Effects of Canoeing on Fish Stocks and Angling

R&D Technical Report W266

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The information within the report is intended to provide underpinning knowledge for Agency staff involved in discussions with anglers and canoeists. It will provide a tool for use in developing Fisheries Action Plans.

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Amendments
Any corrections or proposed amendments to this manual should be made through the regional Agency representative on the Water Resources National Abstraction Licensing Group.

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1. INTRODUCTION

1.1 BACKGROUND

Rivers, canals, and lakes provide many different opportunities for recreation in the United Kingdom (UK). They are focal points for, as examples, angling, canoeing, sailing, diving, cycling, and walking. Ease of access to areas where these pursuits may be undertaken is crucial for many participants and, therefore, it is to be expected that competition for resources and conflicts of interest arise in accessible areas that are suitable for more than one pursuit. Where canoeing is concerned, this situation is compounded by the fact that 'of the approximately 40,000 [kilometres (km)] of rivers in England and Wales, only about 4,000km are statutory navigations and about another 500km of rivers are subject to access agreements' (EA, July 1999).

It is generally recognised that there has been a massive increase in the number of people participating in outdoor pursuits in recent years. The British Canoe Union (BCU) estimates that one million people currently canoe each year and trade statistics estimate that there are 100,000 privately owned canoes in the UK which suggests that there are 100,000 canoeists. Membership of the BCU (and affiliated organisations such as the Welsh Canoeing Association, WCA) increased steadily between 1985 and 1998 from 14,000 to 24,000. However, numbers have been declining since October 1998. By comparison, a 1994 NOP survey for the National Rivers Authority estimated that there were 2.3 million coarse and 0.8 million game anglers in England and Wales.

Both pastimes are important in terms of their contribution to both the national and local economies. Nationally canoeing is considered to generate around £30-50 million per annum, which contributes directly to many local economies. For comparison, it is estimated that the total annual amount spent by anglers in England and Wales in the pursuit of their pastime is £3.3 billion. Both canoeing and angling attract some grant aid from the government via Sport England, in the case of canoeing this amounted to £415,000 in 1999, whereas freshwater angling attracts £50,000 per year. This financial support is invariably ring-fenced for specific uses, particularly the promotion of sporting excellence and youth development programmes.

Revenue is also generated from subscriptions and in the case of angling organisations, it is usually this source of revenue which is used to either purchase riparian rights to sections of river, or to negotiate lease arrangements with riparian owners. Similarly, the BCU and WCA raise revenue from subscriptions, and although they have free reign to decide what this money is used for, it is frequently used as an accessory to obtaining grants from organisations such as Sport England.

It is also important to recognise that significant funding is generated from angling within the Environment Agency Fisheries Function (£21 million[1]). This money is used by the Agency to fund a significant proportion of its various of statutory and regulatory functions. However, none of this finance is available to increase access for individual anglers or clubs.

Clearly both recreational pursuits are significant both in terms of the numbers of participants and the financial contributions they make to the economy. Increasing demands for recreational space, particularly near large densely populated urban centres may lead to greater

[1] 1999 figures - Grant in aid £7.4M; Licence income approximately £13M

interaction between people and the environment. The ramifications of this increased use of the countryside are manifold and include not only conflicts of interest between different users but potentially an increase in deleterious impacts upon flora and fauna in the absence of effective management strategies. Although both angling and canoeing can be undertaken in a diverse range of locations throughout the UK, the accessibility of some areas suitable for both to a large number of the population is, perhaps, bound to result in conflict if one group of users feels that their pastime is being interfered with by that of another.

There is currently some debate over the compatibility of angling and canoeing. Clearly, conflict may arise as a result of these activities occurring in the same stretch of water at the same time. However, the compatibility debate has more recently transgressed the issue of direct interference (canoeists paddling through an anglers swim for example) and attention has increasingly been focussed upon some indirect and potentially longer lasting negative effects, specifically damage to fish stocks by the actions of canoeists.

In line with one of it's general duties 'to promote the recreational use of water ... throughout England and Wales', one of the Agency's aims is 'to conserve and improve river navigation'. However, this aim must be viewed in context as the Agency also has a duty to protect wildlife and landscapes, and with the desires of other water users (specifically here, anglers) in mind. Further, the Agency also has a statutory responsibility 'for maintaining, improving, and developing salmon, sea trout, non-migratory trout, coarse and eel fisheries'.

The Agency has undertaken the role of broker/arbiter in establishing new access agreements to help ensure that anglers and canoeists can continue to enjoy their pursuits in harmony, whilst maintaining its duty to protect the environment. To ensure this end, the Agency is working with the British Canoe Union (BCU), the Country Landowners Association (CLA), the National Farmer's Union (NFU), National Federation of Anglers (NFA), the Salmon and Trout Association (SATA) and the National Association of Fisheries and Angling Consultatives (NAFAC), who collectively form the Angling and Canoeing Liaison Group (EA, July 1999).

A key issue currently being tackled by the Angling and Canoeing Liaison Group is that of access for canoeists through rivers where no statutory right of navigation exists. Negotiations may often be thwarted by negative perceptions, e.g. that canoeists cause damage to fish stocks and disturb anglers, views often put forward by riparian and fisheries owners.

A lack of precise and accurate information about the potential impacts of canoeing upon angler catch rates and fish populations as a whole and the needs of canoeists has resulted in great difficulties when attempts are made to produce access agreements and qualify the reality of perceived impacts.

The purpose of this project is to provide a review of existing research on the effects of canoeing on angling and fish stocks in order to inform the debate and identify any further areas for study.

1.2 OBJECTIVES

The specific objectives of the project are:

- to provide a review of the literature pertaining to the effects, if any, of disturbance on fish behaviour and the potential for harm during each of the stages of the spawning cycle of the major fish species;

- to provide a summary of the various types of angling and canoeing that occur according to season/time and location;

- to identify the types and scale of possible disturbance to fish from canoeing;

- to undertake a questionnaire survey of relevant Agency staff, canoeing, and fishing organisations to identify specific problems and areas/sites of conflict;

- to identify the types and scale of possible direct conflict with anglers (e.g. impacts on the ability of anglers to fish and to enjoy fishing) from canoeing;

- to provide a summary of proven methods for the limitation of identified impacts and to suggest other methods which may address other types and scales of impact; and

- to assess the need for further study to improve understanding of the issues.

1.3 METHODOLOGY

Research was based on a desk study comprised of three information gathering techniques:

- A traditional scientific literature search;

- A questionnaire survey;

And subsequently,

- An expert opinion consensus.

In addition, in order to gain greater insight into the reasons behind conflict between canoeists and anglers from both perspectives, the following representative bodies were interviewed:

1. **British Canoe Union**, Carel Quaife, Access and Development Manager, 25th October 1999;
2. **Welsh Canoe Association**, Richard Lee, Chief Executive, 22nd November 1999;
3. **National Association of Fisheries and Angling Consultatives**, Mark Hatcher, Director 15th December 1999;
4. **Salmon and Trout Association**, Chris Poupard, Director, 15th December 1999;
5. **National Federation of Anglers**, Ken Ball, President, 2nd February 2000; and
6. **Scottish Canoe Association**, Frances Pothecary, Access Officer, 15th February 2000.

2. LITERATURE SEARCH AND REVIEW

2.1 INTRODUCTION

As a preliminary introduction to this report, a brief understanding of the various types of practice in angling and canoeing is useful.

2.1.1 Angling

Angling is split into two main disciplines in freshwaters, coarse and game angling. Typically coarse fish anglers tend to be sedentary, occupying a swim or peg which is intensively fished over a period of time. Game anglers adopt a more active, mobile approach, fishing a stretch of river known as a beat, slowly advancing and covering all available fish holding water. Coarse angling tends to involve a higher density of anglers in any given stretch of river, particularly during angling matches, whereas for game fishing the density of anglers is much less, a more solitary approach being adopted.

Most types of angling are currently subject to a closed season of approximately 12 to 15 weeks duration. Closed seasons normally cover peak spawning times or those times when the behaviour of some species causes the concentration of stocks.

Game fishing involves angling for varieties such as salmon, brown trout, and rainbow trout. Migratory salmonid are targeted during their return to freshwaters as this is the time when they may be caught using traditional methods such as fly and spinner. To ease the pressure put upon spawning salmon during their return period upstream various restraints and fishing limits are frequently imposed. Salmonids spawn in clean gravels, typically at the head of riffles during late autumn/early winter. Fishing and closed seasons vary according to whether fish are migratory or non-migratory salmonids. The fishing season for non-migratory salmonids (mainly brown trout) extends from 1st March to 30th September. The fishing season for migratory salmonids (salmon and sea trout) varies according to location as not all salmon return (*run*) at the same time. Hence, for example, it starts on January 1st on the River Tay, Scotland, but much later on the River Dart in Devon.

Coarse fish angling involves freshwater fishing for such varieties as perch, pike, bream and carp. Spawning takes place over the spring to summer period depending on the species, water plants being the most commonly used substrate. However, some species, such as dace, attach their spawn to gravels. The coarse fishing season begins on June 16th and ends on March 15th in rivers. The coarse fishing closed season no longer applies to canals. However, close seasons are likely to be subject to considerable change in future following the recommendations of the Salmon & Freshwater Fisheries Review Group.

2.1.2 Canoeing

The term 'canoeing' encompasses a multitude of activities that range from leisurely canoe touring to the competitive disciplines of slalom and wild water racing. Some disciplines, such as white water racing, require fast moving water and therefore take place mainly in rivers. Others, such as canoe polo can take place in swimming pools or any stretch of flat water. The disciplines listed below are those which require or are normally undertaken in fresh water

environments where there is speculative potential for damage to fish stocks and/or interference with angling. The list is not exhaustive.

- Sprint Racing
- Marathon Racing
- Freestyle Kayaking
- Slalom
- Wild Water Racing
- Recreational Canoeing
- Canoe Touring
- Canoe Sailing

Recreational canoeing and touring takes place all year round in all types of water including lakes, canals and rivers. Such canoeists operate independently or, more frequently, in groups, on occasion in large numbers. Many competitive canoe disciplines are also practised all year round either as events or for training provided necessary flow conditions permit.

Wild water canoeing requires high river discharges and is, therefore, facilitated during those times of the year when these are most likely to occur, particularly autumn and spring. This form of canoeing more often than not takes place in upland environments, where topography produces suitable riverine conditions. For some types of canoeing, spates and freshets offer ideal conditions.

2.2 LITERATURE REVIEW

2.2.1 Approach

A search for published literature was undertaken by utilising the facilities available to APEM in the University of Manchester's John Rylands Library. Specifically, a CD-ROM catalogue was used to search for journal abstracts based on key word criteria. In addition, questionnaire respondents were asked to give details of any relevant reports or publications of which they were aware.

