs = ONE, _LOCATI2, BOATFREQ,
            EDUC, INCOME,
            _REGION3, WHY_WTP2
            ; HET $

*********************************************************************
* NOTE: Deleted    304 observations with missing data. N is now    403
*
*********************************************************************

+-----------------------------------------------------+
| Ordinary    least squares regression                |
| Model was estimated Jan 17, 2007 at 06:26:09PM      |
| LHS=LNWTP    Mean                 =   2.595760      |
|              Standard deviation   =   1.121446      |
| WTS=none     Number of observs.   =        403      |
| Model size   Parameters           =         14      |
|              Degrees of freedom   =        389      |
| Residuals    Sum of squares       =   415.8853      |
|              Standard error of e  =   1.033980      |
| Fit          R-squared            =   .1773957      |
|              Adjusted R-squared   =   .1499050      |
| Model test   F[ 13,   389] (prob) =   6.45 (.0000)  |
| Autocorrel   Durbin-Watson Stat.  =  1.7796735      |
|              Rho = cor[e,e(-1)]   =   .1101633      |
| White heteroscedasticity robust covariance matrix   |
| Br./Pagan LM Chi-sq [ 13]  (prob) =   8.31 (.8226)  |
+-----------------------------------------------------+

+---------+--------------+----------------+--------+---------+-------+
|Variable | Coefficient  | Standard Error |t-ratio |P[|T|>t]|Mean ofX|
+---------+--------------+----------------+--------+---------+-------+
 Constant      2.09473926      .14816453    14.138   .0000
 ABERYST        .49386267      .21494646     2.298   .0221   .07196030
 BLACKBU       -.69753994      .16346289    -4.267   .0000   .03722084
 KESWICK       -.58190576      .21597147    -2.694   .0074   .03473945
 SALISBU      -1.20804839      .32075358    -3.766   .0002   .02729529
 SOUTHAM       -.48402714      .23620673    -2.049   .0411   .04466501
 BOATFREQ       .33878168      .09938741     3.409   .0007   .22580645
 EDUC           .24706306      .12990809     1.902   .0579   .81885856
 INCOME       .360048D-05    .174643D-05     2.062   .0399  23325.3350
 W             -.31340409      .14816655    -2.115   .0350   .15632754
 W_MID         -.53892654      .17815166    -3.025   .0027   .10669975
 ENVCONC        .35296460      .11613607     3.039   .0025   .70223325
 ANGLING        .44408225      .21029774     2.112   .0354   .06699752
 EATFISH        .65172567      .22467546     2.901   .0039   .04962779
```

Distance decay: Final model (Ref AD13)

```
--> REGRESS ; Lhs = LNWTPX
            ; Rhs = ONE, BOATFREQ, WALKFREQ,
                    RIVDISTL,
                    LENGRIV
            ; HET $


*********************************************************************
 * NOTE: Deleted  429 observations with missing data. N is now   466 *
*********************************************************************


+-----------------------------------------------------+
| Ordinary    least squares regression                |
| Model was estimated Mar 13, 2007 at 02:23:29PM      |
| LHS=LNWTPX   Mean                 =   .5093957      |
|              Standard deviation   =   .9701696      |
| WTS=none     Number of observs.   =        466      |
| Model size   Parameters           =          5      |
|              Degrees of freedom   =        461      |
| Residuals    Sum of squares       =   402.3983      |
|              Standard error of e  =   .9342812      |
| Fit          R-squared            =   .8059282E-01  |
|              Adjusted R-squared   =   .7261532E-01  |
| Model test   F[  4,   461] (prob) =  10.10 (.0000)  |
| Autocorrel   Durbin-Watson Stat.  =  1.6714861      |
|              Rho = cor[e,e(-1)]   =   .1642570      |
| White heteroscedasticity robust covariance matrix   |
| Br./Pagan LM Chi-sq [  4]  (prob) =  60.37 (.0000)  |
+-----------------------------------------------------+
+---------+-------------+---------------+--------+---------+---------+
|Variable | Coefficient | Standard Error|t-ratio |P[|T|>t] |Mean of X|
+---------+-------------+---------------+--------+---------+---------+
 Constant     .38079397      .10298930     3.697   .0002
 BOATFREQ     .27209816      .12140684     2.241   .0255     .19098712
 WALKFREQ     .11921450      .04867271     2.449   .0147    1.30257511
 RIVDISTL    -.00614479      .00152534    -4.028   .0001    36.6887124
 LENGRIV      .00172089      .00067584     2.546   .0112    85.3004292
```

CE: RPM (Ref L4C)

```
--> NLOGIT          ; Lhs = CHOICE
                    ; Choices = WORST, MIDDLE, BEST
                    ; Rhs = NEGTAX , RGOOD, RMOD, SGOOD, SMOD, SPOOR,
FGOOD, FMOD, B
                    ; PDS = 8
                    ; RPL
                    ; FCN = NEGTAX ( L )
                    ; PTS = 100
                    ; HALTON
                    ; START =
    0.024,
    0.91564,
    0.792661,
    1.16408,
    0.893029,
    0.285905,
    1.21302,
    0.5505,
    1.21834         $

Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Start values obtained using nonnested model |
| Maximum Likelihood Estimates                |
| Model estimated: Nov 13, 2006 at 04:19:32PM.|
| Dependent variable               Choice     |
| Weighting variable                 None     |
| Number of observations             3432     |
| Iterations completed                  6     |
| Log likelihood function       -3124.228     |
| R2=1-LogL/LogL*  Log-L fncn  R-sqrd  RsqAdj |
| No coefficients  -3770.4374  .17139  .17018 |
| Constants only   -3443.1336  .09262  .09130 |
| Response data are given as ind. choice.     |
| Number of obs.=  3432, skipped   0 bad obs. |
+---------------------------------------------+
+---------+--------------+----------------+--------+---------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] |
+---------+--------------+----------------+--------+---------+
 NEGTAX         .02420812      .00261436     9.260   .0000
 RGOOD          .54807298      .10469951     5.235   .0000
 RMOD           .31936439      .08078393     3.953   .0001
 SGOOD          .92709993      .09892544     9.372   .0000
 SMOD           .68456294      .08413722     8.136   .0000
 SPOOR          .03916875      .07283978      .538   .5908
 FGOOD         1.08885646      .09789920    11.122   .0000
 FMOD           .28353201      .06559786     4.322   .0000
 B             1.01200808      .04724167    21.422   .0000


Using user supplied start value instead of MNL results.
