

Angling and conservation at Sites of Special Scientific Interest in England: economics, attitudes and impacts

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ABSTRACT

1. An extensive questionnaire (181 questions) was devised to examine the relationships and attitudes of angling clubs to their local environment and conservation organizations. Questions related to the fishery itself and the economics of the club were also asked. The questionnaire was sent to 59 coarse-angling clubs that fished shallow Sites of Special Scientific Interest (SSSIs) in England. SSSIs are statutorily designated sites of the highest conservation value in Britain. Thirty-one valid questionnaires were returned.

2. The average cost of leasing a water body was £645 ha⁻¹ year⁻¹ (1997 prices) and an adult angler paid, on average, £67 year⁻¹ to fish at a club. The overall profit made by an angling club in an SSSI was, on average, £1760 year⁻¹. Most clubs were not run on a profit basis. Compensatory cash payments were unlikely to influence attitudes to restrictions on stocking.

3. Angling clubs generally had a positive attitude to nature conservation and its enhancement. In 83% of cases, where stocking restrictions had been introduced by English Nature (the statutory nature conservation organization in England) the club involved agreed with the decision. Only 10% of respondents thought that a close season was detrimental to fishing. Aesthetic qualities and tranquillity were considered very important for a fishery to be successful and these were seen to be consistent with nature conservation values.

4. There were areas of concern. Common carp was the fish most likely to be stocked, largely because of financial benefits. Nonetheless, a trend towards carp stocking may have reached a peak. Management culling of fish such as pike took place at 42% of sites and some clubs believed that stronger ties with environmental groups should not be pursued. It may be some time before certain aspects of fishery management, suggested by English Nature as best conservation practice, are accepted by all angling clubs in SSSIs, but attitudes were found to be more positive than often assumed.

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KEY WORDS: angling; conservation; economics; fisheries; freshwater; questionnaire; SSSI

INTRODUCTION

England is a densely populated country and multiple use of many standing fresh waters is common. As well as having amenity and conservation value they may be used for boating and angling. The latter makes a considerable contribution to the economy, whilst also providing an important recreation for

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many urban dwellers. Multiple use involves compromises, and management for angling may not always be in the best interests of nature conservation (Maitland and Turner, 1987). Stocking of fish, particularly exotic species that are favoured by anglers, may be particularly detrimental to biodiversity and structure of the ecosystem. This conflict potentially reaches its zenith in Sites of Special Scientific Interest (SSSIs).

SSSIs are sites of the highest conservation value, legally designated in Britain for greater protection than other areas. Many freshwater SSSIs have or had notable submerged plant communities potentially at risk from a variety of impacts. Carvalho and Moss (1995) examined the trophic status of 102 freshwater SSSIs and found that 76 showed symptoms of eutrophication. In 36% of these, the prime cause was attributed to mobilization of nutrients by common carp (*Cyprinus carpio* L.) and, to a lesser extent, common bream (*Abramis brama* (L.)) and mechanical damage to plant communities by these fish (King and Hunt, 1967; Crivelli, 1983; Wright and Phillips, 1992; Breukelaar *et al.*, 1994). These fish species are much prized by anglers though the common carp is not native to Britain. Furthermore, the threshold biomass density of cyprinid fish associated with damage, particularly to macrophyte communities, is relatively low (about 200 kg ha⁻¹; Williams A, Moss B, unpublished experimental data) and much lower than stocking densities for many fisheries.

Past stocking with species such as roach (*Rutilus rutilus* L.) and pike (*Esox lucius* L.) is thought to have had little detrimental effect on conservation value. However, changing attitudes of anglers and market forces have caused fishery managers to change their stocking programmes. Stocking with carp and bream has become prevalent. To assess this problem at SSSIs, an extensive questionnaire was compiled to investigate stocking regimes and attitudes to conservation in the economic context of managed angling. The results illustrate some of the conflicts that may occur on a much wider basis in countries with a high population density, especially in Europe, where recreational angling for cyprinid fish is also popular.

More than 60% of SSSIs are privately owned or managed, the remainder being owned or managed by public bodies such as the Forestry Commission, Ministry of Defence and The Crown Estate, or by the voluntary conservation movement. As a result, management practices in SSSIs vary greatly. English Nature, the statutory conservation body in England, liaises with owners and managers to meet agreed nature conservation objectives for SSSIs. This is achieved through Site Management Statements, supported, where appropriate, by management agreements or less formal agreements. The questionnaire compiled for this investigation aimed to discover how these agreements were viewed by fisheries managers at SSSIs to gauge the likely future of relationships between angling and conservation.

Disputes sometimes occur between owners or occupiers and English Nature over Site Management Statements and management agreements. In these cases compensation may need to be paid. Previously, any compensation paid has been based on *ad hoc* criteria and no uniform system has been devised. The questionnaire investigated attitudes towards compensation and the financial status and attitudes of the angling clubs concerned. These might be expected to influence potential demands for compensation.

METHODS

Subject selection

A scoping list of shallow (< 5 m maximum depth) still waters, located in SSSIs was compiled from English Nature files. Of these 36 were not fished or were only fished very rarely, 19 were more than 5 m deep or were primarily trout fisheries and 10 were either brackish rivers present within common land, having problematic SSSI boundaries, or were fished by many clubs. Two were not allocated SSSI status on the basis of their waters even though they contain freshwater basins. Seventy-five appropriate sites therefore remained. Of these, fishing clubs at four could not be contacted, seven would not participate in the questionnaire and five were used for a pilot test of an earlier version. Fifty-nine sites remained that

fulfilled the criteria of depth, nature conservation status and fishing practice and had clubs willing to participate. It was decided that questions regarding the practices of angling clubs were best answered by club secretaries or committee members rather than individual anglers. Targeted postal survey, with telephone follow-up was used.