- key words:
  canoe, kayak, recreation, water sports, leisure activities, fish, fish populations, fisheries, angling

- key word permutations:
  canoeing and *angling*, *kayaking* and *angling*, *canoeing* and *fisheries*, *kayaking* and *fisheries*, *water sports* and *angling*, *water sports* and *fisheries, leisure activities* and *fisheries, leisure activities* and *angling, canoeing* and *fish populations, kayaking* and *fish populations, water sports* and *fish populations, leisure activities* and *fish populations*

- abstract databases accessed via the University of Manchester's John Rylands Library CD-ROM catalogue:
  Aquatic Sciences and Fisheries Abstracts
  Aqualine
  BIDS
  BIOSIS

As anticipated, little pertinent material was uncovered by the literature search. Those references of any relevance are shown in the reference list. A few unpublished documents were referred to by questionnaire respondents and subsequently obtained.

2.2.2 Review

The most frequently referred to item of published literature was the 1994 National Rivers Authority report on the *Impact of Canoeing at Chester Weir on Salmon Behaviour*. This describes a study of radio tagged salmon movements and continuous video monitoring of canoe and bathing activity at Chester Weir on the River Dee to determine, whether these activities contributed to the overall effect of the weir as a barrier to salmonid migration. The study concludes that;

> *'[in] general the impact of canoeing was of insignificant magnitude to differentiate it from the variability in behaviours [of salmon] recorded through the interaction of a number of extrinsic environmental and physical factors operating in the vicinity of Chester Weir' (NRA, 1994, p.21). 'No causal relationship was found to support the view that delay of river entry increased in a population of radio-tagged salmon, when subjected to canoeing or bathing activity' (NRA, 1994, p.21).*

Chapman (1997) describes an experiment conducted for an unpublished degree dissertation. The work involved use of a hydrophone in an attempt to determine whether the sound of canoeing activity disturbed fish in a lake. The work concluded that that canoeing did not disturb fish.

In a report documenting river restoration research at Ozark National Scenic Riverways (ONSR) between 1970 and 1977, Marnel *et al* describe fieldwork that utilised an underwater camera system in an attempt to establish whether intensive canoe use on some sections of river disturbed nesting male longear sunfish (*Lepomis megalotis*). They concluded that the degree of disturbance was related to nest depth, distance of the guarding fish from protective cover, and speed-distance relationships of water craft, and that time over the nest was the principle disturbance factor associated with boating activity. However, the relevance of this research to the present debate is limited as three-spined sticklebacks (*Gasterosteus aculeatus*) and nine-spined sticklebacks (*Pungitius pungitius*) are the only fish in the UK known to guard their nests.

A review of the effects of recreation on freshwater plants and animals by Liddle and Scorgie (1980) states that all boating activities are potentially disturbing to some groups of animals. However the only research they were aware of, that relates to the disturbance of fish, concerned the impact of outboard motors. The work of Pygott (1987) and Staples (1992) demonstrated that, water quality aside, the most significant impact on canal fisheries appeared to be frequency of boat traffic, a factor also severely impacting upon the macrophyte and macroinvertebrate communities. Effects on fish community and population structure,

diversity and biomass were demonstrated at increasing levels of boat traffic. However, there appears to be no evidence in the literature that canoeing is responsible for any of the impacts recorded for larger craft.

The National Rivers Authority R&D Note 408, 'Impact of Recreation on Wildlife', discusses the disturbance of gravel in rivers and streams by a variety of activities including: gill scrambling; the passage of four wheel drive, forestry, agricultural and engineering vehicles, and motorcycles; wading anglers; and canoeists. This R&D note refers to several studies that have demonstrated that mechanical shock can damage or destroy salmonid eggs. However, no specific evidence of canoe damage was referred to.

Several other papers in the literature (Parker 1975; Bielby, 1977; Etchell, 1998; O'Sullivan, 1991) discuss access conflicts, conflicts of interest between anglers and canoeists, and competition between aquaculture and leisure pursuits. However, aside from alluding to these issues none offers any substance to further consideration of the points at issue in this study.

3. QUESTIONNAIRE SURVEY

A questionnaire about the effects of canoeing on fish stocks and angling was sent to various representative angling and canoeing organisations and individuals. It contained the following questions:

1. Please provide details on whether you participate in canoeing and/or angling ?

2. Do you have, or are you aware of, any written reports or publications regarding the effects of canoeing on fish stocks and angling ? Please supply details.

3. What is your perception of the damage, if any, caused by canoeists to fish populations ? Do you have any evidence to support your views ? If possible please state the name and location of the waterbody.

4. Are you aware of any major conflicts between anglers and canoeists ? If so, please provide details. If relevant, are you aware of areas of waterbodies and times (seasons) when such problems are more prevalent and/or severe ? If possible, please state the name and location of the waterbody.

5. Please provide details on any areas where canoeing agreements have been reached or even revoked ?

A copy of the questionnaire was sent to:

- Agency Regional Fisheries, Recreation, Conservation, and Navigation (FRCN) Managers, Area Fisheries, Ecology, and Recreation (FER) Managers, and other interested parties in the Agency;
- National Federation of Anglers;
- Salmon and Trout Association;
- National Association of Fisheries and Angling Consultatives;
- the British Canoe Union;
- the Welsh Canoe Association;
- the Scottish Canoe Association (SCA);
- the American Canoe Association;
- the Canadian Canoe Federation;
- Deutscher Kanu Verband (the German Canoe Association) and;
- Federation Francaise de Canoe-Kayak (French Canoe and Kayak Federation).

The National Federation of Anglers distributed copies of the questionnaire to 450 angling clubs. The National Association of Fisheries and Angling Consultatives sent their own version of the questionnaire to approximately: 32 consultatives; 24 club members; and 120 individual members. The questionnaire was posted on the British Canoe Union's website (http://www.bcu.org.uk) where people logging on were invited to e-mail completed forms to APEM. The Welsh Canoe Association included a copy in its newsletter, *Ceufad*, with a circulation of approximately 2500 individuals.

3.1 RESULTS

A total of 79 responses to the questionnaire were received. A breakdown of respondents is given in Table 3.1 and a breakdown of their answers is given in Table 3.2 and Figure 3.1.

Table 3.1 Questionnaire Respondents

Source	Number of Responses
Agency	32
BCU	3
BCU Website	9
Ceufad	1
NFA	23
SCA	1
NAFAC	8
WCA	1
Miscellaneous	1
Total	**79**

Table 3.2 Questionnaire Responses

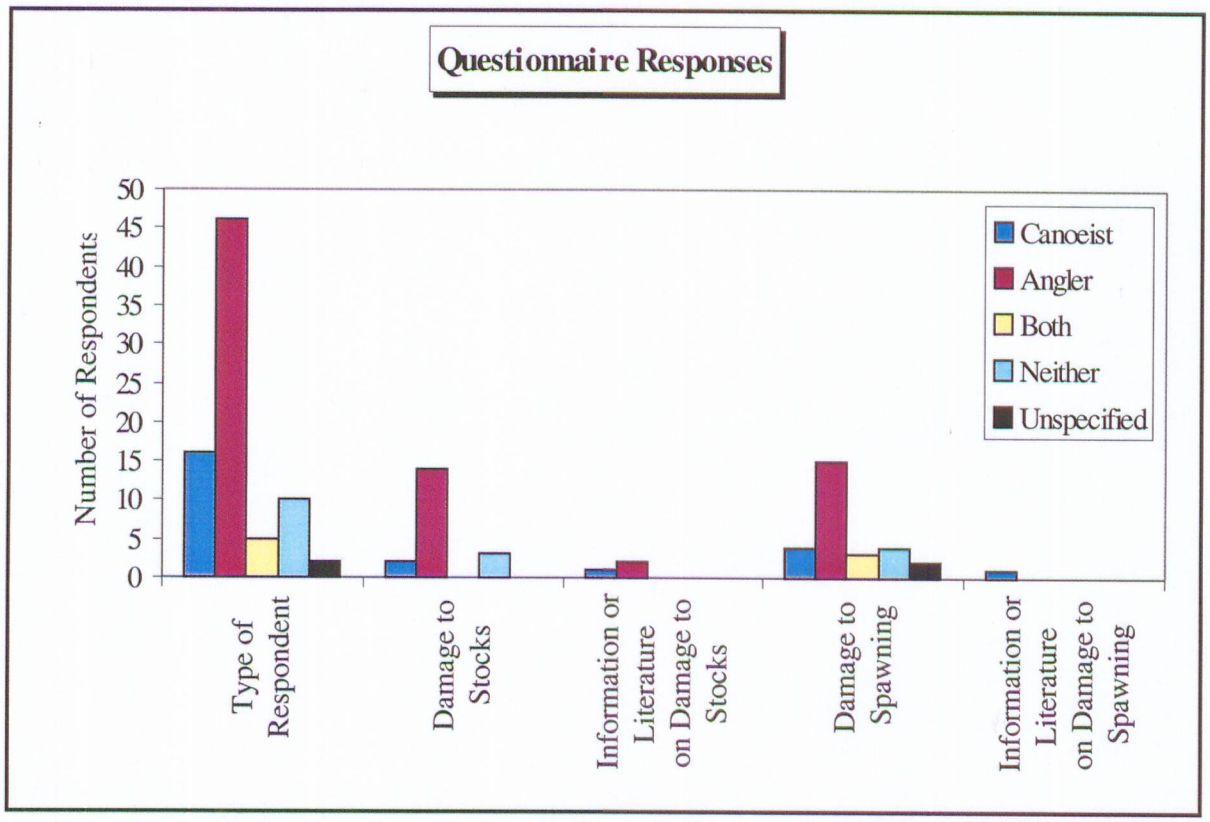
Type of Respondent	Number of Respondents	Damage to Stocks	Information or Literature on Damage to Stocks	Damage to Spawning	Information or Literature on Damage to Spawning
Canoeist	16	2	1	4	1
Angler	46	14	2	15	0
Both	5	0	0	3	0
Neither	10	3	0	4	0
Unspecified	2	0	0	2	0

Of the 32 responses received from the targeted Agency employees, 14 were anglers only, 1 a canoeist only, 6 people participated in both activities, and 11 people participated in neither. NB Some targeted individuals sought the opinions of others in their department to provide valuable composite responses. These have been treated as individual responses for the purposes of compiling the questionnaire response statistics.

Of the fourteen anglers, eleven said they believed damage could be done to spawning gravel by canoeists, two that water management regimes, e.g. the release of water from a reservoir to facilitate canoeing events, could cause damage, and three that they didn't believe any damage is caused by canoeing.

The sole canoeist believed that there was a risk of damage to fish populations during spawning times. No evidence was given.