Normal exit from iterations. Exit status=0.
+---------------------------------------------+
| Random Parameters Logit Model               |
| Maximum Likelihood Estimates                |
| Model estimated: Nov 13, 2006 at 04:32:26PM.|
| Dependent variable               CHOICE     |
| Weighting variable                 None     |
| Number of observations            10296     |
| Iterations completed                 18     |
| Log likelihood function       -2640.180     |
| Restricted log likelihood     -3770.437     |
| Chi squared                    2260.515     |
| Degrees of freedom                   10     |
| Prob[ChiSqd > value] =          .0000000     |
| R2=1-LogL/LogL*  Log-L fncn  R-sqrd  RsqAdj |
| No coefficients  -3770.4374  .29977  .29875 |
```

```
| Constants only   -3443.1336  .23320  .23209 |
| At start values -18775.1159  .85938  .85917 |
| Response data are given as ind. choice.     |
+---------------------------------------------+

+---------------------------------------------+
| Random Parameters Logit Model               |
| Replications for simulated probs. = 100     |
| Halton sequences used for simulations       |
| ------------------------------------------- |
| RPL model with panel has  429 groups.       |
| Fixed number of obsrvs./group=        8     |
| Random effects model was specified          |
| ------------------------------------------- |
| Hessian was not PD. Using BHHH estimator.   |
| Number of obs.=  3432, skipped   0 bad obs. |
+---------------------------------------------+
+---------+--------------+----------------+--------+---------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] |
+---------+--------------+----------------+--------+---------+
          Random parameters in utility functions
 NEGTAX       -4.60759300      .39155536   -11.767   .0000
          Nonrandom parameters in utility functions
 RGOOD         1.30279555      .11534487    11.295   .0000
 RMOD           .96755548      .09822618     9.850   .0000
 SGOOD         1.51973286      .09180322    16.554   .0000
 SMOD          1.09577314      .08016057    13.670   .0000
 SPOOR          .39483294      .06545201     6.032   .0000
 FGOOD         1.60633396      .09723446    16.520   .0000
 FMOD           .72710103      .06465389    11.246   .0000
 B             1.24865317      .04859539    25.695   .0000
          Derived standard deviations of parameter distributions
 LsNEGTAX      3.14793720      .25355593    12.415   .0000
```

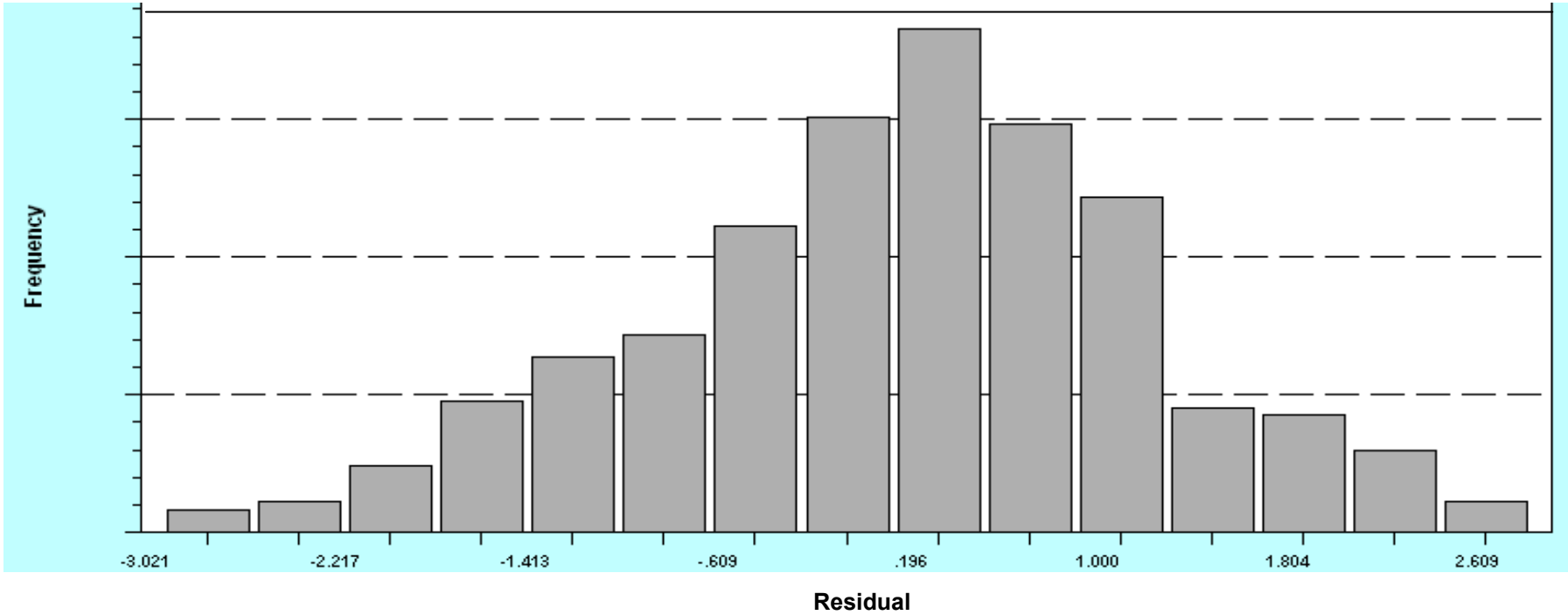
Annex 8: Correlations between the variables in the stage 2 model

	CLARIFY	ABERYST	BLACKBU	KESWICK	SALISBU	SOUTHAM	BOATFREQ	EDUC
CLARIFY	1.00000	.10335	-.16971	.07939	.06664	.08793	.08388	.10981
ABERYST	.10335	1.00000	-.02817	-.06199	-.05204	-.06866	-.05518	.02686
BLACKBU	-.16971	-.02817	1.00000	-.02164	-.01817	-.02397	-.04358	-.04476
KESWICK	.07939	-.06199	-.02164	1.00000	-.03997	-.05274	.05061	-.02859
SALISBU	.06664	-.05204	-.01817	-.03997	1.00000	-.04428	-.01163	.03232
SOUTHAM	.08793	-.06866	-.02397	-.05274	-.04428	1.00000	.10760	.03117
BOATFREQ	.08388	-.05518	-.04358	.05061	-.01163	.10760	1.00000	.11365
EDUC	.10981	.02686	-.04476	-.02859	.03232	.03117	.11365	1.00000
INCOME	-.07589	.06539	-.04055	-.10011	.00131	-.04270	.14949	.14873
W	.08427	.28463	-.05029	-.11066	-.09289	-.12256	-.11691	-.05561
W_MID	-.46577	.06375	-.03995	-.08790	-.07379	-.09736	-.00091	-.12298
ENVCONC	.08245	.03117	.06674	.07954	.04417	.00917	-.00736	.03968
ANGLING	-.16576	-.08070	-.02817	-.00270	.01765	-.01458	-.05518	-.00637
EATFISH	-.05854	-.00689	-.02244	-.04937	-.04145	-.05469	-.01436	-.10211
NEAR_RIV	-.00617	-.04166	-.01787	.24461	-.04624	-.00684	.01592	.05941

	INCOME	W	W_MID	ENVCONC	ANGLING	EATFISH	NEAR_RIV
INCOME	1.00000	-.06948	.04411	.11422	.06876	.04628	-.02291
W	-.06948	1.00000	-.20427	.06319	-.08281	-.00255	-.12780
W_MID	.04411	-.20427	1.00000	.02837	.09939	-.00410	-.08264
ENVCONC	.11422	.06319	.02837	1.00000	-.15550	-.04314	.05090
ANGLING	.06876	-.08281	.09939	-.15550	1.00000	-.00689	-.00610
EATFISH	.04628	-.00255	-.00410	-.04314	-.00689	1.00000	-.02017
NEAR_RIV	-.02291	-.12780	-.08264	.05090	-.00610	-.02017	1.00000