Questionnaire design

The questionnaire (given in full in Williams, 1999) was developed with professional assistance so as to avoid the common pitfalls of design (Dillman, 1978; Oppenheim, 1994). It was lengthy, with up to 181 questions, and would have taken up to 2 h to complete. The questions were grouped around the following topics:

- (a) species and densities of fish currently present;
- (b) desired species and densities of fish and any obstacles to the intended stocking;
- (c) perceptions about problems and benefits of carp stocking;
- (d) fisheries management practices employed;
- (e) financial and personnel (employees and membership) structure and management of the clubs and lakes;
- (f) overall profits and losses experienced by clubs;
- (g) perceptions concerning environmental and management problems;
- (h) effects and perceptions of English Nature policies on fisheries management;
- (i) perceptions concerning the close season;
- (j) attitudes towards co-operation between conservation and angling organizations.

Owing to the sometimes sensitive nature of the questions asked, club and site confidentiality were assured so as to increase the chances of completion and honesty. Therefore, neither the clubs nor sites involved in this questionnaire are named.

RESULTS

Questionnaire return

Fifty-nine questionnaires were sent out during 1998 but the water bodies linked with eight of these were found subsequently not to fulfil the required criteria as they were either too deep or primarily used as trout fisheries. Thirty-one of the fifty-one remaining questionnaires were returned (61%). Results apply to those that answered particular questions. Blanks or 'don't knows' are not included except where the number of such responses is notable. 'Club' refers to an angling club or an organization that deals with angling at a specific site such as a local council or a water authority.

There was an uneven geographical spread of suitable SSSIs. Southern and Anglian regions of the Environment Agency were the best represented, each with seven sites; the North East had no suitable sites and the South West only one. These latter have a greater proportion of trout fisheries and fewer freshwater SSSIs than elsewhere. The Midlands and North West both returned six questionnaires and the Thames region four.

Species and densities of fish currently present in SSSI water bodies

Roach were the most frequently caught fish, followed by common bream and perch (*Perca fluviatilis* L.) (Figure 1). Tench (*Tinca tinca* (L.)) and common carp were next, followed by pike and rudd (*Scardinius erythrophthalmus* (L.)).

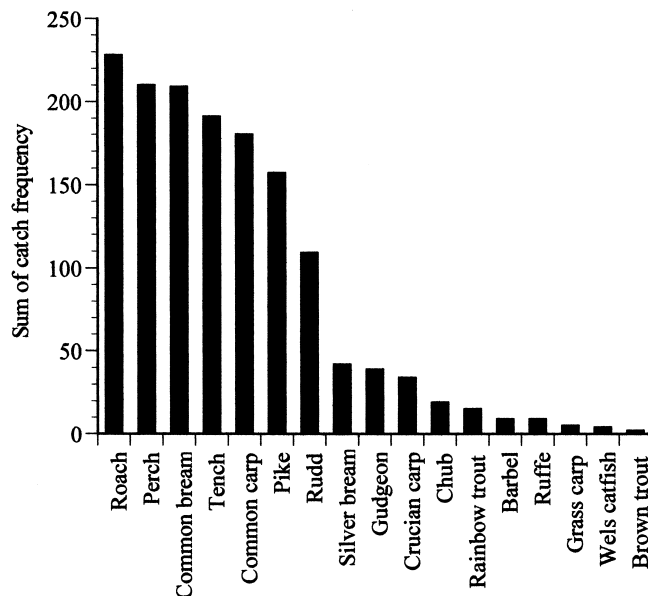


Figure 1. Most frequently caught fish species. For each water body and species a score was assigned based on the frequency with which the fish was caught. Respondents gave a '10' to the species most frequently caught, a '9' to the next and so on until a '1' was given to the tenth most likely fish to be caught at a site. Species scores were then summed across all 31 water bodies.

Fifty-five per cent of respondents did not know what densities of fish were present in their lakes. Of those that gave an estimate, 14% thought there were less than 450 kg ha^{-1} , while 86% believed there were more than 800 kg ha^{-1} . The estimated fish stock densities were very high, probably unrealistically so: 19% considered that their lake had more than 2000 kg ha^{-1} and in one case the estimated density was 7620 kg ha^{-1} .

Desired species and densities of fish and obstacles to stocking in the desired manner

Forty-five per cent of respondents felt that an ideal density of fish was present at their site. Of the remainder, 44% did not know the density of fish present and 56% claimed a present density of between 50 and 2800 kg ha^{-1} . Ideal stocking densities ranged from 98 to 3360 kg ha^{-1} . Only 19% gave both actual and ideal stocking densities, half of whom ideally wanted a higher density of fish than they had. The remaining half had an actual stocked density greater than or equal to their ideal and only a change in population structure was wanted. There was a general wish to increase the density of common bream, carp, tench and rudd and to decrease that of pike.

The present fishery in 62% of cases was mixed, in 30% a specimen fishery for either carp, bream, tench, pike or a combination of two of these, and in one case a large total-catch-weight-fishery. Mixed fisheries were the most popular 'ideal' fishery, at 85%, the remainder quoting specimen fisheries for either carp, bream, tench or a combination of two of these. Of those who had attained an ideal fish stock, 58% attributed this to a sympathetic management policy. In 29% of the cases, respondents had what they considered a natural site with very little management and 21% of respondents had sites with low angling intensity and little environmental interference.

Responses explaining why an ideal fish stock and density had not been achieved were wide ranging. Restrictions due to SSSI status were the cause in 27% of cases and lack of funds the reason in another 27%. Thirteen per cent complained about water quality at the site. Another 13% claimed that the fish

stocks were unsatisfactory but did not explain why. In 7% of cases, fish predation by pike or cormorants was blamed and for a further 7% the presence of too many benthivorous fish was considered the reason. Finally in 7% of cases a combination of the above factors was adduced.