Figure 3.1



Five out of 6 of the people who were both canoeists and anglers believed that damage to redds may occur as a result of canoeing; three of these respondents said they thought this was more likely to occur in flows that are inappropriately low for canoeing. None could provide any evidence to substantiate these beliefs. One respondent did not feel that any damage was done but had heard anecdotal evidence to the contrary.

Of the 11 respondents who participated in neither activity, 6 said they believed damage could be done to spawning gravel by canoeists, one referred to general habitat degradation (on the River Washburn) as a result of canoeing, one that they believed damage was more likely to be done to game rather than coarse fish stocks, one that more damage was likely to be done to gravel than weed spawners, and two that no damage was caused. Apart from the habitat degradation noted on the River Washburn, no other evidence was proffered to substantiate these views.

The majority of Agency responses provided information about conflicts and agreements although some of these referred to the same agreement or conflict.

Of the 23 respondents from the National Federation of Anglers, 4 stated that they believed canoeing damaged fish populations although no evidence was provided. Nine respondents were aware of conflicts. Three people gave details of access agreements.

All of those returned by NAFAC consultees stated that canoeing causes damage fish populations with the majority of respondents suggesting that it occurred by way of damage to redds. No evidence to support these views was provided. All of the NAFAC distributed

questionnaire forms received referred to conflicts between anglers and canoeists and 5 mentioned areas where they knew access agreements existed.

Of the 9 people who responded to the questionnaire posted on the BCU website, 7 were canoeists, one a canoeist and angler, and one a canoeist and ex-fisheries scientist. With the exception of the canoeist and ex-fisheries scientist, none of the respondents believed that canoeing could impact upon fish stocks. Five people were aware that conflicts occur between anglers and canoeists; four of these were aware of access agreements. The canoeist and ex-fisheries scientist gave details of conflicts, was aware of access agreements, and felt that canoeing could possibly damage fish stocks at spawning times if inappropriately low waters were paddled.

None of the 3 BCU respondents thought that canoeing impacts upon fish stocks. The response from the WCA was that they understood that damage might be possible in low water conditions, but that in water deep enough to accommodate canoeing no damage to fish stocks should occur. The SCA response was that they did not think damage was likely. Two of the BCU respondents were not aware of any conflicts; the SCA and WCA respondents acknowledged the fact that they do arise. One BCU respondent and the WCA respondent provided details of access agreements. The SCA response was that it 'does not enter into national access agreements and asserts its belief that canoeists have a freedom to take passage over water, akin to the hillwalkers freedom to roam over land'.

The sole questionnaire response from *Ceufad* described a specific area of conflict and suggested that greater freedom of access would avoid the development of honey-pots and 'inevitable' pirate runs.

The questionnaire response from a Scottish landowner allied the declining fish stocks in a particular area with a high level of canoe activity. The respondent felt that this, combined with the inappropriate behaviour demonstrated by some canoeists may lead to future conflict.

3.2 SUMMARY

The majority of respondents believed that canoeing *could* impact upon fish stocks by disturbing spawning gravel/redds. Some respondents stated that canoeing *does* impact upon fish stocks by disturbing spawning gravel/redds. None could provide any evidence. Most respondents were aware that conflicts have occurred between anglers and canoeists; many were able to provide details of specific incidents or mentioned particular areas where conflicts frequently arise.

4. AREAS OF CONTENTION

The following section presents a synthesis of the comments and opinions expressed in the questionnaires and interviews with key organisations.

4.1 DAMAGE TO FISH STOCKS

Conflicting views were presented on this issue.

Anglers:

- *"There is much anecdotal evidence for declining fish stocks as numbers of canoeists has increased."*

Canoeists:

- *"Declining fish populations are often associated with increases in other recreational users and/or craft."*

4.2 DISTURBANCE OF ANGLING

Anglers believe their sport is affected in two ways by canoeists.

Anglers:

- *"Angling is disrupted during passage by canoes."*
- *"Fishing quality deteriorates as fish go off the take following passage by canoes."*

Canoeists:

- *"A code of Conduct has been produced to avoid or minimise disturbances and advice is provided by Governing Bodies for organised events."*

4.3 REGULATION & LICENSING

Both groups raised the issue of regulation, including licensing and controlling rogue elements in canoeing and angling.

Anglers:

- *"With respect to dealing with rogue elements, anglers are well policed by the club/riparian charging structure whereas canoeing is not."*
- *"Penalties for fishing without a rod licence are severe whilst canoeing without permission attracts little if any financial penalty."*

Canoeists:

- *"Canoeists are required to licence their craft with navigation authorities on the majority of rivers and canals on which they paddle."*

4.4 FINANCE

Financial issues were raised by both groups.

Anglers:

- *"There is a requirement to pay for a rod licence in addition to fees charged by riparian owners whilst this financial burden is not placed on canoeists."*
- *Fishing permits and lease agreements are a source of income for the owners of riparian rights.*
- *Frequently anglers pay for exclusive use of the river.*

Canoeists:

- *"Canoeists would pay for the provision of facilities such as car parks and maintenance of ingress and egress points if greater access was obtained."*

4.5 COMMUNICATION

It is apparent from the interviews that communication problems between angling and canoeing organisations are a common occurrence.

Anglers:

- *"Often not consulted on access and organised events."*
- *"License/club/riparian structure provides good channels of communication whereas canoeists need not belong to any association or group."*

Canoeists:

- *"Enquiries to establish when fishing matches are taking place are frequently difficult and may involve many individuals/groups."*

4.6 ACCESS

This point is a fundamental area of disagreement between the two groups.

Anglers:

- *"When a right of navigation is assigned to a stretch of water it is not currently to the exclusion of all other craft except canoes and kayaks."*
- *"Creation of more statutory rights of navigation may lead to greater environmental degradation, particularly near large conurbations."*
- *"Anglers generally feel that the onus is upon the canoeing community to devise mutually acceptable solutions to the problem of shared access."*

Canoeists:

- *"Canoeists would like to have greater access to rivers via changes to legislation."*
- *"Those who benefit from new legislation regarding increased access should be required to adhere to a code of responsible use."*

5. EXPERT OPINION CONCENSUS

5.1 INTRODUCTION

Due to the lack of published literature on the effects of canoeing on fish stocks an additional means of achieving an informed view was required. It was therefore decided to consult individuals deemed knowledgeable in appropriate areas of fisheries research with the objective of achieving an expert consensus of opinion. Whereas this in itself may not necessarily be regarded as definitive, in the absence of other data, it does provide an informed view with which to progress the issues further.

5.1.1 The Delphi Technique

The Delphi Technique is a method for undertaking an expert opinion consensus. It originates from North America and was originally developed during the cold war as a technological forecasting tool. It has subsequently been adapted and used in such diverse areas as healthcare, transportation, environmental science and fisheries. Zuboy (1980) provides an overview of the technique and demonstrates an application of it to a fisheries problem.

In outline, the technique involves identifying a group of experts knowledgeable in the area under investigation. The experts are then polled, usually by questionnaire. The results are summarised, generally determining the mean and ranges of the response to a given question. This information is then given to each respondent who is then asked to re-answer the question in the light of the 'new data' generated by the aggregate responses. Each respondent is given the opportunity to write a brief explanation of his subsequent response, justifying maintaining or changing their position as appropriate. These explanations are then provided to all the respondents in the next round. In this way, by undertaking several rounds of the procedure, a consensus opinion based on the mean or median of the responses is achieved.

5.2 METHODOLOGY

The Delphi technique used in this report was based on the following questions:

Do you think canoeing is harmful to coarse fish populations in rivers ?

Do you think canoeing is harmful to salmonid fish populations in rivers ?

In order to maintain the focus of the experts involved, the following points were emphasised:

- The question relates only to rivers.
- Individual fish welfare is not a consideration.
- Answers should be targeted at the population level only.

Panel members were asked to respond to questions with a score that ranged from 1 to 5 based on whether they considered canoeing to be harmful to coarse/salmonid fish stocks or not. The objective of this approach was to avoid the discrete variable which would result from a straight forward yes or no response and which can lead to the establishment of polarised and entrenched positions which would restrict subsequent room for persuasion and movement during the Delphi process, constraining a major advantage of the technique.

The scoring system was defined as follows;

1 = no overall harm at all to ***5 = seriously damaging to the population***

This method of scoring enables changes in panel members opinions to be illustrated, further influencing the groups view by demonstrating the direction of movement in the overall consensus as the rounds progress. A total of four rounds was proposed as sufficient to define existing positions and allow for movement following persuasion from the newly generated data on three occasions.

5.3 RESULTS

The results of the four rounds are shown in Tables 5.1-5.2 and Figures 5.1-8. The written responses from individual participants are given in Appendix VI.

Table 5.1 *Do you think canoeing is harmful to coarse fish populations in rivers ?*

	Coarse Fish			
	Round 1	**Round 2**	**Round 3**	**Round 4**
	2	2	2	2
	2	2	2	2
	1	1	1	1
	2	2	2	2
	1	1	1	1
	1	1	1	1
	2	2	2	2
	1	1	1	1
	1	1	1	1
	2	2	2	2
Mode	**1 / 2**	**1 / 2**	**1 / 2**	**1 / 2**
Mean	**1.5**	**1.5**	**1.5**	**1.5**

The mode for Round 1 was split between a score of 1 and 2.The mean score for Round 1 was 1.5 with a range of 1–2. The mean, mode and range remained constant for the remaining 3 rounds.

Table 5.2 ***Do you think canoeing is harmful to salmonid fish populations in rivers ?***

	Salmonid Fish			
	Round 1	**Round 2**	**Round 3**	**Round 4**
	2	2	2	2
	2	2	2	2
	2	2	2	2
	1	2	2	2
	1	2	2	2
	2	2	2	2
	2	2	2	2
	3	2	2	2
	2	1	1	1
	2	1	1	1
Mode	**2**	**2**	**2**	**2**
Mean	**1.9**	**1.8**	**1.8**	**1.8**

The modal score remained at 2 throughout. The mean score for Round 1 was 1.9 with a range of 1–3. The range narrowed after Round 2 to 1–2 and the average score decreased correspondingly to 1.8. There was no further change after Round 2.

5.4 CONCLUSION

The conclusion from the Delphi study is that canoeing is, on balance, not harmful to coarse or salmonid fish populations. There was almost no variation between rounds in the way respondents provided a score for each question. Only one respondent gave a score above two and they had changed their opinion by round 2 and gave a score of 2 to the same question in the remaining rounds. The result of the Delphi was, therefore, unquestionable.

Examination of the respondents individual comments during each round provides an indication of the reasoning behind the scores. The focus of attention of respondents answers to both questions was upon the likelihood of disturbance to spawning by canoe activity, particularly via damage to salmonid redds. The consensus was that the degree of disturbance would be a function of river size and the intensity of canoeing.