Annex 9: Residuals from the stage 2 model

The figure below is a plot of the residuals from the final stage 2 model against the dependent variable (ln(WTP)), showing a reasonably good fit to a normal distribution:



Annex 10: Checks on the sample characteristics after making exclusions

This annex summarises the checks made on six key variables (age; children; education; income; boating frequency; and walking frequency) to test for any non-response bias introduced by making exclusions to the original sample (for protest votes; those who changed their mind subsequently; and Stratford residents), which reduced the sample size from 911 to 594.

1. Age (QD)

Age	Revised sample frequency	Revised sample percentage	Original sample frequency	Original sample percentage	National percentage[1]
16-24	90	15.2	136	14.9	14.96
25-34	106	17.8	159	17.5	16.60
35-44	108	18.2	174	19.1	19.39
45-64	184	31.0	275	30.2	31.31
65+	106	17.8	166	18.2	17.74
Refused			1	0.1	N/A
Total	***594***	***100***	***911***	***100***	***100***

The age profile of respondents was not significantly altered by the exclusions.

2. Children living at home (QE)

Number of children	Revised sample frequency	Revised sample percentage	Original sample frequency	Original sample percentage
0	389	65.5	596	65.4
1	109	18.4	159	17.5
2	72	12.1	116	12.7
3	16	2.7	26	2.9
More than 3	8	1.3	14	1.5
Total	***594***	***100***	***911***	***100***

Again, the profile of respondents was not significantly altered by the exclusions.

[1] Source: Office of National Statistics, 2006

3. Level of educational qualification (QG)

Educational qualification	Revised sample frequency	Revised sample percentage	Original sample frequency	Original sample percentage
No formal qualifications	140	23.6	219	24.0
O-level/GCSEs or equivalent	162	27.3	266	29.2
A-level or equivalent	114	19.2	153	16.8
Degree or equivalent	101	17.0	153	16.8
Professional or equivalent	73	12.3	114	12.5
Refused	4	0.7	6	0.7
Total	***594***	***100***	***911***	***100***

The only noticeable change resulting from the exclusions was a slight increase in the proportion educated to A-level or equivalent (rather than to O-level/GCSEs or equivalent); however, this distinction was not found to influence WTP in our final model (Section 6.3.5), so was unlikely to bias the results.

4. Pre-tax household income (QH)

Pre-tax household income (£ per year)	Revised sample frequency	Revised sample percentage	Original sample frequency	Original sample percentage
Less than 5,000	24	5.6	42	6.5
5,000-9,999	57	13.3	90	14.1
10,000-14,999	61	14.2	96	14.9
15,000-24,999	99	23.1	138	21.5
25,000-39,999	112	26.1	154	24.0
40,000-59,999	48	11.2	76	11.8
60,000-99,999	17	4.0	30	4.7
Over 100,000	11	2.6	14	2.1
Refused/ Don't know	165	N/A	271	N/A
Total	***594***	***100***	***911***	***100***

England and Wales household income[2]	
Annual income (£)	**Percentage**
Less than 5,200	2.6
5,200 - 10,400	15.4
10,400 - 15,600	17.5
15,600 - 26,000	22.6
26,000 - 41,600	21.6
41,600 - 52,000	7.8
Over 52,000	12.4

The income profile of respondents changed only slightly as a result of the exclusions; there was a slight shift away from the bottom three income bands and towards the £15,000-£25,000 and £25,000-£40,000 bands. This shift equated to a roughly 1.5 per cent increase in average income (suggesting that those who were excluded had slightly lower incomes than the rest of the sample). Given the presence of other sources of uncertainty in the results, this 1.5 per cent increase in income was considered to be a minor issue, which would not cause a major bias to the results.

[2] Source: Family Resources Survey, 2004-5

5. & 6. How frequently have members of your household taken part in the following activities in the last 12 months? (Q2)

Original sample

Riverside activity	More than once per month	Less than once per month	Never
Walking by rivers	48.7%	29.9%	21.4%
Boating/yachting on rivers	4.2%	9.9%	85.9%

Revised sample

Riverside activity	More than once per month	Less than once per month	Never
Walking by rivers	48.7%	30.3%	21.0%
Boating/yachting on rivers	4.0%	10.6%	85.4%

The level of these two activities in the sample was not significantly altered by the exclusions.