Overall the species of fish present was considered to be the most important factor in a fishery's success (Figure 2). The abundance of fish was considered the next most important and the size of fish was considered the least important factor.

Perceptions concerning carp stocking

The potential conservation problems caused by common carp were unknown to 26% of respondents. Nine per cent felt that there were no detrimental effects of carp and one club felt 'the more the better'. However, 44% of respondents said that carp 'bully other fish' and dominate the aquatic ecosystem and 17% of respondents said that carp stir up mud and destroy aquatic vegetation. In another 17% of cases, both bullying and plant destruction were mentioned and in one response carp were considered to benefit a water body by releasing phosphorus from the sediment. Sixteen per cent thought that conservation concerns were unfounded and 42% that the concerns were justified but only when carp was 'overstocked'. They believed carp could be managed successfully at limited densities. The remaining 42% of respondents replied that carp should really only be found at commercial sites and carp ponds. Apart from the sport provided by carp, several reasons were suggested for their popularity: 45% mentioned large size, fast growth and robustness; 39% the revenue attracted; 19% the year-round feeding and catchability; and 6% that they were cheap and readily available from fish farms.

There was a general feeling amongst respondents that the future of mixed fishing was bright (71%). Only 25% of respondents thought that mixed fisheries had little future and in a few cases respondents were unsure but hopeful. Sixteen per cent of respondents put forward very strong views about carp. Thirteen per cent thought that carp angling was essentially dominated by socially undesirable anglers and that it involved little skill. They saw carp fishing as an inferior form of angling. Only 3% of respondents embraced carp fishing enthusiastically.

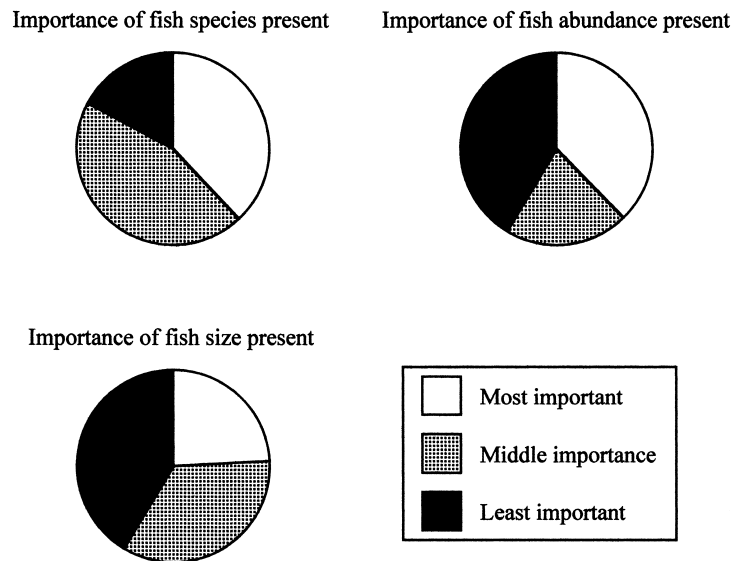


Figure 2. The relative importance of three criteria for a successful fishery as perceived by respondents to the questionnaire.

Fisheries management practices employed

In 65% of cases, respondents said that their lakes were deliberately stocked but in 40% of these stocking had not taken place in the last 2 years. The main reason for stocking was given by 37% as replacing dead, unhealthy, stunted or predated fish, by 26% to increase fish density, and by 16% to achieve a better balanced fishery. Other reasons given were: maintaining stock, restocking after site drainage, taking advantage of excess fish from another site and to introduce carp. Common carp was the fish species most commonly stocked (Figure 3). Roach and tench were stocked relatively frequently followed by rudd, common bream and perch. The average size of fish stocked was 2.47 kg for common carp, 0.26 kg for roach, 0.91 kg for tench, 0.17 kg for rudd, 1.13 kg for bream and 0.28 kg for perch.

The reason for stocking these species and sizes in 22% of cases was their being the 'right size' to avoid predation, and in another 22% to achieve a healthier and better fishery. Other reasons included: cost and availability, the desire to include species not present naturally and restrictions on stocking other species owing to SSSI status. Carp were stocked most commonly because of their popularity with members, resulting in turn from their fast growth and angling attributes.

Management culling of fish was carried out at 42% of sites, and at least annually in 73% of these. Reasons were to reduce predation on the other fish (67%), and to reduce competition with other fish (17%). Other reasons included the removal of illegally introduced species and the removal of carp and bream. Pike was the most widely removed species (62%) followed by carp and bream (23%). Roach and other coarse fish were also removed.

Financial and personnel (employees and membership) structure and management

Sixty-eight per cent of clubs leased the site with most others owning the SSSI. The annual lease averaged £645 ha⁻¹ (1998 prices) although 52% paid £240 ha⁻¹ or less. There was no clear link between geographical location and the cost of leasing. The most expensive areas were in the Southern, Anglian and Midland regions and the cheapest in the Thames and North West regions (Figure 4). The amount spent on

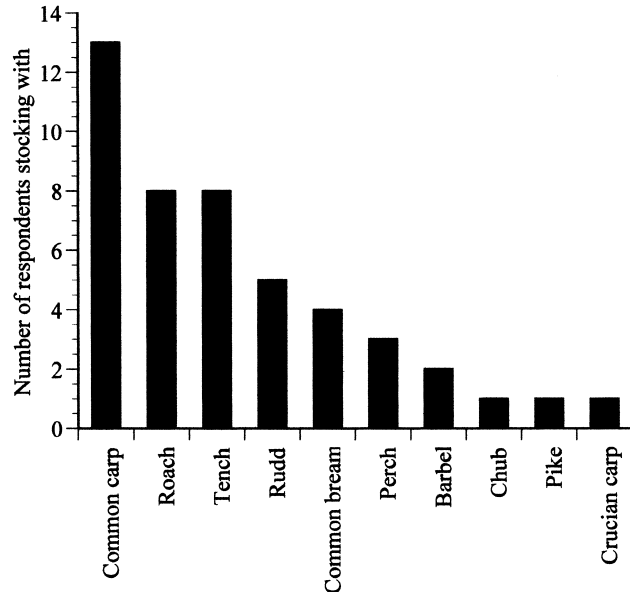


Figure 3. Fish species most commonly stocked as given by respondents to the questionnaire.