The possibility of the transfer of fish diseases by canoes was also raised and debated. The Agency's National Fisheries Laboratory was able to elucidate upon this idea. It stated that most of the known bacteria and viruses that are associated with fish diseases require water as a medium for their effective transfer. The laboratory's major concern was about the movement of spring viraemia in cyprinids. This is a highly resilient virus that can withstand drying-out. However, most bacteria and viruses are denatured by exposure to ultra-violet light for a minimum of ten minutes, and, therefore drying canoes and other equipment in sunlight is a highly effective denaturing process. The laboratory also stated that the major cause of diseases spreading was the movement of fish (by humans) from infected to uninfected waters, and that angling nets and other equipment were a major concern.

Therefore in conclusion, the consensus opinion of the assembled panel of experts is:

"Canoeing is not harmful to coarse or salmonid fish stocks in rivers."

Figure 5.1-4 ***Do you think canoeing is harmful to coarse fish populations in rivers ?***

Figure 5.1

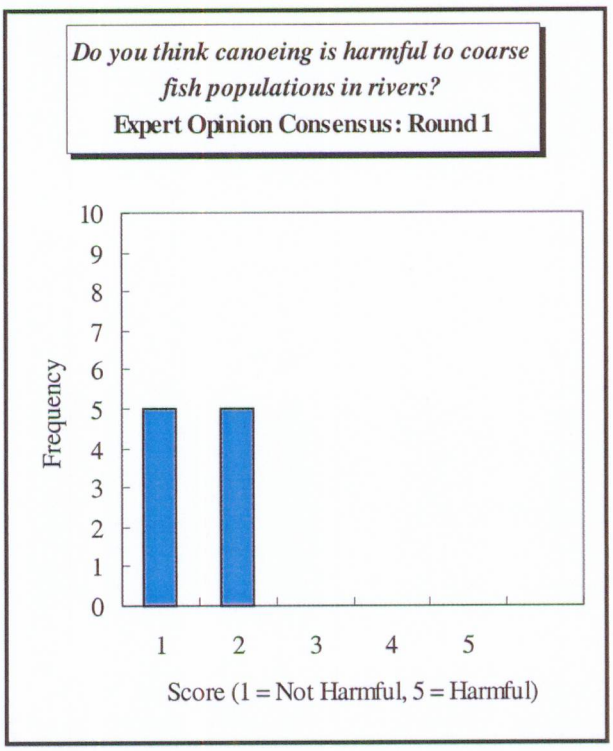


Figure 5.2

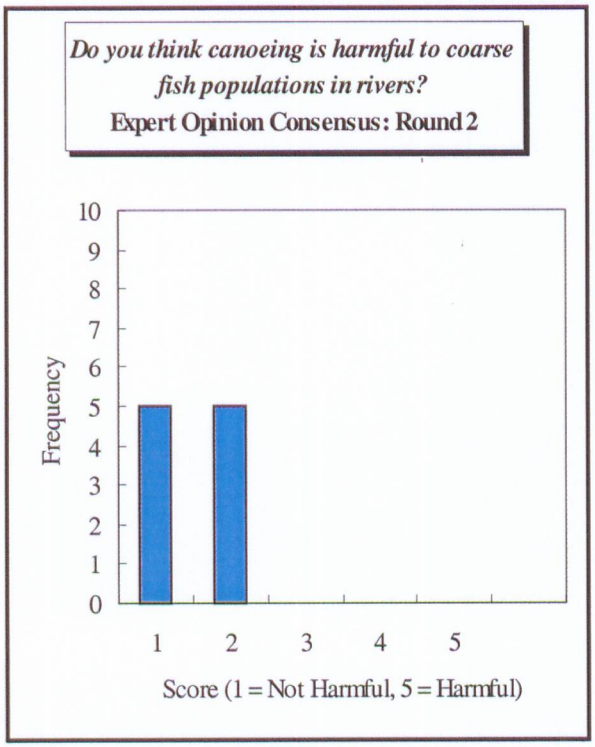


Figure 5.3

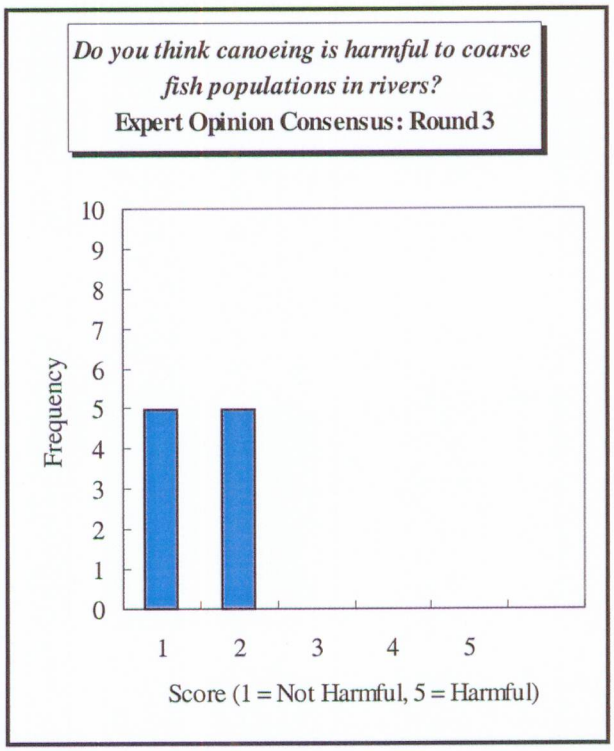


Figure 5.4

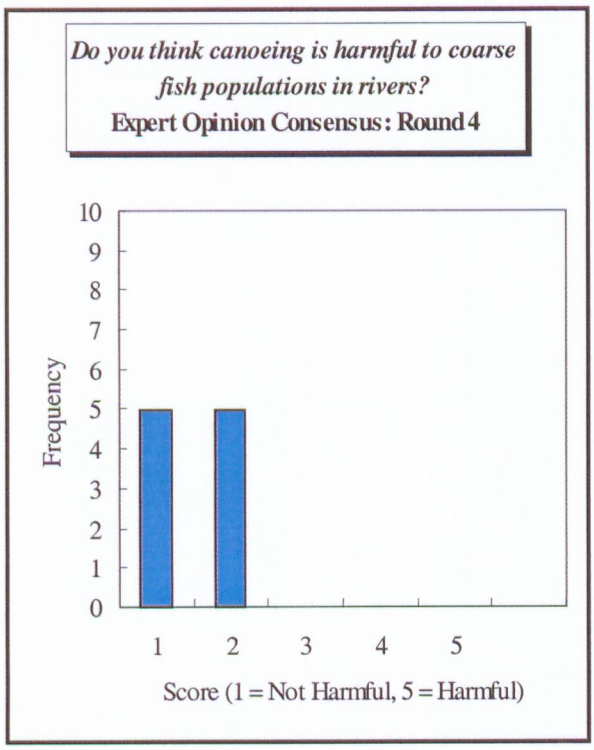


Figure 5.4-8 ***Do you think canoeing is harmful to salmonid fish populations in rivers ?***