Overall, the only noticeable bias that was introduced was a slight tendency towards higher incomes in the revised sample; however, this was considered to be a minor impact and not a significant cause for concern.

Annex 11: Target audiences for this study

This annex links the results of this study with the interests of several potential audiences, explaining how it may contribute to their activities.

Environment Agency

The day-to-day management and regulatory responsibility for salmon and freshwater fisheries in England, Wales and the Border Esk rests with the Environment Agency, which has a statutory duty to maintain, improve and develop salmon, trout, freshwater and eel fisheries. The Environment Agency's fisheries work is funded by rod and net licence duties and Government grant-in-aid.

The Environment Agency's fisheries duty now requires the Environment Agency to "enhance the contribution salmon and freshwater fisheries make to the economy" and also to "enhance the social value of fishing as a widely available and healthy form of recreation." These requirements are integral to the Environment Agency's fisheries strategies and plans.

The Environment Agency launched its strategy for inland fisheries on 28 February 2006, *A better environment, healthier fisheries*. This emphasises the economic importance of angling, stating that:

"*Nearly four million anglers spend around £3 billion a year on their sport. This provides important economic and social benefits to rural and urban communities. We know that angling provides an important source of tourism in rural areas, opportunities for life-long learning and an important first contact with the water environment. It appeals to all ages and does not discriminate against gender, race or physical ability*."

The strategy sets the following aim: "*We want fisheries to play a greater role in England and Wales to encourage more people to help us protect and improve our environment and to help fishing contribute more to society*". Its intended outcomes are to make big improvements in three areas by 2011:

- improved fish stocks and a better environment for wildlife and people;
- more chances for more people to fish and fisheries performing better;
- sustainable fisheries boosting the local economy.

This study will directly inform the third outcome, by providing information on the Environment Agency's key indicators of progress, namely:

- "*we have looked at the estimated benefit to the economy from fisheries and the factors that influence them;*
- *we have found out and communicated the contribution that fisheries make to regional economies;*
- *there are more fisheries where we have optimised the benefits to local communities (baseline and programme to be established);*
- *people see that sustainable tourism associated with angling makes an important contribution to the local economy.*"

The Environment Agency has recently launched its new strategy for water-related sport and recreation[3], which outlines how it intends to promote water-related sport and recreation "*so that it gives the greatest economic, social and environmental benefits*". This strategy includes working "*to prevent pollution, review the impact of waste disposal, and work with others to reduce the impact that environmental damage like fly-tipping has on …enjoyment of the outdoors*". This study's results can help to inform the strategy as it relates to angling, and where it requires a balancing of economic, social and environmental issues.

The Environment Agency recognises its need to understand and demonstrate the benefits of environmental improvements (and the costs of environmental damage) in relation to all of its areas of responsibility. As well as its obligations under the Water Framework Directive, it also has a general duty under S.39 of the Environment Act (1995) and a duty to have regard to any effects on the economic and social wellbeing of local communities (S.7(c)(ii) of the same act).

The Environment Agency is the Competent Authority for making sure the Water Framework Directive (WFD) is carried out across England and Wales. This directive is discussed in more detail below. The Environment Agency also coordinates Salmon Action Plans and Fisheries Actions Plans, which are also discussed below.

The study's results will be useful for both national and regional staff in the Environment Agency.

Department for Environment, Food and Rural Affairs (Defra)

The Secretary of State for Environment, Food and Rural Affairs has overall responsibility for government policy on salmon and freshwater fisheries in England, tied to a commitment to sustainable consumption and production of both food and overall natural resources. Defra is the Environment Agency's sponsoring department in England, and so anything of relevance to the Environment Agency is also of interest to Defra. There are other Defra responsibilities beyond those covered by the Environment Agency, including the work of the Fish Health Inspectorate.

Defra's role in fisheries management also incorporates the need to meet the UK's international commitments on biodiversity and sustainable development, and the international commitment to conserve salmon. It aims to establish a robust framework for future development decisions that respect environmental constraints. Healthy fish stocks are an important indicator of environmental quality. Defra also leads on international issues such as at the EU and at intergovernmental organisations such as the North Atlantic Salmon Conservation Organisation (NASCO).

Defra has a strong focus on improving the local environment and on the ways in which physical recreation and access to open spaces link to public health issues. Furthermore, Defra plays an important role in achieving a balance between recreational and commercial fisheries. Finally, Defra is concerned about the potential impact of various fish diseases on animal welfare, the environment and the economy. It has a remit to reduce the risk of animal disease and to control epizootics. This is further discussed below.

National Assembly for Wales

The National Assembly for Wales has the power to take decisions on a range of economic, educational, health, planning, transport and tourism issues in Wales. The Assembly's Agriculture Department (NAWAD) has responsibility for fisheries strategy in

[3] *A better place to play* (Environment Agency, 2006)

Wales. The Countryside Council for Wales is the Government's statutory adviser on sustaining natural beauty, wildlife and the opportunity for outdoor enjoyment in Wales and its inshore waters.

The *Sustainable Fisheries Programme*/*Fishing Wales* is an example of an initiative that successfully enhanced the economic benefits of angling in Wales. The programme helped to develop and market fishing in Wales through a partnership between Environment Agency Wales and the Wales Tourist Board (WTB), starting in 2002. Its aims were to:

- increase the value of angling tourism within the economy of Wales by attracting new visitors to rural areas;
- protect and enhance the environment of Wales for the benefit of the wildlife within it and for those that live in or visit it;
- contribute to the wellbeing of local communities through the provision of improved facilities for angling and other recreational activities.

These objectives specifically highlight the economic benefits of angling. They were influenced by a previous study (Nautilus Consultants, 2000), which, despite being only a brief analysis, succeeded in highlighting the substantial economic benefits of angling. The study's results have been widely cited by politicians and decision-makers and have been influential in altering the perception of angling's significance to Wales. However, this case also highlights the dangers of inappropriate use of economic figures; the study's results were probably used more widely than was warranted by the level of analysis undertaken, and the results interpreted as being more certain than was actually the case.

The Welsh Assembly Government (WAG) spent around £2.4 million on the *Fishing Wales* marketing campaigns. Results from research carried out to measure the effectiveness of the campaigns (Minister for Countryside, Environment and Planning, 2005) claim that £27.3 million of both direct and indirect expenditure in Wales could be directly attributed to the campaigns. This probably represents an excellent return on the initial investment, as economic output, income and employment will have been generated by this expenditure (note that the expenditure itself is not a benefit, as discussed in Section 3).