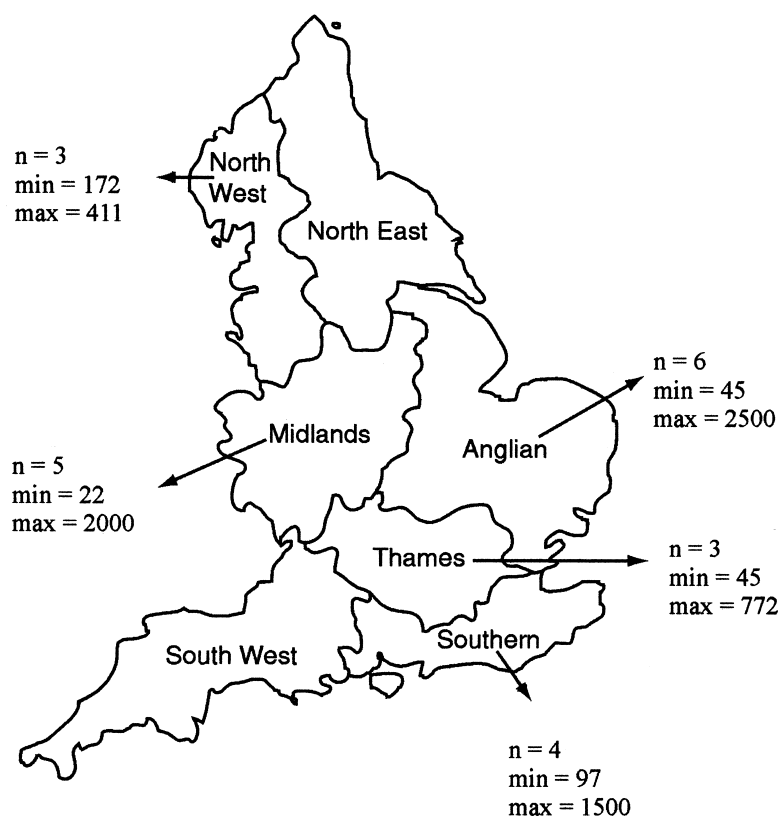


Figure 4. Leasing costs (£ ha⁻¹) for angling water bodies in different Environment Agency regions as given by respondents to the questionnaire.

stocking averaged £35 ha⁻¹ yr⁻¹ including sites where nothing was spent on stocking. For clubs that did stock the annual average was £57 ha⁻¹. The costs of advertising, public relations and fish culling were very low.

Most (87%) clubs preferred individual anglers to be members of the club. In 65% of cases, clubs were members-only and of these 23% were run as small, limited syndicates. The number of members in a club ranged from 15 to 8000 (owing to some clubs having up to 20 other sites). The number of anglers regularly using a site ranged from 5 to 500 with 0.1–32 members per hectare of open water (mean 8 ha⁻¹). For those clubs that allowed non-members to fish there were, on average, nine non-members per hectare of open water.

Many clubs (63%) had a pre-determined maximum number of members, averaging 23 per hectare of open water. In 65% it was claimed that the reason was to prevent overfishing whilst in 24% it was due to a licence agreement. In 12% of cases limited membership resulted from the site being an expensive and therefore exclusive syndicate fishery.

Annual memberships cost between £12.50 and £400 (mean £67; $n = 27$, S.D. = 81.4). There was no correlation between such costs and geographical location but charges were greater at owned than at leased sites (one-way ANOVA, $p < 0.05$). Staff were employed by 30% of the clubs, and several other sites relied on volunteers. Most employees were bailiffs, wardens or fishery officers and of those with staff, three employees, costing £14800 per year in total was the average.

Overall profits and losses experienced by clubs

The balance of income and expenditure ranged from an annual profit of £38000 to a loss of £17000. There was no significant correlation with geographical location. However, the highest profits were made in the Thames and North West regions and the greatest losses in the Midlands and Thames regions (Figure 5). The greatest profits were made at owned sites and the lowest at leased sites but the difference was not statistically significant. The highest annual profit (£38000) was made at an owned site where adult yearly membership was £400 per year. Both the greatest losses and the highest profits were found at sites that were described as mixed fisheries.

Environmental and management problems

Most clubs thought that aesthetic qualities and tranquillity were very important for a successful fishery and thought their site had these properties. Poor water quality was considered highly undesirable by most clubs but 26% of respondents thought their site did have poor water quality. Plentiful aquatic vegetation and a car park were considered the next most important features and the majority of sites had both.