Figure 5.5

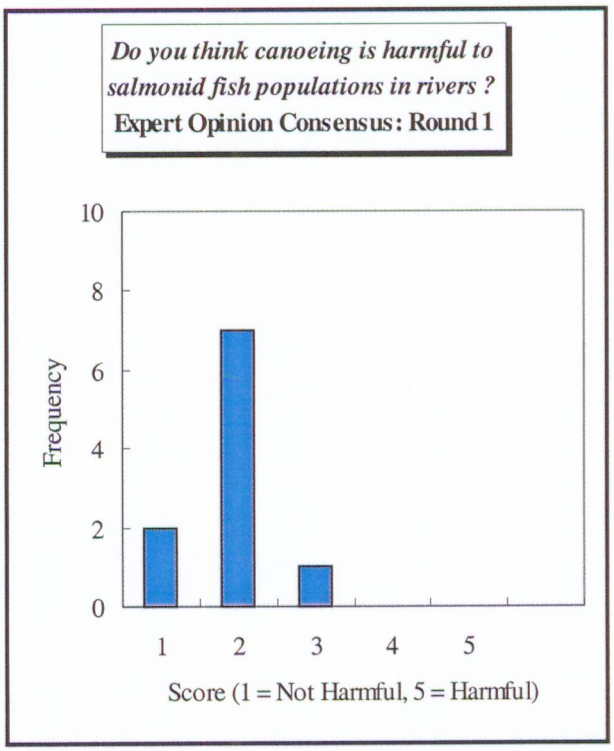


Figure 5.6

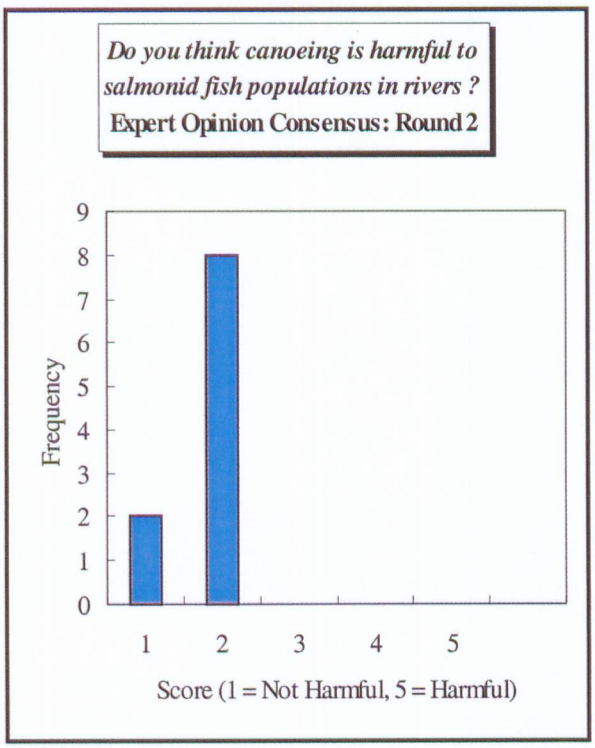


Figure 5.7

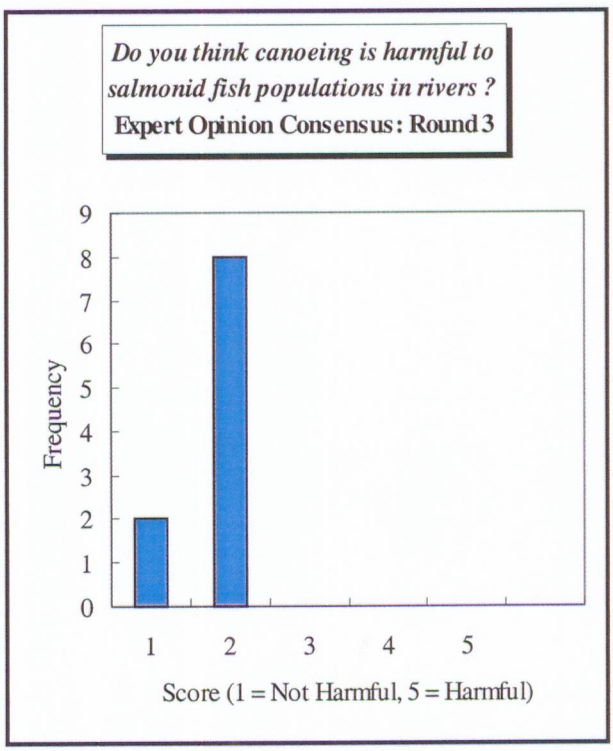
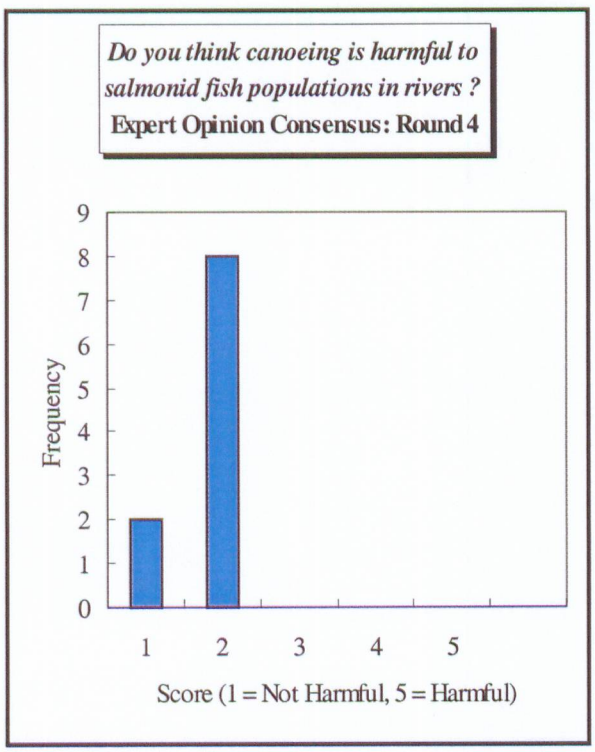


Figure 5.8



6. DISCUSSION

6.1 DAMAGE TO FISH STOCKS

This study indicates that canoeing does not harm fish populations. Although many anglers argue that the circumstantial evidence is simply too convincing to be overlooked, many of the examples provided were of areas where other recreational activities (including the use of other craft) occurred as well as canoeing. It should also be noted that some Delphi panel members would increase their score (indicating detrimental effects) for a high intensity of canoe activity. Nevertheless, the balance of scientific opinion considers that fish populations are not detrimentally affected by canoeing.

In the light of the representations received for this report, many of the objections to allowing shared access on the basis that canoeing causes damage to fish stocks are untenable. Rather the argument now centres around issues of disturbance to angling and exclusivity together with its financial implications.

6.2 DISTURBANCE OF ANGLING

In the questionnaire responses and key organisation interviews, the likelihood of canoeing disturbance angling was frequently allied with the intensity of canoe activity. Some coarse anglers referred to a 'quietening of the swim' following disturbance. However, others commented that they observed an increase in 'fish activity' after canoe passage attributed to stirring up of the bed, suspending fish food organisms in the water column.

Salmon anglers provided similar comments, identifying a scaring effect by canoes that put fish 'off the take'. However, one respondent commented that he had personally witnessed fish being caught immediately following canoe passage over a salmon pool, and reported an identical effect from an angler on an upstream beat on the same occasion.

It should be stressed, however, that the evidence above, both positive and negative, is anecdotal. It is prudent, therefore to consider the other main element of contention here, and that is physical disruption of the act of fishing itself, the activity being temporarily suspended, for whatever period to allow passage of canoes. In coarse fish angling this is at its most apparent during angling matches when passage of canoes will temporarily, albeit briefly, result in a level of disruption of proceedings. In salmonid angling, although the density of anglers is considerably less, disruption again takes the form of a temporary cessation of fishing activity. Obviously where large numbers of canoes or organised events are concerned, disruption can be more protracted.

If canoeing does affect the presence of fish in an area and anglers ability to catch them, then it seems fair to assume that the degree of impact will be a function of river size and the number of canoes on it at any one time. Therefore an increase in canoe activity may have a more profound effect on smaller rivers than on large.

For their part the canoeing associations produce leaflets giving advice to members on organising larger events to minimise disturbance. Individuals are provided with a code of conduct by the BCU, which promotes courteous behaviour with a view to avoiding or minimising disturbance to other water users including anglers.

6.3 REGULATION & LICENSING

In canoeing, with the exception of specific navigation authorities, licensing is not required. Further, although as with angling, there is no requirement to belong to a governing body, the absence of the long standing system of riparian owners or lease-holding clubs which exerts control over angling access directly, is of concern to fisheries interests. Hence regulation does not therefore apply outside of the voluntary Code of Conduct produced by canoeing organisations.

A key element in overcoming this obstacle is better communication between canoeists themselves and canoeist and angling interests. This is explored further in 6.5 below.

The issue of regulation and licensing is often seen by the canoeing fraternity as being linked to the issue of access in some way. However, this is not the case. Licensing of anglers is a specific fee charged in relation to the national fishery service provided by the Environment Agency, whose fishery activities encompasses a range of statutory obligations. This has no bearing or influence on right of access for anglers (see 6.6 below), which is an entirely separate issue. It is difficult to envisage how a parallel can be drawn with a national license for canoes in relation to the service that would be provided. In the absence of an identifiable service provided in return for a licence, inevitably this would be regarded as a tax. In addition in the absence of fundamental legislative change for access (see 6.6) licensing as a tool to provide facilities for greater access would be nonsensical.

The issue of regulation is perhaps of more relevance to the issue of confrontation regarding rogue elements in either sport and how they might be controlled. Anglers would argue that the sport is highly regulated by a combination of factors, the primary one being the ability to deny access to waters by riparian owners or lease-holding clubs. Although membership of the governing bodies is not mandatory, many match angling organisations for example must belong to the NFA in order to compete in its leagues. Expulsion is therefore a powerful regulatory tool in this context. The angling license itself holds no regulatory role at present, although a recommendation of the Salmon & Freshwater Fisheries Review Group is that for serious fisheries offences there should be provision to refuse issuing of a license to fish for a fixed period.

6.4 FINANCE

The financial significance of licensing is not relevant to the issue of greater access and so will not be explored further. However, the riparian rights of ownership referred to above, which are central to the issues of access and exclusivity, are available to all individuals and organisations, including canoeists, if they wish to purchase them when available. It is recognised that considerable resources would be required in many river stretches to purchase rights of access, although precisely the same financial pressures are imposed upon angling interests.
In the view of many angling organisations, introduction of canoeists removes exclusivity. The outcome is a reduction in the value of the resource and hence the price paid for lease, thereby reducing riparian income. The fact that this right of access is paid for directly by fisheries interests is the cause of much of the concern from the angling community.

On this point, the Salmon and Freshwater Fisheries Review Groups recommendation is that resources to increase public access should not come from the public purse. Nevertheless,

alternative sources of funds are successfully obtained by angling clubs and arguably can equally be secured by other interested organisations, including canoeists.

Hence, the possibility of further development of dedicated facilities, such as those that exist at the Welsh National White Water Centre at Tryweryn, could be promoted by canoeing organisations. Alternatively wild water stretches that are of little value in angling terms could also be purchased to provide specific river conditions. Steep falls and rapid glides with no holding pools or rest areas are of little use to angling but offer passage of migratory fish to appropriate habitat up and downstream. However, such areas can be regarded as valuable to canoeists and if managed appropriately could be worth more to riparian interests than angling. It should be stressed, however, that the need for large areas of water to facilitate some canoeing disciplines (such as touring) may mean that purchase is impractical, in which case negotiation and access agreements are essential (see 7.6).

Leasing or ownership of riparian rights presents several opportunities to canoeing organisations to increase revenues. First of all they can charge canoeists for use of the river section in question, in much the same way as anglers are charged. Secondly they may wish to open the water to other recreational pursuits, such as angling on a charging basis, to supplement income during periods when canoeing conditions are less favourable.

Alternatively the option of combined multi-use lease/access agreements with riparian interests could be explored further (see 6.6). Although some canoeists consider this inappropriate, preferring to see access as a right, a lease option is precisely the tool that facilitates access for most angling organisations. Losses to riparian interests, due to lower fees resulting from a loss of exclusivity, may be offset by charges levied on a number of different user groups.

6.5 COMMUNICATION

Difficult or poor communication appears to be central in much of the information collected during this study. Improved communication offers a realistic possibility of alleviating some of the root causes of antagonism between anglers and canoeists. The Angling & Canoeing Liaison Group, brokered by the Environment Agency, is an excellent example of providing a forum to facilitate improved communication. At a practical riverbank level, improved communication is vital for any form of agreement to be successful, and particularly so where access agreements are to be negotiated.

It is apparent from all organisations that such agreements require a considerable amount of effort to establish them and continued nurturing to maintain them. The Dee Tour, for example, necessitates contacting 40 riparian owners on an annual basis, most of which is effected by voluntary canoe access officers. Both the BCU and WCA are served by a network of volunteer access officers whose aim is to broker new agreements and to provide information to members. The WCA is currently reviewing its network, with a view to increasing the concentration of officers in those areas that are prone to access problems, recognising he importance of improved communications between the two recreational groups. Nevertheless, canoeing organisations also need to examine methods to improve discipline and policing of any rogue elements to enable widespread acceptance of increased access. Improved communication, dissemination of information and ultimately some form of policing is therefor vital.

As mentioned earlier, although the BCU and the WCA are the representative bodies of Canoeists in England & Wales, canoeists do not have to subscribe to either to participate in canoeing. Despite the fact that these organisations publish advice for the benefit of all canoeists (i.e. not just their members) it is clear that the vectors by which this information is passed on are sometimes ineffective. There is a need therefore for an effective communication network that will benefit anglers and canoeists. In this regard the proliferation of individuals having access to the Internet may be beneficial to the dissemination of information. An excellent example of this in action is the WCA website which provides details of an "Access Line" which canoeists can call to get information on local access agreements, water levels and surf conditions. Further development of this technology would appear advantageous.

6.6 ACCESS

The BCU believes that greater access to rivers should be achieved via legislative change and, in particular, is hopeful that the current government will legislate for greater access to the countryside. However, the Salmon & Freshwater Fisheries Review Group have advised that unfettered access along watercourses would undoubtedly affect fisheries and angling interests. The Review Group points out that there are no provisions in existing fisheries legislation that give anglers preferential rights of access and that the ownership of fishing rights and private rights of access are long standing rights under English Law, dating back to the Magna Carta. Any proposal to amend them would therefore need to be considered in this wider context.