Other government departments and agencies

A number of other government departments and agencies have roles that interact with the management of inland fisheries in England and Wales. The results of this study can also potentially inform them in their work.

English Nature[4] champions the conservation of wildlife, geology and wild places in England. It is a government agency funded by Defra. English Nature's interests include issues such as the preservation of rare and endangered species of freshwater fish, and maintaining and enhancing fish populations in SACs and SSSIs where they are integral to the designation.

Countryside Agency[3] helps "*to remove some of the barriers to countryside enjoyment, especially for minority ethnic and black people, young people and people with disabilities*". This is achieved in part through the Outdoor Recreation Strategy.

Department for Culture, Media and Sport promotes the economic contribution and educational benefits of the arts, media, sport and our national heritage.

[4] English Nature has recently merged with the Countryside Agency, to become a new body, Natural England.

Department of Health aims to improve people's health and wellbeing through its strategic responsibility and accountability for the health and social care system in England.

Office of the Deputy Prime Minister (ODPM) is responsible for policies which promote social inclusion, neighbourhood renewal and regional prosperity. It has a public service agreement target to "*lead the delivery of cleaner, safer and greener public spaces and improvement of the quality of the built environment in deprived areas and across the country, with measurable improvement by 2008*".

Home Office, as angling schemes can play a role in preventing reoffending and can offer rehabilitation for some offenders.

Prime Minister's Strategy Unit carries out strategy reviews and provides policy advice on a variety of different policies.

Sport England and the **Sports Council for Wales** are responsible for developing and promoting sport and recreation in England and in Wales, respectively.

Regional and local government

Information on the significance of angling for regional economies will assist **regional development agencies** (RDAs) and their partners in prioritising investments in fisheries against their other activities. This will include applying for European Structural Funds in eligible areas. Angling can be a particularly important economic activity in rural and less affluent areas and this can be a powerful message for RDAs.

RDAs are principally driven by economic arguments. Their remit is to secure the economic stability of a region and to promote economic growth. RDAs have five statutory objectives:

1. to further economic development and regeneration;
2. to promote business efficiency and competitiveness;
3. to promote employment;
4. to enhance the development and application of skills relevant to employment;
5. to contribute to sustainable development.

The results of this study could help to strengthen funding applications by illustrating their expected economic benefits.

This study will be relevant for objectives 1 and 3 (by informing measures to enhance the economic contribution of angling) and 5 (through measuring the importance of maintaining healthy freshwater ecosystems). The study also links with the role RDAs have in promoting tourism in their region, as angling tourism is an important sub-sector of the economy in many rural areas.

Despite their focus on economic outputs, RDAs also have responsibilities to the natural environment and to sustainable development. They work with people in communities and partner organisations to regenerate unused or run-down sites, and improve the quality and attractiveness of public spaces. They also ensure that economic development in the regions takes into account the current and future needs of local and regional communities and the natural environment in which they live.

Since April 2003, the RDAs have had formal responsibility for the strategic leadership of tourism in the regions, and are now developing and implementing Sustainable Tourism Strategies for their regions. Improving tourism productivity has synergies with the RDAs' other priority areas, such as skills improvements, enterprise creation, regeneration and culture.

Local authorities (LAs) have control of a large number of venues where angling is practised. Environmental quality varies a great deal between different locations, with specific issues existing in areas such as deprived neighbourhoods. Local authorities can help by tackling local air quality hotspots; employing suitable transport and land use planning strategies; dealing with the inherited legacy of contaminated land; and promoting citizenship initiatives that lead to environmental improvements.

Other audiences

Anglers may be interested to learn more about the economic importance of their sport.

Angling organisations, fishery owners and trade bodies may choose to use our results to further their advocacy/lobbying efforts. If used appropriately, this is an excellent way to feed information about the size and impact of angling into debates on the future of the sport and the environment it relies upon.

Other organisations, notably the ACA[5], focus on fighting legal cases to force polluters to pay compensation for damage caused to rivers; this study's results could form evidence on the size of any such compensation payments.

Charities and NGOs who are working to restore rivers and other angling sites (such as *Get Hooked on Fishing*, *Thames21*) may be able to use the results as part of their funding applications and to help demonstrate the beneficial effects of their work.

Publicity using the results can help to increase recognition that angling is one of the largest participation sports in England and Wales and is an important contributor to regional economies, especially in rural areas. This will be of interest to **the public**.

All audiences mentioned above might use **the media** as a route for presenting their arguments. Press releases need to be prepared carefully to ensure that the correct message is given in an unambiguous manner and to ensure that the story is of interest to the target audience. As well as using national and regional media outlets, using the extensive specialist angling press in the UK is an excellent way to put messages across to anglers. This includes websites as well as printed media, TV and radio.

Water companies and **OFWAT** can use the results in the PR09 process (see below).

Tourist boards are linked to the RDAs through their shared goals to raise the economic activity derived from recreation and other visits.

5 Anglers' Conservation Association

Annex 12: Economic impact analysis

This annex discusses the economic impact analysis approach to assessing the impacts of angling (or any other activity), to elaborate upon Section 3.1.3. This approach is used in Module B of this study, which is presented in a separate report.

Angling expenditure itself is not a particularly useful measure of economic impact. Nevertheless, in the public domain the total expenditure of anglers and the employment generated through the provision of angling services is often used for advocacy purposes. Unfortunately, in many instances the findings of an impact study are often used inappropriately. This inappropriate use may be deliberate but may also simply be misguided. Both culpable and innocent misuse is best tackled by ensuring that all sides are familiar with the scope and limitations of impact studies. It is therefore important initially to examine the relevance of angler's expenditure for policy decisions.

Anglers' expenditure could be relevant as an indication of the *size* of the sector. For example, in the media the 'value' of an industry is often quoted as the annual total of consumers' spending on its products. Such figures, however, are really only a measure of 'size' and do not relate meaningfully to any specific concept of 'value'.