Factors that attracted membership were the fish species present and their abundance (32%). Thirty-six per cent claimed that lack of fish or difficulty of fishing was detrimental to their club. Locality and easy

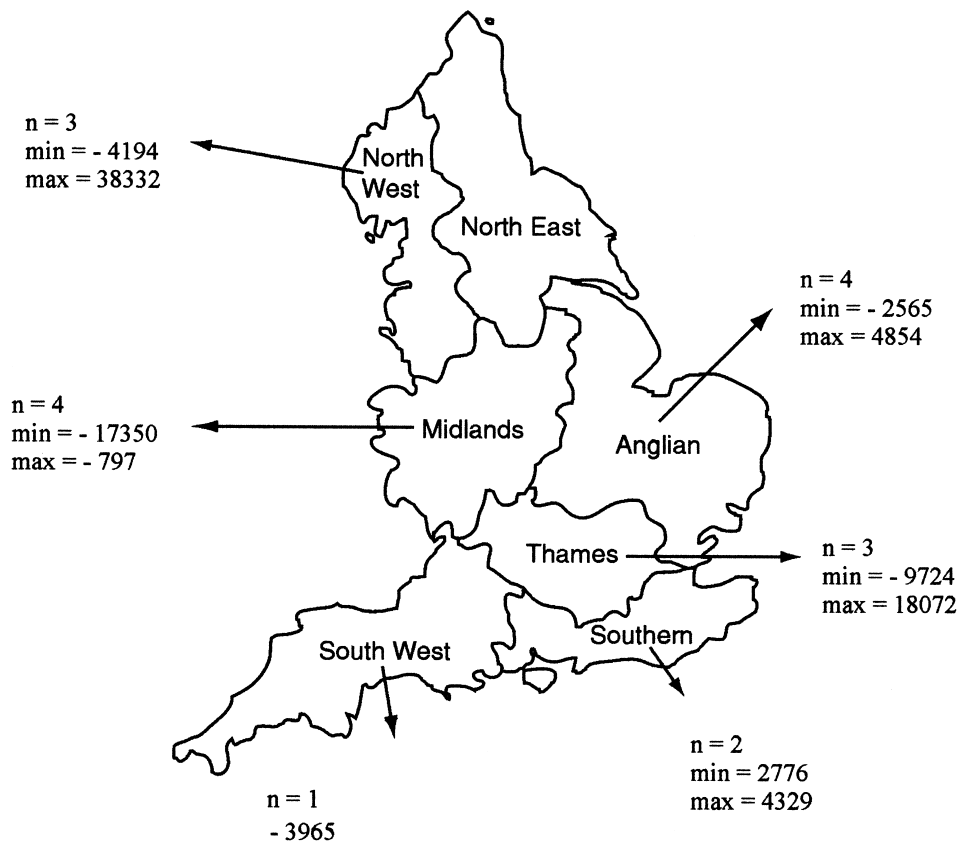


Figure 5. Annual profits and losses (£ year⁻¹) for angling clubs in different Environment Agency regions as given by respondents to the questionnaire.

access was considered attractive by 29% and deficiencies in these were considered detrimental at 16% of sites. Low intensity of fishing attracted members at 29% of sites. Potential problems were the cost of angling at the site (10%) and the restrictions in place because of the SSSI status of the site (23%).

Some form of undesirable external nutrient input into the lake was noted in 55% of cases, with agricultural run-off the greatest problem, followed by flooding from nearby polluted waterways and sewage effluent. Litter was also of major concern at 45% of sites. The problems of discarded lead and line and trampling of vegetation by anglers were the next greatest problems, both occurring at 39% of sites. Bird disturbance by anglers was next (29%) followed by excessive ground baiting. The introduction of exotic and illegal fish species was considered a lesser problem and was noted at 19% of sites. Other perceived problems included rubbish dumping and littering by non-anglers, algal blooms, feeding of birds and input from bird food and guano. Siltation and cormorants were only considered a problem at one site each. The majority of clubs said that strict rules, bailiff supervision, punishment and professionalism were the only suitable management tools (89%). However, 11% of respondents said that education of anglers was the best way forward. Problems not caused by anglers were tackled in various ways, including co-operation with local councils to highlight problems and developing long-term water monitoring plans.

Cash investment was being made at 56% of those sites where problems were being actively tackled. Mostly (91%) this was on labour and materials although in 9% of cases expenditure had to be made owing to lost revenue. In 60% of cases the investment was lower than £300 per year. In 75% of cases, respondents did not think there would be a cash return on the investment but 60% believed the cost was worth the outcome, two-thirds of these giving environmental benefit the reason. Some clubs successfully avoided all the above problems and in 71% of these cases they said this was due to co-operation with English Nature or the owners and other users of the lake along with professional, sensitive management. In 14% of cases the reason for success was restriction of angler numbers along with strict rule enforcement, punishment and education of anglers.

Effects of English Nature on fisheries management at SSSIs

There was a management plan for the water body in 61% of cases. Eighty-three per cent of these were established by English Nature, 11% by owners or local councils and 6% by the Environment Agency. In 75% of cases fishery restrictions (fish stocking (species and densities), bank access and on-site maintenance) were part of an English Nature Management Plan but respondents gave few details.

The earliest recalled management plan had been put in place in 1975 but 57% of plans post-dated 1991 and in most cases the agreement was in place indefinitely. In 72% of cases the management plan limited fish species and densities that could be stocked and in 91% of these particular species were totally banned — common bream in 26%, carp and wels catfish (*Silurus glanis* L.) in 23% and roach, zander (*Stizostedion lucioperca* L.), tench, pike and perch in 19%. At 16% of sites there was a total ban on stocking of any fish species at any density. At 15% of sites there was a voluntary ban on fish stocking. Reasons for restrictions were apparently rather general ('nature conservation') and 23% of restricted clubs claimed to have been given no reason at all. In 83% of cases respondents agreed with the decision although 58% of respondents were frustrated by it. Only 17% of respondents did not agree with English Nature's decision. Most clubs (82%) had not incurred financial losses because of the restrictions, although 44% claimed other detriments. Where no stocking restrictions had been imposed, this was attributed to existing sensitive management (67%) as well as joint co-operation with English Nature and landowners from the outset. Other restrictions included bank access. Ninety per cent of respondents could not fish from the whole bank all year, in 52% of cases because of restrictions in English Nature Site Management Plans. Impassable bushes and trees were responsible in 26% of cases.