The specific recommendation from the Review Group on this point is that if there are circumstances where the Government wishes to improve public access to water and the land adjacent to it, this should be considered locally, on a case by case basis. Further, it is proposed that there should be full consultation with all those who have legal rights in relation to the land and water in question.

The issue of exclusivity is central to the issue of access and is inseparably bound to the financial value of a fishery and the money received by riparian owners.

6.7 ACCESS AGREEMENTS

Hence, leaving the rights of ownership aside, the debate falls back to the issue of voluntary agreement between anglers and canoeists. It should however be noted that where access agreements are in place they apparently work well. Arguably, developing this approach further, offers the best vehicle for resolving conflict and avoiding the key reason for disenchantment, disruption to angling. Whereas this does not represent a departure from the current situation, the framework within which access agreements are produced may vary considerably in the near future. Further, despite the suspicions of parties on either side of the debate, the efforts of the Environment Agency to assist in developing a framework within which voluntary access agreements can be brokered, is to be welcomed.

The Salmon & Freshwater Fisheries Review Group have recommended the development of Fishery Action Plans, on a catchment basis, each covering all species within a catchment and identifying problems, targets etc. and producing a workable management framework. Issues such as local closed season, important spawning areas, obstructions and so on will be identified. The Action Plans are to be fully integrated into the LEAP process and hence offer

the opportunity to provide a background against which canoe access agreements can be discussed. This then offers the possibility to develop voluntary agreements based on the ideas of zonation in time and space on a catchment specific basis, but armed with local fisheries knowledge to hand. This is the preferred approach recommended by Sport England in their evidence to the Review Group.

In a review of recreational activities and conflicts, Parker (1975) cites water skiing as the activity that is most incompatible with other water-based pursuits and states that zonation offers the best solution, a management option that could perhaps be applied to canoes. Zonation may be spatial or temporal. It may involve, for example, the provision of dedicated areas for canoe slalom training and events that are available all year. Or canoeing being permitted on a stretch of water only at certain times of the year, avoiding periods when anglers are present.

An example of an area where zonation of canoeing apparently works well is the Jura region of France. Here canoe training is permitted 24 hours a day on certain stretches of the River Doubs (which is incorporated in a National Nature Reserve), whilst on other stretches of the river, canoeing can only take place between 09-00 and 18-00. Angling is allowed outside of these times. When river flows are less than 4 cubic metres per second no canoeing is allowed.

In the UK successful access agreements are also founded upon canoeing intensity and in addition to spatial and temporal zonation or upon permutations of these limiting factors. Agreements that specify the permitted intensity of canoeing range from those that permit only one trip per year for a specified number of canoeists (e.g. on the River Blackwater, Essex) to those that permit a certain number of canoes per day (e.g. on the River Eden in Cumbria between Lazonby and Armathwaite).

Time regulation may be implemented in several ways. Access times may be related to flow conditions with canoeing allowed on a stretch of river when it is in spate (e.g. on the River Usk in Powys). Time regulated access frequently avoids those times that are popular with anglers on particular stretches of water. For example, on the River Wye, canoeists are requested not to launch at Glasbury between 10.00am and 4.30pm to avoid disturbing anglers.

Some canoe access agreements take advantage of angling closed seasons when interference with angling will not occur. Although previously anglers have questioned the reasoning behind such agreements based on purported damage to fish stocks, the consensus opinion in this report are that fish populations are unlikely to be detrimentally affected by canoeing.

Finally, it should be born in mind that granting improved access to canoeists does not mean that numbers participating in this sport will suddenly rocket. It seems more likely that increased access will aid the prevention of 'honey pot' sites by reducing the density of canoeists in certain areas. In many ways this could be seen as advantageous to anglers if reduced disturbance results.

7. CONCLUSIONS

The general conclusion from this study is that canoeing is not harmful to fish populations. Therefore, the main area of conflict between anglers and canoeist centres around the disturbance of angling, which to a greater or lesser degree is dependent on the intensity and duration of canoeing activity. Disturbance is in turn allied to the concept of exclusivity with its attendant financial implications for riparian interests and anglers.

The current debate regarding a general improvement in access to the countryside is considered to be potentially damaging to fisheries interests, in the context of English law ownership rights. Therefore in line with the Governments Salmon & Freshwater Fisheries Review Group recommendation, any increased access should be on a local basis, with full consultation of all those with existing legal rights. Access to sporting rights is outside the scope of fisheries legislation and it would be inappropriate to use it to obtain increased access for one group of users over another

The suggested way forward to improve access for canoeists whilst reducing conflict with anglers is via further development of voluntary access agreements but within the framework the Fisheries Action Plans proposed by the Review Group. The precise format of such Action Plans needs to be developed but it is envisaged that they will form an integral part of the LEAP framework, and as such should provide a useful vehicle as the basis for discussion on a catchment specific basis. This format could be used to explore the possibility of temporal and spatial zonation of waterway use where conditions are appropriate.

The need for an effective communication network that will benefit anglers and canoeists has been identified and the role of the Agency in forming the Angling & Canoeing Liaison Group to be welcomed. Use of modern technology, particularly the Internet to disseminate information on Access Agreements in place, Codes of Conduct etc. is seen as an important development in this regard and offers new opportunities for the future.

The financial issues surrounding exclusivity can perhaps be dealt with more imaginatively. Where voluntary access agreements are successfully negotiated, opportunities for increased revenues may be apparent in some cases with charges for parking, launching, and permits being possible. Alternatively reduced rents following a removal of exclusivity may be appropriate, with the income shortfall being balanced by revenues from other users, such as canoeists. Finally, the same English law ownership rights that benefit anglers are available to canoeists if they wish to pursue them allowing a reversal of the revenue streams referred to above.

8. FURTHER RESEARCH

The main recommendation of this project is that access for canoeists should be progressed on a voluntary basis by further development of Access Agreements. Financial considerations have been identified as essential components of the discussion and warrant further investigation. Specific issues requiring further research include:

- Exclusivity
  - True financial value
  - Variation with river types/reaches
  - Willingness to pay
- Combined Use
  - Financial implications for riparian interests
  - Additional value generated
- Rights Purchase
  - Riparian rights purchase by canoeists
- River Values
  - Variation in value of river reaches/areas
- Access Charges
  - Willingness to pay
  - Income potential

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APPENDIX I

DELPHI TECHNIQUE EXPERT PANEL MEMBERS

EXPERT PANEL MEMBERS

Dr. Gordon Copp.	Fish Biologist, University of Hertfordshire.
Dr. Nick Giles.	Environmental Consultant Specialising in Freshwater Fisheries, Aquatic Ecology, and Conservation.
Professor Paul Giller.	Freshwater and Community Ecologist, Department of Zoology and Animal Ecology, University College Cork, Ireland.
Dr. Anton Ibbotson.	Senior Scientific Officer, Centre for Ecology and Hydrology.
Dr. Michael Ladel.	Retired Head of the Fisheries Department, Institute of Freshwater Ecology.
Professor Peter Maitland.	Independent Freshwater Ecology Consultant, Fish Conservation Centre, Haddington.
Professor Richard Mann.	Thirty-five years as a fish biologist at the Institute of Freshwater Ecology. Part time consultant. Visiting Professor at the University of Hertfordshire.
Dr. David Summers.	Fisheries Manager, Tay District Salmon Fisheries Board.
Dr. Ian Winfield.	Fish Ecologist, Institute of Freshwater Ecology, Windermere.

NB: To ensure anonymity of comments the panel members have been listed in alphabetical order. Their position in the list is, therefore, not related to the comment numbers.

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APPENDIX II

DELPHI TECHNIQUE SUPPORTING EVIDENCE

DELPHI TECHNIQUE - ROUND 1
SUPPORTING EVIDENCE

NB: To maintain anonymity the comment numbers are not related to any of the panel members and hence are not consistent in successive rounds.

Comment 1

My score (1) assumes that only the impact on fish populations is being considered, rather than the impact on angling itself. I am unaware of any way in which canoeing could realistically impact on coarse species, given the relatively large rivers that such species typically inhabit.

My score (2) assumes that only the impact on fish populations is being considered, rather than impact on angling itself. I have given a slightly higher score to the impact on salmonid species because these typically inhabit smaller rivers where physical disturbance, including potential damage to redds, is more likely. In addition, although this may be beyond the present remit, I consider that river flow management for canoeing may have detrimental effects on the macroinvertebrates of salmonid habitats.

Comment 2

I have no hard evidence of harmful effects. My mark (2) is based on the fact that disturbance is likely to interfere with feeding, breeding, migration, and predation of populations. The impact will depend on the degree and frequency of disturbance and the state of the fish populations and nature of the habitat.

I have no hard evidence of harmful effects. My mark (2) is based on the fact that disturbance is likely to interfere with feeding, breeding, migration, and predation of populations. The impact will depend on the degree and frequency of disturbance and the state of the fish populations and the nature of the habitat.

Comment 3

Coarse fish will be disturbed by large moving objects (like canoes) close to them and thus various activities (feeding, spawning, etc.) may be affected. However, as most canoes are likely to be moving smoothly and steadily along the river, the disturbance will be very short-term and therefore minimal. It is important to note though, that if numbers of canoes are operating regularly on one stretch of the river on a daily basis, then more serious damage may be done – especially, say, in spawning areas at spawning time.

Salmonid fish will be disturbed by large moving objects (like canoes) close to them and thus various activities (feeding, spawning, etc.) may be affected. However, as most canoes are likely to be moving smoothly and steadily along the river, and more quickly in faster flowing salmonid habitat rather than stretches favoured by coarse fish, the disturbance will be very short term and therefore minimal. It is important to note though, that if numbers of canoes are operating regularly on one stretch of the river on a daily basis, then more serious damage may be done – especially, say, in spawning areas at spawning time.

Evidence from experimental work at Loch Lomond, with Brown trout in cages, indicated that they were relatively little disturbed even by boats with outboards approaching them and it was not until the boats were very close and especially when the boat shadow fell on a cage that the fish showed any real escape reaction.

Comment 4

There is the potential to disturb / damage macrophyte beds and hence habitat for young fish, refuges from predators etc. but this depends on the extent of canoeing activities. It is unlikely to be extensive. There is also potential for sediment addition via canoe slipways, but this is likely to be minor and of limited longitudinal extent.

Canoeing is unlikely to take place in preferred salmonid habitats of low order/headwater streams, which are generally shallow, riffle/pool sequences.

Comment 5

Canoes would be little different to logs floating downstream- a natural phenomenon. As they cause little physical disturbance to either substrate or macrophytes I cannot see how they would significantly disturb coarse fish stocks.