Of far more relevance is the ways in which angling expenditure feeds into the economy (both locally and on a wider scale), creating jobs, income and economic output. Input-output models can be employed to answer questions such as "What would happen to income and employment in this region if angling ceased to exist?" The DREAM® model employed in this study is an example of such a model. It takes into account:

- **Substitution possibilities** open to anglers, with consideration of what anglers would do if angling was not available to them.
- **Multiplier effects** indicating the knock-on impacts to the regional economy as angling expenditure increases, the amount of goods produced locally and the incomes of local people. The impacts of angling will include:
    - **Direct effects:** Initial spending activity, comprising the increased purchase of inputs required to manufacture the goods and services used by anglers.
    - **Indirect effects:** Second round effects; this is the value of the inputs used by firms that produce additional goods and services for those firms affected directly by the initial expenditure.
    - **Induced effects:** Some of the added income received by individuals and businesses from the original expenditure is spent in the local economy. This increases demand for goods and services, which in turn increases production and output.
- **Leakages:** Expenditure spent on goods and services sourced outside the region in question do not benefit that region's economy.
- **Inter-firm** links within the regional economy.

A number of cautionary notes should be borne in mind when using these results:

- Expenditure is a *gross* measure and so ignores what is foregone in choosing angling rather than some other activity.
- Care is required to avoid double-counting between the jobs created and the income generated; these are two ways of measuring what is essentially the same impact. They should not be added together.
- An equivalent analysis at a national level would be far less interesting than the regional analysis. Angling probably has only a minor impact on the national economy; if angling were to completely disappear, people would simply transfer their time and money into an alternative activity, which would also generate income and jobs for the country. A national impact would only occur if:
    - this alternative activity created less (or more) jobs and income in England and Wales than angling, for example if people chose to go abroad as their alternative activity;
    - if angling expenditure helped to correct a market failure, such as helping to remove involuntary unemployment from a region. It is common to believe that there are failures in the labour market that lead to involuntary unemployment in some localities whilst there is full employment in other localities. One might also want to encourage employment in order to indirectly improve health, reduce crime and so on. This similarly falls into the market/institutional failure category.

At a national level, the impact of angling is mostly about a redistribution of economic activity between regions, rather than a net gain or loss of economic activity. Economic impact analysis can help to identify these redistributions. There may be an important benefit to rural areas with little economic activity, where angling is often located. These may be priority areas for investment or may match with local development objectives.

These distributional effects may be important benefits in their own right. Annex 5 of the Treasury's Green Book (HM Treasury, 2003) deals with distributional impacts and is very specific about how the benefits of additional income should be weighted depending on the existing income of the recipient. If these distributional effects are considered to be important (for example, if they help to correct a localised market failure) then, unlike the other outputs from the economic impact analyses, they may be considered to be additional to the values assessed in TEV assessments.

Assessments of the impacts of angling on jobs and income may be considered to be useful additional indicators for decision-making purposes. This type of analysis will probably be of most interest to regional development agencies and others who are primarily focused on creating income and employment for local and regional economies. They may also be considered to be useful items of information to include in applications for funding, or to help in justifying investments made in angling.

Economic impact analyses do not consider the wider welfare benefits (or costs) of angling, such as consumer surplus, health and social welfare impacts or non-use values; these concepts are discussed further in Section 5.2. There is not necessarily a link between anglers' expenditure and these other components of value.

The outputs of such studies take forms such as "Anglers spend a total of £*x* million on angling in the North East. This results in the regional economy producing over £*y* million worth of annual output, which supports around *z* thousand jobs and generates nearly £*xx* million in wages and self-employment income to North East households."

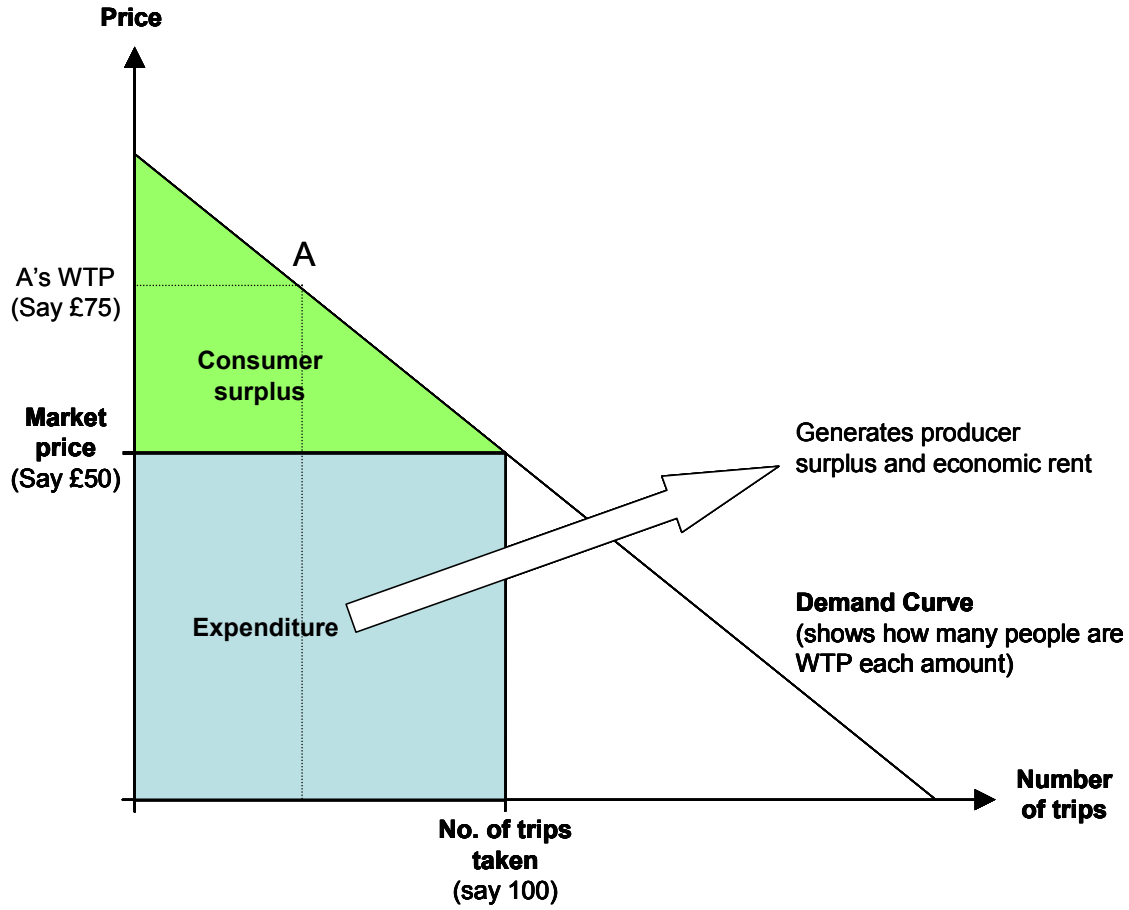
These impacts can be assessed using input-output models. Expenditure data must first be collected through some form of questionnaire or survey. These data are fed through

the input-output model (which contains large numbers of pre-programmed parameters describing the way that economic flows move through the economy), to determine the output, income and jobs created. Alternative means of estimating the knock-on effects in the regional economy (indirect and induced effects) and estimates of jobs created include use of generic multipliers and ratios. Such approaches are not generally particularly accurate, but may be adequate under certain circumstances.