Only 12% of respondents received any compensation for restrictions placed on them, although, in principle, 67% of respondents would accept compensation if offered for new restrictions. Of those that

disliked the idea of restriction and compensation, around 50% would accept compensation if the amount paid was a fair indication of losses experienced whilst the rest did not know whether this was just. There was a general agreement (79%) that monetary compensation was fair. Of those who disagreed, the reasons were that tax payers' money should not be used to subsidize anglers, that agreement and co-operation from the outset was a much better solution and that money does not replace the fishing for which clubs were established in the first place. Alternative solutions to cash compensation were limited but suggestions included help with management of the fishery and maintenance work, co-operation and negotiation on other issues and making other sites available for angling.

The close season

At 81% of sites a close season was in force. In 72% of cases this was imposed by the Site Management Plan, in 16% of cases it was voluntary, and in 12% it was due to the wishes of owners or local councils. Usually (88%) the close season was from 15 March to 15 June although a few sites were closed for a shorter period. For those sites observing a close season, the reasons were primarily (50%) conservation concerns allowing fish breeding and/or rejuvenation of the flora and fauna in and around the lake. In 44% of cases the only reason given by English Nature for the close season was SSSI status. Sixty-three per cent of clubs that had a statutory close season agreed with the reasons given by English Nature, as it was generally thought to be right to rest the site. Of those that did not agree, 50% of respondents complained that others, for instance boat users and walkers, could use the site all year and would disturb the flora and fauna to a similar extent as anglers. Other points raised were that the close season was not enforced at every SSSI so it was unfair, and that so little fishing occurred or most of the bank was so inaccessible throughout the year that fishing did not interfere with conservation, even if the site was fished year round.

Of those clubs on sites that had a close season, 74% claimed that it had not affected them financially. The rest estimated that they had lost on average more than £1600 per annum. Non-ecological benefits of the close season included allowing club members to carry out maintenance more easily as well as taking care of family commitments. One disadvantage was that during the close season the lack of anglers meant that fish poaching could become rife, a problem pointed out by 25% of respondents.

The close season was seen as beneficial by 62% of respondents, detrimental by only 10% and a mixed blessing by the remaining 28%. Of those that thought the close season beneficial, 94% thought that 'nature' needed a rest from anglers and that it was a good time to carry out maintenance. For those that thought it detrimental, the reasons were that the angling 'rush' at the beginning of the open season was considered to be very damaging to the water body as a whole (33%) and that if the water was managed properly there was no need for a close season (33%). Of those who said that the close season was a mixed blessing, 50% claimed that every water body was different and that a statutory close season was not flexible enough for today's fisheries although there should be a close season. This was supported by responses that claimed that for many fish the breeding season had shifted to later in the season and therefore the close season dates were outdated (25%). Indeed 30% of respondents expressly did not want a return to an all-encompassing close season. They believed that fishery managers should be given the responsibility to manage as they saw best to enhance all aspects of the fishery from fish to conservation of the area, as all sites were different.

Trends in co-operation between conservation organizations and fisheries

Many (57%) club representatives attended and were active in meetings with environmental organizations. English Nature was the most usual group cited (65%). Local groups were also important (35%) whilst British Waterways and the Environment Agency were involved in meetings only rarely. All expressing an opinion thought that the meetings were beneficial. Sixty-three per cent claimed they helped agreements to be reached and fostered better understanding. Another 25% wrote that their meetings were with English

Nature and that good advice was given by English Nature officers to the clubs to help improve club management as a whole. When asked whether stronger ties should be made between angling clubs and environmental groups nation-wide, 89% of respondents said that they should. The importance of sharing knowledge and expertise for mutual benefit was the main reason given (58%). In 21% of cases strong ties were encouraged on the belief that everyone should work together for a better environment. Another reason given was that anglers care a great deal about the environment and the general public may come to appreciate this if clubs work more closely with environmental groups. Sometimes lack of public awareness about anglers' care resulted from reticence by anglers in proclaiming their good works. One reply suggested that groups should work together to prevent conflict rather than having to resolve it retrospectively. Another claimed that greed was prevalent in angling and damage was being done such that ties with environmental groups were needed. One club claimed that working more closely with environmental groups had helped them to achieve a better club.

Opposition to closer links was expressed by 11% of respondents and centred around claims of already sufficient care for the environment: anglers do not need to be told how to protect it. Moreover, it was assumed that most environmentalists are opposed to angling and that once they become involved, fishing will be restricted further and further.

There was a mixed response to a question about how fisheries and nature conservation could work together in future. Only 7% thought that there would be no working future. This negative response was based on the idea that anglers had been looking after nature for years and did not want interference. It was also claimed that as long as English Nature continued with its alleged dogmatic approach nothing could be achieved. Nineteen per cent expressed uncertainty about future co-operation: 'it depends on how the power and control structure of the two sides is dealt with'; 'ground root communications and finances need to be established first'; '[there is] difficulty whilst so many conservationists are anti anglers'. It was also pointed out that fisheries depend on income and unless there were incentives it was easy to overlook future conservation needs in favour of current needs for financial security. Another response was that fisheries and conservation would work more closely in the future, but only through legislation. The views expressed by those that thought there would be a good and positive future (74%) included ideas about both sides having similar general aims. Others stated that all anglers need to recognize current criticism of angling. Another view, severally expressed, was that clubs should realize that an improvement in the ecosystem as a whole would bring benefits to the waters and fish within them. Finally, in several cases it was claimed that it was best to protect the environment by agreement and that as a result fisheries and conservation need to work together. It was thought that to achieve this anglers need to learn more and conservationists need to listen more so that mutual respect and co-operation can be established.