The comment above ... is applicable here ... . However should canoeists walk or drag their craft across gravel shoals during the November to April period they could disturb/kill many salmon eggs in redds. (Score = 1 [except in the November to April period when 5 would apply; no supporting evidence).

Comment 6

Canoeing hardly damages aquatic vegetation (= spawning sites, fry habitat), which would be the only case for concern (as it is in the case of motor boats, i.e. damage by propellers and boat wash).

Disturbance to benthic invertebrates (= salmonid prey) on shallows and to spawning fish has been reported, but probably these have only minor population consequences. See Marnell, L., Foster, D., and Chilman, K. (1978) *River recreation research conducted at Ozark National Scenic Riverways 1970-1978: a summary of research projects and findings.* Van Buren, Missouri. National Park Service.

Comment 7

I think it feasible that, where spawning shallows are in short supply (e.g. heavily engineered rivers), coarse fish such as barbel and chub could be regularly disturbed during spawning by fairly intensive canoeing activity over relatively shallow, fast flowing river sections. This could affect recruitment success. Outside the spawning period I think that population effects on coarse fish are likely to be negligible.

Where winter canoeing occurs at high frequency over and close to salmon and trout spawning areas I think that it is quite feasible that these salmonid fish may be hampered, to a degree, in spawning site choice and perhaps in optimal spawning behaviour. This could affect

recruitment success. Outside the spawning period I think that population effects on salmonid fish are likely to be negligible.

Comment 8

Where canoeing and coarse fish populations meet, it is unlikely that there is a large amount of physical disturbance. The only potential disturbance would be weed removal on paddles and this could have some limited effect, if weeds contained eggs, but this would probably be negligible. It is hard to imagine canoeing removing all weed.

Canoeing is likely to have some limited impact on salmon populations where it is very intensive, perhaps during competitions and if canoeing takes place when eggs or alevins are still in the gravel and sensitive to disturbance of the substrate. However, I believe this effect may be localised and hence the low score (2).

Comment 9

The intensity of canoeing activity, the timing of the activity, and the size of the river are not specified, making the question rather open ended. However, in general the disturbance (or activity) caused by canoeing could cause some stress to the fish, but unless this coincided with reproduction or systematically upset feeding, little impact is expected.

The intensity and the timing of canoeing activity again are not specified. Nonetheless, salmonid rivers tend to be shallower and/or smaller, and riverine salmonids are generally territorial, increasing the possibility of a detrimental impact on the population, particularly in the case of intensive canoeing, through disturbance of feeding or reproduction (depending upon the timing of the activity). In the case of the occasional and/or irregular canoeing activity, no impact is expected.

Comment 10

I suspect canoeing will only have a minor effect on coarse fish populations in most places. The main problem I can foresee would be the disturbance factor to fish which could prevent fish from occupying feeding lies at certain periods. If canoeing activity was protracted then this might perhaps ultimately impact on growth or fish residence. On the River Tay there are few coarse fish. One of the best areas for roach and grayling is in a particularly slow stretch of river above Stanley Weir. This, however, is a hotspot for canoeists. Although they are primarily attracted to the fast flow below the weir they spend much time rolling etc. in the pool above where the roach are. Another concern is that canoeists could spread diseases and parasites - argulus is something which has recently appeared in this catchment and might be further spread by them.

On a river like the Tay, frequented by canoeists, white water rafters etc., spawning salmon might receive considerable disruption in some areas. They are unlikely to disrupt juveniles but could displace adult salmon from holding pools. While the direct effect may be generally limited, I am much more concerned about long-term indirect effects. Disease and parasites (e.g. gyrodactylus). In some areas the frequency of canoeists can make angling impossible. While this is a separate issue, anything which undermines the financial viability of salmon angling in Scotland will undermine our ability to fund management activities (habitat restoration, bailiffing etc.).

DELPHI TECHNIQUE - ROUND 2
SUPPORTING EVIDENCE

Comment 1

There appeared to be good consensus between respondents, but I feel that canoeing would have more impact on salmonids than coarse fish because of the increased disturbance to substrate in salmonid rivers and the importance of that to salmonid spawning success. The only issue I had not previously considered seriously was the transfer of parasites and disease. However, there are so many other activities that occur in rivers which could equally transfer disease and parasites. As far as I am aware there is not any particular characteristic of canoeing which would increase the risk of transporting parasites or disease.

Comment 2

On balance, I would reduce my salmonid score from a 3 to a 2 as the direct effects are likely to be limited as all are agreed. There is no information to make me reconsider my coarse fish estimate.

While I agreed with the general tenor of the responses on direct effects of canoes on fish, I am concerned that we may underestimate the future impacts of canoeing. This is because canoeing will become much more popular if the proposed legislation on access comes through (well this is the case in Scotland at least). Most responses assumed the presence of canoes to be fleeting but there was recognition that areas of intensive use could occur. I am concerned that such use could become much more common in the future. In the Tay catchment for example, which has perhaps the highest frequency of 'paddlers' of all descriptions of any river, canoeists do use anything from moderate headwater tributaries to the main stem. There are a number of localities where paddlers are present almost permanently, often all day and on most days. To make matters worse these are usually groups, often practising paddling etc. in the presence of instructors. This will get more frequent.

I consider the spreading of disease to be serious risk and was surprised this had not been noted by other respondents. I personally know people who have taken canoes on holiday with them to Scandinavia. This could be a means of transmitting gyrodactylus to this country.

Comment 3

Coarse fish: I agree with most of your respondents remarks with these exceptions:

(1) I do not agree that coarse fish necessarily inhabit 'relatively large rivers'; many small rivers and canals have coarse fish populations and some of these are used by canoeists.

(2) It is partly true that 'Canoes would be little different to logs floating downstream' (though I have never seen any logs flapping their branches regularly in the water) but there are places, especially where there are competitions or where instruction is being given to young canoeists, that activity and disturbance are high; if these coincide with important fish habitat, then some disturbance will occur- especially if disturbance is regular over a season.

Most respondents seem to agree that disturbance will be related to the extent of usage by canoeists. Without knowing what this is, scoring is difficult, but in these circumstances I believe that a score of 2 is a realistic one.

Salmonid fish: Again I agree with most of the comments except:

'Canoes would be little different to logs' (see above).

Again, most respondents seem to agree that disturbance will be related to the extent of usage by canoeists. Without knowing what this is, scoring is difficult, but in these circumstances I believe that a score of 2 is a realistic one.

Comment 4

The spread of disease aspect was one which I had not really considered but it would seem unlikely to be significant unless circumstances were exceptional. I would not revise my estimates.

I suspect that the differences in response are due simply to the differing experiences and perceptions of the respondents. For example, if the respondent is mainly familiar with salmon in small, shallow streams it would be easier to imagine disturbance of spawning by passage of canoes.

The main difference (albeit a small one) between the evaluation of the effects on coarse fish and salmonids stems essentially from the fact there are fewer species of the latter involved, they are more conspicuous (and have been studied in more detail) in their behaviours and thus potential disturbance is more apparent. In practice the differences in susceptibility between different species of coarse fish are probably as great or greater than those between salmonids and coarse fish.

Comment 5

No information was provided which affected my estimates, either for coarse or game fish. Rather, I found myself in agreement with most of the comments made by the other experts. I found it notable that most experts, including myself, made some comment on the potential impact of canoeing on redds of salmonid fish.

My only comment addressed to the comments of other experts is that I do not consider that canoes would have a significant effect on macrophyte beds, even when effects during the spawning season are considered.

Comment 6

The responses in Round 1 do not affect my estimates, which were spot on the medians. The citation of a report on the topic is nice to see, as I doubted the topic has not been addressed somewhere by somebody.

Most respondents appear to have similar views on the potential impacts of canoeing on cyprinids and salmonids. The comment of one respondent that even outboard motors did not disturb brown trout in experimental cages in Loch Lomond supports a personal

communication I have from a colleague in France who stated that fish generally ignore motor boats except at very close proximity. The concern of one respondent about the transfer of diseases by boats corresponds well with boating regulations in parts of North America, where the movement of boats overland requires decontamination treatment of the boats, either for reasons of fish diseases or to impede the spread of detrimental exotic aquatic plants.

Comment 7

No new information. I am aware of a paper mentioning canoe disturbance of radio-tracked barbel.

Comment 8

Re coarse fish: A number of comments raised the potential of some deleterious effects but this was totally dependent on the intensity and location of the activity. Without further information on either of these factors, I would not consider changing my score.

Re salmonids: In my opinion the major potential damage for salmonid populations would occur if the canoeing activity took place in the major spawning reaches and habitat of fry and parr. This is likely to be headwater streams (normally 1st or 2nd order). Is it likely that canoeing will occur in such streams ? Unless additional information is available to suggest that canoeing will occur here, I am not convinced there will be any effect. If the canoeing is set to occur in these headwater streams, or if management of the system to facilitate canoeing is take place, then I would consider increasing my score.

I would agree that if canoeing did occur in breeding habitats for salmonids, then the potential impact on redds and habitat for fry and parr could be locally important, but is it likely that canoeing will occur in such headwater (1st and 2nd order) streams ? If there was more information on the location and activity level of the planned canoeing, and whether or not any in-stream management activities were to take place to facilitate the canoeing, a more rational assessment would be possible.

Comment 9

The comments from Round 1 largely reinforce my initial scores of 1 (coarse fish) and 2 (salmonid fish). However, it is evident that any assessment of the effects of canoeing on fish populations needs to embrace the size of the river and the intensity and timing of canoeing activities. For coarse fish, also, the particular species in the river is/are important.

My experience of boat operations (inflatable dinghies rather than canoes) in coarse fish and salmonid rivers is that boat passage hardly disturbs fish, either within or outside spawning periods. I believe that heavy canoe traffic **could** have an effect on gravel-spawning fish (e.g. chub, dace, barbel), either on spawning activity or on deposited eggs, if boats are dragged across spawning shallows. However, I consider the risk to be very small- smaller than that for salmonids, whose eggs are present in the gravel for much longer periods than those of coarse fish. I do not believe that species that spawn among marginal aquatic plants will be affected in any way.

Although there has been very little research on the subject, some past studies of the impact of egg mortality in dace from invertebrate predation and siltation have shown that it is negligible

in its effect on recruitment success compared with mortalities of 0 group fish (especially during their first few weeks of life) arising from predation and lack of suitable refugia. I suspect that the same would be true for any impact of canoeing.

The possible spread of disease and/or parasites is mentioned in the comments. Yes- this is a risk, but my view is that the risk is not great enough to warrant a score greater than 2.

I assume that the comments on the impact on salmon angling and fund management activities are irrelevant within this particular Delphi assessment.