The present study will use this approach to assess the impact of angling expenditure in each of the ten government regions in England and Wales. The DREAM® economic model will be used, licensed from CogentSi Ltd. Economic impact analyses will therefore be revisited under Task 7, which will describe the DREAM® model in more detail.

Other studies which have addressed the economic impact of angling include; Cobham Resource Consultants (Anon 1983), Whelan and Marsh (1988), Mackay Consultants (Anon 1989), Dunn *et al*. (1989), Radford *et al.* (1991), Moon and Souter (1994), Spurgeon *et al* (2001), Riddington *et al*. (2004) and Radford *et al*. (2004).

Annex 13: The demand curve for angling trips



This chart represents the demand curve for angling trips, showing consumer surplus and expenditure.

Annex 14: Supporting information for Section 7 (choice experiment)

This annex presents additional information relevant to the CE section, giving further details of the methodology used, including an explanation of the exclusions made.

Cheap talk

There is some evidence that providing **"**cheap talk" (see glossary) text can reduce the "hypothetical bias" in responses. Cheap talk attempts to reduce the hypothetical bias by thoroughly describing and discussing the propensity of respondents to exaggerate stated willingness to pay (WTP). Some studies have shown this to be successful; for example, Carlsson *et al*. (2005) used the following "cheap talk" text:

> "*The experience from previous similar surveys is that people often respond in one way but act differently. It is particular common that one states a higher willingness to pay than what one actually is willing to pay for the good in the store. We believe this is due to the fact that one does not really consider how big an impact an extra cost actually has to the family budget. It is easy to be generous when one does not really need to make the choices in a store. If you have another idea or comment on what this behaviour depends on, please write this down on the last page of the questionnaire*."

Other studies into cheap talk have been less conclusive. Cheap talk probably reduces but does not eliminate respondents' tendency to overestimate the value of a good when they are asked for an immediate response.

One downside of this approach is that it can make the text rather long. A less burdensome alternative would be to use a simple 'budget reminder', such as that used in Spurgeon *et al*. (2001): "*Bearing in mind your financial constraints and other things you would like to spend your money on* …" This ensures that respondents would be thinking about their overall household budget and how they would prioritise spending on environmental improvements within this budget, thereby helping to overcome issues with embedding effects and income constraints.

Qualitative assessment levels

Using qualitative levels has the advantage of simplicity of design, although it makes the analysis more difficult in that it becomes harder to achieve statistical significance. Results will be phrased in ways such as "the WTP to upgrade the river from 'moderate' to 'good' is £x". Note that this may well be a useful piece of information for uses like the WFD, for example to find WTP for moving from moderate to good ecological status.

Qualitative levels have been used before in this subject area. For example, Hanley *et al*. (2006) carried out a CE on river improvements for the WFD, assessing use and non-use values. They split the improvements into three categories: "healthy wildlife and plant populations", "aesthetics/appearance" and "river banks", which were designed to be comprehensible whilst also tying in with the objectives of the WFD. They used just two levels ("fair" and "good") for each attribute, giving a brief description of what each level represented (for example, for "aesthetics/appearance", their two levels were "no sewage or litter" and "some sewage or litter").

The alternatives of using quantitative (expressed in numerical terms such as “500 salmon per km^{2}”) or percentage-based (such as “50 per cent decrease”) levels would have been more complex to design and it would have been difficult for respondents to absorb and react to numerical data.

Choice card design

The survey instrument had a total of 4 x 4 x 4 x 9 = 576 possible combinations. It was not practical or useful to attempt to present all of these possible combinations; instead, a sub-set was selected that represented the full diversity of choices that might be made. This is known as a “fractional factorial design”. One key aim of this process is for the design to be “orthogonal”, to minimise correlations between attributes[6].

Additional steps were taken (using a scoring system for each level) to ensure that levels were combined so that respondents were not presented with states where the river was worse on every attribute (clearly they would not pay money to achieve a worse state for the river) and to maximise the statistical efficiency of the design.

Increasing the number of cards shown increases the amount of data received and therefore improves the statistical validity of the results. The downside is that this lengthens the interview; and some experts have suggested that respondents may engage in strategic behaviour as they progress through long survey instruments (Bateman *et al*., 2004). Eight was believed to represent a sensible balance.

Econometric analysis

In the first instance, NLOGIT 3.0 employed a Conditional Logit Model (CLM). This is a type of Random Utility Model (McFadden, 1974), and is the standard econometric model used to estimate choice models. The premise is that the individual chooses from a number of alternatives (in this case, three different hypothetical states of the river) and picks the one that yields the highest utility level on each choice occasion.

The indirect utility function contains a deterministic element (the utility to respondent i of choosing state j) and a stochastic element. In the *base model*, this utility is influenced by the site attributes (including cost). Loss aversion was tested for by examining whether there is a systematic preference for the status quo.

In the CLM, the error terms are independently and identically drawn from an extreme value distribution (McFadden, 1974). The estimated model was tested to ensure that the independence of irrelevant alternatives (IIA) assumption was adhered to. The model failed this test, suggesting that the IIA assumption was false. This would usually mean that the CL model was flawed. However, in this case the states of the river were not labelled (other than the status quo). The IIA assumption is only required when there are 'labelled' alternatives (Professor Ken Willis, personal communication). Thus, the IIA test was somewhat irrelevant.