DISCUSSION

Reliability of questionnaire responses

Returned questionnaires provided qualitative data whose accuracy and bias are unknown. Response bias has been observed in many surveys and despite Hyman (1954) suggesting that this bias is random and cancels itself out, Blalock (1969) and Hauser (1969) consider that the removal, reduction or understanding of this bias is crucial to the advancement of sociological surveys. The use of angling club committee members as subjects avoided some of the bias, as these individuals should be better informed than individual anglers about the club. Because the financial value of a fishery is often related to the quantity of fish, stocks (for example) may be underestimated by committee members fearing increased leasing costs. However, the questionnaire was confidential, most answers appear reasonable, and this may not have been a problem. In contrast estimates of 7620 kg ha⁻¹ of fish, the maximum quoted, are certainly

unreliable. A heavily-stocked commercial system is unlikely to have more than 1000 kg ha⁻¹ and most natural systems have between 50 and 350 kg ha⁻¹ (Giles, 1998).

Anglers tend to underestimate stocks of species that are not fished but may be present in large numbers (e.g. eels (*Anguilla anguilla* L.) and species that are easier to catch may be overestimated. It is also likely that preconceived notions about which densities and sizes of fish *should* be present may influence those respondents who do not have precise catch data records. The less desirable the species and density the less likely it is that responses will be truthful (Clark and Tiffit, 1966; Sudman and Bradburn, 1974). Information on species and densities of fish was taken directly from catch and survey records in only a few cases, personal subjectivity must have played some part in the responses given. However, long experience of a site is likely to be no less reliable than spot surveys carried out as part of short-term research projects. In general the estimated stock sizes were rather greater than the threshold associated with damage to the macrophyte communities (200 kg ha⁻¹).

Data about which fish species were caught most frequently are likely to be more reliable. The list (roach, common bream and perch followed by tench, common carp, pike and rudd) mirrors an earlier report (National Rivers Authority (NRA), 1994) where the order was: roach, carp, perch, bream, tench. The NRA (1994) also found that between 1970 and 1994, carp became more popular, pike and perch less popular and roach slightly less popular. Clubs generally increase numbers of common carp, bream and tench through stocking and reduce those of pike by culling. The rise in popularity of common carp is associated with younger adult anglers (NRA, 1994). The presence of wels catfish, an exotic species in SSSI, is potentially worrying and these fish were the largest fish caught.

Fish stocking

Stocking is done for a variety of reasons: after fish kills, economic enhancement of fisheries lacking a particular species, restoration of pre-existent populations, replacement at 'put and take fisheries', biomanipulation and control of unwanted organisms, or by accident (Cox, 1994). Stocking had taken place in the last 2 years at 25% of sites in this study, with carp the most frequently stocked fish. Around 42% of clubs had been refused permission for stocking, in particular of common carp and bream, and perceptions concerning ideal stocks were usually greater than the threshold stock associated with damage to the ecosystem.

Stocking may be damaging to native stocks because of competition, predation, disease introduction and genetic dilution. Stocked fish often come from farms, raising potential problems of abstraction, pollution, disease and escaped stock (Maitland and Campbell, 1992). Overstocking can lead to competition for resources such as food and spawning sites and may ultimately lead to a deterioration of the fishery (Maitland, 1989). Loss of genetic integrity of native fish populations may also be a cause for concern (Maitland, 1989). It is estimated that Europe currently spends £0.7–2.8 billion yr⁻¹ on fish stocking (Cox, 1994) and yet codes of practice or ecological and economic implications of stocking are largely unquantified.

Although stocking may give a short-term increase in fish numbers, the population will, for reasons of available food supply or other limiting factors, ultimately revert to around the initial pre-stocking density. Stocking may even lead ultimately to fewer fish (Kelly-Quinn and Bracken, 1989). Furthermore the interactions of stocked exotic fish with native species and the ecosystem are often problematic. The introduction of pikeperch (zander) into rivers in eastern England has allegedly caused a decline in cyprinid stocks (Linfield, 1984). Carp have had detrimental effects, in particular a reduction in macrophyte abundance (Cahn, 1929; Crivelli, 1983). However, the pressures on fisheries managers to stock are high owing to anglers' expectations.

It is therefore a concern to conservation interests that carp fishing has become very popular. Respondents were generally attempting to increase their carp stocks or wished to do so, and on average

there were 150 kg ha⁻¹ of common carp in the lakes surveyed. In a third of cases, the fishery was a specimen fishery for either carp, bream, tench or a combination of any two of these. Carp do not react passively to being hooked, grow quickly, are robust, cheap and widely available and ultimately attract members and therefore revenue. Over one quarter of respondents did not know about the possible ecological problems that carp have been shown to cause and 90% had carp in their water bodies. However, a third of respondents had some idea of potential sediment disturbance by carp, and macrophyte decline, and the majority (84%) believed that concerns about carp were in some part true and that carp should either be kept at relatively low numbers or confined to carp pools. Overall dislike of carp appeared stronger than preference for it. This may be related to the age of respondents. NRA (1994) found that carp anglers tend to be young anglers who had never become interested in traditional angling. Angling clubs at SSSIs are likely to have a long tradition and be more inclined to favour natural fisheries and sensitive management. As such the management structure is more likely to consist predominantly of older fishermen than in a recently established commercial fishery. The overall disdain shown for carp is therefore encouraging so far as conservation interests are concerned and the trend in carp stocking may have reached a peak.

Other impacts of angling and fisheries management practices

The culling of piscivorous fish and birds has caused considerable debate amongst anglers and ornithologists. Fish culling took place at 52% of sites and was typically undertaken to remove predators such as pike; however, the real value of this practice is debatable. Some anglers perceive predators as competitors with themselves, yet there are self-evident conservation arguments for keeping the food web intact and predators help maintain a wide range of fish sizes. In their absence, fish biomass may become skewed towards small size.

Many anglers consider themselves dedicated conservationists in a situation where many other human activities substantially damage water quality and freshwater ecosystems. They form a large group with lobbying power used in commenting on issues such as water pollution (Mackay, 1987). In 55% of responses in this study, nutrient inputs were considered to be a problem. The greatest of these problems was perceived to be caused by agricultural run-off and 26% of respondents thought their site had poor water quality.