I retain my score of 1 for the effect of canoeing on coarse fish populations. However, canoeing in some salmonid rivers may have a minor impact and, consequently, my previous score of 2 seems justified. Perhaps an eventual recommendation would be to prohibit canoeing during the salmonid spawning season (which varies geographically).

Comment 10

In the light of the comments made by other respondents, I do not wish to change the scores I gave for the questions asked in Round 1.

DELPHI TECHNIQUE - ROUND 3
SUPPORTING EVIDENCE

Comment 1

I do accept the point made about potential introductions of diseases or parasites, but this rather limited threat was incorporated in my initial scores. I also agree that the impact of canoeing is of course linked to its intensity, but the present study is intended to address only the generalities of its potential conflict with fisheries interests.

My only comment addressed to the comments of experts is in reply to point 1 of Comment 3 which stated that 'I do not agree that coarse fish necessarily inhabit 'relatively large rivers''. If this is in reply to my initial statement, I would like to point out that I qualified the remark with 'that such species typically inhabit'. Of course, I accept that many coarse fish populations, particularly of species such as dace and chub, inhabit relatively small rivers comparable in dimensions to 'typical' small game rivers. My point was that on a national basis, coarse fish populations generally occupy relatively larger rivers than do game species and so are less likely to be impacted by canoeing.

Comment 2

There was little information in Delphi 2 that we had not previously seen. Keeping in mind that this is considering impacts at the population level and not on individual fish I retain my score of 1 for coarse fish and 2 for salmonid fish.

Comment 3

A consensus seems to be building based upon what I consider to be sensible opinions of the various potential risks.

Comment 4

I have read through all the responses and do not feel there is anything new there which would make me change my scores. The main uncertainty, as several respondents have pointed out, is the extent of canoeing taking place and it is only knowledge of this which would make me change my score.

Comment 5

I have read all the responses but, as mentioned by some of the other respondents, without any further information on where the planned canoeing will occur, or the likely intensity, I do not wish to alter my estimates. There is only a small discrepancy overall amongst the respondents, and this will largely stem from the experience of the various researchers and where they themselves work in lotic systems. Information on where the planned canoeing is to occur (i.e. the type and order of river) would, I am sure, help everyone, but perhaps you are not authorised to release this.

Comment 6

I had previously overlooked the question of canoes spreading disease and/or exotic species. Clearly they have the capacity to do so. One might avoid changing current average scores on impacts if it were compulsory to disinfect canoes before moving from one catchment to another. Without such compulsion it would seem necessary to increase average scores very significantly.

In the last five years Lough Derg on the River Shannon, one of the largest lakes in the British isles has been "invaded" by the Zebra Mussel. It is thought to have been introduced by boat. This mussel is thriving and has already caused major changes in the ecology of this large lake (surface area 11,700 ha).

Comment 7

The latest comments do not persuade me to change my previous scores of'2' for salmonid fish and '1' for coarse fish. I have nothing more to add to my previous comments.

Comment 8

Coarse fish:
From the information received from other respondents, I do not wish to alter my score – 2.

Game fish:
From the information received from other respondents, I do not wish to alter my score – 2.

Comment 9

I have no further comment or change to my scores.

Comment 10

No, there seems to be general agreement, though some aspects are perhaps emphasised more by some respondents than others. My estimate remains the same.

No, I do not expect that any further statements I provide will cause others to re-evaluate.

DELPHI TECHNIQUE - ROUND 4
SUPPORTING EVIDENCE

Comment 1

We seem settled in our opinions which are largely similar. Quite reassuring really !

Comment 2

The disease influence raised again by one respondent in the last round of course a possibility, but I have not come across any data on canoes transferring disease/invasive species. In the USA, where canoeing is extensive, presumably there is much movement across catchments but I have not heard of any restrictions imposed. The invasion of Zebra Mussels into Ireland appears to have been from relatively boats and I think mainly in ballast water. With the requirement for a generalised evaluation of impact on rivers "of any type" I do not feel any change in the score is warranted. Scores on the effects of canoeing on different specifically identified types of rivers and with different intensities would vary somewhat, for many of the reason already raised by various respondents, but at a general level, I feel the current consensus is about right

Comment 3

My estimates are unaffected. However, I would make the comment that the proposal for a requirement to disinfect canoes between different water bodies would be practically impossible to enforce. I also suspect that in terms of avoiding introductions of diseases or potential pests (e.g. Zebra Mussels), the level of disinfection required would be very difficult to achieve without specialist facilities.

Comment 4

The question about the size of river inhabited by coarse fish seems to have incited a small debate. From my experience in a number of catchments, river size is probably less important than water quality. The upper courses of some lowland streams, previously characterised by trout, have been subjected over the long term to elevated nutrient levels, and these same streams are now characterised by sticklebacks, accompanied by benthic species such as stoneloach, bullhead, and minnow. Some slightly larger stretches of these same streams contain extremely high numbers of small roach, dace, etc., sometimes large perch though trout would have traditionally been found in these waters (in some cases, remnant trout populations still exist, though barely). These developments have resulted in the description of a so called 'stickleback zone', which I have seen mentioned in a publication somewhere – though this is not a new idea, with some of the initial publications (late 1800's) describing European catchments that started off upstream with a 'stoneloach zone' or 'minnow zone'.

Some chalk streams in the south and east (again, rather smaller water courses) are now so nutrient rich that trout are unable to reproduce and the dominant species are chub, roach, barbel, etc. So, even from a national basis, river size would be a poor indictor of the composition of the fish community. However, in areas where truly 'upland' streams exist, the generalisation, that coarse fish inhabit larger rivers, may perhaps be applicable.
No further information has been provided that would tempt me to alter my scores.

No, I do not expect that any further statements I provide will cause others to re-evaluate.

Comment 5

My responses for Round Four are that I do not wish to change my scores for either coarse or game fish. There seems to be a good consensus among respondents and nothing new in comments to make me change my remarks.

However, it is clear from the overall comments that (a) scores would increase with canoeing effort (if this was known), (b) they might also vary seasonally (e.g. be higher for salmonids in the autumn), and (c) with size of river (i.e. a negative relationship), and (d) that there is some danger from the transfer of disease and parasites. This would imply that the organisers of such events can minimize disturbance to fish by taking these points into account and having a code of conduct for canoeists in general.

Comment 6

The latest responses do not lead me to change my assessments of "1" for coarse fish and 2 for salmonids. My feelings about the scores are summed up in Comment 1 (para 1) and Comment 4 of the R3 responses.

It is possible to imagine an ***extreme*** situation that ***could possibly*** lead to a higher level of damage to a fish population, but my scores reflect my assessment of both the low likelihood of such an extreme situation arising and the low chance of it creating such damage. As Marnell *et al* (1978) noted regarding disturbance to fish breeding sites - this is no basis for concluding "that such occurrences will impart biological consequences to the *population* (my italics) of the species involved".

It would seem from the scores that most participants have taken this view for all the potential impacts of canoeing on fish populations in rivers.

I do not consider any of the new information received is sufficient to cause me to alter my scores. However, I was interested to hear of the concerns regarding the spread of Zebra Mussels in Lough Derg. The mobility and frequency of canoeists has to make them potentially a very serious means of spreading diseases and parasites.

APPENDIX III

LETTER OF INTRODUCTION FOR THE QUESTIONNAIRE SURVEY AND QUESTIONNAIRE SURVEY FORM DETAILS

Dear ...,

APEM have been commissioned by the Agency to undertake the R&D project:

"Effects of Canoeing on Fish Stocks and Angling."

As part of the project we are attempting to gather as much information as possible with regard to potential impacts of canoeing on fish and areas of conflict with anglers. Any reports which you may have, or may be aware of, will be particularly valuable.

In addition we would be interested to hear of areas where canoeing agreements have been reached or indeed revoked, such that we may examine any fisheries data available in these areas.

I enclose a brief questionnaire together with a prepaid envelope for your convenience. Feel free to circulate the same to any of your colleagues who may be able to furnish us with any relevant information.

As the project is operating to a tight Agency deadline, I would appreciate a prompt response if at all possible.

Many thanks for your assistance.

Regards.

Yours sincerely,

Dr Keith Hendry.
Managing Director

Enc.

"Effects of Canoeing on Fish Stocks and Angling."

1. Please provide details on whether you participate in canoeing and/or angling ?

2. Do you have, or are you aware of, any written reports or publications regarding the effects of canoeing on fish stocks and angling ? Please supply details.

3. What is your perception of the damage, if any, caused by canoeists to fish populations ? Do you have any evidence to support your views ? If possible please state name of water body and location.

4. Are you aware of any major conflicts between anglers and canoeists ? If so, please provide details. If relevant, are you aware of areas of water bodies and times (seasons) when such problems are more prevalent and/or severe ? If possible, please state name of water body and location.

5. Please provide details on any areas where canoeing agreements have been reached or even revoked.

May we contact you to follow up any of the comments supplied above ? Y/N

Contact Details

Name: _____ **Organisation:** _____

Telephone: _____ **E-mail:** _____

APPENDIX IV

BRITISH CANOE UNION WEBSITE QUESTIONNAIRE

"Effects of Canoeing on Fish Stocks and Angling"

1. Please provide details on whether you participate in canoeing and/or angling?

2. Do you have, or are you aware of, any written reports or publications regarding the effects of canoeing on fish stocks and angling? Please supply details.

3. What is your perception of the damage, if any, caused by canoeists to fish populations? Do you have any evidence to support your views? If possible please state name of water body & location.

4. Are you aware of any major conflicts between anglers and canoeists? If so, please provide details. If relevant, are you aware of areas of waterbodies and times (seasons) when such problems are more prevalent and/or severe? If possible, please state name of waterbody and location.

5. Please provide details on any areas where canoeing agreements have been reached or even revoked?

May we contact you to follow up any of the comments supplied above? Y/N

Contact Details

Name: _____ **Organisation:** _____

Telephone: _____ **E-mail:** _____

APPENDIX V

NAFAC QUESTIONNAIRE

"Effects of Canoeing on Fish Stocks and Angling."

1. Please provide details on whether you participate in canoeing and/or angling ?

2. Do you have, or are you aware of, any written reports or publications regarding the effects of canoeing on fish stocks and angling ? Please supply details.

3. What is your perception of the damage, if any, caused by canoeists to fish populations ? Do you have any evidence to support your views ? If possible please state name of water body and location.

4. Are you aware of any major conflicts between anglers and canoeists ? If so, please provide details. If relevant, are you aware of areas of water bodies and times (seasons) when such problems are more prevalent and/or severe ? If possible, please state name of water body and location.

5. Please provide details on any areas where canoeing agreements have been reached or even revoked.

May we contact you to follow up any of the comments supplied above ? Y/N

Contact Details

Name: _____ **Organisation:** _____

Telephone: _____ **E-mail:** _____

APPENDIX VI

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