It was decided to test the model using a more advanced model, the Random Parameters Model (RPM). The RPM does not require an IIA assumption. It is also a theoretical advance over the CLM approach, as it explicitly recognises the presence of heterogeneity in the general public’s attitudes towards rivers and fish stocks. Failing to

[6] Or more strictly, to minimise correlations between attributes in terms of *differences in the levels* of attributes between one state and the others on the same card.

allow for this can result in biased attribute coefficient estimates, leading to misleading welfare measurements of changes in site attributes (Train, 2003).

The RPM approach resulted in substantially improved fit to the data and so this model was employed.

Exclusion criteria for responses

In addition to the exclusion of protest bids and the Stratford-upon-Avon sample, there were a number of other rationales for excluding certain respondents from the sample:

- logic trap: 127 people failed (14.2 per cent);
- consistency trap: 82 people failed;
- order trap: 63 people failed;
- 108 people gave the same answer for all eight cards, for example they answered B every time;
- 273 respondents were classified as protest bids under the CVM survey.

Three different levels of excluding people from the sample were tested:

- E_ANY: Exclude any respondent who failed any of the above tests; this was the most extreme test and represented a very harsh level to exclude at. This excluded 609 respondents (68 per cent).
- E_MANY: Exclude protest bids, refusals, those who failed the logic trap and protests from the CVM survey. Also exclude any respondent who failed *more than one* of the other traps (consistency trap; order trap; and giving the same answer to all eight cards). This was still a fairly harsh level to exclude at, excluding 467 respondents (52.1 per cent).
- E_MIN: Only exclude protest votes and people who refused one or more cards. This excluded 220 respondents (22.5 per cent)

A RPM was run with each of these levels of exclusions, and the results were examined to look at the implications of different levels of exclusions for:

- **The sample size remaining**
  Excluding E_ANY reduced the sample to n = 287; although this was somewhat low for a choice experiment, it could still be sufficient to generate useful results. Excluding E_MANY gave n = 429, which was an acceptable sample size. With this sample size, each of the qualitative levels (such as “good” for the attribute salmon) was presented on over 200 different choice occasions; this was safely above the recommended minimum of 100-150 (Bhaskaran, 2005). Excluding E_MIN gave n = 676, which was clearly better, providing all the responses represented valid answers to the questions posed.
- **The significance of results**
  Reducing the sample size was expected to reduce the significance of the results generated, making it more difficult to reach firm conclusions. However, if we excluded irrational answers, it was possible for significance levels to improve as sample size decreased. Results became less significant as the sample size decreased, but not by a substantial amount, and most key results were still significant, even with E_ANY excluded.
- **How well the model fits the data**
  The best fit was found when E_MANY was excluded (pseudo-R^2 = 0.273). As the fit was poorer when E_ANY was excluded (pseudo-R^2 = 0.234), this

reduced the rationale for making this additional level of exclusion. The poorest fit was when E_MIN was excluded (pseudo-R^2 = 0.220), suggesting that this sample still included some irrational responses.

- **Whether results match a priori expectations**
  The general pattern of results was similar in all three cases; virtually all variables matched a priori expectation in terms of the sign of each coefficient.
- **The difference in WTP values generated**
  WTP values were very similar when either E_ANY or E_MANY was excluded. However, WTP values were substantially higher (50-100 per cent higher) when E_MIN was excluded. In general, the results produced substantially higher WTP values than resulted from the CVM survey (see Section 7.4.2). As discussed there, the high WTP values appeared to suggest a weakness in how respondents interpreted the CE questions. As WTP decreased when E_MANY was excluded (rather than E_MIN), this weakness in interpretation could become less of a problem when this harsher level of exclusion was used.

The decision was taken to exclude E_MANY from the sample, reducing the sample size to 429. Just over half of the original respondents were excluded from the sample; this was a very high level of exclusion.

However, this was believed to be justified, as this level of exclusion produced the best fit to the data; the key results remained significant; weaknesses in interpretation might become less of a problem with the reduced sample; and the remaining sample size was still a good size for a choice experiment[7].

This high level of exclusion suggests that a relatively high proportion of respondents struggled with some aspect of the choice experiments, either because it was conceptually difficult or because they did not agree with the idea of individuals paying for improvements to rivers and to fish stocks through income tax/water bills.

We would suggest that these problems probably affect most choice experiments, but are particularly acute in surveys describing environmental changes, which can be difficult to explain clearly in terms that respondents can relate to. In any case, we believe that the lengths gone to in identifying potentially suspect responses (and where appropriate, excluding them) helped to make the survey results more reliable and credible.

[7] Particularly as we had eight choices from each respondent; so the total choices made were 429 x 8 = 3,432.

Annex 15: List of salmon rivers in England & Wales

This annex lists the 75 rivers in England and Wales that are considered to be “salmon rivers” for the purposes of this study. This includes the 64 rivers listed in CEFAS and Environment Agency (2006), plus three rivers added due to subdividing two rivers in the list into mutliple parts (marked *). The list also includes eight additional rivers that are known to have at least some salmon in them (marked **).

Avon-Devon
Avon-Hants
Axe
Bristol Avon**
Calder
Camel
Clwyd
Conwy
Coquet
Crake
Dart
Dee
Derwent
Duddon (and Lickle)
Dwyfawr
Dwyryd
Dyfi
Dysinni
E&W Cleddau
Eden
Ehen
Ely*
Erme
Esk
Esk-Border
Esk-Yorks
Exe
Fal**
Fowey
Frome
Glaslyn
Irt
Itchen
Kent
Leven
Lune
Lyn
Lynher
Mawddach
Medway**
Mersey**
Nevern
Ogmore
Ogwen
Parrett**
Piddle
Plym
Rheidol
Ribble
Seiont
Severn
Stour
Taf
Taff
Tamar
Tavy
Taw
Tawe
Tees
Teifi
Teign
Test
Thames**
Torridge
Trent**
Tyne
Tywi
Usk
Warwickshire Avon*
Wear
Worc. Stour*
Wye
Wyre
Yealm
Yorkshire Ouse**

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