Angling has its own environmental impacts: for example, littering and the discarding of nylon line that may be damaging to birds (Edwards and Cryer, 1987; Maitland, 1995), changing water levels and removal or construction of obstacles to water flow (Campbell, 1967). The removal of aquatic vegetation with herbicides and the clearance of bank-side vegetation are also common (Brooker and Edwards, 1975; Murphy and Pearce, 1987). Such damage is considered undesirable by conservation bodies (Liddle and Scorgie, 1980). Rees and Tivy (1978) and Dartington Amenity Research Trust (1973) describe how anglers have caused loss of plants by trampling. At sites surveyed here, trampling of vegetation was considered to be a problem in 39% and bank erosion in 23%. However, Sukopp (1971) found that at a site with intensive recreational use, the effect of anglers on the vegetation was minimal and that trampling by boaters and swimmers was most detrimental. Disturbance of birds, otters (*Lutra lutra* L.) and particularly nesting animals may occur (Jeffries, 1987). This disturbance is typically accidental and caused by all lake users, but because walkers move on, their impact may be less intensive. At 30% of sites, bird disturbance was considered a problem, at least in part, caused by anglers.

Excessive 'weed' growth is generally considered undesirable by anglers (Murphy and Eaton, 1981) but a moderate plant cover is frequently considered an asset (Bouquet, 1978) for food, shelter and spawning resources (Marshall and Westlake, 1978; Keast, 1984). Only 13% of respondents thought that excessive weed removal by anglers was a problem at their site; indeed the presence of dense aquatic vegetation was considered highly desirable by most angling clubs.

Other problems of possible relevance to conservation include ground baiting (through organic and nutrient loading) and introduction of illegal and exotic fish species. The use of ground bait was considered by respondents to be excessive at 29% of sites surveyed. Wolos *et al.* (1992) found that on average a carp angler will use 1.77 kg of bait per day and 1 kg of bait introduces approximately 2.3 g of phosphorus. However, in the context of total phosphorus load, this input is usually negligible (Tenner, 1996). The addition of exotic fish and illegal introductions of fish was considered to be one of the least pressing problems faced at the lakes surveyed and only 19% of respondents thought that this was a problem at their site.

Reduction in the number of anglers limits the impacts of angling. Numbers of anglers were limited at 63% of sites. In 77% of these, limitation aimed to prevent overfishing and in 12% of cases the limitations had been enforced by licence agreements. This widespread limitation was echoed by all respondents considering that tranquillity was paramount for creating a successful fishery. Most clubs considered that their sites had this and at 29% of sites a paucity of anglers and resulting low fishing intensity and peacefulness was considered very attractive to potential customers.

Angling demand and financial aspects of angling

There was no correlation between the cost of fishing and geographical region. The only significant correlation showed that customer costs at club-owned sites were more expensive than at leased sites. This could be because syndicates tend to be owned and are deliberately more expensive so as to keep fishing pressure down but fishing quality extremely high. In the absence of detailed bank and tax records, estimating the overall income at a site is difficult. However, the information received from a reasonable number of sites was sufficient for a balance to be calculated. The highest annual profit was £38000 and the greatest loss £17000. However, the majority of sites were not run as profit-making ventures and, as such, income was equivalent to outgoings. Membership fees were kept to a minimum allowing for leasing, maintenance and stocking costs. The usual net turnover was a few hundred pounds, allowing for emergencies to be dealt with. The majority of sites broke approximately even, with most sites gaining or losing around £1000 within the limits of our calculations.

The number of anglers, as a percentage of the population, was found to be highest in the Southern and Anglian Environment Agency regions and lowest in the Thames region (NRA, 1994). This may explain why in this survey the leasing cost per hectare, although statistically not significant, was highest in the Southern, Anglian and Midland regions and lowest in the Thames and North West regions.

Popularity of current legislation and English Nature

Despite some frustration, there was a general feeling (83%) that the restrictions put in place by English Nature or voluntary bans on fish stocking were justified. Conservationists' fears that angling will tend even more towards specimen carp fisheries may be unfounded and there was a general consensus that the popularity of carp fishing was reaching a peak. The future for mixed fisheries seemed bright. It must be borne in mind, however, that the coming generation of club secretaries, which may be drawn from current carp enthusiasts, may have contrary views.

In all there was some form of management plan in place for the water body in 61% of cases. The majority of sites had not incurred financial losses as a result of the restrictions (82%) although 44% claimed that the agreements had restricted their club in other ways. There were mixed feelings about a statutory close season with 52% of respondents believing it to be a good idea. The lack of a close season in some fisheries was considered unfair and a threat, as they could attract customers from fisheries where a close season was enforced. In general, respondents thought that close seasons should be under the control of fisheries managers as different sites had different requirements.

A feeling of good will generally existed between the majority of clubs and English Nature and this bodes well for future co-operation. Many of the conflicting issues involving anglers and conservationists were to some extent understood and acknowledged by anglers. Financial compensation for restricting fishery practices was not ruled out although alternative solutions were limited. One of the main problems involving compensation was that most sites were not run by profit-making clubs, and fishing rather than financial gain was the prime motivator of the clubs' existence. Levels of compensation to be paid in respect of fishery restrictions are therefore difficult to gauge.

There was, broadly, a positive attitude in the ways in which angling clubs and organizations such as English Nature work together at present. Future co-operation was considered both desirable and possible. As one respondent wrote 'it is better to avoid conflict in the first place than try and resolve conflict once it has started'. A good practice guide (Giles, 1998), produced by English Nature and the Countryside Council for Wales and supported by 12 angling organizations is a positive step giving suggestions for how organizations can work together. Nevertheless it could be some time before all fisheries managers accept some aspects of these guidelines.

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